Project Name: **Technology and Growth Readiness**

Project Location: **Eurocopter Site, Columbus, MS**

Project Purpose: Environmental challenges associated with commercial, industrial, and residential development include site plans that minimize disruption of the natural hydrologic regime of the area, especially the impact on water quality. Site development plans that maintain the hydrologic regime and sustain water quality downstream are consistent with an approach described as Smart Growth. Significant advances have been made in the use of spatial models, including geographical information systems (GIS) and sophisticated hydrologic models, to assess the impact of potential development. This research project was designed to provide TVA and EPA with a public domain model that supports balancing watershed protection with low impact site development strategies, also known as Smart Growth.

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Team Members:

Wayne Wilkerson	**Department of Landscape Architecture**
James Martin	**Department of Civil Engineering**
William McAnally	**Department of Civil Engineering**
Jeff Ballweber	**GeoResources Institute (now with the College of Forest Resources)**
Mary Love Tagert	**GeoResources Institute (now with the College of Forest Resources)**
Rita Jackson	**GeoResources Institute**

Special Factors:

This research effort was no different than most: a short timeline, high expectations, and a limited budget. Private sector software developers had approached the same problem with more resources, but had limited success. LATIS is the result of a collaboration of highly trained individuals working on a challenging project with no personal agendas. The result is a successful mix of pure and applied research. The primary funding agency for this project was the Tennessee Valley Authority (TVA) through grants received from the U.S. Environmental Protection Agency (EPA) and the Mississippi Department of Environmental Quality (MDEQ).

Significance:

The output from this research effort is a prototype for a more user friendly planning tool that can be used by design professionals with limited technical expertise in the use of hydrologic models, best management practices (BMPs) and geographical information systems (GIS). This project reviewed available BMP effectiveness and cost information and incorporated selected information in an easily retrievable form. Spatial data manipulation tools were selected for preparing site characteristics input. The hydrologic model HSPF was selected and tested on a controlled set of data – that of the Eurocopter plant in Lowndes County, Mississippi. The potential for linking the model to a desktop GIS was assessed. Environmental Systems Research Institute (ESRI) Arcview® software was selected as the desktop GIS product to be used in the evaluation. A methodology was developed to link the selected BMP database to Arcview® for real time costing of master planning and site specific design alternatives. The final product will be a tool that can assist planners, developers, and design professionals become more involved in water quality management, especially during the design phase.

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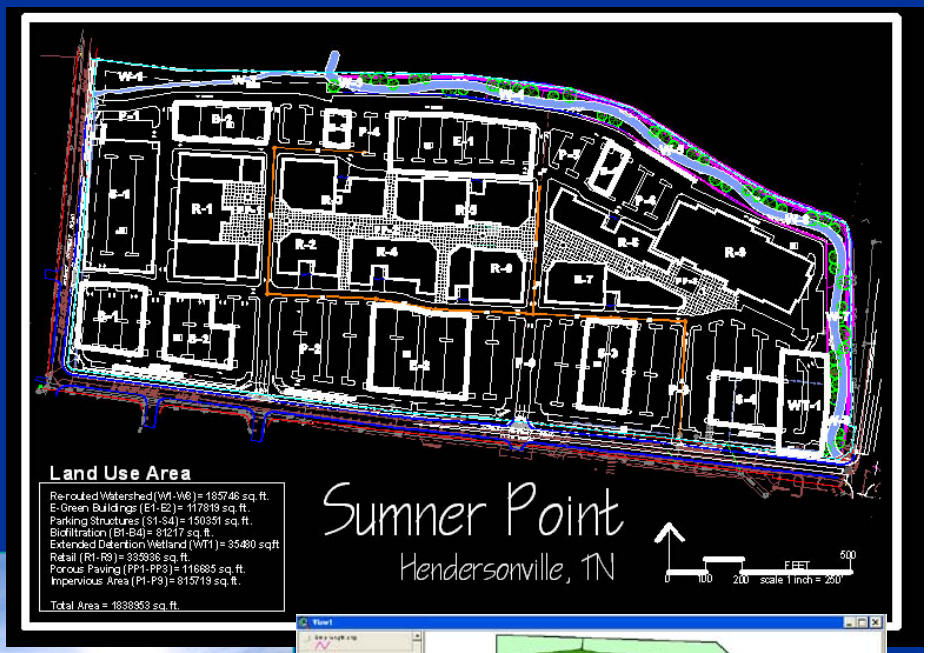
Smart Growth

- Preserves open space, farmland, and many other environmental amenities.
- Encourages compact building design to reduce sprawl and unnecessary impervious cover.
- Emphasizes a strong correlation between sustainable design practices and water quality.
- Consistent with economic growth.



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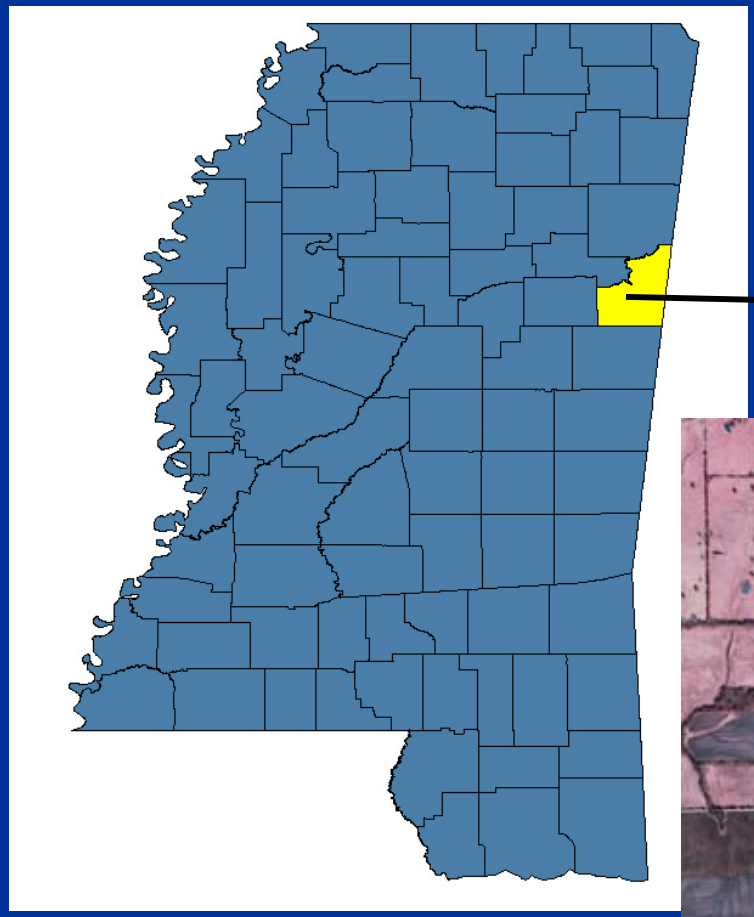
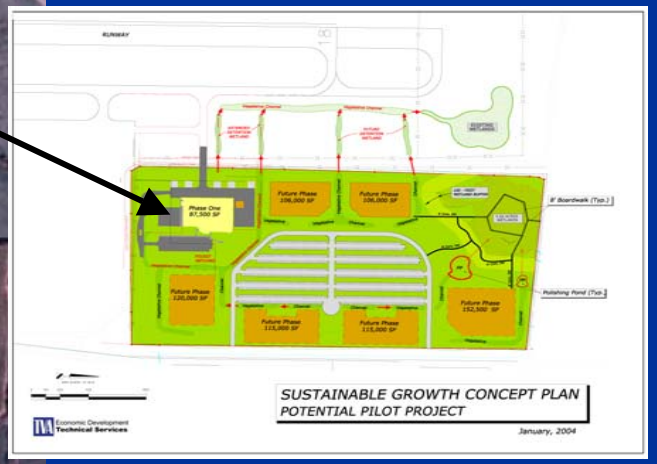
Eurocopter Test Site





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LATIS

- LATIS is the goddess of clean water.
- LATIS is a collection of tools.
  - Simple graphical user interface
  - BMP/LID database
  - Standard hydrologic modeling
  - Connections to standard GIS & CAD
- LATIS has the potential to be applied at both site & watershed scales.
- LATIS will be able to calculate BMP cost and effectiveness on the fly.
- LATIS will be in the public domain to the maximum extent possible.
- LATIS can assist planners and designers balance smart growth and environment stewardship.

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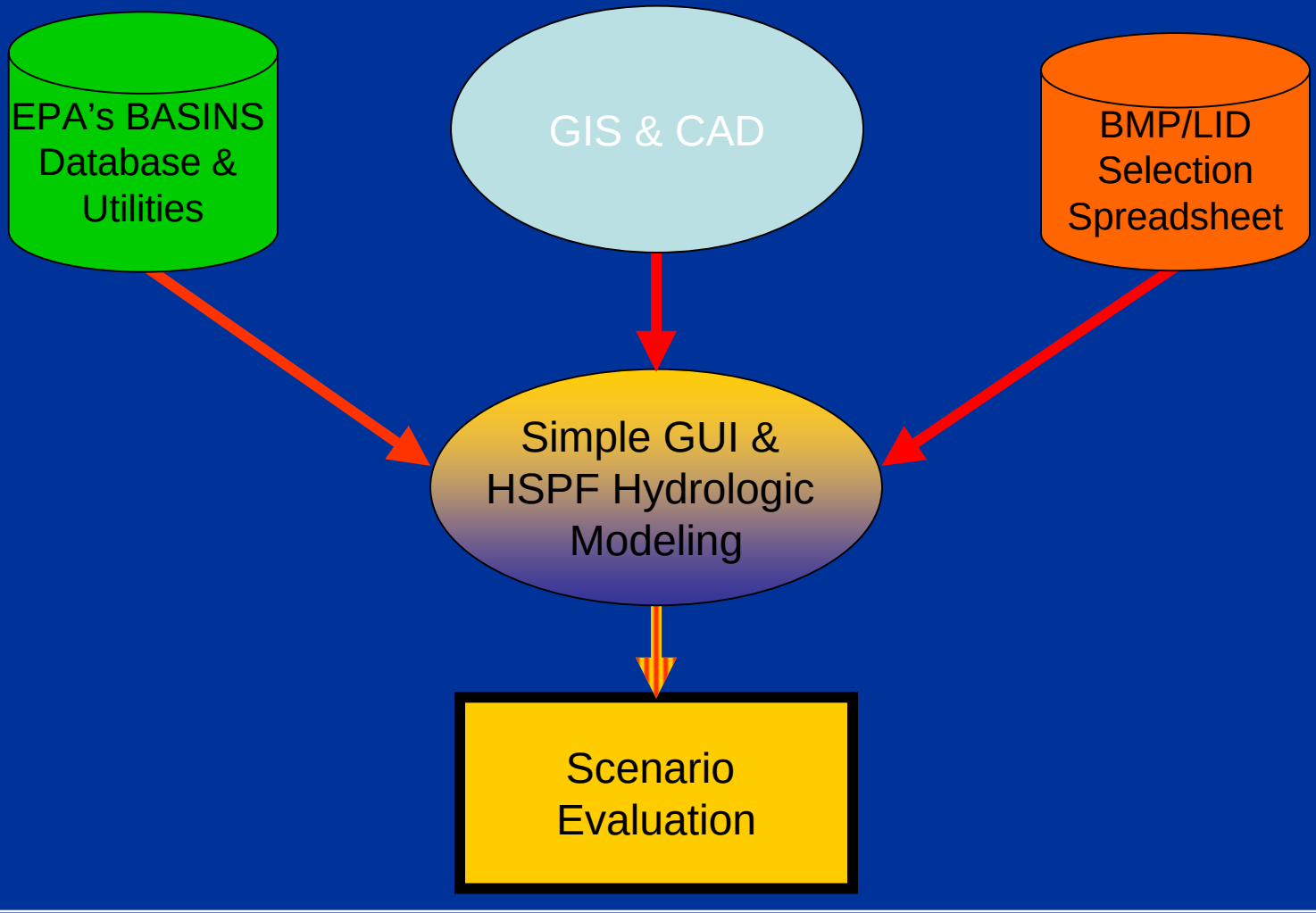
LATIS Components



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LATIS Goals and Objectives

- Assess Existing Hydrologic Models
  - •Identify significant processes & questions.
  - •Select a modeling engine.
- Select BMPs and Develop a Database
  - •Review current literature for BMP design and cost.
  - •Build a spreadsheet to house the data containing:
    - •Removal efficiencies.
    - •Implementation and maintenance cost.
- Assess GIS Interface Solutions
  - •Review GIS software functionality.
  - •Develop methodology to link BMP cost to GIS project.

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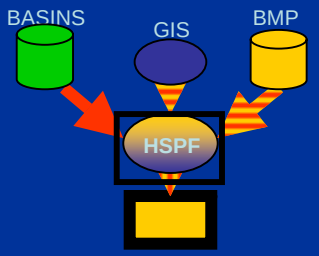
Assess Existing Hydrologic Models

- 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.
- 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.
- The latest version HSPF is version 12, which is packaged with BASINS (version 3.1).
- BASINS required Arcview 3.X.



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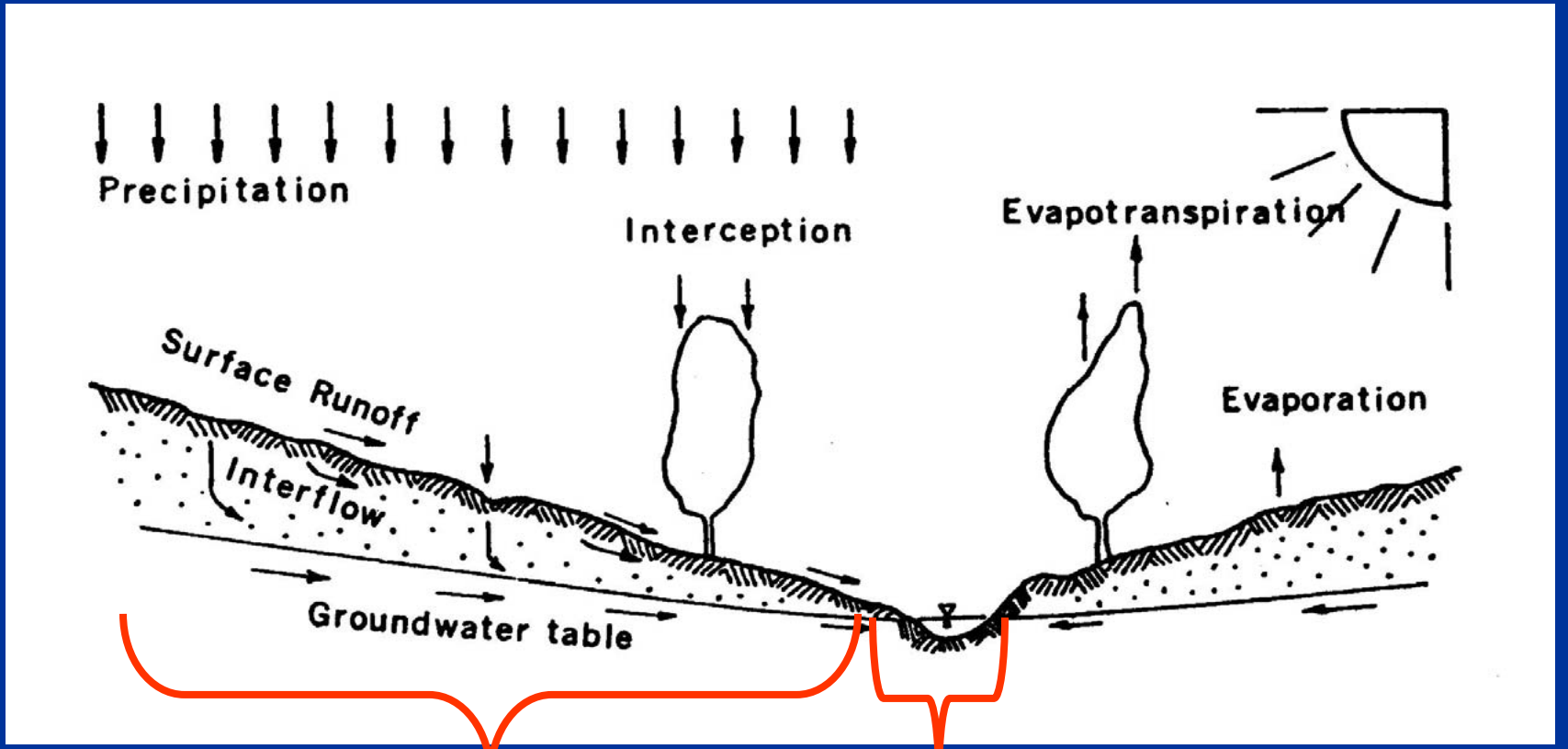
HSPF - Hydrologic Cycle & BMPs



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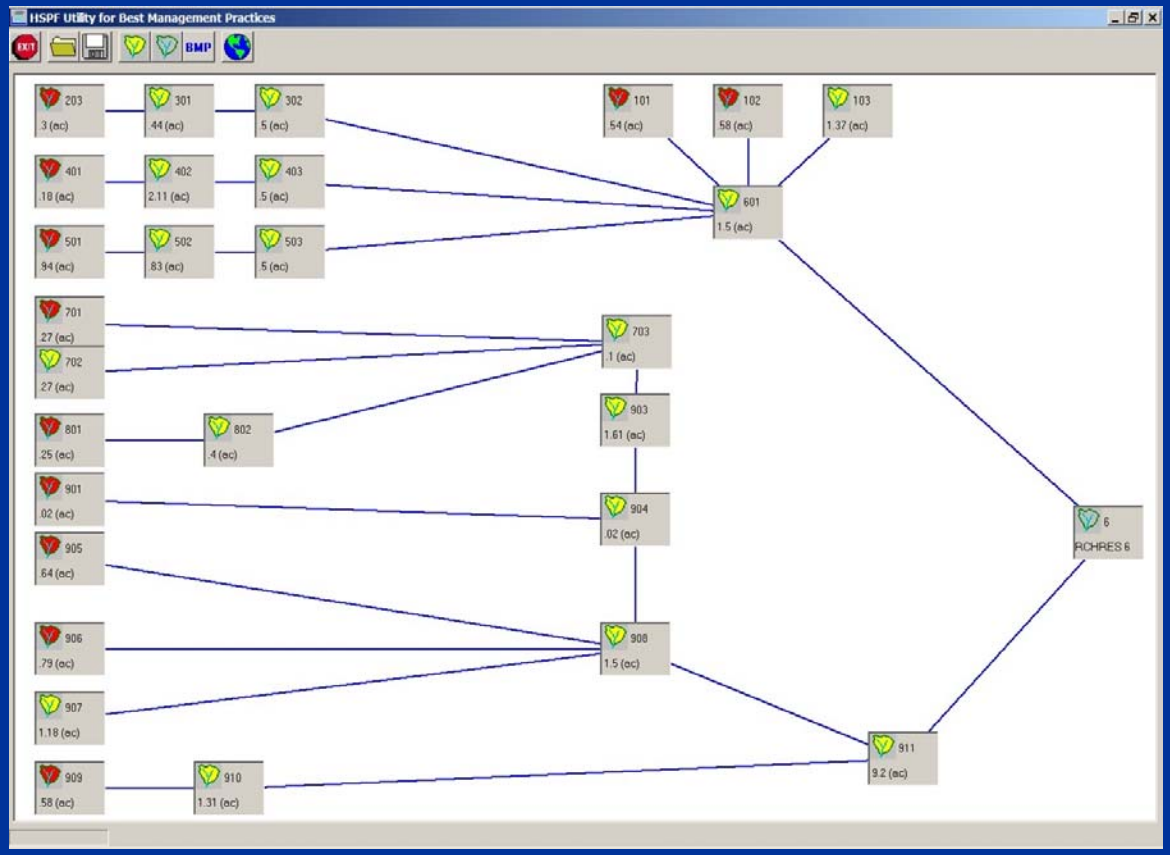
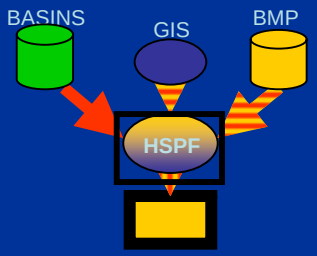
LATIS HSPF Interface



The initial graphical interface used By HSPF proved to be cumbersome and inefficient. LATIS researchers, working in consultation with software developers in the private sector, created a simplified interface that relates stronger graphically with landscape components such as reaches and land segments.



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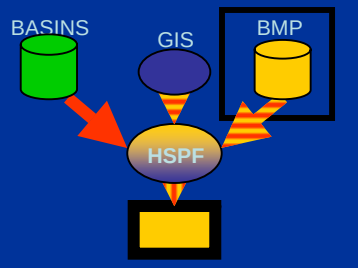
Select BMPs and Develop a Database

- Housed in an Excel spreadsheet and composed of five parts:
  - •Selection Worksheet
  - •Removal Data Worksheet
  - •Cost Worksheet
  - •Maintenance Worksheet
  - •Infiltration Worksheet
- Three primary sources of information:
  - •U.S. Department of Transportation, Federal Highway Administration, Stormwater Best Management Practices in an Ultra-Urban Setting: Selection and Monitoring
  - •U.S. Environmental Protection Agency, National Pollution Discharge Elimination System, Post-Construction Storm Water Management in New Development & Redevelopment, BMP Fact Sheets
  - •Atlanta Regional Commission, Georgia Stormwater Management Manual, Volume 2: Technical Handbook



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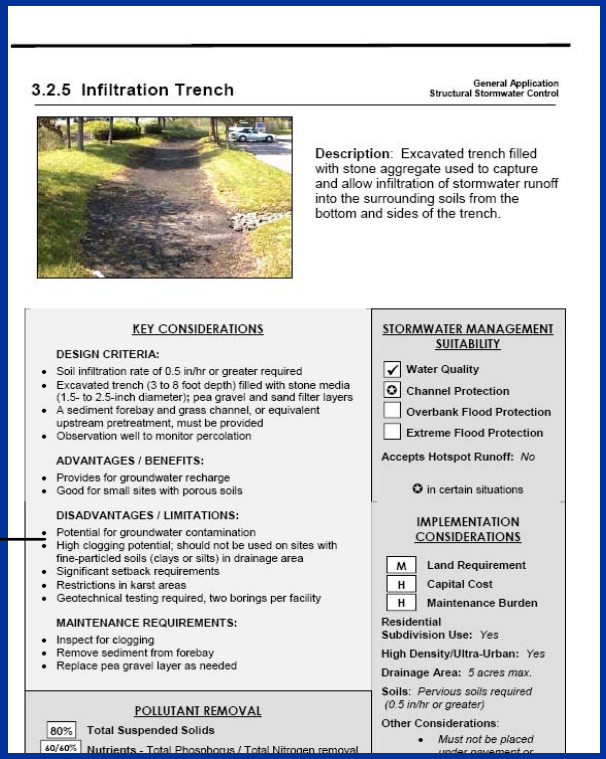
BMP Database

- Examples of BMP data that is linked to Selection Worksheet.
  - One section has links to .PDF files similar to the Infiltration Trench shown at the right.
  - Another section, similar to the one below, has WEB links to external sites.



3.2.5 Infiltration Trench

General Application
Structural Stormwater Control

Description: Excavated trench filled with stone aggregate used to capture and allow infiltration of stormwater runoff into the surrounding soils from the bottom and sides of the trench.

KEY CONSIDERATIONS

DESIGN CRITERIA:
- Soil infiltration rate of 0.5 in/hr or greater required
- Excavated trench (3 to 8 foot depth) filled with stone media (1.5- to 2.5-inch diameter); pea gravel and sand filter layers
- A sediment forebay and grass channel, or equivalent upstream pretreatment, must be provided
- Observation well to monitor percolation

ADVANTAGES / BENEFITS:
- Provides for groundwater recharge
- Good for small sites with porous soils

DISADVANTAGES / LIMITATIONS:
- Potential for groundwater contamination
- High clogging potential; should not be used on sites with fine-particled soils (clays or silts) in drainage area
- Significant setback requirements
- Restrictions in karst areas
- Geotechnical testing required, two borings per facility

MAINTENANCE REQUIREMENTS:
- Inspect for clogging
- Remove sediment from forebay
- Replace pea gravel layer as needed

POLLUTANT REMOVAL

80% Total Suspended Solids

60/60% Nutrients - Total Phosphorus / Total Nitrogen removal

STORMWATER MANAGEMENT SUITABILITY

- ☑ Water Quality
- ✪ Channel Protection
- ☐ Overbank Flood Protection
- ☐ Extreme Flood Protection

Accepts Hotspot Runoff: *No*

✪ in certain situations

IMPLEMENTATION CONSIDERATIONS

- M Land Requirement
- H Capital Cost
- H Maintenance Burden

Residential Subdivision Use: *Yes*

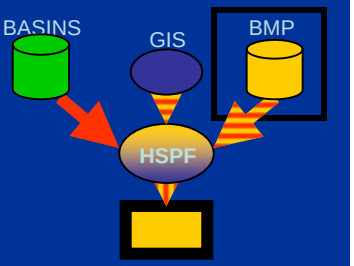
High Density/Ultra-Urban: *Yes*

Drainage Area: *5 acres max.*

Soils: *Pervious soils required (0.5 in/hr or greater)*

Other Considerations:
- *Must not be placed*

BMP Type	WEB site
Dry Ponds	http://cfpub.epa.gov/npdes/stormwater/menuofbmps/post_9.cfm
Infiltration Trenches	http://cfpub.epa.gov/npdes/stormwater/menuofbmps/post_14.cfm
Sand Filters	http://www.stormwatercenter.net/
Grassed Channel	http://www.stormwatercenter.net/
Stormwater Wetland	http://cfpub.epa.gov/npdes/stormwater/menuofbmps/post_27.cfm
Stormwater Wetland	http://www.stormwatercenter.net/
Gravity Separator	www.cabmphandbooks.com
Organic Filters	http://www.stormwatercenter.net/
Underground Sand Filters	http://www.fhwa.dot.gov/environment/ultraurb/3fs7.htm
Bioretention System	www.cabmphandbooks.com



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Sample BMP Interface

Mississippi State University

Latis: BMP Selection Tool

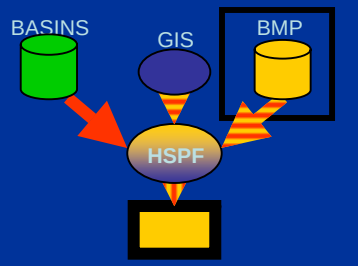
DRAFT 8/03/04: This spreadsheet is for review purposes only. Not for distribution or application.

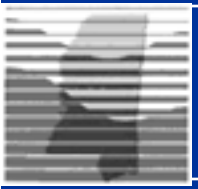
INSTRUCTIONS
1) Use this worksheet to evaluate BMP removal effectiveness
2) Use the detailed fact sheets for additional information

PART (A)

Choose BMPs Used In Drainage Area 1 for Analysis

Choose BMP Type 1:	Infiltration Trench				
	Infiltration Rate:	0.5-3.0	in/hr		
Constituent	Removal Effectiveness (%)	Construction Costs			
Total Suspended Solids	75 - 99	Low	High	Average	Unit
Total Phosphorus	50 - 75	$2.50	$7.91	$5.21	Cu. ft.
Total Nitrogen	45 - 70	Maintenance Costs			
Nitrate-Nitrogen	NA	Low	High	Average	Unit
Metals	75 - 99	$0.05	$0.20	$0.13	of initial construction cost
Bacteria	75 - 98				
Oil and Grease	NA				
TPH	75				





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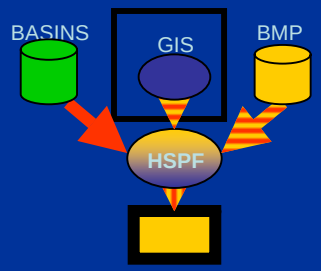
Assess GIS Interface Solutions

- **Reviewed GIS software functionality.**
- Major software (SW) packages were identified.
- Characteristics required of the model were compared to functional capacity of the SW.
- ESRI Arcview™ was selected as the GIS interface for future research.
  - Widely used by developers and planners.
  - Currently used as an interface to HSPF.

- **Developed methodology to link BMP cost to project.**
- Multiple approaches were tested to link the BMP information collected in the previous step to the GIS features.



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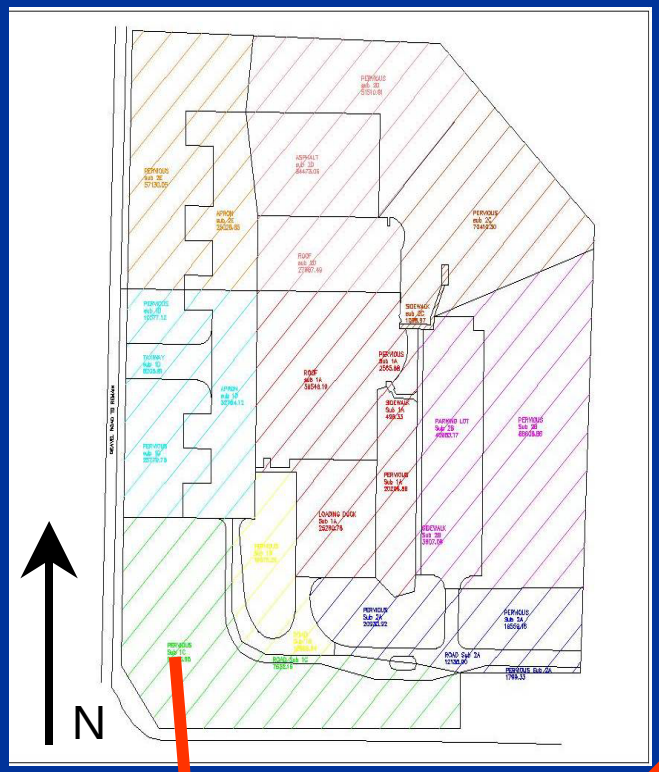
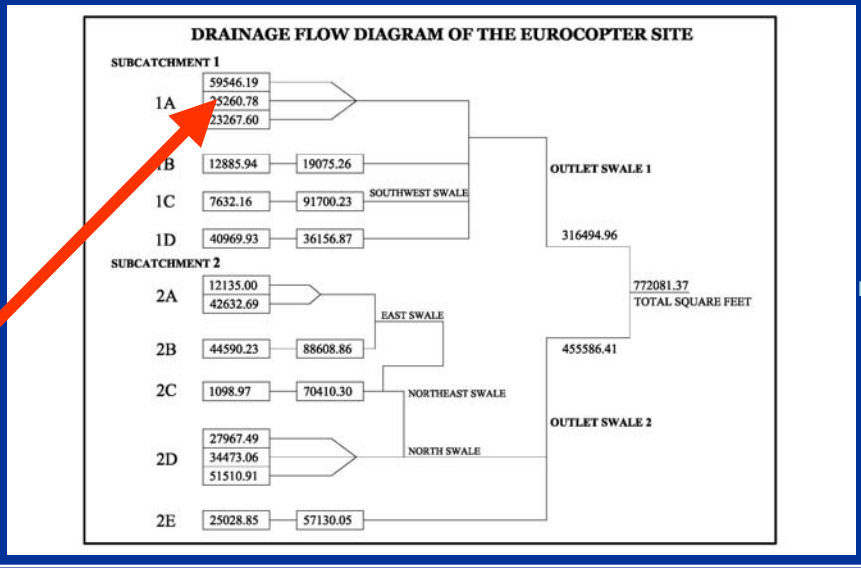
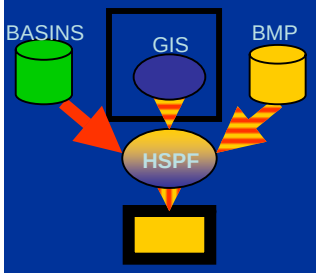
AutoCAD Site Delineation



- Subcatchment Areas
- Flow Paths

- An AutoCAD base map was used to identify HSPF subcatchment areas.
- Area and cover type for each subcatchment area were calculated.
- The .DWG file was imported into Arcview and BMP GIS features created.





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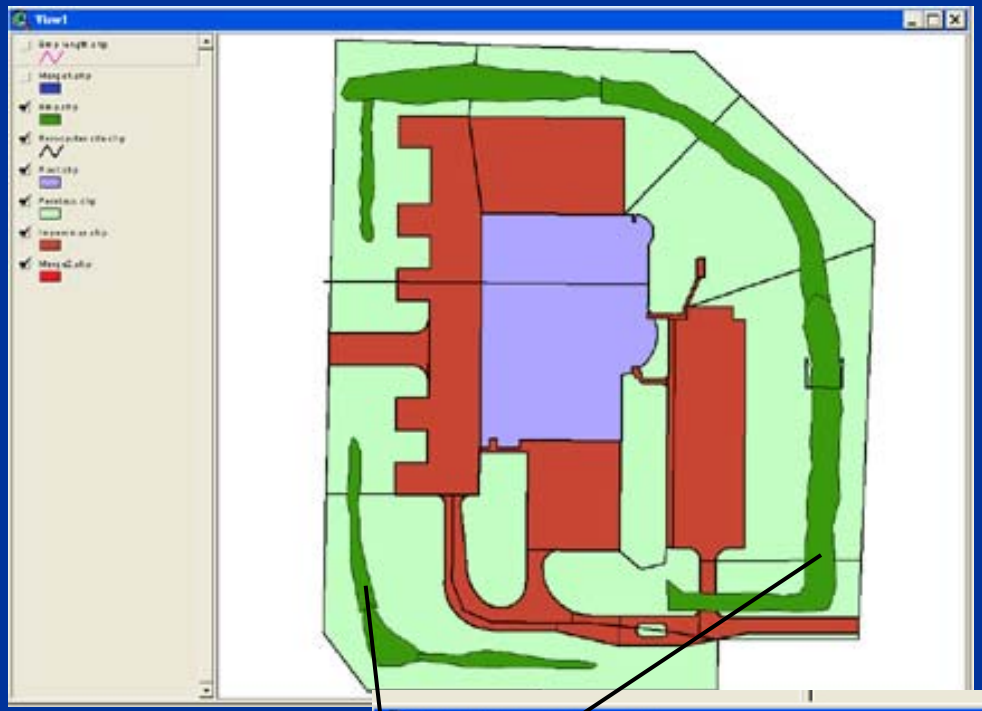
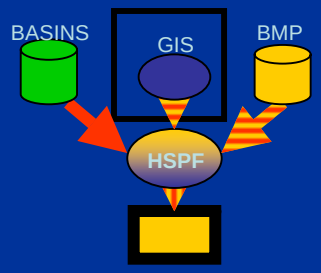
Linking BMP to GIS



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.

Attributes of Bmp.shp

Shape	ID	Abbr	Type	Area	AT_Acres	Perimeter	BMP_costs
Polygon	0	BS	extended detention wetland	18028.390	0.414	871.588	504795
Polygon	0	VFS	vegetative channel	3767.658	0.086	470.526	3768
Polygon	0	VFS	vegetative channel	16504.484	0.379	1122.136	16504
Polygon	0	SW	pocket wetland	6347.230	0.146	361.637	6347
Polygon	0	VFS	vegetative channel	21404.845	0.491	1216.630	21405
Polygon	0	VFS	vegetative channel	5297.004	0.122	572.193	5297
Polygon	0	SW	pocket wetland	4591.797	0.105	307.396	4592
Polygon	0	VFS	vegetative channel	4487.023	0.103	567.780	4487



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Swale on Eurocopter Site

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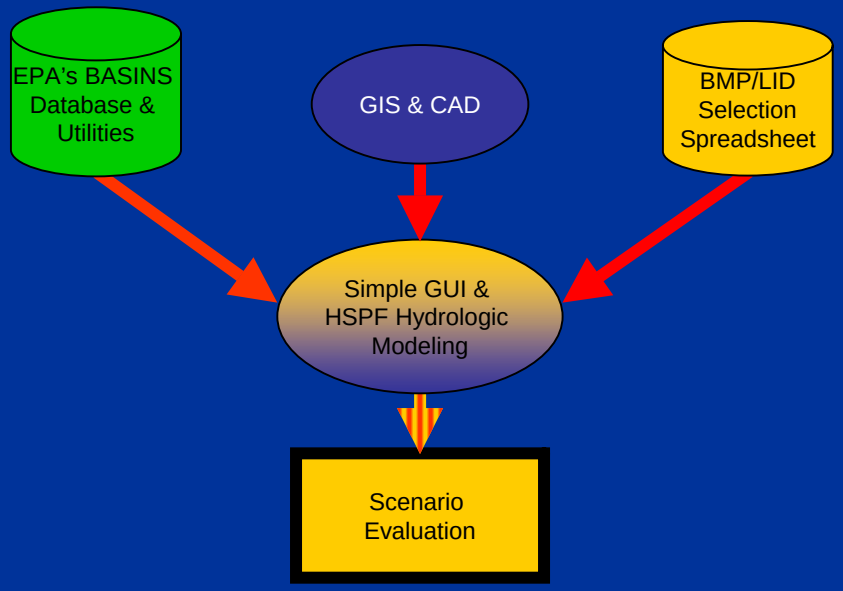
SOFTWARE COPYRIGHT

Invention Disclosure # 05-0329-145

An invention disclosure was issued by Mississippi State University on April 25, 2005 to the landscape architect submitting this package and three fellow researchers for **ClnWater**, a Spatial Decision Support System (SDSS) incorporating a hydrologic model and a best management practice (BMP) data base with a GIS. This invention is the intellectual property that forms the foundation for LATIS.



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Conclusions

- HSPF can be used to evaluate development site hydrology and management practices.
- Manual steps required were cumbersome and will be improved.
- Acceptable initial development.
- BMP database Information can be used for preliminary costing and assessment of effectiveness.
- HSPF and BMP database are easily linked to GIS.
- Current GIS solution lacks on-the-fly updates.
- The model should be tested with ArcGIS and CAD.
- Design professionals should be included in the next phase of testing.
- Comments from eleven attendees of a March 23, 2005 peer review sponsored by TVA were positive.

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Future Directions

- Applications
  - Proposals has been submitted to EPA and the USDA to fund the second phase of the GUI development and implement on-site monitoring at multiple sites across Mississippi.
  - Identify more site-specific test beds, including commercial, industrial, and residential applications.
  - Seek out design professionals to test LATIS in the field.

- Research
  - Physics-based BMP algorithms.
  - Improved transport & kinetics.
  - Expand BMP database .

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