gwinnett county

October 2008

2030 unified plan

Comprehensive Plan

Consolidated Plan

Comprehensive Transportation Plan

Technical Appendices

Overview of the Appendices

The 2008 Gwinnett Unified Plan, at around 200 pages, is the tip of an iceberg. These appendices, nearly 950 pages long are its base. A very substantial research effort underpins the policies and maps of the Plan. The Appendices are its record. They will provide a deeper understanding than the Plan itself of the trends, driving forces, scenario development and analysis conducted for Gwinnett and the region.

Volume 1 of the Appendices contains two plans executed concurrent and parallel with the Comprehensive plan. These are the:

- **Consolidated Transportation Plan (CTP).** This is a Plan whose format and content is specified by ARC. Significantly contributed to by *Moreland –Altobelli Inc.*, it is one of the three plans that make up and cross-pollinate the Unified Plan. It uses the Middle of the Pack scenario to generate a list of needed transportation projects and adds additional projects that are desirable, resources allowing. The modeling done for the CTP was used in the Unified Plan, which also modeled the International Gateway scenario.

- **Consolidated Plan (CP).** This HUD-specified Plan, developed by *Bay Area Economics*, is the third leg of the Unified Plan, and the result of a pilot program by HUD to better integrate such plans into the ongoing agenda of community plans. This pilot, thus, seeks to raise the profile of Gwinnett's housing affordability gap and the social services needs that lower income residents have. While the data required by the plan, and its detailed reporting requirements, are contained in this appendix the findings and implications of the CP have influenced the policies in the Unified Plan. A "crosswalk" between these two documents, that makes these influences clear, prefaces the appendix.

Volume 2 of the appendices is organized in a sequence of: Public Outreach Process (A); basic analysis (B through E); modeling and evaluation (F through H). They reflect the substantive contributions of the team of experts assembled to help prepare the Unified Plan. Some highlights of each appendix in Volume 3 follow.

A – Public Outreach Process. Summarized in Part 2, Section B.2 of the Plan, this appendix describes in full the outreach process used to develop the Plan. It list interviewees, dates, agendas of the Plan Advisory Committee and so forth. It also contains summaries of the six focus group meetings, organized and conducted by *Ventana Marketing Inc*. These meetings were an effort to solicit the input of minority/ethnic groups, usually under-represented, into the planning work.

B – Community Assessment. This is the summary document produced at the end of the first phase of the Plan, a DCA requirement. It analyzes recent trends, discusses important features and issues for the county and sets up the meat of the Plan. Some of this material is incorporated in Part 1 of the Plan but the Assessment is obviously fuller and contains, in particular, more City-specific information.

C – Population and Employment Forecasts. Gwinnett has a 30–year history of outstripping its growth forecasts. It was deemed particularly important, therefore, to make sure that the forecasts for this Unified Plan were robust and defensible. *Dr. Thomas Hammer* undertook a comprehensive analysis of growth trends from a state, regional and county perspective, deploying a massive data base of counties nation-wide in which to ground his projections. Several meetings with ARC, which uses a different methodology, were held to review the Plan's assumptions. In the event, both approaches yielded very similar results, the projections generally showing a slowing of growth for Gwinnett.

D – Economic Development Overview. The *Robert Charles Lesser Company*, locally based, mined its hands-on familiarity with the region and Gwinnett to write this overview of economic development prospects for the County. Covering much ground and peppered with data nuggets and insights, much of this material found its way into different sections of the Plan and strongly influenced its direction. RCLCo's judgments also determined many of the parameters of the Land Use Allocation model.

E – Homeownership and Socio-Economic Trends. The sweeping changes in the racial and ethnic makeup of Gwinnett over the decade since the last plan necessitated a closer look. These reports, by *Dr Dan Immergluck of Georgia Tech*, constitute important original research on this phenomenon and its implications. They portray some encouraging signs and patterns of relative integration rather than wholesale racial/ethnic segregation. These 2006/2007 reports were also a very early warning of the sub prime mortgage fiasco in which Gwinnett is now so heavily embroiled. This analysis also informed the Consolidated Housing Plan.

F – Land Use Allocation. One look at the zoning targets in the Plan (Table 53, Figure 80) will make it clear that there is an unusually detailed level of land use analysis supporting the Plan. This appendix explains the way in which land uses were allocated in the various scenarios and their relationship to other forecasting and modeling efforts for the Plan. This guidance on future land use actions, conducted by *Facet Decision Systems*, also provides a tool for future use by the County as conditions change.

G – Transit Testing. As part of the transportation modeling effort different transit routes and services were tested. This appendix provides information on the additional transit services tested in the International Gateway Scenario and provides a detailed table of mode splits for the eight County subareas.

H – Fiscal Analysis. No analysis in this Plan is more sobering than that conducted by *Dr. Robert Eger* (Georgia State University) of the County's fiscal future. By significantly expanding the reach of existing fiscal models used by the County this analysis reveals the coming fiscal crunch. It compares the various scenarios against each other and recommends significant changes in the way the county raises and spends monies to secure a positive fiscal future. Its recommendations have deeply shaped the Plan's policies and maps. The fiscal model, part of the land use allocation modeling described above, also furnishes the County with a useful, ongoing tool.

Appendix C – Population and Employment Forecasts

Appendix C: Population and Employment Forecasts

Contents

Socio-Economic and Employment Forecast Summary

Background

Gwinnett County has chosen to produce a separate set of socioeconomic forecasts for the Unified Plan effort instead of using ARC's numbers. One primary reason for this was schedule. The Unified Plan was underway in Spring 2006, and these forecasts were foremost on the project's critical path. ARC's numbers were not ready by this time, and in fact were not received by the County until August of that year. Gwinnett County was also interested in a methodology that could generate alternative scenarios. This could be accomplished efficiently with a transparent, fully documented allocation process. This forecast development process is described in detail below.

Forecasts for the Nation, Atlanta Region, and 29 Individual Counties

The forecasting component of the Gwinnett County comprehensive planning process is structured in two phases. The first phase is charged with generating initial forecasts to serve as a benchmark for plan development. The second phase will then use largely the same methods to prepare forecasts that describe alternative future scenarios. Changes relative to the initial forecasts will almost surely be a consequence – perhaps an objective – of the plan elements incorporated in the second phase. [The Comprehensive Transportation Plan Needs Assessment made use of the initial forecasts generated for a trends based scenario, also called the Middle-of-the-Pack Scenario.]

As an integral part of the Atlanta urban complex, Gwinnett County cannot be forecasted in isolation. Hence the forecasting task addresses a "region" consisting of the 28-county Atlanta metropolitan area plus Hall County (which officially comprises metropolitan Gainesville but is clearly part of the larger complex). The chosen approach involves the successive preparation of forecasts for the region as a whole, for individual counties within the region, and finally for eight sub-county areas (SCAs) within Gwinnett County.

The following discussion will offer abbreviated descriptions of the regional and county-level methodologies for readers lacking time or need for technical detail. The resulting county forecasts are not included here but are available elsewhere. These results include all major economic and demographic variables for 30 observation units (the abovementioned counties with Fulton divided into two parts), so that the Gwinnett forecasts can be evaluated in a region-wide context.

A leading characteristic of the overall forecasting approach is strict and exclusive reliance upon empirical relationships – i.e., on forecasting equations that have been fitted statistically to observed data. This feature has increased the forecasting workload and significantly constrained the nature of the forecasting relationships, as discussed at the end of this text. Its benefits can be summarized as objectivity and realism. Objectivity is an important concern since forecasting programs can easily slip into a prescriptive mode rather than focusing strictly upon prediction. Realism is a challenge since the dynamics of urban development are extremely complex. Molding predictive relationships to observed reality is the only way to assure that they effectively subsume, if not explicitly express, the myriad influences on urban growth. Consequently the forecasts yielded by an empirically based approach make an ideal platform

from which to entertain revisions based on detailed circumstances and prospective public actions.

The core variables addressed by the forecasting sequence are: employment by industry (using a 19-category NAICS-based classification system); population by age and sex; and households by relative income. The baseline year, or jumping-off point, for forecast preparation is 2005. All variables are being forecasted through 2035, even though the relevant time frame for plan preparation only extends through 2030.

Regional Forecasting

The regional forecasting approach rests upon an assumption that all long-term trends at the regional level are economically driven. This assumption would not apply well to retirement areas or many foreign countries, but job availability rules metropolitan growth in most of America, and greater Atlanta is the most American of places.

To assist evaluation of the findings, the regional forecasting process is kept as mechanical and transparent as possible. Its key element consists of linking regional industries to national industries and assuming that past relationships will hold in the future. Regional forecasts are thus obtained by: 1) preparing a forecast of national employment; 2) linking regional industries to their national counterparts; 3) projecting the regional/national linkages forward to derive a regional economic forecast; and 4) forecasting regional demographics on the basis of employment.

The best existing forecast of national employment is a detailed projection by the Bureau of Labor Statistics (BLS) that currently extends through 2014. Conditions further in the future have been addressed by assuming that over the long term U.S. employment will be demographically limited. While this assumption may look dubious from today's perspective, the supporting arguments are that: 1) political forces will always push the economy toward full employment in the long run, even at a cost of drastic measures like bringing back inflation or cheapening the currency; and 2) the challenge of maintaining full employment should progressively abate as aging of the population reduces growth in the labor force. The assumed demographic linkage has made it possible to project total U.S. employment beyond 2014 by applying labor force participation rates to the Census Bureau's population forecasts, then allowing for unemployment. The aggregate figures were then allocated across industries by projecting forward the industry shares specified by the BLS employment projections through 2014.

The input data for regional forecasting consisted of employment by industry for an historical period starting in 1969. For each industry, the regional employment level in each year was expressed as a ratio to employment in the corresponding national industry. A straight-line trend was fitted to the ratio values, sometimes using the whole 37 years of record and sometimes using just the last 20 years. Each industry trend line was then extrapolated into the future, with no adjustment other than an upward or downward shift to make the extrapolated line depart exactly from the point for 2005. Future ratio values were determined from the trend line and applied to the forecasted levels of national employment in the given years. The figures were then assembled to yield overall descriptions of the future regional economy.

The actual process was more complicated than just implied because an input-output table (or rather, a time-variant series of input-output tables) was used to split out the "final demand" component of employment in each industry. These components – considered the regional economic drivers – were the basis for forming regional-national ratios, fitting historical trend lines, and estimating future employment by applying values from the extrapolated trend lines to forecasted national employment. Input-output was then applied in reverse to obtain future descriptions of the overall regional economy.

Regional population by age, sex and race was forecasted using familiar cohort-survival methods, which "age" each population group across each time interval on the basis of birth, death and net migration rates. Population was linked to employment by way of net migration and labor force participation rates. Given the latter rates along with assumptions about unemployment and net commuting, it was possible to compute the level of jobholding supportable by any given population profile. Hence the forecasting process for each future year involved systematically adjusting the net migration rates in the cohort-survival tableau so that they yielded a population profile consistent with the regional employment total already established. The adjustment was a straightforward expression of economic determinism: the more jobs, the more persons would migrate into the region for economic reasons.

County-Level Forecasting

The task of county-level forecasting is to allocate predetermined regional quantities across the region's component counties. The relationships used to accomplish this objective are collectively referenced as an allocation model. In the present approach the quantities subject to allocation have been increments rather than absolute amounts, because the model was designed to predict changes across a succession of future time intervals. The intervals spanned ten years and hence were all bracketed by years ending in 5. As a last step, the forecasted variables have been interpolated (by fitting curvilinear relationships to data for three intervals) to years ending in 0.

Obtaining reliable predictive relationships through statistical calibration requires hundreds of observation units, so the calibration database must extend far beyond the study region of ultimate concern. The practice of drawing upon experience outside the study area is justified by the facts that: 1) growth patterns in U.S. metropolitan areas exhibit a high degree of commonality; and 2) the last stage of model calibration consists of "pegging" the equations as necessary to replicate local conditions. The Gwinnett study has utilized data for all metro areas in the eastern half of the country with populations above one million, excluding several areas at the northeastern and southern extremes of this territory. The resulting sample consisted of 355 counties and independent cities in 34 metro areas, with a combined population of slightly over 90 million.

The calibration process consisted of using multivariate statistical analysis to "explain" changes observed in the 355-county sample across the 1993-2003 interval. The calibration period ended in 2003 because this was the latest year covered by a key data source when the inputs were assembled. The target variables consisted of employment in nineteen industries and households in five income groups (which were quintiles based on the regional income distribution), with all other variables set aside for estimation on a derivative basis. Model calibration thus involved fitting twenty-four equations.

The predictors in the equations were limited almost entirely to past, initial, and current values of the same quantities being analyzed – i.e., employment and households – when embedded in complex functions to replicate real-world linkages. This feature followed from the requirements of model application, namely the fact that any quantity used as a predictor in a forecasting routine must itself be predicted. A related feature was a sequencing of equations accompanied by a limitation of the current-change predictors in each equation to variables addressed earlier in the sequence, which assured that all required inputs would be available when needed in the forecasting process.

To simulate urban growth dynamics realistically, an allocation model must at minimum have the capacity to: 1) express possible interactions among all combinations of economic sectors and household groups; 2) capture the influence on each area (county) of events in nearby areas; and 3) register the growth-retarding effects of progressive reductions in available land. The Gwinnett approach met the first criterion by treating employment and households on a fully integral basis, with all sectors tested for influence on all other sectors. The second criterion, relating primarily to spillover of growth from one urbanizing area to the next, was met by structuring most predictors as "proximity" measures that covered past, initial or current conditions in all areas of a region rather than just the area to which a measure pertained. These quantities were computed as sums of changes or initial conditions inversely weighted by distance from the subject area, using parameters that were varied to yield multiple versions of each variable. The third criterion was met by forming an index of land availability (estimated as a function of employment and dwelling units in the 824-zone analysis described momentarily). This was included as a weighting factor in all proximity variables, bearing an exponent that became sector-specific in the calibration process. The multiplicative form allowed each predictor to balance the advantages of centrality – i.e., nearness to existing development and growth – against the advantage of greater land abundance at less central locations.

After the twenty-four equations were fitted to 1993-2003 data (and explanatory variables referencing 1983-93) for the calibration sample, they were applied to "predict" 1995-2005 changes in all variables for counties in the Atlanta region. On this basis the model was pegged to local conditions by including reduced versions of the 1995-2005 residuals (prediction shortfalls) as additive adjustment factors in the equations. The forecasting process then consisted of applying the adjusted equations recursively to the 2005-15, 2015-25 and 2025-35 intervals. At each step the outputs obtained for one interval became the inputs – i.e., the basis for updating all predictors and the land availability index – for the next interval.

This description has omitted various complications, one of which was that there were actually two allocation models. The functional forms used in such models are constrained by the need to achieve exact allocations of fixed regional totals. Past studies had employed two different types of functional forms. Only one was initially used in the Gwinnett study, but the results were considered unsatisfactory in terms of predictive accuracy across the 355-observation sample, so another model was calibrated using the other form. The forecasting process then applied these models in parallel, using whatever equation or combination of equations provided the best explanation of 1995-2005 Atlanta trends for each sector.

Returning to the subject of overall strengths and weaknesses, the commitment of any forecasting approach to empirical calibration limits the quantities usable as predictors to variables that can feasibly be obtained for hundreds of observation units. These do not include most of the factors, over and above land area and existing activity levels, which shape the availability and suitability of land for future development. Highways, other infrastructure, environmental constraints, and policy-related factors such as zoning are omitted as independent influences on growth. The result is a "demand-side" model that tells what outcomes the market is likely to produce given a continuation of all supply-related conditions that prevailed in the recent past. Accepting forecasts produced on these terms basically requires an assumption that over the long run the key supply factors will be shaped by demand rather than vice versa. But notwithstanding the plausibility of this assumption, demand-side modeling is well suited to the present task of developing objective initial forecasts to serve as a platform for policy-related refinements.

Sub-County Area Forecasts to Traffic Analysis Zone Forecast Data

The direct outputs of the above process were "initial" sub-county area (SCA) level forecasts of the following quantities: employment in 19 industries; occupied dwelling units in five structure-type categories; and households in 20 categories involving five income quintiles and four racial/ethnic groups. The initial forecasts – obtained at five-year intervals through 2030 – became the basis for the Middle-of-the-Pack scenario (or the Trends based scenario), one of three scenarios addressed by the planning process, and the scenario used for CTP future needs assessment.

These basic variables have been translated into other demographic descriptorsl; the allocation outputs have subsequently been projected into a full set of descriptors for each TAZ. These notes do not cover the process of constructing a 2005 baseline or the special steps involved in creating scenarios other than Middle-of-the-Pack.

Three of the necessary steps involved conversions of SCA-level tabulations from one set of categories to another. The conversions were simple in concept, but involved fairly elaborate procedures incorporating various kinds of external data. They consisted of:

1) Converting the household income breakdowns from quintiles to four other categories of relative income;
2) Converting employment data from the 19-category NAICS-based classification system used in economic modeling to an 8-category SIC-based system; and
3) Converting the breakdowns of occupied dwelling units by structure type to tabulations by land-use category (with the addition of vacant dwellings estimated from SCA-specific and structure-type-specific vacancy rates).

The four-category income classification and the eight-category employment classification were dictated by the needs of transportation modeling, while the land use categories were those chosen for TAZ allocation.

The converted employment data and dwelling numbers by land-use category for SCAs were allocated across TAZs using methods described below. Meanwhile other steps were needed to obtain variables that would serve as SCA control totals when expanding the outputs of the

allocation process. The ultimate focus was a demographic table that would drive the transportation model (along with descriptors of economic activity) when made available at the TAZ level. This table – referenced hereafter simply as the "transportation table" – was a 24-item tabulation covering all combinations of four income categories and six household-size categories. The latter categories consisted of one person per household, two persons per household, and so forth up to six or more persons per household.

Travel Demand Model Input Data

The first step in developing SCA-level versions of the transportation table for use as control totals consisted of developing future household-size distributions. This was done by working forward from distributions obtained from the decennial census (since more recent information of this nature was not available for small areas). Starting from a distribution based on the previous year's results, an algorithm shifted households up or down among size categories as needed to obtain a distribution consistent with the current SCA population total.

No tabulated versions of the transportation table were available at the SCA level for any year. However, a table for the region as a whole was obtained and mathematically analyzed to establish characteristic relationships among cells (which ultimately involved a typology of 34 cases based on relative magnitudes). These relationships were applied to 2005 Gwinnett households by income and size to develop baseline transportation tables for all TAZs. The tables were then aggregated to the SCA level and projected into the future to provide the necessary control totals for processing of allocation results. The projection process was analogous to that employed for household size per se, except that iterative methods were required to enforce consistency with the income and size totals (i.e., with the predetermined row and column totals of the transportation table for each SCA when expressed as a matrix).

The receipt of TAZ-allocated dwelling units by land-use category then triggered the most complicated estimation tasks. These included:

- Translation of the 2030 dwelling units by land-use category back into the structure-type categories used in the demographic analysis (with elimination of vacancies to equate the figures with households).
- Development of structure-type tabulations for TAZs in all forecast years between 2005 and 2030 (i.e., all years ending in 0 or 5), using the SCA-level tabulations from the original modeling process as control totals.
- Development of four-category income distributions for all TAZs in all years using continuity with prior distributions, regression-based linkages to structure types, and iterative methods to enforce consistency with SCA control totals.
- Development of household size distributions for TAZs, again working from one year to the next, using an upshift/downshift algorithm and iterative methods for SCA-level reconciliation. This process yielded household population figures that when added to independent estimates of persons in group-quarters gave total TAZ population.
- Estimation of all cells in the transportation table for each TAZ in each successive year. Based on the distributions of values across cells in the prior year, two provisional versions of the transportation table were prepared for each TAZ, one preserving the correct income profile and one preserving the correct size profile. These were then averaged and became the basis for two new versions, with the correct income and size

profiles enforced as before. This process was continued until convergence was achieved at values consistent with the 24-element SCA control totals. (Since all 492 TAZs were addressed simultaneously, the iterative process for each year spanned 60 MB of Excel files.)

The TAZ-level transportation tables and employment breakdowns were then delivered to the transportation modelers, while the other TAZ and SCA descriptors were made available for other planning tasks.

Employment Allocation Methodology

The algorithmic assignment of "Employment" land is a proportional allocation at the TAZ level. This avoids the need to identify specific parcels that will be developed, and gives us more reproducible results than any "Monte Carlo" allocation methodology. It also has the advantage of being very easy to explain.

In summary, our overall approach is:

1) Determine all of the "classes' of employment land
2) Determine how much land is in each category in each TAZ, and how much land is available in total for each category
3) Determine the ratios of employment that will be attributed to each "class"[1]
4) Determine how much land would be used for this employment use [2]
5) Determine how much land will be consumed in each category, and assign that percentage of use to the land contained in each TAZ[3]

This gives us a development pattern with enough "knobs" to allow us to adjust the variables until we come up with a development pattern that looks realistic.

[1] For our simple example (assuming that all classes of employment are of roughly equal area) we will simply allocate half as much to each less desirable class, so the overall ratio of employment land will be 16:8:4:2:1, which will result in roughly half of the "employment land" being allocated to the "first tier" developments, 25% to the "second Tier" developments, 12.5% to the "Third Tier" and so on, which is simple to explain. Another common allocation methodology would be the 1/n series, so the ratios would be 1, 1/2, 1/3, 1/4 etc. It is relatively straightforward for us to change these ratios and generate new allocation profiles on this basis. Since this is strongly dependent on the distribution of areas available to each "class", we need to do a bit more work before we can propose these ratios.

[2] Since this is an approximation, we will simply use the FAR values and average square feet per employee based on existing Gwinnett data (InfoUSA, ELU parcel and tax data) to determine how much land is used, and how many employees this represents. These values may be modified by Robert Charles Lesser Co. to more accurately reflect future trends. Since these values will be at a TAZ level, this could represent a number of new buildings which all have "average" FAR's and employees per square foot, or a mix of uses and densities (such as a shipping yard with very low FAR's and employee densities coupled with a business park having very high FAR's and employee densities: at a TAZ level these are equivalent).

[3] As an example, if a TAZ had 100 acres of "First Tier" 200 acres of "Second Tier" employment land, if 20% of "First Tier" and 5% of "Second Tier" land was used then this TAZ would have consumed 20 Acres of "First Tier" and 10 acres of "Second Tier" land. Note that the number of employees added has already been calculated in the previous step.

Population and Employment Forecasts

Introduction

Socioeconomic forecasting in support of the Gwinnett Unified Plan involved two major activities: preparation of an "initial" forecast series that assumed a continuation of recent trends and policies; and development of alternative future scenarios based on other assumptions. The following were the steps involved in obtaining the initial forecast (which in modified form became the "Middle-of-the-Road" scenario):

1) Preparation of national and regional forecasts
2) Allocation of regional forecast totals to counties
3) Allocation of Gwinnett County forecast totals to sub-county areas (SCAs)
4) Expert review and revision of SCA forecasts
5) Preparation of supplementary variables required for transportation modeling
6) Allocation of forecast variables to TAZs (involving conversion to land-use variables and allocation to individual land parcels)

The present discussion will cover the first five of these steps, with notes on their linkages to TAZ-level and parcel-level forecasting and commentary on the preparation of alternative SCA forecasts. Another appendix describes the SCA-to-parcel allocation process and other tasks involving fine-grained description of land uses.

Initial forecasts were obtained in steps 1 through 3 via a top-down forecasting sequence with two key features: an exclusive reliance upon empirically calibrated forecasting relationships; and a linkage of Gwinnett County forecasts to anticipated developments in the Atlanta region as a whole. The limitation to predictive relationships based on empirical data profoundly shaped the region-to-county and county-to-SCA allocation tasks, which constituted the bulk of the initial forecasting effort.

The Atlanta region covered by the forecasting process was the 28-county Atlanta metropolitan area plus Hall County (which officially constituted metropolitan Gainesville but was clearly part of the Atlanta urban complex). Fulton County was split into two parts, namely the portions located above and below the northern loop of I-285, so the region-to-county allocation step addressed 30 separate geographic units.

Forecasts were prepared using a 2005 baseline year. In concept this "jumping-off point" was the last year covered by actual values of variables, although many of the sub-county descriptors for 2005 were in fact estimates due to limits on data availability. All forecasts for the region, Gwinnett County and its component SCAs were carried to 2035, because the allocation procedures dealt with ten-year increments starting in 2005. The forecasted values of variables for years ending in five were subsequently interpolated to years ending in zero, and the 2035 values were never used thereafter.

Economic conditions at all geographic levels were described in terms of employment by industry, utilizing a Bureau of Labor Statistics (BLS) definition of employment that included part-time jobs but excluded self-employed persons. (This

definition was chosen because the BLS was the only federal agency that offered NAICS-classified historical data, and because various statistics supplied by the Atlanta Regional Commission were BLS-consistent.) All forecasts down to the SCA level addressed 19 industry groups based on the North American Industrial Classification System (NAICS). At that point the baseline and forecasted magnitudes were converted to an 8-category grouping based on the older Standard Industrial Classification (SIC) system, because these SIC industries were required as transportation modeling inputs.

Demographic characteristics were described using a variety of variables, which differed among geographic levels due to requirements of the forecasting methodology. These variables are summarized in the following list. Some of the entries indicate the reasons for differences in emphasis (for example, the fact that the national forecasting process worked from demographics to total employment, whereas the regional forecast was employment-driven), but for the most part the explanations are postponed to the discussion of individual tasks. Some of the listed variables played only instrumental roles. For example, breakdowns of households by dwelling-unit structure type were needed for interaction with parcel allocation tasks but were not required by statistical end-users, and breakdowns of population and households by race were needed to estimate labor force participation, household size and income trends but were not carried beyond the third forecasting step.

National Forecast
- Population by age, sex and race (used to peg total end-year employment)
- Employment in 19 NAICS industries (breakdown based on BLS forecast)

Regional Forecast
- Employment in 19 NAICS industries (linked to national employment)
- Population by age, sex and race (linked to regional employment)
- Households by income quintile (estimated on the basis of population)

County Forecasts
- Employment in 19 NAICS industries (joint output of core allocation model)
- Households by income quintile (joint output of core allocation model)
- Households by structure type (from model housing loop)
- Households by race/ethnicity (from model racial loop)
- Population by age, sex, race and household status (from supplementary rel.s)

Forecasts for Gwinnett SCAs
- Same as above, plus households by number of persons in household

Gwinnett SAC Forecasts after Review/Revision and Conversion
- Employment in 8 SIC industries
- Households in four income categories specified by transportation model
- Households by structure type and number of persons in household
- Cross-tab: households by income and number of persons in household
- Population by age, sex and household status

Gwinnett TAZ Forecasts
- Employment in 8 SIC industries
- Population by household status
- Cross-tab: households by income and number of persons in household

National and Regional Forecasting

Historical Context

The enormous growth of metro Atlanta over the second half of the last century is widely familiar. Table 1 below summarizes the relevant population trends since 1940. This table covers the entire 29-county region of present concern and offers separate figures for a nine-county core area. In no decade since 1960 has the Atlanta region failed to gain population at a compound rate of less than 2.35% per year, or failed to grow at least twice as fast as the U.S. as a whole. These generalities also held during the 1940-60 interval for the nine-county core area that constituted the metropolis at that time.

Table 1. HISTORICAL POPULATION TRENDS IN THE ATLANTA REGION

	Fulton & Eight Contiguous Counties*		Other 20 Counties in Present Metropolis		Total 29-County Region		
	Persons	% Ch./Yr.	Persons	% Ch./Yr.	Persons	% Ch. Per Yr.	Ratio to U.S. %
1940	608,513		334,849		943,362		
1950	778,895	2.50%	340,542	0.17%	1,119,437	1.73%	1.266
1960	1,077,299	3.30%	359,825	0.55%	1,437,124	2.53%	1.478
1970	1,479,108	3.22%	424,630	1.67%	1,903,737	2.85%	2.258
1980	1,851,693	2.27%	550,451	2.63%	2,402,144	2.35%	2.162
1990	2,445,317	2.82%	719,536	2.71%	3,164,853	2.80%	2.981
2000	3,338,334	3.16%	1,048,924	3.84%	4,387,258	3.32%	2.670
1950-2000		2.95%		2.28%		2.77%	2.218

* All counties touching Fulton except Carroll and Coweta.

A similar situation prevailed for employment, the driver of population growth. Between 1969 and 2000, the 29-county region gained employment at a compound annual rate of 3.67%, as compared with a U.S. rate of 2.02% per year. This 31-year period included only two individual years in which the region lost employment and four years in which it failed to exceed the national rate of job growth. There was no five-year interval in which the region's employment gain failed to exceed 100,000 jobs and 8.65% of the initial-year level (which today would translate into 200,000-plus jobs).

But at the start of the present decade the region's explosive job growth came to a halt. Its employment base expanded by only half a percentage point between 2000 and 2001, then declined for two consecutive years. The ensuing gains during 2003-05 just succeeded in bringing the 2005 annual average to a level 48,500 jobs or 2.1% above the 2000 figure. This unprecedented period of stagnation was linked to national economic conditions, but in contrast to prior experience, the Atlanta region did not fare appreciably better than U.S. Its losses during 2001-03 were in fact worse than the accompanying national declines.

Remarkably, the near-standstill in regional employment during 2000-05 had only modest impact on population growth. This is shown by Table 2 on the next page, which describes population and net migration for five-year intervals starting in 1990. Both sets

of figures include breakdowns by racial/ethnic status (with all Hispanic persons isolated from the three race-based groups). The figures outside the first and third columns have been estimated from Census Bureau data and the cohort-survival analysis to be described.

Table 2. POPULATION AND NET MIGRATION IN THE ATLANTA REGION

	Population				Estimated Net Migration		
	1990	1995	2000	2005	1990-95	1995-00	2000-05
White	2,271,623	2,464,579	2,701,199	2,845,548	93,575	137,941	62,192
Black	778,212	984,446	1,237,349	1,490.731	141,611	172,660	167,505
Asian	51,660	96,309	151,061	209,681	38,558	44,135	45,555
Hispanic	63,358	168,596	297,649	459,867	90,003	96,813	114,354
Total	3,164,853	3,713,930	4,387,258	5,005,827	363,747	451,549	389,606
Annual % Ch.		3.25%	3.39%	2.67%			

The region grew rapidly during the early 1990s and a bit more rapidly in the late 1990s, with net migration supplying about two-thirds of the population gain in each case. A slowdown then occurred, but from 1995-2000 to 2000-05 the region's annual growth rate dropped by less than three-quarters of a percentage point and its net migration stayed high in absolute terms. As a result, the region's population increased by 14.1% over the first half of the present decade while its employment was rising by only 2.1%.

Table 2 shows the huge population increases that occurred during the 1990s for the region's three major minority groups. Starting with only 28% of the region's 1990 population, these groups supplied more than two-thirds of its population gain for the decade. The minority population then kept increasing at a comparable pace after 2000 (lower in percentage terms but higher in absolute terms), with rises in net migration occurring for two of the three groups. Meanwhile the adverse employment situation caused white net migration to fall by more than half from 1995-2000 to 2000-05.

The region's economic and demographic history raised a series of questions for the Gwinnett forecasting effort. Metro Atlanta's rapid growth in the early postwar years had been attributable to a fundamental restructuring of economic geography. The nation was due for the rapid emergence of regional capitals, and for a number of straightforward reasons Atlanta was a leading candidate. It was less clear is why some of the regional capitals, most notably Atlanta, went on to become major global players. Atlanta's lifestyle, cost, scale and transportation advantages formed a powerful combination but were not obviously special enough to assure high growth in perpetuity. The forecasting project thus had to consider the possibility that future economic forces would not require the Atlanta region to supply an ever-greater share of the nation's economic activity, and that the 2000-05 retrenchment might be a sign in this direction.

Other questions involved growth constraints, with transportation an obvious concern. It is easy to imagine that traffic jams will someday brake Atlanta's progress, although longstanding predictions of this nature have never borne out in places like Washington and Los Angeles. Water supply is a more unusual situation. Atlanta lies

downhill from a humid mountain range but relies for water upon a river basin – the Chattahoochee – that remains oddly narrow in its diagonal path across the state. All land northwest of this basin drains into North Carolina, Tennessee and Alabama. The largest flows exit via the Etowah River and thereby feed the Coosa River waterway in Alabama, making them a major concern to that state (which sued the Corps of Engineers in 1990 to prevent water diversions to Atlanta). For these reasons Atlanta has been called the most likely of the nation's major metro areas to be growth-constrained by water supply.

The above paragraph was written in March of 2006, before the 2007 drought that left the region only a few months away from running out of water (and continues at the present writing).

A more concrete question involved economic-demographic balance. Between 2000 and 2005, the region's employment per capita dropped from 0.528 to 0.472. Given continued employment gains at the relatively buoyant 2004-05 rate of 3.07% per year, returning to the per-capita employment level that prevailed in 2000 would require the region's population to expand by only 1.9% per year – two-thirds of the 2000-05 rate – from 2005 to 2015. Thus the region could regain its former economic trajectory and still experience persistently slow demographic growth by historical standards. Employment was exceptionally high relative to population in 2000, both regionally and nationally, so a full return to the 2000 relationship could not be reasonably assumed in the forecasting process; but there was little guidance in positing a new economic-demographic balance.

After much deliberation, employment forecasts were prepared for the Atlanta region by forming and applying regional-national linkages as in previous studies, with no special provision for infrastructure-related contingencies. The region's post-2000 slump registered proportionally in the predictive relationships but was not treated as a paradigm shift. Regarding economic-demographic balance, the region's labor force participation rates were adjusted upward after 2005 by amounts only sufficient to raise its employment per capita to 0.491 by 2015 (34% of the way from the 2005 level to the 2000 peak). The latter decision has been supported by later events. As for the former decision, only time will tell.

National Forecast

The first requirement for regional forecasting was the preparation of a national employment forecast. This task built upon a BLS projection of national employment by detailed industry through 2014. (Since the early 1990s no federal agency has forecasted employment more than ten years out.) Conditions further in the future were addressed by assuming that over the long term U.S. employment would be demographically limited. That is, the number of jobs would expand proportionally with the number of persons available to fill them. The supporting arguments were that: 1) political forces would always push the economy toward full employment in the long run, even at a cost of drastic measures such as kindling inflation or cheapening the currency; and 2) the challenge of maintaining full employment would progressively abate as aging of the population reduced growth in the labor force.

The assumed demographic linkage made it possible to project total U.S. employment beyond 2014 by applying labor force participation rates to the Census Bureau's population forecasts, then allowing for unemployment. Separate participation rates were developed and applied for persons in the four abovementioned racial groups by age and sex. (Labor force participation rates covering the entire forecast period were available from a BLS file, but greater reliance was placed on rates from a more recent series accompanying the 2014 employment projections.) Total employment was obtained by assuming an unemployment rate of 5.5% in 2010 and 5% thereafter. The aggregate figures were then allocated across industries by projecting forward the industry shares specified by the BLS employment projections through 2014. Table 3 below shows the national employment totals yielded by this process, accompanied by some historical employment data and comparisons with population.

Table 3. TRENDS IN NATIONAL EMPLOYMENT AND POPULATION

Historical BLS Employment			Projected Employment and Population				
Year	No. of Workers	Annual % Chg.	Year	No. of Workers	Annual % Chg.	Popu-lation	Workers Per Capita
1975	79,749		2005	135,860		295,507	0.460
1980	93,203	3.17%	2010	142,404	0.95%	308,936	0.461
1985	100,042	1.43%	2015	148,533	0.85%	322,366	0.461
1990	111,888	2.26%	2020	152,816	0.57%	335,805	0.455
1995	119,713	1.36%	2025	157,176	0.56%	349,439	0.450
2000	134,223	2.31%	2030	162,627	0.68%	363,584	0.447
2005	135,860	0.24%	2035	169,329	0.81%	377,886	0.448

Between 1975 and 2000, the nation's employment growth often exceeded 2% per year – for example, during the late-1990s boom and periods of rapid female entry into the labor force – and never fell below 1.3% per year for any half-decade. In contrast, future employment gains are expected to proceed at less than 1% annually and fall below 0.6% per year between 2015 and 2025. This outcome is attributable to rapid population aging, and occurs despite the assumption of sharply higher labor force participation for most older population groups. (If applied to the 2005 population profile, the participation rates assumed for 2035 would yield a labor force 5% higher than the 2005 rates.) Even though most individual age groups will have larger shares of persons working than at present, aggregate employment per capita will decline after 2015 from above 0.46 to below 0.45.

The five national industries expected to register the fastest employment gains are professional-technical services, administrative support services, private education, health and social services, and arts and recreation. Each of these industries will expand by at least 1.45% per year during 2005-35, while no other sector will achieve a growth rate above 1%. This pattern involves a good deal of continuity with the past, since the given five industries were all among the seven fastest-growing sectors during 1975-2005.

Regional Employment Forecasting – Input-Output Analysis

The regional forecasting approach assumed that all long-term trends at the regional level were economically driven, i.e., that employment determined demographic characteristics rather than vice versa. This assumption would be seriously flawed for a retirement area or a declining context subject to demographic inertia, but for an economic boomtown such as greater Atlanta it should provide a close approximation to reality.

The forecasting approach used was very simple in concept. The input data consisted of employment by industry for an historical period starting in 1969. For each industry, regional employment in each year was expressed as a ratio to employment in the corresponding national industry. A straight-line trend was fitted to the ratio values, sometimes using the whole 37 years of record and sometimes using just the last 20 years. Each industry trend line was then extrapolated into the future, with no adjustment other than an upward or downward shift to make the extrapolated line depart exactly from the point for 2005. Future ratio values were determined from the trend line and applied to the forecasted levels of national employment in the given years. The figures were then assembled to yield overall descriptions of the future regional economy.

What complicated the procedure was that the employment levels used to compute regional/national ratios and establish trend lines were not in fact the employment totals for the various industries. All industries were divided into two components – a "final demand" share and a residual component serving the region's own needs – using an input-output table. Only the final demand share of each industry's employment was linked to the national economy and projected forward. The input-output table was then applied in reverse to reassemble the industry components and obtain overall descriptions of future regional employment.

Input-output models are basically expanded versions of the familiar economic base multiplier model, which says (when applied on the margin) that any independent economic stimulus in an area will have "multiplier" effects yielding an overall growth increment larger than the original stimulus. Input-output analysis expresses multiplier effects on an industry-specific basis by using a table of purchase coefficients to trace the individual transactions required to support an industry expansion. In static terms, input-output modeling attributes all economic activity to a set of industry components that are collectively called "final demand." These are generally not whole industries but the estimated shares of industries that bring in revenue from the outside world. The final demand shares are typically large for manufacturing and other goods-producing activities and small to moderate for most population-serving functions (although such differences are fading in the post-industrial era).

The Gwinnett study utilized an input-output table prepared for the 29-county Atlanta-Gainesville region by the RIMS division of BEA. Since the customers of this data outlet are generally engaged in impact analysis rather than forecasting, RIMS only supplies input-output tables in inverse form. An I-O inverse is a coefficient matrix that when postmultiplied by a final-demand vector yields a vector of total employment (or output or earnings if the matrix is denominated in those terms). However, since the linear

equations comprising an input-output model yield unique solutions in both directions, a matrix inverse can also be used to solve iteratively for the final-demand vector associated with any given pattern of total activity. Thus in concept the same matrix inverse can be used to isolate final demand for historical years, then later translate forecasts of final demand back into descriptions of overall economic activity.

A major complication is that input-output coefficients are subject to change over time. The coefficients express patterns of demand for the products of various industries, and there are long-term trends in these patterns due to changes in economic structure. For example, relative demand for the employment-service industry has risen dramatically as companies substitute labor contractors and temp workers for permanent employees, and demand for health care has risen due to population aging and the increasing variety of medical treatments. Realistically isolating final demand requires projecting these changes back in time across the historical period used for trend analysis; and realistically forecasting total employment on the basis of final demand requires projecting them forward across the forecasting period. Furthermore there is need when adjusting the matrix to avoid building in an overall forecasting bias, which can exist if the matrix implicitly specifies a varying relationship between final demand and other economic activity. Such bias can be avoided by controlling the overall multiplier – i.e., the ratio of total employment to final-demand employment – specified by the matrix, as is explained momentarily.

In the present case the matrix adjustment process had to span a 37-year historical period and a 30-year forecasting period. It was accomplished by preparing a matrix for every third year and handling intermediate years by interpolation. Table 4 on the next page shows the resultant partitioning of the Atlanta regional economy for the baseline year and two prior years. The table's left-hand side shows the portions of employment assigned to final demand and its right-hand side describes total employment. Because the I-O matrix did not address them separately, two pairs of industries treated elsewhere on an individual basis are lumped together here (namely durable and nondurable goods manufacturing and accommodations and food services).

Conventional applications of input-output analysis treat all government activity as final demand, on the premise that tax payments are fundamentally different from other expenditures for goods and services. Even if this principle is followed, the use of input-output to model a whole economy requires a vector describing government inputs from other industries. The custom I-O tables delivered by RIMS no longer include such a vector (though they once did). Hence one task in addressing the Atlanta region was to estimate a government input vector using input relationships based on I-O tables from past studies. A further modification was the removal of local government from final demand. Notwithstanding theoretical considerations, local government activity – about half of which involves public education – is no less endogenous to a regional economy than any other activity, at least over the long run. This shift did not involve the insertion of local government into the structural I-O matrix. Instead local government employment was expressed for predictive purposes as a simple function of regional population.

Table 4. PARTITIONING OF REGIONAL EMPLOYMENT IN SELECTED YEARS

	Final Demand			Total Employment		
	1969	1987	2005	1969	1987	2005
Ag., mining & other extractive	6,177	9,465	9,153	10,993	14,473	12,143
Construction	8,195	23,726	43,017	33,298	81,768	130,460
Manufacturing	113,653	157,806	158,202	183,135	217,762	190,567
Wholesale trade	20,919	57,023	96,457	46,353	108,015	158,592
Retail trade	9,844	22,933	32,928	101,727	199,318	248,832
Transportation & utilities	19,793	43,023	65,771	48,390	90,601	120,650
Information	7,525	21,820	39,876	23,247	57,317	91,490
Finance, insurance & real est.	14,172	34,704	58,836	45,236	95,969	144,276
Prof. & tech. serv. and mgmt.	11,564	40,369	84,626	35,242	104,263	190,976
Administrative support serv.	3,208	16,364	50,272	16,458	71,762	191,373
Educational services	4,187	7,389	18,675	14,456	21,908	48,147
Health serv. & social assist.	3,691	15,175	41,076	22,721	79,857	187,628
Arts, entertainment & recr.	1,057	2,789	6,472	5,832	13,022	26,271
Accommodations & food serv.	5,586	21,480	41,265	35,957	116,598	195,569
Other services (incl. rental)	6,443	11,073	19,759	47,573	70,418	108,991
Federal & state government	50,920	86,111	110,483	50,920	86,111	110,483
Local government	(52,375)	(111,601)	(208,625)	52,375	111,601	208,625
Total:						
With local government in FD	339,310	682,851	1,085,494	773,913	1,540,765	2,365,074
Multiplier	2.281	2.256	2.179			
Without local gov't in FD	286,934	571,250	876,869	773,913	1,540,765	2,365,074
Multiplier	2.697	2.697	2.697			

Given the abovementioned modifications, the input-output table for the Atlanta region yielded a baseline employment multiplier – i.e., a ratio of total employment to final demand in the baseline year – of 2.697. This figure appears at the bottom of Table 4, along with the multiplier values that would be obtained if local government were considered part of final demand. The latter are within the 2.0-to-2.3 range normally associated with regional employment multipliers, so the local government shift makes a very major difference.

Controlling the multiplier in the matrix adjustment process meant pegging the adjustments in such a way that application of the matrix to data for a given year always yielded a multiplier of exactly 2.697, for every year in both the historical period and the forecast period. (In a few past studies of this type, the employment multiplier has been allowed to vary in a linear fashion over time, but maintaining a constant value is probably safer in terms of protection against forecasting bias.) As in other long-term applications of I-O, no further guidance was available for adjustment of individual coefficients other than professional judgment and familiarity with historical shifts in demand. The present study followed precedent in setting up routines to produce systematic variation in the off-diagonal elements of the matrix and the portions of the diagonal elements in excess of unity. There was a significant innovation, however, based on the principle that whatever is done to an I-O matrix going back in time should be paralleled as closely as possible by

the treatment of the matrix going forward into the forecast period. The new procedure consisted of controlling the adjustments so that the final-demand shares of employment emerging from application of the matrix always equaled a constant factor times the shares established in the baseline year. The factor varied over time but was held constant across all industries. Even though solutions with this characteristic had to be found by trial-and-error (with final-demand vectors established iteratively when working backward through the matrix inverse for historical years), this innovation plus the constant-multiplier rule turned matrix adjustment into an entirely mechanical process.

Regional Employment Forecasting – Industry Linkages

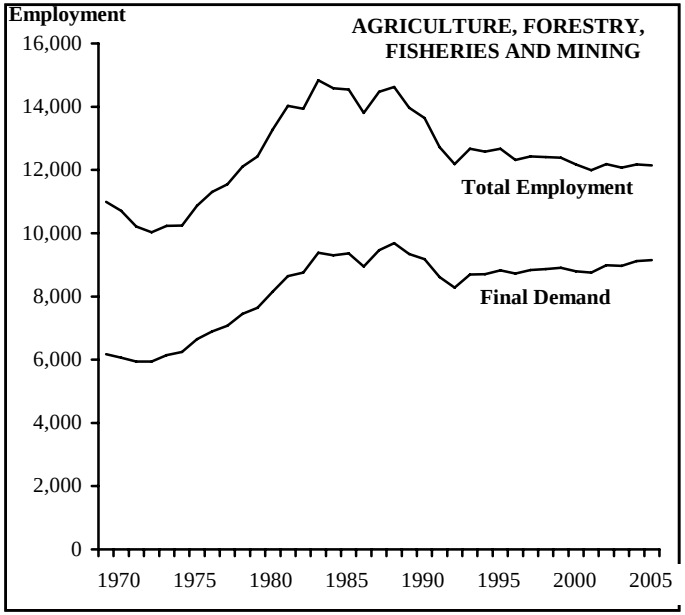
Forecasting involved linking final-demand employment in each regional industry to U.S. employment in the same industry. The linkages were established by expressing regional final demand as a percentage of national employment and fitting two trend lines to the percentages by simple linear regression (with calendar time as the independent variable). One trend line covered all 37 years in the 1969-2005 historical record, while the other was fitted to the percentages for the last 20 years, 1986 through 2005. The only discretionary aspect of the forecasting process was deciding for each industry whether the 37-year trend or the 20-year trend was more appropriate for projection into the future.

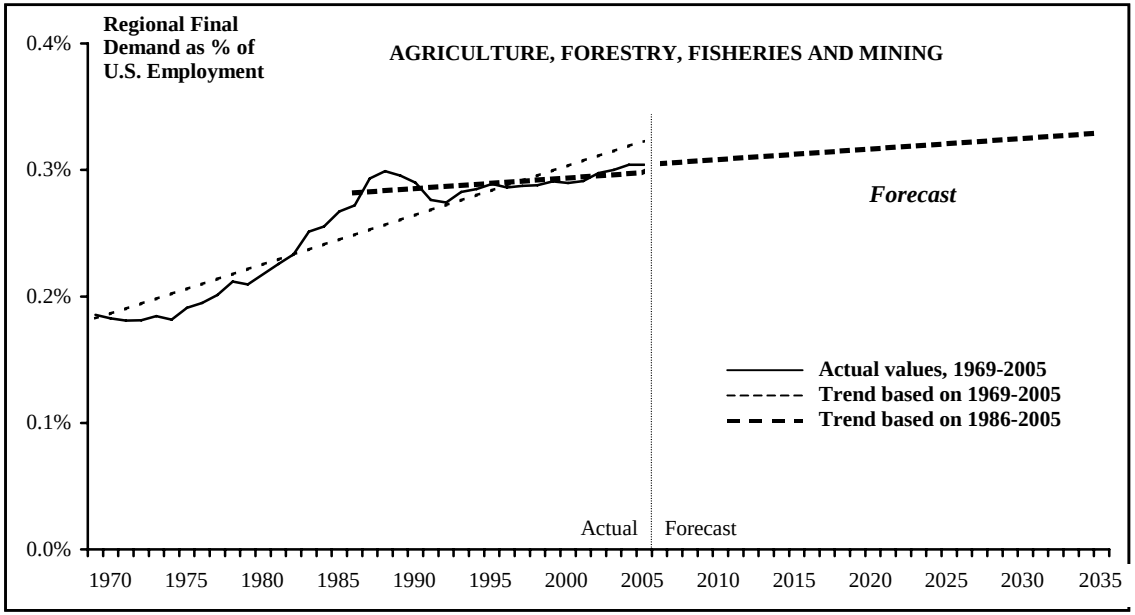
Figures 1 through 9 on the next nine pages offer graphical presentations of the resulting predictive relationships for the economic sectors listed in Table 4. The trend lines shown in these graphs have been entirely responsible for the present forecasts of both economic and demographic conditions in the Atlanta region (given the assumptions summarized at the end of this section). The graphs thus render the forecasting process fully transparent for purposes of review.

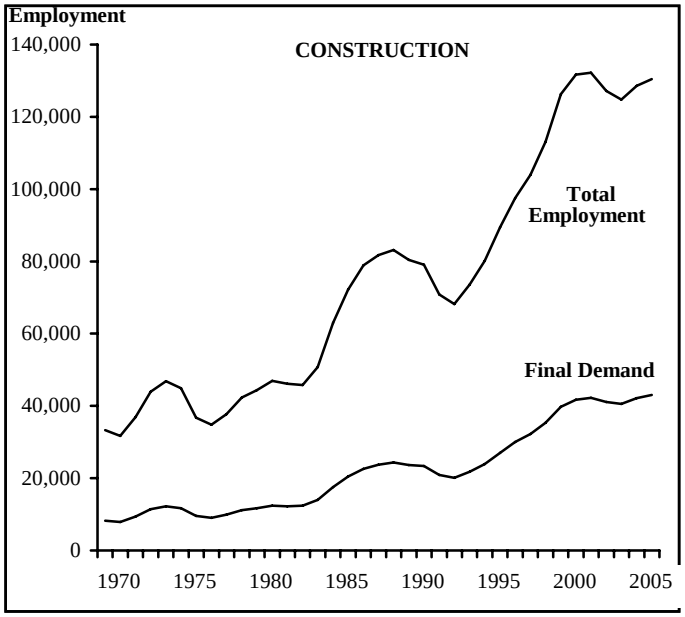
Every figure addresses two industries in two pairs of graphs. The left-hand graph in each pair describes an industry's total employment and final-demand employment for all years since 1969. The right-hand graph then plots final demand as a percentage of total U.S. employment in the same industry. Dashed lines in this graph show the 37-year and 20-year trends in the percentages (which are distinguishable by the fact that only the 37-year trend starts near the left-hand axis). Heavier dashes are used to denote whichever of the trend lines has been chosen as the basis for forecasting. The graph's right-hand portion shows the extrapolation of this line across the forecast period. In the process of extrapolation, the chosen trend line has been shifted uniformly up or down as necessary to make it pass exactly through the data point for 2005 (although the depiction of the line does not start until 2006).

It turned out that 20-year trends were chosen for eleven of the industries, while 37-year trends were used for only five. In every case but the "other services" sector, the chosen trend line was the more conservative option, i.e., was the one that yielded lower forecasts. However, there were quite a few cases such as manufacturing, wholesale trade, retail trade and health services in which the two trend relationships had virtually the same alignment. All of the chosen trend lines were upward-sloping, meaning they described past and future gains in the Atlanta region relative to the U.S.

Figure 1. TOTAL AND FINAL-DEMAND EMPLOYMENT IN EXTRACTIVE INDUSTRIES AND CONSTRUCTION







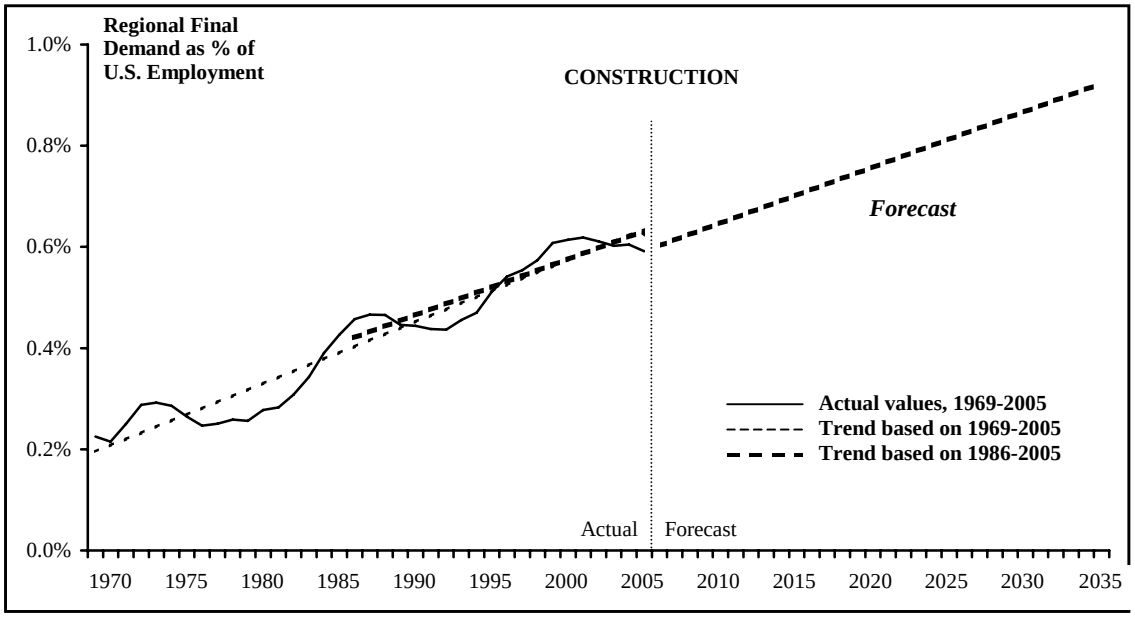
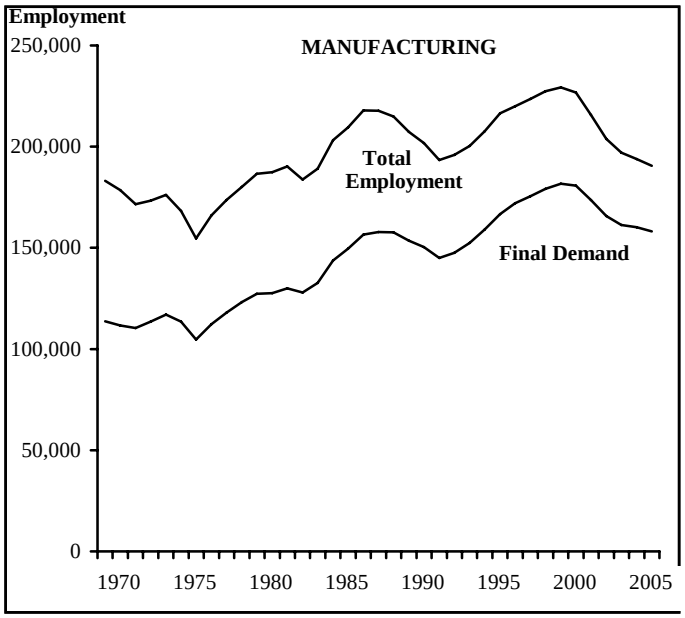
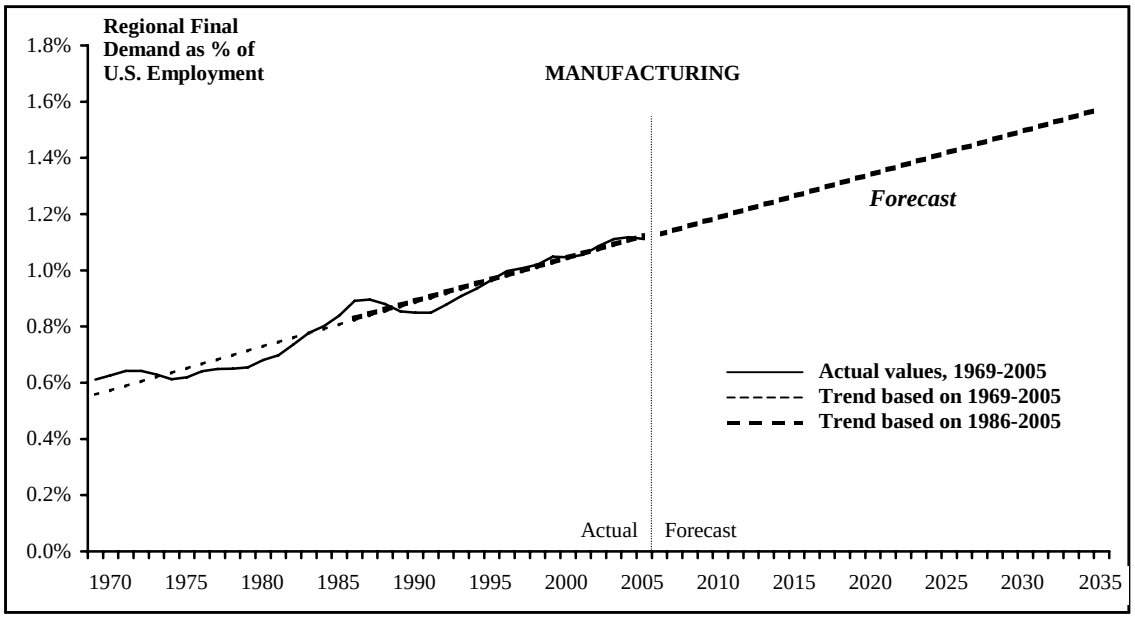
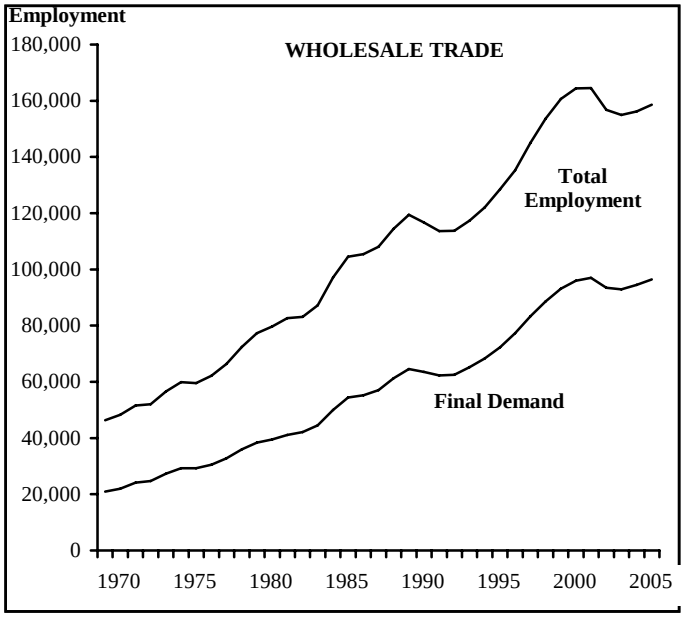


Figure 2. TOTAL AND FINAL-DEMAND EMPLOYMENT IN MANUFACTURING AND WHOLESALE TRADE







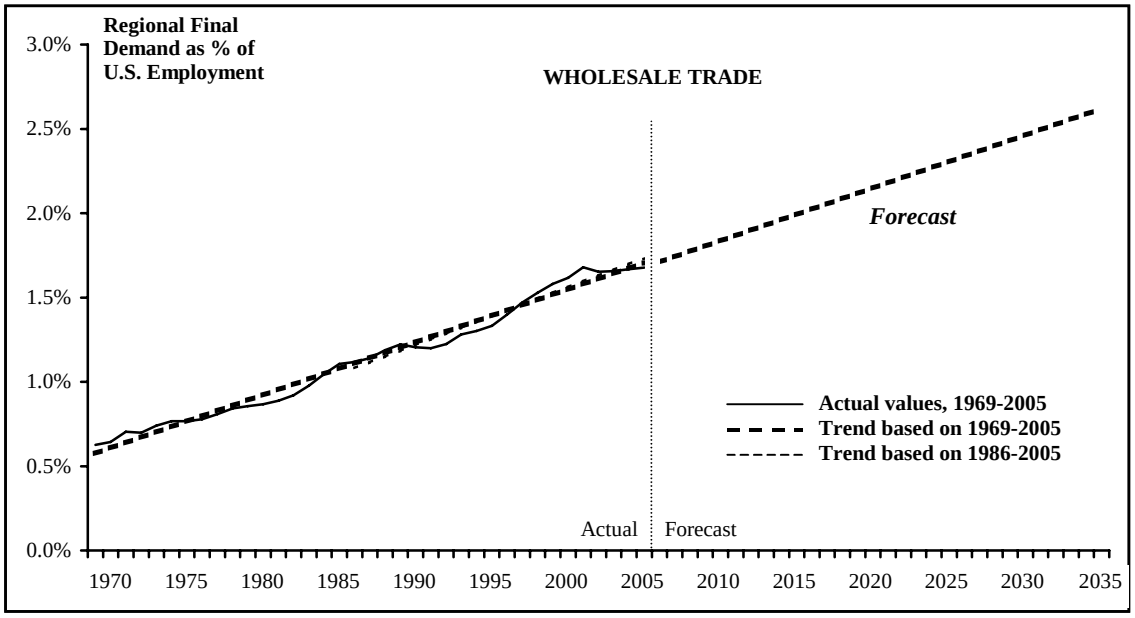
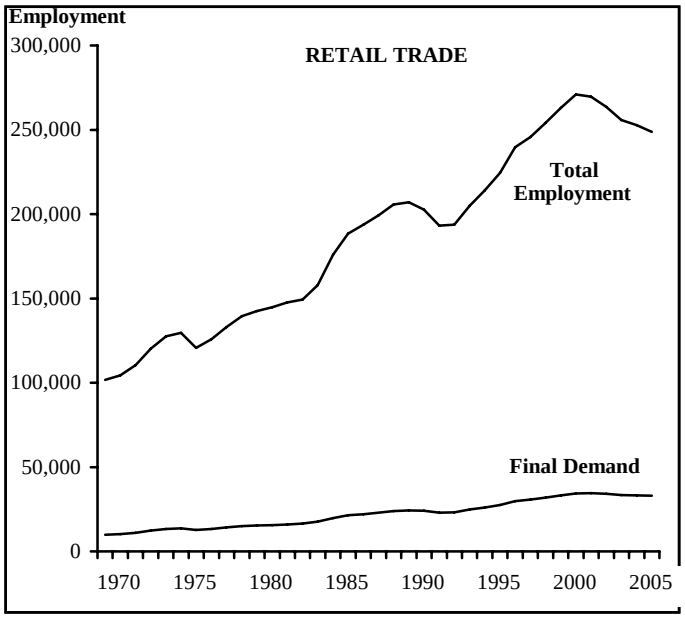
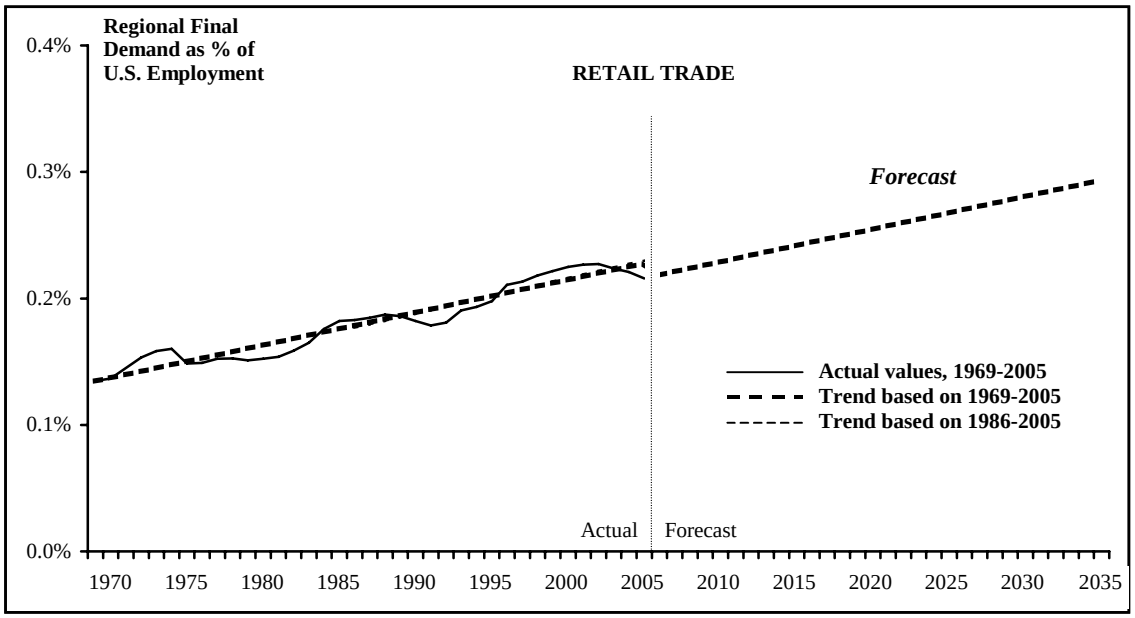
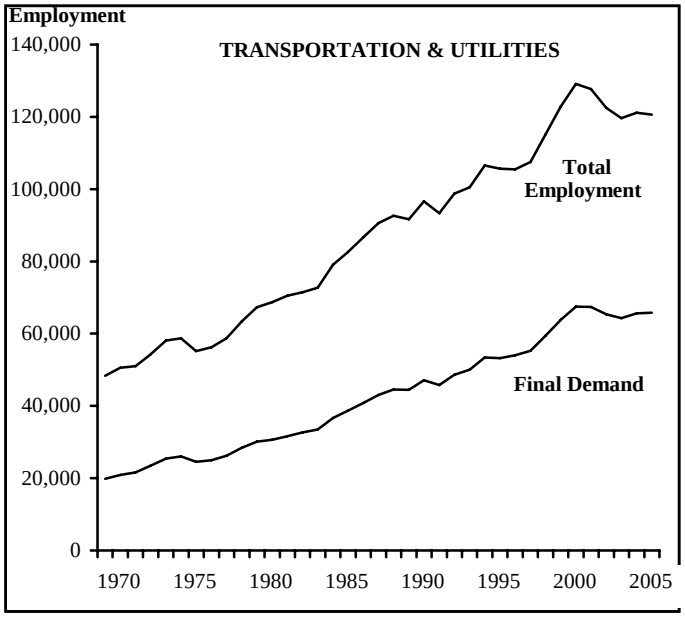


Figure 3. TOTAL AND FINAL-DEMAND EMPLOYMENT IN RETAIL TRADE AND TRANSPORTATION & UTILITIES







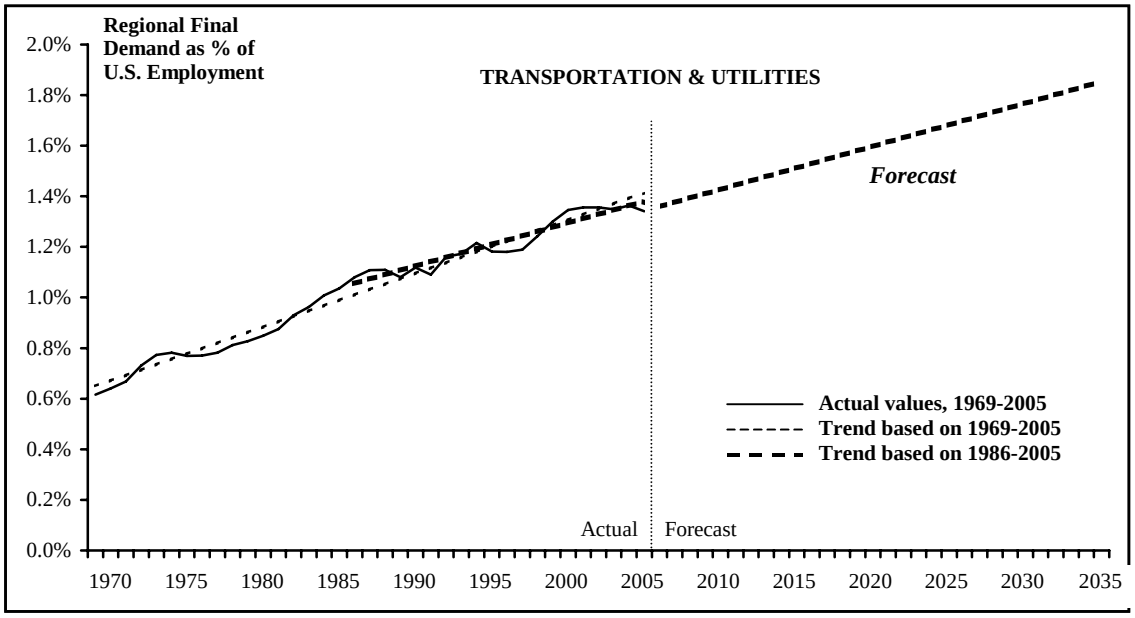
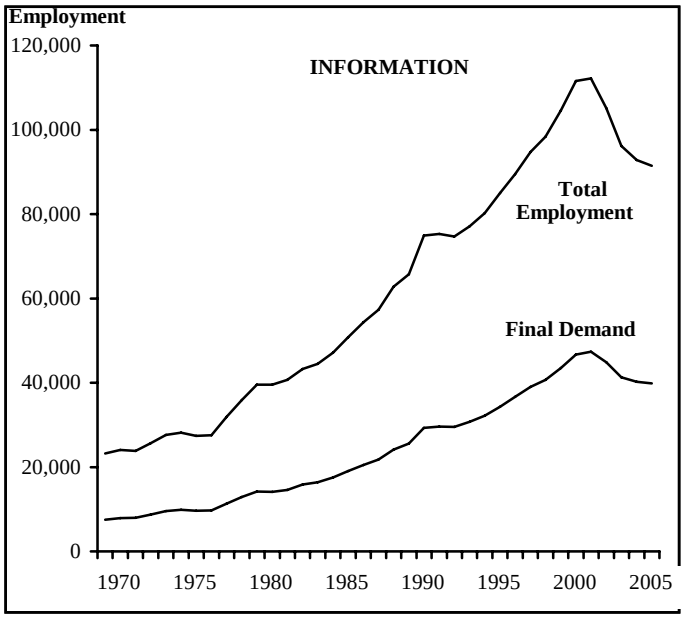
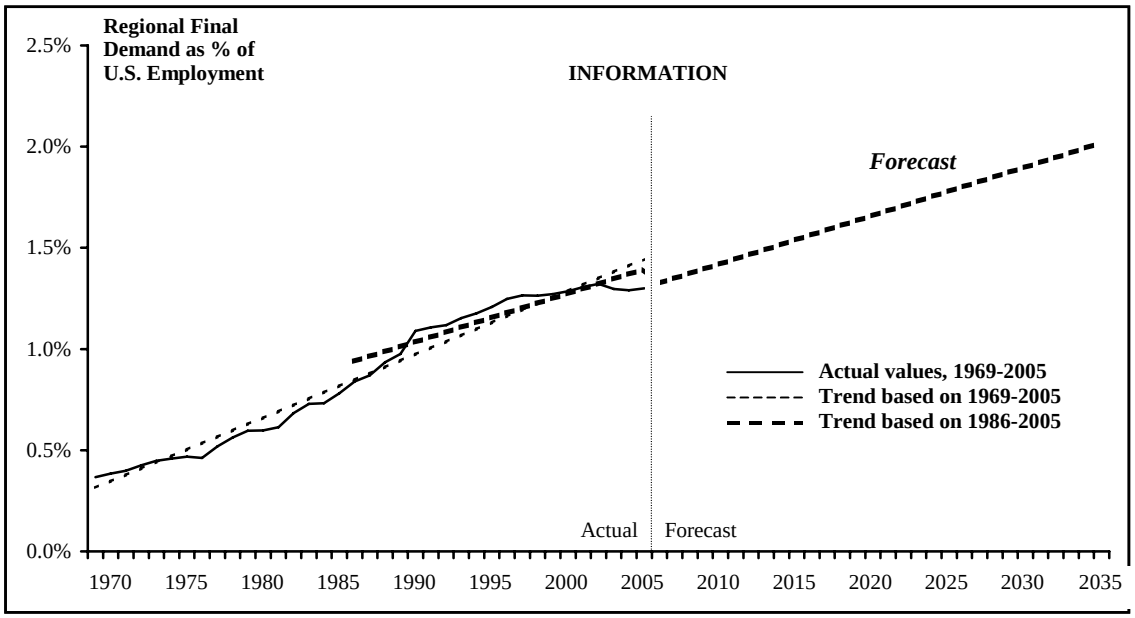
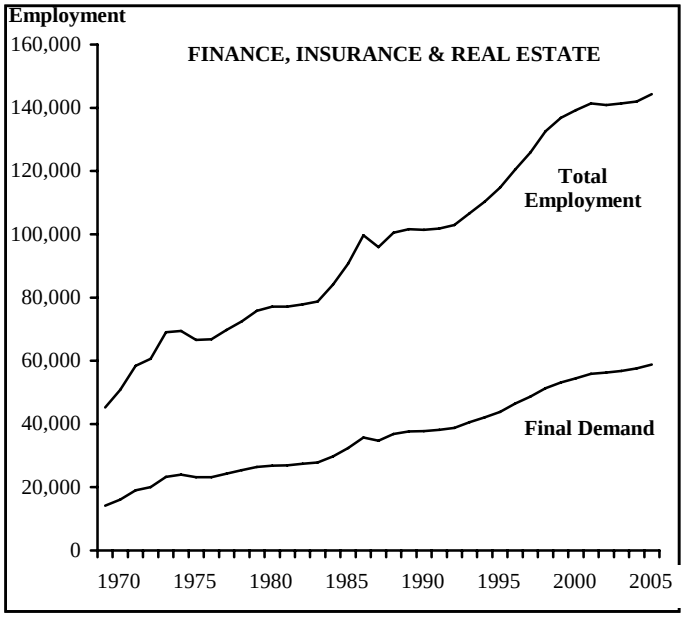


Figure 4. TOTAL AND FINAL-DEMAND EMPLOYMENT IN INFORMATION AND FINANCE, INSURANCE & REAL ESTATE







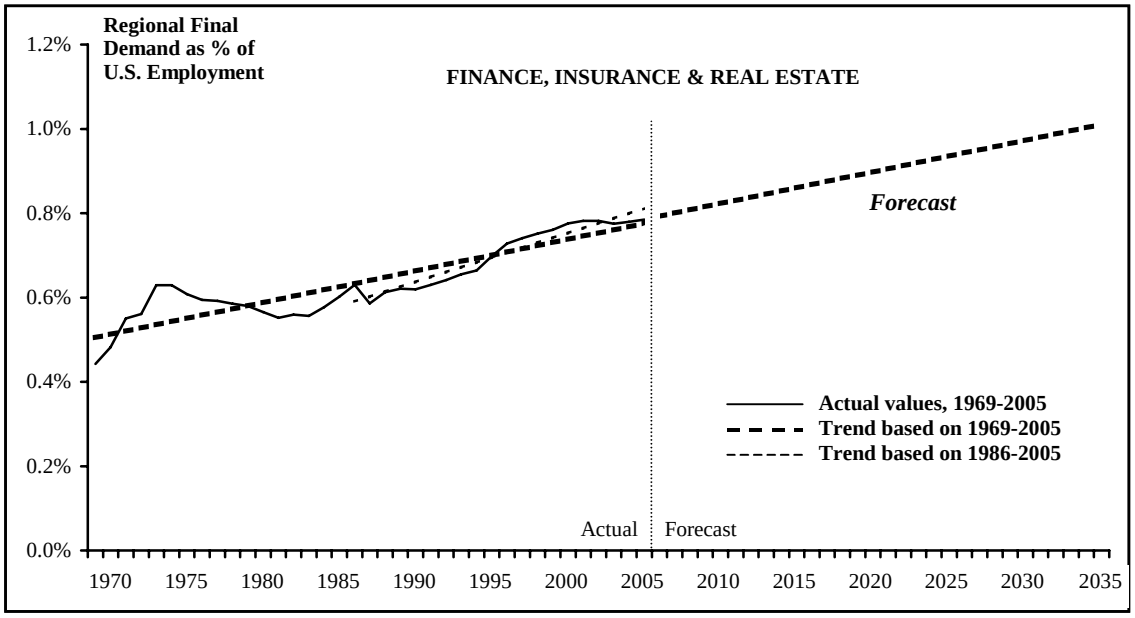
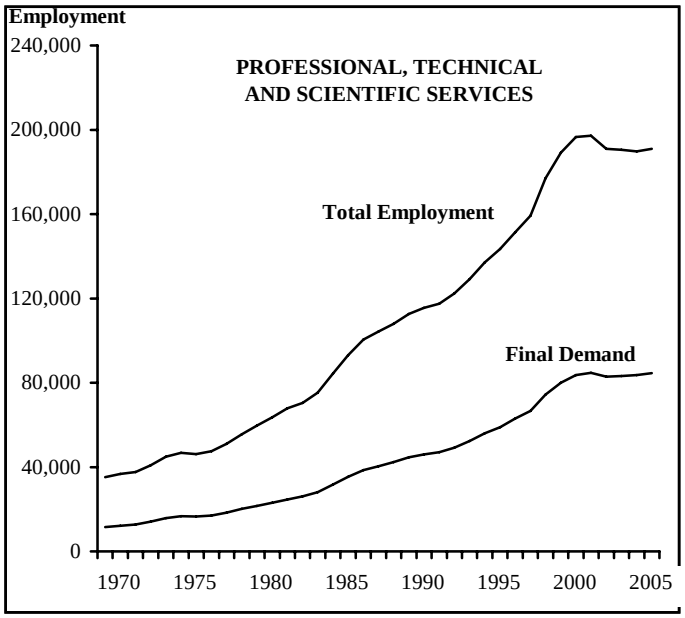
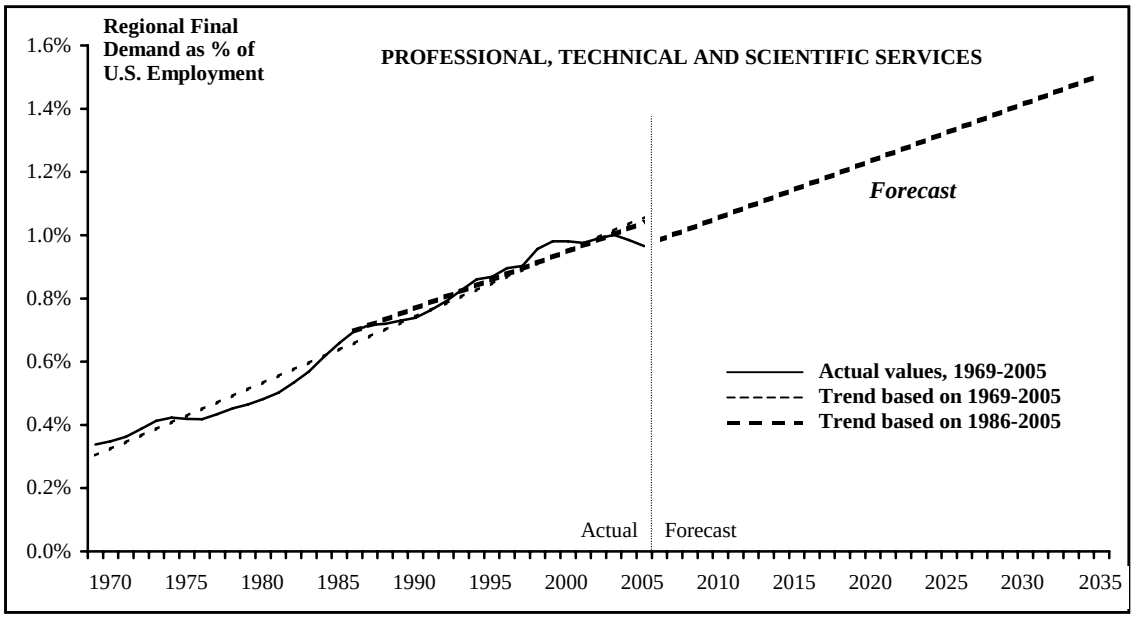
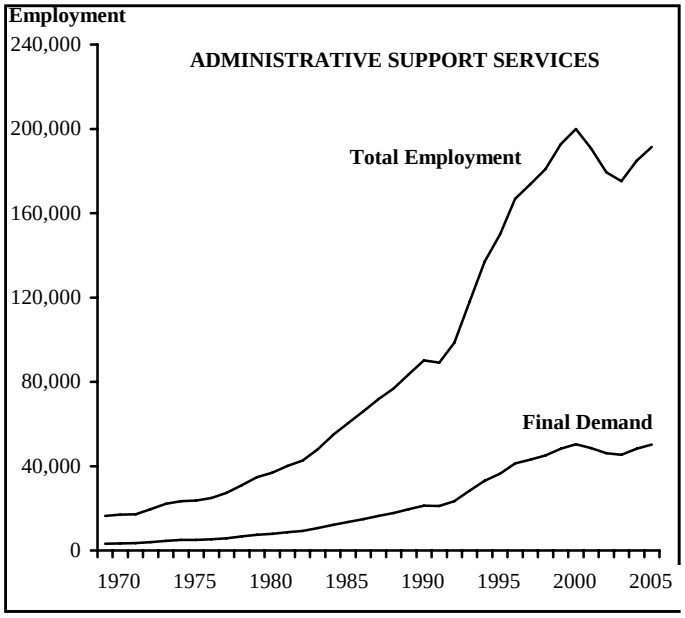


Figure 5. TOTAL AND FINAL-DEMAND EMPLOYMENT IN PROFESSIONAL-TECHNICAL AND ADMINISTRATIVE SUPPORT SERVICES







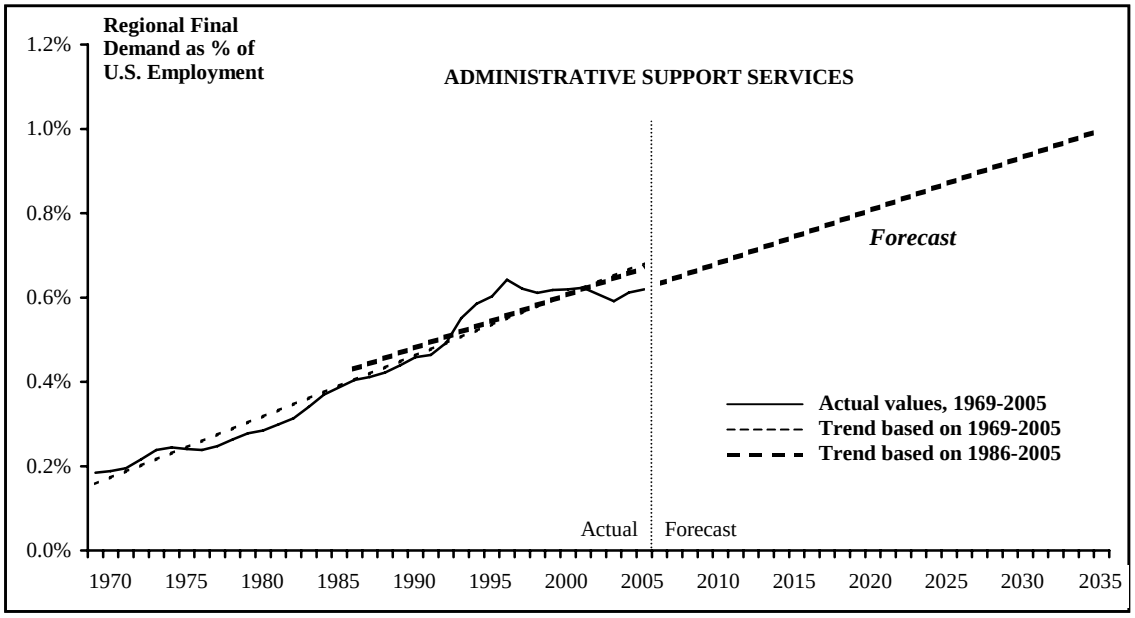
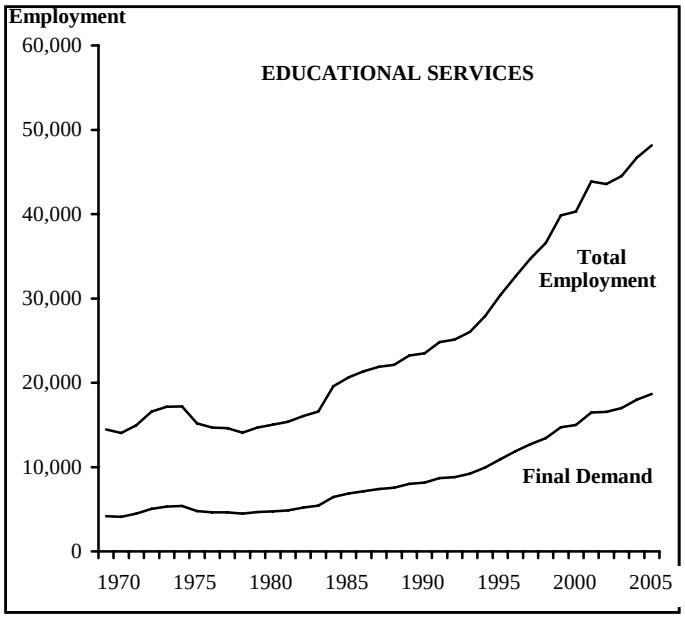
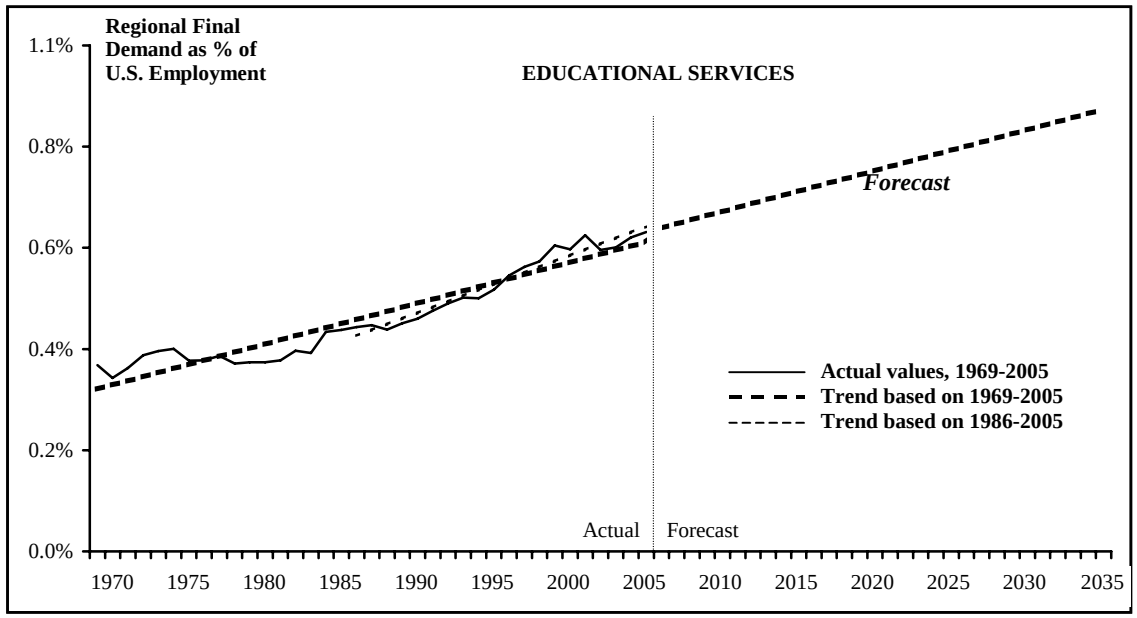
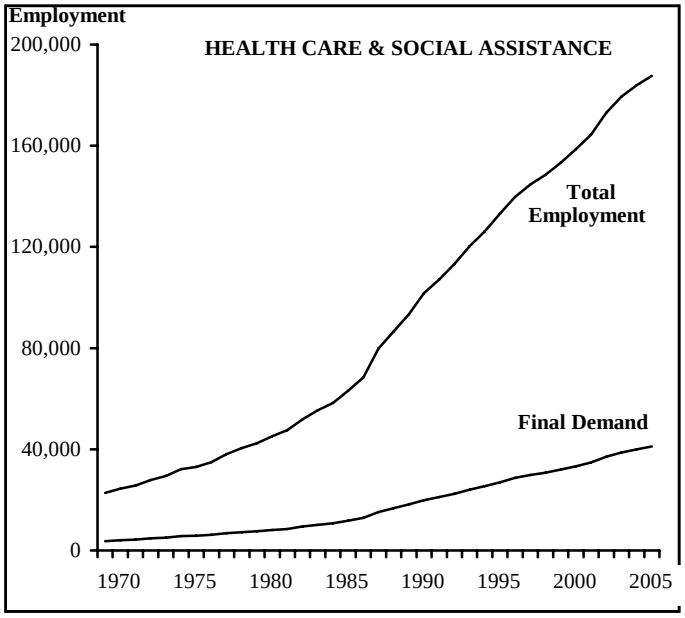


Figure 6. TOTAL AND FINAL-DEMAND EMPLOYMENT IN EDUCATIONAL SERVICES AND HEALTH CARE & SOCIAL ASSISTANCE







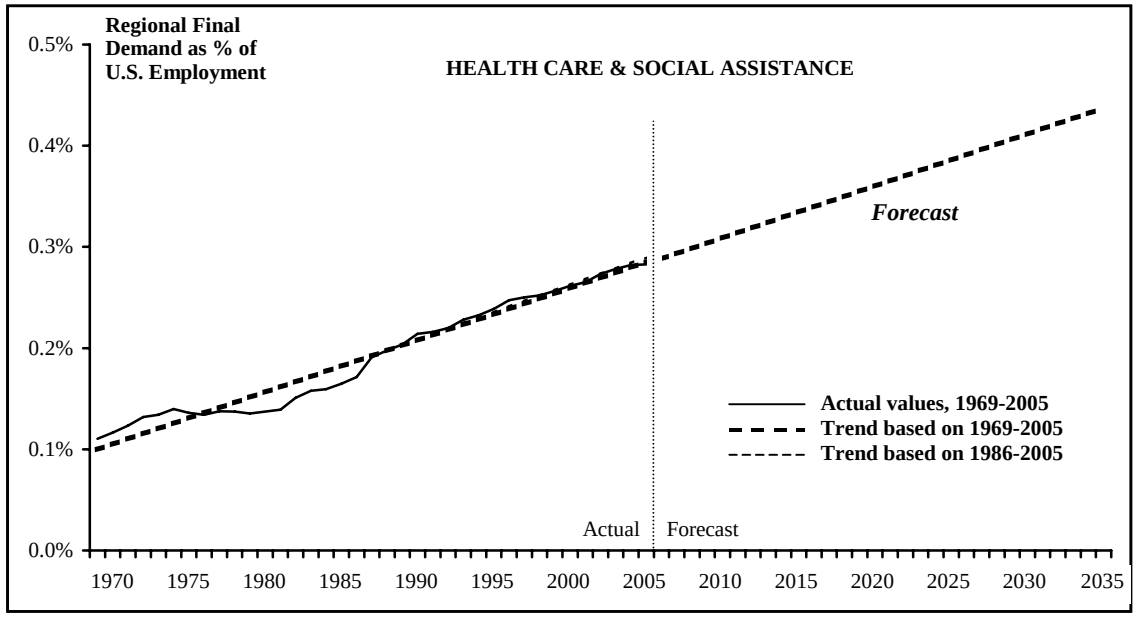
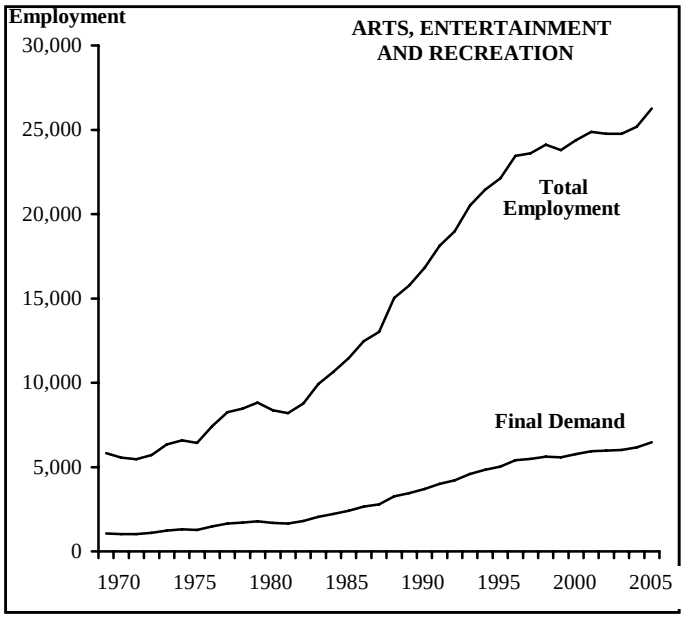
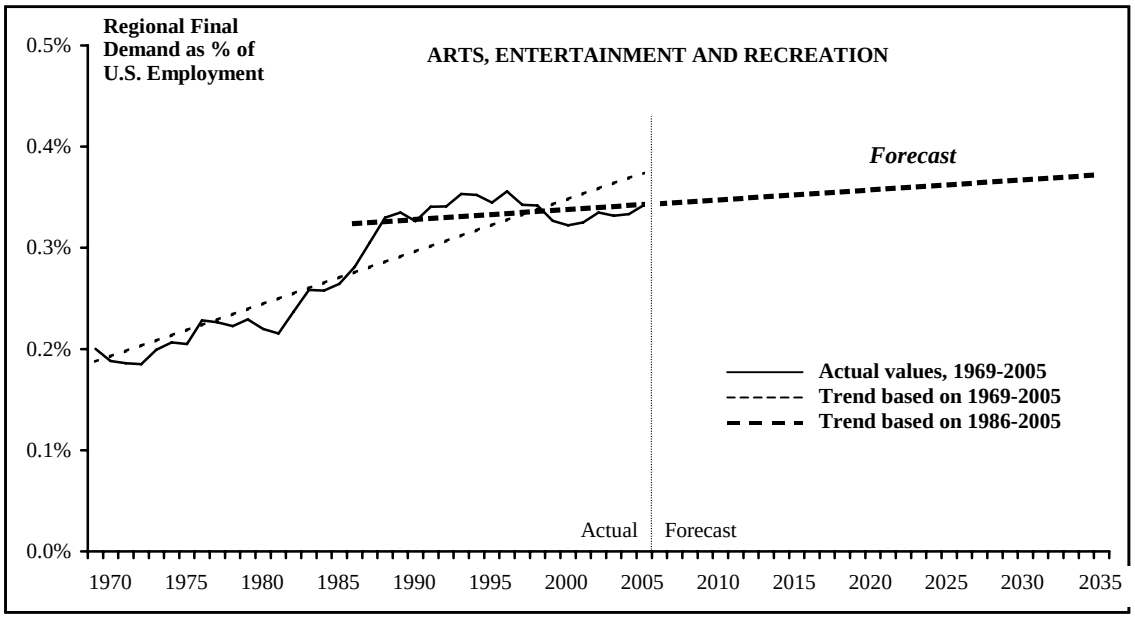
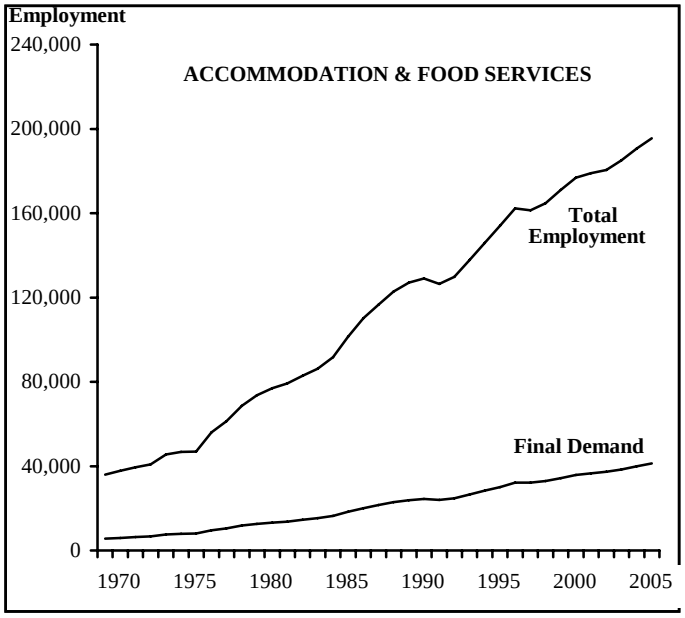


Figure 7. TOTAL AND FINAL-DEMAND EMPLOYMENT IN ARTS & RECREATION AND ACCOMMODATION & FOOD SERVICES







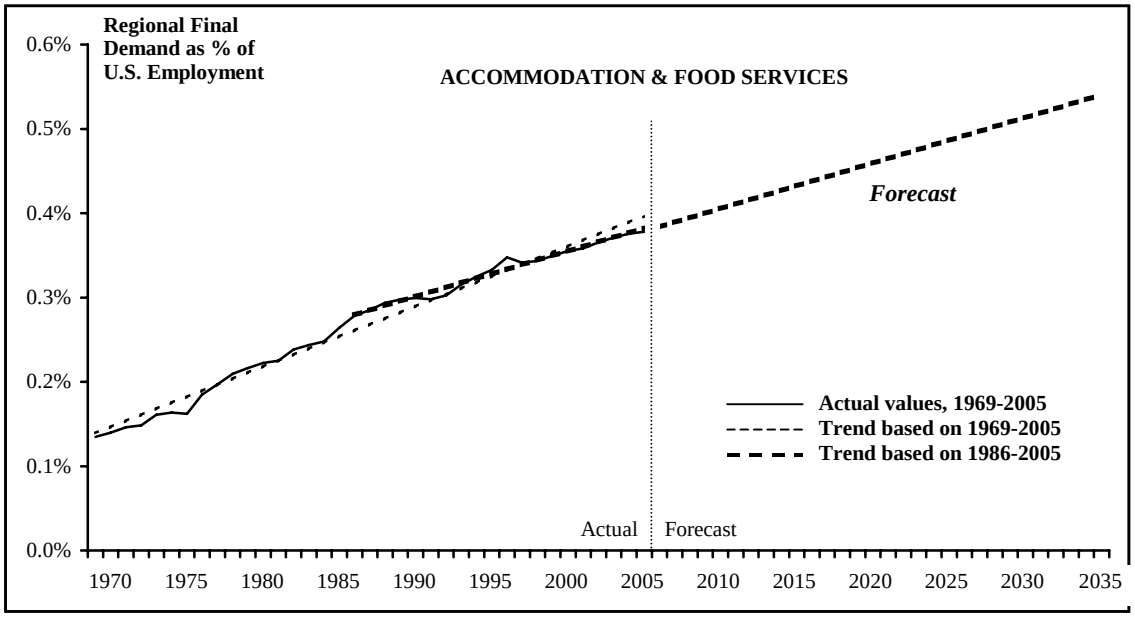
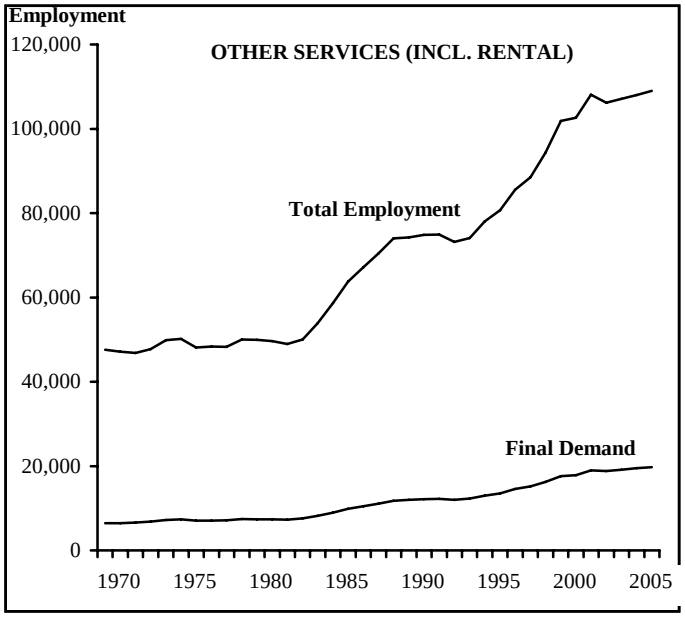
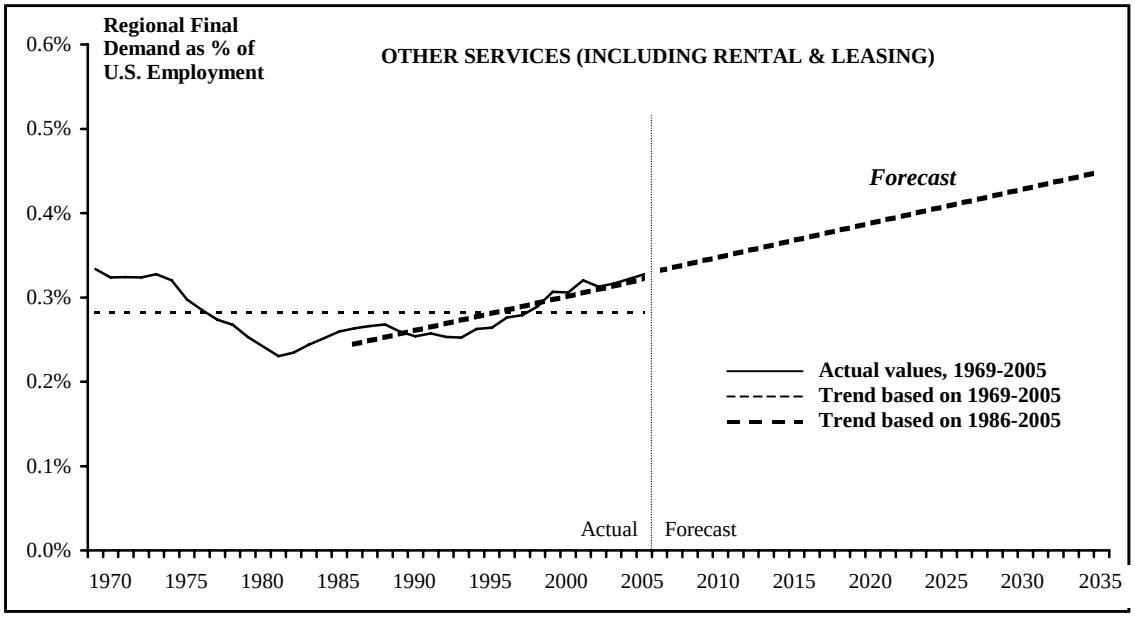
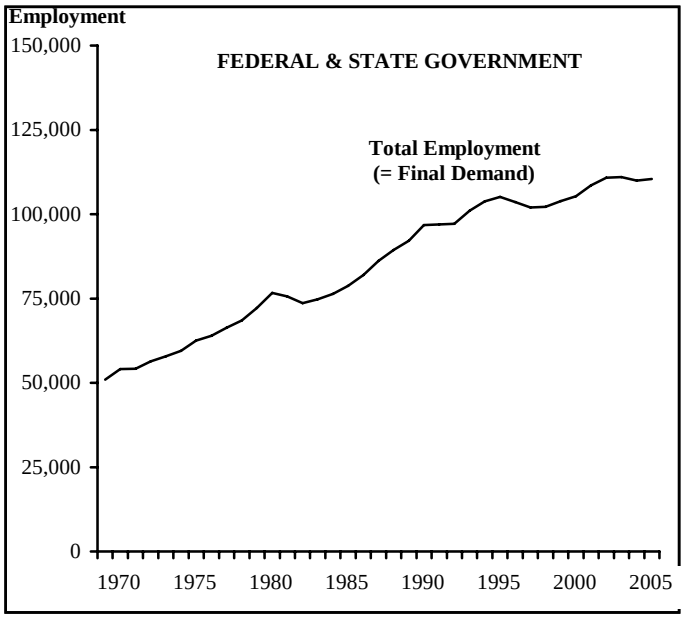


Figure 8. TOTAL AND FINAL-DEMAND EMPLOYMENT IN OTHER SERVICES AND FEDERAL & STATE GOVERNMENT







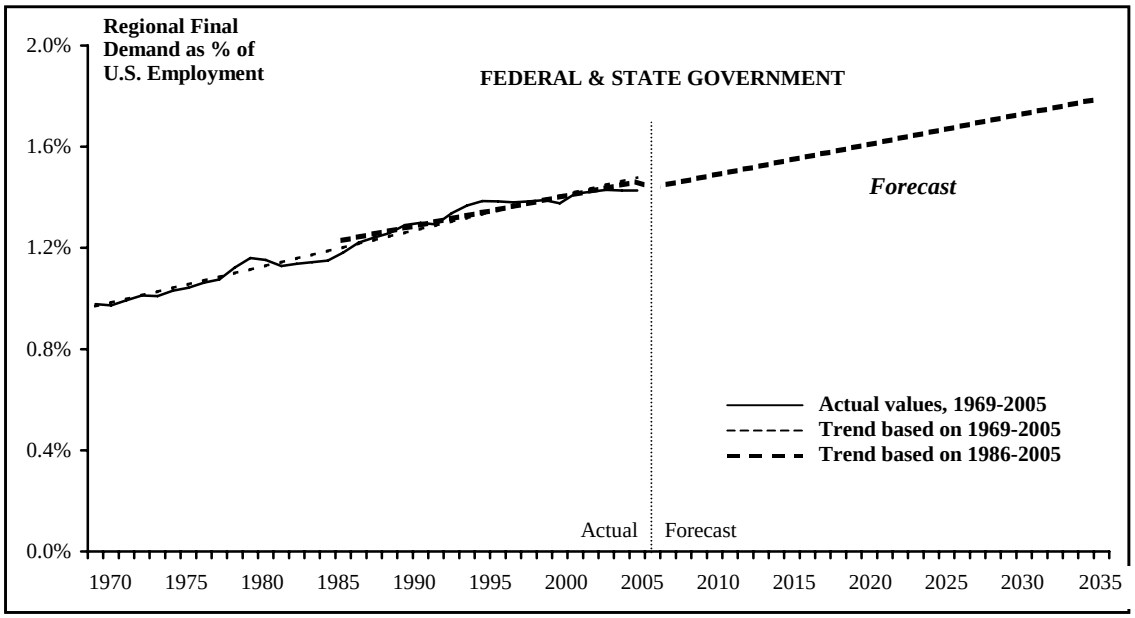
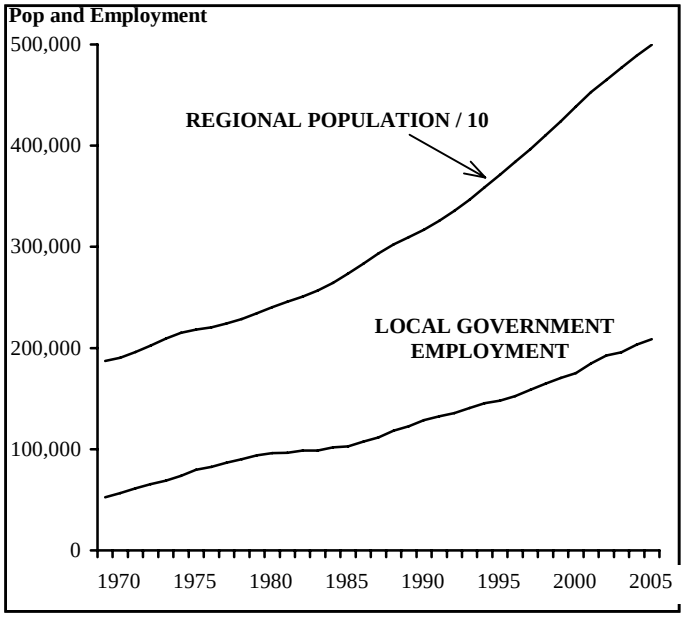
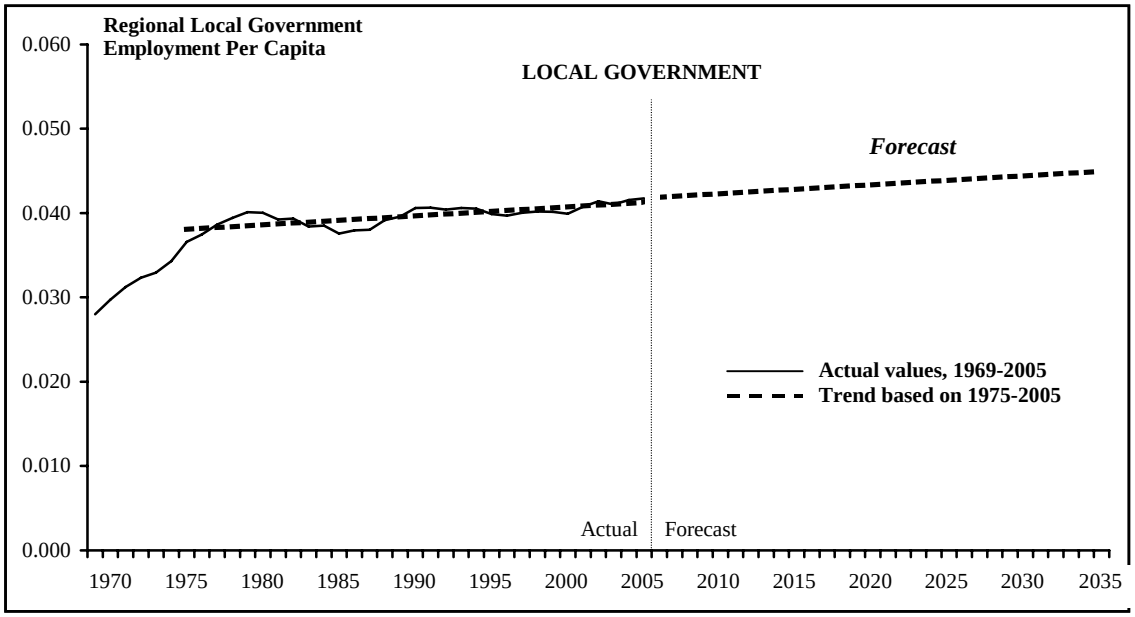
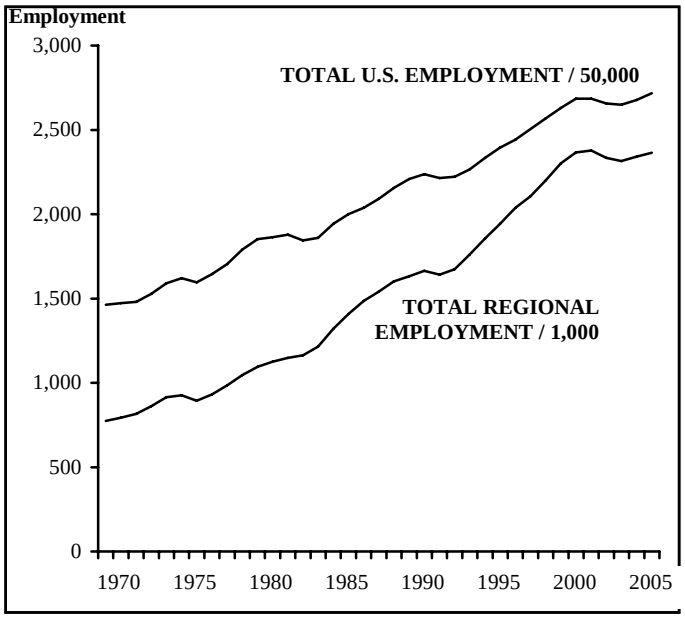
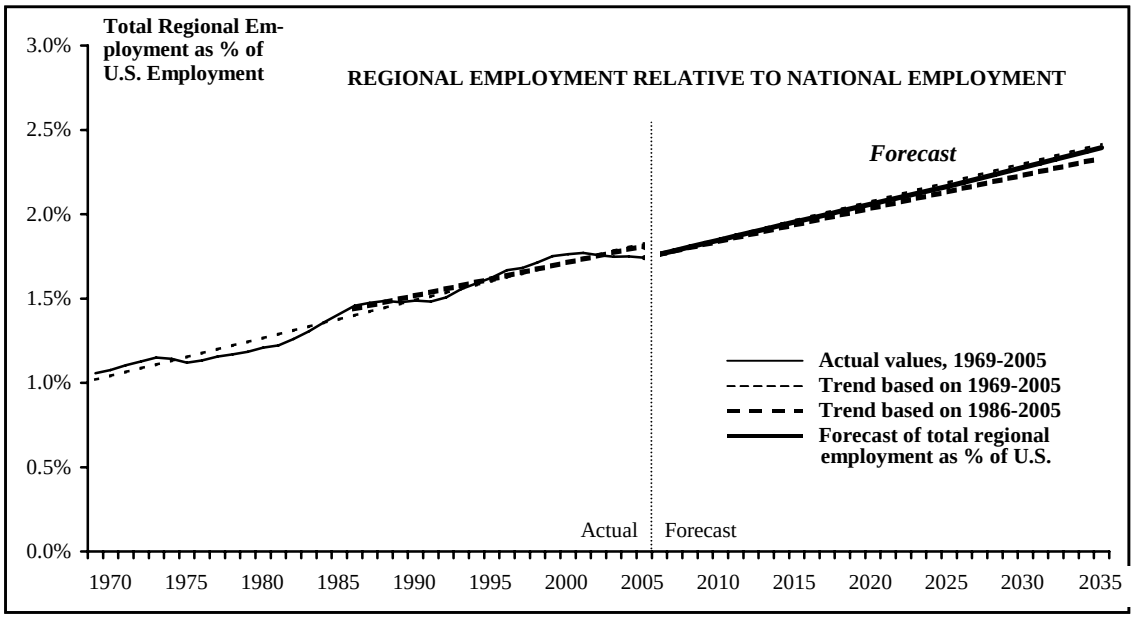


Figure 9. PREDICTIVE RELATIONSHIP FOR LOCAL GOVERNMENT, AND COMPARISON OF AGGREGATE REGIONAL FORECASTS









The shifting of trend lines to make them hold exactly for 2005 served to lower the relationships for three-quarters of all sectors and thus added an element of conservatism. The philosophy behind this step is illustrated by the graphs for the construction industry in the lower portion of Figure 1. Construction employment in the Atlanta region relative to the U.S. has long followed a strongly cyclical pattern (resembling the overall business cycle except that Atlanta stayed below trend between the national recessions of 1974 and 1981-82). This pattern has involved periods of very rapid advancement followed by retrenchment. As of 2005 the region was markedly below trend. A forecasting process that treated 2000-05 as just another slow period would extrapolate one of the historical trend lines without adjustment on the assumption that the region would soon bounce back strongly enough to resume its former oscillatory pattern. However, the forecasts reported here assumed that for construction and many other sectors, the 2000-05 stagnant period would prove to have some permanent costs. The region would regain its former capacity to outpace the nation economically, but would proceed from a lower base than would have applied if the recent slump had been less protracted.

The relationships in figures 1 through 8 do not require further commentary. The sectors featuring the most abrupt changes of trend during the historical period were agriculture, arts-recreation, and "other services" (all addressed with 20-year trend lines). Perhaps the most questionable cases were information and administrative support services, where much lower forecasts could have been obtained by projecting forward 10-year trends rather than 20-year trends.

The upper portion of Figure 9 shows the relationship used to forecast local government employment. It simply consists of a linear time trend in the region's local government employment per capita. Because the first few years of the historical period differed substantially from the remainder in terms of this measure, the time trend covers only the 31 yearly observations for 1975 though 2005. This relationship was applied later in the forecasting sequence than those for components of final demand. The sequence involved: 1) obtaining final-demand percentages for future years from the 16 extrapolated relationships just discussed; 2) multiplying these percentages by forecasted U.S. employment to obtain final-demand estimates in absolute terms; 3) applying the predetermined multiplier of 2.697 to overall final demand to obtain total employment for each future year; 4) using cohort-survival analysis to forecast regional population on the basis of employment; 5) applying the predictive relationship from Figure 9 to estimate local government employment on the basis of population; and 6) using the input-output table to allocate future private employment among industries. The last step treated all government employment as final demand and involved the rule-based matrix adjustment process discussed above.

The relationships appearing in the lower portion of Figure 9 are offered for reasons of interest and played no role in the forecasting process. The left-hand graph in this case describes total employment in the region and the U.S. (divided respectively by 1,000 and 50,000 to situate the plots conveniently). The right-hand graph shows regional employment as a percentage of U.S. employment, with 37-year and 20-year trend lines fitted to the percentages. The right-hand portion of the graph shows these trend lines

when pegged to the 2005 percentage and extrapolated across the forecast period. Also appearing on the right-hand side is a heavy solid line describing the forecast of regional employment obtained by the steps summarized above. This line – which looks straight but actually has a slight bend – falls between the two trend lines obtained by simple extrapolation. Thus, rather than partitioning the regional economy and going through tortuous input-output computations, we could have gotten essentially the same answer by performing a simple extrapolation based on total employment. Of course, there was no way to know this ahead of time

Regional Demographic Forecasting

Regional population by race, age and sex was forecasted using familiar cohort-survival methods. The only complication was that breaking down population by race created a need to address 144 different population components.

A cohort-survival tableau "ages" a population group across a time interval – always understood here to equal 10 years, since the present analysis was structured on that basis – by observing that the end-year population in a given age bracket must equal the initial-year population ten years younger, plus births (if the initial-year population is unborn), minus deaths, plus net migration. A tableau is first established for an historical period in order to compute net migration as a residual for each population cohort. Then successive tableaus are used to address population changes across future intervals, with births, deaths and net migration computed using estimated rates and other information from the historical analysis.

For the Atlanta region much attention was devoted to establishing race-specific birth rates by age of mother and individual death rates for all race-sex-age groups. (Such rates were needed to allocate births and deaths in the historical analysis as well as to estimate future magnitudes.) The data sources included: aggregate births and deaths for the Atlanta region; race-specific birth rates by age of mother for the state of Georgia; and detailed U.S. birth and death rates, needed for various supplementary purposes including establishment of trends over time. Two notable findings from the historical analysis pertained to the Hispanic population. First, Hispanic females in Georgia – of whom over two-thirds occupied the Atlanta region – had exceptionally high birth rates, totaling well over three lifetime births per woman. Second, Hispanic net migration into the Atlanta region was skewed toward males to such an extent that it raised the male share of total Hispanic population from 55% in 1990 to 60% in 2000. The cohort-survival forecasting process assumed that both of these situations would moderate in the future, with the male share of net migration falling to 53% and birth rates declining to equal the national Hispanic rates by the end of the forecast period.

Given its dependence on census data, the historical analysis necessarily focused on the 1990-2000 interval. It was followed by an intermediate analysis addressing 1995-2005, wherein the cohort-survival tableau was used in a forecasting mode but the results were pegged to pre-established totals for race-sex groups. This analysis generated age breakdowns for 2005 and the five-year patterns of net migration summarized in Table 2.

The findings of the historical analysis yielded a three-way partitioning of net migration. For population cohorts with end-year ages not exceeding 55-59 for white males, 50-54 for white females, and 60-64 for other race-sex groups, net migration was always positive and was referenced as "economically motivated" migration (on the assumption that children accompanied working-age adults). To obtain factors for later application, the values of this migration component were expressed as percentages of total economically motivated migration. (The intermediate analysis used percentages of race- and sex-specific totals, whereas the forecast for each future interval utilized an overall percent distribution.) The second migration component consisted of negative flows for all white males above end-year age 55; for white females of end-year ages 55 through 69; and for black males in the two oldest age groups. These negative flows were expressed as percentages of average population in the individual cohorts to which they applied. The third migration component consisted of positive flows for all remaining population groups above the age of economically motivated migration. They were expressed as percentages of average total population in the racial categories where they occurred. Given these migration-related factors plus birth and death rates, the only additional input required to project the region's population across a future time interval was an estimate of total economically motivated migration.

Net migration and labor force participation rates formed the linkages whereby demographic changes were economically driven. Labor force participation rates for the region in 2000 and 2005 were prepared from census labor force data for race-sex groups and from U.S. data on participation by age. The 2005 rates were then projected forward on the assumption that they would move in parallel with future U.S. rates (after partially rebounding in 2005-10 from their declines earlier in the decade). The rates thus established for a given year were entered into the relevant cohort-survival tableau and multiplied by its end-year population predictions to yield an estimate of the region's total labor force. After adjustments for unemployment and net interregional commuting, the result would be an estimate of the total at-place employment consistent with the given population. A tableau's predicted population would depend upon the assumed level of economically motivated net migration that entered its computations. So the forecasting process consisted of finding the volume of migration that would just allow the region to staff its economy at the employment level already established by the economic analysis.

Cohort-survival projections thus linked to the economic forecasts were obtained in succession for the 2005-15, 2015-25 and 2025-35 intervals. In each case the solution value of economically motivated net migration had to be found by a three-step process of trial and error. (There was also an inner iterative loop because many of the rates in the tableau multiplied averages of initial-year and end-year populations, which meant that the tableau had to converge upon solution values of the latter for whatever migration level had been assumed.) Values of demographic variables for 2010, 2020 and 2030 were obtained by interpolation using a third-degree polynomial equation, which was a means of fitting a curved line through four points.

A 5% unemployment rate was used in translating 2015, 2025 and 2035 labor force magnitudes to employment. Net interregional commuting – the number of nonresidents

working inside the region minus the number of residents working outside – equaled 1.7% of employment in 2000 and was assumed on a trend basis to reach 2.7% by 2035. A key assumption for the region's future racial profile involved the mix of economically motivated net migration. The cohort-survival forecasts assumed that in all future years this migration component would be distributed across the four racial groups in the same proportions as during 1990-95. As suggested by Table 2 (which disregards gender and includes the second and third migration components along with the first), this distribution involved a white share intermediate between the peak of the late 1990s and the trough of 2000-05, and a Hispanic share intermediate between extremes in the other direction. The specific percentages were 25.7% white, 38.9% black, 10.6% Asian and 24.7% Hispanic. A forecasted outcome of this pattern was that persons in the white category – even with that group's inclusion of miscellaneous races – would become a minority of the region's population sometime in 2019.

Regional Demographic Forecast Summary

The regional forecasts thereby obtained are best described by reversing the order of presentation and addressing demographics first. Table 5 on the next page summarizes the population forecasts through 2035 by racial group. Like others to follow, this table includes some historical data and uses a horizontal line to demarcate observed quantities (or estimates thereof) from forecasted quantities. Unlike other cases, however, Table 5 repeats the line for 2005 to accommodate the racial shift described in the footnote.

The total population of the 29-county Atlanta region was forecasted to increase from just over 5 million persons in 2005 to approximately 7.6 million persons in 2030 and 8.3 million in 2035. For the first fifteen years of the forecast period, the region's annual population gains would be smaller in both absolute and percentage terms than those observed during the 1990s, and would even fall below the average gain during 2000-05 when employment was almost static. Population growth would begin to rise appreciably after 2020, first in absolute terms and then also on a percentage basis. There would be a mild acceleration near the end of the forecasting period due to an upturn in the national employment magnitudes driving the regional forecast. Overall, the region's forecasted annual growth rates would be modest by metro Atlanta standards, but would exceed the corresponding U.S. rates by 0.8% to 1.0% per year, with the gap steadily increasing after 2015.

The interior and lower portions of Table 5 show a demographic transition of staggering proportions. In 1990 the region's population was nearly 72% non-Hispanic white and only 2% Hispanic. By 2035 the population will be 43% white and nearly 17% Hispanic. Meanwhile the black share of population will have increased from less than one-quarter to over one-third, and the relatively small Asian share will have quadrupled. In ascending order of importance these changes will be linked to: 1) differences in initial age distributions (with whites now having a median age 5.6 to 11.5 years older than the other groups and thus an expectation of higher deaths); 2) differences in birth rates, most importantly affecting Hispanics; and 3) differences in net migration rates. The last factor involves the assumed racial mix of net migration discussed at the end of the last section.

Table 5. FORECASTED REGIONAL POPULATION BY RACIAL GROUP

	Number of Persons by Racial/Ethnic Group					Change Per Year	
	White	Black	Asian	Hispanic	Total	Absolute	Percent
1990	2,271,623	778,212	51,660	63,358	3,164,853		
1995	2,464,579	984,446	96,309	168,596	3,713,930	109,815	3.25%
2000	2,701,199	1,237,349	151,061	297,649	4,387,258	134,666	3.39%
2005	2,845,548	1,490,731	209,681	459,867	5,005,827	123,714	2.67%
2005*	2,848,222	1,490,731	207,007	459,867	5,005,827		
2010	2,964,845	1,665,904	246,068	569,851	5,446,668	88,168	1.70%
2015	3,078,001	1,854,234	288,786	691,776	5,912,797	93,226	1.66%
2020	3,190,468	2,059,530	336,579	830,097	6,416,674	100,775	1.65%
2025	3,305,026	2,285,596	390,867	989,270	6,970,760	110,817	1.67%
2030	3,424,457	2,536,240	453,066	1,173,751	7,587,514	123,351	1.71%
2035	3,551,539	2,815,268	524,596	1,387,995	8,279,398	138,377	1.76%
% of Total							
1990	71.8%	24.6%	1.6%	2.0%	100.0%		
1995	66.4%	26.5%	2.6%	4.5%	100.0%		
2000	61.6%	28.2%	3.4%	6.8%	100.0%		
2005	56.8%	29.8%	4.2%	9.2%	100.0%		
2005*	56.9%	29.8%	4.1%	9.2%	100.0%		
2010	54.4%	30.6%	4.5%	10.5%	100.0%		
2015	52.1%	31.4%	4.9%	11.7%	100.0%		
2020	49.7%	32.1%	5.2%	12.9%	100.0%		
2025	47.4%	32.8%	5.6%	14.2%	100.0%		
2030	45.1%	33.4%	6.0%	15.5%	100.0%		
2035	42.9%	34.0%	6.3%	16.8%	100.0%		

* Line for 2005 is repeated to reflect the shift of Native Hawaiians and Pacific Islanders from the Asian category to the white-and-other category (for source-related reasons).

Table 6 on the next page describes the anticipated components of demographic transition for all categories of regional inhabitants. As indicated by the earlier discussion of cohort-survival forecasting, these components are births, deaths and net migration. Table 6 lists them in rows that refer to time intervals rather than individual years and carry forward the population totals from one interval to the next. The table's last column expresses net migration as a percentage rate for each interval.

Natural increase – births minus deaths – will continue to supply large population gains throughout the forecast period, but will stay in a range of 45,000 to 48,000 persons per year rather than increasing. Net migration will drop to a bit over half of its 2000-05 level in the remainder of the present decade, but then will rise persistently to become the dominant source of population growth after 2015 and regain its 2000-05 level by 2025-30. As a percentage rate, however, net migration is never expected to approach the magnitudes that occurred prior to 2005.

Table 6. COMPONENTS OF REGIONAL DEMOGRAPHIC TRANSITION

	Initial-Year Population	Births	Deaths	Net Migration	End-Year Population	Annual Rate of Net Migr.*
1990-95	3,164,853	294,694	109,364	363,747	3,713,930	2.12%
1995-00	3,713,930	343,824	122,044	451,549	4,387,258	2.23%
2000-05	4,387,258	375,130	146,168	389,606	5,005,827	1.66%
2005-10	5,005,827	404,656	165,088	201,273	5,446,668	0.77%
2010-15	5,446,668	426,552	189,428	229,006	5,912,797	0.81%
2015-20	5,912,797	447,076	217,379	274,181	6,416,674	0.89%
2020-25	6,416,674	474,532	249,580	329,134	6,970,760	0.98%
2025-30	6,970,760	512,114	286,798	391,438	7,587,514	1.08%
2030-35	7,587,514	567,314	329,568	454,138	8,279,398	1.14%

* Equals annual net migration divided by the average of initial-year and end-year pop.

Table 7 on the next page looks at the regional age distribution. The five age categories are standard except that a 55-to-74 group has been inserted between middle age and today's version of old age. The table's central portion gives percent distributions across the age brackets, and its lower part offers equivalent percentages for the U.S. The right-hand column shows the median ages of the regional and national populations in each year.

The regional population is expected to age over time but remain young relative to the U.S. From 2005 to 2035, the two bottom age groups will increase by 50% to 60% and the 25-to-54 group will rise by only 43%, while the 55-to-74 and 75-plus groups will respectively increase by 136% and 231%. The shares of population supplied by the various groups will generally track U.S. trends, starting from a younger profile. The region's population shares aged 0-to-17 and 25-to-54 will decline somewhat more than the corresponding national shares by virtue of starting higher. The biggest differences will involve the two top categories, with the region gaining much faster than the nation in the 55-to-74 bracket but slower in the 75-plus group.

The region's 2000 median age of just under 33 years was 2.4 years lower than the corresponding national median. The regional/national gap rose to 2.9 years in 2005 because gains in the regional median were moderated by continued high in-migration (which selects strongly for young persons). The gap is expected to decline from now until 2015, when it will reach 2.33 years, then rise after 2020. In 2035 the region's median age will be almost three years lower than the national median at that time, and will remain a shade lower than the national median in 2005.

Table 7. AGE PROFILE OF THE REGIONAL POP. WITH U.S. COMPARISONS

	Number of Persons by Age Bracket						Median
	0-17	18-24	25-54	55-74	75+	Total	Age
2000	1,167,141	419,343	2,133,479	518,677	148,618	4,387,258	32.96
2005	1,320,449	494,118	2,355,048	667,359	168,852	5,005,827	33.39
2010	1,412,203	530,433	2,469,376	843,169	191,486	5,446,668	34.38
2015	1,501,972	569,335	2,582,056	1,027,129	232,305	5,912,797	35.13
2020	1,597,073	612,597	2,710,795	1,205,855	290,354	6,416,674	35.65
2025	1,704,823	661,995	2,873,304	1,365,962	364,675	6,970,760	36.00
2030	1,832,539	719,304	3,087,291	1,494,068	454,313	7,587,514	36.17
2035	1,987,536	786,299	3,370,464	1,576,788	558,311	8,279,398	36.20
Shares							
2000	26.6%	9.6%	48.6%	11.8%	3.4%	100.0%	
2005	26.4%	9.9%	47.0%	13.3%	3.4%	100.0%	
2010	25.9%	9.7%	45.3%	15.5%	3.5%	100.0%	
2015	25.4%	9.6%	43.7%	17.4%	3.9%	100.0%	
2020	24.9%	9.5%	42.2%	18.8%	4.5%	100.0%	
2025	24.5%	9.5%	41.2%	19.6%	5.2%	100.0%	
2030	24.2%	9.5%	40.7%	19.7%	6.0%	100.0%	
2035	24.0%	9.5%	40.7%	19.0%	6.7%	100.0%	
U.S. Shares & Medians							
2000	25.7%	9.6%	43.6%	15.2%	5.9%	100.0%	35.35
2005	24.9%	9.9%	42.5%	16.6%	6.1%	100.0%	36.28
2010	24.2%	9.8%	41.3%	18.6%	6.1%	100.0%	36.96
2015	23.9%	9.3%	39.8%	20.8%	6.3%	100.0%	37.46
2020	23.9%	8.7%	38.4%	22.2%	6.8%	100.0%	37.98
2025	23.8%	8.9%	37.3%	22.1%	8.0%	100.0%	38.54
2030	23.6%	8.9%	37.0%	21.3%	9.2%	100.0%	38.98
2035	23.4%	9.0%	36.9%	20.2%	10.5%	100.0%	39.19

Regional Employment Forecast Summary

The Atlanta region's economic recovery during the second half of the present decade is expected to raise employment by 2.32% per year, a bit less than three-quarters of the early 1990s growth rate and still further below the other rates achieved in the past century. The pace of job expansion will then decline to about 1.6% per year during the 2020s before rebounding to 1.85% per year in 2030-35. As in the case of population, these annual rates are all more than twice as large as the expected U.S. employment growth rates and exceed the latter after 2010 by a nearly constant 1% margin.

The region's employment per capita is expected to rebound from 0.472 in 2005 to 0.487 in 2010 and 0.491 in 2015. Even though these gains far exceed the corresponding U.S. gains of less than 0.001, the region's position will represent a greater deterioration relative to 2000 than experienced by the nation as a whole. U.S. employment per capita will lie within 5% of its 2000 peak during 2010-15, while the region is expected to

remain at least 7% below its 2000 employment per capita (0.528). The upside, however, is that for demographic reasons the region's employment per capita will hold almost constant after 2015 while the U.S. position erodes substantially.

Table 8 breaks down regional employment by industry and gives percent changes across the forecast period as a whole. The fastest-growing sectors – with percentage gains in the triple digits, leading all other industries by at least 38 points – are expected to be: professional and technical services (combined here with corporate management offices); administrative support services; educational services; and health services and social assistance. All of these were among the region's eight sectors that tripled in employment between 1975 and 2005 (the others being construction, information, arts-recreation and food services). Regarding education, a point omitted in the introductory text was that the federal data sources underlying the present forecasts relegate all public workers to the government sector regardless of their function. Hence the figures here for educational services do not cover public education, and up to half of the cited local government workers are associated with public elementary-secondary schools.

Table 8. FORECASTED REGIONAL EMPLOYMENT BY INDUSTRY

	Employment (BLS Definition)							% Chg.,
	2005	2010	2015	2020	2025	2030	2035	2005-35
Extractive activities	12,143	11,682	10,838	9,852	8,962	8,406	8,423	-31%
Construction	130,460	137,490	144,373	151,847	160,647	171,512	185,179	42%
Durable goods mfg.	95,983	100,591	100,636	98,532	96,699	97,551	103,506	8%
Nondur. goods mfg.	94,583	94,950	91,414	86,053	80,944	78,165	79,795	-16%
Wholesale trade	158,592	176,934	191,313	204,045	217,444	233,826	255,505	61%
Retail trade	248,832	269,679	284,868	297,708	311,513	329,591	355,256	43%
Trans. & utilities	120,650	131,189	138,905	145,438	152,429	161,517	174,344	45%
Information	91,490	102,993	112,618	121,528	130,888	141,862	155,613	70%
Fin., ins. & real est.	144,276	163,294	176,452	186,543	196,364	208,710	226,377	57%
Prof./tech. & mgmt.	190,976	226,296	261,689	297,880	335,593	375,552	418,482	119%
Admin support serv.	191,373	234,053	278,651	325,248	373,925	424,763	477,843	150%
Educational services	48,147	57,060	66,192	75,547	85,126	94,930	104,963	118%
Health & social srv.	187,628	225,949	265,629	306,828	349,710	394,434	441,164	135%
Arts & recreation	26,271	28,918	31,316	33,562	35,754	37,990	40,367	54%
Accommodations	22,870	24,776	26,402	27,893	29,393	31,049	33,006	44%
Food services	172,699	194,805	214,228	232,728	252,064	273,993	300,275	74%
Other services	108,991	119,450	127,582	134,752	142,326	151,671	164,152	51%
Federal & state gov.	110,483	118,899	125,108	130,377	135,971	143,158	153,205	39%
Local government	208,625	233,088	257,555	283,144	310,973	342,158	377,817	81%
Total	2,365,074	2,652,097	2,905,769	3,149,505	3,406,723	3,700,839	4,055,269	71%

County-Level Forecasting

Introduction

Forecasts for Gwinnett County were obtained using a regional allocation procedure applied in roughly a dozen other studies since 2000. The hallmark of this approach is exclusive reliance upon empirically calibrated relationships, with a minimum of subjective input. Collectively these relationships are referenced as an allocation model because they are used to allocate pre-established totals across the component areas of a region. They are obtained from cross-sectional statistical analysis of growth patterns in numerous metropolitan counties, most of which necessarily lie outside the study region, on the premise that urban development forces operate very similarly throughout the U.S. For data availability reasons the observation units in the calibration sample always consist of counties and independent cities, but the calibrated model may be used to generate forecasts for large sub-county areas (SCAs) as well as whole counties. The Gwinnett project has used the same model for region-to-county and county-to-SCA allocation in two separate phases.

The present model calibration sample consisted of 355 counties and independent cities in 34 metro areas. These included all MSAs in the eastern half of the country with populations exceeding one million, except for New York, Miami and metro areas in New England and South Florida. The aggregate 2005 population of the sample was just above 90 million. As in other studies, western metro areas were set aside because their geographically large counties would make poor observation units and their frequently mountainous terrain would complicate the estimation of land availability. The Miami-Fort Lauderdale urban complex did not cover enough counties to support the model's reliance on inter-county comparisons, and metro areas in the far Northeast were avoided for reasons of size and contiguity.

Following standard practice, the allocation model focused upon employment by industry and households by income (with households also broken down by race and dwelling unit type in external routines to be discussed later). Other demographic variables were set aside for determination outside the model on the basis of household forecasts and supplementary relationships. Employment was grouped in the nineteen categories shown above in Table 8, which consisted for the most part of two-digit NAICS industries. Income was described in relative terms by assigning households to quintiles based on the regional income distribution. (That is, each metro area's households in each year addressed by the model calibration process were assigned to five equal groups, and the income ranges thus defined were used to assign each county's households to the five groups.) The allocation model thus consisted of twenty-four equations, one for each of the targeted employment and household variables. The equations were structured to address ten-year increments rather than absolute amounts, and their predictive terms were limited in such a way that the equations could be calibrated independently and applied sequentially. The calibration process consisted of using multivariate statistical analysis to "explain" changes in the target variables throughout the 355-county sample during the 1993-2003 interval. The calibration period ended in 2003 because this was the latest year covered by a key source at the time of data assembly. The calibration database included

values of all variables for 1983 as well as 1993 and 2003 because past (i.e., 1983-1993) changes were needed as predictors of current changes.

The predictors in the equations consisted of lagged, initial, and in some cases current values of the same variables addressed by the model (usually embedded in complex functions as explained momentarily). The only quantities entering the model other than categories of employment and households consisted of area measures and dwelling unit data for estimating available land, and latitude-longitude values for computing inter-county distances. As in past studies, the eligible explanatory variables were restricted in this fashion due to the severe limitations on types of data that could feasibly be collected for hundreds of observation units.

Advantages and Disadvantages of "Demand-Side" Modeling

The exclusive reliance upon predictive relationships fitted to empirical data distinguished the present forecasting approach not only from handicraft methods but also from most forecasting models offered by proprietary and literature sources. The gains from insisting upon empirical calibration can be summarized as objectivity and realism. Objectivity is an important concern since it is very easy for forecasters, especially those professionally engaged in guiding urban development, to slip into a prescriptive mode rather than focusing strictly upon prediction. Realism is a challenge since the dynamics of urban development are extremely complex. Molding predictive relationships to observed reality is the only way to assure that they effectively subsume, if not explicitly express, the myriad influences on urban growth.

The limitations of the approach arise from the fact that the predictive relationships of the desired types can only be calibrated reliably using large samples of observations, far larger than required by statistical theory alone. One consequence is that the sample must consist primarily of geographic areas located outside the study region. Another is that for reasons of data availability the observation units must consist of whole counties and independent cities, since these are the basic building blocks of the federal data system. And a third consequence is that only certain types of variables can feasibly be obtained for use as predictors. With a few exceptions these variables are limited to the same quantities one is concerned with predicting, namely demographic measures and employment by industry.

The first two of these three limitations are less serious than they may sound. Growth patterns that are jointly observed across many metropolitan areas can normally be attributed to a given region without hazard because U.S. urban dynamics operate in a highly uniform fashion. Also, with careful treatment of the data one can reliably apply county-based relationships to SCAs that are generally smaller than counties in geographic and socioeconomic terms. What matters most is the limitation on variables available as predictors. This constraint essentially means that a system of equations calibrated in the present manner can only be a "demand-side" model as defined below.

The forecasting problem mostly consists of predicting future land development. In general, the demand for land development to support a given type of activity in a given

area is a function of the area's proximity to all other activities in the region, along with past and current growth in those activities. Sometimes natural features such as waterfront are important, but for the most part what matters is the built environment, which is measurable in terms of the same socioeconomic variables that one is concerned with predicting. What a demand-side model can do is allocate growth across a region by balancing activity-based demand of this nature against rough estimates of land availability based on the amounts of activity already present.

What a demand-side model cannot do, at least not explicitly, is allow for detailed aspects of land supply. "Supply" refers here to the amount of land in a given locality with characteristics favorable to support a given type of development. The characteristics in question include all natural and man-made conditions that can affect the probability of land conversion, whether enduring or subject to change over time. Some of the major categories are: natural land features affecting construction cost; conservation areas and other ecologically based development controls; zoning codes and comprehensive plans; and availability of infrastructure to support various kinds of land development. The key elements of infrastructure tend to be roadways and water and sewer service, which often operate on a relative basis rather than determining development feasibility in absolute terms. These and other factors shaping land supply cannot be covered explicitly in a demand-side allocation model because they cannot be quantified for all the counties and independent cities used as observation units in the model calibration process.

Much depends on the scale at which a model is applied. In general, demand-side factors dominate land development at large spatial scales, while supply-side factors become progressively more important at smaller scales. Demand-side factors clearly matter more at the county level (absent a strong commitment to countywide growth management), while supply-side influences hold sway in small areas like census tracts. Past forecasting studies have suggested that the dividing line falls at about 50 square miles, i.e., that demand-side modeling yields reliable forecasts for areas above this size. Hence there is a general rule that no SCA targeted by a forecasting project should be smaller than 50 square miles unless it already contains more than 25,000-residents, preferably many more.

"Reliable" is a relative term in this context. Stating that demand-side model outputs are normally reliable for areas above 50 square miles is not tantamount to saying that they should stand as final forecasts. What demand-side forecasting provides is a benchmark or platform from which to entertain possible revisions. A pegged demand-side model objectively describes the future conditions that market forces would produce given a continuation of the supply-related influences prevailing in the recent past. If such influences are expected to change – because of new policies, projects, et cetera – a revision process can and should be undertaken. The demand-side forecasts then provide an unambiguous starting point and a very useful context for judging relative magnitudes. Another advantage is that, while subjective judgment can never be banished from a forecasting enterprise, demand-side modeling serves to roll down the subjective element of forecast development to the SCA level and make all judgments explicit.

A final argument for the approach revolves around the fact that any variable used as a predictor in any forecasting procedure must itself be predicted. There is some basis for contending that, notwithstanding relative leverage on land development, demand-side variables tend to make better predictors than supply-side factors because they themselves are more predictable. For example, past trends and current development patterns may yield clear indications that housing demand will be heating up in county X. A new freeway to county X may make a big difference to what happens there. But given the vagaries of highway funding and environmental constraints and transportation politics, there may be more uncertainty about the freeway than the housing demand. In fact, housing demand may be the best predictor of when and if the freeway will get built. So in such situations an investigator faced with a choice of predictors would often do well to go with demand.

Basic Model Characteristics

To simulate urban growth dynamics realistically, an allocation model must at a minimum have the capacity to express: 1) possible interactions among all combinations of economic sectors and household groups; 2) the influence of events in each area on events in nearby areas; and 3) the retarding effects on growth of progressive reductions in available land. The Gwinnett approach met the first criterion by treating all economic sectors and household groups – collectively called "activities" – as eligible predictors in all equations. The only limitations were that the nineteen industries were combined into four groups for predictive purposes, and that contemporaneous change in an activity could only enter the equations for activities addressed later in the modeling sequence (to eliminate the need for simultaneous-equation estimation).

The second and third criteria must be met for an allocation model to replicate the familiar S-shaped pattern of suburban development, wherein growth initially escalates due to external influence – the propagation of demand from other areas – but eventually slows as land supply becomes constraining. Every equation of an allocation model should have the capacity to balance the advantages of centrality (proximity to existing urban development and growth) against the draw of more abundant and presumably cheaper land at less central locations. These factors clearly interact on a multiplicative rather than additive basis, since growth potential goes to zero when either proximity or available land approaches zero. Hence the capacity in question is best imparted by structuring a model so that both of these factors are embedded in most individual predictive variables. The present study employed the standard solution of using "proximity" terms weighted by equation-specific indexes of land availability.

Other than a few variables pertaining to past change and initial level of the specific activity being addressed, all of the candidate explanatory variables in each regression analysis were based upon "proximity" measures. A given area's proximity to some activity – i.e., some category of employment or households – was computed by weighting the amount of that activity in every part of the area's home region by an inverse function of distance to the subject area, then summing the results. Distances between areas were computed on a straight-line basis using latitude-longitude, and the inverse function was a simple gravity-model term involving three parameters (two of

which expressed terminal time and self-distance). Three different versions of each variable were computed using different combinations of gravity-model parameters. Based on past experience, these combinations were chosen so that one set caused the variable mostly to reflect internal activity levels while another yielded values reflecting an area's access to the given activity on a region-wide basis. The variables per se were not simple proximity measures but functions thereof that expressed change in proximity or initial-year proximity in relative terms. (See later discussion of the two different models.) No proximity-based variable was allowed to enter any regression equation with a negative coefficient. While negative influences among sectors and areas probably existed, prior studies had shown that permitting negative coefficients would do more to introduce spurious and counterintuitive relationships than to increase predictive accuracy.

The allocation model necessarily used the same measure of land availability when addressing all activities. This measure incorporated a functional form that was developed in the analysis of 824 urban zones noted later. It consisted of a constant divided by the same constant plus a linear function of occupied dwelling units by structure type and employment by major category. What yielded an equation-specific index was the raising of this measure to an exponent whose value was determined as part of the calibration process. The resulting available land index was used as a weighting for all proximity-based variables – i.e., entered all of the candidate independent variables other than a few pertaining to the subject activity itself. The exponent contained in the index could not be estimated as a regression coefficient. Instead the analysis involved a trial-and-error process of finding the exponent value that maximized the explanatory power of the equation as a whole. This value would be influenced by the particular set of variables included in an equation, but as found in earlier studies there was never any ambiguity about the optimal solution. The data could dictate that land availability was unimportant for a given activity, by yielding a best-fitting equation with an exponent near zero, but the approach gave land availability maximum exposure as an explanatory factor. Due to the land-intensive nature of residential development, the model calibration process yielded the usual finding of relatively high exponents for household categories (0.8 and above for the top three income quintiles) and generally lower values for employment categories (ranging from zero to 0.48 in the relative-change model, but averaging 0.51 in the share-of-change model).

Model Structure

A special characteristic of allocation modeling is that the equations involved must employ functional forms suitable for allocating fixed totals among observation units. There is no "right" way to meet this requirement, and all of the available options have both strengths and weaknesses. Past studies by this investigator have employed two different approaches, referenced as "relative-change" and "share-of-change" modeling. The present study has wound up using both.

In a relative-change model, the dependent variable in each equation equals the actual change in an activity minus the change that would have occurred if the activity had expanded at the same percentage rate in all component areas of a region. For example, if an activity has increased from 100 to 150 units in a given area and from 1,000 to 1,200

units in the region containing that area, the relative-change value for that activity in that area equals 30 units. A relative-change model uses this functional form not only for the dependent variable but also for most independent variables (i.e., those expressing past and current change in proximity measures), and the other independent variables employ analogous sorts of relative measures. Along with some convenient mathematical properties, this formulation has the advantage that it incorporates a plausible null hypothesis. If no explanatory variables are found significant in the regression analysis for some industry, the result is an equation that simply predicts a uniform expansion of the industry's employment in all component areas of each region.

A disadvantage of the relative-change approach is exposure to heteroscedasticity problems. In statistical terms, heteroscedasticity refers to the existence of unequal error variances, violating the assumptions of the general linear model. In practice it basically means excessive dominance of regression results by observations featuring large numbers or drastic changes. For example, in past studies using hundreds of observations, over half of all variation in a relative-change measure for the communications industry involved the growth of Sprint Corporation in one Kansas county; and over half of all variation in finance involved the relocation of Capital One from Richmond to its suburbs. Such dominance by individual cases is an open invitation to spurious regression results. Even if the results of an analysis are reasonable, heteroscedasticity reduces effective sample and thus tends to produce exaggerated statements of statistical significance.

Other than logarithmic transformation, which is obviously infeasible for allocation equations, the principal means of reducing heteroscedasticity is the use of divisors. A convenient feature of the general linear model is that multiplying or dividing all variables on both sides of a regression equation by a constant does not bias regression results. The quantity in question – hereafter represented as a divisor – must be constant for each observation but can vary across observations. The strategy for reducing heteroscedasticity is to choose divisors that are positively correlated across the sample with error variances, or presumed error variances. The only constraint is that for obvious reasons the divisors cannot be related directly to the dependent variable. In the Gwinnett project and similar studies, the divisor used in relative-change models has been a quantity expressing the relevant "size" of each observation. This quantity is shown near the end of the materials on the SDC model in Figure 10 below.

The share-of-change approach was developed to bypass the heteroscedsticity problem and obtain more reliable forecasts when addressing many small areas (SCAs). In concept it represents a very straightforward response to the allocation problem. Since the task is to apportion change among component areas of a region, the dependent variable in a share-of-change equation simply equals area change divided by regional change. The independent variables are similarly obtained by computing percent distributions across a region's component areas (although various weightings and combinations come into play).

The main problem with the share-of-change approach is that shares of growth are meaningless when regional change is negative, and tend to be analytically hazardous

when regional change is positive but small. Consequently change must be computed from a discounted base. If we let Y_t and Y_{t+1} stand for levels of some activity in the initial and ending years of an interval, an area's change in the given activity must be computed as: $Y_{t+1} - k*Y_t$, where k is a discount parameter. This quantity must be divided by a similarly adjusted regional change to obtain the area's share-of-change value. The parameter k must be far enough below unity to keep the adjusted regional change substantially positive, but there are no other a priori guidelines for choosing a value of k. Hence the regression analysis becomes a process of finding trial-and-error solutions for two parameters – k and the available-land exponent – rather than just one. Furthermore, while tests of significance for individual variables remain valid, R-square loses its meaning as an overall measure of goodness-of-fit. (R-square can always be elevated by lowering k, because this increases the extent to which the "change" being explained is merely the fictional recovery of activity already present.) Predictions must therefore be converted from shares to absolute changes so that the trial-and-error process can maximize explanation on those terms. Lastly the formulation does not incorporate a plausible null hypothesis, unless an equation containing only initial-year activity is considered to qualify as a "null" case. Yet in spite of these problems, the share-of-change formulation often yields results superior to those from relative-change models, particularly for households.

The Gwinnett study was originally intended to rely only upon a share-of-change model. When such a model was calibrated, however, its ability to replicate 1993-2003 events in the 355-observation sample was considered inadequate. (This judgment was based on comparisons of total households and total employment like those shown graphically in figures 13 and 14 below.) Hence a relative-change model was also calibrated, and the forecasting process relied upon both. The quantities selected as forecasts for a given activity equaled the predictions from the share-of-change model, or the predictions from the relative-change model, or some weighted average of these values, depending upon which provided the best explanation of 1995-2005 changes for counties in the Atlanta region. (The comparisons in figures 13 and 14 were based upon weightings optimized for the whole 355-observation sample in 1993-2003, which were not always the same.) For economic sectors this strategy turned out to place slightly more overall reliance on the relative-change model than the share-of-change model. For household groups, there was still exclusive reliance on the share-of-change model for coverage of standard allocation relationships, but the "racial loop" described below involved the introduction of racial avoidance effects that could only be established in the relative-change model.

Figure 10 on the next page summarizes the regression model characteristics just discussed, addressing first the relative-change model and then the share-of-change model. Figure 11 on the second following page outlines the computation of proximity measures. Figures 12A and 12B on the third following page then describe the classes of independent variables tested in the two models.

Figure 10. Explanation of Regression Models

Units of observation: counties (and independent cities) grouped by region.

Quantity under analysis: Y = employment in some industry or households in some income group.

Objective is to explain change in Y from year t to year t+1.

Let $\acute{Y}_t$ = the regional sum of Y in year t.

RELATIVE-CHANGE MODEL

Null hypothesis: All counties in each region gain Y at the same percentage rate.

The dependent variable is then the difference between the observed value of Yt+1 and the value that would have prevailed given growth from year t at the regional rate.

Dependent Variable = $Y_{t+1} - Y_t*(\acute{Y}_{t+1}/\acute{Y}_t)$ (before denominator)

Dependent variable sums to zero, and all independent variables are structured to have zero sums (before application of denominator).

Liability of model: Dependent variable is likely to be dominated by a relatively few large observations. (Heteroscedasticity problem.)

Response: Divide both sides of equation by a quantity that is constant for each observation but varies across observations. This divisor "U" is computed as follows. (It can be disregarded when applying the calibrated equation.)

Divisor: $U = (E_t*\acute{Y}_t/N)^{0.25}$ where E is total county employment and N is the number of counties in the region

H (total households) is substituted for E when Y pertains to households.

SHARE-OF-CHANGE MODEL

Quantity analyzed is each county's share of regional change in Y (times number of counties in the region to yield a mean of unity for each region and the sample).

Liability: Shares of change are meaningless unless regional change is appreciably positive and nearly all county changes are positive.

Consequently change must be computed relative to a discounted initial value.

Dependent variable = $N*(Y_{t+1} - k*Y_t) / (\acute{Y}_{t+1} - k*\acute{Y}_t)$

where k is a parameter determined when fitting the equation

Complication: R-square is inflated because part of what's being explained (namely the portion of Y_{t+1} equaling $(1-k)*Y_t$) consists of activity that's already present.

R-square is also inflated because the null hypothesis states that growth in Y (absolute, not %) is the same in all counties, which is grossly implausible.

Resolution is to use ordinary significance tests when developing each equation for a given value of k, but to select an equation that minimizes unexplained variance in Y_{t+1} rather than the dependent variable as analyzed.

Figure 11. Computation of Proximity Measures

A majority of predictors incorporate "proximity measures" obtained by summing activity levels across all areas (counties) of a region when weighted inversely by distance to the area for which the measure is being computed. The proximity measures contained in any given independent variable pertain to one of the nine major types of activity covered by the model (four employment categories and five household groups; see elsewhere). Here the activity is just called "A" without subscripts for year or type of activity. A proximity measure for area "j" is computed as follows (where the summation across i includes j):

$$\text{Proximity measure: } P_j = \sum_i A_i/(D_{ij}+F_j+g)^r$$

where: A_i is the level of the given activity in area i;
D_{ij} is the straight-line distance between centroids of areas i and j;
g is a "terminal time" parameter (expressed in miles);
F_j is an estimate of internal travel distance in area j; and
r is a distance-decay exponent.

The internal distance term F_j is a function of land area and includes a parameter h. Thus computing a proximity measure requires assumed values of three parameters: r, g, and h. Customarily three versions of each variable are computed using the following values and tested independently: (r=2.0, g=5, h=5); (r=2.5, g=5, h=5); and (r=2.5, g=3, h=3). The strongest predictors in the present study have overwhelmingly involved the last of these sets of parameter values (as has generally been found in prior studies). Hence the final equations have been limited to variables incorporating these values.

Land Availability Term

In the dynamics of urban growth, proximity to an attractant (activity) is interactive with the amount of land available for development. Impact on growth goes to zero as either proximity or land availability goes to zero. Hence in the model predictors, proximity measures are always multiplied by a land availability term. This term always pertains to the initial year of the prediction interval (i.e., year t) even though one of the proximity measures may pertain to another year. It is defined as follows (omitting the subscript t):

$$\text{Land availability index: } V = ((M*c/(c+W))/(\text{Regional mean of } M*c/(c+W)))^s$$

where: c is a constant; M is land area in square miles;
W is a linear combination of employment by industry and occupied dwelling units by structure type; and
s is an exponent to be determined when fitting the equation.

The exponent s (which can go to zero, expressing no land-availability impact) is held the same across all predictors in an equation. Its best-fitting value is determined by trial-and-error. The present analyses have used values of c and parameters in W obtained from previous studies. The hope is that better land availability measures based on Maryland statewide data can be substituted in the model-pegging process.

Since proximity measures are always multiplied by land availability, it is convenient to denote the product as another quantity Z:

Weighted proximity measure: $Z = P*V$ Regional sum: $\acute{Z}$

Figure 12A. Independent Variables Tested in Relative-Change Model

1) Variables pertaining to all activity groups – restricted to positive relationships

Past change	$(Z_t – (Z_{t-1}*Ź_t/Ź_{t-1}))/U$
Current change	$(Z_{t+1} – (Z_t*Ź_{t+1}/Ź_t))/U$ (cases limited)
Initial level	$(Z_t – (Ź_t/N))/U$

2) Variables pertaining to household groups only – restricted to positive relationships

Let: X = activity level (not proximity measure); and O = X*V

Relative initial level	$(O_t – (S_t*Ó_t/Ś_t))/U$ where S = sum of households across groups

3A) Variables pertaining to activity under analysis – restricted to positive relationships

Let: L = activity level (not proximity measure); and O = L*V

Past change	$(L_t – (L_{t-1}*Ĺ_t/Ĺ_{t-1}))/U$
Initial level	$(O_t – (Ó_t/N))/U$
Relative initial level	$(Ot – (Rt*Ót/Ŕ))/U$ where R is the sum of households or employment across groups

3B) Variables pertaining to activity under analysis – restricted to negative relationships

Initial level	Same as above except O = L/V
Relative initial level	Same as above except O = L/V

Figure 12B. Independent Variables Tested in Share-of-Change Model

(Parameter k = 0.6 or 0.75 for "basic" employment, 0.7 or 0.8 for wholesale-transportation-utilities employment, and 0.9 for all other activity categories.)

1) Variables pertaining to all activity groups – restricted to positive relationships

Past change	$N*((Z_t – (k*Z_{t-1}))/(Ź_t – (k*Ź_{t-1})))$
Current change	$N*((Z_{t+1} – (k*Z_t))/(Ź_{t+1} – (k*Ź_t)))$ (cases limited)
Initial level	$N*(Z_t/Ź_t)$

Let S = level of activity under analysis divided by regional sum of this activity

Weighted past change	$N*(S*(Z_t – (k*Z_{t-1})))/$(reg. sum of $S*(Z_t – (k*Z_{t-1}))$)
Weighted current change	$N*(S*(Z_{t+1} – (k*Z_t)))/$(reg. sum of $S*(Z_{t+1} – (k*Z_t))$)
Weighted initial level	$N*(S*Z_t)/$(regional sum of $S*Z_t$)

2) Variables pertaining to activity under analysis (with quantity L as defined above)

Past change	$N*(L_t – (k*L_{t-1}))/(Ĺ – (k*Ĺ_{t-1}))$	pos. rel.s only
	(here k is the value used in computing the dependent variable)	
Initial level	$N*L_t/Ĺ_t$	negative relationships permitted

Sequencing of Variables

The "activity groups" referenced in Figure 12 consisted of households in the five quintile categories plus employment in four aggregate industry groups – not the nineteen separate industries for which equations were estimated. Industries were aggregated when used as predictors because experience had shown that entertaining them separately would create too much latitude for spurious results. The nine activity groups were as follows:

- Employment in extractive activities, manufacturing and nonlocal government
- Employment in transportation, utilities and wholesale trade
- Employment in professional, technical and administrative support services plus finance, management functions and accommodations.
- Households in five quintile groups
- Employment in educational, health, food and "other" services plus retail trade, arts-recreation, construction and local government

The activity groups were part of a sequencing strategy to limit mutual determination among the variables addressed by the model. If current changes in all activities had been entertained as predictors in all equations, the resulting model would have required the use of simultaneous-equation estimation techniques (e.g., two-stage or three-stage least-squares) that would have hopelessly burdened the calibration process. Consequently the variables were grouped and addressed in the sequence shown above, under the constraint that the equations for variables in any given group could only contain predictors pertaining to groups appearing earlier in the sequence. Thus for example current change in upper-income households could serve as a predictor of current change in retail trade but not wholesale trade. This convention maintained a one-way flow of causation through the model. Accordingly, the sequence was intended to place the economic sectors in descending order of locational independence: from "basic" sectors with special locational determinants, to office functions with mixed requirements, to consumer-oriented functions driven largely by household location.

Other Modeling Considerations

The Atlanta area has been characterized by very rapid racial transition. Until 1990 this mainly involved substitutions of African-American for white inhabitants, but the pattern has since broadened with the rapid influx of Hispanic and Asian migrants to the region. The present study was not concerned with race per se, but racial breakdowns were needed to estimate general parameters such as household size and labor force participation rates. Hence an independent research project was undertaken to quantify racial avoidance and attraction behaviors. In this research project and the subsequent racial breakdowns of households in the model-related data samples, the following four categories were utilized: 1) non-Hispanic white (plus minor groups not belonging elsewhere); 2) black or African-American; 3) Asian; and 4) Hispanic regardless of race. Assignments of households to these categories were based on the status of the householder as described by household members to the census. For convenience the categories are referenced as "racial" even though Hispanic status is strictly a matter of language and/or cultural heritage.

The racial investigation looked at 1990-2000 interactions among racial groups in urban zones generally measuring between 10 and 20 square miles. The observation units were created by exhaustively partitioning three major metropolitan areas – Atlanta, Dallas-Fort Worth and Washington-Baltimore – into a total of 824 component zones. The racial analysis addressed twenty separate household groups, namely the four racial categories broken down by income quintile. For each of these twenty groups, the 1990-2000 household changes observed across the 824-observation sample were entered as dependent variable in a regression analysis wherein the candidate explanatory variables included: 1) initial numbers of occupied dwelling units by structure type; 2) 1990-2000 changes in occupied dwelling units by structure type; 3) each zone's 1990 household profile by race and income; and 4) 1990-2000 changes in some but not all household groups by race and income. The restrictions on explanatory use of current household changes were mostly relevant to avoidance relationships (negative linkages) and reflected a sequencing strategy like that just discussed for the allocation model. The sequence was defined in terms of race only, and after some experimentation was established as: black, Hispanic, Asian, white. This arrangement provided maximal opportunity to estimate the "white flight" that was expected to be quantitatively most important.

The estimated racial interactions turned out to be far stronger than expected. The interactions consisted of "attraction" relationships established by positive regression coefficients and "avoidance" relationships involving negative coefficients. The former were mostly linkages of household change to pre-existing households in the same racial category, reflecting the tendency of ethnic groups – especially Asians and Hispanics – to congregate in delimited areas. The avoidance relationships were mostly negative linkages to current household-change variables and were found to exist for at least some income groups wherever such relationships were permitted by the sequencing of equations. The relationships for white households were especially strong, expressing a tendency for whites at all income levels to move away from households in all three minority groups. A question left unanswered by the analysis, however, was the extent to which avoidance effects might dissipate when measured for progressively larger areas, because some of the households relocating for avoidance reasons might not move great distances (or more generally, because all of the comings and goings for a particular group might yield only localized displacement effects on a net basis).

The results of the racial study were incorporated in the forecasting process via the following steps. First, the racial interaction equations were recalibrated to increase their usability. Along with the explanatory variables listed above, the original versions of the equations included proximity measures like those employed in the allocation model. These played only marginal roles in the equations and hence were eliminated to increase their applicability. Also, new equations were estimated for the five black household groups using the 355-observation model calibration sample rather than the zone sample, which allowed the use of 1980-1990 black household change as a predictor. (Due to problems of area definition and data assembly, collecting 1980 racial data for the 824-observation zone sample was out of the question.) This step yielded equations with much greater predictive power and had little cost since current-change avoidance relationships were ruled out for black households by the sequencing arrangement.

Second, the recalibrated equations were used to compute attraction and avoidance effects for the 355 counties in the model calibration sample (based on full racial/income breakdowns of 1993 and 2003 households in that sample). These effects were aggregated in various ways so that they were specific only to income quintiles and hence were usable in the allocation-model equations. Then they were tested as predictors of household change in the relative-change model. To address dissipation of avoidance with area size, the avoidance effects were weighted by a quantity equaling 15 (the typical zone size in square miles) divided by county area in square miles, all raised to an exponent. The exponent was determined by trial-and-error in the regression analysis and allowed for possibilities ranging from no dissipation (exponent = zero) to virtual disappearance of avoidance effects in large areas. It turned out that, because the modeling context offered so many other relevant variables to credit with positive changes, no racial attraction variables were found significant in any of the household equations. However, weighted avoidance variables proved highly significant in the relative-change equations for the top three income quintiles. The versions that worked best covered only white households (i.e., white avoidance of other households). The regression results and their implications are summarized at the top of the next page. In theory, if the 355-observation and 824-observation samples reflected the same race-related behaviors, the regression coefficients for the given variables should have equaled unity and the dissipating influence of area size should have registered entirely in the exponents of the weighting factors. In actuality the coefficient estimates came in well below unity – at 0.41 to 0.76 – and thus captured some of the difference between zone-level and county-level effects. The table's bottom portion shows the relative levels of avoidance predicted for areas the size of Gwinnett County and its component SCAs. For example, the entries in the last column say that for upper-income households, white avoidance behavior can be expected to have about one-third as much net impact in Gwinnett County as a whole – but over half as much impact at the SCA level – as it would in a zone measuring 15 square miles.

	Regression Results for White Avoidance Variables		
	Middle-Income Households	Upper-Middle-Inc. Households	Upper-Income Households
Weighting-factor exponent	0.28	0.25	0.25
Regression coefficient	0.4079	0.4784	0.7617
t-statistic	5.48	4.46	2.80
Significance level	<0.01%	<0.01%	0.5%
Predicted relative impact at:			
433 sq. miles (Gwinnett Co.)	0.16	0.21	0.33
50 sq. miles (typical SCA)	0.29	0.35	0.56

Third, when the two sets of allocation-equation results were assembled in a framework for predictive use, a "racial loop" was established outside this framework to break down the quintile household forecasts by race. The external routines were called a "loop" because a circular process was required to enforce consistency between the racial breakdowns and the model's inputs and predictions. The loop consisted of two sets of computational routines. The first set generated forecasts of occupied dwelling units by

structure type, using empirical relationships based on the 355-observation sample that linked dwelling characteristics to households by income. This component was needed because the equations from the racial investigation used dwelling units by structure type as predictors along with household variables. The second set of routines incorporated the racial equations per se. Given updated values of dwelling units by type and households by income, these routines generated initial breakdowns of income-specific households by race, then enforced consistency between these estimates and two sets of control totals (for region-wide households by race and income from the regional forecasts, and for county households by income from the allocation model). The results were then used to update the racial attraction and avoidance effects entered in the allocation framework, which initially were guesses based on forecasts for the prior interval. Several computational trips around the loop (which involved an internal cycle in its second part, plus iterative solutions at two points) were required to obtain overall convergence of estimates for a given interval.

When the forecasting process was designed, some discretion was exercised in deciding which race-related effects should be directly included in the allocation-model framework, with the choices turning upon the composite model's predictive accuracy for Atlanta counties in 1995-2005. The avoidance effects for white upper-middle-income and upper-income households – computed using the parameters shown in the two right-hand columns of the above table – were included in the framework, but the avoidance effect for middle-income households did not improve predictive accuracy and hence was not included. This meant that the tendency of white middle-income households to avoid households of other races would affect the forecasted racial distributions for counties, but not their income distributions (which were the sole province of the allocation model). On the other hand, racial attraction effects were included for the two bottom household groups even though these effects had not been attributed statistical significance in the model calibration process. This decision was justified by improvements in predictive accuracy – particularly for Gwinnett – and the fact that dissipation with area size should not be an issue for attraction. The chosen attraction terms covered only Hispanic and Asian households, not blacks. They were computed as in the racial investigation, but their values for future years were capped in a fashion that kept attraction from spiraling upward as the base numbers of Hispanic and Asian households increased.

The household forecasting tableau simply added the two positive attraction effects and the two negative avoidance effects to the predictions from the share-of-change equations for the relevant household groups. Adjustment factors were then added to the predictions for all five household groups (thereby creating "pegged" values), and the results were scaled to enforce consistency with regional control totals. The outputs were then sent through the racial loop. Back came new attraction and avoidance effects for substitution into the tableau, and the cycle was repeated until the new effects precisely equaled those already assumed.

The consideration of race in the county-level forecasting process was intended solely to improve the accuracy of the income-specific household forecasts and the projections of household size. The race-specific numbers were never subjected to the

expert review process or released as project outputs. However, the structure-type breakdowns obtained in the racial loop had a further purpose of linking the household forecasts to the land use categories employed in parcel-level forecasting. Hence these breakdowns were carried through expert review and finalized on that basis.

Model Performance

Since forecasting is an activity that targets the unknowable, the possible ways of evaluating a forecasting project are limited to: 1) examining and pondering all aspects of its methodology; and 2) looking at the ability of its procedures to "predict" events that are already known. The graphs on the next four pages are offered to support the second type of evaluation. Figures 13 and 14 show the present study's predictions of 1993-2003 change in total employment and total households for the 355-county model calibration sample (based on procedures lacking attraction effects and the racial loop). Figures 15 and 16 show similar predictions for Atlanta-area counties in 1995-2005, based on the same forecasting procedures subsequently applied to future intervals. Each graph plots predicted change on its vertical axis and actual change on its horizontal axis, with a 45-degree line included to show where all data points would lie if the forecasting process were perfectly accurate.

When the model equations were calibrated, all variables were computed using actual values of employment and households. When the equations were applied in predictive mode, however, the current-change variables were all based on predictions generated earlier in the process. (What linked the parallel applications of relative-change and share-of-change equations was the use of pooled predictions to compute current-change variables for activity groups.) This allowed errors to cumulate across the process – as they would when the equations were applied to future intervals about which nothing was known. The graphs in figures 13 through 16 describe applications of the equations in predictive mode, hence suggest the levels of error that would prevail when they addressed the first forecasting interval.

Figures 13 and 14 include labels on some of the points that represent major outliers or pertain to Atlanta-area counties. For employment, the model had trouble with two of the largest urban-core counties – Philadelphia and Wayne, MI (Detroit) – because these counties respectively overcame a long-term downtrend and an adverse industry mix. For households, the model's worst performance consisted of underpredicting change in Collin County, TX, a phenomenally fast-growing area north of Dallas.

Figures 15 and 16 include labels on the points for all major counties in the Atlanta region. Each graph has three points pertaining to Fulton County: one for the county as a whole and two for county subdivisions that are referenced as North Fulton and Central & South Fulton. (As noted earlier, Fulton was divided at the northern Perimeter Road and treated as two separate counties.) The model's worst performances in the study region consisted of underpredicting employment change in DeKalb County and all types of growth in Henry County. An extenuating circumstance in the former case was that the error was not terribly large in percentage terms – at 5.3% of total employment – since the actual pattern for DeKalb involved slow growth from a high base.

Figure 13

ACTUAL VERSUS MODEL-PREDICTED CHANGE IN EMPLOYMENT DURING 1993-2003 FOR COUNTIES AND INDEPENDENT CITIES IN THE MODEL CALIBRATION SAMPLE

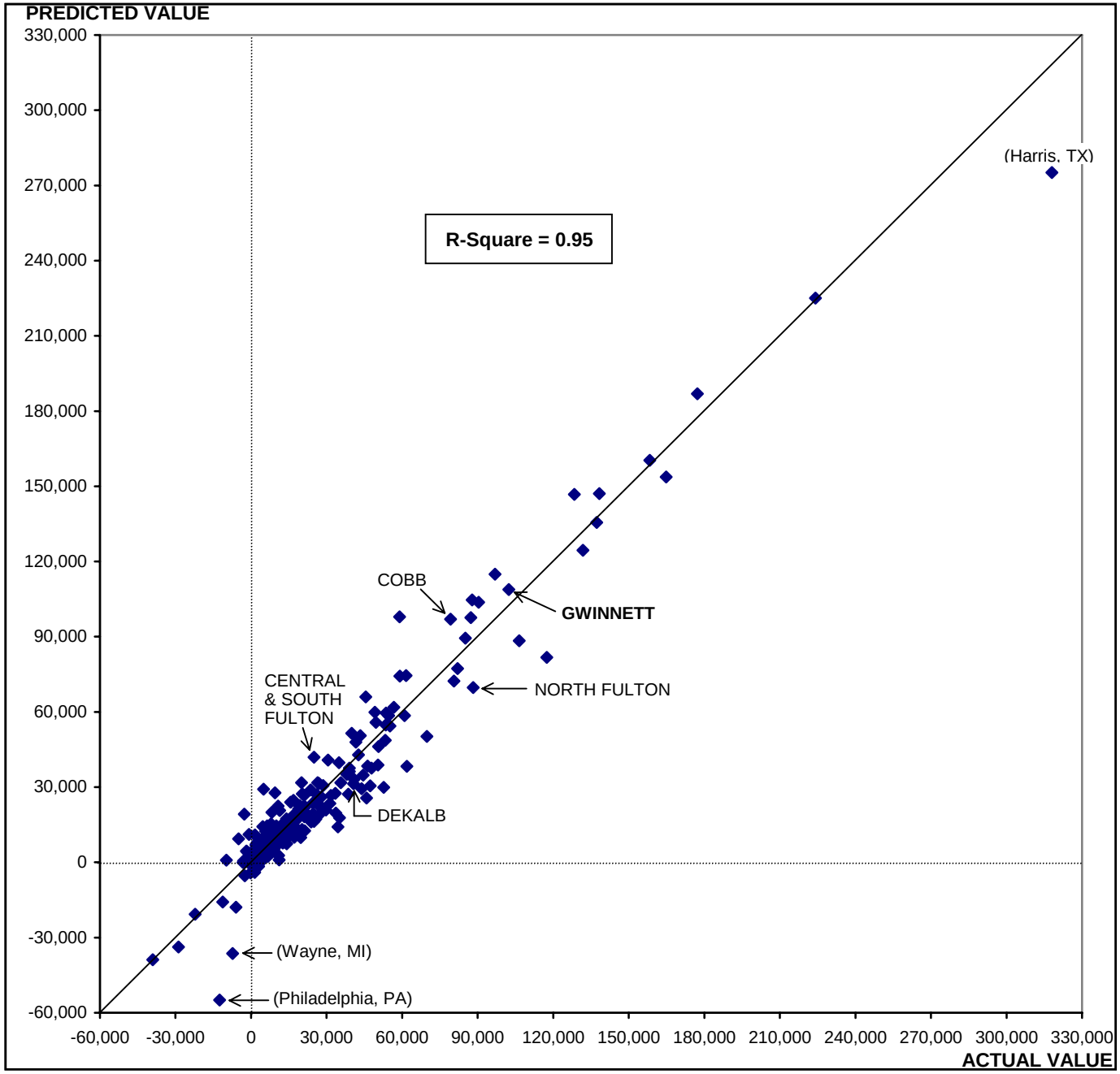


Figure 14

ACTUAL VERSUS MODEL-PREDICTED CHANGE IN HOUSEHOLDS DURING 1993-2003 FOR COUNTIES AND INDEPENDENT CITIES IN THE MODEL CALIBRATION SAMPLE

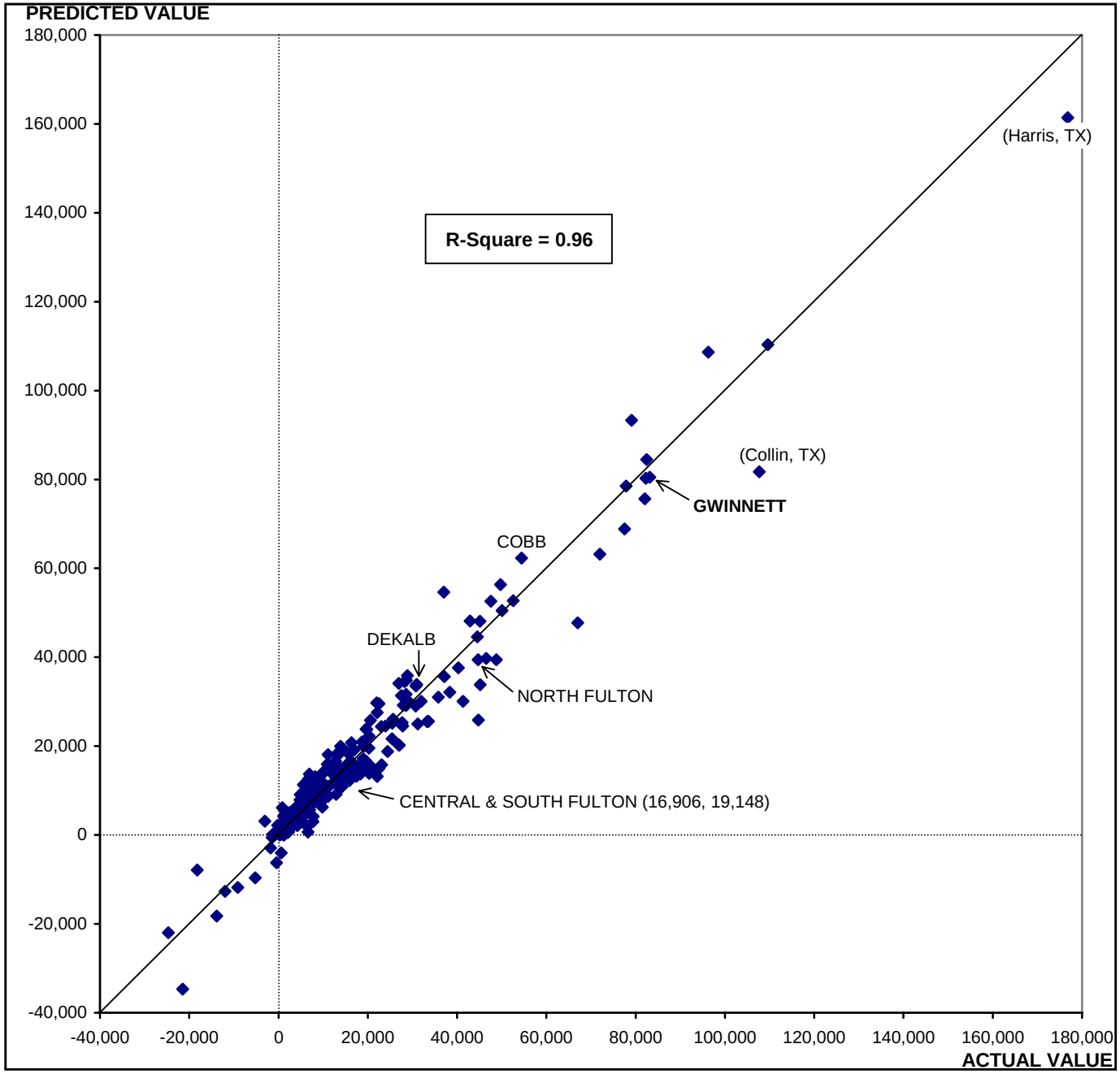


Figure 15

ACTUAL VERSUS MODEL-PREDICTED CHANGE IN EMPLOYMENT DURING 1995-2005 FOR COUNTIES IN THE STUDY REGION

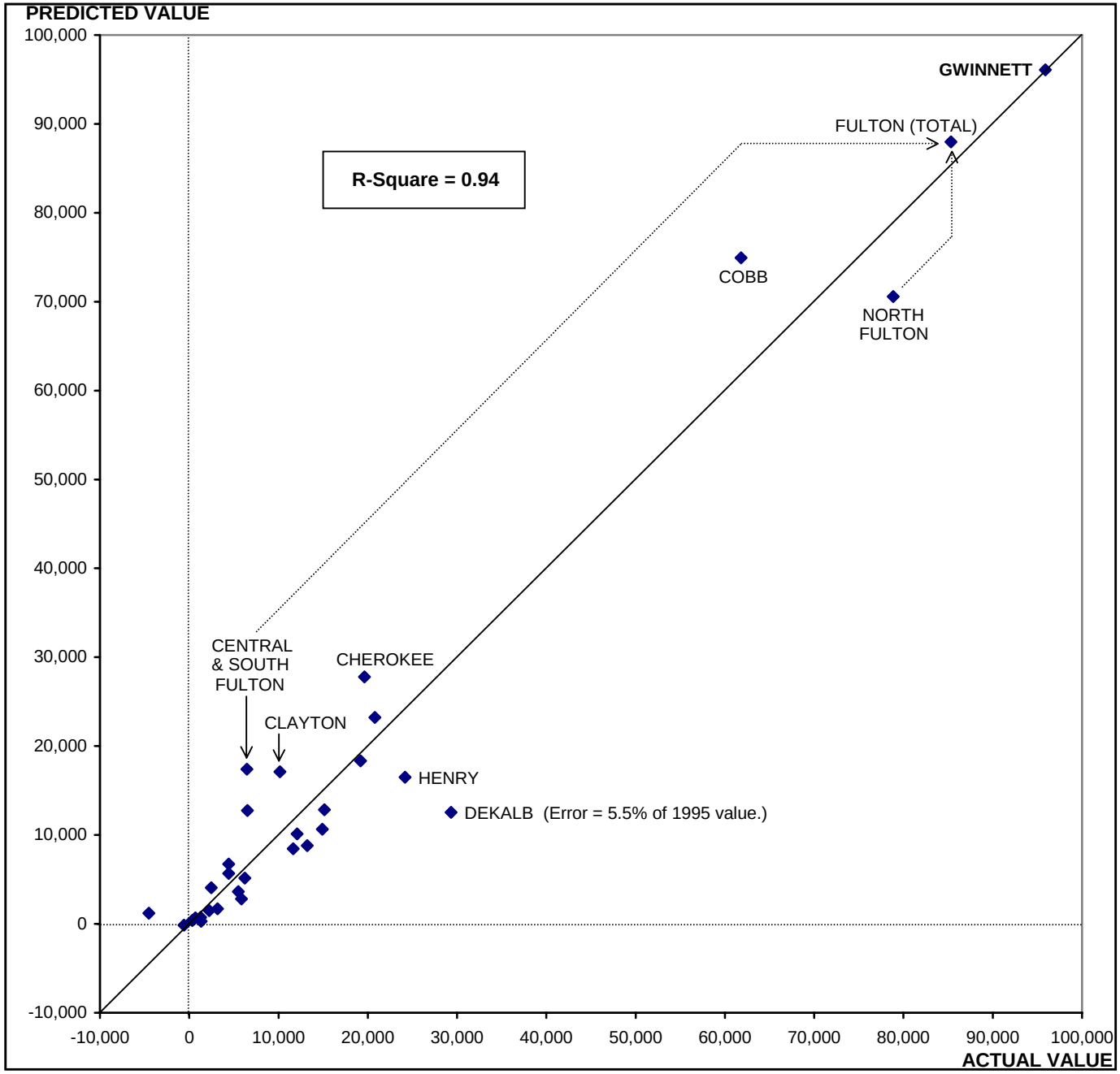
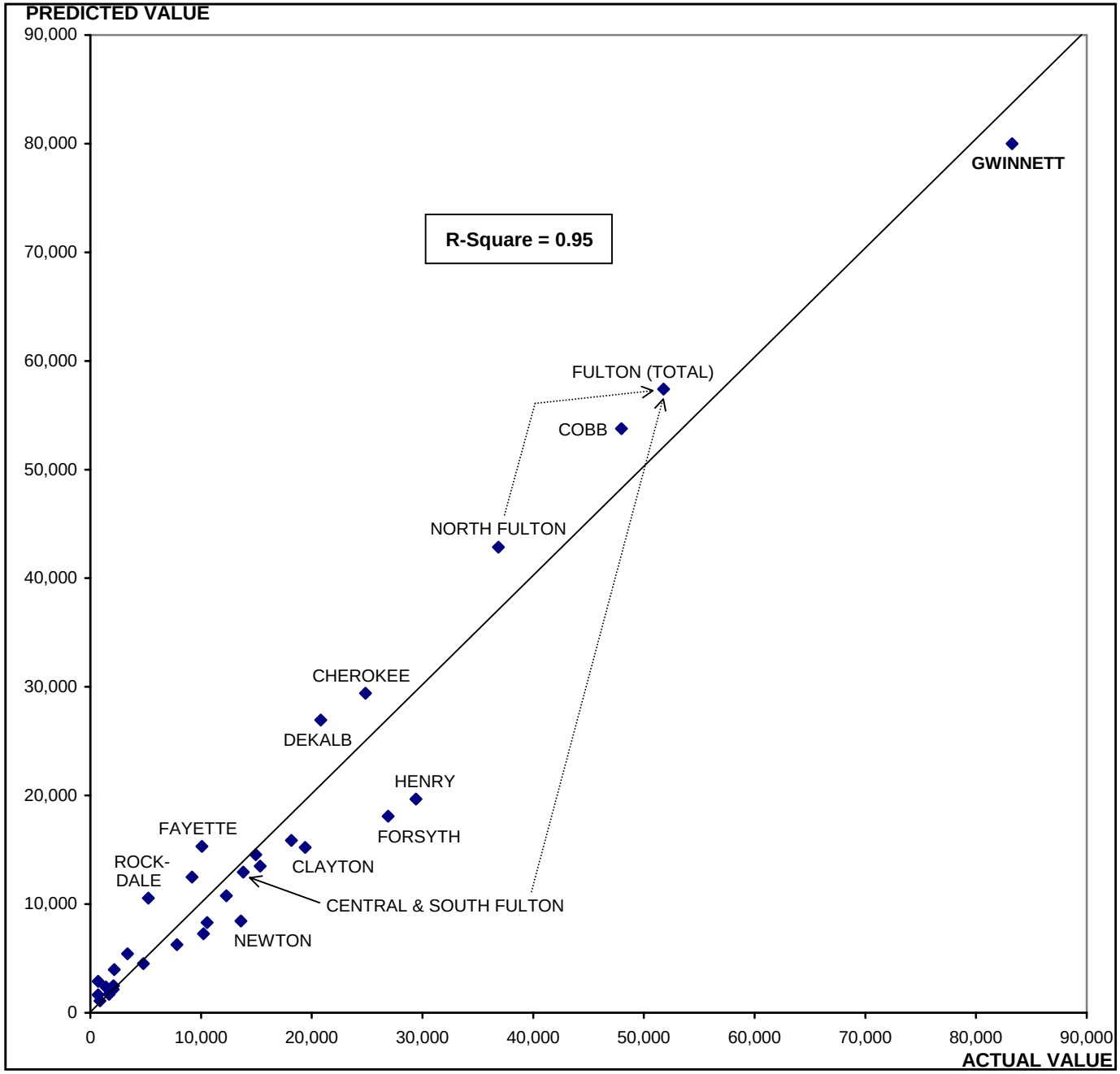


Figure 16

ACTUAL VERSUS MODEL-PREDICTED CHANGE IN HOUSEHOLDS DURING 1995-2005 FOR COUNTIES IN THE STUDY REGION



County Forecasts

The application of model equations to the Atlanta region was the basis for a model-pegging process. This consisted of computing residuals – the same as prediction errors, but with opposite signs – and then compensating for these deficiencies. Following standard practice, the compensation consisted of including reduced versions of the 1995-2005 residuals as additive "adjustment factors" in the model equations used to address future intervals. The residuals were reduced in part to allow for various offsetting effects and in part to enforce a gradual convergence of predictions with those yielded by the regression-based portions of the equations.

The forecasting process then consisted of applying the pegged model equations recursively to three future intervals: 2005-15, 2015-25 and 2025-35. In each round of forecasting the outputs obtained for the previous interval became the new model inputs, i.e., the basis for updating all predictors including the land availability index. Throughout the process the regional magnitudes established in the earlier regional forecasting task served as control totals, usually applying on an incremental basis. Following the model application, values of all variables for future years ending in zero were obtained via an interpolation process that involved fitting third-degree polynomial equations to the model-predicted values for 2005, 2015, 2025 and 2035. Demographic variables not covered directly by the model were then estimated using supplementary relationships. For example, residential population was estimated using independent forecasts of group-quarters population and future population per household, plus various conversion factors related to racial breakdowns. The supplementary relationships were obtained outside the modeling framework but were all empirically derived using data from the 355-observation and 824-observation samples.

Tables 9 and 10 on the next two pages summarize the resulting forecasts for all counties in the Atlanta region. The given numbers pertain only to the 2005 baseline year and the 2030 forecast year. (There are some slightly inconsistencies between the these forecasts, the regional totals presented earlier and the Gwinnett SCA breakdowns appearing later because the process was subject to numerous revisions.)

Table 9 describes total employment, total households and total population, with 2005-30 changes expressed in absolute and percentage terms. Gwinnett County is expected to achieve the highest absolute 2005-gains in all three variables (though Fulton would be well ahead if not split into two parts). In percentage terms, however, Gwinnett is forecasted to lag the region as a whole by four percentage points for employment and nine to ten percentage points for the two demographic variables.

Table 10 gives the actual and expected percent distributions of households by income quintile. The Gwinnett figures show declines in the shares of households occupying the upper three quintiles and increases in the two bottom quintile shares. This lowering of the county's income profile would continue a trend that started in the 1980s. (The county's combined share in the top two quintiles fell from 55% in 1980 to 52% in 1990 and 47% in 2005.) Thus according to the benchmark forecast, Gwinnett will be a fully middle-class rather than upper-middle-class area by 2030.

Table 9. SUMMARY OF COUNTY-LEVEL FORECASTS FOR THE ATLANTA REGION

	Total Employment				Households				Population			
	2005	2030	Change	% Ch.	2005	2030	Change	% Ch.	2005	2030	Change	% Ch.
Barrow County	16,974	40,824	23,850	141%	20,895	44,129	23,233	111%	59,130	118,760	59,630	101%
Bartow County	38,581	62,549	23,969	62%	31,658	61,296	29,637	94%	88,650	162,939	74,289	84%
Butts County	7,368	17,698	10,330	140%	7,179	18,288	11,109	155%	20,931	50,888	29,958	143%
Carroll County	36,435	61,063	24,628	68%	38,369	74,141	35,772	93%	104,626	193,541	88,915	85%
Cherokee County	47,748	133,851	86,103	180%	63,569	130,831	67,261	106%	181,871	353,359	171,488	94%
Clayton County	115,047	145,553	30,506	27%	91,879	126,940	35,061	38%	267,031	356,181	89,150	33%
Cobb County	321,009	413,356	92,347	29%	245,978	292,662	46,684	19%	661,526	767,649	106,123	16%
Coweta County	34,452	62,182	27,730	80%	38,391	76,784	38,393	100%	108,776	205,222	96,446	89%
Dawson County	7,214	39,480	32,267	447%	7,657	28,910	21,253	278%	19,559	73,118	53,559	274%
DeKalb County	335,543	379,279	43,736	13%	251,853	270,583	18,730	7%	677,053	724,958	47,905	7%
Douglas County	40,085	69,948	29,863	74%	40,509	69,052	28,542	70%	111,341	180,051	68,710	62%
Fayette County	44,355	83,978	39,622	89%	36,189	56,501	20,312	56%	103,486	153,696	50,210	49%
Forsyth County	42,680	173,283	130,603	306%	48,256	130,184	81,928	170%	138,282	346,330	208,048	150%
Fulton N. of I-285	194,846	345,125	150,278	77%	119,321	174,899	55,579	47%	312,177	442,275	130,097	42%
Fulton Central & S	529,437	690,940	161,503	31%	220,461	294,160	73,698	33%	554,937	738,908	183,971	33%
Gwinnett County	315,838	482,890	167,052	53%	246,140	361,827	115,687	47%	719,849	1,019,166	299,317	42%
Hall County	69,041	108,252	39,211	57%	54,999	100,290	45,291	82%	164,525	291,190	126,665	77%
Haralson County	8,200	14,254	6,053	74%	10,917	20,893	9,977	91%	28,245	50,798	22,553	80%
Heard County	2,673	4,334	1,662	62%	4,204	7,976	3,772	90%	11,326	20,335	9,009	80%
Henry County	47,655	118,136	70,481	148%	57,855	131,128	73,273	127%	165,621	355,475	189,855	115%
Jasper County	3,233	7,096	3,864	120%	4,813	12,890	8,076	168%	13,055	32,927	19,873	152%
Lamar County	3,972	5,120	1,148	29%	5,899	9,186	3,287	56%	16,365	24,365	8,000	49%
Meriwether County	6,194	8,873	2,679	43%	8,690	13,564	4,874	56%	22,887	34,116	11,230	49%
Newton County	20,970	53,945	32,975	157%	30,826	69,984	39,158	127%	85,441	186,691	101,250	119%
Paulding County	24,869	66,903	42,034	169%	38,114	84,803	46,688	122%	110,817	230,936	120,119	108%
Pickens County	7,278	30,002	22,724	312%	11,266	32,970	21,703	193%	28,281	80,447	52,166	184%
Pike County	3,370	6,910	3,540	105%	5,608	13,014	7,406	132%	16,018	35,137	19,119	119%
Rockdale County	35,475	57,256	21,781	61%	26,965	37,731	10,766	40%	78,123	106,182	28,059	36%
Spalding County	26,021	32,342	6,321	24%	22,907	29,787	6,880	30%	61,153	76,411	15,258	25%
Walton County	18,631	59,616	40,985	220%	26,372	67,184	40,812	155%	74,746	178,369	103,622	139%
Total Region	2,405,192	3,775,039	1,369,847	57%	1,817,741	2,842,583	1,024,842	56%	5,005,827	7,590,420	2,584,593	52%

Table 10. PERCENT DISTRIBUTIONS OF COUNTY HOUSEHOLDS BY INCOME QUINTILE, 2005 AND 2030

	2005 (Actual)						2005 (Forecast)					
	Lower	Lower Middle	Middle	Upper Middle	Upper	Total	Lower	Lower Middle	Middle	Upper Middle	Upper	Total
Barrow County	19.8%	23.0%	27.3%	19.9%	10.1%	100.0%	14.1%	21.6%	30.1%	22.3%	11.9%	100.0%
Bartow County	22.6%	23.4%	24.4%	19.3%	10.3%	100.0%	17.7%	20.1%	28.8%	23.0%	10.4%	100.0%
Butts County	26.8%	23.7%	24.2%	16.5%	8.9%	100.0%	17.0%	16.8%	30.6%	23.2%	12.3%	100.0%
Carroll County	32.9%	20.8%	20.8%	15.6%	9.9%	100.0%	28.3%	15.9%	22.8%	19.8%	13.2%	100.0%
Cherokee County	12.3%	16.6%	20.4%	25.1%	25.6%	100.0%	11.3%	16.2%	20.0%	24.3%	28.2%	100.0%
Clayton County	24.7%	28.0%	23.2%	16.5%	7.7%	100.0%	28.6%	28.7%	21.7%	15.0%	6.0%	100.0%
Cobb County	15.5%	18.8%	20.1%	21.3%	24.2%	100.0%	20.6%	22.3%	17.7%	17.7%	21.7%	100.0%
Coweta County	16.7%	16.9%	23.3%	25.0%	18.1%	100.0%	12.0%	14.2%	27.9%	27.3%	18.5%	100.0%
Dawson County	18.8%	21.4%	24.8%	19.1%	15.9%	100.0%	11.2%	14.8%	24.5%	22.8%	26.7%	100.0%
DeKalb County	21.6%	22.2%	20.6%	18.4%	17.2%	100.0%	27.7%	23.8%	17.1%	14.7%	16.7%	100.0%
Douglas County	20.0%	23.3%	22.5%	20.4%	13.9%	100.0%	21.8%	25.1%	22.5%	19.2%	11.4%	100.0%
Fayette County	10.9%	13.8%	17.8%	24.6%	33.0%	100.0%	14.1%	16.1%	16.2%	22.7%	30.9%	100.0%
Forsyth County	11.6%	11.2%	14.8%	25.4%	37.0%	100.0%	11.0%	10.7%	15.3%	24.1%	38.8%	100.0%
Fulton N. of I-285	10.6%	13.9%	15.4%	19.5%	40.7%	100.0%	13.5%	16.1%	12.9%	17.9%	39.6%	100.0%
Fulton Central & S	35.1%	20.4%	15.0%	12.7%	16.8%	100.0%	33.1%	19.9%	14.2%	13.9%	19.0%	100.0%
Gwinnett County	13.5%	18.8%	20.8%	24.1%	22.8%	100.0%	18.0%	21.9%	18.9%	21.5%	19.7%	100.0%
Hall County	23.6%	22.4%	21.7%	18.5%	13.8%	100.0%	21.2%	20.9%	22.2%	20.0%	15.7%	100.0%
Haralson County	39.6%	25.2%	17.2%	11.7%	6.3%	100.0%	33.6%	21.0%	18.6%	15.7%	11.1%	100.0%
Heard County	33.8%	25.9%	19.9%	15.1%	5.2%	100.0%	15.5%	19.7%	26.4%	25.2%	13.3%	100.0%
Henry County	12.3%	18.3%	23.3%	27.2%	19.0%	100.0%	11.7%	18.0%	25.0%	26.5%	18.8%	100.0%
Jasper County	25.4%	26.2%	24.9%	15.9%	7.6%	100.0%	11.0%	21.7%	31.7%	23.4%	12.1%	100.0%
Lamar County	27.7%	27.0%	23.1%	14.2%	8.1%	100.0%	13.9%	23.3%	31.6%	21.3%	9.9%	100.0%
Meriwether County	36.5%	24.6%	17.7%	14.2%	7.0%	100.0%	20.8%	19.4%	25.9%	22.7%	11.2%	100.0%
Newton County	20.0%	23.9%	24.0%	20.5%	11.6%	100.0%	15.0%	21.5%	28.5%	22.6%	12.4%	100.0%
Paulding County	14.3%	19.9%	25.3%	27.8%	12.6%	100.0%	12.1%	19.0%	28.6%	28.3%	11.9%	100.0%
Pickens County	23.7%	24.0%	23.3%	17.4%	11.6%	100.0%	14.7%	17.7%	25.1%	23.5%	19.1%	100.0%
Pike County	23.7%	20.5%	26.1%	18.3%	11.4%	100.0%	15.4%	15.5%	31.6%	23.9%	13.5%	100.0%
Rockdale County	19.1%	21.8%	18.8%	21.2%	19.1%	100.0%	23.7%	25.3%	14.2%	19.9%	16.8%	100.0%
Spalding County	33.9%	24.1%	20.3%	13.7%	8.1%	100.0%	31.0%	22.5%	22.0%	15.3%	9.1%	100.0%
Walton County	21.6%	20.6%	20.7%	22.7%	14.4%	100.0%	13.4%	14.5%	25.4%	26.5%	20.1%	100.0%
Total Region	20.0%	20.0%	20.0%	20.0%	20.0%	100.0%	20.0%	20.0%	20.0%	20.0%	20.0%	100.0%

Table 11 below presents the Gwinnett forecasts in more detail. (Similar results were obtained for all counties in the region-to-county allocation process.) The industry groups covered in the employment tabulation are the 19 NAICS industries discussed previously, which were replaced in later steps by the 8 SIC industry groups required for transportation modeling. The forecasted Gwinnett gains generally follow the pattern shown for the region in Table 8, with the largest increases occurring in the professional, management, administrative support, educational and health service sectors. The county is also expected to achieve a relatively large gain in arts, entertainment and recreation.

The expected Gwinnett trend in household income has just been discussed. The last line of Table 11 shows the county's expected population growth rates over the 5-year intervals from 2005 to 2030, which progressively taper off from 2.0% to 0.9% per year.

Table 11. GWINNETT COUNTY FORECASTS

	2005	2010	2015	2020	2025	2030
Employment by Industry						
Extractive activities	629	527	440	369	313	272
Construction	21,681	23,071	24,175	25,061	25,797	26,454
Durable goods mfg	16,269	16,215	15,481	14,400	13,311	12,548
Nondurable goods mfg	6,625	7,648	8,106	8,189	8,085	7,984
Wholesale trade	32,891	36,126	38,055	39,167	39,952	40,897
Retail trade	42,663	46,464	48,407	49,082	49,082	48,997
Transportation & utilities	6,170	6,512	6,719	6,875	7,066	7,378
Information	10,280	12,395	13,690	14,389	14,716	14,896
Finance, insur & real est	20,407	24,678	27,836	30,192	32,056	33,740
Professional & mgmt serv	28,947	36,591	43,421	49,550	55,091	60,158
Admin support services	31,609	38,669	45,560	52,245	58,688	64,852
Educational services	3,336	4,455	5,675	6,941	8,194	9,379
Health & social services	20,307	25,263	30,177	34,996	39,667	44,134
Arts, entertainment & rec	2,966	4,209	5,058	5,578	5,836	5,895
Accommodations	1,746	1,831	1,873	1,883	1,874	1,859
Food services	22,905	26,036	28,309	29,968	31,261	32,434
Other services incl rental	15,559	17,584	19,089	20,251	21,247	22,256
Fed. & state government	5,325	6,062	6,566	6,920	7,204	7,499
Local government	26,157	29,774	33,045	36,046	38,851	41,538
Total	316,472	364,112	401,682	432,102	458,291	483,169
Households by Income						
Lower Quintile	33,122	39,213	45,388	51,707	58,231	65,018
Lower-Middle Quintile	46,329	52,961	59,496	65,989	72,496	79,073
Middle Quintile	51,298	56,255	60,438	63,865	66,558	68,535
Upper-Middle Quintile	59,214	64,789	69,427	73,134	75,914	77,774
Upper Quintile	56,177	60,520	64,026	66,886	69,290	71,427
Total	246,140	273,738	298,775	321,582	342,489	361,827
Total Population						
Number	719,849	795,444	861,985	920,660	972,657	1,019,166
Annual % Change		2.0%	1.6%	1.3%	1.1%	0.9%

SCA Forecast Preparation and Review

Gwinnett County was subdivided into eight sub-county areas (SCAs) for purposes of analysis and forecasting. As shown in maps elsewhere, SCAs 1 through 7 circle the county in a clockwise direction from its northern corner to its northwestern margin, while SCA 8 is a central territory including Lawrenceville. SCAs 1, 2 and 3 are partly rural with 2005 population densities around 1,000 persons per square mile. (See the last line of Table 12 below.) SCA 6 – spanning the inner portion of I-85 – is the most intensively developed area with a 2005 population density of about 3,263 persons per square mile, and the other SCAs range from approximately 1,800 to 2,000 persons per square mile. Table 12 on the next page presents the baseline values of leading variables for the eight SCAs. Employment is now classified by SIC rather than NAICS industries, and some of the county totals are modified slightly from the region-to-county allocation outputs shown earlier..

Forecasts were prepared for the eight SCAs using the same methodology as the region-to-county allocation, with the same model equations and forecasting steps. The only differences involved the model-pegging process and the weighting of predicted values from the relative-change and share-of-change equations. This task was conducted in mid-2006 and the results were modified slightly a few months later. Then the model-based forecasts were subjected to an expert review process in October-December of 2006. The review panel, consisting of project team members and county representatives, evaluated the forecasts against known development trends and land availability in the various SCAs and reached consensus on appropriate changes.

Tables 13 through 15 on the second through fourth following pages present the resulting SCA forecasts for 2030, showing both the model-based figures and the forecasts that emerged from the review process. Table 13 covers employment, Table 14 addresses population and households by income, and Table 16 addresses households by dwelling-unit type. The review process and accompanying investigations yielded some changes in baseline as well as forecasted values of variables, most notably for employment in SCA 4. The 2005-30 percent changes in the tables compare the revised 2030 forecasts with the revised baseline values (which are the ones appearing in Table 12).

The largest employment revisions in relative terms were increases in the 2030 forecasts for SCAs 1, 2 and 4. These increases were mostly offset by reductions in the 2030 employment predicted for SCA 6 (which currently has about 37% of the county's jobs). The most prominent revisions in total 2030 households consisted of a decrease for SCA 8, where land availability was considered an issue, and an increase for SCA 4. The revisions for individual income categories had the effect of raising the 2030 income profiles for SCAs 1, 2 and 8 and modestly lowering those for the other five SCAs. Table 15 shows 2005-30 percent changes for all dwelling types rather than just total occupied dwellings (households), because predicted shifts toward higher-density types are a major feature of the forecasts. Accentuation of this feature was a major impact of the revision process, which greatly reduced the detached housing shares of new development in SCAs 5 and 8.

Table 12. BASELINE (2005) VALUES OF VARIABLES FOR SUB-COUNTY AREAS (SCAs)

	SCA 1	SCA 2	SCA 3	SCA 4	SCA 5	SCA 6	SCA 7	SCA 8	Total
Employment by SIC Industry									
Construction	1,709	4,160	3,085	1,316	2,561	4,871	2,678	5,228	25,608
Manufacturing	1,620	2,708	438	386	635	12,571	3,304	7,807	29,469
Transportation, commun., util.	581	718	192	152	326	5,508	2,538	3,461	13,476
Wholesale trade	2,121	2,049	370	496	583	17,327	4,252	9,576	36,775
Retail trade	4,162	6,950	3,300	2,553	6,121	27,716	5,828	11,663	68,292
Finance, insurance, real estate	1,379	1,123	1,374	734	1,511	8,667	2,511	4,703	22,002
Services	5,212	6,036	3,851	2,552	7,181	33,995	10,890	18,446	88,162
Government	2,221	3,460	2,644	1,105	3,138	7,209	3,064	9,212	32,054
Total	19,004	27,206	15,254	9,294	22,056	117,864	35,064	70,095	315,838
Households by Income Quintile									
Lower	2,224	2,115	2,375	1,809	2,795	13,886	2,596	5,347	33,147
Lower Middle	2,562	4,302	5,278	2,887	4,576	17,097	3,120	6,480	46,301
Middle	2,590	6,523	6,612	3,045	5,875	15,279	4,195	7,217	51,337
Upper Middle	3,255	8,303	8,067	3,291	8,709	12,424	6,033	9,068	59,149
Upper	2,755	8,487	6,293	3,041	9,713	7,345	9,434	9,137	56,206
Total	13,386	29,730	28,625	14,074	31,668	66,030	25,378	37,249	246,140
Occupied Dwellings By Units in Structure									
Single-Family Detached	10,870	27,736	26,469	11,954	29,413	27,168	18,807	29,406	181,824
SF Attached & Duplex	530	744	871	451	862	6,991	1,346	2,852	14,647
3 to 9 Units	566	330	268	874	755	14,372	2,356	1,769	21,290
10 or More Units	375	409	422	274	347	16,628	2,717	2,752	23,925
Mobile Home & Misc.	1,044	511	596	521	291	869	152	470	4,453
Total	13,386	29,730	28,625	14,074	31,668	66,030	25,378	37,249	246,140
Population and Density									
Population (April 1)	37,335	90,232	83,813	41,948	94,304	190,680	70,012	111,524	719,849
Land Area in Square Miles	37.0	92.8	82.9	23.3	45.1	58.4	38.5	54.8	432.9
Population Per Square Mile	1,008	972	1,011	1,799	2,092	3,263	1,820	2,035	1,663

Table 13. FORECASTED 2030 EMPLOYMENT BY SIC INDUSTRY

	SCA 1	SCA 2	SCA 3	SCA 4	SCA 5	SCA 6	SCA 7	SCA 8	Total
Original Forecast									
Construction	2,001	4,919	2,965	866	1,771	6,779	3,443	4,275	27,020
Manufacturing	1,251	3,410	1,323	319	1,304	9,479	3,466	5,271	25,823
Transportation, commun., util.	1,452	2,125	1,480	454	1,514	5,660	3,645	3,593	19,923
Wholesale trade	2,741	4,008	1,645	651	1,447	13,431	4,503	12,704	41,131
Retail trade	6,917	14,797	7,821	2,151	8,341	31,053	8,773	16,715	96,569
Finance, insurance, real estate	2,815	4,274	3,777	584	1,924	11,620	4,721	7,888	37,602
Services	10,065	17,084	13,639	5,075	15,874	59,386	26,397	37,355	184,876
Government	3,361	7,034	4,805	1,694	4,348	9,104	4,668	14,933	49,947
Total	30,602	57,650	37,456	11,796	36,524	146,512	59,615	102,734	482,890
Revised Forecast									
Construction	2,913	6,085	5,431	1,407	3,095	4,454	3,613	5,581	32,579
Manufacturing	1,778	4,798	1,186	604	1,207	8,578	3,384	6,890	28,426
Transportation, commun., util.	1,121	2,419	615	405	856	6,418	3,334	4,498	19,666
Wholesale trade	3,665	5,963	1,155	1,009	1,695	15,441	5,737	12,390	47,055
Retail trade	6,196	13,300	7,629	2,973	7,275	26,867	8,100	14,829	87,168
Finance, insurance, real estate	2,821	5,177	3,416	946	2,019	9,702	4,726	8,505	37,314
Services	11,603	19,280	12,292	5,947	15,199	52,571	22,602	39,672	179,166
Government	4,056	7,457	6,200	1,901	4,747	10,148	5,041	11,966	51,516
Total	34,155	64,479	37,925	15,191	36,094	134,179	56,538	104,331	482,890
Percent Change, 2005-30	80%	137%	149%	63%	64%	14%	61%	49%	53%
Revised Minus Original									
Construction	913	1,166	2,466	540	1,324	-2,325	170	1,306	5,559
Manufacturing	526	1,388	-137	285	-96	-901	-81	1,620	2,603
Transportation, commun., util.	-331	294	-865	-50	-658	758	-310	905	-257
Wholesale trade	925	1,954	-490	357	248	2,010	1,235	-315	5,924
Retail trade	-721	-1,498	-193	822	-1,066	-4,187	-673	-1,887	-9,402
Finance, insurance, real estate	6	904	-361	362	95	-1,918	6	618	-288
Services	1,539	2,197	-1,347	872	-676	-6,815	-3,795	2,317	-5,709
Government	696	423	1,395	206	399	1,044	373	-2,967	1,570
Total	3,552	6,829	468	3,394	-430	-12,333	-3,077	1,597	0

Table 14. FORECASTED 2030 HOUSEHOLDS BY INCOME AND 2030 POPULATION

	SCA 1	SCA 2	SCA 3	SCA 4	SCA 5	SCA 6	SCA 7	SCA 8	Total
Households by Income									
Original Forecast									
Lower Quintile	3,994	5,540	5,674	3,533	5,885	21,766	6,263	12,363	65,018
Lower-Middle Q.	4,779	9,677	10,120	4,268	7,738	21,868	7,128	13,494	79,073
Middle Quintile	4,754	12,881	11,934	3,440	6,810	12,974	6,162	9,581	68,535
Upper-Middle Q.	5,710	15,724	13,638	3,382	8,769	11,495	7,991	11,066	77,774
Upper Quintile	5,060	13,119	10,396	2,617	9,212	9,668	11,040	10,316	71,427
Total	24,296	56,941	51,763	17,239	38,413	77,771	38,584	56,819	361,827
Revised Forecast									
Lower Quintile	3,948	5,693	5,719	3,972	6,146	22,273	6,327	11,154	65,231
Lower-Middle Q.	4,849	9,827	10,879	5,190	8,409	20,908	6,593	12,180	78,836
Middle Quintile	4,927	13,220	12,301	3,813	6,790	12,829	5,889	8,817	68,586
Upper-Middle Q.	6,042	16,076	14,307	3,535	8,591	11,416	7,607	10,159	77,735
Upper Quintile	5,304	14,338	9,739	2,995	9,094	9,011	10,559	10,397	71,438
Total	25,071	59,155	52,945	19,505	39,030	76,437	36,975	52,709	361,827
% Chg., 2005-30	87%	99%	85%	39%	23%	16%	46%	42%	47%
Revised Forecast Minus Original Fore.									
Lower Quintile	-46	153	45	439	260	507	64	-1,208	213
Lower-Middle Q.	70	150	759	922	672	-960	-535	-1,314	-236
Middle Quintile	174	339	367	373	-20	-145	-273	-764	51
Upper-Middle Q.	332	353	669	153	-178	-78	-384	-906	-39
Upper Quintile	245	1,220	-658	378	-117	-657	-480	82	11
Total	774	2,214	1,182	2,265	617	-1,334	-1,609	-4,110	0
Population									
Original Forecast	65,896	166,025	145,799	49,177	110,407	216,549	102,964	162,349	1,019,166
Revised Forecast	67,835	172,102	149,239	55,561	112,183	213,073	98,799	150,373	1,019,166
% Chg., 2005-30	82%	91%	78%	32%	19%	12%	41%	35%	42%
Revised Forecast Minus Original Fore.	1,940	6,077	3,440	6,385	1,776	-3,477	-4,165	-11,976	0

Table 15. FORECASTED 2030 HOUSEHOLDS BY NUMBER OF DWELLING UNITS IN STRUCTURE

	SCA 1	SCA 2	SCA 3	SCA 4	SCA 5	SCA 6	SCA 7	SCA 8	Total
Original Forecast									
Single-Family Detached	17,867	50,104	45,287	13,885	34,262	30,806	25,223	40,276	257,709
SF Attached & Duplex	1,992	2,990	2,950	1,044	2,518	8,087	3,719	5,607	28,907
3 to 9 Units	1,879	2,274	1,741	1,256	1,001	16,502	4,397	4,177	33,226
10 or More Units	2,342	1,470	1,670	899	558	22,116	5,207	6,647	40,910
Mobile Home & Misc.	216	103	115	155	74	260	39	113	1,075
Total	24,296	56,941	51,763	17,240	38,413	77,770	38,584	56,819	361,827
Revised Forecast									
Single-Family Detached	18,965	49,896	45,818	14,107	30,999	29,374	24,440	36,258	249,855
SF Attached & Duplex	2,111	4,075	3,715	1,701	3,464	7,396	2,947	4,779	30,188
3 to 9 Units	1,628	2,484	1,709	1,974	2,624	15,340	3,936	4,611	34,307
10 or More Units	2,157	2,598	1,585	1,584	1,886	24,154	5,617	6,953	46,534
Mobile Home & Misc.	209	102	119	139	58	173	35	107	943
Total	25,071	59,155	52,945	19,505	39,030	76,437	36,975	52,709	361,827
% Change 2005-30, Revised Forecast									
Single-Family Detached	74%	80%	73%	18%	5%	8%	30%	23%	37%
SF Attached & Duplex	298%	448%	327%	277%	302%	6%	119%	68%	106%
3 to 9 Units	188%	653%	538%	126%	248%	7%	67%	161%	61%
10 or More Units	475%	535%	276%	478%	444%	45%	107%	153%	94%
Mobile Home & Misc.	-80%	-80%	-80%	-73%	-80%	-80%	-77%	-77%	-79%
Total	87%	99%	85%	39%	23%	16%	46%	42%	47%
Revised Forecast Minus Original Fore.									
Single-Family Detached	1,097	-208	531	222	-3,264	-1,432	-783	-4,018	-7,854
SF Attached & Duplex	119	1,084	765	657	946	-691	-772	-828	1,281
3 to 9 Units	-251	211	-32	719	1,623	-1,162	-460	435	1,082
10 or More Units	-185	1,128	-85	685	1,328	2,037	410	306	5,624
Mobile Home & Misc.	-7	0	4	-16	-16	-86	-4	-6	-132
Total	774	2,214	1,182	2,265	617	-1,333	-1,609	-4,110	0

Development of Planning Scenarios

All of the foregoing discussion has pertained to the development of a benchmark forecast expressing a most-likely outcome for Gwinnett given no change from the present in public policies related to land use. The further work requirements related to SCA-level forecasting consisted of supporting the project team in the development of alternative scenarios and contributing to the TAZ allocation task.

Scenario development was initiated near the end of 2006 in conjunction with the review process just described. At that time the revised benchmark forecast was dubbed a project scenario (which was not a foregone conclusion) and given the name "Middle-of-the-Road." Three other scenarios were also tentatively identified and quantified: one involving lower employment and demographic magnitudes than the benchmark forecast and two involving higher magnitudes. Further deliberation of planning issues led the project team to set aside the second-highest scenario in the spring of 2007 and the low scenario somewhat later. Meanwhile the Middle-of-the-Road alternative was modified slightly, with total employment rising by 1% and total population and households up by 2%, due to various factors including a higher-than-expected population estimate for 2006 and decision to convert all demographic variables from an April 1 basis to a July 1 basis.

Then in early August the high alternative – referenced as the "Gateway" scenario – was thoroughly reformulated. The aims were to: 1) optimize the fiscal consequences of this alternative, given a finding that the county risked major exposure to fiscal stress; 2) improve the county's competitive position vis-à-vis the burgeoning Route 400 corridor; and 3) assure that the Gateway scenario was potentially achievable. Relative to the former version, the new Gateway scenario featured: moderately lower employment, household and population totals; substantially more economic growth and high-end residential development in the I-85 corridor and the county's northwestern margin, supported by enhanced transportation improvements; and a greater continuation of low-density estate development, much without sewer service, in the county's present rural areas.

Tables 16 and 17 on the next two pages describe the final versions of the Middle-of-the-Road and Gateway scenarios, respectively. Income is now described using the system required by the transportation model, involving a four-way classification to be explained later.

The three rows of percentages in Table 17 describe for each SCA the extent to which the Gateway exceeds the Middle-of-the-Road scenario in total employment, total households and total population. The first show that the Gateway scenario involves much higher employment in SCAs 1 and 6, more moderate excesses in SCAs 7 and 8, and substantially lower employment elsewhere. The other percentages show a similar pattern for demographics, except that only SCAs 2 and 3 have lower households and population in the Gateway alternative than the Middle of the Road scenario.

Table 16. CHARACTERISTICS OF MIDDLE-OF-THE-ROAD SCENARIO

	SCA 1	SCA 2	SCA 3	SCA 4	SCA 5	SCA 6	SCA 7	SCA 8	Total
Employment									
Construction	2,942	6,146	5,485	1,421	3,126	4,498	3,649	5,637	32,905
Manufacturing	1,796	4,846	1,198	610	1,219	8,664	3,418	6,959	28,710
TCU	1,132	2,443	621	409	865	6,482	3,368	4,543	19,863
Wholesale tr.	3,702	6,022	1,167	1,019	1,712	15,596	5,794	12,514	47,525
Retail trade	6,258	13,433	7,705	3,003	7,348	27,135	8,181	14,977	88,039
FIRE	2,850	5,229	3,451	956	2,039	9,799	4,774	8,590	37,687
Services	11,719	19,473	12,415	6,006	15,351	53,097	22,828	40,068	180,958
Government	4,097	7,531	6,262	1,920	4,795	10,250	5,091	12,086	52,031
Total	34,496	65,124	38,304	15,343	36,455	135,520	57,104	105,374	487,719
Households by Relative Income									
Bottom 14.3%	2,863	3,996	3,841	2,392	4,171	14,225	4,086	7,498	43,073
Next 31.94%	7,836	15,645	16,967	7,793	12,498	33,880	10,592	18,735	123,947
Next 35.22%	10,927	29,054	25,310	7,165	15,155	22,025	13,253	18,388	141,277
Top 18.54%	4,165	12,110	8,312	2,477	7,904	7,218	9,755	8,931	60,871
Total	25,791	60,804	54,430	19,828	39,728	77,348	37,688	53,552	369,168
Households by Units in Struct.									
SF Detached	19,422	51,014	46,921	14,209	31,082	29,575	24,761	34,650	251,633
SFA & duplex	2,233	4,360	3,936	1,780	3,654	7,426	3,049	6,103	32,540
3 to 9	1,712	2,668	1,843	2,058	2,847	15,370	4,061	5,096	35,655
10 or more	2,284	2,702	1,662	1,695	2,119	24,876	5,794	7,640	48,773
Mobile home	141	61	69	86	25	101	21	62	567
Total	25,791	60,804	54,430	19,828	39,728	77,348	37,688	53,552	369,168
Households by Persons in HH									
1 person	5,735	11,742	9,825	3,858	6,914	20,830	8,492	11,042	78,438
2 persons	7,890	17,864	16,443	5,549	11,300	21,450	11,245	14,324	106,066
3 persons	5,036	12,648	11,471	4,193	8,678	13,929	7,490	11,222	74,666
4 persons	4,409	11,945	10,424	3,807	8,078	10,040	6,884	10,435	66,023
5 persons	1,701	4,336	4,317	1,592	3,217	5,650	2,451	4,218	27,482
6 persons	589	1,576	1,323	535	1,052	2,867	766	1,507	10,215
7+ persons	430	692	626	294	489	2,581	361	804	6,277
Total	25,791	60,804	54,430	19,828	39,728	77,348	37,688	53,552	369,168
Population by HH Status									
In households	69,752	169,756	153,290	56,278	114,069	212,447	100,691	151,597	1,027,880
In group qtr.s	231	7,363	325	223	241	3,533	210	1,374	13,500
Tot. population	69,983	177,120	153,615	56,501	114,310	215,980	100,901	152,972	1,041,380

Table 17. CHARACTERISTICS OF GATEWAY SCENARIO

	SCA 1	SCA 2	SCA 3	SCA 4	SCA 5	SCA 6	SCA 7	SCA 8	Total
Employment									
Construction	5,849	6,520	4,161	1,435	2,871	8,864	5,182	7,464	42,344
Manufacturing	2,304	3,827	669	451	778	10,209	3,530	7,407	29,175
TCU	2,058	2,079	355	264	508	10,048	4,309	5,448	25,069
Wholesale tr.	6,573	4,282	672	726	964	20,410	7,429	15,007	56,063
Retail trade	9,066	12,322	4,584	2,597	6,231	36,760	8,722	15,648	95,929
FIRE	5,237	4,556	2,151	836	1,697	18,440	6,250	10,195	49,363
Services	24,411	17,964	7,581	4,324	10,471	90,270	33,184	51,985	240,190
Government	6,971	6,319	3,889	1,397	3,548	15,633	5,896	13,165	56,818
Total	62,471	57,867	24,061	12,030	27,068	210,632	74,501	126,319	594,950
% Above Mid.	81%	-11%	-37%	-22%	-26%	55%	30%	20%	22%
Households by Relative Income									
Bottom 14.3%	4,566	2,758	2,596	1,647	2,563	14,782	3,111	6,172	38,196
Next 31.94%	11,474	12,495	13,061	6,539	9,547	44,932	9,541	17,597	125,186
Next 35.22%	15,292	25,869	21,466	8,830	18,418	37,997	17,691	25,397	170,961
Top 18.54%	5,602	12,227	8,020	3,502	10,509	8,987	14,798	12,391	76,036
Total	36,934	53,349	45,142	20,519	41,038	106,698	45,142	61,557	410,378
% Above Mid.	43%	-12%	-17%	3%	3%	38%	20%	15%	11%
Households by Units in Struct.									
SF Detached	22,305	42,668	38,910	14,054	31,041	37,884	26,577	37,550	250,988
SFA & duplex	5,361	4,599	3,151	2,035	4,126	11,713	5,161	6,985	43,130
3 to 9	3,652	2,969	1,535	2,323	3,242	21,028	5,543	7,123	47,415
10 or more	5,369	3,051	1,465	1,969	2,575	35,888	7,818	9,767	67,903
Mobile home	247	63	81	139	53	184	43	132	942
Total	36,934	53,349	45,142	20,519	41,038	106,698	45,142	61,557	410,378
Households by Persons in HH									
1 person	8,226	10,391	8,210	4,005	7,268	29,163	10,449	12,895	90,608
2 persons	11,295	15,648	13,619	5,739	11,643	29,472	13,376	16,421	117,212
3 persons	7,211	11,095	9,510	4,338	8,959	19,123	8,957	12,891	82,083
4 persons	6,309	10,443	8,622	3,934	8,290	13,762	8,135	11,906	71,402
5 persons	2,435	3,791	3,569	1,645	3,299	7,730	2,894	4,809	30,171
6 persons	844	1,379	1,095	553	1,080	3,941	907	1,722	11,521
7+ persons	616	604	517	304	500	3,507	423	912	7,382
Total	36,934	53,349	45,142	20,519	41,038	106,698	45,142	61,557	410,378
Population by HH Status									
In households	99,854	148,699	126,964	58,201	117,458	291,782	119,876	173,643	1,136,476
In group qtr.s	231	7,378	326	223	241	3,539	210	1,376	13,524
Tot. population	100085	156,076	127,289	58,424	117,700	295,321	120,086	175,019	1,150,000
% Above Mid.	43%	-12%	-17%	3%	3%	37%	19%	14%	10%

Table 18 describes in percentage terms the income distributions specified by the two scenarios. As shown by the differences of percentages in the table's last section, the Gateway scenario involves a significantly higher income profile overall (measured as the sum of differences for the two upper income groups). The income gaps are especially large for SCAs 4, 5, 7 and 8. Only SCA 1 – which would have much more employment and housing of higher-density types in the Gateway scenario – has a lower income profile in the Gateway than the Middle-of-the-Road scenario.

Table 18. INCOME DISTRIBUTIONS IN FINAL SCENARIOS

	SCA 1	SCA 2	SCA 3	SCA 4	SCA 5	SCA 6	SCA 7	SCA 8	Total
Middle-of-the-Road									
Bottom 14.3%	11%	7%	7%	12%	10%	18%	11%	14%	12%
Next 31.94%	30%	26%	31%	39%	31%	44%	28%	35%	34%
Next 35.22%	42%	48%	46%	36%	38%	28%	35%	34%	38%
Top 18.54%	16%	20%	15%	12%	20%	9%	26%	17%	16%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%
Gateway									
Bottom 14.3%	12%	5%	6%	8%	6%	14%	7%	10%	9%
Next 31.94%	31%	23%	29%	32%	23%	42%	21%	29%	31%
Next 35.22%	41%	48%	48%	43%	45%	36%	39%	41%	42%
Top 18.54%	15%	23%	18%	17%	26%	8%	33%	20%	19%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%
Difference									
Bottom 14.3%	1%	-1%	-1%	-4%	-4%	-5%	-4%	-4%	-2%
Next 31.94%	1%	-2%	-2%	-7%	-8%	-2%	-7%	-6%	-3%
Next 35.22%	-1%	1%	1%	7%	7%	7%	4%	7%	3%
Top 18.54%	-1%	3%	2%	5%	6%	-1%	7%	3%	2%
Total	0%	0%	0%	0%	0%	0%	0%	0%	0%

Additional Variables and Allocation Support

Along with allocation modeling and support for scenario development, the present work component was responsible for: 1) forecasting SCA values of variables other than those yielded directly by the allocation model; 2) converting several variables to different classification systems; and 3) generating TAZ forecasts of all relevant variables based on the results of parcel-level allocation by another party. The following paragraphs will discuss the activities briefly without getting into the details of baseline estimation.

The variables yielded directly by the county-to-SCA allocation process and the development of alternative scenarios consisted of employment by industry, households by income quintile, and households by structure type (from the model's external loop). The required additional variables were population by household status, households by size (number of persons), and households cross-tabulated by income and size. Some of the additional and converted variables have already been cited in the previous tables.

Forecasting population on the basis of households required: 1) preparing independent estimates of population in group quarters (usually very small); 2) developing relationships to translate household population between two different types of racial classification (namely classification by race of individual versus race of householder); and 3) estimating and projecting values of population per household for the four racial groups. Assistance in population forecasting was the main payoff from the model-based forecasting of households by race as well as income, because population per household varied dramatically among racial groups. An outcome was that, even with average household size assumed to decline markedly for most individual groups, only modest decreases in overall household size were forecasted for Gwinnett and its SCAs due to the rising presence of groups with large households, particularly Hispanics.

The breakdowns of SCA households by number of persons per household were developed, like most of the TAZ-level variables discussed below, by working forward from the 2005 baseline in five-year increments, with the results for each year serving as inputs to computations for the next. The focus of attention was the percent distribution of households among size categories (these being one person, two persons, and so on up to seven-plus persons). For each SCA in each year, the solution consisted of finding the number of percentage points that had to be shifted from each size category to the next higher or lower category (usually lower) to convert the prior year's distribution to a new distribution that exactly accounted for the SCA's predetermined household population. (The household cross-tabulation by income and size will be explained momentarily.)

The conversions of employment by industry and households by income to new classification systems were accomplished by developing conversion matrices for the baseline year and applying these without modification to future years. Like the quintile system, the new income classification expressed relative rather than absolute income, based on the regional income distribution, but its four categories accounted for varying shares of households. These shares – 14.30%, 31.94%, 35.22% and 18.54% – equaled the proportions of regional households with incomes of under-$19,999, $20,000-$49,999, $50,000-$99,999 and $100,000-plus as reported by the 2000 census. (The region in this case consisted of the 20 counties addressed by the Atlanta Regional Commission rather than the 29 counties relevant elsewhere.)

The tabulations of households by number of dwelling units per structure had to be converted into a land-use classification system based partly on residential density. As in other cases, the conversions for future years were accomplished using a matrix developed from baseline data, but an extra feature was the need to add estimates of vacant dwellings so that the forecasts covered all dwelling units. The resulting figures, along with the converted employment forecasts, were delivered to serve as SCA control totals for the allocation of land uses to individual parcels by the consultant charged with that effort.

The cross-tabulation of households by income and size involved twenty-four categories: the four income groups just described times six household size categories (wherein the top group covered households containing six-plus rather than seven-plus

persons). The immediate requirement was to prepare such cross-tabulations for the baseline year. The only available information other than marginal totals for income and size was a cross-tabulation for the region as a whole obtained from the ARC. This table was mathematically analyzed to establish characteristic relationships among cells (which ultimately involved a typology of 34 cases based on relative magnitudes). The relationships were then applied to 2005 Gwinnett households by income and size to develop baseline cross-tabulations for all TAZs. These cross-tabs were aggregated to the SCA level and projected forward for use as control totals, but ultimately were used only for checking purposes as explained momentarily.

The final steps in the work effort described here consisted of generating TAZ-level variables for input to the transportation model. The cross-tabulation of households by income and size was the ultimate concern (along with employment variables that did not require processing), but multiple steps were required for its production.

The SCA-to-parcel allocation process yielded land-use variables for 2030 aggregated to the TAZ level. The first processing step involved a deduction of vacant units and a reverse application of the conversion matrix to yield 2030 TAZ households by dwelling structure type. Values for intermediate years (referring as elsewhere to years ending in 5 and 0) were then estimated by interpolating between the 2005 and 2030 values using SCA-specific factors that yielded consistency with the model-based SCA control totals.

Population and households by size category were addressed in reverse order. TAZ household size distributions were projected from each year to the next by applying the percentage-point shifts developed in the SCA-level estimation process and using an iterative procedure to reconcile the results with the SCA control totals. Households were converted to numbers of persons in each category (using average top-group sizes from the SCA estimation process). These figures were summed to yield household population, then added to estimates of group-quarters population to yield total TAZ population.

Tabulations of future TAZ households by income were estimated using a series of regression equations that linked income percentages to shares of households by structure type, plus household growth and dummy variables for SCAs. The percentages obtained for a given year were added to adjustment factors that were specific to each income category in each TAZ (and were based like the regression equations on 2005 data). The resulting figures were then converted to absolute numbers and reconciled via iterative procedures with control totals. The controls in this case were TAZ-level household sums (from the structure-type interpolation process) and SCA totals for income groups.

The cross-tabulations of households by size and income for TAZs were developed for each year using the tabulation for the previous year and the separate tabulations by size and income already developed for the current year. Based on the distributions of previous-year values, two provisional versions of the cross-tabulation were prepared for each TAZ, one preserving the correct income profile and one preserving the correct size profile. These were then averaged and became the basis for two new versions, with the

correct income and size profiles enforced as before. This process was continued until convergence was achieved at values consistent with both the income and size profiles. The same methodology was applied at the SCA level to yield the abovementioned figures intended for use as control totals. However, a three-way reconciliation proved to be computationally intractable, so the numbers were only reconciled with the marginal totals at the TAZ level, and when aggregated to the SCA level they were not fully consistent with the independent SCA figures. The differences were considered unimportant since both sets of numbers were estimates. The resulting TAZ cross-tabulations for 2030 became the principal basis for transportation modeling when combined with the SIC-classified employment forecasts.

Appendix D – Economic Development Overview

Robert Charles Lesser & Co., LLC (RCLCO) has prepared an introduction to Gwinnett County, its context within the larger Atlanta Region, and the key issues identified impacting growth and trends within the county. The following represents a summary of these issues and trends.

For the purposes of this report the "Atlanta region" refers to the 10-county Atlanta Regional Commission (ARC) planning area comprised of the following member counties: Cherokee, Clayton, Cobb, DeKalb, Douglas, Fayette, Fulton, Gwinnett, Henry, and Rockdale.

ARC's 13 county forecasting area, which includes the 10 member counties plus Coweta, Forsyth, and Paulding counties, as well as the 28-county Atlanta MSA will also be referenced in this document. These 13 counties represent approximately 90% of the MSA population and a larger share of employment.

Atlanta Regional Context

The Atlanta region has been among the most rapidly growing metropolitan areas in the United States over the past 15+ years. As with many Sunbelt cities, people and businesses have flocked to Atlanta driven by its favorable quality of life, mild climate, relatively low cost structures, diverse and expansive labor market, full spectrum of affordably priced housing options, infrastructure (including highway and airport), and general perception as the center of a thriving Southeastern economy.[1]

The Atlanta region experienced one of its longest and most impressive periods of growth in the post-recession 1990s with the addition of 556,600 new jobs and a population increase of nearly 872,000 new residents (a net increase in employment of 606,000 and in population of 1,045,066 in the central 13 counties)[2]. Shortly before the recession in the early 2000s, the Atlanta region was adding nearly 100,000 residents annually, bringing the total population to 3.4 million (4.1 million in the 20 county MSA[3]) and employment to nearly 2 million by 2000.

While the recession in the early 2000s curbed the region's dynamic growth for a few years, the region has recovered well and is adding population at a rate equal to or even greater than experienced in the 1990s. According to Atlanta Regional Commission estimates, between 2000 and 2006 the 10-county region added an average of more than 82,000 people per year, compared to 87,000 on average in the 1990s. Claritas estimates from 2007 put the 10-county growth even higher at over 88,000 on average since 2000. Somewhat counter-intuitively, employment growth, while still relatively strong, has diminished somewhat since 2000, with an average of around 23,500 additional jobs each year, compared to the 56,000 average in the 90s. However, since

[1] The impact of the current water crisis has not been quantified or accounted for in any growth projections. It is possible that a significant and extended drought could dampen the actual performance of the metro economy.
[2] Source: US Census Bureau
[3] The Atlanta MSA was expanded from 20 to 28 counties in 2003

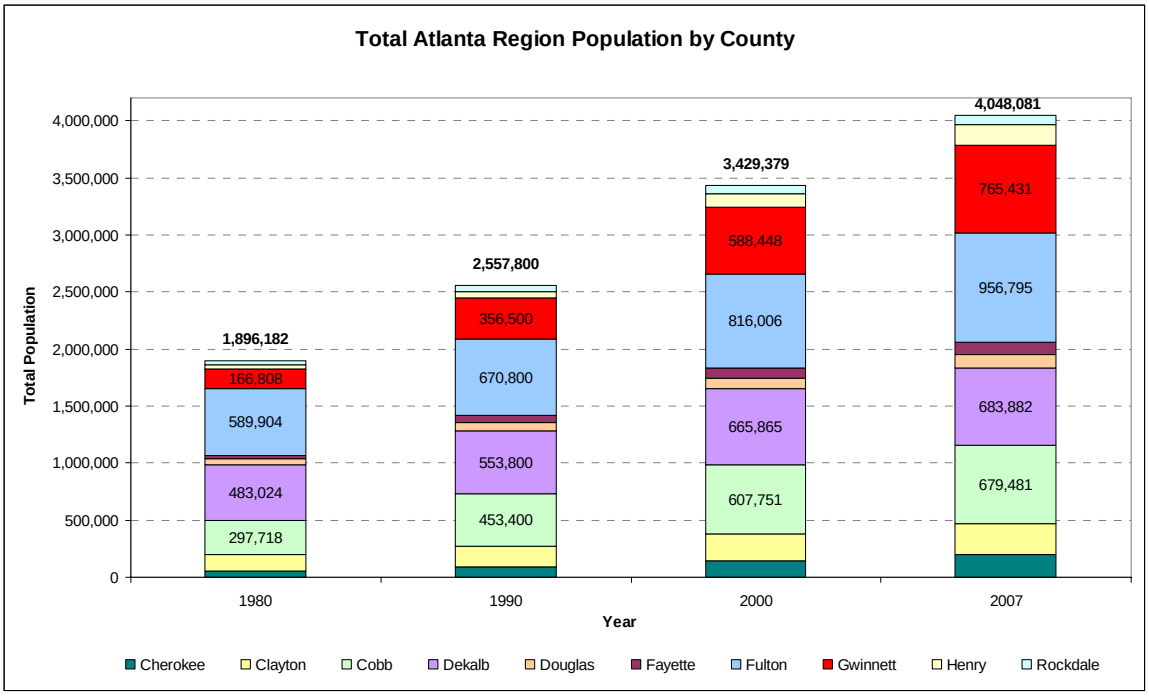
the recovery from the recession of the early 2000s, the job growth statistics have been much stronger. It should be noted that several economists believe these estimates to be quite low, with increasing job growth potentially occurring in entrepreneurial jobs or others that may not show up on the radar. This belief is fostered by the strong population gains occurring with unemployment remaining low, indicating job growth must be higher than indicated.

Initial indications are that beginning in late 2007 or early 2008 the national economy entered a period of slow to negative growth. Although the duration and severity of the downturn is unknown at this time, it is likely to have a softening effect on employment and population growth in metro Atlanta for the next few years.

Concentration and Direction of Growth

The highest population levels, attained through historically significant growth, in the Atlanta region are found in Atlanta's core (most urban) counties.

Figure 1: Total Population by County, 1990 – 2007

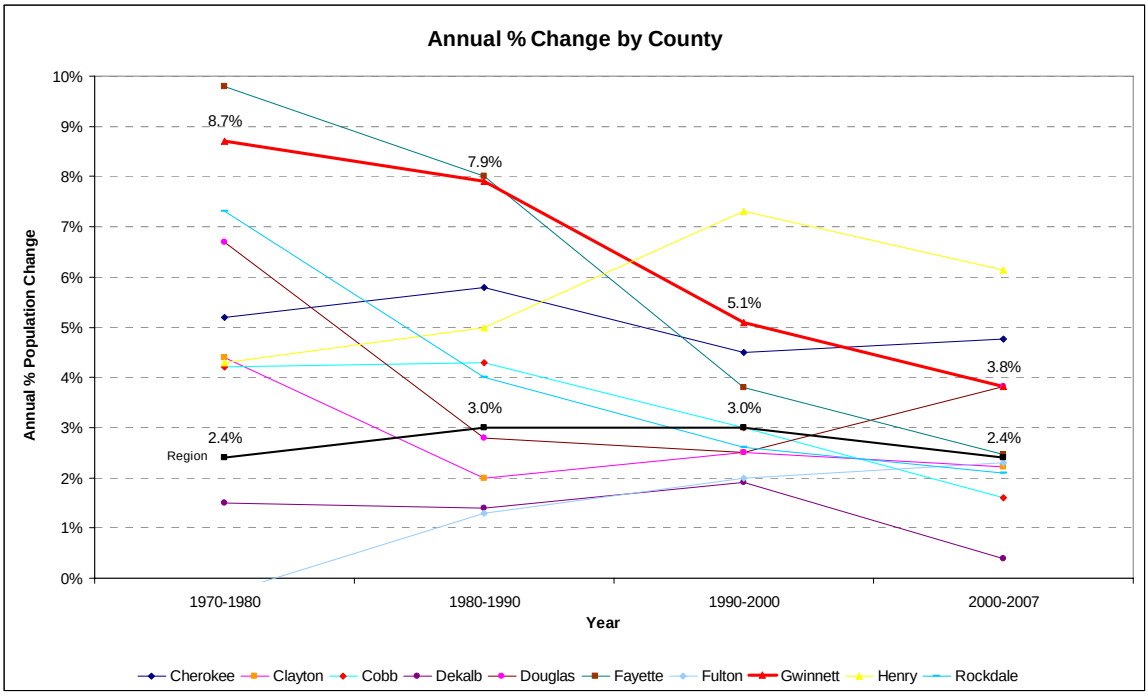


Source: US Census; 2007 figures from Claritas, Inc.

Population and employment growth has largely occurred in the region's "favored quarter", in which Gwinnett lies. The favored quarter is defined as the radiating quarter of an MSA where the bulk of the executive housing and white-collar jobs locate, and the largest portion of new housing growth, both executive and more affordable, is developed. Atlanta's favored quarter largely equates to area north of Downtown between I-75 and I-85 and anchored by Georgia 400 and the Chattahoochee River.

Between 1990 and 2000, nearly 80% of the region's job growth occurred within the favored quarter. Although an increasing amount of growth has located in areas outside of the favored quarter in the last few years, the large majority of growth will continue to move up I-75, I-85 and Georgia 400.

Figure 2: Annual Population Change by County, 1970 - 2007



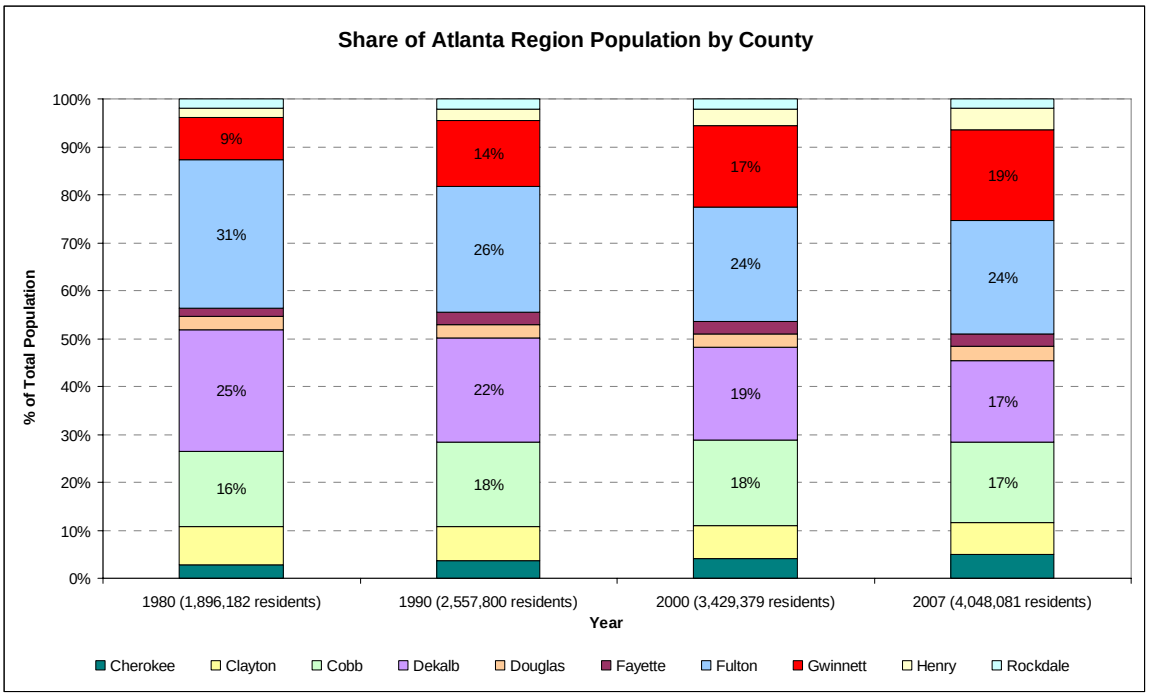
Source: US Census; 2007 figures from Claritas, Inc.

Much of the new office development is anticipated to occur in the metro cores within the favored quarter. Metro cores are concentrations of employment and regional activity and have evolved as the metro area continues to grow. Atlanta's largest urban cores include Downtown, Midtown, Buckhead, Central Perimeter and Cumberland-Galleria. These latter three cores are examples of 3rd generation cores; cores that were largely founded in the 1970s and evolved into major employment and activity concentrations in the 1990s. These cores, which dominated office growth in the 1980s, have since seen gradual declines in their capture (although still seeing positive growth) of new office and retail demand, losing share to newer 4th generation cores, (typically more amorphous and somewhat "edgeless") located even further out. The strongest example of a 4th generation core in Atlanta is the Georgia 400 North corridor in North Fulton, which accounted for close to half of the region's office growth in the late 1990's and 2000's. The other two major 4th generation cores are Town Center on I-75 and Gwinnett Place Mall and Sugarloaf areas in Gwinnett. During the 1990s and early 2000s, mature 3rd Generation cores consistently lost ground to these newer cores in part due to significant traffic congestion along major freeways feeding the cores. However, the events of the past few years indicate that this continued outward expansion may be slowing down somewhat. Most notably, the resurgence of Downtown as a place for new construction

office and housing has made headlines, as has the evolution of Central Perimeter as both an employment, and now housing core. While this reinvestment in core submarkets is a noticeable trend, the 4th generation cores should still expect to capture large amounts of future growth due to their proximity to many executives' homes and their relative affordability as compared to more in-town locations.

Gwinnett and its historically pro-growth mentality, variety of housing options which accommodate a range of prospective buyers and renters, expanding office cores, popular malls and retail centers, new civic and cultural amenities such as the Gwinnett Center, and acclaimed school system has been the primary beneficiary of this suburban growth, doubling its share of the region's residents from 9% in 1980 to 18.9% in 2007.[4] The County was the fastest growing county in the nation in 1984 and has consistently remained in the top 100 since that time.[5] Fulton and DeKalb have lost the greatest proportion of population with each conceding 7-8% of their share of the metro population in the past 27 years (i.e. Fulton has gone from 31% of the population to 24% and DeKalb from just over 25% to less than 17%).

Figure 3: Share of Atlanta Region Population County, 1980 - 2007



Source: US Census; 2007 figures from Claritas, Inc.

In terms of absolute growth, Gwinnett continues to rank among the counties with the most robust growth in the nation. According to the US Census, between April 1, 2000

[4] Source: 2007 figures from Claritas, Inc.
[5] Source: Metro Atlanta Chamber of Commerce, US Census

and July 1, 2006, Gwinnett ranked ninth in the nation in absolute population growth (adding over 168,000 people).

However, given Atlanta's primary development pattern being the "drive for value," a significant portion of buyers are likely to opt for suburban areas even further out than Gwinnett and will fuel growth for the next ring of counties. This is illustrated in the counties experiencing the most rapid percentage growth, many of which rank among the fastest growing counties in the nation.

Figure 4: Population Growth Estimates by County for the Fastest-Growing US Counties, 2000 - 2006

U.S. Rank	Geographic area	Population estimates		2000 to 2006	
		2006	2000	Net Change	Percent Change
1	Flagler County, FL	83,084	49,835	33,249	66.7
2	Kendall County, IL	88,158	54,520	33,638	61.7
3	Rockwall County, TX	69,155	43,074	26,081	60.5
4	Loudoun County, VA	268,817	169,599	99,218	58.5
5	Forsyth County, GA	150,968	98,407	52,561	53.4
6	Pinal County, AZ	271,059	179,537	91,522	51.0
7	Douglas County, CO	263,621	175,766	87,855	50.0
8	Henry County, GA	178,033	119,344	58,689	49.2
9	Paulding County, GA	121,530	81,608	39,922	48.9
10	Lyon County, NV	51,231	34,501	16,730	48.5
11	Newton County, GA	91,451	62,001	29,450	47.5
22	Barrow County, GA	63,702	46,144	17,558	38.1
24	Cherokee County, GA	195,327	141,903	53,424	37.6
32	Jackson County, GA	55,778	41,589	14,189	34.1
43	Lee County, GA	32,495	24,757	7,738	31.3
47	Walton County, GA	79,388	60,687	18,701	30.8
51	Effingham County, GA	48,954	37,535	11,419	30.4
58	Douglas County, GA	119,557	92,244	27,313	29.6
61	Coweta County, GA	115,291	89,215	26,076	29.2
64	Dawson County, GA	20,643	15,999	4,644	29.0
65	Pickens County, GA	29,640	22,983	6,657	29.0
69	**Gwinnett County, GA**	**757,104**	**588,448**	**168,656**	**28.7**
82	Bryan County, GA	29,648	23,417	6,231	26.6

Source: US Census

Employment growth in Gwinnett County has also been relatively strong over the past few years, averaging more than 5,000 net new jobs per year from 2000 to 2006.[6] Over the past three years, the Northeast/ I-85 corridor (which includes Gwinnett County) has captured slightly more than its "fair share" of office absorption (representing 10% of current space compared to 12% of absorption).[7] While there has been much discussion of shifting attitudes towards more "inside-the-perimeter" lifestyle, Gwinnett County and

[6] Source: Atlanta Regional Commission estimates
[7] Source: CoStar 4th Quarter 2007 Office Guide

the rest of the suburbs still constitute a large capture of the metro area's employment growth; a trend which is likely to continue over the next few decades.

These growth trends of the past 25 years are forecasted to continue (by ARC) over the next 25 years with Gwinnett continuing to lead the way in growth. Fueled by a continually expanding economy, led by services and retail trade, and corresponding job creation and evolution of suburban cores, the 13-county area is expected to increase by 1.3 million jobs and 2.7 million residents between 2000 and 2030, for total employment of 3,355,269 and a total population of 5,962,177.

The Atlanta Regional Commission estimates that Gwinnett County will add 400,246 residents and 224,101 jobs during this 30-year period, leading all other counties in population growth and ranking second behind Fulton County employment growth. As a result, Gwinnett is estimated to have a 2030 population of 988,694 and employment of 516,001, surpassing DeKalb County as the 2nd largest population in the region, and overtaking both Cobb and DeKalb to also gain the secondary position in regard to employment; trailing only Fulton County in both cases.

Six Major Issues Impacting Gwinnett Today

Based on this larger context and RCLCO's knowledge and experience in Gwinnett County, we have identified six significant issues that should be explored further in the planning process, and that will shape growth and investment in Gwinnett in the coming years.

1. Gwinnett is transitioning from an industrial job center to a more office-oriented job center;
2. Demographically, the area is rapidly diversifying both in terms of racial and ethnic composition as well as in the types (age, size, etc.) of households being attracted;
3. Housing continues to serve the full spectrum in terms of price points;
4. Gwinnett serves as a major regional shopping destination for the I-85 corridor;
5. Several areas, particularly those in the south of the county are struggling with revitalization; and
6. Currently Gwinnett lacks a "center" or downtown area, although multiple centers are emerging as cities are reinvesting in their downtowns.

The following represents a more detailed discussion of these major trends.

1. Gwinnett Non-Retail Job Growth is Transitioning from Primarily Industrial to Office

Historically, Gwinnett's economy has been concentrated in warehouse, distribution, manufacturing, and retail services jobs. Interstate 85 has been the primary distribution corridor in the Southeast, which has driven demand for industrial and business park space throughout the county. Consistent with evolution of metro cores discussed earlier, the Gwinnett/I-85 corridor represents an emerging office core as jobs continue to follow executive housing growing between the Chattahoochee River and I-85.

While the industrial market in Gwinnett County remains strong, supply of land fueling this market is decreasing significantly, resulting in increasing growth in exurban areas such as Jackson County, as well as southern counties where land is cheaper, such as Henry and South Fulton counties.

- The majority of recent activity in the Northeast Atlanta submarket (which encompasses northern DeKalb, Gwinnett, Barrow, Hall, Walton, and Jackson counties) has occurred in areas outside of Gwinnett County. In 2007, of the 6.3 million square feet of industrial space either delivered or under construction in the Northeast Atlanta submarket, only 1.7 million square feet, or 27%, was located in Gwinnett County. This share of new activity is significantly below the existing share that Gwinnett County holds, which is 53% of the industrial space in the Northeast Atlanta submarket. [8]

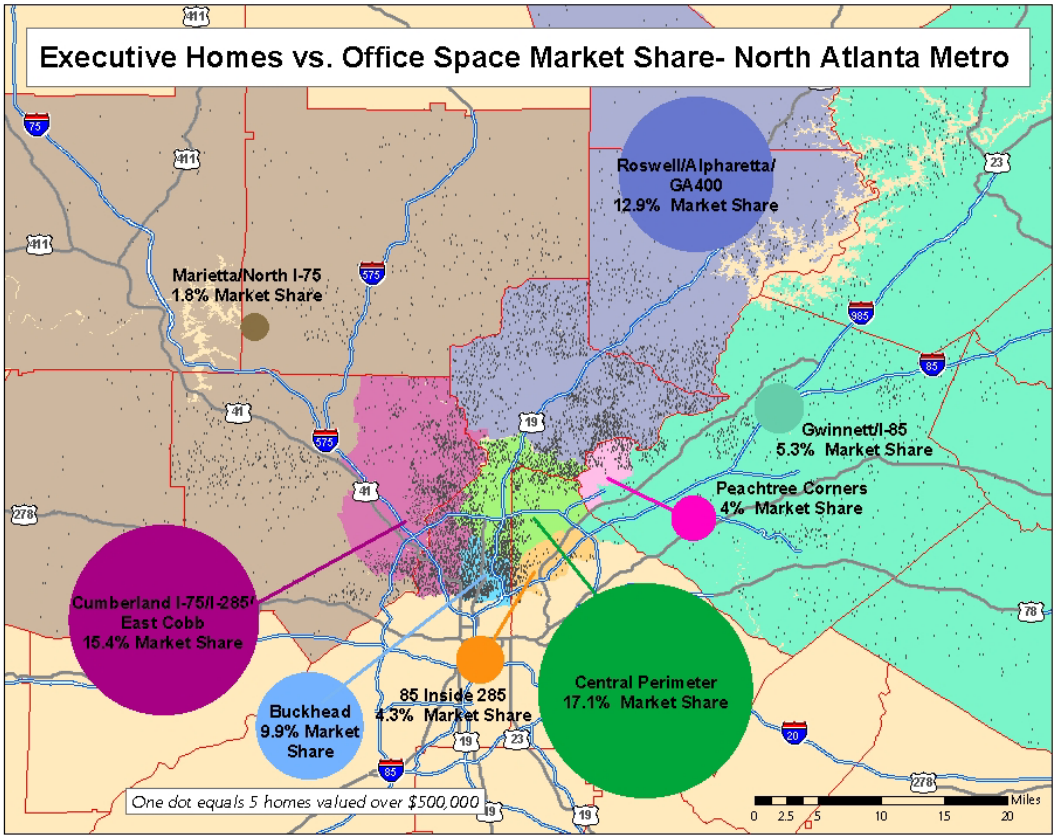
- Industrial development in Gwinnett County is challenged by increasing competition both locally and from a regional perspective, as other southeastern cities, such as Nashville, expand as industrial hubs. However, the significance of I-85 as a regional transportation route and the volume of quality industrial inventory, residential products, and the expansion of office cores in the county should continue to attract facilities and tenants to the market. As is to be expected new development and sales/leasing success in one land use is mutually beneficial to others.

Outside of Peachtree Corners and some mid-rise office surround Gwinnett Place mall, flex space or service centers were the only viable options for prospective office tenants until the latter part of the 1990s. However, since that time the supply has increased in order to accommodate an emerging demand.

As executive housing has continued to emerge along the Chattahoochee River in Gwinnett County (in particular the Sugarloaf area), and as office growth has continued to decentralize, increasing office growth has occurred along I-85 in Gwinnett County, particularly around Gwinnett Place Mall outward to Sugarloaf Parkway.

[8] Source: CoStar 4th Quarter 2007 Industrial Guide

Figure 5: Locations of Office Concentrations Relative to Executive Housing



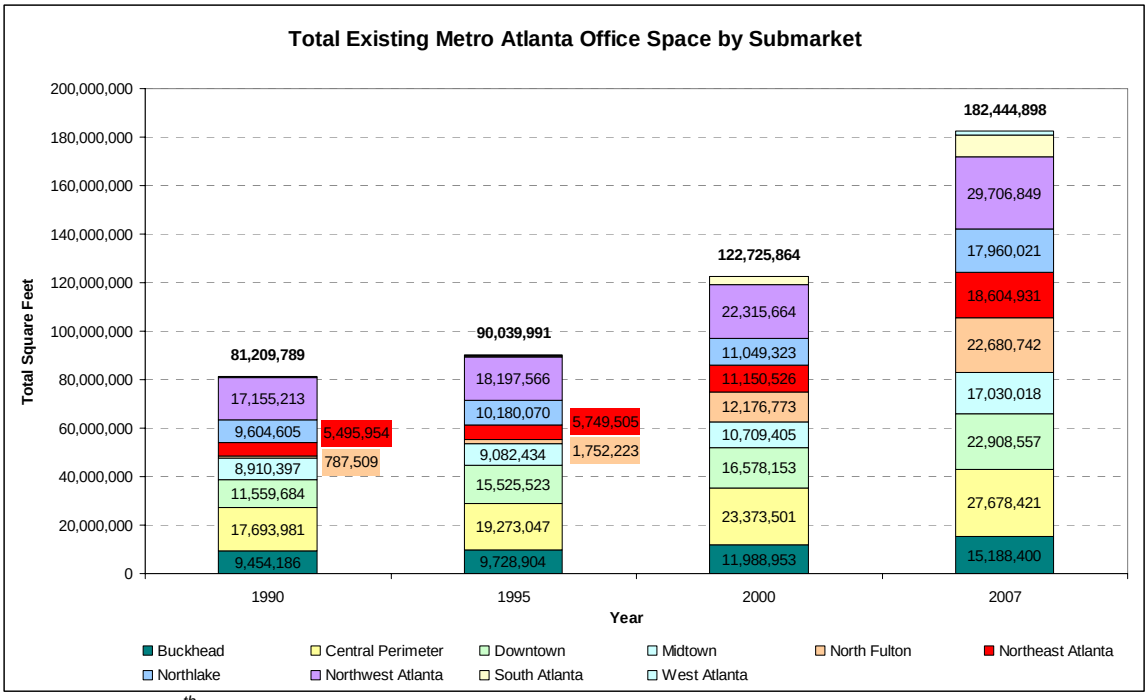
Source: Housing data from Claritas, Inc; Office data from Dorey's 4th Quarter 2007 Office Guide

In accordance with this trend, and stimulated by the county's rapid residential growth, supporting development such as the Mall of Georgia, and the increasing ability to telecommute in order to avoid traffic and congestion increases, the Gwinnett office market experienced more substantial growth in the early part of this decade.

The Northeast Atlanta market has only delivered roughly 600,000 square feet of office space between 2004 and 2007. Gwinnett has suffered from high vacancy rates, which has stalled new development until recently. Currently there is nearly 500,000 square feet of office space under construction and an additional 300,000 square feet planned.[9] Although vacancies are still high overall, they are approaching normal levels in areas furthest south on I-85, particularly in the Peachtree Corners area. The Northeast Atlanta market currently constitutes 10% of the overall metro Atlanta market for office space with a vacancy rate of 19.1% (compared to the metro Atlanta average of 16.3%).[10] It appears that despite high vacancies, developers are banking on continued job and population growth in Gwinnett to fill new office space.

[9] Source: Dorey's 4th Quarter 2007 Office Guide
[10] Source: CoStar 4th Quarter 2007 Office Guide

Figure 6: Size of Metro Atlanta Office Market



Source: CoStar 4th Quarter 2007 Office Guide

The most prominent submarket in Gwinnett County has historically been Peachtree Corners, near Peachtree Industrial and Jimmy Carter Boulevard. This area, characterized by single-story and mid-rise space surrounded by business parks and residential subdivisions, offered the only real option for companies seeking to establish operations in the Northeastern sector of the metro area. However, as more space has emerged along I-85, the market in Peachtree Corners has tightened. There has been only 100,000 square feet of space delivered since 2001 and since early 2005 vacancies have steadily dropped in the Peachtree Corners area, dropping to 17.8% in the fourth quarter of 2007.[11]

Enabled by its solid labor base, close proximity to I-85 and GA Highway 316, and considerable supply of executive housing, Sugarloaf has emerged as the new corporate center of business in the county. The majority of recent development activity in the Gwinnett/I-85 submarket has occurred in this area and it serves as the primary supplier of new Class A space. This area has further benefited by the near build-out conditions in the Peachtree Corners area.

One trend noteworthy, yet challenging to quantify at this preliminary level, is the strong growth in Gwinnett, and the Atlanta region, in smaller office firms increasingly locating in suburban areas. As noted before, technology is allowing small firms to locate away from major employment cores, typically closer to where the firm owner or manager resides. This trend has led to a proliferation of office condominiums and small office buildings in many areas of Gwinnett, including in some town centers; a trend that will likely continue to gain momentum in the coming years.

[11] Source: CoStar 4th Quarter 2007 Office Guide

2. Gwinnett is Rapidly Diversifying

Racial and Ethnic Make-up is Changing

Gwinnett has experienced dramatic growth in Hispanic and non-white households over the past decade. The massive growth of Hispanic households in the suburbs is not unique to Gwinnett County or the Atlanta metropolitan area. A July 2002 study by the Pew Hispanic Center and Brookings Institute analyzed 2000 Census data for the United States largest metropolitan areas and found that "Hispanics flocked to the suburbs during the 1990s." According to the study, fifty-four percent of all Hispanics in the U.S. live in the suburbs opposed to an urban setting. In 1990, the balance of Hispanics in the suburbs verses urban locations was equally balanced. Between 1990 and 2000, however, Hispanic suburban population grew 71%.

What is somewhat unique to Atlanta is the rapid diversification certain areas are experiencing. The Pew study classifies Atlanta as one of 51 "New Latino Destinations", where there is a small Latino base experiencing rapid growth. Atlanta, with the second highest Latino growth rate in the nation between 1980 and 2000, is described as an "emerging immigrant gateway" experiencing "hypergrowth" of the Latino population. During this time period, Latinos went from 1% of population in 1980 to 7% of population in 2000, representing a 995% growth rate.

This greater diversity is being experienced in Gwinnett as the county is becoming an increasingly multiracial and ethnic county. To this:[12]

- The white share of the county's population dropped from 91% to 73% in the 1990s;
- Over the same decade the African-American population increased 330% to 78,000 in 2000;
- The Hispanic/Latino population grew 670% to 64,000 residents from 1990-2000.;
- The Asian and Pacific Islander population also grew from 10,000 to 40,000.

Since the 2000 Census, it appears that the county has diversified even further, as has the entire southeastern US. According to a 2005 study by the Pew Hispanic Center:[13]

> "The Hispanic population is growing faster in much of the South than anywhere else in the United States. Across a broad swath of the region…sizeable Hispanic populations have emerged suddenly in communities where Latinos were a sparse presence just a decade or two ago."

According to the 2006 American Community Survey from the US Census Bureau, the influx of Hispanics and other minorities to Gwinnett County since 2000 has been significant. The white share of the population was estimated to be at 60% in 2006, down from 73% in 2000. In that same time period, the African-American population doubled to account for 20% of the population and those of Hispanic or Latino ethnicity also doubled, now representing 17% of the population.

[12] Figures from US Census Bureau
[13] Pew Hispanic Center, The New Latino South, July 2005

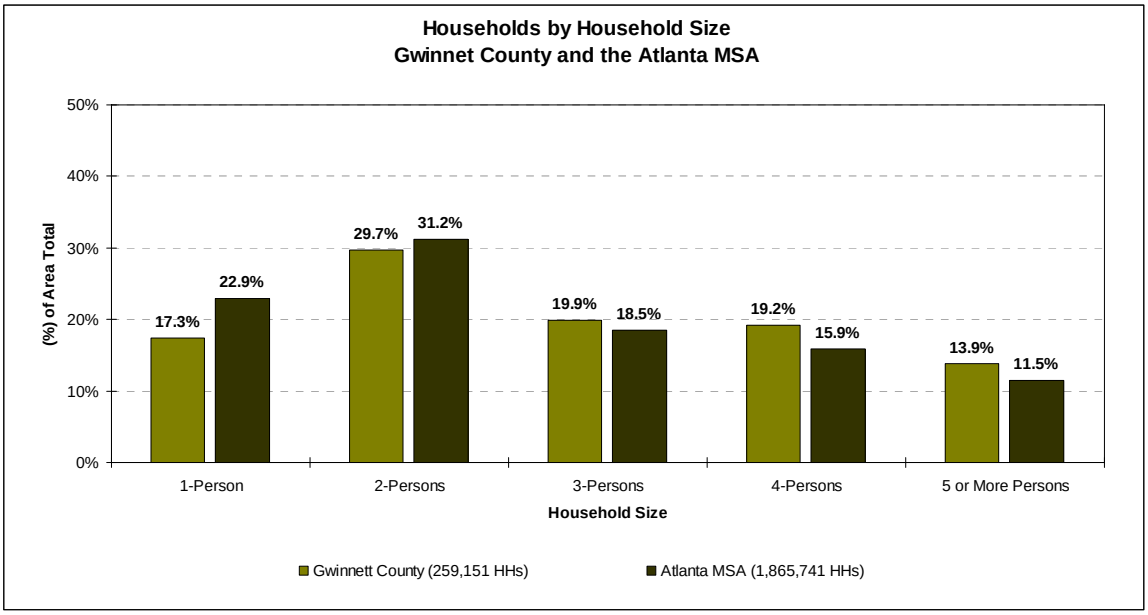
Greater Diversity in Household Types Attracted

Historically, during the time of Gwinnett's most robust growth, Gwinnett was driven by growth in family households seeking a suburban lifestyle – larger home, larger lot, quality schools, access to quality retail and services, etc. This time period of Gwinnett's rapid growth coincided with the suburbanization of the Baby Boomers, which likely accelerated the rate of growth that Gwinnett experienced.

Nationally, now that the Baby Boomers are transitioning to becoming empty nesters and their children (of whom there are more than their Baby Boomer parents) are going to and graduating from college, we are seeing significant growth in one- and two-person households. This trend is being further fueled by the large-scale growth of singles and childless couples, including those not planning for children and those delaying parenting until later in life.

As the graph on the following page indicates, this trend is evident in Gwinnett County as well as the greater Atlanta MSA.

Figure 7: 2007 Households by Household Size, Gwinnett County & Atlanta MSA



Source: Claritas, Inc.

Providing for the continuing growth of these 1 & 2-person households, through housing products and lifestyle shifts (increasingly these smaller household types value convenience and lifestyle), will be an increasing challenge for Gwinnett in the coming decade and beyond.

3. Housing Increasingly Serves the Full Spectrum

Gwinnett County has historically led the Atlanta region in housing growth, serving the full spectrum of housing needs, from the more affordable to the most affluent.

- Between 1990 and 2006, Gwinnett County has added 134,272 housing units, approximately 24% of the 554,849 total units built in the 10-county Atlanta region.[14]
- The majority of these units have emerged in North Gwinnett followed by East and Central Gwinnett, all three of which are among the eight metro districts to increase housing inventory by more than 10,000 units between 2000 and 2006. North Gwinnett had the largest increase of any district, adding over 20,000 residents.[15]
- Much like the rest of the Atlanta region, the housing landscape in Gwinnett County is largely dominated by single-family homes, which comprise more than 78% of the total housing stock. The only two counties where the share of single family homes is below two-thirds are Fulton and DeKalb.[16]
- Multifamily units made up only 22% of Gwinnett's inventory in 2006, with the large majority of that stock being garden-style rental apartment communities.[17]

Broadening by Price

As noted earlier in this report, two factors are impacting home prices in Gwinnett County:

- The increasing push of suburban expansion and the drive for value market out of the county; and
- The continuing growth of executive housing along the Chattahoochee River and convenient to the Georgia 400 corridor office core, impacting housing along the northern portion of Gwinnett County.

Given these two impacts, single-family home prices have increased steadily in Gwinnett County, with new detached home sales below $150,000 dropping from roughly 31% of all Gwinnett new home sales in 2000 to nearly 3% of new home sales in 2007.[18]

Also evident is the growth of the executive housing market in Gwinnett, where new home sales above $300,000 have increased in share from 9.6% of new home sales in 2000 to more than 35% in 2007).[19] Given moderate rates of appreciation in Atlanta overall (about 4% annually through 2006[20]), much of this increase can be attributed to demand for higher-end housing in the county. Over the next several years, land desirable for the development of executive single-family housing will diminish significantly, resulting in higher-end infill housing proximate to the river.

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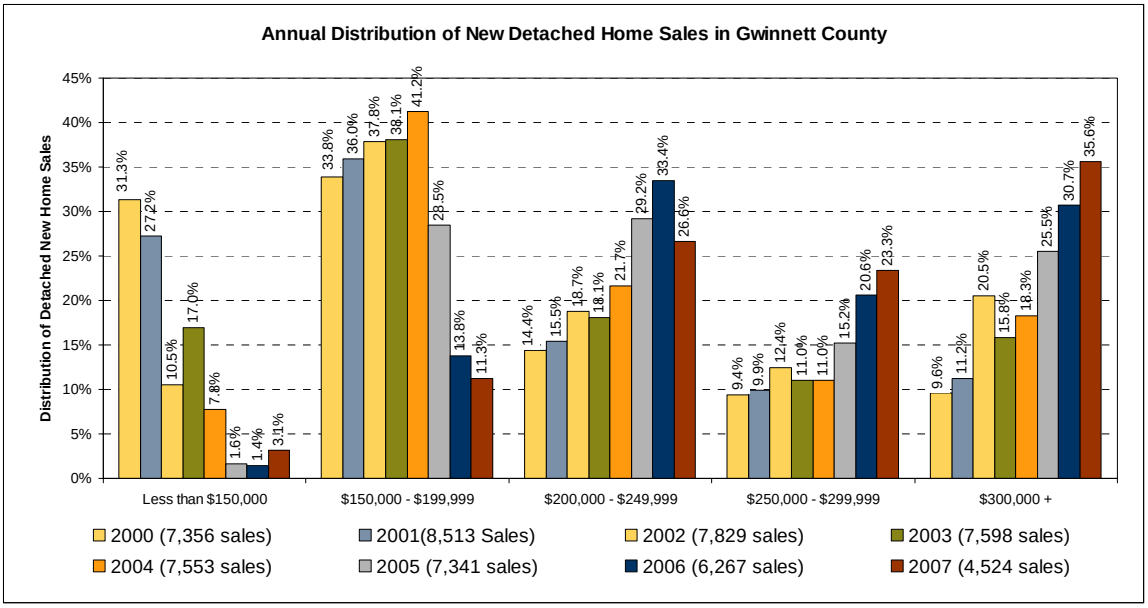
[14] Source: Atlanta Regional Commission
[15] ibid
[16] ibid
[17] ibid
[18] Source: Smart Numbers
[19] Source: Smart Numbers
[20] Through November of 2007, the Atlanta metro experienced negative price growth of (1.5%) compared to a national decrease of approximately 7% according to the Case Shiller Home Price History.

Figure 8: Distribution of New Detached Home Sales by Price, 2000 - 2004



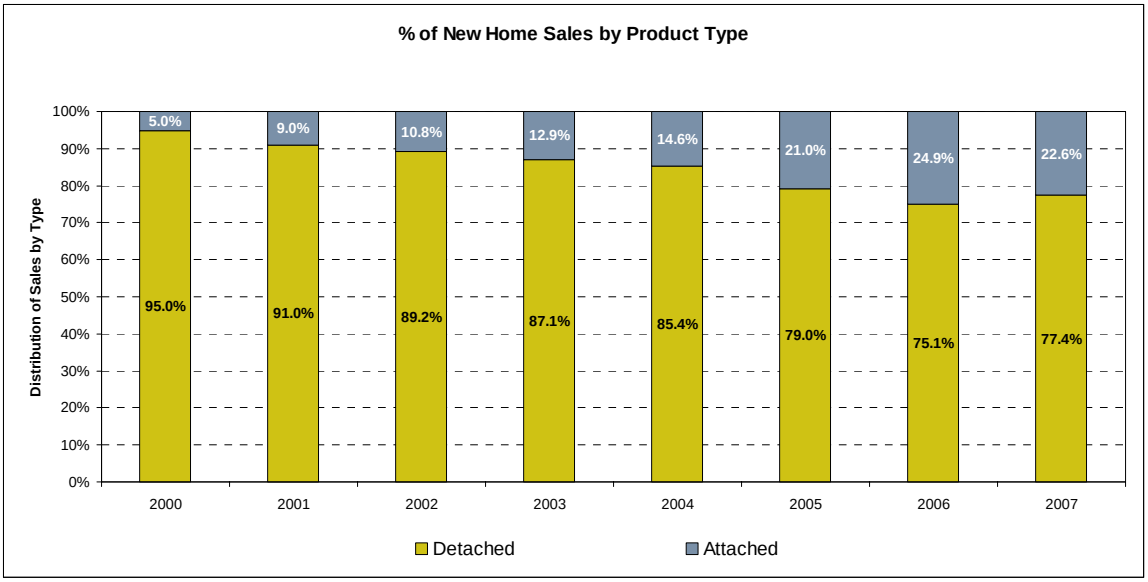
Source: Smart Numbers. 2007 figures annualized from midyear data

Broadening by Product Type

New residential sales in Gwinnett have also become somewhat more diverse in recent years, with townhouses and condominiums accounting for an increasing share of new home construction. While still a relatively small share of the market, attached home sales have increased from 5% of Gwinnett's new home sales in 2000 to a peak of nearly 25% in 2006, before retreating slightly in 2007. While impressive, this increase lags the shifts occurring in the Atlanta region overall, where the 20-county MSA saw attached product account for about 28% of new homes in 2006 (up from around 2% in 1997).[21]

[21] Source: Smart Numbers

Figure 9: Shift in New Attached and Detached Sales in Gwinnett County, 2000 - 2004



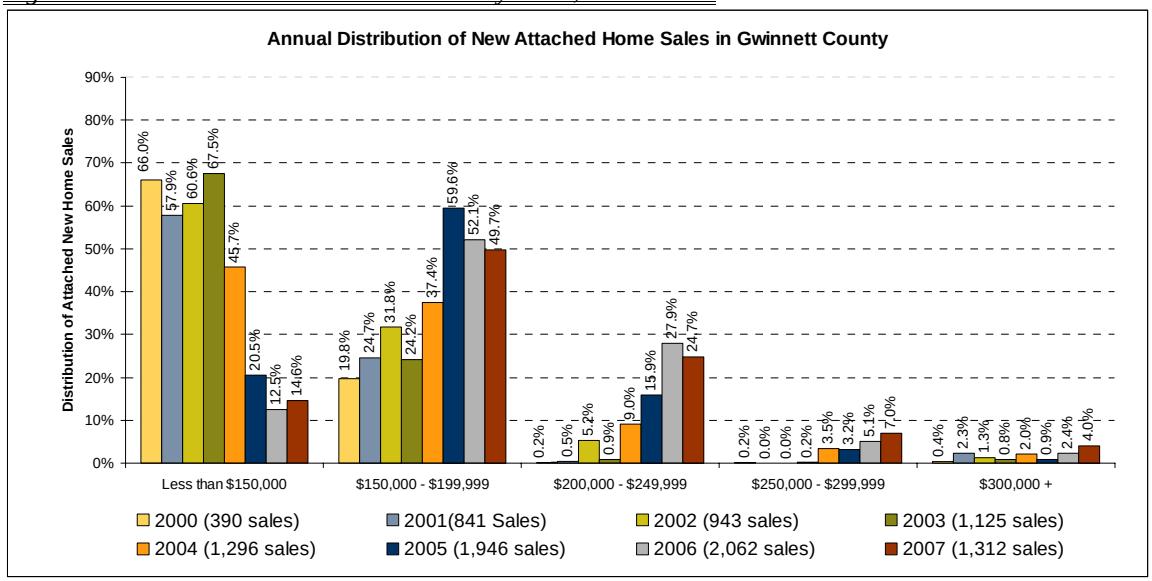
Source: Smart Numbers

This shift can be attributed to several major factors, including:

- Increasing commuting distances and longer drives for value for single-family homes;
- Shifting demographics, including the growth in Baby Boomers and childless households; and
- Increasing home prices in many areas of metro Atlanta, including parts of Gwinnett County.

To date, much of what has been developed in Gwinnett County has functioned as a price alternative product to more expensive single-family homes, as can be seen in the strong sales below $150,000 in Gwinnett County. That said, opportunities are growing for lifestyle products, such as townhouses and condominiums in strategic locations, such as town centers, proximate to the river or parks, or in closer-in locations. Over the next five to ten years and beyond, attached product should account for a growing portion of new residential construction in Gwinnett County.

Figure 10: New Attached Home Sales by Price, 2000 - 2004



Source: Smart Numbers

It is important to note that recent events are pointing to a significant slowdown in the housing market nationally, including Gwinnett County. Detached home sales reached their peak in Gwinnett County in 2001, while it appears that attached product sales peaked in 2006. Although these may be temporary troughs in the growth cycle, there are several recent developments in the housing market, such as subprime lending and tightening of overall capital markets, which are having a significant impact on the housing market in Gwinnett County. The positive news is that supply (new construction) is responding to constricted demand and permitting was down by 48% in 2007 compared to 2006.

4. Gwinnett as a Major Retail Destination

Gwinnett County has emerged as a major retail destination serving not only northeast Atlanta, but much of northeast Georgia. The I-85 corridor is home to three major, regional malls, including:[22]

1. *Gwinnett Place Mall*. With 1.2 million square feet plus significant retail in surrounding "big box" centers, Gwinnett Place Mall was the original regional mall for the county. Built in 1984, it is now experiencing significant competition from other regional retail cores and it in the process of trying to reposition the itself in the market;
2. *Discover Mills*. 1.1 million square feet, built in 2001 to offer more value, outlet shopping; and
3. *Mall of Georgia*. Built in 1999 with 1.7 million square feet of space, plus significant additional space in surrounding centers, Mall of Georgia is among the largest retail nodes in the Southeast and serves much of northeast Georgia.

[22] Mall data from Dorey's 4th Quarter 2007 Retail Guide

There is increasing concern that the market cannot support three regional malls within this short distance and that at least one of these malls, possibly Gwinnett Place, may lose over time.

Another significant question revolves around the amount of retail space in portions of Gwinnett County relative to the population being served. Not including free-standing space, Gwinnett features approximately 27 million square feet of retail space, of which roughly 10% sits vacant today.[23] Again, not including free-standing, owner-occupied space, Gwinnett County provides roughly 35 square feet of multi-tenant space per person, well above the U.S. average of 21 square feet per person and above the Atlanta MSA average of approximately 28 square feet per person.[24]

Additionally, over the past few years rents and vacancies have performed poorly in certain areas of Gwinnett County. There are three retail submarkets that include Gwinnett County: Peachtree Corners/Norcross, Snellville/Stone Mountain, and Northeast Gwinnett. The table below demonstrates that the aging retail submarkets (Snellville) are struggling while the newer submarkets (particularly Peachtree Corners) are performing better and likely siphoning demand from the older properties.

Average Rents ($/SF)

	2005	2006	2007
P'tree Corners	$14.98	$16.91	$17.26
Snellville	$11.52	$10.91	$11.39
NE Gwinnett	$15.02	$16.59	$16.48
Metro Atlanta	$14.34	$15.63	$15.37

Vacancy Rates

	2005	2006	2007
P'tree Corners	7.6%	8.2%	14.8%
Snellville	14.8%	17.3%	19.8%
NE Gwinnett	9.8%	9.7%	17.2%
Metro Atlanta	10.5%	11.8%	16.6%

Source: Dorey's 4th Quarter Retail Market Report

The ability of Gwinnett County to support this large amount of retail, and issues of retail abandonment in aging suburban areas (an issue nationally, not just in Gwinnett), should be examined in the context of understanding the future of these aging strip retail corridors and centers and the impact they have on surrounding residential neighborhoods.

5. Struggling with Revitalization

To date, the large majority of new development in Gwinnett County has been greenfield development. Redevelopment is difficult, logistically and financially, and until recently was nearly impossible due to lack of mixed-use zoning. The county is in the process of

[23] Source: Dorey's 4th Quarter 2007 Retail Guide
[24] Source: RCLCO analysis of local, regional, and national retail figures

exploring means by which some of the areas that built out 10 – 25 years ago can enjoy reinvestment.

As indicated above, many areas of Gwinnett are suffering from an over-supply of retail and subsequent retail abandonment. Retail expenditures are being spread across too much space, resulting in high vacancies and, in many cases, centers that are suffering from disinvestment. Analysis completed in 2008 by RCLCO demonstrates how this over-supply of retail is negatively impacting the retail market in the sales achieved per square foot which, in turn, negatively impacts the rents properties can garner. While the sales in Gwinnett County are performing better than Georgia as a whole, they are significantly below the US average. Gwinnett sales are likely below the metro Atlanta average as well. In a metro area widely recognized as being over-supplied with retail, Gwinnett County appears to be in an even less desirable situation. Please note that $230 per square foot is likely optimistic as the secondary retail data sources have eliminated small centers and chronically vacant centers from their statistics.

	U.S.	Georgia	Gwinnett County
Sales per Square Foot	$253	$222	$230

Source: US and Georgia figures from National Research Bureau's 2006 Shopping Center Census. Gwinnett figures compiled from ESRI retail sales data and Dorey's 4th Quarter 2007 Retail Guide

In part due to the market saturation of retail discussed above, many areas within the county are struggling with retail revitalization. Retail abandonment has created the perception, and in some cases the reality, of crime.

Most of the concentrations of disinvestment is in the southwestern portion of the county, areas in which most of the new development occurred 25 years ago and are now suffering from the "shinier, newer" competition further north in the county.

Many of the older apartments have become the primary means to serve affordable housing needs in the county and have attracted significant population of recent immigrants.

Gwinnett County selected three areas of the county to study how revitalization may take place, each representing a different prototype of redevelopment. Community Improvement Districts (CIDs) have been formed in these areas to help spur revitalization.

1. Gwinnett Place Mall – a major retail core that has the opportunity to turn into more integrated metro core with office, retail and residential.

2. Gwinnett Village – a neighborhood that has older single-family homes, lower density apartment stock, and struggling retail.

3. Evermore – a corridor (Highway 78) that is largely over-supplied with retail and lacks integration of uses.

6. Gwinnett Has Had No Center but Has Emerging Multiple Centers

- No city currently serves as “downtown Gwinnett.” Most parts of Gwinnett typify the sprawling, suburban development model with single-family subdivisions and garden-style apartments separate from strip retail and local-serving office.
- Gwinnett Place Mall once served as one of the major activity centers but was primarily for retail and is now suffering due to competition from other regional malls. As the mall area tries to reinvent itself, it has the opportunity to serve as that central hub for the county, but is challenged by traffic congestion and the complexities of infill development and redevelopment.
- Numerous Gwinnett towns are creating small, community-serving centers either through redevelopment of their historic downtowns or the creation of a new town center through mixed-use developments. Some areas already have existing downtowns and are building on those assets. Other Gwinnett County towns are trying to create new downtowns.
    - Existing: Duluth, Suwanee, Norcross, Snellville, and Lawrenceville
    - Planned: Lilburn, Buford/Mall of Georgia, Grayson
    - All are efforts to integrate retail, higher-density housing, local-serving office, and public services (among other uses) to create a focal point for the community.
- Given the magnitude of growth projected for the county, shifting demographics, and market factors such as land values, the types of places that can be built and that are in demand are likely to continue to change in order to accommodate the growth and be responsive to market demands.

Appendix E – Homeownership and Socio-Economic Trends

Homebuying in Gwinnett County: A Demographic Profile, 1997 to 2004

Prepared by

Dan Immergluck, PhD
Associate Professor
City and Regional Planning
Georgia Institute of Technology
Atlanta, GA 30332-0155
dan.immergluck@coa.gatech.edu

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Homebuying in Gwinnett County: A Demographic Profile, 1997 to 2004

Part I. Homebuying Patterns by Race and Ethnicity, 1997 to 2004

In order to examine the demographic shifts among homebuyers in Gwinnett County, we analyzed Home Mortgage Disclosure Act (HMDA) data from 1997 and 2004.[1] HMDA data are collected by federal bank and mortgage regulators for virtually all mortgage lenders (banks, thrifts, mortgage and finance companies) taking applications for home purchase loans, as well as other types of residential finance products. We examined only those loans originated that were designated as home purchase loans for one-to-four unit residential properties, which are generally considered "single-family" units under HMDA. The HMDA data provide a variety of information on each loan, including the borrower's income, racial or ethnic category, the size of the loan, whether the home will be owner-occupied, and its census tract location. While the data do not tell us anything about the seller of the property, this is quite a rich dataset on homebuyers. Unlike census data, the data are not sample data and are reported each year.

Unlike traditional census data, these data are flow, and not stock, data. They tell us who is buying houses in a census tract. By comparing the data across years, we are essentially analyzing changes in the inflow of homebuyers. Of course, some fraction of owner-occupied homebuyers are relocating from within the same tract, but the majority of buyers in a tract are certainly expected to be relocating from another census tract, and in the case of Gwinnett County at least, many are likely to be relocating from other counties or other regions.

The HMDA data allow us to look at the demographic composition of homebuyers in different years, and so permits analysis of changes in homebuyer demographics over time. The maps in this section generally do two things. First, they measure and compare across tracts the percentage-point change in racial, ethnic and income composition of homebuyers from 1997 to 2004. Also provided are maps showing the end-of-period (2004) compositions of homebuyers by census tract.

Because changes in the composition of homebuyers in a tract among racial or income groups may be due to simultaneous changes in the numbers of buyers in more than one group, this report also includes figures that plot changes in the number of buyers of a specific racial/ethnic or income group against total homebuyers over the 1997 to 2004 period. This enables one to understand whether a specific group is growing or declining in magnitude in different tracts and the relationship of such change to overall growth in homebuying.

Finally, in addition to the figures characterizing the demographic change in homebuyers, some additional trends are noted, in part because they relate to these trends. First, there has been a significant increase in the amount of debt homebuyers are taking on relative to their incomes.

[1] See the Appendix for a fuller discussion of the HMDA data used in this report.

This is not a trend specific to Gwinnett County, and is related to national trends in home financing, but it appears that this trend is having a particular impact on homebuyer debt burdens in the County and that the levels of burden are geographically clustered.

This report also includes maps describing the proportion of home purchases that are being made with buyers who indicate that they are not owner-occupants in their mortgage applications. Again, this trend is not unique to Gwinnett County, but it is a sizable and potentially important development, that could have significant implications for housing needs and issues in the County.

Purchase of Owner-occupied Homes by Asians

Figure 1 shows the percentage-point change in the proportion of owner-occupied homebuyers who were Asian from 1997 to 2004. Red tracts are those in which the percentage of all owner-occupying buyers who were Asian increased by more than 10 percentage points over this 7-year period. Pink tracts saw more moderate increases—from 3 to just under 10 percentage points—in the proportion of buyers who were Asian. If the change in the proportion of buyers who were Asian was less than +/- 3 percentage points, then these areas (shown as white) are relatively stable in their proportion of buyers who are Asian. Only three tracts saw appreciable losses in the proportion of buyers who were Asian. They are shown in light green (loss in Asian share of between 3 and just under 10 percentage points) and dark green (loss of 10 percentage points or more).

The largest shifts toward Asian homebuying generally occurred north of I-85, from Duluth to Suwanee, with similarly large shifts in western Gwinnett around Lilburn and west of Snellville. More moderate increases, however, occurred throughout most of the rest of the county with the exception of much of the county south of Snellville. Areas around Norcross also generally saw either stable or declining proportions of Asian homebuying, as did the tract which includes Braselton to the northeast.

Figure 2 shows the resulting pattern of Asian homebuying concentration in 2004. The dark red tracts are those where more than 20 percent of homebuyers were Asian in 2004, while the medium red tracts are those where the proportion was in the 10 to just under 20 percent rage. The tracts with high proportions of Asian buyers are mostly located in the northern and western parts of the county, though there are tracts around Norcross (along the Fulton and Dekalb borders) with Asian buying at less than 5 percent of all buying. The trends shown in Figure 1 have resulted in Asians not constituting a sizeable portion of homebuyers along the southeastern county border (bordering Walton County primarily).

Because changes in one group's share of homebuyers in a tract is a function of increases or declines in buying by other groups in the same tract, it is helpful to examine whether tracts are generally seeing increases or decreases in the raw number of Asian homebuyers. Moreover it is helpful to compare such changes in overall changes in owner-occupied home purchases, especially in a county that has experienced as much growth as Gwinnett.

Figure 1

Change in the Percent of Home Purchase Loans for Owner-Occupied Homes to Asians, 1997 to 2004

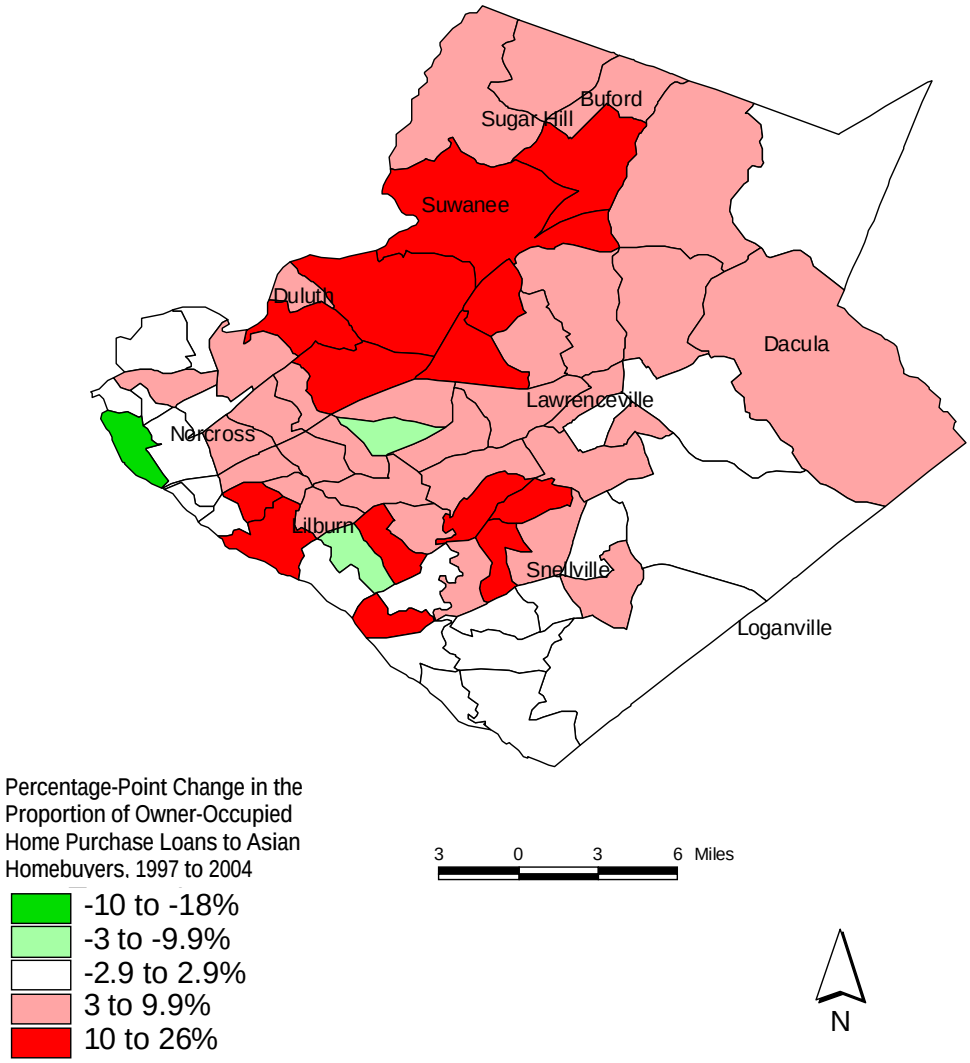


Figure 2

Percent of Home Purchase Loans for
Owner-Occupied Homes to Asians, 2004

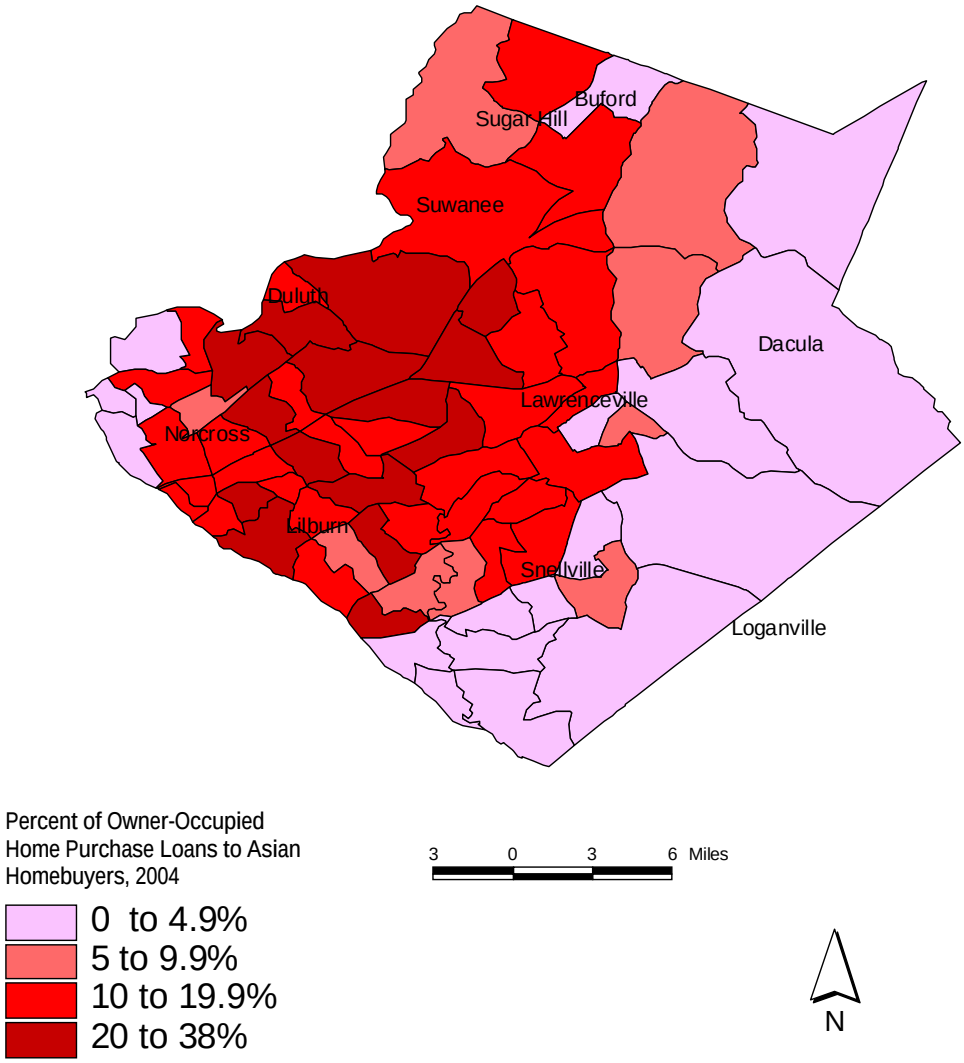


Figure 3.
Percent Change in Asian Owner-Occupied Home Buyers vs. All Owner-Occupied Buyers,
1997 to 2004 Gwinnett County Census Tracts (2000 Boundaries)

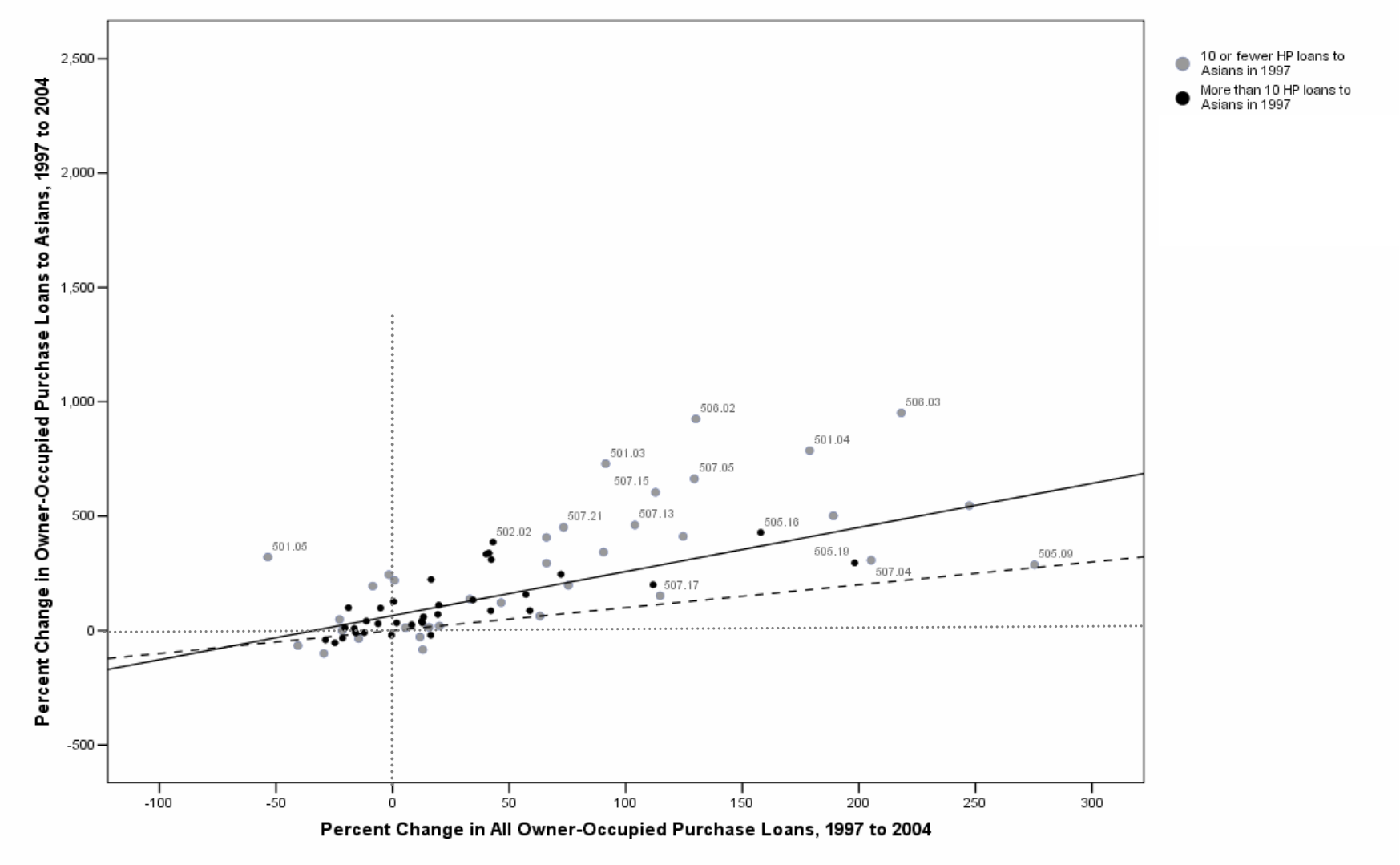


Figure 3 does just this. It shows the percent change in the number of Asian buyers of owner-occupied homes from 1997 to 2004, plotted on the vertical axis, compared to the percent change in all owner-occupied purchases over the same period. If Asian share remained constant, which it did not, then, the plot would fall along the dashed line, which represents a 1:1 slope with a zero intercept. That is, the dashed line represents a pattern in which the increase in the number of Asian buyers would be equivalent to the increase in all owner-occupied buyers. (Note, however, that the axes do not have equivalent unit scales; this is done in order to allow the graphing of some quite large percent increases among some homebuyer groups.)

Figure 3 shows that most tracts in the county saw increases in the raw number of Asian homebuyers. (The horizontal gray dotted line indicates zero change in the number of Asian buyers.) As homebuying increased overall, Asian homebuying also increased, but at an even faster rate. Because tracts with very small numbers of Asian buyers in 1997 are expected to have particularly large *percent* increases in Asian homebuyers, tracts with fewer than 10 Asian buyers in 1997 are indicated in gray rather than black.

Figure 3 also plots a bivariate regression line for percent change in loans to Asians regressed on percent change in all owner-occupied purchase loans. However, this regression was run using only tracts in which there were more than 10 loans to Asians in 1997. Thus it is a fit of the tracts plotted in black only. The difference between the regression line and the dashed 1:1 slope line provides a graphical measure of relative growth in Asian buyers compared to homebuyers generally. Moreover, those tracts which fall substantially above or below the regression line may be thought of as experiencing relatively higher or lower increases in Asian homebuying compared to other tracts in the county.

Purchase of Owner-Occupied Homes by African-Americans

Figure 4 shows the percentage-point change in the proportion of owner-occupied homebuyers who were African-American from 1997 to 2004. Magenta tracts are those in which the proportion of all owner-occupied homebuyers who were African-American increased by more than 25 percentage points. Red tracts are those that saw increases from 10 to just under 25 percentage points. Pink tracts are those that saw increases between 3 and 10 percentage points. White tracts experienced no substantial change (less than plus or minus 3 percentage points) in the proportion of homebuyers who were African American. Green tracts are those that saw a decrease in the proportion of buyers who were African American of at least 3 percentage points. The largest shifts toward increased African-American homebuying occurred in the southern tip of the county and along the southeast border with Rockdale and Walton Counties. Generally, however, African American homebuying is increasing as a share of all buying in many parts of the county. The tracts that saw declines in their share of buyers who were African American are located in and/or around Norcross and Lilburn.

Figure 5 shows the resulting pattern of African-American homebuying in 2004. The highest levels of African-American homebuying (indicated by magenta) were occurring in the southern tip of the county. In these tracts, African Americans accounted for more than 50 percent of homebuyers. Many other parts of the county – including tracts in central and southeastern

Gwinnett – had shares of homebuyers who were African American that were in the 20 to 49 percent range. In most census tracts in the county, African Americans constituted over 10 percent of homebuyers in 2004.

Figure 6 shows the percent change in the number of African-American buyers of owner-occupied homes from 1997 to 2004, plotted on the vertical axis, compared to the percent change in all owner-occupied purchases over the same period. If African-American share remained constant, which it generally did not, then the plot would fall along the dashed line. That is, the dashed 1:1 slope line represents a pattern in which the percent increase in African-American buyers would equal the percent increase in all buyers.

Figure 6 shows that most tracts saw increases in the number of African-American homebuyers. (Again, the horizontal gray dotted line indicates zero change in the number of African-American buyers.) Only a few tracts saw a decline in the number of African-American buyers, and most of these experienced an overall decline in homebuyers. Because tracts with very small numbers of African-American buyers are expected to have particularly large percent increases in African-American buyers, tracts with fewer than 10 African-American buyers in 1997 are indicated in gray rather than black.

Figure 6 also includes a bivariate regression line for percent change in loans to African Americans regressed on percent change in all owner-occupied purchase loans. (This regression was run using only tracts in which there were more than 10 loans to African-Americans in 1997. Thus, it is a fit of the tracts plotted in black only.) The difference between the regression line and the dashed 1:1 slope line provides a graphical measure of the relative growth in African-American homebuyers compared to all homebuyers in the tract. Those tracts which fall substantially above or below the regression line may be thought of as experiencing relatively higher or lower increases in African-American homebuying compared to other tracts in the county.

Note that, in this case, the regression line essentially runs through the origin (where both rates of change are equal to 0 percent). This means that in low growth areas, the rates of increase in black buyers are generally expected to be relatively low. But the large slope of the regression line suggests that it is the high growth areas where many of the large increases in black buying have occurred.

Among the tracts with the very largest increases in homebuyers, however, there seems to be a significant split as it concerns African American buyers. In some high-growth tracts, such as 505.00, 506.02 and 507.04 (indicated by the red dashed oval), the growth in black buyers far exceeds the growth rate for buyers overall. In some other high-growth tracts (e.g., 501.14, 505.16, 505.19, indicated by the green dashed oval), rate of growth in African American homebuying is essentially the same as the growth in homebuying overall. This suggests that in the fastest growing tracts, significant segregation of Black versus nonBlack homebuyers is occurring.

Figure 4

Change in the Percent of Home Purchase Loans for
Owner-Occupied Homes to African-Americans, 1997 to 2004

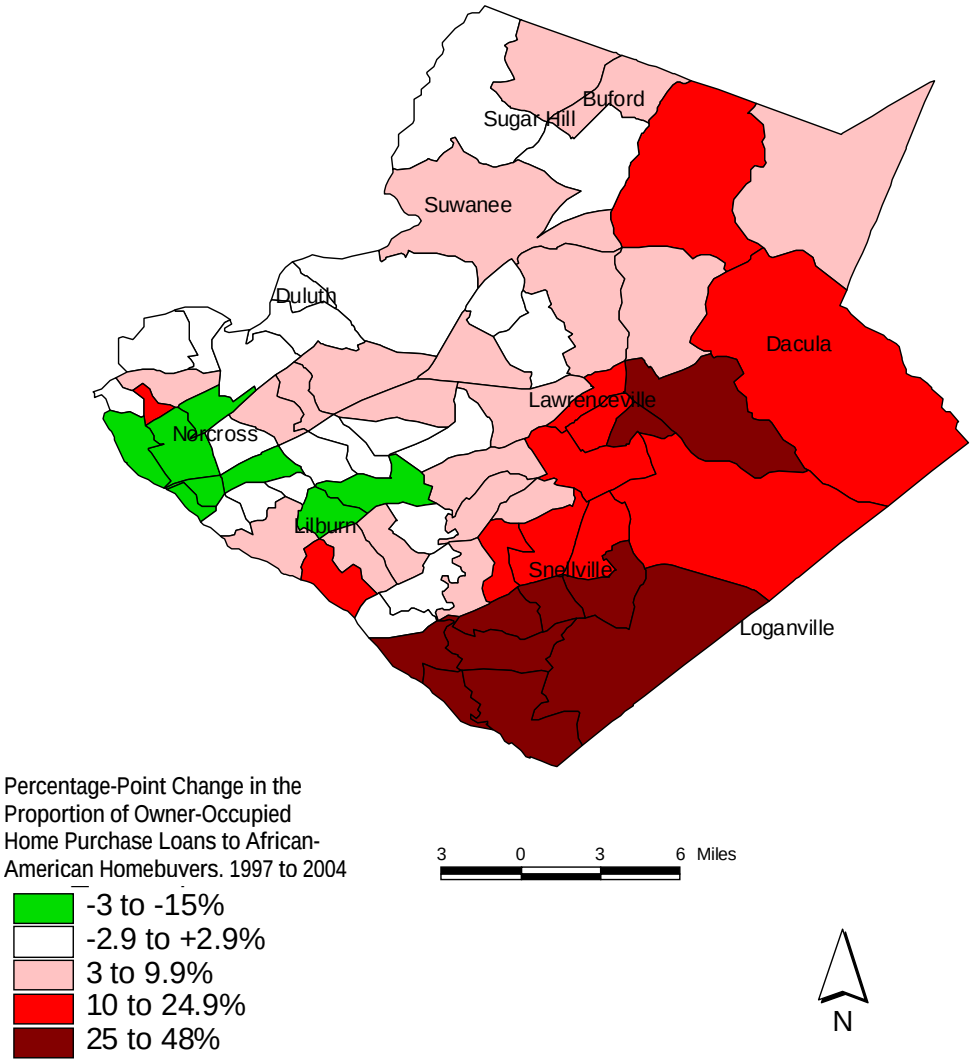


Figure 5

Percent of Home Purchase Loans for
Owner-Occupied Homes to African-Americans, 2004

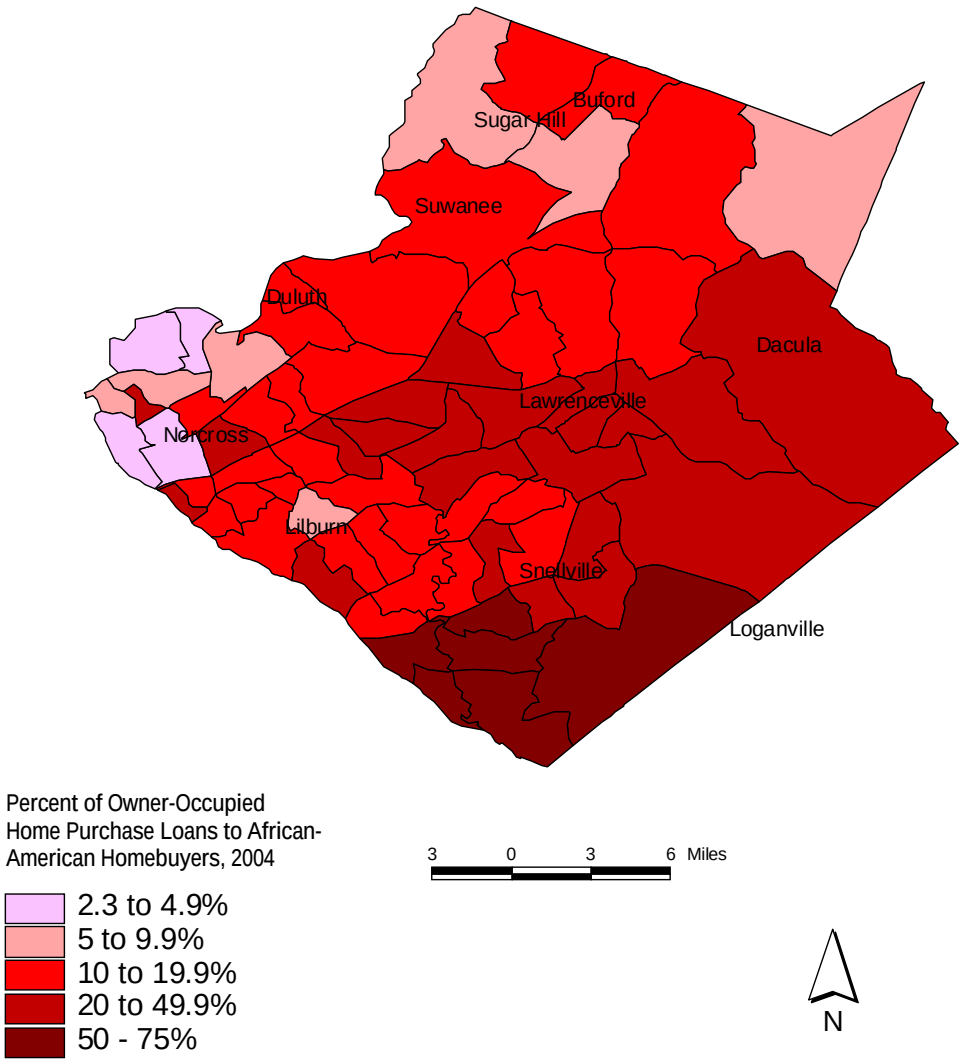
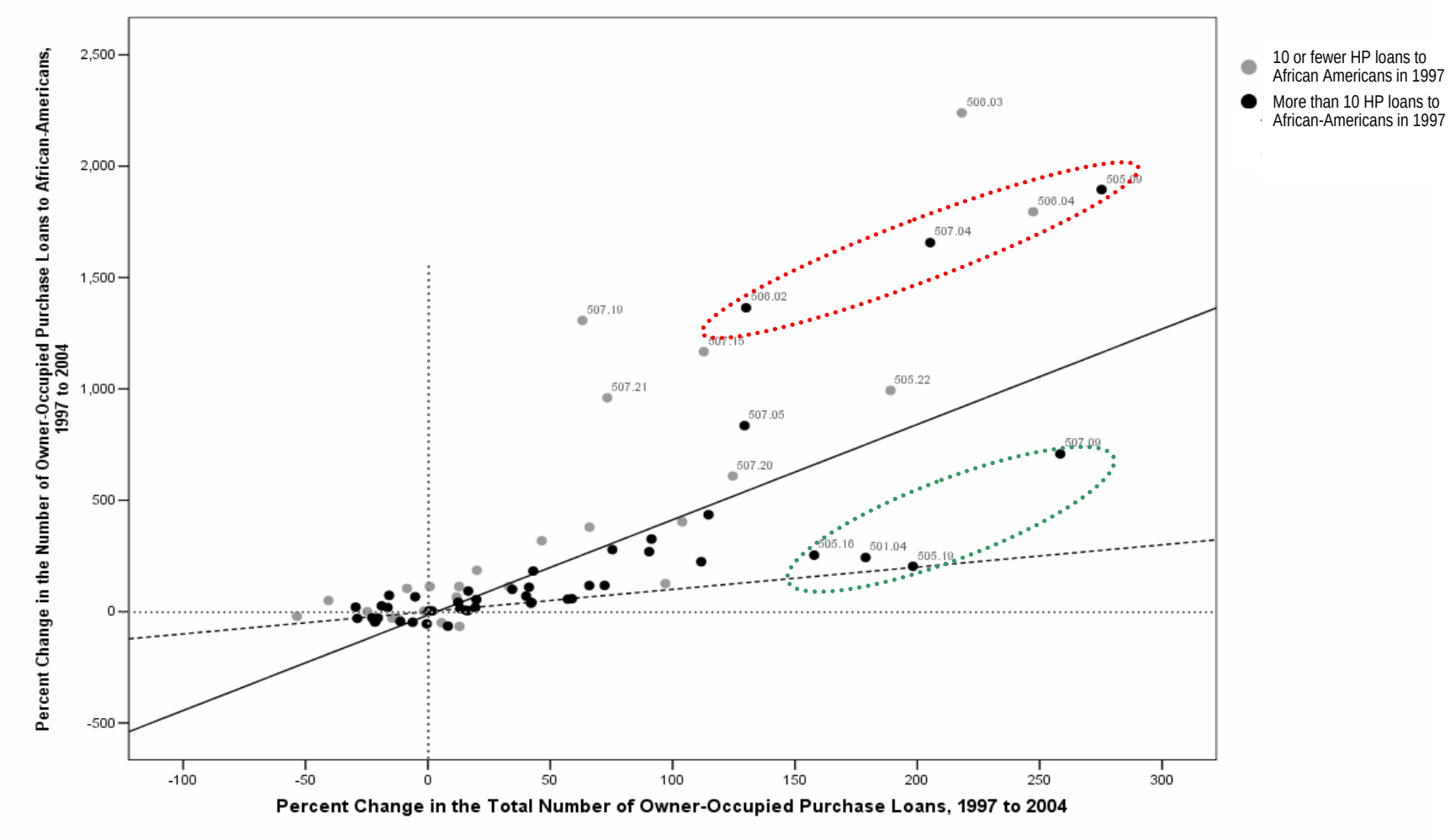


Figure 6

Percent Change in African-American Owner-Occupied Home Buyers vs. All Owner-Occupied Buyers, 1997 to 2004
Gwinnett County Census Tracts (2000 Boundaries)



Purchase of Owner-Occupied Homes by Hispanics

Figure 7 shows the percentage-point change in the proportion of owner-occupied homebuyers who were Hispanic from 1997 to 2004. Magenta tracts are those in which the proportion of all owner-occupied homebuyers who were Hispanic increased by more than 25 percentage points. Red tracts are those that saw increases from 10 to just under 25 percentage points. Pink tracts are those that saw increases between 3 and 10 percentage points. White tracts experienced no substantial change (less than plus or minus 3 percentage points) in the proportion of homebuyers who were Hispanic.

The largest shifts toward increased Hispanic homebuying occurred in the east-central part of the county, north of Lilburn and west of Lawrenceville. Generally, however, African American homebuying increased as a share of all buying throughout most of the county. Only 12 of 71 tracts saw less than a 3 percentage point increase in Hispanic home buying.

Figure 8 shows the resulting pattern of Hispanic homebuying in 2004. The highest levels of Hispanic homebuying (indicated by magenta—over 50 percent Hispanic buyers—and dark red—20 to 49 percent Hispanic buyers) were occurring in the eastern and central-eastern parts of the county, as well as in a tract in Buford. In most tracts in the county (57 of 71), the proportion of buyers who were Hispanic in 2004 exceeded five percent. And in more than half of the tracts (37), Hispanic buyers constituted more than 10 percent of all buyers.

Figure 9 shows the percent change in the number of Hispanic buyers of owner-occupied homes from 1997 to 2004, plotted on the vertical axis, compared to the percent change in all owner-occupied purchases over the same period. (Again, the dashed 1:1 slope line represents a pattern in which the percent increase in Hispanic buyers would equal the percent increase in all buyers.)

Figure 9 indicates that most tracts experienced increases in the number of Hispanic homebuyers. (The horizontal dotted line indicates zero change in the number of Hispanic buyers.) Only a few tracts saw a decline in the number of Hispanic buyers, and these generally experienced a decline in total homebuyers. Because tracts with very small numbers of Hispanic buyers are expected to have particularly large percent increases in Hispanic buyers, tracts with fewer than 10 Hispanic buyers in 1997 are indicated in gray rather than black. Figure 9 also includes a bivariate regression line for percent change in loans to Hispanic buyers regressed on percent change in total homebuyers. (Based on tracts indicated by black dots only.) Again, tracts above this line experienced particularly large increases in Hispanic homebuying relative to other tracts in the county.

Figure 7

Change in the Percent of Home Purchase Loans for Owner-Occupied Homes to Hispanics, 1997 to 2004

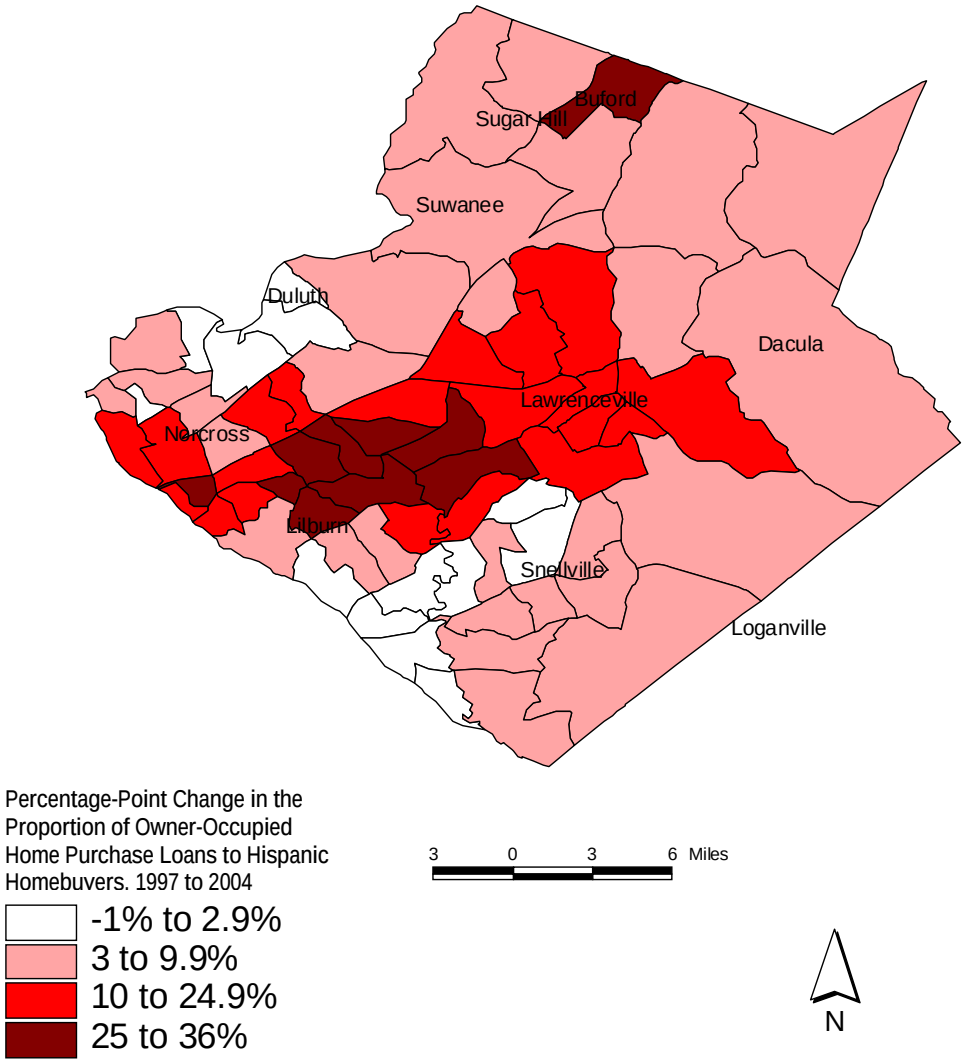


Figure 8

Percent of Home Purchase Loans for
Owner-Occupied Homes to Hispanics, 2004

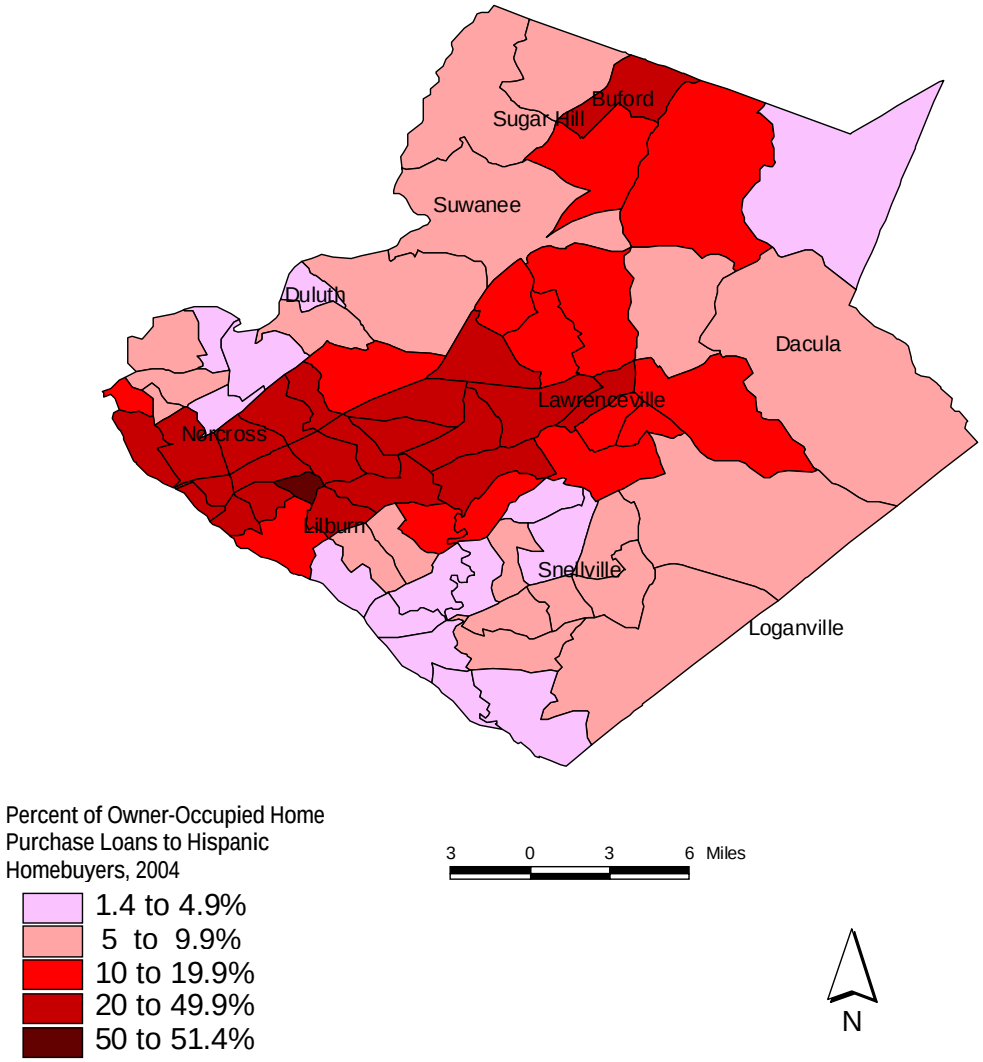
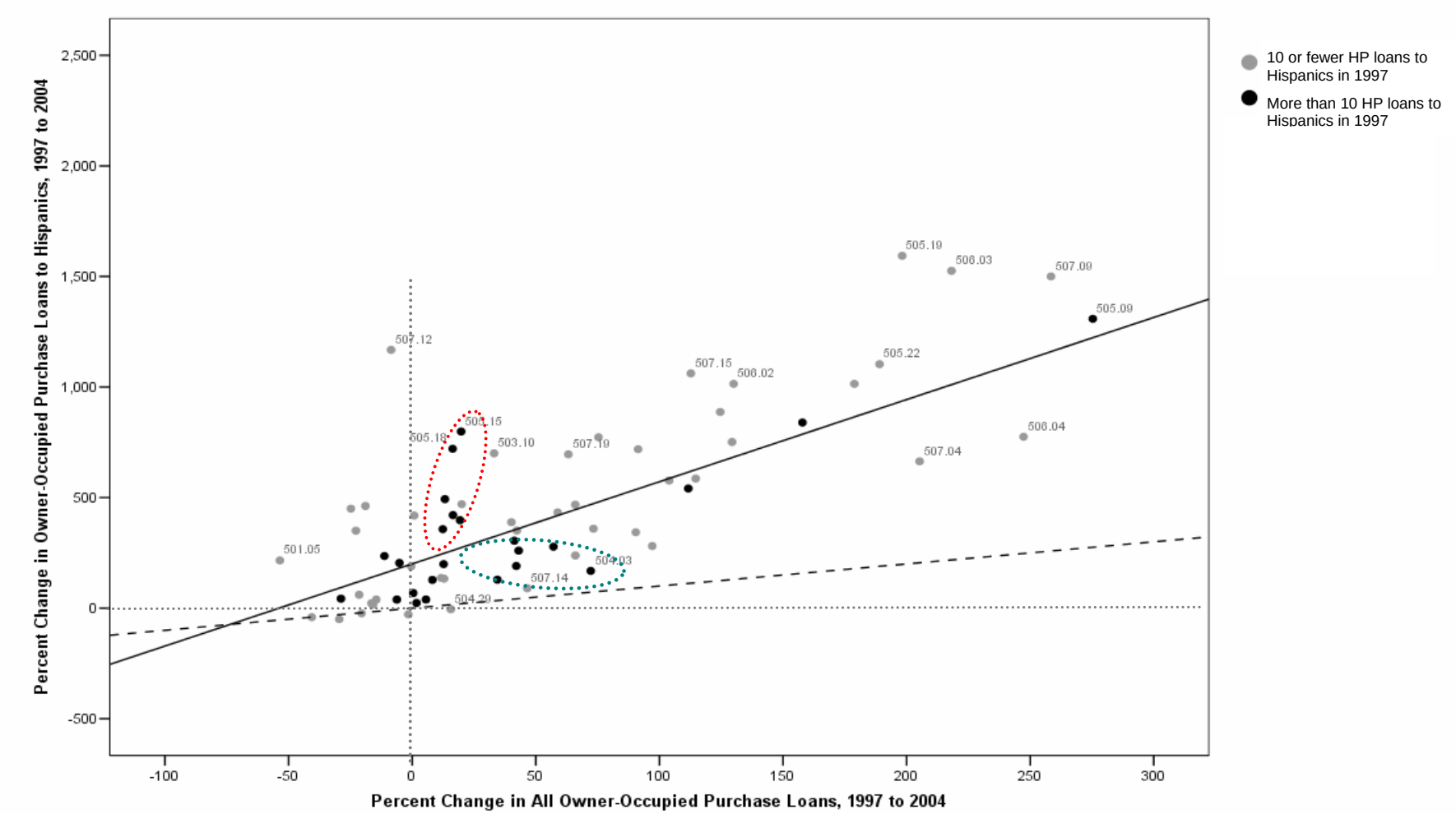


Figure 9

Percent Change in Hispanic Owner-Occupied Home Buyers vs.
All Owner-Occupied Buyers, 1997 to 2004
Gwinnett County Census Tracts (2000 Boundaries)



There is a noticeable spike (indicated by the dashed red oval) of slower-growth tracts that did not experience very large increases in total owner-occupied homebuying (under 25 percent), yet experienced very large increases in Hispanic homebuying (on the order of 300 to 800 percent). Examples include tracts 505.15 and 505.18. At the same time, many tracts experiencing somewhat stronger growth (30 to 80 percent) in total homebuying, experienced less extreme rates of growth (generally under 300 percent) in Hispanic buying. Some of these are indicated by the dashed green oval. This bifurcation of trends in Hispanic homebuying suggests a significant trend towards particularly high levels of segregation between Hispanic versus nonHispanic buyers.

This pattern contrasts somewhat with the case of African-American homebuyers, in which the most apparent signals of segregation in African-American vs. nonAfrican-American buying patterns occur in tracts with the highest levels of overall home purchase growth.

Identifying Tracts with Diverse Home Buying in 1997 and 2004

Figure 10 and 11 identify census tracts, based on 1997 and 2004 homebuying patterns respectively, as falling into one of five categories:

- Predominantly white buyers (white): More than 75 percent of buyers are nonHispanic white
- Majority white buyers (yellow): From 50 to 75 percent of buyers are nonHispanic white
- Majority African-American buyers (blue): More than 50 percent of buyers are African-American
- Majority Hispanic buyers (brown): More than 50 percent of buyers are Hispanic (only 1 tract)
- Diverse (red): No racial or ethnic group constitutes more than 50 percent of homebuyers

Comparing Figures 10 and 11 indicates that most tracts in the county have become much more diverse in their homebuying demographics over the 1997 to 2004 period. In 1997, most of the tracts in the northern, eastern and southern parts of the county had homebuying patterns that consisted of predominantly white buyers. Tracts with moderate diversity (50 to 75 percent white buyers) were clustered in western and southwestern Gwinnett, with a set of only eight tracts that had diverse homebuying patterns by the definition above.

By 2004, most of the tracts in the county had become much more diverse in the composition of homebuyers. In fact, Figure 11 shows that there are only five tracts in which nonHispanic Whites constituted more than 75 percent of homebuyers in 2004. The most diverse tracts – those in which no racial or ethnic group accounted for more than 50 percent of homebuyers – generally lie in the west-central to central part of the county running from Norcross to Lawrenceville. One tract in the Buford area and three tracts around Snellville are also classified as diverse under this definition.

Figure 10

Diversity of Homebuyers by Tract, 1997

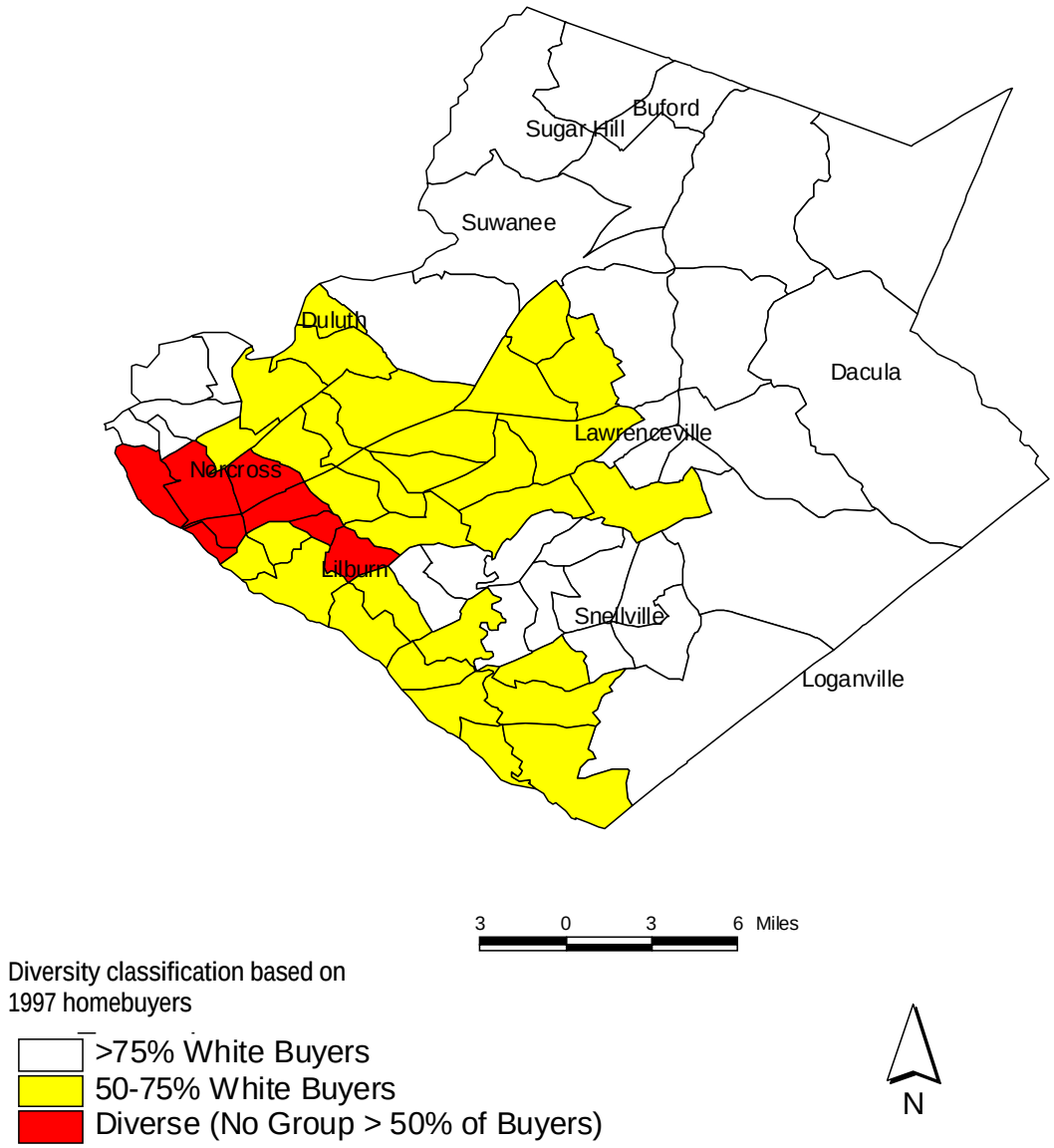
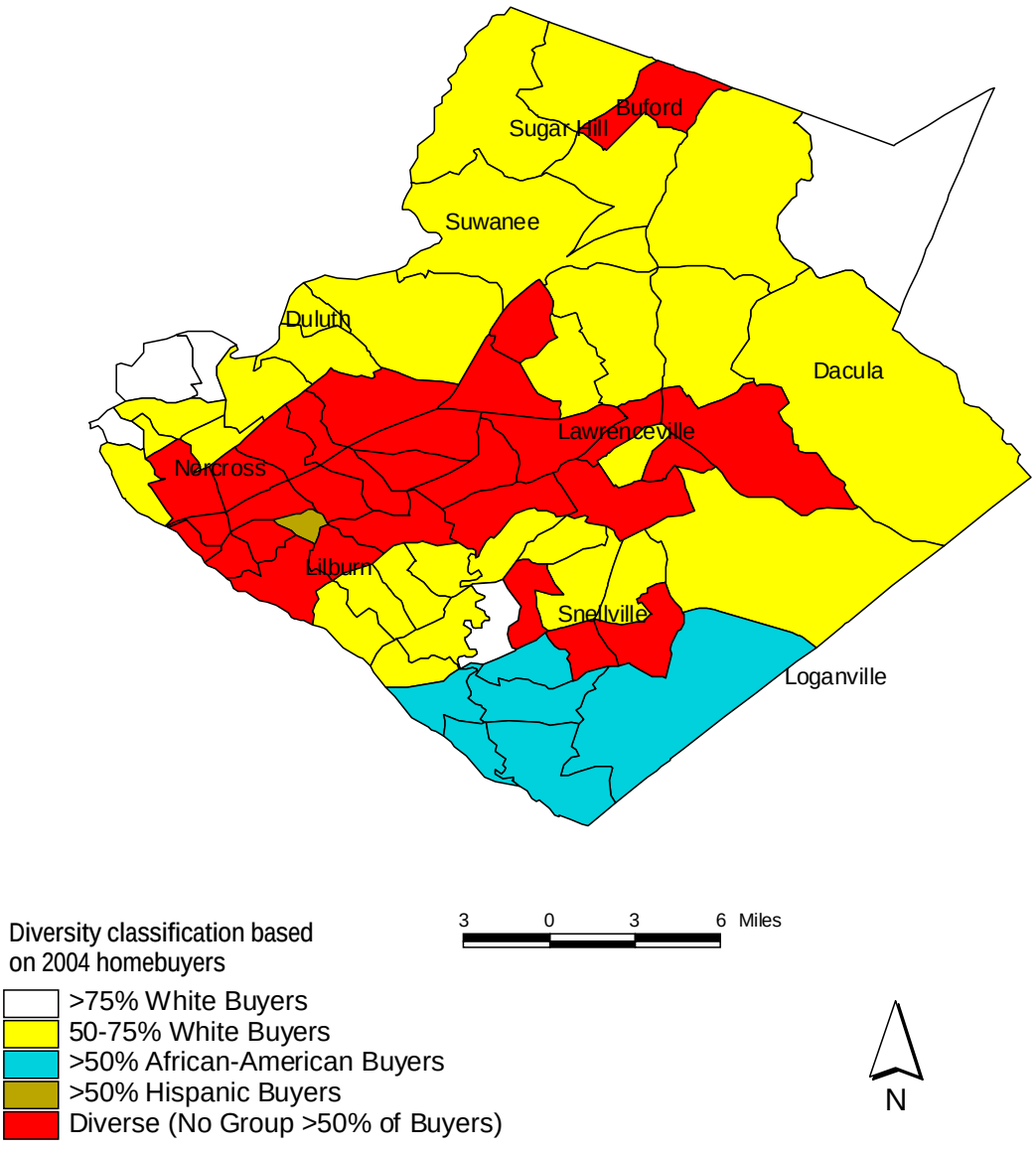


Figure 11

Diversity of Homebuyers by Tract, 2004



Part II. Homebuying Patterns by Income

Purchase of Owner-occupied Homes by Low-Income Households

Figure 12 is a map of the percentage-point change in the proportion of homebuyers who with "low" incomes between 1997 and 2004 in Gwinnett census tracts. Low income is defined here as those with borrowers with family incomes below 50 percent the MSA median income for the same year, as defined by the U.S. Department of Housing and Urban Development. Red tracts saw the proportion of buyers with low incomes increase by more than 10 percentage points over the 1997-2004 period. These tracts include ones in Buford, east of Lawrenceville, and several around Norcross and Lilburn. Pink tracts saw somewhat more moderate increases in low-income homebuying, by 3 to just under 10 percentage points. Many of these tracts were in the southern and central parts of the county.

Although most tracts either saw significant increases in low-income buying or saw essentially no change, a few tracts saw significant declines in the percent of buyers who had low incomes. Interestingly these tracts were located adjacent to some of the tracts experiencing substantial increases in low-income buying.

Figure 13 shows the percent of owner-occupied buyers in 2004 that had low incomes. Red tracts—those with more than 20 percent of buyers having low incomes—include ones in Buford and around Norcross. Tracts with low-income buying in the 10 to 20 percent range are mostly located in western, central and southern parts of the county. The tracts with very low levels of low-income buying (less than 5 percent) include ones north of Norcross, and ones near Suwanee/Duluth, and near Lilburn and Snellville.

Because changes in one income group's share of homebuyers in a tract is a function of increases or declines in buying by other groups in the same tract, it is helpful to examine whether tracts are generally seeing increases or decreases in the raw number of low-income homebuyers. Moreover it is helpful to compare such changes to overall changes in owner-occupied purchases, especially in a county that has experienced as much growth as Gwinnett.

Figure 14 shows the percent change in the number of low-income buyers from 1997 to 2004, plotted on the vertical axis, compared to the percent change in all owner-occupied purchases over the same period. If low-income share had remained constant, which it did not, then the plot would fall along the dashed line, which represents a 1:1 slope. That is, it represents a pattern in which the rate of increase in the number of low-income buyers would be equivalent to the rate of increase in all owner-occupied buyers.

Figure 14 shows that most tracts in the county saw increases in the number of low-income homebuyers. (The horizontal dotted line indicates zero change in the number of low-income buyers.) As homebuying increased overall, low-income homebuying also increased, but at an even faster rate. Because tracts with very small numbers of low-income buyers in 1997 are expected to have particularly large *percent* increases in low-income homebuyers, tracts with fewer than 10 low-income buyers in 1997 are indicated in gray rather than black.

Figure 12

Change in Percent of Home Purchase Loans for
Owner-Occupied Homes to Buyers with Low Incomes, 1997 to 2004

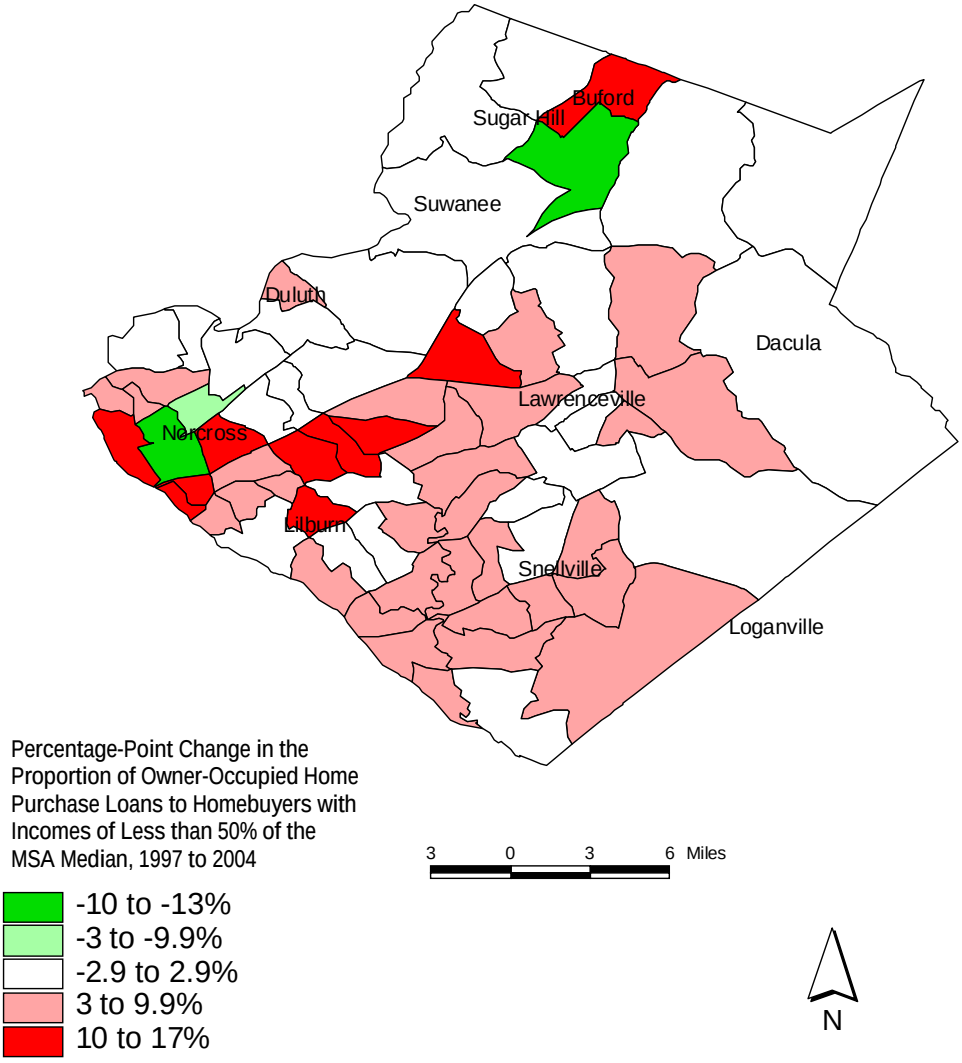


Figure 13

Percent of Home Purchase Loans for Owner-Occupied Homes to Buyers with Low Incomes, 2004

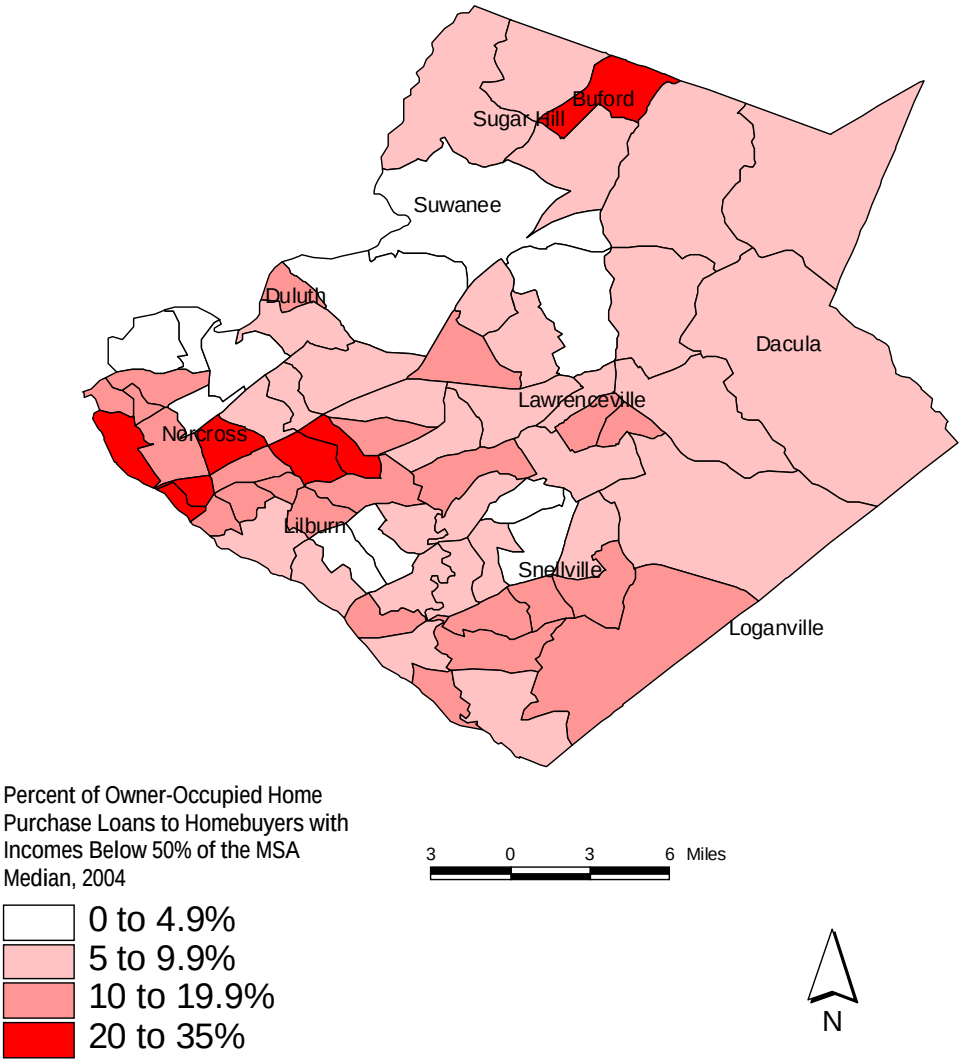
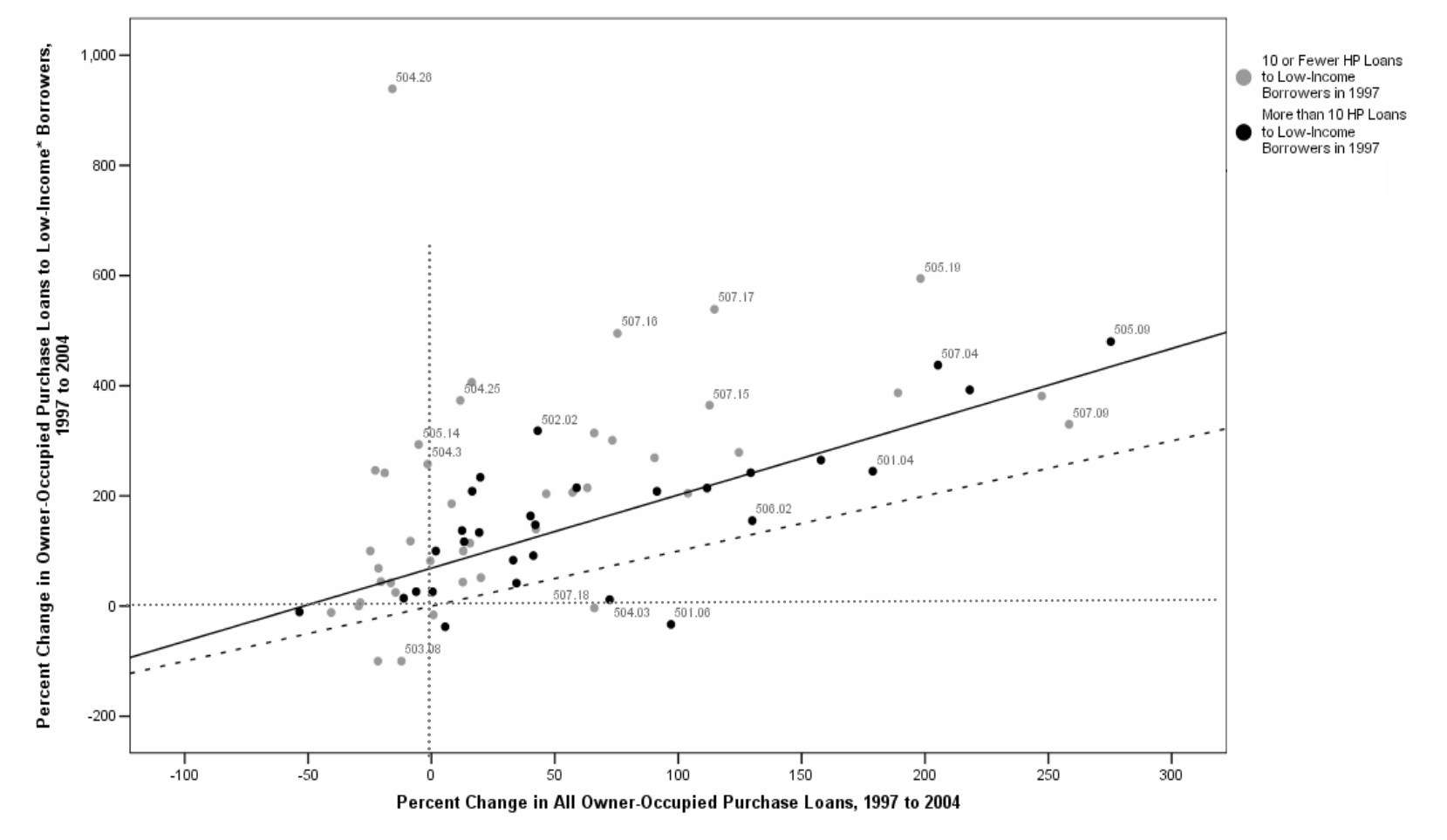


Figure 14

Percent Change in Low-Income Owner-Occupied Home Buyers vs.
All Owner-Occupied Buyers, 1997 to 2004
Gwinnett County Census Tracts (2000 Boundaries)



*Low-income means borrowers with incomes below 50% of the metropolitan median income (HUD defined).

Figure 14 also plots a bivariate regression line for percent change in loans to low-income buyers regressed on percent change in all owner-occupied purchase loans. (The regression was run using only tracts in which there were more than 10 loans to low income borrowers in 1997. Thus, it is a fit of the tracts plotted in black only.) The difference between the regression line and the dashed 1:1 slope line provides a graphical measure of relative growth in low-income buyers compared to homebuyers generally. Moreover, those tracts which fall substantially above or below the regression line have experienced relatively higher or lower increases in low-income homebuying compared to other tracts in the county.

The regression line in Figure 14 is almost parallel to the 1:1 slope line. This suggests that the difference between rates of growth for low-income buyers and for other buyers in a tract is positive and relatively consistent as the rate of overall homebuyer growth increases. This means that, unlike in the case of African-American homebuyers, in which growth in African-American buyers tended to be much larger in tracts with high growth rates, growth in low-income buyers is occurring in all sorts of tracks – from slower growth to higher-growth areas.

Purchase of Owner-occupied Homes by Moderate-Income Households

While many tracts experienced increases in the proportion and number of homebuyers with low incomes, low-income homebuyer continue to constitute a relatively modest share of all homebuyers in Gwinnett County and for the region as a whole. However, moderate income homebuyers—those with incomes between 50 and 80 percent of the MSA median income—constitute quite a substantial and growing share of homebuyers in Gwinnett and in the MSA. Moreover, it is in this income segment where much of the growth in homebuying has occurred in many Gwinnett neighborhoods and throughout the region.

Figure 15 shows that many tracts experienced substantial increases in the proportion of buyers who are moderate-income. From 1997 to 2004, 11 tracts experienced more than a 20 percentage-point increase in the share of buyers who had moderate incomes. These tracts are shown in magenta. Another 34 tracts (red) saw gains in moderate-income share of between 10 and just under 20 percentage points. And 20 experienced more modest gains—between 3 and just under 10 percentage points (pink). Only two tracts experienced a decline of three percentage points or more in the proportion of buyers who were moderate-income (green) and only four others fell into the "stable" category (white). The tracts with the greatest percentage-point increases in the share of moderate-income buyers lie in the central part of the county, north and west of Lawrenceville, as well as some tracts near Lilburn and Snellville.

Figure 16 plots the share of owner-occupied homes purchased by moderate-income households at the end of the 1997 to 2004 period. It shows that, by 2004, moderate-income homebuyers constituted at least 50 percent of the homebuyers in 18 census tracts (deep magenta). In another 20 tracts (dark red), moderate income buyers accounted for between 40 and just under 50 percent of homebuyers. In only 5 tracts did moderate-income buyers constitute less than 20 percent of homebuyers. Tracts with higher levels of moderate-income home buying are concentrated in western and southern parts of the county, but moderate-income buyers have become a larger share of buyers in most tracts throughout the county.

Figure 15

Change in Percent of Home Purchase Loans for
Owner-Occupied Homes to Buyers with Moderate Incomes, 1997 to 2004

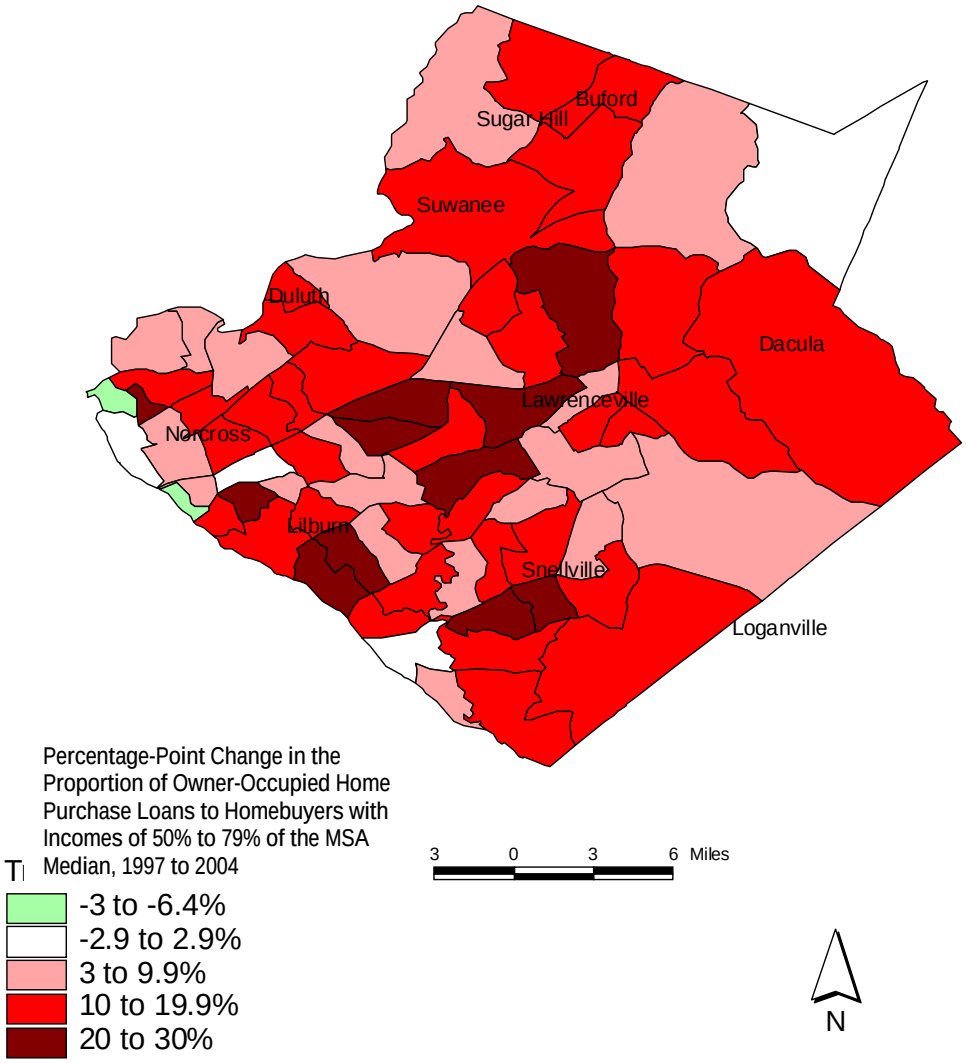


Figure 16

Percent of Home Purchase Loans for Owner-Occupied Homes to Buyers with Moderate Incomes, 2004

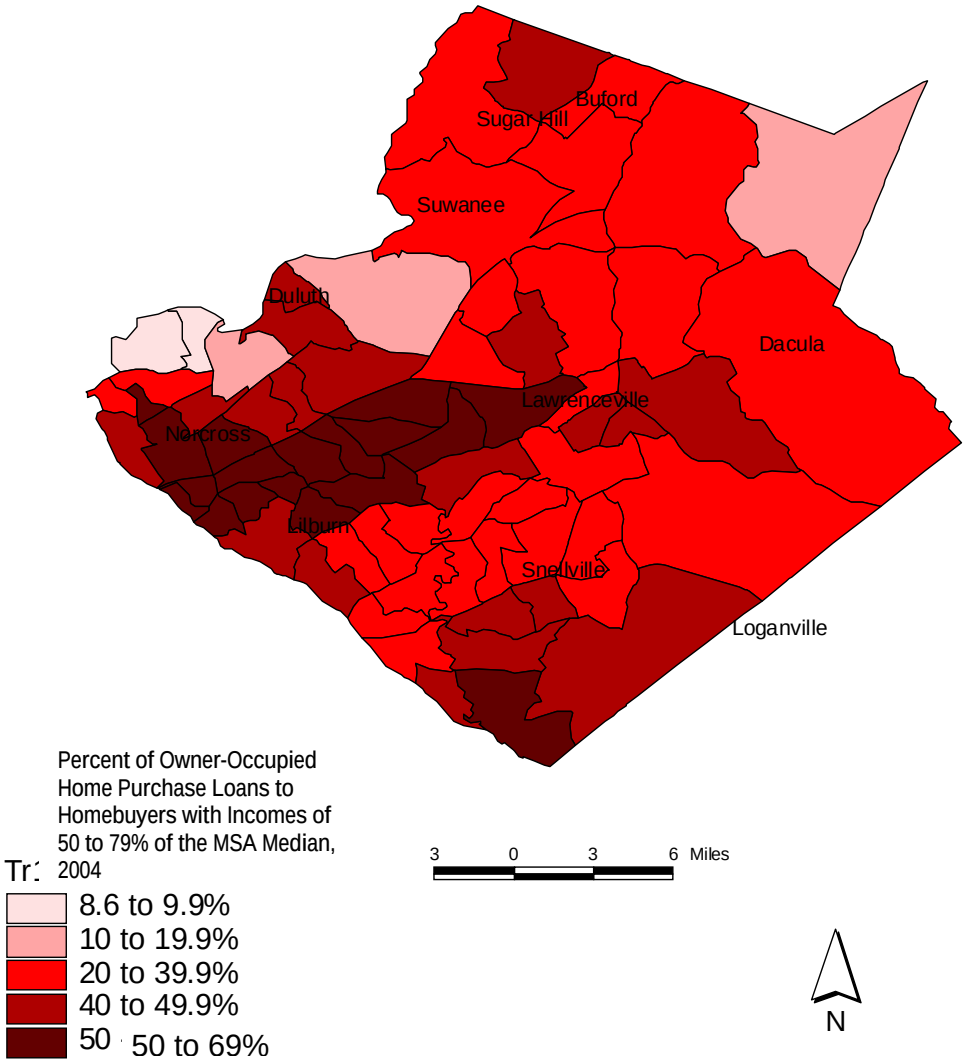
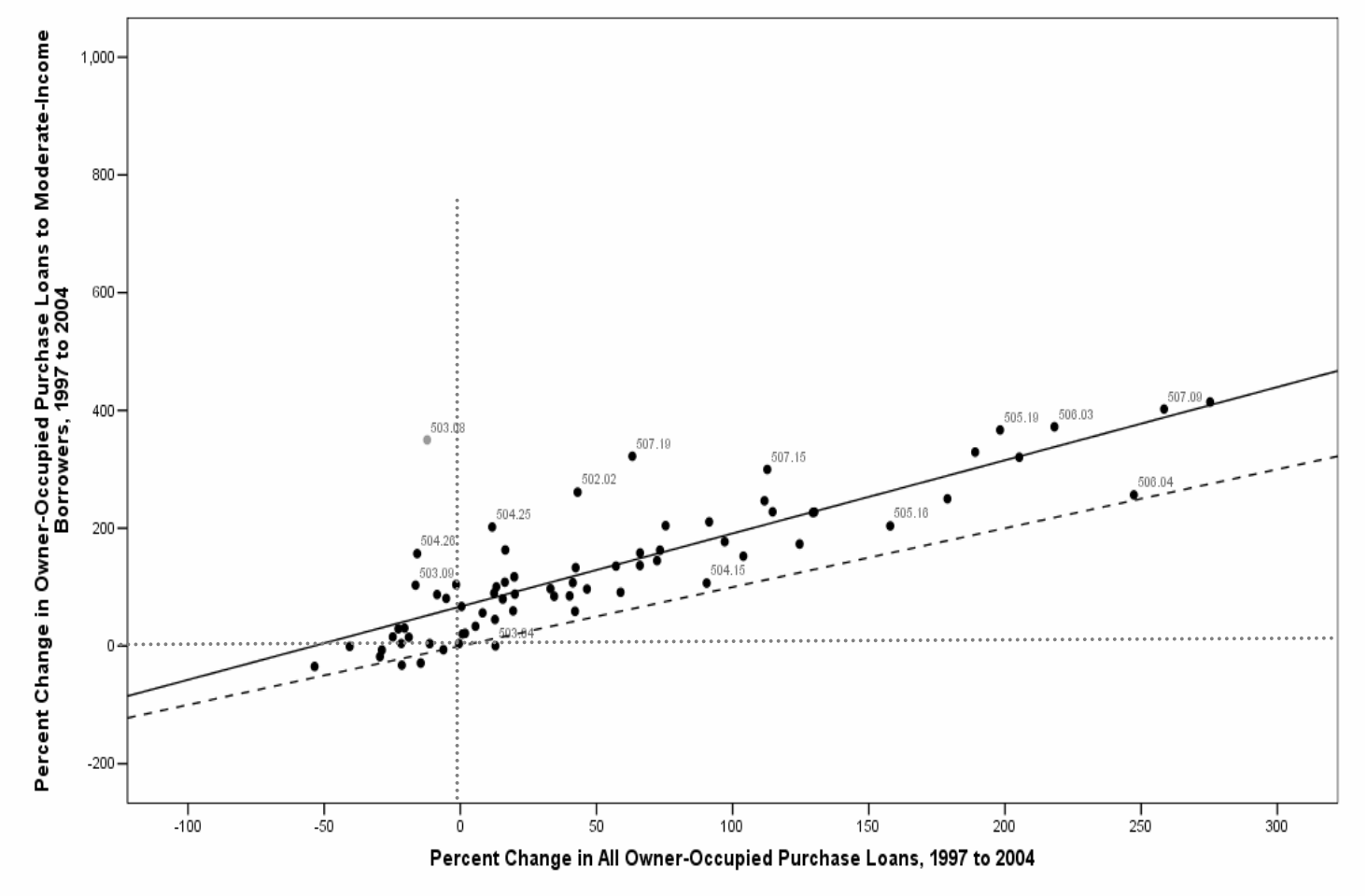


Figure 17

Percent Change in Moderate-Income Owner-Occupied Home Buyers vs.
All Owner-Occupied Buyers, 1997 to 2004
Gwinnett County Census Tracts (2000 Boundaries)



*Moderate-income means borrowers with incomes from 50 to 79% of the metropolitan median income (HUD defined).

Figure 17 shows the percent change in the number of moderate-income buyers of owner-occupied homes from 1997 to 2004, plotted on the vertical axis, compared to the percent change in all owner-occupied purchases over the same period. (Again, the dashed 1:1 slope line represents a pattern in which the percent increase in moderate-income buyers would be equal to the percent increase in all buyers.)

Figure 17 indicates that all but a few slow-growth tracts experienced increases in the number of moderate-income homebuyers. (The horizontal dotted line indicates zero change in the number of moderate-income buyers.) Figure 17 also includes a bivariate regression line for percent change in loans to moderate-income buyers regressed on percent change in total homebuyers. Tracts above this line experienced particularly large increases in moderate-income homebuying relative to other tracts in the county, given their overall growth in homebuyers.

Figure 17 suggests that while the number of moderate-income buyers did increase at a faster rate than overall homebuyers in most tracts, this difference was generally constant across slower- vs. faster-growth tracts.

Purchase of Owner-occupied Homes by Middle-Income Households

Unlike the case for low- and moderate-income homebuyers, in most Gwinnett tracts, the proportion of buyers who are middle- or upper-income decreased over the 1997 to 2004 period. In many tracts, these declines are of significant magnitude. Figures 18 through 20 describe the trends for middle-income buyers—those with family incomes from 80 to 120 percent of the MSA median.

Figure 18 shows that, in 26 of the 71 tracts, the proportion of buyers who were middle-income declined by more 10 percentage-points or more from 1997 to 2004. In another 16 tracts, declines were in the range of 3 to just under 10 percentage-points. There were 9 tracts in which the share of buyers with middle incomes increased moderately (from 3 to just under 9 percentage points). In the remaining tracts, the middle-income share was essentially stable (less than plus or minus 3 percentage points).

Figure 19 shows that, despite significant changes, in most tracts in Gwinnett County, middle-income homebuyers still constituted a large share of homebuyers as of 2004. Moreover, tracts with relatively high middle-income shares (above 30 percent) are dispersed across many parts of the county, and not heavily concentrated in just one or two geographic sectors.

Figure 20 provides an analysis of changes in the number of middle-income buyers, rather than of their share of all buyers. It shows that, while, in many tracts, the declining middle-income share is wholly or partly due to the increasing numbers of low- and moderate-income buyers, in many tracts, the number of middle-income buyers actually did decline over the 1997 to 2004 period. (These tracts are the ones falling below the dotted gray horizontal line.)

Figure 18

Change in Percent of Home Purchase Loans for
Owner-Occupied Homes to Buyers with Middle Incomes, 1997 to 2004

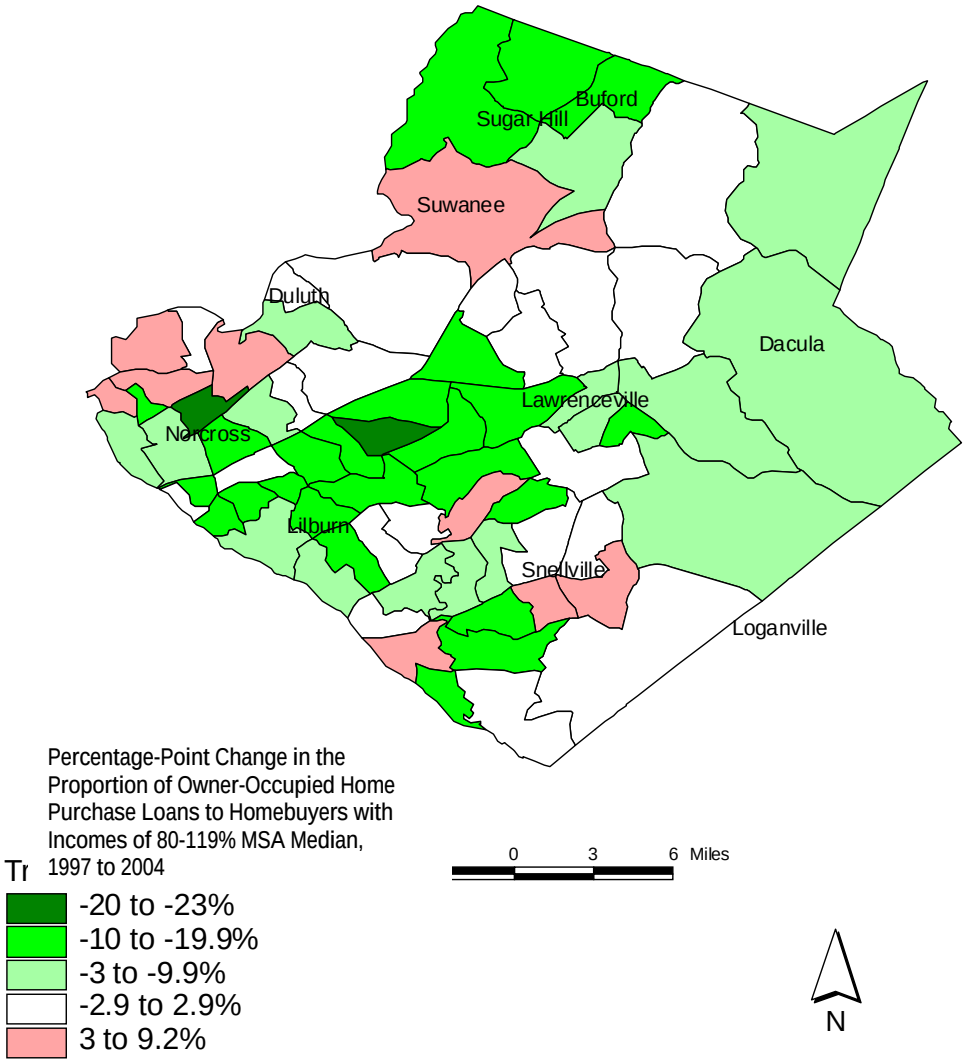


Figure 19

Percent of Home Purchase Loans for Owner-Occupied Homes to Buyers with Middle Incomes, 2004

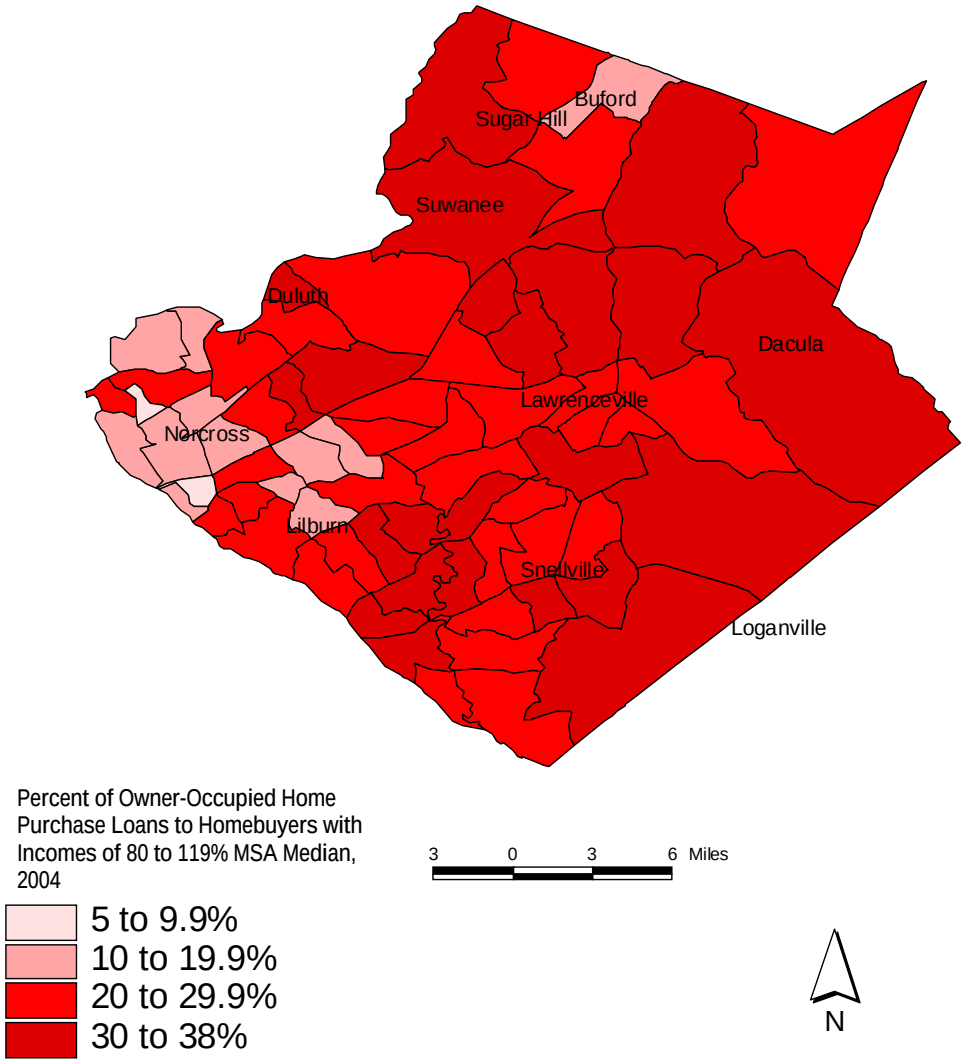
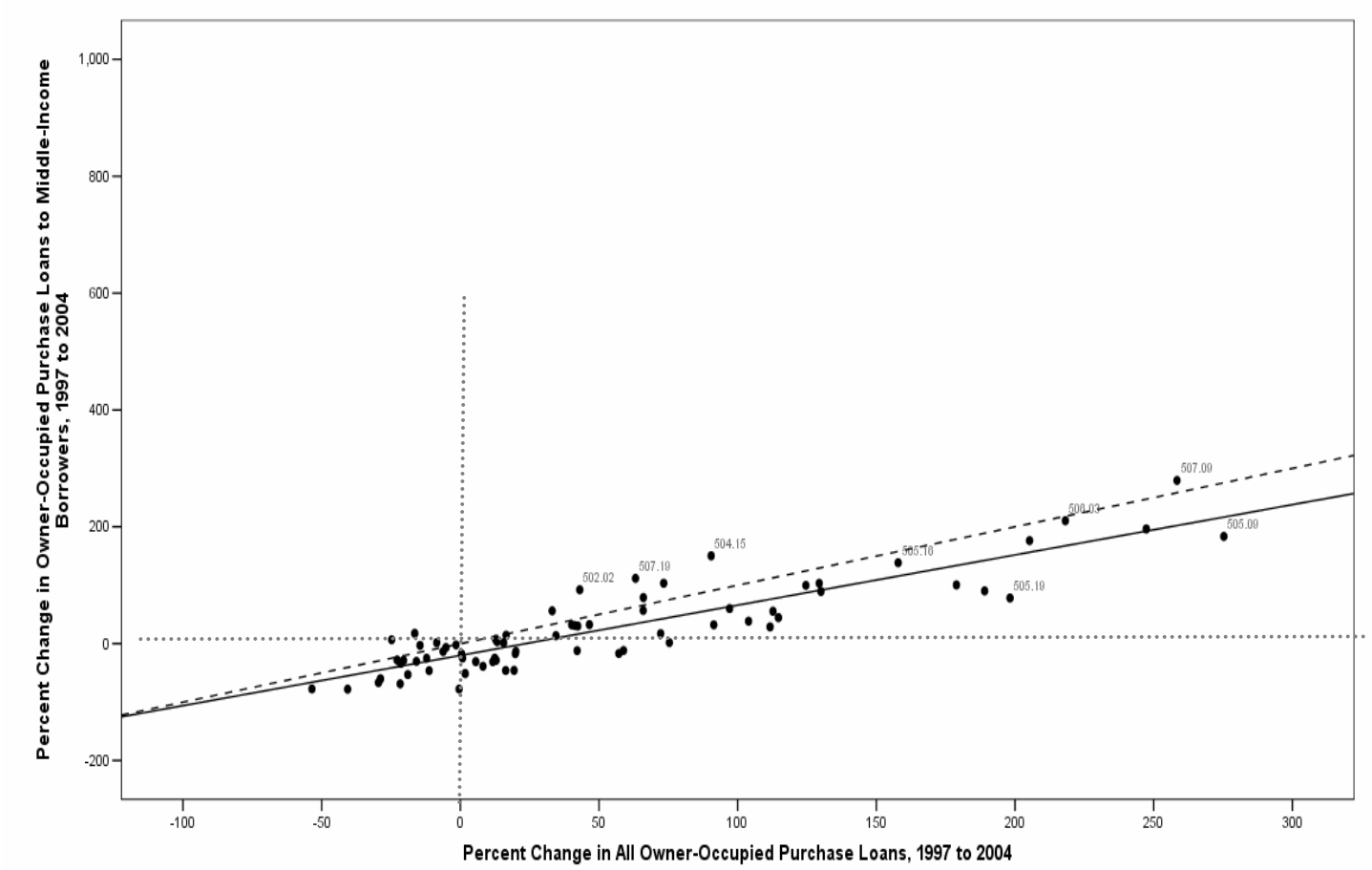


Figure 20

Percent Change in Middle-Income Owner-Occupied Home Buyers vs.
All Owner-Occupied Buyers, 1997 to 2004
Gwinnett County Census Tracts (2000 Boundaries)



*Middle-income means borrowers with incomes from 80 to 119% of the metropolitan median income (HUD defined).

Figure 20 indicates a pattern in which, as overall homebuyer growth from 1997 to 2004 exceeded approximately 25 percent, there was some positive growth in the number of middle-income buyers. However, when growth was below this figure, or negative, then the number of middle-income buyers frequently declined. This is not to imply a causal relationship; these numbers are descriptive only. Basically, because low- and moderate-income homebuying is increasing generally, the middle-income share of homebuyers is declining in most tracts in Gwinnett (and in many tracts in metropolitan Atlanta for that matter). Therefore, if the total number of homebuyers did not increase very much, the number of middle-income buyers was likely to be smaller in 2004 than in 1997.

Purchase of Owner-occupied Homes by Upper-Income Households

Figure 21 describes the changes in the share of homebuyers who are upper-income (incomes above 120 percent of the MSA median). As was the case with middle-income buyers, most tracts in the county experienced a decline in the proportion of buyers with upper incomes. Of the 71 tracts in the county, 36 saw the share of buyers who had upper incomes decline by at least 10 percentage points. Of these 36, 10 saw declines of 20 percentage points or more. Only six tracts experienced stability (change of than plus or minus three percentage points) in their share of buyers who had upper incomes. Seven tracts did see nontrivial increases in upper-income homebuyer shares, with two of these experiencing increases of more than 10 percentage points.

Figure 22 indicates that there are a significant number of tracts in which upper-income homebuyers constituted less than 10 percent of homebuyers in 2004. Many of these are concentrated in the west-central part of the county. At the opposite end of the income spectrum, there are some tracts in which upper-income buyers constituted more than half of all buyers in 2004. All but one of these lie north of I-85 in the western/northwestern part of the county.

Figure 23 shows that in many tracts, the number of upper-income buyers declined from 1997 to 2004. However, if a tract experienced a growth in overall homebuying of approximately 80 percent or more, this was sufficient to compensate for the declining share of upper-income buying and yield a net increase in upper-income buyers. However, even for the faster growing tracks –with some exceptions—the increase in upper-income buyers lagged the increases in total buyers. Moreover, this lag was, on average, somewhat greater in the faster growing tracts. This is indicated by the smaller slope of the regression line versus the dashed, 1:1 slope line. In some tracts (e.g., 507.04) growth in upper-income buyers was modest despite very large (over 200 percent) growth in total buyers.

Figure 21

Change in Percent of Home Purchase Loans for
Owner-Occupied Homes to Buyers with Upper Incomes, 1997 to 2004

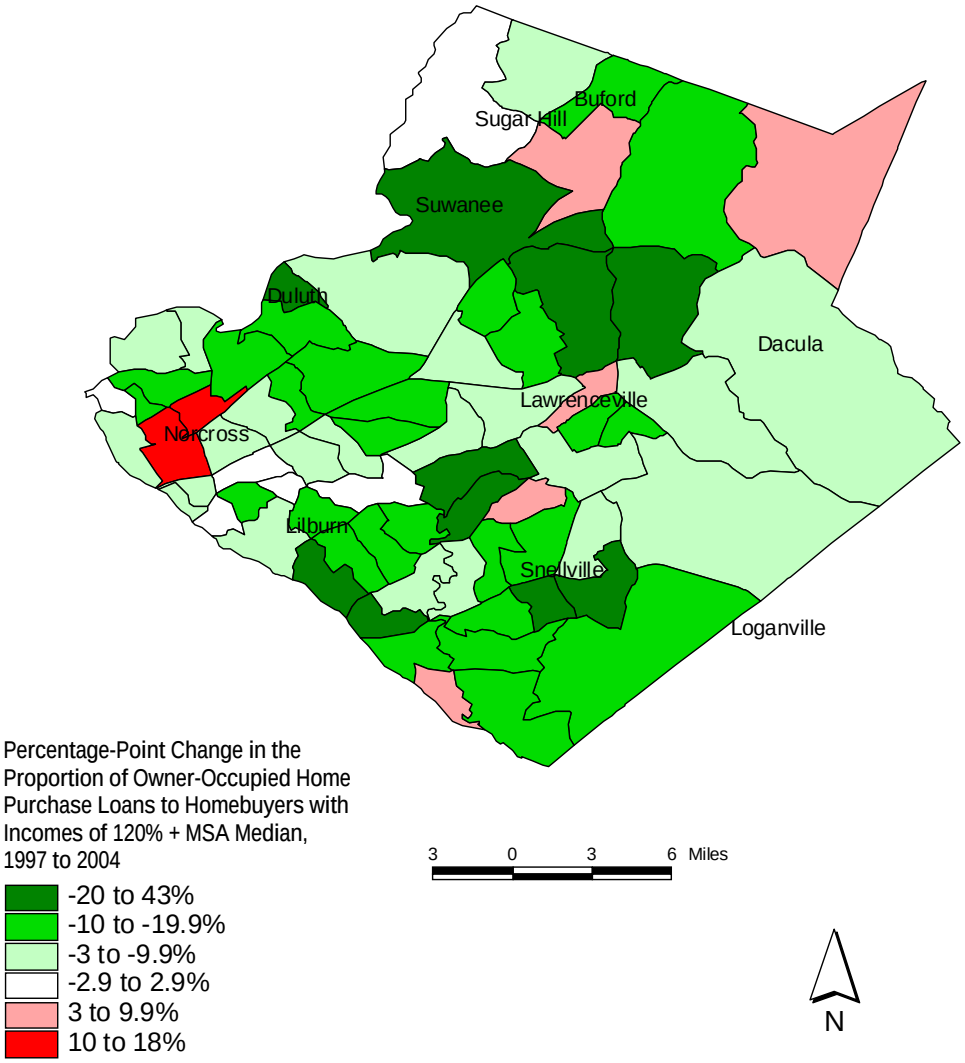


Figure 22

Percent of Home Purchase Loans for Owner-Occupied Homes to Buyers with Upper Incomes, 2004

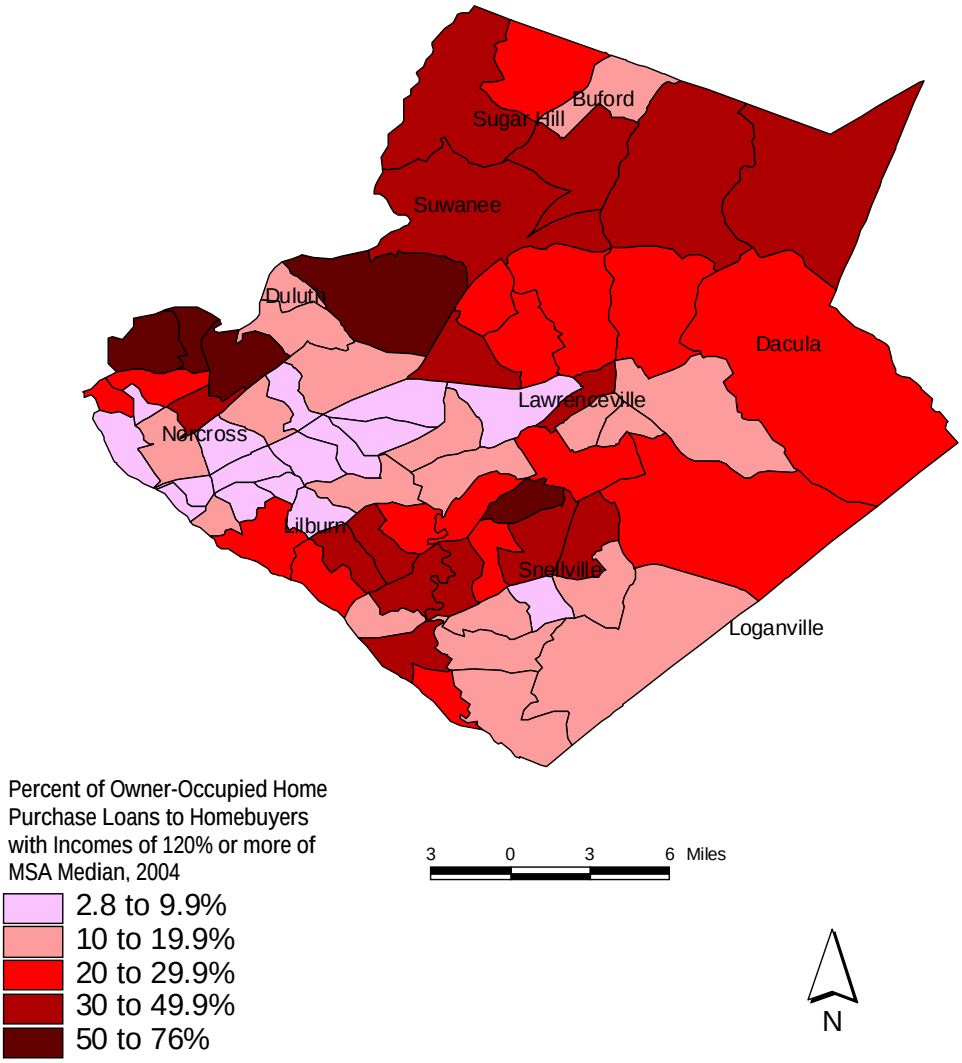
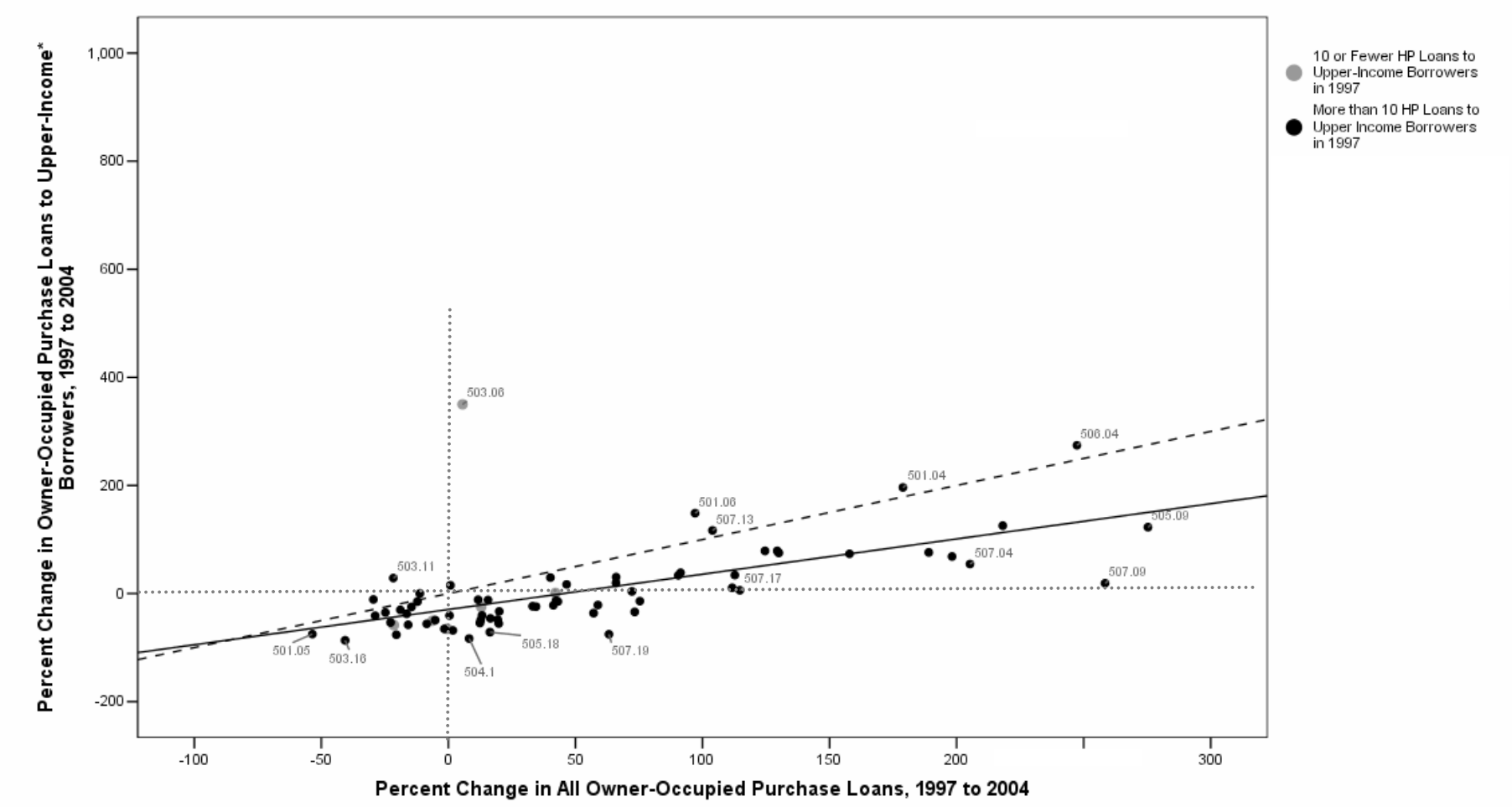


Figure 23

Percent Change in Upper-Income Owner-Occupied Home Buyers vs.
All Owner-Occupied Buyers, 1997 to 2004
Gwinnett County Census Tracts (2000 Boundaries)



*Upper-income means borrowers with incomes of 120% or more of the metropolitan median income (HUD defined).

Important Related Trends in the Single Family Market

Financing

In the last five years or so, there has been substantial, nationwide growth in what are called nontraditional or "exotic" mortgage products, which are marketed to both prime and subprime borrowers. Before 2000-2001, many of these products either did not exist or were marketed quite selectively to high-worth, often self-employed homebuyers. Included among exotic products are interest-only loans, payment-option loans, negative amortization loans, no-documentation or "stated-income" loans, and what are called "hybrid" adjustable rate mortgages (ARMs). The proliferation of these products has been attributed to a number of factors, including rising housing prices, the growth of non-agency securitization, and the growth of specialized mortgage lenders, including subprime lenders.

Many if not most exotic mortgages involve adjustable interest rates, especially those made in the 2003 to 2005 period, when exotic mortgages became so popular. Traditionally, as rates for fixed-rate loans fall, the short-term savings that ARMs can provide decline, and the share of mortgages that have fixed-rates increase. However, from 2001 to 2003 interest rates generally fell, but the share of loans that were ARMS increased. Then, although rates remained relatively flat, ARMs increased dramatically in 2004, so that ARM share reached 71 percent of jumbo loans and 31 percent of nonjumbo loans.[2]

The increase in exotic mortgages has been viewed by some as driven by rising property values, as home buyers use such loans to lower the initial debt service of increasingly expensive properties. At the same time, the ability of buyers to "stretch" further via such products can also fuel demand for higher cost homes and thus be as much a cause as an effect of higher home prices. Many lenders have promoted such products as a means for buyers to afford larger homes. As long as property values are expected to rise, some lenders will be willing to take on added repayment risks associated with more highly leveraged borrowers, because they are confident that properties, at least in most cases, will appreciate sufficiently to cover losses.

However, because many exotic mortgage products involve some version of adjustable interest rates, the risks that borrowers face due to changing interest rates can be quite substantial. Industry analysts have estimated that as much as $1 trillion in ARMs are subject to resetting interest rates in 2007, up from $400 billion in 2006 and $100 billion in 2005.[3] Moreover, in many cases, these ARM loans involved "teaser" interest rates that are set at a below-market level in order to entice borrowers. This means that, when rates on these loans reset, they will go up much more than simply the increase in market interest rates, but will increase by the difference

[2] Jumbo mortgages are those whose amounts exceed the limits of the government-sponsored secondary markets (Fannie Mae and Freddie Mac) to purchase them. These figures are from a survey by the Federal Housing Finance Board. Since subprime lenders, which make more ARM loans, are underrepresented in this survey, the total ARM share is likely substantially higher than these figures suggest.

[3] Frantantoni, Michael. 2005. *Housing and Mortgage Markets: An Analysis.* Washington, DC: Mortgage Bankers Association, September 6. <http://www.mortgagebankers.org/files/News/InternalResource/29899_HousingandMortgageMarkets-AnAnalysis.pdf> (retrieved on June 30, 2006).

between the teaser and market rates at the time of origination, plus any increase in rates since the origination date. In some cases, this may mean that loan rates will go from something as low as 3 or 4 percent to 7 or 8 percent or more, effectively doubling the loan payment in some cases.

The rise of exotic products and the proliferation of ARMs and ARMS with teaser rates have increased the levels of debt that many households take on in purchasing a home. One way of measuring this at a neighborhood level is to measure the ratio of the median home purchase loan size to the median income of homebuyers in the neighborhood.

Figure 23 plots this ratio for 2004 for census tracts throughout the 10 county Atlanta region. It shows that many tracts within Gwinnett County have relatively high loan-to-income ratios for homes bought in 2004. The highest category (magenta) includes tracts with a ratio from 2.51 to 4.02. Traditional underwriting generally held that borrowers should not borrow more than 3 to 3.5 times their income for a home loan. Yet the ratio mapped is the ratio of the *median* loan size to the *median* borrower income, suggesting that many homebuyers are exceeding this ratio.

Figure 24 illustrates the increase in the loan-to-income ratio for homebuyers from the 1997 to 2004 period for the Atlanta region. It shows that most tracts in Gwinnett experienced relatively large increases in the loan-to-income ratio over the 1997 to 2004 period.

Related to this issue is Table 1, which indicates that Gwinnett County has experienced large increases in foreclosures from 2005 to 2006. Anecdotal evidence suggests that ARMS are accounting for a substantial portion of this increase. (A later report will focus on foreclosure trends within Gwinnett County).

Investor/Rental Single Family Purchases

Figures 25 and 26 indicate another trend that is occurring in the single-family market in Gwinnett, as well as in some other parts of the region. Home purchase loans made to nonowner-occupants has risen significantly in recent years, especially since 2000. Figure 25 shows that a majority of tracts in the county experienced at least a 5 percentage-point increase in the proportion of houses purchased by nonowner-occupants. In 14 tracts the increase was over 10 percentage points. These loans could have been taken out by basically three types of home buyers. First, buyers could be investor/speculators looking to purchase homes and resell them in a short period of time. These buyers may or may not plan to make significant improvements to the properties. Second, buyers may be planning to buy the homes as rental properties. Finally, buyers may be buying the homes as second homes, but not principal residences.[4]

[4] Nonowner-occupant purchases may also be more likely to represent transactions in which some mortgage fraud has occurred, so that the property is flipped in order to obtain a large mortgage with an inflated purchase price.

Figure 23

Ratio of Median Loan Amount to Median Borrower Income, Home Purchase Loans, 2004

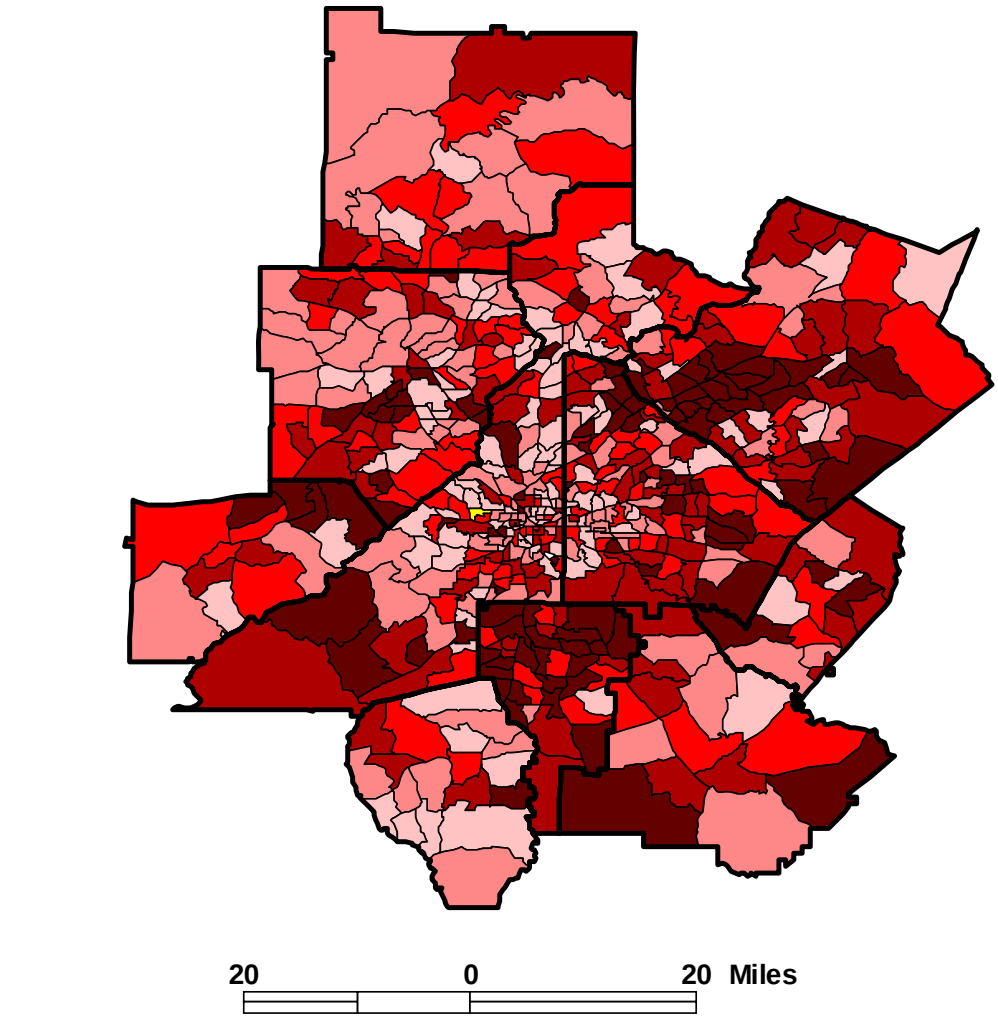


Figure 24

Change in Ratio of Median Loan Amount to Median Borrower Income, Home Purchase Loans, 2000 to 2004

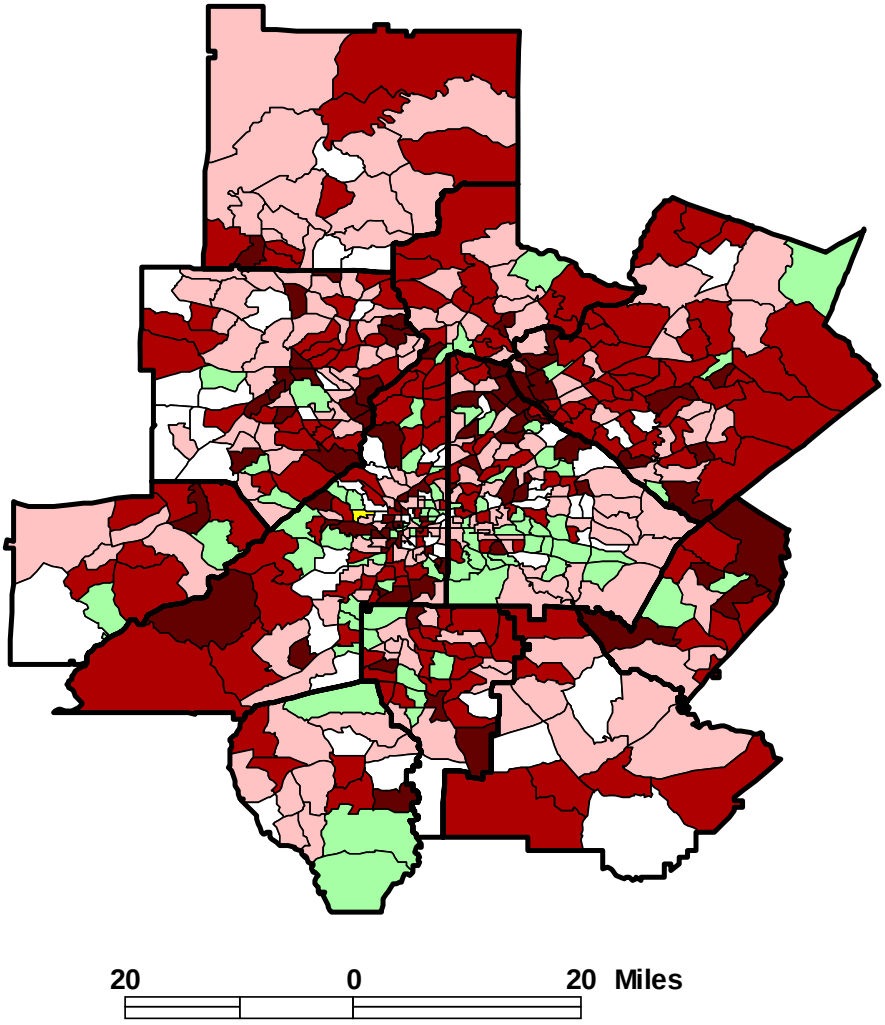


Table 1.

Change in the Number of Foreclosures Started in the 13-County Area, 2000-2006

	Jan-Aug 2005 to Jan-Aug 2006	Jan-Aug 2000 to Jan-Aug 2006
FULTON	33%	207%
DEKALB	11%	137%
COBB	15%	161%
GWINNETT	17%	258%
CLAYTON	17%	183%
CHEROKEE	17%	207%
DOUGLAS	14%	180%
FAYETTE	19%	116%
HENRY	26%	315%
ROCKDALE	30%	166%
FORSYTH	-6%	220%
BARTOW	-3%	88%
HALL	12%	149%
TOTAL	19%	184%

Data source: Atlanta Foreclosure Report; EquityDepot.net

Figure 25

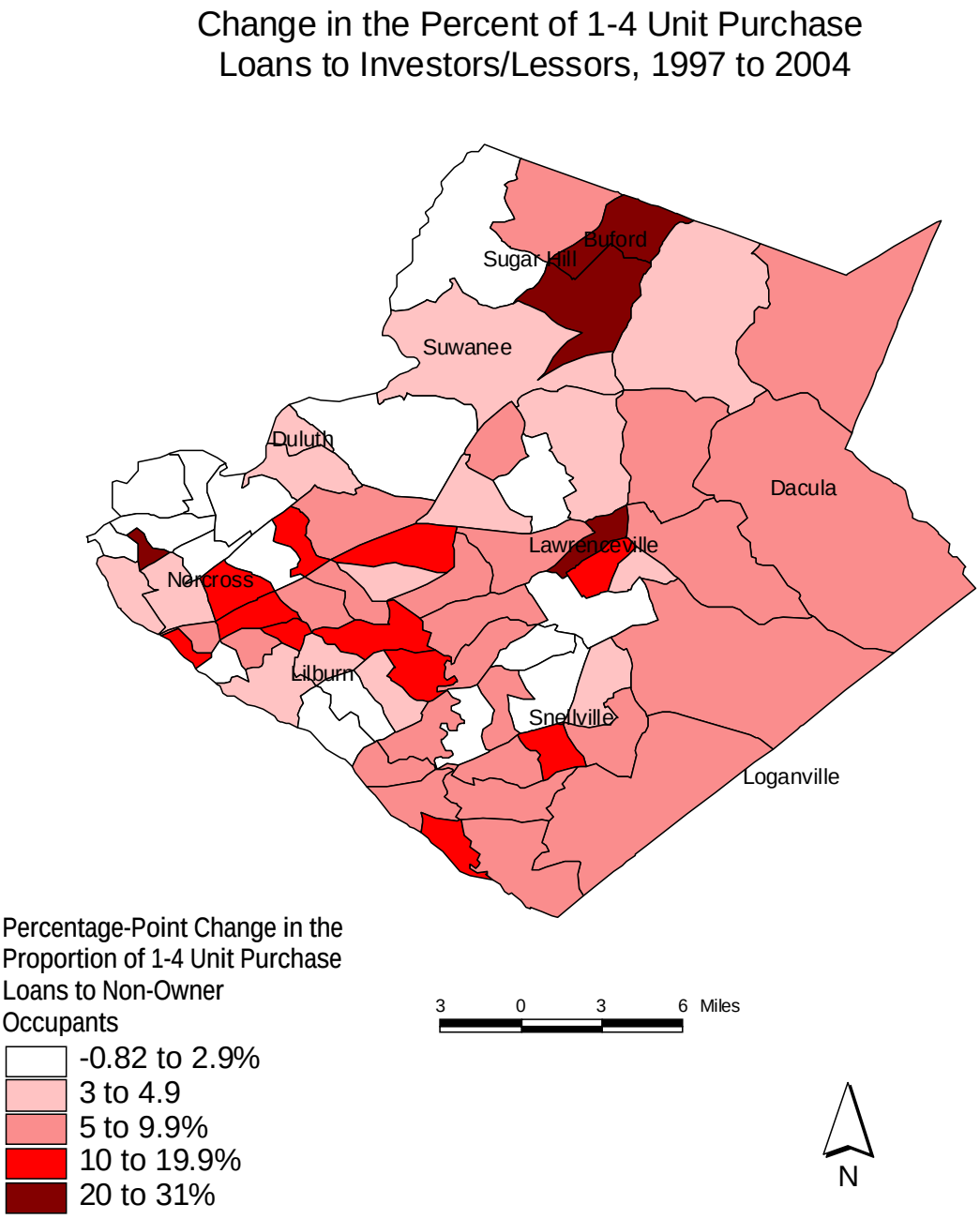
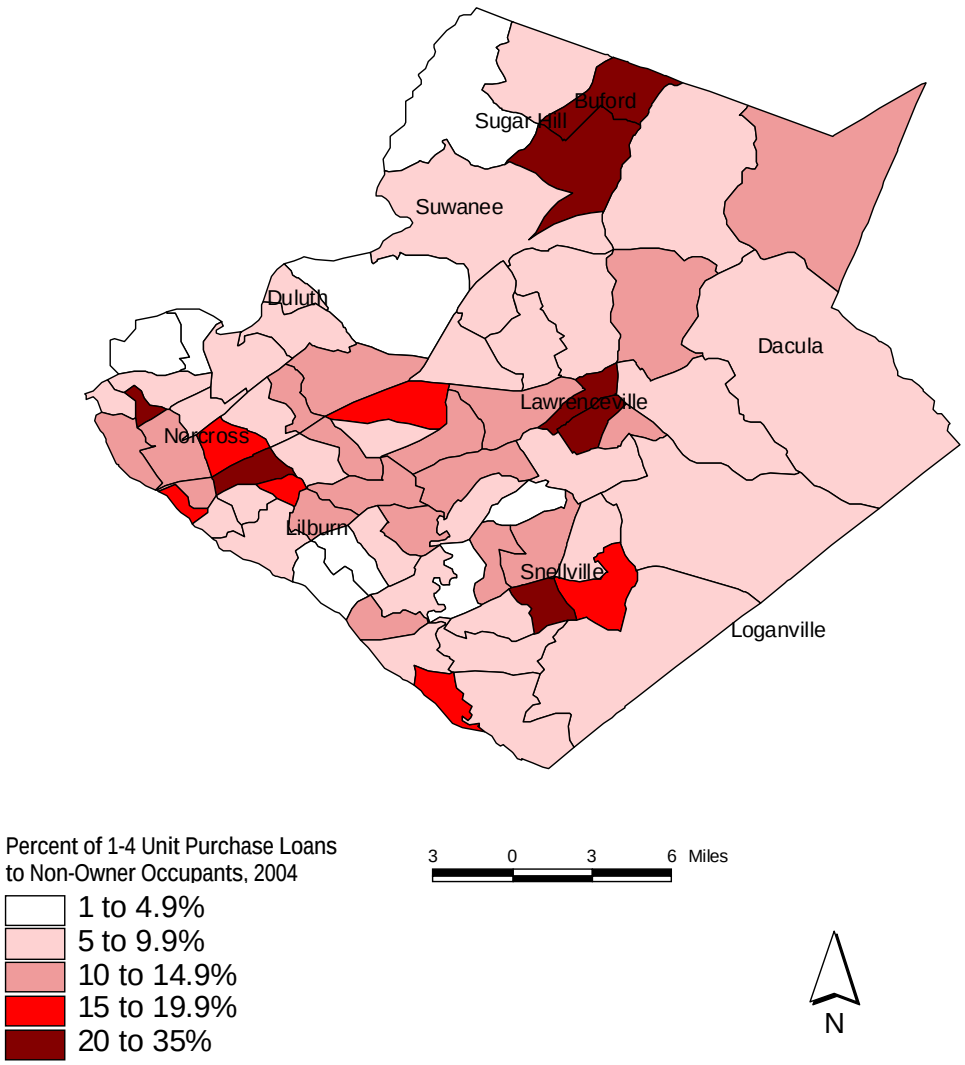

Change in the Percent of 1-4 Unit Purchase Loans to Investors/Lessors, 1997 to 2004
Buford
Sugar Hill
Suwanee
Duluth
Dacula
Lawrenceville
Norcross
Lilburn
Snellville
Loganville
Percentage-Point Change in the Proportion of 1-4 Unit Purchase Loans to Non-Owner Occupants
-0.82 to 2.9%
3 to 4.9
5 to 9.9%
10 to 19.9%
20 to 31%
3 0 3 6 Miles
N

Figure 26

Percent of 1-4 Unit Purchase Loans to Investors/Lessors, 2004



Appendix

Home Mortgage Disclosure Act Data and Reporting of Racial and Ethnic Data

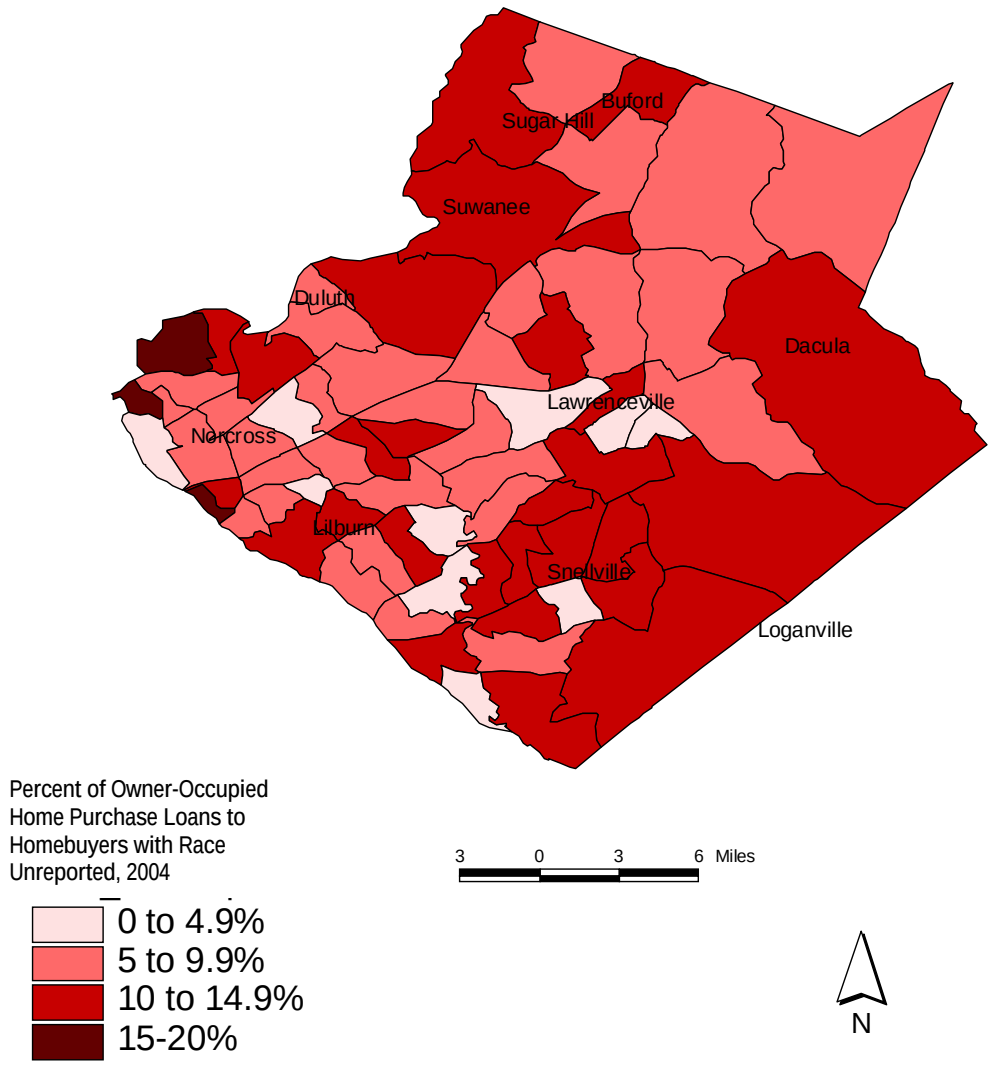
We obtained the Home Mortgage Disclosure Act (HMDA) data used here from the Urban Institute, which in turn had compiled a large set of HMDA variables (over 1,000) for census tracts for years dating back to 1997 for use in the Fannie Mae Foundation's website www.dataplace.org. The Urban Institute allocated data in years before 2003 to 2000 tracts (the earlier years' data were originally reported by 1990 tract boundaries). They did this using the same algorithms as in the now widely used National Urban Change Database, developed by Geolytics, Inc., which reallocates 1970 through 1990 census data according to 2000 tract boundaries.

Figure A-1 indicates the proportions of owner-occupied home purchase loans in 2004 in Gwinnett County in which race of the borrower was not reported. In most tracts, this figure varies between 5 and 15 percent. The variation is due to a number of factors, including the particular composition of lenders active in different communities. Lenders are generally obligated to attempt to obtain the race of the loan applicant, but they cannot compel such information. If the application is taken in person, they are to indicate apparent race or ethnicity from their observation. Lenders taking internet or telephone applications are expected to have higher levels of unreported race and ethnicity information as a result. Also, subprime lenders – those specializing in lending to people with imperfect credit—have historically had higher levels of unreported race loans. Subprime lenders disproportionately lend to minorities and minority neighborhoods, and so this may also account for some of the spatial variation in incomplete racial data.

All proportions in this study were calculated with a denominator that included only loans with reported racial/ethnic data. Thus, to the extent that minorities may be disproportionately represented among borrowers with unreported racial/ethnic data, these proportions may be biased downward somewhat. If this is the case, then the geographical disparities shown in the proportion of buyers who are Hispanic, African-American, or Asian, may be underestimated.

Figure 1-A

Percent of Home Purchase Loans for Owner-Occupied Homes
Where Race is Unreported, 2004



Foreclosure Trends in Gwinnett County, Georgia, 2000 – 2006

Prepared by

Dan Immergluck, PhD
Associate Professor
City and Regional Planning
Georgia Institute of Technology
Atlanta, GA 30332-0155
dan.immergluck@coa.gatech.edu

and

Yun Sang Lee
PhD Student
City and Regional Planning
Georgia Institute of Technology
Atlanta, GA 30332-0155

May 3, 2007

Introduction

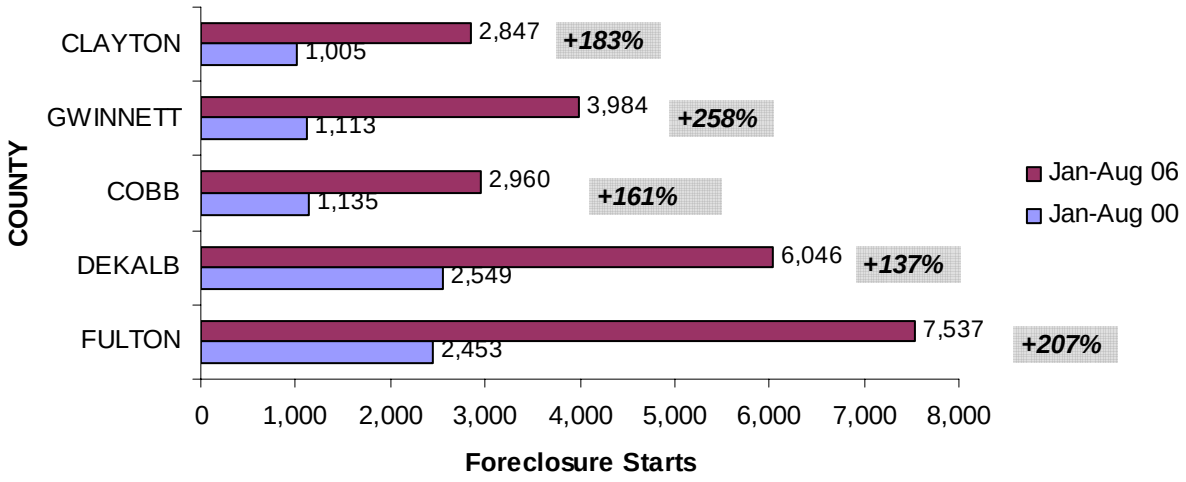
In recent years, mortgage foreclosures of single-family homes have increased at a rapid pace in many major U.S. metropolitan areas. The Atlanta region and Gwinnett County have been no exception to this unfortunate trend. The growth in foreclosures has been due both to an overall change in the types and structures of mortgages being made, especially a large increase in subprime mortgages since 2000, but also due to the deteriorating performance of these higher risk loans. Moreover, unlike some earlier trends in foreclosures, local economic conditions (e.g., changes in unemployment or wages) appear to have played little to no role in these increases.

Besides the substantial growth in subprime lending, two other changes in lending markets have played a role. First, from 2001 to 2005, there was a large increase in the prevalence of alternative, or "exotic" mortgages to borrowers with good credit – which include low or no-documentation loans, interest-only loans, payment-option loans, and piggy-back 80/20's (where a 20 percent junior mortgage is made in conjunction with an 80 percent senior mortgage). Finally, there was a substantial increase in zero-downpayment mortgages nationally.[1] The increase of these products has increased the overall risk in the mortgage market and, because most of these products involve adjustable rate loans, shifted much of that risk to the homebuyers from the lenders. As interest rates fluctuate, these changes are passed on to the borrower, some of whom are not prepared to deal with higher house payments.

The proportion of outstanding subprime loans that are seriously delinquent have risen from under 10 percent in 2000 to over 13 percent in 2006. The rate of subprime foreclosure starts has almost doubled over this period. But the overall number of foreclosures has increased by much higher than the simple increases in the rates of delinquency and foreclosure rates, because the growth of the subprime lending market has driven up the overall number of higher risk loans on which these rates are calculated. Subprime foreclosures now account for approximately 60% of all foreclosures.

[1] Immergluck, Dan. From the Subprime to the Exotic: Expanded Mortgage Market Risk and Implications for Metropolitan Areas and Neighborhoods, *Journal of the American Planning Association*, forthcoming, 2007.

Figure 1. Growth in Foreclosures in the Five Core Atlanta Metro Counties, 2000-2006 (first 8 months 2000 to first 8 months 2006 comparison)



Source: Atlanta Foreclosure Report; EquityDepot.net, 2006

Figure 1 shows that, in the core five-county Atlanta market, the number of foreclosure starts increased from just over 8,200 to more than 23,000 from the first eight months of 2000 to the first eight months of 2006, an increase of over 180 percent. All five counties saw increases in foreclosures of more than 135 percent between 2000 and 2006, but the rate of increase in Gwinnett was the highest at 258%.

Foreclosures, Housing Needs and Neighborhood Stability

Foreclosures can entail significant costs and hardships for those most directly affected. They often involve losing not only accumulated home equity and the costs associated with acquiring the home, but also access to stable, decent housing. Moreover, foreclosures can damage credit ratings, hurting the owners' prospects not only in credit markets but also in labor and insurance markets, and in their ability to find quality rental housing.

The costs of foreclosures are also born by the communities in which they occur. Neighborhoods see values and confidence decline. Cities, counties and school districts then lose tax revenue due to lower values. Even after controlling for other neighborhood characteristics, higher foreclosure levels negatively affect the values of

nearby properties.[2] For every foreclosure within one-eighth of a mile of a single-family home, property values are expected to decline by approximately 1 percent. And when foreclosures catalyze property vacancy abandonment, these properties can become blighted and havens for crime, begetting a spiral of severe neighborhood decline. Moreover, higher foreclosure levels can contribute to higher levels of violent crime.[3]

Foreclosures also entail out of pocket costs to local government. William Apgar and Mark Duda found that the direct costs of foreclosure processes and ancillary services (e.g., securing dangerous vacant property, etc.) to city government in Chicago – not counting those due to falling property values -- involve more than a dozen agencies and two dozen specific municipal activities, generating governmental costs that in some cases exceeded $30,000 per property.[4]

Increases in Foreclosures within the County

To examine changes in foreclosure levels within the county, we obtained address-level foreclosure data from the Equity Depot, Inc. (formerly Atlanta Foreclosure Report) for 2000 through July of 2006. Because residential foreclosures were not distinguishable from commercial and industrial foreclosures until the 2001 data, we compared foreclosures for January to July of 2001 to those in January to July of 2006. In total, foreclosure starts went from 1,065 to 3,386 in the county over this period.

Figures 2 and 3 show the locations of foreclosures started in the January-July 2001 and 2006 periods, respectively. (Census tract totals are presented in Appendix A.) The medium gray shaded census tracts are those which had 1999 median incomes that were below 80 percent of Atlanta MSA median family income. The light gray tracts are those with median incomes that were between 80 and 100 percent of Atlanta MSA median family income.

Comparing Figures 2 and 3 illustrates the strong growth in foreclosures throughout most parts of the county. Table 1 provides summary statistics on the growth

[2] Immergluck, D. and Smith, G. (2006). The external costs of foreclosure: The impact of single-family mortgage foreclosures on property values, *Housing Policy Debate* 17: 57-79.

[3] Immergluck, D and Smith, G.(2006). The impact of single-family mortgage foreclosures on neighborhood crime. *Housing Studies* 21:851.

[4] Apgar, W. and Duda, M. (2005). *Collateral damage: The municipal impact of today's mortgage foreclosure boom.* Washington, DC: Homeownership Preservation Foundation. May 11. Retrieved December 12, 2006 from http://www.nw.org/Network/neighborworksprogs/foreclosuresolutions/documents/Apgar-DudaStudyFinal.pdf.

Figure 2. Residential mortgage foreclosure starts from January to July, 2001

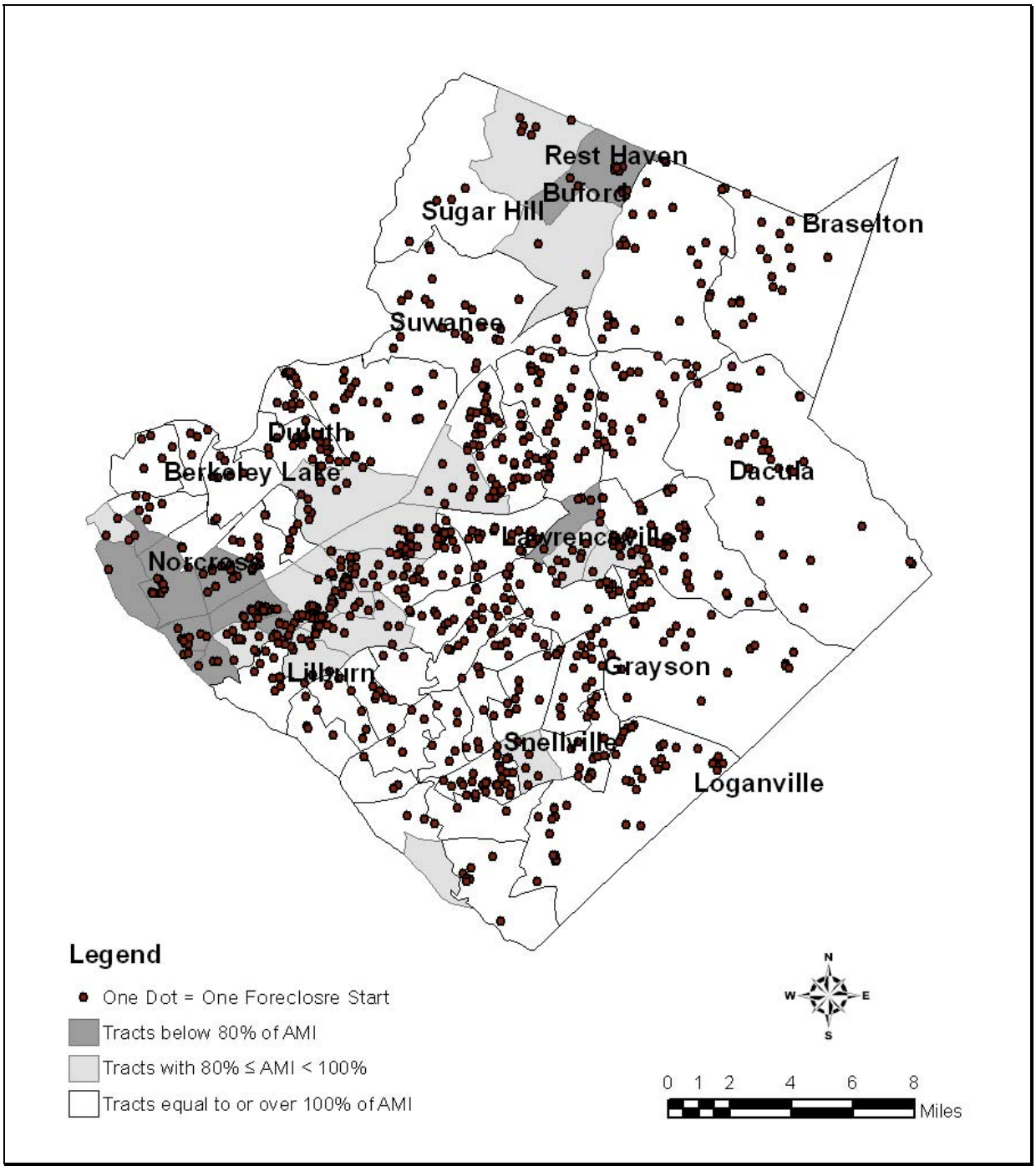


Figure 3. Residential mortgage foreclosure starts from January to July, 2006

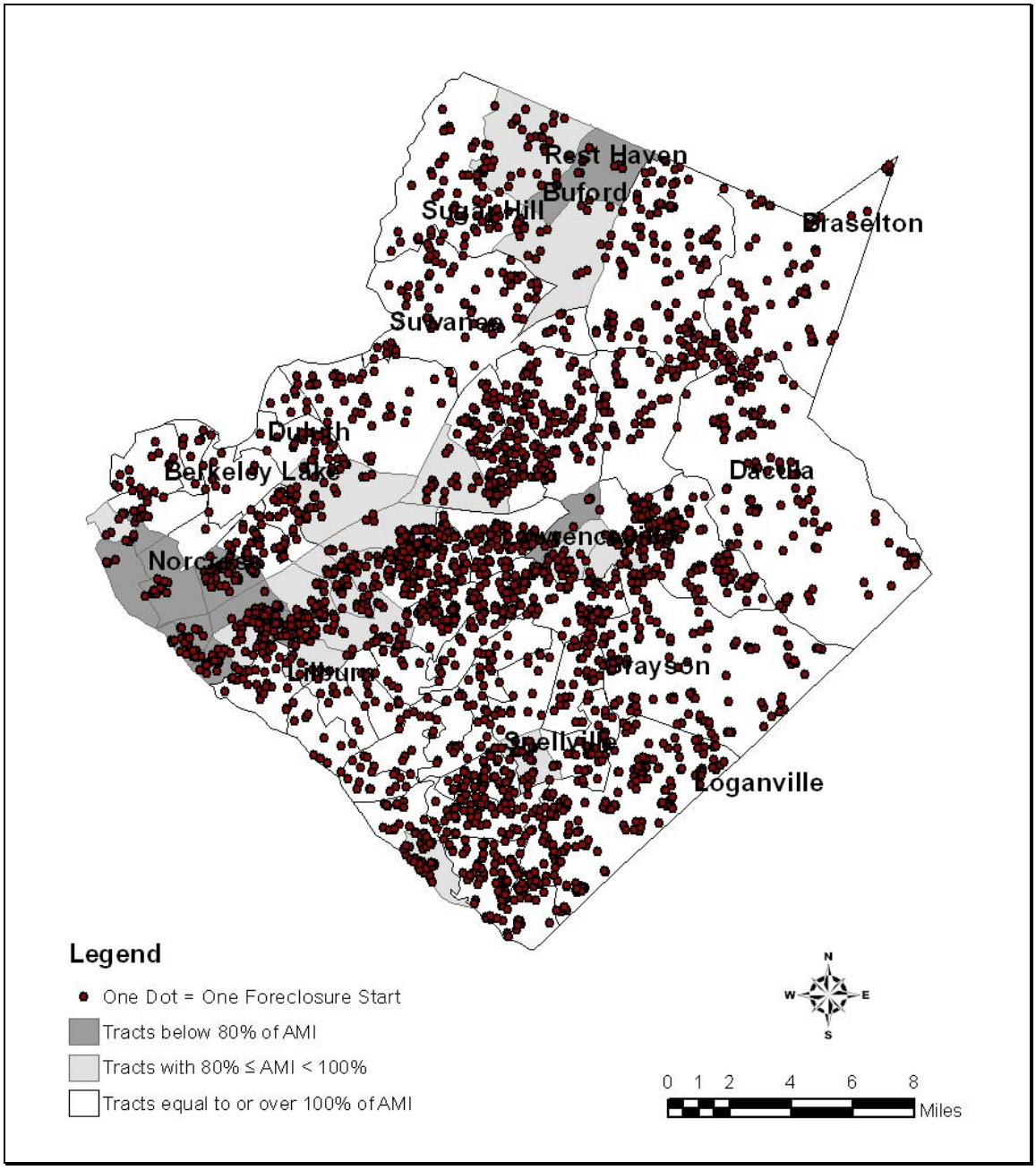


Table 1. Increases in Annualized Foreclosures Across Census Tracts, 2001-2006

Increase in Number of Annualized Foreclosures, 2001 - 2006	*Number of Tracts*	*Cumulative %*
Decline	2	2.82%
0	1	4.23%
1-10	16	26.76%
11-25	9	39.44%
26-50	18	64.79%
51-75	6	73.24%
76-100	6	81.69%
101-200	10	95.77%
201+	3	100.00%

Table 2. Increases in Annualized Foreclosures Across Census Tracts, 2001-2006

Percent Increase in Number of Annualized Foreclosures, 2001 - 2006	*Number of Tracts*	*Cumulative %*
Decline	2	2.82%
0%	1	4.23%
1-50%	9	16.90%
51-100%	11	32.39%
101-200%	17	56.34%
201-500%	22	87.32%
500-1,000%	4	92.96%
1,000% +	5	100.00%

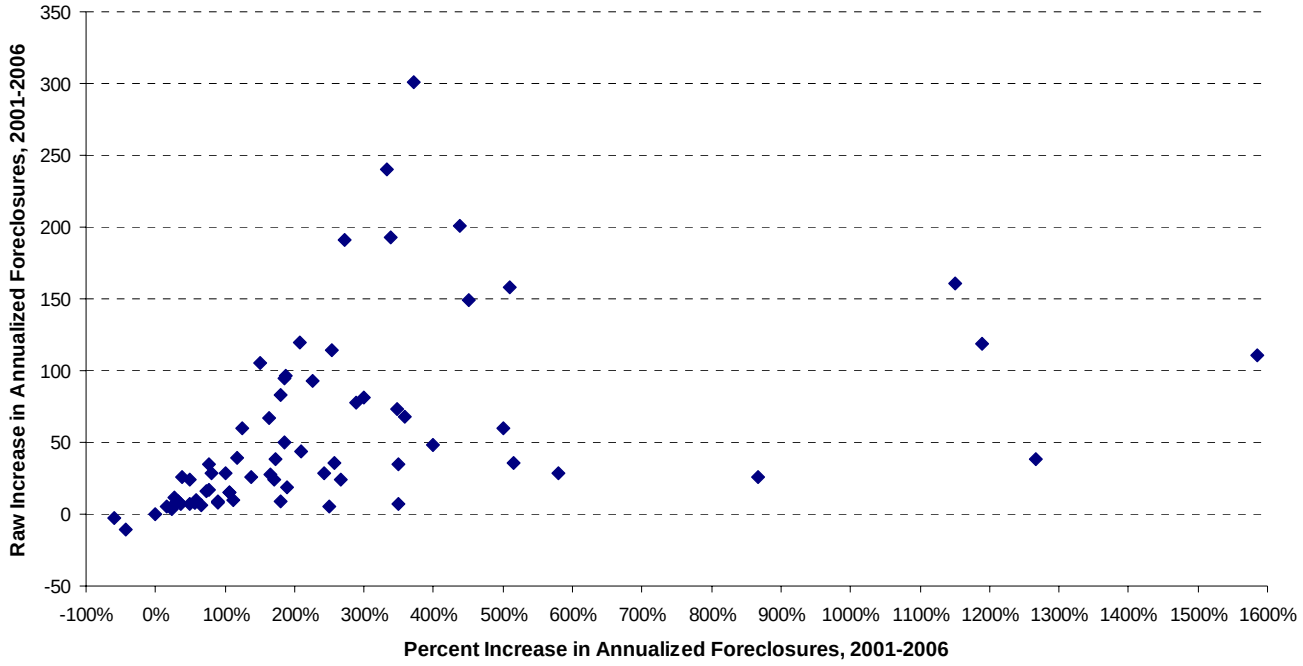
in the number of foreclosures for the 71 Gwinnett census tracts. It shows that in 73 percent (52) of tracts the increase in annualized foreclosures was more than 10; in 35 percent (25) of tracts, the increase was more than 50; and in 18 percent (13) of tracts, the increase was more than 100.

Table 2 provides a similar breakdown of tracts, but this time by percent change in foreclosures. It shows that 83 percent (59) of tracts experienced more than a 50 percent increase in foreclosures over the 2001 to 2006 period. More than 68 percent (48) experienced more than a 100 percent increase in foreclosures, and 44 percent (31) experience more than a 200 percent increase in foreclosures. Thus, the increases in foreclosures, while extremely high in some tracts, was widespread and affected most neighborhoods throughout the county.

To check whether the large percentage growth in foreclosures that has occurred in many neighborhoods might simply be due only to very small initial levels of foreclosures and so not reflect substantial raw increases, we plotted the raw increase in annualized foreclosures against the percentage growth. Figure 4 illustrates that, in general, the tracts with high percentage growth also have high levels of raw increases in foreclosures.

Of course, the raw levels of foreclosures in a census tract or changes in these levels are partly dependent on the number of mortgageable properties in a tract and, more specifically, the number of loans actually taken out in the tract in recent years. (For prime loans, foreclosures tend to occur within the first five-to-six years of origination; for subprime loans this period is considerably shorter, typically 18-36 months.) Therefore, from federal Home Mortgage Disclosure Act data, we calculated the total number of home purchase, refinance and home improvement loans that were originated from the second to fourth years preceding the foreclosure period. For the 2001 period, we summed the number of loans originated in 1997, 1998 and 1999. For the 2006 period, we summed the number of loans originated in 2002, 2003 and 2004. The sum of these loans for each tract

Figure 4. Raw Increases in Annualized Foreclosures Versus Percent Increases Gwinnett County Census Tracts, 2001-2006



formed the denominator of a tract-level foreclosure index. For the numerator, we simply annualized the seven-month foreclosure totals and multiplied the ratio by 100 so that we end up with an annualized foreclosure index in terms of foreclosures per 100 loans. The details of these calculations are indicated in Appendix A.

This analysis suggests that the rate of foreclosures in the county, as measured by foreclosures normalized by preceding loan activity, is increasing substantially, particularly in some parts of the county. Of course, this is partly due to the fact that a larger portion of loans are higher-risk loans, including subprime loans.

Table 3 shows that the mean index for 2001 was 2.28 while the mean for 2006 was 3.79, an increase of 66 percent. The relative variation (coefficient of variation) among the values of the foreclosure index was roughly similar across the two years, equaling 0.60 in 2001 and 0.57 in 2006. Table 3 also indicates the distribution of the foreclosure index values across 7 ranges. While only 7 percent (5) of tracts had an index of 5.0 or more in 2001, 26 percent (18) of tracts had indexes of at least 5.0 by 2006.

Table 3. Summary Statistics and Distribution of Foreclosure Index for 2001 and 2006 Gwinnett County Census Tracts

	2001		*2006*	
Foreclosure Index Range (per 100 preceding loans)	***Number of Tracts, 2001***	***Cumulative Percentage***	***Number of Tracts, 2006***	***Cumulative Percentage***
0	1	1.43%	0	0.00%
0.99	9	12.86%	1	1.43%
1.99	26	50.00%	14	21.43%
2.99	18	75.71%	14	40.00%
3.99	8	87.14%	15	61.43%
4.99	4	92.86%	9	74.29%
5.00 or greater	5	100.00%	18	100.00%
Mean	2.28		3.79	
Median	1.96		3.24	
Standard Deviation	1.37		2.16	
Coefficient of Variation (Std. Dev/Mean)	0.60		0.57	

Figure 5. 2006 Foreclosure Index vs. 2001 Foreclosure Index
Gwinnett County Census Tracts

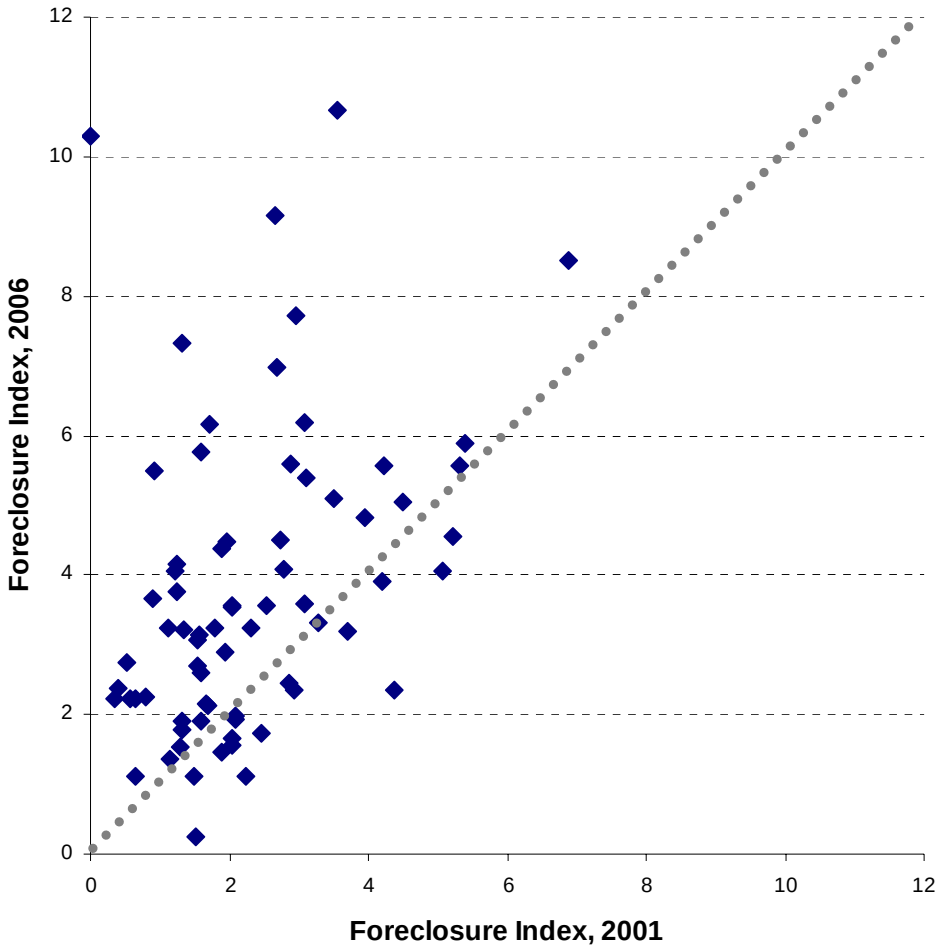


Figure 5 plots the foreclosure index for 2006 versus the foreclosure index for 2001. The dotted 45-degree line serves as a reference line, indicating where a tract would fall if its foreclosure index were identical in 2001 and 2006. Tracts to the northeast of the line are those which experience increases in the index. The figure indicates that many tracts saw large increases in their foreclosure index values.

Table 4 indicates that all but 23 percent (16) of the tracts experienced an increase in the value of the foreclosure index. In 49 percent (35) of the tracts, the index increased

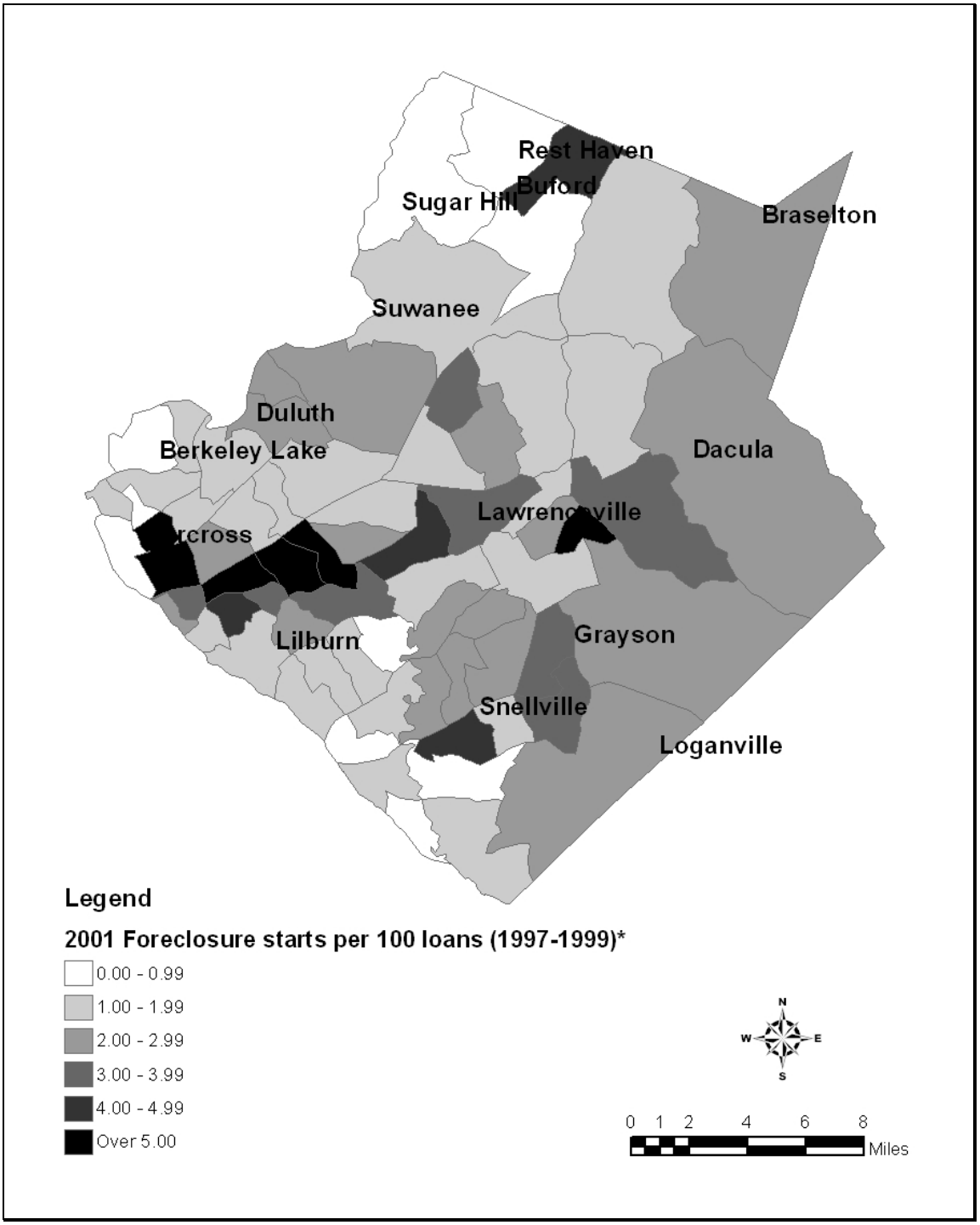
Table 4. Percent Change in Foreclosure Index, 2001 to 2006
Gwinnett County Census Tracts

Percent Change in Foreclosure Index	*Number of Tracts*	*Cumulative %*
<0%	16	22.54%
0-50%	20	50.70%
51-100%	10	64.79%
101-200%	9	77.46%
201-300%	9	90.14%
301% +	7	100.00%

by more than 50 percent, and in 35 percent (25) of the tracts, the increase was more than 100 percent.

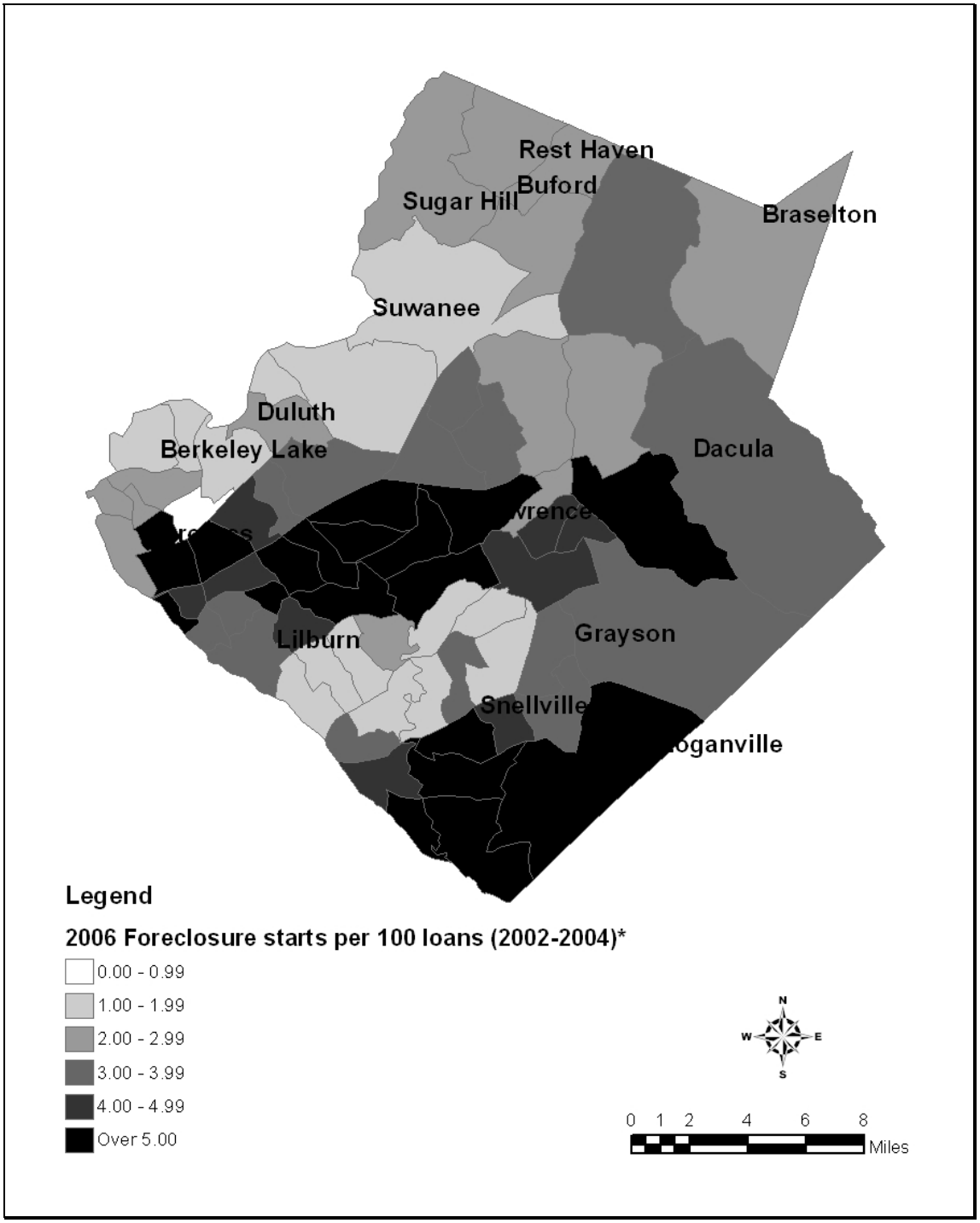
Figures 6 and 7 map the foreclosure index for the 71 census tracts for 2001 and 2006, respectively. Consistent with the analysis above, the figures confirm that most tracts saw significant increases in foreclosure index values. Moreover, the tracts with the highest foreclosure index levels in 2006 were located in the central and southern parts of the county. However, compared to foreclosures in 2001, many parts of the county had relatively high foreclosure index levels, well above a level of 3 per 100 loans.

Figure 6. 2001 Foreclosure Index:
Estimated 2001 Foreclosure starts per 100 loans (1997-1999)



*** Estimated foreclosures based on annualizing January–July, 2001 data. Denominator is the number of home loans made from 1997 through 1999.**

Figure 7. 2006 Foreclosure Index:
Estimated 2006 foreclosure starts per 100 loans (2002-2004)



*** Estimated foreclosures based on annualizing January–July, 2006 data. Denominator is the number of home loans made from 2002 through 2004.**

Appendix A. Number of Foreclosures, Number of Foreclosures Annualized, and Foreclosure Index

Tract	No. of Foreclosures (Jan-Jul, 2001)	No. of Foreclosures (Jan-Jul, 2006)	No. of Foreclosures (Annualized, 2001)	No. of Foreclosures (Annualized, 2006)	Foreclosure Index (No. per 100 loans) 2001	Foreclosure Index (No. per 100 loans) 2006
050103	7	42	12	72	0.655	2.226
050104	4	69	7	118	0.400	2.383
050105	15	9	26	15	4.366	2.359
050106	2	24	3	41	0.527	2.754
050202	34	104	58	178	1.311	1.904
050204	39	54	67	93	2.048	1.550
050205	7	7	12	12	2.048	1.657
050206	26	33	45	57	2.930	2.350
050207	11	51	19	87	1.129	3.243
050304	1	4	2	7	0.797	2.263
050306	10	16	17	27	5.307	5.575
050307	6	17	10	29	0.634	1.114
050308	5	10	9	17	1.295	1.542
050309	11	15	19	26	1.490	1.117
050310	8	17	14	29	1.677	2.159
050311	3	1	5	2	1.504	0.244
050312	16	61	27	105	2.946	7.717
050313	7	35	12	60	1.242	4.167
050314	7	24	12	41	1.560	3.148
050315	3	8	5	14	1.602	2.592
050316	1	5	2	9	0.568	2.238
050403	12	38	21	65	1.792	3.233
050410	10	26	17	45	2.730	4.511
050411	16	45	27	77	3.117	5.383
050415	4	25	7	43	1.207	4.058

Appendix A. Number of Foreclosures, Number of Foreclosures Annualized, and Foreclosure Index

Tract	No. of Foreclosures (Jan-Jul, 2001)	No. of Foreclosures (Jan-Jul, 2006)	No. of Foreclosures (Annualized, 2001)	No. of Foreclosures (Annualized, 2006)	Foreclosure Index (No. per 100 loans) 2001	Foreclosure Index (No. per 100 loans) 2006
050416	0	42	0	72	0.000	10.300
050417	8	13	14	22	3.941	4.813
050418	6	26	10	45	2.665	9.152
050419	13	22	22	38	4.197	3.900
050420	5	19	9	33	1.246	3.765
050421	18	21	31	36	5.212	4.551
050422	12	55	21	94	3.541	10.666
050423	21	38	36	65	5.397	5.879
050424	27	47	46	81	6.878	8.508
050425	5	11	9	19	1.307	1.777
050426	6	11	10	19	1.147	1.368
050427	2	17	3	29	0.347	2.235
050428	8	12	14	21	1.897	1.456
050429	8	17	14	29	1.589	1.909
050430	3	20	5	34	0.894	3.667
050507	26	93	45	159	3.076	6.184
050509	42	182	72	312	3.507	5.089
050510	28	42	48	72	3.707	3.204
050511	13	35	22	60	1.347	3.214
050512	30	86	51	147	2.039	3.545
050513	41	102	70	175	1.936	2.886
050514	24	63	41	108	1.541	2.697
050515	18	110	31	189	1.602	5.772
050516	19	106	33	182	1.963	4.470
050517	16	63	27	108	1.704	6.157
050518	24	78	41	134	2.675	6.979
050519	30	85	51	146	4.496	5.053

Appendix A. Number of Foreclosures, Number of Foreclosures Annualized, and Foreclosure Index

Tract	No. of Foreclosures (Jan-Jul, 2001)	No. of Foreclosures (Jan-Jul, 2006)	No. of Foreclosures (Annualized, 2001)	No. of Foreclosures (Annualized, 2006)	Foreclosure Index (No. per 100 loans) 2001	Foreclosure Index (No. per 100 loans) 2006
050520	5	9	9	15	1.681	2.128
050521	11	26	19	45	2.785	4.082
050522	13	23	22	39	5.076	4.048
050602	33	146	57	250	2.047	3.552
050603	27	144	46	247	1.546	3.061
050604	27	75	46	129	2.852	2.458
050704	47	223	81	382	2.875	5.583
050705	41	152	70	261	2.543	3.568
050709	8	102	14	175	1.329	7.335
050712	16	21	27	36	2.086	1.935
050713	10	12	17	21	2.229	1.125
050714	8	13	14	22	2.084	1.984
050715	8	22	14	38	2.313	3.243
050716	28	63	48	108	4.225	5.556
050717	6	75	10	129	0.920	5.483
050718	15	19	26	33	2.461	1.721
050719	8	29	14	50	1.897	4.372
050720	17	34	29	58	3.289	3.304
050721	19	42	33	72	3.081	3.593

Appendix B. Details on Foreclosure data

Foreclosure data within Gwinnett County were obtained from Equity Depot (www.equitydepot.net), which compiles records of individual foreclosure notices for the Atlanta metropolitan area. Data have the dates that the foreclosure was initiated and street address as well as other information about foreclosure. Foreclosure start dates obtained range from January 2000 to July 2006. Using street address, foreclosure data were geocoded to the streets in Gwinnett County. Geocoding was performed by both ArcGIS using Tiger street files and an Internet-based service using its own street files (http://www.batchgeocode.com).

Due to errors in street address, some data could not be geocoded accurately. In addition, some foreclosures appear to be located outside Gwinnett County, possibly due to incorrect addresses, so those data were deleted from the data set. The success rate was better when using the Internet-based service. The street data used in the Internet-based service are more recently updated than the Tiger file used in ArcGIS, so the different success rates are not surprising. This is consistent with the pattern of success rate over time. In ArcGIS geocoding, the older data show better success rates, while in Internet-based service, the newer data show better success rates. The total number of foreclosures, the number of foreclosures geocoded, and the success rates are presented in Table B-1.

Table B-1 Foreclosure Data Geocoding Results

		ArcGIS Result		Internet Service Results	
Year	Total number of foreclosures	Number geocoded	Success rate	Number geocoded	Success rate
2000	1,675	1,316	78.6%	1,546	92.3%
2001	2,306	1,825	79.1%	1,995	86.5%
2002	3,561	2,835	79.6%	3,442	96.7%
2003	4,735	3,580	75.6%	4,645	98.1%
2004	5,130	3,690	71.9%	5,075	98.9%
2005	5,122	3,482	68.0%	5,050	98.6%
2006(pt)	3,449	2,288	66.3%	3,414	99.0%

Appendix F – Land Use Allocation

Gwinnett Land Use Allocation for the Unified Plan – Process and Modeling Approach

Overview

The generalized maps that will guide future land use patterns in the Unified Plan and the rezoning acreages targeted are the result of a rigorous land use allocation and testing process that is summarized in this Appendix.

Using detailed land use data from the County's GIS system, the study team translated the intentions, policies and assumptions of the scenarios into land use types and acreages and tested their ability to be accommodated, in desired locations, given current land uses. Current zoning was not treated as a constraint in these exercises since a new and preferred pattern was being tested and sought. While allocation was directed to vacant land, the possibility of redevelopment was incorporated in the modeling, given the limited amounts of greenfield land and the increased growth projections of the International Gateway scenario.

The approach described here is a mix of mechanical allocation following defined rules (rule based models), informed by expert judgment and reasonability reviews. In other words, maps or tables showing allocations of housing, employment or acreages were subject to commonsense review by staff and the market expertise of RCLCo. Rules of allocation were then tweaked and the models rerun until a plausible pattern emerged. In some cases, as many as 8 iterations at the TAZ level were needed to achieve an acceptable outcome. Some scenario assumptions (e.g. a rural Eastern County) might never be yielded by market-simulating models like those used here and these were simply allocated as givens or Overlays in the modeling process.

The allocation process was approached at three scales: countywide, at the SCA level and at the TAZ level. Countywide totals for future growth differed by scenario and their development has been discussed in Appendix C. A summary of the forecast methodology is also at the end of this report. The SCA allocations are discussed below and this is followed by an explanation of the more complex TAZ level modeling. Finally, the way in which the output from this process was used by other models (transportation, sewer and fiscal) is touched on.

Sub County Area (SCA) level allocations

The plan alternatives were developed and quantified in an extended process spanning more than a year. The first step consisted of developing a "market-driven" forecast that described probable conditions through 2030 in the absence of any major policy changes. This scenario was quantified in terms of economic and demographic variables for Gwinnett County and its eight sub-county-areas (SCAs) using a forecasting methodology described in Appendix C. The model results were then subjected to a multi-stage review process in which the

consultant team and county staff assessed the physical feasibility and probable market acceptance of the new development forecasted for each SCA. The resulting consensus forecast was dubbed the "Middle-of-the-Pack" scenario and held unchanged thereafter.

The other scenarios were initially quantified by pivoting off the Middle-of-the-Pack forecast using the team's informed judgment to approximate an SCA distribution of population, housing and employment that appeared to be consistent with the scenario's intent and with assumptions about the land use market's elasticities. Starting with pre-specified population and employment totals:

- the high-growth International Gateway scenario was fleshed out in several versions involving different assumptions about residential settlement patterns, dwelling types, income distributions and employment levels.
- The Radical Restructuring alternative – resembling Middle-of-the-Pack in overall growth but achieving higher incomes and a better employment base – was quantified in more geographic detail than the Gateway due to its municipal linkages.
- Regional Slowdown became a scaled-down version of the Middle-of-the-Pack with more adverse income trends.

These initial scenario descriptions were subjected to an expert review process resembling that for the market-driven forecast. The new process spanned a much longer period, however, to allow feedback from the study's land-use, fiscal and transportation models. At length the Radical Restructuring alternative was set aside from further consideration. The planning team determined that this scenario, while feasible in concept, was too dependent upon actions by other parties to be an appropriate planning focus for Gwinnett County. The Regional Slowdown scenario was also discarded since it represented an outcome that was both undesirable and avoidable.

The SCA level allocations yielded in the above process were treated as control totals by SCA for the further allocations of population, housing and employment, as converted to land use acreages, to the TAZ level.

TAZ Allocation Overview

The model used a series of algorithms to allocate land use to each parcel in the county. These parcels were then aggregated to the TAZ (Traffic Area Zone) level. Analyzed individually, the allocations at the parcel level are likely to be inaccurate due to the fact that the attractiveness of each parcel used as an input to allocation was very general and not necessarily parcel specific. For example, given 2 adjacent vacant parcels, it was very hard to justify why one was developed while the other was not. However, this inaccuracy is abstracted out and minimized when all the individual parcel allocations are averaged over the larger TAZ area.

Overview of Allocation Process

Beyond the words, overall numbers and concepts associated with the scenarios, generalized depictions of their spatial patterns were developed. Figures 1 through 3 capture the land use concepts for the three surviving scenarios.

Figure 1: Regional Slowdown Scenario

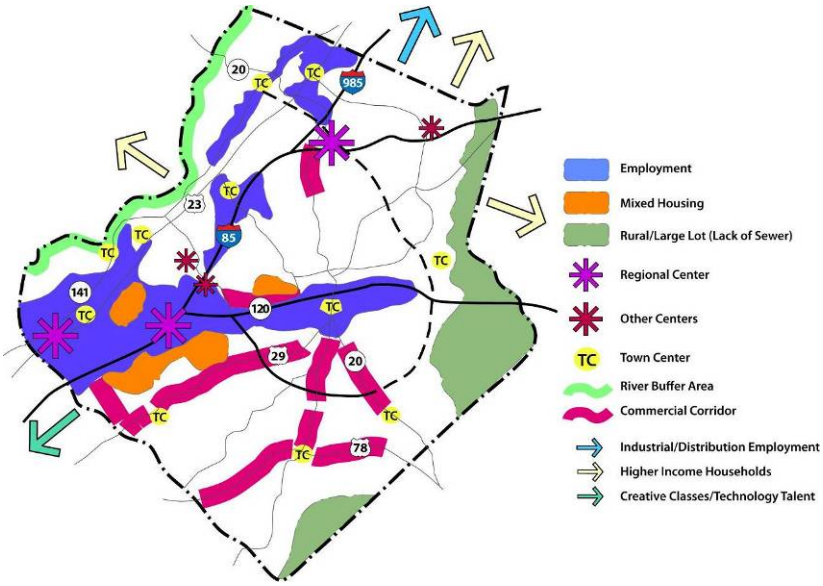


Figure 2: Middle of the Pack Scenario

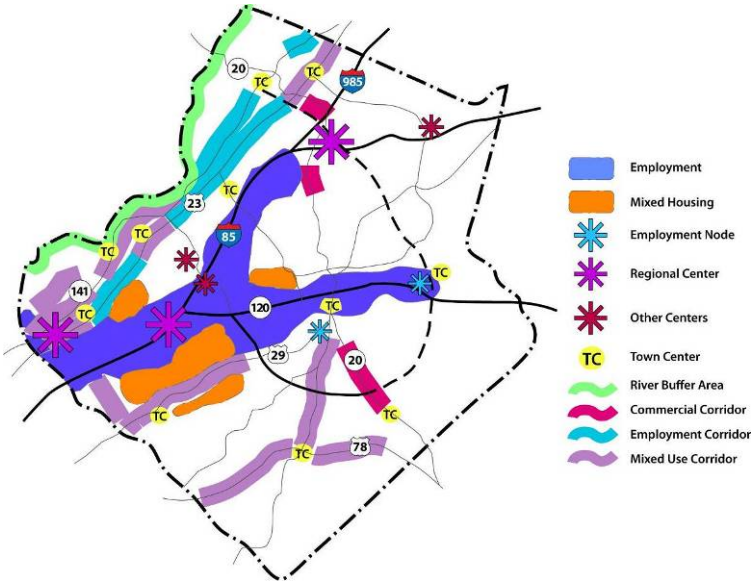
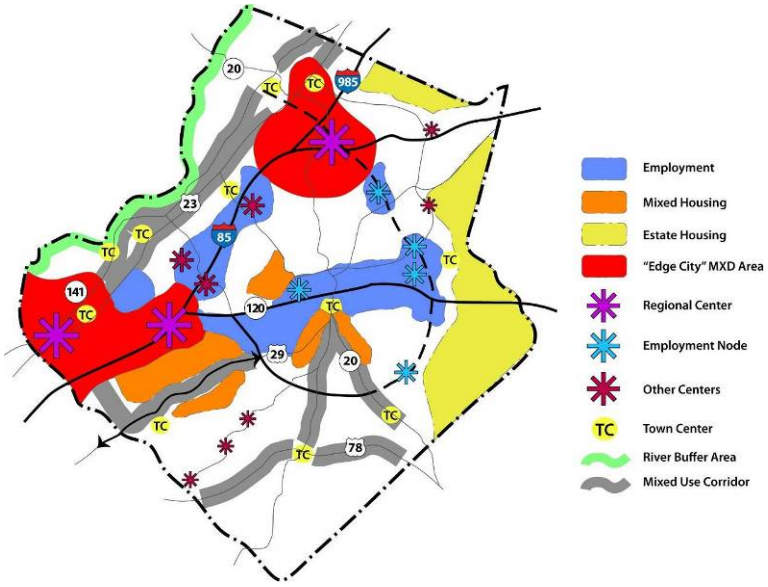


Figure 3: International Gateway Scenario



Moving from the general concepts represented by the above sketches to a more specific and concrete allocation of land uses that could be evaluated against various criteria represented a significant work effort that could only be executed via some modeling or simulation process, given the size and complexity of the County. Because the actual distribution of future land uses is at the heart of the Unified Plan, it is very important that the method used to develop these allocations is clearly explained.

At a high level the following overall process was used to allocation land uses to parcel that were subsequently aggregated up to the TAZ level for further use in the Unified Plan.

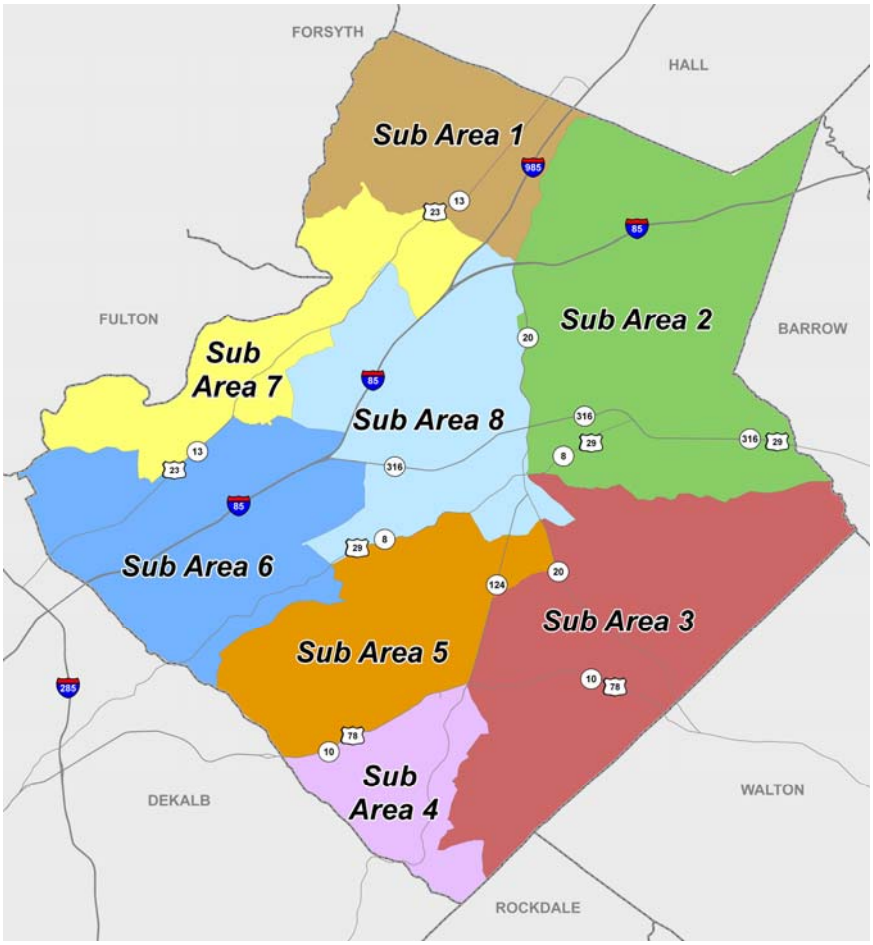
Converting Scenario Concepts into Land Use Allocations

This was a two step process, mixing modeling with expert judgment, starting at a coarser geography of 8 Sub County Areas or SCAs (see Figure 4) and proceeding to a finer grain of Traffic Analysis Zones or TAZs, (see Figure 5), which was in turn based on a parcel level database in the county's GIS system. These processes are described in turn.

Sub County Areas

The various scenarios described in the previous section were initially quantified by drawing upon the Middle-of-the-Pack forecast and a description of buildout conditions under present zoning rather than by reusing the allocation model. Starting with pre-specified population and employment totals, the high-growth International Gateway scenario was fleshed out in several versions involving different assumptions about residential settlement patterns, dwelling types, income distributions and employment levels. The Radical Restructuring alternative – resembling Middle-of-the-Pack in overall growth but achieving higher incomes and a better employment base – was quantified in more geographic detail than the Gateway due to its municipal linkages. Regional Slowdown became a scaled-down version of the Middle-of-the-Pack alternative with more adverse income trends.

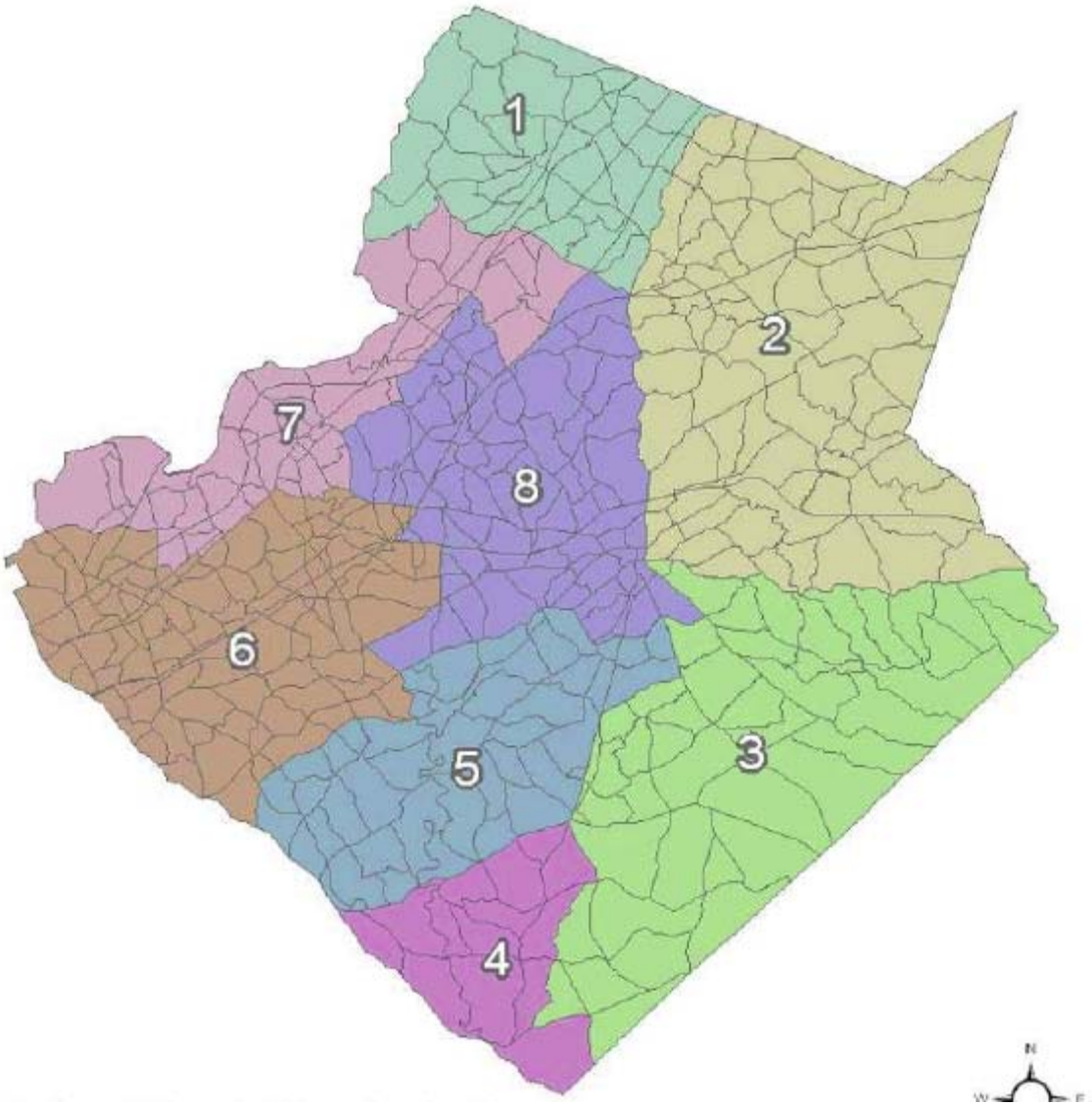
Figure 4: Gwinnett County Sub County Areas



Transportation Analysis Zones

The conversion of the SCA level forecasts, treated as control totals, down to the finer geography of TAZs was accomplished via an allocation model. This model used a set of rules to allocate households and jobs to parcels throughout the county.

Figure 5: Gwinnett County Transportation Analysis Zones (TAZs)



To convert acreages to employment and household, densities of future growth were assumed with the guidance of RCLCo, the Plan's market analysts. Tables 4 and 5 give these densities (or intensities expressed as Floor Area Ratios or FARs) for residential and non-residential land uses. More detail on these conversions and on other related assumptions can be found in at the end of this Appendix.

To allocate projected employment and household to the county's land areas, a broad set of factors that would influence the relative attractiveness of land was developed. These factors, 12 in all, were used to "score" the land areas for each of the 11 land use types (see list of land use types on Table 1). The factors are commonsense in nature and weights were established as an initial judgment that was later refined by the team and County over numerous iterations of outcomes. Table 7 reflects the final weightings used.

Additional features of the allocation process warrant mention. These addressed Conversion Difficulty, Expert Opinion Bonus, No Change Bonus and Overlays. Each of these is described in detail in the Allocation Model details. The additional features could be different for different scenarios.

The sequence in which the land uses are allocated is crucial since the first allocated have a much larger set of options than the last uses allocated. The logic of the allocation priority used in the modeling was that the overriding Overlays should go first, followed by the "highest and best" uses that would outbid lesser uses to gain their preferred locations. Table 1 shows the sequence used in the model.

Multiple iterations of each scenario and many tweaks to the model were needed before the team was satisfied that the land use patterns and outcomes were persuasive enough for testing. The land use outcomes are reported at the TAZ level visually and in tabular form (examples are shown in Figures 6 and 7]). Planning Districts boundaries match the TAZ boundaries so the roll up to Districts is simple.

The actual allocation in the model is done at the parcel level but this is an illustrative and hypothetical allocation. While the model knows if land is vacant, it is entirely unaware of whether a particular parcel is actually available for development or constrained. This is not a problem when the results are rolled up into the TAZ level since each TAZ has many parcels and the errors of detailed allocation that inevitably accompany such modeling "come out in the wash". Consequently, no reporting occurs at the parcel level.

However, there are other models that require other geography domains; for instance, the sewer model requires the data in the sewer sub-basin level. But the TAZ boundary and sub-basin level do not match up well, so the sub-basin aggregation is done at the parcel level, instead of conversion from TAZ into sewer sub-basin. Therefore, there is a need to allocate land use, employment, and population to a fine enough resolution that it can be used for other models for realistic planning.

Figure 6: High-Level Land Use Allocation Process

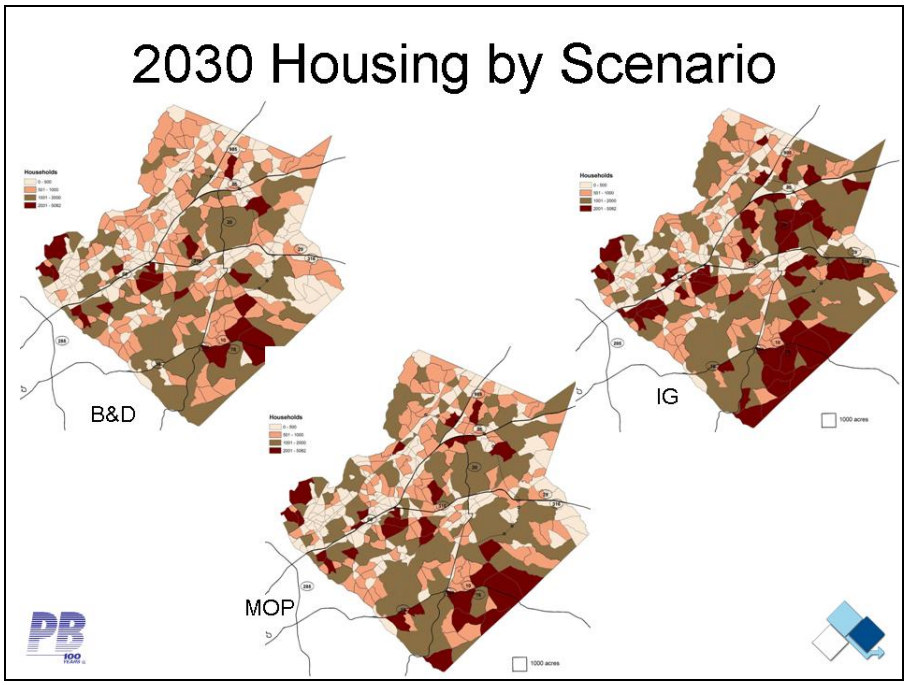
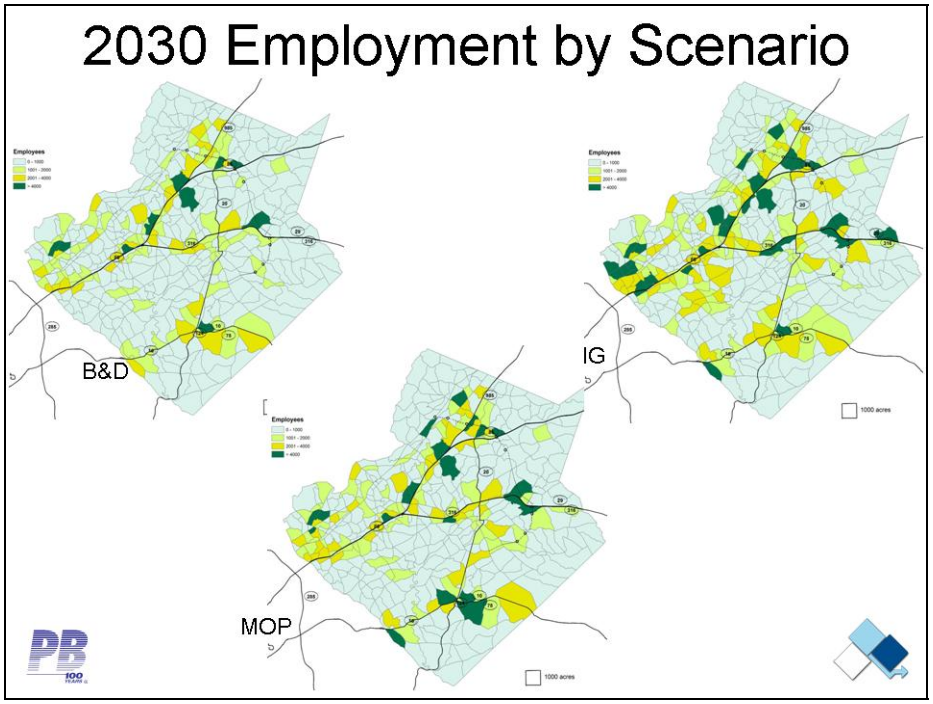


Figure 7: High-Level Land Use Allocation Process

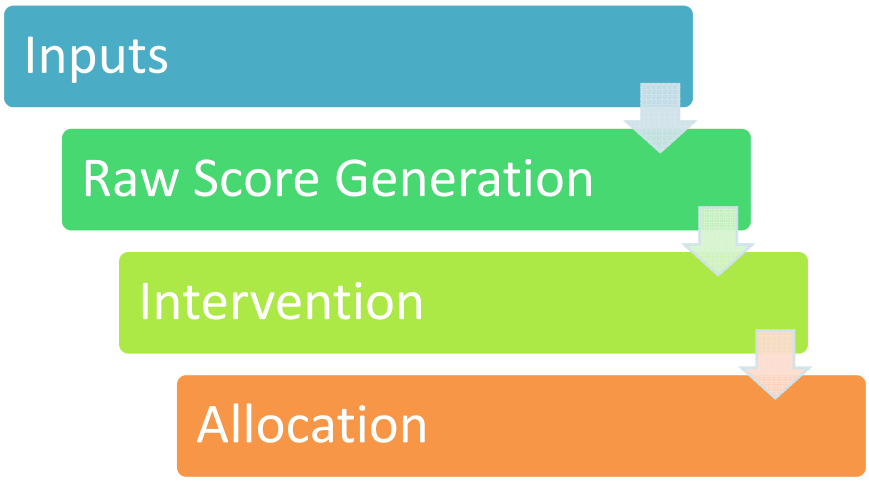


Details of Allocation Process

At the highest level, allocation follows a 4-step process:

- Each parcel was characterized according to a number of attributes that described its potential attractiveness for developments of different types (e.g.: commercial real estate is attracted to busy intersections, but single family dwellings aren't)
- Each parcel's attributes were used to develop a score for every potential land use.
- The planning team made interventions where necessary to show the impact of policies that would run counter to pure market forces.
- The allocation step matched the scenario's land use requirements for each SCA with the available land. This matching allocated land use based on market forces defined by the raw scores as modified by the interventions.

Figure 8: High-Level Land Use Allocation Process



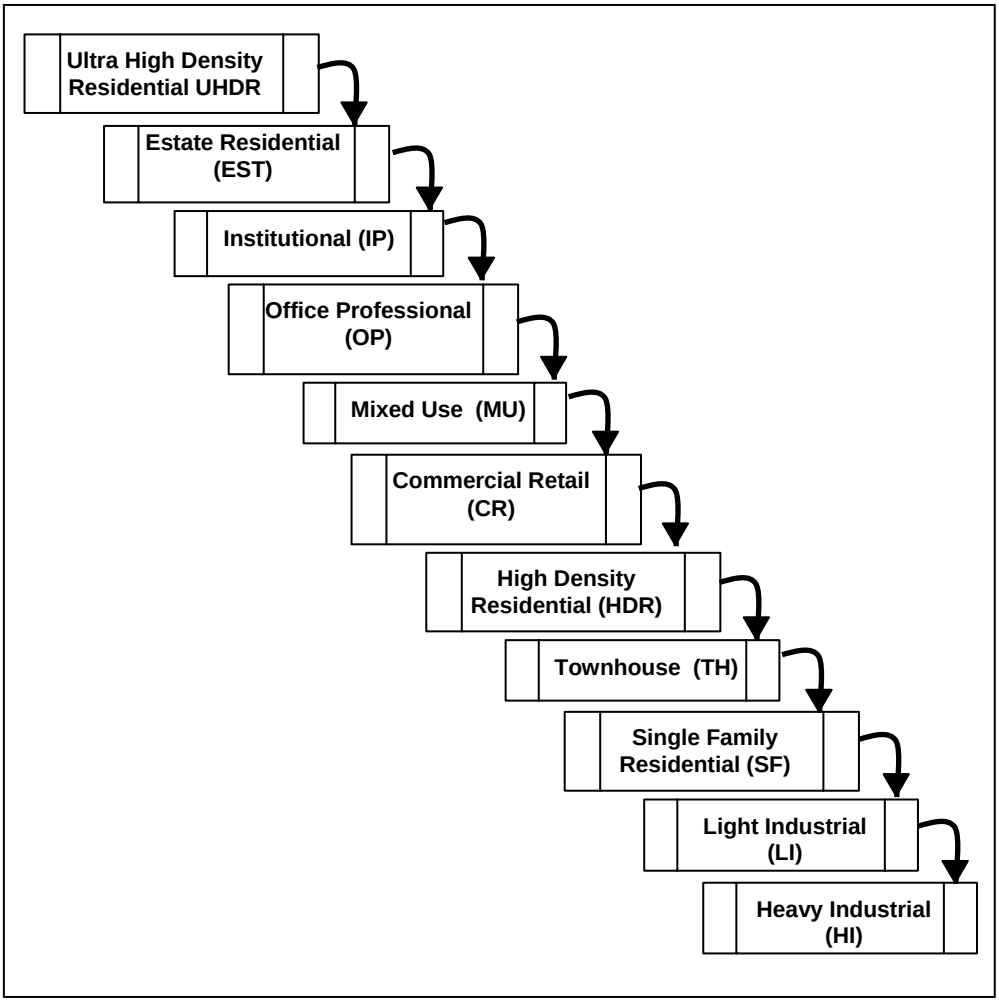
All land use types compete for their optimal location and condition with other types, so the allocation order of each land use type is an important determinant of the outcome. The appropriate sequence, therefore, was also the subject of much discussion and iteration. Once the parcels were scored, they were allocated in a priority order as follows:

Table 1: Land Use Types and Priority Order

1. Ultra High Density Residential (UHDR)
2. Estate Residential (EST)
3. Institutional (IP)
4. Office Professional (OP)
5. Mixed Use (MU in both MAC, also known as red area and city)
6. Commercial Retail (CR)
7. High Density Residential (HDR)
8. Townhouse (TH)

9. Single Family Residential (SF)
10. Light Industrial (LI)
11. Heavy Industrial (HI)

Figure 9: Land Use Allocation Order



The choice of allocation order was based on several considerations:

1) Any overlay defining an intervention was scored higher than any non overlay use.
2) The highest value land uses or high yielding land uses were allocated next because high density uses usually outbid lower density uses when land is purchased.
3) The land use types that were going to need a lot of acreage went toward the end; otherwise, there would be very little selection for the remaining land use types. Therefore the residential types place higher than the industrial types, the residential types starting with the highest density and lowest acres taken type.

Note the following:

- Under the first category, UHDR and some MU were added to the model by planning department overlays, so they were effectively "set" at the beginning of a given scenario.
- IP was also supposed to be allocated using planning department overlays; however, it was difficult to determine where the new IP was going to be. Therefore IP was allocated along with OP because it was assumed that most of the IP were office related.
- Both Parks and Recreation (PRC) and Telecom and Utilities (TCU) were dropped from the allocation list because no-one could specify where such overlays should be. The PRC and TCU employees accounted for very few employees and would have a minimal effect on the allocation result. The PRC and TCU employees were later distributed uniformly across the county.

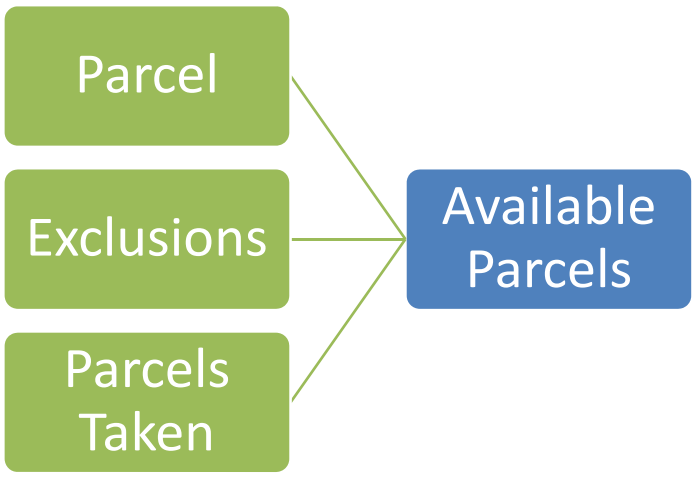
The following sections describe the allocation procedure itself in more detail. The overall procedure works the same for each land use type.

Inputs

There are three inputs to the allocation process. The inputs are processed and merged into the candidate set of available parcels that progress through the rest of any particular allocation iteration.

There are 3 main pieces of data that form the set of available parcels for each land use allocation Parcel, Exclusion and Parcels Taken. Each is discussed below.

Figure 10: Inputs



Parcel

The base set of parcel data used in this project was from 2005, as provided by Gwinnett County (James Pugsley in the Long Range Planning Division was the primary point of contact with the County for this work).

The initial parcel data contained the 3-digit property class, but had no land use and no number of households attached to it. This information was needed for modeling so the parcels were linked back to the 2004 parcel data to retrieve the land use and number of households. Unfortunately, the new parcel set of 2005 had been spatially realigned, which made the matching complicated. These problems were overcome and the County approved the baseline data set. The County later sent some updated parcels that had changed from the 2005 baseline data. These changes were incorporated into the model and will be discussed later.

Exclusions

Some parcels were entirely inappropriate for certain types of development due to their physical characteristics (e.g. a factory cannot be built on a small parcel). As a result, a large (generally -10.0) modifier was added to these parcels to ensure that they were not developed for a given use. The exclusions table mimics real estate market preferences and operations.

Table 2: Exclusions

	CR	OP[1]	LI	HI	MUR	MU	EST[4]	SF	TH	HDR	UHDR[3]
Park, Row and Water in current land use	exclude	exclude	exclude	exclude	exclude	exclude		exclude	exclude	exclude	
5 miles away from highway interchange			exclude	exclude							
CR in current land use				exclude				exclude			
OP in current land use			exclude	exclude				exclude			
IP in current land use			exclude	exclude				exclude			
LI in current land use								exclude[2]			
HI in current land use					exclude	exclude		exclude[2]	exclude[2]	exclude[2]	
MU in current land use											
SF in current land use			exclude	exclude							

-	CR	OP[1]	LI	HI	MUR	MU	EST[4]	SF	TH	HDR	UHDR[3]
TH in current land use			exclude	exclude				exclude			
HDR in current land use			exclude	exclude				exclude			
UHDR in current land use	exclude	exclude	exclude	exclude	exclude	exclude		exclude	exclude	exclude	
1 miles within executive housing			exclude	exclude							
Parcel smaller than 1 acre				exclude						exclude	
Parcel greater than 40 acre	exclude										
Outside City Limit						exclude					
Within red area								exclude[2]			
Outside red area					exclude						
Not on Road Frontage	exclude										

[1] Allocated along with OP
[2] These were not excluded for the International Gateway Scenario
[3] Only had overlay layers
[4] No New Estate was expected in the model, except that all remaining agriculture land use was turned into estate in the International Gateway scenario

Parcels Taken

The land use allocation is done in a sequential order and each parcel can only belong to one land use type. So if a parcel is taken earlier by another land use type, that parcel is no longer available for another type of land use allocation

Available Parcels

The resulting dataset is a list of available parcels with attributes describing each parcel (e.g.: its size and current use).

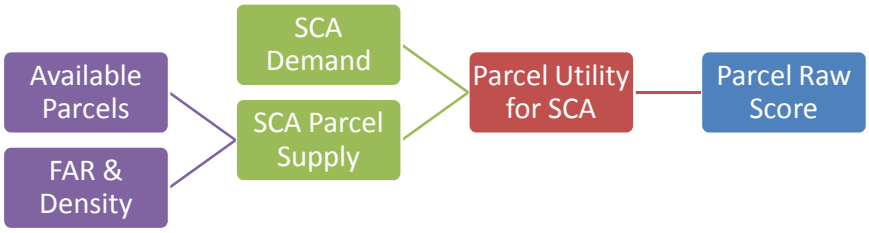
Raw Score Generation

A scoring system rated each parcel for every possible land use. The scoring system used the following data:

1. SCA Demand
2. FAR and Density
3. SCA Parcel Supply
4. Parcel Utility Score

A high level diagram of the process is shown here followed by a more detailed description of each.

Figure 11: Raw Score Generation



SCA Demand

The Countywide and SCA model by Dr. Tommy Hammer provided control numbers for each SCA. The 8 employment types used for the socio-economic projections were not exactly matched to the parcel commercial land use types and therefore, some conversions were necessary. Based on input from RCLCo and the other consultants, the final matrix was as follows:

Table 3: Breakout of Socio-Economic Employment Categories into Parcel Land Use Type

	To						
From	**IP**	**PRC**	**CR**	**OP**	**LI**	**HI**	**TCU**
Government	95%	5%					
Retail			80%	20%			
FIRE			20%	80%			
Services			40%	40%	20%		
Manufacturing					40%	60%	
Wholesales					100%		
TCU					20%		80%

Note that the Construction employment category was not mapped to any of the land use types. Construction workers were allocated based on where new development was occurring within the County.

FAR and Density

Based on information from RCLCo (Sarah Kirsch and Todd Noell) and input from other consultants, the following Floor Area Ratio (FAR) list and densities were used for the scenarios. These densities define how much land is needed to satisfy a certain demand.

Table 4: Floor Area Ratios for Different Land Use Types

Land Use Type	Area	
	Major Activity Center (MAC)	County
CR (Commercial Retail)	0.5	0.25
OP (Office Professional)	0.5	0.25
IP (Institutional Public)	0.5	0.25
Light Industry	0.25	0.25
Heavy Industry	0.13	0.13
MUR (Mixed Use in MAC only)	1	N/A
MU (Mixed Use)	0.5	0.5

The residential density list (households per acre) was as follows:

Table 5: Residential Densities

Land Use Type	Area						
	Middle of the Pack		International Gateway				
	MAC	County	MXD	Rural	SCA 6, 7, 8	MAC	County
SF (Single Family)	3	3	6	0.5	4	3	3
TH (Townhouse)	10	10	10	10	14	10	10
HDR (High Density Residential)	18	18	18	18	22	18	18
UHDR (Ultra High Density Residential)	25	25	25	25	32	25	25
MU Res (Mixed Use Residential Part)	10	10	10	10	10	10	10
MUR Res (Mixed Use Residential Part in MAC only)	30	N/A	N/A	N/A	N/A	30	N/A

The commercial density list (square footage per employee) was as follows:

Table 6: Commercial Density

Land Use Type	Area	
	Major Activity Center (MAC)	County
CR (Commercial Retail)	500	400
OP (Office Professional)	200	275
IP (Institutional Public)	200	275
Light Industry	400	400
Heavy Industry	800	800
MU Comm (Mixed Use Commercial Part)	440	440
MUR Comm (Mixed Use Commercial Part in MAC only)	250	N/A

Note: Where the parcel belonged to more than one of the pre-defined areas (some pre-defined areas overlapped), the highest density result was used.

The definition for the key land use areas follows:

Figure 12: Rural Area (only used in the International Gateway Scenario)

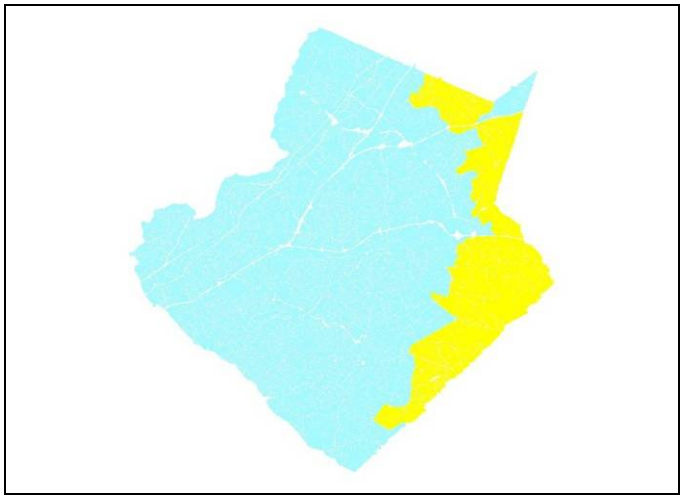


Figure 13: Major Activity Center Area (used in both Scenarios)

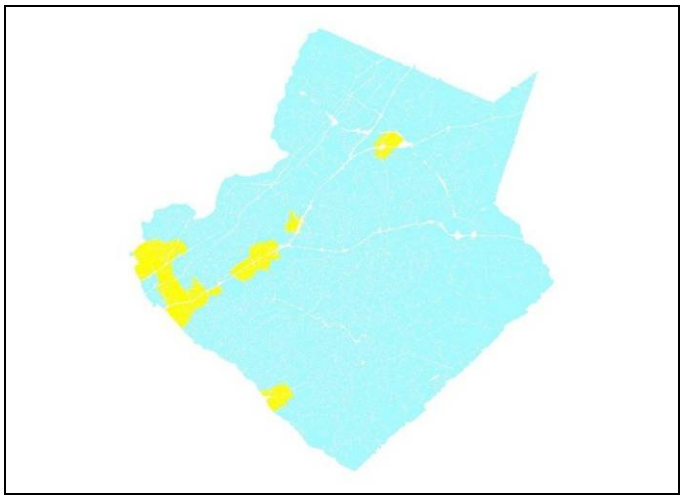
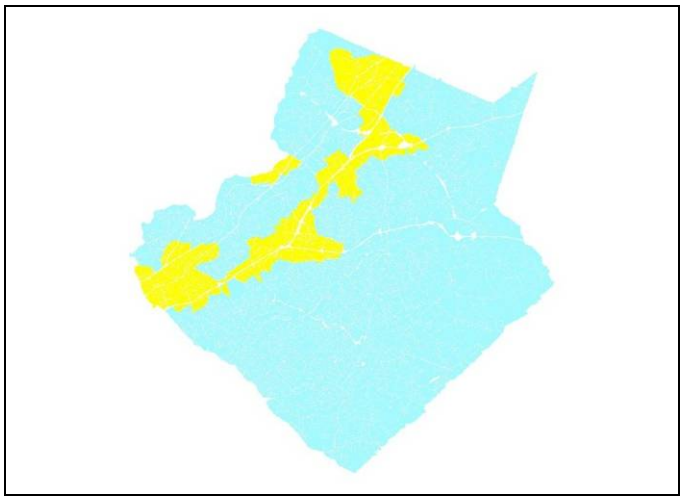


Figure 14: MXD Area (only used in the International Gateway Scenario)



SCA Parcel Supply

With the densities and FARs, each available parcel can yield a different number of householder or employees depending on which land use is chosen. The SCA Parcel Supply captures this information.

Parcel Utility Score

Several factors influence a parcel's attractiveness for each land use. These are listed in the rows in the table below and correspond with commonsense understanding of what drives different development types to different locations. Use similarity and highway access are two of the obvious factors. Several others found to be relevant in Gwinnett were also compiled. For example, The Proximity to Roads was a major factor for Single Family. Initially, the model only incorporated proximity to highway interchange and

principle arterials as the utility factors. During some runs, some new Single Family resulted in parcels not very close to the existing roads, in fact, rather far away. James Pugsley of the County suggested that existing roads should be a driver for the SF. This resulted in more Single Family being allocated closer to the existing roads, more representative of what actually occurs.

The attractiveness score ranges from 1 to 5, 1 being the least influential and 5 being the most influential. The values in the table below are the result of numerous iterations to achieve a plausible land use pattern. The attractiveness scores were a primary vehicle for tweaking the allocations but the other modifiers were also used.

Table 7: Attractiveness Scores

	CR	OP	IP[1]	LI	HI	MUR[2]	MU[2]	EST[3]	SF	TH	HDR	UHDR[2]
Cluster of similar use		1		2	2				3	4	4	
Proximity to Hwy Interchange		4		4	4						4	
Proximity to Principal Arterials						2	2			3		
Proximity to Roads									5			
Proximity to City Center		3										
Proximity to Commercial Center		4				2					3	
Proximity to Park									2	1	2	
Proximity to School												
Parcel Size				1	1							
Proximity to Employment Center										2	2	
Proximity to Executive Housing		5							3			
Traffic Count	5											

[1] Allocated along with OP
[2] Had overlay layers
[3] No new parcels were allocated to Estate land use in the model, except that all remaining agriculture land use was turned into estate in the International Gateway scenario

A utility is a score of a specific attribute of a parcel for a given purpose. Each of the relevant utilities is a score for each parcel based on the SCA supply and demand. For example, to model proximity to highway: the parcels are sorted by distance; the nearest parcels are assigned a score of 1 until their combined area met the demand for a specific land use. Because competing land uses may preempt the use for a lower priority purpose, the remaining parcels are given scores in a linear ramp from 1 to 0 based on their distance (i.e.: the closest parcels have higher scores).

Parcel Raw Score

From each utility score, a weighted score was generated. There are raw scores for each land use types and are used to control the allocation process.

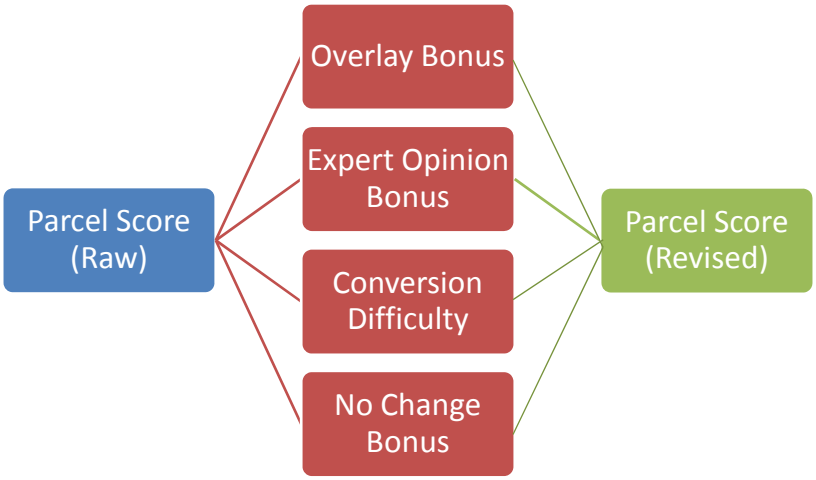
Interventions

The raw scores alone aren't sufficient for allocation purposes. A number of interventions were required.

1) No Change Bonus – this models inertia (i.e.: there is a tendency for land to remain in its current use even if that isn't optimal from a purely financial or economic viewpoint.
2) Overlay Bonus – This models special conditions or planning areas.
3) Expert Opinion Bonus – This allows direct intervention by the planning team to force patterns that go against market forces.
4) Conversion Difficulty – This models the difficulty of converting land from one use to another (usually because of high costs).

The raw score is combined with the 4 interventions to generate the revised parcel score as shown below. Each of the interventions was applied as a positive or negative effect on the raw score. The revised parcel score was used in the Allocation Process.

Figure 15: Interventions



No Change Bonus:

The allocation for each run was done for the total amount of land use in the County, not just the incremental increase for 2005 to 2030. However, it was assumed that most exiting parcels would stay the same land use type as they were today. The raw score measured the attractiveness of the land, but did not take into consideration what was currently on the ground. For example, assume two parcels – one with a single family home and the other parcel vacant. A townhouse was more likely to be built on the

vacant parcel than on the land that currently has a house on it. The No Change Bonus models the tendency of parcels to remain as their current type.

Overlay Bonus:

For some land uses, such as ultra high density residential (UHDR), the allocation is based on an overlay. A large bonus score is given to ensure that parcels in the overlay area will be picked up as UHDR. In addition, the overlay bonus to was used to model development that took place between 2005 to 2007.

Expert Opinion Bonus:

New SF developments tend to develop in big parcels, rather than on individual small parcels. A bonus was therefore applied to SF development based on parcel size.

The county has also established MXD and RD zones to attract certain kinds of development, so in the International Gateway Scenario there is a bonus score for certain land uses, like OP and CR, for the parcels inside these zones.

Conversion Difficulty:

While the attractiveness factors draw development to certain parcels and Exclusion factors prevent obviously inappropriate substitutions of use, there is a middle ground of uncertainty where uses may be more or less susceptible to conversion depending on the uses themselves. A conversion difficulty relationship was therefore established, expressed in Table 8.The conversion difficulty was assessed as a penalty in the score. In the table, 1 indicates great ease in changing from one type to another, while 5 indicates extreme difficulty in changing from one type to the other.

Table 8: Conversion Difficulty Score

CONVERT FROM	CONVERT TO											
	CR	OP	IP[5]	LI	HI	MUR	MU	Estate[6]	Single Family	Townhouse	HDR	UHDR[4]
CR	1	2		5	5	2	2		5	4	3	
OP	2	1		5	5	2	2		5	3	3	
IP	2	2		5	5	2	2		5	3	3	
LI[2]	2	2		1	4	2	2		5	3	3	
HI[2]	3	3		2	1	4	4		5	4	4	
PRC	4	4		5	5	4	4		5	4	4	
TCU	3	3		3	5	3	3		5	3	3	
MU[3]	1	2		5	5	1	1		1	2	2	
Estate	1	1		1	5	1	1		1	1	1	
Single Family[1]	2	2		4	5	1	1		1	2	2	
Townhouse	3	3		4	5	3	3		4	1	3	
HDR	4	4		5	5	4	4		5	4	1	
UHDR	5	5		5	5	5	5		5	5	5	
AGRI or UNDEV	1	1		1	1	1	1		1	1	1	

[1] Single Family development within a large subdivision had a higher conversion difficulty to other land uses
[2] The conversion difficulty from LI and HI to residential was reduced for the International Gateway Scenario because of the obsolescing nature of some of the industrial lands especially in the southwestern area
[3] The MU was re-adjusted because most of the current MU parcels were mistakenly identified as SF with 1 household. In the initial 2005 parcel land use, there were parcels indentified as Mixed Residential/Commercial with three digit code 105. However, they were later found out to be small and the mixed use type had different meaning than the mixed use type used in the allocation model. Most of the current MU parcels were actually transformed back to SF in the model using interventions.
[4] Overlay, so there is no conversion difficulty
[5] Allocated along with OP
[6] No New Estate parcels were expected in the model, except that all remaining agriculture land use was turned into estate in the International Gateway scenario

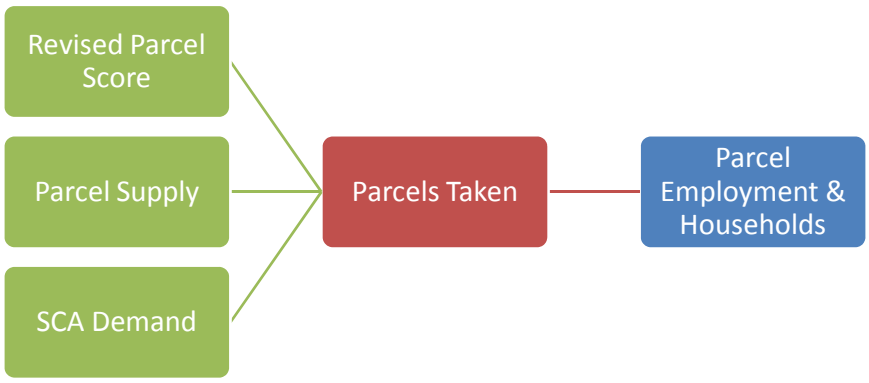
Revised Parcel Score

Combing the raw parcel scores with the above intervention scores, a revised parcel score was generated. The score is no longer normalized from 0 to 1. It provides the rank order of parcel attractiveness for each land use.

Allocation

For the Allocation itself, the Revised Parcel Score is combined with the original Parcel Supply, and the original SCA demand to determine the final land use allocation. This is shown below.

Figure 16: Allocation



The resulting Parcel Employment / Household allocation is used as input into the Financial, Transportation and Sewer Models.

SCA demand

As discussed in the Raw Score Generation section, the control numbers were generated by Dr. Tommy Hammer. Some conversions in land use, described earlier, were required to match the employment types used in Dr Hammer's model to the land use types used in the allocation model.

Parcel Supply

Parcel supply defines the number of households and/or jobs that could be supported by a parcel for each given land use.

Revised Parcel Score

This is the score of the parcel after it have been overlaid by interventions and other score modifiers.

Parcels Taken

Each land use is allocated in its own step in order of priority. For each step the unallocated parcels are sorted from the highest to the lowest score for the step's land use. Each of the parcels has a supply number associated with it for that land use. The parcel supply numbers are accumulated until the supply meets the SCA demand. All the parcels before this point are allocated to the land use. The rest of the parcels are freed so they can be allocated to lower priority land uses.

Once each parcel has a designated land use, acreage, land use type, future FAR, future density and current household/employee, the number of households and employees are calculated.

The Allocation model generates the following three pieces of data for each parcel.

1) land use type
2) number of households
3) number of employees

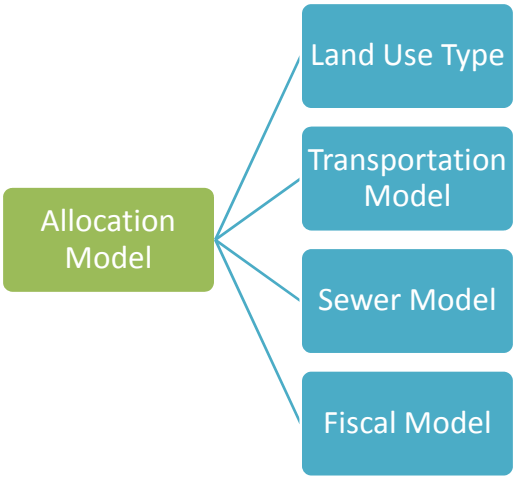
Linkages with Other Models

Introduction

Land use, employment, and number of household values are used to feed other models:

1) Land Use Type
2) Fiscal Impacts
3) Sewer Demand
4) Transportation Demand

Figure 17: Use of Allocation Model Results



Land Use Type

The land use type is a direct output from the allocation model.

Transportation Model

There is additional work to be done before the allocation model can feed into the transportation model:

- First, the land use employment type must be changed back to the control number employment types.
- Second, the land use household typed must be transformed into the 24 income-household size types that the transportation model uses as input.

The first transformation is the reverse of the step that transforms the employment control number into the land use control numbers.

Dr. Tommy Hammer in Appendix C, in the Additional Variables and Allocation Support section, describes the process to transfer the land use household types into the 24 income-household size types. A summary of the methodology can also be found at the end of this report

Sewer Model

The sewer model uses the number of households and number of employees as part input to generate its result.

The sewer model needs the data in the sewer sub-basin area which are different from the TAZs, so the aggregation to the sewer sub-basin is actually done from the parcel level. There was no conversion from TAZs to sewer sub-basin. The number of households and number of employees were given to the Department of Water Resources in both parcel and sewer sub-basin levels for their models.

Fiscal Model

For the fiscal numbers, all figures are in 2005 dollars. From his Alternative model, Robert Eger, the fiscal consultant, generated a rough revenue and expense for each land use type. Using the scenario numbers generated from the model, Dr. Eger was able to generate revenue and expense per household or acre. Using these per acre or per household calculations as parameters in the model, it is able to calculate the total revenues and expenses resulting from each of the scenarios. It is also possible to generate new fiscal results when new scenarios are created.

The fiscal model uses the number of households and the acreage to calculate projected revenue and expenditure using the following assumptions:

Table 9: Fiscal Model Expense and Revenue Assumptions

Land Use Type	Average Expense per unit ($)	Average Revenues per unit ($)
UNDEV (Undeveloped) Acre	0	214
AGRI (Agriculture) Acre	942	457
SF (Single Family) Household	2043	1800
ESTATE (Estate) Household	5657	5293
TH (Townhouses) Household	1277	1109
HDR (High Density Residential) Household	1245	1595
UHDR (Ultra High Density Residential) Household	1367	1590
CR (Commercial Retail) Acre	8844	12675
MU (Mixed Use) Acre	7631	13105
OP (Office Professional) Acre	6621	9976
PRC (Parks, Recreation, and Conservation) Acre	2962	4153
LI (Light Industrial) Acre	6684	10650
HI (Heavy Industrial) Acre	7982	13161
TCU (Transportation, Communications, Utilities) Acre	57	87
IP (Institutional Public) Acre	1689	0

A full discussion of the fiscal analysis can be found in Appendix H.

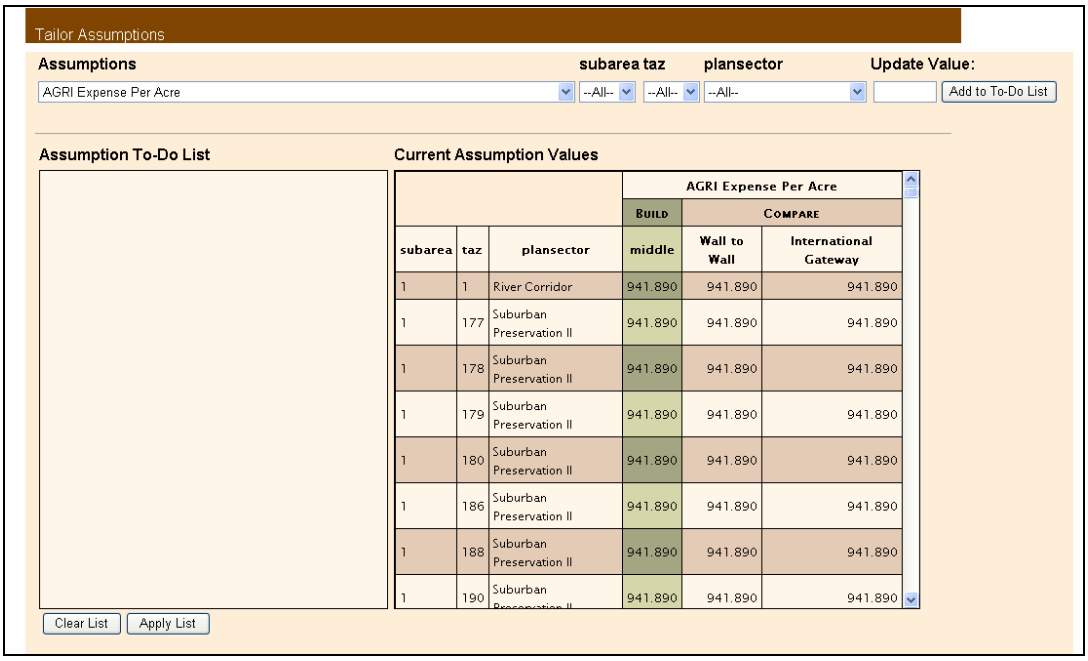
PlanMaster Web Tool

The land use model was also used in a web-based scenario testing tool. A key element of the website is the user's ability to select scenarios, create new scenarios by changing the assumptions, then comparing how the scenarios differ on measures. Figure 18 shows where the user would select scenarios to build upon.

Figure 18: PlanMaster Scenario Manager

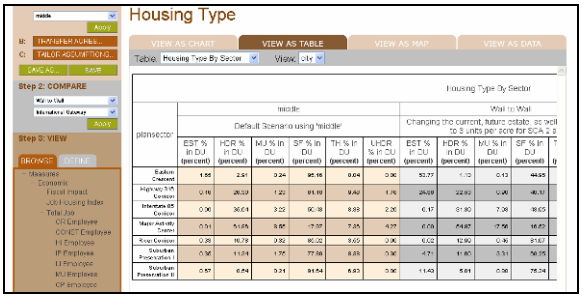
To modify the assumptions, users select the assumption they want to modify, the geographic area they want to apply the assumption, and the updated value. The Assumption To-Do list captures all of the new scenario's assumptions. Once all the assumptions have been made, the list is applied and the new scenario is created. Figure 19 shows how the user tailors the assumptions.

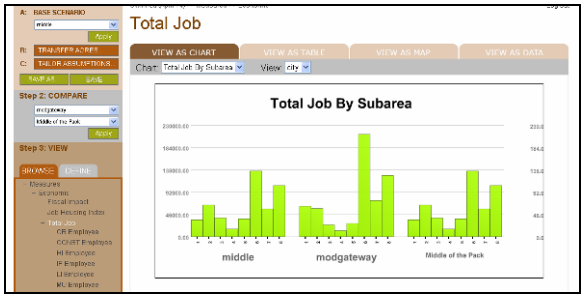
Figure 19: Assumption Tailoring Screen



The most powerful component of the tool is comparing the different scenarios across various measures and geographic scales. The results can be displayed as tables, charts, and maps. Figure 20 shows examples of the possible outcomes.

Figure 20: PlanMaster Scenario Evaluation Displays





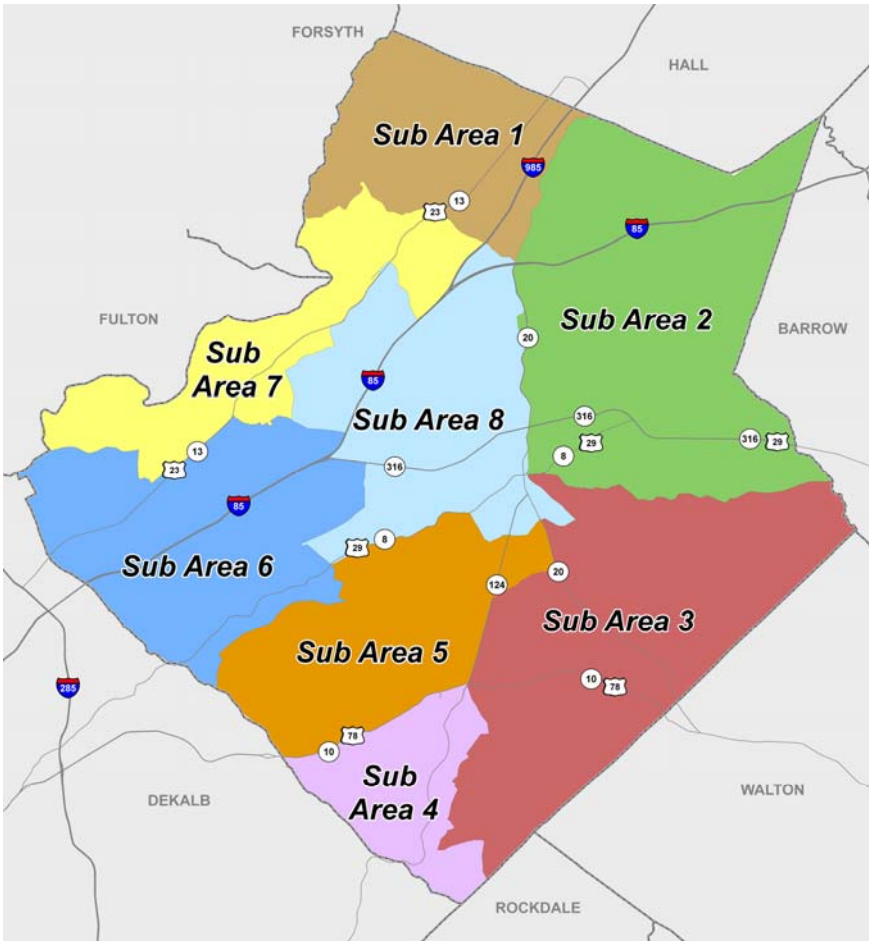
This tool can be used by Gwinnett County to evaluate land use changes and the impacts they could have.

Appendix G – Transit Testing

Appendix G: Transit Testing

The transit alternatives for the Middle of the Pack Scenario and the International Gateway Scenario are derived from the Atlanta Regional Commission's (ARC) long range plans. The Middle of the Pack transit network is that identified in ARC's Envision6 plan. It was used in the Consolidated Transportation Plan (CTP). The International Gateway transit network is that shown in ARC's earlier and more ambitious Mobility 2030 plan. This network was used in the Unified Plan.

Table 1 shows the mode splits for the different scenarios for each of the County's eight subareas. A map of the subareas is below.



Figures 1 through 9 show the various bus rapid transit, express bus, and local bus routes that are included in the International Gateway transit network. It should be noted that these figures include transit services that are in addition to those in the Middle of the Pack transit network, which is described in the Unified Plan and the CTP.

The Table's last column (2030 IG LU/MoP Network Alternative) also shows the transit usage implications of substantial and rapid land growth without comparable highway and transit investment.

Table 1: Mode Splits for the Different Scenarios

	2005	2030 Middle of the Pack Scenario	2030 International Gateway Scenario	2030 IG LU/MoP Network Alternative
All Work Person Trips from Subarea 1	100.0%	100.0%	100.0%	100.0%
All Work Person Trips from Subarea 1 Driving Alone	86.3%	88.3%	83.9%	84.6%
All Work Person Trips from Subarea 1 Traveling in HOV	13.4%	11.4%	15.3%	15.1%
All Work Person Trips from Subarea 1 Using Transit	0.2%	0.3%	0.8%	0.3%
All Work Person Trips from Subarea 2	100.0%	100.0%	100.0%	100.0%
All Work Person Trips from Subarea 2 Driving Alone	87.2%	88.3%	86.8%	88.0%
All Work Person Trips from Subarea 2 Traveling in HOV	12.8%	11.4%	12.2%	11.7%
All Work Person Trips from Subarea 2 Using Transit	0.1%	0.3%	1.0%	0.3%
All Work Person Trips from Subarea 3	100.0%	100.0%	100.0%	100.0%
All Work Person Trips from Subarea 3 Driving Alone	86.7%	89.8%	89.3%	89.8%
All Work Person Trips from Subarea 3 Traveling in HOV	13.3%	10.0%	10.1%	9.9%
All Work Person Trips from Subarea 3 Using Transit	0.0%	0.2%	0.6%	0.3%
All Work Person Trips from Subarea 4	100.0%	100.0%	100.0%	100.0%
All Work Person Trips from Subarea 4 Driving Alone	85.1%	86.8%	86.3%	87.2%
All Work Person Trips from Subarea 4 Traveling in HOV	14.5%	11.5%	11.0%	11.3%
All Work Person Trips from Subarea 4 Using Transit	0.4%	1.7%	2.6%	1.5%
All Work Person Trips from Subarea 5	100.0%	100.0%	100.0%	100.0%
All Work Person Trips from Subarea 5 Driving Alone	86.8%	86.8%	86.4%	87.4%
All Work Person Trips from Subarea 5 Traveling in HOV	12.9%	12.0%	11.4%	11.5%
All Work Person Trips from Subarea 5 Using Transit	0.4%	1.2%	2.2%	1.1%
All Work Person Trips from Subarea 6	100.0%	100.0%	100.0%	100.0%
All Work Person Trips from Subarea 6 Driving Alone	83.3%	77.8%	68.8%	72.2%
All Work Person Trips from Subarea 6 Traveling in HOV	14.0%	18.0%	22.2%	23.1%
All Work Person Trips from Subarea 6 Using Transit	2.8%	4.2%	9.0%	4.7%
All Work Person Trips from Subarea 7	100.0%	100.0%	100.0%	100.0%
All Work Person Trips from Subarea 7 Driving Alone	87.9%	86.0%	83.3%	84.5%
All Work Person Trips from Subarea 7 Traveling in HOV	11.3%	13.0%	13.7%	14.6%
All Work Person Trips from Subarea 7 Using Transit	0.7%	1.0%	3.0%	0.9%
All Work Person Trips from Subarea 8	100.0%	100.0%	100.0%	100.0%
All Work Person Trips from Subarea 8 Driving Alone	86.5%	84.4%	80.8%	82.5%
All Work Person Trips from Subarea 8 Traveling in HOV	12.6%	14.6%	16.5%	16.4%
All Work Person Trips from Subarea 8 Using Transit	0.9%	1.0%	2.7%	1.1%

Figure 1: International Gateway Network - Transit Projects

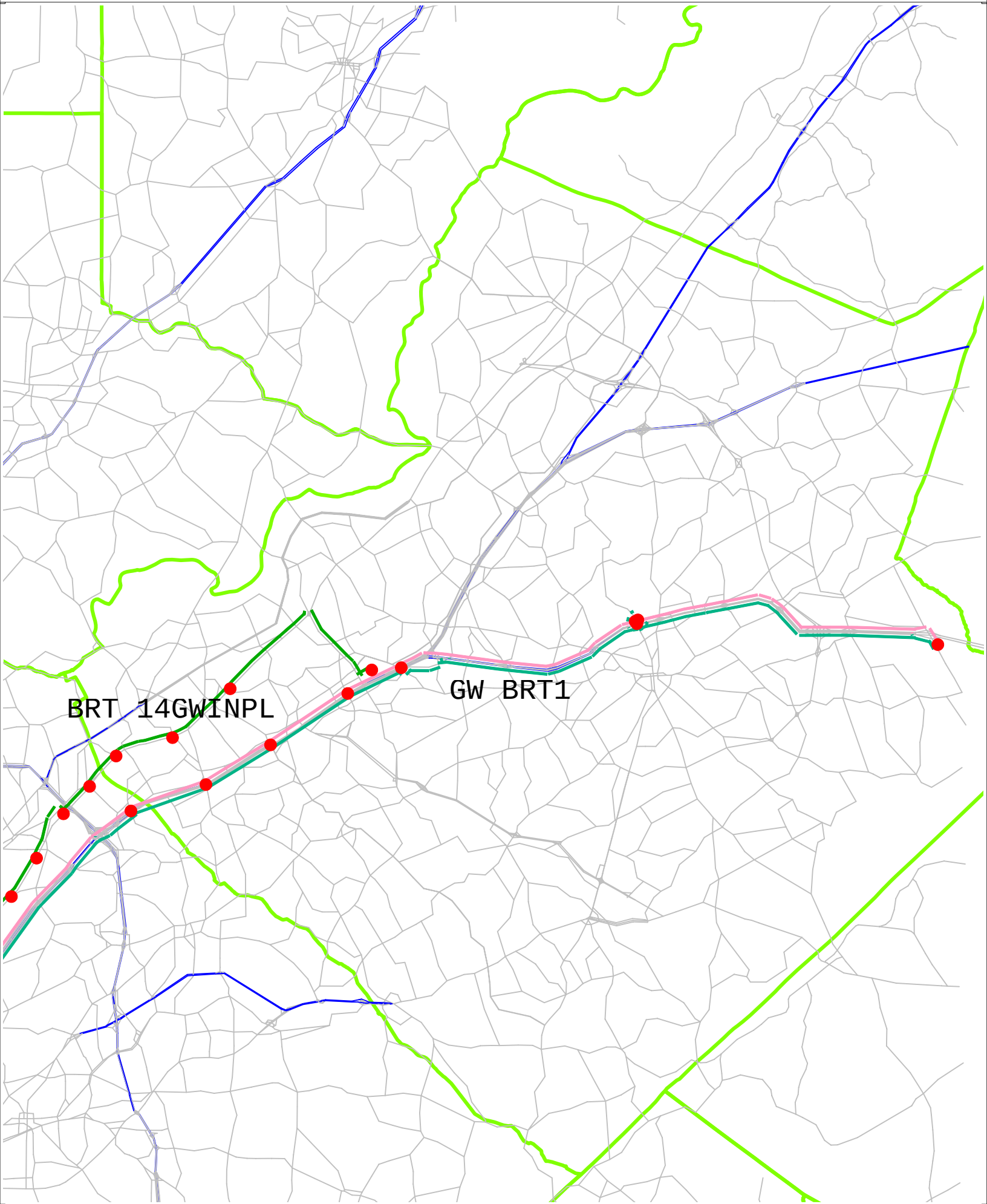


Figure 2: International Gateway Network - Transit Projects

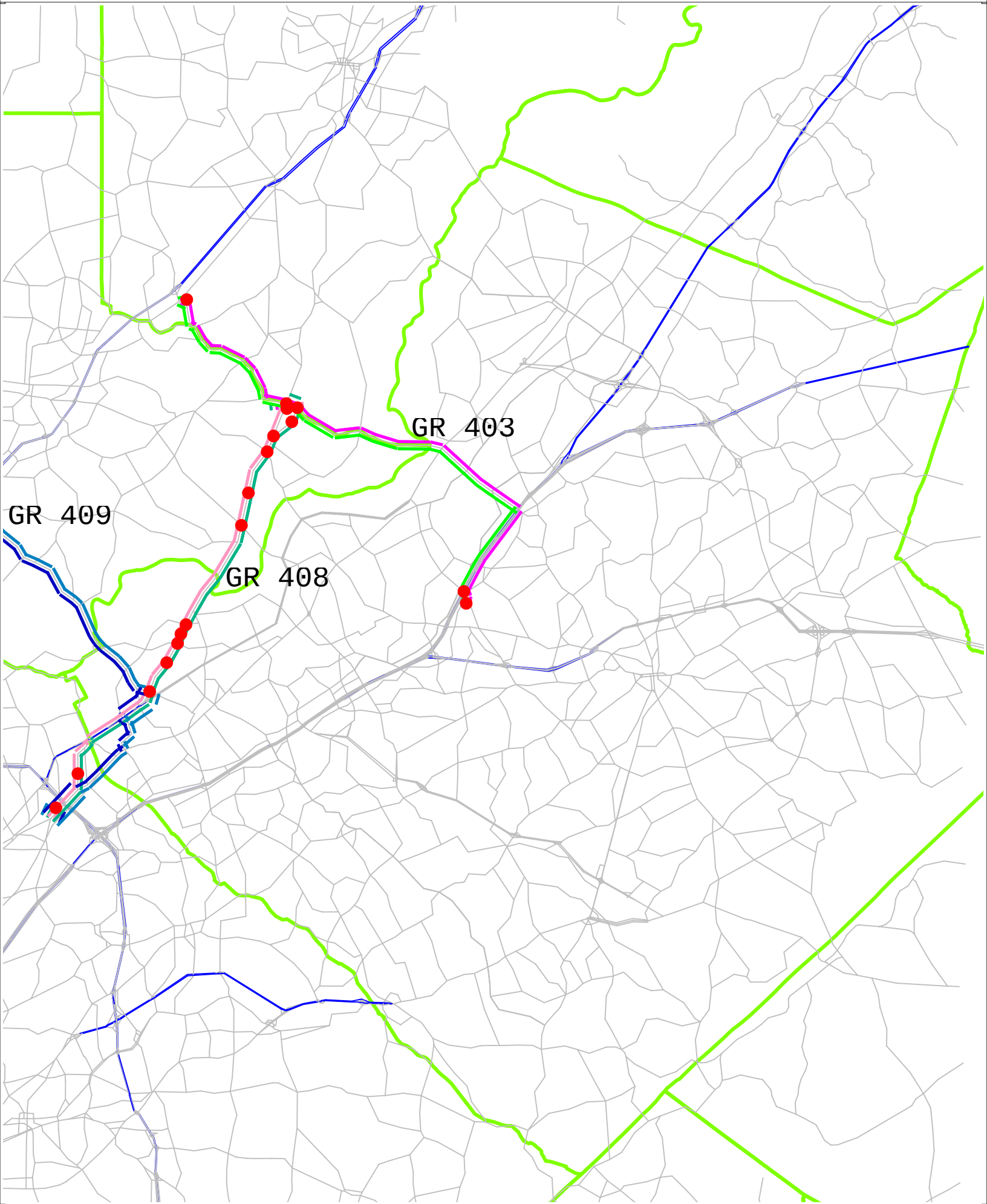


Figure 3: International Gateway Network - Transit Projects

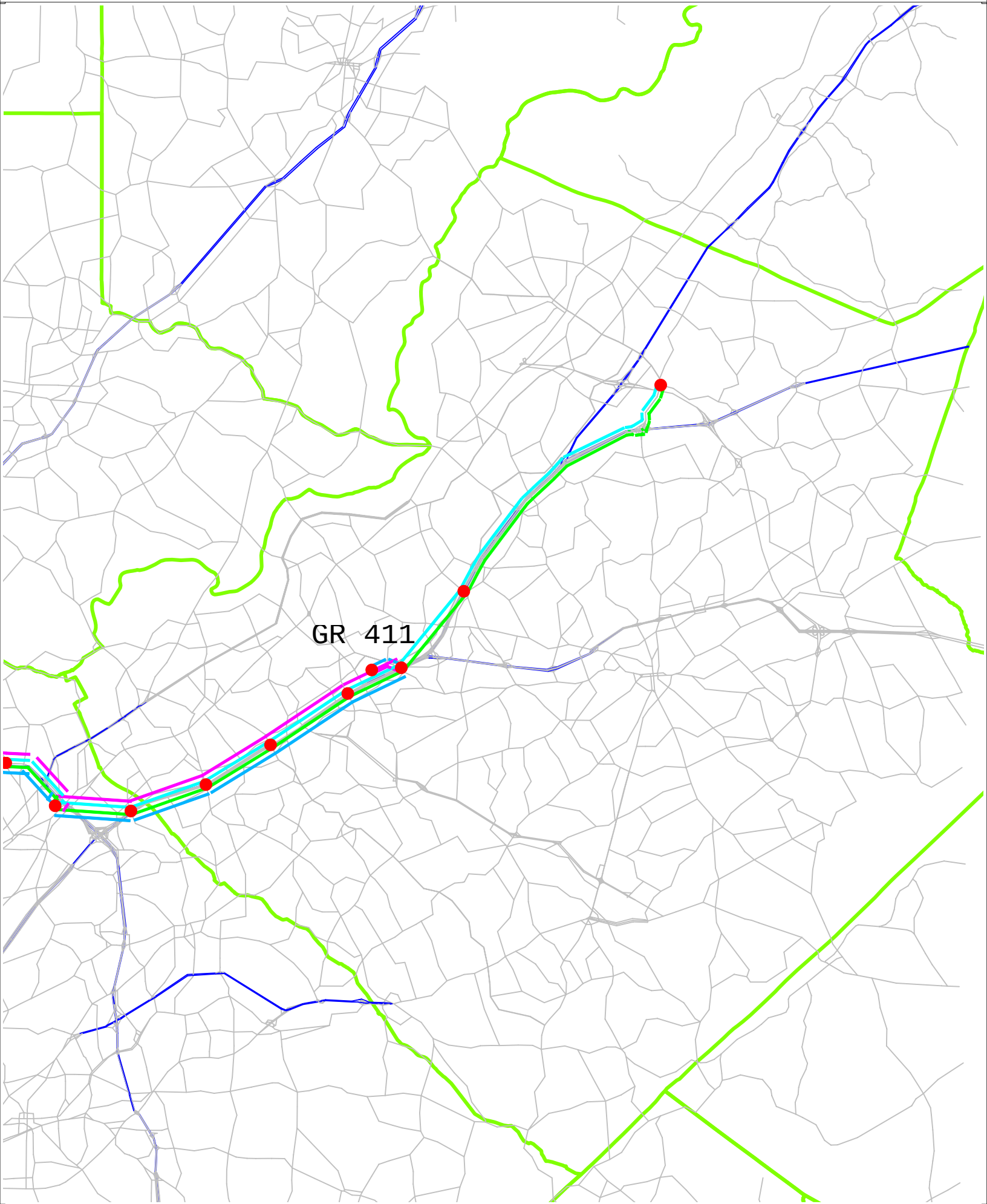


Figure 4: International Gateway Network - Transit Projects

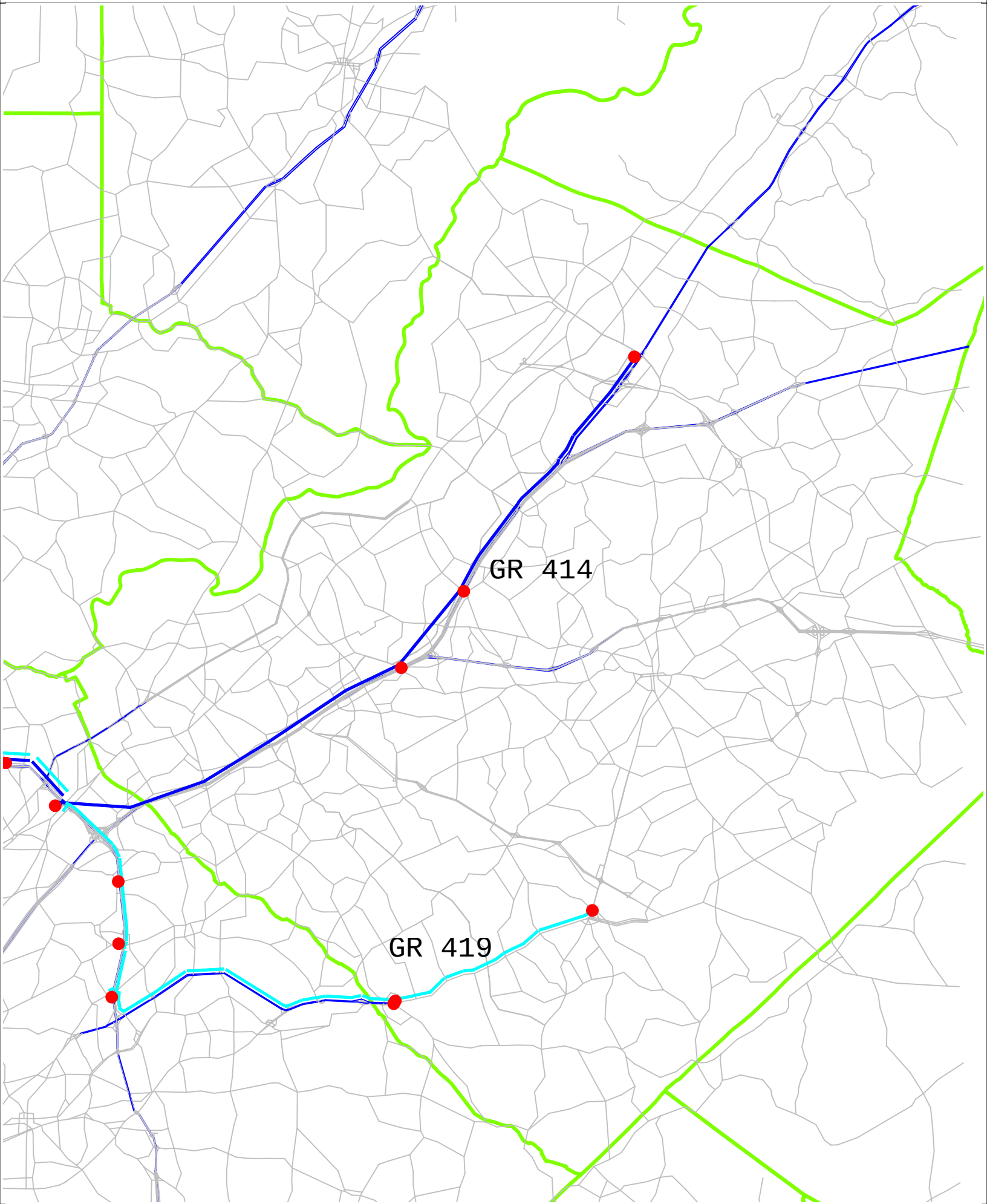


Figure 5: International Gateway Network - Transit Projects

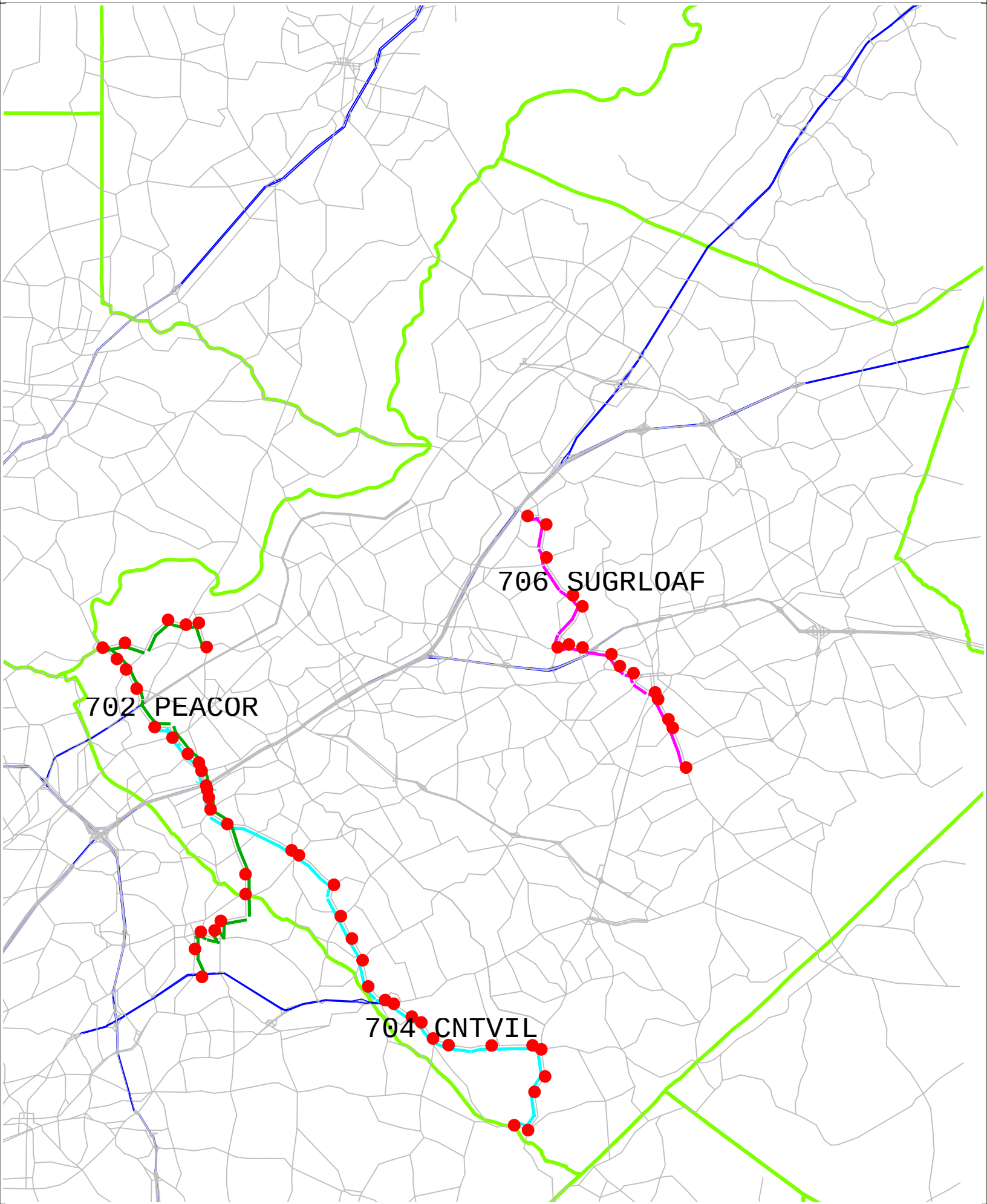


Figure 6: International Gateway Network - Transit Projects

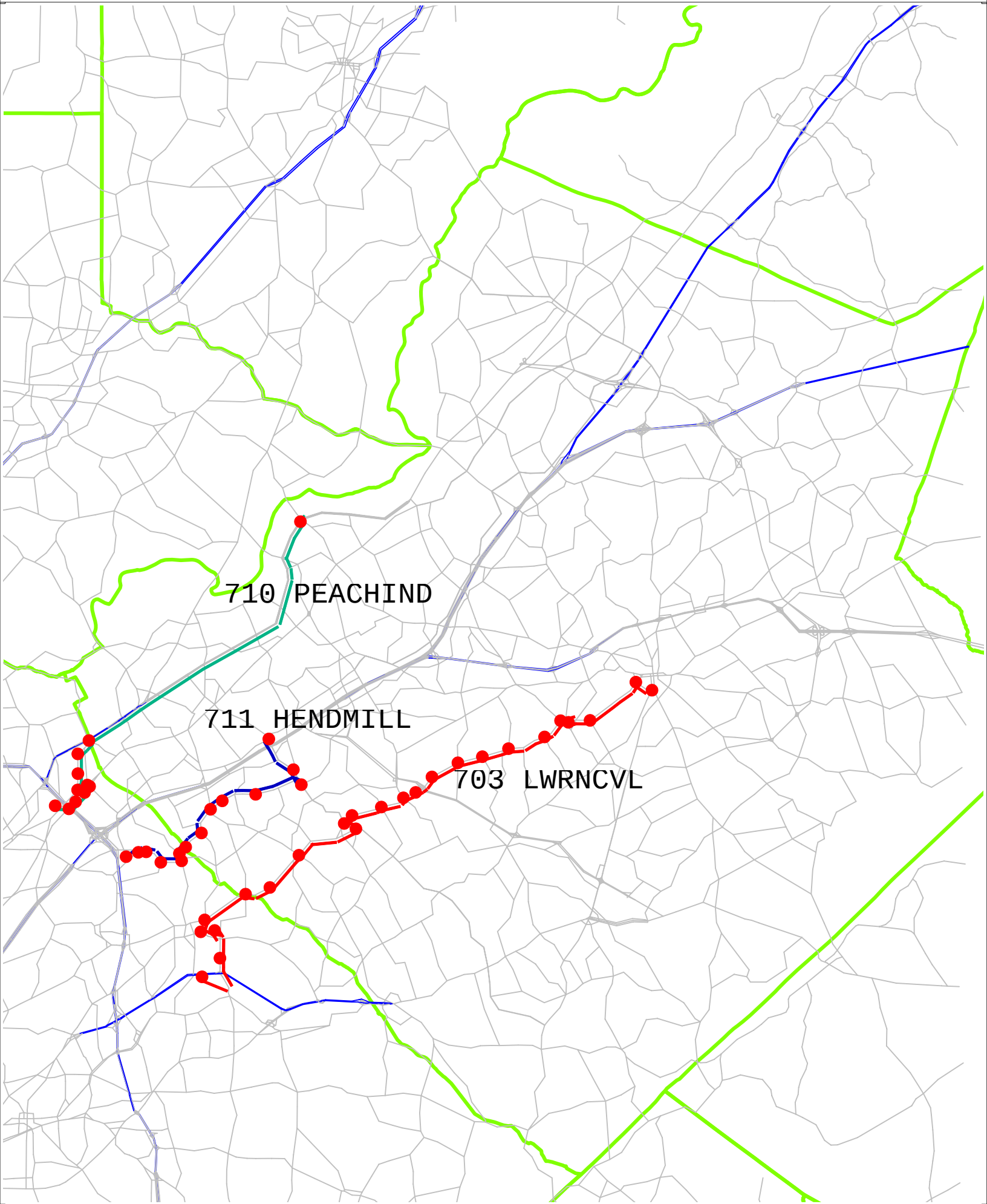


Figure 7: International Gateway Network - Transit Projects

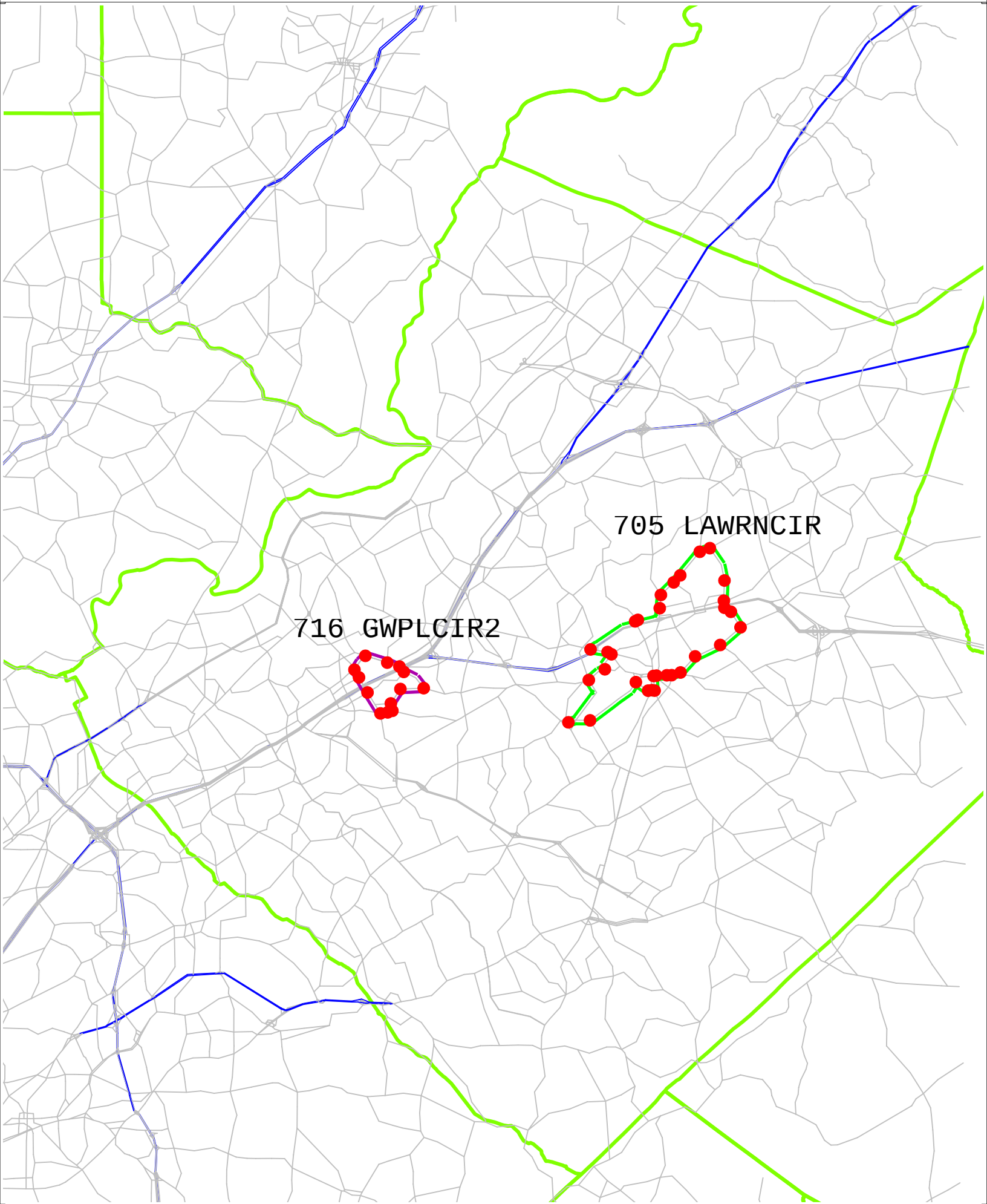


Figure 8: International Gateway Network - Transit Projects

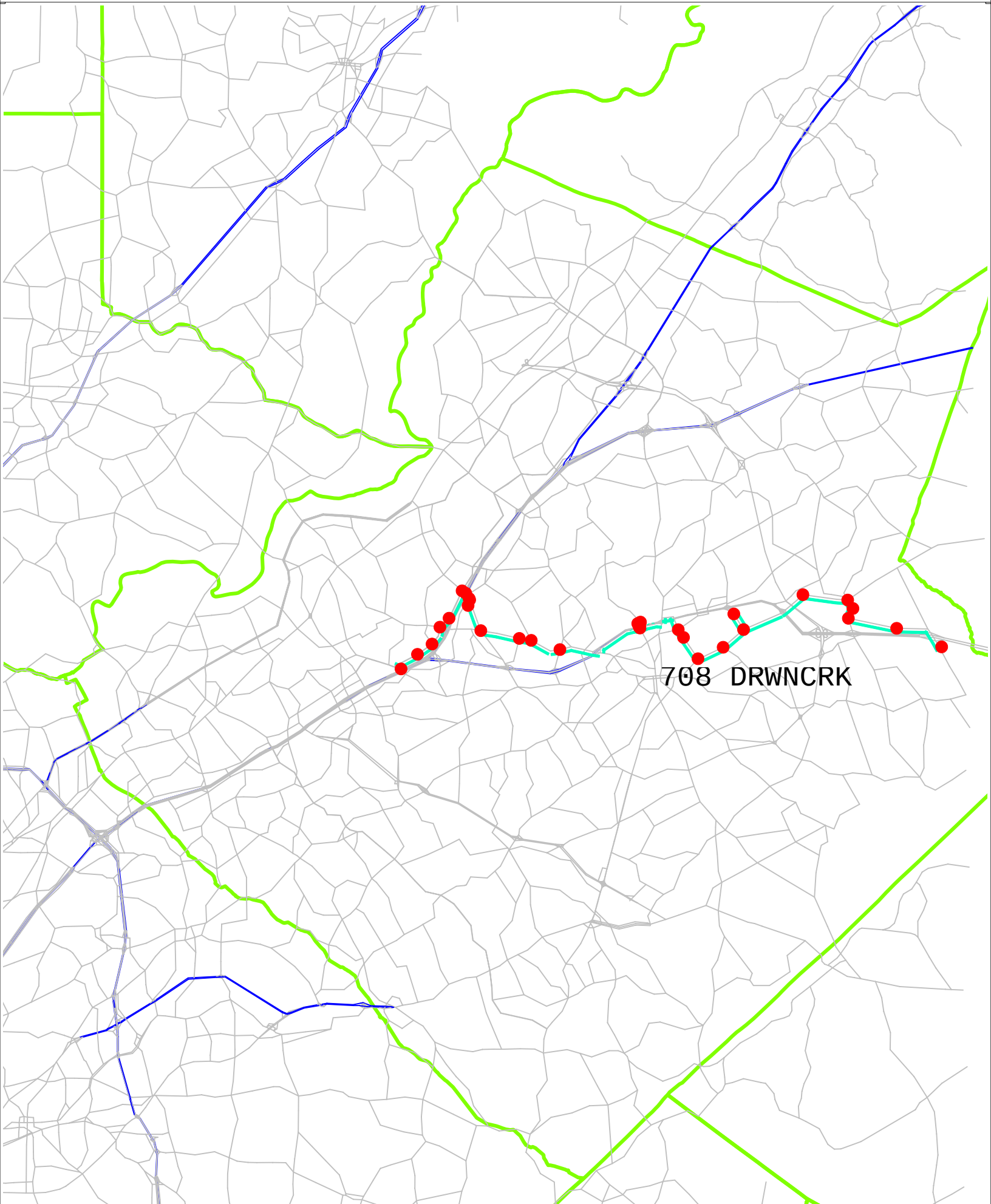
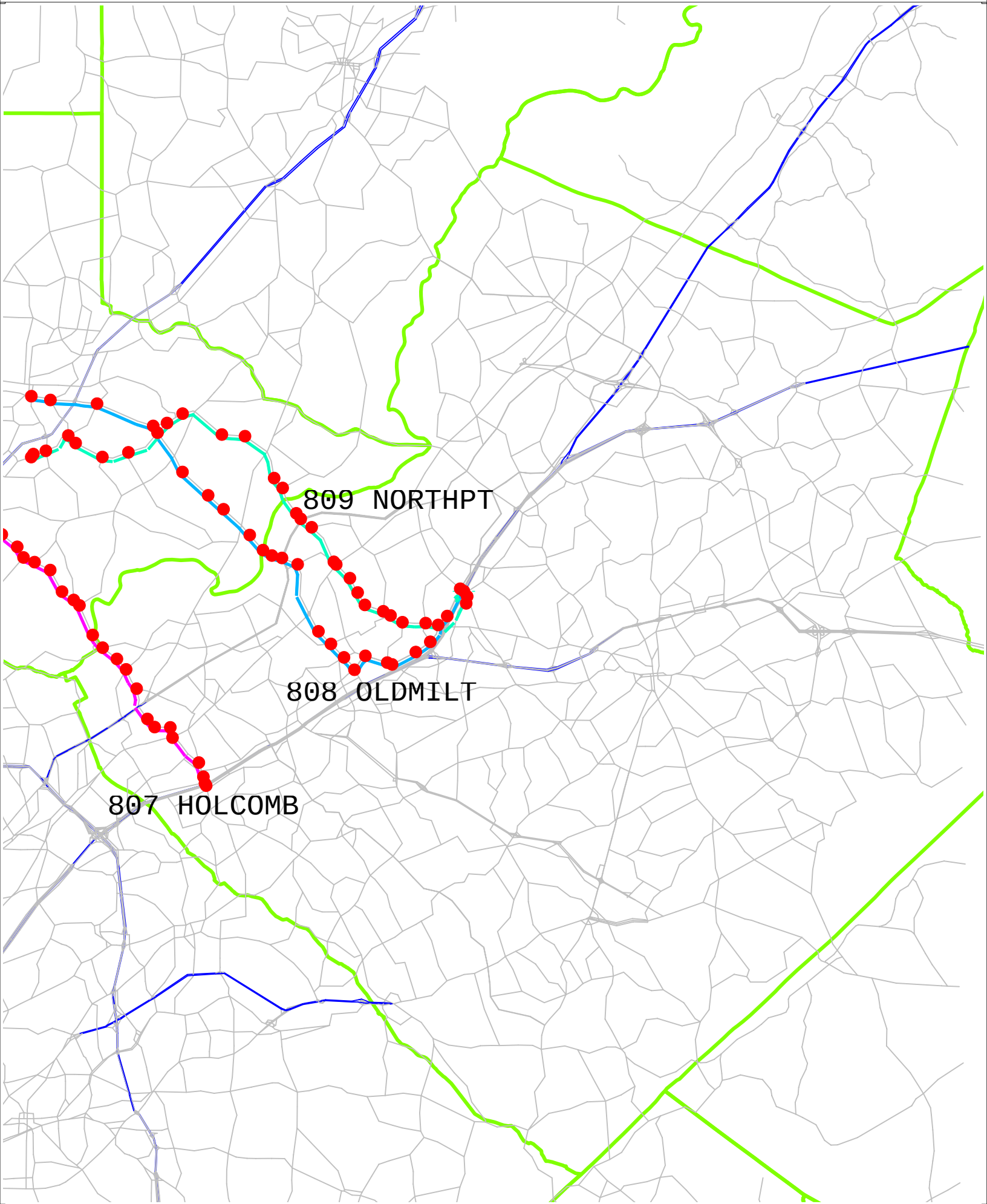


Figure 9: International Gateway Network - Transit Projects



Appendix H – Fiscal Analysis

Gwinnett County 2030 Unified Plan

Fiscal Analyses & Financing Options

Robert J. Eger III, Ph.D.

Principal Associate
Fiscal Research Center
Georgia State University
&
Associate Professor
Reubin O'D. Askew School of Public Administration and Policy
Florida State University

February, 2008

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List of Tables and Figures

Executive Summary

The fiscal analyses presented in this report are one component of the 2008 Gwinnett County Unified Plan, an update of the County's Comprehensive Plan which sets the pattern for future land use and development patterns in the County. The fiscal analyses findings are offered as both information and an opportunity to take action to assure the County's fiscal stability. Two fiscal analyses were conducted. The results of both fiscal analyses have a long term viewpoint – out to 2030 - and focus on the three scenarios. These are called a Regional Slowdown scenario, a trends scenario ("Middle Of the Pack"), and an optimistic "International Gateway" scenario. Both analyses report revenues and expenses in 2005 dollars.

We begin the fiscal analysis with expenditure and revenue estimates based on Gwinnett County data provided to the Georgia Department of Community Affairs (DCA). This data is inclusive of operational expenses and revenues along with capital costs. The DCA data excludes enterprise funds, such as the water and sewer fund in Gwinnet County. Using the DCA data we estimate expenses and revenues for Gwinnett County for the year 2030 using a straightforward estimating tool called WebFIT™ that Gwinnett has previously applied to future land use plans. Using WebFIT™ all three scenarios expenditures and revenues are point estimates that increase over the three scenarios.

The WebFIT™ estimate has only one scenario in a budgetary surplus, the Slowdown scenario. This very counterintuitive outcome can be explained in several ways. First, the WebFIT™ outcomes do not take into consideration any direct changes in services based on the changing socio-economic conditions proposed in the scenario. This is a well-known limitation of this model. The second explanation is that changes in the capital investment required in maintaining the county infrastructure is based on FY2005 spending and therefore does not consider any infrastructure needs beyond the FY2005 spending levels although the SPLOST revenues are included. Third, the WebFIT™ estimates treat all areas in Gwinnett County as identical in service needs.

To address the limitations inherent in the WebFIT™ estimates, an Alternative model is derived. The Alternative model uses the fiscal operating base as reported in the County's financial reports. This fiscal base is composed of all operating expenses and revenues including the enterprise fund for water and sewer. Since the County wholly owns its water and sewer facilities and services we consider this an important aspect of County operations. We exclude any capital costs from the Alternative analysis due to the lumpiness of capital costs, annual capital costs vary year to year based on capital needs and priorities. This removal of capital costs renders the two analyses independent of each other; however the loss of direct comparability allows the Alternative model to focus on operating expenses and revenues, by far the largest component of the budget. Given the known limitations of the WebFIT™ estimates due to changes in socio-demographic conditions and treatment of all County areas as similar in service requirements, the Alternative model allows us to relax these assumptions. This ability to relax some of the assumptions of the WebFIT™ model should provide a more accurate analysis of potential operating expenses and revenues.

The Alternative model expenditures provide a low range and high range. This range, instead of a single point estimate, is due to the potential minimum and maximum effect of poverty over the time period. In the Alternative model, the low range expenditures are very similar in the three scenarios while the upper range expenditures decrease as we move from the Slowdown to the Gateway scenario. Revenues increase as we move from the Slowdown to Gateway scenario.

Table 27: Operational Expenditures and Revenues - Alternative Model

	Forecast (in Millions of Dollars)			
Scenario	**Expenditures**			**Revenues**
Slowdown	$ 1,022	to	$ 1,172	$ 913
Middle	$ 1,028	to	$ 1,109	$ 1,025
Gateway	$ 1,028	to	$ 1,045	$ 1,090

The Alternative model expenditures indicate that expenditures may be able to be held constant throughout the scenarios if the low range expenditures are realized. If revenues are realized as projected by the Alternative model, the smallest deficits for the Slowdown and Middle scenarios are realized, while the largest surplus is realized for the Gateway scenario. The Alternative model produces a more intuitive outcome where the regional economic slowdown produces the largest deficit and the regional gateway scenario offers the largest surplus of the three scenarios.

It appears that when we consider the Alternative model's incorporation of poverty effects and treatment of the County as having potentially differing service requirements based on location that the scenario outcomes indicate these effects on both revenues and expenses. Although projecting the future is not an exact science, providing direct responses to poverty and differing service requirements may assist Gwinnet County in holding poverty and service impacts to the forecasted lowest range of expenditures. This policy choice can offer an opportunity to directly impact the potential outcomes of these three scenarios.

Introduction

This fiscal analysis is one component of the 2008 Gwinnett County Unified Plan, an update of the County's Comprehensive Plan which sets the pattern for future land use and development patterns in the County. Its findings are meant to provide information on actions that may be taken to assure the County's fiscal stability. Both the Unified Plan and this fiscal analysis have a long term viewpoint – out to 2030. The fiscal analysis is applied to various alternative future scenarios whose development and testing were central to the Unified Plan effort.

Fiscal Analysis Assumptions

We focus the financial analysis and the recommendations derived from the analyses on two major analytical techniques. The first technique is to estimate the 2030 revenues and expenditures with WebFIT™ a future land use Web-based simulation developed by Robert Lann of Georgia Institute of Technology. The WebFIT™ analysis uses data from the Georgia department of Community Affairs which is inclusive of operating expenses and revenues including capital allocations for a given year while non-inclusive of enterprise funds (this fund includes water and wastewater) for a local government. The reported data for the WebFIT™ model differs from a traditional assessment of operating expenses and revenues since it includes capital expenses and revenues. The second technique applies an Alternative model derived for forecasting expenditures based on four key elements: allocations by operating expenses/revenues, allocations by sub-county area, managerial effects[1], and poverty/income effects. The Alternative model excludes capital costs however, but is inclusive of enterprise funds for local governments. The Alternative model was calibrated to reproduce, within a 0.50% accuracy level, the actual expenses/revenues that occurred in Gwinnett County in FY2005 prior to analyzing the 2030 scenarios.

WebFIT™ and Alternative Model Assumptions

Both models assume:

- Level of Services provided are identical to those services provided in FY2005
- Millage rate is held constant at FY2005 level
- Water resources are available for each scenario

Both models estimate the fiscal impact of three different growth scenarios on Gwinnett County government. The growth scenarios are referred to in this report as: *gateway*, *middle*, and *slowdown*. The *gateway* ("International Gateway") scenario assumed the highest growth in population and income and the *slowdown* ("Regional Slowdown") scenario assumed less growth overall but far more growth in low income households. The *middle ("Middle of the Pack")* scenario was an estimate that focused on a steady growth similar to that found in FY2005. All the growth scenarios use the base year FY2005 spending and revenue accumulation.

Assumptions of WebFIT™

The WebFIT™ model assumes:

[1] Based on the 2004 Gwinnett County management survey. The survey asked managers to provide an assessment of expenditures by land use type (Farm/Forest, Residential, and Commercial/Industrial). The focus was on what percentage of expenditures should be allocated to each land use type.

- Continuation of the Special Purpose Local Option Sales Tax (SPLOST)
- Capital costs are implicitly included in Gwinnett County's expenditures
    - This assumption is based on the presentation of the Statement of Activities the county provides which is inclusive of capital costs and the Special Purpose Local Option Sales Tax (SPLOST) as a revenue source.
- The mix of land use types, and therefore, property values captures changes in the level of service by category, based on historical relationships between service expenditures, property values, and population.
- Population per household is the same for each residential land use type and the same across unincorporated Gwinnett. City-specific ratios are used to estimate population change from household growth in each city.
- Income distributions are the same in each scenario except for what may be captured implicitly by the type and value of residential development forecast.
- Revenue is based on FY2005 millage rates.

Limitations of WebFIT™

The model can start with a rich array of land use types, such as, low-density residential, medium-density residential, and high-density residential, but property value projections for each are aggregated together into total residential before being passed to the regression equations to estimate the change in revenues and expenditures. Therefore, density, as implied by housing type (single or multi-family), does not directly enter the regression equations.

Furthermore, the cost of providing government services to higher-density development is not captured in the regression equations. The model also cannot include redevelopment of existing properties in its full buildout scenario, explicitly. Parcels designated for redevelopment must be held at their FY2005 land uses and property values for the full buildout scenario. To add redevelopment to the full buildout scenario, the redeveloped parcels must be run separately using the model's redevelopment module. The two sets of results must then be added together to get a complete full buildout scenario. Lastly, the model cannot explicitly incorporate changes in poverty or other income/wealth or managerial choices related changes during the forecast period.

Because of these limitations, an Alternative Model was developed to be sensitive to additional factors that impact fiscal outcomes.

Assumptions of the Alternative Model

The Alternative model assumes:

- Fire, police, and general government related operational expenditures are directly affected by constituent wealth.
- Service demand within a specific land use type varies across Gwinnett, but is constant across time.
- Persons per household are the same for each residential land use type and the same across unincorporated Gwinnett as in WebFIT™.
- Income distributions differ across Gwinnett.
- Revenue contributions differ based on land use type.

Limitations of the Alternative Model

The model separates residential land use type by categories. The model then applies a weight value based on operational cost/revenue allocations provided by management in Gwinnett. This implies that operational cost/revenue allocations will not change over time. The operational cost of providing government services to higher-density development is not captured in the equations.

We acknowledge this limitation with the following caveat. We looked at DeKalb County's Perimeter Mall as a function of density costs. We find that operational costs of services are not higher within the Perimeter Mall area. We conclude that density, as defined by the Perimeter Mall area, does not directly change the operational costs for providing services. Second, we looked at the Midtown Business District in the City of Atlanta, Fulton County. We find that capital and operational costs for high rise type density increases emergency service costs, but this type of density does not seem to affect other operational service costs. The emergency service cost increase is between 13 – 17% but is primarily due to changes in fire equipment (capital cost) and training costs (operational cost). Since the scenarios do not explicitly use a high rise business district, we assume the effects of emergency services costs will be minimal in Gwinnett.

The final limitation is in the explicit incorporation of poverty or other income/wealth related changes during the forecast period. Large shifts in the poverty rate can have additional effects on the level of service provision and revenue collection. The model does not take into account the poverty effects on potential revenue collections since the poverty effect focus is on operational expenses.

WebFIT™ Estimates

Gwinnett County was the first county in Georgia to implement the web-based tool called WebFIT™ for examining the fiscal impact of its future land use plan. The database used in the earlier implementation of WebFIT™ was modified to focus on the current analysis for Gwinnett County. In the following discussion, we provide a detailed description of the steps the developers at the Enterprise Innovation Institute, Georgia Institute of Technology led by Robert Lann used to adapt the tool's structure to the format of the scenarios, what data was updated for the scenarios, and the results obtained from the simulations.

The scenario development began with the FY2005 Gwinnett County tax digest. Informational updates were used in the WebFIT™ database including tax digest figures provided through the county's consolidated tax digest, sales tax rates, and property millage rates. Some demographic information such as households, population, and enrollment was also incorporated in the WebFIT™ model. These data were obtained from the county government and from the Georgia Department of Revenue.

Revenue and Expenditure Data for WebFIT™

WebFIT™ produces a fiscal impact for the county government, each city, and the county school system. In this analysis only county government data was used since other local governments in the county and the school district were not included in the simulations.

The forecast of fiscal impact for the county government is based on the land use scenario input to the model. This is accomplished through a series of regression equations, one for each major component of revenue and expenditure. Each equation is initially calibrated to current levels using the most recent data submitted to the Georgia Department of Community Affairs. This data corresponds to Gwinnett County's fiscal year 2005. Table 1 shows the revenues and expenditures used in the calibration.

In Table 1, two revenue categories are disaggregated to provide the major sub categories underlying the revenue amounts. For example, excise and special use taxes is composed of three subcategories. Each of the values in Table 1 provides the starting point for the WebFIT™ fiscal impact simulations.

Table 1: 2005 Revenue & Expenditures by Category

Revenue Categories	**2005**
Property Taxes	$260,282,545
Sales Taxes	$140,971,729
Excise and Special Use	$30,216,872
Alcoholic beverage taxes	$5,348,442
Insurance premium	$20,699,676
Franchise taxes	$4,168,754
Licenses and Permits	$25,265,571
Business Occupation Tax	$12,488,611
Liquor Licenses	$1,930,822
Building Permits & Other	$10,846,138
Charges for Services	$30,639,128
Fines & Forfeitures	$21,725,217
Other Revenue	$165,511,880
Total Revenue	**$674,612,942**
Expenditure Categories	
General Administrative	$218,901,936
Public Works	$152,596,769
Courts	$34,190,804
Public Safety	$217,179,136
Health	$6,011,708
Public Assistance	$3,956,138
Recreation and Library	$41,144,932
Other Expenditure	$631,519
Debt Service	$0
Total Expenditures	**$674,612,942**

Source: Gwinnett County Finance Office

Demographics

Total households in 2005 for the county were estimated to be 265,462 and total population was estimated at 726,273. Figures for each city and for the unincorporated area of Gwinnett are shown in Table 2.

The population per household detail in Table 2 is used to determine the population in the forecasted build-out year of 2030 based on an estimate of total households. The households are estimated from the acres of new residential development in the scenario and household-per-acre densities for each residential land use.

Table 2: 2005 Population and Households

	Population	Households	Pop/HH
Buford	10,972	4,236	2.59
Dacula	4,425	1,570	2.82
Duluth	24,482	10,925	2.24
Grayson	1,314	761	1.73
Lawrenceville	28,393	9,678	2.93
Lilburn	11,416	4,166	2.74
Loganville	8,881	3,228	2.75
Norcross	9,887	3,606	2.74
Snellville	19,238	7,001	2.75
Sugar Hill	15,696	5,640	2.78
Suwanee	12,553	4,446	2.82
Berkeley Lake	2,071	630	3.29
Rest Haven	147	65	2.26
Auburn	7,134	2,350	3.04
Braselton	2,294	1,319	1.74
Total Cities	158,903	59,621	2.67
Incorporated	143,375	50,692	2.83
Unincorporated	582,898	214,770	2.71
County Total	**726,273**	**265,462**	**2.74**

Source: U.S. Census Bureau and Atlanta Regional Commission. City populations are based on the portion of each city within the Gwinnett County boundaries.

Tax Digest Update

A FY2005 tax digest configured for use in the WebFIT™ application for the land use types in the scenarios are listed below. The "LUT Code" is the coding system used in the database files.

The focus of the WebFIT™ fiscal impact simulations was based on the FY2005 building and land values for each parcel as well as the scenarios projected building and land values in 2030. Parcels that are undeveloped and designated to be developed into one of the land uses shown in Table 3 were marked in the database. Those parcels that were to be redeveloped from one land use to another were also marked in the database.

Table 3: Land Use Types

Land Use Type Name	LUT Code
Agricultural	AGRI
Commercial Sector LUTs	
Commercial/Retail	CR
Mixed Use Commercial	MUCOM
Office/Professional	OP
Industrial Sector LUTs	
Heavy Industrial	HI
Light Industrial	LI
Residential Sector LUTs	
Estate	EST
High Density Residential	HDR
Mixed Use Residential	MURES
Single Family	SF
Townhouse	TH
Ultra High Density Residential	UHDR
Public Sector LUTs	
Institutional/Public	IP
Parks, Recreation, Conservation (PRC)	PRC
Public Park	PARK
Other LUTs	
Brownfield	BROWN
Transportation, Communication, Utilities (TCU)	TCU
Undeveloped	UNDEV
Water	WATER

WebFit™ Fiscal Impact Simulations

Having future land and building values provided required modifications to the WebFIT™ structure. WebFIT™ has a series of regression equations that are focused on current values. Typically, future values are not estimated by planning departments and instead, current values are used. These have to be calculated from the parcel-level tax digest data. To accomplish this, summaries are calculated from current development for each tax district, land district, and land use type combination and then used in lieu of estimated future values for all developable acreage.

With this simulation it was not necessary to use current development patterns directly from the tax digest. Instead, future building and land values were estimated by other team members and provided for use in WebFIT™. Because of this, processing programs had to be modified to adapt to this situation.

Another difficulty with adapting the scenario data to WebFIT™ was encountered with the redevelopment parcels. WebFIT™ has the facility to estimate the fiscal impact of a redevelopment project, but not as part of a full build-out, future land use plan. However, the tool can read a set of parcel identification numbers that make up the parcels to be redeveloped and then create an “original” data summary based on existing improvements on these parcels. The

second step is to read in the future land and building values for the new land use types which define the redevelopment scenario. With these two sets of data, the tool can calculate the change in land and building value for each land use type and use these data to run the fiscal impact.

Once all modifications were made to the WebFIT™ program and its processing programs, each scenario could be run by first running a "greenfield" case and then the "redevelopment" case. Summing the results from each case produces the full fiscal impact of each scenario.

WebFIT™ Results for Each Scenario

The three scenarios were abbreviated to Slowdown (Regional Slowdown), Middle (Middle Of the Pack), and Gateway (International Gateway) scenarios. The Middle scenario is considered the most likely or base case. The Slowdown scenario is considered the low end in terms of economic growth and the Gateway scenario is considered to be the high end growth scenario.

The Slowdown scenario results are shown in Tables 4 and 5. This low growth scenario shows the smallest change in total revenues and total expenditures but net revenues in 2030 are positive. Net revenue for the greenfield portion of this scenario was slightly negative, but the redevelopment portion was quite positive, resulting in positive net revenue for the complete scenario. This counterintuitive outcome for this scenario can be explained when considering that expenses are not affected by the increase in poverty in the scenario. Thus, the slowdown of growth slows expense at a faster rate than revenues. This is clearly present when you look at the Middle scenario expenses. The Middle scenario expenses are rapidly increasing since the model is focused on population change as a focal driver of expenses. It has been shown in other research that wealth and poverty are important issues when considering a slowing or stagnant population growth. It is important to consider that expense may be under estimated in this model since wealth and poverty shifts are not considered.

Table 4: Slowdown Scenario Fiscal Impact - Totals

	Current - 2005	Forecast - 2030	Change	Percentage Change
Total Revenues	$674,612,942	$820,404,195	$145,791,253	22%
Total Expenditures	$674,612,942	$811,016,986	$136,404,044	20%
Net Revenues		$9,387,209		

Table 5: Slowdown Scenario Fiscal Impact by Revenue and Expenditure Category

Revenue Category	Current - 2005	Forecast - 2030	Change	Percentage Change
Property Taxes	$260,282,545	$332,391,830	$72,109,285	28%
Sales Taxes	$140,971,729	$166,148,460	$25,176,731	18%
Excise and Special Use	$30,216,872	$35,639,635	$5,422,763	18%
Alcoholic beverage taxes	$5,348,442	$6,351,721	$1,003,279	19%
Insurance premium	$20,699,676	$23,931,405	$3,231,729	16%
Franchise taxes	$4,168,754	$5,356,509	$1,187,755	28%
Licenses and Permits	$25,265,571	$33,160,262	$7,894,691	31%
Business Occupation Tax	$12,488,611	$16,795,641	$4,307,030	34%
Liquor Licenses	$1,930,822	$2,286,636	$355,814	18%
Building Permits & Other	$10,846,138	$14,077,985	$3,231,847	30%
Charges for Services	$30,639,128	$37,100,585	$6,461,457	21%
Fines & Forfeitures	$21,725,217	$25,732,050	$4,006,833	18%
Other Revenue	$165,511,880	$190,231,373	$24,719,493	15%
Total Revenue	**$674,612,942**	**$820,404,195**	**$145,791,253**	**22%**
Expenditure Category				
General Administrative	$218,901,936	$260,457,153	$41,555,217	19%
Public Works	$152,596,769	$181,950,195	$29,353,426	19%
Courts	$34,190,804	$41,020,473	$6,829,669	20%
Public Safety	$217,179,136	$263,811,271	$46,632,135	21%
Health	$6,011,708	$7,003,173	$991,465	16%
Public Assistance	$3,956,138	$4,687,777	$731,639	18%
Recreation and Library	$41,144,932	$51,315,122	$10,170,190	25%
Other Expenditure	$631,519	$771,822	$140,303	22%
Debt Service	$0	$0	$0	0%
Total Expenditures	**$674,612,942**	**$811,016,986**	**$136,404,044**	**20%**

Table 6 contains the Middle scenario overall results and Table 7 provides a breakdown by category for revenues and expenditures. The difference in 2030 between total revenues and total expenditures is very small. Given the uncertainty in forecasting to 2030, this difference is not significant and the middle scenario can be said to be essentially "break even." The greenfield portion of this scenario shows negative net revenues in 2030 but the redevelopment portion of this scenario shows slightly positive net benefits in 2030.

Table 6: Middle Scenario Fiscal Impact - Totals

	Current - 2005	Forecast - 2030	Change	Percentage Change
Total Revenues	$674,612,942	$916,998,334	$242,385,392	36%
Total Expenditures	$674,612,942	$924,205,270	$249,592,328	37%
Net Revenues		($7,206,936)		

Table 7: Middle Scenario Fiscal Impact by Revenue and Expenditure Category

Revenue Category	Current - 2005	Forecast - 2030	Change	Percentage Change
Property Taxes	$260,282,545	$363,242,511	$102,959,966	40%
Sales Taxes	$140,971,729	$190,363,506	$49,391,777	35%
Excise and Special Use	$30,216,872	$37,418,051	$7,201,179	24%
Alcoholic beverage taxes	$5,348,442	$6,683,143	$1,334,701	25%
Insurance premium	$20,699,676	$24,863,711	$4,164,035	20%
Franchise taxes	$4,168,754	$5,871,197	$1,702,443	41%
Licenses and Permits	$25,265,571	$38,918,001	$13,652,430	54%
Business Occupation Tax	$12,488,611	$20,344,634	$7,856,023	63%
Liquor Licenses	$1,930,822	$2,413,646	$482,824	25%
Building Permits & Other	$10,846,138	$16,159,721	$5,313,583	49%
Charges for Services	$30,639,128	$42,626,584	$11,987,456	39%
Fines & Forfeitures	$21,725,217	$29,740,641	$8,015,424	37%
Other Revenue	$165,511,880	$214,689,040	$49,177,160	30%
Total Revenue	**$674,612,942**	**$916,998,334**	**$242,385,392**	**36%**
Expenditure Category				
General Administrative	$218,901,936	$289,585,572	$70,683,636	32%
Public Works	$152,596,769	$207,472,571	$54,875,802	36%
Courts	$34,190,804	$47,503,314	$13,312,510	39%
Public Safety	$217,179,136	$308,053,034	$90,873,898	42%
Health	$6,011,708	$8,099,392	$2,087,684	35%
Public Assistance	$3,956,138	$5,235,094	$1,278,956	32%
Recreation and Library	$41,144,932	$57,351,347	$16,206,415	39%
Other Expenditure	$631,519	$904,946	$273,427	43%
Debt Service	$0	$0	$0	0%
Total Expenditures	**$674,612,942**	**$924,205,270**	**$249,592,328**	**37%**

The Gateway scenario results are shown in Tables 8 and 9. In this scenario the net revenue in 2030 is substantially more negative than in the Middle scenario. Net revenue for the greenfield portion of the scenario was slightly positive, but the redevelopment portion was very negative, resulting in negative net revenue for the complete scenario. Similar to the Slowdown scenario, expenses are driven by population and are not inclusive of wealth or poverty shifts. Thus, expenses may be overestimated in this scenario. Overall, revenues and expenditures are much larger in this high-growth scenario.

Table 8: Gateway Scenario Fiscal Impact - Totals

	Current - 2005	Forecast - 2030	Change	Percentage Change
Total Revenues	$674,612,942	$964,068,925	$289,455,983	43%
Total Expenditures	$674,612,942	$1,008,494,878	$333,881,936	49%
Net Revenues		($44,425,953)		

Table 9: Gateway Scenario Fiscal Impact by Revenue and Expenditure Category

Revenue Category	Current - 2005	Forecast - 2030	Change	Percentage Change
Property Taxes	$260,282,545	$379,418,549	$119,136,004	46%
Sales Taxes	$140,971,729	$201,555,794	$60,584,065	43%
Excise and Special Use	$30,216,872	$39,465,641	$9,248,769	31%
Alcoholic beverage taxes	$5,348,442	$7,130,442	$1,782,000	33%
Insurance premium	$20,699,676	$25,906,911	$5,207,235	25%
Franchise taxes	$4,168,754	$6,428,288	$2,259,534	54%
Licenses and Permits	$25,265,571	$45,509,095	$20,243,524	80%
Business Occupation Tax	$12,488,611	$23,955,047	$11,466,436	92%
Liquor Licenses	$1,930,822	$2,571,716	$640,894	33%
Building Permits & Other	$10,846,138	$18,982,332	$8,136,194	75%
Charges for Services	$30,639,128	$47,335,038	$16,695,910	54%
Fines & Forfeitures	$21,725,217	$32,554,922	$10,829,705	50%
Other Revenue	$165,511,880	$218,229,886	$52,718,006	32%
Total Revenue	**$674,612,942**	**$964,068,925**	**$289,455,983**	**43%**
Expenditure Category				
General Administrative	$218,901,936	$315,087,483	$96,185,547	44%
Public Works	$152,596,769	$228,888,963	$76,292,194	50%
Courts	$34,190,804	$52,571,693	$18,380,889	54%
Public Safety	$217,179,136	$336,976,497	$119,797,361	55%
Health	$6,011,708	$8,684,373	$2,672,665	44%
Public Assistance	$3,956,138	$5,780,142	$1,824,004	46%
Recreation and Library	$41,144,932	$59,489,148	$18,344,216	45%
Other Expenditure	$631,519	$1,016,579	$385,060	61%
Debt Service	$0	$0	$0	0%
Total Expenditures	**$674,612,942**	**$1,008,494,878**	**$333,881,936**	**49%**

WebFit™ Fiscal Impact Simulations Conclusions

The three scenarios were all run through WebFIT™ with the treatment of redevelopment as described in the limitations. Given the forecast of new development, redevelopment, and changes in the real property values of current development that did not get redeveloped, the model was able to produce reasonable estimates of the change in revenues and expenditures for the county, if one assumes no change in socioeconomic factors.

The slowdown scenario is the one in which WebFIT™ cannot accurately forecast the change in expenditures because of the limitation on its ability to factor in a change in wealth or poverty. There is ample evidence that growth in poverty drives growth in certain expenditure categories irrespective of growth in population or households. In other words, given two scenarios where population and households show the same growth but where poverty rates grow more rapidly in one than in the other, expenditures should increase faster in the scenario with the more rapid growth in poverty level.

The gateway scenario shows about a six percentage point difference in revenue growth and expenditure growth, with expenditure growth the more rapid. In this scenario, the redevelopment portion showed a sharp decline in industrial property values and a slight rise in residential property values. This cuts down considerably on property taxes collected on redeveloped parcels in 2030. This is one of the primary reasons for the growth in expenditures outstripping the growth in revenues in the redevelopment portion of the scenario. Furthermore, the growth in ultra high-density development in the gateway scenario is multiple times higher than in the middle scenario. This creates rapid household growth in the gateway scenario and subsequently greater pressure on expenditure growth.

The middle scenario showed the smallest difference in the spread between total revenues and total expenditures at about one percentage point. But, the one percentage point difference cannot be considered statistically significant given the 25 years of the simulation and the known uncertainty in estimates over such a long period. Therefore, the middle scenario shows basically the same growth in revenues and expenditures.

Alternative Model Estimates

One of the limitations of the WebFIT™ fiscal impact simulations is WebFIT™'s inability to vary as population and income shifts change the need for service within sub-county areas. This limitation leads to an alternative estimate that incorporates the active socio-economic change that can occur within sub-county areas. To address these active changes we focus on a base case for expenses and revenues per land-use type. Recall, as stated in the assumptions, that WebFIT™ incorporates capital spending and revenues. The Alternative model's focus is on operating expenses and revenues and is inclusive of enterprise funds. Thus, although the Alternative model addresses some of the limitations of WebFIT™, the fiscal base differs between the two models.

We establish the base case for expenses and revenues by land-use type by using the 2004 Gwinnett County management survey. This survey, conducted by the Economic Development Division, directed by Alfie Meek PhD, focused on level of service expenses and revenues in three land-use types, residential, commercial/industrial and farm/forest. Each major category and subcategory of expenses and revenues were assessed a weighting based on the perceived contribution for each land-use type for the entire county. We aggregate the information into total expenditure and total revenues by land-use type as shown in Table 10 to provide an overview of the total allocations. The first analysis, based on WebFIT™, does not incorporate this managerial data, instead assigning expenses and revenues based on amount of land within each land-use type.

Table 10: Distribution of Expenditures and Revenues

	Residential	Commercial/Industrial	Farm/Forest
Total Expenditures	71.98%	26.58%	1.43%
Total Revenue	65.17%	33.71%	0.82%

Note: Revenues distribution does not include 0.30% of revenues that come from external sources.

Using the percentages obtained from the survey, we break the major land-use types offered in Table 10 into the tax digest property categories as follows:

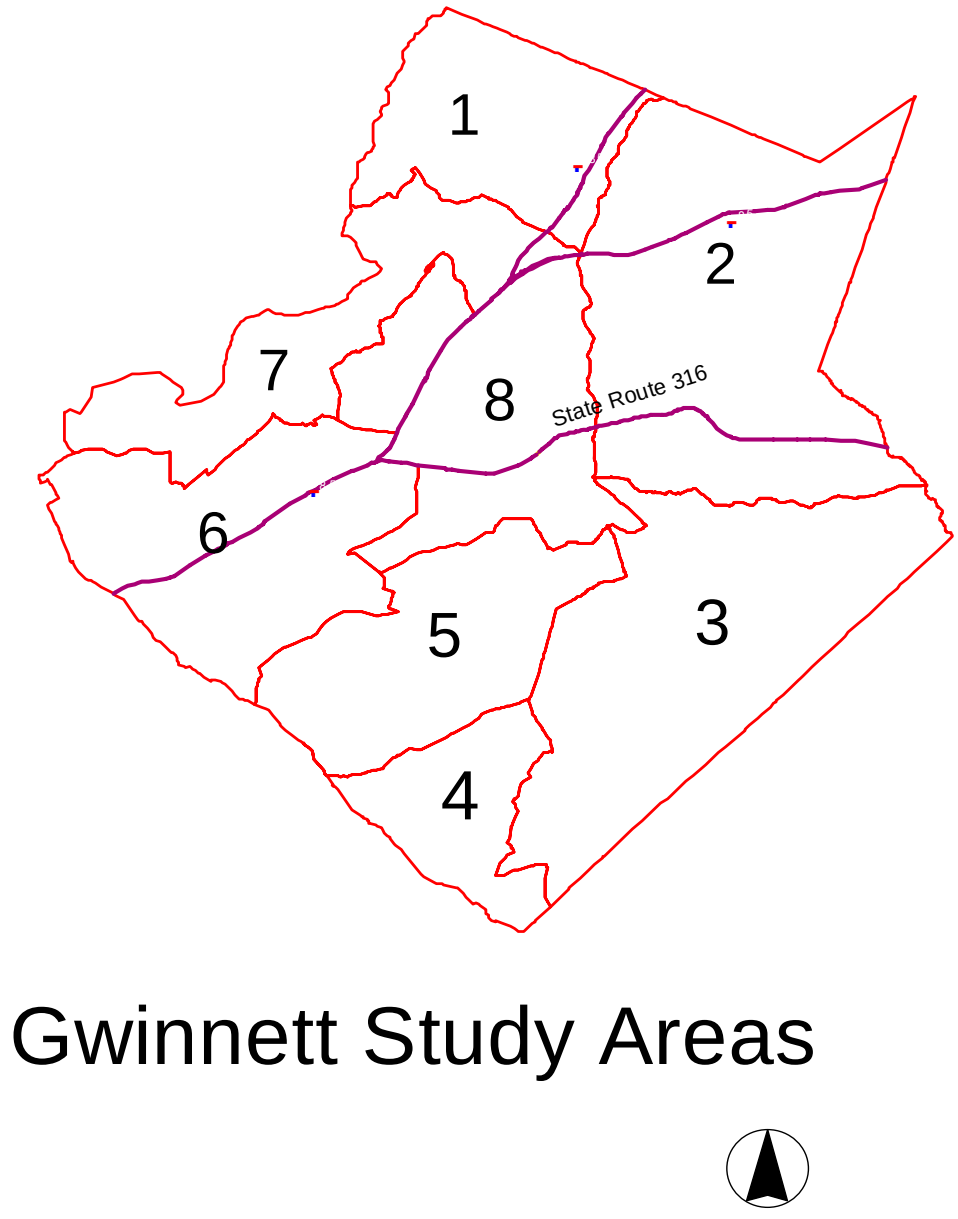
- Residential includes the following property categories: Single Family; Estate; TownHouse/Condo; Mobile Home; and Multifamily
    - In the residential land-use type we allocate multifamily. We use this classification since we are treating multifamily (usually apartments) similar to the treatment by service providers, such as police and fire. Our assumption is that the call for service is to a residence, such as apartment #3, not to a building.

- Commercial/Industrial includes the following property categories: Hotel/Motel; Commercial; Mixed; Office, Bank, etc; Rinks, Clubhouses, etc; Warehouse/Light Industrial; Utilities; and School/Church/etc.

- Farm/Forest includes Agricultural land and Vacant/Undeveloped land

To redistribute the multiple property categories into the three survey land-use types, we use the proportion of each property type within the three land-use types. For example, if single family is 80% of residential land-use then 80% of expenses and revenues are allocated to single family. After redistributing the expenses and revenues to each property category, we use GIS to place each property into each of the sub-county areas as shown in Figure 1.

Figure 1: Sub-County Areas in Gwinnett County



The use of each property category and its corresponding expense and revenue contribution leads to allocations of expenses and revenues into each sub-county area that is equivalent. For example, if sub-county area 2 has the same number of single family properties as sub-county area 3, then expenses are equal in single family properties for those sub-county areas while revenues vary based on property values. One of the distinct disadvantages of this process of expense and revenue allocations is that sub-county areas may differ in socio-economic condition and managerial allocation of service need. Thus, calls for service (the expenses associated with the sub-county area) may not be identical across all the different sub-county areas violating one of the assumptions in WebFIT that all sub-county areas request/require the same service levels. We assume that for the largest single revenue source, property tax, the tax assessor's office will accurately provide property values across all sub-county areas regardless of socio-economic conditions within the sub-county area. Given that the millage rate is identical across sub-county areas, the revenue and expenses derived within each sub-county area will be unique to that area, varying based on socio-economic forces.

To explore differential service needs (expenses) by sub-county area, we begin by graphically looking at the calls for service for fire and police. In Figure 2 we offer calls for service by police and fire along with the median for both of these services. The median calls for service indicates the number in which 50% of the calls for service are below that number and 50% of the calls for service are above that number. In this way, the median provides an accurate statistic for expected calls for service. As shown in the figure areas 2, 6, 8 are higher than the median for both fire and police calls for service. This indicates that the use of equivalent expenses across the sub-county areas may be misleading.

This graphic presents a visual assessment of the future requirements for Gwinnett County within sub-county areas. The graph shows us that calls for service vary greatly and particularly in sub-county areas 2, 6, and 8. The information gained from the graphic allows us to make modifications to the future scenarios that incorporate our best forecast for expenses and revenues in Gwinnett County in the year 2030.

Service Changes and Analysis

Municipal-like services offered by Gwinnett County provide a practical basis to look at the changing demographic and economic patterns within the scenarios. These services, such as police, fire, and recreation services allow us the opportunity to look at Gwinnett County as a large municipal-like service provider. This differs from the WebFIT™ analysis in that we can incorporate the issues of income and population shifts/changes, important factors to municipal-type services. This allows for Gwinnett County to experience income and population shifts/changes similar to the fiscal impact felt by a municipal government. While WebFIT™ provides us an expenditure analysis focusing on land-use changes; WebFIT™ cannot incorporate the changing dynamics of demographics and income, a similar outcome to our analysis of expenses when considering all sub-county areas as equivalent in service need.

Prior work in cities with populations greater than 300,000 (Pack, 1998) shows that non-poverty related expenses- defined as police, fire, and general government- rise by $27.75 per capita as poverty changes by one percentage point. Pack's (1998) analysis focused on large cities and although Gwinnett County spending on municipal-like services is indicative of large city like

spending, consideration must be given to the intrametropolitan nature of Gwinnett County. Simply put, Gwinnett County is part of a large metropolitan area, the Atlanta Metropolitan region. Prior research by Joassart-Marcelli et al. (2005) focuses on the issues oriented toward intrametropolitan locations. Joassart-Marcelli et al. (2005) find that non-poverty expenses (fire, police, and general government) rise by $64 per capita for each one percent increase in poverty in the intrametropolitan areas.

Using these prior studies, we have the opportunity to look at expense *ranges* for the scenarios based on income and demographic changes while incorporating land use changes. An important factor when using prior studies as a basis for current fiscal analysis is to analyze the government under study to assure us that the prior study outcomes may be generalizable to the current government under study, Gwinnett County.

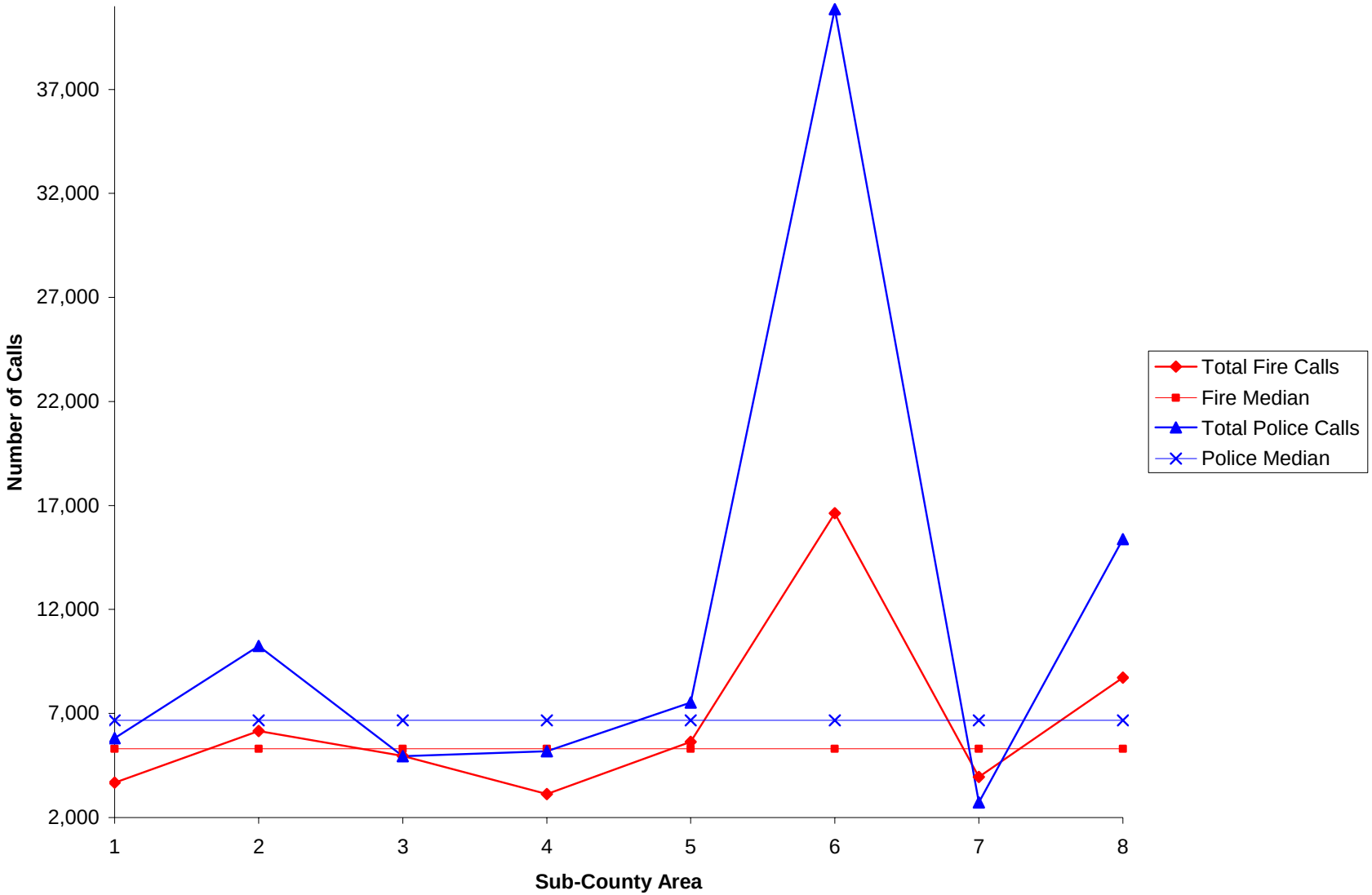
To generalize the affects of poverty found in earlier studies to Gwinnett County, we first need to establish a relationship between service needs, income levels, and poverty demographics. To begin the analysis of the effect of income and demographic changes/shifts for Gwinnett County we establish that the eight sub-county areas, as defined in the scenarios, are currently correlated with calls for service by police and fire. We disaggregate calls for fire service into fire calls only, medical calls only, and all other fire calls. We disaggregate police calls for service into person crime calls (armed robbery, battery, sexual assault, rape, aggravated assault, false imprisonment, murder, and carjacking), property crime calls (criminal damage, burglary, and criminal trespass), and all other crime calls. We establish a simple correlation analysis to look at the correlation between police and fire calls in the sub-county areas. We find that police and fire calls are significantly correlated with a correlation coefficient of 0.96 or greater. This indicates that as fire calls for service increase police calls for service also increase at about the same rate. This finding is expected since this is one of the reasons municipal governments combine the fire and police budgets into a service commonly identified as safety or emergency services.

To focus on the correlation analysis, we define the income quintiles in Table 11. Using the calls for service data for both police and fire for the last 2 years (FY2005, FY2006) we correlated the calls for services in the eight sub-county areas with household income.

Table 11: Income Quintiles Defined

	Definition of Income Quintiles
Lower	Under $27,380
Lower Middle	$27,380 to $47,215
Middle	$47,215 to $69,728
Upper Middle	$69,728 to $105,415
Upper	Over $105,415

Figure 2: Gwinnett County FY2006 Calls for Service Police and Fire



We find, as shown in Table 12, that the correlation between the household income quintile and calls for services are very strong for all household income levels except middle income households. The important findings from the correlations are:

- Households that are in the lower and lower middle income quintiles have a positive relationship with calls for service in both police and fire services.
- As the number of households in the lower and lower middle income quintiles increase in Gwinnett County, calls for fire and police services also rise.
- Households in the middle income quintile have no direct effect on calls for service for police and fire.
- Households in the upper and upper middle income have a negative effect on calls for police and fire services.
- As the number of households in the upper and upper middle income quintiles increase in Gwinnett County, calls for fire and police services decline.
- Fire calls for service are not as strongly related to household income as are police calls for service

Table 12: Correlations for Fire and Police Services with Sub-County Areas

Income Quintile	Fire Call	Medical Call	Other Fire	Person Crime	Property Crime	Other Crime
Lower	0.62*	0.65*	0.67*	0.69*	0.74*	0.72*
Lower Middle	0.58*	0.66*	0.64*	0.75*	0.73*	0.73*
Middle	0.36	0.45	0.39	0.53	0.44	0.47
Upper Middle	-0.65*	-0.63*	-0.65*	-0.69*	-0.72*	-0.71*
Upper	-0.55*	-0.64*	-0.62*	-0.72*	-0.70*	-0.70*

* = statistically significant

In Table 13 we focus on the specific sub-county areas noted as sub-county areas 2, 6, and 8. These three areas include the major interstate corridor of I-85, I-985 and State Route 316. The three sub-county areas account for 60% of total fire calls for service and 72% of total police calls for service in Gwinnett County. Table 13 shows that in these three sub-county areas total calls for service for police and fire are highly correlated with household income.

- Both total fire and total police calls are highly positively correlated with lower and lower middle income households
- Both total fire and total police calls are highly negatively correlated with upper and upper middle income households
- Neither total fire and total police calls are statistically significantly correlated with middle income households

There is an important assumption in the correlations for police and fire service and income levels. We have assumed that calls for service are not affected by the surrounding geography, e.g. the interstate freeway system only affects specific sub-county areas. We relax this

assumption by looking at the correlation between calls for police and fire service and income when calls oriented to traffic related issues are removed. We find that the results shown in Tables 12 and 13 are robust when calls related to traffic incidents are removed.

Table 13: Correlation of Income Quintile with Fire and Police Service Calls in the Three Sub-County Area

Income Quintile	Total Fire Service Calls	Total Police Service Calls
Lower	0.95*	0.92*
Lower Middle	0.99*	0.99*
Middle	0.56	0.63
Upper Middle	-0.98*	-0.97*
Upper	-0.99*	-0.99*

* = statistically significant

Although we have evidence that lower and lower middle incomes are positively correlated with calls for police and fire services, we reassess the relationship by focusing on poverty rates in each sub-county area. Poverty is not an identical measure to lower and lower middle income quintiles. Poverty is defined in the Federal Register in 2005 as an income of $16,090 or less for a family of three. Since the average household size in Gwinnett County in 2005 has a range of 2.87 to 2.95, we use a family of three as our comparative base. The Federal poverty guidelines are shown in Table 14.

Table 14: 2005 Poverty Guidelines for the 48 Contiguous States for FY2005

Persons in Family Unit	Federal Poverty Guideline
1	$ 9,570
2	12,830
3	16,090
4	19,350

Using the guidelines in Table 14, we show the correlation between poverty and the calls for service in Gwinnett County for FY2005 in Table 15. Table 15 indicates that as poverty increases within sub-county areas calls for both fire and police services increase. The findings of the positive correlation between income quintiles and poverty rates with calls for both fire and police services support an analysis that takes into account the demographic and socioeconomic shifts within Gwinnett County for our forecast, similar to the results found in Joassart-Marcelli et al. (2005) analysis of metropolitan area governments. These indicators of service need, income level and poverty, establish a generalizability of earlier studies in assessing their role in the dynamic expenditures of governments that provide municipal services.

Table 15: Correlation of Poverty with Fire and Police Calls for Service in the Sub-County Areas

	Total Fire Service Calls	Total Police Service Calls
Poverty July 2005	0.86	0.91

Establishing a Baseline Budget

In the correlation analysis, we established that changing demographics and income play a role in service provision. We begin establishing our baseline budget by making several revisions to the FY2005 expenditures for Gwinnett County. The first modification to FY 2005 expenditures is in emergency services. In 2006, the county had a large change in police officers, leading to a total of 696 sworn officers. The second change is in the budget for the fire department to accommodate the acceptable service level of 80% of calls responded to within an 8 minute time period. Since we are forecasting out 25 years, the baseline budget provides us an opportunity to establish acceptable levels of services.

The change for both fire and police are based on acceptable service levels. Since the scenarios focus on a vision of Gwinnett County in 2030, we make the following changes to both the police and fire budgets:

- Change Police to 955 positions based on interview with Police Chief and supporting analysis. Desired minimal staffing level is 1.1 personnel per 1000 population. Staffing in FY2005 was approximately 0.9 personnel per capita. Desired ideal staffing is 1.5 personnel per 1000 population. Gwinnett County's 2005 population as defined by Dr. Thomas Hammer, the Plan's demographic consultant, is 726,581 rounded up to 727,000. We chose the midpoint between minimal and ideal staffing as defined by the Police Chief which is 1.3 personnel per 1000 population. This provides for 955 Police personnel.

    - To support the change in police personnel, we investigated surrounding like size counties. DeKalb County (2005 Population 677,959) has about 1.95 police personnel per 1000 population, Fulton County (2005 Population 915,623) has about 1.8 police personnel per 1000 population, and Cobb County (2005 Population 663,818) has about 1.1 police personnel per 1000 population.

    - Derive police expenses as follows:
        - Use 2007 proposed budget of 895 police personnel as base with expenses inclusive of staffing starting October 2007. This expense is $79,926,981 in 2007 dollars. Add $6,806,048 (2007 dollars) for an additional 60 personnel which include:

            42 Police Officers
            7 Corporals
            7 Sergeants
            2 Lieutenants
            2 Administrative Support Personnel

- Adjust for Consumer Price Index from 2007 to 2005 dollars. This provides a budget of $81,529,047 in 2005 dollars.

- Fire is focused on response times as a major factor. We use an acceptable level of staffing to respond to 80% of all calls within eight minutes or less. This standard is

identical to that set by the National Fire Protection Association Standard 1710-3 (5) that states:

> "Eight minutes or less for the arrival of an advanced life support unit to eighty (80) percent of emergency medical incidents, where this service is provided by the fire department."

However less than the National Fire Protection Association Standard can apply for urban area response times which states in 1710-3 (3):

> "Urbanized Cluster Area Deployment. Six minutes or less for the arrival of the first engine company to eighty (80) percent of the fire suppression and emergency medical incidents and a second engine company and a Supervisory Chief Officer within ten minute response time to eighty (80) percent of the incidents. Definition: Urbanized Cluster area with over 15,000 residents as defined by the U.S. Census Bureau's 2000 census."

The use of the 8 minute response time for 80% of calls may be due to Gwinnett County's mixed urban and rural settings. Therefore, the 8 minute for 80% of calls response time appears to be accordance with NFPA standards. In 2005, 68% of calls were responded to within 8 minutes or less. Using this response time, to achieve an 8 minute response time for 80% of calls, we calculate a ratio of expenses per percentage change. Using 2004 through 2007 data, we find that an expense per 1% increase to the acceptable 8 minute response time provides a median expense of $862,003. This leads us to a budget that accommodates the 8 minute or less response time for 80% of all calls equivalent to $69,242,134 for FY2005.

Our second change to the FY2005 budget is based on the changing demographics of Gwinnett County. Recall that income and poverty increase calls for service. It has been found in the literature that poverty also increases poverty related services (public welfare and public assistance) although the results are mixed. Pack (1998), Summers and Jakubowski (1996), and Joassart-Marcelli et al. (2005) have argued that poverty increases municipal expenditures. Although the argument has been posited, little empirical support has been found for the relationship between poverty and poverty related spending. The results of this mixed outcome have led many to suggest that fiscal or institutional characteristics may be more important than the change in poverty when looking at poverty related expenses. Therefore, to analyze the issue of poverty and poverty related expenses, we look at the proportion of poverty spending as it relates to general revenues for like-size counties, a fiscal measure. Table 16 offers the comparison counties to Gwinnett. We find that Cobb and DeKalb Counties have similar spending on poverty related expenses, while Fulton County has a very high amount of poverty spending and Gwinnett County has the lowest poverty spending of the like-size counties.

Table 16: Poverty Spending as a Percent of General Revenues* for FY2005 using DCA Data

County	Poverty Spending**	Difference from Median
Cobb	8.23%	0.12%
DeKalb	7.98%	-0.12%
Fulton	15.15%	7.04%
Gwinnett	4.48%	-3.62%
Mean	**8.96%**	
Median	**8.10%**	

*General revenues are computed by combining total property taxes, total sales taxes, total excise taxes, total fees, licenses, and permits with welfare grants and community development block grants. Public welfare grants include grants for welfare purposes such as reimbursements for food stamp distributions, U.R.E.S.A., indigent care, and indigent defense payments. Community development block grants include either the Small Cities Program or the Entitlement Program.

** Poverty spending is the combining of public health, public welfare and social services, and community development expenditures. Public health spending includes expenditures for health center, animal control, immunizations, classes for unwed mothers, mosquito abatement; Public welfare and social services spending includes DFACS payments, senior citizen programs, food stamps, WIC, Head Start, etc.; Community development expenditures include expenditures for urban renewal, slum clearance, housing rehabilitation projects (other than housing authority projects), trees for a mall, contributions to the Chamber of Commerce, community Development block grant activities unless for a utility system or other enterprise fund, hotel/motel tax expenditures for such items as tourism, and conventions and trade shows.

We acknowledge the inaccuracy of the expenditure side since it includes spending on Chamber of Commerce, tourism, and conventions and trade shows. However, the data is limited since the DCA does not separate "poverty" spending only. We do take care to not include any funds from or to an enterprise fund.

Our finding in Table 16 suggests that the poverty rates between Cobb and DeKalb counties should be similar and both Gwinnett and Fulton counties should differ, with Gwinnett County having a lower poverty rate than any of the other counties based on poverty spending. Table 17 shows the poverty rates in 2005 and 2006 for our counties of interest. As shown in Table 17, Gwinnet and Cobb counties have very similar poverty rates in 2006, while DeKalb has a higher poverty rate. Focusing on just the two years offered in Table 18, we see that both Cobb and Gwinnett counties poverty rates are rising while DeKalb County's poverty rate is declining. If we included the poverty rate in Gwinnett and Cobb counties in 2003, we would find that Cobb County's poverty rate in 2003 was 6.6% – 9.9%, while Gwinnet County's was 4.2% - 8.1%. Thus, over the last several years Gwinnett County's poverty rate has increased at a faster rate than Cobb County. This leads to our final adjustment to the FY2005 baseline budget for Gwinnett County. We increase poverty related spending to equal that percentage spent by Cobb County in 2005, 8.23% of general revenue as shown in Table 16.

Table 17: Poverty Rates Range* for 2005 and 2006

County	2005	2006
Cobb	7.2% - 9.6%	8.6% - 10.4%
DeKalb	14.6% - 17.6%	12.9% - 15.9%
Fulton	14.1% - 16.7%	14.3% - 16.5%
Gwinnett	6.2% - 8.6%	8.0% - 10.4%

* Poverty rates are from the American Community Survey. Ranges are inclusive of the confidence intervals.

We have provided an analysis of the changes needed to the FY2005 budget based on both evidence from the fire and police services and an analysis of poverty spending by similar size jurisdictions in the Atlanta Metropolitan region. We conclude that an increase for police and fire services are necessary to provide accurate future estimates for the year 2030. We also find that increasing poverty expenditures in the baseline budget by 3.62% will increase the accuracy of our estimates. Taking demographic and income shifts into account will provide an improved estimate for Gwinnett County in 2030.

Alternative Model Estimates

The resulting analyses lead us to an estimation of the poverty levels that may be experienced by Gwinnett County in 2030. Table 18 provides poverty estimates by sub-county area and scenario. Using the July 1, 2005 American Community Survey as our base, the identical base used in the estimates provided by Dr. Thomas Hammer, we see that by 2030 in the Middle and Slowdown scenarios, poverty increases in Gwinnett County. The most dramatic change is the Slowdown scenario, while in the Gateway Scenario poverty levels are similar to those in 2005.

Table 18: Poverty estimates for 2030 by Sub-County Area (SCA)

	SCA 1	SCA 2	SCA 3	SCA 4	SCA 5	SCA 6	SCA 7	SCA 8	County
July 1, 2005 est.	6.85%	3.11%	3.21%	5.26%	3.78%	14.82%	4.94%	7.26%	7.44%
Gateway 2030	7.23%	3.33%	3.42%	5.56%	4.03%	15.50%	5.27%	7.69%	7.86%
Middle 2030	6.50%	4.23%	4.20%	8.36%	6.77%	20.57%	8.29%	10.73%	9.62%
Slowdown 2030	8.21%	5.51%	5.37%	10.17%	8.51%	24.20%	10.51%	13.17%	12.10%

To address the issue of population shift, Table 19 provides the population estimates as obtained by Dr. Thomas Hammer, who generated the socio-economic projections for this study (see Appendix C – Population ad Employment Forecasts). From these estimates the number of households are derived which lead to the estimated land use for residential properties.

Table 19: Population Estimates for 2030

Scenario	Population Estimate
Gateway 2030	1,136,476
Middle 2030	1,027,880
Slowdown 2030	887,847

Alternative Model Results for Each Scenario

Using the poverty change and the population estimates, we derive the operational expenses and revenues that Gwinnett County could face based on the scenarios. We base the scenario estimates on the modified FY2005 budget for Gwinnett County.

The Slowdown scenario results are shown in Tables 20 and 21. This low growth scenario shows the largest change in total expenditures of the scenarios. We estimate revenue at $913 million realizing a deficit in the range of $109 million and $259 million. We use a range since the poverty estimates are not a point estimate. This leads to low and high operational expenses

which we note as our operational expenses range. This deficit is in the range of 11.9% and 28.4% of total estimated revenues. Driving this outcome is the large change in poverty forecasted for Gwinnett causing a large rise in the costs of services, particularly in police and fire services.

Table 20: Summary Expenditure and Revenue Estimates for Slowdown Scenario

Scenario	Estimates
Slowdown Revenue	$913 million
Slowdown Expenditure	$1,022 million to $1,172 million

Table 21: Detail Expenditure and Revenue Estimates for Slowdown Scenario

Revenue Category	Forecast Revenues
Real/Personal Property Taxes	$ 355,000,000
Motor Vehicle Taxes	35,000,000
All Other Property Taxes	14,000,000
Insurance Premium Taxes	25,000,000
All Other Taxes	32,000,000
Business License	19,000,000
Total Other Licenses & Permits	13,000,000
Total Intergovernmental Revenue	8,000,000
Total Judicial Revenue	31,000,000
Building Permits/Fees	14,000,000
Tax Commissions	15,000,000
E-911 Fees and Charges	16,000,000
Street Lighting Assessment Fees	8,000,000
Other Charges for Services	12,000,000
Water and Sewer Sales and Fees	274,000,000
Other Sales and Rental	30,000,000
Total Miscellaneous	13,000,000
Total Revenues	$ 913,000,000

Expenditure Category	Forecast Expenditure Range		
Administration	$ 83,000,000	to	$ 95,000,000
Tax Commissioner	13,000,000	to	15,000,000
Justice	72,000,000	to	82,000,000
Sheriff & Corrections	101,000,000	to	116,000,000
Medical Examiner	1,000,000	to	1,000,000
Community Services	91,000,000	to	104,000,000
Planning, Transportation & Utilities	360,000,000	to	412,000,000
Police & Fire	239,000,000	to	274,000,000
Non-Departmental Expenses	62,000,000	to	72,000,000
Total Expenditures	$ 1,022,000,000	to	$1,172,000,000

The Middle scenario results are shown in Tables 22 and 23. This steady-state scenario shows the low range of total expenditures identical to that of the Gateway scenario. We estimate revenue at $1,025 million realizing a deficit in the range of $3 million and $84 million. This deficit is in the range of 0.3% and 8.2% of total estimated revenues. At the low estimate of expenditures this is a breakeven scenario and at the high end of expenditures there is a deficit. This steady state

scenario may leave Gwinnett County at breakeven in the year 2030 or has a potential revenue shortfall of about 8% in 2030.

Table 22: Summary Expenditure and Revenue Estimates for Middle Scenario

Scenario	Estimated Range
Middle Revenue	$1,025 million
Middle Expenditure	$1,028 million to $1,109 million

Table 23: Detail Expenditure and Revenue Estimates for Middle Scenario

Revenue Category	Forecast Revenues
Real/Personal Property Taxes	$ 393,000,000
Motor Vehicle Taxes	40,000,000
All Other Property Taxes	15,000,000
Insurance Premium Taxes	30,000,000
All Other Taxes	35,000,000
Business License	20,000,000
Total Other Licenses & Permits	14,000,000
Total Intergovernmental Revenue	9,000,000
Total Judicial Revenue	36,000,000
Building Permits/Fees	16,000,000
Tax Commissions	16,000,000
E-911 Fees and Charges	18,000,000
Street Lighting Assessment Fees	9,000,000
Other Charges for Services	13,000,000
Water and Sewer Sales and Fees	314,000,000
Other Sales and Rental	33,000,000
Total Miscellaneous	14,000,000
Total Revenues	$ 1,025,000,000

Expenditure Category	Forecast Expenditures Range		
Administration	$ 84,000,000	to	$ 91,000,000
Tax Commissioner	13,000,000	to	14,000,000
Justice	72,000,000	to	78,000,000
Sheriff & Corrections	102,000,000	to	110,000,000
Medical Examiner	1,000,000	to	1,000,000
Community Services	91,000,000	to	98,000,000
Planning, Transportation & Utilities	365,000,000	to	394,000,000
Police & Fire	236,000,000	to	255,000,000
Non-Departmental Expenses	63,000,000	to	68,000,000
Total Expenditures	$ 1,028,000,000	to	$ 1,109,000,000

The Gateway scenario results are shown in Tables 24 and 25. In this scenario the police and fire expenses in 2030 are higher than the Middle scenario on the low range but lower on the upper range *This scenario assumes limited suburbanization on the east side of Gwinnett County, which may directly affect the operational expenditures.* This assumption is not present in either the Slowdown or Middle scenarios. Expenditures overall have a much smaller range than either the Slowdown scenario or the Middle scenario. We estimate revenue at $1,090 million realizing a

surplus in the range of $62 million and $45 million. This surplus is in the range of 4.1% and 5.7% of total estimated revenues. This outcome indicates that the Gateway scenario is considered a potential budgetary surplus result.

Table 24: Summary Expenditure and Revenue Estimates for Gateway Scenario

Scenario	Estimated Range
Gateway Revenue	$1,090 million
Gateway Expenditure	$1,028 million to $1,045 million

Table 25: Detail Expenditure and Revenue Estimates for Gateway Scenario

Revenue Category	Forecast Revenues
Real/Personal Property Taxes	$ 414,000,000
Motor Vehicle Taxes	43,000,000
All Other Property Taxes	15,000,000
Insurance Premium Taxes	33,000,000
All Other Taxes	36,000,000
Business License	20,000,000
Total Other Licenses & Permits	14,000,000
Total Intergovernmental Revenue	10,000,000
Total Judicial Revenue	38,000,000
Building Permits/Fees	17,000,000
Tax Commissions	17,000,000
E-911 Fees and Charges	19,000,000
Street Lighting Assessment Fees	10,000,000
Other Charges for Services	14,000,000
Water and Sewer Sales and Fees	338,000,000
Other Sales and Rental	35,000,000
Total Miscellaneous	15,000,000
Total Revenues	$ 1,090,000,000

Expenditure Category	Forecast Expenditures Range		
Administration	$ 84,000,000	to	$ 85,000,000
Tax Commissioner	13,000,000	to	13,000,000
Justice	72,000,000	to	73,000,000
Sheriff & Corrections	101,000,000	to	103,000,000
Medical Examiner	1,000,000	to	1,000,000
Community Services	87,000,000	to	88,000,000
Planning, Transportation & Utilities	365,000,000	to	371,000,000
Police & Fire	242,000,000	to	246,000,000
Non-Departmental Expenses	63,000,000	to	64,000,000
Total Expenditures	$ 1,028,000,000	to	$ 1,045,000,000

Alternative Model Conclusion

Overall the three scenarios result in very different fiscal outcomes. When poverty and cost allocation are taken into account, we find that the Alternative model that incorporated a series of socioeconomic issues provides a very intuitive outcome. In an economic slowdown, as forecasted with the Slowdown scenario, Gwinnett County is in deficit throughout the expenditure

range. In the Middle scenario, a steady state based on FY2005, we find that Gwinnett County has two potential outcomes based on the expenditure range. Those outcomes, breakeven or deficit are important. Throughout the expenditure range of the Middle scenario the County is never in fiscal surplus. In the Gateway Scenario, revenues exceed expenditures throughout the expenditure range, providing the County with a fiscal surplus.

Summary of the Two Fiscal Analyses

We begin the summary analysis with Table 26 showing the resulting expenditures and revenues of the three scenarios using WebFIT™. Note that all three scenarios expenditures and revenues in the model are point estimates that increase over the three scenarios.

Table 26: Expenditures and Revenues - WebFIT™ Model

	Forecast (in Millions of Dollars)	
Scenario	**Expenditures**	**Revenues**
Slowdown	$ 811	$ 820
Middle	$ 924	$ 924
Gateway	$ 1,008	$ 964

In Table 27 the Alternative model offers revenues that are point estimates like found in the WebFIT™ model. The Alternative model expenditures provide a low range and high range. In the Alternative model, the low range expenditures are very similar in the three scenarios while the upper range expenditures decrease as we move from the Slowdown to the Gateway scenario.

Table 27: Operational Expenditures and Revenues - Alternative Model

	Forecast (in Millions of Dollars)			
Scenario	**Expenditures**			**Revenues**
Slowdown	$ 1,022	to	$ 1,172	$ 913
Middle	$ 1,028	to	$ 1,109	$ 1,025
Gateway	$ 1,028	to	$ 1,045	$ 1,090

Outcomes of the two modeling techniques provide an opportunity to project potential outcomes in FY2030 for Gwinnett County. Focusing on the Alternative model expenditures, it appears expenditures may be able to be held constant throughout the scenarios if the low range expenditures are realized. If revenues are realized as projected by the Alternative model, the smallest deficits for the Slowdown and Middle scenarios are realized, while the largest surplus is realized for the Gateway scenario. Although projecting the future is not an exact science, providing direct responses to poverty may assist Gwinnet County in holding poverty impacts to the forecasted lowest range of expenditures offering an opportunity to directly impact the potential outcomes of these three scenarios.

Optional Financing Choices using the Alternative Model Outcomes

Given that the Slowdown scenario leads to a large deficit and the Middle scenario leads to a potential deficit in the Alternative model, we look at optional financing structures. We approach the issue of optional financing with the following assumptions:

- Gwinnett County financial focus is to retain their AAA bond rating
- Revenue sources are those currently approved by the State of Georgia

We begin our analysis with the most obvious solutions to Gwinnett County under the Slowdown and Middle scenarios. Revenue shortfall for the Slowdown scenario ranges from 11.9% to 28.4% of total estimated revenue. The Middle Scenario has a potential deficit of 8% of revenues.

There is little doubt that the initial choices are the most controversial. First, Option 1 would be to reduce services to only those required under the Georgia Constitution for County governments. This would eliminate the service cost of municipal services that are currently provided by Gwinnett County. Table 28 highlights those costs that are the provision of municipal like services.

Table 28: Option 1: Municipal Like Services and Costs

Expenditure Category	Service	Potential Savings
Police & Fire	Police and Fire	$236.0 to $274.0 million
Planning, Transportation, & Utilities	Planning	$15.2 to $19.8 million
Community Services	Parks and Recreation	$51.8 to $67.6 million
	Total Potential Savings	$303 to $361.4 million

Under Option 1, the reduction of Police and Fire services would have an adverse impact not only on the unincorporated areas in the county, but also on the municipalities whom are dependent on fire services and police services for major crimes that are provided by the county. In our opinion, although the removal of Police and Fire services does not affect the County under Georgia Statutes, the impact on both the citizens of the unincorporated area and the municipalities make this portion of Option 1 impossible. When looking at Planning, this service provides land use and land development information for the county. Given that Gwinnett County has approximately 80% of its citizens residing in the unincorporated areas; the removal of planning appears infeasible. The reduction or elimination of Parks and Recreation in the county would have adverse effects on the quality of life. In our opinion, Option 1 may be plausible under Georgia Law; however, the negative effects appear to be unacceptable.

Option 2 would increase the millage level to accommodate the deficit in the scenarios. For property, this would increase the millage rate based on a 1 mill per $1000 in property value as shown in Table 29. Following this potential option, a two (2) mill increase would position the Middle scenario at breakeven at the high range of expenditures. Looking at the Slowdown scenario the millage rate would require an increase of about 26% of the FY2005 millage to approximately 15 mills at the low range of expenditures and an increase of about 44% of the FY2005 millage to approximately 17 mills at the high range of expenditures.

Table 29: Increased Millage Effect on Property Tax Revenue

Revenue Category	Scenario	Eliminate Forecasted Deficit*	Potential Revenue Increase
Property Taxes	Slowdown	+3 to 5 mills	1 mill ≈ $35 million
	Middle	≈ 2 mills	1 mill ≈ $39 million

* based on FY2005 millage of 11.47

Increasing taxation is complicated by the fact that revenue capacity and effort both affect the potential outcome. Simply put, we need to evaluate whether or not the economic base of the County is either under or over utilized. To provide this assessment, we look at both revenue capacity and effort in Gwinnett compared to the Atlanta Regional Commission (ARC) 20 county area.

Table 30: Estimated 2005 Expected Per Capita Revenue, Effort and Capacity for ARC's Regional Counties

ARC's 20-County	Estimated 2005 Population*	Expected Revenue Per Capita**	Estimated Capacity	Estimated Effort
Barrow County	59,920	$ 423	0.79	0.69
Bartow County	89,049	491	0.92	0.86
Carroll County	104,386	413	0.77	0.65
Cherokee County	184,360	554	1.04	0.77
Clayton County	266,614	461	0.86	1.09
Cobb County	663,528	561	1.05	1.04
Coweta County	109,769	494	0.92	0.74
DeKalb County	713,679	516	0.97	1.09
Douglas County	112,914	486	0.91	0.87
Fayette County	104,186	659	1.23	0.65
Forsyth County	140,804	664	1.24	0.79
Fulton County	934,242	639	1.20	1.03
Gwinnett County	**726,790**	**524**	**0.98**	**1.25**
Hall County	166,302	502	0.94	0.82
Henry County	168,204	500	0.94	1.00
Newton County	86,529	451	0.84	0.91
Paulding County	112,566	461	0.86	0.79
Rockdale County	78,398	482	0.90	1.17
Spalding County	61,262	408	0.76	1.18
Walton County	75,670	Did not report all revenue sources		

* U.S. Census July 1, 2005 estimates.

** Based on average millage of 10.46 per $1000 property value and average SPLOST/LOST revenues. Includes average fee, charge, and other source revenues.

The twenty ARC counties are listed in Table 30 along with expected (average) millage rate, expected revenues per capita, estimated capacity, and estimated effort. Using the net certified tax digest[2] provided by the Georgia Department of Revenue, we derive the expected average

[2] Traditionally, the Department of Community Affairs has used the gross tax digest. Using the gross digest produces an overall expected revenue collection. One issue with using the gross digest is that it assumes an ability to collect revenue from exempt properties. This distorts a county's revenue constraint in that the State and Federal

revenue per capita for Gwinnett which is $524 per capita. Using the Representative Tax System (RTS) method, we estimate Gwinnett County's tax capacity. Tax capacity is defined as how much revenue Gwinnett County would collect in a year if it levied the average tax rate for the ARC 20 county area for Gwinnett County's economic base.
Estimated revenue effort is the percentage value of each county's actual revenue collections relative to its revenue capacity. Accordingly, effort measures the extent to which a county is taxing its taxable resources relative to the average of all counties in the ARC 20 county area.

Both the estimated revenue capacity and the estimated revenue effort indicate the fiscal effort in Gwinnett County. Revenue capacity based on Gwinnett County's economic base is at 98%. Looking at effort, Gwinnett County actually collects 125% of its tax capacity, the highest in the ARC 20 county area.

In Option 3, we begin to look at options not used in Gwinnett County in FY2005. The major revenue choice that Gwinnett County currently uses includes property taxes and SPLOST. These two major revenue sources accounted for about 59.5% of all revenues in FY2005. An option to the SPLOST is the Local Option Sales Tax (LOST), a tax that unlike the SPLOST can be used for operating costs. Under the LOST, any government within the county is deemed qualified to receive a distribution of the LOST revenues if that government levies at least one tax in addition to the sales tax and provides at least three of the following six services: water, sewage, law enforcement, fire protection, garbage collection, or libraries. Incorporated governments that fulfill these conditions are allowed under the legislation to receive a share of the LOST revenues. The limitation of the LOST is that a population based proportion of the revenue generated under the LOST is allocated to the incorporated cities within the county. This usually differs from the SPLOST which may have a revenue share with the incorporated cities within the county; however the revenue is restricted to capital spending. Thus, Option 3 would include a shift away from a SPLOST and into a LOST. The effect would be a decrease in infrastructure construction, but an increase in flexibility to use the LOST funding for operating or recurring expenses. In Table 31, we show the projected SPLOST and LOST revenue in 2005 dollars for the three scenarios in 2030.

Table 31: SPLOST and LOST Forecasted Revenue in 2030 (in Millions of Dollars)

Revenue Category	Scenario	Forecasted Revenues
SPLOST or LOST	Slowdown	$166
	Middle	$190
	Gateway	$202

Revenue derived by either source, SPLOST or LOST, should be virtually identical since the sales tax base is the same. Given that the population of unincorporated Gwinnett County is about 80% of the total population of the county, about 20% of the funds raised in a LOST would be allocated to the municipal governments within the county. Care must be taken with these general estimates since the distribution of LOST dollars is traditionally resolved within an intergovernmental agreement. The intergovernmental agreement between the County and the

governments exempt properties based on enacted laws that counties cannot effect. Thus, a more accurate measure is to use the net tax digest when computing a capacity or tax effort numeric.

municipalities is usually based on an authoritative population count, traditionally within the State of Georgia this authority is the Decennial US Census.

Option 4 follows from Option 3. If Gwinnett County moved to a LOST that would leave a large loss in revenue for infrastructure construction. However, with the introduction of a LOST, the County would have a series of options. One option would be to spend all the revenue raised by the LOST in the same manner as the current SPLOST. This would have no effect on infrastructure spending, however it would not provide the needed operating revenue. Another option would be to address infrastructure needs with Tax Allocation Districts (TAD). The most significant financing innovation associated with TADs is the use of TAD-backed debt. The County can issue debt to fund infrastructure improvements in a specifically recognized area, dedicating the anticipated increase in property revenue to finance the debt. Recently, Georgia expanded this law to allow localities to commit incremental gains in sales taxes and other taxes such as the hotel-motel taxes to support TAD activities. In most cases, the incremental revenues involved include those of all the tax jurisdictions that overlap with the TAD – cities, counties, schools, and special districts. One limitation is that intergovernmental cooperation is required: under Georgia State Law all the affected jurisdictions must agree to commit their incremental revenues to the TAD.

TAD benefits are:

- Finance economic development activities based on anticipated increases in revenues, rather than drawing on the current tax base.
- Issue TAD debt, which is not calculated in the state-imposed local debt ceilings.
- TAD debt does not require the full faith and credit of the issuing jurisdiction.
- Overlapping jurisdictions can use pooled resources to support economic development activities
- Access to redevelopment powers, such as eminent domain.

TAD risks include:

- Reduction of the net wealth of jurisdictions due to:
    - TAD revenues used to finance projects do not materialize sufficiently to cover the costs of the debt issued or other public sector investments
    - Increased capital costs due to debt risk as perceived by the market
    - Moral obligation of locality due to default on debt issued
- TAD investments may stimulate growth, thereby increasing demand for local services while incremental revenue is used to pay debt obligation and not new service requirements
- TAD resources provided to benefit businesses when the business may have made the necessary improvements or investments without public support

TADs may also come with social equity issues that have been associated with previous redevelopment policies. For instance, TADs may explicitly or inadvertently force low to moderate income families out of neighborhoods as new investment and redevelopment occurs, commonly described as gentrification. These costs and risks are non-trivial, so the State of Georgia and other localities have adopted strategies to address these risks. In Georgia a

jurisdiction can only commit 10 percent of its property tax base to TADs at any given point in time. This limitation allows localities to develop TADs as part of an overall planning and economic development strategy. This provides an opportunity for local governments to identify the areas that should be targeted for redevelopment, identifying the public purpose that will be served by TAD, and the types of projects that are appropriate for TAD backing. Similar to good capital planning and infrastructure construction, local governments need to conduct careful feasibility, fiscal impact, and cost-benefit analysis of proposed TAD projects.

TAD also provides the opportunity for local governments to share risk with the private sector. This should lead to agreed upon annual performance audits or evaluations, as well as financial audits, to determine private sector progress towards agreed upon goals. These audits need to indicate how public funds are being used to support TAD redevelopment plans. Within the public-private partnership brought about through the use of TAD, specification of the sanctions for failure to meet goals should be developed.

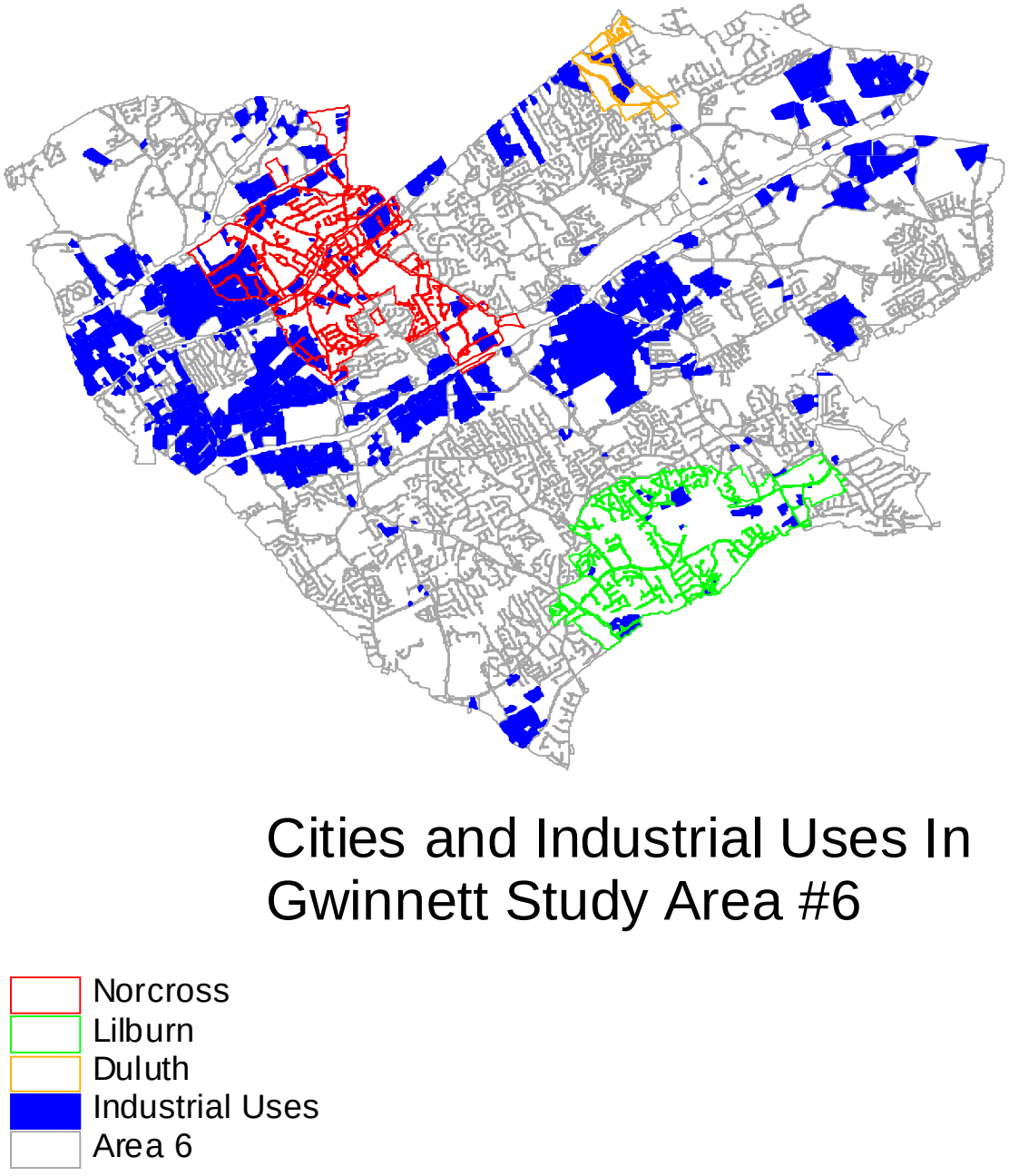
As a concluding measure, TAD debt needs to be assessed in conjunction with the initial review of the project(s) being considered. This should lead to a thorough "worst case" scenario that anticipates a potential shortfall in TAD revenues and how that revenue would be derived external of the TAD. As an example we look at sub-county area 6 which is located on the I-85 corridor. Figure 3 indicates the industrial areas within sub-county area 6. The industrial areas within this sub-county area total about 5,258 acres out of 33,600 or about 15.65% of the land. Industrial uses include:

Distribution warehouse
Light manufacturing
Light warehouse
Lumber storage
Mini warehouse
Truck stop
Utility storage

We find that in FY2005 17.5% of total land and building value in sub-county area 6 were contributed by industrial properties. This is about 3% of the entire property tax base in Gwinnett, far below the maximum allowed under Georgia Law. The industrial properties have associated Gwinnett County revenue of approximately $9.56 million. If we placed these properties within a TAD, holding the millage rate constant, a 1% increase in industrial property value would lead to an increase of tax revenue of about $95,000. In the TADs, an intergovernmental agreement as required by the State of Georgia, would also allow collection of the Gwinnett County School District incremental revenue raised from the industrial properties. This would raise approximately $169,000 additional dollars per year. This would allow for a combined incremental revenue increase of $264,000 annually excluding any additional sources such as municipal or other overlay tax sources. Given this incremental cash flow, we look at a simple issuance of a bond. For example, the Bloomberg posted average rate for FY2005 for a Triple A rated (AAA) municipal issue has an associated interest yield of 4.5%. Using a scenario that includes an issuance cost of 3%, the $264,000 annual incremental revenue from the sub-county area 6 industrial properties would lead to a potential bond issuance of $3,434,000. If we

look at the leverage potential, for every $1 incremental increase in tax collection in the industrial area of sub-county area 6 leads to a potential indebtedness of $13.

Figure 3: Sub-County Area 6



Considering the current debt ratios for Gwinnett County Government, the issuance of this debt does not appear to have any adverse affects on the current bond ratings. This debt revenue could then be used within the TAD to provide additional leverage for public-private partnerships or development incentives in the provision of infrastructure. This narrow look at a small area could be expanded and enhanced with a series of potential revenue sources including impact fees to derive an increased leverage ratio or the use of other tax sources as allowed under Georgia Law for TADs.

An option to the TADs is the Community Improvement Districts (CID). Community Improvement Districts are authorized at Section VII of Article IX of the Constitution. Art IX, Sec VII, paragraph (c) limits the tax rate to a maximum of 25 mills (2.5 % of assessed value). This section also specifies the petition requirement – a majority of all property owners and owners representing 75% of the value of all properties must sign the petition requesting creation of the CID (Art IX, Sec VII (b)(2)(A) and (B). The most limiting aspect of CIDs is the 2.5% of assessed value. This is far more limiting than the TADs limit of 10% of assessed value and the millage in the CID is constrained to 25 mills, however in the TADs there is no limit on the increased value within the TAD.

Fiscal Analysis Conclusion

In this analysis we have offered two estimation techniques for the projected expenditures and revenues in 2030 for Gwinnett County. Using the three land use scenarios, we find that the Slowdown, Middle, and Gateway scenarios in the WebFIT™ simulation are at breakeven. Thus, in these cases, revenues are project to equal expenditures under this modeling technique.

In the Alternative model analysis, we find that both the Slowdown and the Middle scenarios are in deficit. Four options are offered to address these deficits through optional financing mechanisms provided under Georgia Law.

Our projections of Gwinnett County's financial situation in 2030 are based on past history and projected changes in a county that is maturing. Many of the surrounding counties, particularly those north of Gwinnett County, indicate that Gwinnett County is in a maturation cycle. We have estimated the effects of this maturation process on the revenues and expenditures of Gwinnett County in 2030. We provide these forecasted estimates as a potential outcome and assume that the forecasts will be used to enhance Gwinnett County's plan for its future growth.

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Appendix A – Transportation Analysis

One of the key aspects to long range estimations is to look at the impact on transportation. Congestion mitigation, transit allocation, and project costs are common impedments when growth is forecasted in a long range fiscal estimation. A limiting factor for local governments, such as Gwinnett County, is the intergovernmental complexity of surface transportation financing. According to the Georgia Department of Transportation (GDOT), the GDOT assistance for local government streets and roads primarily is provided through two programs, the Local Assistance Road Program (LARP) which is designated exclusively for resurfacing, and State Aid contracts, which cities and counties can use for any type of road or bridge work. Table 32 provides a breakdown for FY2006 and FY2007 LARP funding by type of area for Gwinnett County and the three comparable counties based on size, Cobb, DeKalb, and Fulton counties. The LARP funding for Gwinnett County, with its large population within the unincorporated areas, shows it is receiving a larger amount of funding than its comparable counties and both the state average and median over the 2 year time period.

Table 32: Local Assistance Road Program Funding (LARP) FY2006 and FY2007

	Unincorporated			Municipal		
FY2006	**Funding**	**Miles**	**Per Mile**	**Funding**	**Miles**	**Per Mile**
Cobb	$ 415,795	6.53	$ 63,675	$ 1,334,731	23.34	$ 57,186
Fulton	138,861	1.87	74,257	255,566	3.84	66,554
DeKalb	356,759	4.00	89,190	272,740	3.57	76,398
Gwinnett	1,938,955	30.85	62,851	430,749	6.72	64,099
State Average	*222,821*	*4.27*	*52,220*	*37,467*	*0.58*	*64,910*
State Median	$ *84,672*	*2.98*	$*61,970*	$ *18,873*	*0.30*	$*62,911*
FY2007						
Cobb	$2,062,005	26.97	$ 76,456	$ 410,243	7.96	$ 51,538
DeKalb	1,705,769	22.28	76,561	488,986	5.59	87,475
Fulton	732,907	12.48	58,727	2,461,085	27.04	91,016
Gwinnett	2,326,762	31.64	73,539	444,259	5.87	75,683
State Average	*217,652*	*3.80*	*57,254*	*37,572*	*0.52*	*72,888*
State Median	$ *160,682*	*2.48*	$*64,791*	$ *19,203*	*0.27*	$*71,122*

Table 33 provides a similar comparison as that offered in Table 32; however Table 33 indicates the funding through State Aid. The two tables differ in that State Aid funding can be spent on any type of bridge or road work thereby not limiting the funding to resurfacing as found in LARP. As shown in Table 33, funding through state aid is uneven when compared to LARP funding. These two years of funding are important since they represent a change in funding by the GDOT, the two years are under a program entitled "Paving The Way Home" that utilized state motor fuel tax revenues to help Georgia cities and counties repair deteriorating streets and roads. As is shown in the two tables, although these two years were focused on for funding local governments, Gwinnett County's unincorporated areas received a total of $4,265,717 for resurfacing and $2,507,824 for road and bridge for the two year time period. If we assumed that the road and bridge funding would be available continuously in this amount, the Ronald Reagan Parkway extension, at a projected cost of $48,198,000 will be substantially underfunded. Gwinnett County is not alone in this situation. According to recent Census data, Counties with populations above 100,000 spent $9.745 billion on highways. Other data shows that local

governments spend about $28 billion annually on transit, about 300 per cent more than the states and almost 350 per cent more than the federal government.

Table 33: State Aid Funding for Roads and Bridges FY2006 and FY2007

	Unincorporated			Municipal		
FY2006	**Funding**	**Miles**	**Per Mile**	**Funding**	**Miles**	**Per Mile**
Cobb	$859,135	1.76				
Fulton				$11,000	0.33	$33,333
DeKalb	164,384	2.35		1,850,000	0.65	2,846,154
Gwinnett	2,499,994	2.22				
State Average	**121,106**	**3.28**	**36,871**	**108,861**	**0.76**	**142,421**
State Median	**$80,000**	**1.24**	**$64,516**	**$37,937**	**0.36**	**$105,380**
FY2007						
Cobb	$299,924	7.88	$38,061	$110,302	0.34	$324,418
DeKalb	1,002,625	13.58	73,831	86,098	1.73	49,768
Fulton				351,533	3.07	114,506
Gwinnett	7,830	0.00		544,221	15.00	36,281
State Average	**95,926**	**2.05**	**46,793**	**118,348**	**0.97**	**122,371**
State Median	**$106,551**	**1.07**	**$100,048**	**$56,361**	**0.56**	**$100,645**

Gwinnett County, like most local governments, raise highway funds almost entirely from own source revenues, property taxes and the general fund. This is in contrast to state governments which raise about 75 per cent of revenues for highways and transit from gas taxes and vehicle fees. This is a problem for local governments which, unlike their intergovernmental partners, rely primarily on sources of revenue that have nothing to do with usage of the system. From the perspective of a citizen who is caught in congestion or navigating an unsafe road, the connection between increasing property taxes and better roads is not clear. Impeding local governments further is that local government taxing options are somewhat limited by both politics and because local taxing authority is something that must be given to a local government by state action or permission. Even when local officials are willing to take a chance by imposing additional or new taxes for transportation, a state may not allow change.

So what can local governments, like Gwinnett County, do to provide needed infrastructure without changing state law? There are limited resources in federal aid for municipal and county governments, but that makes up only about 2% of the total funds used for road construction. Other sources that have been used are income tax, state aid, property tax, sales tax, and other revenue. Currently, SPLOST, property tax, and other tax revenue sources such as TAD and CIDs are the limited sources local governments have to provide local roads and bridges. As noted earlier, State Aid and LARP are minor sources of revenues for large projects. Debt financing as either pay-as-you-go or general obligation bonds are an additional option. Currently, Georgia law does not allow for a local option gasoline tax as found in Florida. Although there are no simple answers, Georgia law does allow for public private partnerships, however the sale of a road to a private corporation as a basis for revenue as found in toll fees has not yet been accomplished in Georgia. Several states, such as Virginia have used public-private partnerships, such as the Pocahontas Parkway project in 1998. Projects that meet the regional importance criteria can apply to the Transportation Infrastructure Finance and Innovation Act (TIFIA). This federal program makes credit available in the form of

secured loans, loan guarantees, and standby lines of credit for projects; however this program does not alleviate the need to raise revenues.

Transportation Analysis Conclusion

In Georgia, local governments have a limited ability to raise revenues outside of general fund revenues and debt financing. Given that state aid to local roads is limited, choices such as public-private partnerships may provide options under Georgia Law. The use of a local option gasoline tax, currently not allowed under Georgia Law could provide local governments with additional choices for funding projects. This taxation idea, currently in use in Florida, would require passage of state law to allow local governments the opportunity for funding based on road usage, instead of the current revenue structure which does not relate to transportation infrastructure usage.