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Water Resources

Growing Smarter

In the 4 Lakes Watershed Area: A Simplified Model of Green Infrastructure Impacts on Water Quality in the Bangs & Slocum Lake Watershed

4 Lakes Watershed Initiative

- Impaired Waters per IEPA for phosphorus, fecal coliform and dissolved oxygen
- Bodies of water include:
  - Bangs Lake
  - Slocum Lake
  - Lake Napa Suwe
  - Griswold Lake
  - Port Barrington Channels
  - Tower Lake
  - Lake Barrington
  - Island Lake

sites.google.com/site.4lakesinitiative/

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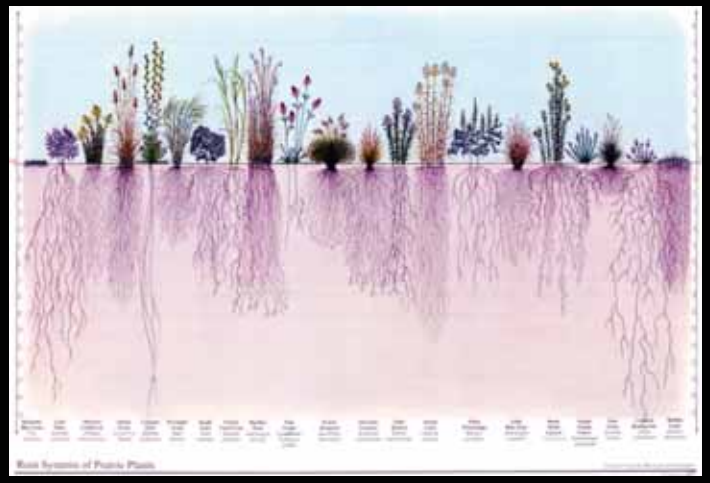
Watershed Impact

- Bangs /Slocum Watershed was the subject of 2010 sedimentation study indicating a need for holistic watershed based plan to address pollutant loading
- Average annual loading determined:
  - Bangs Lake: 61.8 Tons
  - Slocum Lake: 47.6 Tons



Water Resources

Land Use and Impervious Cover

The Bangs/Slocum Lake watershed consists of 8 recognized land uses

1. Water Wetlands
2. Commercial
3. Agricultural
4. High density residential (1/4 acre)
5. Low density residential (1/2 acre)
6. Grass/Prairie
7. Forest
8. Industrial

Each land use provides variable impervious cover

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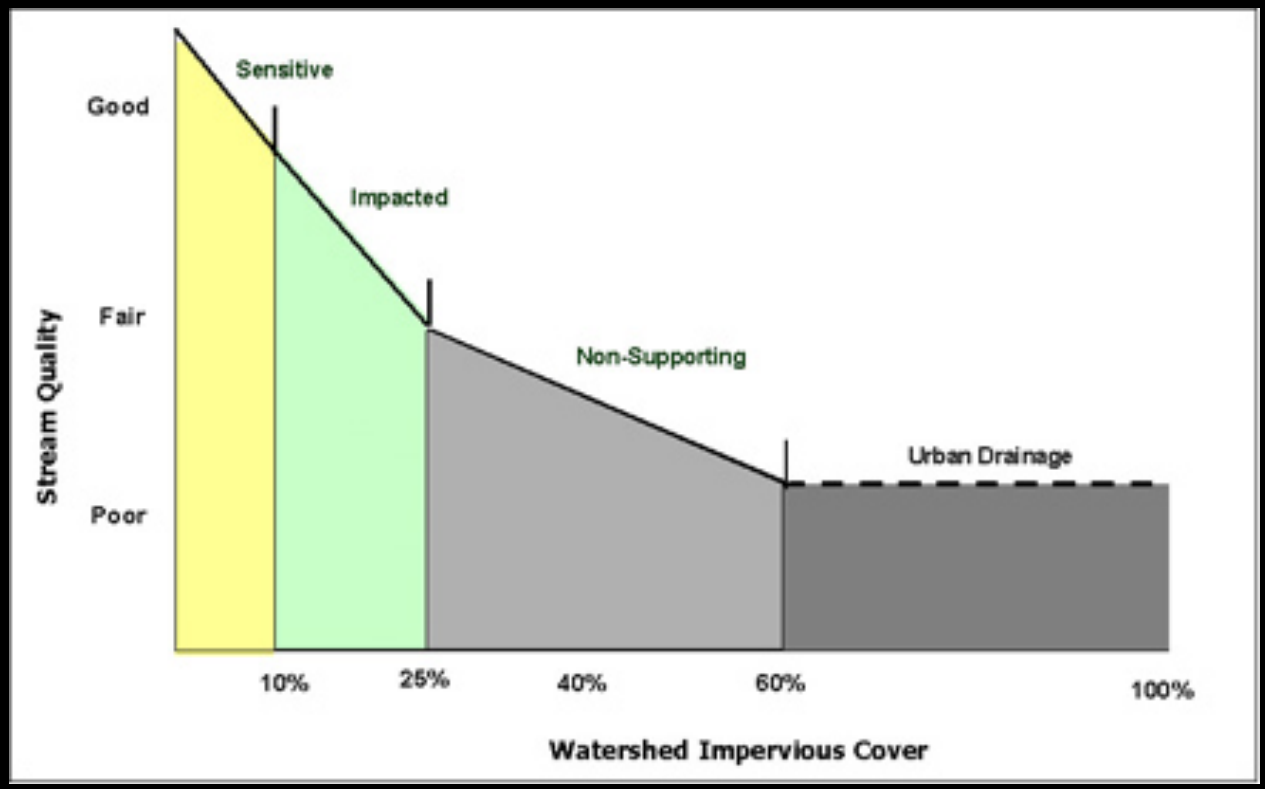
Impervious Area Impacts

How can we assess these impacts?



Center for Watershed Protection, 2000

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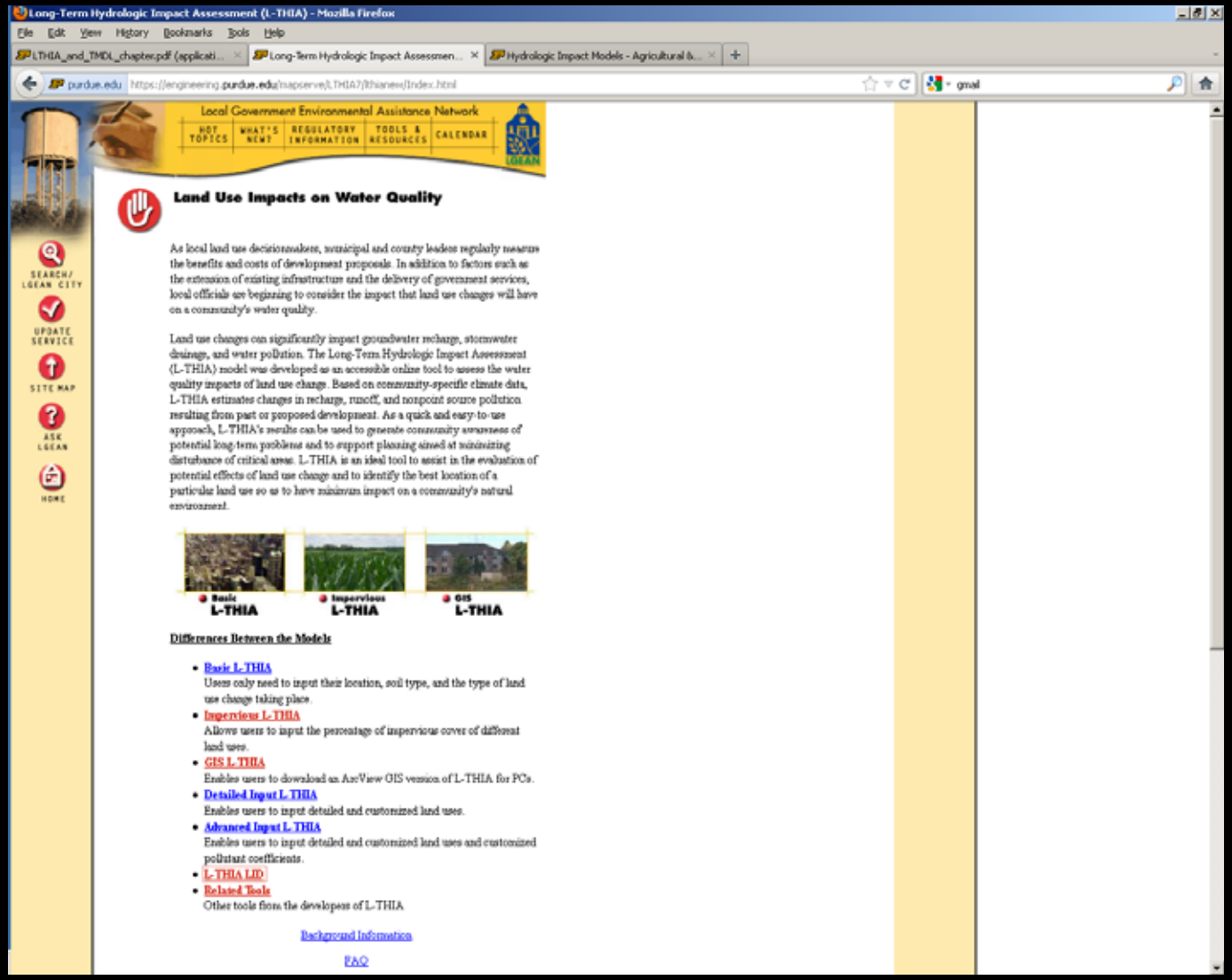
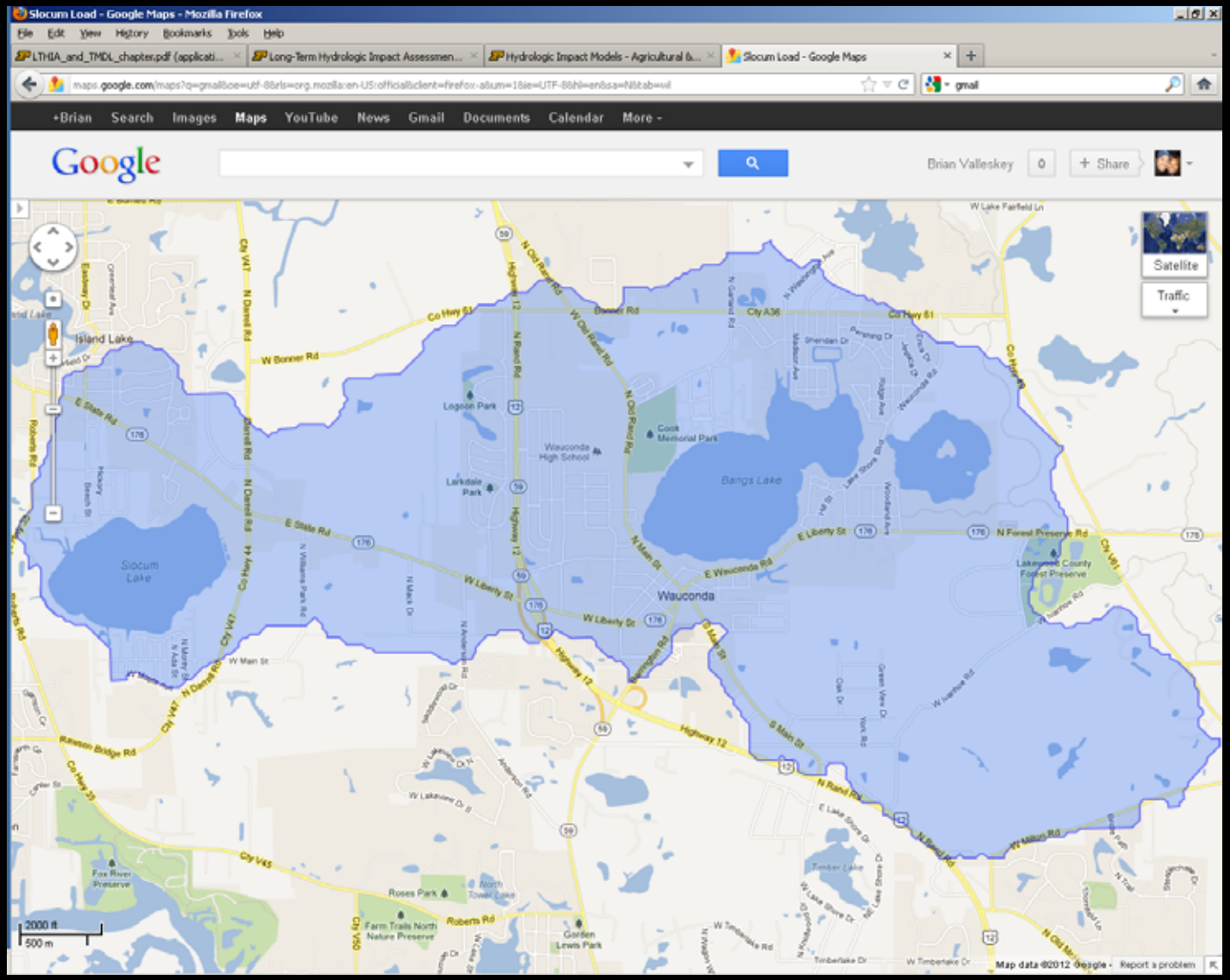
Long Term Hydrologic Impact Assessment (L-THIA) Model

- Estimates impact over 30 years of average annual precipitation events
- Supported through Purdue University
- Looks at annual events, not extremes
- Useful tool for estimating trends in water resources impacts and methodology for reducing these impacts
- Not a design tool
- https://engineering.purdue.edu/mapserve/LTHIA7/lthianew/Index.html

Understanding the Impact



Long Term Hydrologic Impact Assessment (L-THIA) Model



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Basis of Analysis

- L-THIA was used to determine the current status of common water resources impacts (sediment, phosphorus, and stormwater volume) to establish a baseline.
- Each of the lakes was viewed independently for side to side comparison but combined for total watershed impact.
- Two proposed scenarios were implemented as alternatives to current land use and stormwater practice.
  - Reduced impervious area percentage (%)
  - Reduced impervious area percentage (%) and application of BMPs.
- To simplify and focus the results, residential served as the land use of choice to isolate the study impact(s).

Watershed Breakdowns

Bangs Lake (4.7 mi^2)

- Water/Wetlands (471 ac)
- Commercial (94.3 ac)
- Agriculture (441.5 ac)
- HD Residential (221.8 ac)
- LD Residential (347.1 ac)
- Grass/Prairie (587.9 ac)
- Forest (806.1 ac)
- Industrial (21.1 ac)

Slocum Lake (3.8 mi^2)

- Water/Wetlands (241.2 ac)
- Commercial (126.4 ac)
- Agriculture (379.1 ac)
- HD Residential (208.3 ac)
- LD Residential (474.8 ac)
- Grass/Prairie (513.8 ac)
- Forest (423.8 ac)
- Industrial (88.5 ac)

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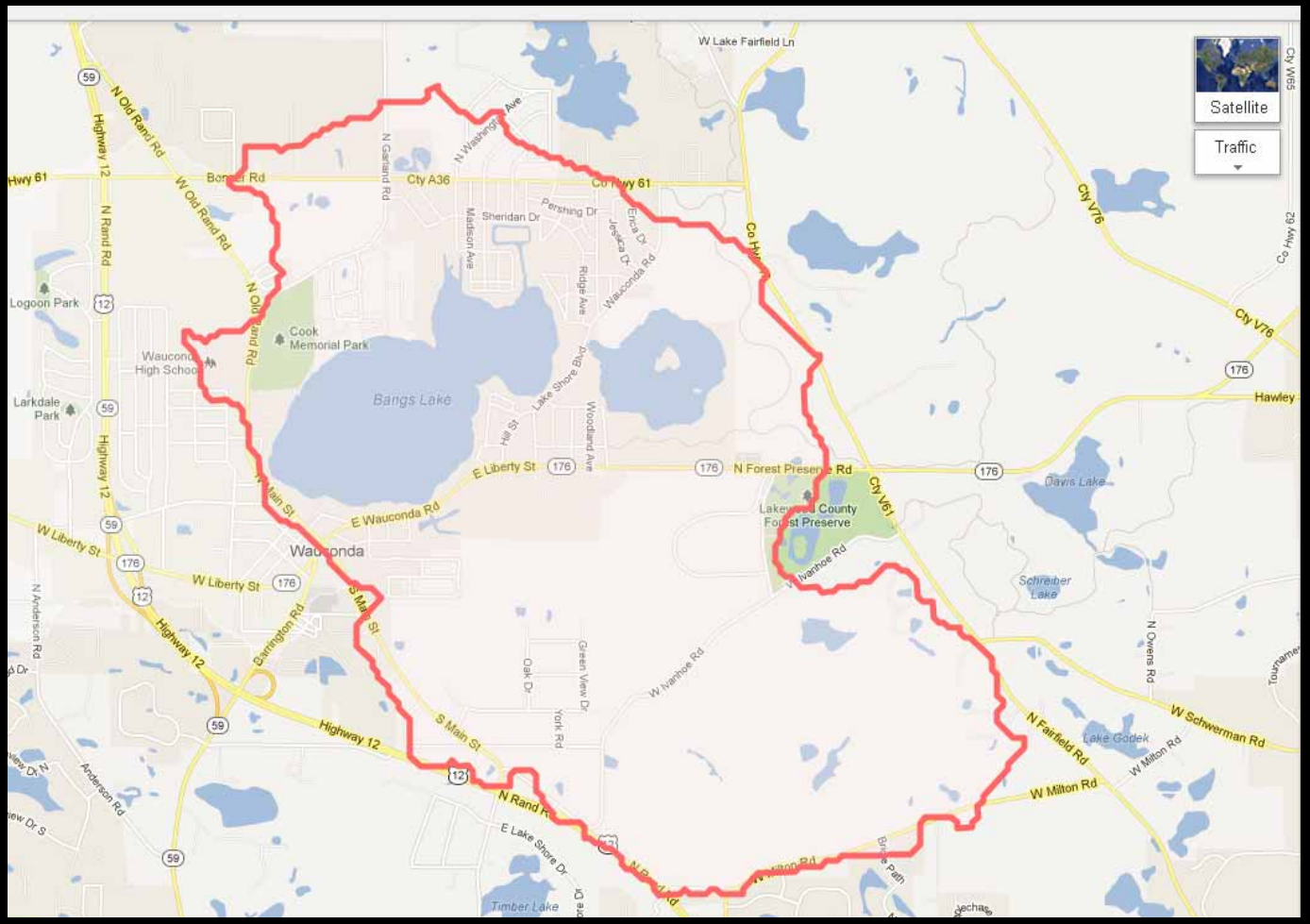
Bangs Lake Tributary



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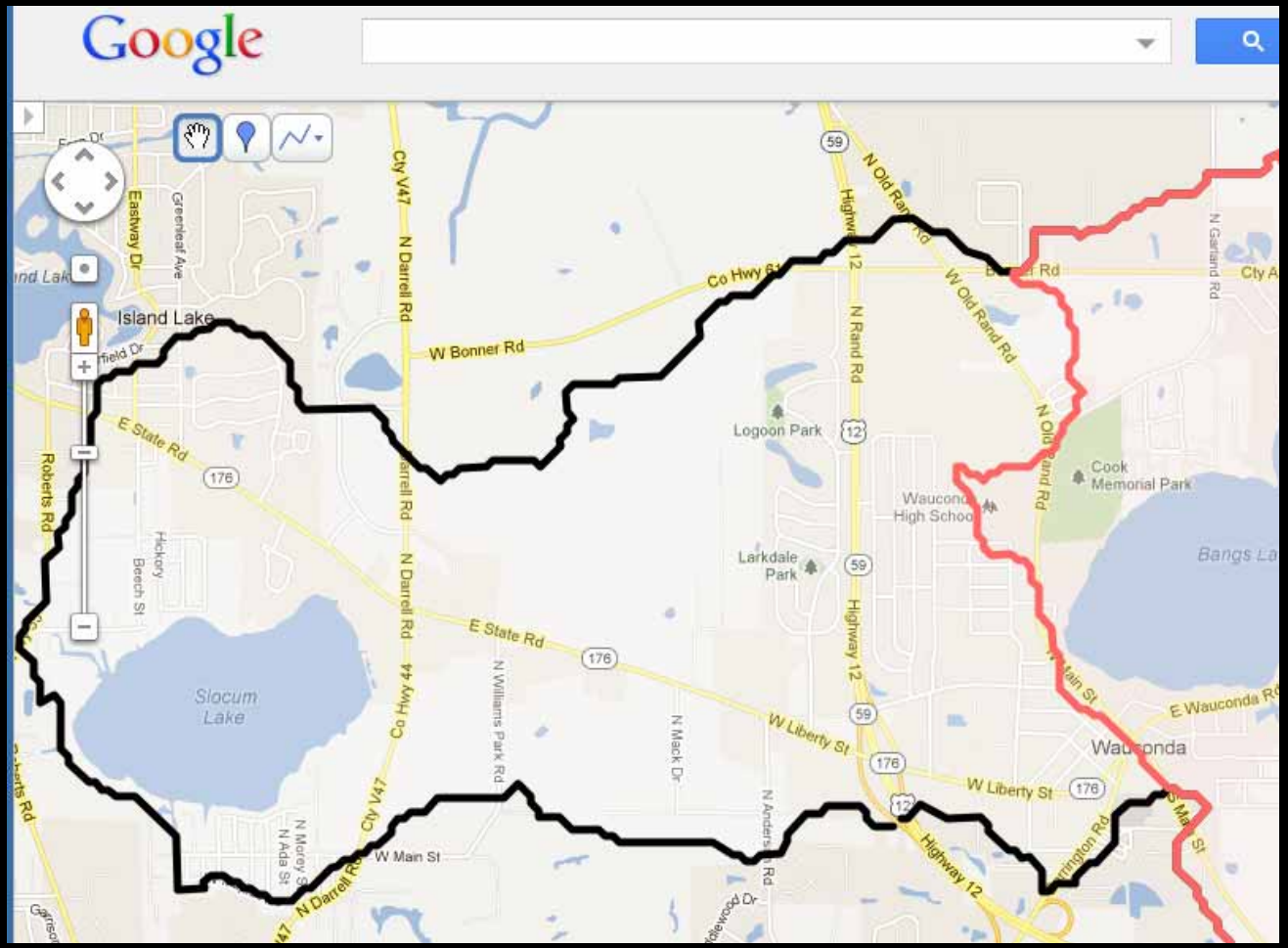
Slocum Lake Tributary



Existing Results (Residential Land Use Only)

Bangs Lake

HD Residential (221.8 ac)

- Phosphorus - 303 lbs
- Sediment – 10.9 TN
- Storm Volume - 193.6 ac-ft

LD Residential (347.1 ac)

- Phosphorus - 205.3 lbs
- Sediment – 7.4 TN
- Storm Volume – 131.3 ac-ft

Slocum Lake

HD Residential (208.3 ac)

- Phosphorus - 201 lbs
- Sediment – 7.3 TN
- Storm Volume – 127.7 ac-ft

LD Residential (474.8 ac)

- Phosphorus – 161.7 lbs
- Sediment – 5.8 TN
- Storm Volume – 102.9 ac-ft

Reference: 1 ac-ft of water = 325,851.4 gallons
Avg. annual household use = 127,400 gallons @350 gallons/day
Loss to avg. annual rainfall = 76,314,397.9 gallons

Water Resources

Alternate (Scenario 1)

- Propose to reasonably reduce the amount of impervious area dedicated to residential land use only
- Propose 10% reduction for HD residential (65% impervious) and 5% reduction of LD residential (25% impervious)
- HD residential now 55% impervious overall
- LD residential now 20% impervious overall
- No changes to any other land use practices in the Bangs/ Slocum Lakes watershed(s)

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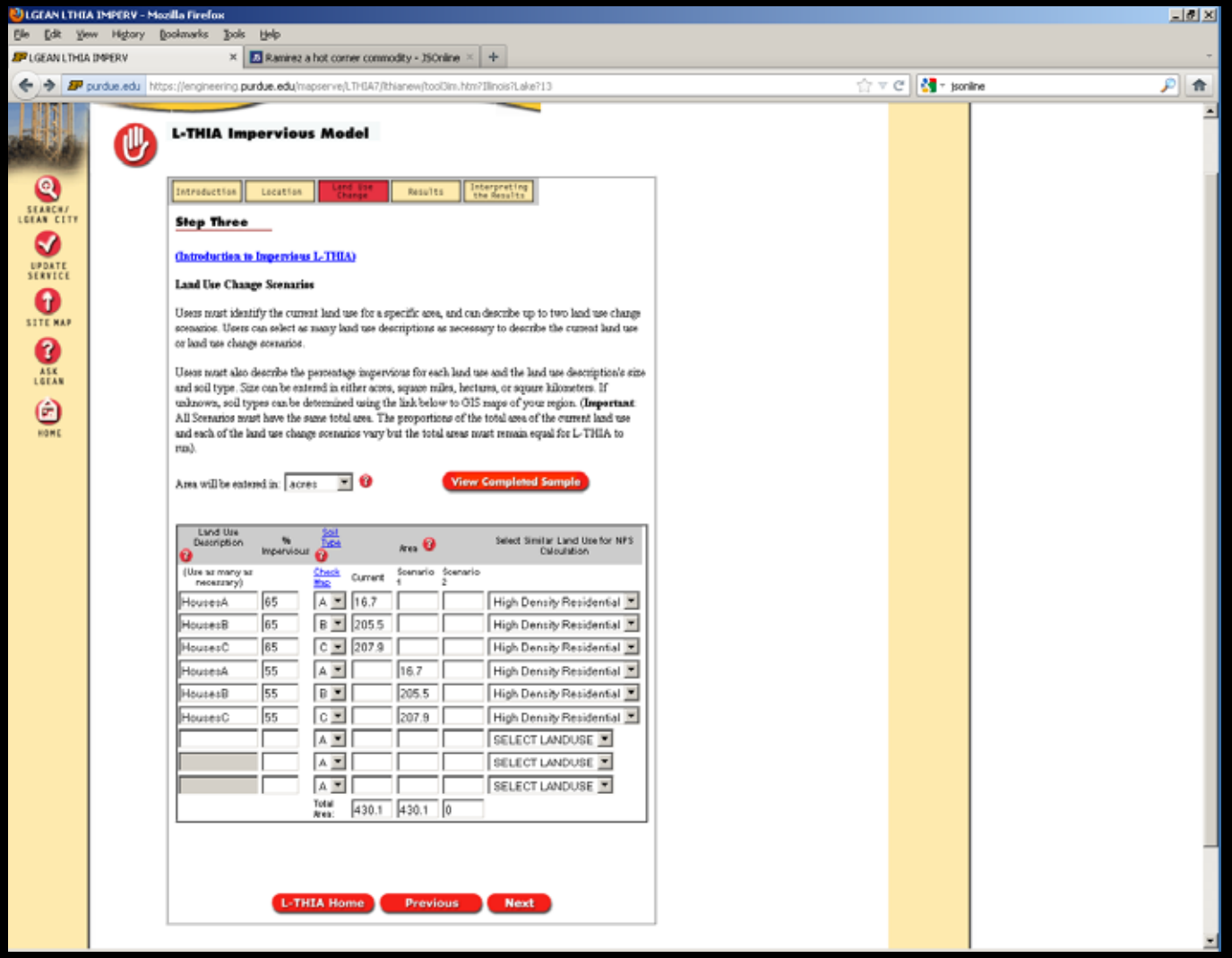
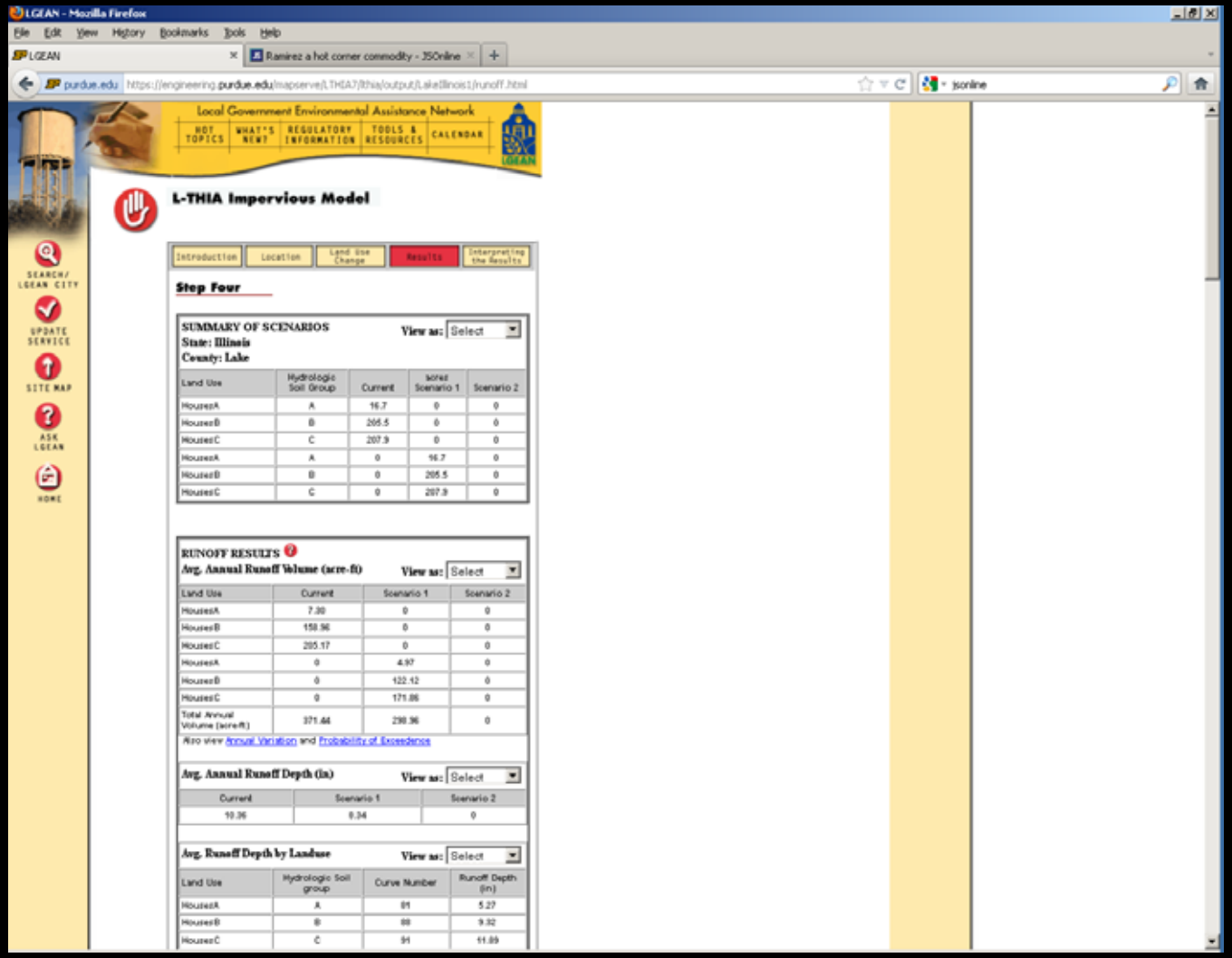
L-THIA Lives!

Impervious L-THIA Input



Impervious L-THIA Output



Scenario 1 – Combined Results

Bangs & Slocum Combined

Sediment
- Showed total reduction of 19%

Phosphorus
- Showed total reduction of 20%

Stormwater Volume
- Showed total reduction of 14%
- Equates to 77.7 ac-ft or 25,318,654 gallons or
- Annual use for nearly 200 households

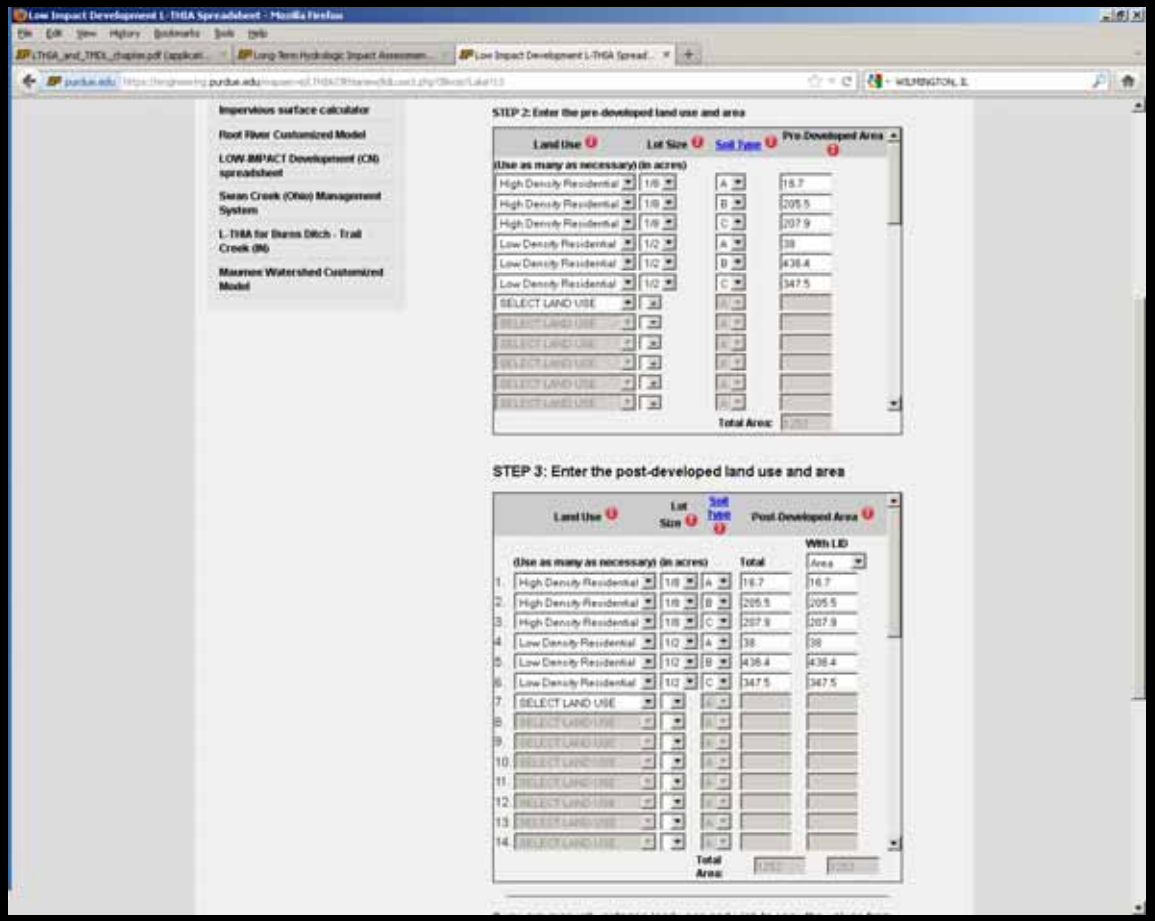
Reference: 1 ac-ft of water = 325,851.4 gallons
Avg. annual household use = 127,400 gallons @350 gallons/day
Loss to avg. annual rainfall = 76,314,397.9 gallons

Water Resources

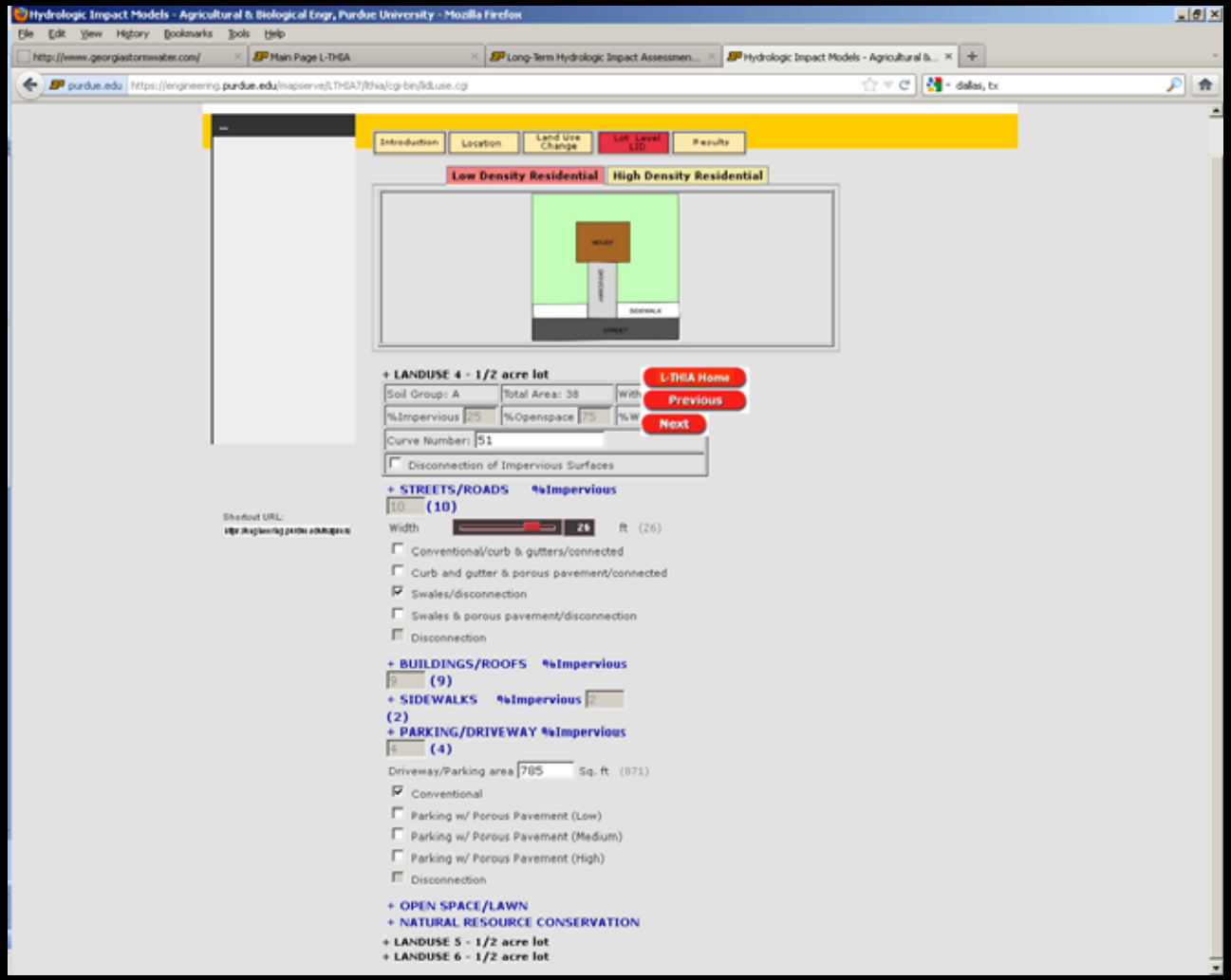
Alternate (Scenario 2) BMP Check

- Propose to reasonably reduce the amount of impervious area dedicated to residential land use only
- Propose 10% reduction for HD residential (65% impervious) and 5% reduction of LD residential (25% impervious)
- Add reasonable on-lot BMP practices in addition to 10% impervious reduction for HD residential
- Add reasonable on-lot BMP practices in addition to 5% impervious reduction for LD residential
- What is the additional benefit?

Data Input for Lot Level LID Screening



On-Lot Low Impact Model - LD



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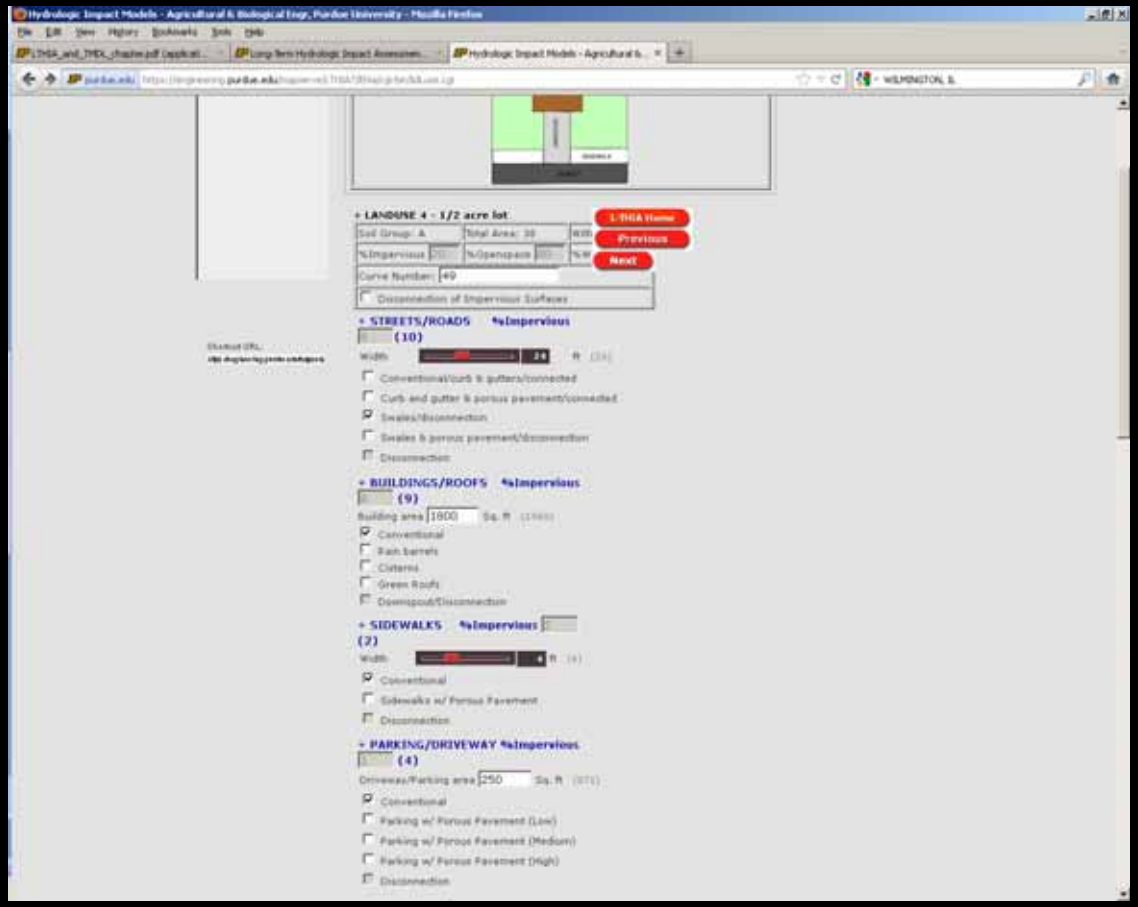
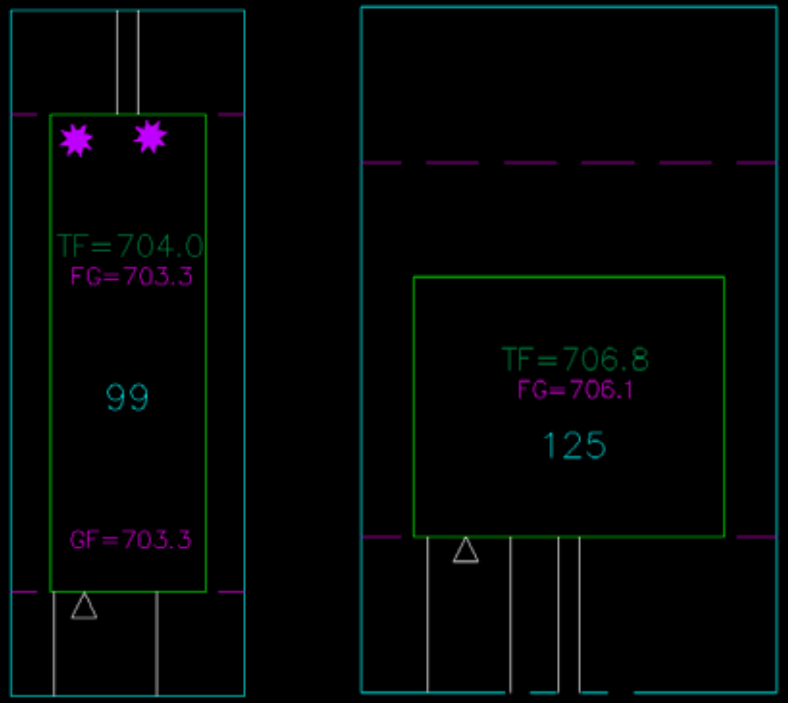
On-Lot Low Impact Model - LD



Example of Alternative lot configuration

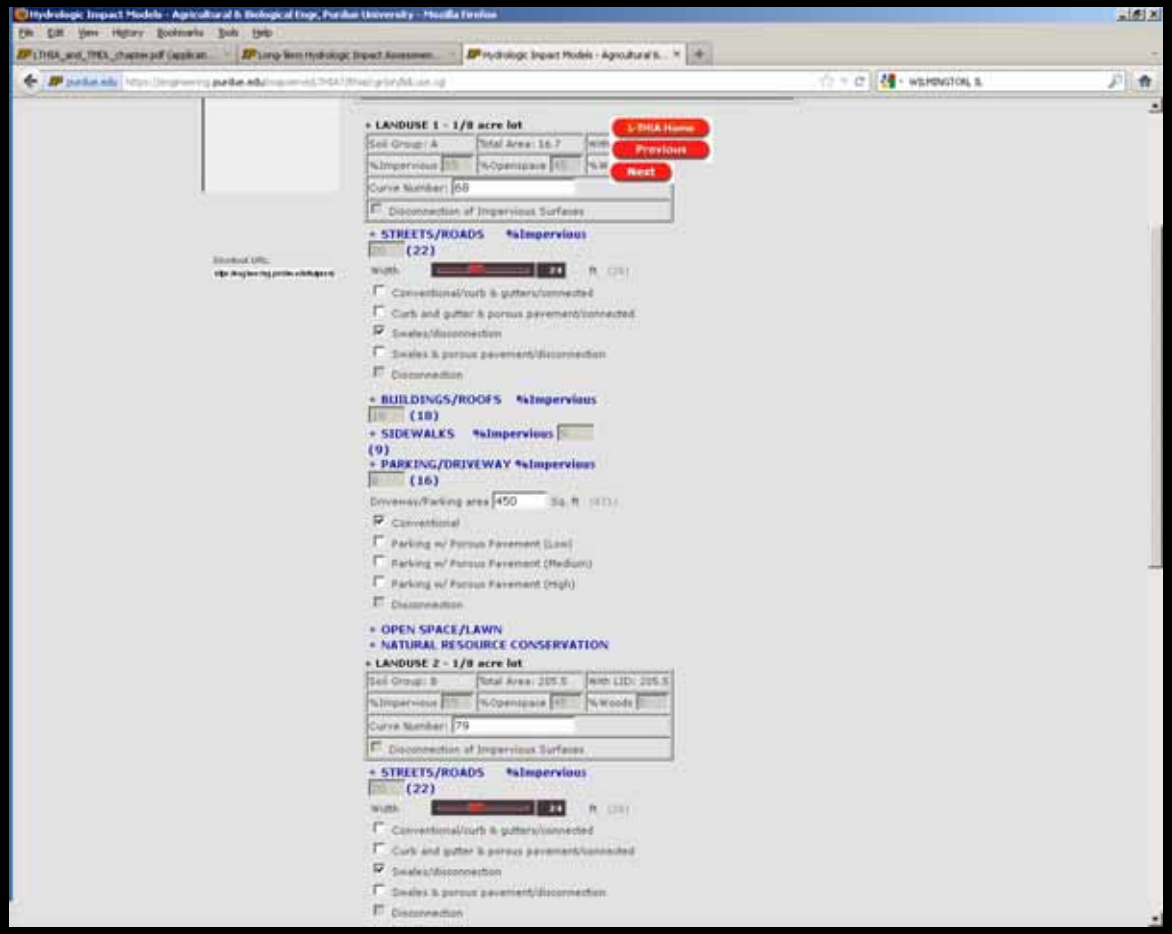


LID Conventional

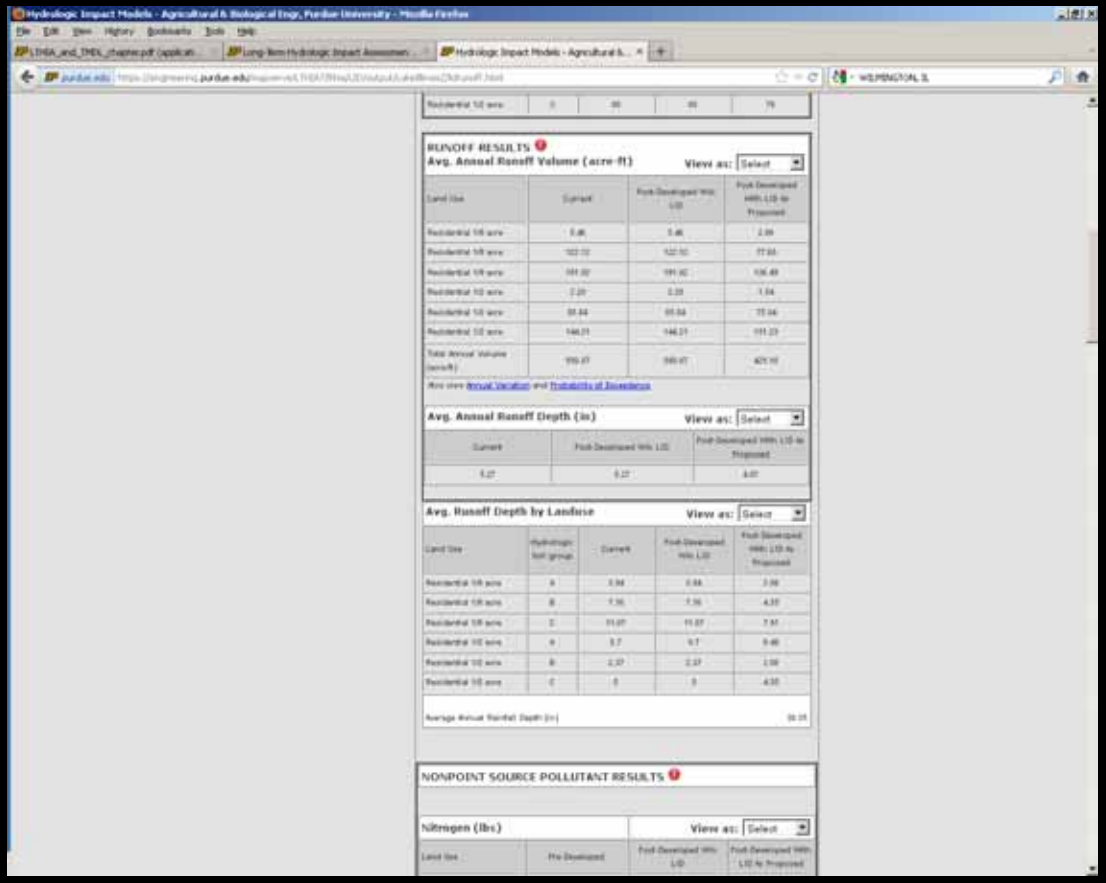
Reduced 10% Impervious footprint

Water Resources

On-Lot Low Impact Model - HD



On-Lot Low Impact Model - Results



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Scenario 2 Results

Bangs & Slocum Combined

Sediment
- Showed additional reduction of 4%, total 23%

Phosphorus
- Showed additional reduction of 3%, total 23%

Stormwater Volume
- Showed total reduction of 9%, total 23%
- Equates to 127.6 ac-ft or 41,578,638 gallons or
- Annual use for nearly 327 households

Reference: 1 ac-ft of water = 325,851.4 gallons
Avg. annual household use = 127,400 gallons @350 gallons/day
Loss to avg. annual rainfall = 76,314,397.9 gallons

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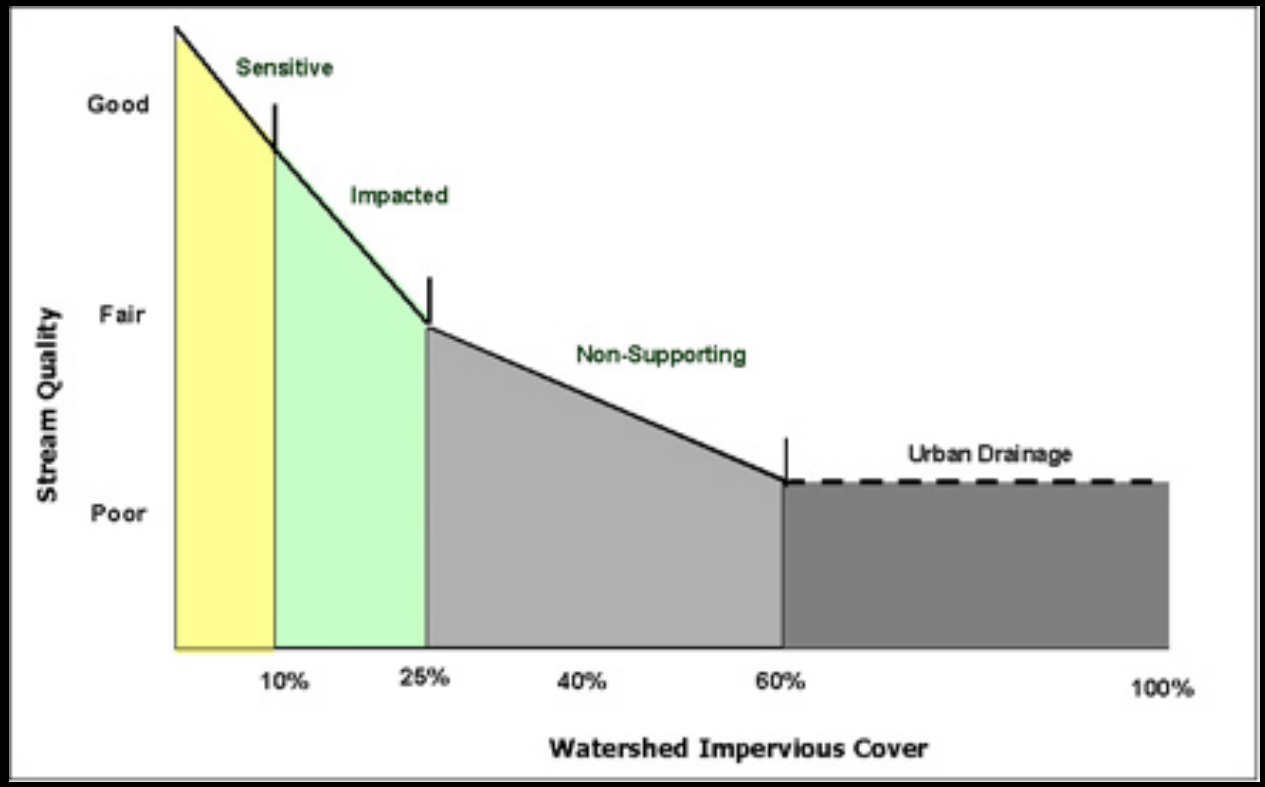
Water Resources

Why is this important?

- The impact of sediment and phosphorus to most is obvious – nuisance sediment and phosphorus is associated with the eutrophication of lakes, Slocum is listed as hyper-eutrophic
- Water Supply – Stormwater mismanagement and hydrologic alteration are partially to blame for water resources shortages
- Flat average of the cost of Wauconda to re-route Lake Michigan water due to depletion of the shallow groundwater well range from $25.5 – $46 M
- Keeping stormwater volume where it falls is important.

Impervious Area Impacts

How are we doing?



Center for Watershed Protection, 2000

Water Resources

Impervious Area Impacts

- Basinwide average puts the Bangs/Slocum Lake watershed in the range of 10% - 25% (impacted)
- Various portions of the watershed impact stream segments more adversely than others, exceeding 25% and nearing 90%

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Water Resources

The Future Looks Dark?

- No the future looks GREEN !
- While the scenarios presented today are unlikely to occur in unison, they present insight into stormwater being a solution rather than a nuisance
- Research done in other parts of the country and the world have implicated green infrastructure and Low Impact Design (LID) as a key component surface and groundwater protection and replenishment
- The following are simple examples:

Rethinking Our Values

traditional

Proposed option

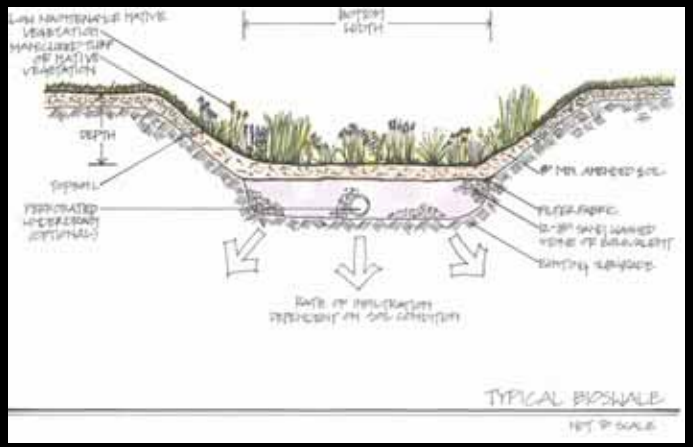
traditional

Proposed option

Water Resources

Physical BMPs - Bioswale

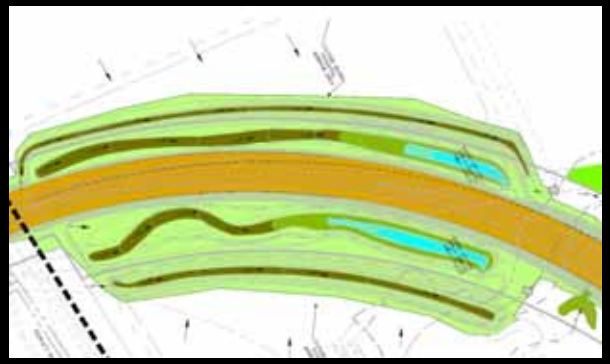
- A swale or vegetated swale IS NOT a bio-swale
- May serve as conveyance much like storm sewer
- Differ in that Bioswales typically have an amended soil or porous media added



BIOSWALES

Physical BMPs - Swale

- A swale relies heavily on vegetative cover and Stoke's Law to remove pollutants and reduce stormwater volume
- Swale conveyance is cheaper than storm sewer by as much as 80%



TYPICAL SWALES

CenterPoint Intermodal, Joliet

Water Resources

Physical BMPs – Depressed Median

- Relies on the same concepts as a swale; however provides a better landscape space than traditional “mounding”
- Landscape debris no longer washes away
- Provides landscaping more readily available water source
- Often used in combination with Curb Cuts

Depressed Median

Water Resources

Physical BMPs – Bioretention/Rain Garden

- Key components focus on trapping water, infiltration and evapotranspiration
- Can work well in conjunction with an underdrain
- Relies on a matrix of soil and plants to serve as a filter for pollutants.

Bio-retention

Physical BMPs – Filter Strip

- Prairie can withstand the 100yr, 24hr storm producing no stormwater runoff
- Plants attract wildlife, promote infiltration, anchor soil
- Reduces the cost of detention basin maintenance, requires no fertilizer once established and is cheaper to maintain than turf grasses.

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Water Resources

Questions? –THANK YOU!

Is it not in our best interests to adhere to better stormwater practices to protect water resources for future generations?

Brian Valleskey, CFM
4 Lakes Watershed Initiative
Water Resources Specialist
Manhard Consulting, Ltd.
900 Woodlands Pkwy
Vernon Hills, IL 60061
847-325-7224