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TCI Scoping Paper Series

Growth in Previously Developed/Designated Areas & Acres of Agricultural or Natural Lands Protected (Acres Consumed by Development)

Prepared for the Georgetown Climate Center and the Transportation and Climate Initiative

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Introduction

The act of concentrating future development in previously developed areas and in those designated for this purpose, as well as the conservation of agricultural and undeveloped land, are central to the notion of smart growth. When realized as heterogeneous land uses characterized by strong population and employment centers, higher density (as opposed to sprawling) developmental patterns[1] allow people to live close to where they work, shop, and play. A multitude of studies have demonstrated the benefits of this land consumption pattern, which include increased physical activity among residents[2], neighborhood revitalization, preservation of green and open spaces, the protection of water quality, and a diminution in vehicle miles traveled (VMT) (EPA, 2011; Ewing et al, 2007; HUD, 2012).

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Given the link between driving and greenhouse gas (GHG) production, the potential VMT savings realizable by encouraging smart growth is of particular importance in the context of the Transportation and Climate Initiative (TCI). As compared to those living on the suburban fringe, people residing in denser developments, in closer spatial proximity to amenities and transportation alternatives to the personal vehicle, can be expected to choose to drive between 20 and 40 percent fewer miles. Extrapolating from this, as a result of the expected reductions in VMT, smart growth alone could reduce an area's GHG emissions by 7 to 10 percent (relative to current trends) by 2050. Therefore, in addition to the development of more fuel efficient vehicles and lower carbon fuels, smart growth (of which concentrated development is an essential component) could serve as a

[1] The interconnectedness of street systems and the construction of human-scale spaces and structures are also recognized as important hallmarks of smart growth.
[2] As compared to individuals living in car-dependent, outer-fringe suburbs.

"third leg" in the transportation sector's efforts to lessen its contribution to global warming (Ewing et al, 2007).

There are a number of environmentally, economically, and socially relevant reasons to encourage development in previously developed and/or designated areas; but in order to gauge the success of efforts to encourage this state of affairs, developmental trends must be accurately tracked. The following pages present a variety of approaches to do just that.

Defining "previously developed" and "designated for growth"

A necessary first step in determining the amount of development occurring in areas of interest is to identify parcels that meet the criteria to be deemed "previously developed" and/or "designated for growth." According to the Environmental Protection Agency (EPA), previously developed land consists of parcels characterized by manmade structures or surfaces, or landscaped or uncovered locations that are used consistently for industrial, commercial or residential purposes, in the period immediately preceding the timeframe of the analysis (ICF International, 2012).

The definition of areas that could be considered "designated for growth," in contrast, will vary by state, and possibly even municipality. In some instances, state-level policies and practices facilitate identification of these priority areas; for example, New Jersey has established growth "centers," and Maryland identifies priority funding areas to which growth-related infrastructural funds are directed. In instances where such special classifications don't yet exist, they can be created, although the process necessary to do so may be lengthy and contentious. Otherwise, locations could be selected

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that have obtained a special status – such as a "transit-oriented development" or "business improvement district" – which although not exclusively focused on promoting targeted development, reflects a desire for development and improvements in the area.

Yet another alternative would be to rely on other state- or locally-identified characteristics to define locations in which growth is desired. Proximity to transit or employment opportunities, for example, might increase an area's appeal for development; in which case, defining study areas' extents could be as simple as creating boundaries of a pre-specified width around such locations.[3]

Tracking Development Using Geographic Information Systems (GIS)

With the advent of Geographic Information Systems (GIS), and the resulting increase in data organization using spatial coordinates, it has become possible to measure and track developmental patterns and predict trends as never before (Maryland Report). There are a number of analytical techniques for analyzing development on previously developed and/or designated growth areas, and the preservation of undeveloped and agricultural lands, that are reliant on this technology, and a number of these are discussed on the following pages.

Data Sources

Whether focused on locations that are previously developed, designated for growth, undeveloped, or agricultural, the availability of data will be a determining factor in selecting and specifying an analytical approach. Data may be compiled for this purpose from publicly accessible sources, or primary datasets can be created using programmatic or other information that contains a geospatial identifier.[4]

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[3] GIS can be used to apply a buffer of a user-defined width to any object (be it a building, parcel, census block group, etc.). Everything that falls within the extent of the buffer can be assigned a value (in this case "designated for growth", thereby creating a new spatial classification useable in the type of analysis discussed here. If growth is desired around transit stations, for example, a buffer can be applied to all station locations, essentially defining a set of new and unique areas in which growth is to be encouraged.

[4] Depending on the type and scale of the data, a geospatial locator may be an address, a zip code, latitude and longitude coordinates, or any other data point that provides information on an entry's location.

Unlike areas that are "designated for growth," previously developed lands are tracked more consistently. One source of data is the National Land Cover Database (NLCD)[5], which assigns developed land (in 30x30 meter square parcels) to one of four categories (open space, low intensity, medium intensity, and high intensity) to reflect the level of existing development.[6] The NLCD also includes a change index, which allows the user to track alterations in land uses occurring between 2001 and 2006 (HUD, 2012).

The NLCD also contains data on undeveloped and agricultural lands. Three supra-categories (bare, vegetated, and wetlands) are used to identify undeveloped areas; and agricultural areas are tagged within the general "vegetated" classification as either "woody upland vegetation" or "herbaceous upland vegetation" that is "planted/cultivated" (Vogelmann et al, 1998).

Although appealing, the NLCD may not be ideal, largely because it is not updated frequently, or on a consistent schedule. Even if the necessary data are included in the database, spatially finite analyses using information from this source are not recommended, as classification inaccuracies are more likely at the parcel or other small-scale study area level (HUD, 2012).

If NLCD data are used, local maps (where available) should be consulted to cross check the data for incorrect labeling (HUD, 2012). It is particularly important to verify that public spaces such as parks are not included among development-eligible locales, as this will skew results (ICF, 2011).

If NLCD data are used, local maps (where available) should be consulted to cross check the data for incorrect labeling.

Using the same land use classifications as the NLCD, the EPA has created a dataset[7] that contains information about the proportion of all unprotected land that has been developed. Data are recorded at the census block group level, and can be combined with housing unit counts (from

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[5] The NLCD can be accessed at: http://www.mrlc.gov/nlcd2001.php

[6] Overall, there are 21 categories into which land can be classified.

[7] The EPA's data can be accessed at: http://cfpub.epa.gov/eroe/index.cfm?fuseaction=detail.viewInd&lv=list.listbyalpha&r=219665&subtop=225

the US Census) to determine the percentage of growth that is occurring in already developed locations (ICF, 2011).

In addition to identifying baseline conditions (i.e. where development exists and/or growth is desired), tracking developmental patterns also necessitates gathering information on where construction is occurring. For commercial development, local tax assessors are the preferred sources of information. Typically, an assessor will record the location (address or latitude and longitude) of the building, its square footage, the year in which construction was started and/or completed, and the dollar value of the structure. These data are often linked to a parcel dataset, which facilitates their geospatial analysis. It should be noted, however, that although the best source of information on new commercial development is an assessor, data quality is highly variable between individuals, and property values may be artificially lowered as a result of state or local legislation (ICF, 2011).

Typically, an assessor will record the location (address or latitude and longitude) of the building, its square footage, the year in which construction was started and/or completed, and the dollar value of the structure.

Permit data may also be used and may be easier to access, as it is typically collected by a permitting or county planning agency. Variations in data management practices between agencies, as well as inherent difficulties in linking permits to specific buildings and locations, however, make this a less desirable source of information on new commercial development (ICF, 2011).

Private data sources, such as Core Logic's ParcelPoint can also be useful. The price, however, may prove prohibitive. For example, a commercial application using this dataset can be expected to cost about $1 million (ICF, 2011).

Whether as a result of infrequent updating, the presence of land use classification errors, or a high price tag, geographic data obtained from the above sources must be thoroughly examined before it can be used as a basis to determine developmental patterns. For this reason, whenever accurate and timely maps are available from local agencies or programs, these are the preferred data source for analyses of developmental patterns.

Tracking Development Using Non-GIS-Based Methodologies

GIS can be a powerful tool for conducting land use focused analyses, but it is not the only approach available to analysts wishing to determine the extent to which development is occurring in target areas. Simple mathematical calculations, largely based on publicly-available Census data can also be quite illustrative in this regard.

The following section describes specific analytical techniques – some reliant on GIS, others not – that can be used for this purpose.

Calculations

GIS can be a powerful tool for conducting land use focused analyses, but it is not the only approach available to analysts wishing to determine the extent to which development is occurring in target areas.

There are a number of specific calculations that can be performed to determine the amount of new development occurring in previously developed areas, and/or those designated for growth, as well as the amount of agricultural or undeveloped land that is protected or consumed. Among the approaches for measuring these trends are:

- Net loss of undeveloped land on a per resident basis
- Acres of agricultural or natural land preserved
- Change in population density within (and without) previously developed and/or designated growth areas
- Change in housing and/or commercial density within (and without) previously developed and/or designated growth areas
- Percent of new office space built on previously developed and/or growth areas
- Percent of new housing constructed in previously developed and/or growth areas

The <u>net loss (on a per resident basis) of undeveloped or agricultural land</u> can be calculated by combining land use data from state and local sources (or if none is available, from the NLCD), and population counts from the US Census Bureau's American Community Survey (ACS).[8] Once the study boundaries have been defined[9], GIS software should be used to identify all of the parcels on which development was desired at the beginning of the study period, and determine what percentage of those lands were actually developed by the end of the period of interest. This may be accomplished through the analysis of a change index, such as the one already created for the NLCD data, or by comparing data layers that reflect land use patterns at the beginning and end of the study timeframe. Likewise, population changes within the areas of interest can be discerned using GIS, and the difference compared to the observed land use shifts (HUD, 2012).

This same calculation can be repeated, replacing parcel and population data from within the study area(s) with those from surrounding or comparison sites, or for the state as a whole to create a baseline net annual loss per resident figure against which the findings for the study area(s) can be compared.

Calculation:
(FDL-IDL)/ (FP-IP)=NLULPC

Where:

Variable	Description	Data Source
FDL	Final Developed Land is the total acreage of developed land in the study area at the end of the study period.	Local or state database, NLDC
IDL	Initial Developed Land is the total acreage of developed land in the study area at the beginning of the study period.	Local or state database, NLDC
FP	Final Population is the total number of people living within the study area at the end of the study period.	American Community Survey
IP	Initial Population is the total number of people living within the study area at the beginning of the study period.	American Community Survey
NLULPC	Net Loss of Undeveloped Land per Capita	

[8] For an in-depth discussion of the ACS, please see the Travel Mode Share scoping paper written as part of this series.
[9] i.e. The boundaries of the previously developed and/or designated for growth areas.

Advantages	Disadvantages
Targeted analysis of areas of interest; no need for "comparison areas"	Accurate, timely land use data may be difficult to obtain.

The amount of agricultural or undeveloped land that is preserved as a result of a specific policy or program can be determined using a technique similar to that described above. Study boundaries should be defined according to the spatial extent of the initiative whose effects are of interest and land use data for the period immediately preceding its implementation. Within those boundaries, all parcels of the type offered protection from development can be identified using GIS, and their spatial extents summed to determine the total amount of land protected.

Advantages	Disadvantages
Targeted analysis of areas of interest; no need for "comparison areas"	Accurate, timely land use data may be difficult to obtain.

A simple way to derive similar results is to compare changes in population density in target areas to those occurring in a control location (this could be a neighboring town, region, or the entire state). To do this, the user can obtain population data from the ACS for the initial and final years under study, and use the US Census Bureau's FactFinder or a state or local GIS layer to determine the number of square miles or acres contained within the study area.

Study area-specific data can be replaced with statewide, regional, or other control data to facilitate comparisons between growth in previously developed and/or designated areas and those in which development is not necessarily encouraged.

Calculation:

(FP-IP)/TSM or TA=CID

Where:

Variable	Description	Data Source
FP	Final Population is the total number of people living in the study area at the end of the study period.	American Community Survey
IP	Initial Population is the total number of people living within the study area at the beginning of the study period.	American Community Survey
TSM	Total square miles within the study area	FactFinder
TA	Total acres within the study area	GIS
CID	Change in density is the change in residents per square mile or acre over the time period under study.	

Advantages	Disadvantages
Does not rely on GIS	American Community Survey data are estimates and contain a known margin of error.
Data are available from easily accessed, public sources	

The change in housing density within target areas can be calculated using the above formula, but substituting population data with the number of residential units that exist within the study area.

Calculation:
(FHU-IHU)/TSM or TA=CID

Where:

Variable	Description	Data Source
FHU	Final Housing Units is the total number of housing units within the study area at the end of the study period.	American Community Survey
IHU	Initial Housing Units is the total number of housing units within the study area at the start of the study period.	American Community Survey
TSM	Total square miles within the study area	FactFinder
TA	Total acres within the study area	GIS
CID	Change in density is the change in housing units per square mile or acre over the time period under study.	

Advantages	Disadvantages
Does not rely on GIS	American Community Survey data are estimates and contain a known margin of error.

Data are available from easily accessed, public sources	

Data on new commercial development can be combined with information on existing development and/or growth areas to determine what percentage of new commercial construction is occurring on these lands. This can be accomplished by using GIS to create a proportional overlay system based on a raster-based land use layer. This type of analysis assumes development to be uniformly distributed throughout a given raster cell, meaning that the percentage of each parcel marked as "developed" would reflect the proportion of it which coincides with a cell that has been identified as "developed" (ICF, 2011). Data can be obtained from local sources, such as assessors or permit databases, from the NLDC, or from private sources, such as ParcelPoint.

Advantages	Disadvantages
Can provide an accurate estimate of changes in commercial development within target areas	Accurate and timely data may be difficult to obtain.

Residential development in target areas can be calculated in a manner similar to the above approach for commercial construction. As with their commercial counterparts, sources of information about the creation of new housing units include local assessors and permit records, as well as private databases such as ParcelPoint; but the US Census and the American Community Survey also contains this type of data. To discern new housing construction, simply identify which Census blocks or block groups coincide with the target area(s) and compare the housing unit total from the beginning of the study timeframe to total reported for the end of the timeframe, then divide this total by the change in housing stock for the region as a whole (or other control area).

Calculation:
(FSAHU – ISAHU)/(FRHU – IRHU) = PNH

Where:

Variable	Description	Data Source
FSAHU	Final Study Area Housing Units is the total number of housing units within the study area at the end of the study period.	American Community Survey
ISAHU	Initial Study Area Housing Units is the total number of housing units within the study area at the start of	American Community Survey

Variable	Description	Data Source
	the study period	
FRHU	Final Regional Housing Units is the total number of housing units within the region (or control area) at the end of the study period.	American Community Survey
IRHU	Initial Regional Housing Units is the total number of housing units within the region (or control area) at the beginning of the study period.	American Community Survey
PNH	Percent New Housing occurring in target areas	

Advantages	Disadvantages
Does not rely on GIS	American Community Survey data are estimates and contain a known margin of error.
Data are available from easily accessed, public sources	

Recommendations

The scale at which growth in previously developed and/or target areas is studied is malleable, but will depend in large part on the type of data available. If, for example, timely and reliable land use data can be obtained for an entire state, a geospatial analysis can be performed with relative ease. In contrast, if such data are not available, and the analyst is forced to approximate study areas using Census blocks or block groups, the process could be much more laborious.

The table below provides a set of general guidelines for selecting an analytical technique that can be applied to analyses of any scale.

Current State	Desired End State	Recommendation
Areas designated for redevelopment and/or growth exist and local data are available and reliable	Monitor the effectiveness of these designations at concentrating growth and preserving undeveloped/agricultural lands	Acquire local data and perform a GIS-based analysis
Areas designated for redevelopment and/or growth exist, but local data are not available and reliable	Monitor the effectiveness of these designations at concentrating growth and preserving undeveloped/agricultural	Acquire Census data and perform an arithmetically-based analysis

Current State	Desired End State	Recommendation
	lands	
No areas for redevelopment and/or growth have been explicitly identified, but districts (or other specially designated locales) are present and local data are available and reliable	Monitor the effectiveness of these districts at concentrating growth and preserving undeveloped/agricultural lands	Acquire local data and perform a GIS-based analysis
No areas for redevelopment and/or growth have been explicitly identified, however, districts (or other specially designated locales) are present, but local data are not available and reliable	Monitor the effectiveness of these districts at concentrating growth and preserving undeveloped/agricultural lands	Acquire Census data and perform an arithmetically-based analysis
Neither redevelopment and or growth areas, nor districts are consistently designated, but local land use data are available and reliable	Determine whether growth is following a “smart growth” pattern	Acquire local data and perform a GIS-based analysis for areas within a predetermined distance from transit and employment centers
Neither redevelopment and or growth areas, nor districts are consistently designated, and local land use data are available and reliable	Determine whether growth is following a “smart growth” pattern	Acquire Census data and perform an arithmetically-based analysis for areas within a predetermined distance from transit and employment centers