L-THIA:
Long- Term Hydrologic Impact Assessment

Purdue University
U.S. Environmental Protection Agency
ICMA

L-THIA:
Long- Term Hydrologic Impact Assessment

Importance of Long-Term Hydrologic Impact Assessment:

- Expansion of urban areas significantly impacts the environment in terms of ground water recharge, water pollution, and storm water drainage.
- Urbanization leads to creation of impervious surfaces which lead to an increase in surface runoff volume, this in turn contributes to downstream flooding and a net loss in groundwater recharge.
- Minimizing the disturbance on an urbanizing watershed is one way of ensuring continued water supply.
- Since each land use has a different level of impact, careful physical planning can minimize these impacts.

(L-THIA Documentation)

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Importance of Long-Term Hydrologic Impact Assessment:

- Assessment of the hydrologic impacts of urban land use change traditionally includes models that evaluate how land use change alters peak runoff rates, and these results are then used in the design of drainage systems.
- Such methods however do not address the long-term hydrologic impacts of urban land use change and often do not consider how pollutants that wash off from different land uses effect water quality.

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Importance of Long-Term Hydrologic Impact Assessment:

- Techniques traditionally used to assess the impacts of land use change on runoff typically focus on individual short-term "design" storm events of specific recurrence intervals, and are used to calculate peak discharge rates and hydrographs.
- Single storm methods are suitable as engineering approaches in estimating flood intensities for stormwater facilities management, they do not address the long-term, cumulative hydrologic impacts of land use change.

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L-THIA Overview:

- L-THIA provides “what if” modeling scenario to evaluate suitability of alternative site scenarios
- Developed to provide easy-to-use tool in assessing the long-term impacts of land use change
- Makes use of information that is readily available from municipal databases

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Purpose:

- An analysis tool to provide estimates of changes in runoff, recharge and nonpoint source pollution resulting from past or proposed land use changes.
- Creates long-term average annual runoff for a land use configuration, based on actual long-term climate data for that area
- Focuses on average impact, rather than an extreme year or storm
- L-THIA results do not predict what will happen in a specific year

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Purpose:

- Quick and easy approach - L-THIA results provide insight into relative hydrologic impacts of different land use scenarios
- Results used to generate community awareness of potential long-term problems & to support physical planning aimed at minimizing disturbance of critical areas
- Important tool to assist in evaluating potential effects of land use change & to identify best location of a particular land use, thus having minimum impacts on natural environment

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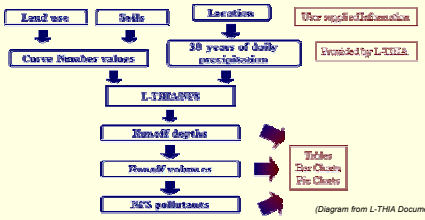
How L-THIA Works:

L-THIA is based on computations of daily runoff obtained from long term climate records, soil data, CN value and land use of the area. By applying the method to actual and planned (zoned) urban developments the long term effects of past, present and future land use can be determined.

The basic information required for the model is:



(Diagram from L-THIA Documentation)

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Methodology:

- Uses Curve Number (CN) approach
- Yearly runoff is predicted using 30 years of precipitation data
- Antecedent Moisture Content (AMC) in the soil, is estimated by precipitation data - the CN is adjusted in accordance with the changes in AMC
- Nonpoint Source (NPS) pollution is estimated by the Event Mean Concentration (EMC) data

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Developed by:

- Purdue University
- US Environmental Protection Agency
- ICMA

Website:

http://www.ecn.purdue.edu/runoff

Versions Available:

- Web-based Version – online data input / output
- ArcView 3.x Extension
- Web-based Interactive Mapping

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Web-based Version:

Spreadsheet application that models runoff and nonpoint source pollution change

Several Input Options:

- Basic Input
  http://www.ecn.purdue.edu/runoff/lthia/basic_input.htm
- Detailed Input
  http://www.ecn.purdue.edu/runoff/lthia/detailed_input.htm
- Advanced Input
  http://www.ecn.purdue.edu/runoff/lthia/advanced_input.htm
- Impervious Input
  http://www.ecn.purdue.edu/runoff/lthia/impervious_input.htm

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Web-based Version - **Basic Input:**

http://www.ecn.purdue.edu/runoff/lthia/basic_input.htm

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Web-based Version - **Detailed Input:**
http://www.ecn.purdue.edu/runoff/lthia/detailed_input.htm

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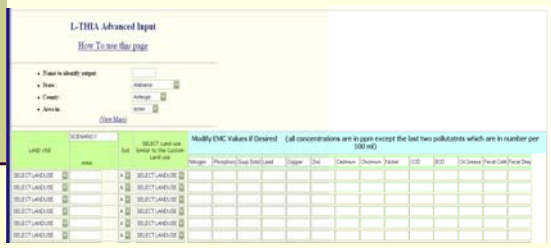
Web-based Version - **Advanced Input:**
http://www.ecn.purdue.edu/runoff/lthia/advanced_input.htm



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Web-based Version - **Impervious Input:**
http://www.ecn.purdue.edu/runoff/lthia/impervious_input.htm

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Hydrologic Soil Groups

Soils are classified by the Natural Resource Conservation Service into four Hydrologic Soil Groups based on the soil's runoff potential. The four Hydrologic Soils Groups are A, B, C and D. Where A's generally have the smallest runoff potential and Ds the greatest.

Group A is sand, loamy sand or sandy loam types of soils. It has low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sands or gravels and have a high rate of water transmission.

Group B is silt loam or loam. It has a moderate infiltration rate when thoroughly wetted and consists chiefly or moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures.

Group C soils are sandy clay loam. They have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine structure.

Group D soils are clay loam, silty clay loam, sandy clay, silty clay or clay. This HSG has the highest runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface and shallow soils over nearly impervious material.

(L-THIA Documentation)

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ArcView 3x Extension
Automates runoff impact modeling

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Web-based Interactive Mapping
Allows user to map an area of interest within a web browser.

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Data Sources:

- Location in terms of State and County which is to be selected from the list available on the 'input' page of L-THIA. This is used to select local climate data stored in the database. It is used in the analysis.
- Area under past, present and future land uses. This can be obtained from paper or digital maps. Satellite images and air photos can be used to determine the land uses.
- Hydrologic Soil groups for land use areas. These can be obtained from the standard soils data layer in GIS or from your local Soil and Water Conservation District (SWCD).

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Limitations of L-THIA:

- The SCS CN method, which is a core component of many traditional hydrologic models, has been used in a straightforward simple fashion to assess the long term hydrological impacts of land use change.
- With the intention of minimizing the complexity of the SCS CN method certain elements were simplified by:
  - Neglecting the contributions of snowfall to precipitation
  - Neglecting the effect of frozen ground that increases stormwater runoff during cold months
  - Neglecting variations in antecedent moisture conditions
- These simplifications are necessary to keep the technique straightforward and accessible but could be removed if a more sophisticated analysis was required.

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Limitations of L-THIA:

- L-THIA has been developed as a tool to assess the long term impact that changes in land use have on hydrology of an area. It is to be used with data that is readily available to planners and decision makers. It is not meant to assess the details for requirements of a storm water drainage system and other such urban planning concerns