Federal guidance on transportation equity shortcomings in practical application, case study: planning and implementation of Omaha Rapid Bus Transit (ORBT), Omaha, Nebraska

by

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A REPORT

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Abstract

This report shows how polices and guidance for considering equity in public transit projects falls short in achieving its purpose of providing fair and equitable distribution of benefits and burdens. The recent planning and implementation of a bus rapid transit (BRT) route in Omaha, Nebraska is used as a case study. The Omaha Rapid Bus Transit (ORBT) route was used to replace route #2, a bus route with several more stop locations along an east to west transportation corridor (Dodge Street) in the eastern half of Omaha, Nebraska. To see how equity was considered in the planning and implementation phases, multiple analyses were performed using 2019 American Community Survey 5-Year Estimates (ACS) data, observed boarding and alighting counts, and the results of the most recent on-board survey which were all available during the planning and implementation phases of ORBT. By exclusively examining data available to planners during the planning process, it can be seen to what extent equity was likely considered and the likely distribution of benefits and burdens.

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Introduction

The field of transportation equity has become increasingly noticed by planners and policy makers alike. The issue of equity in transportation planning is highly important as transportation provides access to opportunities and resources making it a vital part of daily life (Newmark, 2014). There are multiple pieces of federal legislation attempting to curb transportation inequities including Title VI of the Civil Rights Act in 1964 and Executive Order 12898 in 1994. Additionally, the U.S. Department of Transportation has created policies and guidance on considering equity to be eligible to receive federal funding. However, these are vague or provide limited enforceable measures (Sanchez & Wolf, 2005). The vague and limited nature of existing regulations for incorporating equity in transportation planning have led to a simple evaluation of any kind being acceptable for meeting federal requirements intended to enhance equity in transportation planning.

Omaha Rapid Bus Transit (ORBT) opened in November 2020 in Omaha, Nebraska along a major east and west corridor (Dodge Street) and is accessed as a case study. ORBT is examined for its level of consideration on equity to meet current federal requirements and show the likely distribution of benefits and burdens to different groups living near the corridor exclusively using data available during the planning process. This analysis shows where current federal guidance and policies fall short in requiring the consideration of equity in meaningful ways. This is seen as equity was given minimal consideration during the planning process and while likely outcomes seem positive overall, there are some concerning factors for equity. ORBT replaced a former bus route with three times as many stops along the same route. This causes all riders to receive the benefit of less time spent on the bus itself due to less stops being made while traveling the same

distance but an increase in the distance that must be walked to access the bus. This report examines how the additional distance which must be walked to access the route after the reduction in stops is distributed amongst different demographic groups. In examining race, household income, and age, the distribution of burdens (additional walk distance) is mostly consistent across the groups for those who utilized the former bus route and live near the corridor. Additionally, it was determined that those without access to a vehicle on average had significantly lower increases in their walk distance to access transit. These findings begin to point to an overall equitable outcome for ORBT. However, the mostly equal distribution of burdens to those living near ORBT points to a system of simply avoiding adverse impacts rather than the distribution of resources based on those starting out with the highest need.

Literature Review

Transportation equity has recently gained attention as many have sought to better define the ways it should be applied to transportation (Feng & Zhang, 2014; Larson, 2018). It is argued by some authors that the incorporation of equity is needed to create sustainable long term transportation plans (Feitelson, 2002). In several cases the intensified focus on equity within transportation planning has come in response to recent movements that have brought social inequities into the public spotlight. This can be seen most recently as police brutality brought about the Black Lives Matter movement and in the Montgomery Bus Boycott (Cantilina et al., 2021; Sanchez et al., 2019). Many underserved groups face barriers in accessing transportation which can hinder economic and social development based on physical or socio-economic factors (Lee et al., 2017; *The Transportation Planning Process Briefing Book*, 2015). Access to quality equitable transportation can mean the difference between gainful employment and opportunities or life in poverty (Korb, 2011).

Defining Equity in Transportation

Equity as it relates to transportation is the way in which transportation practitioners can provide affordable and reliable transportation to all members of a community while specifically focusing on traditionally underserved communities who have historically received a lower quality of transportation (Martens et al., 2019; Sandt et al., 2016). There are three pieces distinguished by transportation equity: the benefits and burdens resulting from a plan, to which populations these benefits and burdens are distributed, and determining if the distribution of benefits and costs is done in a moral and proper manner (Martens et al., 2019). Benefits are often measured as an increase in access to opportunities. Many authors state this is a limited, but most ideal method of

measurement. (Golub & Martens, 2014). Costs in transportation are noise, safety concerns, health impacts, and time spent traveling (Cantilina et al., 2021). Transportation equity examines the distribution of benefits and costs to differing groups and demographics (Karner et al., 2016; Litman, 2002). Transportation equity should seek to meet local needs rather than equal distribution of resources, while considering that decisions will have differing effects on population shares (Van Dort et al., 2019). In an article by Norman Krumholz, transportation equity is an effort to provide more "choices to those…residents who have few, if any choices" (Krumholz, 1982). For this reason the placement of transit routes in low-income or vulnerable areas is often not coincidence, but rather intentional placement to provide additional needed resources to communities that have been disadvantaged previously (Garrett & Taylor, 1999).

In transportation inequities are often categorized as social, procedural, and geographic. Procedural inequity refers to cases in which policies are not carried out equally for all members of a community. Geographic inequity refers to decisions that have distributive impacts that may negatively or positively impact members of a community based upon their physical location. Social inequity refers to decisions made in transportation planning that do not randomly benefit or adversely affect members of the population. This can be seen in decisions that often impact financially well to do shares of a community while adversely affecting low-income shares (Bullard, 2004). For ORBT, the large scale stop reduction with an increase in the quality of service poses a risk for both geographic and social inequities to occur in which those who incur longer walking distances are given a larger share of the burden while choice riders receive the benefit of shorter commute time spent on the bus.

Equity is also commonly understood as either vertical or horizontal equity (Berg & Newmark, 2020; Caggiani et al., 2017). Horizontal refers to the equal distribution of resources to as many individuals as possible regardless of their need (Ben-Elia & Benenson, 2019). Vertical equity refers to the distribution of resources amongst groups or geographic areas with differing needs and resources. The most equitable outcome is one that assists the most disadvantaged persons with the goal of reducing the gap between the best and worst off (Behbahani et al., 2019). Author Michael Walzer states that unlike other goods and services transportation should be considered apart from normal supply/demand standards and transportation benefits should be distributed based upon a societal need attributed to them rather than through a competitive exchange process (Martens et al., 2012).

Limitations in Current Practice

Despite recent development and research in the field of transportation equity there is still relatively little agreement on how to analyze and incorporate equity (Santos et al., 2008). Equity is often referred to interchangeably with terms like fairness or justice leading to more confusion (Thomopoulos et al., 2009). Approaches for evaluating equity in transportation usually aim to quantify the benefits and burdens of a decision and their distribution to different groups or demographics (Martens, 2016). Other literature attempts to quantify equity based on proximity to resources and opportunities. In this method differing modes are considered along with physical distance. This method was used in a study of the Detroit, Michigan metro area which identified that in many cases at risk populations have better physical access due to proximity of nearby stores, but less overall access due to low rates of car ownership (Grengs, 2015). Regarding ORBT, the mode of transit now being a BRT brings an improved efficiency to travel on the bus

line, but a decrease in the accessibility to the route for those living near the corridor because of fewer stops/stations.

Federal Guidance and Requirements for Transportation Equity

There is limited federal guidance on ensuring equity is considered and how to incorporate equity. The American Institute of Certified Planners (AICP) in its Code of Ethics and Professional Conduct states that planners have a duty to ensure that previously underserved populations are now accounted for in ongoing planning efforts to better their conditions, however, it gives no set criteria on how or in what circumstances (AICP, 2021; Newmark, 2014).

In 2017 the Federal Transit Administration (FTA) published a briefing book containing a short section on transportation equity. The briefing book defines transportation equity as the way in which the unique needs of many different population members are addressed, while focusing most heavily on those historically adversely effected by transportation planning such as racial minorities, low-income households, aging populations, and those with physical handicap, and that equity should be considered early on and often in the planning process (*The Transportation Planning Process Briefing Book*, 2018). However, the briefing book does not offer specific analysis to examine equity or set criteria for evaluation. Additionally, it is argued in the literature that public involvement in transportation planning comes too late after most major decisions have been made and public input is disregarded (Karner & Levine, 2021; Karner & Marcantonio, 2018; Sanchez et al., 2003). Other authors suggest that less traditional modes of public outreach, such as advocacy partnerships with the community, will foster better outcomes, but these are not discussed in the briefing book (Karner & Levine, 2022).

Two major legal pieces are in place for regarding transportation equity: Title VI of the Civil Rights Act enacted in 1964 and Executive Order (EO) 12898 put in place by President Clinton in 1994. Both policies have also brought about other policies and guidance from the U.S. Department of Transportation (Gordon, 2015). Title VI of the Civil Rights Act states that no project that is receiving federal financial assistance may discriminate against anyone on the basis of race, color, or nation of origin. Executive Order (EO) 12898 which details environmental justice instructs agencies to address and avoid any disproportionate adverse effects on vulnerable populations including minority and low-income populations. Discrimination against those who are limited English proficient (LEP) has also become a consideration for environmental justice within transportation planning (Cronley et al., 2021). Title VI and EO 12898 are often used together but cannot be used interchangeably. EO 12898, commonly referenced for environmental justice, is a directive from President Clinton to improve operations within all levels of government to better serve and consider vulnerable communities. Title VI is a legal mechanism in both enforcing and carrying out the mission of EO 12898. It is important to note that while EO 12898 establishes executive branch policy on environmental justice legislation, the executive order itself is not enforceable in a court of law. Title VI, however, is legally enforceable in all cases in which federal funding is granted and ensures that federal funding is not given or used in any way that creates discrimination against communities (U.S. Department of Transportation, 2012b).

Based on the combined aspects of Title VI and EO 12898, the two main factors that are commonly evaluated for equity and environmental justice standards within public transit

planning are a person's race/ethnicity and their household income (Bullard, 2004). While the factors of race and income are legally required, several transit agencies have begun evaluating other areas such as vehicle ownership, physically or mentally handicapped persons, and seniors (those ages 65 and over).

In 2012 the U.S. Department of Transportation released circulars regarding both Title VI and EO 12898 with guidance and requirements for local governments, organizations, and transit agencies receiving federal funding or resources to follow in meeting the requirements of Title VI and EO 12898. The FTA circular on Title VI for federal funding recipients, published August 15, 2012, put in place guidance for recipients of federal funding and set requirements for both project planning submittals and ongoing submittals pertaining to Title VI criteria. The fourth chapter of the circular is dedicated to giving guidance and requirements to operators of fixed route transit vehicles and outlines requirements for large scale transit agencies receiving federal funds to prepare a Title VI report and to update and submit this report every three years. The circular includes several items that should be included in an organization's report such as demographic information and maps of the service area, demographic information on ridership, details of the organization's meetings, and public outreach. The circular also states that organization must set and adhere to standards for its whole service area regarding distribution between stops, amenities at any given stop or transit vehicle, transit vehicle capacity, service frequency, and level of accessibility for each form of transit (i.e. bus rapid transit, light rail, express bus, streetcar). Additionally, the organization must set in place a policy for identifying and preventing adverse effects. However, the circular provides little detail on what specific criteria should be analyzed and leaves it almost entirely up to the organization to set its own standards and own methods for

determining and adhering to these standards. Additionally, it is up to the organization to determine what is considered an adverse effect and whether it is considered significant (U.S. Department of Transportation, 2012b). The lack of set standards and specific requirements in the circular is concerning in regards to allowing any degree of analysis or consideration to be considered acceptable (Sanchez et al., 2003). Additionally, the ways in which a transit agency chooses to address equity can vary greatly. Differences based on available staff and resources for addressing equity, organizations being required to set few benchmarks or measurable goals, and current policy allowing for the incorporation of equity to be done in a manner that is either vague or given minimal consideration during the planning process all still allow an agency to remain within the criteria in the circular (Karner, 2016).

The FTA's circular on environmental justice as it relates to EO 12898 was published on August 15, 2012 and contains similar sections and format to the circular on Title VI. The circular covers strategies for improving public engagement, conducting an analysis on environmental justice, identifying and acting on disproportionate adverse effects, and incorporating environmental justice into a project's environmental impact analysis. This has prompted many local planning agencies to conduct various forms of analyses centered around environmental justice and ridership demographics, but in the literature authors argue that while key data is collected, the statistical relationship between this data and equity is given little actual consideration (Karner, 2016). While several potentially beneficial points are raised in the circular, they are mostly vague or overarching in nature and do not provide specific benchmarks or measurable goals. Additionally, since EO 12898 is not a legally enforceable measure like Title VI, there is little legal requirement for agencies to follow these guidelines. This can be seen in comparing the

analysis that was done for the planning of ORBT to that described in the circular. In the categorical exclusion documentation which took the place of a full environmental impact analysis in the planning of ORBT (as discussed in the prior section of this report) it was stated that since the demographic composition of those living within a ¼ mile of route #2 were less than 15 percent minority of vulnerable populations there were no adverse effects from this project (Omaha Metro, 2015). This over simplified analysis based solely on population size and not the actual distribution of burdens contradicts guidance given in the circular. In discussing the creation of meaningful public engagement, the circular states:

> "A very small minority or low-income population in the project, study, or planning area does not eliminate the possibility of a disproportionately high and adverse effect on these populations. Some people wrongly suggest that if minority or low-income populations are small ("statistically insignificant"), this means there is no environmental justice consideration. While the minority or low-income population in an area may be small, this does not eliminate the possibility of a disproportionately high and adverse effect of a proposed action. EJ determinations are made based on effects, not population size" (U.S. Department of Transportation, 2012a).

As discussed earlier, this not only shows a weak analysis that leaves room for potential inequities, but also shows that the FTA's guidance was not followed or adhered to while the project was allowed to move forward, revealing the lack of clear terms/benchmarks in the guidance allows only a basic analysis of equity to be considered sufficient. With vague guidance in place for reducing adverse effect to vulnerable communities and improving public engagement in the planning process, it is questionable if the FTA's strategies created in 2012 in both of the FTA's circulars on Environmental Justice and Title VI will produce the desired outcome

(Oswald Beiler & Mohammed, 2016). Therefore it is not surprising that the literature makes the argument for the creation and implementation of meaningful standards in implementing equity and refers to Title VI and policies on equity as a "sleeping giant" (De Barbieri, 2017; Johnson, 2014).

Planners' Current Understanding on Transportation Equity

It is important to recognize what tools and guidance current planners are being given for considering equity in their designs and where additional knowledge is needed. As part of a research report interviews with fifty-nine transportation practitioners were conducted to identify their approaches and perceived barriers to implementing equity. Professionals were selected from both private and public sectors as well as professionals working in academic roles. Eighty-one percent of those surveyed stated that they worked to address questions related to equity in their current positions. Forty-six percent of the practitioners interviewed stated that there was little to no support from the organization where they worked for implementing equity in their practices. Sixty-one percent stated that their workplace had no clear standards or metrics for equity and eighty percent of those interviewed stated that they felt there was either insufficient or only very low-quality data available for evaluating equity within a given situation (Cantilina et al., 2021). The gaps in knowledge and available resources identified in these interviews points to a need for both more awareness and specific standards and guidance within transportation planning.

Current Practice in Stop Consolidation

Lastly, it is important to investigate what the literature currently contains on the implementation of bus rapid transit (BRT) or other express service vehicles such as light rail transit (LRT)

replacing existing local level service and stop consolidation to local transit routes as both were present in ORBT's planning and implementation. Martin Wachs and Ethan Elkind both discuss the use of rail transit similar to BRT over traditional bus service. They both argue that in many cases rail transit operates in areas that do not provide an additional level of access over traditional bus routes. Rail transit does have the potential to bring about higher density land uses near the line meaning more individuals would have access to it, but this is only if local leaders and planners are committed to this change (Elkind, 2014; Wachs, 2014). Concerning ORBT, there is much discussion in the TIGER grant application to work towards building up the corridor, although nothing is stated on improving the level of access over the former route #2 (Omaha Metro, 2014b).

The implementation of ORBT poses a unique case where while the mode of transit has changed from a more traditional local bus route to a bus rapid transit (BRT) route, the new service follows an identical path to the previous local service route with many of the ORBT stations being former local bus stop locations rather than being built in an adjacent corridor. This makes the implementation of ORBT and its replacing a local service route most similar to the practice of stop consolidation. In literature stop consolidation is defined in the removal/reduction of stops along a local bus route while the vehicles and mode of transit remain constant. Stop consolidation should be done to a point at which a balance is achieved between transit accessibility and overall transit system efficiency (Kehoe, 2004). Current approaches to stop consolidation often focus on factors such as run times, rider access, egress/dwell time, and rider wait times. A successful approach to stop consolidation would decrease the overall run time of a bus route by decreasing the total egress/dwell time the bus spends at individual stops along the

route without adversely affecting rider's access to stops. In some cases stop consolidation may allow for a higher frequency of service if the decrease in total travel time throughout the day is enough for another trip(s) to be made along the same route (El-Geneidy, 2005).

In the literature on stop consolidation some authors state that stop reductions may be required for current local bus routes in order to increase transit ridership trends. The reduction in time spent at individual stops and decrease in the overall run time of a route make local bus routes a more competitive alternative to driving a personal vehicle to access locations along the route. However, for this goal to be achieved stop reduction must be carried out in coordination with long term land use planning that supports transit ridership (Murray, 2003). Stop consolidation planning is often done with either the intent of reducing total travel time using transit and/or maximizing transit ridership (Saka, 2001). The literature also suggests that gains in transit ridership are made mostly in cities with rail transit/express transit modes as opposed to local routes with a larger number of stops (Newman & Kenworthy, 1999).

Drawing Conclusions from the Literature

From the literature it can be seen that there is currently a lack of sufficient guidance for evaluating and incorporating equity within transportation planning. In many cases, even though it is required that projects receiving federal funding incorporate equity in their design, the lack of specific guidance allows for any form or minimal consideration to be considered adequate. While the literature also points to possible benefits in both transit stop consolidation and changing from local transit service routes to express service routes such as increased transit ridership, proposing transit as a competitive alternative to driving, and reducing overall travel times, it does raise

some concerns. As stated in the literature, stop consolidation and transitioning from local to express service should only be done when the benefits described above can be achieved without adversely affecting existing riders' access to a stop/station along the route.

This report uses the recent planning and implementation of ORBT, a bus rapid transit line in Omaha, Nebraska that replaced an existing local transit route, as a case study of how equity was considered and what effects the reduction of stops/stations had on access to transit for existing riders living within the corridor. This report also aims to identify and show methods for using available transit ridership data and demographic analysis to evaluate how current riders' access to transit will likely be affected when considering changes in service or stop consolidation. These methods can also be used in determining the likely distribution of benefits and burdens regarding changes in transit access to vulnerable and historically underserved groups beyond what is currently required for the consideration of equity within transportation planning guidance and policy. These methods aim to show new ways to further evaluate transportation equity in planning for changes to public transit and also highlight where current practices and guidelines fall short of fully considering equity.

Background

ORBT (Omaha Rapid Bus Transit) first opened in Omaha, Nebraska in 2020 and replaced a local service bus route with a BRT (bus rapid transit) operating on the same route as the former local service route. The route, as shown in figure 1, operates along Dodge Street or Highway 6, which services as a major east and west transportation corridor within Omaha. ORBT operates on an eight-mile section of Dodge Street connecting downtown to a suburban shopping center. Along the route are multiple hospitals, a university campus, and multiple mixed-use developments. The largest number of low income and minority groups living within a quarter mile of the route are in the central to eastern portion of the route. The largest change that came with the change from local service to BRT was the reduction of total stops/stations along the route. This can be seen in figure 2 below that shows both the locations of the former local service stops (route #2) and the current BRT stations (ORBT). While the transition from local to BRT service brings a decrease in the total travel time of the route and a higher level of service, it brings the concern to how the access to a stop/station of those living near the route was affected.

BRT in Omaha was first conceived in 2014 during a process undertaken by the City of Omaha, Omaha Metro, and the Metropolitan Area Planning Agency (MAPA) to determine transit alternatives for connecting activity areas and neighborhoods within eastern Omaha. The process began in 2012 and the final report “Central Omaha Transit Alternatives Analysis” was released in 2014 (Omaha Metro, 2014a). This proposed multiple new BRT and streetcar lines. A BRT line (which would later become known as ORBT) running on either side of Dodge Street was identified as the preferred alternative to prioritize (Omaha Metro, 2014a). The location of ORBT and the proposed stations within the City of Omaha are shown on the map below. On September

15th of 2014 Omaha was awarded a $15 million “Transportation Investment Generating Economic Recovery” or TIGER grant towards the construction and implementation of ORBT (Burbach, 2014). Omaha Metro also receives other forms of federal funding for maintaining its regular operations making it subject to Title VI and Executive Order 12898 regulations for including equity and environmental justice considerations in its planning and design. Both Title VI enacted in 1964 and environmental justice guidelines, most prevalent in Executive Order (EO) 12898, place additional requirements on federally funded projects to avoid any adverse effects to vulnerable populations in the planning and implementation of a federally funded project. Both are commonly used together as legal requirements for incorporating equity into public transit and ensuring an equitable distribution of burdens and benefits (Bullard, 2004; Karner et al., 2020).

In both the Alternative Analysis and TIGER grant application documentation equity and environmental justice are only briefly mentioned and stated that they will be further evaluated during the environmental justice analysis for the required by the National Environmental Policy Act (NEPA). The Alternative Analysis does provide a ranking on social justice for BRT and other modes considered but does not detail how that ranking was determined. The TIGER application key goals identified include improving mobility and access to transit, but these goals do not call out for improving access for any specific groups commonly considered in transportation equity. It also includes a section on sustainability which does not mention equity or environmental justice, but focuses on reducing single occupant vehicle commuting and reducing vehicle emissions (Omaha Metro, 2014b). This goal shows that ORBT is working to

target choice riders more so than those living near the corridor without access to a vehicle and raises the question as to what level of consideration these riders were given.

Public engagement during the early stages of the project was well carried out. Omaha Metro in its 2016 Title VI Action Plan Update lays out guidelines for public engagement based on having meetings in a public place and at convenient times and locations (Omaha Metro, 2013). This approach was taken in planning ORBT by having public meetings and open houses at various times at Westroads Mall which connects to a major bus transfer station now served by the ORBT route (Omaha Metro, 2020b). However, the mall location at the far western end of the route does raise concern that most riders and minority populations near the corridor are near the eastern portion of the route and would have had to travel out of their way to attend.

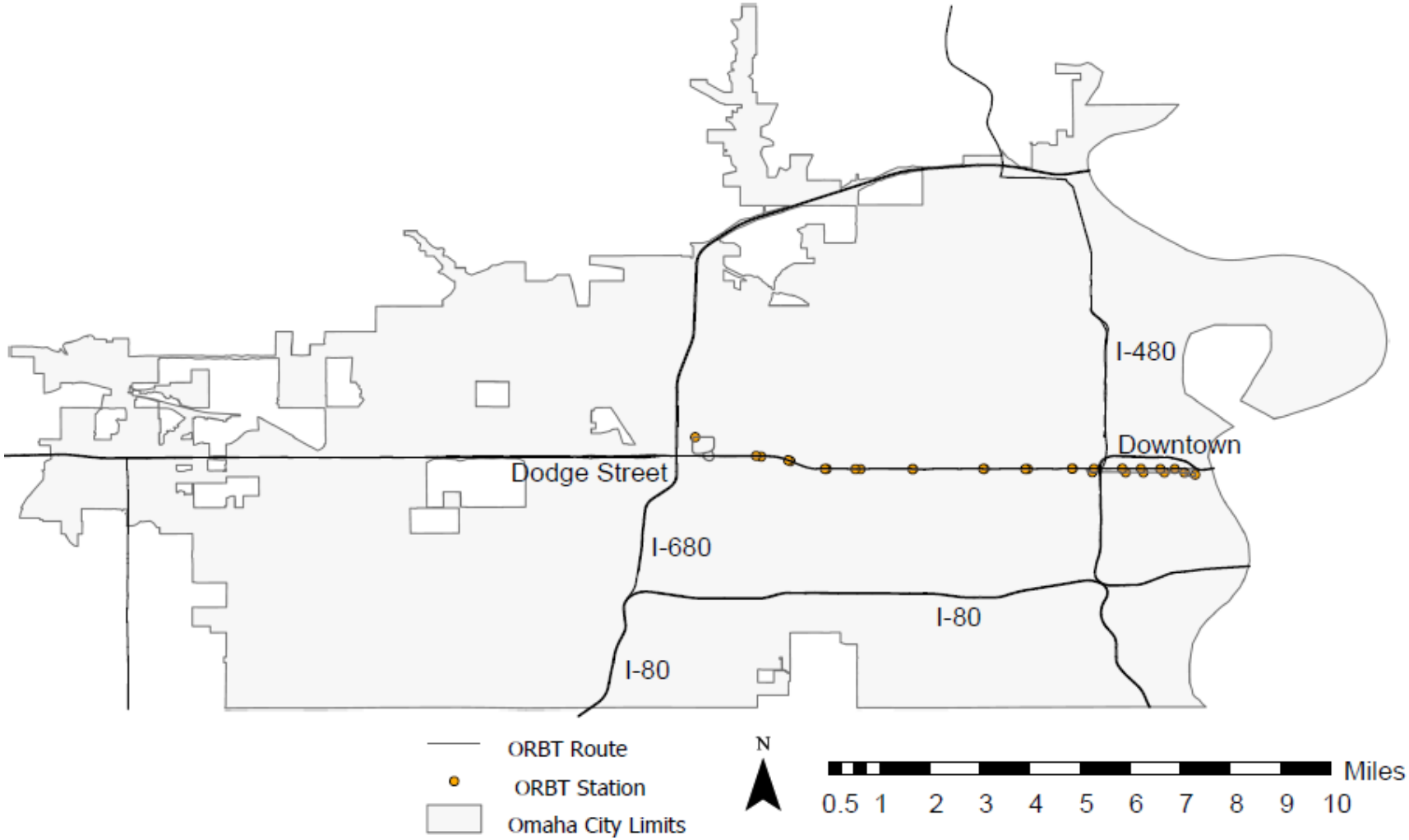


Figure 1: Map of Omaha, Nebraska. The map above shows an outline of the city limits of Omaha, Nebraska, and major highways/interstates. The ORBT line is shown in grey with the station locations shown as orange points.

During the implementation of ORBT a full environmental impact statement was not required since the project was determined to be within the Council of Environmental Quality (CEQ) parameters for not requiring a full evaluation. This is due to the nature of the project not having an individual or cumulative effect on the human environment as defined in the guidance. Due to the scope of the project a categorical exclusion was made that stated no further environmental review was required (Sutley, 2010). The categorical exclusion documentation written by Omaha Metro stated that:

> "minority populations within ¼ mile of the project corridor are 15% or less. Low-income populations greater than 40 percent exist north and south of Dodge Street in the Lincoln Boulevard vicinity, and on the north side of Dodge Street from 24th Street to the east terminus. The proposed project would not result in the displacement of any minority or low-income persons. Therefore, there will be no disproportionately high or adverse impacts to minority or low-income populations. The project would benefit these populations by providing them with additional transit service and amenities for connection to community facilities and employment centers" (Omaha Metro, 2015).

While the statement categorical exclusion document touches on the project benefiting low-income and minority groups, no detail is stated in how specifically they will benefit. Additionally, the only analysis to determine that there will be no adverse effects to these groups is based on the percentage of each group living near the corridor and not on actual distribution of burdens. However, this method for determining adverse effects on vulnerable groups and minimal discussion of equity is somewhat consistent with that of the FTA's circular on environmental justice which discusses examining the area near the location of a proposed project using demographic data of the area to identify any possible adverse effects rather than examining

who is most likely to use a new project (U.S. Department of Transportation, 2012b). This low level of analysis being consistent with the FTA's wording on determining shows the lack of thorough guidance that exists for evaluating equity in federally funded projects (Sanchez & Wolf, 2005).

Omaha Metro's limited analysis on vulnerable groups affected by ORBT falls short in not considering a larger picture. Using 2019 American Community Survey 5-Year Estimates it can be determined that 27 percent of those living within a quarter mile walking distance of route #2 identified as a race other than White alone, 10 percent were over the age of 65 and 16 percent had a household income of less than $15,000 per year. Additionally, according to Metro's 2017 on-board survey report for the original bus route #2 later replaced by ORBT, 46 percent of riders identified as being other than White alone and 26 percent had a household income less than $15,000 per year as discussed later in the analysis sections of this report (SRF Consulting Group, Inc., 2020). It is concerning to see that the only evaluation done in determining adverse effects on vulnerable groups for the categorical exclusion documentation seems to be based the share of groups living near the corridor as a whole and fails to account for which groups have access and the demographics of those observed actually riding on route #2 as both identify a much higher share of venerable groups being potentially affected.

Methodology

The recent implementation of ORBT in Omaha, Nebraska received funding from the U.S. Department of Transportation, therefore it is a requirement for this project to include the consideration of equity of its users in its planning and analysis as discussed earlier. This report uses the recent planning and implementation of ORBT as a case study to show the ways in which typical evaluation of equity in transportation planning practice falls short for projects receiving federal funding. By exclusively using data that was available to planners and decision makers during the planning and design process, this report aims to use various analysis methods to show the likely distribution of burdens and benefits to different groups living near the route #2/ORBT corridor that were not highlighted during the planning and design process of ORBT despite having the available data to do so.

The first analysis section uses 2019 American Community Survey 5-Year Estimates (ACS) data to examine the demographic groups and their access to either route #2 or OBRT based on potential rider's home location and the changes in the service area based on locations within walking distance of a stop/station. The second analysis examines the distribution of demographic groups within the service area to visualize ORBT's more specific effects. The third analysis incorporates on-board survey data collected on route #2 to determine the average increase a person of each demographic group would have to walk to reach an ORBT station compared to a former route #2 stop using home locations of riders collected during the survey and a GIS network analysis model. This section also examines some of the potential concerns in using survey data in this type of analysis and highlights discrepancies between the spatial distribution of riders surveyed and normal rider activity on route #2.

Analysis 1: Determining Changes in the Service Area

The transition from route #2 to OBRT included the reduction of 45 stops to 15 stops in one direction. Omaha Metro stated that over half of those who used route #2 boarded or alighted within a block of where there is now an ORBT station (Omaha Metro, 2020a). The placement of the former route #2 stops and current ORBT stations is shown below in figure 1. Esri GIS was used to determine the service area for both route #2 and ORBT. This determines areas that have access to a stop/station within a quarter mile using existing roads and trails to access it. This is done using the network analysis package in GIS and street centerline locations obtained from the Douglas County GIS office. The process of measuring quarter mile travel along existing streets is an alternative to a traditional quarter mile buffer system that does not account for road networks. The service area of both route #2 and ORBT are shown below in figure 2.

In comparing both service areas, unlike route #2, ORBT does not have a continuous service area within the corridor and covers a significantly smaller area. ORBT has a service area that is 37 percent smaller than that of route #2. This finding, while not considering how likely those within the identified service areas are to use transit or their demographic profile, does raise concern in regard to the change from route #2 to ORBT since the service area did become smaller and therefore ORBT has a geographically smaller reach than route #2. However, the transition to a BRT line did introduce a higher level of service and while the distance required to reach a stop/station in most cases increased, time spent riding the bus would have decreased for most riders. The concern for equity exists in determining how the distribution of the burden of additional walk distance required to reach a stop/station was distributed to key demographic groups. For a reduction of service area to have been done equitably, it must be able to be proven

that demographic factors typically considered in transportation equity such as persons of color, and low-income persons, were not disproportionally burdened. To further examine and consider equity as it pertains to transportation planning the demographic shares of the riders who have access to both route #2 and ORBT must be considered.

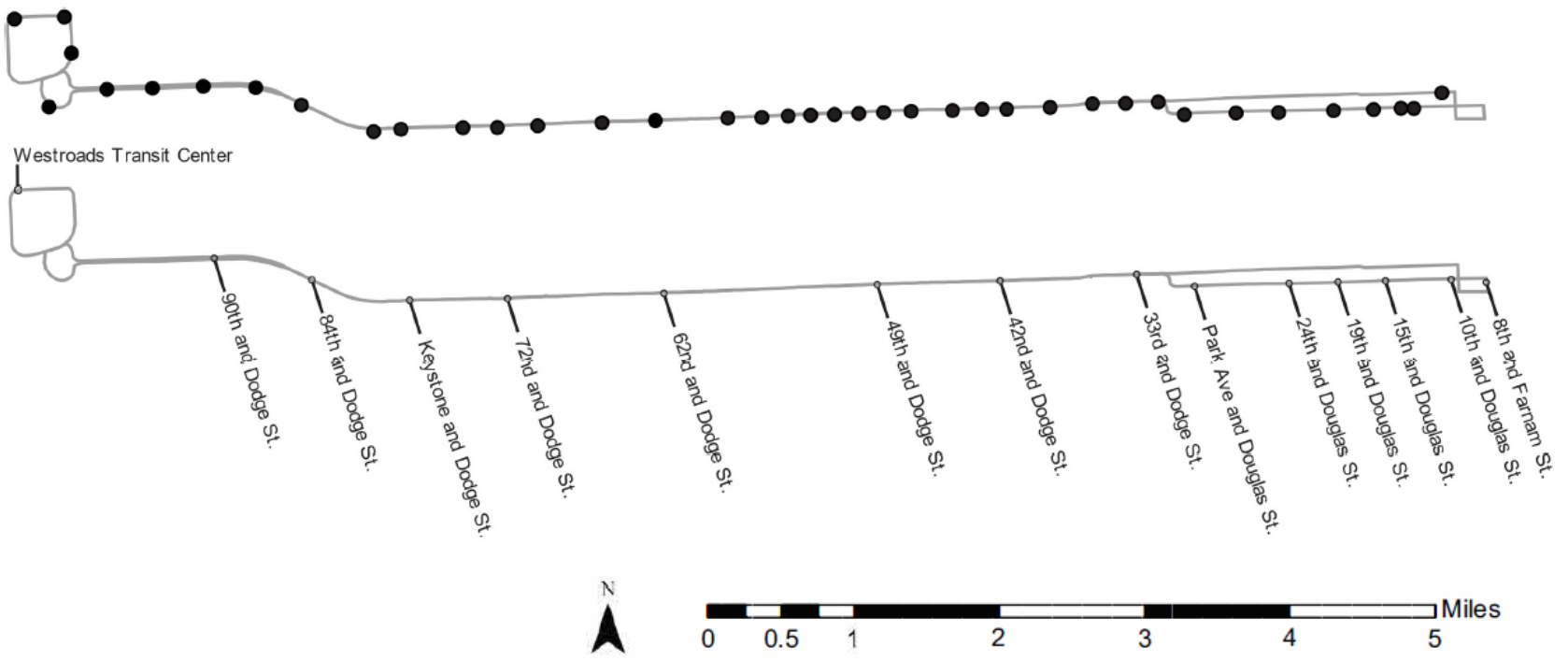


Figure 2: Route #2 and ORBT Stop Locations. The figure above shows the locations of former route #2 eastbound stops on the top portion represented by solid black dots. The lower portion of the graphic shows the location of ORBT eastbound stops represented by a solid grey dot and street name/stop labels. It can be seen by comparing both the upper and lower portion of the graphic the large-scale reduction in stops, especially in the central portion of the route. Created using Esri software, data from Omaha Metro.

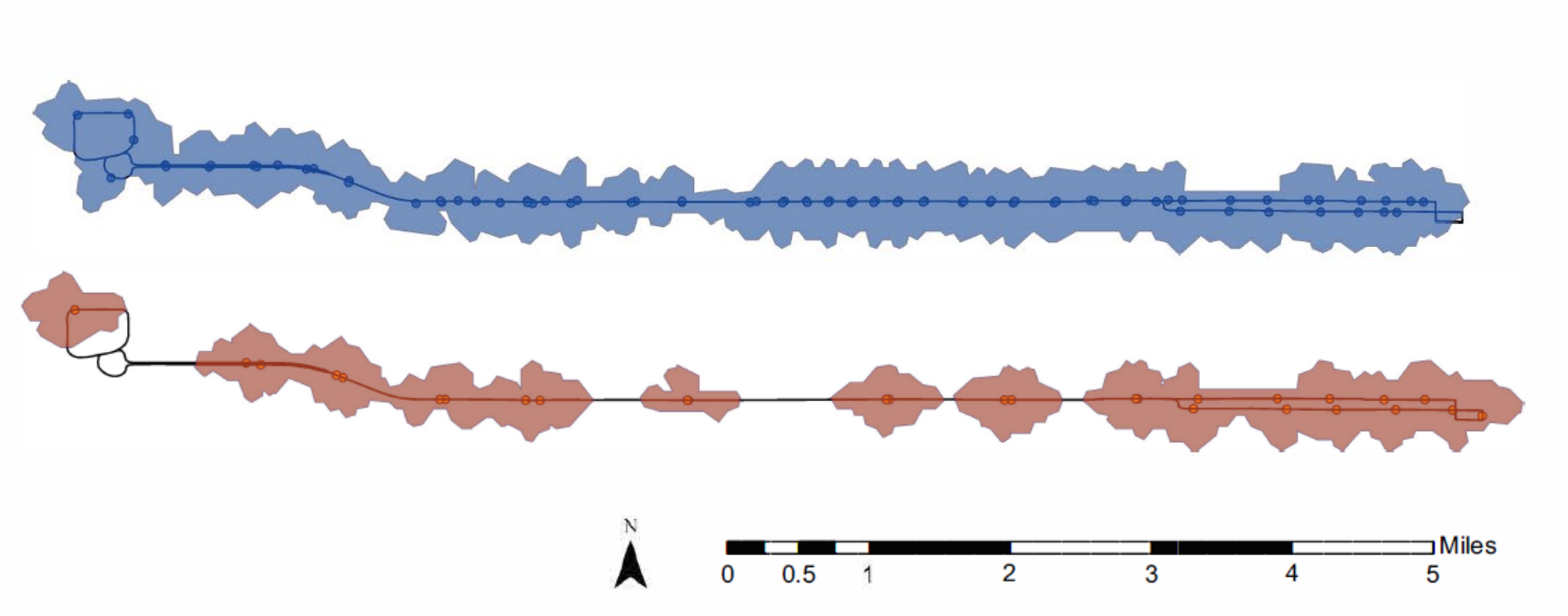


Figure 3: Route #2 and ORBT Service Area. The maps above show the service area of route #2 shaded in blue and OBRT shaded in orange based on locations within a quarter mile of a stop/station locations using existing streets and trails. The location of stops/stations is marked with solid-colored dots in both the route #2 and ORBT service areas.

To examine the effects that the reduction in service area has had on those living near the corridor, block group level 2019 American Community Survey 5-Year Estimates (ACS) data was used along with the outlines of the service area for both route #2 and ORBT. Using the clip function in GIS, ACS block groups were reduced to match the shape of the service area for both route #2 and ORBT. This is like using a cookie cutter to cut the service area out of the larger map. Each block group contains information on the total number of persons living within the block group and breaks them out into individual fields relating to several factors: race, income, transportation, and age. In cases where the clip function reduced the size of a block group, the attributes of the block group were adjusted using the ratio of the new shape size from its original. For example, if the service area was determined to only cover half of a block group the population within that block group would be reduced by 50 percent. This process was used to examine race/ethnicity, age, and household income of those living within the service area. These factors were also examined in Metro's most recent on-board survey in 2017 and are commonly used in analysis for examining equity. The results of this survey are shown in the charts below.

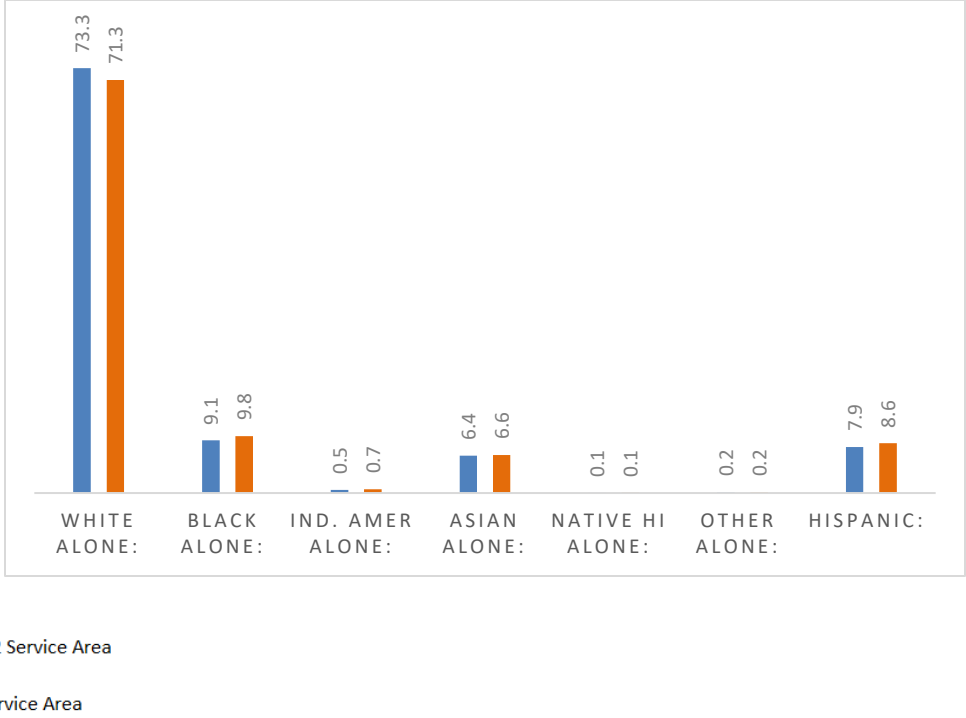


Figure 4: Race/Ethnicity Within Route #2 / OBRT Service Area. The chart above shows the percentage of the total population within the Route #2 and ORBT service area that identified as one of the demographics in the survey.

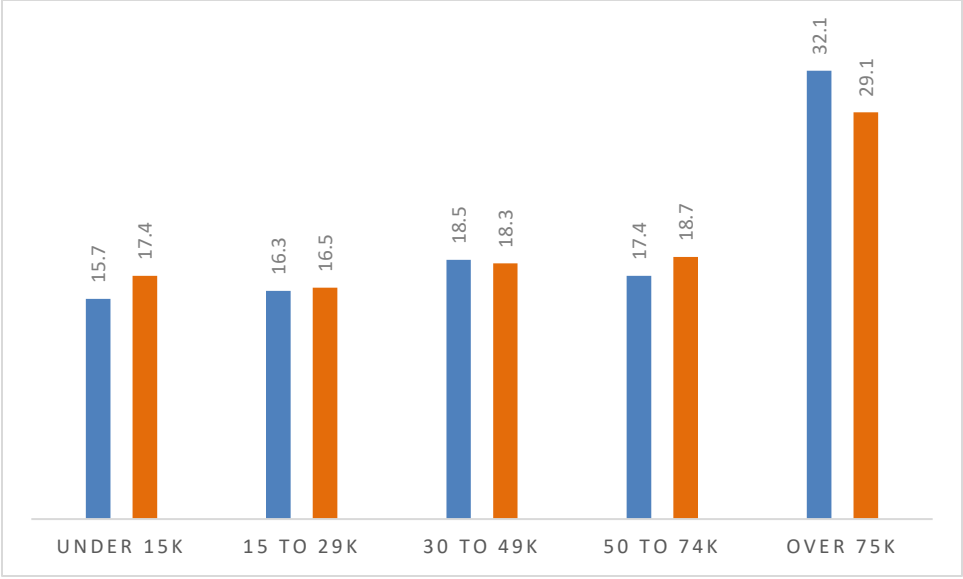


Figure 5: Household Income Within the Route #2 / ORBT Service Area. The chart above shows the percentage of the total population within both the Route #2 and ORBT service area who identified their household income as being in one of the set income categories based on the survey.

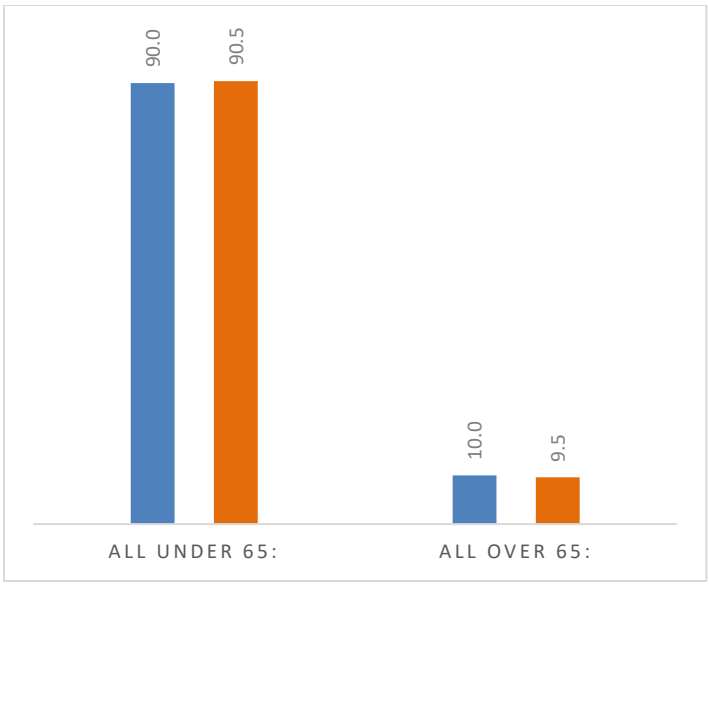


Figure 6: Persons Over 65 Within the Route #2 and ORBT Service Area. The chart above shows the percentage of the total population within the route #2 / ORBT service area who identified themselves as being over or under the age of 65 based on the survey.

It can be seen in the charts above that the demographic proportions for age, race, and household income are similar when comparing route #2 to ORBT. However, some differences concerning equity can be seen when looking at the percentage change between the demographic shares making up the route #2 and ORBT service areas. Households making less than fifteen thousand per year saw the largest percent increase in their percentage of the ORBT service area compared to that of route #2, and households making more than seventy-five thousand per year saw the largest percent decrease in their percentage make up of the service area. The same trend is true of minority race/ethnicity persons seeing an over five percent increase in the percentage share of ORBT's service area compared to route #2's while there was an almost two percent decrease in

percentage share of the ORBT service area representing White/Caucasian persons. It is also important to note that the total number of persons who have access to ORBT compared to route #2 is less. The route #2 service area contained approximately 18,038 persons living within the service area. The service is for ORBT contains approximately 11,274 persons living within the service area. It is also important to consider that this is only reflective of those living within the service area and does not consider observed ridership on either route #2 or OBRT. To better understand the effects of stop reduction on those living within those who previously used route #2, the demographic composition of those observed using route #2 must be considered. Almost 70 percent of persons who live within the route #2 service area are in the eastern half of the route encompassing downtown and dense residential neighborhoods. The map below shows the route #2 service area split into four sections based on the combining of block groups with similar demographic attributes within the service area. The furthest west section contains a large shopping mall, and suburban neighborhoods extending to 90th Street. The second to the east extends from 90th Street to the eastern edge of Memorial Park and includes the University of Nebraska Omaha (UNO) campus. This section is mostly commercial and non-residential properties. The third section from the west extends from Memorial Park to 33rd Street and contains a mix of both business and dense single-family housing. The furthest east section extending past 33rd Street is completely encompassing of downtown and contains a mix of dense multifamily housing and commercial space. The values shown above the service area are the percentage of total persons within the service who live in each section. The values shown below the service area are the percentage of the total route #2 boarding and alighting documented in February of 2020 that occurs in the section. It can be seen in the graphic below that the distribution of those living in the route #2 service area differs from the distribution of boarding

and alighting. This suggests that route #2 and now ORBT service a mix of both riders living in the service area and others commuting or making business to business trips. To further understand the effects of ORBT on demographic groups, it is important to also visualize their distribution within the route #2 service area.

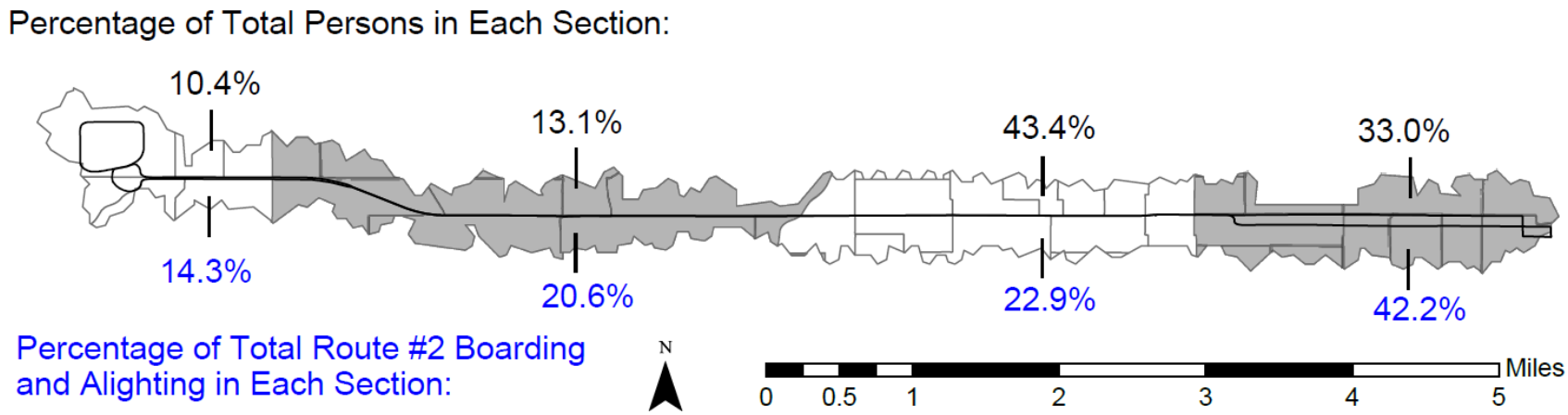


Figure 7: Distribution of Boarding/Alighting and Residents Near Route #2. The map above compares the distribution of residents living near route #2 and the distribution of boarding and alighting on route #2. The percentage of residents living in each section is shown above the service area outline. The percentage of boarding and alighting that takes place in each section based on February 2020 counts is shown below the service area.

To visualize the distribution of demographic groups living in the route #2 service area, a dot density analysis, a method of mapping that places a single dot for a set number of persons in that group, was performed using GIS. In the maps below each individual dot represents 10 persons within each demographic group. In this case 100 persons would be represented by 10 individual dots. This analysis was performed for race/ethnicity, household income, and age. The results of this analysis are shown in the maps below and utilize the same sections as the earlier analysis to show the distribution of vulnerable groups within the corridor and the former route #2 service area.

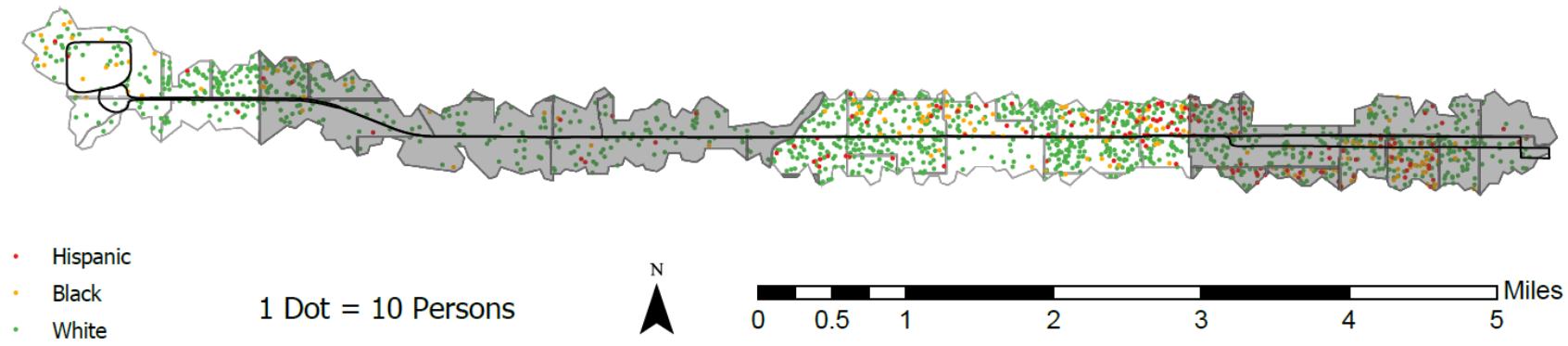


Figure 8: Minority Race/Ethnicity Within the Corridor. The map above shows the distribution of minority race/ethnicity groups within the route #2 service area. Each dot is representative of 10 persons.

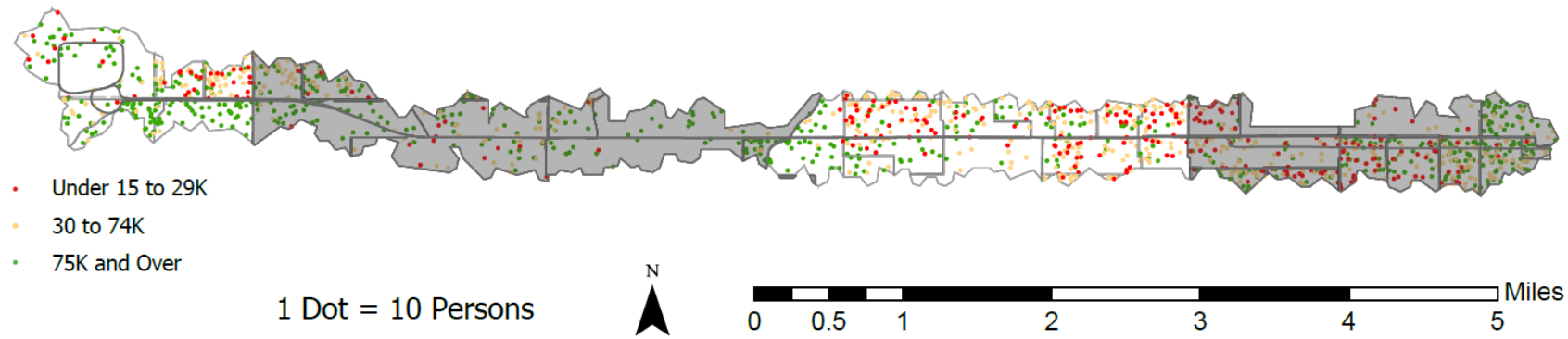


Figure 9: Household Income Groups Within the Corridor. The map above shows the distribution of different household incomes of residents who live within the original route #2 service area. Each dot is representative of 10 individual persons.

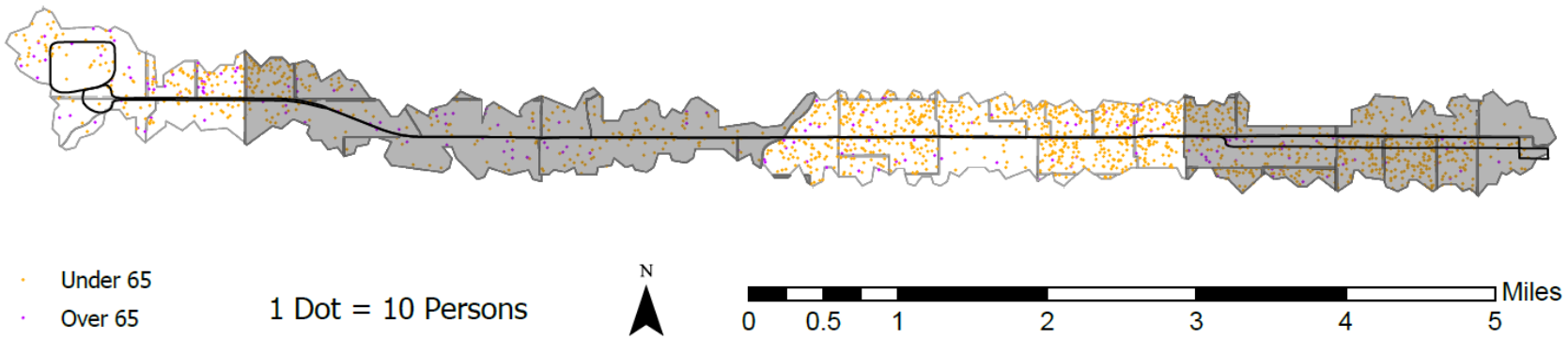
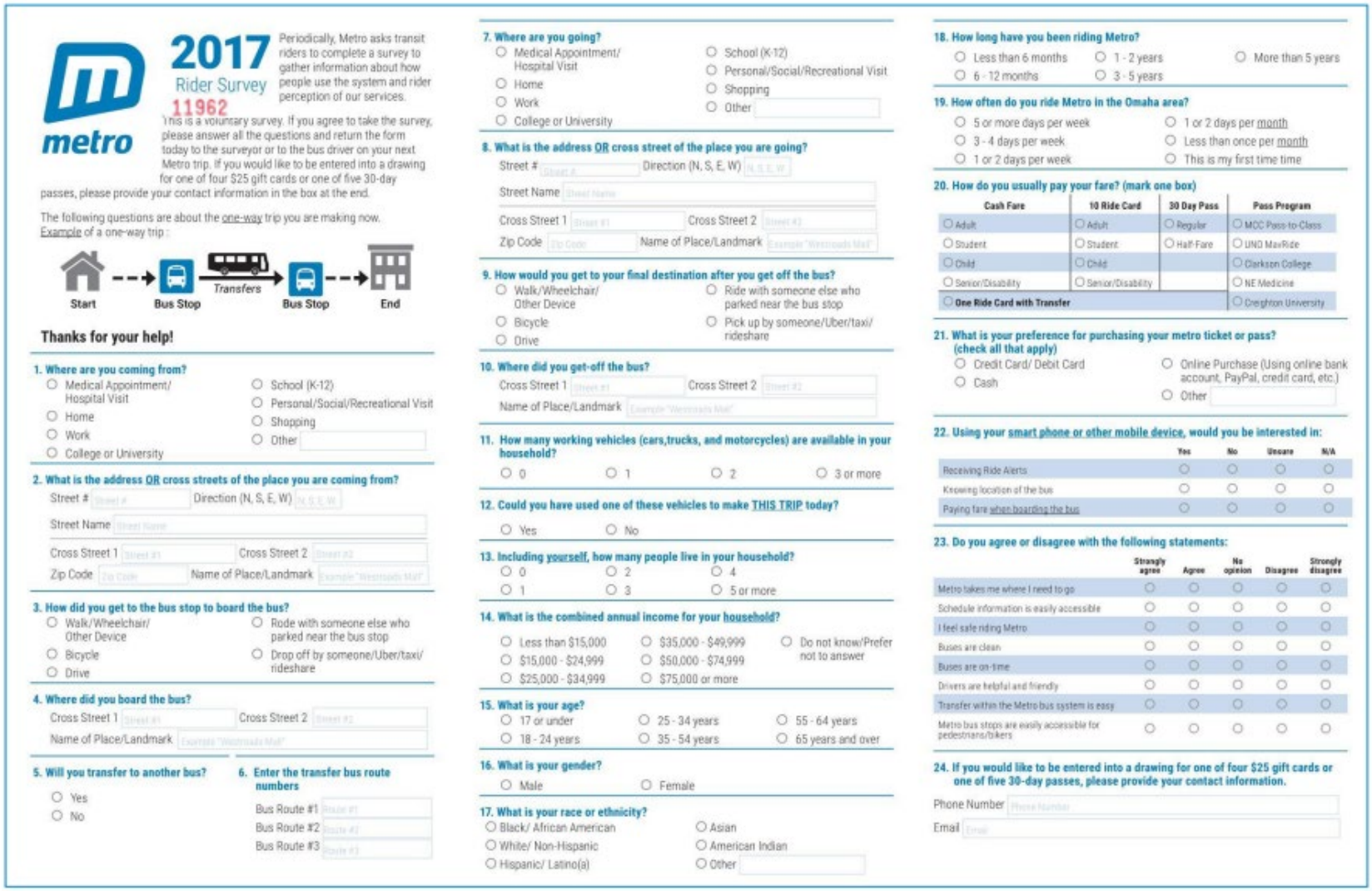


Figure 10: Persons 65 and Over Within the Corridor. The map above shows the distribution of those over and under the age of 65 living within the original route #2 service area. Each dot is representative of 10 individual persons.

Both minority race/ethnicity and low-income persons are concentrated in the eastern portion of route #2 service area. Additionally, the furthest east section encompassing downtown contains the largest concentration of Black/African American and Hispanic groups. Those over the age of 65 are more evenly spread throughout the length of route #2 service area with the largest concentration being in the furthest west section of the route #2 service area. It is a positive for the consideration of equity that the highest concentration of vulnerable demographics groups occurs in the furthest east section of the route #2 service area which after the stop reduction the ORBT service area in this section includes most of the former route #2 service area. This is important to recognize since other sections of the OBRT service area have a smaller coverage than route #2, however this occurs outside of the highest concentrations on vulnerable demographic groups within the route #2 service area.

Analysis 2: Using On-Board Survey Data to Incorporate Actual Riders

In 2017 Metro conducted an onboard survey of all its routes. The survey form, as shown below, collected the rider's home address, the origin and destination of their current trip, as well as household demographic information. In using the results of the 2017 survey which shows observed riders demographics and their home locations it is possible to better determine how the accessibility to transit of those who live along the corridor has changed with the introduction of ORBT rather than only relying on the demographic composition of those living in the service area. For this analysis rather than examining rider's time spent on the bus, the analysis aimed to identify the level of access to transit for those living within the corridor who heavily rely on transit. The assumption is made that once riders reach an ORBT station they will all evenly receive the same benefits of more frequent service and shorter travel times between stops. Additionally, the survey data does not allow for a way to account for time spent waiting for a bus to arrive in addition to time spent walking to/from a station and time spent on a bus. However, since the benefits of the reduced travel time between stations and increased frequency will affect each rider equally once they reach a station, it is not necessary to factor the total travel time of the respond's trip. Instead, this analysis examines the change in the walking distance from respondents' homes to the stop/station where they boarded.



2017 Rider Survey

11962

Periodically, Metro asks transit riders to complete a survey to gather information about how people use the system and rider perception of our services.

This is a voluntary survey. If you agree to take the survey, please answer all the questions and return the form today to the surveyor or to the bus driver on your next Metro trip. If you would like to be entered into a drawing for one of four $25 gift cards or one of five 30-day passes, please provide your contact information in the box at the end.

The following questions are about the one-way trip you are making now.
Example of a one-way trip :

Start → Bus Stop → Transfers → Bus Stop → End

Thanks for your help!

1. Where are you coming from?
- Medical Appointment/ Hospital Visit
- Home
- Work
- College or University
- School (K-12)
- Personal/Social/Recreational Visit
- Shopping
- Other

2. What is the address OR cross streets of the place you are coming from?
Street # Direction (N, S, E, W)
Street Name
Cross Street 1 Cross Street 2
Zip Code Name of Place/Landmark

3. How did you get to the bus stop to board the bus?
- Walk/Wheelchair/ Other Device
- Bicycle
- Drive
- Rode with someone else who parked near the bus stop
- Drop off by someone/Uber/taxi/ rideshare

4. Where did you board the bus?
Cross Street 1 Cross Street 2
Name of Place/Landmark

5. Will you transfer to another bus?
- Yes
- No

6. Enter the transfer bus route numbers
Bus Route #1
Bus Route #2
Bus Route #3

7. Where are you going?
- Medical Appointment/ Hospital Visit
- Home
- Work
- College or University
- School (K-12)
- Personal/Social/Recreational Visit
- Shopping
- Other

8. What is the address OR cross street of the place you are going?
Street # Direction (N, S, E, W)
Street Name
Cross Street 1 Cross Street 2
Zip Code Name of Place/Landmark

9. How would you get to your final destination after you get off the bus?
- Walk/Wheelchair/ Other Device
- Bicycle
- Drive
- Ride with someone else who parked near the bus stop
- Pick up by someone/Uber/taxi/ rideshare

10. Where did you get-off the bus?
Cross Street 1 Cross Street 2
Name of Place/Landmark

11. How many working vehicles (cars,trucks, and motorcycles) are available in your household?
- 0
- 1
- 2
- 3 or more

12. Could you have used one of these vehicles to make THIS TRIP today?
- Yes
- No

13. Including yourself, how many people live in your household?
- 0
- 1
- 2
- 3
- 4
- 5 or more

14. What is the combined annual income for your household?
- Less than $15,000
- $15,000 - $24,999
- $25,000 - $34,999
- $35,000 - $49,999
- $50,000 - $74,999
- $75,000 or more
- Do not know/Prefer not to answer

15. What is your age?
- 17 or under
- 18 - 24 years
- 25 - 34 years
- 35 - 54 years
- 55 - 64 years
- 65 years and over

16. What is your gender?
- Male
- Female

17. What is your race or ethnicity?
- Black/ African American
- White/ Non-Hispanic
- Hispanic/ Latino(a)
- Asian
- American Indian
- Other

18. How long have you been riding Metro?
- Less than 6 months
- 6 - 12 months
- 1 - 2 years
- 3 - 5 years
- More than 5 years

19. How often do you ride Metro in the Omaha area?
- 5 or more days per week
- 3 - 4 days per week
- 1 or 2 days per week
- 1 or 2 days per month
- Less than once per month
- This is my first time time

20. How do you usually pay your fare? (mark one box)

Cash Fare	10 Ride Card	30 Day Pass	Pass Program
Adult	Adult	Regular	MCC Pass-to-Class
Student	Student	Half-Fare	UNO MavRide
Child	Child		Clarkson College
Senior/Disability	Senior/Disability		NE Medicine
One Ride Card with Transfer			Creighton University

21. What is your preference for purchasing your metro ticket or pass? (check all that apply)
- Credit Card/ Debit Card
- Cash
- Online Purchase (Using online bank account, PayPal, credit card, etc.)
- Other

22. Using your smart phone or other mobile device, would you be interested in:

	Yes	No	Unsure	N/A
Receiving Ride Alerts				
Knowing location of the bus				
Paying fare when boarding the bus				

23. Do you agree or disagree with the following statements:

	Strongly agree	Agree	No opinion	Disagree	Strongly disagree
Metro takes me where I need to go					
Schedule information is easily accessible					
I feel safe riding Metro					
Buses are clean					
Buses are on-time					
Drivers are helpful and friendly					
Transfer within the Metro bus system is easy					
Metro bus stops are easily accessible for pedestrians/bikers					

24. If you would like to be entered into a drawing for one of four $25 gift cards or one of five 30-day passes, please provide your contact information.
Phone Number
Email

Figure 11: Survey Instrument, 2017 On-Board Survey. The form shown above was used for Metro's 2017 on-board survey. Origin to destination data from this survey was used in determining respondent's total travel time and walking distance while riding route #2.

The on-board survey which was conducted in 2017 on all 28 of Omaha Metro's transit routes generated 2,192 completed surveys and a 71 percent response rate overall. On route #2 260 individually completed survey records were obtained. To find the walk distance required to reach a stop/station a valid home origin or destination is required so 18 records were removed from the analysis since they did not contain an origin or destination in the response. As the goal of this analysis and report is to show to what extent equity was considered in the planning of ORBT, specifically for those living within the corridor relying on transit for access to opportunity, only survey records containing a home origin or destination were considered as these contained the location of riders' homes within the corridor. Business to business trips, or other non-home locations were excluded from this analysis. Additionally, home locations were only considered if they identified walking as their mode to reach a stop since the analysis was based on examining physical walk distance to transit which can become much greater when other modes such as biking or driving are included. Therefore 136 survey records were removed from the analysis that had either a mode other than walking for reaching the stop/station or were business to business trips without a home destination or origin. Lastly a home location was only considered if the survey record contained information on at least one of the following for the rider: race, age, income, vehicle ownership, and number of household members. In some cases, partly completed surveys were used in the analysis only for sections which were completed. The denominator for total survey responses were updated for each field individually to account for this.

Based off the criteria outlined in the preceding paragraph 106 home locations of transit riders who responded to the 2017 on-board survey while taking route #2 were identified. The locations

of these homes were identified as either an origin or destination on the survey with the rider reaching either a stop location or their home by walking. The locations of these homes are shown on the map below in relation to the route #2 and ORBT bus line centered in the map below. It is important to note that some of the home locations provided by survey respondents are located on or directly adjacent to the street on which route 2 operated. This scenario likely occurs when riders did not want to disclose their exact home address or confused their survey answer as being where they boarded/alighted rather than their home location. This does limit the data in being able to determine the exact level of accessibility to transit when walking from the rider's home. In these cases, the assumption is made that the points provided are relatively close to the respondent's home location and in examining the change in the overall distance to an ORBT stop from the previous route 2 stop will still highlight many cases in which the removal of a station has brought about an increase in walking distance.

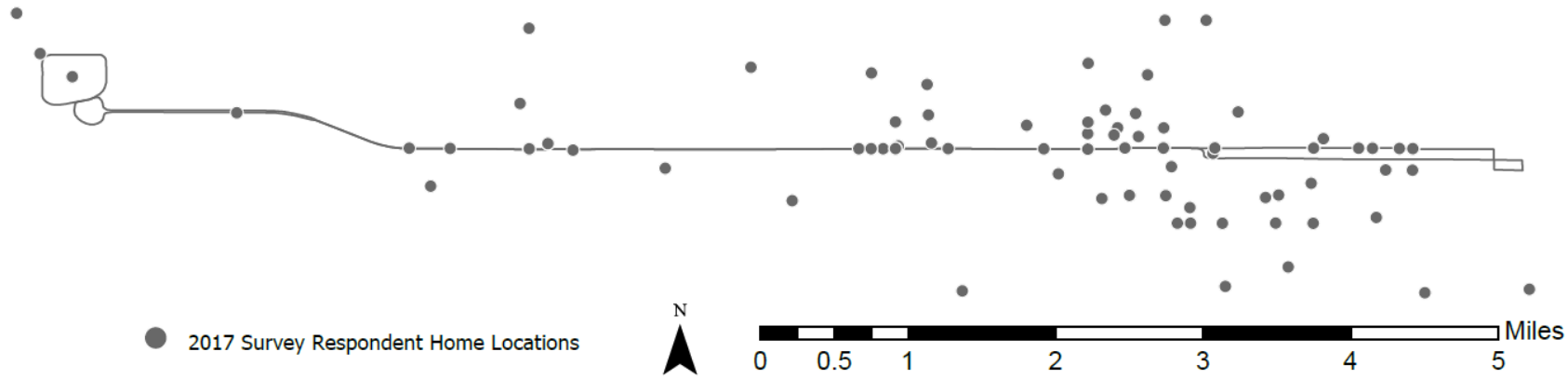


Figure 12: Route #2 Riders' Home Locations, 2017 Survey Results. The map above shows the home locations for 106 respondents of the 2017 on-board survey. The locations shown with a grey point were selected from the full response list based on their responses indicating that they walked to reach a route #2 stop and provided adequate demographic information on race/ethnicity, household income, age, or vehicle ownership.

The next step in this analysis after having identified the home locations of respondents living near route #2/ ORBT is to determine the distance required in walking from the rider's home location to transit. For the purposes of this analysis a rider's level of transit accessibility is accounted for in the difference in distance required to be walked to reach route #2 or ORBT. Using a network analysis function within Esri GIS it can be determined the distance required to walk to reach the closest route #2 or ORBT station. This operation is performed by using street center line data from Douglas County Nebraska, in which the City of Omaha is located. By using street center lines GIS will map the distance that must be traveled using existing roads and trails. Each home location is then assigned the closest route #2 stop based on travel distance using streets and GIS measures the full distance traveled in miles. The same process is then run using locations of ORBT stations rather than route #2 stop locations. An example of this type of analysis is shown in the graphic below. In the graphic all square icons represent the reported location of a rider's home address and each circular icon represents the location of a route #2 or ORBT station with the shaded lines representing the shortest path determined for accessing a stop/station. Once the analysis was done using both route #2 and ORBT stations the walking distance required to reach route #2 was then subtracted from the walking distance required to reach ORBT given in most cases the additional walking distance required to reach a stop/station after the introduction of ORBT. In only a few cases where walking distance to access a stop/station was reduced by the introduction of ORBT, a reduced walk distance is represented by a negative value.

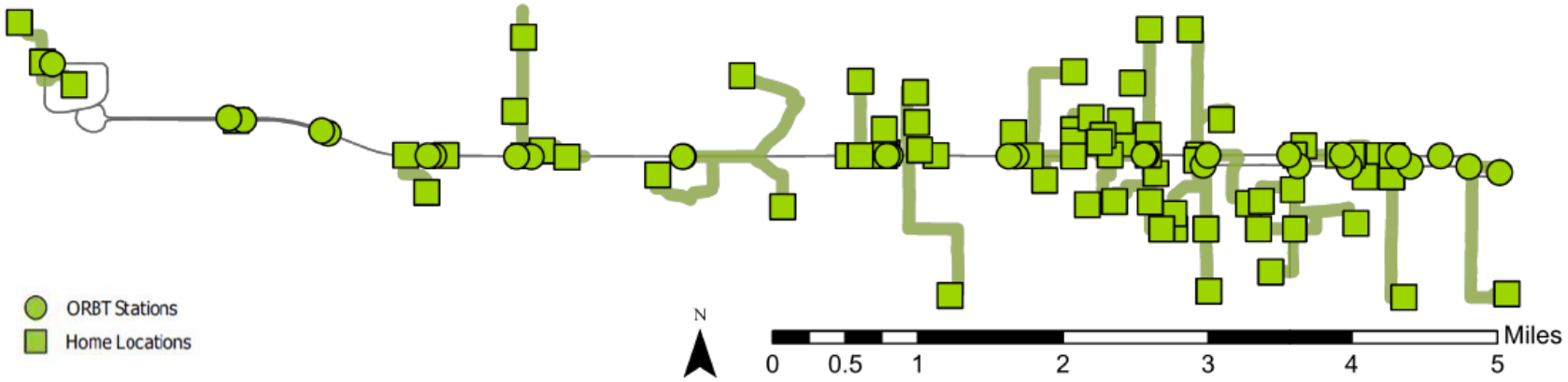


Figure 13: Route #2 Home to Stop Network Analysis. The map above shows the recorded home location of survey respondents with a square and the location of route #2 stops with a circle. The shaded lines show the route determined by GIS for connecting each home location to a route #2 stop using existing streets and trails. This method was used to calculate the distance necessary to walk to both the closest route #2 stop and then repeated for finding the distance to the closest ORBT station. The differences in the calculated distances were then used to determine the increase/decrease in distance to reach a stop/station with the implementation of ORBT.

In examining the results of the GIS analysis described above, the majority of survey respondents using route #2 had a walk distance of a quarter mile or less to reach a stop. After the implementation of ORBT, a larger share of survey respondents now have up to a half mile walk to reach a station with the largest group still walking a quarter mile or less as seen in the figure below. While the calculations of walking distance to reach both route #2 and ORBT presented some outliers with walking distance being over a mile in some cases, these points were kept in order to stay true to the original survey data provided by Omaha Metro.

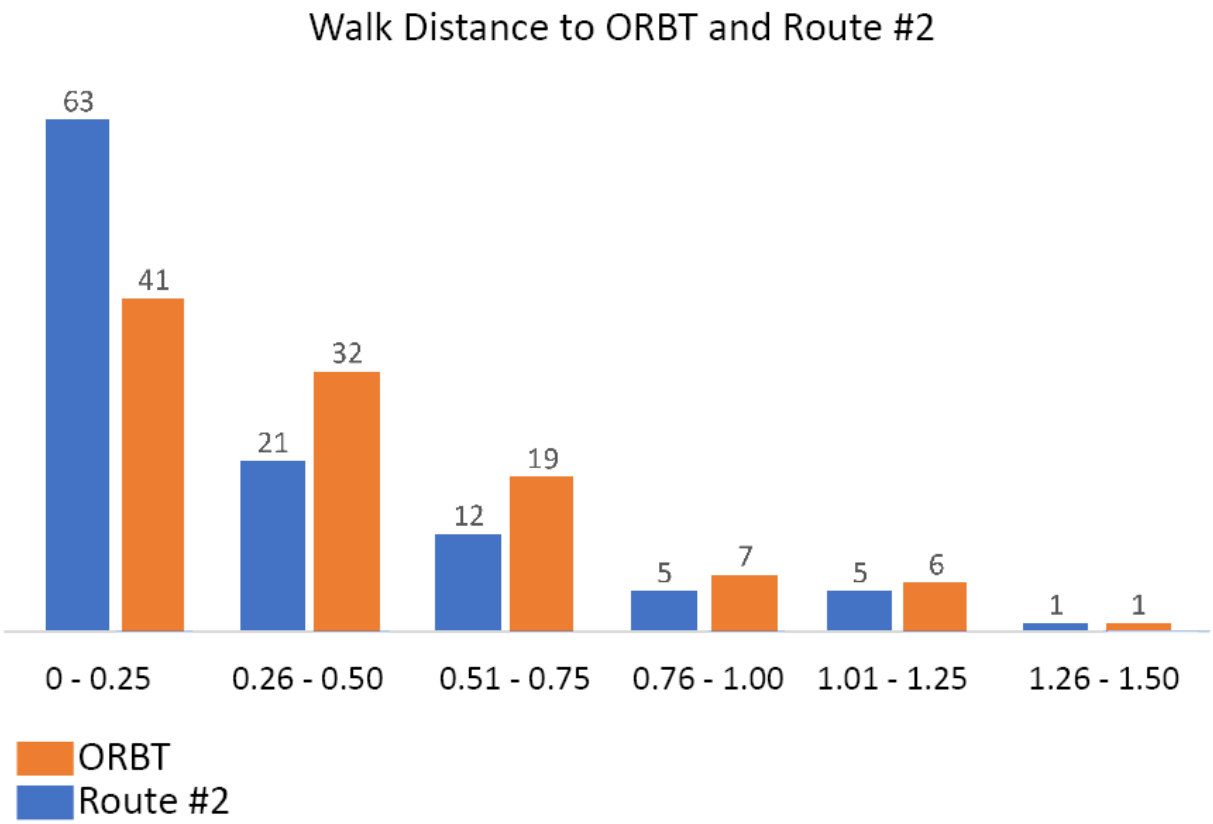


Figure 14: Walk Distance to Reach a Stop/Station. The histogram above shows the distribution in distances (in miles) that survey respondents walked to reach a route #2 stop (in blue) and an ORBT station (in orange) based on GIS network analysis.

After determining the increase in walk distance to access a stop/station for each survey, the data was then further examined to show what effect a respondent's race/ethnicity, age, household income, or access to a vehicle played in the increase of their walking distance required to reach a stop/station. To give a better idea of how the increase in walking distance changed for those most frequently using transit, each survey record was weighted based on how often the respondent reported utilizing transit within a given week.

The 2017 on-board survey asked respondents how often they rode transit in the Omaha area. The results of this were used in weighting the additional walk distance created by the introduction of ORBT. Weights were assigned to each survey entry based on the number of days in a week that they rode transit. Someone who indicated using transit five or more days per week was assigned a weight of 5, while someone who reported riding transit three to four days per week was assigned a weight of 3.5. Those who reported riding transit for their first time or doing so less than once per month received a weight of 0.2. The weighted value of 0.2 was derived by considering that there are approximately 4.3 weeks in a month, so a person using transit once a month is therefore riding 0.23 times per week. Since the value is for someone who is riding for either the first time or less than once a month, the value of 0.23 was rounded down to 0.2. In factoring these weights into the calculation for average increase in walking distance to reach a stop/station, as shown in the first graphic below, the individual weight was first divided by the sum of all the weights for each survey entry to determine the share of the total weight accounted for by each individual survey record. This share of the survey weight is then multiplied by the determined additional walking distance. Finally, the added walk distance multiplied by the share of the total weight is added together for all of the individual survey records to yield the weighted

average additional walk distance for all survey respondents. The second graphic below lists the weights used and their distribution amongst the 106 home locations used in this analysis.

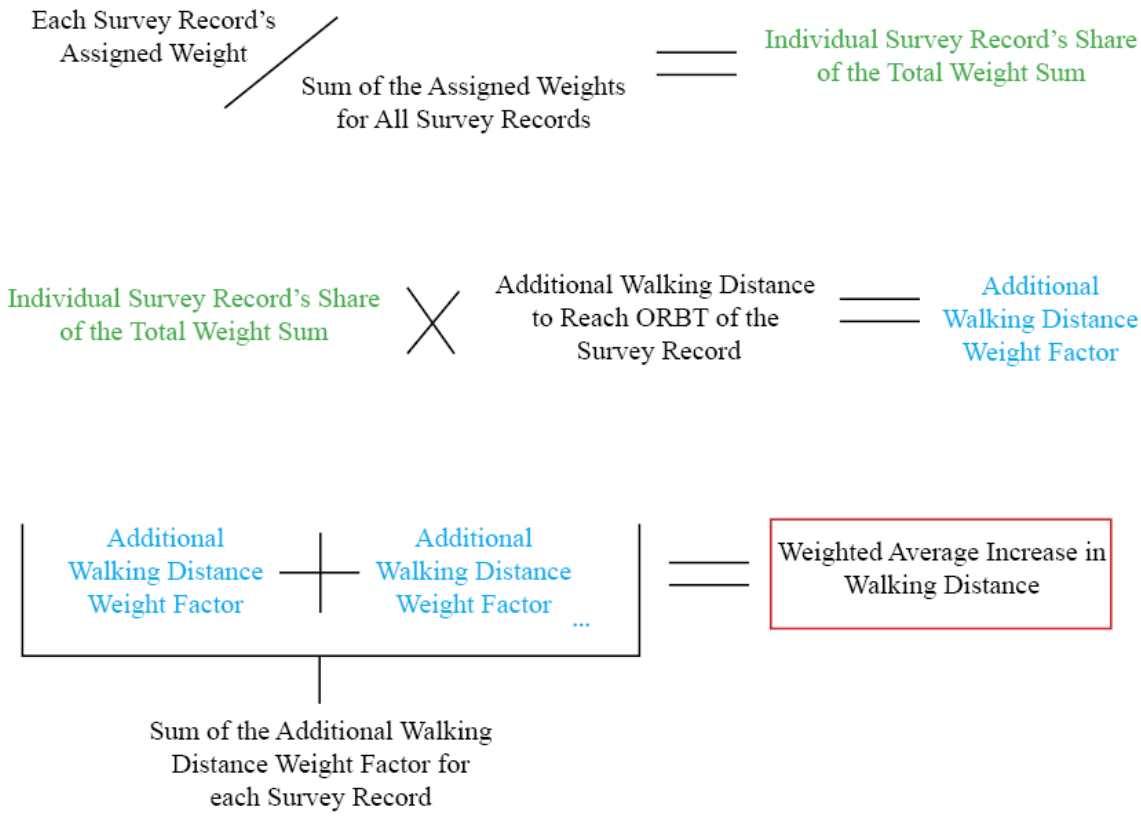


Figure 15: Equation for Determining Weighted Average Increase in Walking Distance. The graphic above depicts the formula used in calculating the weighted average increase in walking distance to reach an ORBT station compared to a former route #2 stop from the respondent's home location. Each line represents a different step in the calculation with like colors used to show the carry over of common variables.

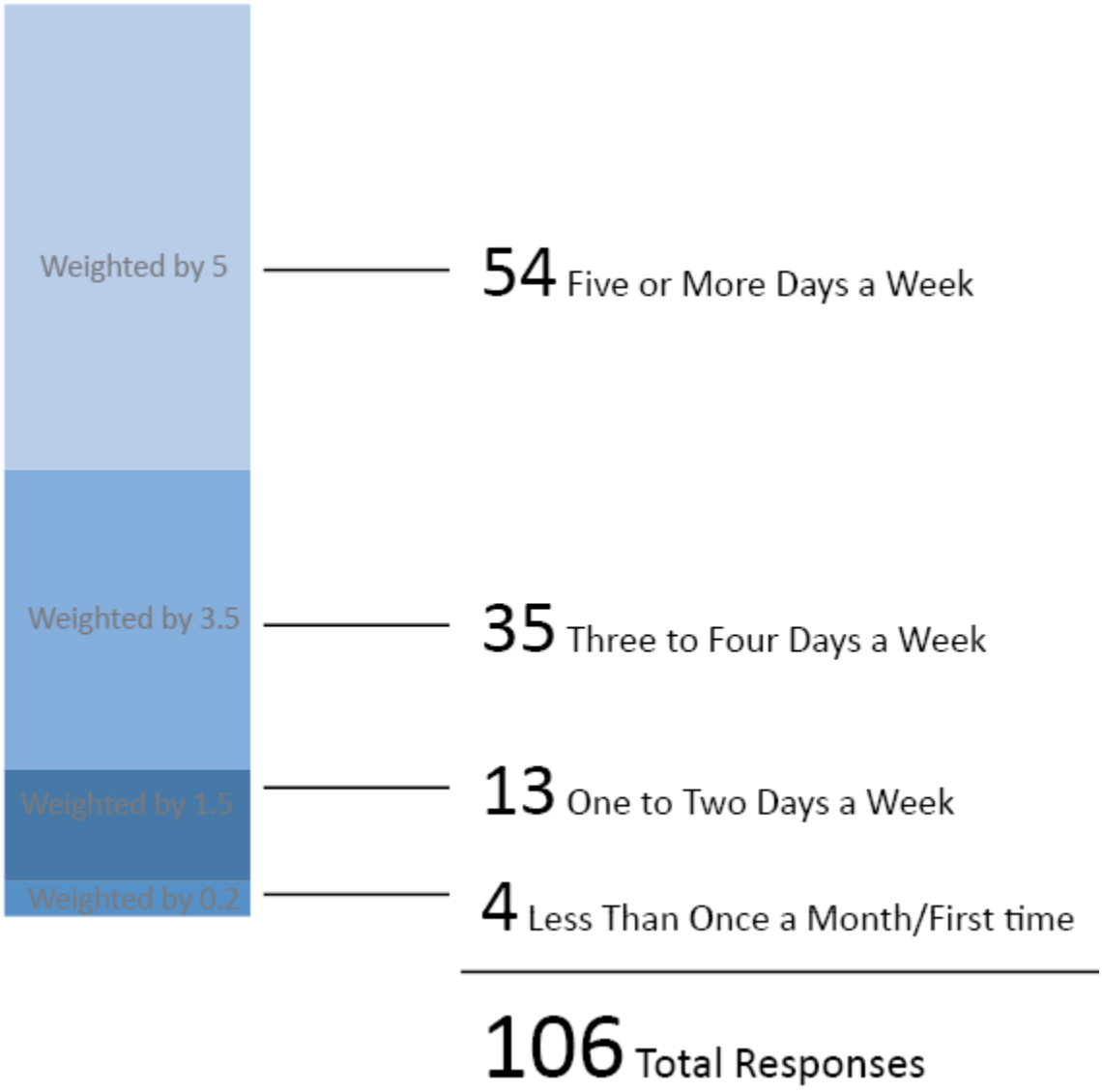


Figure 16: Route #2 On-board Survey Weighting Based on Days per Week Riding Transit. The graph above shows the distribution of survey respondents in how many days per week they reported riding transit. The values in grey show the weighted value assigned to each individual record used in computing the weighted average increase in walk distance to reach a stop/station after the implementation of ORBT.

The first step of this portion of the analysis was to analyze the effects of a person's race/ethnicity on their increase in walking distance required to reach a stop/station. Each race is calculated individually to determine both the weighted and unweighted average additional walking distance required to reach a stop/station the transition to ORBT has caused for each individual race/ethnicity. The composition of each race/ethnicity analyzed is shown in the table below.

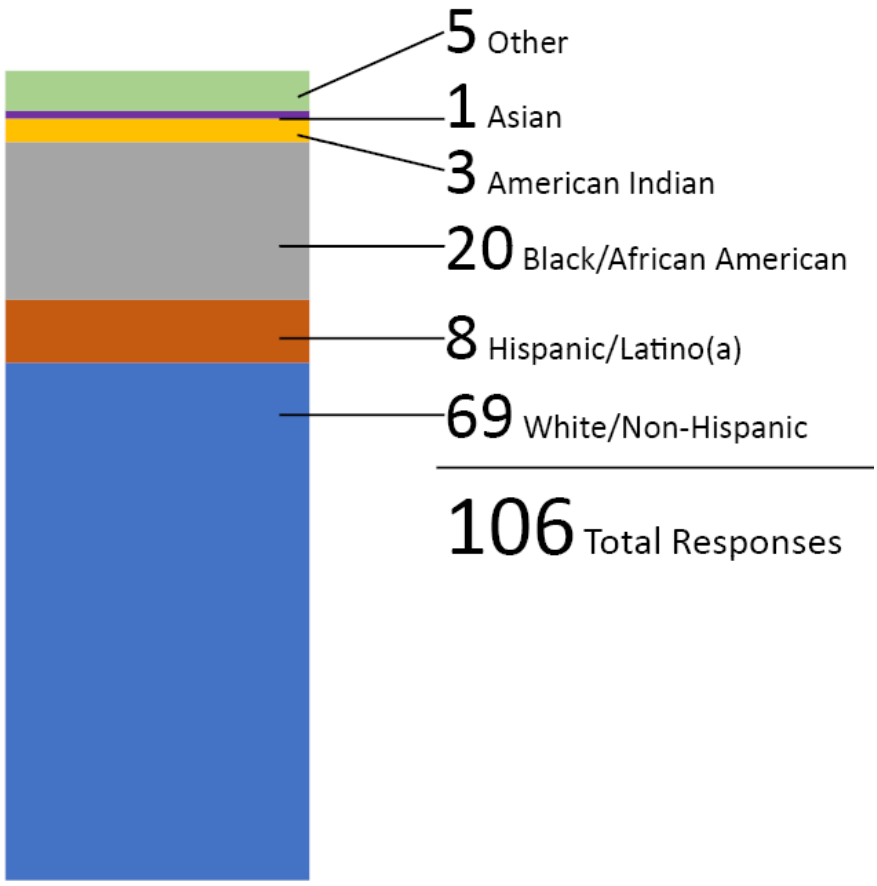


Figure 17: Route #2 On-board Survey Racial/Ethnic Distribution of Respondents. The graph above shows the distribution of respondents' race/ethnicity from the 2017 on-board survey. Each race/ethnicity was calculated separately in determining average weighted increase in walk distance required to reach an ORBT station compared to a former route #2 stop.

The next factor considered when deciding to what extent equity was considered in the planning and implementation of ORBT is the income of riders and their households. This is also in line with criteria to be considered when planning for Title VI. The 2017 on-board survey contained a question in which respondents reported their household income as being within one of six different income categories. The survey also contained a question asking respondents to report how many individuals lived within their household. By having both reported household income and the number of individuals living within the household a respondent's income can be determined based on income per person rather than relying only on household income. This additional level of analysis provides a better representation of a household's income by considering the number of persons in a household that must be provided for by a household's income. By using this method, a four-person household making the same income as a single person household will be considered lower income than the single person household since the household's income must be split between its members.

The U.S. Department of Housing and Urban Development (HUD) publishes yearly limits by county and urban areas for each state. These income levels are used in determining what percentage of the median income for a given area is received by a household based on both the total household income for the household, but also considering how many members within the household the total income must provide for. This method of categorizing household income was used as a standard method in categorizing household incomes to provide a baseline system for analysis. This method of using HUD income levels is similar to that used by Gregory L. Newmark Ph.D. and Peter M. Haas Ph.D. in a report prepared for The California Housing Partnership examining the impact housing in location-efficient neighborhoods had on reducing

total vehicle-miles traveled (VMT) within the study area (Newmark & Peter M. Haas, 2015). Using both the total household income and the number of household members each survey record was assigned a category of HUD's income limits for 2017 for the Omaha-Council Bluffs area where route #2/ ORBT is located. The first chart below shows the 2017 HUD income levels and categories used in this analysis and the second chart shows the breakdown of all survey records used in this analysis and into which income category they were placed. It is important to note that some responded said they preferred not to disclose their personal income and therefore were not considered in this portion of the analysis.

U.S. DEPARTMENT OF HUD 04/11/2017
STATE: NEBRASKA

PROGRAM		1 PERSON	2 PERSON	3 PERSON	4 PERSON	5 PERSON	6 PERSON	7 PERSON	8 PERSON
Omaha-Council Bluffs, NE-IA HUD Metro FMR A									
	30% LIMITS	15750	18000	20250	22500	24300	26100	27900	29700
*All % Values based on median income	50% or Below: VERY LOW INCOME	26250	30000	33750	37500	40500	43500	46500	49500
	60% LIMITS	31500	36000	40500	45000	48600	52200	55800	59400
	80% or Below: LOW INCOME	42000	48000	54000	60000	64800	69600	74400	79200

2017 ADJUSTED HOME INCOME LIMITS

Figure 18: HUD 2017 Income Limits for Omaha-Council Bluffs. The chart above shows the way in which income categories are determined using HUD's criteria for accounting for both household income and the number of persons living in the household. This system was used in categorizing the income of respondents to the 2017 on-board survey in order to provide an analysis examining available income per person rather than only examining household income.

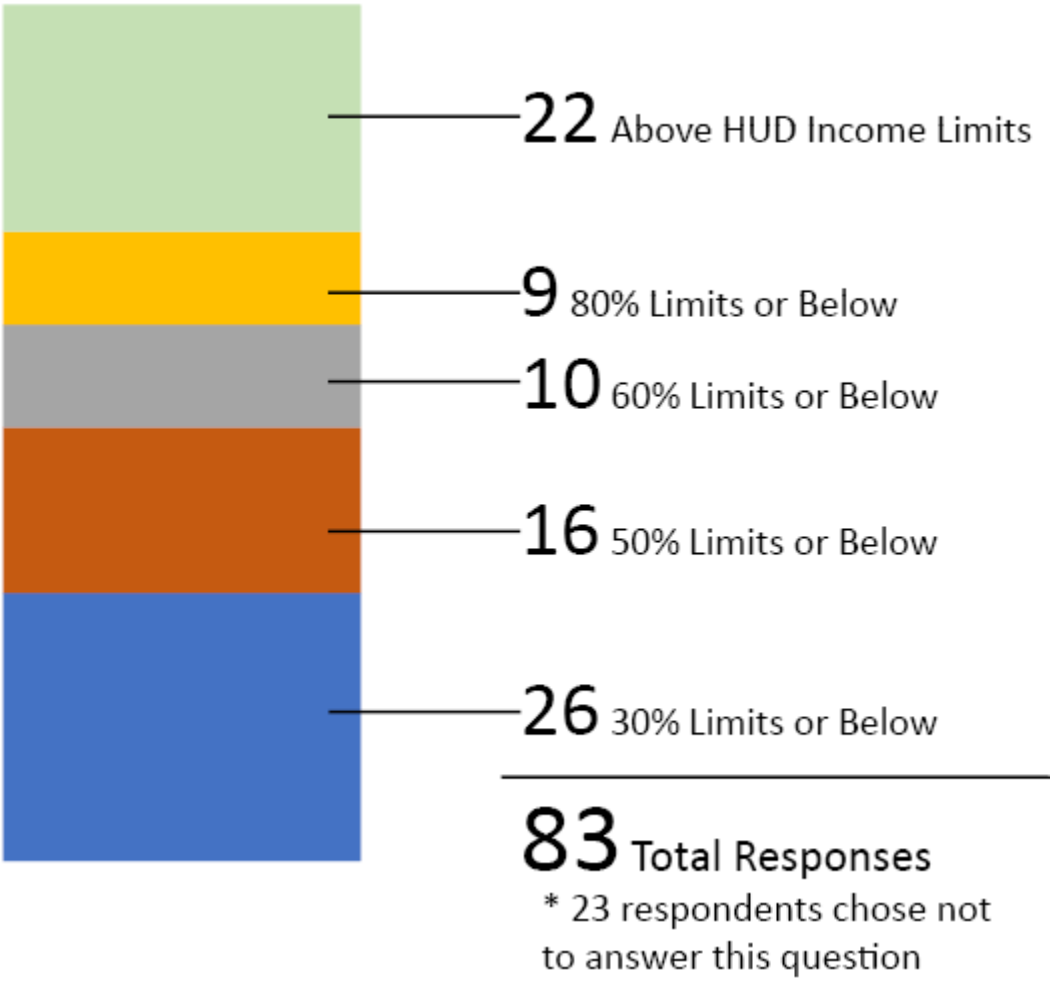


Figure 19: Route #2 On-Board Survey HUD Income Category Distribution of Respondents. The graph above shows the distribution of respondents within the different HUD income categories based on the 2017 on-board survey. Respondents within each income category were calculated separately in determining their weighted average increase in additional walking distance to reach an ORBT station compared to a former route #2 stop.

Using the 2017 on-board survey data the respondent's age was also analyzed to show the effect of the respondent's age on their increase in walking distance required to reach a stop/station. The respondent's age was also collected in the 2017 on-board survey in which respondents were

asked to place themselves in six different age categories. Like the analysis done for both household income level and race, the average weighted and unweighted additional distance in kilometers required to walk to a stop/station was computed separately for those 65 and over from those who recorded themselves as being 64 and under. By performing these analyses separately, it can be determined the impact of ORBT on these different demographics. The chart below shows what portion of the total survey respondents identified themselves as being from each age group during the 2017 survey.

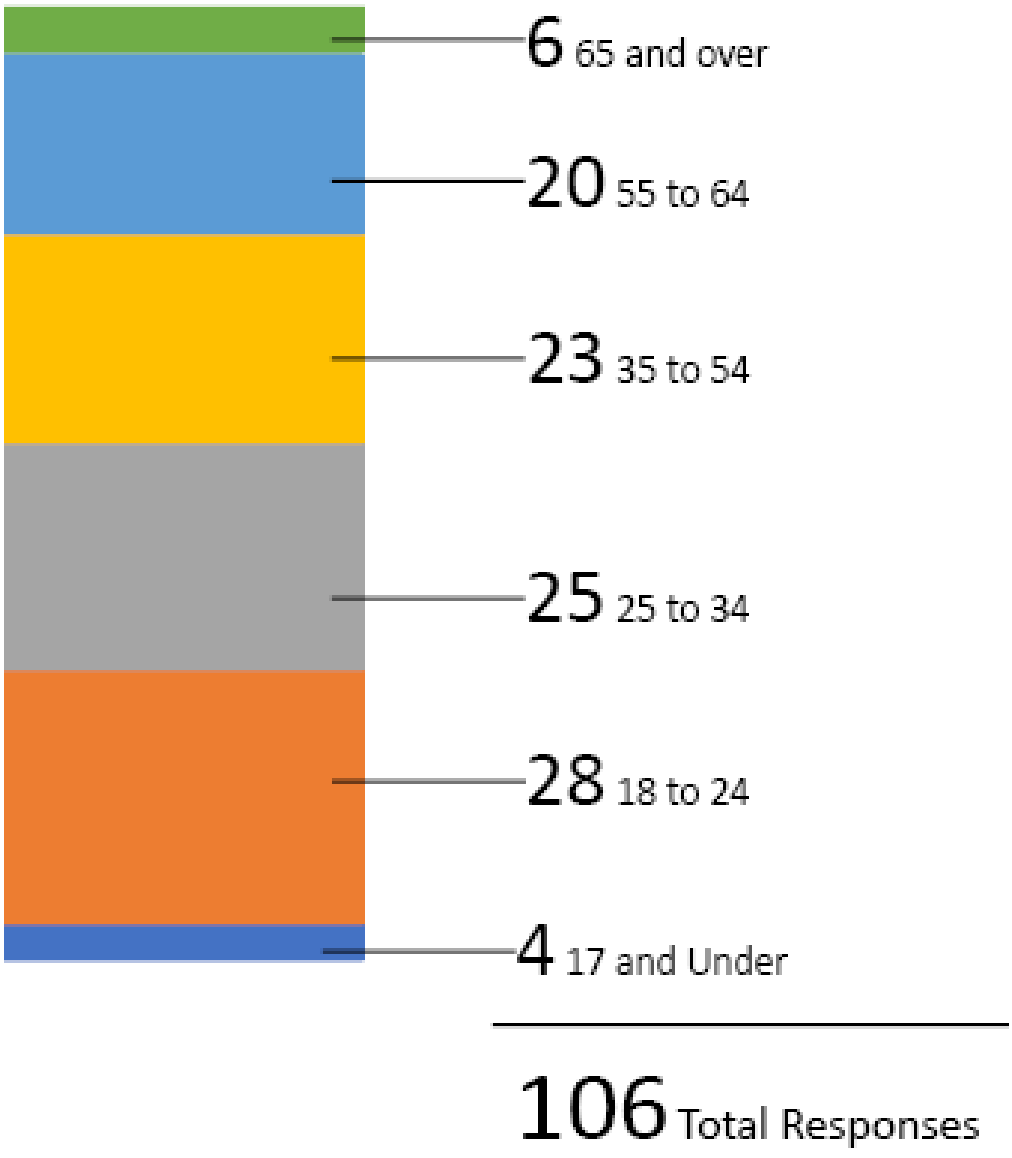


Figure 20: Route #2 On-Board Survey Age Category Distribution of Respondents. The graph above shows the distribution of respondent's age based on the 2017 survey. To determine the effect that the implementation of ORBT has had on those over 65 years of age, this category was calculated separately from the remaining age categories in determining the weighted average increase in walk distance required to reach a stop/station.

The same process was used in examining the effects of having access to a vehicle on a respondent's increase in walk distance required to reach a stop/station. This data was also collected from the 2017 survey and asked respondents whether they had a vehicle that could be used for their trip. The table below shows the total number of home locations who reported having either access or no access to a vehicle.

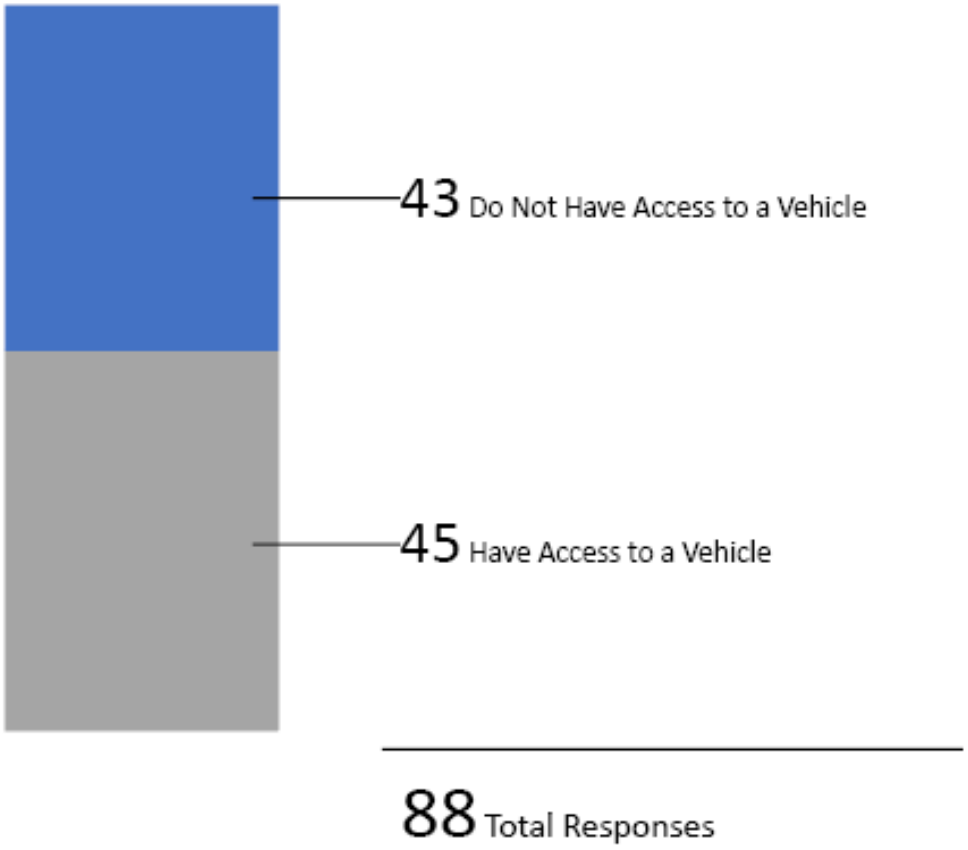


Figure 21: Route #2 On-Board Survey Vehicle Access Distribution of Respondents. The graph above shows the distribution of survey respondents based on their ability to access a vehicle. Those with and without access to a vehicle were calculated separately in determining the weighted average increase in walk distance to reach a stop/station.

After isolating the survey responses of each race and computing both the average and weighted average increase in walking distance for each race/ethnicity it can be seen that all persons of color have a lower increase in their walk distance than those who reported themselves as being White/Caucasian. Those who responded as Black/African American had a weighted average additional walk distance that was shorter than that of all respondents as a whole while those who responded as Hispanic/Latino(a) had a weighted average additional walk distance that was slightly higher than the weighted average of all respondents, but less than those who responded as White/Caucasian. This is shown in the table below with each race/ethnicity in both the weighted and non-weighted average additional walk distance to reach a transit stop/station.

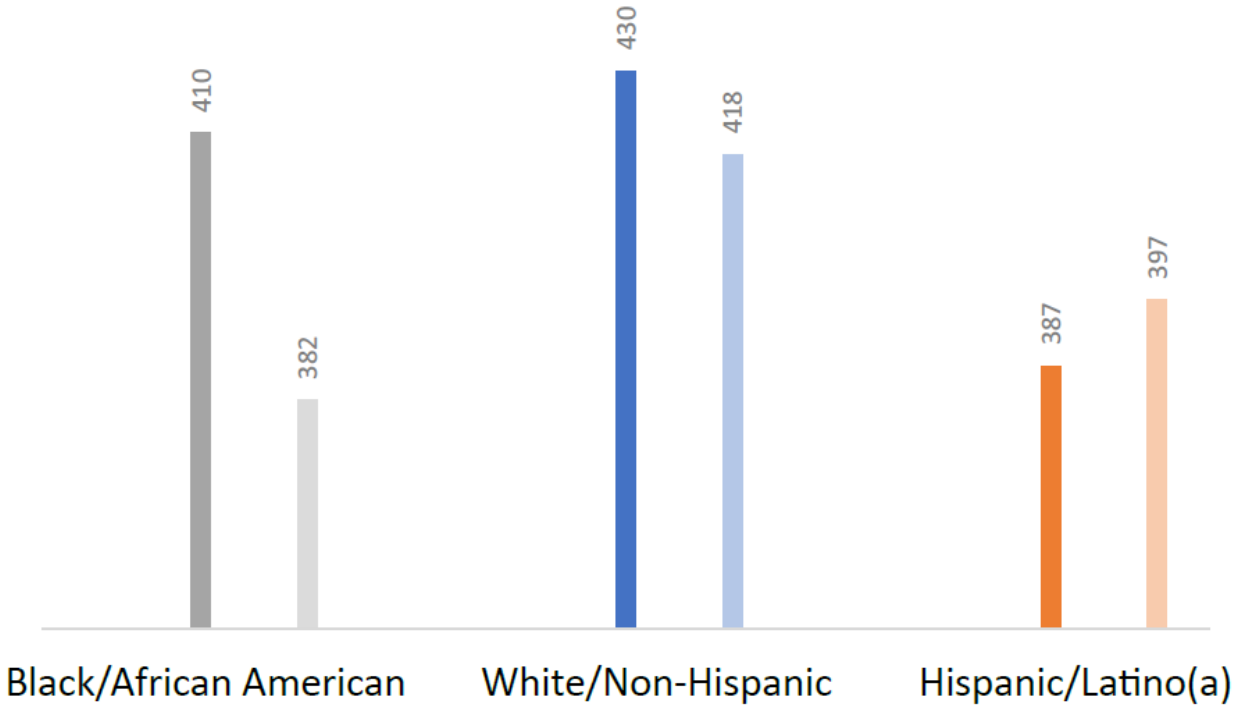


Figure 22: Average Increase in Walk Distance to a Station/Stop by Race/Ethnicity. The chart above shows the average increase (in feet) in distance that is required to be walked to a stop/station by race/ethnicity based on riders' home locations gathered in the 2017 on board survey. The lightly shaded columns show the average increase in walk distance when each survey record is weighted by the number of times the respondent reported using transit throughout the week.

In looking at the respondents' household income level and both their weighted and unweighted average increase in walk distance to reach a stop/station, generally households making 50-79 percent of median income in 2017 fared the best with the lowest average additional walk

distance. Their average additional walk distance, both weighted and non-weighted, was also less than the average for all survey respondents. Households making less than 50 percent median income in 2017 or more than 80 percent of median income in 2017 both had the highest average increase in their walk distance to a stop/station, and both were above the average additonal walk distance for all survey respondents as seen in the chart below. These outcomes are concerning for deciding if they are equitable since those with the lowest percentage of median income had a higher increase in the distance to access a stop/station than those making over 50 to 79 percent of income and only slightly less than those making over 80 percent of median income. This outcome suggests that those with the lowest income are bearing a higher share of the burdens in the longer walks to access ORBT compared to route #2.

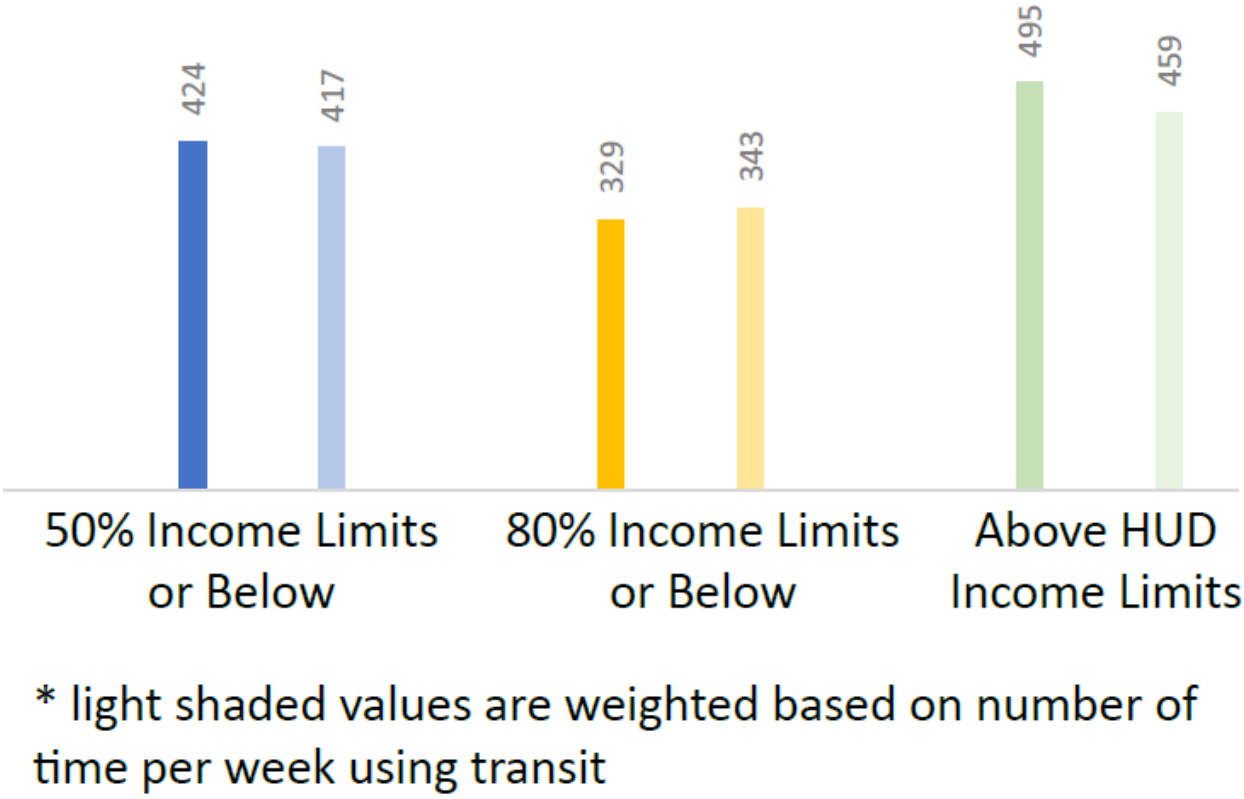


Figure 23: Average Increase in Distance to a Stop/Station by HUD Income Category. The chart above shows the average increase (in feet) in walking distance to reach an ORBT station compared to a route #2 stop computed separately for income levels categorized by the 2017 HUD income limits. The average additional walking distance was calculated using the home location of respondents to the 2017 on-board survey. The lightly shaded columns show the average increase in walk distance when each survey record is weighted by the number of times the respondent reported using transit throughout the week.

Those 65 and over experienced a lower average increase in the distance required to walk to a stop/station compared to those under 65. Those under 65 experienced an average increase in their walk to access transit that was only slightly longer than that of all survey respondents considered.

This is a positive and equitable outcome since those over 65, who would most benefit from shorter walk distances, saw the average shorter increase in their walk. It is interesting the 25 to 54 age group saw the largest gain walking distnace to reach a stop/station. While this poses an area for additional research beyond the goals of this report, this is likely due to middle age respondents being more likey to live in a spread out neighborhood area, whereas younger and older generations are likley to live in dense apartment style housing near major boarding/alighting points.

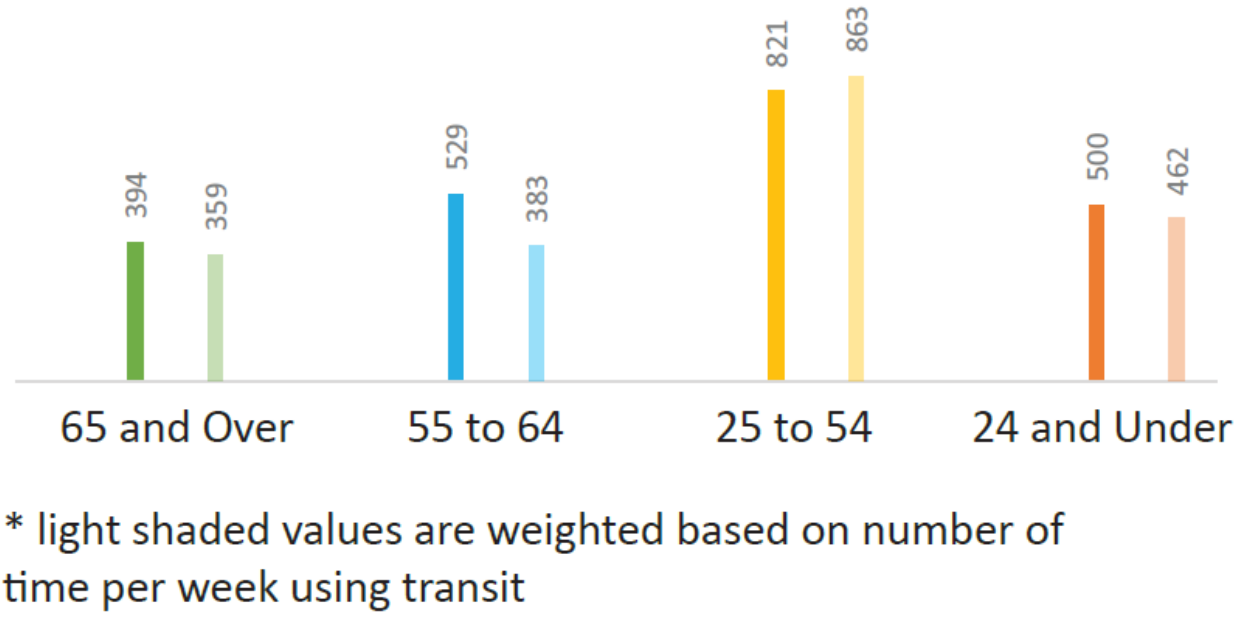


Figure 24: Average Increase in Distance to Reach a Stop/Station by Age Group. The chart above shows the average increase (in feet) in walking distance to reach a stop/station after the implementation of ORBT. The average increase was calculated using the home locations of respondents to the 2017 on-board survey. The average increase was calculated separately for different age categories of survey respondents to show the effects of ORBT's implementation on these groups. The lightly shaded columns show the average increase in walk distance when each

survey record is weighted by the number of times the respondent reported using transit throughout the week.

Lastly, the effect of a person's access to a vehicle was computed. This data was also collected from the 2017 survey and asked respondents whether they had a vehicle that could be used for their trip. The table below shows the total number of home locations who reported having either access or no access to a vehicle. This portion of the analysis plays an important role in deciding if ORBT was planned and implemented in an equitable manner since those without access to a vehicle are both more likely to benefit from shorter distances to access transit and more likely to be burdened by longer distances than those who have access to a vehicle to make their trip. It is promising that of the home loactions included in the analysis, those without access to a vehicle saw a significantly lower increase in their distance to walk to accesss a stop/station. As shown in the chart below when weighted by how many times a week a person utilized transit, those without access to a vehicle saw a 37.5 percent lower increase in walking distance compared to those with access to a vehcile.

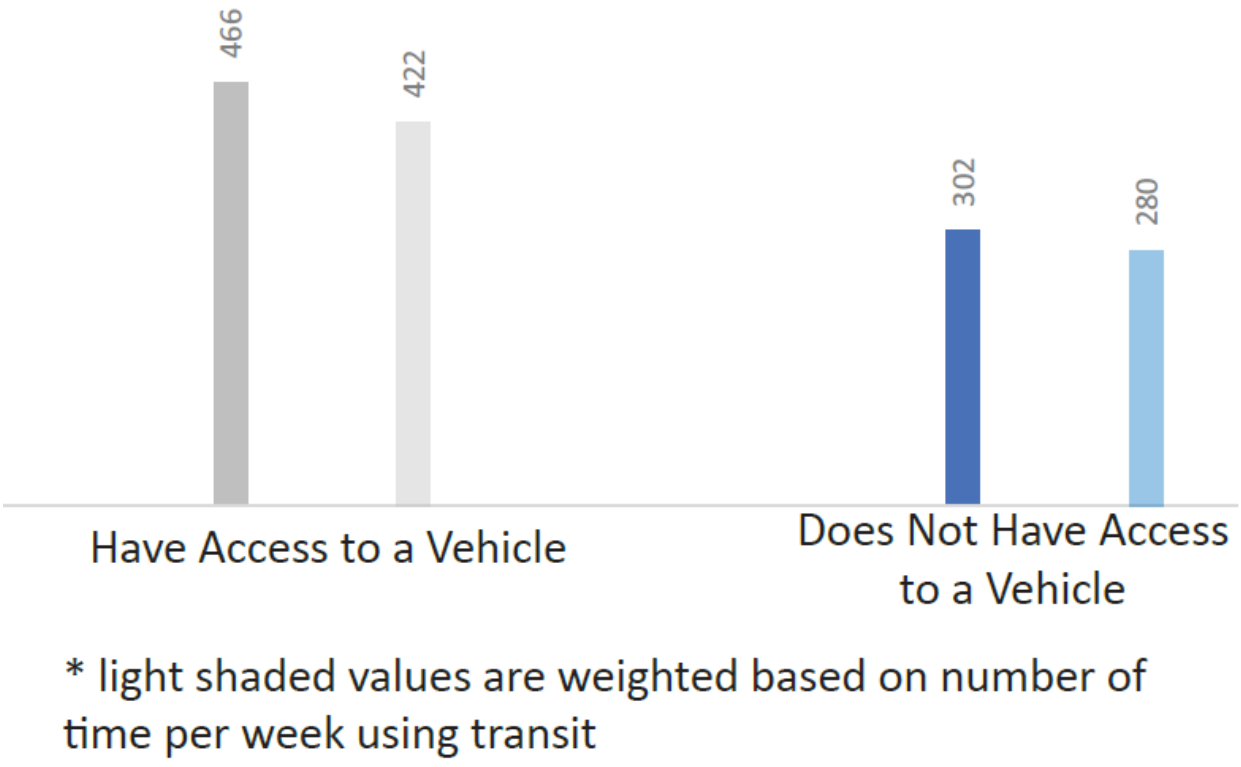


Figure 25: Increase in Walking Distance to a Stop/Station by Vehicle Access. The chart above shows the average increase (in feet) in walking distance required to reach a stop/station after the implementation of OBRT. The average increase in walking distance was calculated separately for those who have access to a vehicle and those who do not to show how the change from route #2 to ORBT has affected each individual group. The lightly shaded columns show the average increase in walk distance when each survey record is weighted by the number of times the respondent reported using transit throughout their week.

Limitations in Using Survey Data

While the 2017 on-board survey poses great opportunities and resources for visualizing the effects ORBT has had on those living in the corridor and in showing the distribution of benefits and burdens, it does however pose limitations. As previously discussed, the most major limitation being those who did not want to disclose their full home address leading to the provided approximate home address or boarding/alighting locations being used in several cases rather than a verified home address location. While this was not ideal for the analysis of showing the distribution of ORBT's burdens and benefits, it does still give an original location and walk distance required to reach a stop/station. Therefore, the walking distance from the approximate home location to reach an ORBT station can be determined and observed how the additional distance to be walked has been distributed to key demographics. There are also other unknown variables that must be considered when using the on-board survey data, mainly in if the data was collected in a way that gave each rider an equal chance of being included in the survey and how the geographic distribution of survey respondents is represented compared to that of the actual ridership.

The map below compares the geographic distribution of 2017 survey respondents living near route #2 to the overall distribution of boarding and alighting of riders counted in February of 2020 based on which section of the route the rider boarded and alighted. The highest percentage of survey responses in 2017of those living near route #2 came from those boarding and alighting in the eastern half of route #2. While the geographic distribution of survey respondents boarding and alighting in each section is like the geographic distribution of those living near route #2, it does raise the concern of the survey records being reflective of the overall ridership on route.

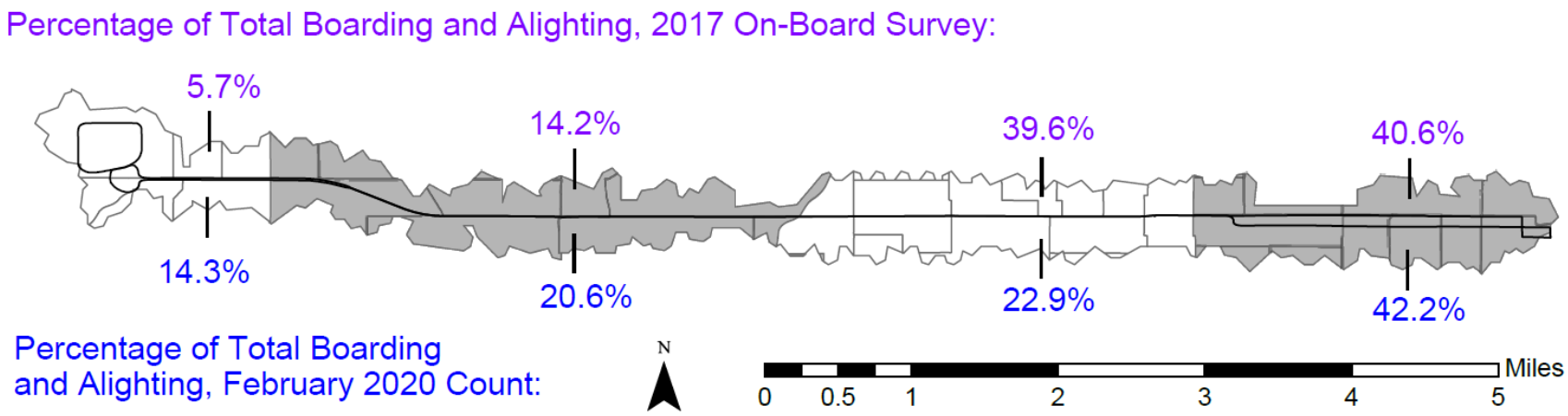


Figure 26: Route #2 Observed Boarding/Alighting Versus to Route #2 Survey Respondent. The map above shows the route #2 service area. The values above the service area represent for each section the percentage of total boarding and alighting for the entire route that occurred in each section based on counts from February 2020. The values below the service area represent the percentage of the total boarding and alighting that occurred in that section based on the home locations in the 2017 on-board survey.

Weighting the Route #2 Survey Data by Boarding and Alighting

As a further level of analysis, the route #2 survey records were also weighted proportionately to the percentage of boarding and alighting that took place in each of the four sections shown in the map above. A single weight was determined for each of the four sections by taking the percentage of boarding and alighting in each section divided by the number of home location survey records that would have boarded and alighted in each section. For example, if a section of the route received 25 percent of the total boarding and alighting, and there were 2 survey records which boarded and alighted in that same section, each record would receive a weight of 12.5. To weight the records by both the number of days per week a respondent used transit and by the boarding and alighting in each section, the two separate weights were multiplied together.

When weighting by both the number of days per week the respondent used transit and by the boarding and alighting of the survey home location records for the separate races, income levels, and access to a vehicle the findings were similar to when weighing only by the number of days a respondent used transit. In most cases the additional walk distance to reach a stop/station was about 0.01 to 0.02 mile or 53 to 106 feet less when weighting by both factors compared to only the number of days a respondent reported using transit. The largest difference occurred in adults 55 and over and those 24 and under with 90% percentage difference when adding weights by boarding and alighting. The additional walk distance for each respondent in these age groups decreased by 0.04 to 0.05 miles or 211 to 264 feet, when weighting by both factors instead of only the number of days someone used transit. These findings are shown in the table below.

	Weighted By Days per Week Using Transit	Weighted by Days per Week and ORBT BnA	Percentage Difference
RACE/ETHNICITY			
Black	382	245	44%
White/Caucasian	418	349	18%
Hispanic	397	340	15%
Age GROUP			
65 AND OVER:	359	191	61%
55 to 64	383	145	90%
25 to 54	863	475	58%
24 and under	462	215	73%
HUD INCOME CATEGORY			
50% MED. INCOME OR BELOW:	417	348	18%
80% MED. INCOME OR BELOW:	343	304	12%
ABOVE 80% MED. INCOME:	459	404	13%
VEHICLE ACCESS			
HAVE ACCESS TO A CAR:	422	341	21%
HAVE NO ACCESS TO A CAR:	280	212	28%

Figure 27: Increase in Walking Distance to a Stop/Station Using Both Methods of Weighting and Percentage Difference. The table above shows a comparison of the calculated additional walking distance (in feet) to reach a stop/station using different methods of weighting. The far-left column shows values that have been weighted by the number of days per week the respondent reported using public transit. The middle column shows values weighted by both the number of days per week the respondent reported using transit and by the share of boarding and alighting within the zone of the stop nearest the respondent's home location. The far-right column shows the percentage difference between the added walk distance using both methods of weighting.

These findings suggest that the additional walking distance to reach an ORBT station compared to the original route #2 stops may actually be slightly less when considering observed boarding

and alighting distribution. This is especially true when considering different age groups as all four of the age groups had a large percentage difference in adding weight by boarding and alighting compared to the other factors that were examined. However, it is important to consider that survey records used are only for those living near route #2, whereas the observed boarding and alighting counts are reflective of all trips made using route #2 regardless of the riders' home locations.

Discussion of Results and Findings

The implementation of ORBT in place of the former local service route #2 brought with it improvements in the level of service due to both the implementation of BRT style vehicles and stations and also a reduced total travel time along the route largely due to the reduction in total stops/stations placed along the route. As stated in the literature review this brings with it a higher quality of service for the rider and also poses transit as a more competitive alternative to driving personal vehicles. However, literature on stop consolidation stresses the importance of balancing transit system operating efficiency with the accessibility of a route's stops/stations to its current riders. Riders' level of access to stops/stations is also important for the consideration of equity which seeks to base the distribution of burdens and benefits on giving more to those with the most need and to historically vulnerable or underserved groups. Regarding ORBT, the assumption is made that all riders receive the main benefits of the higher quality of service and the shorter travel time spent on the bus with the main burden being how the riders' accessibility to a stop/station is affected.

By first examining the service area of both ORBT and route #2 it raises some concern that the service area of ORBT is not continuous throughout the full corridor as that of route #2. However, it is a positive for equity that the percentage makeup of low income and minority populations within the service area of ORBT saw an increase from that of route #2. When reducing the service area about 6,750 fewer persons are now within a quarter mile walking distance of an ORBT station out of the about 18,000 persons who were within a quarter mile walking distance of a route #2 station. However, the increase in percentage share of both low income and minority groups in the service areas suggests that the inclusion of more low income and minority

households were maintained in the creation of the new service area compared to other households which holds true to the ideals of equity discussed in the literature of limiting adverse effects to vulnerable and historically underserved groups.

The findings in the previous paragraph only exam potential transit users living near the route and not observed transit users already utilizing the route. This was examined using on board passenger survey data to determine the likely distribution of the burden of additional walking distance incurred in reaching a station/stop after the implementation of ORBT and the reduction in total stops. Using GIS to determine the additional walking distance incurred by riders of different race/ethnicities, it was found that the additional walking distance to a stop/station was similar for White/Caucasian, Black, and Hispanic with all three being within 50 feet of each other and White/Caucasian seeing the largest increase in walking distance. There is a little more variance in household income of transit riders regarding additional walking distance to reach a stop/station. All three household income levels considered were within 120 feet of each other in additional walking distance with respondents from households earning 51 to 80 percent of HUD's income limits receiving the lowest overall increase in walking distance, and all households below HUD's income limits having less additional walking distance on average than those above the limits. The age of the respondent had the largest difference in additional walk distance to reach a stop/station with there being as much as a 500 foot difference between the age groups considered. It is promising though for equity that those 65 and older had the lowest additional walk distance added compared to other age groups.

While the examinations of ORBT's effects on race/ethnicities, aging populations, and differing income levels all point to an overall even distribution of burdens, this distribution points to the ideals of equality rather than those of equity. In looking back to the literature review portion of this report, many in transportation planning have begun to define equity as giving additional options to those who have historically been underserved by transportation planning while minimizing adverse effects. Therefore, the near equal distribution of benefits and burdens of ORBT regarding race/ethnicity, income, and age show a level of fairness is maintained, but does not exhibit the full ideals of equity in distributing benefits based on improving conditions for previously underserved communities. However, it is promising that those without access to a vehicle living near the corridor received slightly less of the burden of additional walking distance to reach a stop/station compared to those with access to a vehicle. Those without access to a vehicle saw on average 140 feet less added to their walk to access a stop/station than those with access to a vehicle. While access to a vehicle is not one of the primary factors considered in the legal guidance for transportation equity, it is a positive that those without access to a vehicle experience on average the shorter increase in walking distance as they do not have the option to use a vehicle for their trip.

It is evident through the documentation produced early in the planning process of ORBT that pointed to there being no adverse effects to minority or vulnerable communities only based on their geographical proximity to the corridor, that only minimal analysis was done concerning equity and the distribution of benefits and burdens. While the findings do not point to a large adverse effect for any minority or vulnerable community, it also does not point to a meaningful benefit compared to that of the general population living near in the corridor and relying on

transit. These findings based solely on data available to planners and decision makers during ORBT's planning and implementation point to a need for a much further evaluation to have been done in the consideration of equity to decide that it was equitable. These outcomes also point to the need for stronger policies and regulation that not just require equity to be considered in transportation planning but set meaningful methods of evaluation and standards for what is considered equitable.

Conclusion

The outcomes of ORBT point to a system of equal distribution of burdens and benefits for those living within the corridor rather than one that considered the actual individuals within the corridor most likely to utilize public transit and their needs. To have truly considered the equity of transit users, data such as ridership demographics, boarding/alighting counts, and origin/destination surveys should have been considered to predict how the implementation of ORBT would affect those who utilize transit and how their commutes would be affected. While the implementation of ORBT seems to have had an overall positive impact, it failed to adequately consider equity in a way that worked to improve conditions for most vulnerable groups and did not utilize the full amount of data available to planners. Rather than fully considering equity, the planners of ORBT seem to have only examined avoiding adverse effects based on physical proximity of vulnerable groups to the project site.

The need to better consider equity in transportation planning extends beyond just Omaha and ORBT. The analysis used in this report can be replicated to evaluate a variety of proposed changes to existing public transit systems regarding either a change in service type or plans which incorporate stop consolidation within an existing route. When evaluating a proposed change, such as the transition from route #2 to ORBT, it is simply not enough to only base an equity analysis on avoiding adverse impacts to populations surrounding the site. Potential transit users' level of access and how it will be impacted for different demographic groups must be considered.

An examination of how transit users' access to a stop/station will be affected and its impact on the equity of a proposed decision should be carried out in two parts: first by examining the impact of the change on the service area and all potential riders of a system, and second by using ridership surveys with ridership demographic data to determine the likely effect the change will have on riders within the corridor already utilizing transit. The service area of both the current system and that of any proposed change must be determined using an approach that accounts for streets and sidewalks that would be used to access a stop/station rather than a simple quarter mile buffer of the route or stop location that does not account for how someone is able to travel to the stop/station. Once the service area is determined for both a current and proposed case, the service area must be overlayed with demographic data within the service area to identify any changes in the demographic makeup of both the current and new service area that would point to a change in potential riders who have access to the route.

After examining the likely impacts a change in service or reduction in total stops/station will have on a service area and its demographic makeup, ridership data and on board surveys must be utilized to determine the likely effect the change will have on riders already utilizing the service. This must be performed by examining the home locations of riders near the corridor utilizing the current transit route and the level of access they have to both the current stop/station locations and where a future stop/station is proposed using a network analysis that accounts for actual distance traveled on a road or sidewalk to reach a stop/station. By using ridership surveys to both identify the home locations and demographics of individual riders near the corridor and their physical change in access to stops/stations it is possible to sort surveys to determine the change in access for various demographic groups (such as age, race/ethnicity, household income, and

access to a vehicle). By determining the likely distribution of benefits and burdens regarding access to the route a proposed change will have on existing riders within differing demographic groups, planners should considerer if the proposed change in service is equitable in its distribution of likely burdens and benefits and if stop consolidation or other changes to improve system efficiency can be done without adverse effects to reach the transit route.

The outcomes of ORBT and this analysis that embody equal distribution of burdens and benefits rather than equitable, point to why transportation equity must be more defined and focused in the planning and implementation of transportation systems. While systems like ORBT that received federal funding have arguably brought many benefits to the corridor with an overall even distribution of burdens, it has not fully fulfilled the idea of transportation equity in providing additional resources and options to communities which have historically had less. For equity to be achieved in transportation planning, standards for receiving federal funding must include having an analysis that considers the users of the transportation system and their needs rather than only the demographics of a surrounding area. These new standards for receiving federal funding must incorporate methods, such as in this report, of using available data to predict the likely distribution of benefits and burdens to vulnerable or historically underserved groups to then make the determination if a proposed plan will have equitable outcomes. This also highlights the need at both the local and federal level to create a more robust definition of transportation equity and how it will be accounted for in the planning of transportation systems, and a need for stronger policies that define standards for examining equity in proposed transportation plans to hold planners and decision makers accountable to considering equity in a meaningful way. Without a robust definition and strategy for how equity is to be accounted for,

even when required for federal funding as required for ORBT, a minimal or surface level only analysis is passable. Finally, if equity is to be incorporated in planning and in the administration of federal funds, clear expectations and process are needed otherwise equity becomes easily overlooked.

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