

# Investigating CRUMB Rubber Amendments to Sustain Long-Term Green Roof Substrate Performance.

Andrew Ristvey, Lorelly Solano, John Lea-Cox, Steven Cohan.



*Applying knowledge to improve water quality*



# Green Roof Classification

Intensive



Extensive



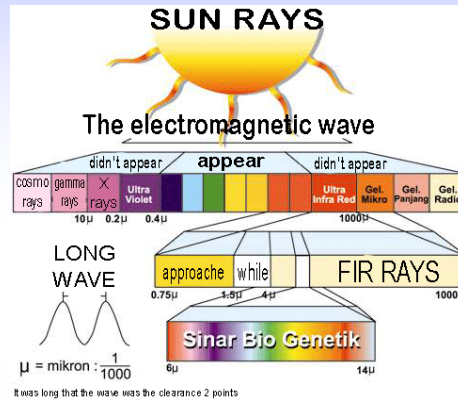
<http://www.hydrotechusa.com/garden-projects.htm>

# Extensive Green Roof Benefits



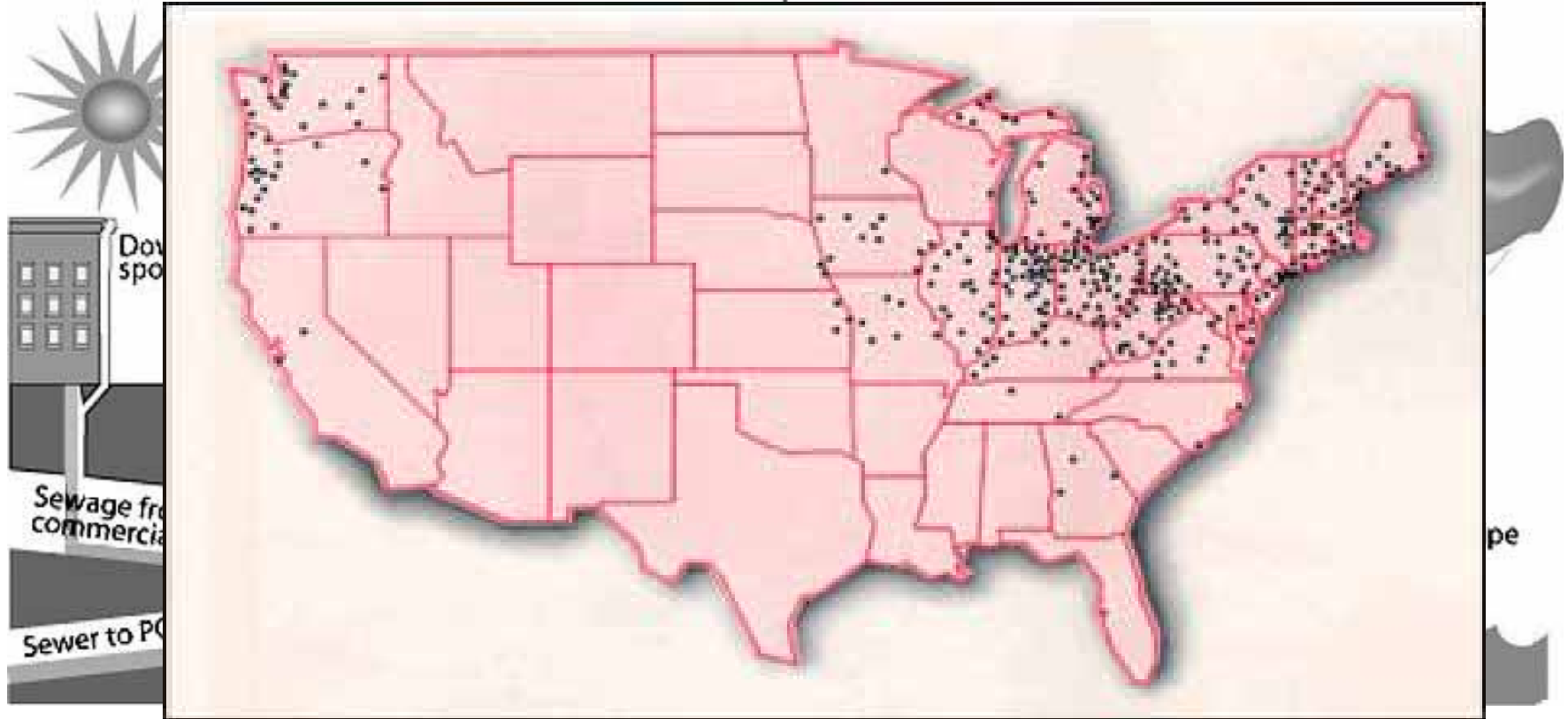
Longevity

Stormwater mitigation



Insulation and Energy Savings

# Stormwater mitigation - The CSO



There are about 772 communities in the United States with **C**ombined **S**ewer **O**utlet systems, serving about 40 million people

<http://cfpub.epa.gov/npdes/cso/demo.cfm>

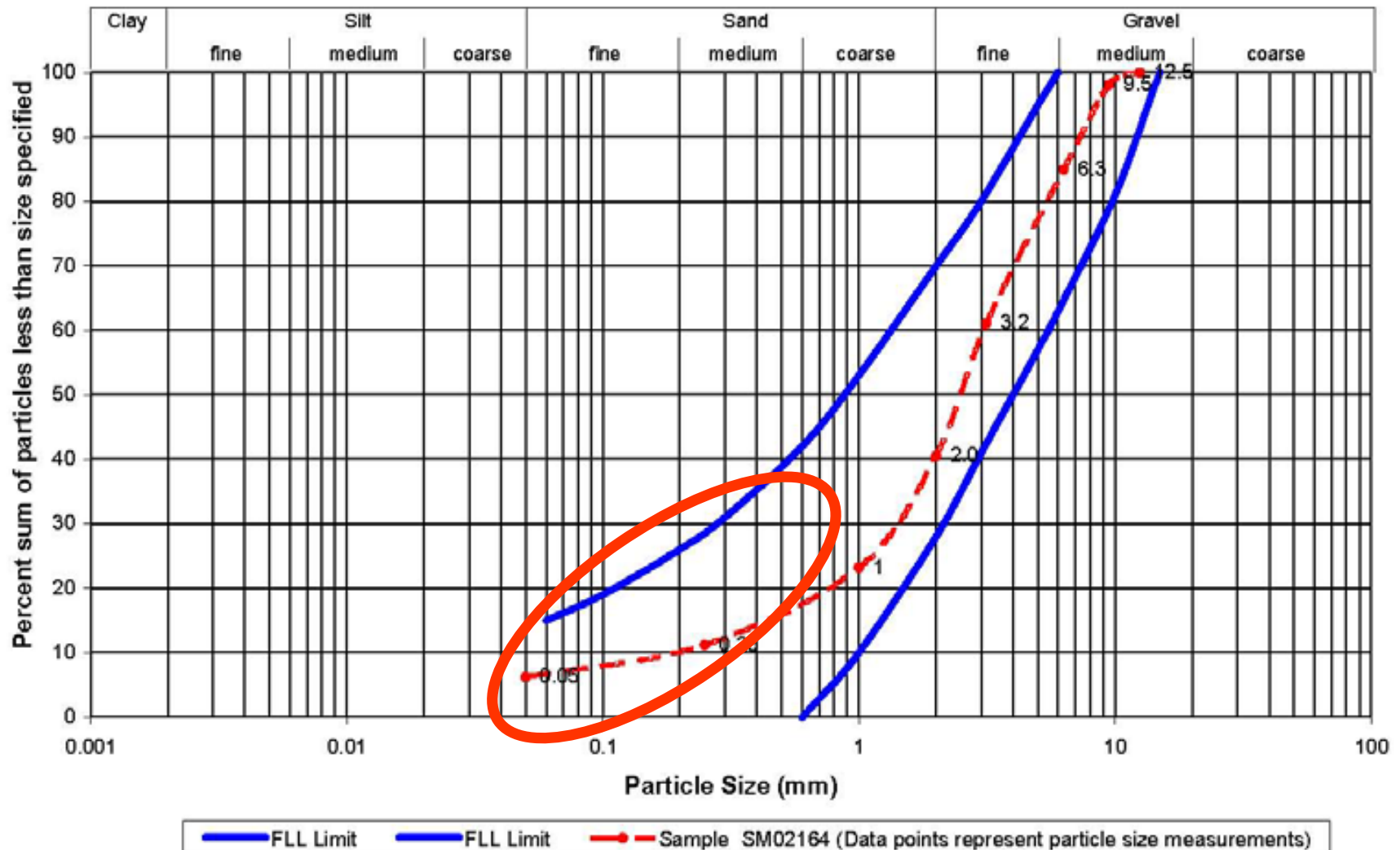
# Stormwater mitigation - The CSO



# Substrate: key component for water retention.

Research Society for Landscape Development and Landscape Design (FLL)

FLL Guidelines:  
Multiple Course Extensive



# Substrate: key component for water retention.

- Balance between water-holding capacity and air-filled porosity
- Light weight
- Long term stability
- Many substrates have high embodied energy

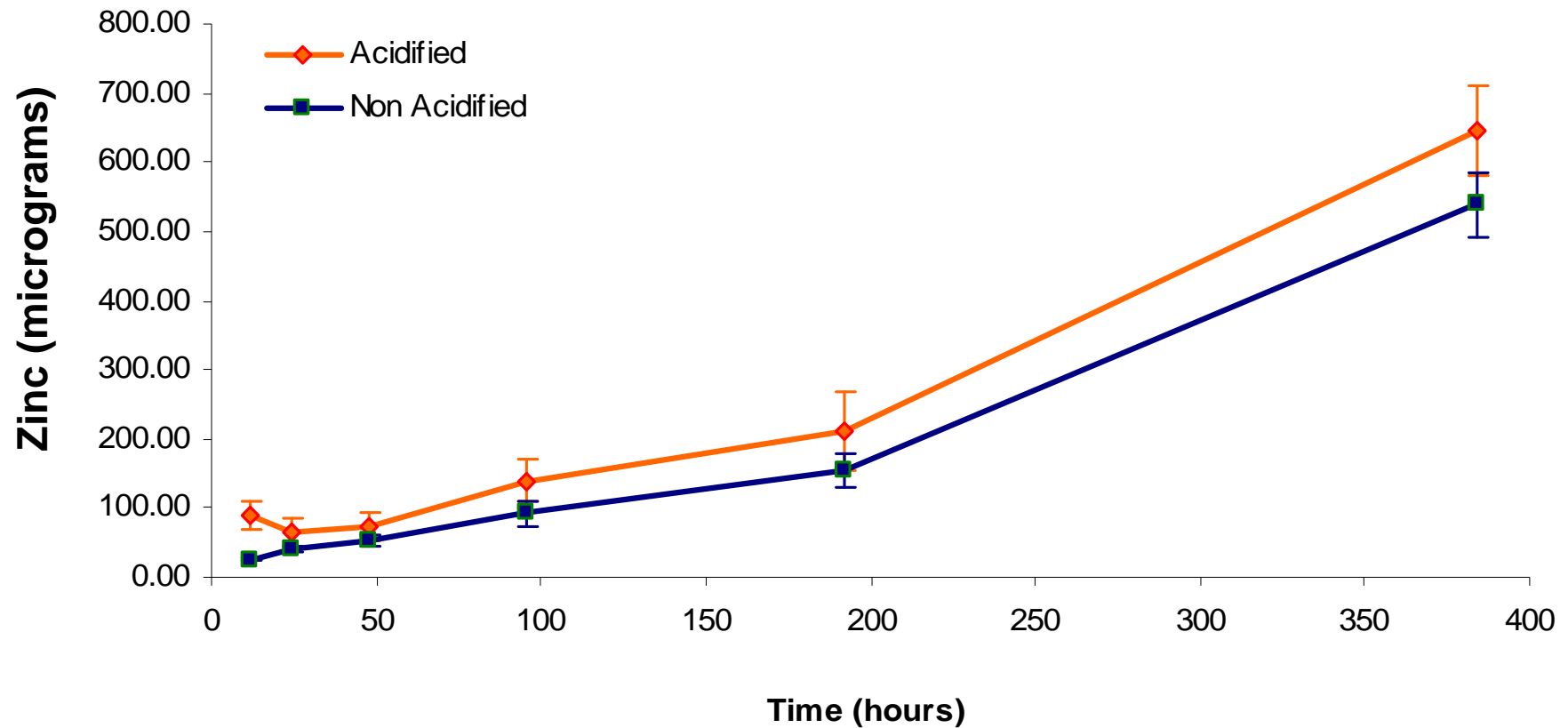




# UMD Reaserch Objectives

- Investigate zinc levels in crumb rubber
- Investigate the phytoremediation / tolerance potential of a range of *Sedum* species
- The potential adsorption of zinc in substrates
- Investigate if crumb rubber amendments mitigate weight, weathering issues, and improve balance of physical properties

# 1. Zinc Leachate in Two Different pH Solutions



**Figure 1. Micrograms of zinc released from crumb rubber for different exposure times in acidified and non acidified solutions.**

# General Conclusions

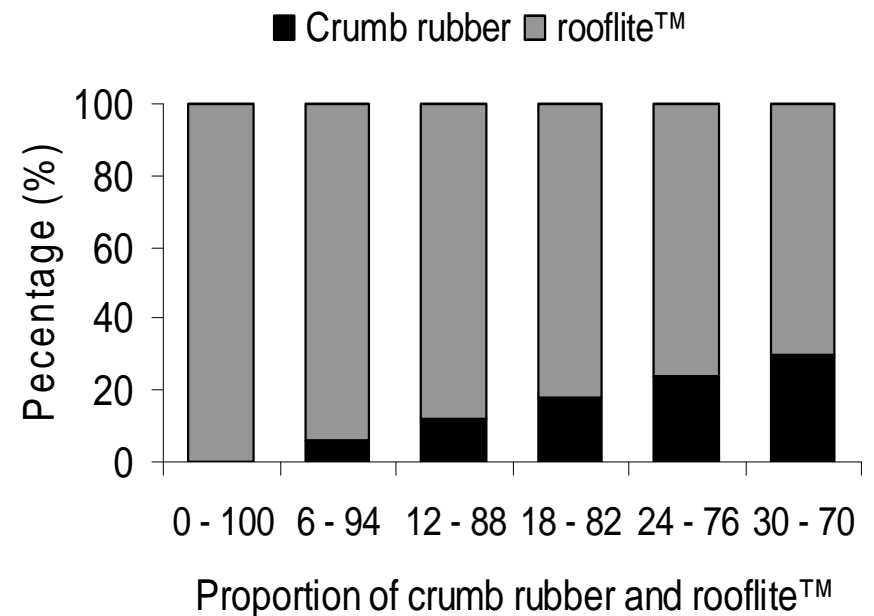
- Crumb rubber releases around 550 micrograms of zinc per gram of crumb rubber after 16 days of saturation
- pH of the water (4.1 or 5.5) did not alter the cumulative zinc release
- An acid wash would not affect zinc release

## 2. Sedum / Zinc toxicity Screening



# Materials and methods

- Three *Sedum* species: *S. album*, *S. reflexum*, and *S. kamtschaticum*
- Six crumb rubber / rooflite™ proportions (0, 6, 12, 18, 24, 30 %)

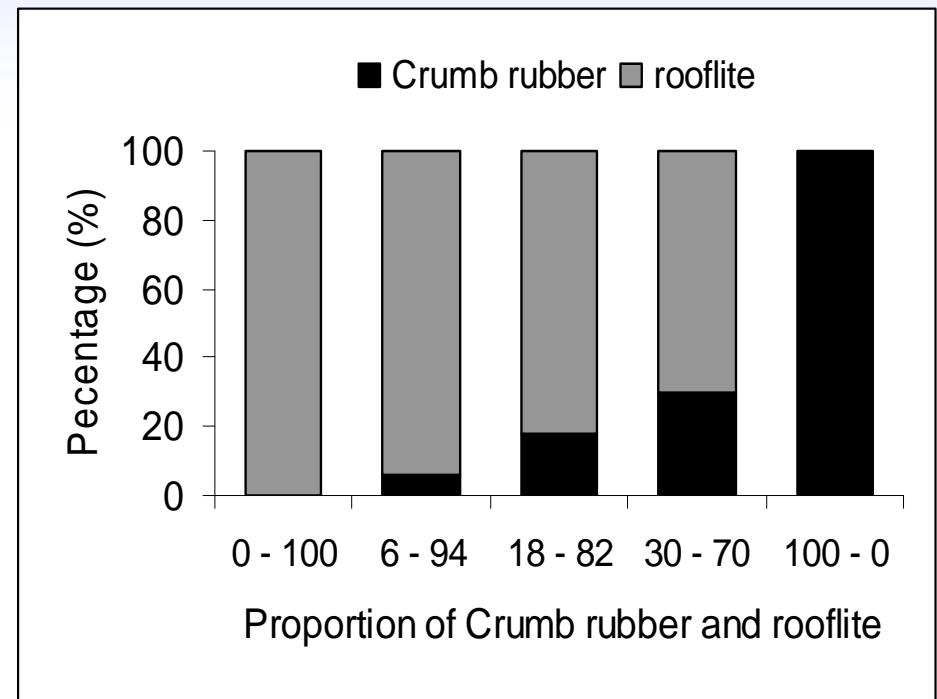


# Results

- No significant differences in growth quality (FVI) with any crumb rubber proportion in any species
- Significant differences in dry mass in all the species
- Non-significant differences in zinc content at any level of crumb rubber in any species

### 3. Adsorption of Zinc in Crumb Rubber-Amended Green Roof Substrates

- Five different volumetric proportions of crumb rubber and rooflite™ were prepared in 300 ml flasks
- The amount of crumb rubber was constant (10 g)



Crumb rubber and rooflite™ proportions.

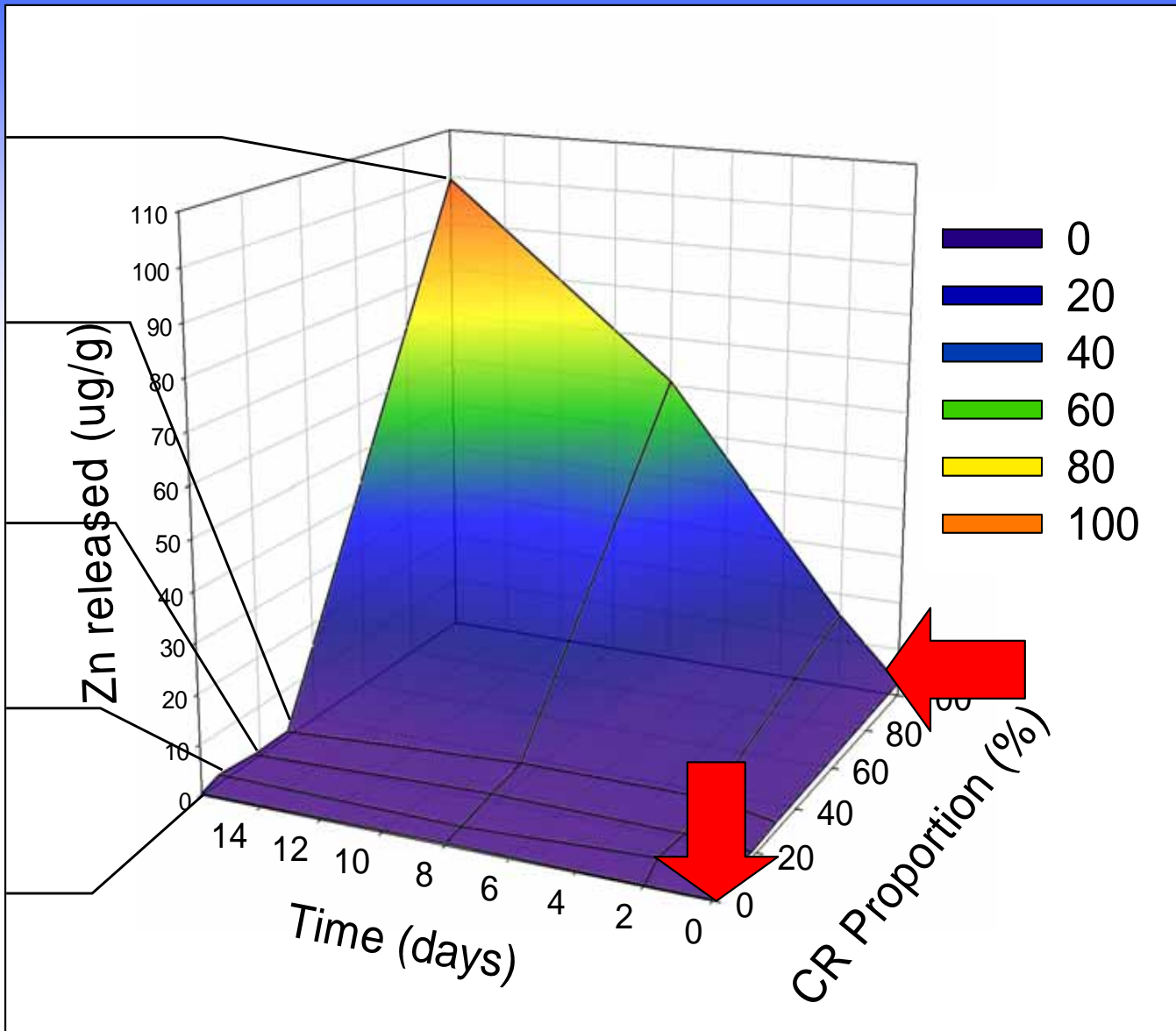
99.5

1.1

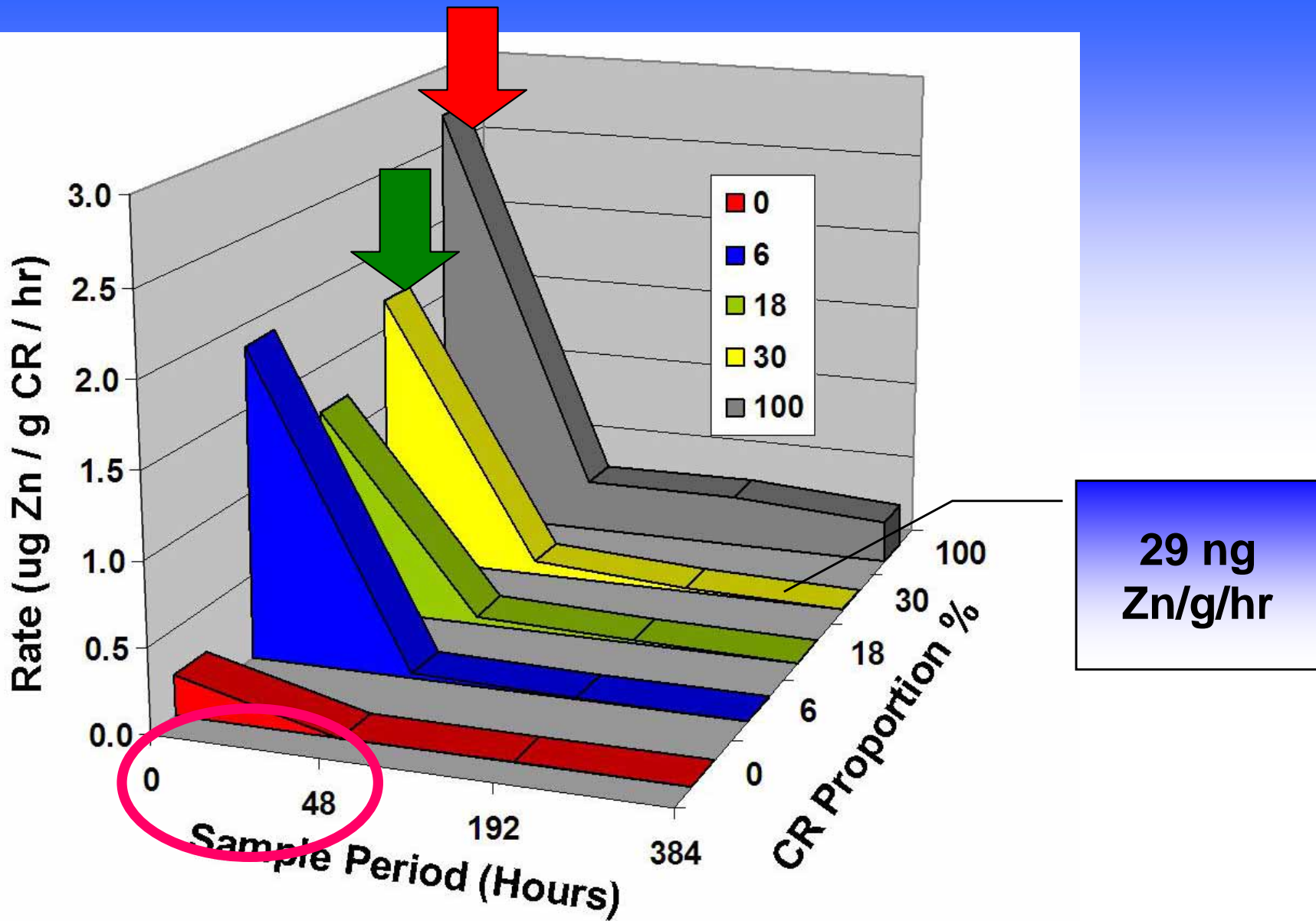
1.0

1.7

0.03



Micrograms of zinc available per gram of crumb rubber over time.



Rate (ug/hr) of Zn released per gram of CR extrapolated over each sampling period from five volumetric proportions (%) of CR and rooflite™ during a sixteen day (384 hour) study period.

# Results

- rooflite™ adsorbed a substantial amount of zinc compared to the 100% CR control after 16 days
- Release rates of zinc were also substantially less for each of the treatments
- Green roof substrates have the potential to retain released zinc...but for how long is unknown

# General Conclusions

- In practical terms, a green roof with a 30% proportion of crumb rubber and rooflite™ would release approximately 15.4 mg of zinc per square meter in 16 days if consistently saturated.
- The use of crumb rubber should be limited to low proportions in substrates having high zinc adsorption capability, planted with zinc tolerant species.
- If 30% was acceptable, a 15% reduction in weight could be achieved.

# General Conclusions



- Our experiments describe particular scenarios, however the zinc uptake of the complete plant pallet, rainfall volume and frequency would have an additional effect upon zinc release.

# Future Research

- Further plant screening
- Weathering simulation
- Compaction and infiltration analysis
- Physical characteristics determination with amendment ratios
- Other substrates physical properties

# Special thanks to:

