The University of Delaware Experimental Watershed

American Water Resources Association

Snowbird, Utah

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Objectives

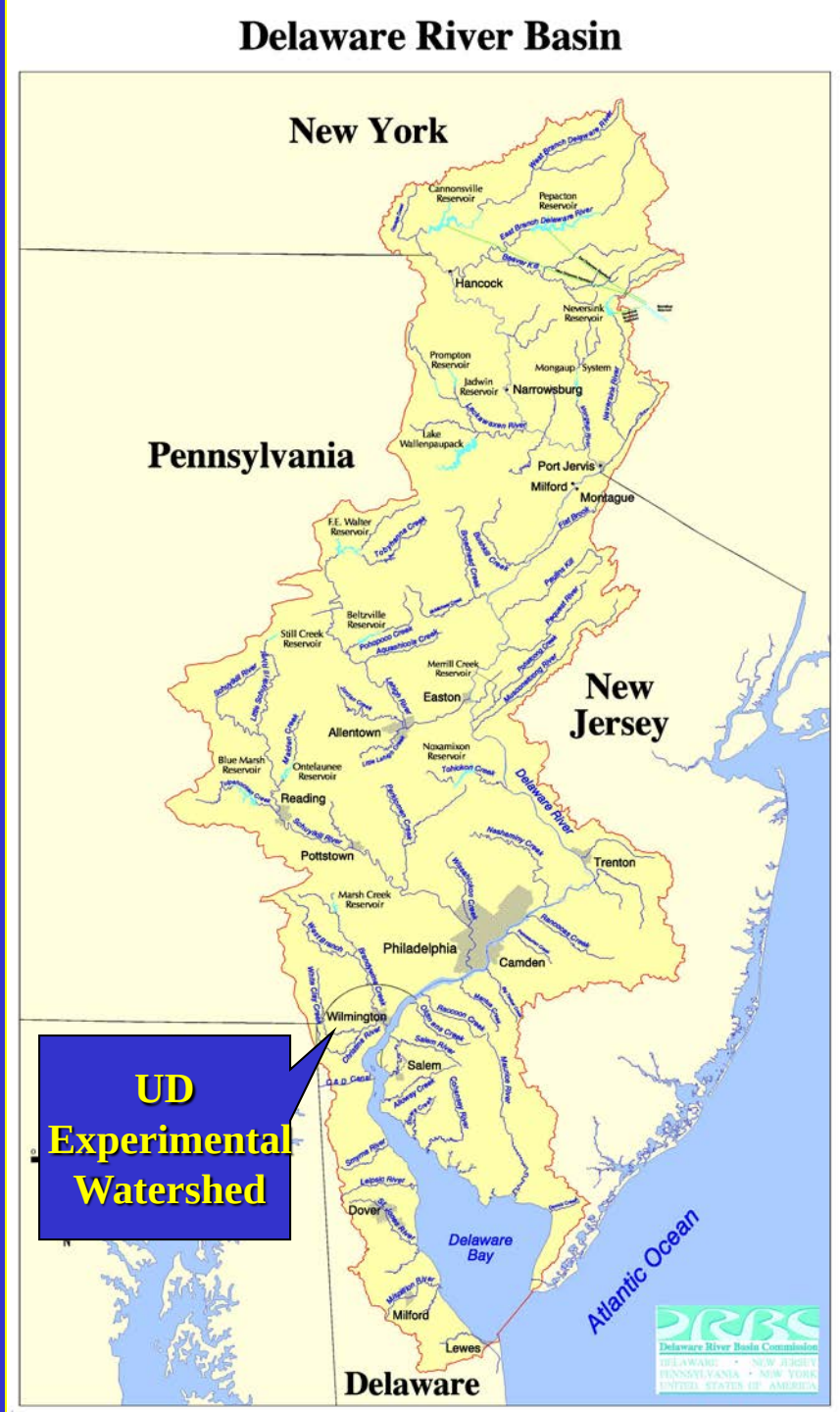
1) Develop a method to assess and characterize the health of the watershed using GIS based on:
   - Impervious cover
   - Land-use
   - Habitat quality
   - Water quality
2) Create an outdoor living laboratory, providing dynamic educational and research opportunities for university faculty, staff and students.

Other Experimental Watersheds

- Pennsylvania State University
- Cornell/Syracuse/Dartmouth Consortium
- Shippensburg University
- University of Michigan
- University of California, San Diego

University of Delaware

Experimental Watershed Study Area

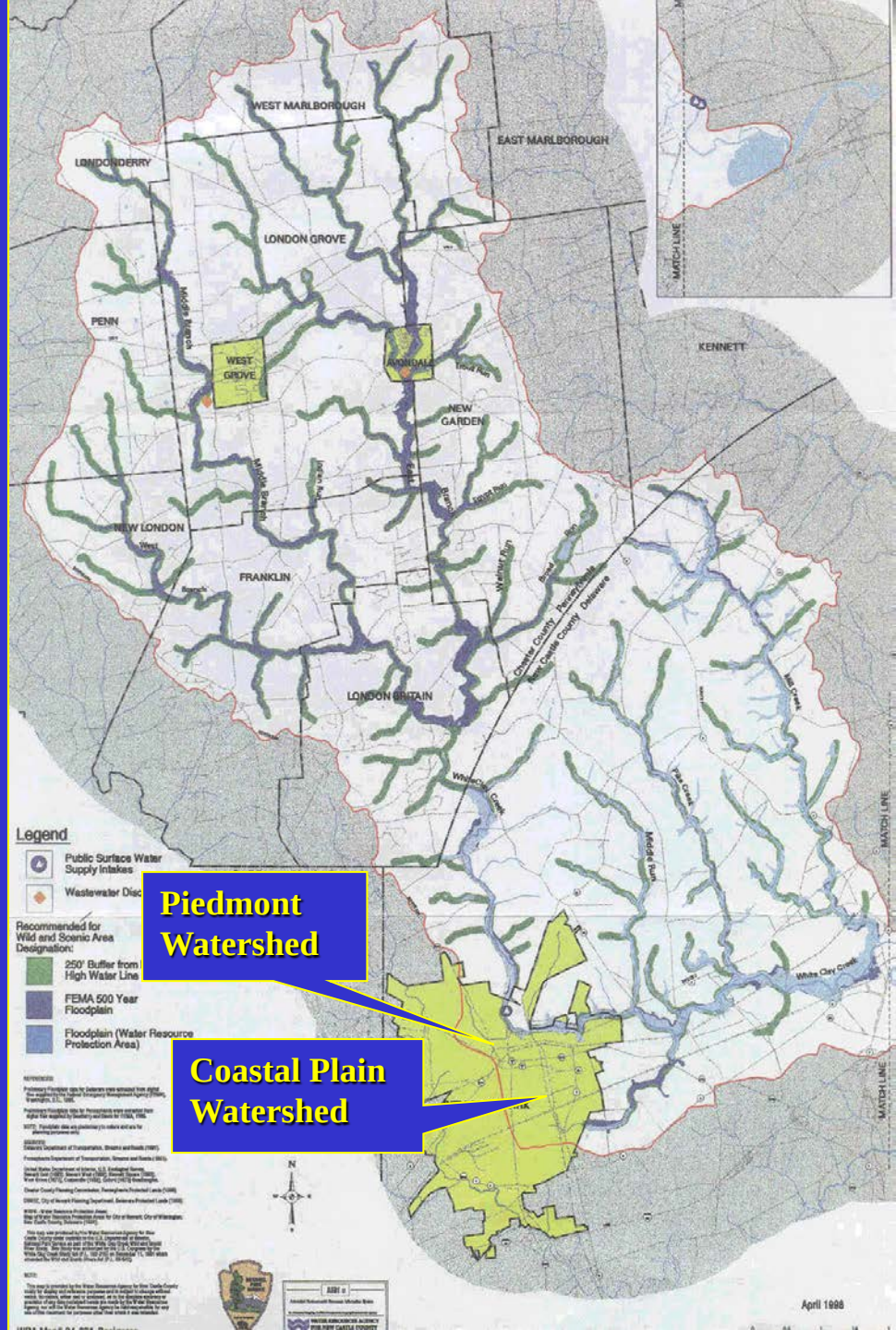


The University of Delaware Experimental Watershed:

- Lies within the White Clay Creek Wild and Scenic River Watershed, in Newark, Delaware.

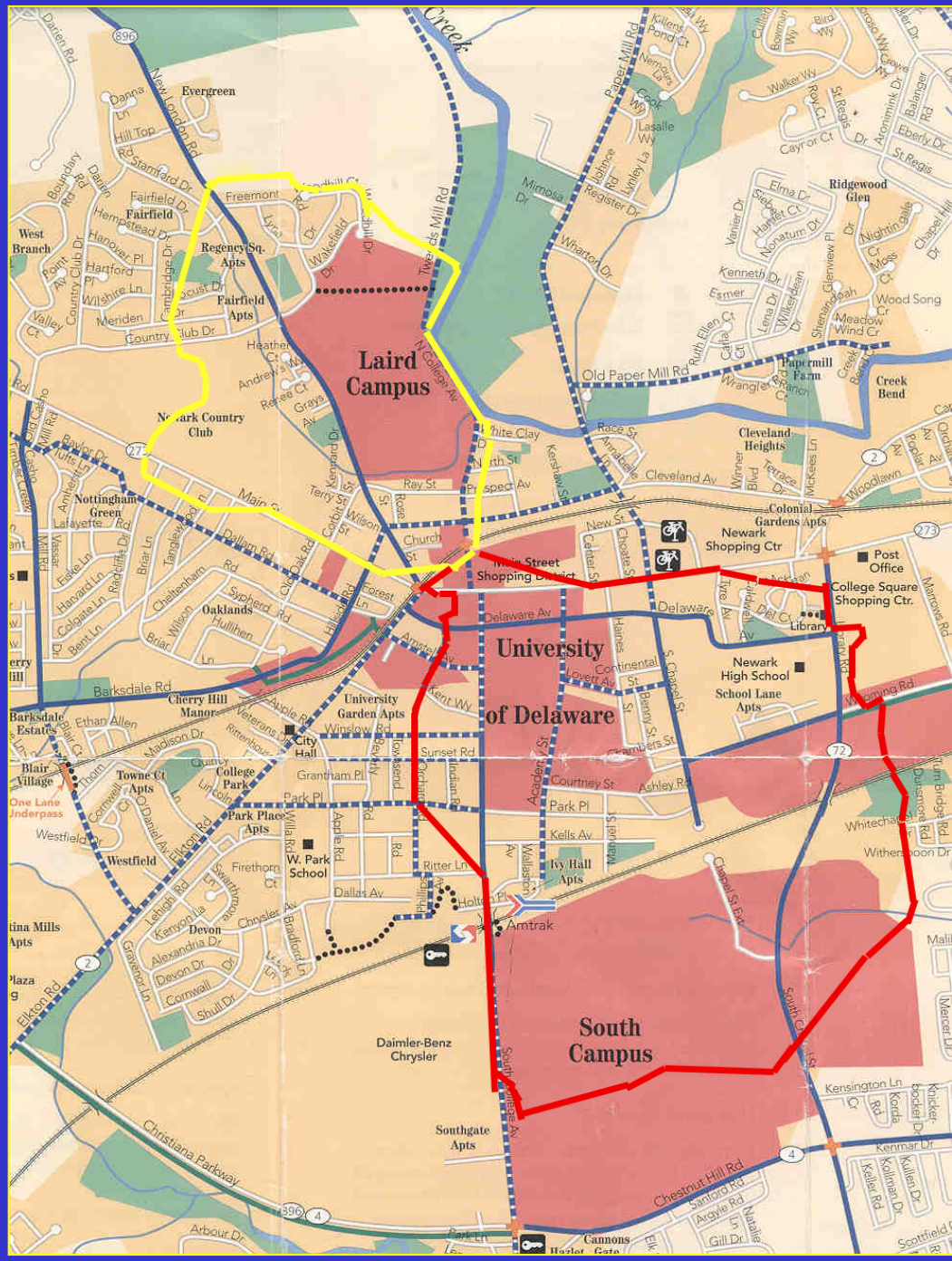
- Falls on the geologic fall line between the Piedmont and Coastal Plain provinces.

- 2 geographically separate watersheds, one in each province.



Ideal location

- The experimental watershed is easily accessible to students and faculty because of its ideal location on the University of Delaware grounds and immediate area.



Unique Characteristics of the Piedmont Watershed

- 427 acres (0.64 sq. miles)
- 3 unnamed tributaries of the White Clay Creek
- Land-uses
  - Golf course
  - Residential
  - Commercial
  - Forested park land

Unique Characteristics of the Coastal Plain Watershed

- 896 acres (1.4 sq. miles)
- 4 unnamed tributaries in the headwaters of the Cool Run
- Land-uses
  - Agricultural
  - Commercial
  - Residential
  - Institutional

Methodology to Develop the Experimental Watershed

1) Designate the study area

2) Delineate the area based on topographic features

3) Design GIS Atlas

4) Field verification

5) Field inventory

Methods to Design the GIS Atlas

Step 1 - Load aerial photos (DOQQs)

Step 2 - Add themes-streams, roads, etc

Step 3 - Add topography and delineate watersheds in the lab

Step 4 - Verify the watersheds and locate sampling stations in the field

ArcView GIS 3.2a

File Edit View Theme Graphics Window Help

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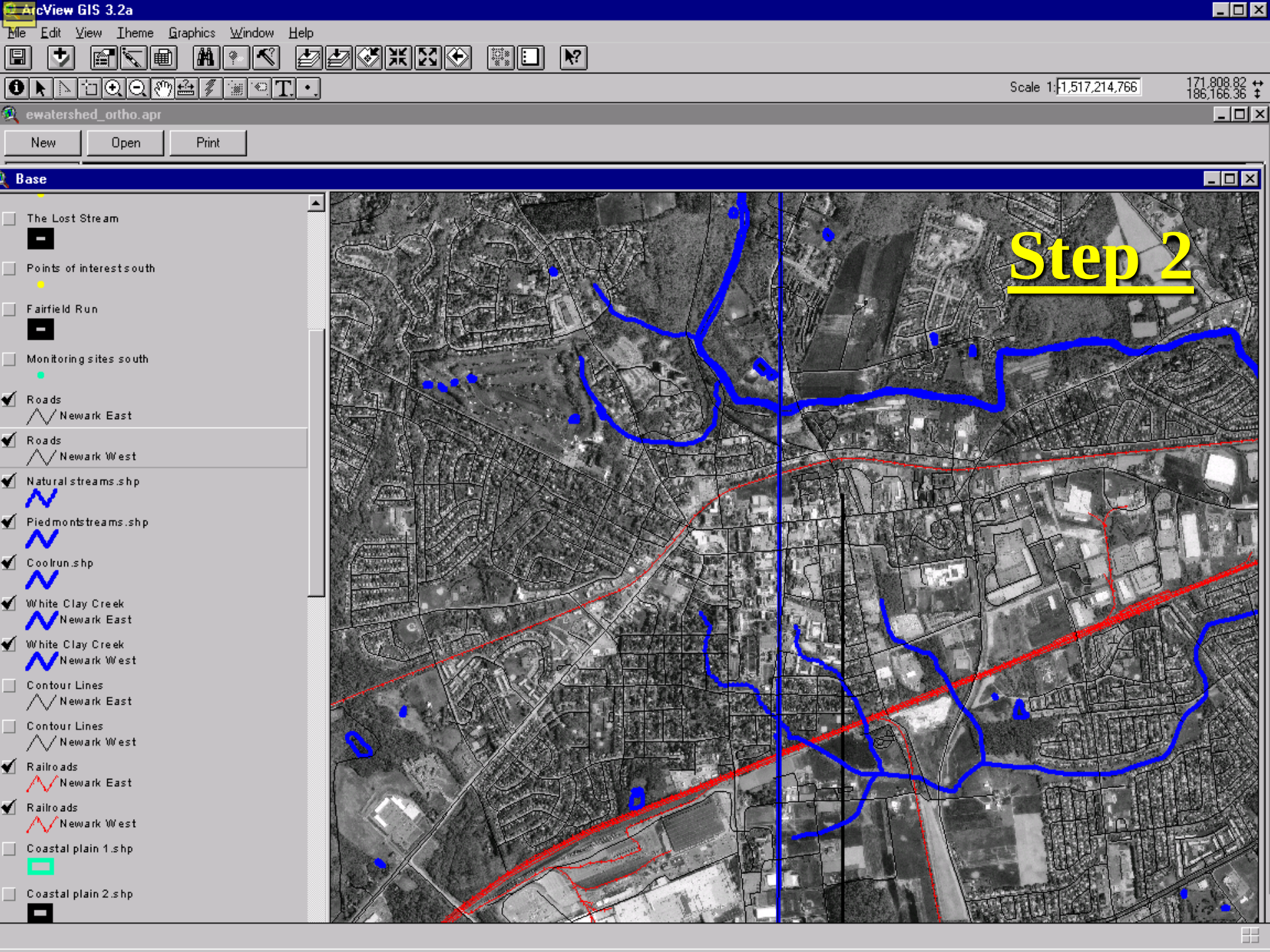
ewatershed_ortho.apr

New Open Print

Base

Railroads
Newark West
Coastal plain 1.shp
Coastal plain 2.shp
Coastal plain 3.shp
Coastal plain 4.shp
Newarkwest.sid
Newarkeast.sid
Chsoil83.shp
ALDINO-KEYPORT-MATTAPEX-URBAN
CHESTER-GLENELG-GLENVILLE
EDGEMONT
ELSINBORO-DELANCO-URBAN
GLENELG-MANOR-CHESTER
GLENELG-MANOR-GLENVILLE
HAGERSTOWN-CONESTOGA-GUTHRIE
KEYPORT-LOAM/CLAY-BLETSVILLE
MATAPEAKE-BUTLERTOWN
MATAPEAKE-SASSAFRAS
MATAPEAKE-SASSAFRAS-URBAN
MATAPEX-ELSINBORO-OTHELLO
NESHAMINY-ALDINO-WATCHUNG
NESHAMINY-CHROME-CONOWINGO
NESHAMINY-GLENELG
NESHAMINY-TALLEYVILLE-URBAN
SASSAFRAS-FALLSINGTON-MATAPEAKE
TIDAL MARSH
URBAN
Delgeo83.shp
AMPHIBOLITE (GNEISS)
AMPHIBOLITE (GRANOFELS)
BIOTITE-ALMANDINE SCHIST
BIOTITE-QUARTZ FELDSPAR
BRYN MAWR FORMATION
COCKEYSVILLE FORMATION
FELSIC & MAFIC GNEISS
GABBRO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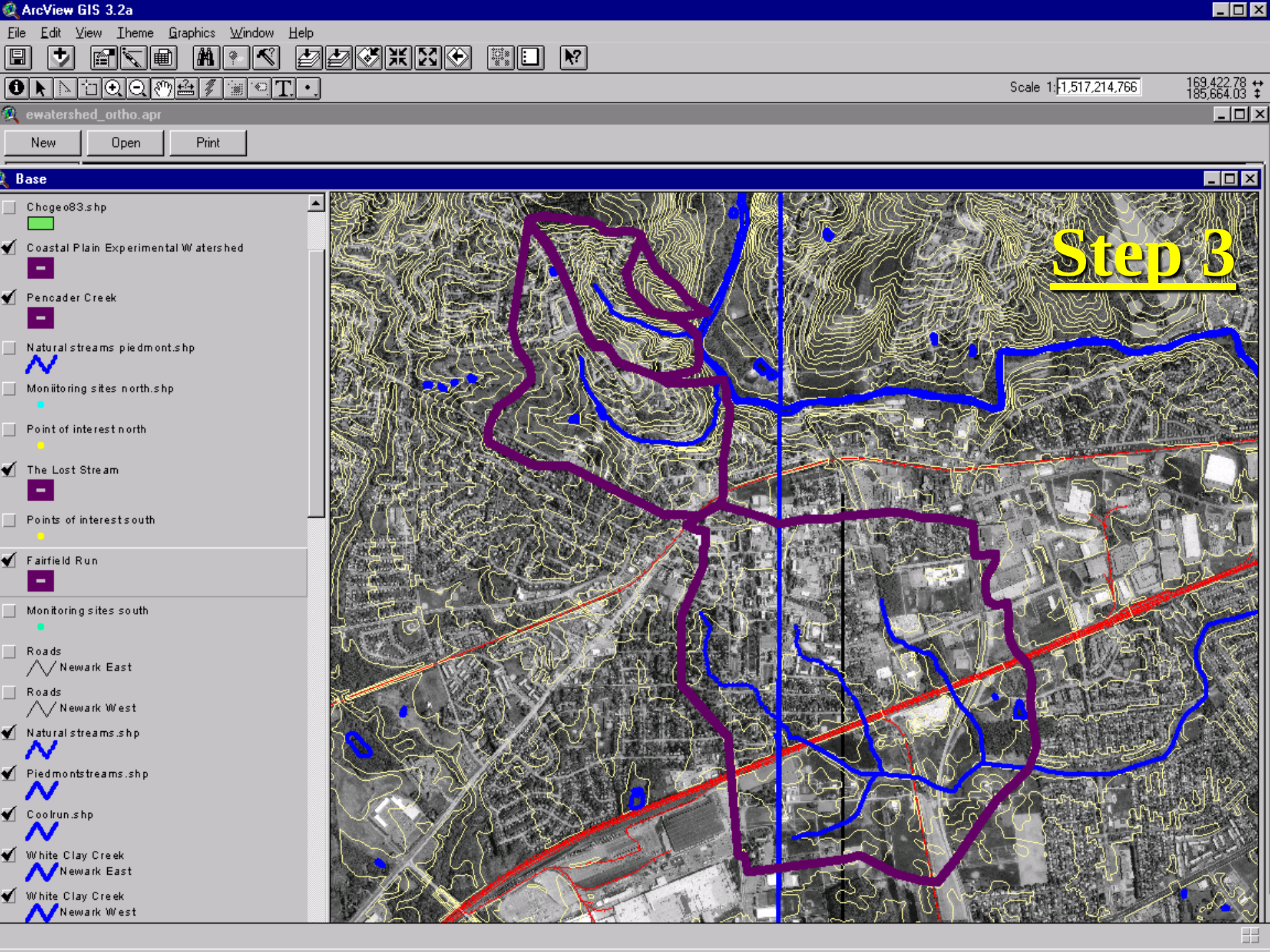
New
Open
Print
Base
The Lost Stream
Points of interest south
Fairfield Run
Monitoring sites south
Roads
Newark East
Roads
Newark West
Natural streams.shp
Piedmontstreams.shp
Coolrun.shp
White Clay Creek
Newark East
White Clay Creek
Newark West
Contour Lines
Newark East
Contour Lines
Newark West
Railroads
Newark East
Railroads
Newark West
Coastal plain 1.shp
Coastal plain 2.shp
Step 2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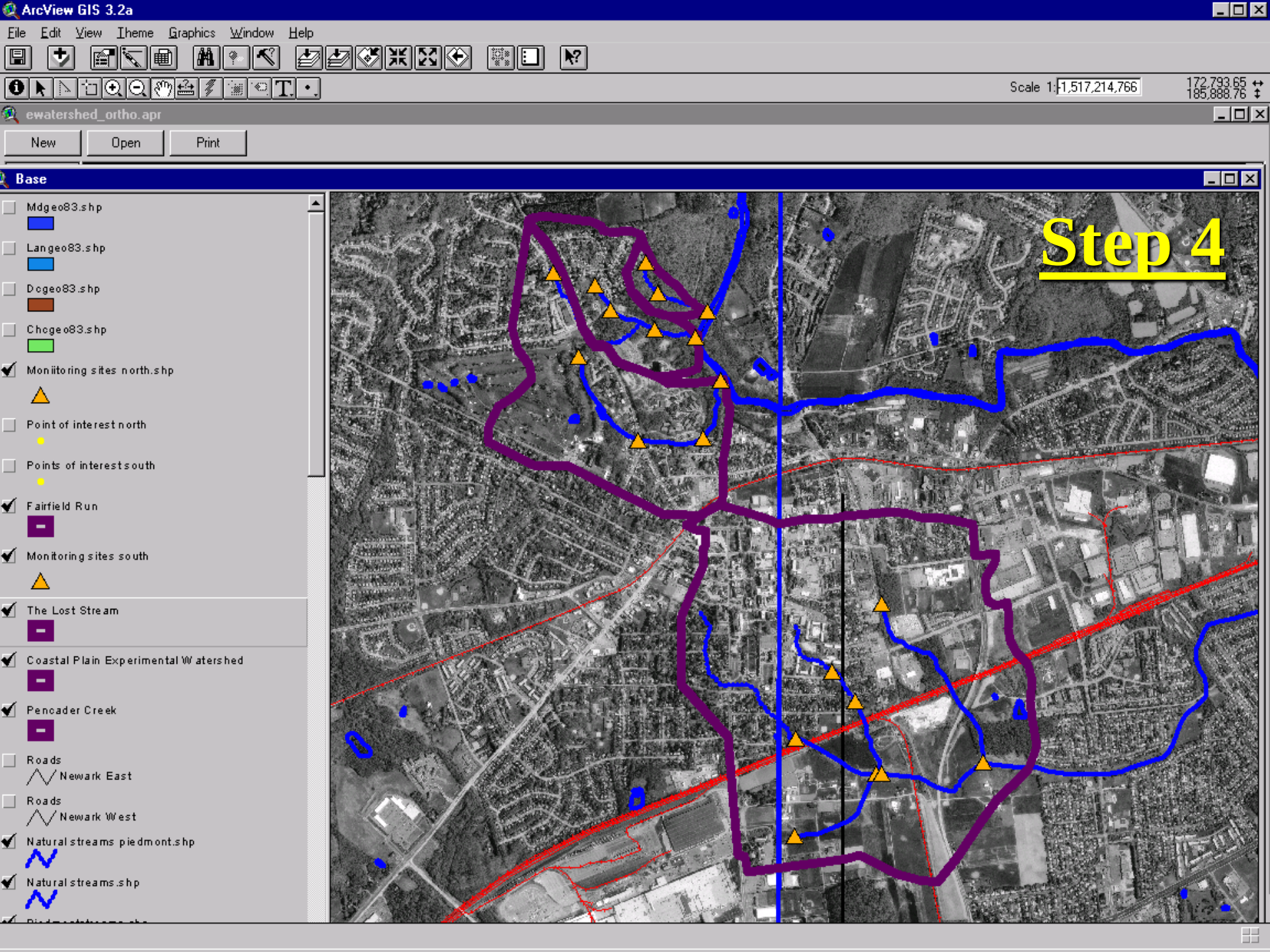
Coastal Plain Experimental Watershed
Pencader Creek
Natural streams piedmont.shp
Monitoring sites north.shp
Point of interest north
The Lost Stream
Points of interest south
Fairfield Run
Monitoring sites south
Roads
Newark East
Roads
Newark West
Natural streams.shp
Piedmontstreams.shp
Coolrun.shp
White Clay Creek
Newark East
White Clay Creek
Newark West
Step 3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Langeo83.shp
Dogeo83.shp
Chogeo83.shp
Monitoring sites north.shp
Point of interest north
Points of interest south
Fairfield Run
Monitoring sites south
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Coastal Plain Experimental Watershed
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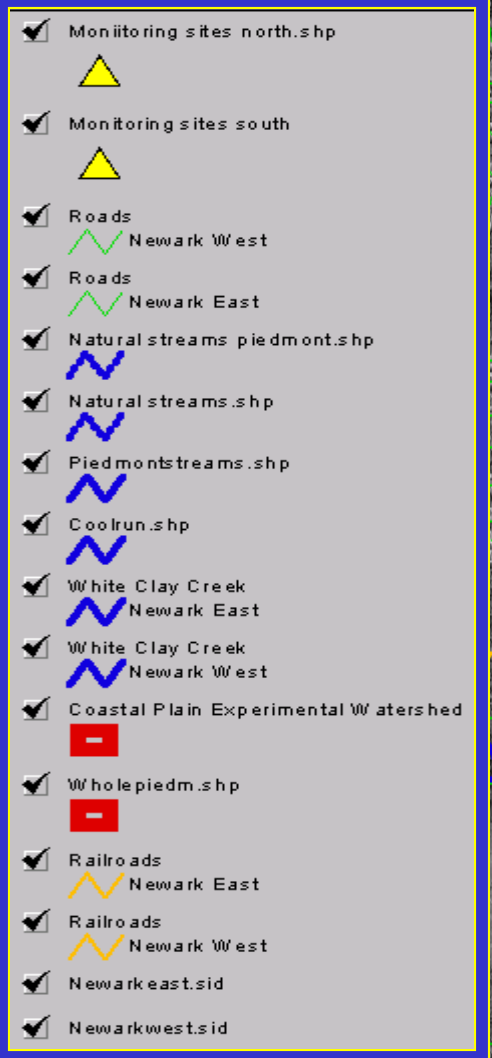
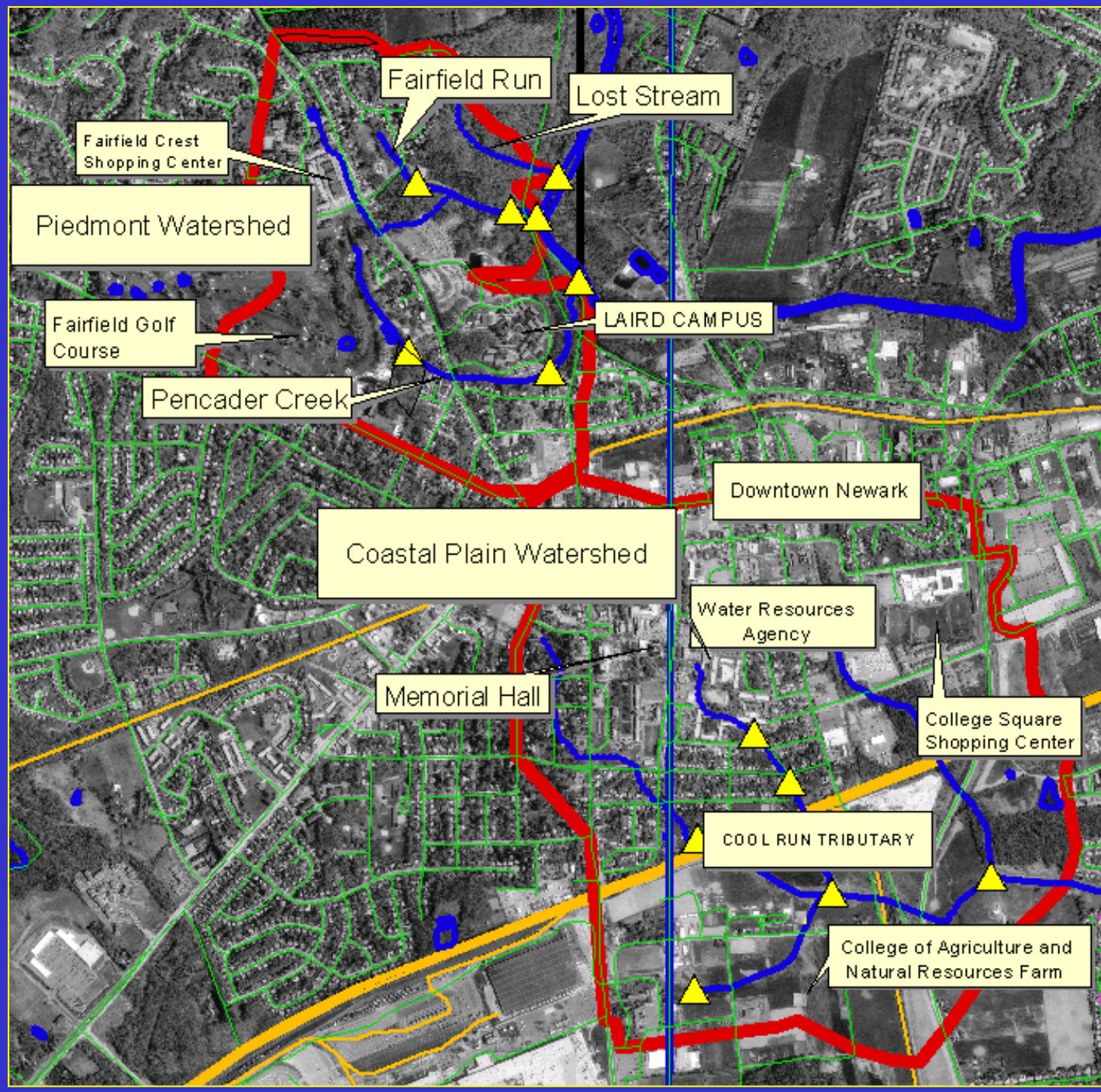
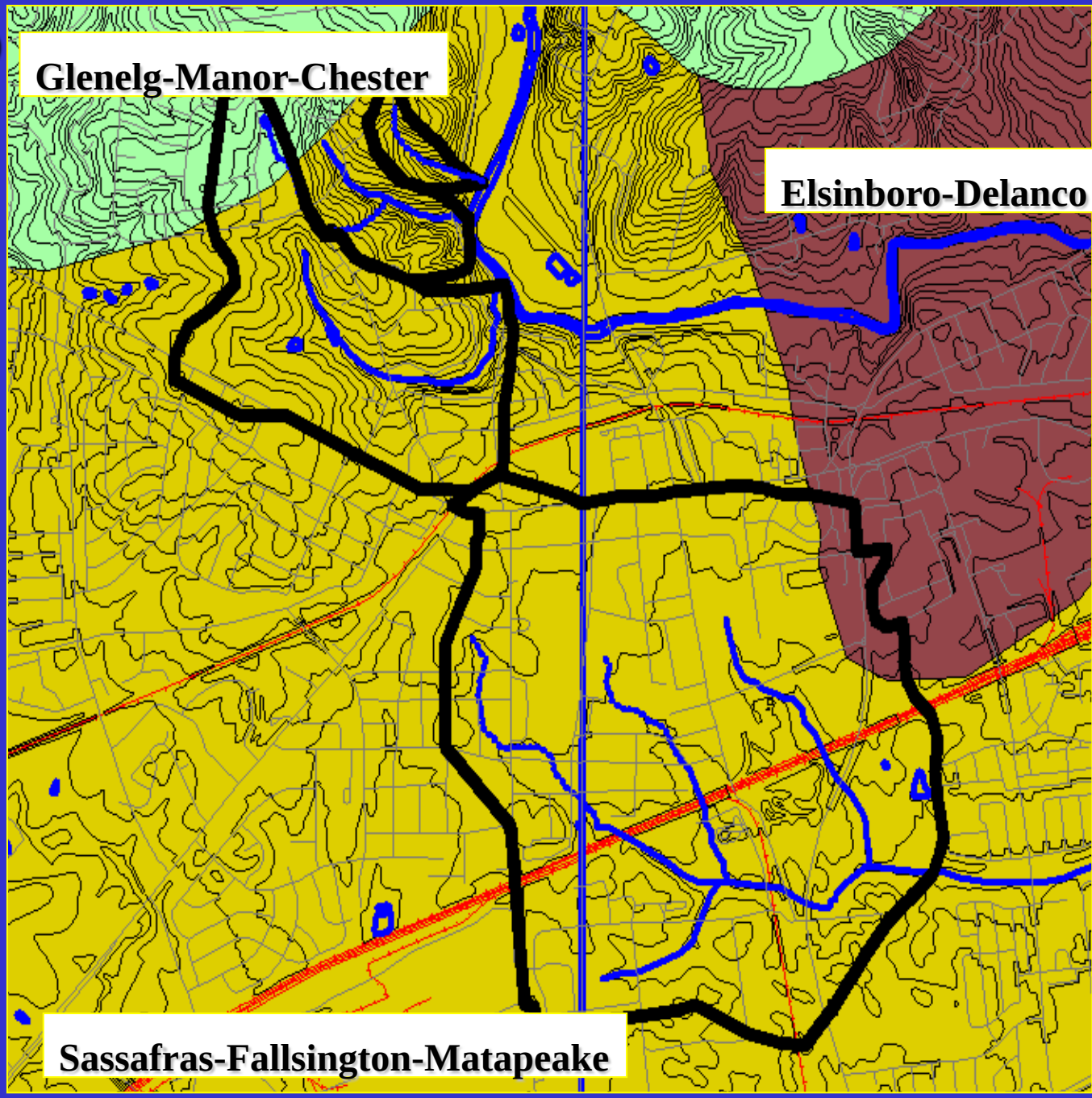
Roads
Newark West
Natural streams piedmont.shp
Natural streams.shp
Step 4

UD Experimental Watershed

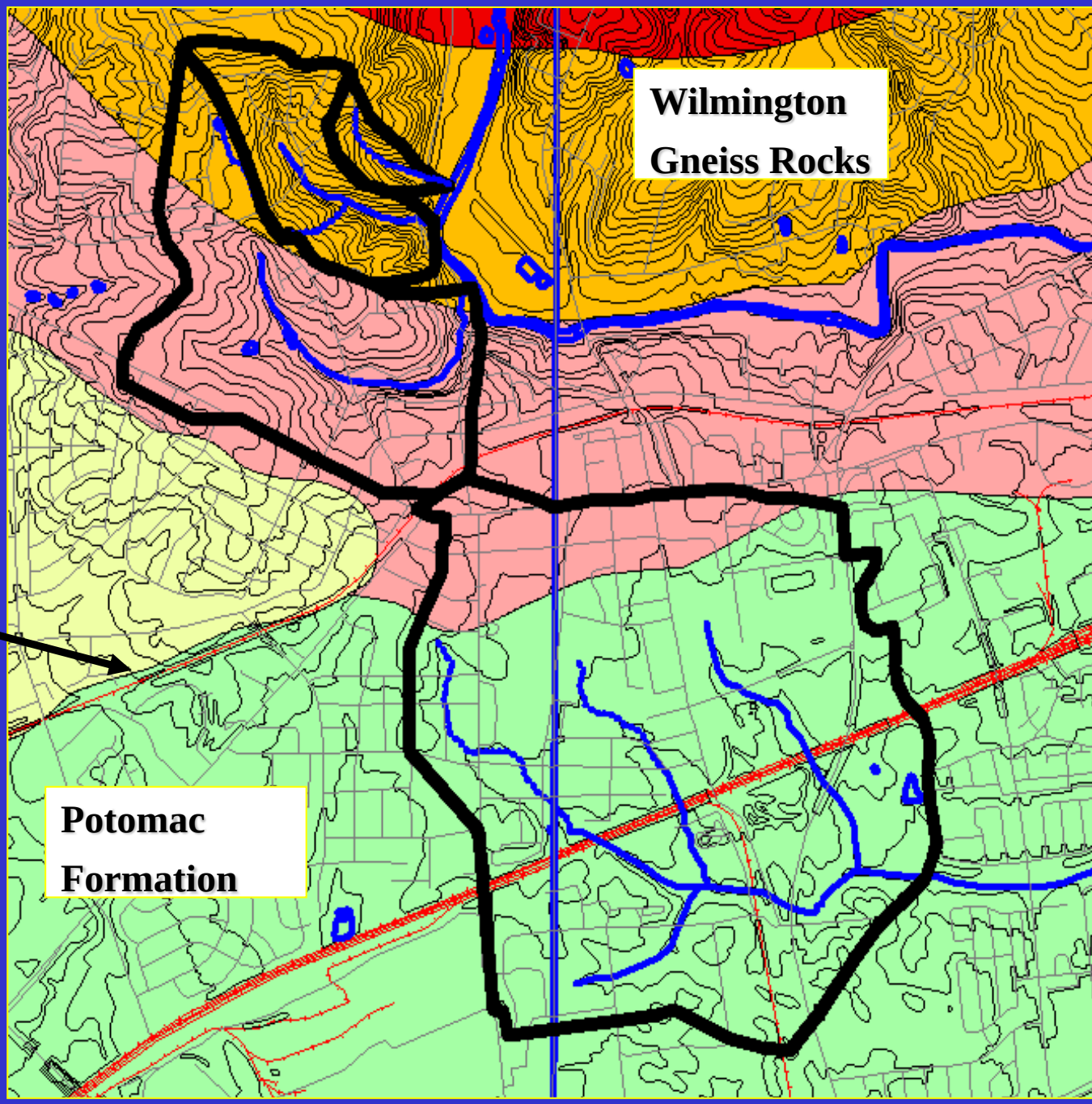




Soils in the UD Experimental Watershed



Geology in the UD Experimental Watershed



Land-use in the UD Experimental Watershed

Single Family Residential (yellow)

High Density Residential (orange)

Commercial (red)

Industrial (purple)

Institutional, university (light blue)

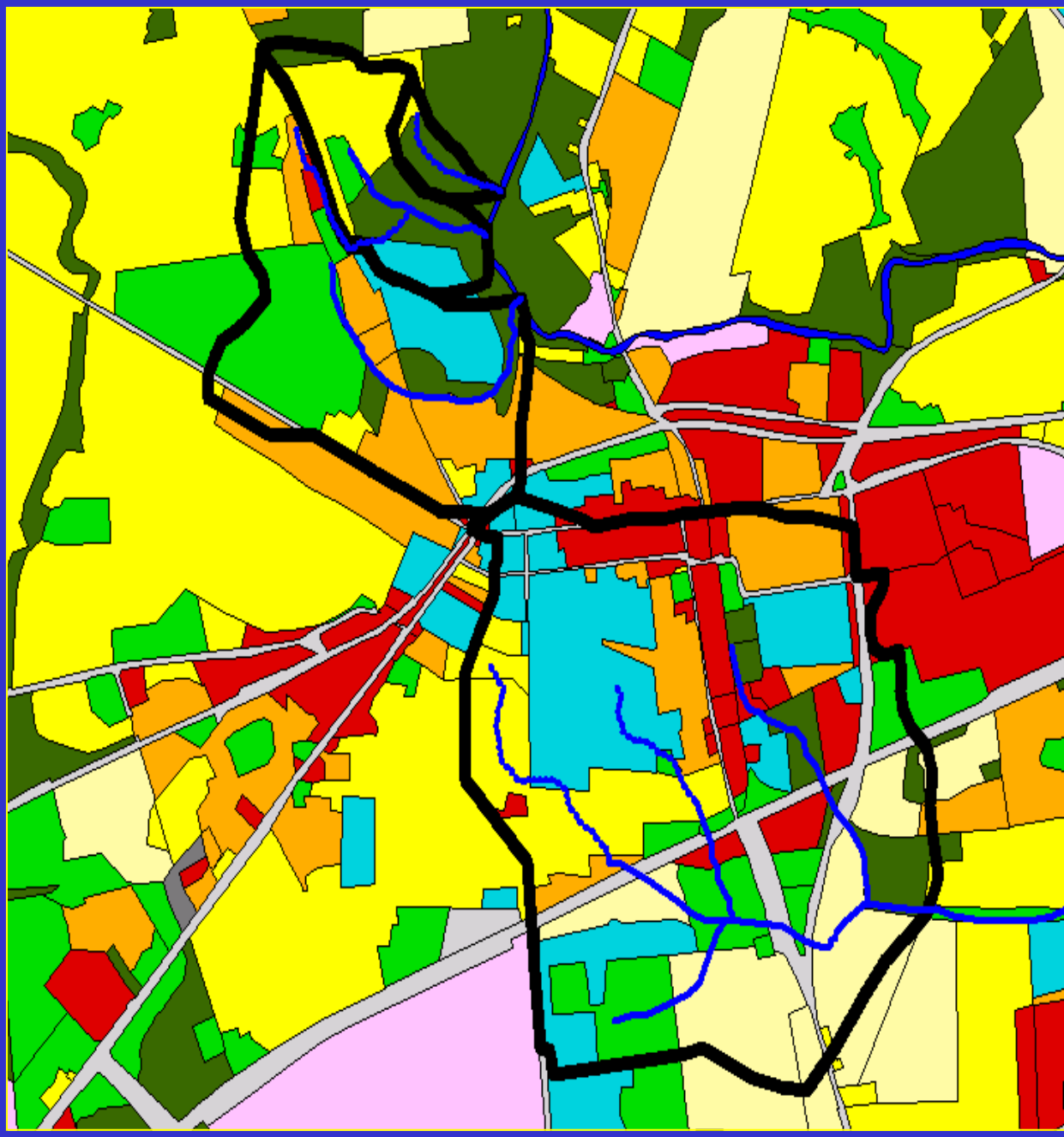
Transportation (gray)

Agriculture (beige)

Open Space/Parks (light green)

Forest (dark green)

Streams and creeks (dark blue)



Field Inventories

STREAM WATER QUALITY

- Nitrogen, Phosphorus
- Alkalinity, Hardness
- Ammonia
- Dissolved Oxygen, pH
- Temperature
- Chlorides
- Metals (Copper, Chromium, Iron)
- Hydrocarbon

Field Inventories

STREAM HABITAT

In-stream

- Available cover
- Pool concentration and variability
- Sediment deposition
- Channel flow and alteration
- Velocity, width and depth
- Aquatic vegetation
- Structures
- Pollution sources
- Water uses

Field Inventories

STREAM HABITAT

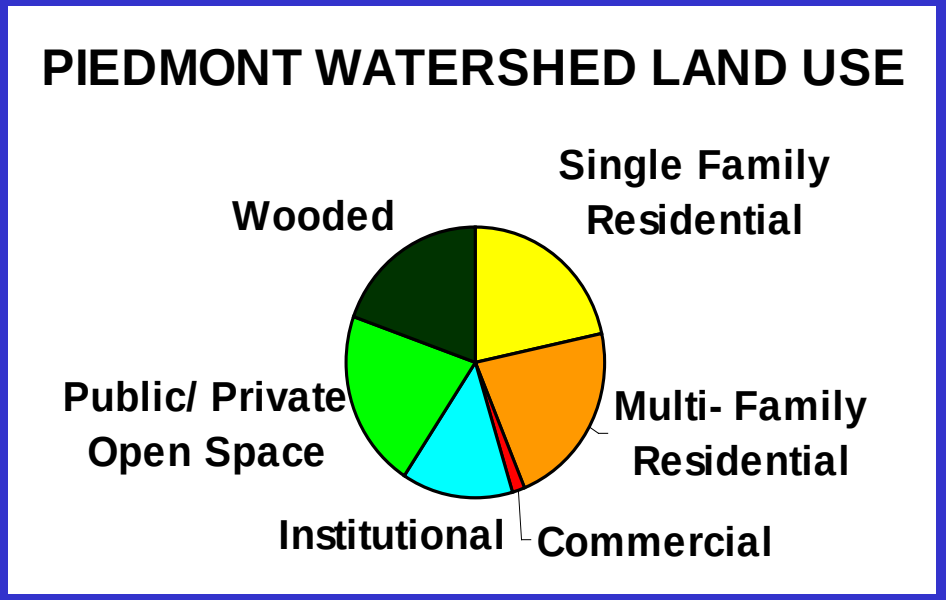
Riparian Buffer

- Bank stability
- Bank vegetation protection
- Riparian buffer width and type
- Condition of buffer/tree canopy

Field Inventories

STREAM HABITAT

- **Land Use**



- **Impervious Cover**

Evaluating the Results

University of Delaware Experimental Watershed Rating Scale				
Rating	*Water Quality*	*Habitat Assessment*	*Land-use*	*Impervious Cover*
4	0-25% of recommended limits	Optimal	Wooded, Public/Private Open Space	0%: No Impact
3	25-50% of recommended limits	Sub-optimal	Institutional, Single-family residential	0-10% Sensitve
2	50-75% of recommended limits	Marginal	Commercial, Multi-family Residential	10-25% Impacted
1	> 75% of recommended maximum limit	Poor	Industrial	> 25% Non-supporting of Aquatic life

*Final Watershed Letter Grade is Based on the Following Scale:				
A+ 4	B+ 3.4	C+ 2.5	D+ 1.5	F <0.7
A 3.9-3.7	B 3.4-3.0	C 2.4-2.0	D 1.4-1.0	
A- 3.7-3.5	B_ 3.0-2.6	C- 2.0-1.6	D- 1.0-0.7	

Report Card

PIEDMONT WATERSHED REPORT CARD					
STREAM	*WATER QUALITY*	*LANDUSE*	*IMPERVIOUS COVER*	*HABITAT ANALYSIS*	*FINAL GRADE*
PENCADER CREEK					C
P1PC	2.5	3.1	1.0	2.7	2.3
P2PC	2.6			2.9	2.4
P3PC	2.5			2.4	2.2
FINAL GRADE	**2.5**	**3.1**	**1.0**	**2.7**	**2.3**
FAIRFIELD RUN					C+
P5FR	2.8	3.3	1.0	3.1	2.5
P6FR	2.6			2.5	2.3
P7FR	2.6			2.7	2.4
FINAL GRADE	**2.7**	**3.3**	**1.0**	**2.8**	**2.4**
LOST STREAM					B
P9LS	2.9	3.8	3.0	3.0	3.2
FINAL GRADE	**2.9**	**3.8**	**3.0**	**3.0**	**3.2**
WATERSHED FINAL GRADE	**2.7**	**3.4**	**1.7**	**2.8**	**2.6**
WATERSHED FINAL LETTER GRADE*	**B-**	**B+**	**C-**	**B-**	**B-**

Implications

1) Basis for experimental watershed

2) Precedence among other universities

3) Applicability to University of Delaware curriculum

4) Transferability of watershed mapping process

5) Relationship of watershed land-use to stream health

6) Transferability of watershed report card

7) Recommendations for the future

Implications

FUTURE RECOMMENDATIONS

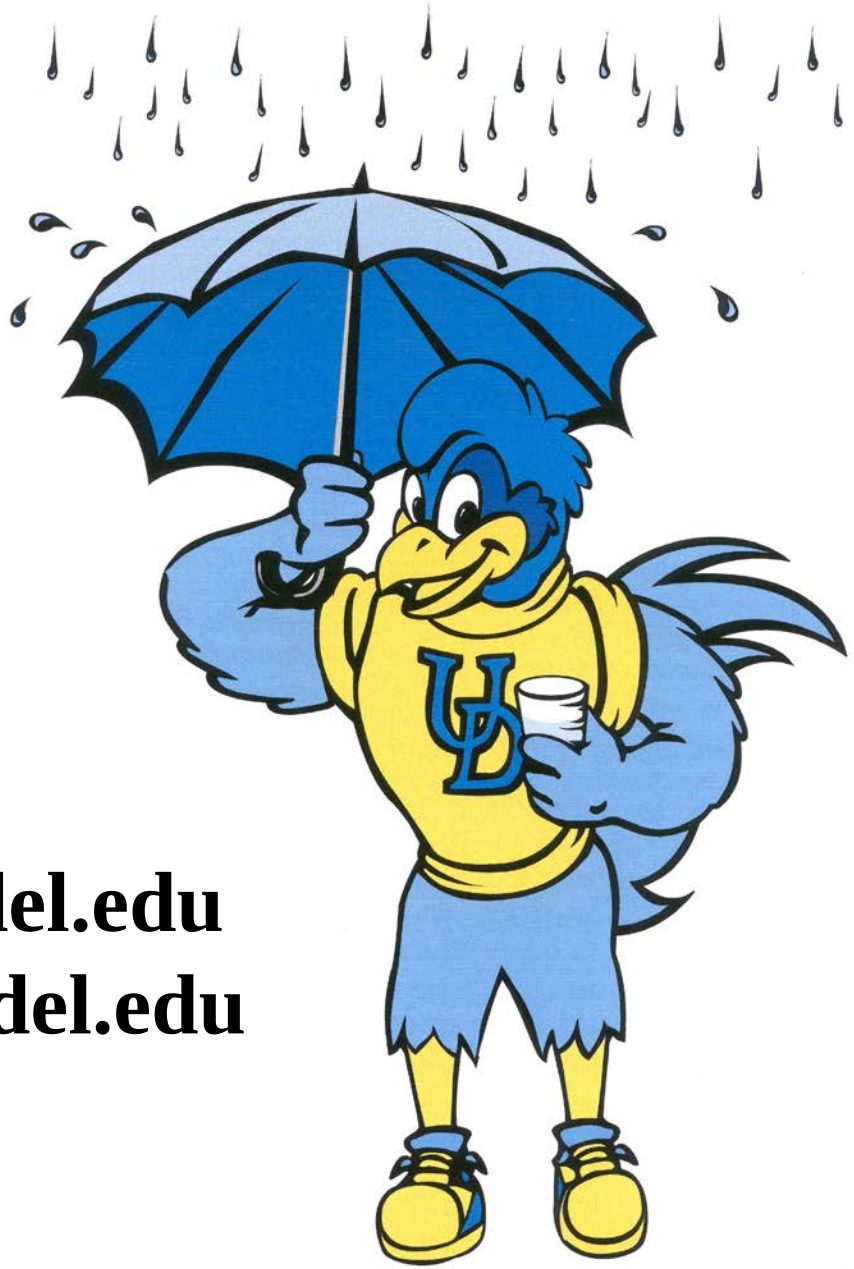
1) Grant proposal

2) Oversight committee

3) Official stream names

4) Public outreach

5) Field station indicators



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The Team