LATIS: A Spatial Decision Support System to Assess Low Impact Site Development Strategies

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Project Funding

Initial funding for this effort was provided by the Tennessee Valley Authority (TVA) from grants received from the Environmental Protection Agency (EPA) and Mississippi Department of Environmental Quality (MDEQ).

Project Objectives

• Predict time-varying runoff as a function of rainfall, site characteristics, and Best Management Practices (BMPs) for development sites within the Southeastern U.S.
• Calculate BMP cost.
• Allow various scenarios to be compared for effectiveness and cost.
• Be GIS-based for input queries and for output displays.
• Run on a desktop computer.
• Be in the public domain to the maximum extent possible.
• Either possess the capability or be extensible to future capabilities to predict water quality variables.

Low Impact Development

• More "environment friendly” than traditional residential or commercial development.
• Preserves open space, farmland, and many other environmental amenities.
• Fosters distinctive, attractive communities with a strong sense of place.
• Encourages compact building design to reduce sprawl and unnecessary impervious cover.
• Recognizes a strong correlation between sustainable design practices and water quality.

Eurocopter Site
Eurocopter Project in Arcview

Eurocopter Site - North Swale

Eurocopter Site - Southwest Swale

Project Components
- Development of Hydrologic Model (William McAnally)
- BMP Assessment and Database Development (James Martin)
- Assessing GIS Interface Solutions (Wayne Wilkerson)

Hydrologic Model Selection
- Nine models were identified as satisfying the basic constraints of being a public domain model with source code available.
- The model selected was Hydrologic Simulation Program – Fortran.
- Also known as HSPF.
HSPF Characteristics

• Computes the movement of water through a complete hydrologic cycle.
• It represents a watershed as a collection of one dimensional land segments and channels (reaches).
• HSPF has the basic ability to simulate BMP effects on runoff of pollutants.

HSPF Characteristics, contd.

• The latest version HSPF is version 12, which is packaged with BASINS (version 3.1).
• BASINS is an integrated system of models and tools for performing water quality analyses on watersheds.
• BASINS required Arcview 3.X.
• EPA supported version runs through WinHSPF.

Eurocopter Site – Phase I

• Roof
• Pavement
• Lawn
• Swales

BASINS – GTR Area

• Weather Data
• Soils Data
• (Basic Geometry)
• (Vegetation)

AutoCAD Site Delineation

• Subcatchment Areas
• Flow Paths

HSPF Results

Discharge, cfs

Precipitation, in/hr

As-Built

No BMP

Eurocopter As-Built
Project Components

- BMP Assessment and Database Development (James Martin)
  - Reviewed current literature for BMP design and cost
  - Built a spreadsheet to house the data containing:
    - Removal Efficiencies
    - Implementation Cost
    - Maintenance Cost

BMP Research

- During this phase a limited review of available data and guidance on BMP characteristics, removal efficiencies and costs was conducted.
- Contaminants of interest included:

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<th>pH</th>
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<tr>
<td>Total Dissolved Phosphate</td>
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<tr>
<td>Turbidity</td>
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<tr>
<td>Fecal Coliform</td>
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<tr>
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<tr>
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<tr>
<td>Fecal Streptococcus</td>
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<tr>
<td>Total Nitrogen</td>
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<td></td>
</tr>
<tr>
<td>Total Settleable Solids</td>
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</tbody>
</table>

BMP Research Findings (negative)

- Limited information on removal efficiencies of contaminants of interest.
- Included such a wide range of efficiencies as to be of little use.
- Example - the International Stormwater Best Management Practices Database (ISBMPD) contained information on over 200 studies, but only contained 13 records for total nitrogen removal. Range from -47% to +62%

BMP Research Findings (positive)

- Three databases were especially useful regarding the design and removal efficiencies of BMP:
  - U.S. Environmental Protection Agency, National Pollution Discharge Elimination System, Post-Construction Storm Water Management in New Development & Redevelopment, BMP Fact Sheets.

BMP Database

- Housed in an Excel spreadsheet.
- Five parts:
  - Selection Worksheet
  - Removal Data Worksheet
  - Cost Worksheet
  - Maintenance Worksheet
  - Infiltration Worksheet

BMP Selection Worksheet A
BMP Selection Worksheet B

BMP Removal Data Worksheet

BMP Database Cost Table

BMP Maintenance Worksheet

BMP Infiltration Worksheet

Project Components

• Assessing GIS Interface Solutions (Wayne Wilkerson)
  • Reviewed GIS software functionality.
  • Selected GIS for test linkage.
  • Developed methodology to link BMP cost to project.
  • Evaluated input solutions for water quality model.
Eurocopter Project in Arcview

Five Steps Process for Linking BMP Database to ArcView

Step 1. Converting Excel Results to Access.
Step 2. Making the ODBC Connection from Access to Arcview.
Step 3. Using SQL to connect the Access file to Arcview.
Step 4. Join the table from step 3 to the BMP Shape File.
Step 5. Using The Calculator Function in Arcview to generate cost per BMP.

Arcview with BMP Costing

Comparison of HSPF model results for the Predevelopment and As-Built Conditions using high and low estimates of parameters

Conclusions – Hydrologic Model

- HSPF can be used to evaluate development site hydrology and management practices.
- Manual steps required were cumbersome and will be improved via interface development.
- HSPF modules are not formulated to reproduce BMP and LID measures.
- WinHSPF proved awkward and does not support some HSPF features essential to this project.

Conclusions – BMP Database

- Acceptable initial development.
- Information can be used for preliminary costing and assessment of effectiveness.
- Limitations are a result of detailed removal efficiencies and up to date regionalized costing.
- Field scale studies are recommended.
Conclusions – GIS Interface

- HSPF and BMP database are easily linked to GIS.
- Current solution lacks on-the-fly updates.
- Should be tested with ArcGIS and CAD.
- Ultimate solution will be WEB enabled.

Future Directions

- Applications
  - Seeking funds to finalize GUI development.
  - Improved models.
  - Site-specific applications.
  - Expand scope of program.
- Research
  - Physics-based BMP algorithms.
  - Improved transport & kinetics.
  - Farm Latis
- Other software tools
  - MUSIC (Australia)
  - SET (Tetra Tech)
  - LSPC (EPA)

Contact

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