Teaching the Costs of Urban Sprawl with Citygreen & ArcGIS

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Context of Study

- Undergraduate Senior Seminar in Environmental Studies
- Capstone
  - Environmental Science
  - Environmental Policy
  - Environmental Values

Learning Goals

- Think critically & creatively about sprawl & sustainability
  - Causes, impacts and alternatives
- Link theory and practice
  - Concepts – Case studies – Methods – Application
- Develop & apply GIS skills
- Work collaboratively
- Present & disseminate results to local community

Pedagogical Methods

- Collaborative Learning
  - Group project with individual assignments
- Active & Applied Learning
  - Field & Computer Lab
  - Tangible End Product
- Service Learning
  - Work to improve local environment & community
- Interdisciplinary Approach

Project: Costs of Urban Sprawl

Assess the social and ecological effects of suburban sprawl through a case study analysis of a proposed 455 unit development in Butler Township, Adams County, Pennsylvania (Summerdale and Biglerville Crossing)

Project Objectives

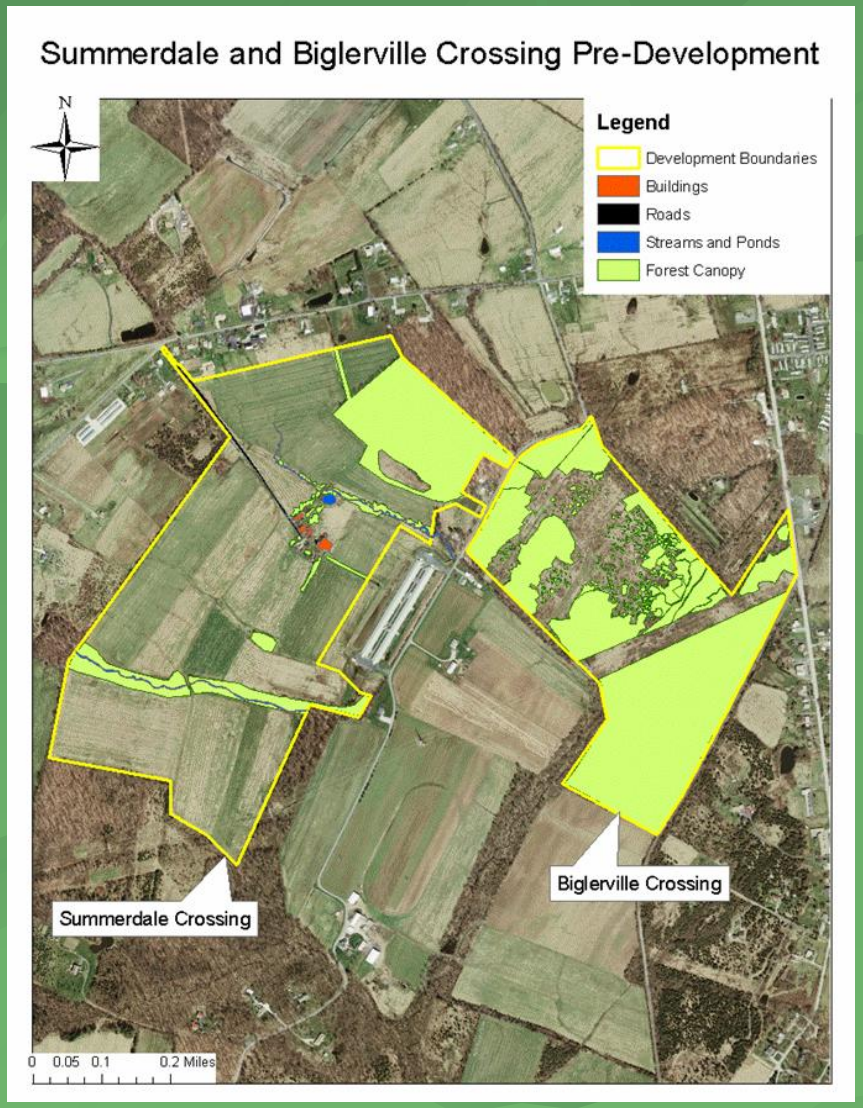
1. Assess impacts of **proposed development**
   - Social and Economic
   - Ecological
2. Construct **alternative design** that reduces negative impacts
   - Re-run assessments
3. **Disseminate** findings

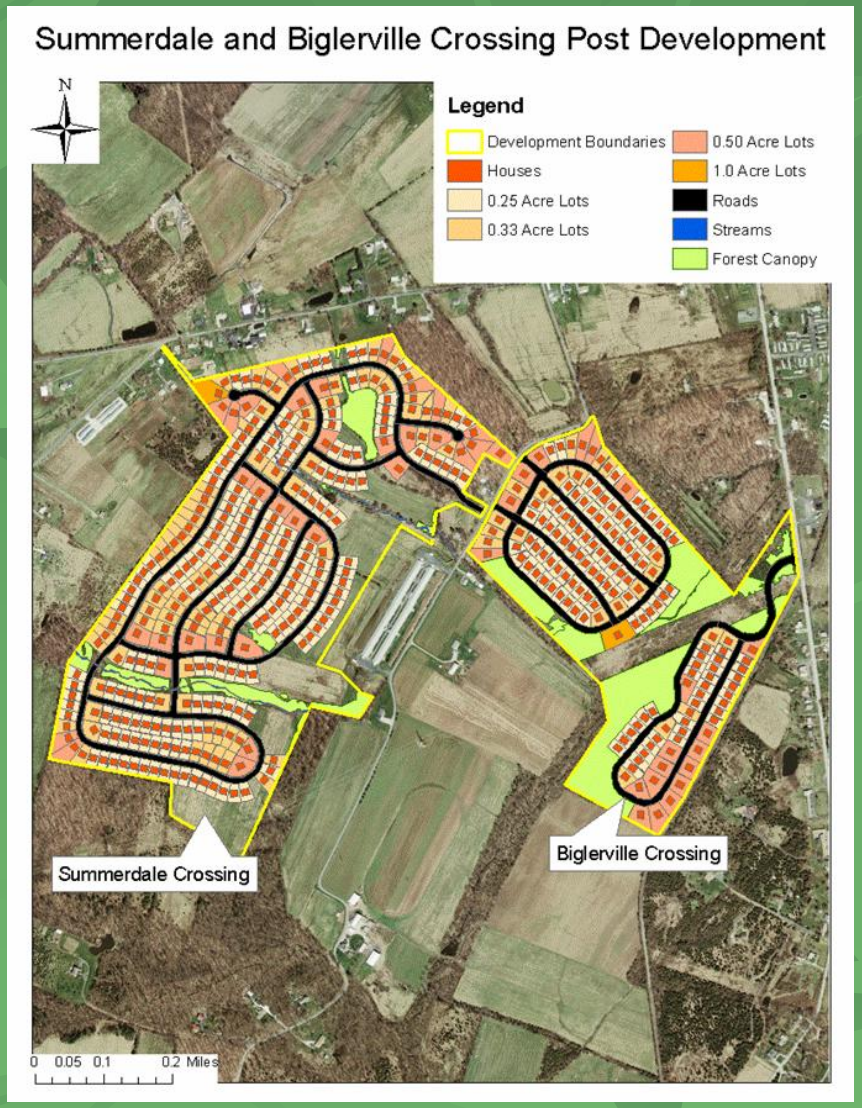
Ecological Analysis: CityGreen

- Extension for ArcGIS
- Developed by *American Forests*
- Based on tree canopy & land cover
- Air pollution abatement
- Storm water runoff
- Water contaminant loading

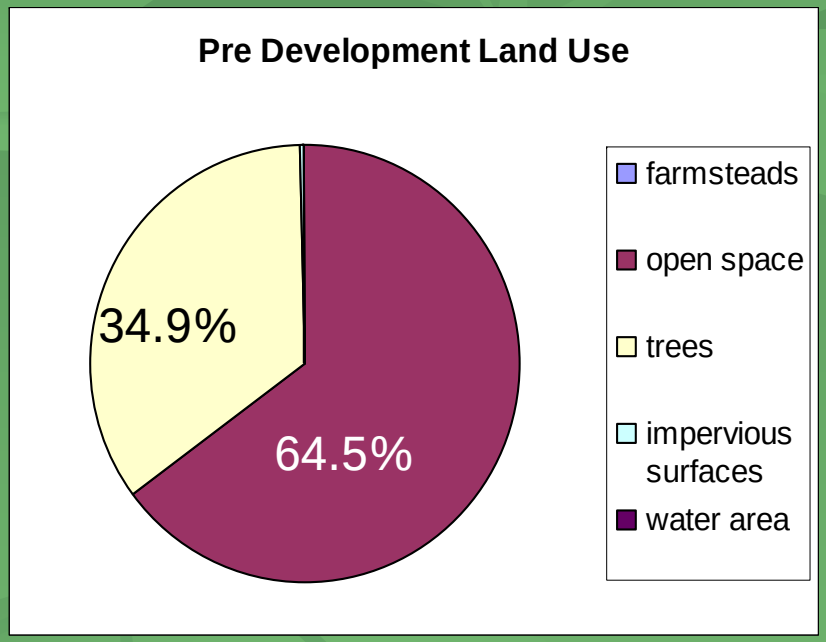
Adams County, Pennsylvania

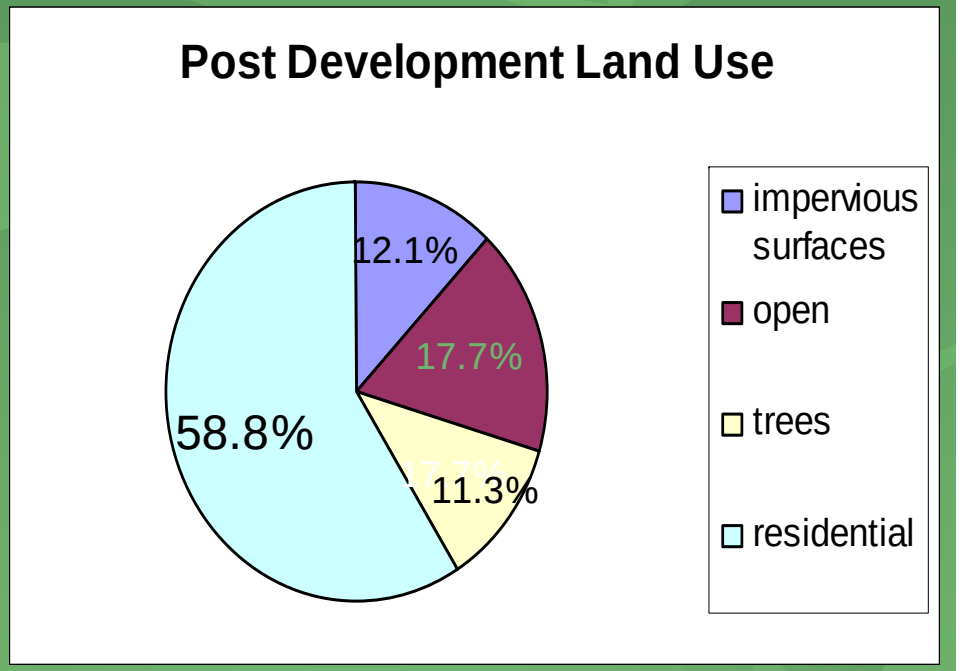
Pre- vs. Post-Development Landover





Contrast of Pre- and Post-Development Land Cover





Impervious Surfaces: 0.16%

Farmsteads: 0.34%

Water: 0.1%

Results

Ecological (CityGreen) Assessment
Pre vs. Post-Development

Air Quality Comparison

Pollutant	Pre-Development (lbs removed/yr)	Post Development (lbs removed/yr)
Carbon Monoxide	223	72
Ozone	2,971	960
Nitrogen Dioxide	2,005	648
Particulate Matter	2,748	887
Sulfur Dioxide	965	312
Total	8,911	2,878

Carbon Sequestration and Storage

	Pre-Development (tons)	Post-Development (tons)	Total Loss
Total Tons Stored	3,584.88	1,157.94	2,426.94
Total Tons Sequestered (annually)	27.91	9.02	18.89

Storm Water Quantity Results

	Additional storage volume needed due to reduction in tree canopy (ft^3)	Total storm water infrastructure cost (based on $2 /cu. ft. estimated cost)
Post Development	257,815	$515,629

Percent Increase in Contaminant Loadings from Pre to Post Development

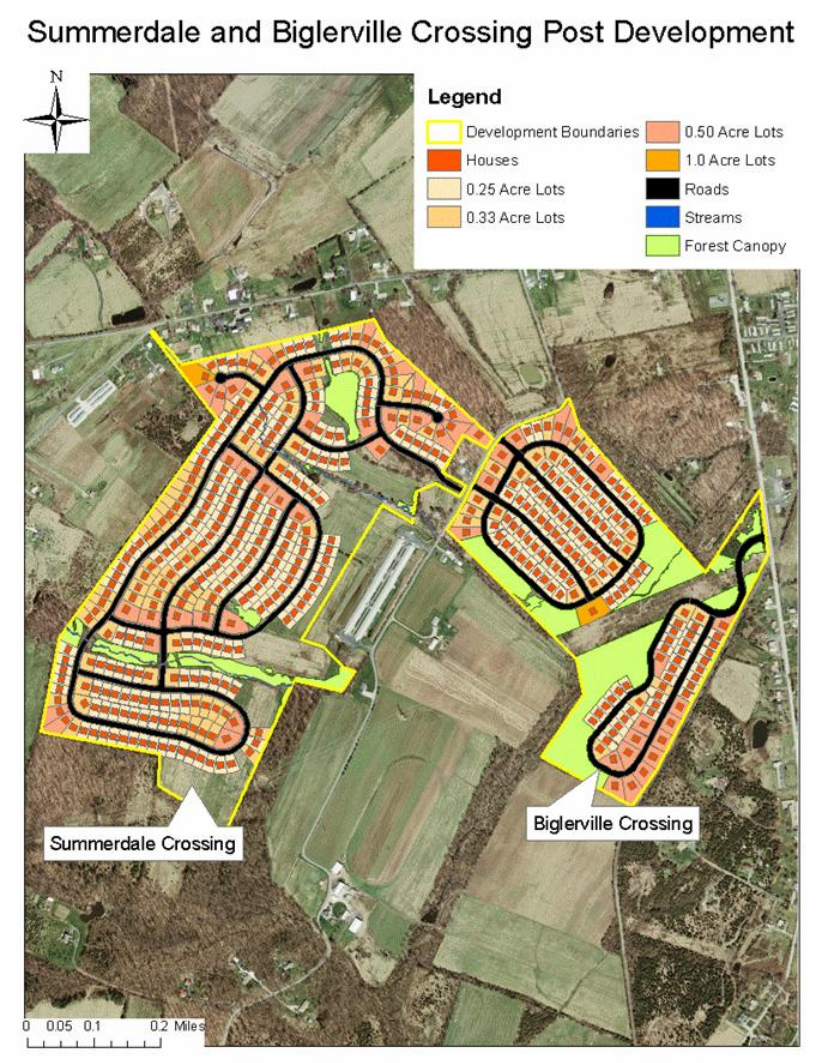
	Summerdale	Biglerville Crossing
Biological Oxygen Demand	18.43%	47.88%
Cadmium	22.75%	63.57%
Chromium	28.12%	86.71%
Chemical Oxygen Demand	29.90%	95.5%
Lead	7.63%	16.88%
Nitrogen	10.15%	23.26%
Phosphorous	21.23%	57.79%
Suspended Solids	18.19%	47.07%
Zinc	5.51%	11.85%

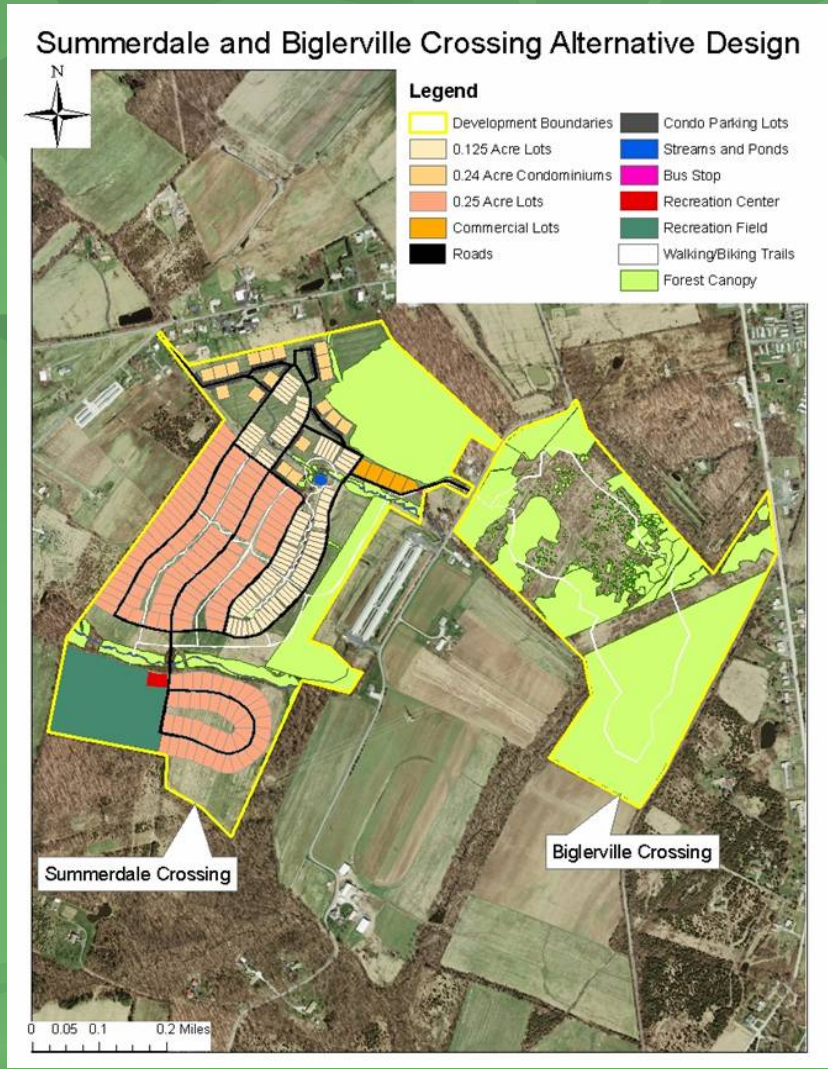
Alternative Design

Alternative Design Goals

- Used results of our ecological and social analysis to determine priorities
- Goals: based on environmental planning principles
  - Primary and Secondary Conservation
  - Strive to comply with regional watershed standards
  - Mixed Use Development
  - Higher Density Residential Area
  - Pedestrian and Community Friendly Design

Post-Development vs. Alternative Design





Results
Alternative Design

Air Quality Results

Pollutant (lbs removed/yr)	Pre-Development	Post-Development	Alternative Development
Carbon Monoxide	223	72	246
Ozone	2,971	960	3,281
Nitrogen Dioxide	2,005	648	2,214
Particulate Matter	2,748	887	3,035
Sulfur Dioxide	965	312	1,066
Total	8,911	2,878	9,842

Storm Water Runoff Quantity Results

	Post Development	Alternative Development	Difference
Additional Storage volume needed if all trees are removed (ft^3)	257,815	61,478	-196,337
Total storm water infrastructure cost	$515,629	$122,956	-$392,573

Water Quality Results

Summerdale Percent Change in Contaminant Loading

	Pre- to Post-Development	Pre- to Alternative Development
Biological Oxygen Demand	18.43	9.21
Cadmium	22.75	11.37
Chromium	28.12	14.06
Chemical Oxygen Demand	29.90	14.95
Copper	0.0	0.0
Lead	7.63	3.82
Nitrogen	10.15	5.08
Phosphorus	21.23	10.61
Suspended Solids	18.19	9.10
Zinc	5.51	2.76

Learning Outcomes

- Achieved!!!!
- Public presentations
  - Campus and local community
  - Butler Township Planning Board
- County recognition
- Graduate school