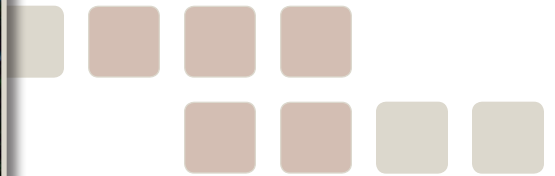


**APPENDIX 2C**  
**TRINITY COUNTY TRAVEL DEMAND FORECASTING MODEL**  
**DEVELOPMENT REPORT**



Trinity County  
TRAVEL DEMAND FORECASTING  
MODEL DEVELOPMENT REPORT



Prepared for:

County of Trinity  
California

June 2011

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# 1. INTRODUCTION

## BACKGROUND

Past transportation planning efforts in Trinity County have relied on the Weaverville Traffic Model developed by LSC, Incorporated in 2004. Since the release of this model, uncertainties have developed with respect to its inputs, base year model calibration, and overall ability to accurately predict future travel demand. As part of the Trinity County 2010 Regional Transportation Plan (RTP), Fehr & Peers developed a County-wide Travel Demand Model (TDM).

## PURPOSE

This report documents the process of developing the base year Trinity County TDM and presents the model calibration and validation results. Once the base year model is adequately calibrated, it can be used to predict future travel demand based on various land use and roadway assumptions. This new TDM can be used for a variety of purposes such as:

- Generating traffic forecasts and other travel data (e.g., vehicle miles of travel per capita) to assist in developing an appropriate roadway network for the RTP.
- Developing a County-wide traffic impact fee program.
- Evaluating changes in travel patterns resulting from a proposed roadway improvement.
- Determining trip distribution patterns and potential impacts of land development proposals.
- Supporting the preparation of project development reports for the California Department of Transportation (Caltrans).

## MODEL AREA AND MODEL YEARS

The TDM encompasses all of Trinity County. Although there are no incorporated cities in Trinity County, the model includes significant detail in the communities of Weaverville, Hayfork, and Trinity Center. The roadway network includes all state highways (State Routes 299, 3, and 36) and several major County roadways.

The model produces traffic estimates of daily, AM peak hour, and PM peak hour conditions. The model is calibrated to traffic counts for what is conventionally termed a “typical weekday”, which is defined as a Tuesday, Wednesday, or Thursday during a week with no holidays when local schools are in session. Because little growth has occurred in the County since 2004, the model was developed based on the same land use as the previous 2004 model. However, land use in several areas has been updated based on aerial surveys. The model’s roadway network represents Trinity County’s 2009 roadways. Traffic counts were provided by the County and were collected in 2007, 2008, and 2009.

Two model years were developed:

- 2009
- 2040

## **ORGANIZATION OF REPORT**

This report is organized into six chapters:

1. Introduction
2. Discussion of Travel Demand Models
3. Summary of the Input Data
4. Description of the Model Calibration
5. Summary of the Model Validation Results
6. Future Year (2040) Model Development

A technical appendix is also attached, which contains model development information that is referenced throughout the report.

## 2. DISCUSSION OF TRAVEL DEMAND MODELS

This section summarizes the answers to commonly asked questions related to travel demand models.

### WHAT IS A TDM?

A travel demand model (TDM) is a computer based tool that estimates traffic levels and patterns for a specific geographic area. TDM's are compiled using a computer program consisting of input files that summarize the area's land uses, street network, travel characteristics, and other key factors. Using this data, the model performs a series of calculations to determine the amount of trips generated by land uses, where each trip begins and ends, and the route taken by the trip. The model's output includes estimates of traffic on major roadways.

### WHY DO WE NEED A TDM?

The Trinity County TDM will be a valuable tool for the preparation of the Trinity County 2010 Regional Transportation Plan and other long-range transportation planning studies. The model will be used to estimate the average daily and peak hour traffic volumes on major roadways in the future under certain growth assumptions. Using these traffic projections, transportation improvements can be identified to accommodate traffic growth.

### HOW DO WE KNOW IF THE TDM IS ACCURATE?

To be deemed accurate for projecting traffic volumes in the future, a model must first be calibrated to a year in which actual land use data and traffic volumes are available and well documented. A model is accurately calibrated when it replicates the actual traffic counts on the major roads within certain ranges of error set by Caltrans. The Trinity County TDM has been calibrated to 2009 (base year) conditions using the existing roadway system and 2004 land use data provided by the County. A thorough review of the 2004 land use revealed that it accurately represents 2009 land use (little growth has occurred in Trinity County since 2004), although some modifications were made to the land use to improve its accuracy.

The ability of a traffic model to replicate traffic counts is known as model validation. For the model validation, 65 roadway segments within the County were included as daily study locations and 37 roadway segments were included as peak hour study locations. Traffic counts at these locations were compared with the base year model's estimates of daily, AM peak hour, and PM peak hour volume to determine the model's accuracy.

### IS THE TRINITY COUNTY TDM CONSISTENT WITH STANDARD PRACTICES?

The Trinity County TDM is consistent in form and function with the standard travel demand models used in the transportation planning profession. The model includes a land use/trip generation module, a gravity-based trip distribution model, and a capacity-restrained equilibrium traffic assignment process. The traffic model uses the Voyager software platform, which is consistent with many of the models used by local jurisdictions in California and Caltrans.

### 3. SUMMARY OF THE INPUT DATA

The Trinity County TDM incorporates many types of input data, which are further described in this chapter.

#### TRAFFIC ANALYSIS ZONE (TAZ) SYSTEM

The County is divided into geographic sub-areas called traffic analysis zones (TAZs). TAZs represent physical areas containing land uses that produce or attract vehicle-trip ends. A TAZ system must provide sufficient detail to accurately represent the way that trips enter and exit the roadway network. With only a few exceptions, the 2004 model's TAZ system within Weaverville was acceptable for use in the development of the 2009 model. Outside of Weaverville, extensive detail was added in Trinity Center, Lewiston, Hayfork, and the remaining rural areas of Trinity County. The following factors were considered when defining zone boundaries: access to the street system, type of land use, streets, and natural boundaries such as rivers and mountains.

The model is divided into 140 TAZs. A total of 81 TAZs represent Weaverville, 18 TAZs represent Hayfork, and the remaining 41 represent the rural areas of the County, including the communities of Lewiston and Trinity Center. Figures 1A-1E include maps of the model's TAZ system.

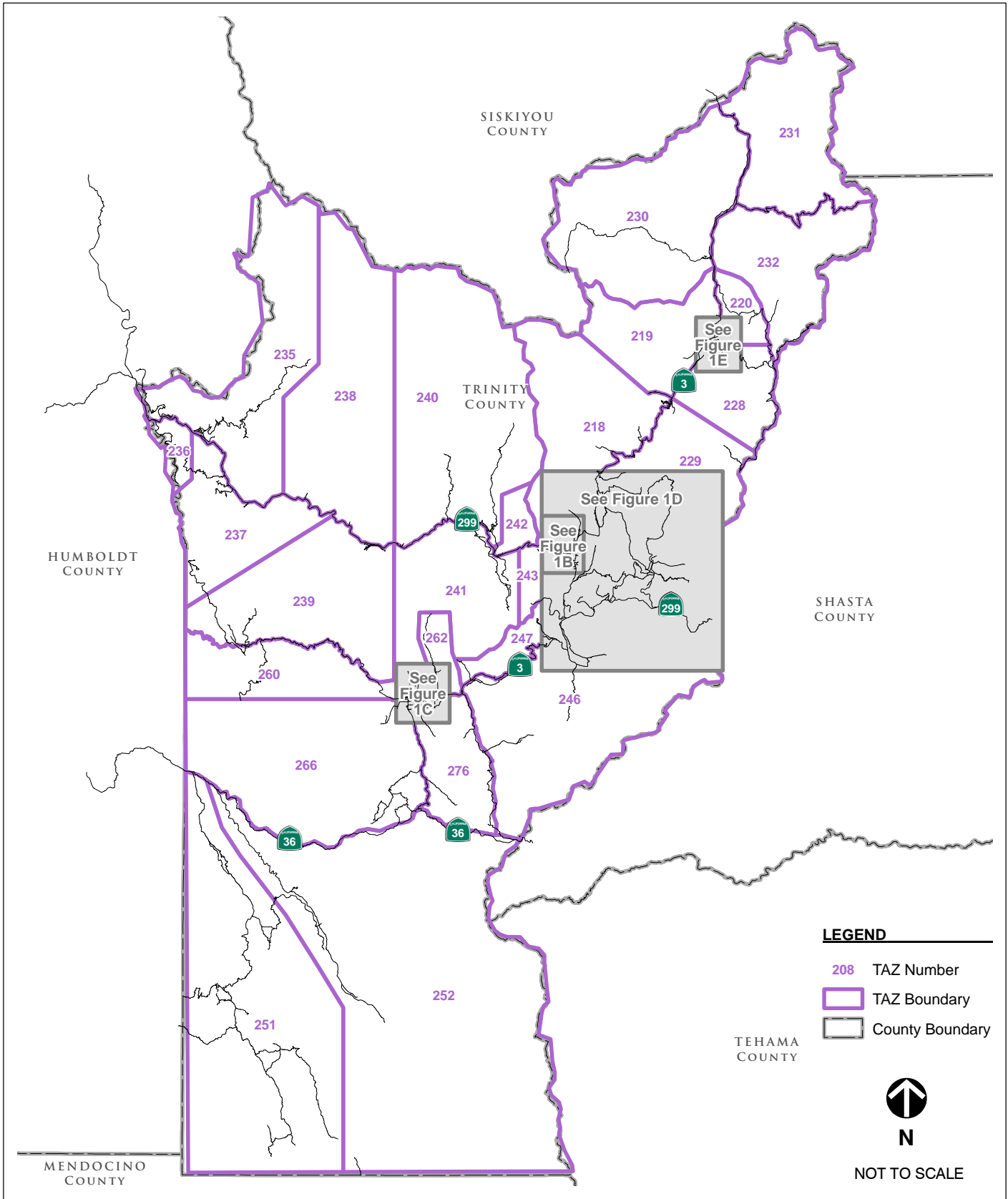
Also included in the zone structure are the external stations: gateways at points where major roadways provide access into the County. These stations model the traffic entering, exiting, or passing through the County. A total of six external gateways were established for this model:

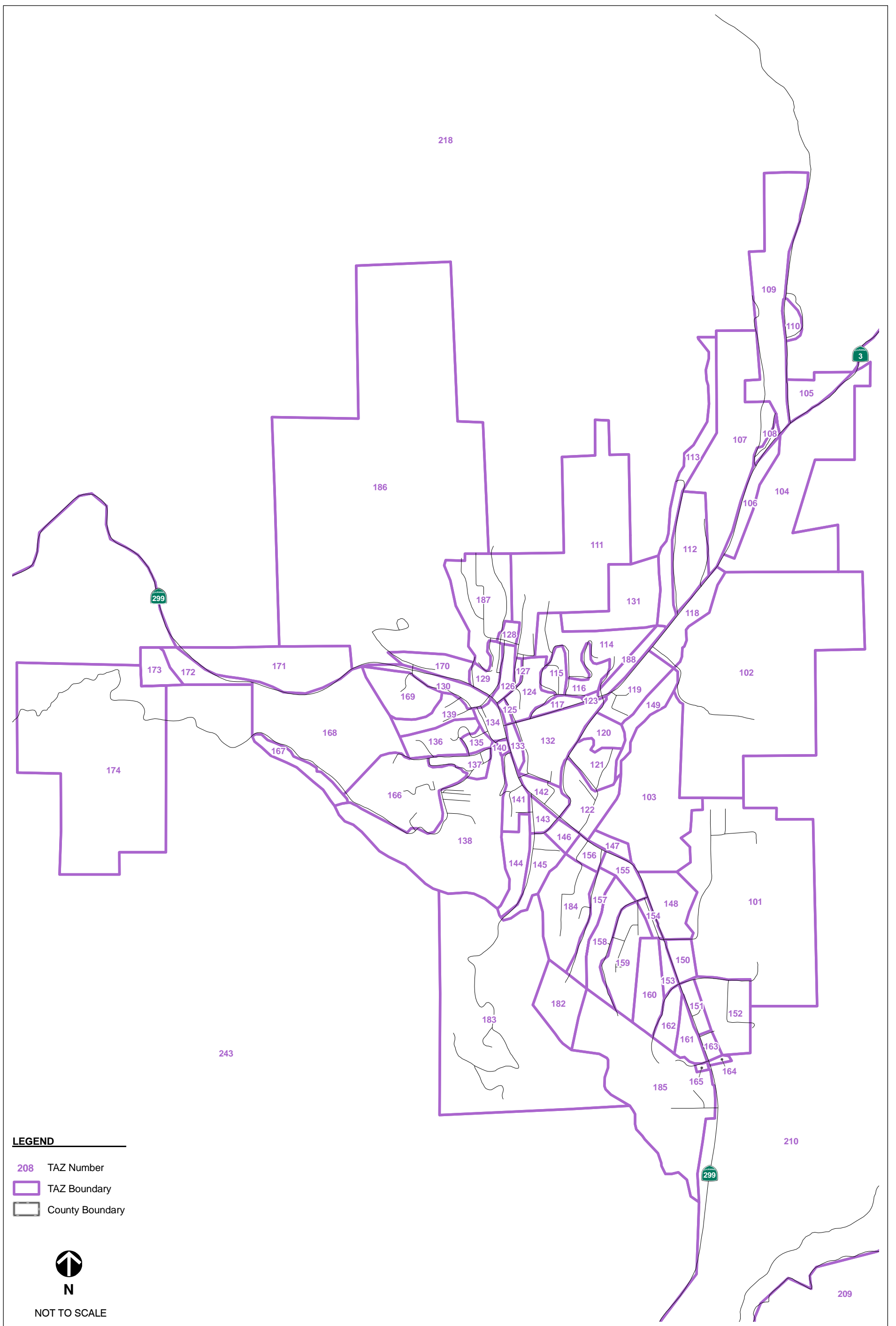
1. SR 3 in northern Trinity County
2. Ramshorn Road in northern Trinity County
3. SR 299 in eastern Trinity County
4. SR 36 in eastern Trinity County
5. SR 36 in western Trinity County
6. SR 299 in western Trinity County

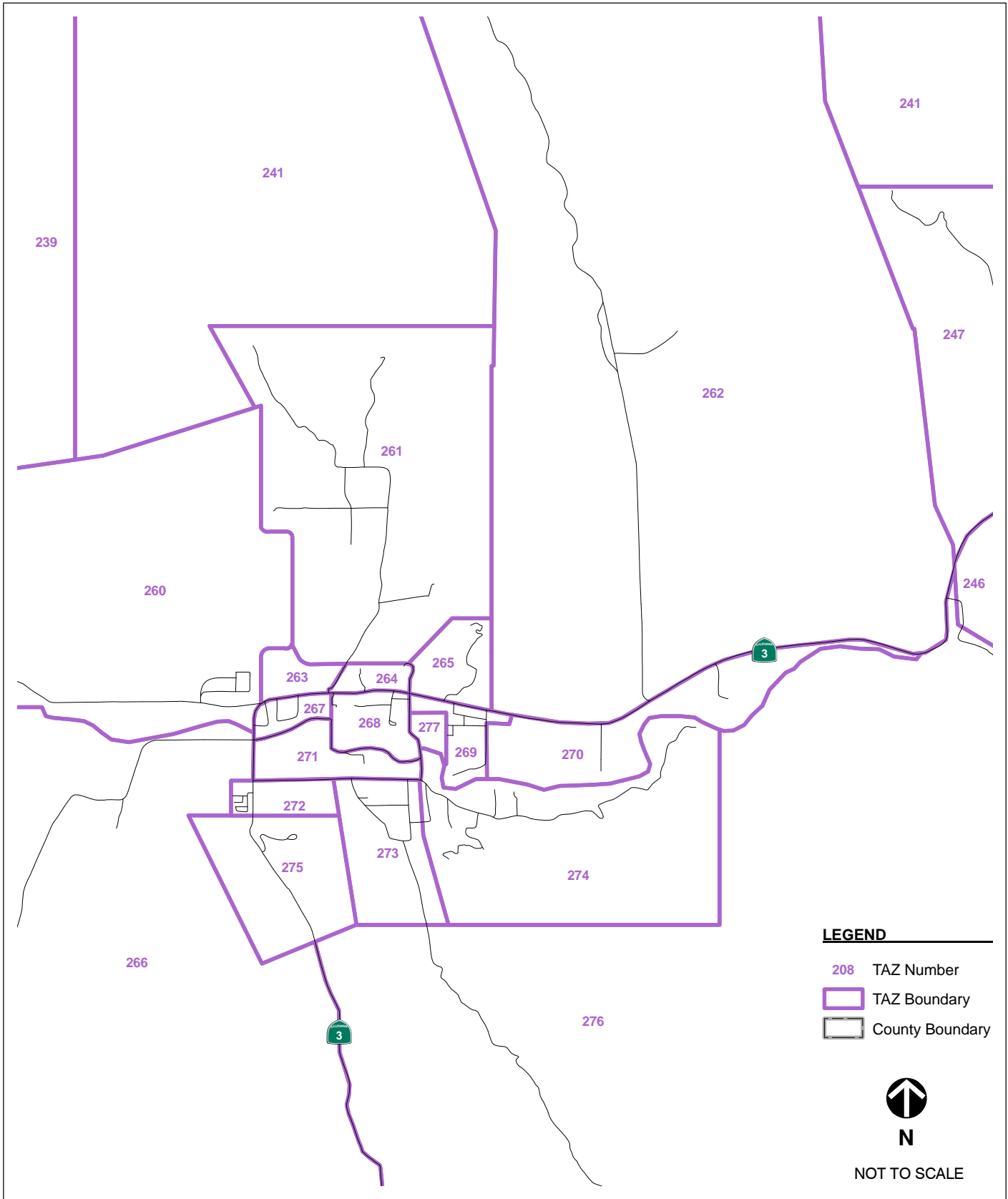
#### LAND USE DATA

One of the primary inputs to the TDF model is the land use data, which is instrumental in estimating trip generation. Table 1 presents the land use data categories for each TAZ including measurement units (e.g., dwelling units, square feet, etc.). In addition to specific land use categories, the model includes a "special generator" land use category meant to accommodate land uses with unusual trip generation characteristics.

The land use used in the 2004 model was provided for use in the development of the 2009 model. A thorough review of the 2004 land use revealed that it accurately represents 2009 land use (little growth has occurred in Trinity County since 2004), although aerial and street-view surveys were completed by Fehr & Peers to improve the inventory of land use in Hayfork. Where TAZs from the 2004 model were disaggregated into smaller TAZs (notably in Trinity Center, Lewiston, and rural Trinity County), Fehr & Peers used aerial imagery and utility meter information provided by the Trinity Public Utilities District to allocate land use to the 2009 model's TAZs. Additionally, the land use from the 2004 model did not include any estimates of school enrollment. The number of students in each TAZ was developed based on any schools located in a TAZ and the enrollment data provided in each school's *Accountability Report Card*.





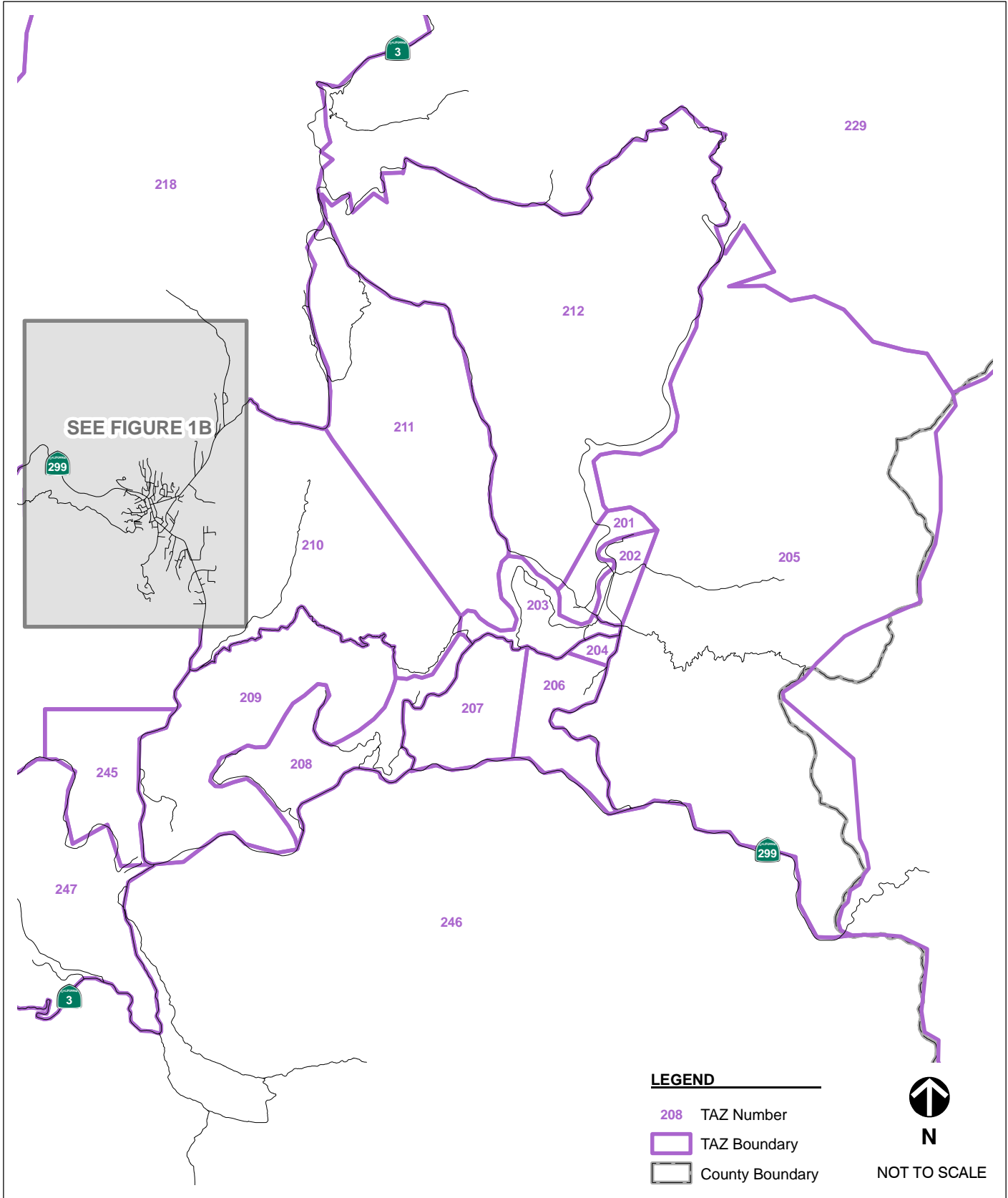


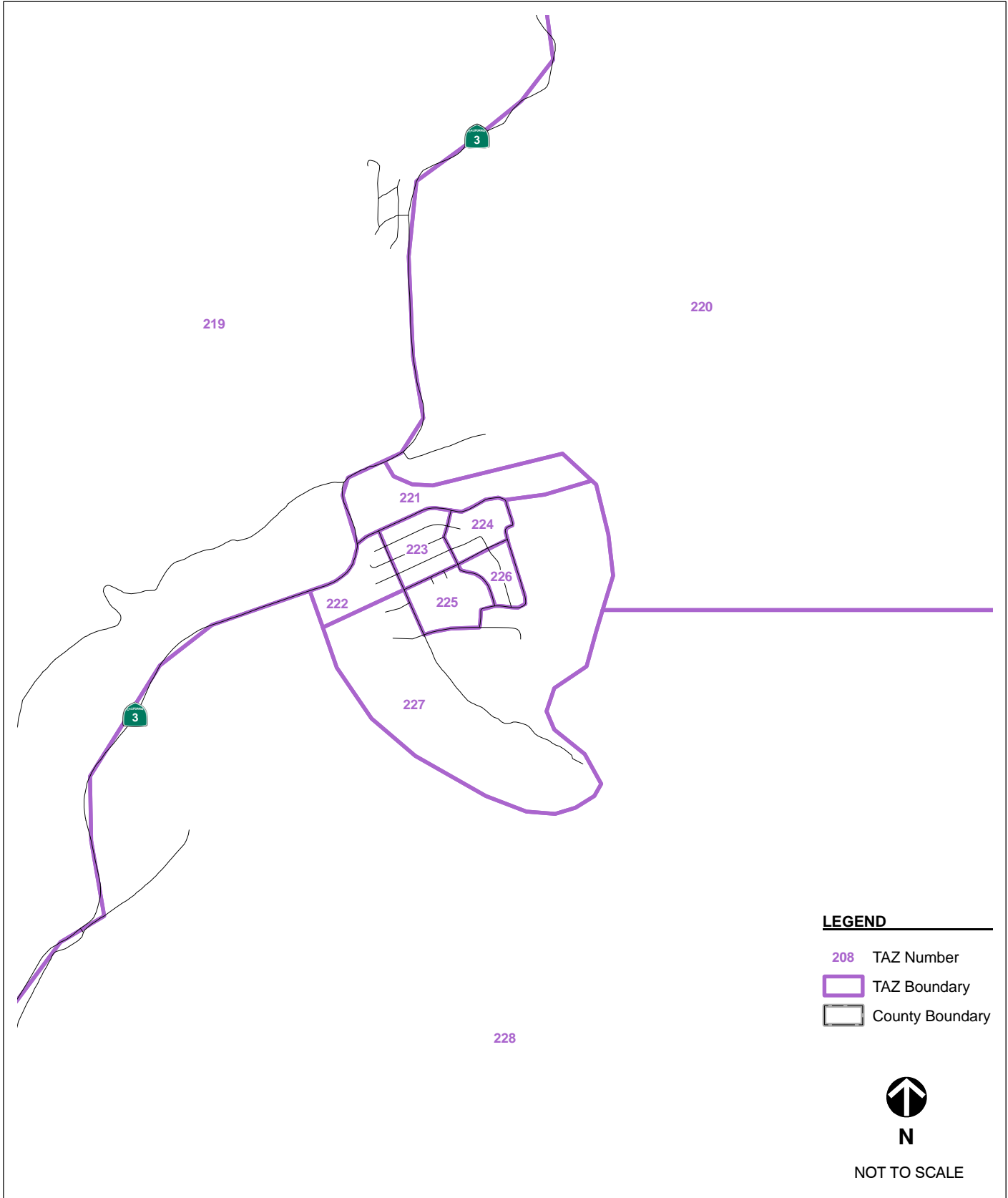
**FEHR & PEERS**  
TRANSPORTATION CONSULTANTS

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**HAYFORK TAZS**

**FIGURE 1C**





<b>TABLE 1 – LAND USE CATEGORIES IN TRINITY COUNTY TDM</b>	
<b>Land Use</b>	<b>Measurement Units</b>
Single-Family Residential	Dwelling Units
Multi-Family Residential	Dwelling Units
Office Commercial	KSF
Retail Commercial	KSF
Grocery	KSF
Restaurant	KSF
Convenience Store	KSF
Entertainment	KSF
Medical Office	KSF
Light Industrial	KSF
Hotel / Motel	Rooms
Storage	Units
Schools (Elementary/Middle, High)	Students
Special Generators	Number of Daily Trips
Notes: KSF = thousand square feet	
Source: Fehr & Peers, 2011	

Appendix A displays the base year land use data file.

### TRIP GENERATION RATES

Trinity County's rural character contributes to a varying level of trip generation depending on the location of land use within the County. Because residential and commercial land uses in Weaverville are located closely to one another, they are likely to generate trips at a higher rate than land uses in rural parts of the County where residential and commercial land uses are separated by long distances. Since trip generate rate varies depending on location within the county, it was necessary to classify the County into four different areas so that different trip generation rates could be applied to each area. These geographic areas are as follows:

1. Weaverville
2. Rural Trinity County (includes communities of Lewiston and Trinity Center)
3. Western Trinity County (areas within Trinity County whose primary trip destinations are outside of Trinity County)
4. Hayfork

The trip generation rates for Area 2 (Rural Trinity County) and Area 3 (Western Trinity County) are the same; however, Census 2000 Journey to Work Data revealed significant differences between the behaviors of the two areas. Among Area 2 TAZs, very few trips (less than 15%) go external to the County

on a daily basis; however, the number of external trips for Area 3 is much higher (approximately 70%) since most attractive destinations are outside of Trinity County.

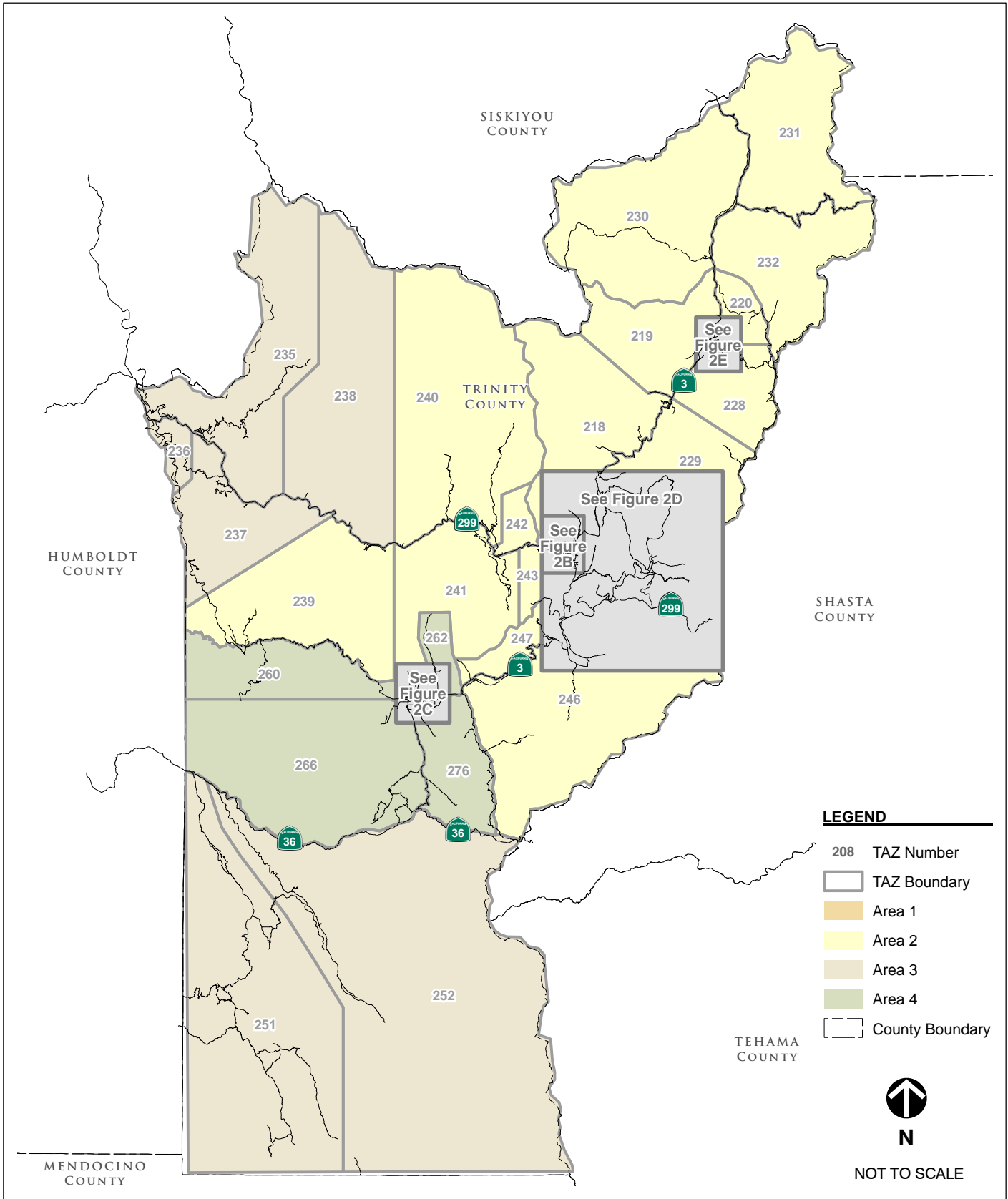
The principal source of data for single-family residential trip generation rates was counts conducted at locations throughout Trinity County:

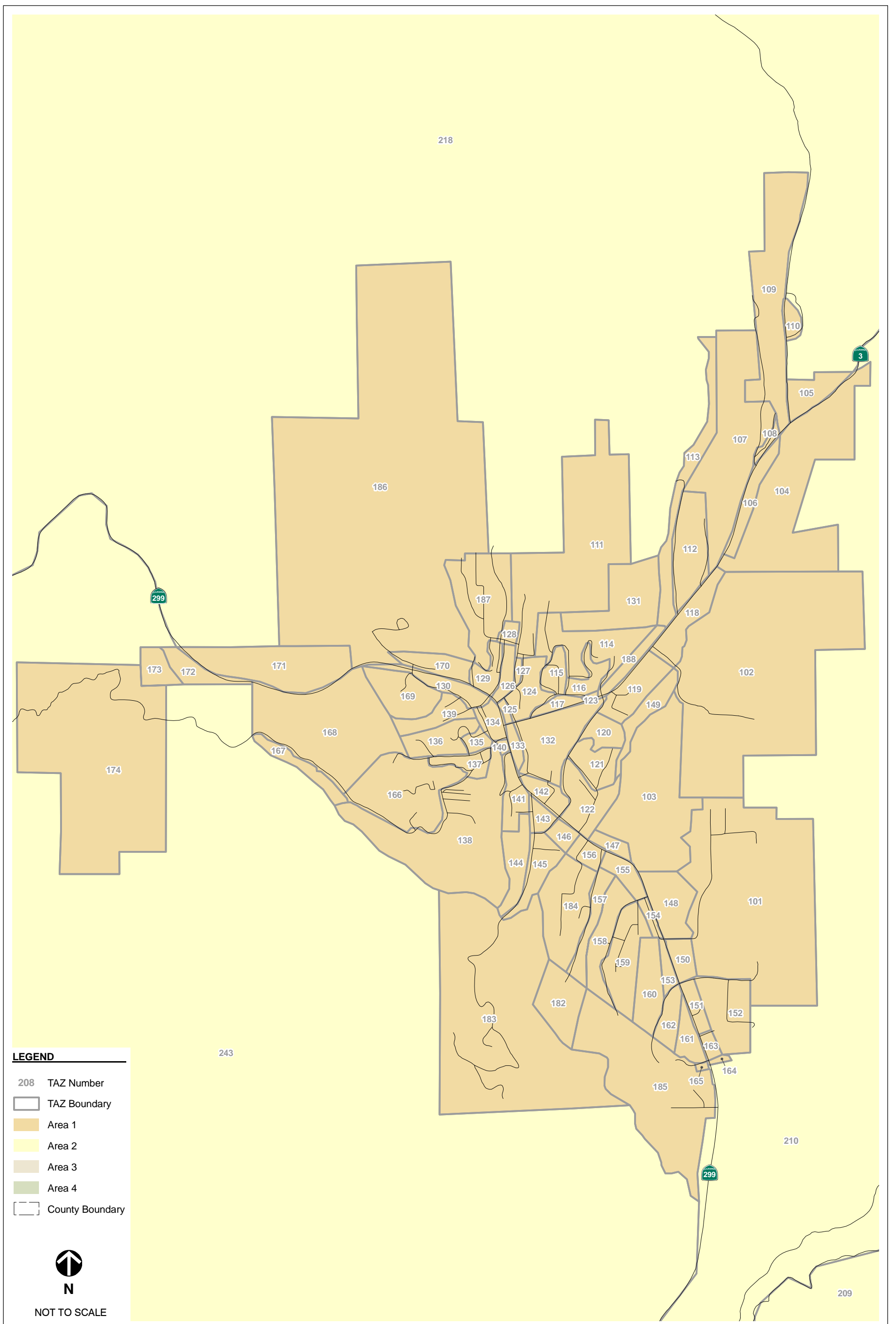
- Area 1 – Weaverville
  - A trip generation survey of 49 single-family residences on Easter Avenue in Weaverville (Area 1) revealed a daily rate of 8.53 trips per unit.
  - A trip generation survey of 15 single-family residences on Hawthorne Street in Weaverville (Area 1) revealed a daily rate of 8.60 trips per unit.
  - The weighted average of these two daily rates is 8.55 trips per unit.
- Area 2 / Area 3 – Rural Trinity County / Western Trinity County
  - A trip generation survey of 40 single-family residences on B Bar K Road near Douglas City (Area 2) revealed a daily rate of 4.3 trips per unit.
  - A trip generation survey of 63 single-family residences on Steel Bridge Road near Douglas City (Area 2) revealed a daily rate of 2.4 trips per unit.
  - The weighted average of these two daily rates is 3.13 trips per unit.
- Area 4 – Hayfork
  - A trip generation survey of 52 single-family residences on Highland Drive in Hayfork (Area 4) revealed a daily rate of 7.21 trips per unit.

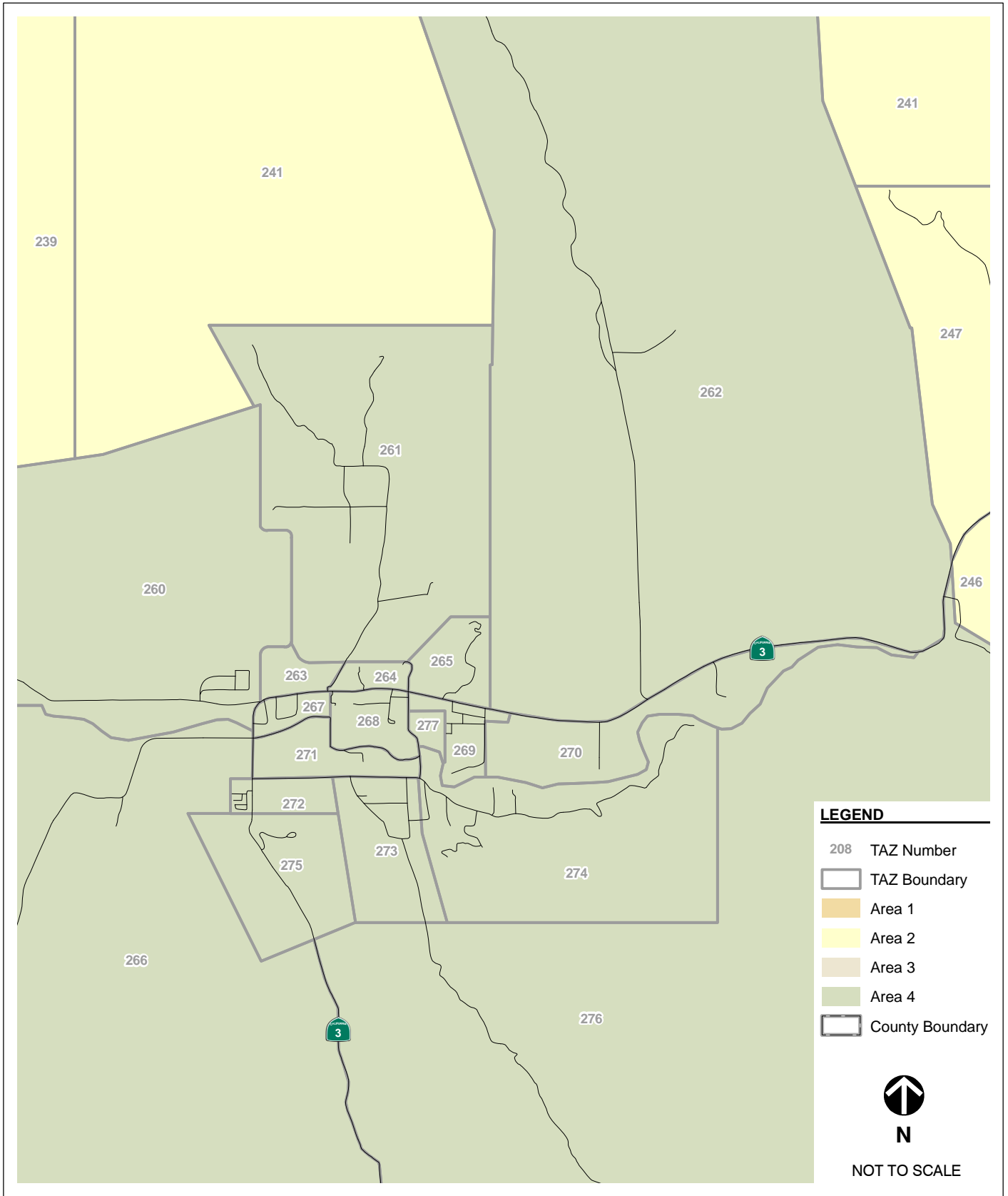
Trip generation rates for other land uses were developed based on *Trip Generation, 8<sup>th</sup> Edition* (Institute of Transportation Engineers, 2008) and adjusted based on the ratio of an area's single-family residential rate to *Trip Generation*'s single-family residential rate. For example:

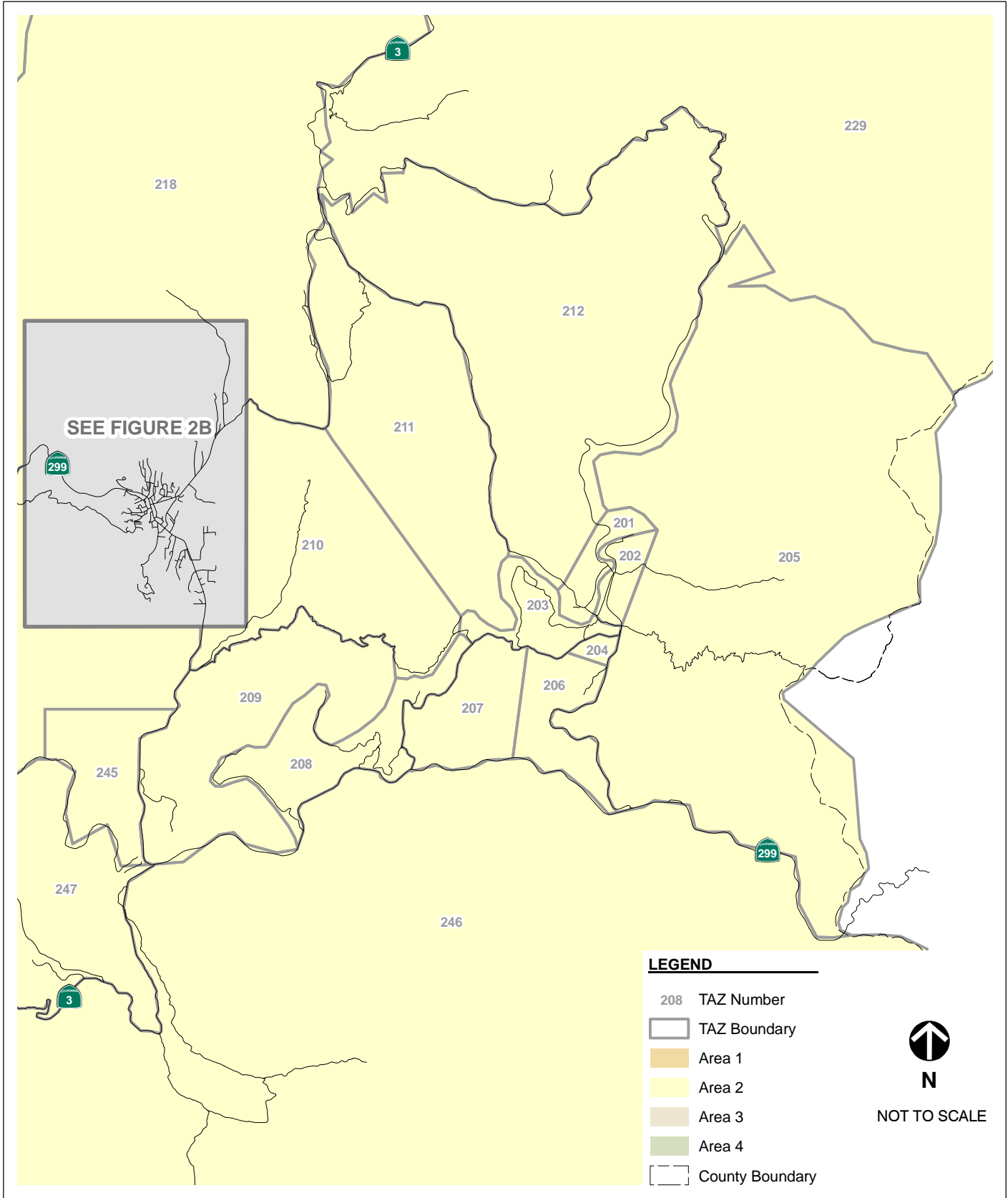
- Weaverville's observed daily rate for single-family residences is 8.55 trips/day
- *Trip Generation*'s daily rate for single-family residences is 9.57 trips/day
- $8.55 / 9.57 = 0.893$
- *Trip Generation*'s daily rate for multi-family residences is 6.59 trips/day
- Weaverville's assumed daily rate for multi-family residences is 5.89 trips/day = 6.59 trips/day x 0.893

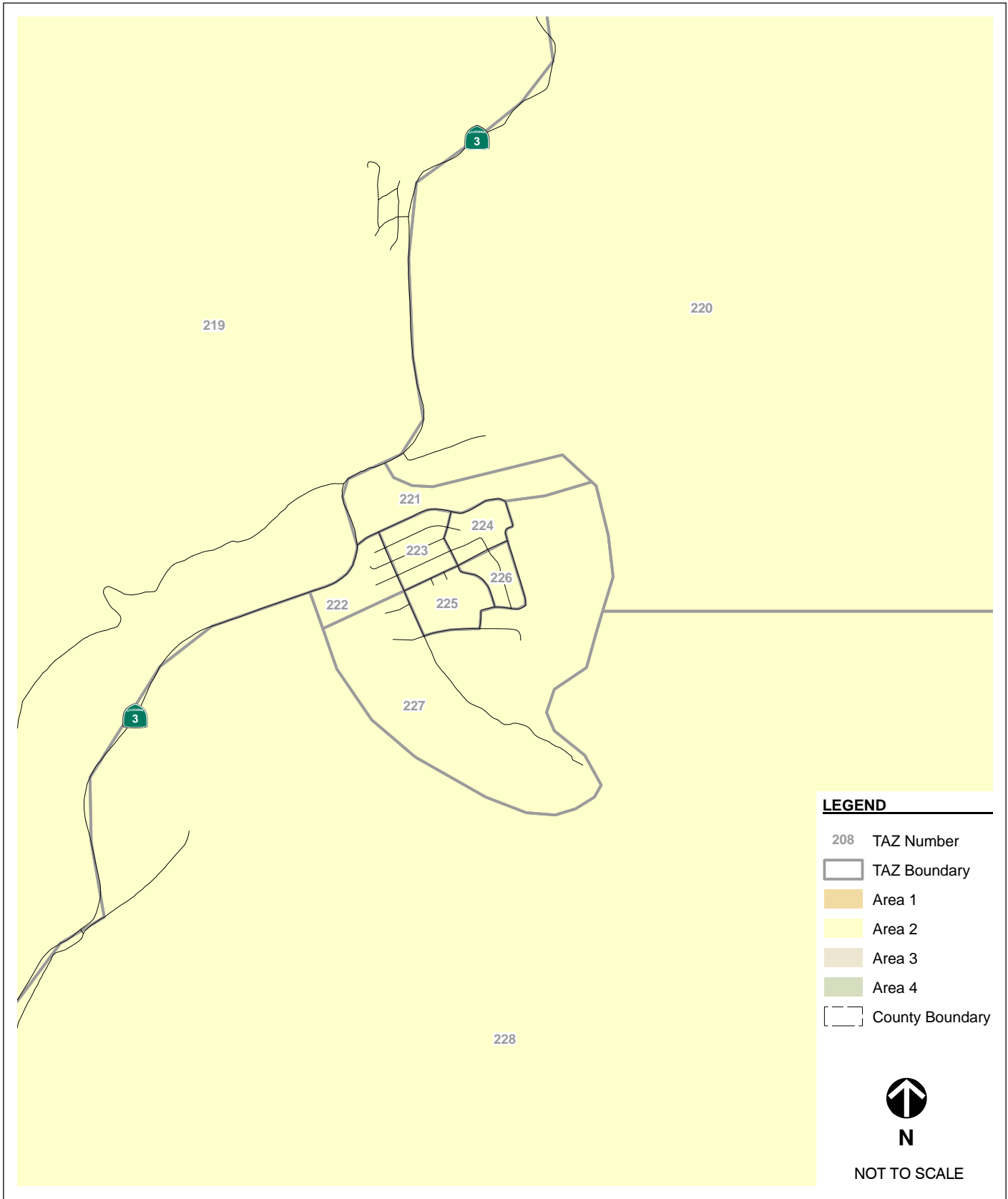
Table 2 summarizes the trip generation rates for all areas of the Trinity County TDM; Figures 2A-2E show the area types assigned to each TAZ in the model.











**TABLE 2–  
TRIP GENERATION RATES IN TRINITY COUNTY TDM**

Land Use	Units	Area 1	Area 2	Area 3	Area 4
Single-Family Residential	Dwelling Units	8.55	3.13	3.13	7.21
Multi-Family Residential	Dwelling Units	5.89	2.16	2.16	4.96
Office Commercial	KSF	9.84	3.60	3.60	8.29
Retail Commercial	KSF	38.36	14.04	14.04	32.35
Grocery	KSF	91.34	33.44	33.44	77.03
Restaurant	KSF	113.60	41.59	41.59	95.79
Convenience Store	KSF	690.00	255.00	255.00	637.07
Entertainment	KSF	69.74	25.53	25.53	58.81
Medical Office	KSF	32.28	11.82	11.82	27.22
Light Industrial	KSF	6.23	2.28	2.28	5.25
Hotel / Motel	Rooms	7.30	2.67	2.67	6.16
Storage	Units	0.25	0.09	0.09	0.21
Elementary/Middle School	Students	1.15	1.15	1.15	1.15
High School	Students	2.20	2.20	2.20	2.20
Special Generators	Daily Trips	1.00	1.00	1.00	1.00

Notes: KSF = thousand square feet  
Source: Fehr & Peers, 2011

In addition to specific land use categories, the model includes a “special generator” land use category meant to accommodate land uses with unusual trip generation characteristics. Table 3 summarizes the base year model’s special generators. Daily trip estimates were developed as follows:

- Airports – Trinity County staff provided Fehr & Peers with estimates of the number of aircraft based at each airport in Trinity County. Daily trip estimates were developed using the ITE rate for general aviation airports (ITE 022).
- Post Offices – counts conducted at the commercial complex containing the post office in Weaverville revealed daily trip estimates of 3,100 trips per day. The number of post office trips was developed by subtracting the estimated number of trips to/from the commercial uses in the complex from the total trips accessing the complex. Estimates of the other post offices were developed based on the number of households that each post office serves as well as the area’s single-family trip generation rate relative to that of Weaverville.

<b>TABLE 3 – TRINITY COUNTY TDM SPECIAL GENERATORS</b>	
<b>Land Use</b>	<b>Daily Trip Estimate</b>
<b>Airports</b>	
Weaverville Airport	75
Trinity Center Airport	110
Ruth Airport	15
Hyampom Airport	10
Hayfork Airport	30
<b>Post Offices</b>	
Weaverville Post Office	2,600
Lewiston Post Office	370
Trinity Center Post Office	220
Hayfork Post Office	1,140
<b>Other Land Uses</b>	
Trinity River Lumber Company (Weaverville)	400 (120 employees & 160 trucks per day)
Trinity Hospital	1,590 (assumes ITE rate for 200 employees)
Trinity Alps Golf Course	320
Source: Fehr & Peers, 2011	

## ROADWAY NETWORK

The roadway network for the TDM is based on the County's Geographic Information System (GIS) roadway centerline file. The TDM roadway network includes all major highways and many County roadways. The network database includes distance, street name, number of lanes, posted speed limit, and capacity. Roadways are classified as either highways or County roadways.

<b>TABLE 4 – LAND USE CATEGORIES IN TRINITY COUNTY TDM</b>	
<b>Roadway Classification</b>	<b>Capacity (vehicles per hour per lane)</b>
Highway	1,400
County Roadway	600
Source: Fehr & Peers, 2011	

## 4. DESCRIPTION OF THE MODEL CALIBRATION

Model calibration is the process by which parameters are set based on a comparison of travel estimates computed by the model with actual travel data from the area being studied. This section provides a general description of the calibration steps and the adjustments made during the process to achieve accuracy levels that are within Caltrans' standards. For detailed information regarding the specified modeling steps, refer to the Voyager model control file that is included in Appendix B.

### TRIP GENERATION

The first step in the model is the estimation of trips that originate and terminate in each TAZ. This is completed using the trip generation rates for each land use category for each area of the model. Trips are then classified either as "productions" or "attractions", and trip purpose data is tabulated.

### TRIP DISTRIBUTION

The trip distribution process determines the specific destination of each originating trip. The destination may be within the zone itself, which results in an intra-zonal trip. If the destination is outside of the zone of origin, it is an inter-zonal trip. Internal-internal (II) trips originate and terminate within the County. Trips that originate within but terminate outside of the County are internal-external (IX), and trips that originate outside and terminate inside the County are external-internal (XI). Trips passing completely through the County are external-external (XX).

The trip distribution model uses the gravity equation to distribute trips to all zones. This equation estimates an accessibility index for each zone based on the number of attractions in each zone and a friction factor, which is a function of time between zones. Each attraction zone is given its pro-rata share of productions based on its share of the accessibility index. This process applies to the II, IX, and XI trips. The XX trips are added to the trip table prior to final assignment. Friction factors, or travel time factors, are used in the trip distribution stage of the model in execution of the gravity model. Iterative runs of the model were conducted with the various sets of friction factors to identify an appropriate set of curves that improved trip distribution and corresponding validation.

### MODE CHOICE

A separate mode-choice model was not developed given the purpose of this model and the limited transit use in the County.

### TRIP ASSIGNMENT

The trip assignment process determines the route that each vehicle-trip follows to travel from origin to destination. The model selects these routes in a manner that is sensitive to congestion and the desire to minimize overall travel time. It uses an iterative, capacity-restrained assignment and equilibrium volume adjustments. This technique finds a travel path for each trip that minimizes the travel time, with recognition of the congestion caused by all other trips.

The general assignment process includes the following steps.

- Assign all trips to the links along their selected paths
- After all assignments, examine the volume on each link and adjust its impedance based on the volume-to-capacity ratio

- Repeat the assignment process for a set number of iterations or until specified criteria are satisfied

As part of the assignment process, an equilibrium volume adjustment is also applied. This adjustment is used to weight the results of each assignment iteration for incorporation into a final total volume for each link.

Attached to the last page of this report is an envelope containing a CD of the base year model. The CD contains all files necessary to run the model, including the output files (i.e., loaded model networks). To properly run this model, users must have a recent version of Citlabs' Cube & TP+ software (version 4.1.1 or later).

## 5. SUMMARY OF MODEL VALIDATION RESULTS

This chapter presents a summary of the base year Trinity County Travel Demand Model's validation to existing conditions.

The term "static validation" refers to the model's performance as it relates to how well its estimate of base year traffic volumes matches existing traffic counts. Caltrans has identified certain guidelines regarding acceptability for forecasting future year traffic. This chapter describes the model's performance in comparison to the Caltrans Travel Forecasting Guidelines, November 1992, Travel Model Improvement Program (TMIP) Model Validation and Reasonableness Checking Manual, February 1997, and Fehr & Peers' internal standards. In addition, dynamic validation was performed to test the sensitivity and reasonableness of the TDF model in responding to land use and roadway network changes.

### VALIDATION COMPARISON TECHNIQUES

Travel model accuracy is tested using these comparison techniques:

- The volume-to-count ratio is computed by dividing the volume assigned by the model and the actual traffic count for individual roadways model-wide.
- The deviation is the difference between the model volume and the actual count divided by the actual count.
- The correlation coefficient estimates the correlation between the actual traffic counts and the estimated traffic volumes from the model.
- The coefficient of determination ( $R^2$ ) is the proportion of variability between the actual traffic counts and the estimated traffic volumes from the model.
- The Percent Root Mean Square Error (PRMSE) is the square root of the model volume minus the actual count squared divided by the number of counts. It is a measure similar to standard deviation in that it assesses the accuracy of the entire model.

### STATIC VALIDATION STANDARDS

For a model to be considered accurate and appropriate for use in traffic forecasting, it must replicate actual conditions within a certain level of accuracy and demonstrate sufficient sensitivity to changes in the model's input variables. Since it is extremely unlikely that any model will precisely replicate all counts, validation guidelines have been established. The following summarizes key validation targets for daily conditions based on the Caltrans guidelines, TMIP guidelines, and Fehr & Peers' internal standards for the Trinity County TDM.

- All screenlines should be within their maximum desirable deviation, which ranges from approximately 5 to 60 percent, depending on total volume.
- A minimum of 75 percent of the roadway links should be within their maximum desirable deviation, which ranges from approximately 5 to 60 percent, depending on total volume.
- The model-wide correlation coefficient is suggested to be greater than 0.88.
- The model-wide coefficient of determination ( $R^2$ ) is suggested to be greater than 0.77.

- Less than 30 percent is suggested for an appropriate aggregate PRMSE for all links with counts or by facility type and area type.

## STATIC VALIDATION RESULTS

The base year Trinity County TDM was run once all of the input data described in Chapter 3 was collected and formatted for Voyager use. The model results were examined and checked for reasonableness. Link volumes that did not conform with traffic counts were investigated further, which led to some modifications of the model parameters.

Table 5 summarizes the aggregate static validation results for all validation links.

<b>TABLE 5 – LINK LEVEL STATIC VALIDATION RESULTS</b>				
<b>Land Use</b>	<b>Caltrans and TMIP Guidelines</b>	<b>Daily</b>	<b>AM Peak Hour</b>	<b>PM Peak Hour</b>
Percent of screenlines within allowed maximum deviation	100%			
Percent of roadway links within allowed maximum deviation	> 75%	88% ✓	73%	84% ✓
Correlation Coefficient	> 0.88	0.97 ✓	0.90 ✓	0.92 ✓
Coefficient of Determination (R <sup>2</sup> )	> 0.77	0.93 ✓	0.80 ✓	0.84 ✓
Overall Percent RMSE at Link Level	< 30%	24% ✓	45%	0.37
Source: Fehr & Peers, 2011				

All aggregate static validation results exceed the validation guidelines established in the Caltrans guidelines and the TMIP guidelines for daily conditions. However, certain static validation results for the AM and PM peak hours do not exceed the validation guidelines. It is important to note that the Caltrans, TMIP, and Fehr & Peers guidelines for static validation were developed for daily, not peak hour, conditions. Generally, roadway links with small volumes are more difficult to validate than those with large volumes. Appendix C contains detailed static validation summary reports.

Figure 3 illustrates the model's daily validation by showing a graph of the daily traffic counts used in the model validation and their corresponding volumes in order from the smallest count to the largest count. As shown in the graph, the model volumes follow the pattern exhibited by the daily counts: as the daily count increases, the model volumes generally increase.

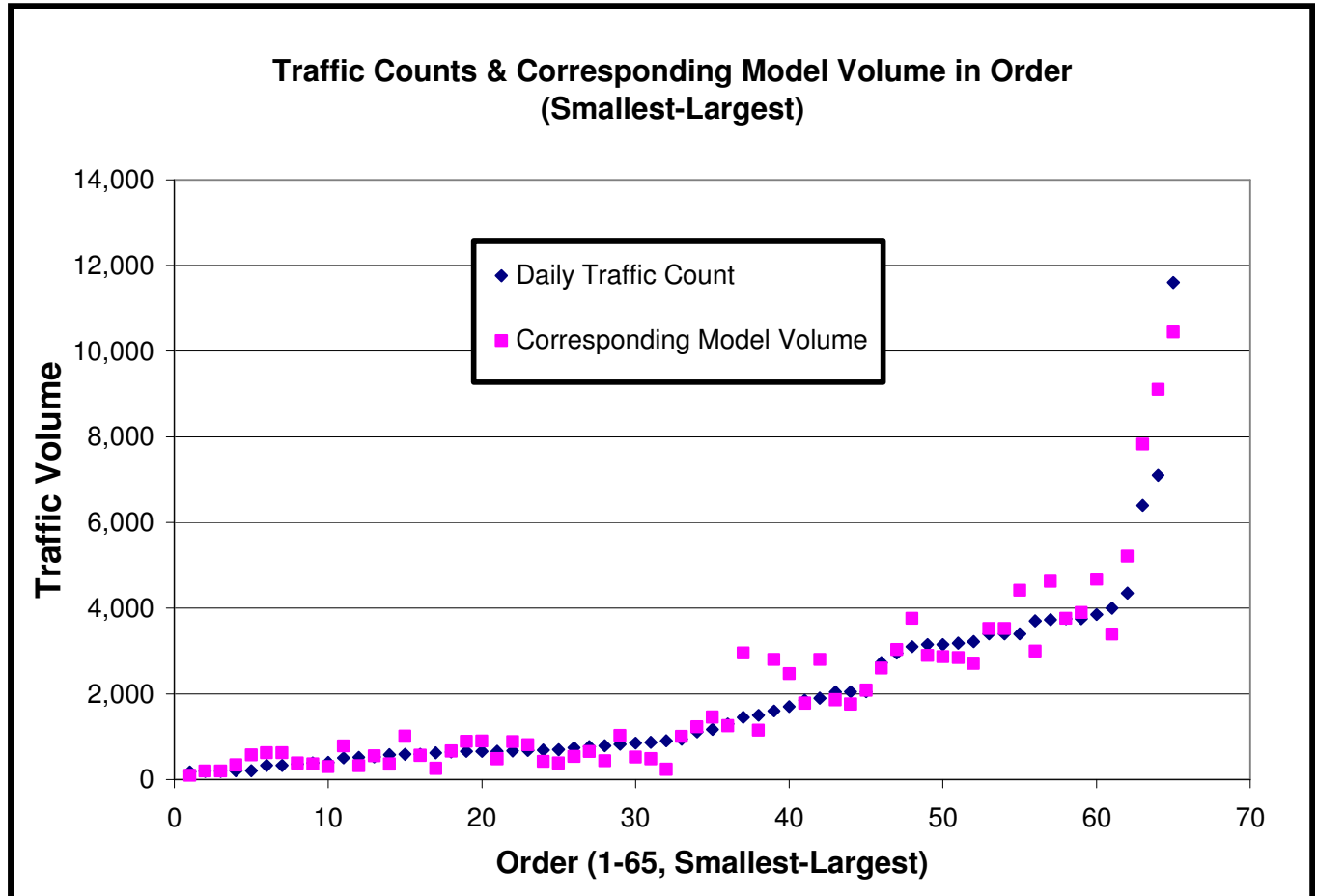


Figure 3 – Daily Traffic Counts and Corresponding Model Volume

### DYNAMIC VALIDATION RESULTS

The previous section described a validation process that consisted of comparing the model's traffic volume forecasts for the base year to traffic counts taken for the same year. This is "static" validation in that it judges the model's ability to replicate a static set of conditions (the traffic counts). While this provides some useful information, its usefulness is limited by the fact that models are seldom, if ever, used for static applications; by far the most common use of models is to forecast how a change in inputs would result in a change in traffic conditions. The most valid tests of a model's accuracy must, therefore, focus on the model's ability to predict realistic differences in outputs as inputs are changed; in other words, dynamic validation rather than static validation. This section describes the results of the dynamic validation tests that were performed on the base year Trinity County TDM.

Residential land use modification, commercial land use modification, and roadway network modification tests were conducted as a part of this dynamic validation.

#### *Residential Land Use Tests*

Single-family residences were added to TAZs in varying quantities to observe the model's response to the change in input. Single-family residences were added to two different TAZs to observe the difference in behavior when adding dwellings units to different area types:

- TAZ 109 in north Weaverville - trip generation Area 1
- TAZ 204 in Lewiston - trip generation Area 2

The results of these tests are summarized in Tables 6 and 7.

<b>TABLE 6 – DYNAMIC VALIDATION RESULTS FOR HOUSEHOLD ADDITION – TAZ 109</b>							
<b>TAZ</b>	<b>Scenario</b>	<b>TAZ Vehicle Trips</b>	<b>Δ TAZ Vehicle Trips</b>	<b>Average VT/Unit for Increment</b>	<b>Vehicle Miles of Travel (VMT)</b>	<b>Δ VMT</b>	<b>Average VMT/Unit for Increment</b>
109	Base Scenario	912	--	--	432,959	--	--
	Add 10 Single-Family Residences	998	86	8.6	433,282	323	32.3
	Add 100 Single-Family Residences	1,762	850	8.5	436,273	3,314	33.1
	Subtract 10 Single-Family Residences	827	-85	8.5	432,672	-287	28.7
	Subtract 100 Single-Family Residences	58	-854	8.5	430,247	-2,712	27.1
Source: Fehr & Peers, 2011							

**TABLE 7 –  
DYNAMIC VALIDATION RESULTS FOR HOUSEHOLD ADDITION – TAZ 204**

TAZ	Scenario	TAZ Vehicle Trips	Δ TAZ Vehicle Trips	Average VT/Unit for Increment	Vehicle Miles of Travel (VMT)	Δ VMT	Average VMT/Unit for Increment
204	Base Scenario	1,080	--	--	432,959	--	--
	Add 10 Single-Family Residences	1,111	31	3.1	433,398	439	43.9
	Add 100 Single-Family Residences	1,392	312	3.1	437,416	4,457	44.6
	Subtract 10 Single-Family Residences	1,049	-31	3.1	432,533	-426	42.6
	Subtract 100 Single-Family Residences	766	-314	3.1	428,641	-4,318	43.2

Source: Fehr & Peers, 2011

The model performed predictably when adding and subtracting single-family dwelling units to the land use. For each test, the number of vehicle trips (VT) and vehicle miles traveled (VMT) responded in the right direction and to a reasonable order of magnitude.

Table 6 shows that the average number of vehicle trips per unit for TAZ 109 was almost identical for the addition of 10 and 100 units. The VT/unit ratios of 8.6 and 8.5 were nearly identical to the trip generation rate for single-family dwelling units in Area 1 of 8.55.

Table 7 shows that the average number of vehicle trips per unit for TAZ 204 was identical for the addition of 10 and 100 units. The VT/unit ratio of 3.1 was nearly identical to the trip generation rate for single-family dwelling units in Area 2 of 3.13.

The average VT/unit for each TAZ test corresponded accurately to the magnitudes of the trip generation rates for single-family dwelling units in each area. That is, single-family dwelling units in Area 1 produce more trips than in Area 3 who produce more trips than in Area 2.

The model also performed predictably in calculating vehicle miles of travel (VMT) for the added single-family dwelling units. The average VMT/unit for the added dwelling units was larger for TAZ 204 in Lewiston versus TAZ 109 in Weaverville because homes in Lewiston are a much greater distance away from supporting commercial land uses. Conversely, TAZ 109 is located near Downtown Weaverville near numerous non-residential land use types.

### **Commercial Land Use Tests**

Retail square footage was added to TAZ 155, which represents the area along SR 299 in Weaverville on which the Plotzke ACE Hardware is located. This TAZ was modified to include an additionally 10,000 square feet (10 KSF) and 20,000 square feet (20 KSF) of retail space. Subsequently, the TAZ was also modified to remove 10 and 20 KSF of retail space. The number of inbound and outbound trips generated by this TAZ was monitored. The results of this test are shown in Table 8.

**TABLE 8 –  
DYNAMIC VALIDATION RESULTS FOR RETAIL ADDITION – TAZ 155**

TAZ	Scenario	TAZ Vehicle Trips	Δ TAZ Vehicle Trips	Average VT/Unit for Increment	Vehicle Miles of Travel (VMT)	Δ VMT	Average VMT/Unit for Increment
155	Base Scenario	2,572	--	--	432,959	--	--
	Add 10 KSF Retail	2,929	357	35.7	435,415	2,456	245.6
	Add 20 KSF Retail	3,282	710	35.5	437,883	4,924	246.2
	Subtract 10 KSF Retail	2,210	-362	36.2	430,563	-2,396	239.6
	Subtract 20 KSF Retail	1,843	-729	36.5	428,200	-4,759	238.0

Source: Fehr & Peers, 2011

Table 8 shows that the model performed predictably when adding retail square footage to the land use. For each scenario, the number of daily trips responded in the correct direction and to the expected order of magnitude. The number of daily vehicle trips increase proportionally to the amount of land use added. As expected, the increase in vehicle trips for the addition of 20 KSF of retail space was approximately two times that of the increase in vehicle trips for the addition of 10 KSF of retail space.

The daily trip rate per each unit added, however, is slightly less than the expected trip generation rate of 38.36 daily trips per KSF. Because the model is designed to balance the number of attractions to the number of productions, the additional attractions by the addition of more retail space are truncated when the model balanced attractions to productions. Users of the model should exhibit caution when adding any new single type of land use to the model. To generate a number of trips closer to the expected number when adding commercial land use, users should add a commensurate number of households to the model or exclude the TAZ to which the land use is added from production-attraction balancing.

### **Roadway Network Tests**

Two different tests were conducted by making modifications to the model network:

- Adding a link
- Removing a link

In both cases, the network modifications were made and the model was completely re-run.

#### Adding a Link

The proposed East Connector, a County roadway from SR 299 near the Glen Road intersection, east of downtown Weaverville, and to SR 3 north of the Browns Ranch Road intersection, was added to the model network. The road was coded as a two-lane County roadway with a speed limit of 35 miles per hour and capacity characteristics similar to those of other County roadways. Only the assignment module of the TDM was run; the origin-destination matrices remained the same, isolating the difference in

the roadway network as the only difference. Trips with an origin south of Weaverville and a destination north of Weaverville were monitored by tabulating the volumes on roadways that go through Weaverville:

- SR 299 east of Glen Road
- SR 3 east of SR 299
- Washington Street between SR 299 and SR 3
- Levee Road between SR 299 and SR 3

The results of this test are summarized in Table 9.

<b>TABLE 9 – DYNAMIC VALIDATION RESULTS FOR ADDITION OF EAST CONNECTOR</b>		
<b>Roadway Segment</b>	<b>Without East Connector</b>	<b>With East Connector</b>
SR 299 East of Glen Road	9,102	9,131
SR 3 East of SR 299	3,421	3,421
Washington Street between SR 299 and SR 3	3,012	1,261
Levee Road between SR 299 and SR 3	76	6
East Connector	--	1,870
<b>Total</b>	<b>15,611</b>	<b>15,689</b>
Source: Fehr & Peers, 2011		

Table 9 shows that the addition of the East Connector to the roadway network results in comparable amounts of traffic going from south of Weaverville to north of Weaverville. The addition of the East Connector diverts trips traffic from Washington Street and Levee Road, indicating that the model is performing properly.

#### Removing a Link

Washington Street north of Lowden Lane was removed from the model network. Only the assignment module of the model was run; the origin-destination matrices remained the same, isolating the difference in the roadway network as the only difference. Trips with an origin south of Weaverville and a destination north of Weaverville were monitored by tabulating the volumes on roadways that go through Weaverville:

- SR 299 east of Glen Road
- SR 3 east of SR 299
- Washington Street between SR 299 and SR 3
- Levee Road between SR 299 and SR 3

The results of this test are summarized in Table 10.

<b>TABLE 10 – DYNAMIC VALIDATION RESULTS FOR REMOVAL OF WASHINGTON STREET</b>		
<b>Roadway Segment</b>	<b>With Washington Street</b>	<b>Without Washington Street</b>
SR 299 East of Glen Road	9,102	9,102
SR 3 East of SR 299	3,421	4,524
Washington Street between SR 299 and SR 3	3,012	--
Levee Road between SR 299 and SR 3	76	1,985
<b>Total</b>	<b>15,611</b>	<b>15,611</b>
Source: Fehr & Peers, 2011		

Table 10 shows that the removal of Washington Street from the roadway network results in the exact same amount of traffic going from south of Weaverville to north of Weaverville. The removal of Washington Street diverts trips onto SR 3 and Levee Road, indicating that the model is performing properly.

## 6. FUTURE YEAR (2040 MODEL DEVELOPMENT)

As part of the Trinity County 2010 RTP, Fehr & Peers developed a 2040 version of the Trinity County TDM. The 2040 model was developed by incorporating the growth in land use likely to occur by 2040 into the 2009 model's platform.

### LAND USE PROJECTIONS

Based on coordination with the RTP Steering Committee and the Trinity County Transportation Commission, growth of 0.28% per year was assumed between 2009 and 2040. Table 11 shows the 2009 land use totals and the 2040 land use totals after incorporating the growth of 0.28% per year.

<b>TABLE 11 – TRINITY COUNTY GROWTH: 2009 TO 2040</b>		
	<b>Single-Family Residential (Dwelling Units)</b>	<b>Multi-Family Residential (Dwelling Units)</b>
2009	4,838	809
<b>0.28% Growth per year between 2009 &amp; 2040</b>		
2040	5,258	879
Difference	<b>420</b>	<b>70</b>
Note: 0.28% per year linear growth assumed between 2009 & 2040 Source: Fehr & Peers, 2011		

Members of the Steering Committee also indicated the areas of Trinity County in which this growth was likely to occur. Table 12 shows the assumed allocation of residential growth to different areas of the County. Non-residential land uses were increased at a rate proportional to the residential growth.

**TABLE 12 –  
ALLOCATION OF TRINITY COUNTY GROWTH**

Community	Percent of Growth Allocated	Single-Family Residential (Dwelling Units)	Multi-Family Residential (Dwelling Units)
		420	70
Hawkins Bar	10%	42	7
Trinity Center	12%	50	8
Lewiston	14%	59	10
Burnt Ranch / Cedar Flat	2%	8	1
Covington Mill	2%	8	1
Junction City	1%	4	1
Douglas City	2%	8	1
Post Mountain	1%	4	1
Ruth / Mad River	2%	8	1
Weaverville	42%	176	29
Hayfork	12%	50	8
<b>Total</b>	<b>100%</b>	<b>420</b>	<b>70</b>

Source: Fehr & Peers, 2011

The total amount of growth allocated to each community was distributed among several TAZs. In small communities such as Hawkins Bar and Douglas City, the allocated growth was distributed to all TAZs that represented the community since all TAZs within the small communities could accommodate the additional growth. However, in Trinity County’s denser communities of Trinity Center, Weaverville, and Hayfork, growth could only be distributed to certain TAZs that were not already built out with land use. A complete summary of TAZs to which growth was distributed within each community is included in Appendix D. Appendix E contains the 2040 model’s land use.

### EXTERNAL-EXTERNAL TRIPS

Growth estimates for external-external (XX) trips were based on analysis of the California Statewide Transportation Demand Model (TDM). The California Statewide TDM accounts for growth in Trinity County and neighboring counties that contribute to external-external trips in Trinity County: Humboldt, Shasta, and Siskiyou counties.

### SPECIAL GENERATORS

Growth of special generators was developed independently of the land use projections discussed above. Table 13 summarizes the assumptions used for the 2040 model’s special generators. Daily trip estimates were developed as follows:

- Airports – Trinity County staff provided Fehr & Peers with the estimated the number of aircraft that will be based at each Trinity County airport in 2026; Fehr & Peers linearly extrapolated this data to develop 2040 projections. Daily trip estimates were developed using the ITE rate for general aviation airports (ITE 022).

- Post Offices – Daily trip estimates at the post offices were increased proportional to the amount of residential land use growth in each community.
- Other land uses:
  - Trinity River Lumber Company – no growth was assumed
  - Trinity Hospital – total daily trips increased proportionally to the residential growth that occurs in Weaverville
  - Trinity Alps Golf Course – no growth was assumed

<b>TABLE 13 – TRINITY COUNTY TDM SPECIAL GENERATORS</b>		
Land Use	2009 Daily Trip Estimate	2040 Daily Trip Estimate
<b>Airports</b>		
Weaverville Airport	75	145
Trinity Center Airport	110	205
Ruth Airport	15	50
Hyampom Airport	10	35
Hayfork Airport	30	75
<b>Post Offices</b>		
Weaverville Post Office	2,600	2,960
Lewiston Post Office	370	390
Trinity Center Post Office	220	230
Hayfork Post Office	1,140	1,230
<b>Other Land Uses</b>		
Trinity River Lumber Company (Weaverville)	400	400
Trinity Hospital	1,590	1,810
Trinity Alps Golf Course	320	320
Source: Fehr & Peers, 2011		