Implementing Watershed Protection and Management Strategies in Hickory Creek

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Environmental Services

PREPARED IN COOPERATION WITH THE TEXAS COMMISSION ON ENVIRONMENTAL QUALITY AND U.S. ENVIRONMENTAL PROTECTION AGENCY

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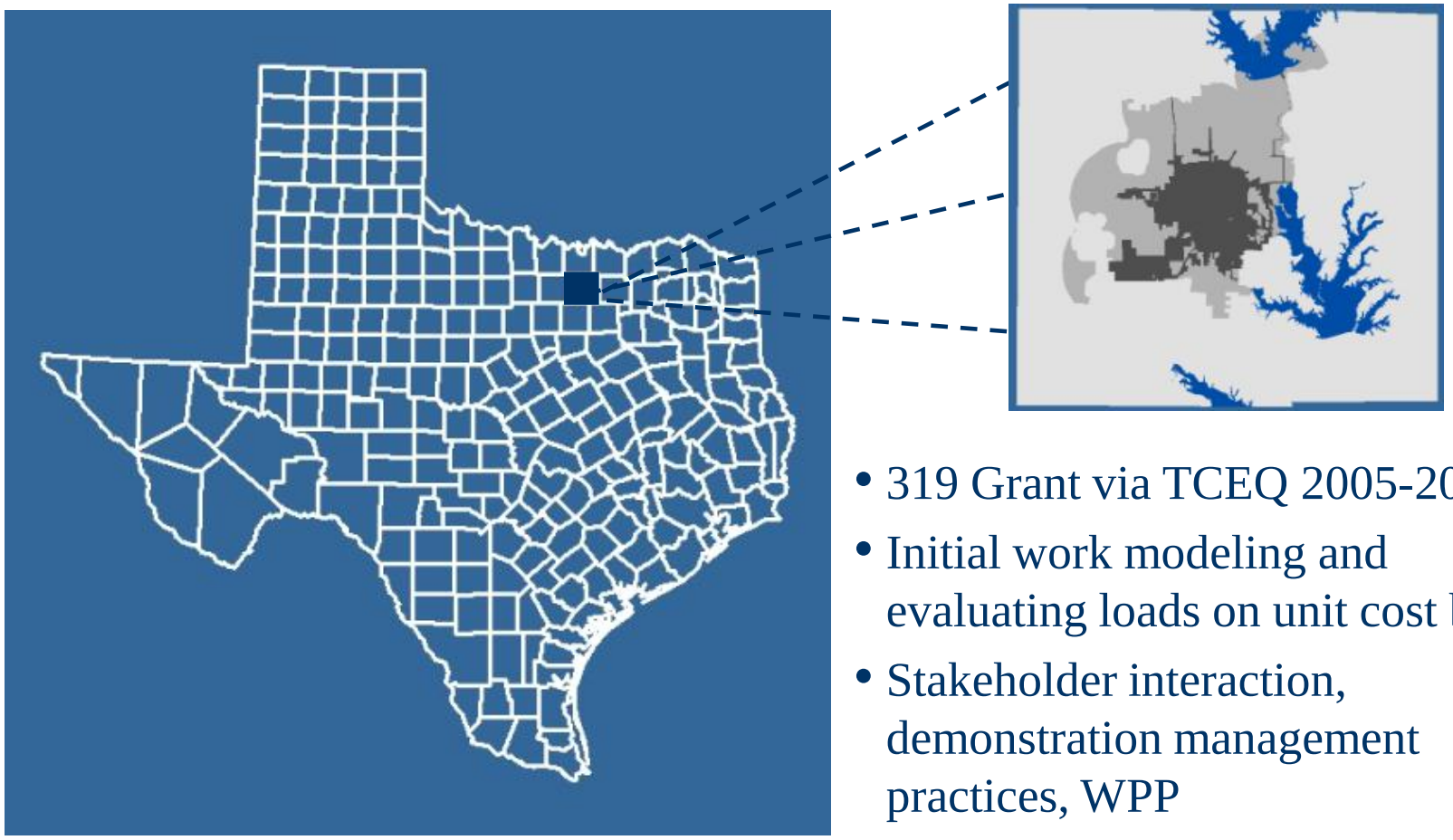
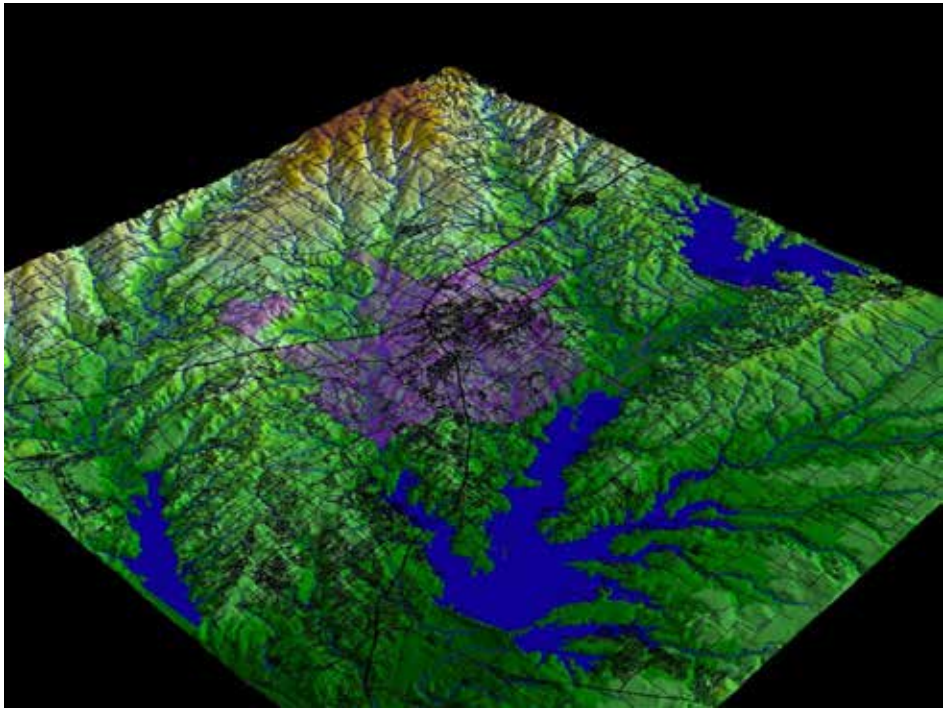
Project Background



- 319 Grant via TCEQ 2005-2008
- Initial work modeling and evaluating loads on unit cost basis
- Stakeholder interaction, demonstration management practices, WPP

Hickory Creek Approach

- Rapid development; gas wells
- Potential to manage
- Develop Watershed Protection Plan (WPP)
- Develop water quality based BMP optimization strategies
- Implement Demonstration BMPs (dBMPs)
- Extend to other areas



Pollutant Sources and Loading Rates

- **Monitoring Program**
  - 2001 to 2005 data
  - Runoff events quarterly (4 stations) base flow monthly (~80)
  - In-stream monitoring devices
- **Point Sources**
  - Krum, Slidell ISD, Acme Brick
- **Nonpoint Sources:**
  - Texas A&M SWAT/QUAL-TX model calibrated / tested using monitoring data

Land Use	Area (acres)
Urban	29,447
Agricultural	38,998
Rangeland	45,734
Forest	9,182
Water	1,109
Total:	**124,470**

Demonstration BMP (dBMPS)

- stakeholders included citizens, developers, Soil Conservation Service, Parks and Wildlife, USACE, a local River Authority, and Sierra Club.
- Provided information on potential sites.
- **Part of the cost / benefit and prioritization approach … What benefits, especially those not easily quantified, are important to stakeholders?**

Stakeholder “preferences”

- **Land ownership / Access** – publicly owned lands
- **Site Conditions** - Undeveloped sites expected to develop (not retrofits)
- **BMPs Alternatives -** “Natural”, multiple functions / native plants
- **BMP Effectiveness** – Greatest long term load reduction for lowest cost, determined via modeling.

Implementation of dBMPs

- 10 candidate sites
- Three final sites selected
- Dollars spent per pounds of pollutants reduced (unit cost basis)
- Public Safety Training Facility, Airport, Lake Forest Dog park

Public safety training facility

Public Safety Training Facility

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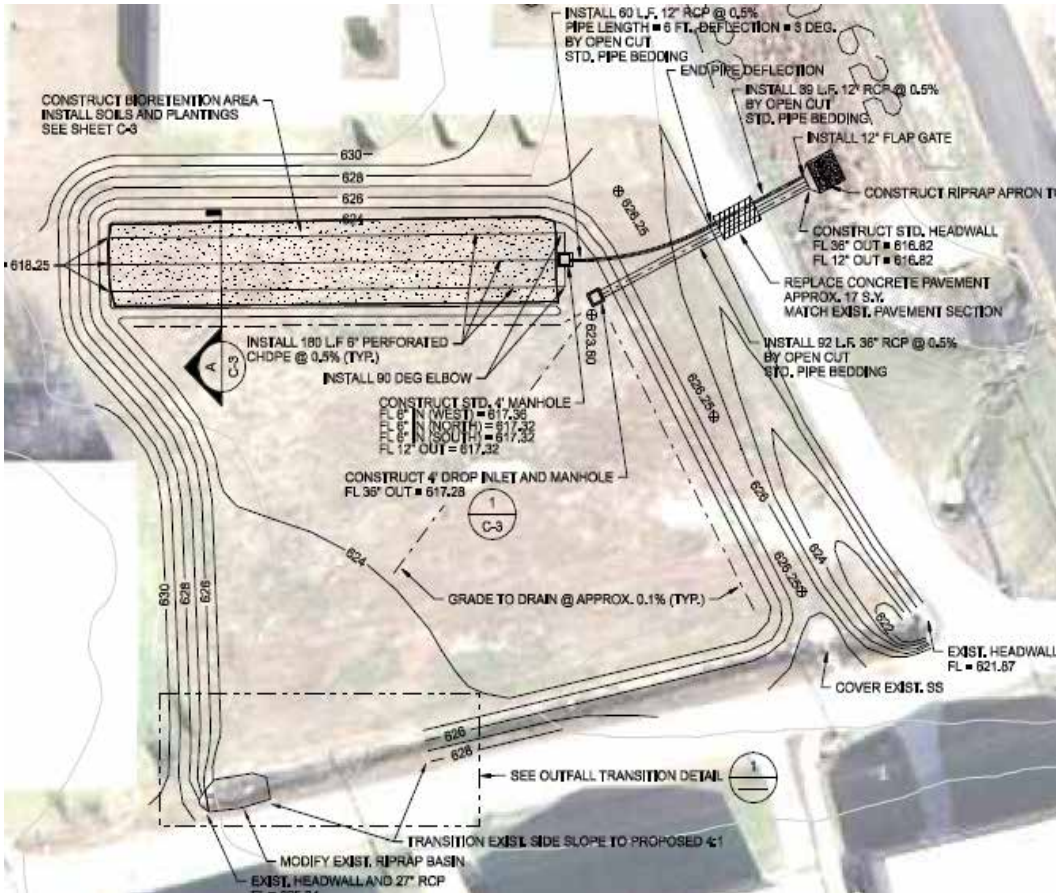
Public Safety Training Facility

Airport – bioretention area

- Bioretention / rain garden
- Must drain quickly

Bird Aircraft Strike Hazard (a.k.a. BASH).

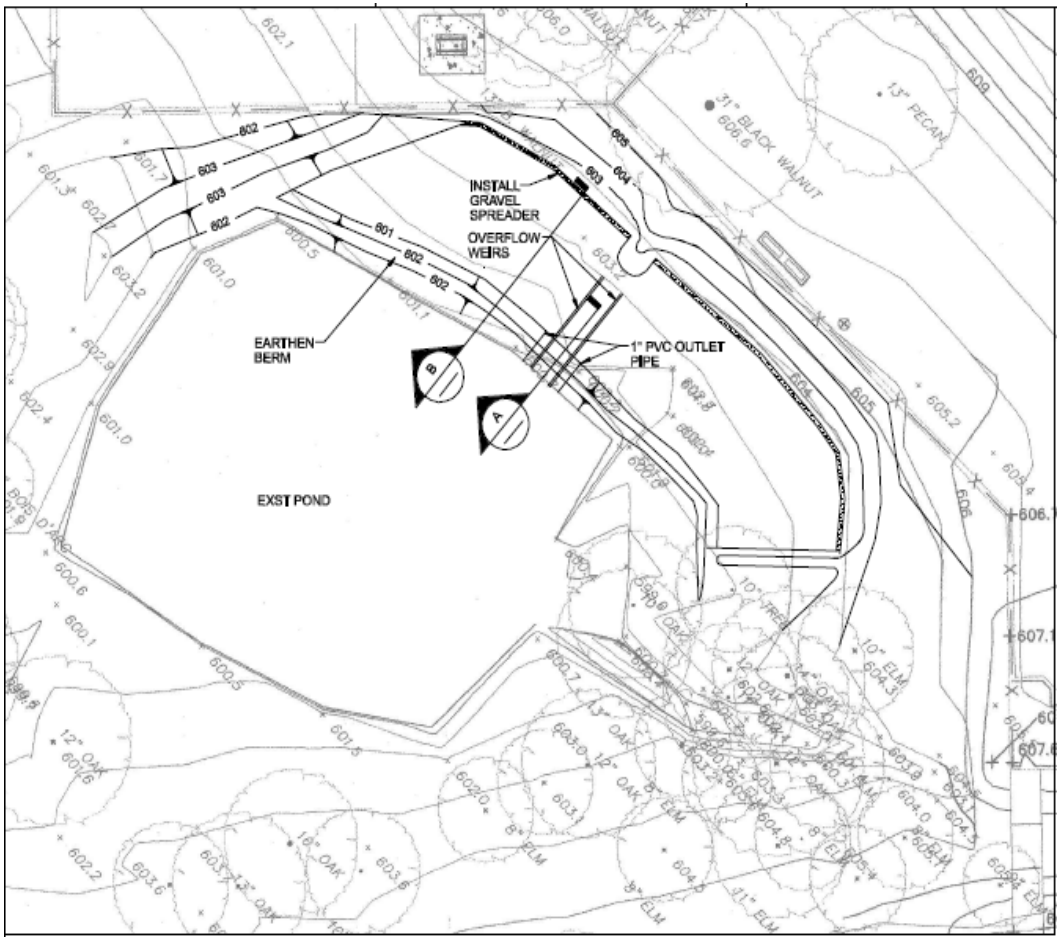


Airport – Bioretention area

Airport – Bioretention area

Lake Forest Park

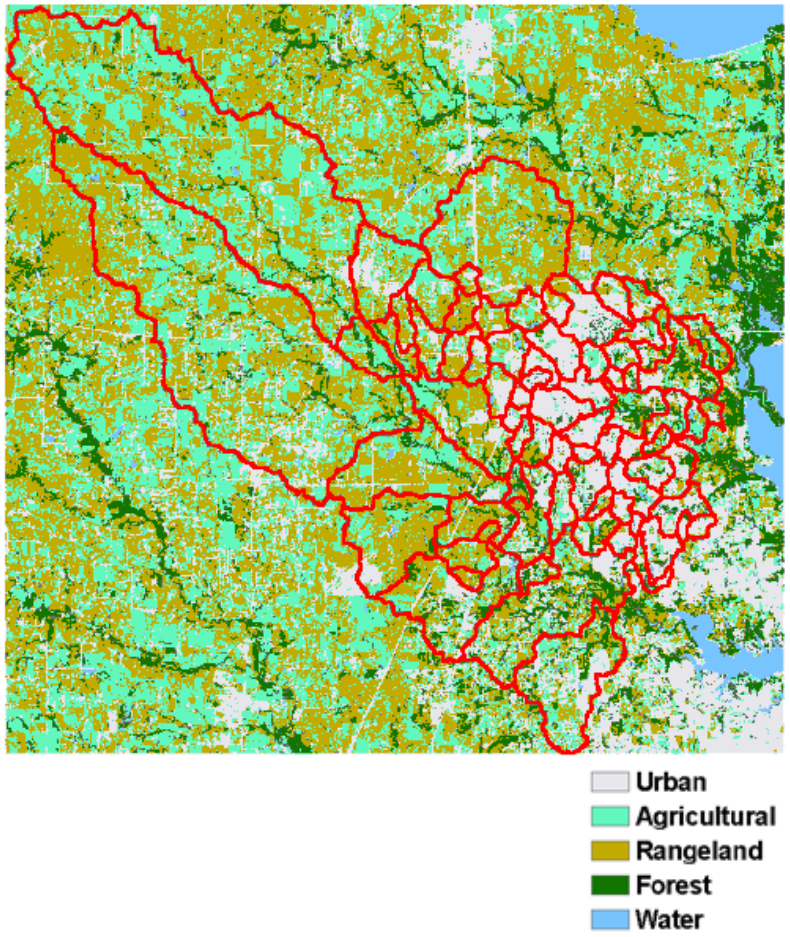
- Filter strip captures small storm flows and slowly releases
- Treats nutrients and sediments; also appears to reduce bacteria



Lake Forest Park

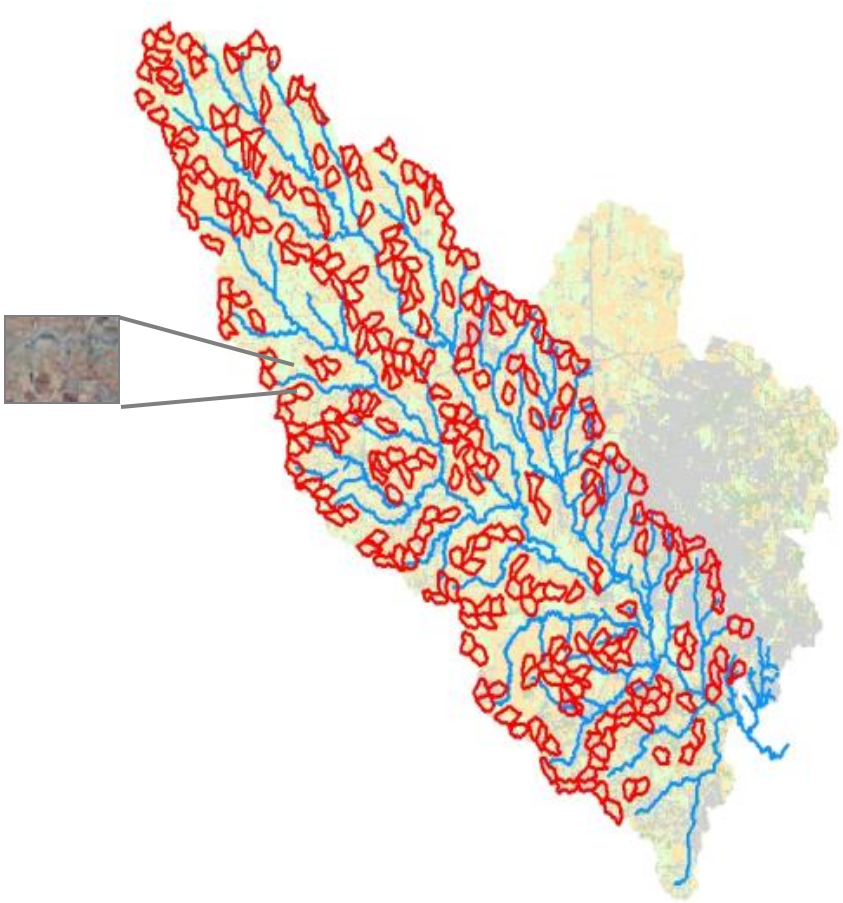
“Next generation” modeling – Sediment, Nitrogen, Phosphorous

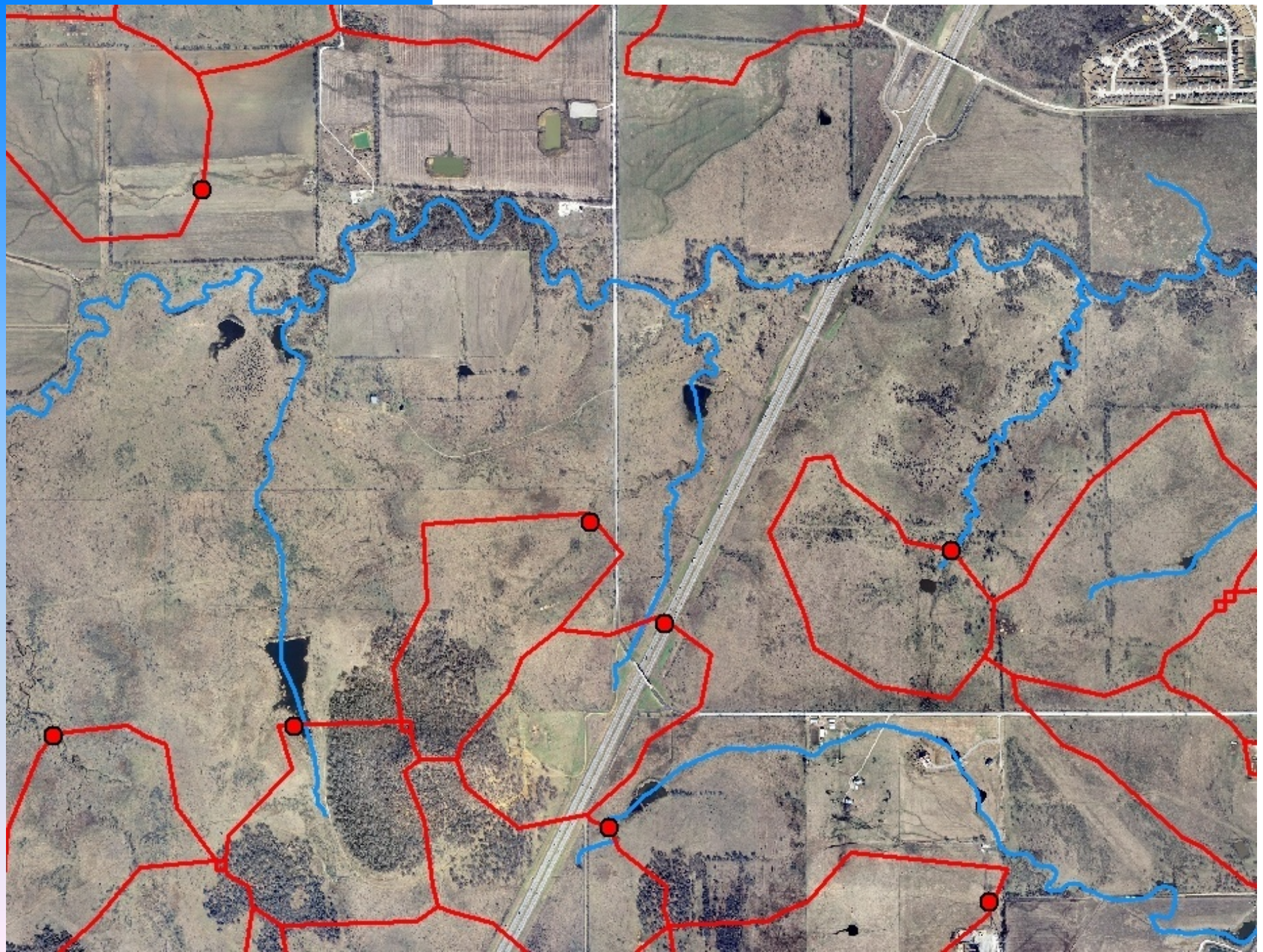
- How do you analyze causes and sources?
- Watershed scale versus “BMP scale”
- No TMDL targets, no numerical WQ criteria.
- How do we apply “unit / cost” concept for entire watershed?



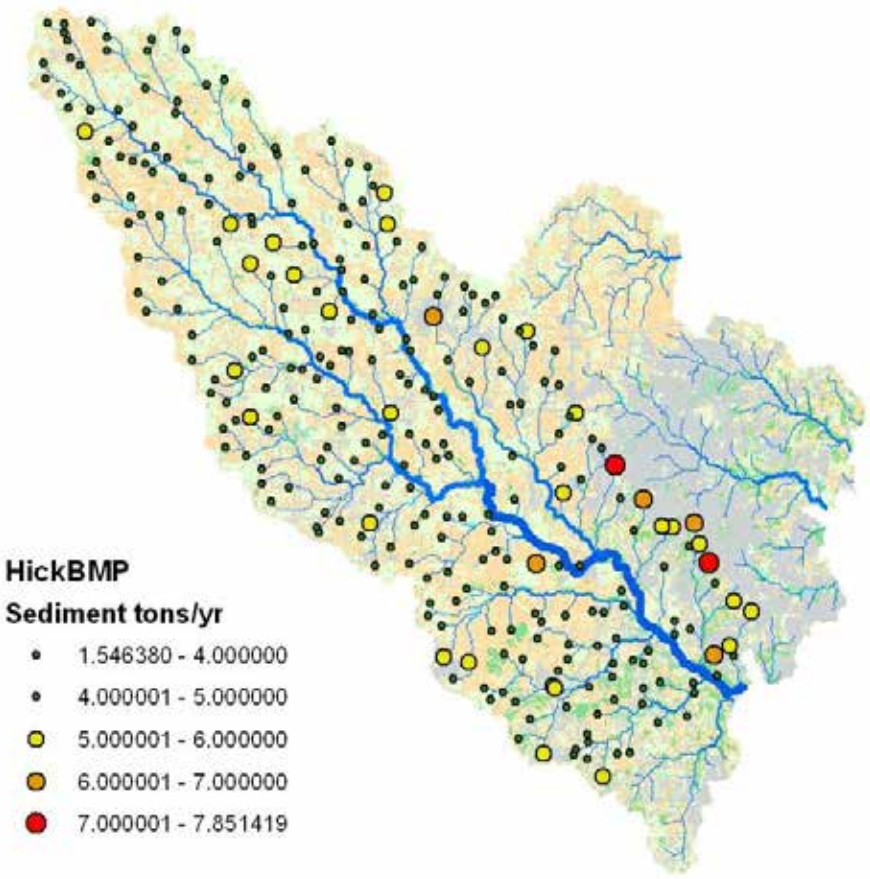
Prioritizing Sources of Loading

- Targeted 282 “priority” parcels 80-120 acres ea.
- Best trade-off of fine resolution (BMP scale) and model accuracy
- Determine loads parcels using model



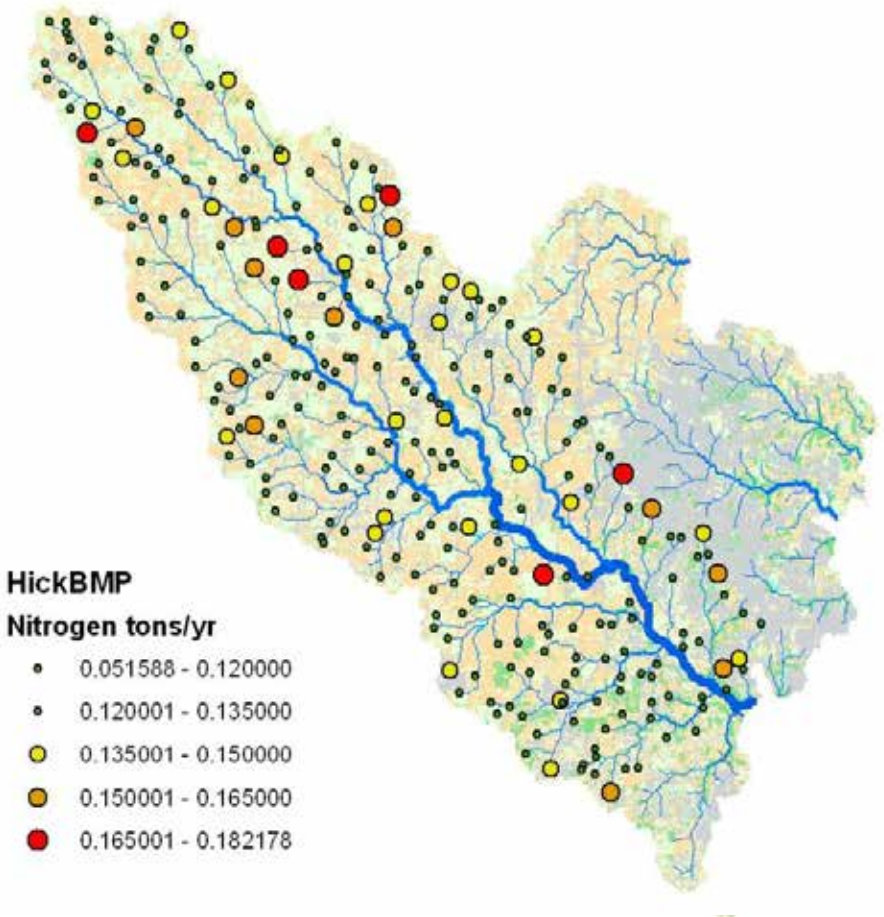


Loadings and ranks – Sediment



Land Use	Annual Loads per Unit Area from each Land Use (pounds/acre/yr)		
	Sediment	Phosphorus	Nitrogen
Urban	161.49	1.34	3.66
Agriculture	123.12	1.96	3.75
Rangeland	55.32	0.27	1.87
Forest	21.41	0.09	0.71

Loadings and ranks – Nitrogen



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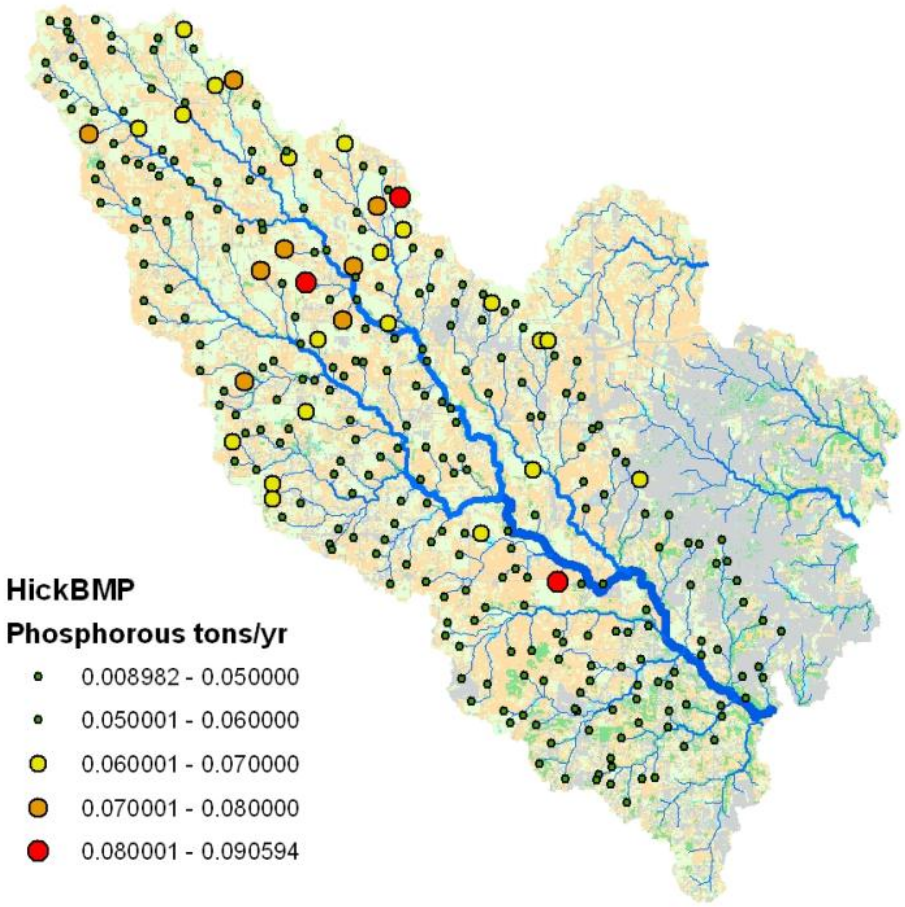

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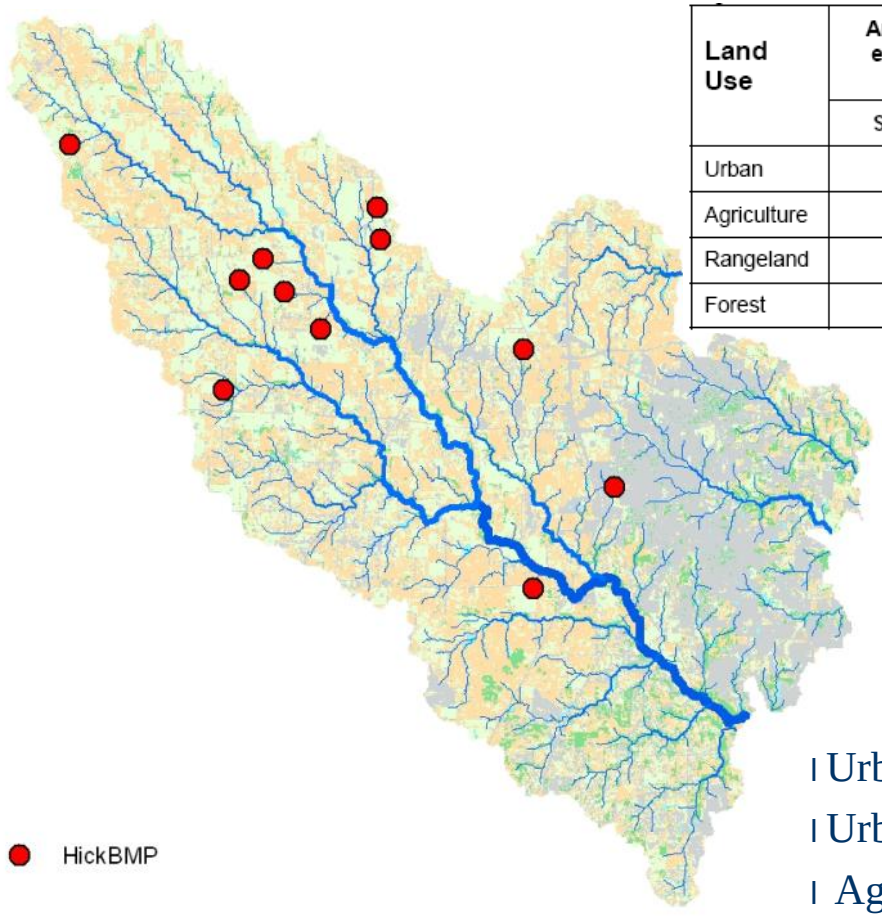
Combined Loadings



Land Use	Annual Loads per Unit Area from each Land Use (pounds/acre/yr)			Total Annual Loads in the Hickory Creek Watershed by Land Use (tons/yr)		
	Sediment	Phosphorus	Nitrogen	Sediment	Phosphorus	Nitrogen
Urban	161.49	1.34	3.66	1,305.14	10.80	29.54
Agriculture	123.12	1.96	3.75	2,030.46	32.41	61.84
Rangeland	55.32	0.27	1.87	1,050.50	5.07	35.60
Forest	21.41	0.09	0.71	71.65	0.33	2.43

- Urban generates more sediment per unit area
- Urban and agricultural generate more nitrogen
- Agricultural contributes more phosphorus.

Framework for Evaluating Strategies

- This is a **proactive** WPP
- Currently no “controlling” water quality targets / criteria
- Planning strategies based on “levels of resources” using a scalable optimization process
- Local regulatory drivers, incentives, economical analyses, grants programs, and political “buy in” are all crucial.
- Timing of opportunities is an integral component of the process

Alternative Strategies for Reducing Nonpoint Source Loads

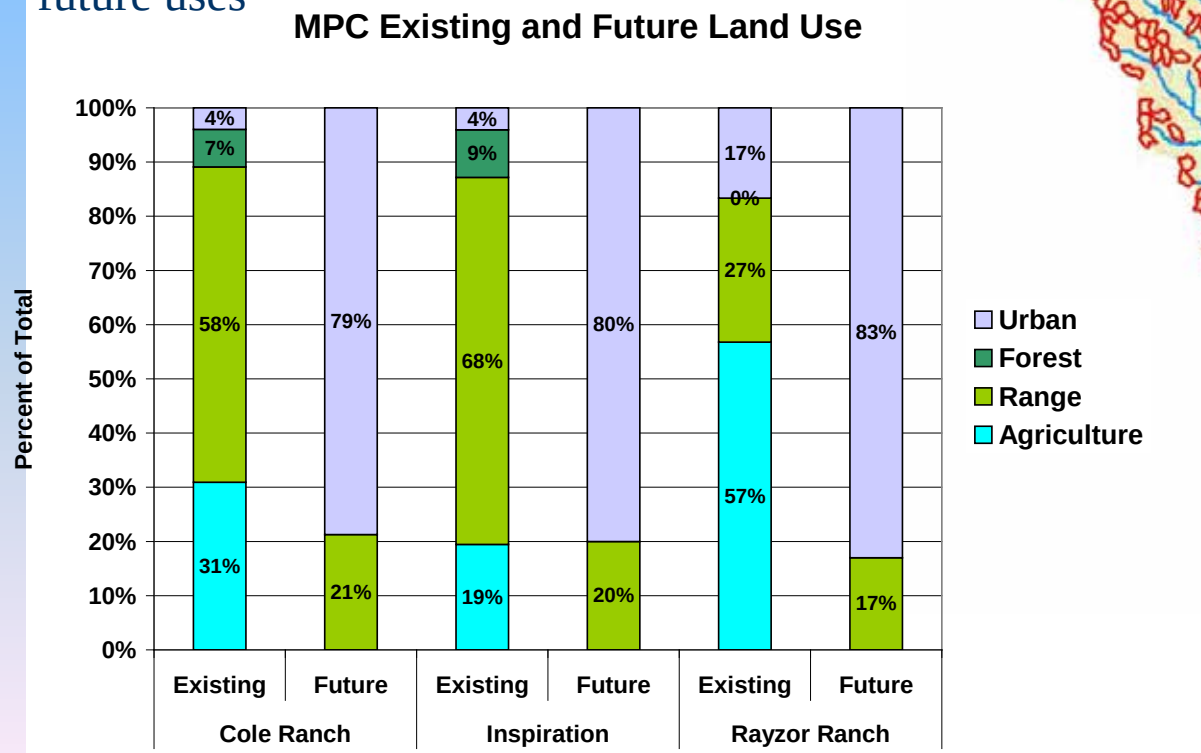
- Basic planning information: Evaluating implementation strategies at three spatial scales
  - Hickory Creek Watershed
  - 282 Priority Sites
  - Three Master Planned Communities (MPCs)

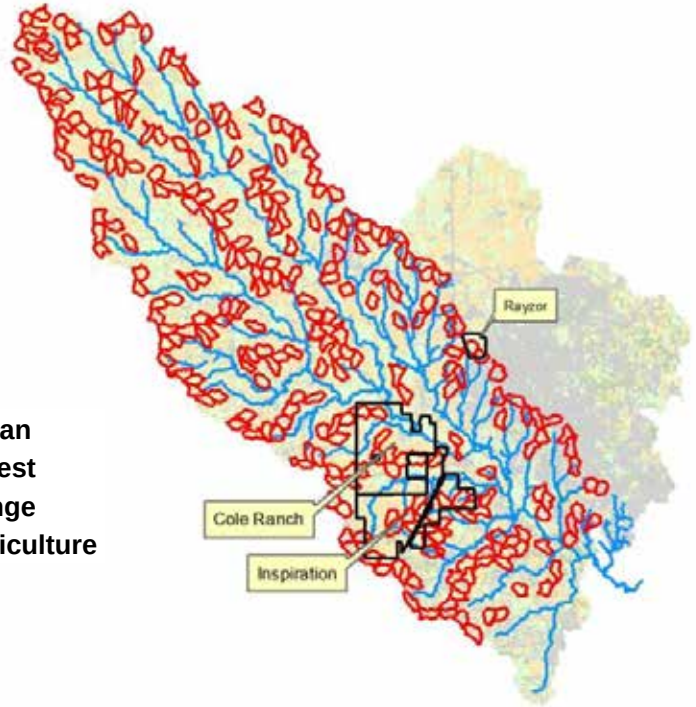
Tool for constructing and evaluating BMP “portfolios”

- Excel workbook with Visual Basic
- Acreage input by land use category
- Calculates total loads for TSS, TP, and TN
- BMP options based on:
  - BMP removal efficiencies
  - Costs and O&M estimates.
- User can construct “portfolios” for defined areas
- Talked about in more detail in earlier presentation

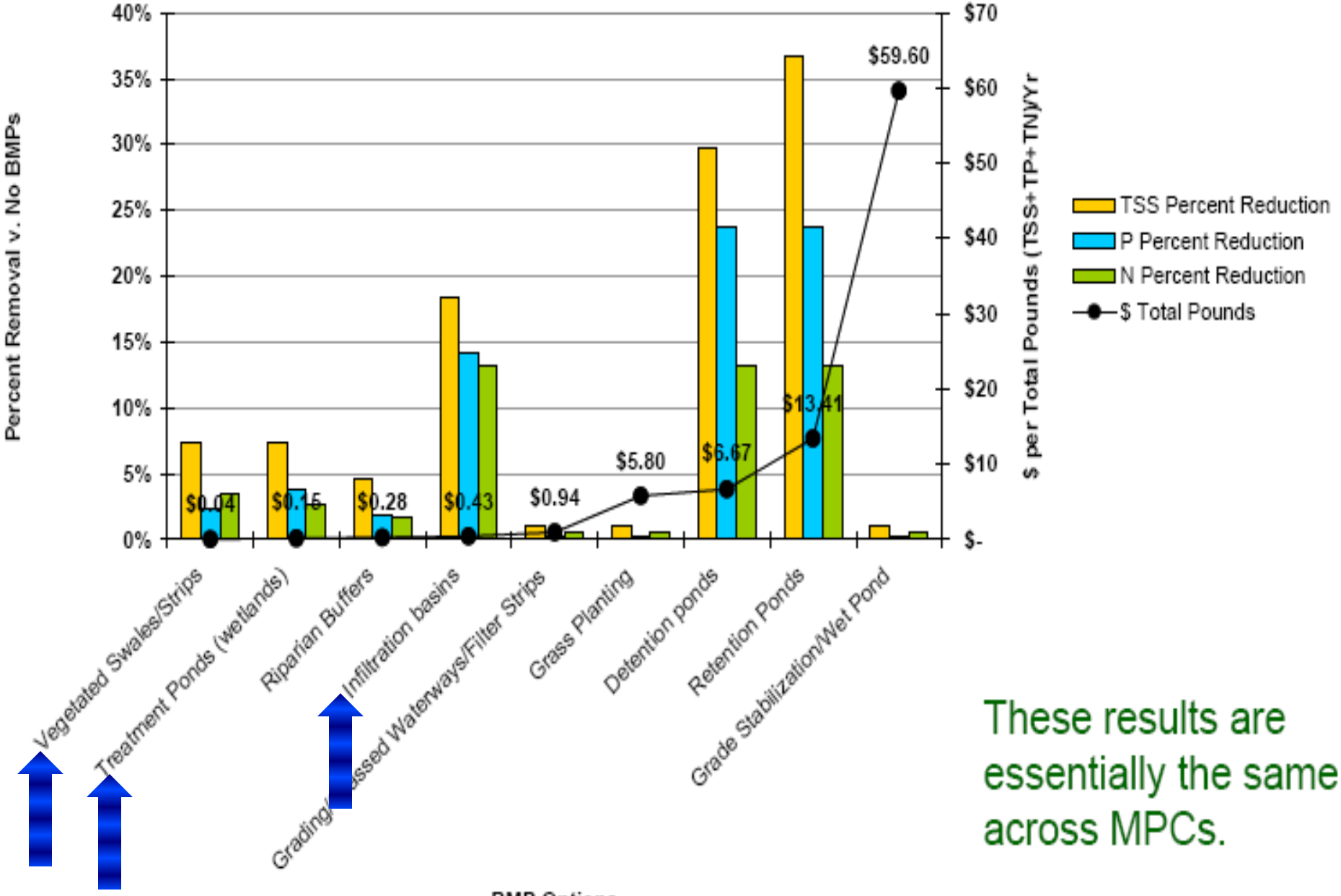
Master Planned Communities

- Large areas several hundred acres or more
- Different current landuses but similar future uses





BMP Options for Cole Ranch MPC:
Individual Effectiveness at Maximum Implementation and Unit Costs



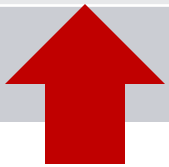
These results are essentially the same across MPCs.

SO WHAT??? HOW does all this work on the ground?

- Planning level tool to explore current or future opportunities .
- Information can education citizens, garner support, and educate / influence policy makers.
- Never design and implement for water quantity only…. design for water quality and quantity
- Helps shape decisions, but refined evaluation / design / engineering will be required at site level.

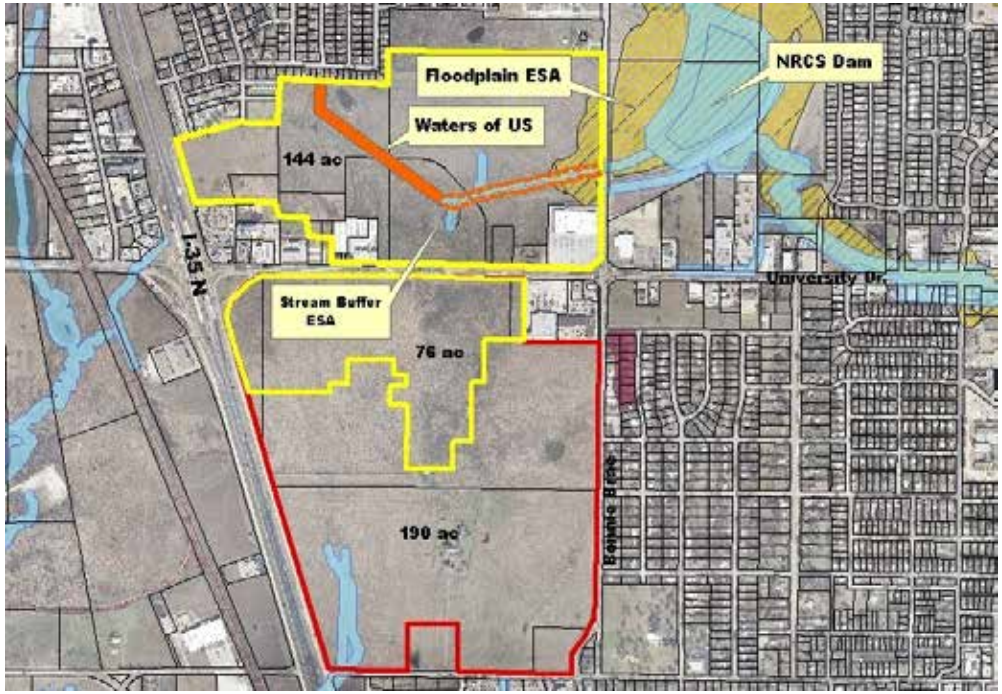
In other words, try to put the Right BMP in the Right Place

- For the analytical types in the room…

	Wrong BMP	Right BMP
Wrong Place	X	X
Right Place	X	Try to be here...
		

Rayzor Ranch

- 410 ac mixed-use development, 13 ac redevelopment, 397 ac green field
- 1 M square feet shopping center
- 900 K retail big boxes
- 10-story hotel
- 15 ac parks
- 10 ac medical offices
- Prime location
- **Regulated by agreement adopted via ordinance**



Storm Water Quality Controls

- Stormwater **quality** and quantity requirements via ordinance
- Swales, infiltration, 2.5 acre wetland
- Code requirements for “100 yr” storm(reason for pond)
- 11.4 ac retention/ detention pond (27.7 acre-ft/44.2 acre-ft), with forebays
- Floatables / trash racks

Parameter	Removal (%)
Total Suspended Solids (TSS)	80
Total Phosphorous (TP)	60
Total Nitrogen (TN)	50
Metals	80
Floatable Objects (Trash)	95

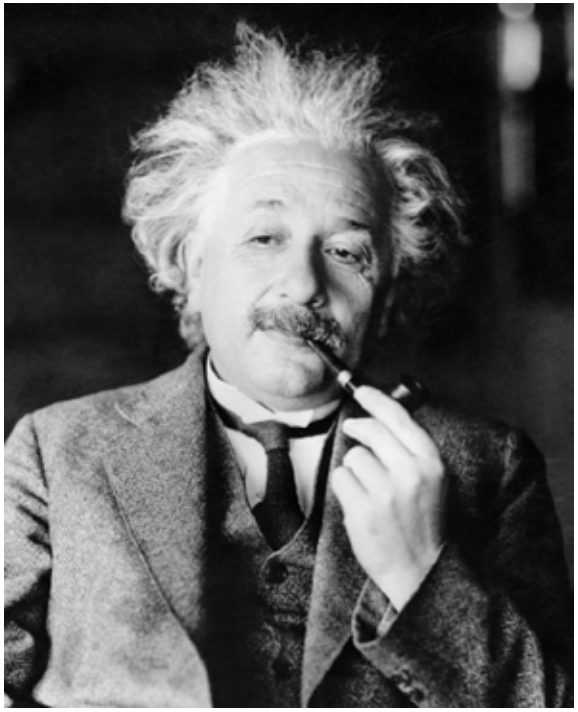
Infiltration

swale after
rain event

Wetland area

Hey Genius
What about maintenance?

- Maintenance specified in ordinance
- Provisions for unrestricted access, indemnification for city maintenance cost, hold harmless clause
- Common areas via property mgr.
- Business Owners via Development Agreement (before building permit)
- Currently, weekly maintenance
- This was **NOT** easy. How to you ensure compliance?



Implementation thoughts

- Successful implementation is the intersection between planning, timing, regulatory requirements, and development.
- **These elements DEFINE opportunities**

Implementation thoughts

- Many opportunities, especially the economically attractive ones, occur during land use changes
- This does not mean other opportunities do not exist, or that these opportunities cannot provide good cost / benefit ratios

Summary of WPP Goals

- Target priority locations through analyses, education, technical support.
- Education and outreach (citizens, developers, council) can result in changes that support watershed management

Summary of WPP Goals

- Minimize net increases in loadings despite continued development
- Minimize / mitigate the impacts of land use changes through development code requirements

Conclusions

- It helps to have a methodology that can function on multiple spatial scales
- Results can help bridge the gap between ecosystem services and implementation costs
- Using information as a tool to help shape Denton Comprehensive Plan revision and Development Code
- So far, well received by elected officials

Contact Information

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