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Memo

To: Jack E. Miller, City Manager of Crossville TN
J. H. Graham, Mayor of Crossville TN
Brock Hill, Mayor of Cumberland County TN
Everett L. Bolin, General Manager of Crab Orchard Utility District
Sandra Brewer, General Manager of South Cumberland Utility District
David Bell, Field Manager of West Cumberland Utility District
Walter Green and Parvathi Gaddipati, Nashville District Corps of Engineers
Dan Eagar, TDEC Water Pollution Control

From: Stuart Stein and Karsten Sedmera, GKY & Associates, Inc. (GKY&A)

Date: December 13, 2006

Re: Land-use assumptions for Phase II of the Cumberland County Regional Water Supply Study

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Background

The Cumberland County Water Supply project was initiated in 2006 by the Nashville District of the U.S. Army Corps of Engineers (USACE) on behalf of the City of Crossville, TN. Recent growth rates have many officials concerned about their future need for water. Thus, the overall goal of the project is to find a regional water solution that will meet the County's need for water over the next fifty years. In the first phase of this project, four people – two from GKY&A and two from the Nashville District USACE – conducted a field visit in Cumberland County TN from May 17-18, 2006 in order to collect data. The Phase I memorandum, dated June 1 2006, summarizes the field visit, pertinent literature, and many of the subsequent communications with various County, City, and Corps officials. This memorandum summarizes the proposed land-use assumptions for Cumberland County TN that will be used to predict the demand for water in the County over the next 50 years. Please review the logic behind these assumptions, assess the three proposed growth scenarios, and then submit written comments regarding your opinion of the assumptions for the three scenarios.

Supporting Data

Table 1 summarizes the pertinent land development, demography, and environmental features that are available for Cumberland County in digital geospatial form, and their general characteristics. Cumberland County lacks a formal Comprehensive Plan that can be used to predict future development. However, there are tax assessment records and water and electric records available that reveal certain spatial and temporal patterns in recent land development.

Table 1. Land-use, demography, and environmental data sets for Cumberland County.

Data Type	Parameters	Regional Extent	Publishing Date
Land parcels	61,467 shapes, parcel ID, area, perimeter	County	2000, 03, 06
Tax assessments	Parcel ID, ownership, land use class, market values for land and improvements	County	2006
Census blocks	24 shapes, ID, population, housing, occupancy	County	1990, 2000
Census places	5 shapes, ID, population, housing, occupancy	Cities/CDPs	1990, 2000
General census	Full suite of census demographics	County	1990, 2000
General census	Total population	County	1970-2000
Census estimate	Annual total population and housing estimates	County	1990-2005
HOA estimates	Population	Cities/CDPs	2006
Commerce	Employment, income, electric meters, etc.	County	1980-2005*
Projections	Total population[1, 2]	County	2000-2050*
Utility districts	4 shapes, utility name	County	2006
Roads	Lines, TIGER road names, route number	County	2000
Streams, gages	930 lines, stream name, HUC; 12 gages, discharge, drainage area	County	Varied
Topography	Elevation (30-m grid): slope	County	Varied

** Some of these data sets have a shorter period than the range listed here.*

Figure 1 shows the five census places in 2000 and the four current utility district (UD) boundaries in Cumberland County TN. Crossville and Crab Orchard are currently the only utility districts in the County that supply their own water. Grandview UD, which serves about 500 customers in the SE corner of the County, is not shown in the figure because it is small, dependent on the Crossville UD, and could not be contacted. The Catoosa UD, which formerly served the north to northwestern part of the County, is also not shown because it merged with the Crossville UD in October 2005. Furthermore, the South Cumberland UD currently buys all of its water from Crossville, while the West Cumberland UD buys water from both Crossville and BonDeCroft (in White County, to the west).

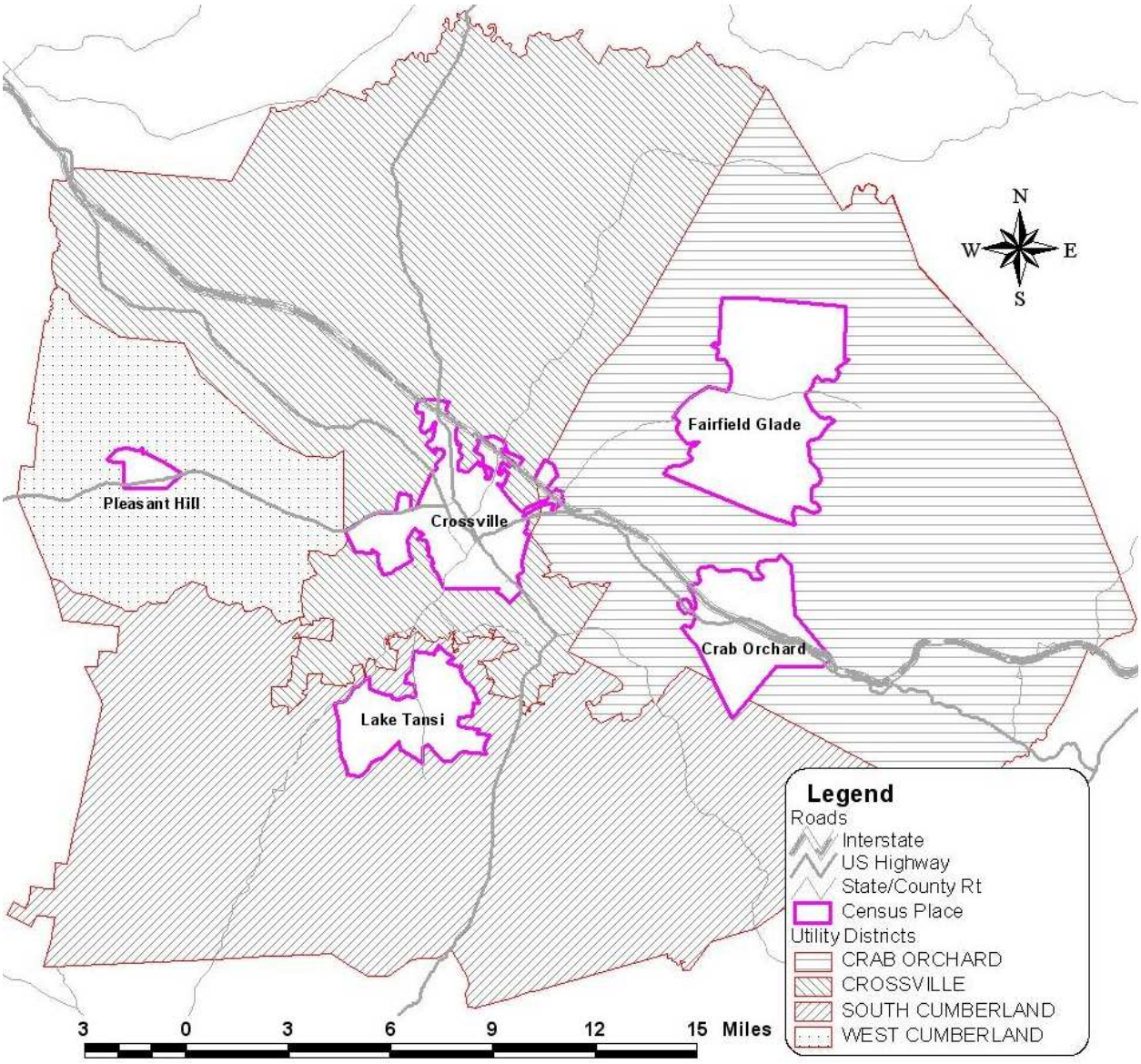

Figure 1. Census places and water utility districts in Cumberland County, TN.

Land Development Analysis

One of the important steps in predicting future water demand in the next 50 years is the difficult task of predicting future population growth and land-use patterns in Cumberland County, TN. This is important because land-use is one of the primary ways to classify different water consumer needs. Cumberland County, however, does not have any formal land-use plan (i.e., zoning) in place to control (or predict) local patterns of growth. While there are a few studies that predict population growth for the County as a whole, none of them appear to focus on local growth rates or detailed land-use patterns. Furthermore, interviews with City, County, and utility officials revealed that they think that local growth rates have increased in the past 3-5 years, perhaps more than what legacy studies predicted.

Cumberland County was one of 10 counties recently selected by the Tennessee Department of Economic and Community Development to participate in a pilot study called “Retire Tennessee” that is designed to promote Tennessee as a great place for retirees to call home. This award derives in

part from Cumberland County officials' efforts to attract retirees by providing low taxes, golf courses, and promoting various retirement communities. The success of these efforts is partly corroborated by the parcels data, which lists many out-of-state property owners. Lake Tansi and Fairfield Glade represent two established communities (not official cities) that attract retirees by offering small lots, convenient maintenance agreements, and various community club amenities. The three cities in the area – Crossville (the County seat), Pleasant Hill, and Crab Orchard – have similar attractions but more diverse development patterns. Crossville, however, has more dense residential communities than either Pleasant Hill or Crab Orchard. The remainder of the County is fairly rural, and most of the scattered residential lots cluster around the major roads shown in Figure 1. The largest rural development that is growing other than the census places shown in this figure is occurring on both sides of I-40 on the northwestern border of the County in two related communities called Cumberland Cove and Cumberland Lakes, which boast large lots and rustic "dream" homes.

Table 2 shows some statistics from the parcels data from the tax assessor's office. This data base contains data that classifies each parcel into one of 12 land-use categories. It also lists the assessed land value and improvement value for each parcel. Thus any parcel with an improvement value greater than 0 has been developed. For the purpose of estimating population density, only developed parcels that are classified as residential, farm, agricultural, or forest are likely to have homes on them. A few of the developed parcels classified as farm have improvement values reflecting recreational (e.g., golf resorts) or farm buildings, but most of them are residential lots with over 15 acres. Agricultural or forest parcels are "farms" that qualify for tax breaks under the TN Greenbelt program. This table also shows the following development patterns.

- 90% of parcels in the County are residential
- 6% are farm/agricultural/forest,
- 37% of the residential parcels are developed,
- 57% of the farm/agricultural/forest parcels are developed, and
- 83.7% of the land area is residential/farm/agricultural/forest.

The parcel data also shows that the dense residential communities generally cluster around Crossville, Fairfield Glade, Lake Tansi, and the Cumberland Cove and Cumberland Lakes area. Furthermore, of these four regions, the latter three contain 69% of the undeveloped residential parcels in Cumberland County. There is also a large state-owned wildlife preserve in the northeast corner of the County, which has almost no development in or immediately surrounding it. The land-use pattern outside of these five study regions, however, is remarkably similar. Thus, the five study regions selected for analysis are as follows.

- City of Crossville
- Cumberland Cove and Cumberland Lakes
- Fairfield Glade
- Lake Tansi
- Remainder of the County

Table 2. Statistics for Cumberland County parcels versus land-use and development.

Land-Use Category	Development	Number of Parcels	Total Area (acres)	Average Area (Acres)	Average Improvement Value
Residential	No	35,797	32,523	0.91	
Residential	Yes	21,166	40,298	1.90	$80,814
County	No	358	510	1.42	
County	Yes	39	481	12.34	$1,692,469
City	No	101	3,279	32.47	
City	Yes	107	532	4.97	$140,351
State	No	92	53,928	586.17	
State	Yes	7	2,764	394.83	$36,629
Federal	No	14	1,363	97.38	
Religious	No	173	245	1.41	
Religious	Yes	144	410	2.84	$378,275
Ed/Sci/Charitable	No	27	50	1.87	
Ed/Sci/Charitable	Yes	33	70	2.12	$163,082
Sap Utility	No	120	428	3.57	
Sap Utility	Yes	6	12	2.01	$138,400
Commercial	No	56	79	1.42	
Commercial	Yes	1,206	5,185	4.30	$229,743
Industrial	Yes	33	319	9.66	$699,718
Farm	No	1,158	116,817	100.88	
Farm	Yes	1,050	42,198	40.19	$134,469
Agricultural	No	383	31,674	82.70	
Agricultural	Yes	1,089	78,366	71.96	$95,489
Forest	No	92	13,172	143.18	
Forest	Yes	40	2,195	54.86	$138,218
Total / Average		*63,291*	*426,898*	*6.744*	*$327,305*

Note that some of the residential parcels bordering these communities may not formally belong to one of these communities, but were included in the five proposed study regions because they share the same residential density or local road(s) as the similarly-named communities.

Table 3 shows all of the pertinent data, analysis, and projections for these five study regions between the years 1990 and 2056. The five selected regions and the County totals are shown in six different groups of rows in the table. The columns in this table have two general sections. The first section, on the left, shows parcel and population statistics. The second section, on the right, shows the annual growth rates corresponding to the parcel or population statistics in certain rows. Each of the two general sections has three columns labeled “Observed” that have statistics collected from parcels data or census data/estimates. Next to the “Observed” columns are five columns labeled “Forecasted” that contain our assumptions regarding future growth after the year 2006 in 10-year increments. The “Parcel and Population Statistics” section has an additional column showing “saturation” totals for certain rows of data, while the “Annual Growth Rates (by increment)” section has an additional column showing the 50-year annual growth rate (i.e. 2006 to 2056) for certain rows of data. In this context, “RES” refers to residential parcels, “All” refers to residential/farm/agricultural/forest parcels, “Dev.” refers to developed parcels (i.e., improvement value > 0), “Lots” are parcels, and “Pop.” is the abbreviation for population. The “People/house” statistics are computed as the “Population count” divided by “All Dev. Lots” (houses). The projected 2006 populations for these study regions are computed as the product of “People/house” and “All Dev. Lots”. The “Remaining County” population and housing statistics were computed as the difference

between the “County-wide” numbers and the sum of the statistics for the other four study regions. The last three rows in each study region section of this table show the three forecasted growth scenarios. The slow growth scenario reflects the possibility that certain limitations (e.g. economic recession, open-space zoning, water/wastewater restrictions, etc.) will cause the County’s current growth rate to decline. The expected growth scenario is self-explanatory, while the aggressive growth scenario reflects the most optimistic growth conditions.

One of the first notable patterns in the “Observed” section of Table 3 is the decline in the “People/house” statistic in all five study regions between 1990 and 2006. This decline is consistent with Cumberland County’s efforts to attract retirees (i.e. typically one to two persons per household). Thus, one of the first assumptions in the land-development forecast is that the people/house statistic for each region is expected to level out. This expectation basically assumes that any future growth in the retirement-aged home-owner population will spur a corresponding growth in the supporting workforce, which is expected to consist of families with two or more people per household. The expected trends in people/house are specified in the “Forecasted” section of Table 3 and displayed in Figure 2.

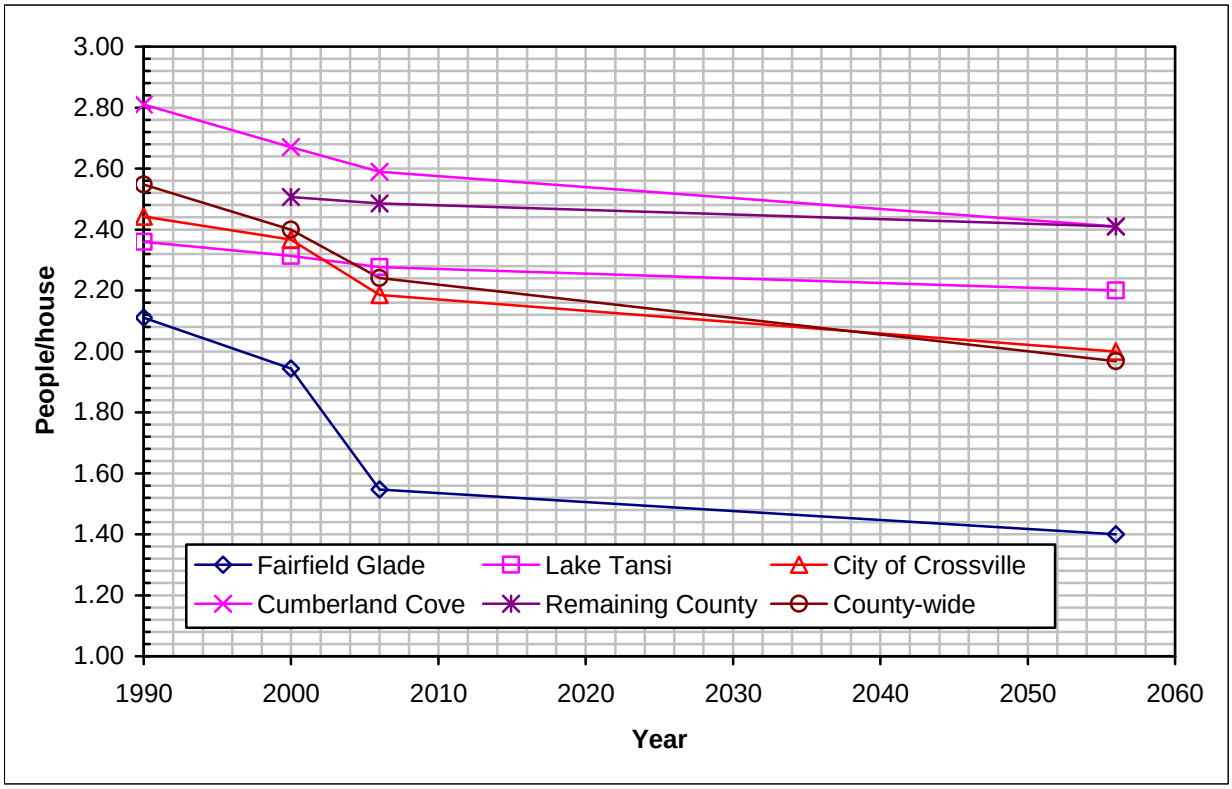

Figure 2. People per house statistics in each Cumberland County study region.

The growth scenarios assume that any expansion in the aerial extent of Fairfield Glade, Lake Tansi, Crossville, or “Cumberland Cove” classifies as growth in the “Remaining County”. The housing density (i.e. the number of lots in a region) in the same four regions is also assumed to remain relatively constant. Thus, the last column in the “Observed” section of Table 3 shows the housing saturation points for each study region – in other words, the total population and housing that would result if all of the existing residential parcels in these regions are inhabited by 2056. One caveat to these saturation points, however, is that the leading developer of Fairfield Glade has two parcels currently classified as “Farm” that are likely to be subdivided into smaller residential lots. Thus, Fairfield Glade’s saturation points (e.g. 21,449 in Table 3) include the number of new residential

parcels that could fit in these two "Farm" parcels given that they are developed with the same residential density as the rest of Fairfield Glade. Another caveat to these saturation points is that they don't really apply in the "Remaining County" region because many of the "Farm" parcels in this region are expected to be subdivided into smaller residential lots by 2056.

Another set of primary assumptions involved specifying future annual growth rates in population, which appear in bold font in Table 3, for the three growth scenarios in each study region. The selected values for the annual growth rates in these scenarios were generally based on the following four factors, but further discussion of each study region follows.

- Observed annual growth rates between 2000 and 2006
- Opinions of local stakeholders (i.e. City, County, and utility district officials, and land developers)
- The fully-developed saturation point assumptions described above
- The U.S. retirement forecast that results from applying Wiatrowski's retirement statistics[4] to the U.S. Census Bureau's 100-year population forecast (by age groups), namely that the annual growth rate in retirees (nation-wide) will increase from about 1% annually in 2000 to about 2.9% in 2015 and then decrease to about 1% annually by 2036 and thereafter

Fairfield Glade has experienced a fairly steady, high growth rate for the last ten years. Fairfield Glade furthermore has many undeveloped parcels, attractive amenities, and enough community commitment and finances to upgrade their sewer plant capacity. Thus, Fairfield Glade is likely to continue growing at a steady 4.5% annual growth rate until the community approaches its housing saturation point.

Lake Tansi has more undeveloped residential parcels than Fairfield Glade and arguably equally-attractive amenities. However, all of the interviewed stakeholders agree that Lake Tansi's inability to get public sewer is limiting their potential for future growth. This is primary reason why the projected growth rates are less than the "historical" growth rate in Table 3. It is also possible that the large "historical" growth rate shown in this table (i.e. 10.8%) may be inflated because the Lake Tansi Homeowner Association's estimate of its population in 2006 may apply to a larger area than the 2000 census area, which does not enclose all of the residential parcels that appear to be part of the Lake Tansi community. Lake Tansi official's current (and partially-funded) plan to gradually increase the sewer capacity will probably sustain a moderate to high growth rate. However, if Lake Tansi builds a sewer plant capable of supporting new home buyers, the growth rate may exceed the growth in the other regions of the County. Regardless of the sewer capacity installed, the annual growth will likely follow the trend in US retirees.

The City of Crossville has some undeveloped lots and many attractive amenities, but most of Crossville's potential for growth is via subdivision of farm parcels bordering or near the current city limits. Expansion of city limits is, in fact, expected when in five years the future road dubbed the "Northwest connector" connects Genesis Road (near I-40) to HW 70 west. However, this road is primarily expected to attract commercial growth. Residential growth may eventually follow, but probably further from town. Thus, Crossville is expected to steadily grow (historically about 2.5% annually) with the trend in US retirees, but most of that growth will occur in areas that this study considers "Remaining County".

The Cumberland Cove area, which includes the Cumberland Lakes development, has many scenic and undeveloped parcels and attractive amenities. Many of the lots are suitable for septic systems, and a leading developer in this area is negotiating with the Crossville UD for a water line. However, the larger lots and "dream" homes arguably attract a smaller market of home buyers. Since none of

these issues are likely to slow the growth in this study region, the annual growth in this study region (historically about 2% annually) is likely to continue and may follow the trend in US retirees.

The “Remaining County” has been experiencing steady growth as more farms are subdivided and sold. These developments take more effort than developments near one of the already mentioned communities, but many of these succeed due to sufficient well and septic conditions. The statistics in Table 3 for this study region and phone interviews with County officials and local developers suggest that the historical growth is something less than 1% annually. Since this study region also includes areas surrounding the other four study regions, its growth rate will probably increase as the other four study regions approach their respective saturation points. Thus, we expect the annual growth in the “Remaining County” will increase as the other study areas approach their respective saturation points.

Table 4 shows the housing forecasts for each growth scenario and study region. The number of houses was computed from Table 3 by dividing the forecasted population by the people/house statistic. Employment data from the Cumberland County Chamber of Commerce shows that the ratio of County population over the number of employees from 1990 to 2006 has been somewhat variable but averages about 2.41 (residents/employee). According to Crossville Mayor J. H. Graham, this statistic agrees fairly well with his experience and with statistics for rural, service-oriented, communities cited in books such as Boomtown USA by Jack Schultz, Hot Towns by Peter Wolf, and The Small Town Survival Guide by Jack McCall. Since there are no indications that Cumberland County will ever have any other type of commercial development or industry, it is probably safe to assume that the approximate number of employees will remain about 41.5% of the total population. This employment assumption is illustrated for each study region and growth scenario in Table 5.

All of the analysis described above ultimately show that the “expected” growth scenario predicts that Cumberland County’s population will grow at an annual average growth rate of about 1.78% over the next 50 years. The slow growth scenario predicts about 1.0% annual growth over 50 years, and the aggressive growth scenario predicts about 2.31% annual growth over 50 years. The county-wide population growth for the three growth scenarios is illustrated in Figure A.1 of Appendix A. This figure also shows the county-wide census population from 1970 to 2000, and the population forecasts from Breedlove, Dennis, Young & Associates, Inc. (BDY&A)[(1)] and the Tennessee Advisory Commission on Intergovernmental Relations (TNACIGR)[(2)]. Figures A.2 through A.4 illustrate the three growth scenarios (slow, expected, and aggressive) in order to compare the predicted trends in all five study regions for a given growth scenario.

Table 3. Population assumptions for five study regions in Cumberland County TN.

Parcel and Population Statistics									*Total if all*	**Annual Growth Rates (by increment)**								
Numbers by	*Observed*			*Forecasted*					*RES parcels*	*Observed*			*Forecasted*					50-yr
Region/Variable	**1990**	**2000**	**2006**	**2016**	**2026**	**2036**	**2046**	**2056**	*are developed*	**1990**	**2000**	**2006**	**2016**	**2026**	**2036**	**2046**	**2056**	Growth Rate
Fairfield Glade																		
All Res. Lots			18,918						21,464									
Dev. Res. Lots			4,083															
All Dev. Lots	1,064	2,513	4,137								8.97%	8.66%						
Population Count	2,246	4,885	6,400						30,125		8.08%	4.61%						
People/House	2.11	1.94	1.55	1.50	1.46	1.44	1.42	1.40										
Slow Pop. Growth	2,246	4,885	6,400	9,474	12,732	15,520	18,919	23,062			8.08%	4.61%	**4.00%**	**3.00%**	**2.00%**	**2.00%**	**2.00%**	2.60%
Expected Pop. Growth	2,246	4,885	6,400	9,939	15,435	22,848	30,125	30,125			8.08%	4.61%	**4.50%**	**4.50%**	**4.00%**	2.80%	0.00%	3.15%
Aggressive Pop. Growth	2,246	4,885	6,400	10,932	18,674	30,125	30,125	30,125			8.08%	4.61%	**5.50%**	**5.50%**	4.90%	0.00%	0.00%	3.15%
Lake Tansi																		
All Res. Lots			10,698						10,698									
Dev. Res. Lots			2,192															
All Dev. Lots		1,166	2,196									11.13%						
Population Count		2,698	5,000						23,544			10.83%						
People/House	2.36	2.31	2.28	2.26	2.25	2.23	2.22	2.20										
Slow Pop. Growth		2,698	5,000	6,095	6,733	8,207	10,004	12,195				10.83%	**2.00%**	**1.00%**	**2.00%**	**2.00%**	**2.00%**	1.80%
Expected Pop. Growth		2,698	5,000	8,954	14,586	19,602	23,544	23,544				10.83%	**6.00%**	**5.00%**	**3.00%**	1.85%	0.00%	3.15%
Aggressive Pop. Growth		2,698	5,000	10,795	19,332	23,544	23,544	23,544				10.83%	**8.00%**	**6.00%**	1.99%	0.00%	0.00%	3.15%
City of Crossville																		
All Res. Lots			7,457						7,457									
Dev. Res. Lots			4,730															
All Dev. Lots	2,837	3,795	4,774									3.90%						
Population Count	6,930	8,981	10,433						15,002			2.53%						
People/House	2.44	2.37	2.19	2.14	2.10	2.07	2.04	2.00										
Slow Pop. Growth	6,930	8,981	10,433	12,718	15,002	15,002	15,002	15,002			2.63%	2.53%	**2.00%**	1.67%	0.00%	0.00%	0.00%	0.73%
Expected Pop. Growth	6,930	8,981	10,433	13,355	15,002	15,002	15,002	15,002			2.63%	2.53%	**2.50%**	1.17%	0.00%	0.00%	0.00%	0.73%
Aggressive Pop. Growth	6,930	8,981	10,433	14,021	15,002	15,002	15,002	15,002			2.63%	2.53%	**3.00%**	0.68%	0.00%	0.00%	0.00%	0.73%
Cumberland Cove																		
All Res. Lots			1,911						1,911									
Dev. Res. Lots			464															
All Dev. Lots		417	477									2.27%						
Population Count									4,637									
People/House	2.81	2.67	2.59	2.55	2.51	2.48	2.45	2.41										
Slow Pop. Growth		1,113	1,235	1,506	1,836	2,238	2,728	3,325				1.75%	**2.00%**	**2.00%**	**2.00%**	**2.00%**	**2.00%**	2.00%
Expected Pop. Growth		1,113	1,235	1,743	2,458	3,304	4,440	4,637				1.75%	**3.50%**	**3.50%**	**3.00%**	**3.00%**	0.44%	2.68%
Aggressive Pop. Growth		1,113	1,235	1,919	2,980	4,410	4,637	4,637				1.75%	**4.50%**	**4.50%**	**4.00%**	0.50%	0.00%	2.68%
Remaining County																		
All Res. Lots			17,979						17,979									
Dev. Res. Lots			9,697															
All Dev. Lots		11,617	11,761									0.21%						
Population Count		29,125	29,238						48,304			0.06%						
People/House		2.51	2.49	2.47	2.46	2.44	2.43	2.41										
Slow Pop. Growth		29,125	29,238	29,828	30,430	30,982	31,450	31,925				0.06%	**0.20%**	**0.20%**	**0.18%**	**0.15%**	**0.15%**	0.18%
Expected Pop. Growth		29,125	29,238	32,297	35,676	39,408	43,531	53,065				0.06%	**1.00%**	**1.00%**	**1.00%**	**1.00%**	**2.00%**	1.20%
Aggressive Pop. Growth		29,125	29,238	33,932	39,379	45,701	67,649	90,915				0.06%	**1.50%**	**1.50%**	**1.50%**	**4.00%**	**3.00%**	2.29%
County-wide																		
All Res. Lots			56,963						56,963									
Dev. Res. Lots			21,166															
All Dev. Lots	13,426	19,508	23,345								3.81%	3.04%						
Population Count	34,207	46,802	52,306						117,398		3.18%	1.87%						
People/House	2.55	2.40	2.24	2.17	2.09	2.03	1.98	1.99										
Slow Pop. Growth	34,207	46,802	52,306	59,620	66,732	71,949	78,103	85,509			3.18%	1.87%	1.32%	1.13%	0.76%	0.82%	0.91%	0.99%
Expected Pop. Growth	34,207	46,802	52,306	66,288	83,157	100,163	116,643	126,373			3.18%	1.87%	2.40%	2.29%	1.88%	1.53%	0.80%	1.78%
Aggressive Pop. Growth	34,207	46,802	52,306	71,598	95,366	118,783	140,958	164,223			3.18%	1.87%	3.19%	2.91%	2.22%	1.73%	1.54%	2.31%

Table 4. Housing assumptions for five study regions in Cumberland County TN.

Parcel and Housing Statistics									*Total if all*	**Annual Growth Rates (by increment)**								
Numbers by	*Observed*			*Forecasted*					*RES parcels*	*Observed*			*Forecasted*					50-yr
Region/Variable	**1990**	**2000**	**2006**	**2016**	**2026**	**2036**	**2046**	**2056**	*are developed*	**1990**	**2000**	**2006**	**2016**	**2026**	**2036**	**2046**	**2056**	Growth Rate
Fairfield Glade																		
All Res. Lots			18,918						21,464									
Dev. Res. Lots			4,083															
All Dev. Lots	1,064	2,513	4,137								8.97%	8.66%						
Population Count	2,246	4,885	6,400						30,125		8.08%	4.61%						
People/House	2.11	1.94	1.55	1.50	1.46	1.44	1.42	1.40										
Slow Pop. Growth	1,064	2,513	4,137	6,316	8,720	10,778	13,323	16,473			8.97%	8.66%	4.32%	3.28%	2.14%	2.14%	2.14%	2.80%
Expected Pop. Growth	1,064	2,513	4,137	6,626	10,572	15,866	21,215	21,518			8.97%	8.66%	4.82%	4.78%	4.14%	2.95%	0.14%	3.35%
Aggressive Pop. Growth	1,064	2,513	4,137	7,288	12,790	20,920	21,215	21,518			8.97%	8.66%	5.83%	5.79%	5.04%	0.14%	0.14%	3.35%
Lake Tansi																		
All Res. Lots			10,698						10,698									
Dev. Res. Lots			2,192															
All Dev. Lots		1,166	2,196									11.13%						
Population Count		2,698	5,000						23,544			10.83%						
People/House	2.36	2.31	2.28	2.26	2.25	2.23	2.22	2.20										
Slow Pop. Growth		1,166	2,196	2,697	2,999	3,680	4,517	5,543				11.13%	2.08%	1.07%	2.07%	2.07%	2.07%	1.87%
Expected Pop. Growth		1,166	2,196	3,962	6,497	8,790	10,630	10,702				11.13%	6.08%	5.07%	3.07%	1.92%	0.07%	3.22%
Aggressive Pop. Growth		1,166	2,196	4,776	8,611	10,558	10,630	10,702				11.13%	8.08%	6.07%	2.06%	0.07%	0.07%	3.22%
City of Crossville																		
All Res. Lots			7,457						7,457									
Dev. Res. Lots			4,730															
All Dev. Lots	2,837	3,795	4,774									3.90%						
Population Count	6,930	8,981	10,433						15,002			2.53%						
People/House	2.44	2.37	2.19	2.14	2.10	2.07	2.04	2.00										
Slow Pop. Growth	2,837	3,795	4,774	5,943	7,144	7,265	7,372	7,501			2.95%	3.90%	2.21%	1.86%	0.17%	0.15%	0.17%	0.91%
Expected Pop. Growth	2,837	3,795	4,774	6,241	7,144	7,265	7,372	7,501			2.95%	3.90%	2.72%	1.36%	0.17%	0.15%	0.17%	0.91%
Aggressive Pop. Growth	2,837	3,795	4,774	6,552	7,144	7,265	7,372	7,501			2.95%	3.90%	3.22%	0.87%	0.17%	0.15%	0.17%	0.91%
Cumberland Cove																		
All Res. Lots			1,911						1,911									
Dev. Res. Lots			464															
All Dev. Lots		417	477									2.27%						
Population Count									4,637									
People/House	2.81	2.67	2.59	2.55	2.51	2.48	2.45	2.41										
Slow Pop. Growth		417	477	591	731	902	1,113	1,380				2.27%	2.16%	2.16%	2.12%	2.12%	2.17%	2.15%
Expected Pop. Growth		417	477	683	979	1,332	1,812	1,924				2.27%	3.66%	3.66%	3.12%	3.13%	0.60%	2.83%
Aggressive Pop. Growth		417	477	752	1,187	1,778	1,893	1,924				2.27%	4.66%	4.67%	4.13%	0.62%	0.16%	2.83%
Remaining County																		
All Res. Lots			17,979						17,979									
Dev. Res. Lots			9,697															
All Dev. Lots		11,617	11,761									0.21%						
Population Count		29,125	29,238						48,304			0.06%						
People/House		2.51	2.49	2.47	2.46	2.44	2.43	2.41										
Slow Pop. Growth		11,617	11,761	12,076	12,395	12,698	12,969	13,247				0.21%	0.26%	0.26%	0.24%	0.21%	0.21%	0.24%
Expected Pop. Growth		11,617	11,761	13,076	14,532	16,151	17,951	22,018				0.21%	1.07%	1.06%	1.06%	1.06%	2.06%	1.26%
Aggressive Pop. Growth		11,617	11,761	13,738	16,040	18,730	27,897	37,724				0.21%	1.57%	1.56%	1.56%	4.06%	3.06%	2.36%
County-wide																		
All Res. Lots			56,963						56,963									
Dev. Res. Lots			21,166															
All Dev. Lots	13,426	19,508	23,345								3.81%	3.04%						
Population Count	34,207	46,802	52,306						117,398		3.18%	1.87%						
People/House	2.55	2.40	2.24	2.17	2.09	2.03	1.98	1.99										
Slow Pop. Growth	13,426	19,508	23,345	27,622	31,990	35,323	39,294	44,144			3.81%	3.04%	1.70%	1.48%	1.00%	1.07%	1.17%	1.28%
Expected Pop. Growth	13,426	19,508	23,345	30,588	39,724	49,404	58,980	63,664			3.81%	3.04%	2.74%	2.65%	2.20%	1.79%	0.77%	2.03%
Aggressive Pop. Growth	13,426	19,508	23,345	33,106	45,772	59,252	69,006	79,369			3.81%	3.04%	3.56%	3.29%	2.61%	1.54%	1.41%	2.48%

Table 5. Employment assumptions for five study regions in Cumberland County TN.

Parcel and Employment Statistics									*Total if all*	**Annual Growth Rates (by increment)**								
Numbers by	*Observed*			*Forecasted*					*RES parcels*	*Observed*			*Forecasted*					50-yr
Region/Variable	**1990**	**2000**	**2006**	**2016**	**2026**	**2036**	**2046**	**2056**	*are developed*	**1990**	**2000**	**2006**	**2016**	**2026**	**2036**	**2046**	**2056**	Growth Rate
Fairfield Glade																		
All Res. Lots			18,918						21,464									
Dev. Res. Lots			4,083															
All Dev. Lots	1,064	2,513	4,137								8.97%	8.66%						
Population Count	2,246	4,885	6,400						30,125		8.08%	4.61%						
People/House	2.11	1.94	1.55	1.50	1.46	1.44	1.42	1.40										
Slow Pop. Growth	928	2,030	2,590	3,931	5,283	6,440	7,850	9,569			8.15%	4.14%	4.26%	3.00%	2.00%	2.00%	2.00%	2.65%
Expected Pop. Growth	928	2,030	2,590	4,124	6,405	9,480	12,500	12,500			8.15%	4.14%	4.76%	4.50%	4.00%	2.80%	0.00%	3.20%
Aggressive Pop. Growth	928	2,030	2,590	4,536	7,748	12,500	12,500	12,500			8.15%	4.14%	5.76%	5.50%	4.90%	0.00%	0.00%	3.20%
Lake Tansi																		
All Res. Lots			10,698						10,698									
Dev. Res. Lots			2,192															
All Dev. Lots		1,166	2,196									11.13%						
Population Count		2,698	5,000						23,544			10.83%						
People/House	2.36	2.31	2.28	2.26	2.25	2.23	2.22	2.20										
Slow Pop. Growth		1,121	2,024	2,529	2,794	3,405	4,151	5,060				10.34%	2.25%	1.00%	2.00%	2.00%	2.00%	1.85%
Expected Pop. Growth		1,121	2,024	3,715	6,052	8,133	9,769	9,769				10.34%	6.26%	5.00%	3.00%	1.85%	0.00%	3.20%
Aggressive Pop. Growth		1,121	2,024	4,479	8,021	9,769	9,769	9,769				10.34%	8.27%	6.00%	1.99%	0.00%	0.00%	3.20%
City of Crossville																		
All Res. Lots			7,457						7,457									
Dev. Res. Lots			4,730															
All Dev. Lots	2,837	3,795	4,774									3.90%						
Population Count	6,930	8,981	10,433						15,002			2.53%						
People/House	2.44	2.37	2.19	2.14	2.10	2.07	2.04	2.00										
Slow Pop. Growth	2,863	3,732	4,223	5,277	6,225	6,225	6,225	6,225			2.69%	2.08%	2.25%	1.67%	0.00%	0.00%	0.00%	0.78%
Expected Pop. Growth	2,863	3,732	4,223	5,542	6,225	6,225	6,225	6,225			2.69%	2.08%	2.76%	1.17%	0.00%	0.00%	0.00%	0.78%
Aggressive Pop. Growth	2,863	3,732	4,223	5,818	6,225	6,225	6,225	6,225			2.69%	2.08%	3.26%	0.68%	0.00%	0.00%	0.00%	0.78%
Cumberland Cove																		
All Res. Lots			1,911						1,911									
Dev. Res. Lots			464															
All Dev. Lots		417	477									2.27%						
Population Count									4,637									
People/House	2.81	2.67	2.59	2.55	2.51	2.48	2.45	2.41										
Slow Pop. Growth		463	500	625	762	929	1,132	1,380				1.30%	2.25%	2.00%	2.00%	2.00%	2.00%	2.05%
Expected Pop. Growth		463	500	723	1,020	1,371	1,842	1,924				1.30%	3.76%	3.50%	3.00%	3.00%	0.44%	2.73%
Aggressive Pop. Growth		463	500	796	1,236	1,830	1,924	1,924				1.30%	4.76%	4.50%	4.00%	0.50%	0.00%	2.73%
Remaining County																		
All Res. Lots			17,979						17,979									
Dev. Res. Lots			9,697															
All Dev. Lots		11,617	11,761									0.21%						
Population Count		29,125	29,238						48,304			0.06%						
People/House		2.51	2.49	2.47	2.46	2.44	2.43	2.41										
Slow Pop. Growth		12,104	11,834	12,377	12,627	12,856	13,050	13,247				-0.38%	0.45%	0.20%	0.18%	0.15%	0.15%	0.23%
Expected Pop. Growth		12,104	11,834	13,401	14,803	16,352	18,063	22,018				-0.38%	1.25%	1.00%	1.00%	1.00%	2.00%	1.25%
Aggressive Pop. Growth		12,104	11,834	14,080	16,340	18,963	28,070	37,724				-0.38%	1.75%	1.50%	1.50%	4.00%	3.00%	2.35%
County-wide																		
All Res. Lots			56,963						56,963									
Dev. Res. Lots			21,166															
All Dev. Lots	13,426	19,508	23,345								3.81%	3.04%						
Population Count	34,207	46,802	52,306						117,398		3.18%	1.87%						
People/House	2.55	2.40	2.24	2.17	2.09	2.03	1.98	1.99										
Slow Pop. Growth	14,130	19,450	21,170	24,739	27,690	29,854	32,408	35,481			3.25%	1.42%	1.57%	1.13%	0.76%	0.82%	0.91%	1.04%
Expected Pop. Growth	14,130	19,450	21,170	27,505	34,505	41,562	48,400	52,437			3.25%	1.42%	2.65%	2.29%	1.88%	1.53%	0.80%	1.83%
Aggressive Pop. Growth	14,130	19,450	21,170	29,709	39,571	49,288	58,489	68,142			3.25%	1.42%	3.45%	2.91%	2.22%	1.73%	1.54%	2.37%

Conclusions

The population estimates resulting from these land-use assumptions generally predict that Cumberland County's population will double in the next 30-40 years. The expected growth scenario predicts that the County-wide population density will increase from 78 people/mi^2 to about 189 people/mi^2 over the next fifty years, slightly more than the year 2000 population density of neighboring Putnam County (155 people/mi^2). Cumberland County lacks a comprehensive land-use plan, which makes it difficult to predict future limits on population growth. A formal land-use plan would not only make such predictions and planning easier, but would be a prudent safeguard of Cumberland County's quality of life. Nevertheless, this analysis shows that the "slow" growth scenario correlates well with the TNACIGR forecast[(2)], and that the "expected" growth scenario is a little more aggressive than the historical quasi-linear extrapolation from the BDY&A study[(1)]. These observations are consistent with the fact that this study utilizes more detailed land-development analysis and more recent trends than the previous studies, and considers the expected peak in the US retirement population growth circa 2015. Thus, this land development analysis, which highlights expected trends in water consumers, provides the first key step toward predicting Cumberland County's need for water over the next fifty years.

Acknowledgments

We, at GKY&A, would like to acknowledge and thank many who helped us since our initial field visit. Mr. M. C. Deck of Crab Orchard was instrumental in helping us obtain County parcel data in GIS format for 2000, 2003, and 2006, and tax assessment data. Sally Oglesby of Crossville was instrumental in obtaining data and answers to many questions relating to Crossville's water records. We also thank Dr. Jack Miller of Crossville, Mayor J. H. Graham of Crossville, and Mayor Brock Hill and Ken Young of Cumberland County for their help in estimating future growth patterns.

References

1. Breedlove, Dennis, Young & Associates, Inc. (BDY&A). *Cumberland County Water Supply Needs Assessment*. May 2002.

2. Tennessee Advisory Commission on Intergovernmental Relations (TNACIGR). *Population Projections for the State of Tennessee 2005 to 2025*. Produced in cooperation with the University of Tennessee Center for Business and Economic Research. 2003.

3. Nashville District Army Corps of Engineers and Ogden Environmental and Energy Services, Inc. *Cumberland County Regional Water Supply Preliminary Engineering Report*. Nashville TN, December 1998.

4. Wiatrowski, W. J. "Changing Retirement Age: ups and downs". *Monthly Labor Review*. pp. 3-12, April 2001.

Appendix A: Development Scenario Plots

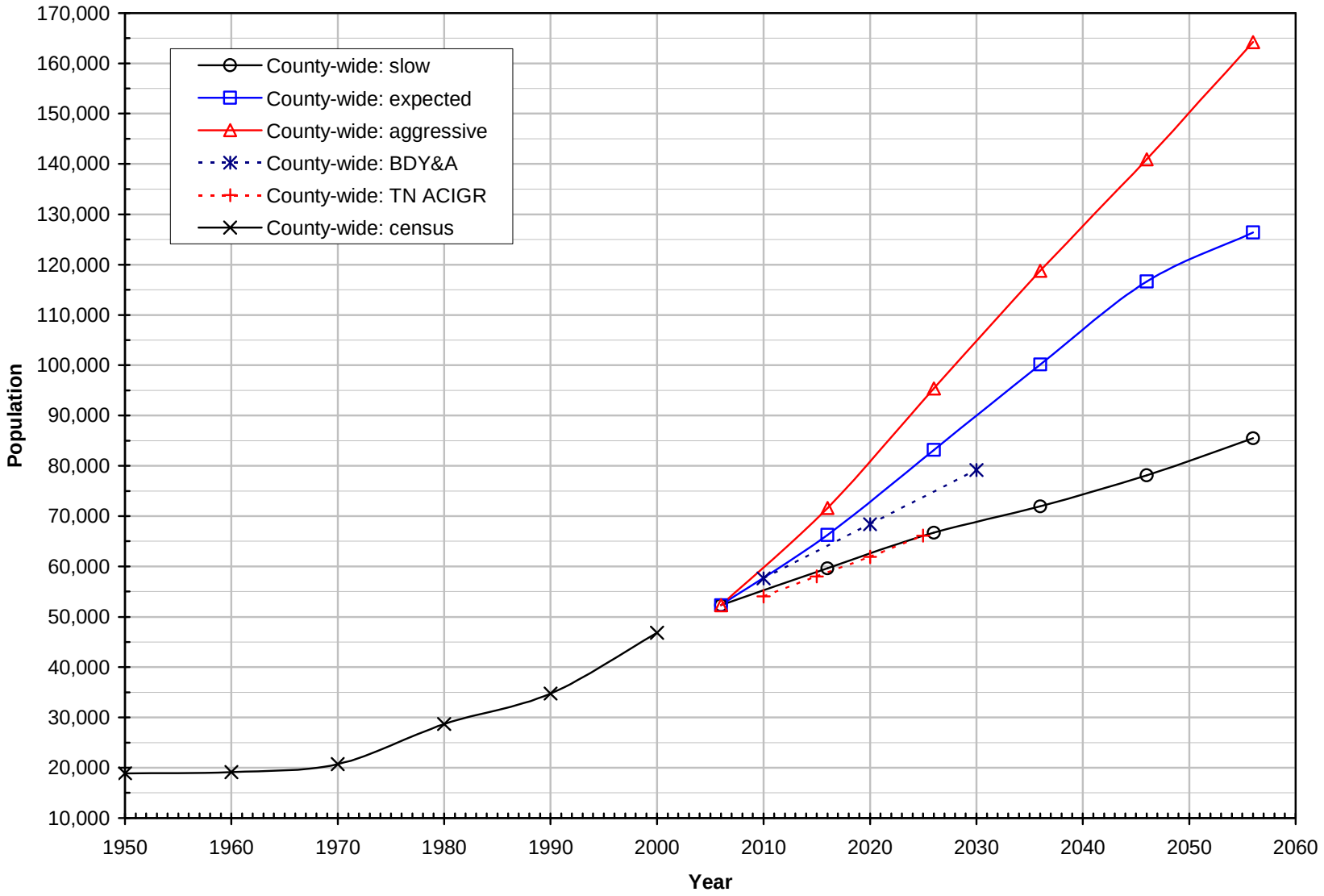

Figure A.1 Three growth scenarios for population in Cumberland County, TN

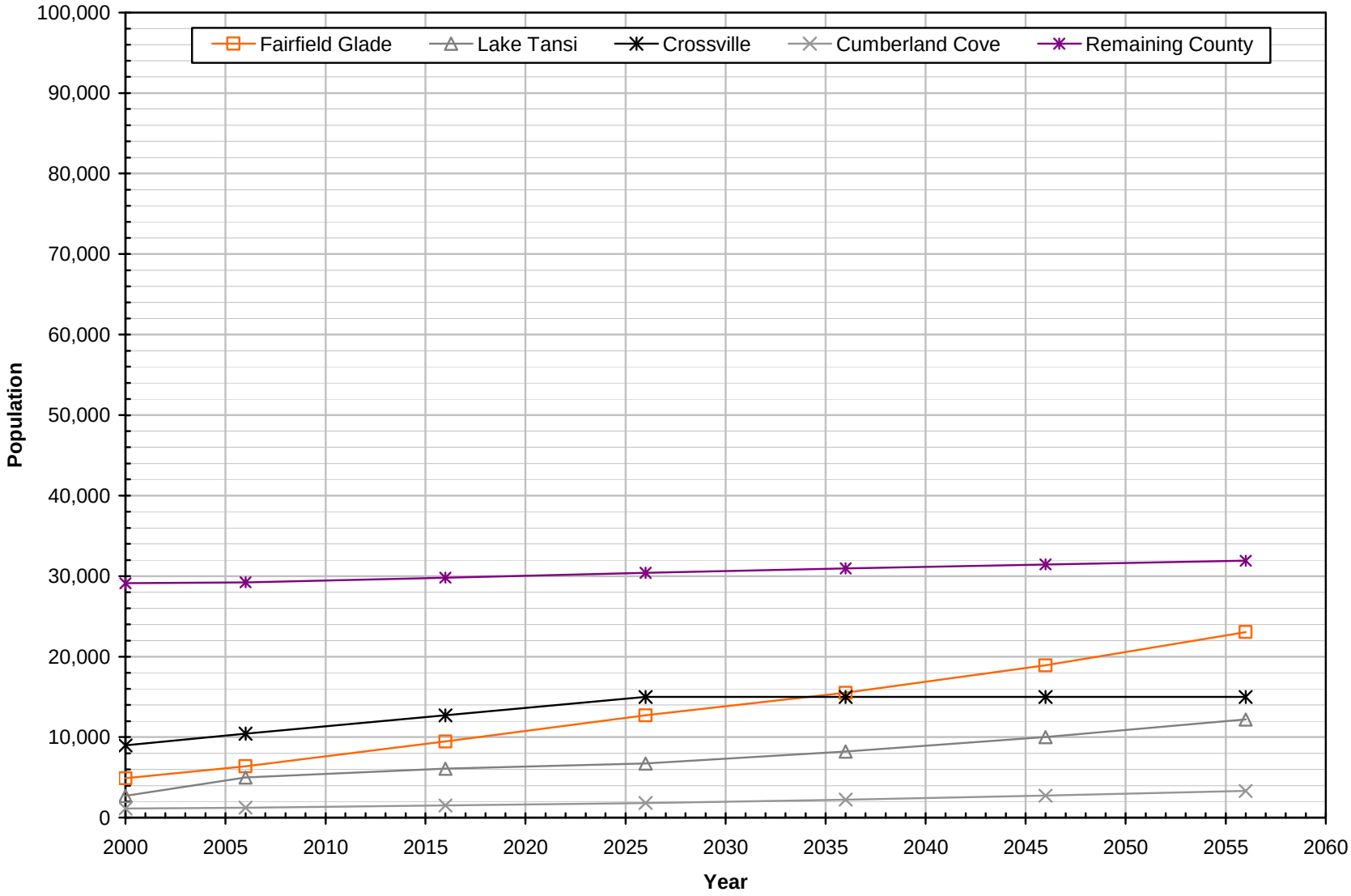

Figure A.2 Slow growth scenarios for population in the five study regions

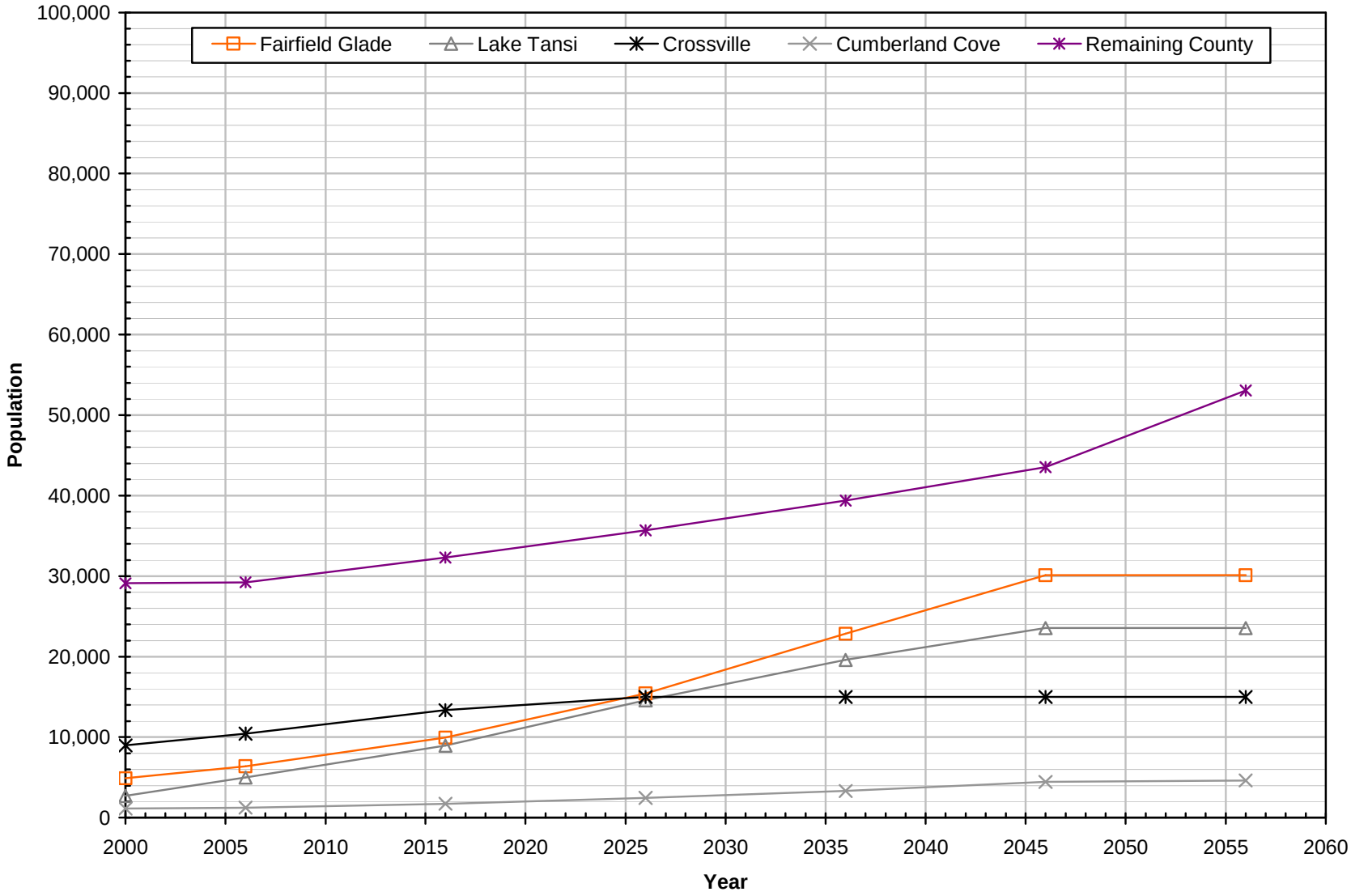

Figure A.3 Expected growth scenarios for population in the five study regions

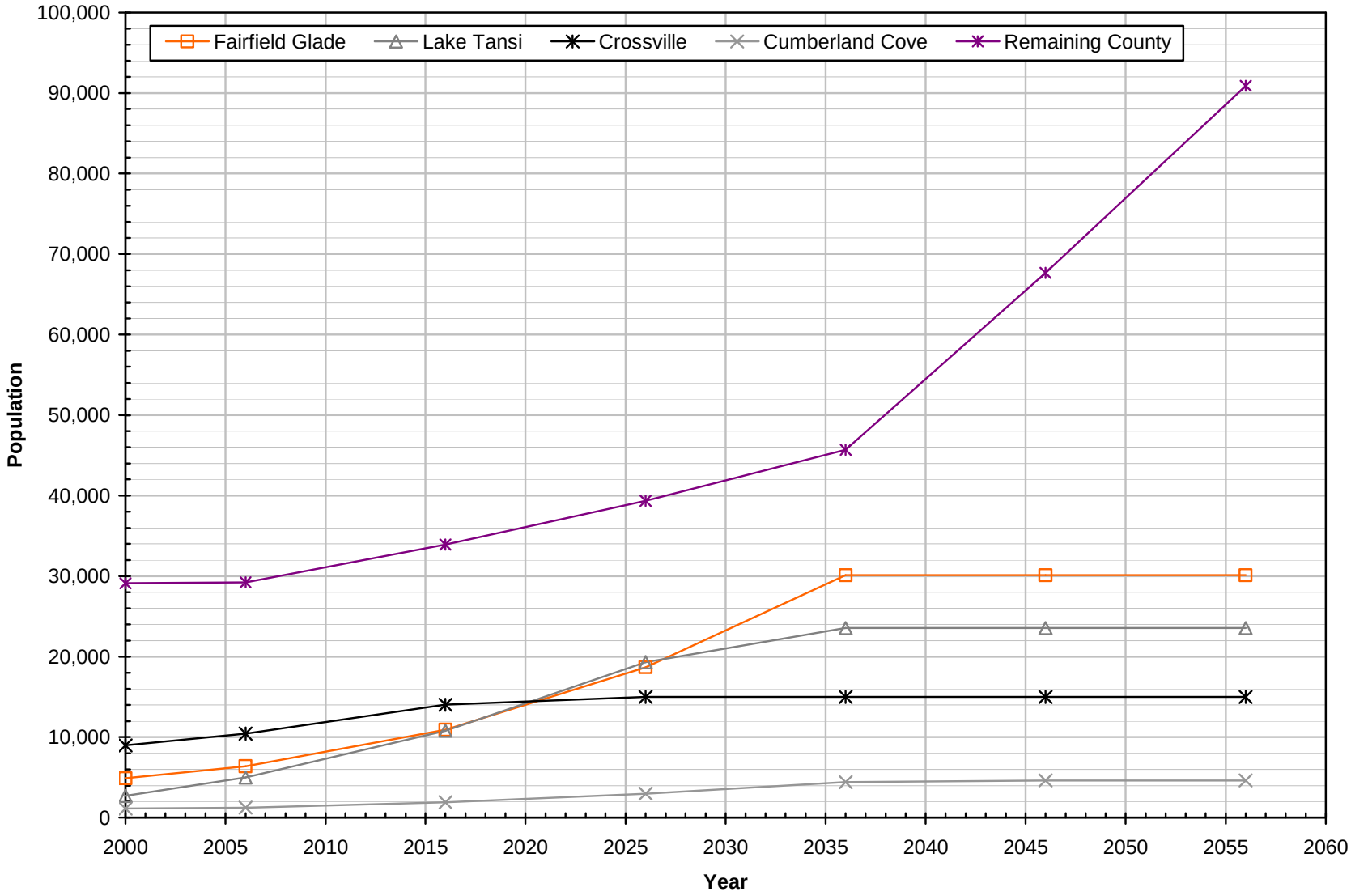

Figure A.4 Aggressive growth scenarios for population in the five study regions