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Cooperative Mobility for Competitive Megaregions

Application of Equity Rubric Showing Purpose and Need for Rural and Low Density Communities Near Megaregions: IH 10 East Corridor, Houston the Texas State Line

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16.Abstract

Rural and low density residents proximate to Megaregion anchor cities could be advantaged by improved public transportation into nearby large urban areas. This is particularly the case for residents challenged by inequities due to ethnicity, language and income. Before planning can begin for any transportation project or service, a need must be established. The need is the gap between the deficiency in the area's transportation system and the possible solutions to address the deficiency. There are a number of methods and strategies to assess vulnerability and determine purpose and need. This work reviews the Equitable Target Area (ETA) tool and compares the outcome to a Composite Vulnerability Index (CVI). Both approaches begin with socioeconomic variables and assess the variables based on census block groups. The IH 10 corridor from Houston east to the Texas State Line forms the case study for this analysis where the research shows that the CVI best identifies vulnerable areas of need.

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Executive Summary

Transportation options are necessary to access health care, education, employment, shopping, recreational activities, and other public services necessary for daily life. However, many individuals in the United States are not able to access opportunities derived from transportation services due to limitations in the network or service provision. The IH 10 East Corridor from Houston to the Texas State Line is comprised of rural enclaves and several small communities and neighborhoods. These areas are in the Gulf Coast Megaregion and connect to the Texas Triangle Megaregion anchor city of Houston. There are concentrations of vulnerable residents in the corridor for whom improved accessibility would be valuable. Basic tenets are assessed in this report regarding that concept related to employment and educational opportunities, health care, and quality food offerings. Those elements confirm the need to facilitate travel.

There are several methods and strategies to assess vulnerability. This research reviews two of them, the Equitable Target Area (ETA) and the Composite Vulnerability Index (CVI), for the corridor. Both approaches begin with socioeconomic variables and assess the variables based on census block groups. The ETA assesses all block groups in each county. The CVI identifies the block groups with a percentage of poverty residents greater than the state of Texas poverty percentage and applies the socioeconomic variables thereafter. ETA is an approach undertaken by the Atlanta, Georgia and Texas MPOs. For this corridor, the ETA masks deep pockets of high need. Of the 292 block groups in the corridor, 275 show low need, 2 with high need and none with very high need.

A CVI of 1.0 would indicate that residents in vulnerable block groups are on par with their county cohorts. Application of the index for IH East Corridor shows 142 vulnerable block groups. Residents in Chambers County are twice as disadvantaged as others in their county considering their relevant socioeconomic variables and percent of income spent on transportation. For Jefferson and Orange County residents, variance between the vulnerable and other residents is shown as both counties show a CVI greater than 1.0; the values are similar in 1.4 and 1.5, respectively. Planners and transportation professionals can use the index when considering

public transit projects for vulnerable communities, particularly to improve access to proximate to megaregions.

Chapter 1. Introduction

Transportation plays a pivotal role in providing access to opportunities supportive of independent living and full participation in society. Transportation options are necessary to access health care, education, employment, shopping, recreational activities, and other public services necessary for daily life. However, many individuals in the United States are not able to access opportunities derived from transportation services due to limitations in mobility. The IH East 10 Corridor from Houston to Texas' eastern state line is comprised of rural enclaves and a number of small communities and neighborhoods. These areas are a part of the Gulf Coast Megaregion and are proximate to the Texas Triangle Megaregion anchor city of Houston. There are concentrations of vulnerable residents in the corridor for whom improved accessibility would be valuable. Basic tenets are assessed in this report regarding that concept related to employment and educational opportunities, health care, and quality food offerings. Those elements confirm the need to facilitate travel.

Previous work developed an equity rubric that helps in defining purpose and need for residents of rural and low density communities. The intent is to increase access to opportunities available in the large urbans that promote equity. The rubric supports advocacy for public transit and demand-responsive services in these communities.

Inadequate attention is paid to the travel needs of people in these communities by planners and public officials. Governmental entities responsible for planning and projects in communities like these often have limited financial resources, leading to lack of staff and expertise to satisfactorily assess or accommodate transportation gaps for rural residents. Even when recognized, lack of planning techniques inhibit quantifying and numerically describing the transportation gaps. Transportation facility and service needs are often based on existing travel, as opposed to desired or latent trips unmade due to facility and service lack.

Addressing this gap and improving planning methodology are important for people who live in rural and small urban communities so improved transportation can lead to upgraded living and, perhaps, enable a stronger tax base for their local economy. There are a number of methods and strategies to assess vulnerability. This research reviews two of them for the corridor, the Equitable Target Area (ETA) and the Composite Vulnerability Index (CVI).

Chapter 2. Literature Review

Determining Need

A purpose and need statement is required for any transportation project to be considered for approval by the USDOT. Therefore, the first step in planning any transportation project is assessing the need to support its implementation. The need is the gap between the deficiency or problem identified within an area's transportation system and the possible solutions that can be implemented. It is often a challenge to strongly support the need for transportation improvements or developments for rural and small towns because their problems do not seem as significant as those of urban areas. Therefore, the severity of transportation need for these communities has to be quantified and justified using the community's well-being and vulnerability.

There are many categories and definitions of community well-being, but it can be summarized as the combination of social, economic, environmental, cultural, and political conditions identified by individuals and their communities as essential for them to flourish and fulfil their potential[1]. Some general indicators of a community's well-being are employment, health, educational achievement, quality of health services, transportation access, voter participation, and financial stability[2]. When communities become deficient in these factors, they are considered vulnerable.

Vulnerable populations comprise the economically disadvantaged, racial and ethnic minorities, the uninsured, low-income children, the elderly, the homeless, those with chronic health conditions, lack of accessibility to social services[3]. In rural and small towns, not only is the quality of community well-being deteriorating, but the percentage of vulnerable populations is also increasing in rural and small towns. Findings comparing the years 2000 and 2010 show that rural areas increased in poverty, unemployment, 65 and older (elderly) population, minority population,

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[1] Atkinson, S., Bagnall, A., Corcoran, R., South, J., et al. (2017). What is Community Wellbeing? Conceptual Review. Retrieved from Research Gate.
[2] Sung, H., Phillips, R. G. (2018). Indicators and Community Well-Being: Exploring a Relational Framework. *International Journal of Community Well-Being*. Vol. 1, pp. 63–79 https://doi.org/10.1007/s42413-018-0006-0.
[3] American Journal of Managed Care (2006). Vulnerable Populations: Who are They? Retrieved from The American Journal of Managed Care.

and lack of education[4]. By providing people with opportunities for better well-being and helping them realize those opportunities, policymakers would not only be acting to promote well-being as an intrinsic good, they would also be minimizing vulnerability and investing in people's potential and in key drivers for long-term economic growth[5]. Further, improved lifestyles for rural and low density residents could ripple to strengthen the economic base of the communities where they live.

Through transportation improvement and development projects, policymakers can enhance the well-being of any community, especially rural and small towns. Rural and small towns are usually more vulnerable because of their lack of access to basic services, amenities, health centers, schools, and employment opportunities. Stommes and Brown[6] reported that only one-third (about 32%) of all rural counties have full access to public transportation services and, if the 28% of communities that have limited access are counted, that leaves 40% of the rural residents with no public transit options at all. The authors pointed out that for low-income individuals, long commutes and lack of transportation are barriers for getting to workplaces. Also, findings confirmed that rural areas struggle more with healthcare barriers than urban and small urban areas.

Therefore, making public transportation possible can improve the lives of people in these communities. The United States is not at pace with other countries in conducting studies on how to address transportation in vulnerable and rural and small communities. These communities are disadvantaged because of lack of transportation and high cost associated with using the available transportation means[7]. Residents in poverty within these rural and small-town communities cannot afford the transportation that grants them the accessibility to employment and education opportunities that could potentially redeem them from their poverty condition.

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[4] Bennett, K. J., Lin, Y., Yeun, M., Leonhirth, D., Probst, J. C. (2016). South Carolina Rural Health Research Center. Retrieved from the South Carolina State Library's Digital Collection.
[5] United Nations Center for Regional Development (2017). Rural-Urban Connectivity in Achieving Sustainable Regional Development. Retrieved from the United Nations Centre for Regional Development.
[6] Stommes, Eileen S. & Brown, Dennis M., 2002. "Transportation in Rural America: Issues for the 21st Century," *Rural America/ Rural Development Perspectives*, United States Department of Agriculture, Economic Research Service, vol. 16(4), January.
[7] Pyrialakou, D. V., Gkritza, K., Fricka, J. D. (2016). Accessibility, Mobility and Realized Travel Behavior: Assessing of Transport Disadvantaged. Journal of Transport Geography. Vol. 51, pp.252-269 https://doi.org/10.1016/j.jtrangeo.2016.02.001.

In considering transportation problems in rural and small-town communities, it is imperative to understand that every rural and small-town community is different. The Rural Policy Research Institute emphasizes that there is more than one type of "rural" community, and the travel behavior and needs of rural residents vary depending on whether they live in an exurb, a tourist destination or an agricultural or mining community[8]. The type and level of vulnerability within the population differs and is changing, and therefore a general solution cannot be viable for every rural and small-town community. Because of these differences, there is diversity in the trips made by residents in these communities. Therefore, various travel options must be considered to meet the transportation needs of the community.

In some rural areas where population density is low and dispersed, trips made are usually infrequent. Therefore, a regularly scheduled transit system similar to that of urban communities may not adequately meet the transportation needs of residents in that particular community. To succeed in rural communities, public transportation often must operate flexible schedules and routes, and it often is an amalgam of various services to accommodate the travel needs of community residents. In rural areas where residents are widely dispersed, other means of transportation like cycling, ridesharing, and shuttles, may have to be implemented in addition to a transit service established to enable residents to access bus stops from their homes. Transportation planning to meet the travel needs for rural and small-town communities has to be executed according to the particular community, considering various travel means to effectively serve the travel needs of the residents.

This research assesses previously designed tools, the Equitable Target Areas (ETA) and the Composite Vulnerability Index (CVI), to identify vulnerable rural and small urban communities from Houston east along IH 10 to the Texas State Line with the idea of linking to the megaregion anchor city of Houston for better work educational opportunities, services and amenities.

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[8] Rails-to-trails. Active Transportation Beyond Urban Centers: Walking and Bicycling in Small Towns and Rural America. Retrieved from Rails to Rails.

Chapter 3. The Corridor: IH 10 Houston East to Texas State Line

The primary Texas megaregion is the Triangle that connects Houston, Dallas and San Antonio/Austin. Most US megaregion maps also show a link north to Oklahoma City and west and east as the Gulf Coast Megaregion corridor that extends from Corpus Christie through Houston to New Orleans. Figure 1 reflects the Triangle and those extents with the Gulf Coast region.

Figure 1. Texas Triangle and Gulf Extension Source: Reddit.

This Gulf Coast Corridor moving east from Houston encompasses several communities including Mont Belvieu, Winnie, Hamilton before arriving at Beaumont, then continuing to the Texas State Line. These rural and small urban cities have basic components and amenities that are still limited compared to availability in the megaregion city of Houston. There are three counties, Chambers, Jefferson and Orange. For purposes of this work, assessment was conducted pulling block groups in a 10-mile width, using 5 miles each side of the IH10 centerline. There are roughly 375,000 residents within the three corridors. Chambers County with 44,000 residents is proximate to Harris, where the Houston is located and is in the metropolitan statistical area of Houston. Roughly 250,000 residents make Jefferson County the largest and it is between Chambers and Orange Counties. Orange County is east of Jefferson with 83,000 residents. An assessment of the corridor's health facilities and food options shows a mix of somewhat available to low to no availability.

3.1 Health Disparities

Using data from Google Maps, a combined total of 107 medical facilities were located in Chambers, Jefferson, and Orange counties. Data for the study area shows that Jefferson County reported two hospitals located in Nederland and Port Arthur. Chambers County listed two hospitals located in Baytown and Anahuac. Orange County did not have a hospital.

The Human Resources and Health Services Administration (HRSA) database designates and scores rural areas based on the primary care Health Professions (HPSAs) (US Health Resources & Services Administration, 2017). A score from 0-26 is assigned and scores closer to 26 indicate high need/priority. Jefferson County facilities for low income persons needing primary care services scored 20 and scored 16 for mental health services. These numbers indicated a greater need for primary care services in Jefferson County. Chambers County reported score of 13 for the geographic population category for primary care services and 14 for mental health services. Orange County showed a score of 16 for geographic population category for primary care services and 17 for mental health services. The scores in Chambers and Orange counties indicate an average need in these areas.

3.2 Food Deserts

Using data from Google Maps, a combined total of 91 grocery or food stores were located in Chambers, Jefferson, and Orange Counties. The tri county area includes regional and national chains, e.g. HEB, Wal-Mart, Kroger, and Family Dollar. Noteworthy is the number of "Mom & Pop" stores and food markets that play a vital role in the study area. These smaller retailers are not always full-service grocery stores, but these grocers offer limited selections of produce, meat, and canned foods. Jefferson County contained multiple locations for the large retailers, e.g. HEB, Kroger, Wal-Mart and Family Dollar. In addition, Jefferson County also reported smaller local grocery chains like Market Basket and Brookshire Brothers. Orange County and Chambers County reported fewer larger regional and national chains than found in Jefferson County. These counties also showed a strong presence of small "Mom and Pop" grocers and food markets. While grocers appeared to be well located, the fact may remain that many county residents may lack the resources or need transportation services to access these facilities.

3.4 Transit Planning by Metropolitan Planning Organizations (MPOs)

Long and short range planning are conducted by two MPOs in the southeast section of Texas -- Houston Galveston Area Council (HGAC) covering the area along IH10 as the corridor traverses through Chambers County. Thereafter, as the corridor approaches Beaumont and eastern Jefferson County, the Southeast Texas Regional Planning Commission's (SERPC) jurisdiction begins and continues east through Orange County to the state border with Louisiana. The urban areas with aggregations of employment, education and health care for the corridor are Houston and Beaumont. A review of both MPO's short (Transportation Improvement Program) and long range (Regional Transportation Plan) plans show the importance of addressing transportation for vulnerable communities in their short range plan and long range plan. However, specific criteria that lead to that outcome are not apparent in either of the MPO's documents.

3.5 Transit in the IH 10 East Corridor

Public Transportation is provided by two entities for the southeast Texas area around IH 10 East – Southeast Texas Transit (SETT) and Beaumont Municipal Transit (BMT). SETT provides curb-to-curb demand/response transportation service to rural areas of Orange and western Jefferson Counties. Seniors or persons with disabilities in mid-Jefferson County can also use the service. South East Texas Regional Planning Commission (SETRPC) is designated a rural transit district and coalesces with several service agencies for service provision. Residents of Beaumont's urban area are served by 10 routes of BMT[9]. SETRPC also coordinates carpool and vanpool for commuting, providing another option for residents in the IH 10 East Corridor.

There is no fixed route service in Chambers County for the general population. Specialty service is provided for seniors, persons with disabilities and those with medical needs. Chambers County's east side service runs from 7:30 a.m. to 5 p.m. for seniors and people with disabilities given 24-hour advanced scheduling for rides to Beaumont, Anahuac and Baytown. There is no fixed fare, but donations are accepted. The west side of Chambers County is served by Chambers County Transit requiring a one-week advance notice for low income seniors and people with disabilities. The span of service is 8 a.m. to 5 p.m. and rides are provided to Harris and Galveston Counties and to the medical center and VA hospitals in Houston.

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[9] Transportation and Environmental Resources and Beaumont Municipal Transit. Retrieved August 10, 2020.

Chapter 4. ETA and CVI Findings: IH 10 Houston East to Texas State Line

This case study examines a corridor that links Houston via Beaumont to the Texas State Line. Several important variables form the foundation for the analysis. The vulnerability assessment examined percentages of female head of household, minority population, non-English speakers (NES), automobile availability and senior population.

The analysis applies two methods to identify vulnerable communities in the IH 10 East Corridor. The first is utilized by agencies throughout the country and is the Equitable Target Areas (ETA) tool. The method uses the traditional variables named above and ranks the block groups in 4 categories from *low* to *very high* need. The second method is a Composite Vulnerability Index that begins by segmenting the block groups that have a higher poverty level than the Texas mean. Thereafter, the traditional variables are examined, along with an additional variable, percentage of income spent on transportation.

Table 1 shows the socioeconomic values by county. Chambers County's poverty value is lower than the state mean, the other two counties are higher than the mean. The percentages of female headed households and auto availability are less than or equal to the Texas mean. Orange County's non-English speakers and minority percentages are less than or comparable to the state's.

Table 1: Vulnerability Values by County

Entity	Poverty (%)	Female Headed (%)	NES (%)	Minority (%)	Homes w/Zero Auto (%)
Chambers	13	3	15	28	2
Jefferson	21	7	20	59	5
Orange	16	6	5	20	3
Texas	16	14	8	21	<5

Source: US Census

4.1 Equitable Target Area (ETA) Analysis for Vulnerable Communities

Texas' largest MPOs, Houston's HGAC and Dallas area's NCTCOG, have conducted analyses using a measure developed by Atlanta's MPO (Atlanta Regional Commission) for determining vulnerability. The Equitable Target Area score (ETA) is a tool designed to assist planners in increasing inclusion and equity through first identifying communities of need. For instance, the Atlanta area's MPO uses the ETA in the decision making process to prioritize and evaluate projects, as well as in review of resource allocation[10]. The ETA applied to the IH 10 East to Texas State Line Corridor yields an interesting result described below.

4.1.1. Equitable Target Area Score

To assess the study area, the research team examined the following variables: low-income, zero automobile ownership, female headed households, non-English speaking, poverty, senior status, and minority status at the Census Block Group (BG) level. The study area included 292 BGs. Percent per variable based on the total population was calculated. The equation below is an example:

$$[\sum(\text{variable})/\sum(\text{Total Pop})]*100)$$

This step was followed for each variable; these calculations then represented the equitable target area (ETA) percentage for the study area. Next, the categories were divided into four categories. Category 1 represents below or at ETA study area. Category 2 is low need with values slightly lower than the ETA for the study area. Category 3 is high need and Category 4 is the very highest need.

The next step involved determining the ETA score for all 292 block groups. All six variables for each block group were assigned a category score based on the study percentage for each variable.

Next, the block group's variable was then assigned a category ranging 1 through 4. The ETA score for the block groups was between a minimum of 6 and the maximum of 16.

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[10] Atlanta Regional Commission, Equity and Inclusion, retrieved June 11, 2020.

Finally, block groups with an ETA score at or below the study area's score were assigned as Category 1/Low Need. Two hundred seventy-five (275) block groups received the Category 1. Category 2/Moderate Need consisted of the 15 block groups with ETA scores above the above the study area's score. Category 3/High Need contained 2 block groups Category 4 counted 0 block groups as Very High Need. The results indicated that very few to no block groups in the study area were in Category 3/High Need or Category 4/Very High Need (Table 2).

Table 2. Equitable Target Area Block Group Scores

Categories	ETA Score	Block Groups
1 = Low Need	6 thru 10	275
2 = Moderate Need	11 thru 12	15
3 = High Need	13 thru 14	2
4 = Very High Need	15 thru 16	0

The area is somewhat known in southeast Texas as having pockets of poverty. The finding of zero *very high need* block groups and only 2 *high need* block groups in the three IH 10 East Corridor counties and most as having low need led the team to consider another method of assessment. The Composite Vulnerability Index was developed and previously applied to another Texas corridor. The index facilitates a more micro level analysis of the block groups by first defining them by their level of poverty[11].

4.2 Composite Index for Vulnerable Communities

The Composite Vulnerability Index is calculated by identifying the block groups with a mean poverty percentage higher than the Texas mean of 16%. One hundred forty-two (142) block groups in the three counties exceed that Texas mean percentage (Figure 2).

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[11]Lewis, Goodwin, Robbins-Stout and Rogers (2019) Framework to Determine Purpose and Need for Increased Travel Options. Source: CM[2].
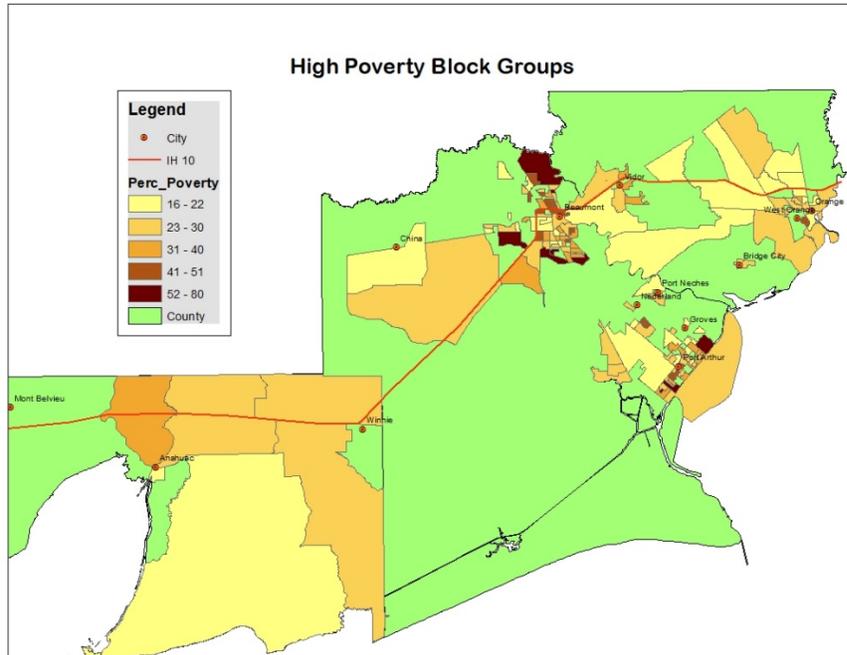
Figure 2. Map of 142 Block Groups with Greater Than 16% (rounded) Poverty Rate

Of the 292 block groups that are within 5 miles either side of the IH 10 East Corridor centerline, 142 are vulnerable by having a poverty mean higher than the 16% Texas mean. Table 3 shows Chambers County with 6 block groups, Jefferson county with 107 block groups, and Orange with 29 block groups. The most prevalent vulnerabilities within the block groups are minority, poverty, and non-English speaking. Of the 142 vulnerable block groups Jefferson county has the highest mean minority and poverty percentages (76% and 33% respectively), and has a 24% non-English speaking population.

When viewing mean percentages, Chambers County shows the second highest mean poverty percentage of 26% and has 50% minority and 21% non-English speaking mean percentages. Lastly, Orange County with the lowest mean poverty percentage (25%) has 27% minority and 6% non-English speaking mean percentages. For the least prevalent vulnerabilities (senior population, female headed households, and zero automobile), Orange County has the highest mean percentage of senior population (18%) and Jefferson County has the highest mean percentage of both female headed households (8%) and zero automobile (9%).

Table 3. Vulnerability Variables for Block Groups Exceeding 16% Poverty Rates

County	Number of Block Groups	Female Headed (%)	NES (%)	Minority (%)	Poverty (%)	Senior (%)	Homes w/Zero Autos (%)
Chambers	6	4	21	50	26	17	2
Jefferson	107	8	24	76	33	14	9
Orange	29	7	6	27	25	18	3

Table 4 shows the mean percentage poverty and ranges for the counties. In addition to the mean values previously described, the vulnerable block group on the low end of the range are equal to the Texas mean. However, block groups at the highest levels are 80% in Jefferson, more than 40% in Orange and more than double the Texas mean with 34% in Chambers County.

Table 4. Texas and County Mean and Ranges

County	Number of Block Groups	Mean	Lowest	Highest
Chambers	6	25	16	34
Jefferson	107	33	16	80
Orange	29	25	17	43
Texas		16		

Table 5 shows the base data for the Composite Vulnerability Index. Because the female head of household for each county is less than the Texas mean, that value is not included in the vulnerability index. Recall that the automobile ownership variable was low for all counties, so it, also, is not included. The non-English speaking population in the vulnerable block groups are higher than their county means, as are the percentage of minorities.

Table 5. Percentages Vulnerable Block Groups Indexed with County Means

County	VBG Non-English Mean	% County Non-English Mean	VBG Non-English Index Value	% VBG Mean Minority	% County Mean Minority	VBG Mean Minority Index Value	VBG Index Value
Chambers	21	16	1.3	50	28	1.8	1.6
Jefferson	24	20	1.2	76	59	1.2	1.2
Orange	6	5	1.2	27	20	1.4	1.3

For the calculation of percent of income spent on transportation, the average annual mileage driven for Texas residents (13,474) was used with the Texas mileage reimbursement rate of .58 cents per mile. For the vulnerable block groups, the income amount was based on the poverty level for a family of five at $30,170 annually (Appendix A). When looking at the percent of income spent on transportation, the vulnerable block groups were compared to the percent of income spent on the median spent on transportation for their county. Recognize that the county median includes the vulnerable block groups, so gaps would be larger if the vulnerable block groups were removed. Still, for Chambers County the vulnerable block groups spend more than double their county counterparts on transportation, resulting in an index value of 2.4. For Jefferson and Orange Counties, the discrepancy is less, but the indexes are still greater than 1.0 (Table 6).

Table 6. Percent of Income Spent on Transportation Index

County	VBG % Income for Trans	County % Income for Trans	% of Income Spent Index
Chambers	.26	.11	2.4
Jefferson	.26	.17	1.5
Orange	.26	.15	1.7

The means for the 142 vulnerable block group indexes on non-English population and minority are calculated for the Vulnerable Block Group value (Table 7). All counties' VBG index values range from 1.2 to 1.6. Next the indexes for percent of income are included and averaged for the Composite Vulnerability Index.

Table 7. Composite Vulnerability Index Values

County	VBG Index Value	% of Income for Transportation Index	Composite Vulnerability Index
Chambers	1.6	2.4	2.0
Jefferson	1.2	1.5	1.4
Orange	1.3	1.7	1.5

The Composite Vulnerability Index shows a large gap between the residents in Chambers County's vulnerable block groups as they are at twice the disadvantage as others in their county considering their relevant socioeconomic variables and percent of income spent on transportation. The contributor to this finding is the very high median income for Chambers County in excess of $70,000. For Jefferson and Orange Counties a variance is shown as both counties show a CVI greater than 1; the values are similar in 1.4 and 1.5, respectively.

Chapter 5. Research Summary

5.1 Addressing the Gap

Before planning can begin for any transportation, a need must be established. The need is the gap between the deficiency in the area's transportation system and the possible solutions to address the deficiency. Both need and purpose must be shown to begin planning for new transportation service or a facility and vulnerability should be a consideration. The ETA as a well-used tool for determining vulnerability served as the starting point prior to conducting the CVI assessment. The ETA was originally developed for urban areas where variables such as female headed households and low auto ownership are characteristics shared by low income and minority persons. For rural and other low density communities, vehicle ownership is a necessity, as there is essentially no public transportation in many of these areas. Through work in previous rural corridors and the IH 10 East Corridor, the low percentage of female headed households was also confirmed. For these communities, because all variables do not carry the same importance in rural compared to urban communities, the ETA tool serves to disguise the intense need for transportation for rural residents. In comparison, the work of the CVI showed a gap between the vulnerable block groups and other residents in their counties.

The ETA showed low need for 275 of the 292 block groups in the corridor, 2 with high need and none with very high need. Only Jefferson had roughly 20% of the block groups showing the poverty level. Chambers and Orange Counties had 13% and 16%, poverty respectively. Because the extremes in values are included in the calculation for ETA, significant poverty pockets may be masked. The CVI work determined there is a need for additional shared ride or public transportation options for 142 block groups in the three counties along the IH 10 East Corridor connecting Houston to the state line through Chambers, Jefferson and Orange Counties.

The CVI demonstrated the need via the socioeconomic criteria and the purpose by highlighting the percentage of income spent on transportation. That these vulnerable individuals and families must spend a larger portion of their income moving around leaves less for all other needs. Disposable income is lost for higher education pursuits or access to better employment, spending that could lead to improved lifestyles. Rural and small-town residents are often challenged in making their

case for public transportation improvements because their problems do not seem as significant as those of urban areas. Unless we identify and examine the vulnerable block groups, people there can see their level of need buried among the haves in nearby neighborhoods.

5.2 Findings and Recommendations for Future Decision Making

The MPOs leading decision making for the communities in the IH 10 East Corridor require a statement of purpose and need to begin a transportation project. By applying traditional socioeconomic characteristics and adding the percentage of income spent on transportation by the vulnerable population compared to their county's mean, the CVI documents the need of low income rural and low density populations. Purpose is implied as the percentage of their income spent on transportation is viewed. There is no way to lower the dollars spent by requiring additional driving individually. Lowering transportation costs for rural and low density residents will require public options that include sharing rides. Public transportation is an option but will require non-traditional thinking to manage costs. Coordinated carpooling or vanpooling could be considered to improve accessibility to educational complexes or job centers in proximate urban areas. The discussion about health disparities and food insecurity are trips that do not require daily travel, so it is important to recognize that transportation options be tailored to the specific communities and needs. Organizing so as to streamline payment options and facilitate transfers to urban transportation would expand the attainable destinations.

Planners and transportation professionals can use the index when considering public service and facility projects for these communities. Also, as conversations and technology improve for automated vehicles, opportunities may be available to enhance travel options for vulnerable rural and low density residents.

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Appendix A: Percent of Income Spent on Transportation

The data for the calculations of percent of income spent on transportation are shown through the population, statistics on average annual miles driven and the state of Texas mileage reimbursement rate of .58 cents.

Table A1. Total Mileage and Dollars Spent on Transportation for IH10 East Corridor

County	Popu-lation	Annual Mean Miles Driven Per Capita	Total Miles	Annual Dollars Spent per County	County Median Income	Vulnerable Household Income*
Chambers	6,707	13,474	90,370,118	$52,414,668	$74,368	$30,170
Jefferson	118,423	13,474	1,595,631,502	$925,466,271	$47,177	$30,170
Orange	1442	13,474	1943	$1127	$53,667	$30,170

* Annual Poverty Level Household Income for Family of Five

Table A2. Percent of Income Spent per Household

County	Median Spent per Vulnerable Block Group	Median Spent per Household County Wide	Index Spent Per Vulnerable Block Group Compared to County Median
Chambers	.26	.11	2.46
Jefferson	.26	.15	1.56
Orange	.26	.17	1.78