Characterization of Stormwater Runoff from Residential Catchments

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Why Do We Care About Stormwater?

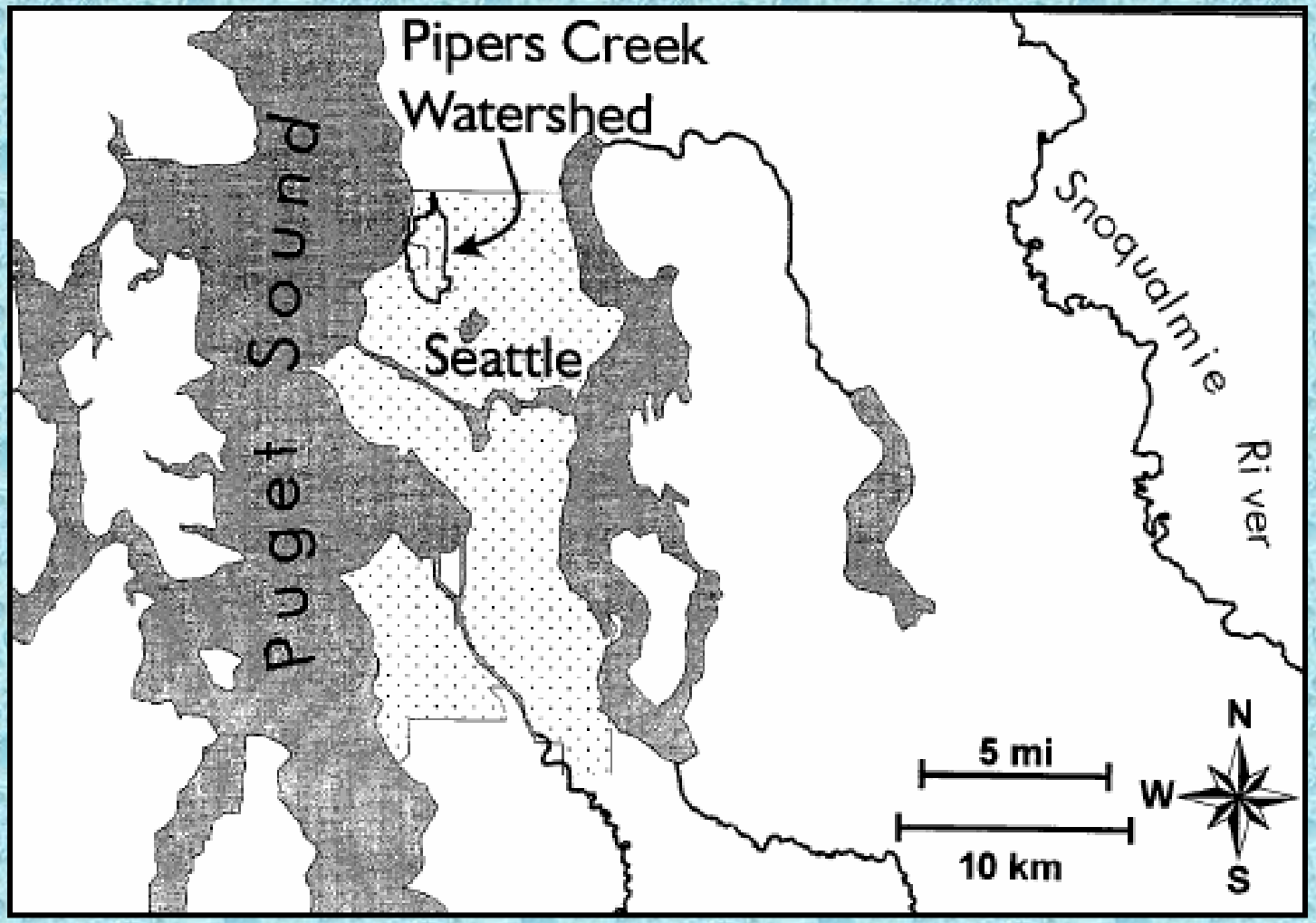
- Urbanization causes changes in runoff
  - quantity: reduced infiltration capacity, increased impervious area, higher peak flows, greater runoff volumes
  - quality: increase in concentrations of solids, chemicals, bacteria, other constituents
- Changes in runoff affect downstream natural systems
  - habitat
  - aesthetics

What Can We Do About Stormwater?

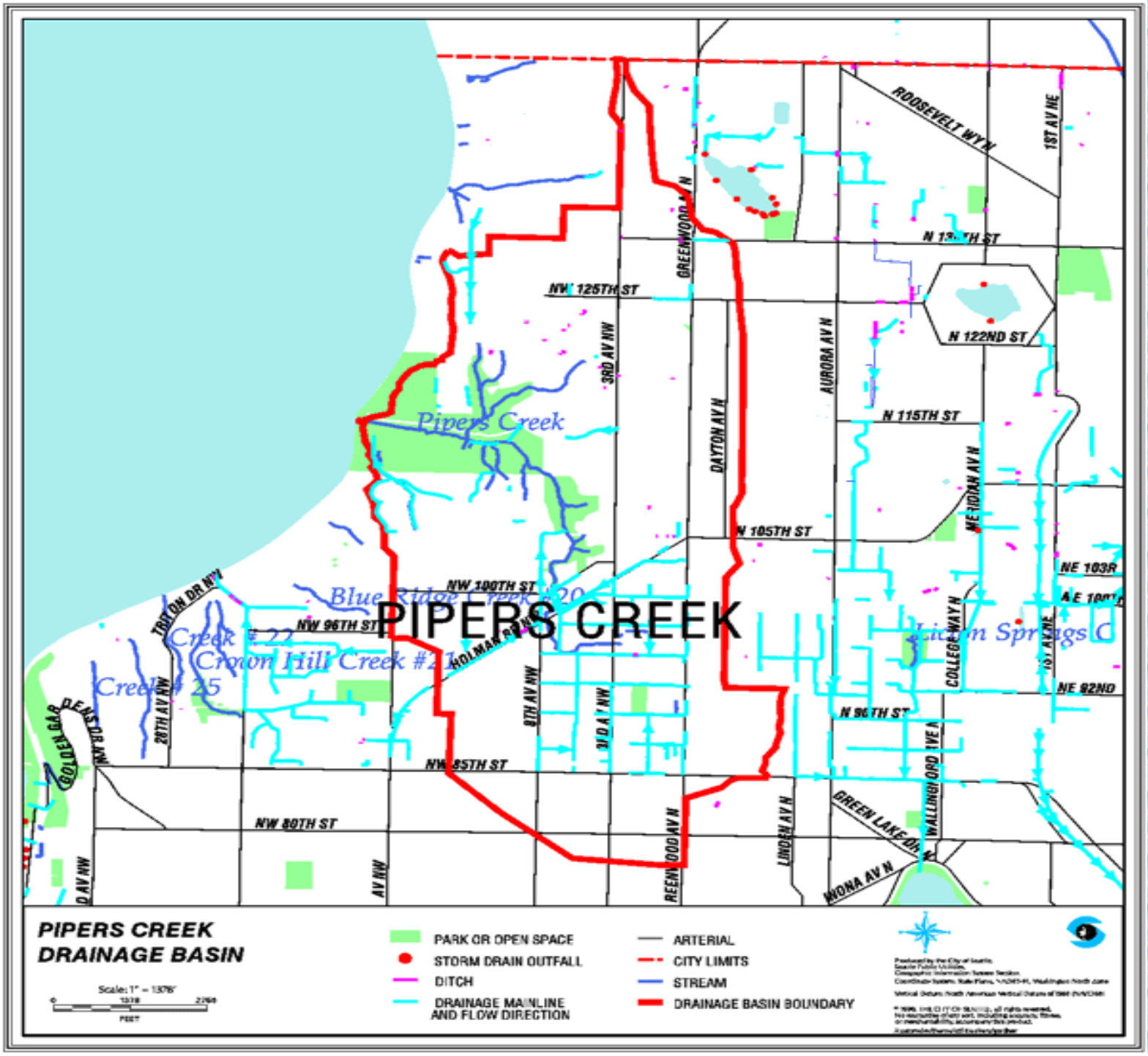
- Education
  - changes in behavior, knowledge of cause/effect of actions
- Restoration
  - physical stream channel modifications/enhancements
- ★Mitigation
  - Best Management Practices (BMPs)
  - Low-Impact Development (LID)

Stormwater Mitigation

An Example…



Source: Barton 2002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PARK OR OPEN SPACE
STORM DRAIN OUTFALL
DITCH
DRAINAGE MAINLINE AND FLOW DIRECTION
ARTERIAL
CITY LIMITS
STREAM
DRAINAGE BASIN BOUNDARY
Pipers Creek
Blue Ridge Creek #20
Crown Hill Creek #21
Creek # 22
Creek # 25
ROOSEVELT WY N
1ST AV NE
GREENWOOD AV N
NW 125TH ST
N 122ND ST
3RD AV NW
AURORA AV N
DAYTON AV N
N 115TH ST
MERIDIAN AV N
N 105TH ST
NW 100TH ST
NW 96TH ST
HOLMAN RD NW
TRITON DR NW
28TH AV NW
8TH AV NW
NW 85TH ST
NW 80TH ST
COLLEGE WAY N
NE 103R
NE 92ND
N 96TH ST
GREEN LAKE DR N
WALLINGFORD AVE N
LINDEN AV N
WONA AV N

Natural Drainage Systems

A Mitigation Effort by Seattle Public Utilities (SPU)

- Individual projects:
  - SEA Streets (Street Edge Alternatives)
  - 110th Cascade
  - Broadview Green Grid
  - future projects
- Design elements:
  - vegetated swales
  - infiltration ponds
  - native vegetation

SEA Streets

(Street Edge Alternatives)

- Re-design of one city block of existing right-of-way
  - traffic control, sidewalks
- Source Control
  - infiltration ponds
  - swales with native vegetation

Source: Seattle Public Utilities

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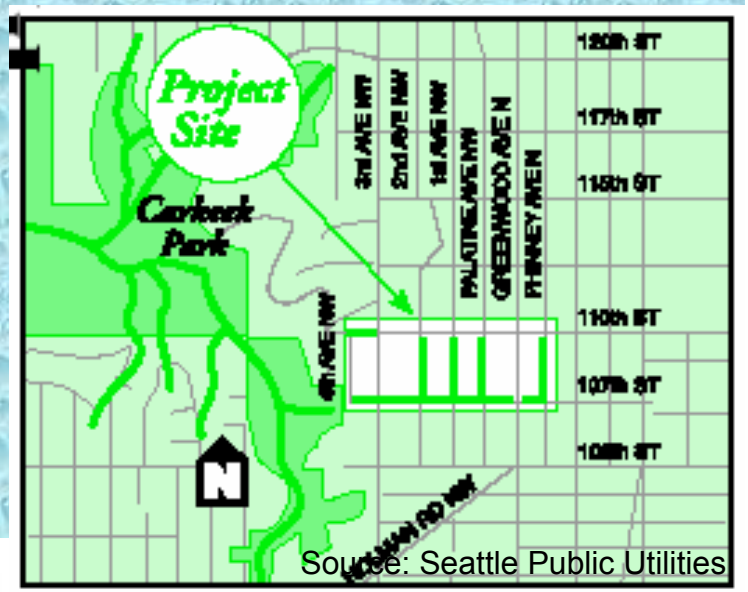
Broadview Green Grid

- Re-design of multiple city blocks of existing right-of-way
  - traffic control, sidewalks
- Source control and “end-of-pipe” elements
  - infiltration ponds
  - swales with native vegetation
  - non-linear conveyance mimics natural systems



What About Performance?

- October 20th, 2003
  - 4.22 inches over 32 hours
  - long duration, low intensity, dry antecedent
- SEA Streets:
  - no discharge
- Broadview Green Grid:
  - construction not fully completed by 10/20/03, but some infiltration swales implemented
  - anecdotal evidence?


Source: Seattle Public Utilities


Source: Seattle Public Utilities

What Have We Learned?

- Implementation
  - $/benefit ratio, public acceptance
- Design elements
  - hydrologic effectiveness
  - potential for water quality improvement (?)

How Are We Using What We've Learned Towards Future Projects?

- Working within constraints (political, etc.)
- Development of hydrologic model
  - optimizing locations of design elements
- Importance of water quality monitoring before and after implementation

Study Design

Water Quality Monitoring of Existing Pre-Construction Conditions

Projects Monitored:

1) Broadview Green Grid
   - 1 station, downstream point
   - time frame: October 2002 through March 2003

2) 120th Future Project
   - 2 stations, downstream point and upstream of existing grassy swale (paired study)
   - time frame: October 2002 through March 2004 (ongoing)

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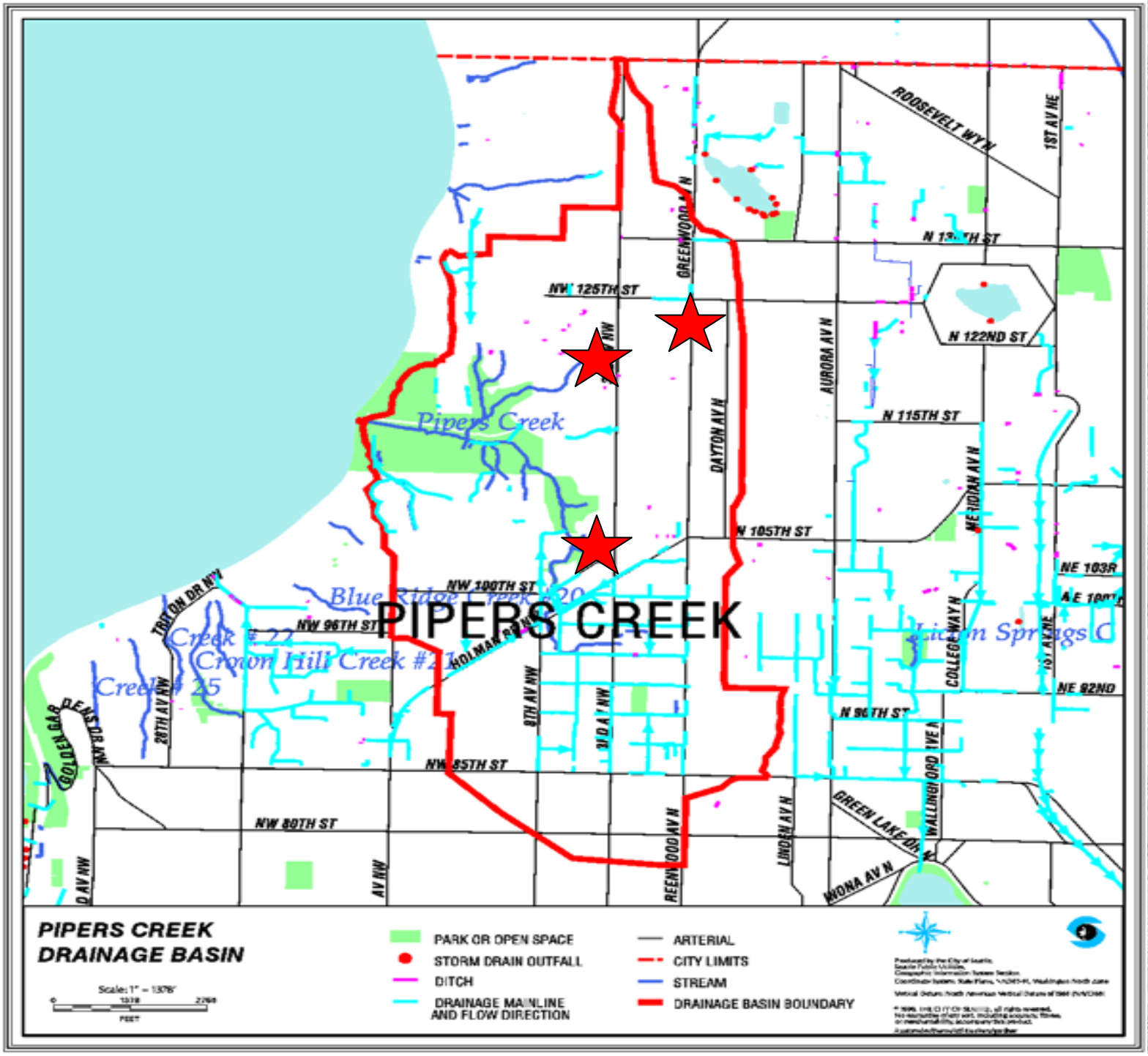
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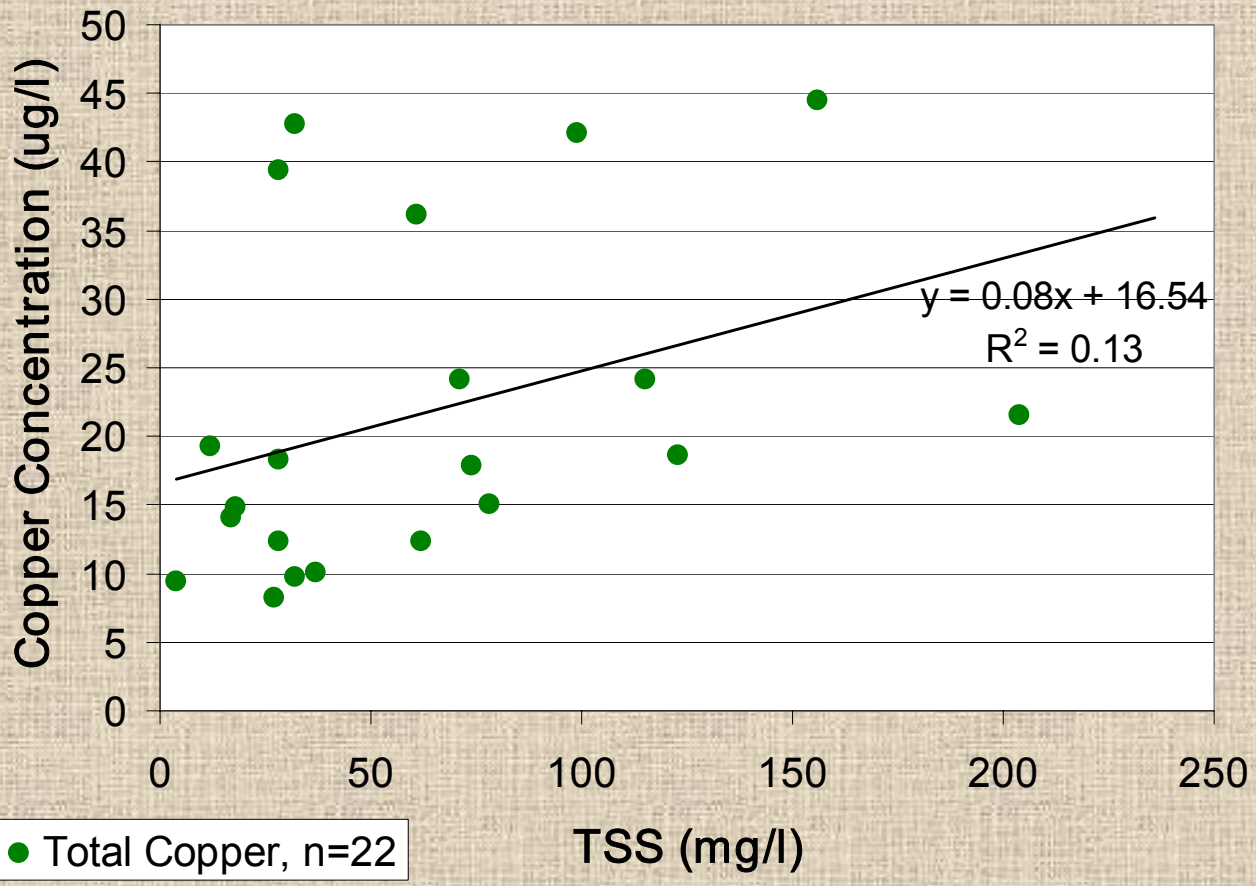
Study Design
Water Quality Monitoring of Existing Pre-Construction Conditions

- Composite sampling over hydrograph (20 events):
  - metals (Zn, Cu, Pb), total and dissolved
  - solids (TSS and particle size distribution)
  - nutrients (TN, TP, SRP)
  - hardness
  - pesticides/herbicides
- Grab sampling over first 1 hour of hydrograph (20 events):
  - TPH
  - e coli and fecal coliform
  - pH and temperature

Preliminary Results

Water Quality Monitoring of Existing Pre-Construction Conditions



-comparison of metals concentrations to solids concentrations

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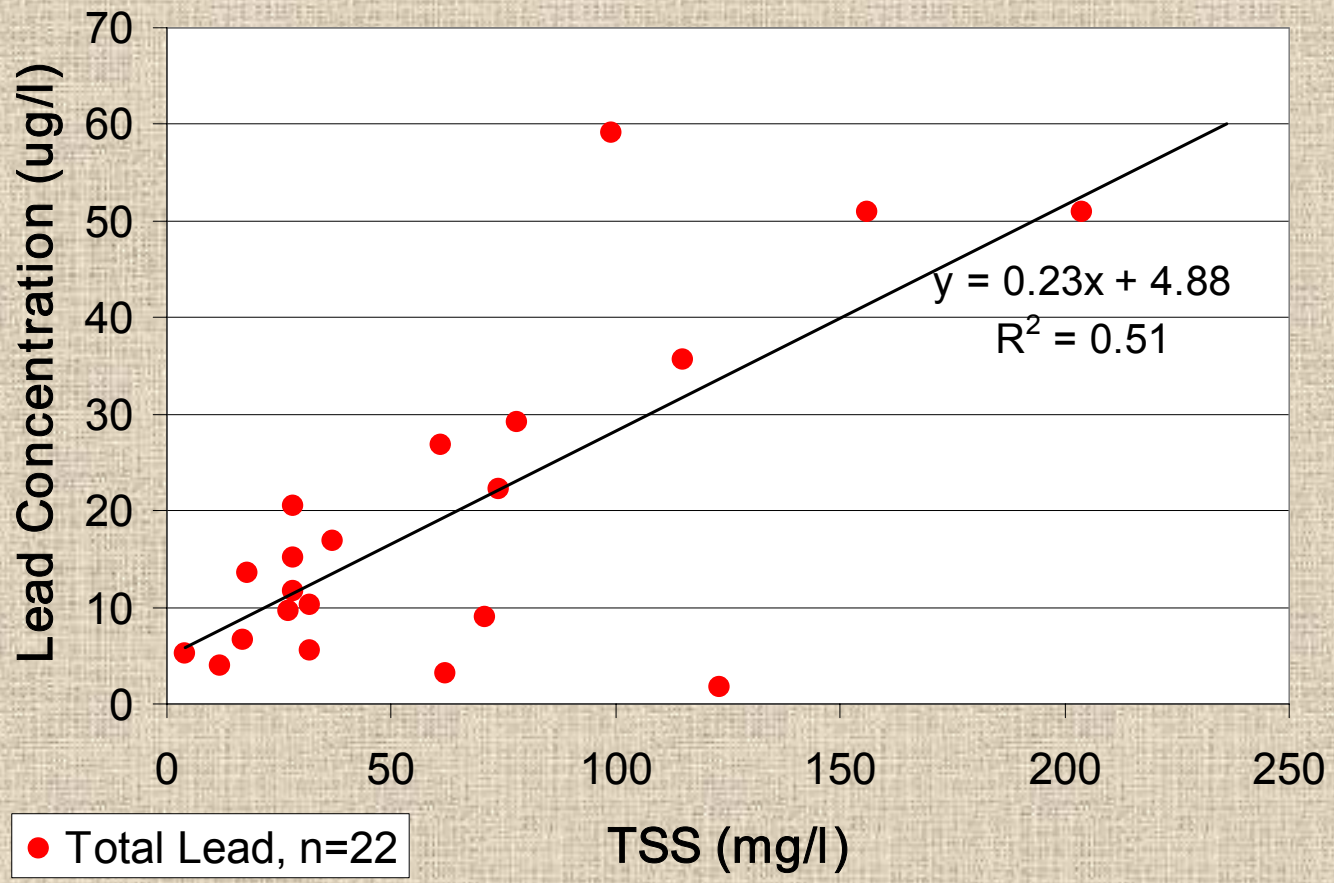

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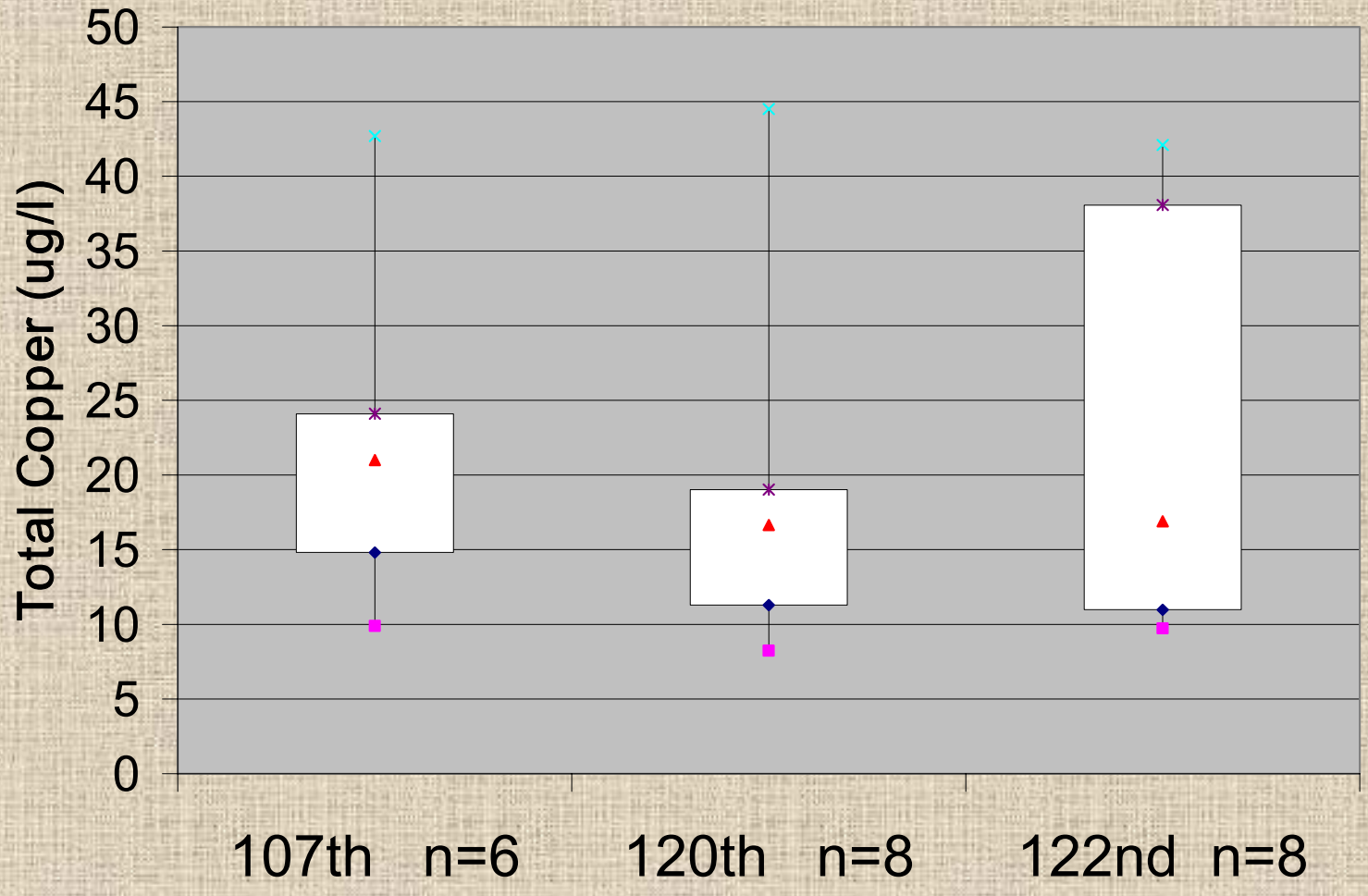

-comparison between monitoring stations, paired study

Preliminary Results

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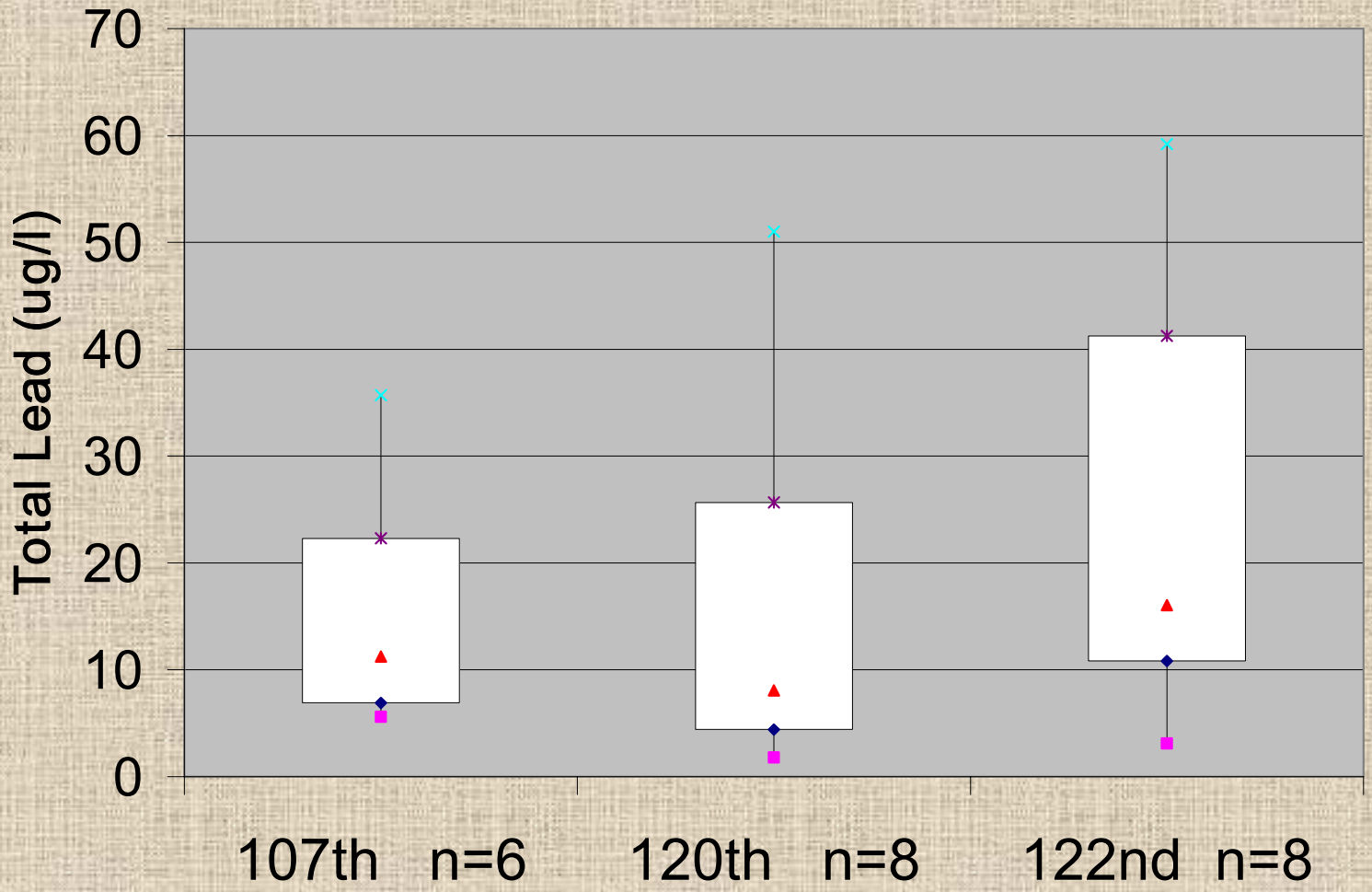

-comparison between monitoring stations, paired study

Significance of Research

- Quantification of existing drainage system water quality
  - correlations between TSS/PSD and metals, nutrients in urban runoff
  - capabilities of existing system (paired study)
- Comparison to post-construction conditions
  - evaluation of design elements for water quality enhancement benefits
- Questions answered (?):
  - Can we effectively remove metals and nutrients by removing solids?
  - Can this reduce total pollutant loading?

Acknowledgements:

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