

## APPENDIX D

### A SIMPLIFIED METHODOLOGY FOR REPORTING LOCAL HIGHWAY FINANCE DATA

This appendix describes a simplified methodology for collecting and reporting local highway finance data. This methodology uses sampling and estimation as a means of reducing the cost and effort associated with data reporting activities by the States, and is intended to provide a practical procedure for meeting FHWA's local highway finance data needs. However, it may have only a limited application in States which already require more complete reporting for State purposes or which have centralized, computer-based data collecting, processing, and reporting systems.

The usual sources of local highway finance data include audits, budgets, and financial reports supplied to the State highway agencies by local governments. These can be supplemented by questionnaires and surveys. Data collected by or reported to other State agencies may also be useful. However, a sampling and estimation procedure has great potential as a cost effective alternative to 100 percent data collection and reporting.

In its simplest form, sampling uses a portion or subset—a sample—of a population to estimate the total population. A number of local governments in a State would be selected, and their financial data used as the basis for estimating local highway finance data for all local governments in the State. In addition to the collection of raw data from a representative sample of local governments, estimation may also involve the use of trends, projections, knowledge of local priorities, and personal judgment about the limitations of the data available.

The first step in sampling is to group or stratify all local governments on the same basis or criteria. The governments within each group should have many features in common, including the nature and extent of highway activities. If the groups are carefully selected, a few counties or municipalities can be expanded to give a representative fiscal picture for the respective grouping, and ultimately all groups.

One possible criterion is population size. Prior local highway finance reporting to FHWA indicates that a small number of local governments with large populations represent the greatest portion and most significant part of the data. While only 20 percent of municipalities have a population above 5,000, these municipalities are responsible for approximately 88 percent of total financial expenditures. By concentrating on larger municipalities, acceptable results can be obtained more efficiently.

Some States may elect to use population density, roadway mileage, or other criteria with or in place of population. The State should determine what criterion will create the most commonality within each group.

Reliable, comparable information to determine the criterion for the groupings is important. For example, when using population as a criterion, the latest available population data from the Bureau of the Census should be used, rather than relying on local estimates of their current population.

The next step in sampling is to select the number of local governmental units (among counties, townships, and cities) to represent the sample for each grouping or strata. The greater number of units surveyed, the greater the accuracy for that grouping.

Some factors to be considered when determining the number of units to include in a grouping are:

- ! The availability of data;
- ! The amount and extent of the desired data recorded by local governments;
- ! The comparability of data among local governments.

Assuming that population is used as the criterion for grouping the units of local government, the sample should focus on the largest population groups. The relatively few municipalities, counties, and townships with large populations account for a disproportionate share of capital outlay and overall expenditures for roads and streets, and typically have more

accurate and readily available financial reports. Therefore, all units within the largest population group should be examined. The size of the other groups and the number of units within each grouping to be examined should reflect their relative share of the State totals.

The sample size necessary to estimate the group total with a desired confidence level can be determined using mathematical formulas, statistical textbooks, or judgmental decision. The composition of the samples should take into account the data reporting burden on individual governments and the accuracy of the data collected. To limit the reporting burden on local governments, the State may examine one quarter of all small local governments' financial reporting every fourth year. The sample would be the total number of governments in that population size group divided by four. The State may also consider the relative burden of reporting the data. If some local governments are able to generate the data more easily than most others, the State may sample these areas more frequently. In order to balance out its data collection and analysis workload on the biennially reported FHWA-536, the State may choose to survey half of its selected sample each year.

After sample selection, subsequent steps involve: analyzing financial reports, developing local highway finance data, testing the data, expanding data within the groups, and combining individual group data to produce the statewide summary totals for the local highway finance reports. If a selected local government's data is incomplete or unavailable, the State may find it necessary to estimate some local data, or to select another local government as a replacement.

The use of sampling should reduce the data reporting burden of both the local and State governments. Local governments would not need to produce data as often, and the State would have fewer local reports to analyze in preparing data for the FHWA-536 report.

The New Mexico case study which follows provides a more complete presentation of sampling and estimation procedures which could be used in collecting and reporting local highway finance data.

## A METHODOLOGY FOR LOCAL HIGHWAY FINANCE STATISTICAL REPORTING (NEW MEXICO CASE STUDY)

This paper presents a practical methodology for the collection, analysis, and reporting of local highway finance data. The methodology is based on sampling and estimation techniques, and illustrates a simplified approach for developing local highway finance data. The case study used published statistical data for New Mexico's counties that were provided by the FHWA division office. A similar approach could be used for estimating data for all local governmental units within a State (e.g., counties, townships, and municipalities combined).

The first step in this methodology involves sorting or ranking all counties on a common basis. As illustrated in table 1, population size was used as the ranking factor. The latest available information from the Bureau of the Census should be used for population statistics.

**Table 1**  
**Population Size Ranking of 31 Counties**

<u>County</u>	<u>Population</u>	<u>County</u>	<u>Population</u>
Bernalillo	362,087	Roosevelt	16,446
Dona Ana	79,593	Luna	14,421
San Juan	64,719	Colfax	13,076
Santa Fe	62,420	Quay	11,221
Lea	51,525	Socorro	9,899
McKinley	51,081	Lincoln	9,710
Chaves	47,695	Sierra	8,302
Valencia	46,141	Torrance	6,383
Curry	43,007	Hidalgo	5,820
Eddy	42,800	Union	4,946
Otero	42,727	Mora	4,886
Rio Arriba	27,896	Guadalupe	4,839
Grant	24,377	De Baca	2,604
San Miguel	23,426	Catron	2,338
Sandoval	22,576	Harding	1,230
Taos	19,375		

Then, by examining population sizes and ranges, the counties may be stratified into easily managed groups. The selection of the groups and group sizes should be based on the ease of data management. Some considerations are: population ranges, population sizes, number of counties, county size characteristics, similar group sizes, etc. In this case study, the counties are stratified into five groups. Because the population of Bernalillo County is four times greater than the next largest county, Bernalillo is segregated into a separate group. The rest of the counties are grouped within arbitrary ranges.

**Table 2**  
**Counties Stratified by Population Size**

<u>Above 100,000</u>	<u>Below 10,000</u>
Bernalillo	Catron
	De Baca
 <u>50,000 - 99,999</u>	
Guadalupe	
Dona Ana	Harding
Lea	Hidalgo
McKinley	Lincoln
San Juan	Mora
Santa Fe	Sierra
	Socorro
 <u>40,000 - 49,999</u>	Torrance
Chaves	Union
Curry	
Eddy	
Otero	
Valencia	
 <u>10,000 - 39,999</u>	
Colfax	
Grant	
Luna	
Quay	
Rio Arriba	
Roosevelt	
Sandoval	
San Miguel	
Taos	

The second step involves a determination of what proportion of receipts and disbursements each county represents to the State total and the individual group total. Table 3 illustrates this distribution and was based on the *1976 New Mexico County and Municipal Road and Street Finance Report*.

The third step involves the selection of a sample from each group. The sample size reflects the desired confidence in the accuracy of the data. If all 31 counties are chosen for the sample, the accuracy of the data would be 100 percent with a margin of error (or confidence limit) of  $\pm 0$ . If only one county was chosen for the sample, there would be little confidence in the accuracy of the data. However, it has been proven by mathematical formulas that a relatively small number of units or counties can represent all counties in the State with a high degree of accuracy. Sample size can be determined by formula, from statistical texts or by arbitrary decision. For this case study, a sample size of 11 counties was selected from the 31 New Mexico counties. The sample was selected on the basis of examining each county every 4 years, but including at least two counties from each group each year. Since the first group contains only Bernalillo County, it will be included in the sample every year. Table 4 illustrates the final sample selection for the case study with corresponding finance data obtained from the *1977 New Mexico County and Municipal Road and Street Finance Report*.

**Table 3**  
**Percentage of Individual County Receipts**  
**and Disbursements to Total County (and Group Totals)**

	<u>Receipts</u> <u>All Counties (Group)</u>		<u>Disbursements</u> <u>All Counties (Group)</u>	
<u>Above 100,000</u>				
Bernalillo	15.4	(100.0)	13.8	(100.0)
<u>50,000 - 99,999</u>				
Dona Ana	4.3	(22.6)	3.8	(15.1)
Lea	4.6	(24.3)	6.7	(26.7)
McKinley	2.4	(12.6)	4.2	(16.7)
San Juan	3.8	(20.0)	7.7	(30.7)
Santa Fe	<u>3.9</u>	<u>(20.5)</u>	<u>2.7</u>	<u>(10.8)</u>
	19.0	(100.0)	25.1	(100.0)
<u>40,000 - 49,999</u>				
Chaves	4.9	(23.0)	4.6	(20.7)
Curry	3.8	(17.8)	2.9	(13.1)
Eddy	4.3	(20.2)	8.4	(37.8)
Otero	3.9	(18.3)	3.0	(13.5)
Valencia	<u>4.4</u>	<u>(20.7)</u>	<u>3.3</u>	<u>(14.9)</u>
	21.3	(100.0)	22.2	(100.0)
<u>10,000 - 39,999</u>				
Colfax	1.7	(7.3)	1.5	(6.8)
Grant	2.2	(9.4)	5.1	(23.1)
Luna	4.4	(18.9)	3.2	(14.5)
Quay	2.6	(11.2)	2.1	(9.5)
Rio Arriba	1.7	(7.3)	2.9	(13.1)
Roosevelt	3.0	(12.9)	2.4	(10.9)
Sandoval	3.5	(15.0)	1.4	(6.3)
San Miguel	2.3	(9.9)	1.9	(8.6)
Taos	<u>1.9</u>	<u>(8.1)</u>	<u>1.6</u>	<u>(7.2)</u>
	23.3	(100.0)	22.1	(100.0)
<u>Below 10,000</u>				
Catron	2.8	(13.3)	2.0	(11.9)
De Bach	1.5	(7.1)	0.8	(4.8)
Guadalupe	1.4	(6.7)	1.5	(8.9)
Harding	1.2	(5.7)	0.9	(5.4)
Hidalgo	0.9	(4.3)	1.0	(6.0)
Lincoln	3.2	(15.2)	2.9	(17.3)
Mora	1.0	(4.8)	0.6	(3.6)
Sierra	1.4	(6.7)	1.2	(7.1)
Socorro	3.4	(16.2)	2.4	(14.2)
Torrance	2.1	(10.0)	1.6	(9.5)
Union	<u>2.1</u>	<u>(10.0)</u>	<u>1.9</u>	<u>(11.3)</u>
	21.0	(100.0)	16.8	(100.0)
Total Counties	100.0		100.0	

**Table 4**  
**Sample and Group Totals**

	<u>Total Receipts</u>	<u>Total Disbursements</u>
<u>Above 100,000</u>		
Bernalillo	\$1,346,066	\$1,182,252
 <u>50,000 - 99,000</u>		
Dona Ana	392,665	370,491
Lea	<u>390,546</u>	<u>769,878</u>
	783,211	1,140,369
 <u>40,000 - 49,999</u>		
Chaves	376,126	333,388
Curry	<u>315,671</u>	<u>294,366</u>
	691,797	627,754
 <u>10,000 - 39,999</u>		
Colfax	125,735	104,581
Grant	196,521	491,518
Luna	<u>389,690</u>	<u>392,730</u>
	711,946	988,829
 <u>Below 10,000</u>		
Catron	293,429	194,214
De Baca	122,056	147,417
Guadalupe	<u>118,417</u>	<u>152,532</u>
	\$ 533,902	\$ 494,163

The fourth step involves determining the total receipts and disbursements for each group by expanding the data for the sample chosen from within each group. This is accomplished by dividing the total for each sample group from table 4 by the sum of the percentages obtained from table 3 which represents the sample counties within the group.

**Table 5A  
Total Receipts**

<u>Above 100,000</u>		
Bernalillo	$1,346,066 \div 1.00$	= \$1,346,066
<u>50,000 - 99,000</u>		
Dona Ana	$783,211 \div (.226 + .243)$	= 1,669,959
Lea @		
<u>40,000 - 49,999</u>		
Chaves	$691,797 \div (.230 + .178)$	= 1,695,580
Curry @		
<u>10,000 - 39,999</u>		
Colfax B	$711,946 \div (.073 + .094 + .198)$	= 1,999,848
Grant C		
Luna D		
<u>Below 10,000</u>		
Catron B	$533,902 \div (.133 + .071 + .067)$	= <u>1,970,118</u>
De Baca C		
Guadalupe D		
Total		\$8,681,571

**Table 5B  
Total Disbursements**

<u>Above 100,000</u>		
Bernalillo	$1,182,252 \div 1.00$	= \$1,182,252
<u>50,000 - 99,000</u>		
Dona Ana		
Lea A	$1,140,369 \div (.151 + .267)$	= 2,728,155
<u>40,000 - 49,999</u>		
Chaves		
Curry A	$627,754 \div (.207 + .131)$	= 1,857,260
<u>10,000 - 39,999</u>		
Colfax B		
Grant C	$988,829 \div (.068 + .231 + .145)$	= 2,227,092
Luna D		
<u>Below 10,000</u>		
Catron B		
De Baca C	$494,163 \div (.119 + .048 + .089)$	= <u>1,930,324</u>
Guadalupe D		
Total		\$9,925,083

The actual 1977 receipts and disbursements for each population group were used to test the results.

**Table 6**

	<u>Receipts</u>	<u>Disbursements</u>
<u>Above 100,000</u>		
Bernalillo	\$1,346,066	\$1,182,252
<u>50,000 - 99,000</u>		
Dona Ana	392,665	370,491
Lea	390,546	769,878
McKinley	187,796	273,465
San Juan	314,377	697,771
Santa Fe	<u>295,150</u>	<u>295,371</u>
	1,580,534	2,406,976
<u>40,000 - 49,999</u>		
Chaves	376,126	333,388
Curry	315,671	294,366
Eddy	358,362	965,715
Otero	315,525	301,324
Valencia	<u>350,315</u>	<u>332,382</u>
	1,715,999	2,227,175
<u>10,000 - 39,999</u>		
Colfax	125,735	104,581
Grant	196,521	491,518
Luna	389,690	392,730
Quay	202,955	220,570
Rio Arriba	172,644	328,166
Roosevelt	330,073	390,073
Sandoval	305,557	269,674
San Miguel	192,259	199,925
Taos	<u>139,681</u>	<u>135,542</u>
	2,055,115	2,532,779
<u>Below 10,000</u>		
Catron	293,429	194,214
De Baca	122,056	147,417
Guadalupe	118,417	152,532
Harding	95,644	92,430
Hidalgo	83,200	76,318
Lincoln	353,910	351,676
Mora	63,931	48,542
Sierra	132,771	126,342
Socorro	307,963	272,037
Torrance	159,489	198,788
Union	<u>169,037</u>	<u>179,419</u>
	1,899,847	1,839,715
Total	\$8,597,561	\$10,188,897



The last step involves the comparison of the estimates for the groups to the actual 1977 receipts and disbursements. By dividing the estimates by the actual data, the accuracy of the sample and estimates can be determined.

Table 7 illustrates the percentage differences between the sample estimates and the actual data for each group.

**Table 7**

<u>Population</u>	<u>Receipts</u>	<u>Disbursements</u>
Above 100,000	0.0%	0.0%
50,000-99,999	+5.7%	+23.3%
40,000-49,999	-1.2%	-16.6%
10,000-39,999	-2.7%	-12.1%
Below 10,000	<u>-4.1%</u>	<u>+4.9%</u>
Total	+0.98%	-2.6%

Although the variance for individual groups for receipts measures up to 5.7 percent, the estimate for all groups differs by less than 1 percent. While individual group estimates for disbursements show greater variance, the estimate for all groups differs by less than 3 percent. Individual group variations essentially cancel when the total for all groups is obtained. Using this methodology, results were obtained with much less than a 10 percent variance from the actual data. The estimates would have been very satisfactory as a basis for reporting local highway finance statistical data to the Federal Highway Administration for New Mexico.