

Building Tennessee's Tomorrow:

Anticipating the State's Infrastructure Needs

July 2003 through June 2008

Reported Infrastructure Needs by County⁴¹

One of the difficulties of comparing infrastructure needs across counties is the lack of information about existing infrastructure. No such data is compiled. Without it, it is hard to evaluate the reasonableness of reported needs. Needs in a county could be high because the area has historically had insufficient infrastructure or low because they have been able to meet their needs in the past. Both situations would be reasonable, but reported needs could also be low because local officials do not wish to report needs they don't expect to be met, or they could be high because the items reported are desirable, but not needed.

With each inventory, TACIR staff assess the potential for over- or under-reporting by comparing reported needs to other indicators of need, such as county size and population, and to factors related to ability to fund infrastructure, such as taxable property and sales. With regional projects factored out, the infrastructure needs reported for all counties across the state have a total cost estimated by local officials at \$20 billion. The total without regional projects could be as high as \$23 billion based on statistical analysis of indicators of need and indicators of ability to fund infrastructure.

Greatest Total Needs Reported for Largest Counties; Greatest Need per Capita Reported Mainly for Small Counties.

Not surprisingly, the greatest infrastructure needs, in terms of total estimated costs, were reported for the counties with the largest populations. Blount and Sullivan counties are the only ones in the top ten for population that are not also in the top ten for greatest total needs; Madison and Sevier counties are the only ones among the top ten for reported needs that are not among the ten largest. The relationship between population and infrastructure needs is not as strong for the bottom ten counties. Only five of the ten smallest counties are among the bottom ten for total reported need. (See Tables 23 and 24.)

While county "top ten" rankings in many of the tables vary from year to year, the list of most heavily populated counties changes very little. Nine of the ten largest counties in 1990 were still in the top ten in

⁴¹ For information on each county, see Appendix D.

Factors That May Explain Differences in Reported Infrastructure Needs

- ✓ Population
- ✓ Population Gain
- ✓ Population Density
- ✓ Land Area
- ✓ Fiscal Capacity or Wealth—i.e., can we afford it?

NOTE: Infrastructure needs that serve substantial numbers of people who lie outside the county in which the infrastructure is located are identified in the inventory as regional to facilitate fairer comparisons across counties. This distinction facilitates comparisons across counties by excluding from county totals infrastructure needs that serve substantial numbers of non-residents.

Examples of regional infrastructure include major transportation corridors designed to route traffic through the county to other destinations; colleges and universities; solid waste facilities that receive refuse from outside the county; and water treatment plants that serve multiple jurisdictions.

Because these types of projects are excluded from the county-level analysis, the totals here will not match the totals elsewhere in this report.

2003. The total infrastructure needs list is almost as stable. Seven of the ten counties reporting the greatest total need—Shelby, Davidson, Hamilton, Knox, Rutherford, Sumner and Montgomery—are in that group for the fourth consecutive time. Williamson County is part of the group for the third straight time, Madison County is part of it for the second time in a row, and only Sevier County is new to the group. For the three previous inventories, the ten largest needs counties have consistently had more than 49% of the state's total population and anywhere between 55% and 62% of the total infrastructure needs. The percentages are comparable this year.

The pattern is not as strong for the bottom ten counties with only four—Lake, Moore, Hancock, and Benton—on the list four years in a row and one more—Crockett—on the list three years in a row. Two others, Lauderdale and Pickett have been among the bottom ten for total reported need twice before, but not three years in a row. Their share of the estimated cost of infrastructure needs has remained almost exactly

Table 23. Largest and Smallest Reported Infrastructure Needs by County
Excluding Projects Identified as Regional
Five-year Period July 2003 through June 2008

Rank	County	Total Reported Cost	Percent of Total	2003 Population	Percent of Total	Cost per Capita
1	Shelby	\$4,185,060,946	20.71%	906,178	15.5%	\$4,618
2	Davidson	3,518,779,034	17.41%	569,842	9.8%	\$6,175
3	Hamilton	881,822,968	4.36%	309,510	5.3%	\$2,849
4	Knox	801,372,542	3.97%	392,995	6.7%	\$2,039
5	Williamson	755,458,182	3.74%	141,301	2.4%	\$5,346
6	Rutherford	638,692,594	3.16%	202,310	3.5%	\$3,157
7	Sumner	572,389,263	2.83%	138,752	2.4%	\$4,125
8	Montgomery	489,246,715	2.42%	141,064	2.4%	\$3,468
9	Madison	440,971,233	2.18%	93,873	1.6%	\$4,698
10	Sevier	440,709,861	2.18%	75,503	1.3%	\$5,837
Top Ten Subtotal		\$ 12,724,503,338	62.97%	2,971,328	50.9%	\$4,282
All Others⁴²		\$ 7,322,689,617	36.24%	2,724,513	46.6%	\$2,688
86	Lauderdale	26,167,000	0.13%	27,077	0.5%	\$966
87	Crockett	24,898,225	0.12%	14,491	0.2%	\$1,718
88	Lake	23,241,714	0.12%	7,824	0.1%	\$2,971
89	Henry	21,763,925	0.11%	31,185	0.5%	\$698
90	Perry	18,732,000	0.09%	7,627	0.1%	\$2,456
91	Moore	11,446,000	0.06%	5,911	0.1%	\$1,936
92	Pickett	10,797,000	0.05%	5,006	0.1%	\$2,157
93	Hancock	9,051,888	0.04%	6,702	0.1%	\$1,351
94	Benton	7,102,199	0.04%	16,500	0.3%	\$430
95	White	6,661,000	0.03%	23,584	0.4%	\$282
Bottom Ten Subtotal		\$ 159,860,951	0.79%	145,907	2.5%	\$1,096
Grand Total		\$ 20,207,053,906	100.0%	5,841,748	100.0%	\$3,459

⁴² For information about the middle 75 counties, see Appendix D.

**Table 24. Infrastructure Improvement Needs Reported
by Most and Least Populous Counties**
Excluding Projects Identified as Regional
Five-year Period July 2003 through June 2008

Rank	County	2003 Population	Percent of Total	Total Reported Cost	Percent of Total	Cost per Capita
1	Shelby	906,178	15.5%	\$ 4,185,060,946	20.7%	\$4,618
2	Davidson	569,842	9.8%	3,518,779,034	17.4%	\$6,175
3	Knox	392,995	6.7%	801,372,542	4.0%	\$2,039
4	Hamilton	309,510	5.3%	881,822,968	4.4%	\$2,849
5	Rutherford	202,310	3.5%	638,692,594	3.2%	\$3,157
6	Sullivan	153,050	2.6%	283,844,873	1.4%	\$1,855
7	Williamson	141,301	2.4%	755,458,182	3.7%	\$5,346
8	Montgomery	141,064	2.4%	489,246,715	2.4%	\$3,468
9	Sumner	138,752	2.4%	572,389,263	2.8%	\$4,125
10	Blount	111,510	1.9%	279,084,210	1.4%	\$2,503
Top Ten Subtotal		3,066,512	52.5%	12,405,751,327	61.4%	\$4,046
All Others⁴³		2,702,001	46.3%	\$ 7,553,043,877	37.4%	\$2,795
86	Jackson	11,208	0.2%	30,788,400	0.2%	\$2,747
87	Houston	8,085	0.1%	44,676,700	0.2%	\$5,526
88	Clay	7,947	0.1%	35,040,000	0.2%	\$4,409
89	Lake	7,824	0.1%	23,241,714	0.1%	\$2,971
90	Perry	7,627	0.1%	18,732,000	0.1%	\$2,456
91	Trousdale	7,447	0.1%	27,195,000	0.1%	\$3,652
92	Hancock	6,702	0.1%	9,051,888	0.0%	\$1,351
93	Moore	5,911	0.1%	11,446,000	0.1%	\$1,936
94	Van Buren	5,478	0.1%	37,290,000	0.2%	\$6,807
95	Pickett	5,006	0.1%	10,797,000	0.1%	\$2,157
Bottom Ten Subtotal		73,235	1.3%	248,258,702	1.2%	\$3,390
Grand Total		5,841,748	100.0%	\$ 20,207,053,906	100.0%	\$3,459

the same despite these changes, but their share of the state's population has fluctuated between 1.7% and 2.8%, resulting in large fluctuations from year to year in this group's reported needs per capita. These fluctuations illustrate what happens when small counties needs are first identified, driving up estimated costs per capita, and then are met, allowing the costs per capita to fall again. A single project can have this effect in a very small county.

Five of the ten counties with the greatest infrastructure needs are in Middle Tennessee (Davidson, Williamson, Rutherford, Sumner, and Montgomery). All five are also among both the ten largest for population and the ten with the largest population gains between 1990 and 2003 (see Tables 23, 24 and 25). Three of them—Montgomery, Rutherford, and Williamson—are also among the top ten for population growth rate (see Table 26), and three—Davidson, Rutherford and Sumner—are

⁴³ For information about the middle 75 counties, see Appendix D.

Table 25. Reported Infrastructure Costs for the Ten Counties with the Largest and Smallest Population Gains*Excluding Projects Identified as Regional***Five-year Period July 2003 through June 2008**

Rank	County	Population 1990	Population 2003	Gain (Loss)	Total Reported Cost	Cost per Capita
1	Rutherford	118,570	202,310	83,740	\$ 638,692,594	\$3,157
2	Shelby	826,330	906,178	79,848	4,185,060,946	\$4,618
3	Williamson	81,021	141,301	60,280	755,458,182	\$5,346
4	Davidson	510,784	569,842	59,058	3,518,779,034	\$6,175
5	Knox	335,749	392,995	57,246	801,372,542	\$2,039
6	Montgomery	100,498	141,064	40,566	489,246,715	\$3,468
7	Sumner	103,281	138,752	35,471	572,389,263	\$4,125
8	Wilson	67,675	95,366	27,691	431,436,776	\$4,524
9	Blount	85,969	111,510	25,541	279,084,210	\$2,503
10	Sevier	51,043	75,503	24,460	440,709,861	\$5,837
Top Ten Subtotal		2,280,920	2,774,821	493,901	\$ 12,112,230,123	\$4,365
All Others⁴⁴		2,487,619	2,951,857	464,238	\$ 7,787,706,222	\$2,638
86	Houston	7,018	8,085	1,067	44,676,700	\$5,526
87	Grundy	13,362	14,389	1,027	38,931,600	\$2,706
88	Perry	6,612	7,627	1,015	18,732,000	\$2,456
89	Clay	7,238	7,947	709	35,040,000	\$4,409
90	Lake	7,129	7,824	695	23,241,714	\$2,971
91	Obion	31,717	32,386	669	42,436,159	\$1,310
92	Van Buren	4,846	5,478	632	37,290,000	\$6,807
93	Pickett	4,548	5,006	458	10,797,000	\$2,157
94	Haywood	19,437	19,626	189	46,920,500	\$2,391
95	Hancock	6,739	6,702	(37)	9,051,888	\$1,351
Bottom Ten Subtotal		108,646	115,070	6,424	\$ 307,117,561	\$2,669
Grand Total		4,877,185	5,841,748	964,563	\$ 20,207,053,906	\$3,459

also among the ten most densely populated counties (see Table 27). TACIR's statistical analysis of all ninety-five counties indicates that all of these population measures except growth rates are closely related to infrastructure needs.

The population rankings have changed little since the 2000 TACIR report began these county comparisons. The ten smallest counties then are still the smallest, and only Washington County is no longer among the ten largest. It was replaced on the list this year by Blount County. The percentage of the population concentrated in the ten largest counties has remained almost exactly the same across all four reports, fluctuating right around 52.5% across all four reports making these comparisons. The percentage of total reported needs for the ten largest counties increased from 54% in the 2000 report to 61% in the next report and remained at that level.

⁴⁴ For information about the middle 75 counties, see Appendix D.

Interestingly, while the bottom ten counties in population remained exactly the same and increased only slightly, from 1.1% of the state's population to 1.3%, their share of the total cost of needed infrastructure improvements varied from 1.0% of the total to 2.0%. The pattern among these counties over the past four years, again, illustrates the disproportionate effect that even relatively small projects can have in the very smallest counties.

Population Gains Are More Closely Related to Infrastructure Needs Than Population Growth Rates Are

Eight of the ten counties shown with the largest total infrastructure needs in Table 23 are also among the ten with the largest population gains between 1990 and 2003 in Table 25. Four of the counties with the smallest needs in Table 23 are among the ten with smallest gains⁴⁵

Table 26. Cost of Needed Infrastructure Improvements Reported by the Ten Fastest and Slowest Growing Counties
Excluding Projects Identified as Regional
Five-year Period July 2003 through June 2008

Rank	County	Population 1990	Population 2003	Growth Rate	Total Reported Cost	Cost per Capita
1	Williamson	81,021	141,301	74.4%	\$ 755,458,182	\$5,346
2	Rutherford	118,570	202,310	70.6%	638,692,594	\$3,157
3	Sevier	51,043	75,503	47.9%	440,709,861	\$5,837
4	Tipton	37,568	54,184	44.2%	67,952,112	\$1,254
5	Meigs	8,033	11,430	42.3%	48,756,984	\$4,266
6	Cumberland	34,736	49,391	42.2%	247,549,162	\$5,012
7	Jefferson	33,016	46,919	42.1%	68,950,441	\$1,470
8	Wilson	67,675	95,366	40.9%	431,436,776	\$4,524
9	Montgomery	100,498	141,064	40.4%	489,246,715	\$3,468
10	Robertson	41,494	58,181	40.2%	163,972,648	\$2,818
Top Ten Subtotal		573,654	875,649	52.6%	\$ 3,352,725,475	\$3,829
All Others⁴⁶		3,876,588	4,515,836	16.5%	\$ 16,071,145,988	\$3,559
86	Weakley	31,972	34,314	7.3%	33,065,559	\$964
87	Dyer	34,854	37,308	7.0%	52,900,584	\$1,418
88	Unicoi	16,549	17,709	7.0%	64,679,467	\$3,652
89	Carroll	27,514	29,342	6.6%	36,806,016	\$1,254
90	Sullivan	143,596	153,050	6.6%	283,844,873	\$1,855
91	Anderson	68,250	71,904	5.4%	125,805,093	\$1,750
92	Gibson	46,315	47,922	3.5%	87,672,304	\$1,829
93	Obion	31,717	32,386	2.1%	42,436,159	\$1,310
94	Haywood	19,437	19,626	1.0%	46,920,500	\$2,391
95	Hancock	6,739	6,702	-0.5%	9,051,888	\$1,351
Bottom Ten Subtotal		426,943	450,263	5.5%	\$ 783,182,443	\$1,739
Grand Total		4,877,185	5,841,748	19.8%	\$ 20,207,053,906	\$3,459

⁴⁵ One county (Hancock) actually lost population during that period.

⁴⁶ For information about the middle 75 counties, see Appendix D.

Each component of rural infrastructure provides an essential link to employment, markets, personnel, and other resources necessary for a healthy rural economy.

Economic Research Service,
U.S. Department of
Agriculture

in Table 25. The relationship between infrastructure needs and population gain is somewhat stronger than the relationship between needs and total population among the top ten, but somewhat weaker among the bottom ten.

A comparison of Tables 26 and 23 demonstrates that a county's rate of growth is a poor predictor of infrastructure needs. Only four of the fastest growing counties are in the top ten for infrastructure needs: Williamson, Rutherford, Sevier and Montgomery. The number has varied from two to four in previous reports. These same four counties also appear among the top ten for population gain shown in Table 25. Among the bottom ten in Table 26, only Hancock County also appears in Table 23 among the bottom ten for total reported infrastructure needs. It is also among the bottom ten for population gain in Table 25, and actually declined in population between 1990 and 2003.

Examination of growth rates contributes little to the understanding of why some counties appear at the top or bottom for total infrastructure needs. TACIR's statistical analysis indicates little relationship between the two. Nor is the list of counties with the top- and bottom-ten growth rates as stable as the other top-ten-bottom-ten lists from year to year. Six counties—Williamson, Rutherford, Sevier, Tipton, Cumberland and Jefferson—have been on the fastest growth rates list in all four reports making the comparison, and only two—Haywood and Hancock—have been on the smallest growth rates list in all four.

Infrastructure Needs Per Capita Are Not Lower in Counties with Higher Population Densities

Conventional wisdom holds that population density should produce lower infrastructure costs because of economies of scale: the most densely populated counties should have the lowest per capita infrastructure needs. This relationship is not borne out by TACIR's infrastructure inventories based either on comparisons of counties that rank high and low for population density or on statistical analysis. In fact, TACIR analysis consistently indicates either a significant or highly significant correlation between population density and higher infrastructure costs.

In the latest inventory, six of the ten counties with the highest needs are also among the ten most densely populated—Shelby, Davidson, Knox, Hamilton, Rutherford and Sumner. Three of the counties with lowest infrastructure needs are also among the ten most sparsely populated. (Compare Tables 23 and 27). There are several possible explanations for this seeming incongruity, first among them the fact

**Table 27. Infrastructure Improvement Needs Reported
by Most and Least Densely Populated Counties**
Excluding Projects Identified as Regional
Five-year Period July 2003 through June 2008

Rank	County	2003 Population	Land Area [square miles]	Population per Square Mile	Total Reported Cost	Cost per Capita
1	Shelby	906,178	755	1,201	\$ 4,185,060,946	\$4,618
2	Davidson	569,842	502	1,135	3,518,779,034	\$6,175
3	Knox	392,995	508	773	801,372,542	\$2,039
4	Hamilton	309,510	542	571	881,822,968	\$2,849
5	Sullivan	153,050	413	371	283,844,873	\$1,855
6	Hamblen	58,851	161	365	87,723,258	\$1,491
7	Washington	110,078	326	337	386,723,244	\$3,513
8	Rutherford	202,310	619	327	638,692,594	\$3,157
9	Bradley	90,264	329	275	192,422,553	\$2,132
10	Sumner	138,752	529	262	572,389,263	\$4,125
Top Ten Subtotal		2,931,830	4,685	626	\$ 11,548,831,275	\$3,939
All Others⁴⁷		2,799,750	32,593	86	\$ 8,272,319,318	\$2,955
86	Humphreys	18,123	532	34	88,525,999	\$4,885
87	Fentress	16,935	499	34	54,105,000	\$3,195
88	Clay	7,947	236	34	35,040,000	\$4,409
89	Bledsoe	12,556	406	31	53,100,000	\$4,229
90	Pickett	5,006	163	31	10,797,000	\$2,157
91	Hancock	6,702	222	30	9,051,888	\$1,351
92	Stewart	12,847	458	28	48,434,000	\$3,770
93	Wayne	16,947	734	23	30,827,426	\$1,819
94	Van Buren	5,478	273	20	37,290,000	\$6,807
95	Perry	7,627	415	18	18,732,000	\$2,456
Bottom Ten Subtotal		110,168	3,939	28	\$ 385,903,313	\$3,503
Grand Total		5,841,748	41,217	142	\$ 20,207,053,906	\$3,459

that five of these six (all except Hamilton County) are among the ten with the largest population gains between 1990 and 2003. High growth may counter the effect of economies of scale. Another explanation, one that may follow from the first, is that scale is a long term economic benefit that enables a governmental entity to serve citizens more efficiently over time, but that has no relationship to initial investment costs. Improving infrastructure may be inherently more costly in densely populated urban areas because of higher land and labor costs and the need to relocate or modify existing infrastructure to accommodate new infrastructure. Also, densely populated areas may require such infrastructure as storm-water drains, sidewalks, street lighting, and traffic signaling that is not necessary or warranted in sparsely populated areas. Finally, urban residents may simply demand and receive more infrastructure-related services than rural residents, and the types of services they need or desire (such as underground wiring) may be more expensive.

⁴⁷ For information about the middle 75 counties, see Appendix D.

After 40 years of city versus suburbs, the dynamic has changed. Now, cities and counties, urban and suburban are increasingly cooperating to maintain the health of the entire metropolitan area – to increase the livability of their communities and maximize their economic competitiveness.

The State of the Cities 1999,
U.S. Department of Housing
and Urban Development

In fact, infrastructure needs reported per capita seem to bear little relationship to any population factor except, possibly, total population. Table 28 shows the top ten and bottom ten counties for infrastructure needs reported per capita along with their populations, population gains and growth rates, and their land area and population densities. There are fast- and slow-growing counties in both sets of ten presented in this table, but there are no high density or large population counties in the bottom ten.

Davidson County appears among the top ten for needs per capita, now for the third year in a row. It is the only heavily populated county with that distinction. One reason may be its highly developed capital improvements program; another may be its location in the middle of the fastest growing part of the state—the fastest both in population and in economic terms. Davidson County itself had the fourth largest population gain between 1990 and 2003 (see Table 25). Two other relatively large counties appeared among the top ten: Sevier and Williamson, both of which appeared in the top ten two years ago. Both are growing rapidly in raw numbers (10th and 3rd largest gains, Table 25) and in percent change (1st and 3rd highest percents, Table 26). Williamson is also among the ten most populous counties, ranking 7th; Sevier ranks 15th (see Table 24). But other large, high-growth counties, most notably Montgomery and Rutherford report much lower per capita needs (30th and 34th highest).

The other seven counties in the top ten demonstrate the fact that needs such as courthouse renovations, new schools and road improvements that would seem moderate or even small in large counties have a disproportionate effect when compared to population in small counties. Van Buren, which has a population of only 5,478, has been among these ten counties now in all four TACIR reports presenting this information. Four large projects put it at the top of the list for needs per capita in this report: a \$10 million dollar project to widen state Route 111 in the Spencer area, an \$8 million new water plant and related infrastructure, a \$7.9 million judicial center, and a \$7.5 million sewage treatment plant. Three of these projects have been in the same stage of development for several years now. The sewage treatment plant, which has been controversial enough to make the national news, is now under construction, and the water plant only recently moved from conceptual to planning and design. Without these four projects, Van Buren would fall out of the top ten into the bottom ten (92nd) in Table 28 with a per capita need of only \$710. This is an extreme example how large, unmet needs can place a county that would not otherwise be there in the top ten for per capita costs and keep it there until those needs are met.

Table 28. Population Factors for Counties With Highest and Lowest Estimated Costs per Capita
Excluding Projects Identified as Regional
Five-year Period July 2003 through June 2008

Rank	County	Population 1990	Population 2003	Change	Growth Rate	Land Area [sq. miles]	Population Density	Reported Cost	Cost per Capita
1	Van Buren	4,846	5,478	632	13.0%	273	20	\$ 37,290,000	\$6,807
2	Davidson	510,784	569,842	59,058	11.6%	502	1,135	3,518,779,034	\$6,175
3	Hardin	22,633	25,927	3,294	14.6%	578	45	155,636,338	\$6,003
4	Sevier	51,043	75,503	24,460	47.9%	592	127	440,709,861	\$5,837
5	Houston	7,018	8,085	1,067	15.2%	200	40	44,676,700	\$5,526
6	Dickson	35,061	44,935	9,874	28.2%	490	92	240,254,724	\$5,347
7	Williamson	81,021	141,301	60,280	74.4%	583	243	755,458,182	\$5,346
8	Sequatchie	8,863	11,958	3,095	34.9%	266	45	63,621,250	\$5,320
9	McNairy	22,422	24,938	2,516	11.2%	560	45	127,537,213	\$5,114
10	Henderson	21,844	25,900	4,056	18.6%	520	50	130,912,759	\$5,055
Top Ten Subtotal		765,535	933,867	168,332	22.0%	4,565	205	\$ 5,514,876,061	\$5,905
All Others⁴⁸		3,833,353	4,579,129	745,776	19.5%	31,598	145	\$ 14,355,456,175	\$3,135
86	Obion	31,717	32,386	669	2.1%	545	59	42,436,159	\$1,310
87	Carroll	27,514	29,342	1,828	6.6%	599	49	36,806,016	\$1,254
88	Tipton	37,568	54,184	16,616	44.2%	459	118	67,952,112	\$1,254
89	Warren	32,992	39,129	6,137	18.6%	433	90	46,438,900	\$1,187
90	Monroe	30,541	41,051	10,510	34.4%	635	65	48,328,800	\$1,177
91	Lauderdale	23,491	27,077	3,586	15.3%	470	58	26,167,000	\$966
92	Weakley	31,972	34,314	2,342	7.3%	580	59	33,065,559	\$964
93	Henry	27,888	31,185	3,297	11.8%	562	56	21,763,925	\$698
94	Benton	14,524	16,500	1,976	13.6%	395	42	7,102,199	\$430
95	White	20,090	23,584	3,494	17.4%	377	63	6,661,000	\$282
Bottom Ten Subtotal		278,297	328,752	50,455	18.1%	5,055	65	\$ 336,721,670	\$1,024
Grand Total		4,877,185	5,841,748	964,563	19.8%	41,217	142	\$ 20,207,053,906	\$3,459

⁴⁸ For more information about the middle 75 counties, see Appendix D.

Four counties—Tipton, Lauderdale, Weakley and Benton—have been among the bottom ten for reported needs per capita in all four reports. Tipton continues to be surprising because of its rapid growth. It is the state's 24th largest county in terms of population and had the 15th largest population gain from 1990 to 2003—it is the 4th fastest growing in percentage terms—but it does not follow the general pattern of high infrastructure needs reported for other high population and high growth counties. The only other county among the bottom ten with relatively high growth is Monroe County, which is 33rd in population and had the 21st largest population gain from 1990 to 2003 (16th largest in percentage terms), but it is 90th for infrastructure needs reported per capita. Monroe County covers 635 square miles, and nearly half of that is taken up by the Cherokee National Forest, but still only 30% of that is taken up by the Cherokee National Forest, but still only 30% of its population lives in its four incorporated municipalities. Three-fourths of its new residents between the 1990 and 2000 U.S. Censuses settled in the unincorporated part of the county. It may be that they are so widely dispersed that they are not having a demonstrable impact on infrastructure costs. Indeed, it is unlikely that they are receiving much in the way of infrastructure-related services, and given that they chose to live in a rural area, they may neither expect nor want much.

Statistical Analyses Confirm Inferences About Population and Infrastructure Needs; Tax Base Factors Also Play a Role

Analysis of the top ten and bottom ten counties for various population factors presumed to be related to infrastructure needs suggests conclusions that can be verified by statistical analysis of all ninety-five counties. Statistical analysis can also suggest explanations for things general observation cannot, and it can help estimate infrastructure needs that may have been missed by the inventory. The inventory is entirely voluntary on the part of local officials, and they may participate

more or less enthusiastically depending on how valuable they consider the process. Variations in their willingness or ability to provide comparable information about their needs may help explain the seemingly weak relationship between population factors and the infrastructure needs reported by counties that appear on the bottom ten lists.

To answer these questions, TACIR analysts compared various factors related to local government's ability to fund infrastructure as well as factors related to needs. The first comparison produced the set of simple correlation measures, called correlation

Table 29. Correlation between Reported Infrastructure Needs and Related Factors in Order of Strength of Relationship

Factors Related to Reported Needs	Correlation Coefficient
Taxable Property Value	0.976
Personal Income	0.974
Taxable Sales	0.959
2003 Population	0.956
2003 Population Density	0.910
Population Gain or Loss	0.749
Land Area (Square Miles)	0.287
Population Growth Rate	0.006

coefficients, presented in Table 29. Correlation coefficients measure the strength of the relationship between two sets of numbers and range from zero to one. The coefficient will be positive if one set of numbers increases as the other increases or decreases as the other decreases; it will be negative if one increases as the other decreases. A perfect relationship between the two sets of numbers would be either 1.0 or -1.0.

As Table 29 indicates, the factors most closely related to reported needs are tax base and income, followed by population and population density. All of the relationships are positive, which means that higher infrastructure needs correspond to higher numbers for each related factor, and lower needs correspond to lower numbers. The coefficients for population factors confirm the general inferences drawn from the top-ten-bottom-ten review:

- Total population is a strong indicator of infrastructure needs.
- Higher population densities correspond to higher infrastructure needs, and lower densities correspond to lower needs.
- Population gain is closely related to infrastructure needs, but growth rates, with a correlation coefficient near zero, are not.
- Land area is a weak indicator of needs; of the factors compared here, only growth rate is weaker.

The most interesting inference from the comparison, however, is that **tax base factors and income correspond even more closely to reported needs than the population factors do.** These near perfect relationships suggest that indicators of ability to fund infrastructure may strongly influence local officials as they respond to the inventory or they may simply reflect the common sense inference that tax base and income tend to concentrate where population concentrates. Regardless, given the strength of these relationships, it seems very unlikely that the needs reported by local officials are a wish list.

While it is not possible to determine which indicators are most important overall, it is possible to use them to identify individual counties with above-average needs and counties with surprisingly low needs. A statistical process called multiple regression analysis can be used to compare several factors to reported needs and calculate weights for each factor. This process includes a mechanism for determining how much confidence to place in the estimates produced by the weights. Any combination of factors can be used, but some combinations produce better estimates than others do. The combination that seems to work best in this case is

- personal income,

- current population (2003),
- population density,
- total taxable property valuation, and
- a composite factor representing the total needs for the county's development district compared to that district's share of total population and population gain (1990 to 2003).

The five factors are listed in order of significance. Estimates based on this model indicate that the current inventory captured 90% of the infrastructure needs in the state, which is consistent with previous inventories. If the total cost per county is based on the greater of the reported cost or the estimate based on this model, the statewide total would be about \$2.7 billion higher than the total reported or about \$27 billion.