# Seeking Balance in Land-Use Planning: **Using the Land-Use Conflict Identification Strategy to Explore Land-Use Futures**

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Land-use policies result in patterns of land use, sometimes predictable, sometimes unintended. The Land-Use Conflict Identification Strategy (LUCIS) provides a foundation for exploring multiple visions of future land use to demonstrate the spatial ramifications of land-use policies. In the near term, the cumulative effect of individual land-use decisions is impossible to grasp. By taking the long view and developing alternatives, the longer-term effects of land-use policies can be explored.

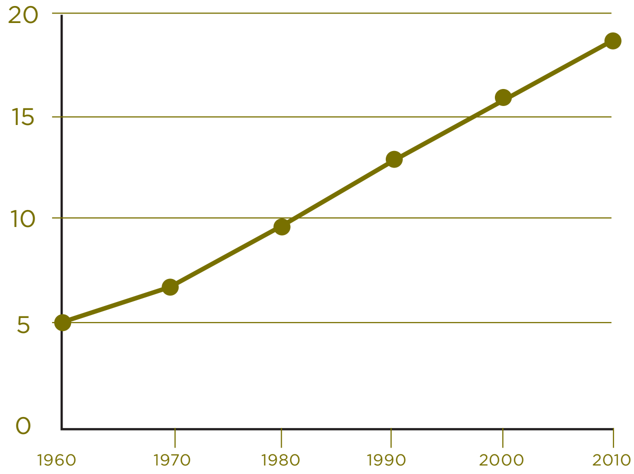
Developed in the State of Florida, USA, in response to rapid population increases and associated land-use change, the LUCIS approach employs cell-based geographic information systems (GIS). In the last 50 years, Florida's population growth has primarily been driven by net immigration, nearly tripling from 4,951,560 in 1960 to 18,801,310 in 2010 (U.S. Census Bureau) (Fig. 1). The highest decadal rate of change for this period occurred between 1970 and 1980 at close to 50 percent (Fig. 2). And though the rate of change continues to decline, the rise in absolute population remains vigourous. This growth, combined with a pervasive pattern of low-density development, has led to the conversion of hundreds of thousands of acres of native habitat and productive agricultural land into a mostly suburban landscape. Yet even though the net effect statewide has been monumental, most would say that they simply cannot fathom the long-term effect of the incremental change happening all around them. Looking forward, with population growth projected to continue, what might the state look like in another 50 years? Out of this reality, the LUCIS tool and process of developing alternative land-use futures was born. With population growth in other parts of the globe projected to be comparable or even greater than that of Florida, the potential is there for LUCIS to assist with visualising the physical dimensions of land-use change in those regions too.

## Steps in Developing Alternative Futures

To develop a single alternative future for a study area, there are five steps to follow, as outlined in Figure 3. The second and third steps form the portion of the process known as LUCIS.

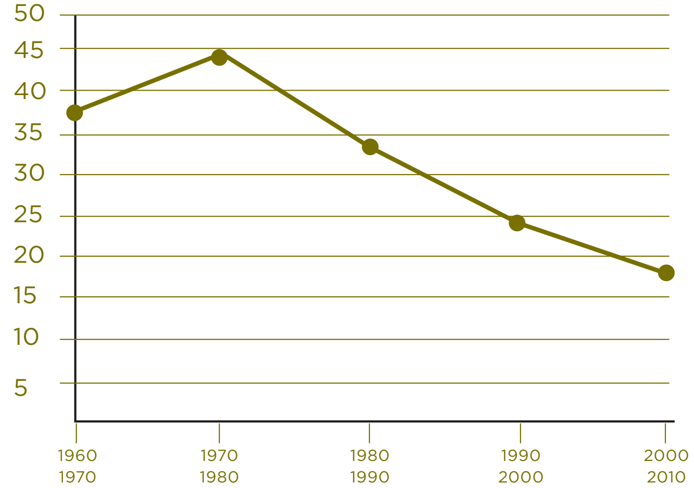
First, the study time horizon (e.g., 25 years, 50 years, …) is established and the additional population to be added to the area in that time frame is determined. Population projections can be derived from determining trends, as is done by most census-taking bodies or by simply agreeing on the population changes to be tested through the development of alternative scenarios.

Second, analyses of land-use suitability are completed for each land-use type of interest. For the work done in Florida, generally three land-use types were analysed: agriculture, conservation, and urban. The urban type is comprised of all land uses found in the urban landscape, including residential, commercial, industrial,




1

Florida Population Data (U.S. Census Bureau)




2

Rate of Population Change Expressed in Percentage by Decade of Florida (U.S. Census Bureau)

institutional, and urban open spaces like parks, plazas, and golf courses. In one area of the state with large areas of phosphate deposits, the suitability for mining was also analysed.

Such a process of suitability analysis is driven by a set of carefully constructed criteria. For example, the suitability for urban use might include analysis based on the land's proximity to roads, utility infrastructure, existing areas of urban development, mass transit, and bike routes. Similar criteria are developed for each land-use type to be analysed. To complete step two, the suitability results for each land-use type are assigned to one of three values of low to high suitability shown in Table A.

Third, to map conflict, the results of the suitability analyses are combined so the results of each can be compared simultaneously. The technique employed for this purpose in LUCIS is simple, yet

| Classification of Suitability Analysis Results | Suitability Value |
|---|---|
| High suitability for the land-use type | 3 |
| Moderate suitability for the land-use type | 2 |
| Low suitability for the land-use type | 1 |

A

Values Assigned Through Suitability Analysis for Each Land-Use Type

elegant. The suitability results for each cell for each land-use type are combined using the simple numerical 3 to 1 schema. If there are three land-use types being combined, they are placed in alphabetical order, for example, "agriculture", "conservation", then "urban". The results for agriculture are multiplied by 100, the results for conservation are multiplied by 10, and these values plus the original value for urban are summed up in a three digit number, with the value of each digit representing the

| Category | Suitability Values | Area in Acres | Percent of the study area |
|---|---|---|---|
| Agriculture/ conservation conflict | 331, 332, 221 | 374,292 | 8.03 |
| Agriculture/ urban conflict | 313, 323, 212 | 331,312 | 7.10 |
| Conservation/ urban conflict | 133, 233, 122 | 81,665 | 1.75 |
| Major conflict (Conflict among all three land-use categories) | 333, 222, 111 | 373,610 | 8.13 |
| Areas of no potential conflict | 321, 322, 311 312, 211, 231 232, 131, 121 132, 123, 223 113, 112, 213 | 1,716,874 | 36.83 |
| Existing urban areas (mapped as part of the development mask) | N/A | 568,746 | 12.20 |
| Existing conservation areas (mapped as part of the development mask) | N/A | 967,275 | 20.75 |
| Areas of open water (mapped as part of the development mask) | N/A | 247,329 | 5.31 |
| TOTAL | N/A | 4,661,103 | 100.00 |

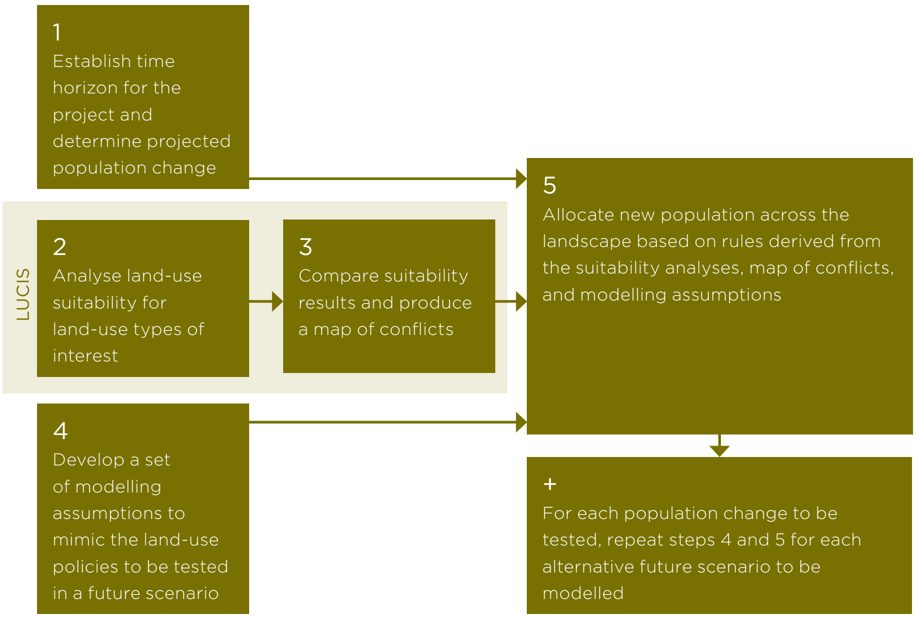
B

Reclassification of the Results for Agriculture, Conservation and Urban Suitability Analyses Into Areas of Potential Land-Use Conflict for an Area of North Central Florida, USA (Carr and Zwick 2007, 160)

| Outcome | Modelling Rule |
|---|---|
| Sprawl | New population is allocated to all undeveloped lands regardless of suitability conflicts using low gross urban densities and small household sizes. |
| Compact urban growth | New population is allocated to undeveloped lands regardless of suitability conflicts using high gross urban densities and large household sizes. |
| Loss of agricultural lands | No priority is given to protection of lands suitable for agriculture. Instead, if a land is suitable for urban use, it will be allocated to that purpose. |
| Protection of agricultural lands | A priority is placed on lands with high and moderate agricultural suitability regardless of their urban suitability. |
| Increased development densities in proximity to mass transit | Population will be allocated at increased densities in areas within walking distance of mass transit stops or routes. |
| Protection for green infrastructure | Regardless of urban, agriculture or mining suitability, lands with certain prioritised characteristics will be off limits to future development. These might include floodplains, areas of high biodiversity, or areas important for aquifer recharge. |
| Redevelopment and/or infill | Some of the new population will be placed in areas of existing urban development and/or vacant urban lands reducing the amount of new population that must be placed on undeveloped lands. |
| New roadway construction | New roads or road corridors are included in suitability analyses, increasing suitability for urban development and decreasing suitability for protection adjacent to the new features. |

C

Examples of Modelling Rules and the Likely Outcomes They Will Produce




3
Process for Developing Alternative Futures

suitability for each land-use type. Thus "333" suggests that the suitability for each land-use type is high; at the opposite extreme, "111" suggests that the suitability for each land use is low (see Fig. 4).

If there are three suitability analyses to be compared, there are $3^3$ or 27 potential combinations. If four suitability analyses are to be compared, there are $4^3$ or 64 potential combinations. The numerical combinations are reclassified to produce the conflict map used to support modelling decisions. Figure 5 and Table B represent one example of how the 27 potential combinations from the comparison of three land-use suitability analyses might be grouped and conflict mapped. The completion of step three concludes the portion of the process called LUCIS.

Fourth, model assumptions that mimic the spatial result of existing or proposed land-use policies are crafted. Table C includes some examples of rules that might be followed to produce certain outcomes. Some rules dictate adjustments to the projected population, some rules address the density at which new development will occur, some rules assume the introduction of new urban amenities like mass transit, and yet other rules suggest how the results of conflict mapping (or LUCIS) will be used.

## Alternative Futures Derived from LUCIS

Among the alternative futures that have been developed for various regions of Florida using LUCIS are:

- A high-density urban redevelopment scenario
- A transit-oriented development scenario
- A green infrastructure or conservation-oriented scenario
- An agriculture preservation scenario
- A rising sea level scenario
- Various combinations of the above

Alternative visions should always be compared to one another and to a trend scenario that is based on a continuation of the policies that produced the current pattern of land use. The first iteration of the Florida 2060 study completed by the authors in 2006 produced a striking result for the entire state (Zwick and Carr 2006). In this project, the 2005 pattern of land use was compared to the 2060 projected pattern of land use that would result if population grew as projected and land-use policies remained unchanged (Fig. 6). This study was widely discussed in the press and the public reaction suggested wholesale dissatisfaction with the 2060 projected pattern; too much native habitat and productive agricultural lands would be lost. The conclusion was that if the state's population does grow as predicted, increasing the density of urban development will be essential to maintaining the environmental quality that Floridians desire. As a result, there have been marked increases in the densities of new development projects statewide.

## The Value of Alternative Futures

Because alternative futures are generated in GIS, they can be rapidly replicated, verified, or changed. With relatively small adjustments to any given model, alternatives can be easily tested. For example, the degree to which the spatial extent required in new development can be reduced by increasing the densities in redeveloped urban areas can be easily visualised.

However, one thing that this approach to alternative futures is definitely not designed to do is dictate the urban form that will be used to implement the development densities it models. The translation of the patterns and densities of projected development are better left to urban designers who add the humanising details of open spaces, building massing and materials, transit design, and supporting infrastructure.

Alternative land-use futures have proved a valuable visualisation tool. They allow the public and policy makers to fully understand the physical ramifications of the complex interactions between population growth, development density, and protection for areas of ecological significance and productive agricultural lands. They project into the future the cumulative spatial effect of current land-use policies and appear to result in changes to those policies if the alternative futures are not to the public's liking.

References:

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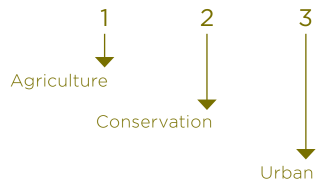
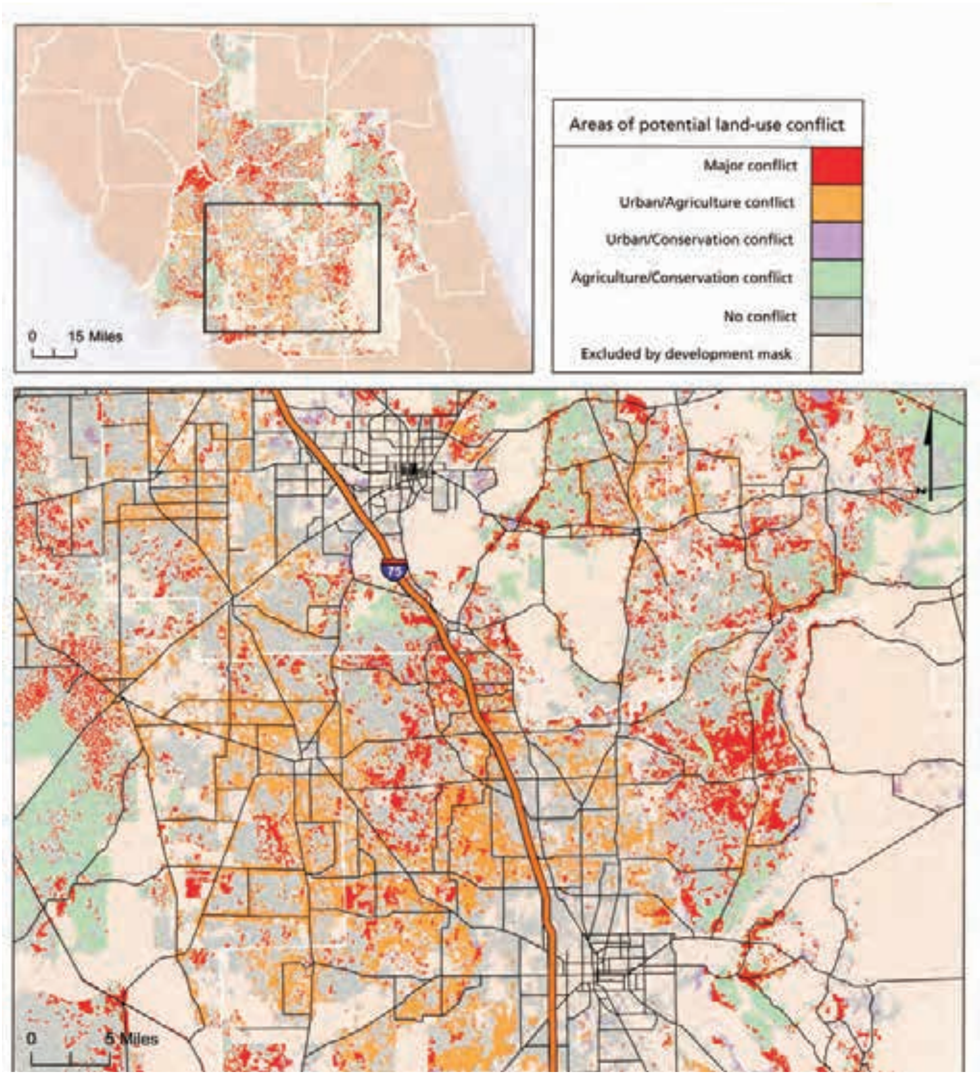



| Value | Conflict Type |
|---|---|
| 111 | Major Conflict Low Suitability |
| 112 | Urban Moderate Suitability |
| 113 | Urban High Suitability |
| 121 | Conservation Moderate Suitability |
| 122 | Minor Conflict Conservation Urban Moderate Suitability |
| 123 | Urban High Suitability Moderate Conservation Suitability |
| 131 | Conservation High Suitability |
| 132 | Conservation High Suitability Urban Moderate Suitability |
| 133 | Minor Conflict Conservation Urban High Suitability |
| 211 | Moderate Agriculture Suitability |
| 212 | Minor Conflict Moderate Agricultural Urban Suitability |
| 213 | Urban High Suitability Agricultural Moderate Suitability |
| 221 | Minor Conflict Agriculture Conservation Moderate Suitability |
| 222 | Major Conflict Moderate Suitability |
| 223 | Urban Suitability Moderate Agriculture Conservation Suitability |
| 231 | Conservation Suitability Moderate Agriculture Suitability |
| 232 | Conservation Suitability Moderate Agriculture Urban Suitability |
| 233 | Minor Conflict High Conservation Urban Suitability Agriculture Moderate Suitability |
| 311 | Agriculture Suitability |
| 312 | Agriculture Suitability Moderate Urban Suitability |
| 313 | Minor Conflict Agriculture Urban High Suitability |
| 321 | Agriculture Suitability Moderate Conservation Suitability |
| 322 | Agriculture Suitability Moderate Conservation Urban Suitability |
| 323 | Minor Conflict Agriculture Urban High Suitability Conservation Moderate Suitability |
| 331 | Minor Conflict Agriculture Conservation High Suitability |
| 332 | Minor Conflict Agriculture Conservation High Suitability Urban Moderate Suitability |
| 333 | Major Conflict High Suitability |

4

Range of Values and Associated Conflict Types Produced When Suitability Results for Three Land-use Types are Combined

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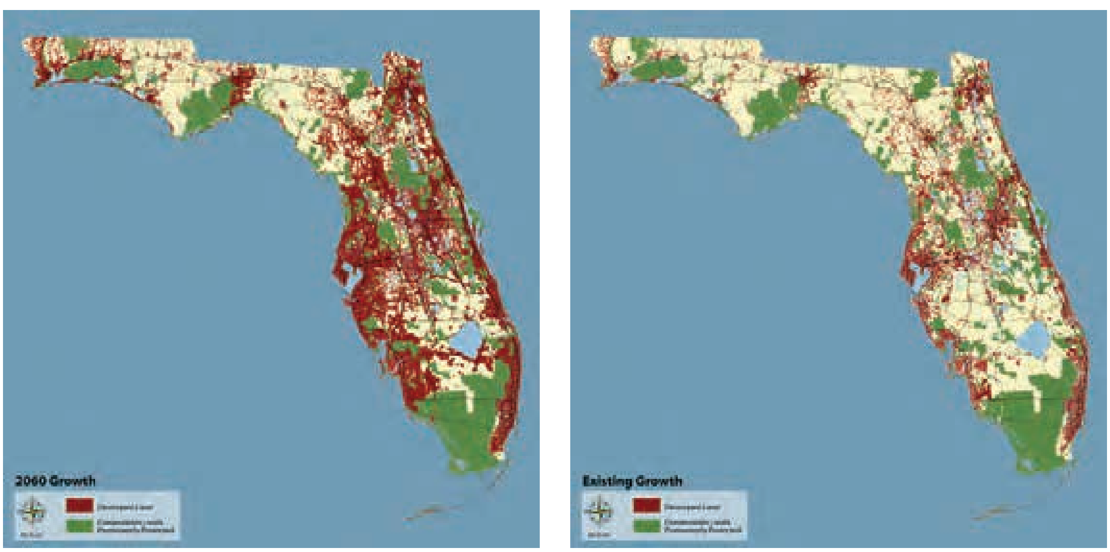
Areas of Potential Land-use Conflict in the Study Area of North Central Florida, USA (Carr and Zwick 2007, 161)

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2005 Florida Land Use Compared to a 2060 Alternative Future Based on Development at 2005 Existing Gross Urban Densities