

# Atmospheric Deposition in the Los Angeles Coastal Region

UCLA Institute of the Environment  
Southern California Coastal Water Research Project

Santa Monica Bay Restoration Project  
Los Angeles County Dept of Public Works  
City of Los Angeles

US EPA Great Waters Program  
Los Angeles Regional Water Quality Control Board  
California Department of Pesticide Regulation  
South Coast Air Quality Management District

# STUDY QUESTIONS

- What are the sources of pollutants to the atmosphere that contribute to deposition?
- What is the contribution of atmospheric deposition to water bodies?
- What is the magnitude and spatial and temporal distribution of deposition?

# STUDY COMPONENTS

## ■ Data

- ARB/AQMD emission database and air quality
- Particle concentration and deposition at UCLA site
- Microlayer concentrations in Santa Monica Bay
- Particle concentration and deposition at seven regional sites associated with five impacted water bodies
- Particle concentration and deposition “footprint” near freeway
- Deposition and runoff in a controlled urban catchment

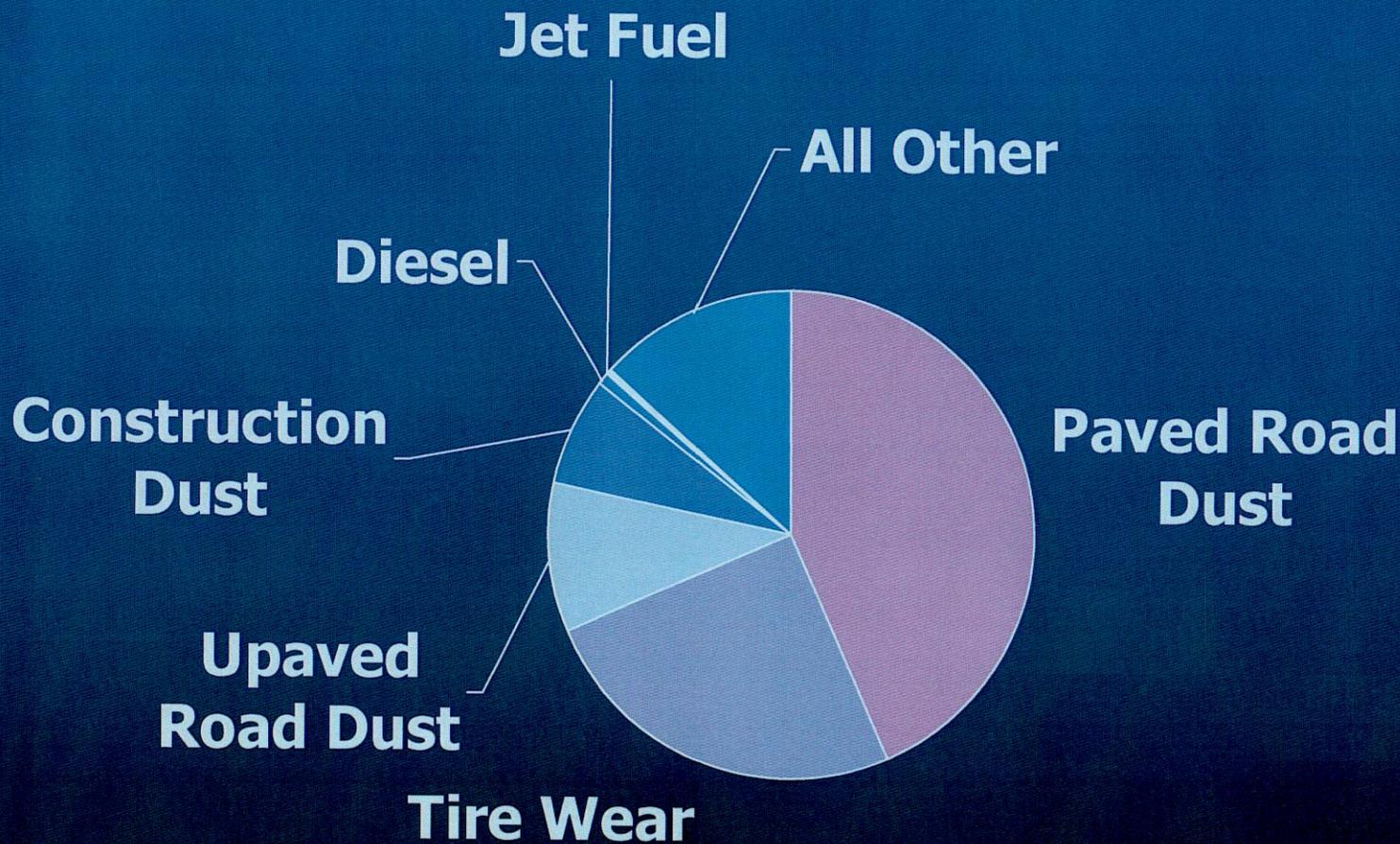
## ■ Models

- UCLA SMOG model
- SCCWRP watershed loading model

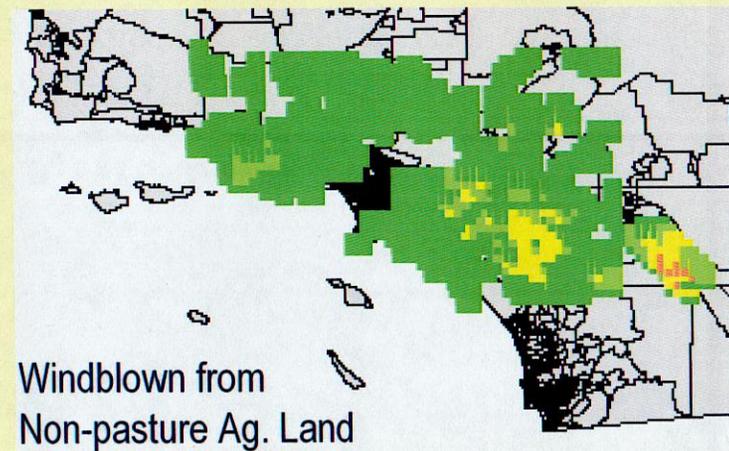
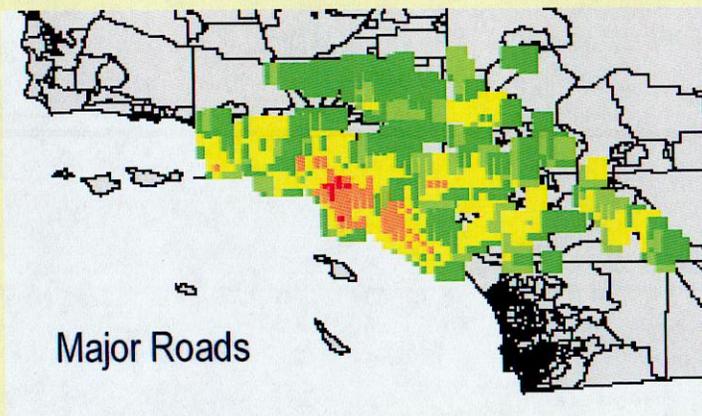
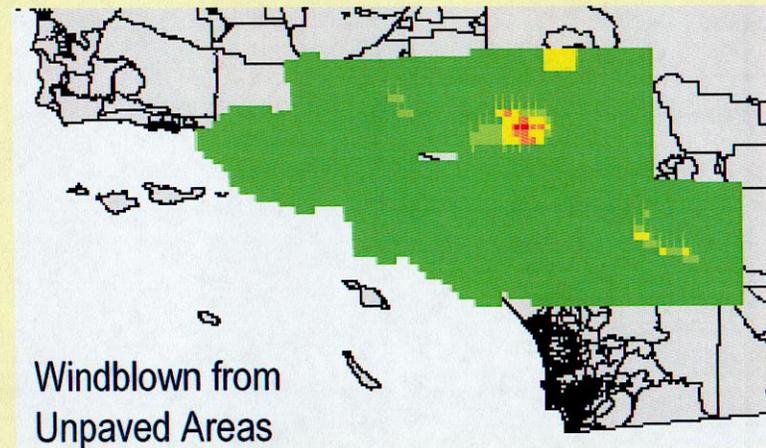
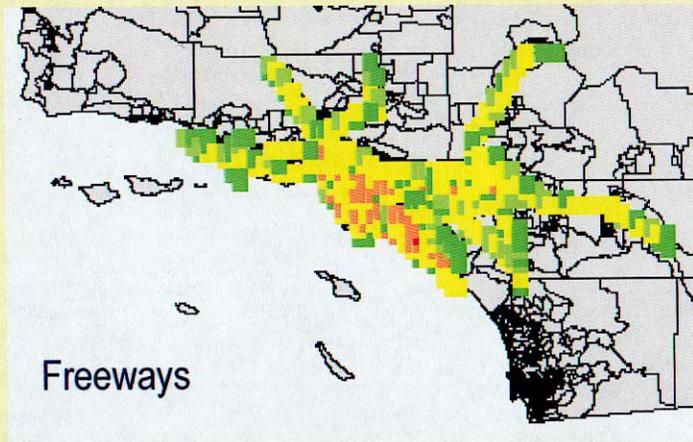
# RESULTS AND CONCLUSIONS

- The major source of contaminants to the atmosphere is resuspended dust, primarily from roads, and may reflect historical as well as current and distant as well as local sources.
- Atmospheric deposition is a significant component of contaminant loading to water bodies.
- Atmospheric loadings are the result of dry deposition of large (greater than 10 microns) particles on the watershed rather than directly on the water body.
- Regional deposition is relatively uniform spatially and temporally, but gradients exist near sources and between urban and non-urban areas and after rainfalls.

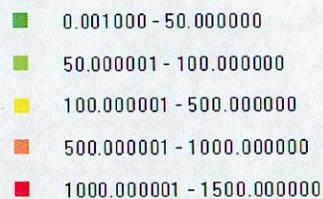
# Basinwide Zinc Emissions (1,069 mt/day)



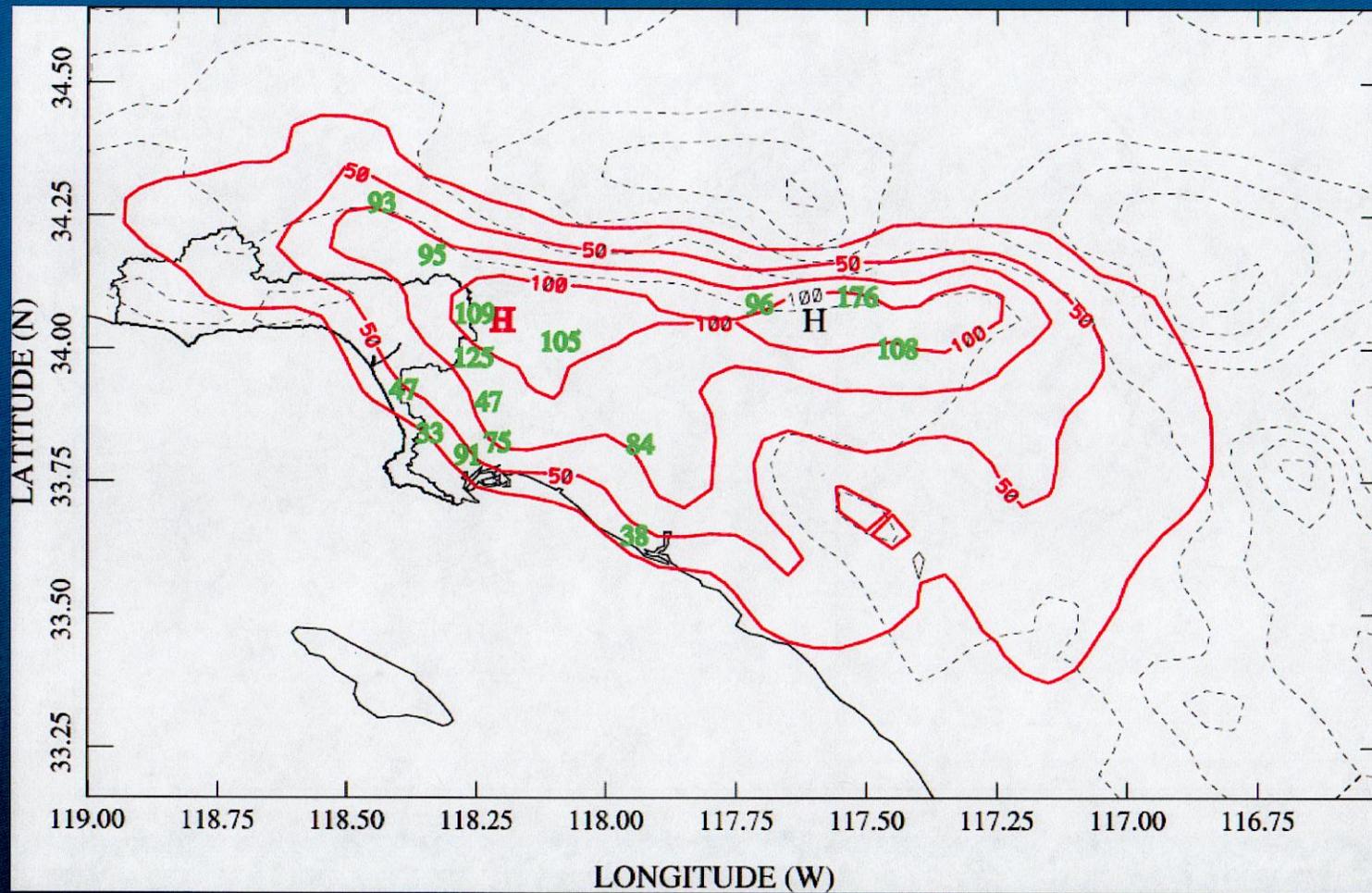
# Geographical Distribution of Dust Sources



PM (kg/day)

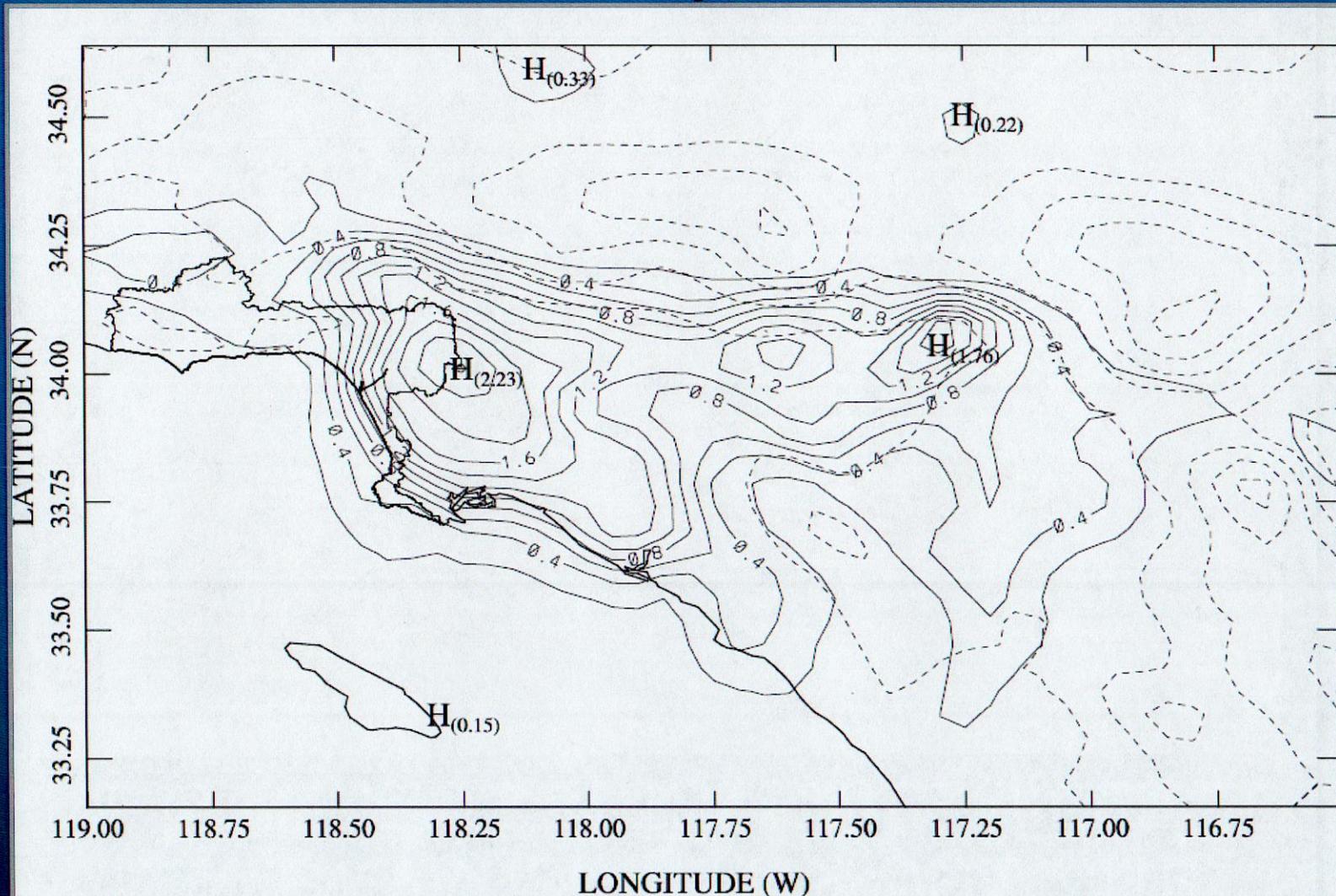


# THE SMOG MODEL DISTRIBUTION OF ZINC CONCENTRATION AGREES WELL WITH MEASUREMENTS BY THE MATES PROGRAM



(all concentrations in ng/m<sup>3</sup>)

# Modeled Zinc Deposition Patterns



Deposition Amount Scaled by  $1.0E-2$

Contour Interval =  $2.00E-03$  grams/ha/hour

Area deposition rate =  $2.9631E+05$  g/day, Fcalibr = 0.831

## ANNUAL LOADINGS TO SANTA MONICA BAY (mt/yr) FROM DIFFERENT SOURCES

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	Aerial Deposition	POTW	Industrial	PowerGS
Chromium	0.5	0.60	0.02	0.14
Copper	2.8	16.0	0.03	0.01
Lead	2.3	<0.01	0.02	<0.01
Nickel	0.45	5.10	0.13	0.01
Zinc	12.1	21.0	0.16	2.40

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NON-AERIAL SOURCES

## ANNUAL MEAN LOADING (mt Nitrogen /yr)

	Water Reclamation Plants	Atmospheric Deposition	
		Direct Dry	Indirect Dry
LA River watershed	1,042	0.2	5,600
Malibu Creek watershed	142	0.07	220
San Gabriel Rvr watershed	2,380	1.4	4,710

# Sampling Sites

## ■ Urban:

- Los Angeles River (LA1, LA2, LA3)
- Ballona Creek (BA)
- Dominguez Channel (DC)
- Santa Ana River (SA)

## ■ Non Urban:

- Malibu Creek (MA)



# Noll Rotary Impactor (NRI)



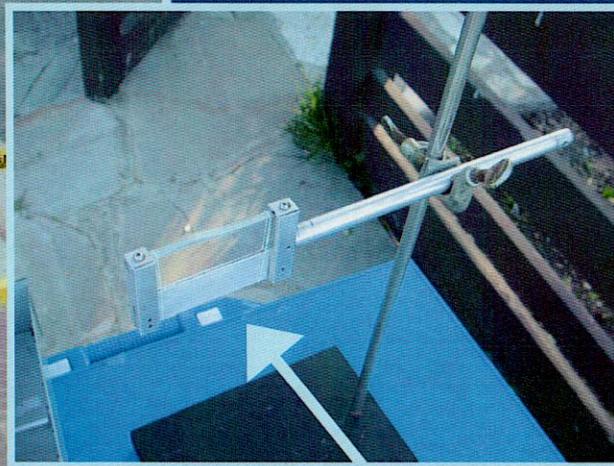
- Collects particles by rotating four rectangular collector stages through the air.
- Stages of different widths to collect different particle size fractions.
- Particle size cut point for each collector stage (at 320 rpm):

A: > 6  $\mu\text{m}$

B: > 11  $\mu\text{m}$

C: > 20  $\mu\text{m}$

D: > 29  $\mu\text{m}$



Collector Impactor Stage B

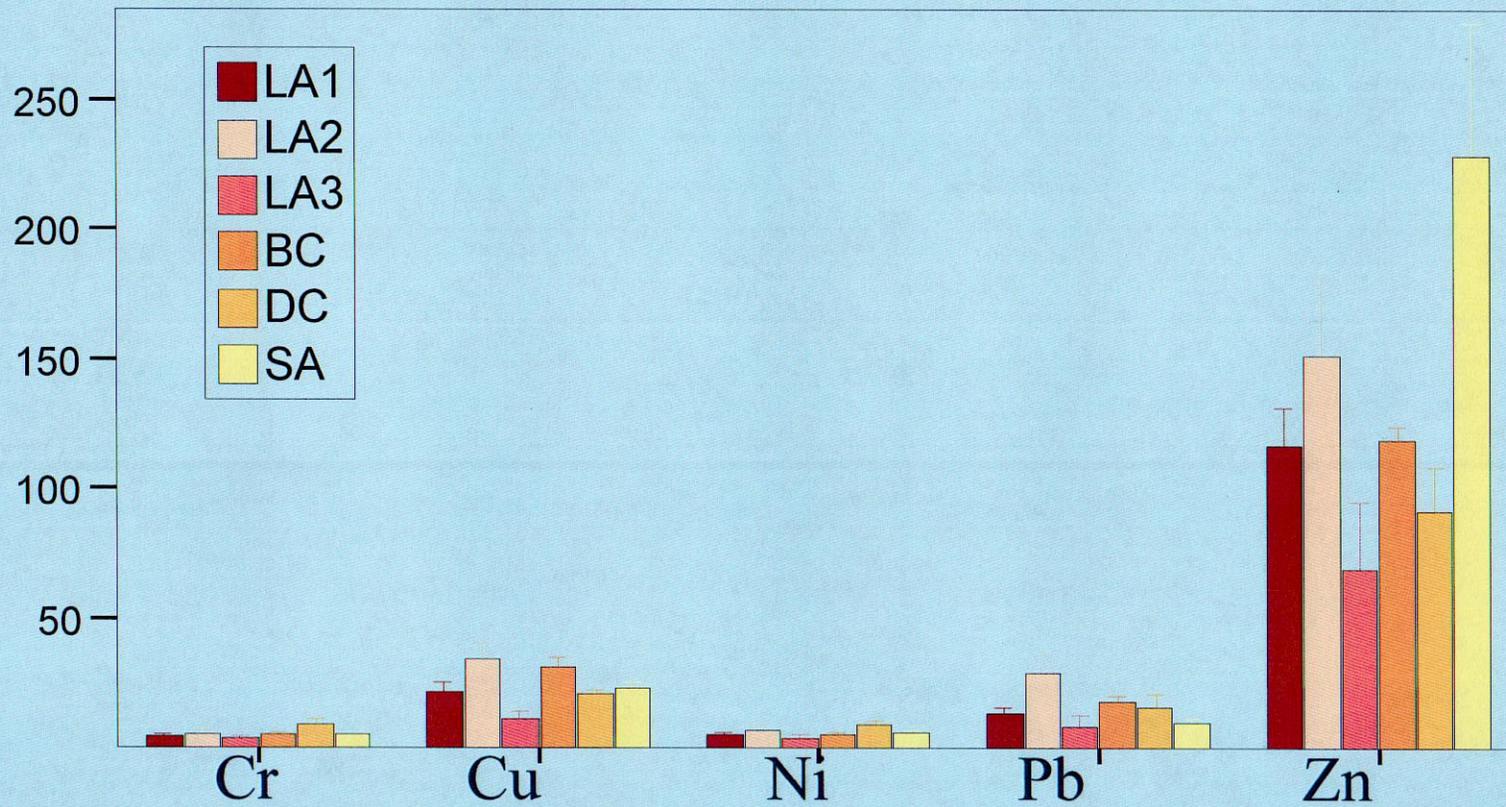
# Deposition Plate



Reference Height: 2m  
Diameter : 28 cm

# Urban Sites

Mean Dry Deposition Flux ( $\mu\text{g}/\text{m}^2/\text{day}$ )



## MEAN DEPOSITION FLUX

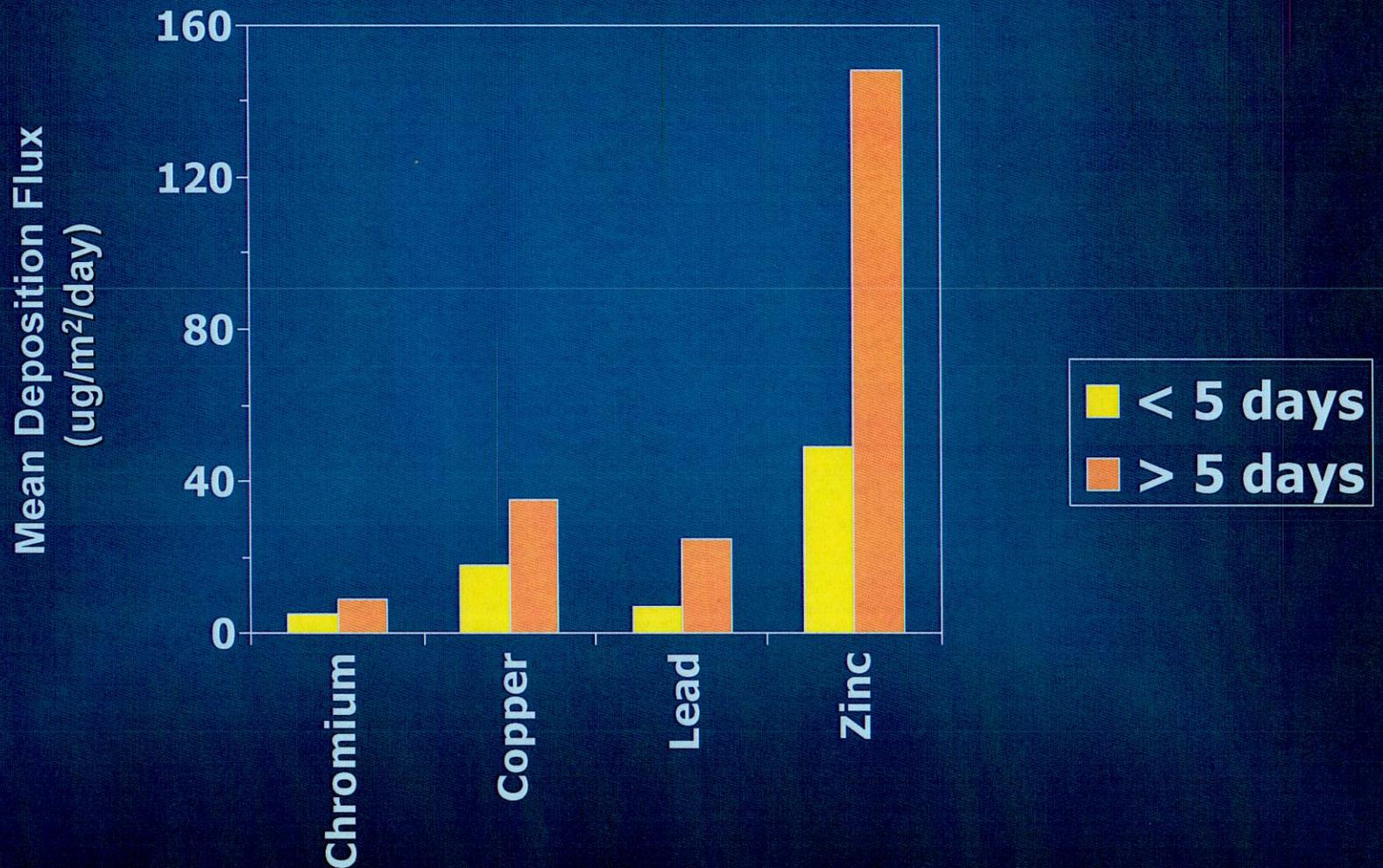
( $\mu\text{g}/\text{m}^2/\text{day} \pm 95\% \text{ CI}$ )

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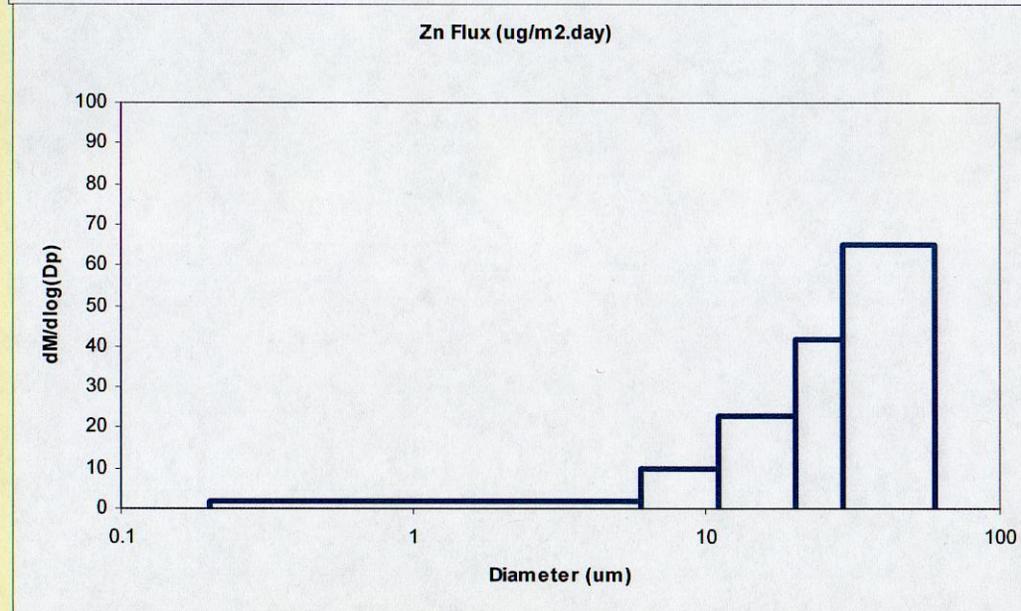
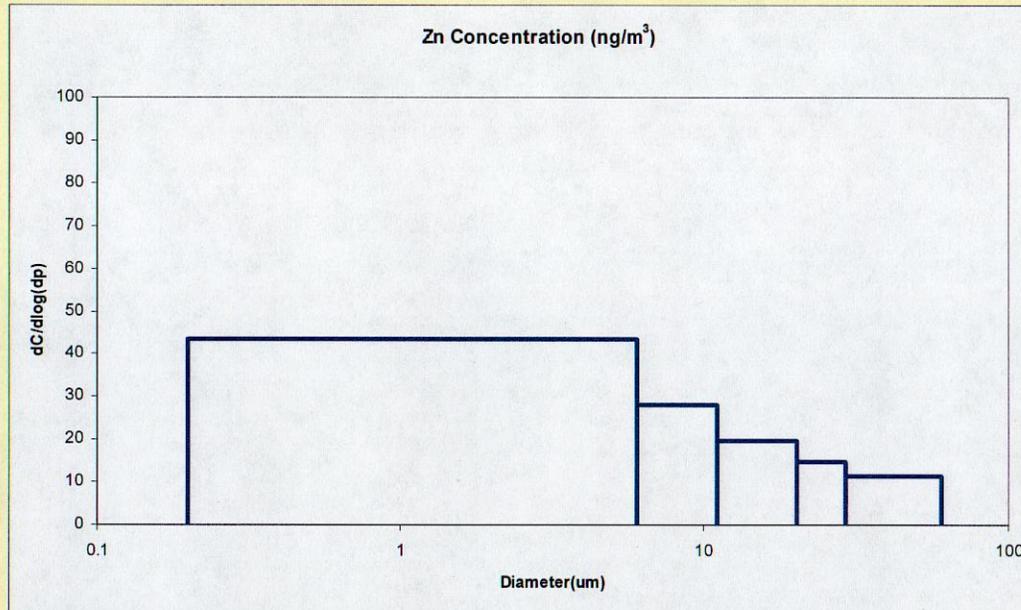
	Urban			Less Urban		
		$\pm$			$\pm$	
Chromium	5.3	$\pm$	1.6	1.1	$\pm$	0.1
Copper	23.6	$\pm$	6.5	3.7	$\pm$	0.4
Nickel	5.9	$\pm$	1.4	1.3	$\pm$	0.4
Lead	15.6	$\pm$	5.8	1.4	$\pm$	<0.1
Zinc	129.1	$\pm$	44.1	38.0	$\pm$	31.0

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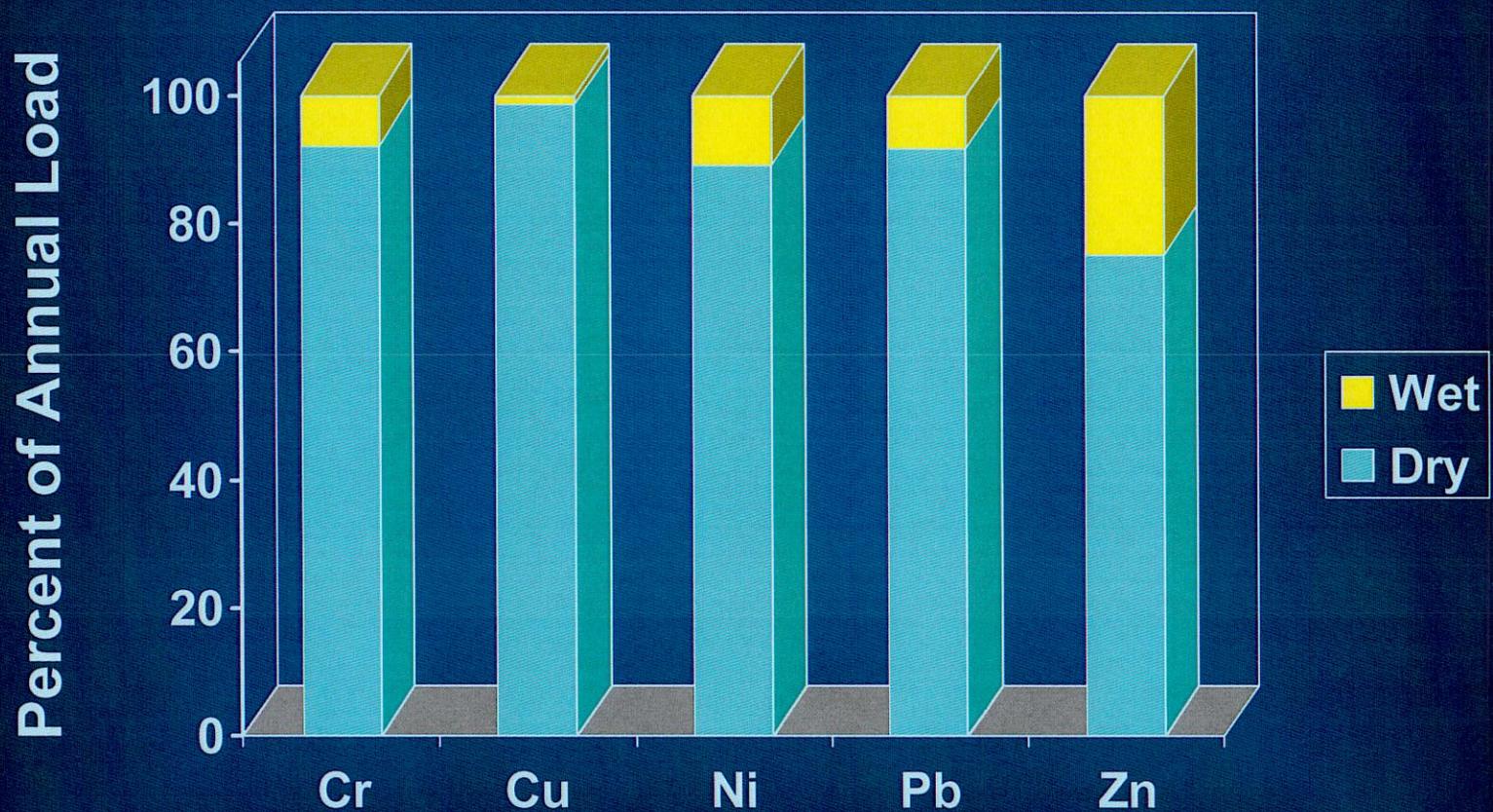
# EFFECT OF ANTECEDENT RAINFALL ON DEPOSITION



# Size distribution of zinc at CSUDH



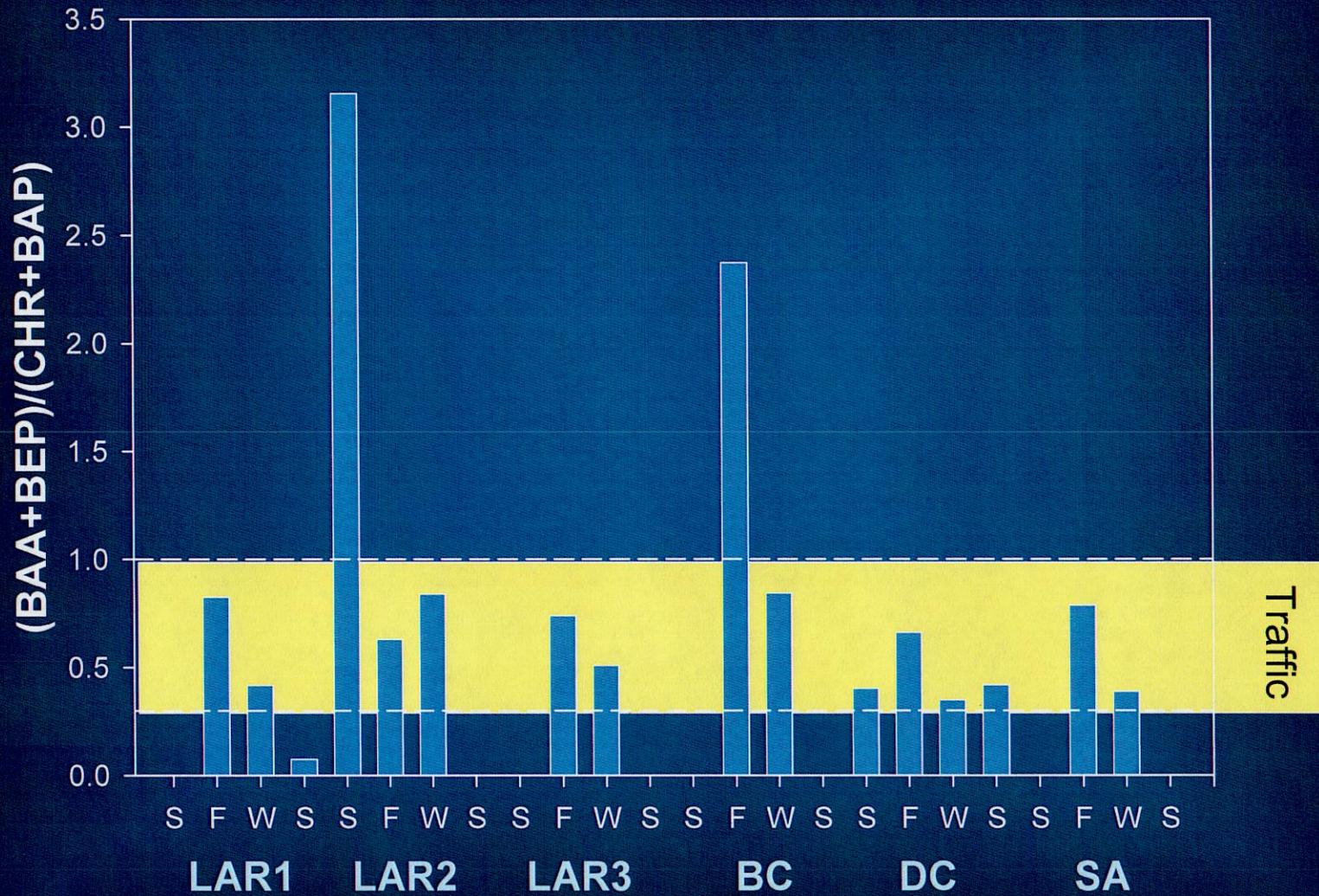
# DRY vs WET DEPOSITION OF ZINC



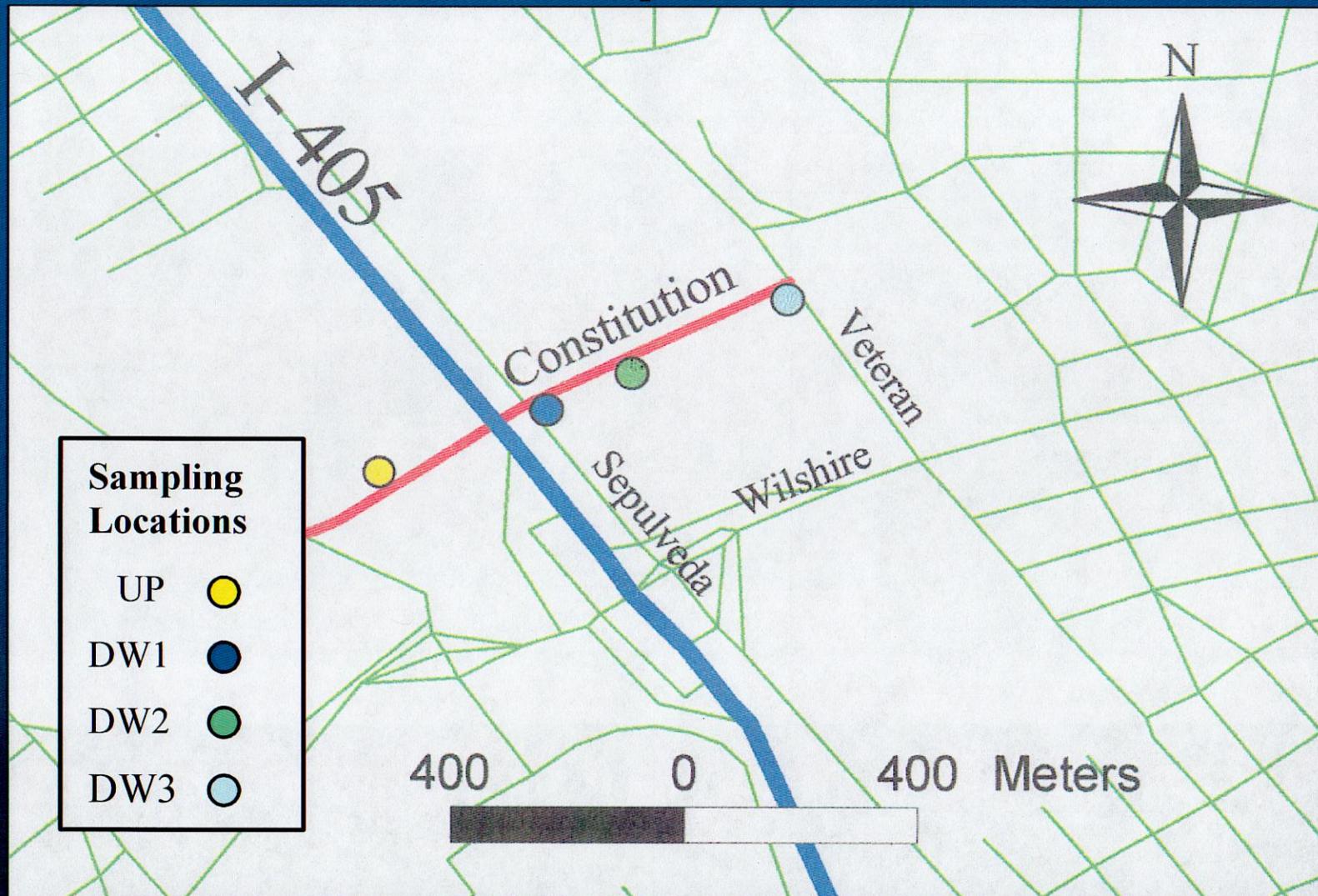
# Organic Constituents

- Few pesticides detected
- PAH always found
  - Similar concentrations among watersheds
- Traffic appears to be a predominant source

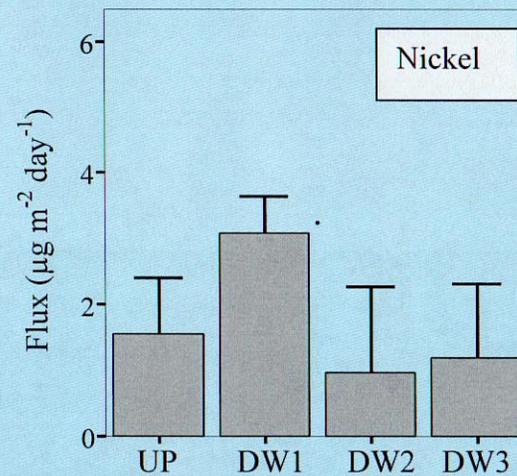
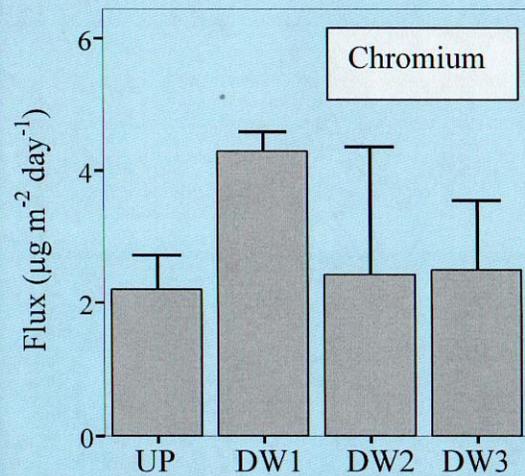
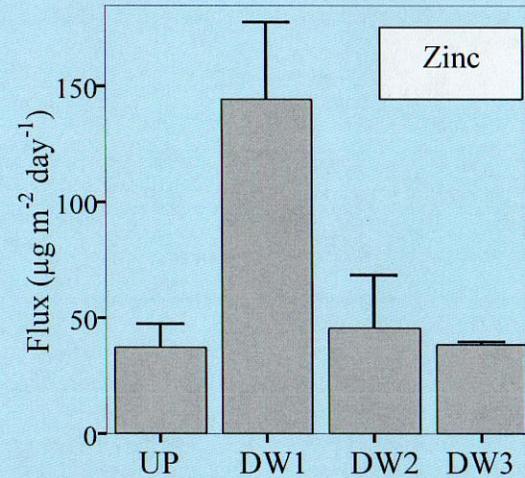
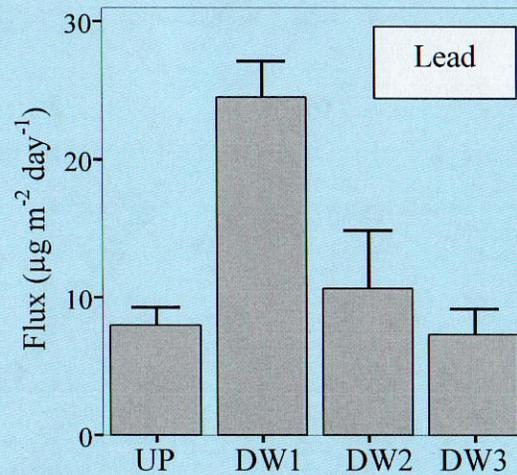
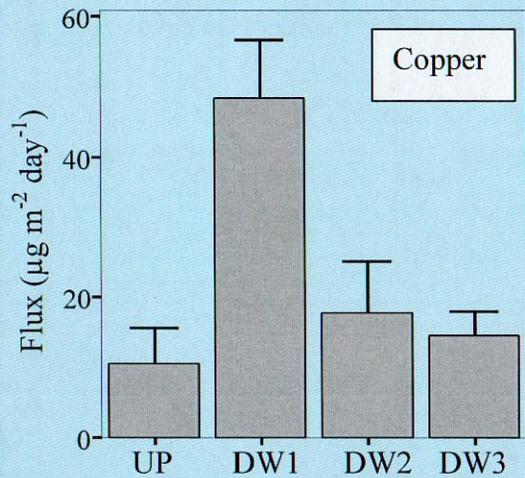
# Source Signature Ratios



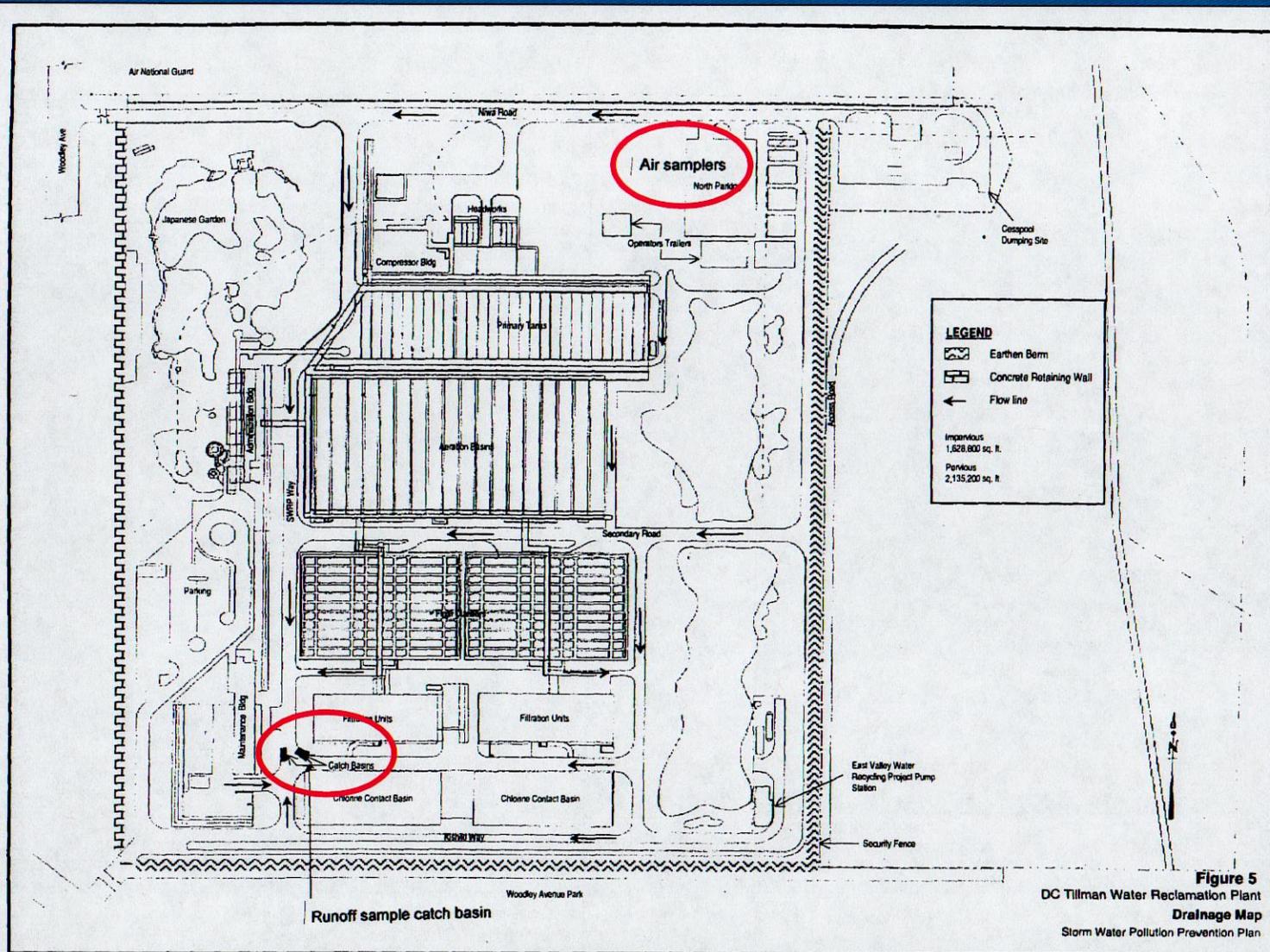
# Freeway Gradient



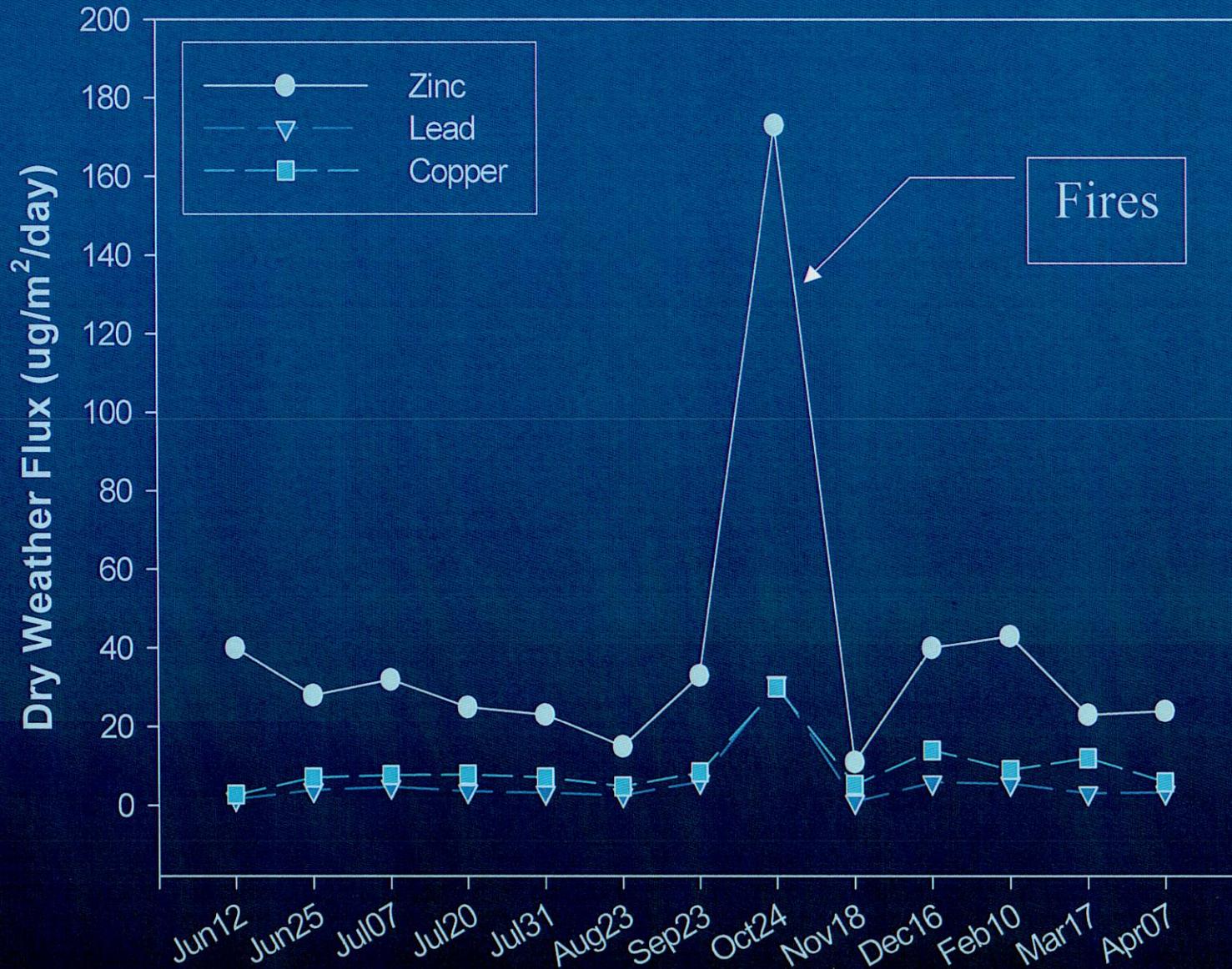
# Dry Deposition Gradient From Freeway



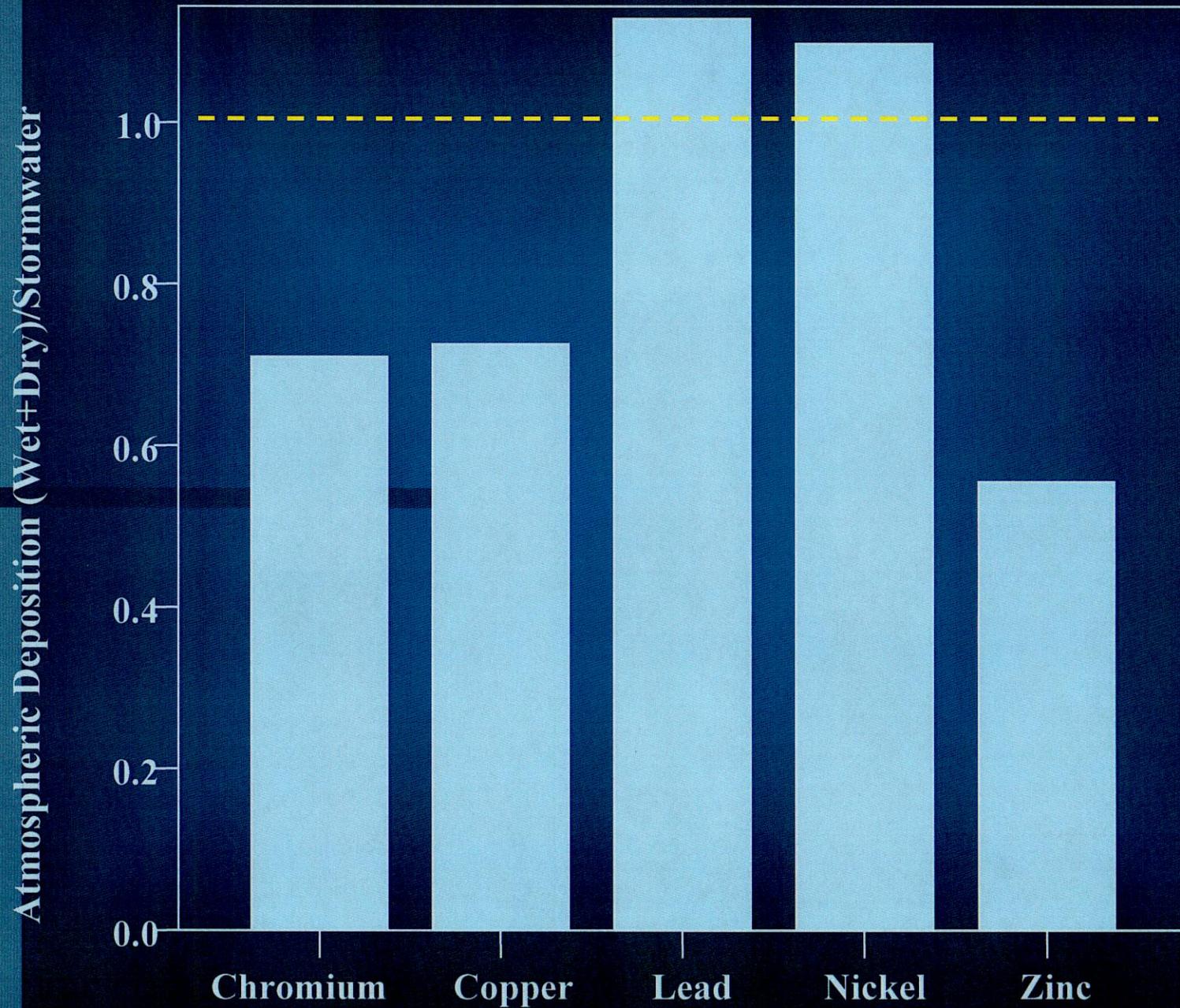
# Tillman Water Treatment Plant



# Temporal Variation of Dry Deposition

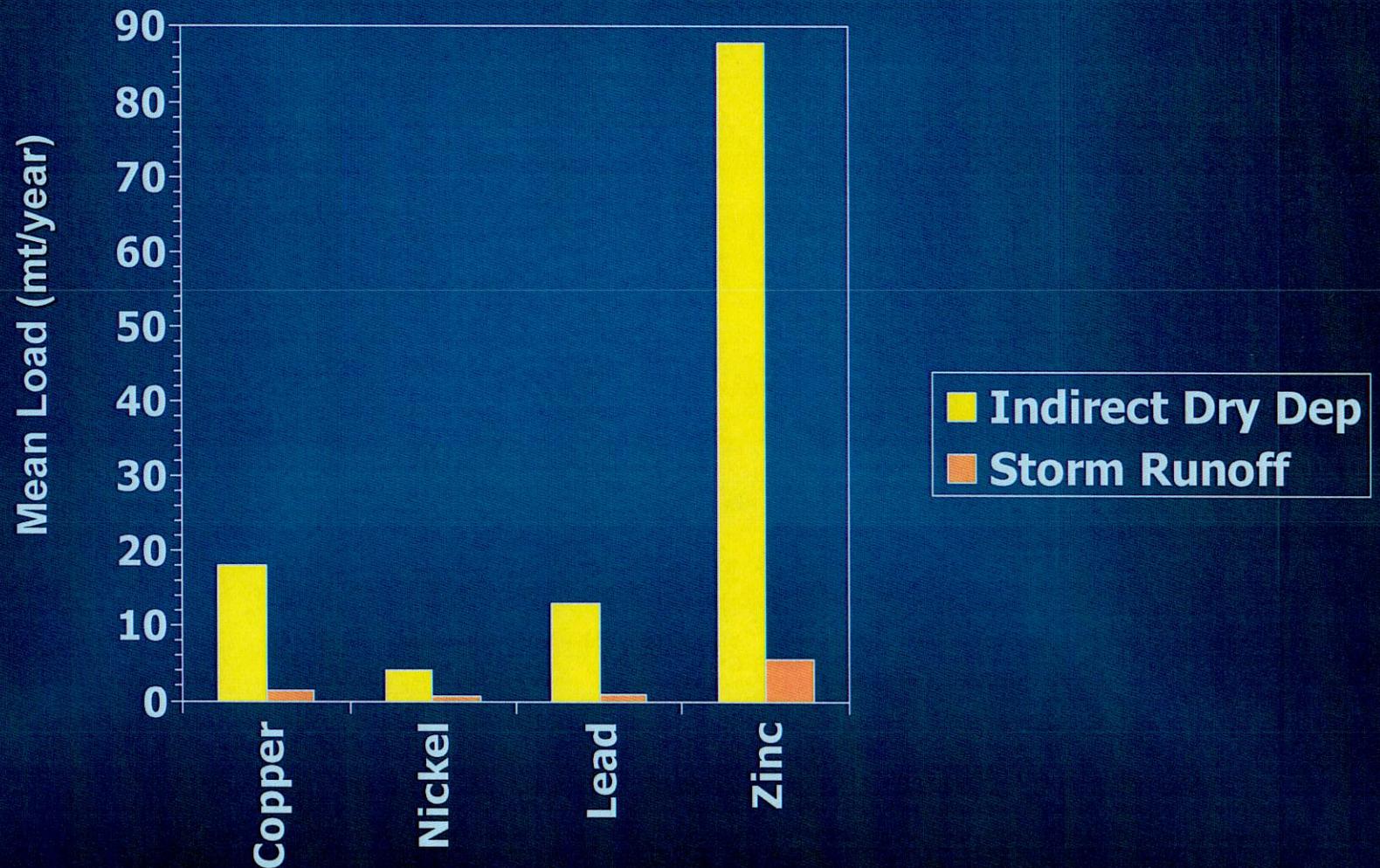


## Deposition : Stormwater Comparison at the Tillman Catchment

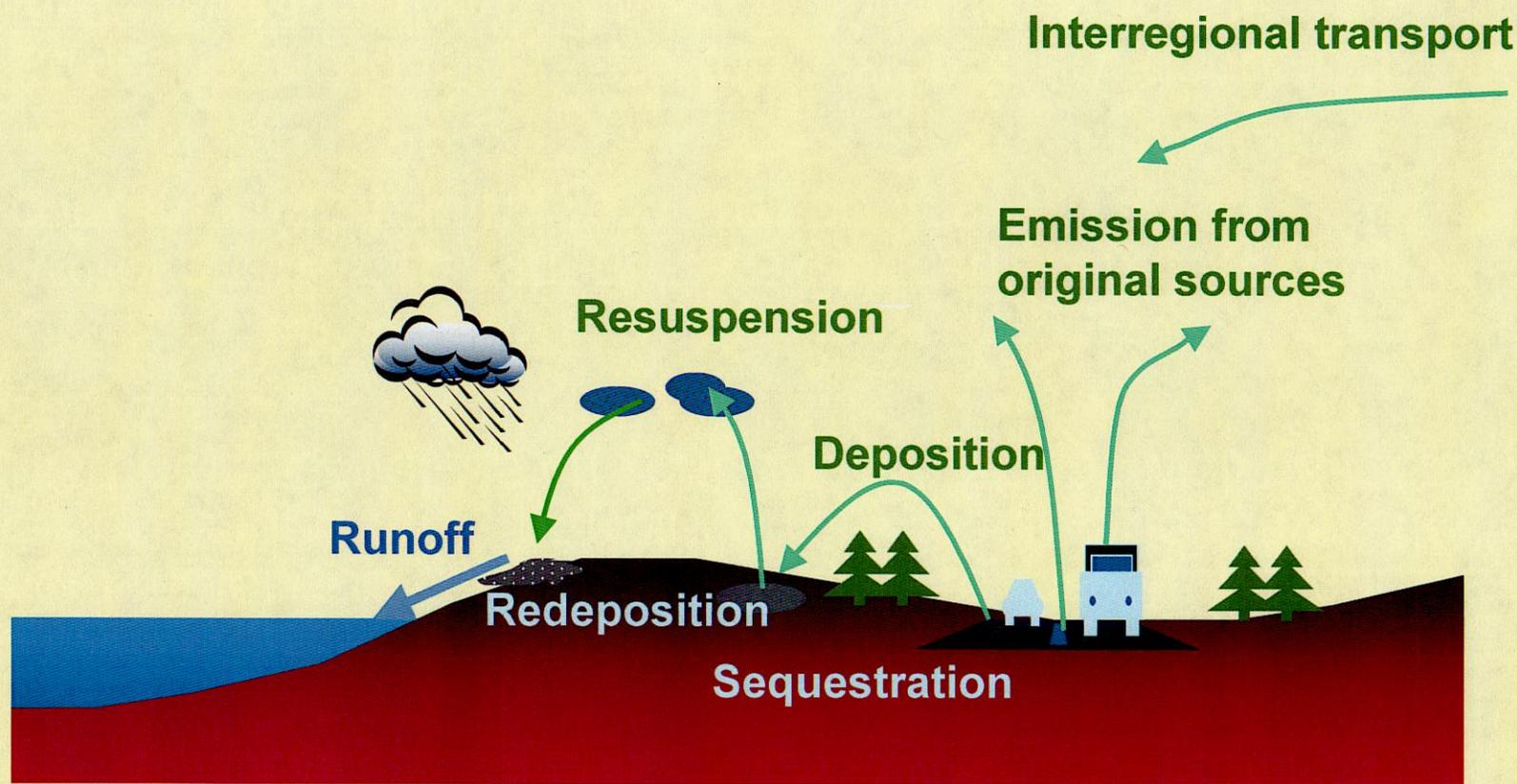


# WATERSHED TRANSFER EFFICIENCY

## *Los Angeles River*



# Cyclical Deposition and Resuspension



# RESULTS AND CONCLUSIONS

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# RESEARCH QUESTIONS

## ■ Sources

- Are the roads really the main source?
- How much material is coming from other regions?
- How can we distinguish historical from contemporary sources?

## ■ Pathways

- How much of what deposits washes off in the next rainfall?
- How long do contaminants remain sequestered before becoming resuspended?

# REGULATORY ISSUES

- Monitoring of larger particles, water toxics, and deposition rates
- Regulation of air sources on the basis of water quality impacts
- Partnerships between air and water regulators and researchers