



## MEMORANDUM

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**To:** Project File  
**From:** Scott Miller, HDR Engineering  
**Date:** Updated 7/31/2012  
**Subject:** Connecting Nevada - Draft Transit Propensity Analysis and Estimate of Ridership Demand

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### **BACKGROUND**

The purpose of this transit propensity analysis is to identify geographical areas within the State of Nevada that have the potential to use transit service. This analysis relies on statewide socioeconomic traits identified by national studies as indicators of populations with a higher than average likelihood to use public transit. To identify areas with higher than average transit markets, this study applies weights and indexes to geographically linked US Census data for each socioeconomic trait. The resulting composite score and series of urban and rural GIS maps show areas with higher likelihood to use transit service and/or that may have a greater need for public transit service than others within the State of Nevada.

Two separate calculations were made with the results of the analysis. First, a measure of propensity was determined for each block group in the State of Nevada that determined the relative percentage of the population most likely to use available transit services. In essence, this analysis helps to quantify the overall need for transit services within each block group. Subsequently, the results of the propensity analysis were used to calculate a theoretical ridership level for each block group that was summed to provide a picture of potential ridership by county. This analysis provides an estimation of potential demand.

### **TRANSIT PROPENSITY ANALYSIS**

Transit propensity is a concept that measures the likelihood of using public transit. At its core, propensity is an economic term used to measure consumer behavior. A higher propensity toward an action suggests a greater likelihood to take the action. Propensity can be quantified such that someone with a propensity of "2" is twice as likely to do something, such as take transit, as someone with a propensity value of "1".

A transit propensity analysis is dependent on several socioeconomic factors, selected based upon industry research regarding the potential users of transit services. This

analysis relies on data collected for variables derived from a series of attributes that national studies identify as having a relationship to transit patronage. Research that supports the methodology includes:

- Transit Cooperative Research Program (TCRP) Report 28: Transit Markets of the Future
- TCRP Report 3: Workbook for Estimating Demand for Rural Passenger Transportation
- TCRP Report 27: Building Transit Ridership

The TCRP transit propensity analysis method used by the project team employs nine population variables proven to indicate a higher than average potential to use public transit. The methods applied by national research teams to identify public transit markets include indexing transit use patterns for demographic groups to the average transit use rate for all metropolitan areas in the United States (TCRP Report 28). Studies of other transportation variables support the use of a similar set of socioeconomic variables to determine strong transit markets (TCRP Reports 28, 3, & 27). The following characteristics, identified in the above mentioned studies to be consistent with population traits associated with strong transit markets, are used as the basis for determining transit propensity:

- 1) Population Density;
- 2) Percent of Population w/ Mobility Limitations<sup>1</sup>;
- 3) Percent of Population w/ Employment Disability<sup>1</sup>;
- 4) Percent of Population that is NOT "White, Non-Hispanic";
- 5) Percent of Population that is Female;
- 6) Percent of Households w/ Income under \$20,000<sup>1</sup>;
- 7) Percent of Occupied Housing Units without an Auto Available<sup>2</sup>;
- 8) Percent of Workforce Age 30 or Younger<sup>2</sup>; and
- 9) Percent of Workforce Age 65 or Older<sup>2</sup>.

The 2010 US Census was the primary data source for each of the variables; however, because the 2010 US Census has not yet released a full set of demographic data, other sources were applied. In instances where 2000 US Census data was the only source of data consistent with the above listed socioeconomic traits and the geographic requirements of the propensity analysis, population growth factors derived from US Census relationship files were applied to provide 2010 counts.

The project team obtained data for these nine variables at the block group level for each county in the state plus Carson City. The project team assigned weights to each category based primarily upon findings in TCRP Report 28. Overall, population density has the highest weight (weight of 17), reflective of its greater overall influence on transit ridership. Housing units without an automobile (weight of 9) and population with

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<sup>1</sup> Data Source: 2000 US Census

<sup>2</sup> Data Source: 2006-2010 American Community Survey

mobility limitations (weight of 7) have the next highest weighting of the nine variables. The remaining variables have weights between one and three. Application of weights (total weights equals 44) is used to develop a composite propensity score for each block group. The analysis also assumes that transit propensity is fully realized by providing the average level of transit service. Propensity is calculated as an index; as such it shows the relative propensity of one block group to other block groups in an assigned geography (urban areas and rural areas). This methodology ensures that rural areas and urban areas are evaluated separately.

Census data at the block group level provided detailed information on the distribution of each socioeconomic variable within the State of Nevada. The data distribution lent itself best to division by rural and urban geographic areas. The advantage of mapping rural areas separately is that it helps to identify potential transit markets in smaller communities, as well as to show opportunities to develop transportation connections to services available in larger communities. Urban areas consisted of Clark County, Washoe County, and Carson City. Rural areas consisted of the remaining counties, as follows:

- Churchill
- Douglas
- Elko
- Esmeralda
- Eureka
- Humboldt
- Lander
- Lincoln
- Lyon
- Mineral
- Nye
- Pershing
- Story
- White Pine

## **RESULTS OF THE TRANSIT PROPENSITY ANALYSIS**

The results of the transit propensity analysis are consistent with what is expected. Urban areas show a greater propensity for transit use, while only the most densely populated rural areas include sections of communities that have a moderate to high level of propensity for transit usage. The rural communities with the highest level of transit propensity include:

- Battle Mountain
- Elko/Spring Creek
- Ely/McGill
- Fallon
- Gardnerville Ranchos/Indian Hills
- Pahrump

Based on the input factors considered, the results for transit propensity by block group were indexed to determine a ranking for each block group that could be compared with each block group's corresponding county as a whole. These indexes were then weighted to develop a composite score for each block group. The composite scores were then statistically grouped into five categories, from "Very Low" to "Very High," based on their relationship to the scores of the other block groups. The results suggest

that residents living in a block group scoring a “High” mark are more likely to use transit as compared with residents living in a block group that scored “Average” or lower. Residents living in block groups scoring a “Very High” mark are most likely to use transit.

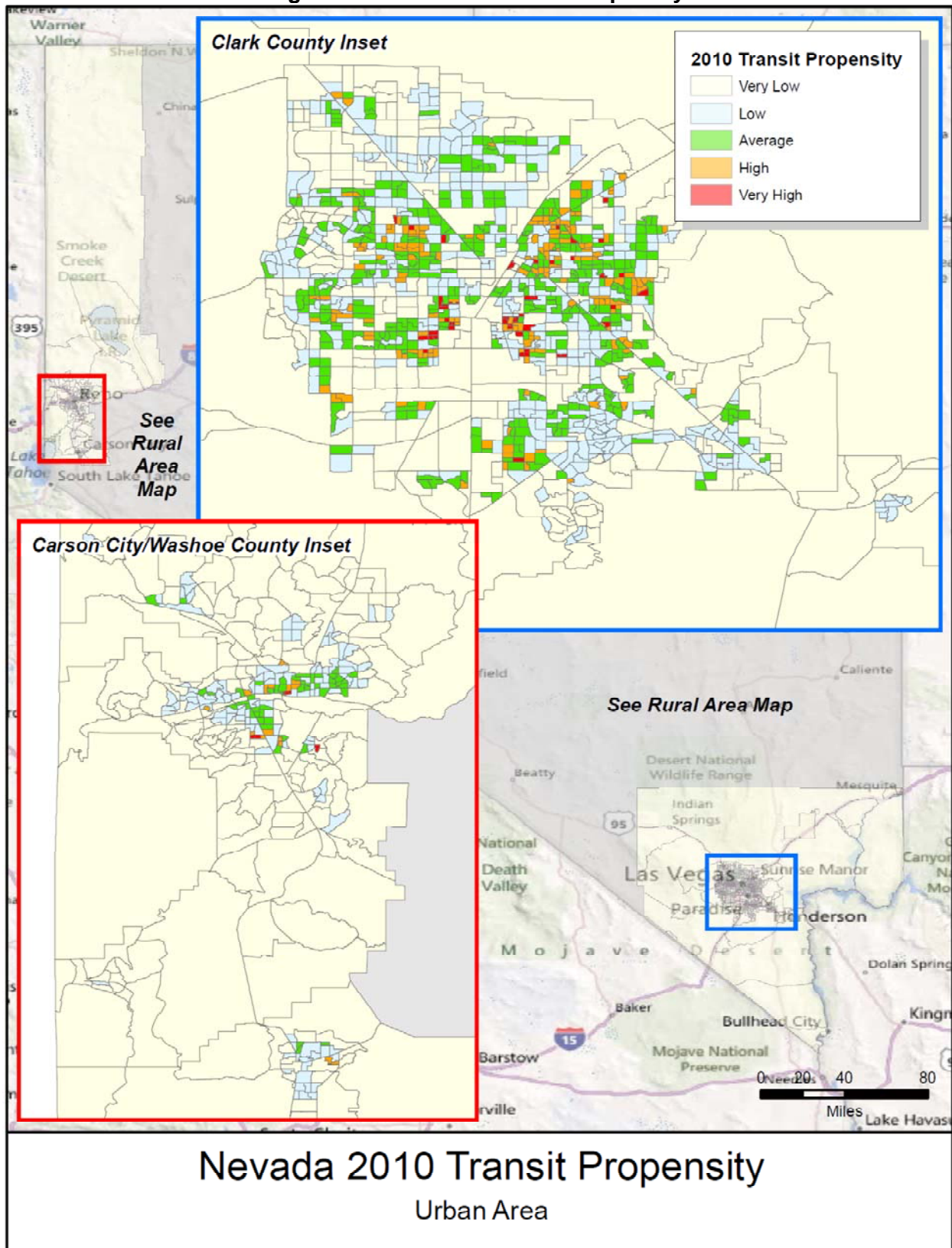
Density is a key variable to transit utilization that is factored as part of a transit propensity analysis. In concurrence with this assumption, TCRP Report 100: *The Transit Capacity and Quality of Service Manual* provides some guidance on determining whether an area is “transit supportive.” A “Transit Supportive” area is identified by the density of the population and employment within a block group. The greater the density, the more intensive the transit service that can be supported. Furthermore, TCRP Report 100 suggests that a density of at least three housing units per gross acre, or a minimum employment density of four jobs per acre is necessary to support hourly bus service. An equivalent combination of housing and jobs would have the same effect.

Figures 1 through 3 show year 2010 transit propensity estimates for the urban and rural areas of Nevada. These figures display the relative ranking of each block groups for the State of Nevada and each block group’s corresponding transit propensity. As evidenced by the maps, the areas with the greatest population and employment numbers are identified as areas with the highest propensity to use transit.

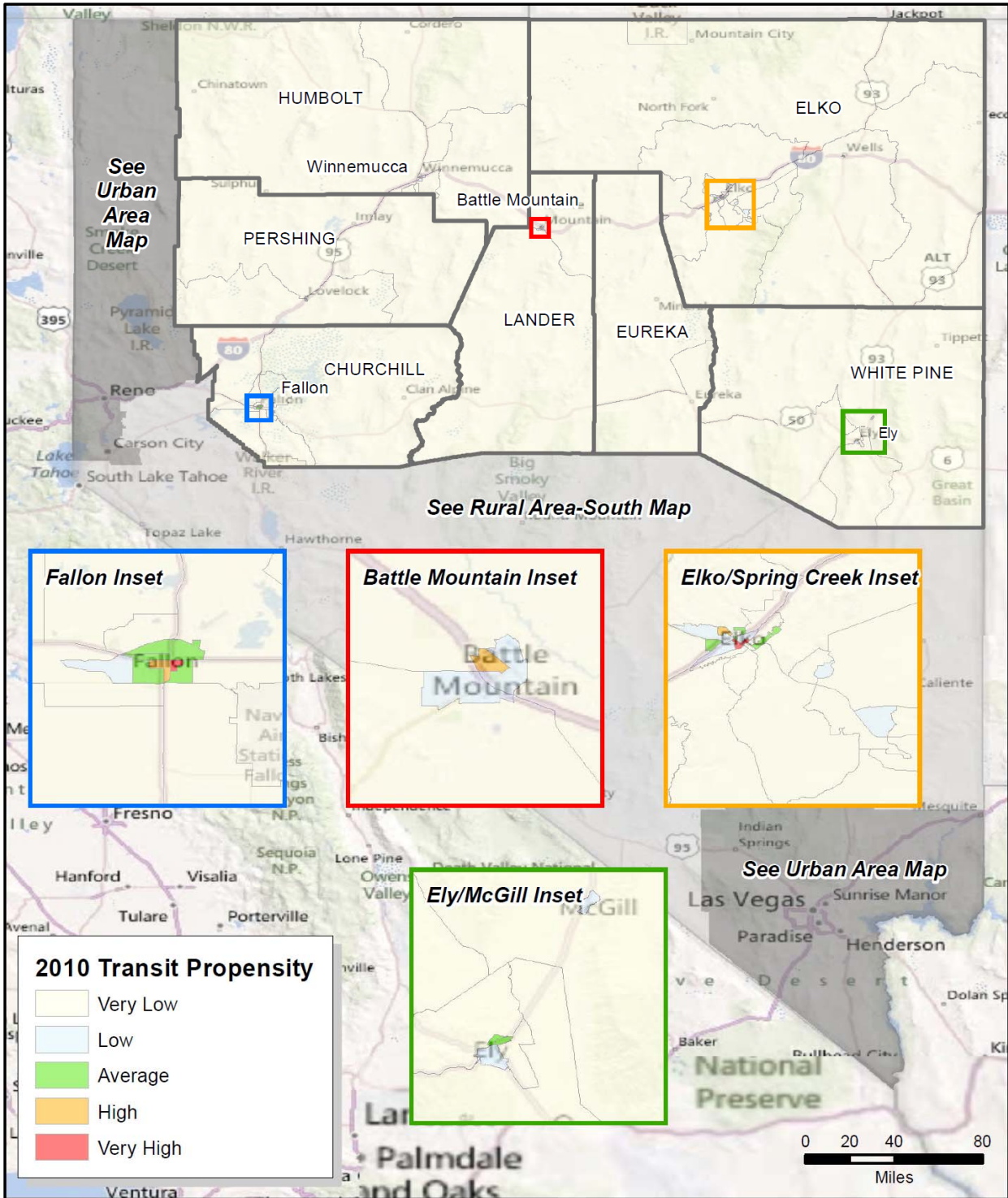
#### **URBAN AREA ESTIMATE OF TRANSIT RIDERSHIP DEMAND**

Based on the results of the propensity analysis, it is possible to determine a theoretical estimate of ridership for each block group in urban areas. Transit ridership estimation in rural areas was not calculated due to the wide dispersion of population, employment centers, and inconsistency in the types and level of transit services that could potentially be provided in these areas. The estimate of ridership provided herein should not be considered a formal ridership forecast, but provides a relative number of potential transit riders sufficient for planning and policy analysis when considering future investments.

Figure 1 – Urban Area Transit Propensity

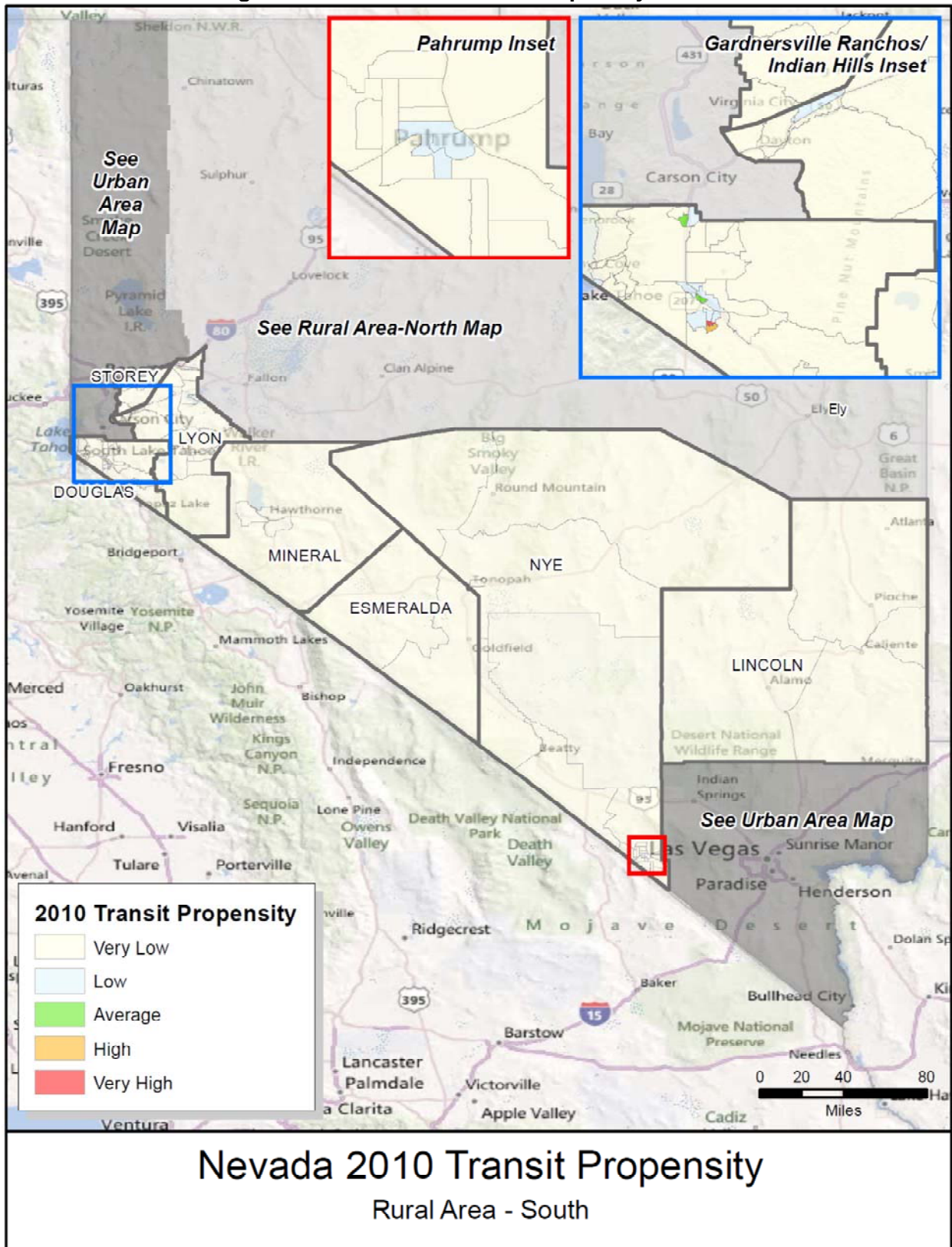


**Figure 2 – Rural Area Transit Propensity - North**



**Nevada 2010 Transit Propensity**  
Rural Area - North

Figure 3 – Rural Area Transit Propensity – South



Using the average capture rate, or percentage of the population most likely to use transit, a composite ridership index was calculated. The composite ridership index is the sum of the estimated riders for each demographic category considered by the propensity analysis. To account for residents who are in more than one category, the resulting sum is divided by the overall population weights. The resulting ridership index is the number of individuals who could be expected to use transit annually, assuming a corresponding level of transit service was provided (based on national averages). Because comparison numbers used were annual totals, this analysis used an annualization factor of 300 in-service days to determine annual ridership levels.

Inherent in the urban area transit ridership estimation calculation is the assumption that a similar level of transit service is provided for each block group in each county. In order to judge the accuracy of the ridership estimate derived from the results of the transit propensity analysis, current data on transit utilization by county were obtained.

It is important to note a key difference between the transit propensity analysis and the estimate of ridership demand calculation. It is possible for a block group to have a high transit propensity ranking, but a low ridership yield. For example, if most residents of a block group are likely to use transit, it will have a high propensity, but if there is a small population base within the block group, the overall ridership will be low.

According to current transit utilization data (year 2010) obtained from the National Transit Database (NTD) and Carson City Transit, Clark County had the highest total transit ridership, followed by Washoe County and Carson City. As discussed, the results of the transit propensity analysis confirmed that the propensity for use is greatest in areas with higher population and employment levels. This same result is confirmed through an estimation of potential annual boardings per population, summed by county, for the ridership estimate. Clark County had the highest number of estimated annual transit boardings (62,255,000); however, Washoe County had the highest number of estimated annual transit boardings per capita (33.2). Carson City had the fewest estimated annual transit boardings (1,700,000) and estimated annual boardings per capita (30.8). Table 1 provides 2010 observed transit ridership data and 2010 estimated transit ridership boardings by county with an urbanized area.

**Table 1 – 2010 Urban Area Observed and Estimated Annual Transit Ridership by County**

<b>County with an Urbanized Area</b>	<b>2010 Observed Transit Ridership<sup>1</sup></b>	<b>2010 Estimated Annual Transit Boardings<sup>2</sup></b>	<b>2010 Annual Estimated Boardings per Capita</b>
Carson City	133,304	1,700,000	30.8
Clark County	57,792,947	62,255,000	31.9
Washoe County	7,714,668	13,992,000	33.2

<sup>1</sup>Source: National Transit Database, 2010 and Carson City Transit (JAC), 2012

<sup>2</sup>Source: HDR, Inc., 2012



Compared to observed 2010 ridership data, the 2010 ridership estimates for each of three urban counties (Carson City, Clark, and Washoe) are higher. These results indicate that demand for increased transit service may exist in each respective county in the form of either increased transit service levels (improved frequencies) or expanded service area coverage to serve un-served transit markets (inside and outside of the urbanized areas).

## **CONCLUSION**

In its current form, transit in Nevada generates many benefits for residents, visitors, and employees. Investments in transit have proven their worth in terms of economic development and quality-of-life improvements otherwise not recognized by private automobile(s). Public transportation providers across the state, both public agencies and private providers, form a comprehensive system despite uncertain funding streams and in some areas, land use patterns that are generally not considered to be transit supportive. While gaps in the state transit system exist, particularly between rural communities and urban centers, public transportation in Nevada is comprised of a network of some rural transit services, human service transportation programs, and urban systems that could be poised for growth.

The results of the transit propensity analysis suggest that there are more potential transit riders than are currently using available services. Despite some rural areas showing signs of transit propensity, their distance from major urban centers or settlement characteristics suggest that transit service would experience minimal success. This suggests two primary findings:

1. Demand for increased levels of transit service or new transit service exists
2. Expanded service area coverage may be warranted in order to attract additional riders, including choice riders
- 3.

While the ridership estimation analysis suggests that each county has the potential to serve several thousand riders annually, the daily number of potential transit riders in rural counties may be insufficient to warrant daily transit service. Still, there is considerable unmet demand in the state, and given the prospect of continued growth in the state's population, especially in transit dependent sectors of the population, future investments in transit systems should be considered. There is also a need for more connectivity, opportunities for improved efficiencies, greater emphasis on commuter transportation, and a need for increased investment in public transit. As noted, the results of the transit propensity and estimated ridership demand analyses should be considered carefully, but provide a sufficient basis for planning and policy analysis when considering future transit investments.