LEAM FAQ – March 2003

What is LEAM?

LEAM, the Land use Evolution and Impact Assessment Model, is a simulation modeling system that helps predict specific encroachment on military installations 30-50 years into the future. Regional planners use LEAM to project and compare alternative futures land use management scenarios based on different combinations of land development policies and investments. These futures are then evaluated with respect to the changes in military installation training and testing alternatives.

Who Developed LEAM?

The initial work that led to the development of LEAM was funded by the National Science Foundation to a group of researchers at the University of Illinois in the departments of Urban and Regional Planning (Dr. Varkki George) and Landscape Architecture (Dr. Brian Orland). Dr. Brian Deal oversaw execution on the project. Followon funding was provided by the Strategic Environmental Research and Development Program

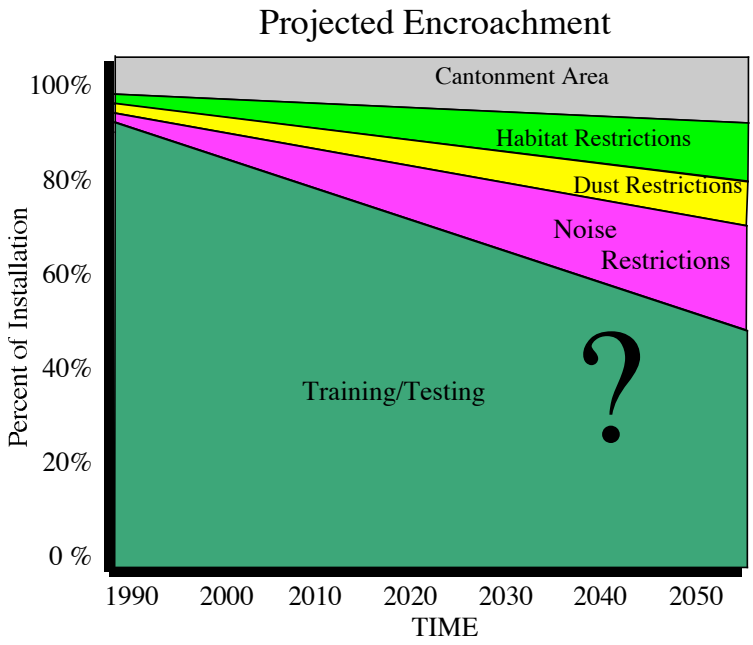
So, LEAM is a single program?

LEAM is a system of software. A GIS is used to develop and prepare digital maps. A spatially explicit simulation modeling system is used for the Land Use Change. Model. Economic projection models are used to determine the land use requirements for the region. A transportation model is used to generate travel-time maps for input to the Land Use Change model. Various GIS-based land use analysis tools and models help evaluate the impact of land patterns on social, economic, ecologic, and military aspects of the region. Web site development tools are typically used to capture and present results to stakeholders.

What development policies can be tested?

Public policies and investments that drive land use changes, which LEAM can test include:

- Investments in major highway construction?
- County and city zoning policies.
- Land ownership patterns?
- Development of parks, forests, preserves, and other open areas.
- Local growth policies and investments.
- Water availability.
- City investments in utility construction.
- Protection of sensitive lands.



How does land use change simulation work?

There are two primary steps. First, land use change is predicted and then the impact of predicted land use patterns on the opportunity to use military installation land is evaluated. LEAM is raster GIS based using a resolution of 30-meters. The core of LEAM is a land use change model that runs in each 30-meter grid cell and is driven by information from a set of GIS input maps. Projected land use change is then evaluated using GIS-based analysis tools and models to estimate associated changes in the opportunities to use military lands.

How does land use change affect military training/testing in LEAM?

Residences and businesses located near military installations expect and demand certain rights with respect to noise, dust, smokes, and views. Training and testing opportunities can be changed based on these demands and associated complaints. LEAM helps predict such complaints and demands.

Land use change changes the value of surrounding lands for different uses – resulting in further land use changes. The adjacent communities can eventually view military installation land as more valuable for commercial, industrial, or residential land uses. Eventually, portions of an installation may be sold to accommodate more valuable uses.

Destruction of natural habitat in the regions surrounding military installations can result in increasing proportions of regional habitat on the installation. This can result in public pressure to constrain training/testing to protect remnant populations of certain species and associated habitat.

LEAM models and analyses help predict resulting future pressures to limit the full use of military lands.

Will LEAM run on my computer?

No. The basic unit of analysis is a 30-meter square grid cell. The land surrounding an installation can be composed of 10 or more million cells. To run LEAM land use change models much more computer memory is required than is typically available on office computers. LEAM runs on a number of supercomputers that allow for making many runs in a very short time. Small areas can be run on personal computers and this is typically done in the process of initial testing. The land use change model requires a Unix-based operating system.

What are the LEAM inputs?

Population Projection

Population projections are available from the U.S. Census Bureau at http://www.census.gov/population/www/projections/popproj.html. This data provides population projections from 2000 to 2025 by state. These projections are broken down to a county level using current county population estimates and growth trends.

National averages (also available from the Census Bureau) are used within the model including:

a. average household size in region (national average is currently 2.61)
b. definitions of high density and low density residential land use in terms of households/cell
c. average dwelling unit sizes and typical distribution of new construction (percentages of small, medium, large, multiunit, etc)

GIS Data Requirements

Several different GIS type maps are required. This data is generally available from federal agencies but state data may also be required.

Land Cover Maps

Land Cover maps are available from the USGS (http://landcover.usgs.gov/nlcd.html). The maps are in a raster format and provide land cover using the National Land Cover Data (NLCD) classification system. The maps are available at 1:24,000 scale and 30-meter spatial resolution.

Digital Elevation Maps

DEM maps are also available from the USGS (http://edc.usgs.gov/geodata/). The files are in Spatial Data Transfer Standard (SDTS) format. Data is at 1:24000 scale and 30-meter spatial resolution.

Boundary Maps

County, township, and Urban Area/Urban Cluster (UA/UC) maps are required. These are available from the U.S. Census Bureau (http://www.census.gov/geo/www/ua/ua_2k.html). In addition population data for urban areas is required and available from the website.

Road Network Map

Road networks are available from the U.S. Census Bureau (http://www.census.gov/geo/www/tiger/). Included with these maps are a classification code designating interstate, US route, state route and county roads. A scale of 1:24,000 is preferred. Ramp information for limited access roads must also be included.

Ownership Property Map

These areas represent areas that may be unavailable for development because of long-term government control for example Parks, Nature Preserves, Military Bases, Federal Lands, and Indian Reservations. This information is available from a variety of organizations including USGS, DoD, BLM, etc.

Floodplain Map

Development is restricted from floodplains. Flood Hazard Boundary Maps are available from FEMA (http://web1.msc.fema.gov/).

What does the LEAM modeling team do?

Data Collection

Basic population and economic projection information and GIS data representing at least the current regional landscape is collected. If calibration of the Land Use Change Model is required, historic land use patterns must also be collected. Where possible, freely available federal and/or state data is collected.

Spatial Data Analysis

The collected data must first be combined into a single data set that uses the same coordinate system. Based on local road networks and major employment centers, a traffic analysis must be completed to create a driving-time map. All maps must be checked to ensure that expected category values are used.

Modify the Land Use Change Driver

The Land Use Change Model may be modified to add analysis components needed to address specific local land use change processes or to remove processes that don't locally matter.

Integrate the Model Drivers

If land use change drivers have been added or subtracted, they must be combined in software to create a specific model for the local landscape.

Calibrate the Model Drivers

There are about a dozen specific reasons in the land use change model that drive land use change. The importance of these reasons must be appropriately weighted. Weightings can be borrowed

from calibrations developed for other areas or they may be statistically generated through an analysis of locally specific land use trends.

Capture customer identified land use policy and investment scenarios

The core purpose of LEAM is to test alternative land use policies and investments. These are captured by the LEAM software team in the form of GIS maps that represent associated potential growth opportunities. For example, investments in new or improved highways is captured in existing transportation maps that are analyzed with a transportation analysis package to generate a new travel time map. Zoning decisions are captured in maps that limit the location of specific growth. Agriculture or habitat protection policies can be similarly captured. It is possible to phase-in policies over time and this can be accomplished by reading maps during simulation runs.

Run scenarios

Scenarios may be run on small parts of the entire area for basic test purposes using a personal computer. Once the operator is satisfied with the operation, the full area can be run on an available super computer at a Major Shared Resource Center.

Evaluate the impacts on installation mission

Finally, projected land use patterns can be evaluated with respect to planned military installation training/testing schedules. Or, they may used to generate installation training/testing constraint maps based on the potential for complaints associated with noise, dust, and smokes.

Develop Web-based output viewers

Scenarios and scenario analyses may then be captured on Web sites and document reports for communication to customers and stakeholders.

What does the customer do?

Assist with initial data collection

In many cases locally developed and available information should be collected and used. This includes historic, current, and future (planned) maps.

Evaluate preliminary model runs

To ensure that results are understandable and reasonable, the customer must evaluate early model runs.

Involve stakeholders

LEAM is a tool for testing proposed public policies and investments. The customer is therefore involved with a public discussion that is generating scenarios that LEAM will help evaluate.

Develop land use policy and investment scenarios

Based on the public debate a variety of suggestions will be put forward. Many of these will be readily dismissed through discussion and a number will require further detailed scrutiny. The customer will help the LEAM modeling group capture certain scenarios as LEAM inputs.

When should I use LEAM?

LEAM should be used by a military installation when 1) there is clear danger that over the next 3-5 decades regional urban growth will seriously threaten the ability of the installation to support a military mission and 2) the installation is participating in guiding regional growth to minimize that impact.

What are alternatives to LEAM?

For comparing the encroachment factors across many installations, comparison of regional population and economic projections, proximity of growth centers, and other indicators should be used. This is relatively inexpensive and much of this work has been accomplished in support of the BRAC 2005 decisions. Simple GIS analyses can be used to get a more detailed local view of factors that affect urban growth. Such an analysis can be used to indicate the need for conducting full LEAM analyses.

What do LEAM simulations cost?

- Step 1: Data collection, base model development, and initial output reports for urban growth. Costs can range from $20 - $40K.
- Step 2: Land use change scenario analysis. This involves detailed customer consultation, collection of specific information, and development of inputs to reflect alternatives, model runs, and development of model output reports. Costs per scenario can cost about $5K each.
- Step 3: Military impact analyses. Base analyses to estimate changes in noise, dust, and smoke restrictions can cost about $5K. Evaluation of habitat fragmentation and loss and resulting pressures to preserve on-installation habitat can cost $5K for a basic analysis and $20K for detailed analyses for specific local species.

Step 4: Development of a web site to share analysis results with stakeholders costs about $15K.