Minnesota Air, Water, and Waste Environmental Conf.

Air Modeling – Training (8am-noon)
Sheraton Bloomington Hotel, Atrium 7

February 14, 2006

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Minnesota Pollution Control Agency

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Air Modeling (98 Slides)

- AERMOD Status and MPCA “Draft” Data
- AERMOD Urban Modeling Developments
  - Metropolitan Statistical Areas and Micropolitan Statistical Areas
- New MPCA NAAQS/MAAQS Feature: FAR Data
- Break - slide 40
- Rochester and Olmsted County SIP Work
  - RPU-Silver Lake Plant Sensitivity Analyses
- Break - slide 75
- AERA/RASS with supplemental Post-RASS Option
- Fugitive PM_{10} emissions: roads, cooling towers, etc.
- VISCREEN (Nearby areas v. Class I areas)
- Future Possibilities

ROCSIPMA Project

- Rochester and Olmsted County SIPs
- PM10 and SO2 Maintenance Areas
  - Several Rochester Facilities
  - Regional Sources (e.g., mobile sources)
    - US Highways: 14, 52, and 63
    - IBM onsite (public) roads
  - Distant Sources via FAR data
  - Zero Sources (50km radius, county outline)
- ROCSIPMA Summary – Next 32 Slides

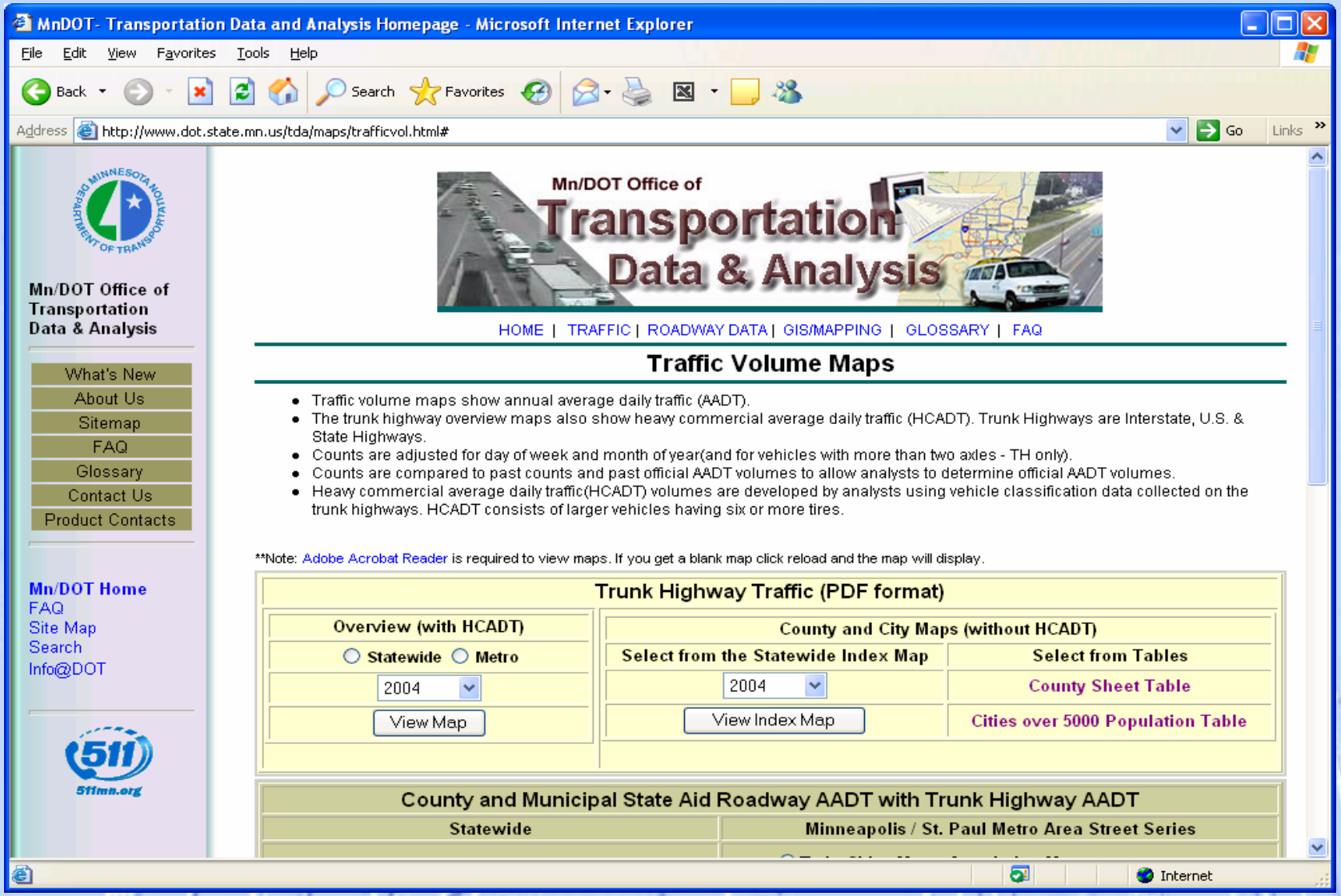
ROCSIPMA Tasks

- Data Collection
  - Work Orders for Key Facilities
  - Literature values for roads and other sources
    - Paved Roads and Highways; Unpaved Roads
    - Other Sources (e.g., cooling towers)
  - “Actual” emissions for distant “FAR” sources
- Computational Challenges
  - Many sources and many receptors
  - “Key” sources for slow, 5-year runs
  - “ALL” sources for fast, event runs

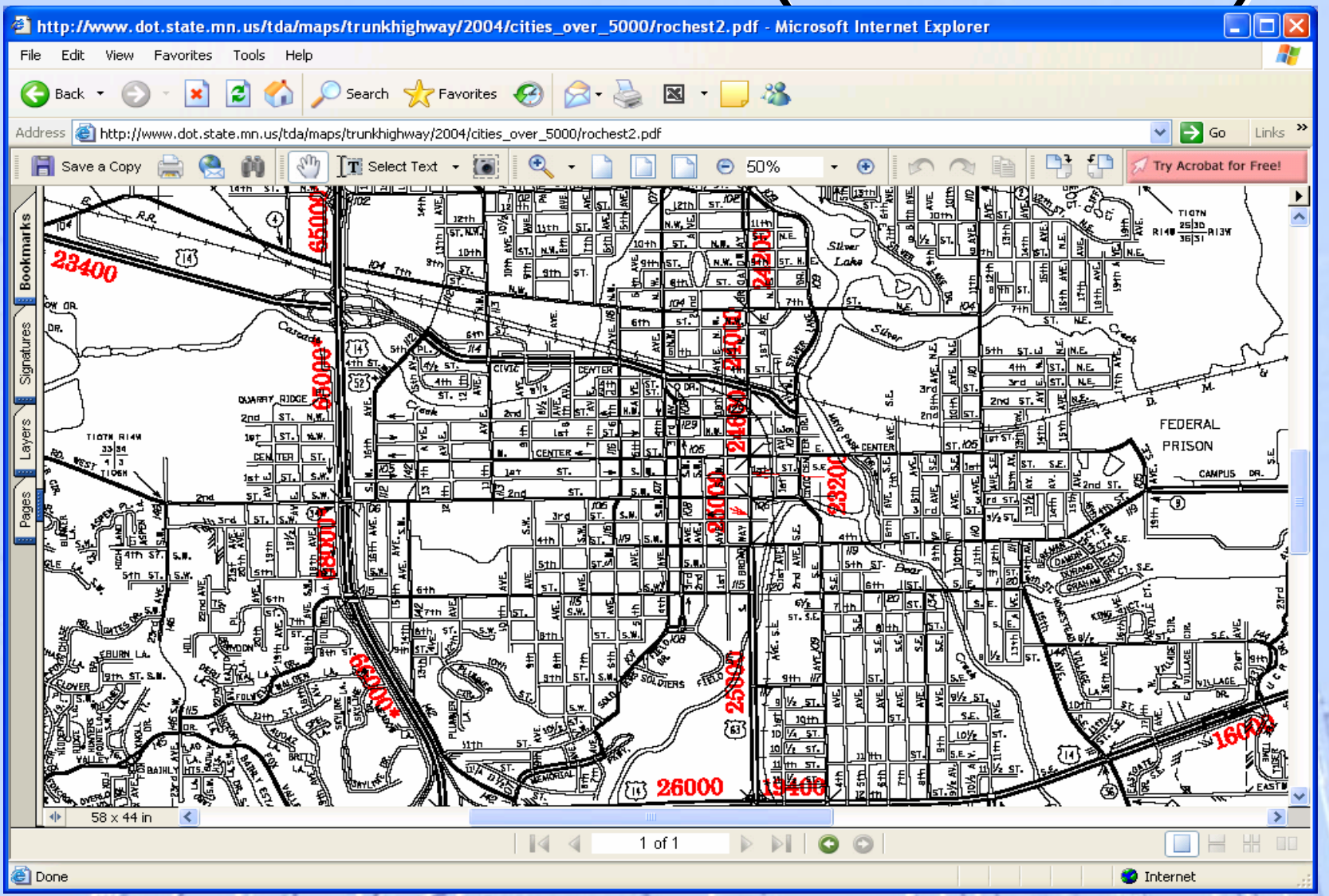
Rochester Highway Assumptions

- Average Daily Traffic (ADT) Rates
  - US Highway 14 at 25,000
  - US Highway 52 at 65,000
  - US Highway 63 at 25,000
- Fleet-average vehicle weight of 5 Tons
- Paved road silt loading at 0.03 grams/m2
- Receptors at 10, 20, 50, 100, 200 meters
- Urban Dispersion
  - “CO URBANOPT 100000 Rochester 0.4”

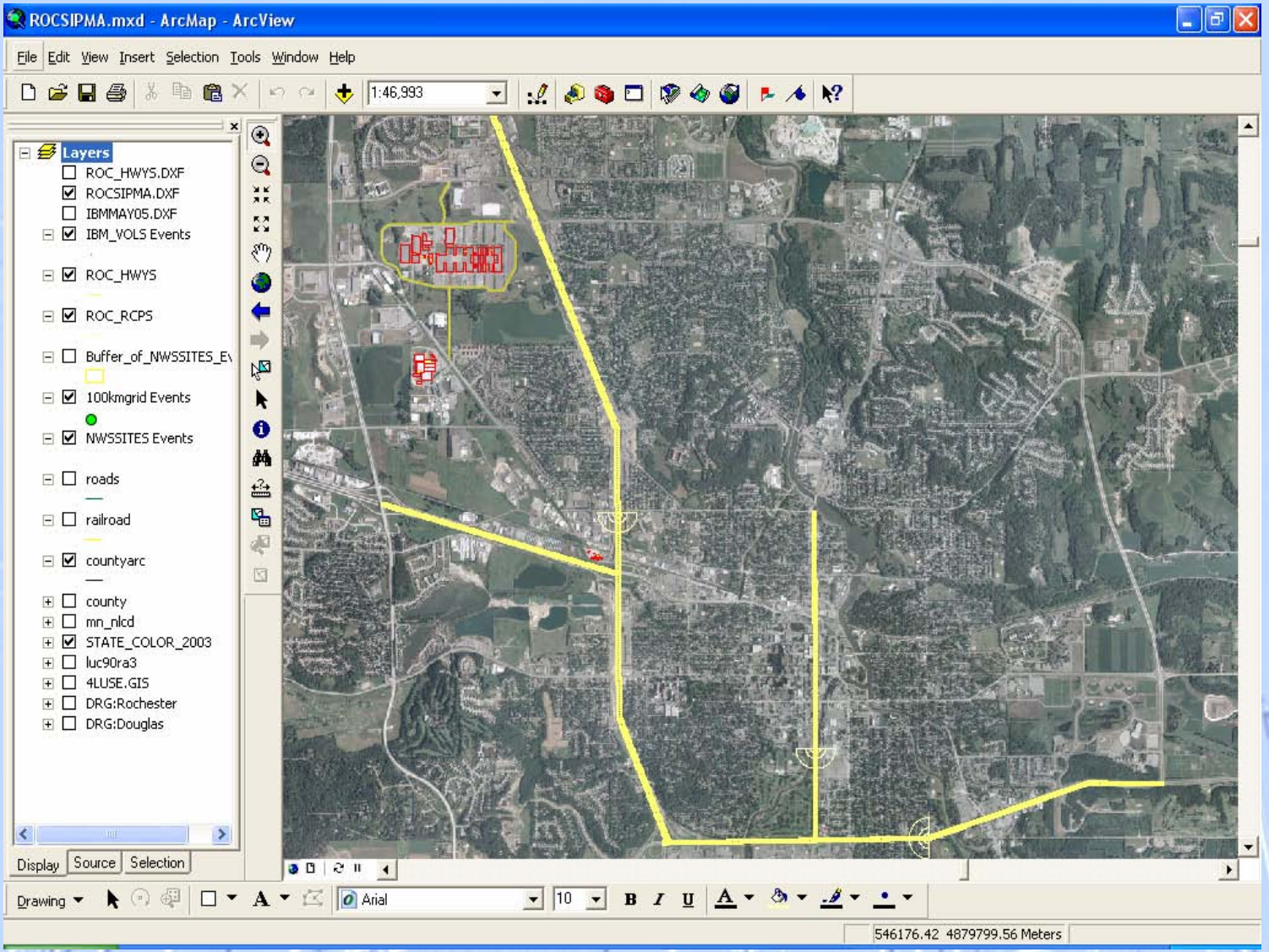
Minnesota Traffic Count Data



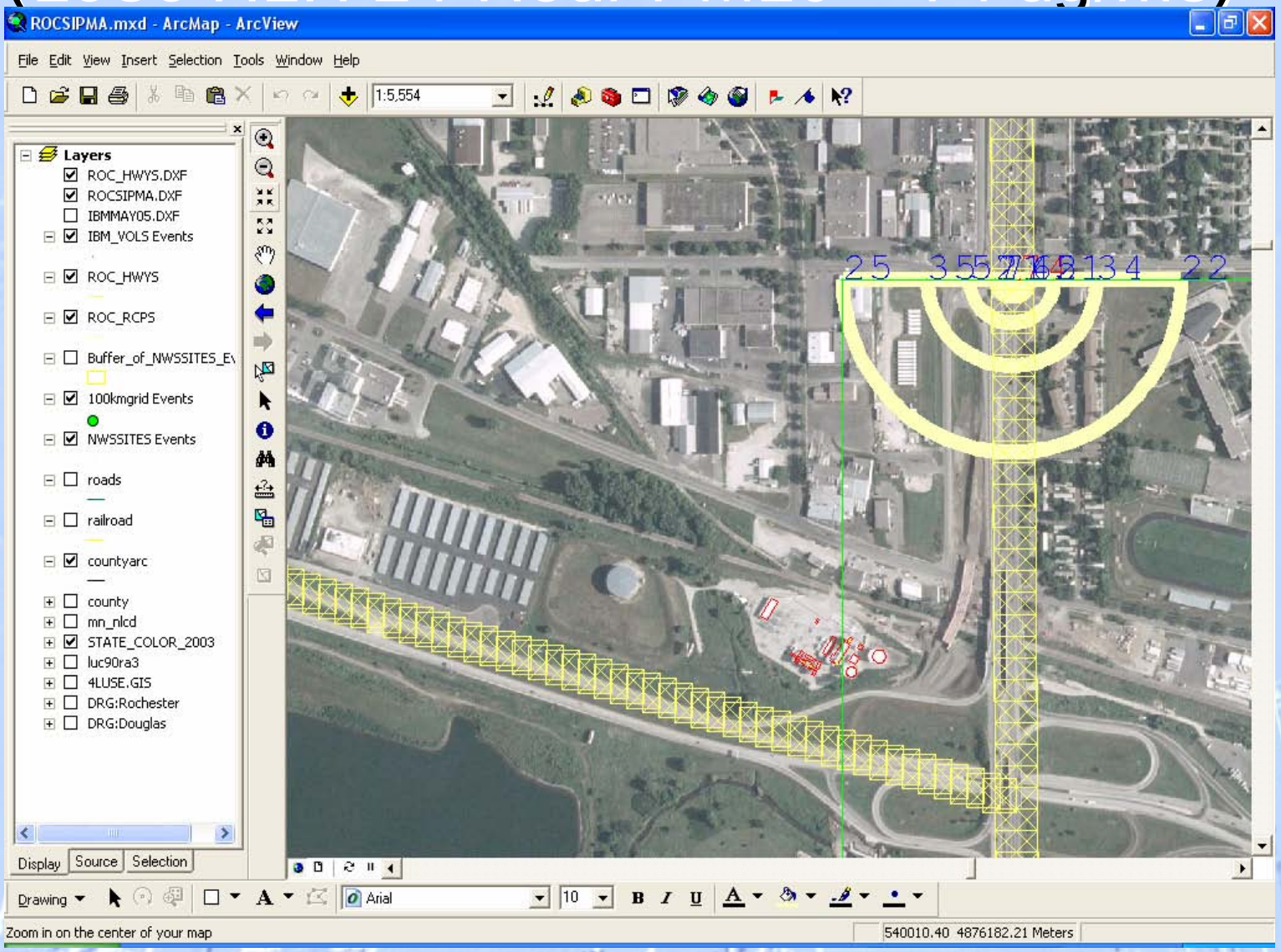
Rochester ADT (2004 Data)



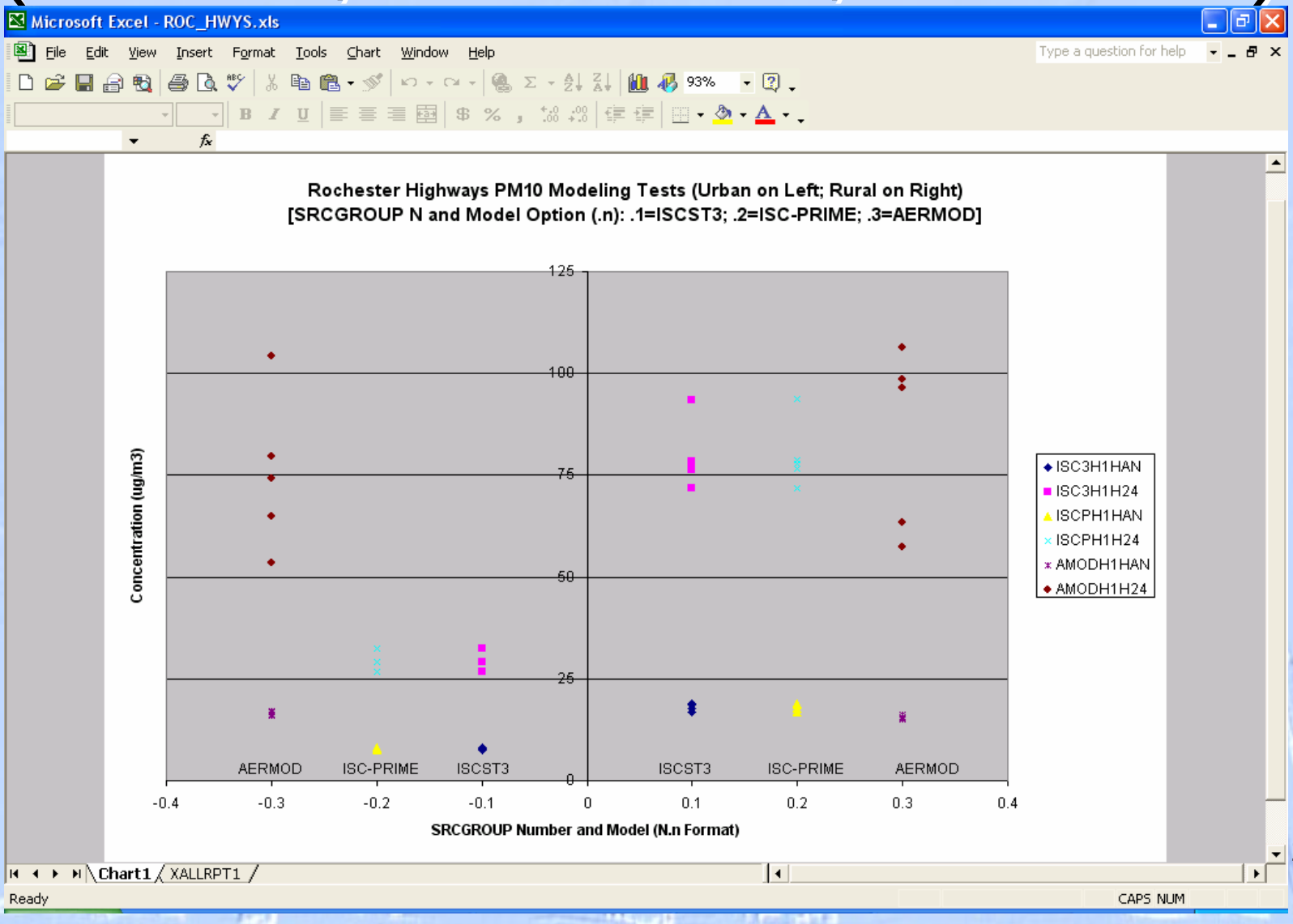
Rochester Highways (14,52,63)



Rochester Highway 52 Results
(1986 H1H 24-Hour PM10 = 74 ug/m3)



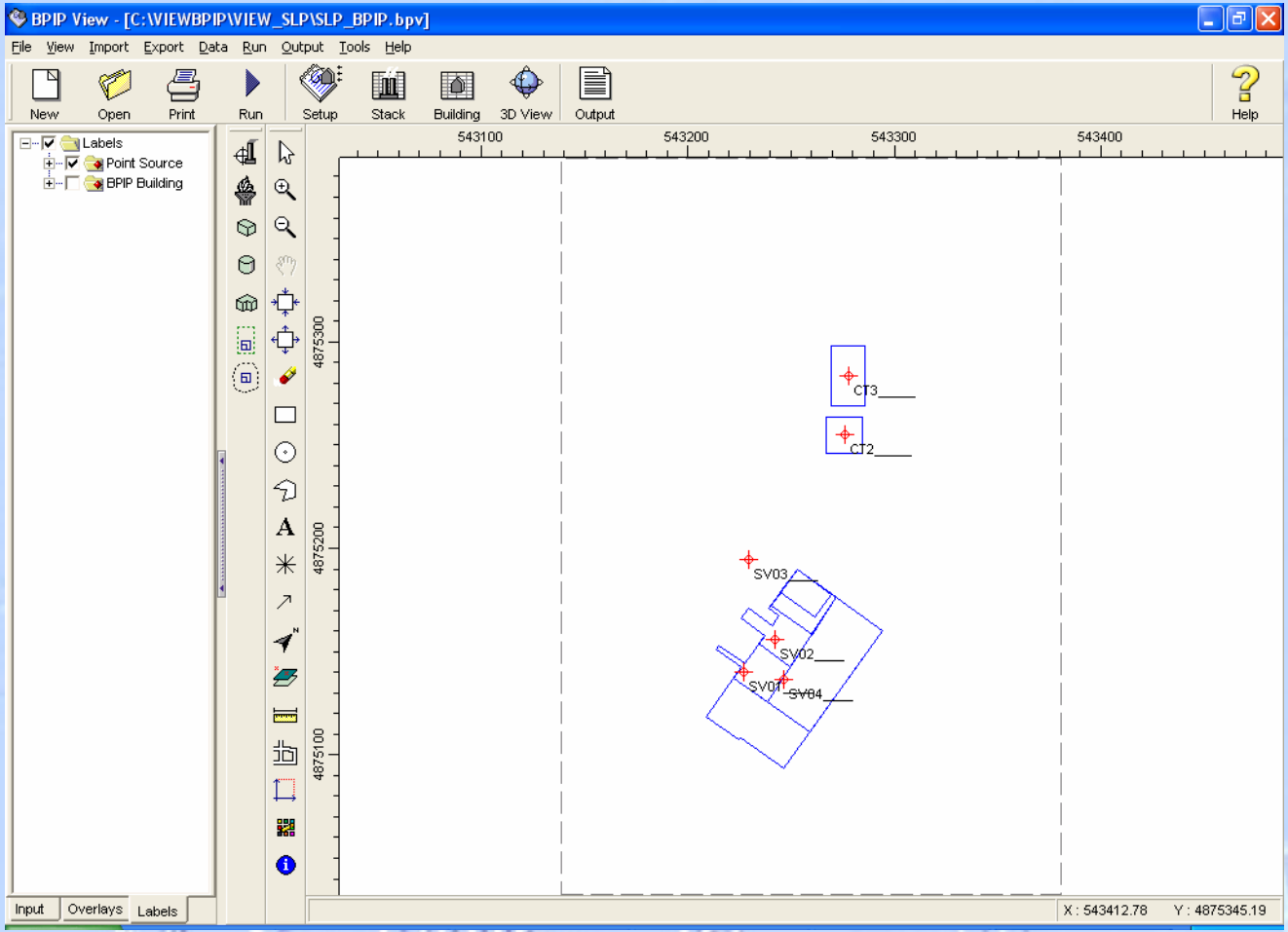
Rochester Highway PM10 Tests (ISCST3, ISC-PRIME, AERMOD)



Rochester Public Utilities – Silver Lake Plant Sensitivity Analyses

- Receptor Grid
  - 360 polar receptors (36 directions and 10 downwind distances)
  - 94 discrete receptors (property line)
- 6 Stacks: 4 Boilers and 2 Cooling Towers
  - Group 1: SV03 (SH~90m) minimal building downwash
  - Group 2: SV01 (SH~61m) moderate building downwash
  - Group 3: SV02 (SH~61m) moderate building downwash
  - Group 4: SV04 (SH~27m) extreme building downwash
  - Group 5: CT03 (SH~19m) cooling tower
  - Group 6: CT02 (SH~14m) cooling tower
- 7 Fugitive Sources (groups 7-13, respectively)
- “ALL” Source Group (group 14)

Site Layout (2D View)



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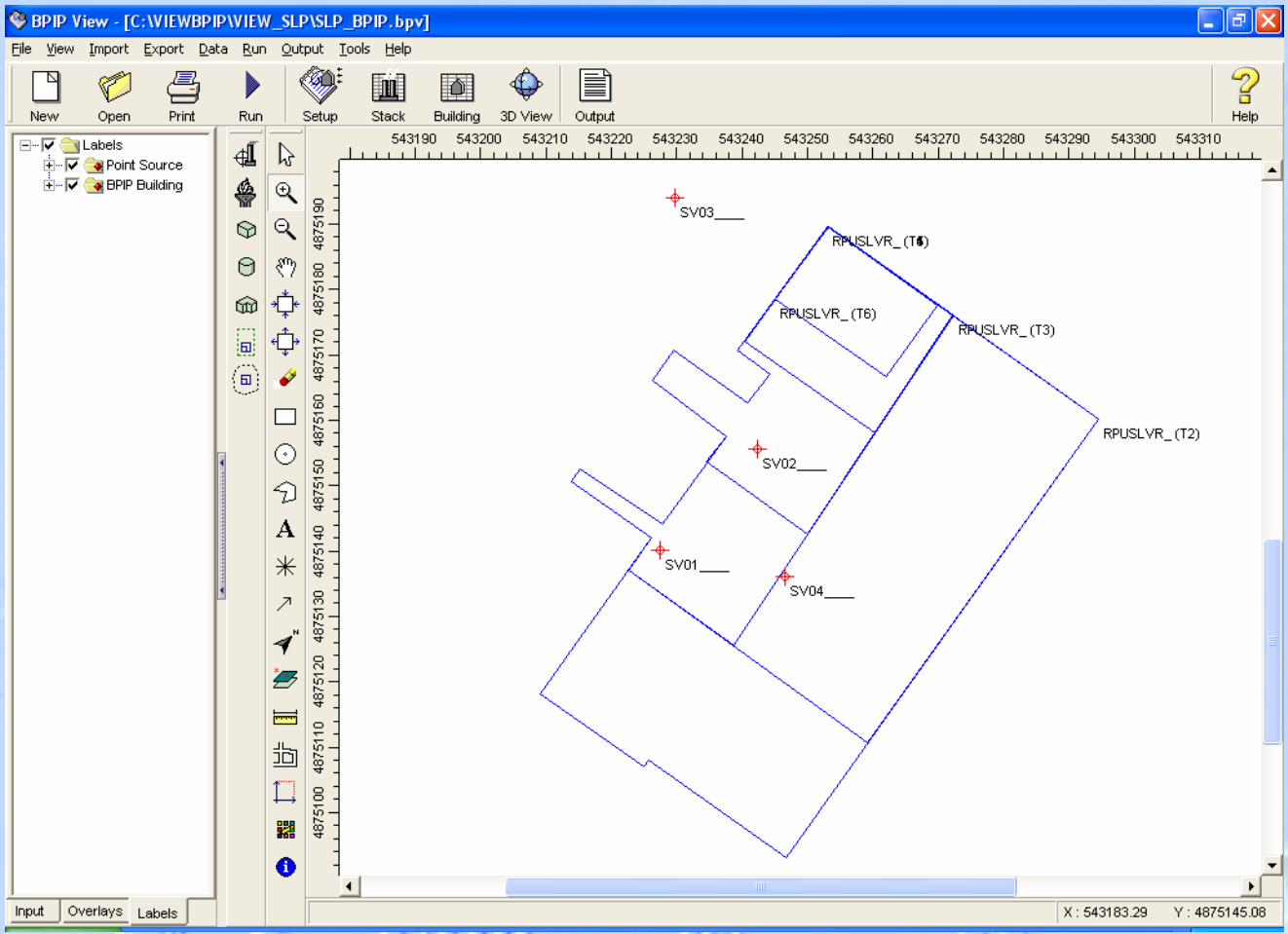
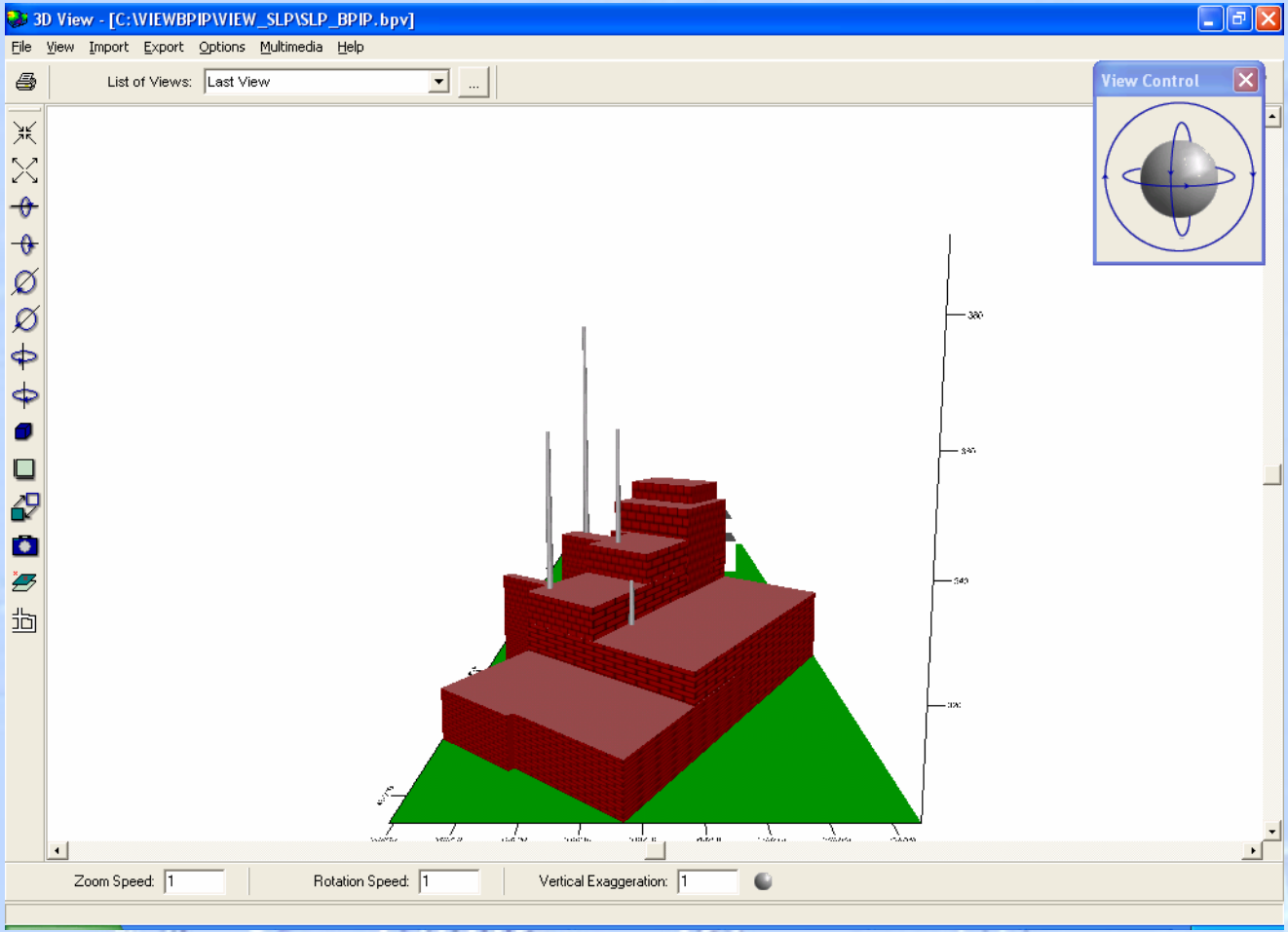
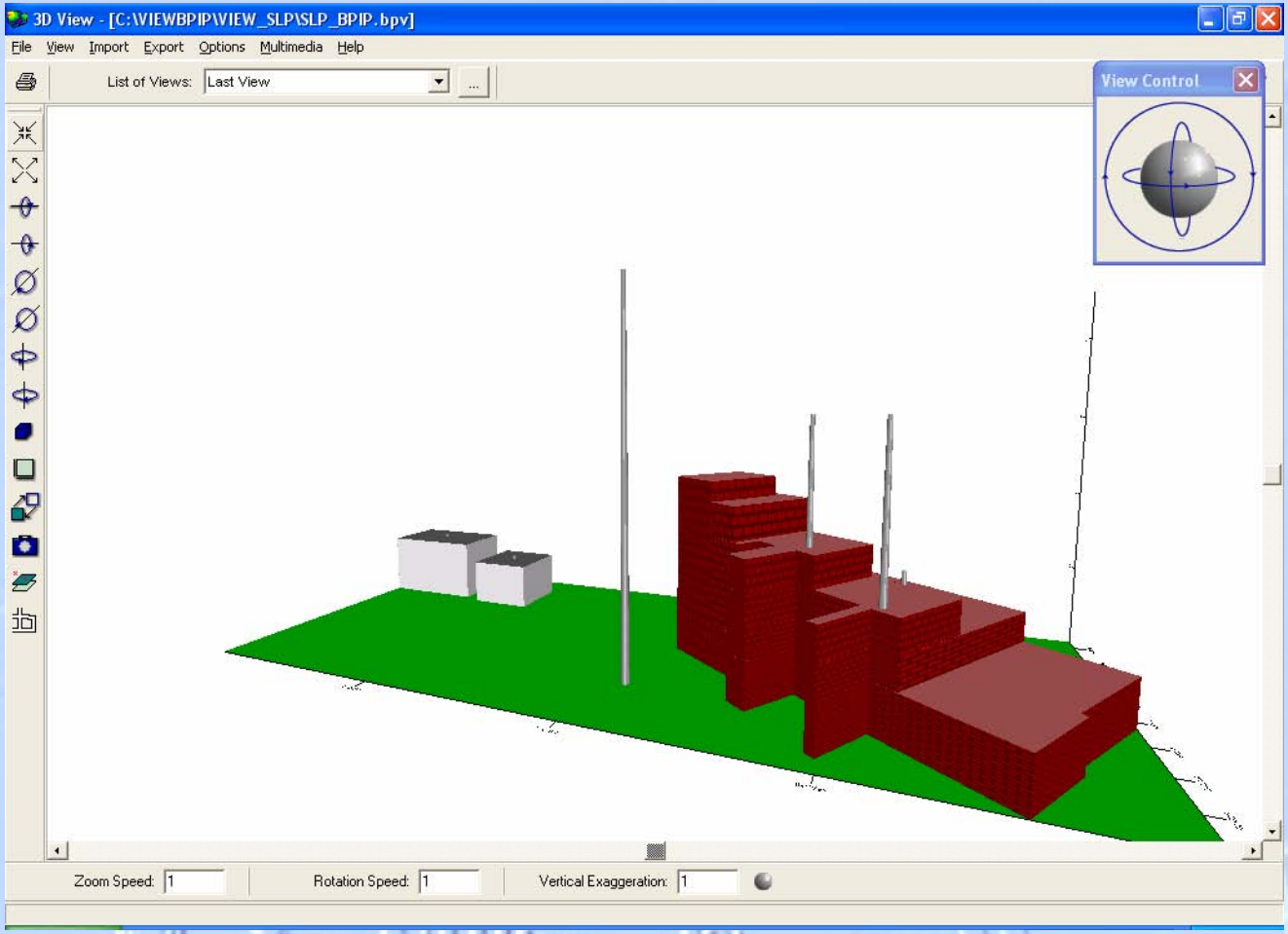


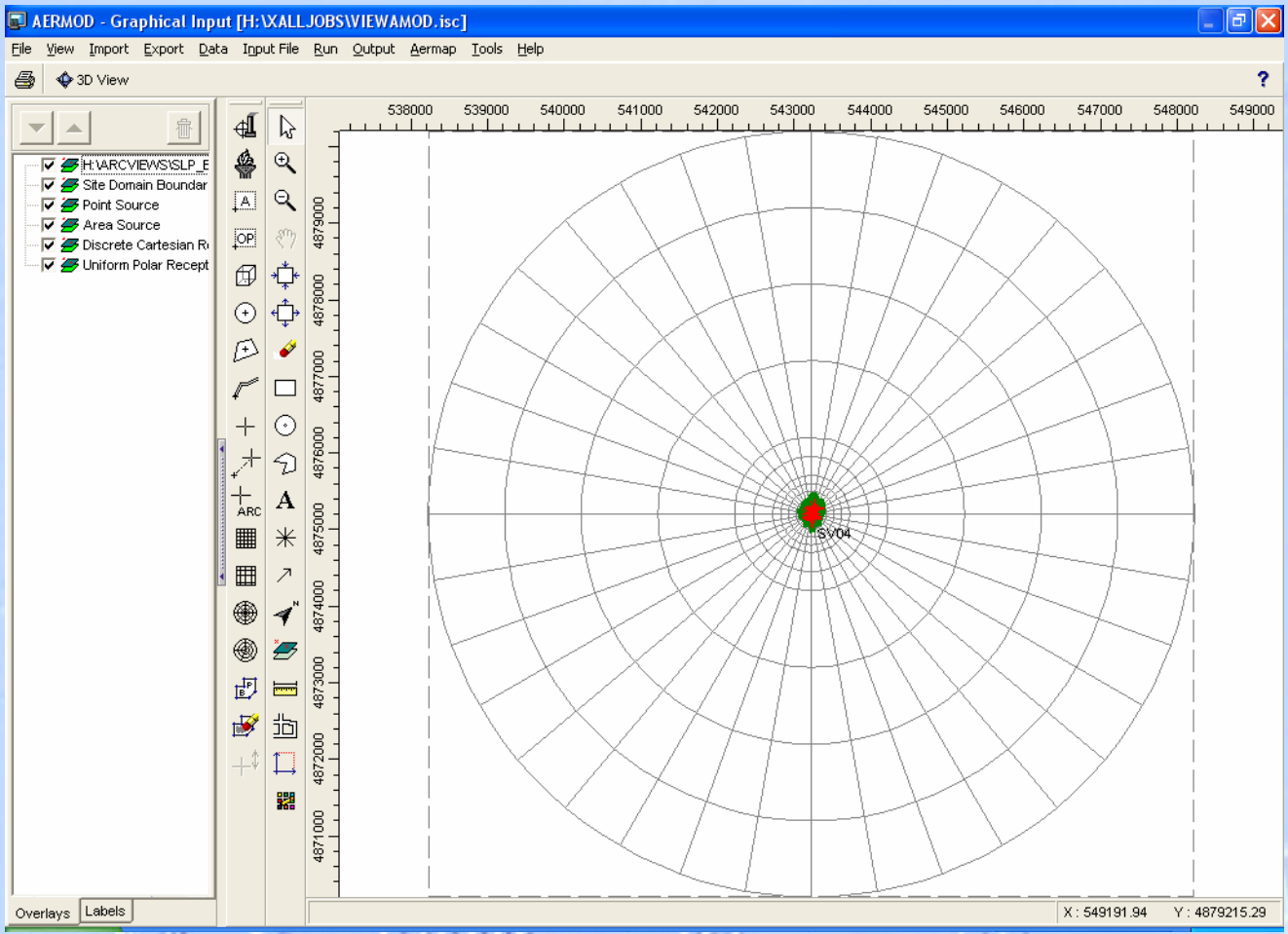
3D View – Looking North



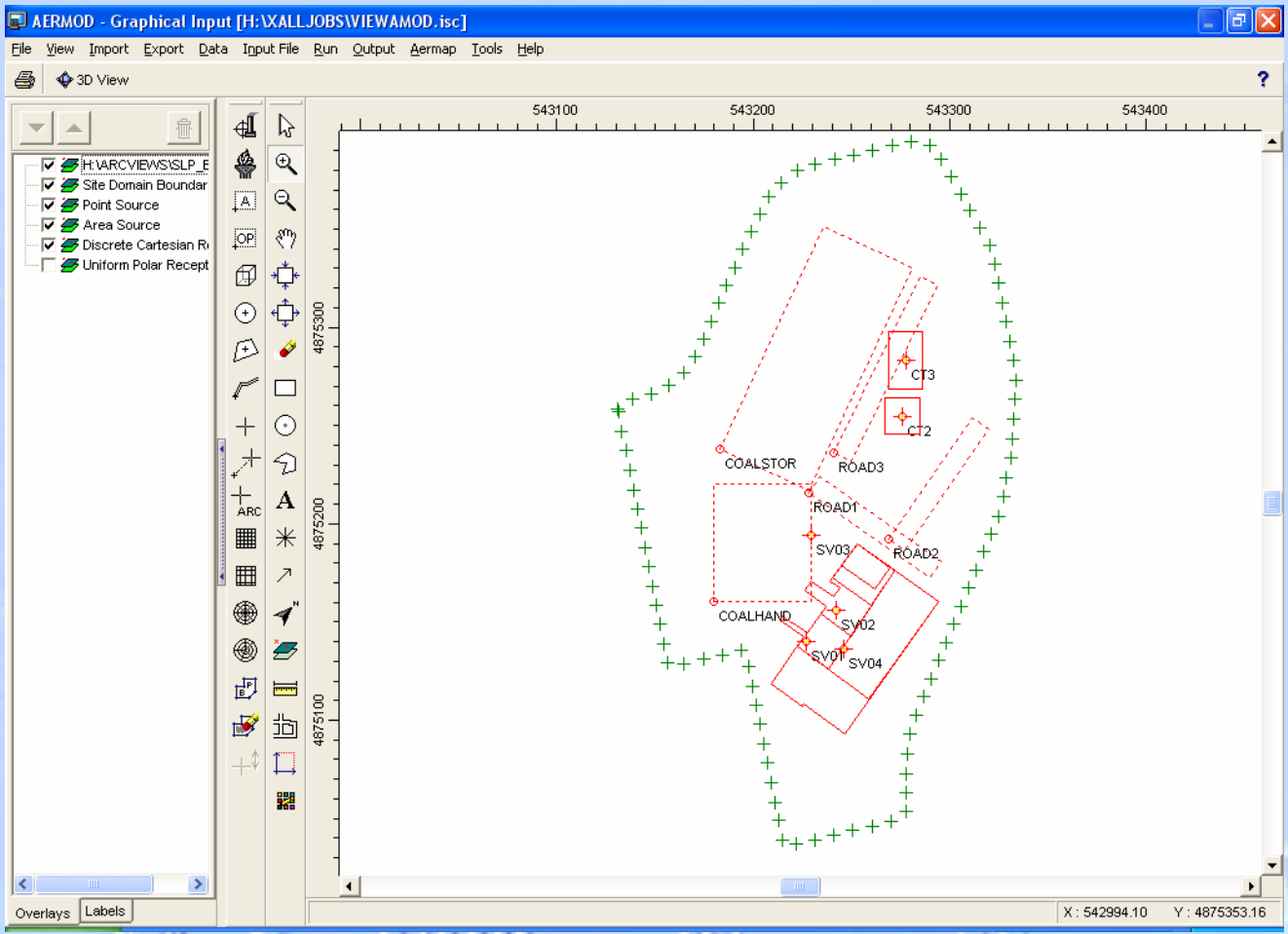
3D View – Looking ENE



Polar Receptors



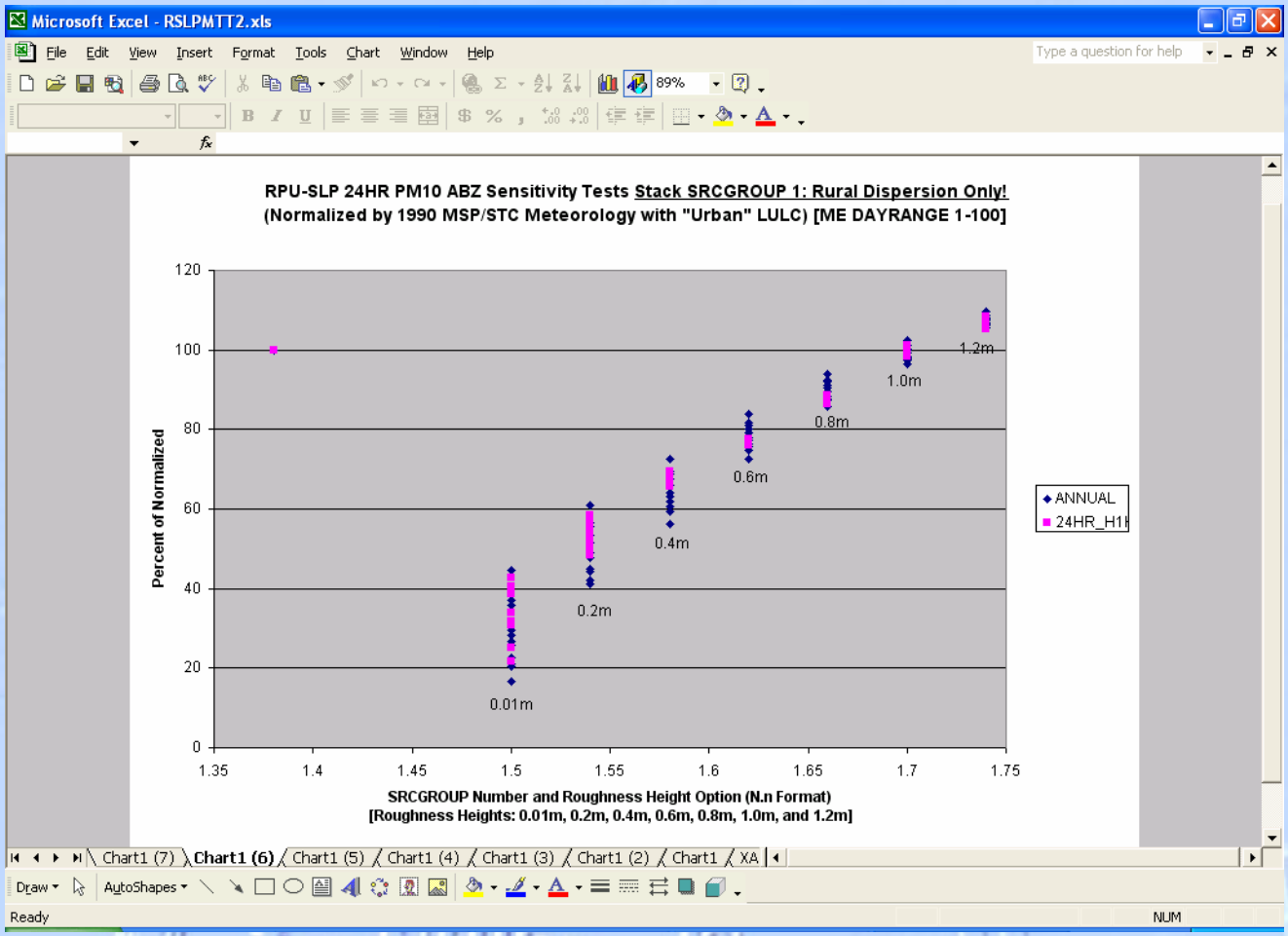
Discrete Receptors



Base Case vs. 84 “ABZ” Tests

- AERMOD/AERMET/AERMAP (02222)
  - First 100 Days of 1990 (Meteorology)
- Base Case: RPU-SLP 24-Hour PM10 Modeling
  - All “urban” LULC [Zo=1m]
- 84 “ABZ” Combinations [3*4*7=84]
  - 3 Albedos (A=0.1, 0.3, and 0.5) [dark to light]
  - 4 Bowen Ratios (B=0.1, 0.5, 0.9, and 4.0) [wet to dry]
  - 7 Roughness Heights (Zo=0.01, 0.2, 0.4, 0.6, 0.8, 1.0, and 1.2 meters) [smooth to rough]
- Results: “Percent of Base Case”

Group 1 (SV03) Rural Results



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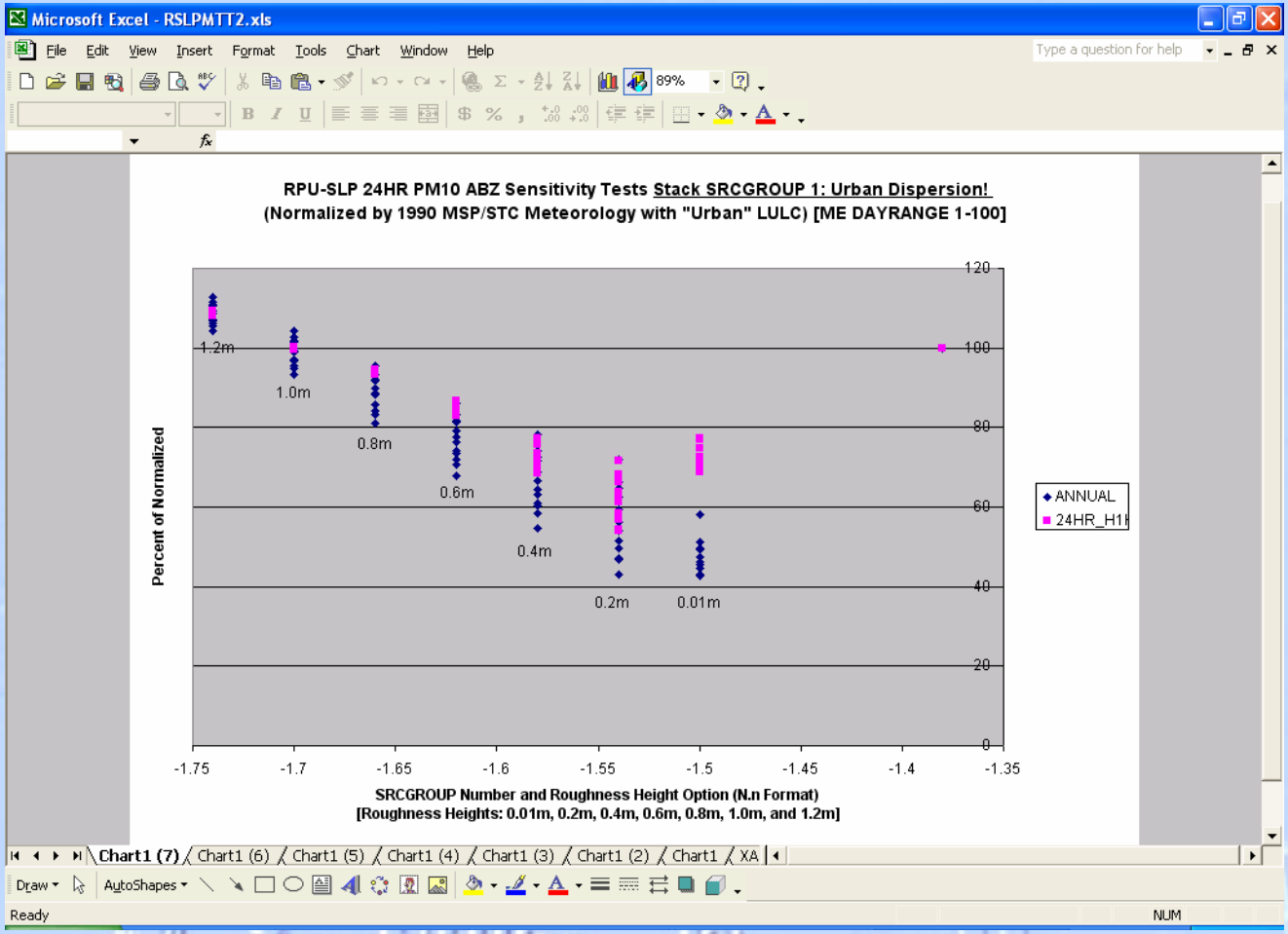
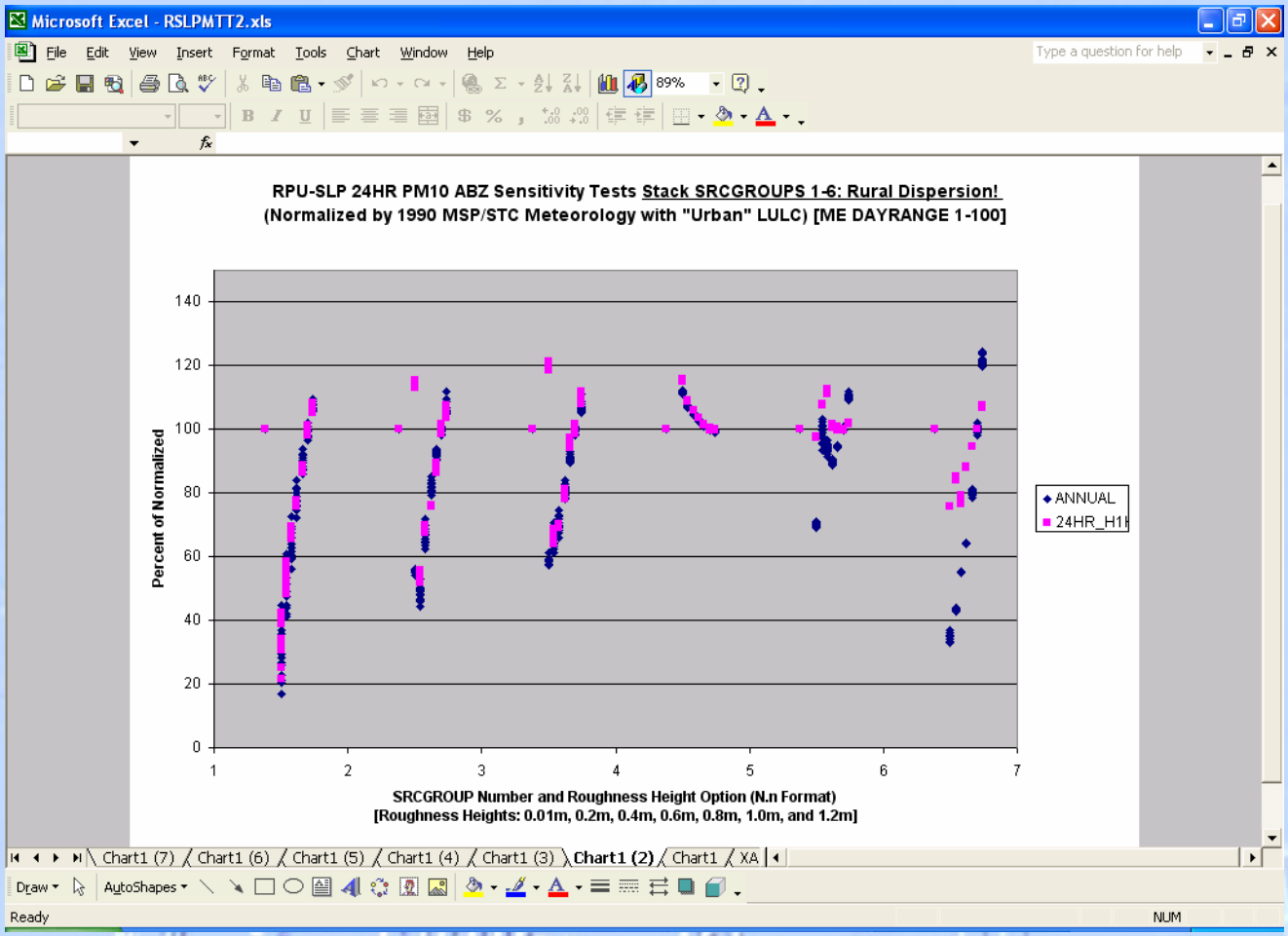


Groups 1-6 Rural Results (SV03,SV01,SV02,SV04,CT03,CT02)



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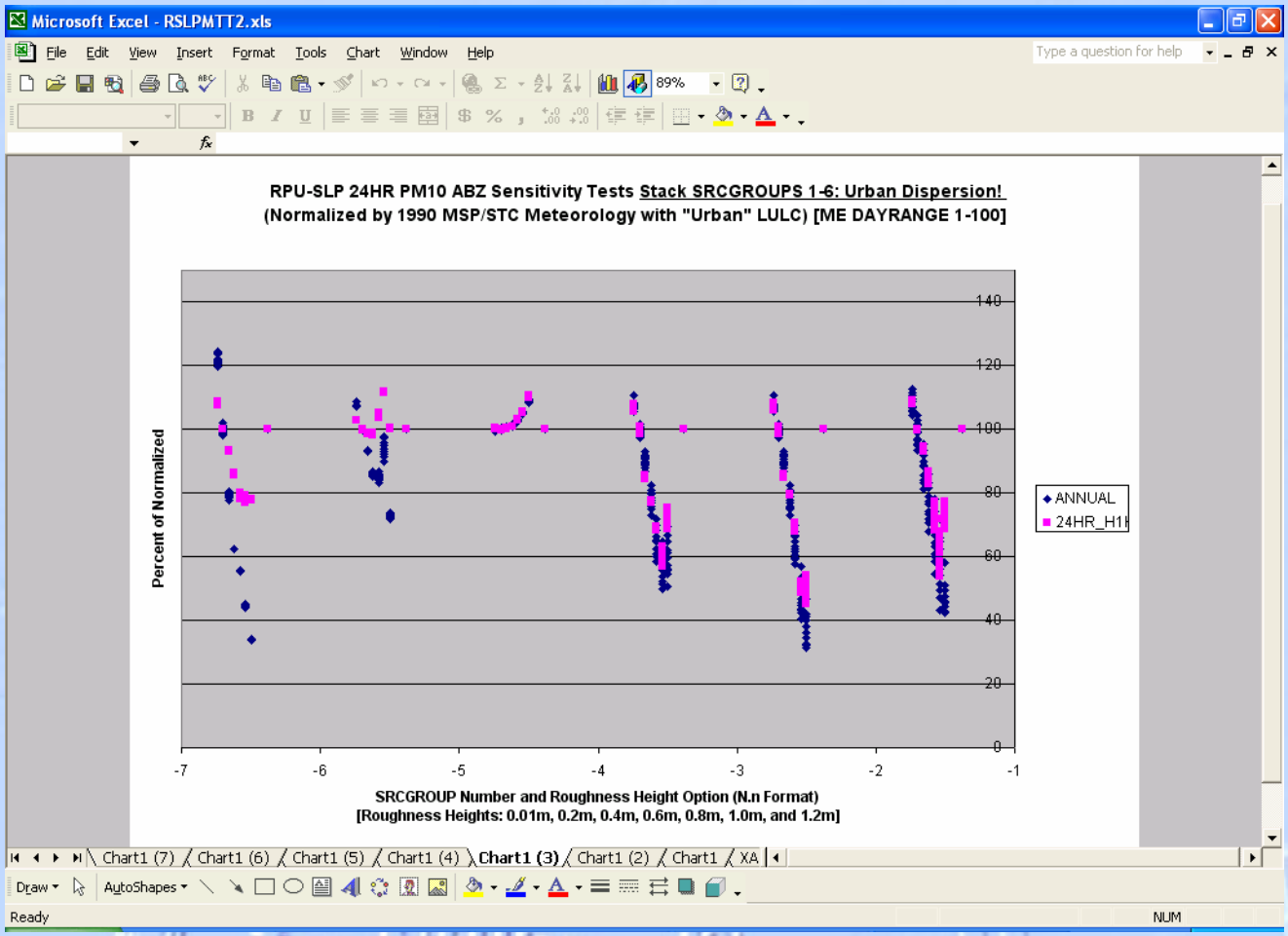
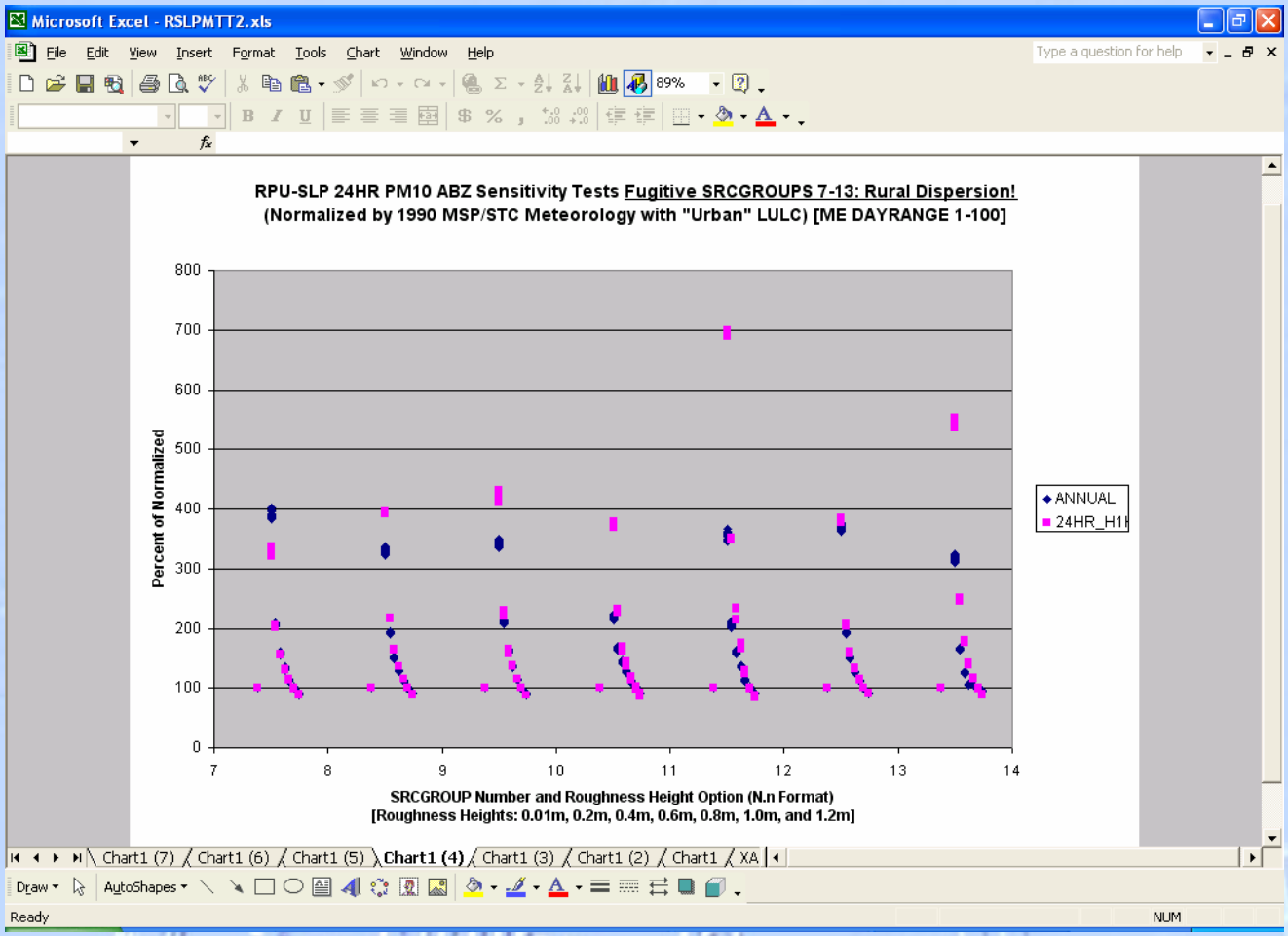


Groups 7-13 Rural Results (Various Fugitive Sources)



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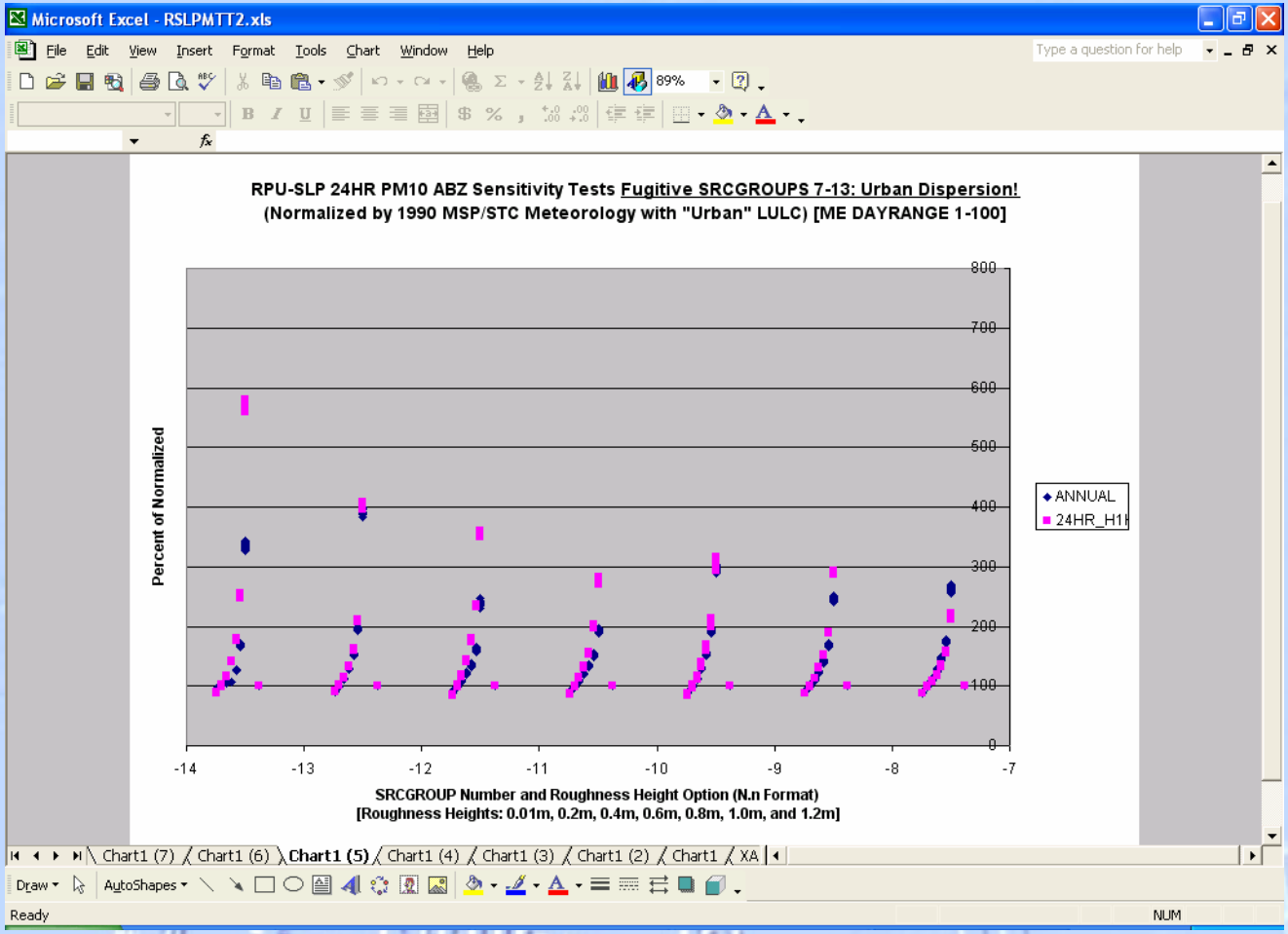
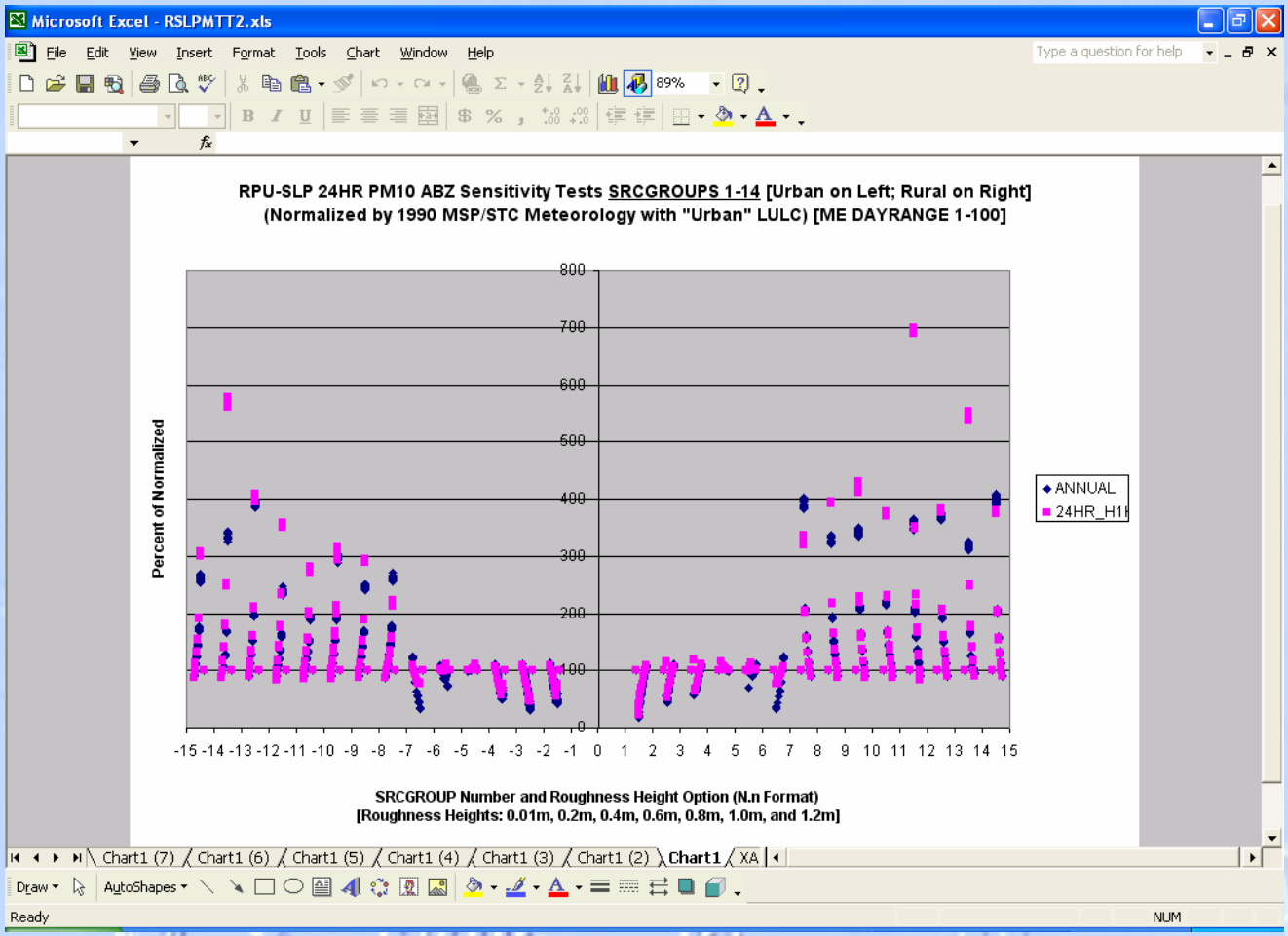


All 14 Groups (6 Stacks, 7 Fugitives, ALL) (Urban on Left; Rural on Right)



“100 Day Test” Summary

- Tall (~GEP) Stacks
  - Roughness Height is most important
  - Albedo & Bowen Ratio are less important
- Intermediate Stacks
  - Roughness Height is still most important
  - Albedo & Bowen Ratio are less important
- Stub Stacks
  - Roughness Height is not very important
  - Albedo & Bowen Ratio are not important
- Fugitive Sources
  - Roughness Height is most important
  - Albedo & Bowen Ratio are less important

DISPERSE Tests

- DISPERSE Categories
  - Cultivated land (Zo~0.01m to 0.2m)
  - 50/50 mix (Zo~0.3m to 0.8m)
  - Deciduous forest (Zo~0.5m to 1.3m)
- 1986-1990 MSP/STC Meteorology
- Rural vs. Urban (pop. 100,000; Zo=1m)
- Results in Micrograms per Cubic Meter

DISPERSE Comparisons

- Display Format (Group N; Modeling Method M)
  - N.1 denotes ISCST3
  - N.2 denotes ISC-PRIME
  - N.3 denotes AERMOD with 100% “urban” LULC (RPU-Silver Lake [PSD] Project)
  - N.4 denotes AERMOD with DISPERSE LULC1 (cultivated land)
  - N.5 denotes AERMOD with DISPERSE LULC2 (50/50 mix of cultivated land and deciduous forest)
  - N.6 denotes AERMOD with DISPERSE LULC3 (deciduous forest)

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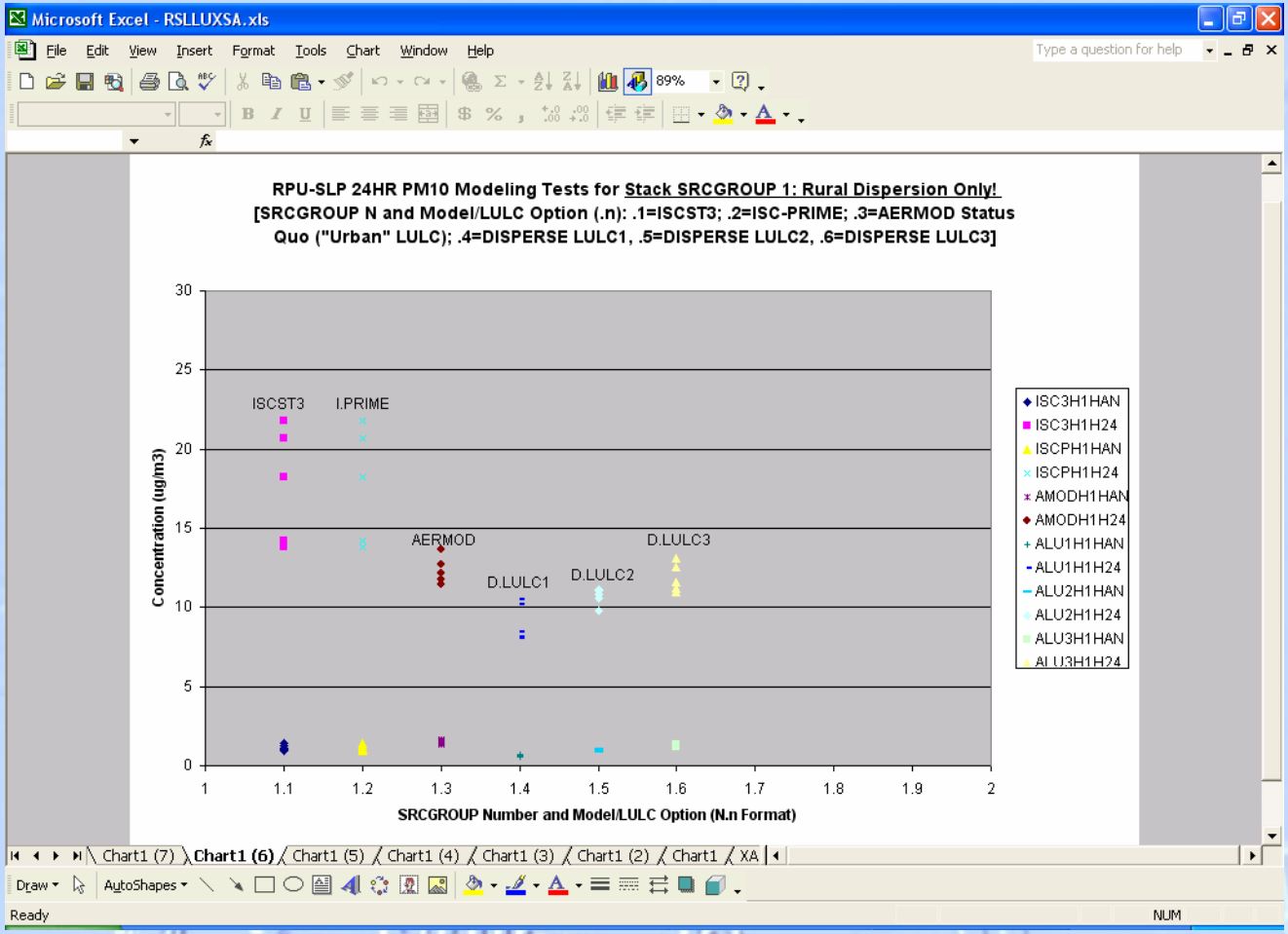

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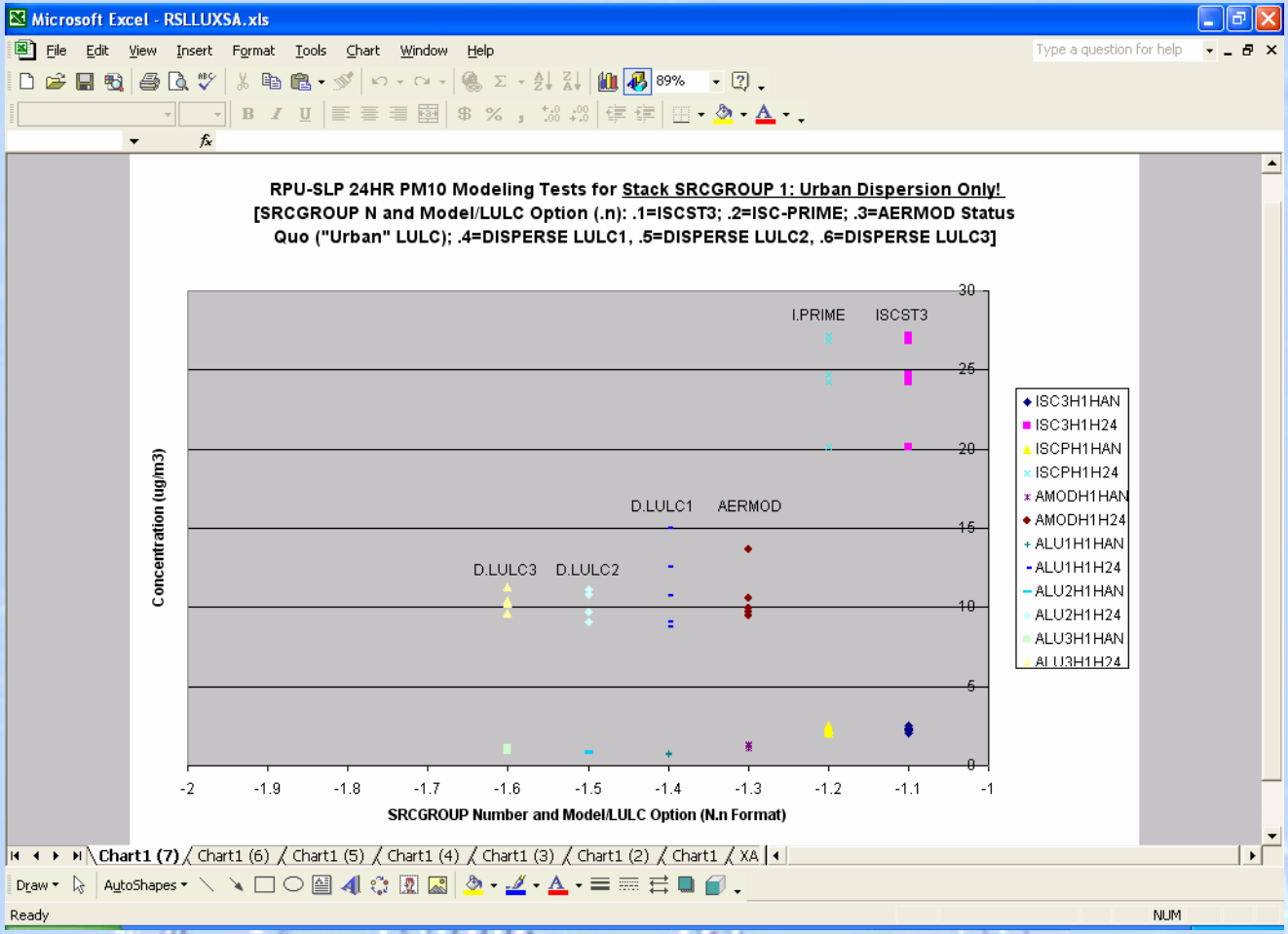

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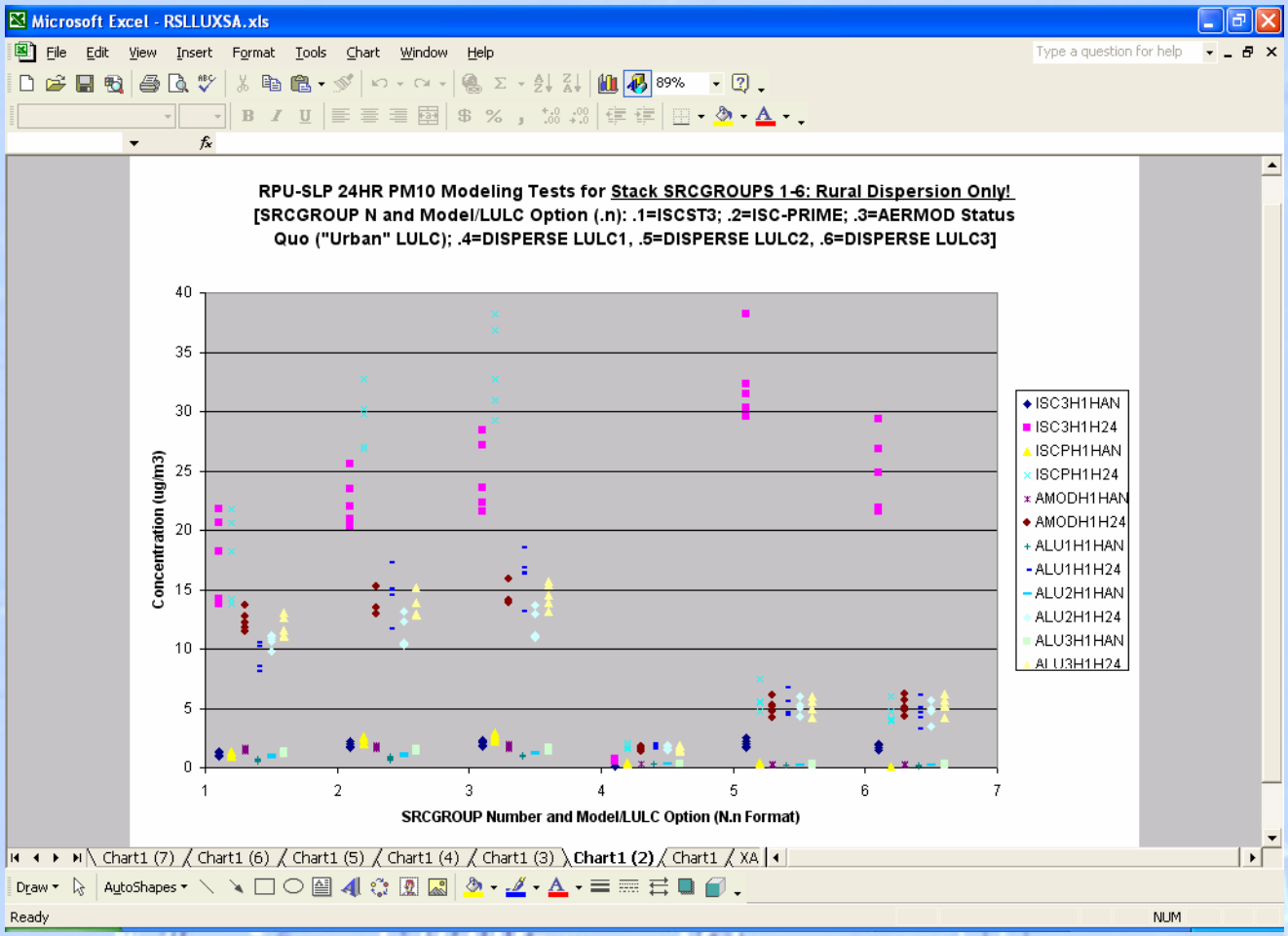

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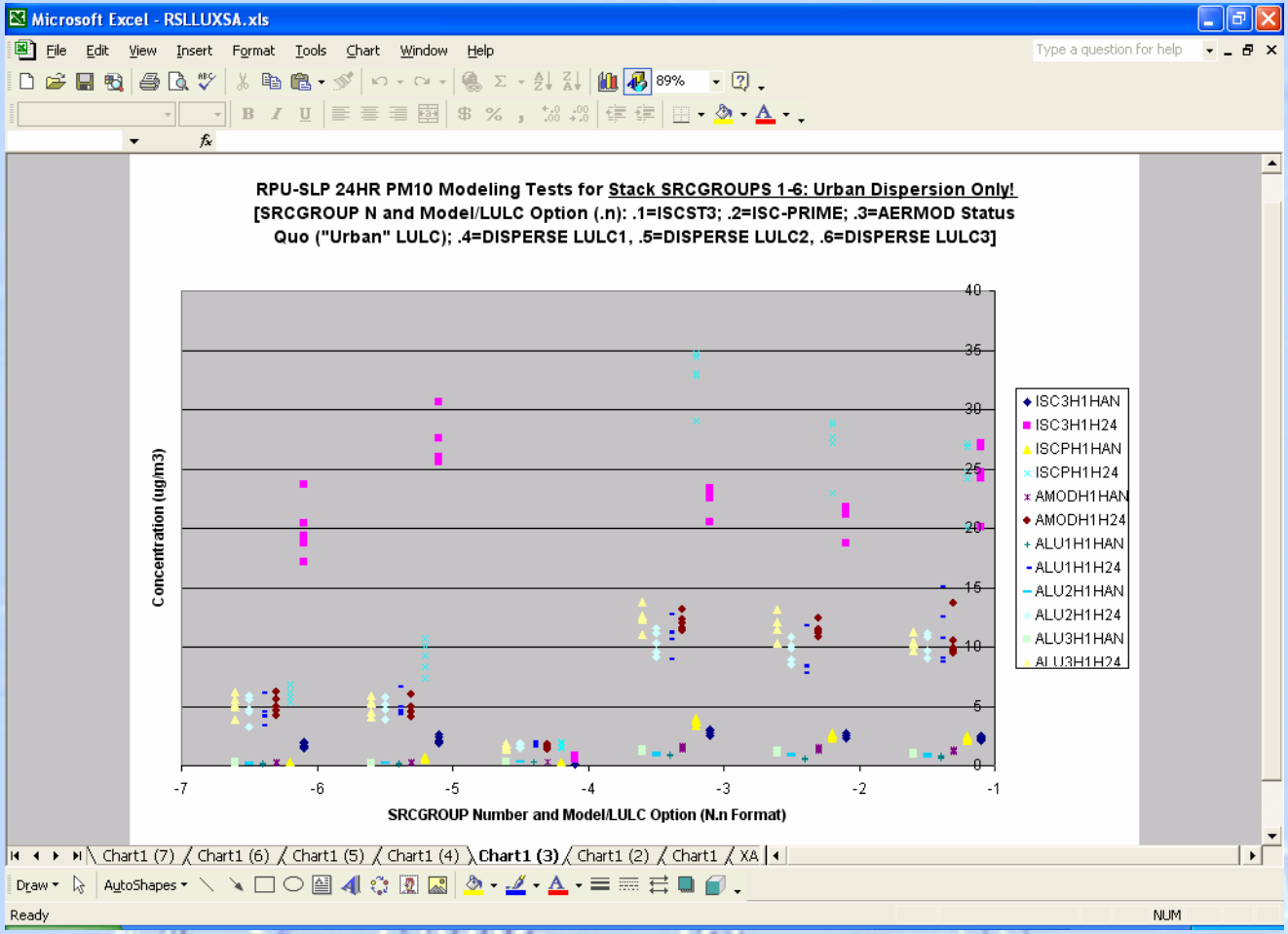

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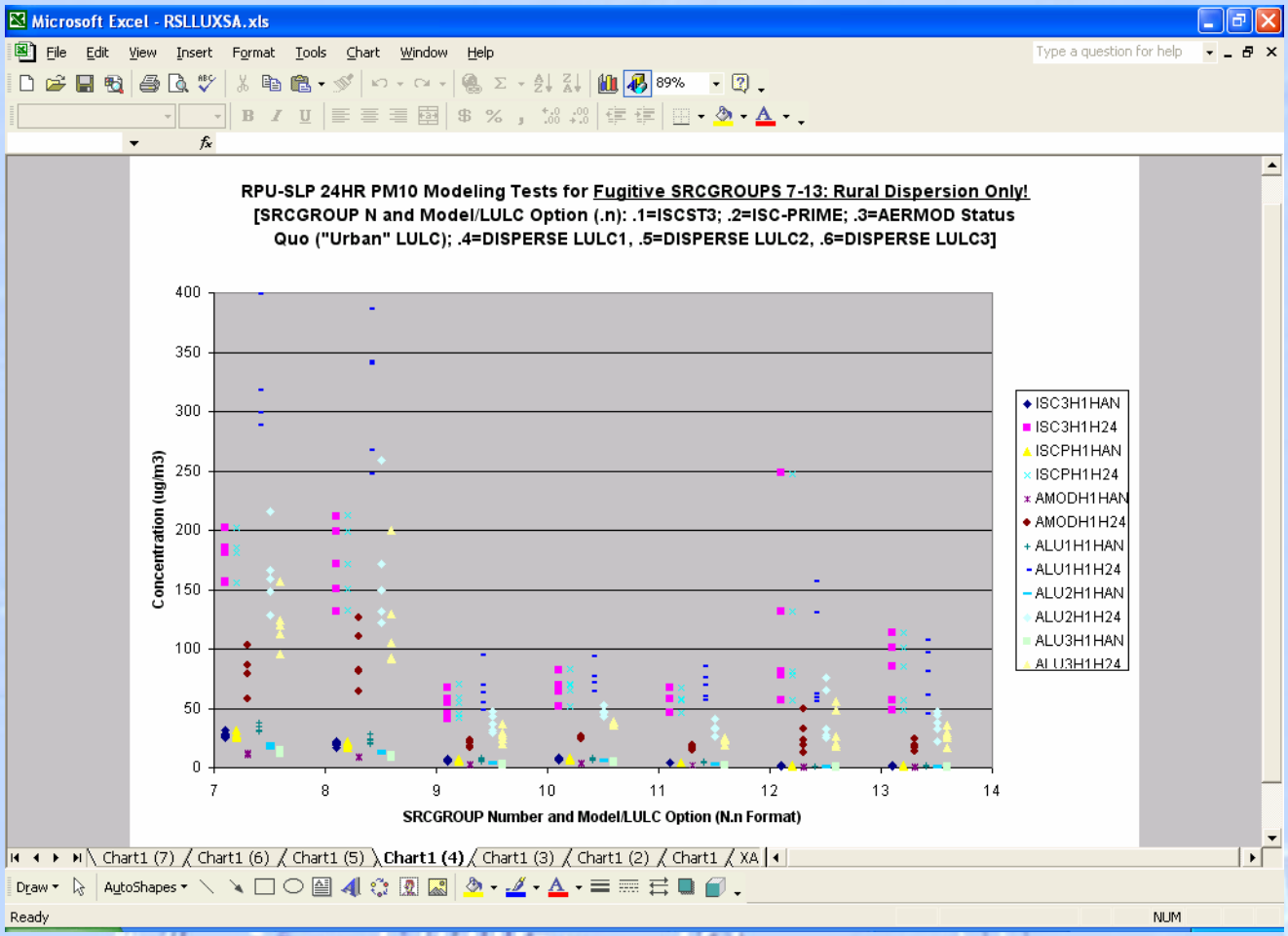

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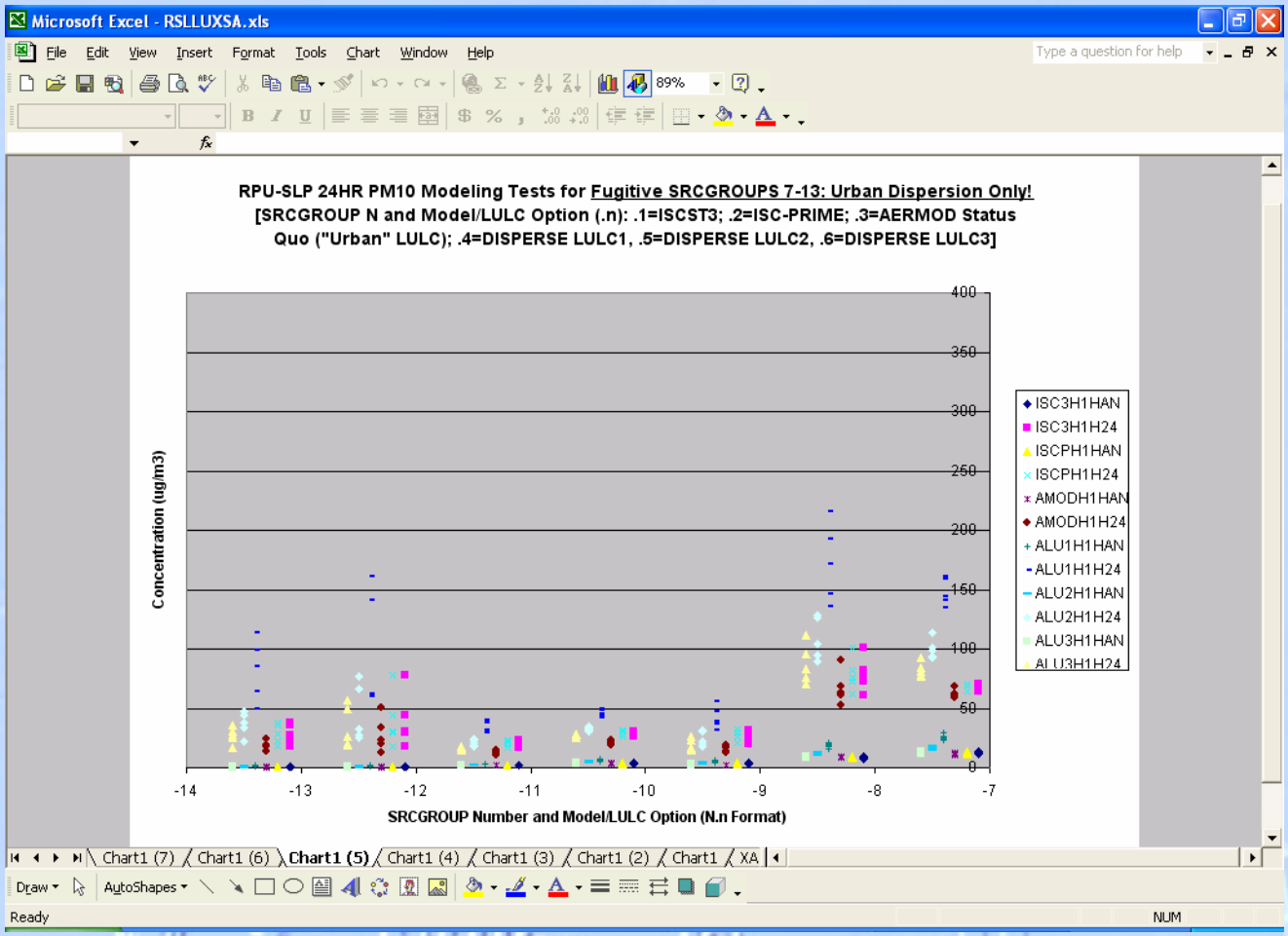

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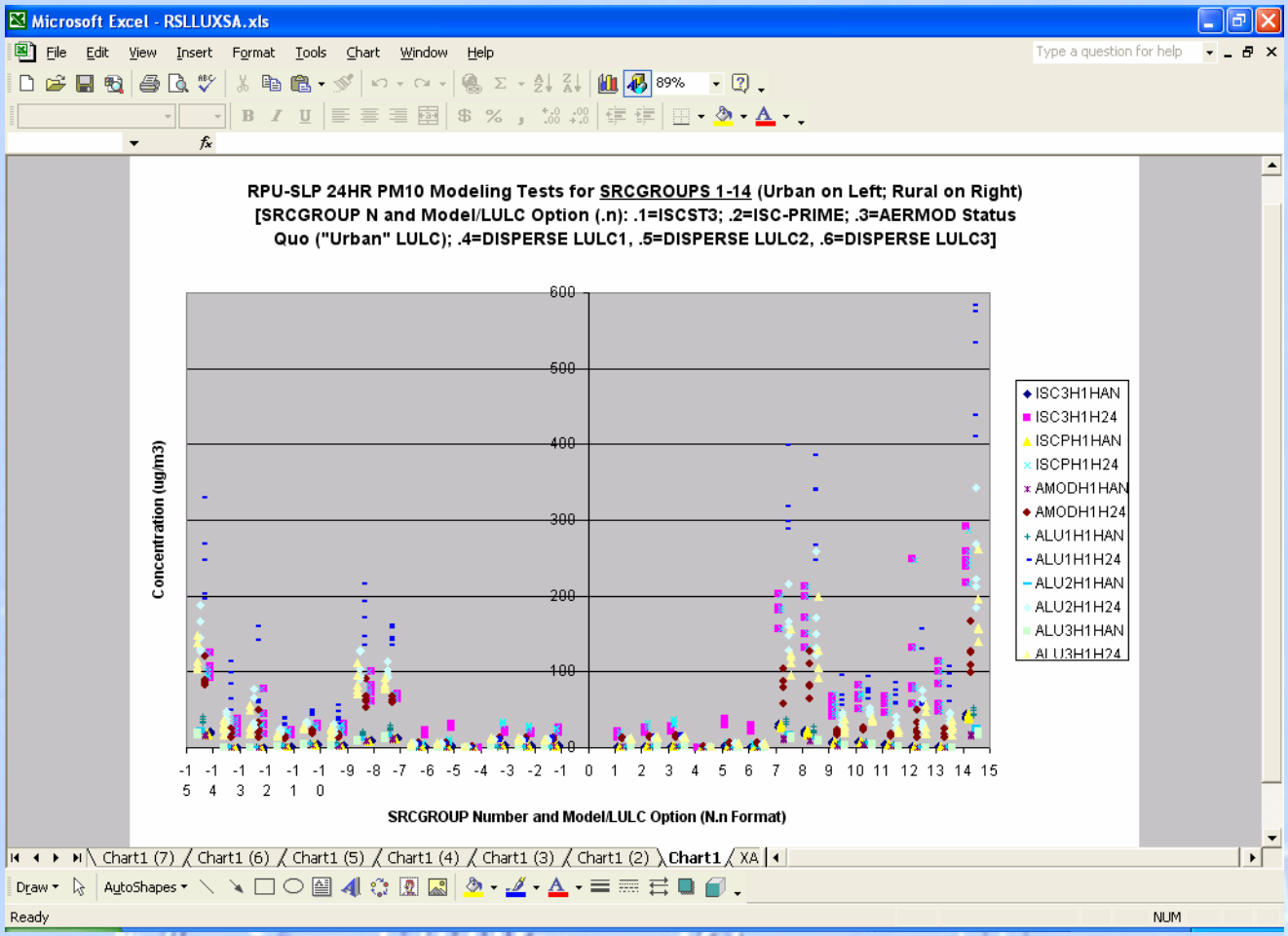

DISPERSE Summary

- Significant changes from ISC to AERMOD
- DISPERSE cases are (surprisingly) similar
  - Recall: AERMOD and 3 LULC cases
  - Significant seasonal variability seems to yield the surprisingly similar results