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…
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
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

Source: Seattle Public Utilities
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?
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) 120\textsuperscript{th} Future Project
   - 2 stations, downstream point and upstream of existing grassy swale (paired study)
   - time frame: October 2002 through March 2004 (ongoing)
Study Design
Water Quality Monitoring of Existing Pre-Construction Conditions
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

\[ y = 0.08x + 16.54 \]

\[ R^2 = 0.13 \]
Preliminary Results

Water Quality Monitoring of Existing Pre-Construction Conditions

\[ y = 0.23x + 4.88 \]

\[ R^2 = 0.51 \]

-Comparison of metals concentrations to solids concentrations
Preliminary Results

Water Quality Monitoring of Existing Pre-Construction Conditions

- comparison between monitoring stations, paired study
Preliminary Results

Water Quality Monitoring of Existing Pre-Construction Conditions

- 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?
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