Northstar Rail Corridor Post-Pandemic Study

Appendix D: Evaluation Methods Technical Report

FINAL

Metropolitan Council

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Evaluation Methods Technical Report

Introduction

This technical report documents the methods undertaken to evaluate six proposed transit service scenarios and produce the stated results included in the Northstar Rail Corridor Study main report. Evaluation criteria are organized into five categories as follows:

- Ridership Estimates
- Community Development
- Environmental Sustainability
- Financial Performance
- Accessibility and Equity

The Accessibility and Equity section also includes detailed maps and results that build on the information included in the study's main report. Detailed results for all other criteria are available in the main report.

Ridership Estimates

Ridership metrics (detailed in Table 1) were estimated for each transit service scenario for comparison. Care has been taken to evaluate the three separate modes in a way that enables fair comparisons. Future studies of a project-specific mode would likely augment this study's methodology to better accommodate individual project characteristics. Results included below should primarily be considered for relative comparisons between scenarios rather than as official forecasts.

Table 1: Ridership evaluation criteria, metrics, and data sources

EVALUATION CRITERIA	METRICS	DATA SOURCE(S)
Weekday Ridership	Estimated average weekday ridership (excluding special event service); 2019 and 2022 base years; 2040 reported as a range	STOPS model
Annual Ridership	Estimated total annual ridership (including special event service); 2019 and 2022 base years	STOPS model; historical special event ridership data
Productivity	Passengers per in-service hour (weekday); 2019 and 2022 base years	STOPS model; service scenarios
Travel Time	Ratio of transit to auto travel time (average across all stations)	Service scenario schedules; StreetLight auto travel time data

Transit forecasting practice around the country has not fully recalibrated to a pandemic era reality. Current guidance from the Federal Transit Administration (FTA) for Capital Investment Grant applicants is to continue to use a pre-pandemic baseline. In the spirit of this study as a pandemic era investigation, methods applied here deviate from earlier regional study methodologies and include ridership estimates using both 2019 and 2022 baselines. Results presented in subsequent sections will be denoted as "2019 Baseline" and "2022 Baseline."

Methods

Apart from travel time, each ridership measure is based on the results of weekday ridership forecasts. The following sections describe methods unique to each measure.

Travel Time

Travel time is used as a supplementary measure to ridership forecasts in assessing service performance. While ridership forecasts incorporate the broader transit network and associated travel times, this metric specifically targets Northstar corridor service scenarios as defined for this study. The metric presented below is a travel time index defined as the ratio of transit travel time to auto travel time. Individual ratios of travel time from each station to Marquette Avenue and 5th Street were averaged to produce the final metric for the entire corridor route.

Rail travel times are consistent with existing Northstar travel times for the commuter rail scenarios; the travel time from St. Cloud (existing Amtrak station) to Target Field Station for the Extend Rail scenarios comes from MnDOT's Northstar Commuter Rail Extension Feasibility Assessment (2020). For all rail scenarios, the travel time analysis includes the time required to travel between Target Field Station and Nicollet Mall Station (located at Marquette Avenue and 5th Street). Bus travel times are consistent with service plans developed for ridership forecasting purposes and have been estimated using a combination of existing express bus travel times and auto travel time.

Auto travel times were extracted using StreetLight data from October 2019. StreetLight uses GPS ping data to estimate traffic volumes and speeds. The data can be selected for user-defined origin and destination zones and disaggregated by time of day. The data used for this analysis uses zones defined as 1-mile buffers of station areas and is from the weekday 6:00 am to 9:00 am peak commute period.

Weekday Ridership Forecasts

The Federal Transit Administration's (FTA) Simplified Trips on Project Software (STOPS) model has been used as the primary tool for ridership estimation. STOPS is a nationally calibrated ridership forecasting model that can be tailored to specific regions using publicly available data. The Met Council has invested in the development of a regional STOPS model making it the locally preferred ridership forecasting software for the Twin Cities metro area.

A significant amount of local data have been applied to STOPS for the purposes of this study including: the 2016 Travel Behavior Inventory (TBI) Onboard Survey conducted by the Met

Council, local population and employment forecasts (published by Met Council), local park-and-ride locations, transit ridership counts at the stop and route level, and transit schedule data in Generalized Transit Feed Specification (GTFS) format.

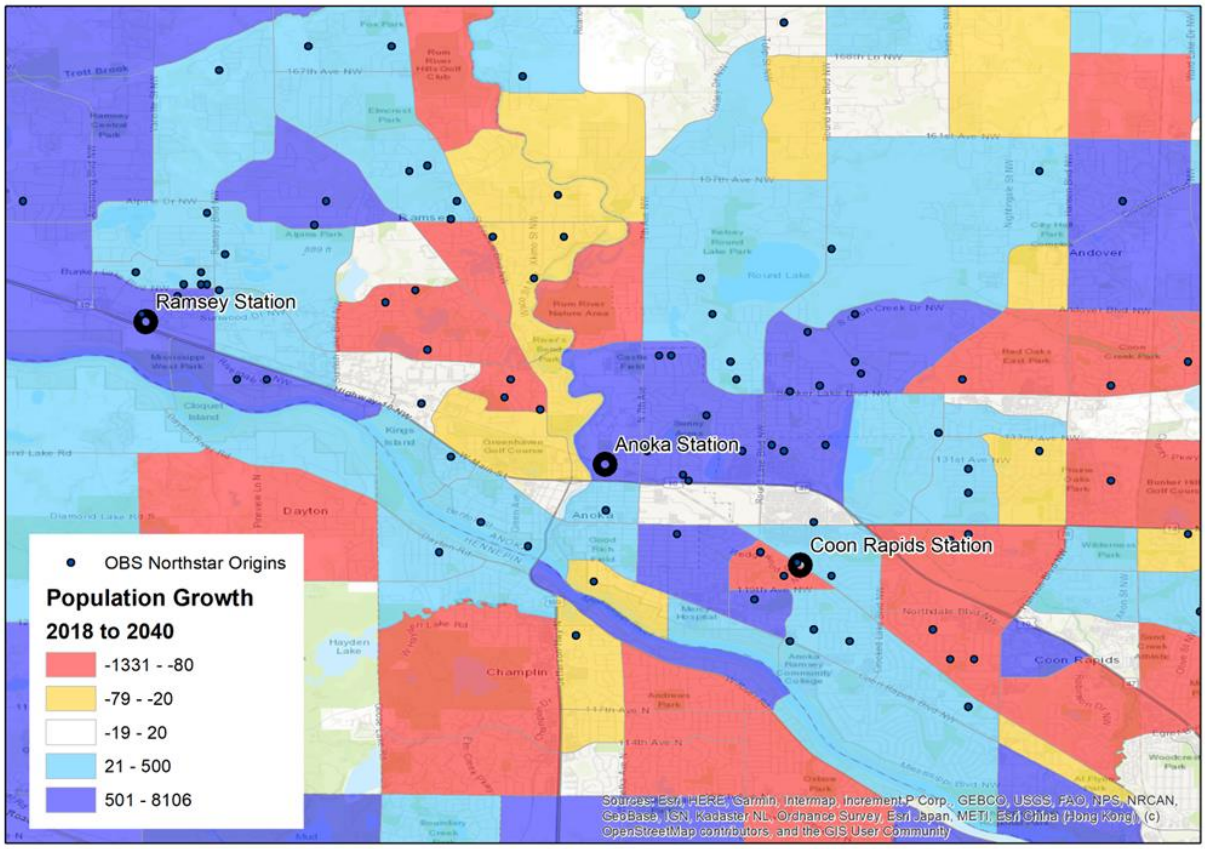
2016 TBI Onboard Survey

The 2016 Travel Behavior Inventory (TBI) Onboard Survey serves as the basis for determining system ridership by trip purpose and rider origins and destinations in the STOPS ridership model. Not having a more recent data source is a limitation of this analysis given that changes in travel behavior have occurred since 2016. In an effort to correct for this, the onboard survey has been scaled to 2019 route counts for the 2019 base year model and 2022 route counts for the 2022 base year model. Both scaling procedures result in a reduction in overall transit demand as ridership had fallen from 2016 to 2019 and then dropped off more severely between 2019 and 2022 due to COVID-19. There were 328,642 total system boardings on an average weekday in fall 2019 versus 127,972 in April 2022.

Local Population and Employment Forecasts

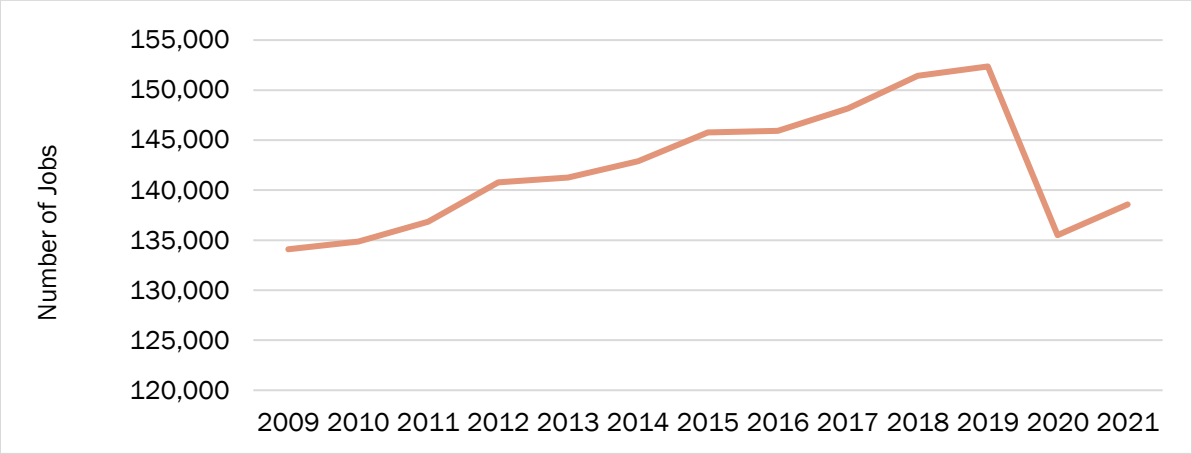
The Met Council publishes population and employment data at the transportation analysis zone (TAZ) level for the Twin Cities region. These data take into account regional forecasts and local communities' development plans. Similarly, the St. Cloud Area Planning Organization (APO) is in the process of developing population and employment forecasts. A draft version of the St. Cloud APO data have been used in this study. Figure 1 shows population growth forecasts near the Northstar corridor along with 2016 onboard survey Northstar passenger origin locations. The map shows that growth in population from 2018 to 2040 is mixed with decline near the corridor area.

Figure 1. Population growth forecasts near select Northstar stations



The population and employment forecasts used for this project were generated prior to the onset of the Covid-19 pandemic and do not account for shifts in residential and employment patterns that have occurred in the last few years. Per the Minnesota Department of Employment and Economic Development (DEED), total jobs in the Minneapolis Central Business District (CBD) declined by 13,000 from 2019 to 2021, about a 9 percent loss. Figure 2 shows how Minneapolis CBD has changed since Northstar opened in 2009. Although population and employment data have not been tailored to the pandemic era, other modifications have been made to forecast models to account for specific changes to ridership (described below in the Ridership Counts section).

Figure 2: Total employment in Minneapolis CBD



Park-and-ride Locations

Special coding is required in the ridership model to designate park-and-ride locations. Park-and-ride locations in the Regional STOPS Model were compared to the 2019 Metro Transit Annual Park-and-Ride Survey. Adjustments to the catchment area of select park-and-rides were made to better reflect their capacity and usage.

Ridership Counts

To tailor ridership forecasts to pre- and post-pandemic levels, ridership data from fall 2019 and April 2022 has been incorporated into two separate model versions. These data include two separate sets of ridership counts, one at the route level (also used in onboard survey refactoring) and one at the stop level. STOPS has different options for model calibration to these counts. To better represent how transit-user behavior has changed since the 2016 onboard survey was conducted, forecasts have been calibrated using both route and stop counts (Type 12 Calibration in STOPS).

Schedules

The forecast model uses transit schedules to represent available transit service. Three distinct transit networks are incorporated for each analysis year in the forecast model. The existing network is used for calibration, the no build network includes service changes not in the existing network that are not associated with the project to be evaluated, and the build network incorporates the project for evaluation. The schedules associated with each scenario are year are summarized in Table 2.

Table 2. Transit schedules incorporated into each model scenario by year

YEAR	EXISTING SCENARIO	NO BUILD SCENARIO	BUILD SCENARIO
2019	Metro Transit Fall 2019 Pick (Includes Northstar and Northstar Link Service) MVTA 2019	Metro Transit 2020 Pre-Pandemic Pick Without Northstar And Northstar Link Service MVTA 2020 Pre-Pandemic Pick	No Build Network Northstar Service Scenario
2022	Metro Transit April 2022 Pick (Includes Northstar and Northstar Link Service)	Metro Transit April 2022 Without Northstar Service MVTA April 2022	No Build Network Northstar Service Scenario
2040	Same As Respective Base Year	Same As Respective Base Year Blue Line Extension (West Broadway Alignment) Metro F And D Line aBRT	Same As Respective Base Year Blue Line Extension (West Broadway Alignment) Metro F And D Line aBRT

Modeling Rail Extension

The Extend Rail scenarios represent a less commuter-oriented transit service than either the commuter rail or express bus options. Since no peer services (either commuter or short-distance intercity rail) currently operate in the state, ridership forecasting must use a modified approach.

The method used for Northern Lights Express (NLX), intercity rail planned between the Twin Cities and Duluth, incorporated auto, intercity bus, and air travel to estimate likely rail travel. This method was rejected for evaluation along the Northstar corridor due to differences in travel markets served and the desire for fair comparisons between scenarios. Key differences between NLX and Northstar include corridor lengths of 150 miles versus 65 miles and levels of tourism. The length of the NLX corridor reduces its likelihood of serving commuters. Conversely, even if offered as bidirectional service extended to St. Cloud, the Northstar corridor will continue to serve the commuters who use it today. For this reason, along with the need to compare results between scenarios, STOPS has been used as the primary tool for the Extend Rail scenarios. .

The STOPS models used for the Extend Rail scenarios were modified relative to models for other modes to account for the possibility of new rider markets going to St. Cloud. These markets are not currently represented in the onboard survey which is the key input to the incremental version of STOPS used for modeling commuter rail and express bus. The Extend Rail scenarios instead use a special markets STOPS version. Special markets STOPS models use Census Transportation Planning Package (CTPP) commuter flows data to estimate ridership in addition to onboard survey data. The goal in incorporating CTPP data was to allow for mode shift from current auto travel to transit.

Metro Transit Park-and-Ride Model

The Regional STOPS model is one option in a suite of local tools for estimating ridership demand. The Metro Transit Park-and-Ride model ("park-and-ride model") was developed for the purpose of assessing capacity needs for park-and-ride facilities in the future. The park-and-ride model was reviewed for potential use in the Northstar Rail Corridor Post-Pandemic Study. The following section describes the reasoning for not using the park-and-ride model to supplement forecasts generated with STOPS including dates of input development, ability to replicate existing Northstar ridership patterns, and availability of alternative methods.

The park-and-ride model uses a base year of 2016 which is not consistent with other data used in this study. These data include park-and-ride utilization from Metro Transit's annual park-and-ride survey, auto and transit travel times tabulated using Google Maps Application Programming Interface (API), socioeconomic data (also used in STOPS), commuter rates from LODES data, and the onboard survey. Elasticities are applied to grow park-and-ride use due to changes in service frequency, transit mode, and parking costs, however these elasticities are not set up to reflect behavioral changes from 2016 to 2022 (including pre-pandemic ridership decline from 2016 to 2019). Updating the park-and-ride model to analysis years consistent with this study (2019 and 2022) would require a complete rebuild of the park-and-ride model.

In reviewing the park-and-ride model's travel times to understand how current they might be, a few inconsistencies were identified in the Northstar corridor (Table 3). Note that the park-and-ride model travel times represent travelling from the park-and-ride to the intersection of South 8th Street and 2nd Avenue South in downtown Minneapolis. The schedule times are from park-and-ride to Target Field Station. The travel time from Target Field Station to South 8th Street and 2nd Avenue South is about 11 minutes plus wait time. The travel times incorporated into the park-and-ride model appear to have some randomness incorporated as the times do not vary consistently relative to scheduled Northstar times. The Coon Rapids park-and-ride appears to have an error as it's park-and-ride model time is 31 minutes longer than the published schedule time.

Table 3: Northstar corridor travel times

STATION	AUTO TRAVEL TIME IN PNR MODEL	TRANSIT TIME IN PNR MODEL	SCHEDULE TRANSIT TIME
Fridley	17	36	19
Coon Rapids	32	58	27
Anoka	36	49	31
Ramsey	45	52	36
Elk River	55	56	42
Big Lake	68	68	52

The park-and-ride model estimates total Northstar park-and-ride utilization well. However, Table 4 shows that the model estimates for individual park-and-rides vary in accuracy with some significant over-estimates (Anoka and Fridley) and some underestimates (Big Lake) compared to actual park-and-ride utilization. The preference for park-and-rides closer to downtown areas is consistent with other travel model methodologies including STOPS.

Table 4: Comparison of park-and-ride model results to survey counts

STATION	CAPACITY	2016 UTILIZATION	PNR MODEL UTILIZATION
Fridley	668	76	166
Coon Rapids	455	260	198
Anoka	525	188	400
Ramsey	360	317	226
Elk River	754	288	301
Big Lake	518	208	122
Total	3,280	1,337	1,413

In reviewing the distribution of park-and-ride use, results are variable (Table 5). The share of park-and-ride use at Elk River is correct, but other lots vary. As expected given the problem with its travel time, Coon Rapids Station's share of ridership is lower than in 2016.

Table 5: Comparison of Northstar park-and-ride distribution between park-and-ride model and actual data

STATION	2016 SHARE OF RIDERSHIP	PNR MODEL SHARE OF RIDERSHIP
Fridley	6%	12%
Coon Rapids	19%	14%
Anoka	14%	28%
Ramsey	24%	16%
Elk River	22%	21%
Big Lake	16%	9%

Due to the outdated input data and issues with Northstar travel times, the park-and-ride model has not been used in the Northstar Rail Corridor Post-Pandemic study. Additionally, because actual data on current and prior Northstar park-and-ride use is available, this information can be used to supplement STOPS model results.

Annual Transit Ridership

Annual transit ridership is calculated as the sum of annualized weekday ridership forecasts and special event day ridership. Weekday ridership is expanded using an annualization factor, or an assumed number of equivalent weekdays. Annualization factors for each scenario are based on the assumed service plan and historic performance of Northstar. Additional data was needed to inform the annualization of the Extend Rail scenarios. Because none of the peer agencies used for this study offered suitable data, the annualization of the Extend Rail scenarios incorporates data from Sonoma-Marin Area Rail Transit, an intercity rail service north of San Francisco, California, which offers a similar style and level of service.[1]

Scenarios with no weekend service (Commuter Rail Base and both Express Bus scenarios) are annualized with a factor of 255, the number of non-holiday weekdays in an average year. Scenarios with weekend service are annualized with a base factor of 255 weekdays, plus the number of weekend days scaled by existing Northstar weekend ridership.

Extend Rail scenario annualization is affected by weekend service levels. The Extend Rail High scenario has a lower level of service on weekends than on weekdays, while the Extend Rail Base scenario assumes a consistent level of service across all days of the week, resulting in a higher annualization factor for the latter scenario. Table 6 shows the annualization factors used for each service scenario.

Table 6: Ridership Annualization Factors by Service Scenario

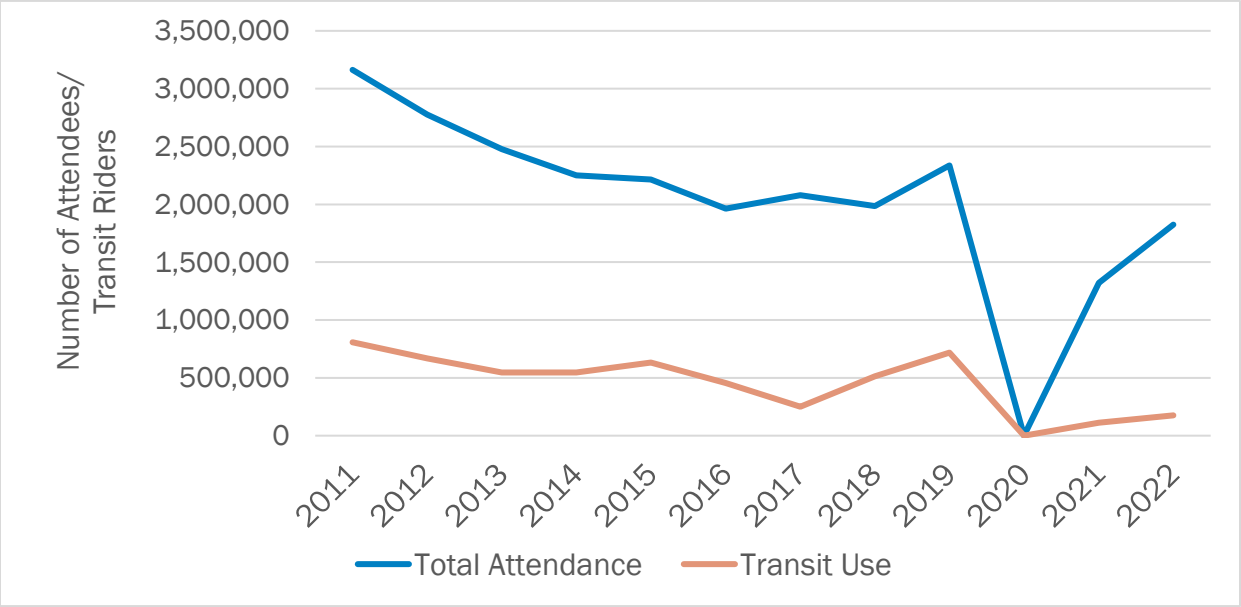
SERVICE SCENARIO	ANNUALIZATION FACTOR
Commuter Rail Base	355
Commuter Rail High	268
Extend Rail Base	290
Extend Rail High	279
Express Bus Base	255
Express Bus High	255

Special event service is also incorporated into annual ridership estimates. Number of transit trips resulting from special event service is based on average 2019 Northstar special event ridership. Due to the relative reduction in transit mode share on light rail lines in 2022 and lack of current Northstar special event service, the number of special event riders assumed for the 2022 baseline is

[1] Although the Downeaster was identified as a peer corridor for the Extend Rail scenario, its annualization was unable to be determined as ridership data for Amtrak services are reported as monthly totals. The ratio of weekday to weekend riders is key to estimating annualization factors for existing service. Sonoma-Marin Area Rail Transit has a similar ratio and is thus its annualization factor was used.

40 percent of 2019 special event rides. This is based on yearly Metro Transit event-day ridership received for use in this study, a sample of which is shown for Twins games in Figure 3.

Figure 3: Annual Twins Game attendance and associated transit ridership



Productivity

Productivity of service is measured in passengers per in-service hour. For each service scenario, in-service hours are calculated from GTFS schedule data developed for use in ridership forecasting. Forecasted boardings for each scenario are divided by the corresponding in-service hours to produce the final measure of productivity.

Community Development

The community development category includes criteria for land use, zoning, development activity, and density. The land use and zoning criteria evaluate what Northstar corridor cities envisioned and planned for in their station areas. The development activity and density criteria evaluate actual development in these station areas since 2009. The metrics for these evaluation criteria are summarized in Table 7.

Table 7: Community Development Evaluation Criteria

EVALUATION CATEGORY	METRICS
Land Use	Transit-supportive land uses – 2010 (%)
Land Use	Transit-supportive land uses – 2020 (%)

EVALUATION CATEGORY	METRICS
Land Use	Percent change of station area transit-supportive land uses, 2010 to 2020
Zoning	Presence of transit-supportive zoning/overlay districts
Zoning	Presence of transit-supportive station area plans
Development Activity	Transit-supportive development (non- residential sq ft)
Development Activity	Transit supportive development (units)
Density	Residential density (units per acre)
Density	Are minimum density expectations for regional transitway stations met for the community type?
Density	Are the target density expectations for regional transitway stations met for the community type?

Since the scenarios evaluated in this study largely use the same station areas, the results for the community development category metrics are presented by station area and city rather than by scenario.

Methods

Transit-Supportive Uses and Developments

For this analysis, the definition of transit-supportive land uses is based on the approach that Metro Transit used to define transit-supportive land uses in the Network Next plan for the agency's bus network. Transit-supportive land uses are those that promote transit-oriented development (TOD), including higher density residential, mixed-use, and commercial uses. Appendix A includes the full list of land uses that are defined as transit-supportive in this study.

In this analysis, a development is defined as transit-supportive if it has a transit-supportive underlying land use. In some cases where the underlying land use did not reflect the type of development, developments were reviewed based on the development description provided by the city. In general, multifamily residential, commercial, and institutional developments were defined as transit-supportive and industrial or auto-centric commercial developments were defined as non-transit-supportive developments.

Land Use and Zoning

For the zoning and land use evaluation criteria, each corridor city's comprehensive plan, zoning ordinance, and/or station area plan were reviewed to identify any transit-supportive regulations or plans. For cities within Met Council jurisdiction, the Council's generalized land use datasets from 2010 and 2020 were used to identify and calculate transit-supportive land uses in Northstar station

areas. For Elk River, Big Lake, and Saint Cloud, land use maps or data provided by the cities were used. For these three cities only the most current future land use data were available.

Development Activity

To evaluate development activity, data were requested from the corridor cities on all development that has occurred within a ½-mile of Northstar stations since 2009. The cities of Big Lake, Elk River, Ramsey, Anoka, Coon Rapids, and Fridley provided data that included information about the project type (i.e., commercial, office, housing), square footage or number of units, and either the year built or an estimated construction timeframe. The City of Minneapolis did not provide a specific list of developments due to the very high volume of development that occurred in the Target Field Station area since 2009.

Density

The density criterion evaluates the density of new development or redevelopment in the Northstar station areas against the thresholds for average residential density near transitway stations that are defined in the Met Council's 2040 Transportation Policy Plan (TPP). The TPP defines minimum and target residential densities by community type (e.g., urban or suburban). These density expectations represent average net densities within a ten-minute walk or a ½-mile of a station in "areas of change" that the community has identified for new development or redevelopment.

For this study, areas of change were defined as any parcel that has been developed or redeveloped since 2009. The team calculated the total area of parcels that were developed or redeveloped since 2009 within a ½-mile radius of the station and calculated the average density per acre for each station based on the residential development data provided by the cities.

Environmental Sustainability

Table 8 shows the evaluation criteria selected for environmental sustainability.

Table 8. Environmental Sustainability Evaluation Criteria, Metrics, and Data Sources

EVALUATION CRITERIA	MEASURES	DATA SOURCE(S)
Auto Emissions Reductions	Change in CO2 emissions due to increase/decrease in regional auto VMT	Regional STOPS model; FTA estimates by mode
Direct Emissions	Estimated CO2 emissions per passenger trip	Regional STOPS model; FTA estimates by mode
Net Emissions	Net emissions change (auto + transit)	Regional STOPS model; FTA estimates by mode

Methods

Environmental sustainability was assessed using the FTA's Capital Investment Grant (CIG) methodology which estimates the change in auto vehicle miles travelled (VMT) and direct transit

vehicle emissions within the corridor for each service scenario. All results are given in annual tons of carbon dioxide equivalent (CO2e) for a comprehensive look at environmental impacts.

Auto Emissions Reductions

Change in auto VMT relative to the no-build scenario (see Schedules section under Ridership Estimates Methods for definition) was calculated for each service scenario to derive **Error! Reference source not found.**annual reduction in tons of carbon dioxide equivalent (CO2e).

Direct Emissions

Annual direct emissions from transit vehicles in tons of carbon dioxide equivalent (CO2e) are calculated based on the number of transit vehicle miles operated in each service scenario. For rail scenarios, direct emissions were calculated for used (non-Tier-4-compliant) diesel locomotives using FTA's standard rate of 0.00797 tons CO2e per vehicle-mile-travelled. Bus scenarios use FTA's standard diesel bus emission rate of 0.003319 tons CO2e per vehicle-mile-travelled.[2]

Net Emissions

Net emissions are defined as the sum of transit direct emissions (expressed as positive tons of CO2e) and the change in auto emissions. Negative net emissions for a given scenario indicates that the reduction in auto emissions due to transit ridership is greater in magnitude than the emissions of the transit service operated in the corridor. Net emissions are calculated for both the 2019 and 2022 ridership base years, with the transit direct emissions held constant for both.

Financial Performance

Methods

Operations and Maintenance Costs

Annual operations and maintenance costs are calculated using a methodology specific to each transit mode under study, as noted below.

- **Commuter Rail** – Annual operations and maintenance costs for commuter rail were calculated based on the number of annual one-way train trips operated in each service scenario, including weekday trips, weekend trips (if applicable), and special event service. Metro Transit provided relevant cost inputs, including expected fixed costs for fiscal year 2023, as well as an estimate of the 2023 average cost per train (variable costs). Total annual operations and maintenance costs consist of the sum of fixed costs and variable costs (cost

[2] Transit vehicle emissions rates are drawn from FTA's Final Interim Policy Guidance for the Capital Investment Grant Program, updated in June 2016. Full document available here: https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/FAST_Updated_Interim_Policy_Guidance_June%20_2016.pdf.

per train trip * number of trips per year). All cost inputs are based on actual Metro Transit operating data from fiscal year 2021; 2023 costs include Metro Transit's standard inflation rate of 3.15 percent per year, as well as costs related to the federal rail settlement reached in fall 2022.

- **Extend Rail** – For the purposes of the evaluation featured in the Final Report, annual operations and maintenance costs for Extend Rail scenarios were estimated using the commuter rail methodology described above, with some changes.
    - Metro Transit's 2023 fixed costs were held constant; the 2023 cost per train trip was scaled by the ratio of corridor miles in the Extend Rail scenarios vs. Commuter Rail (67/40). As in commuter rail service, costs for Extend Rail scenarios are based on 2021 actual data, include Metro Transit's standard inflation rate of 3.15 percent per year, and reflect costs related to the federal rail settlement reached in fall 2022. This methodology results in a single value for each Extend Rail scenario. To these results were added the cost of the single midday bus roundtrip incorporated in the Extend Rail scenarios, as well as the costs of special event bus service, both estimated using the express bus methodology described below.
    - Appendix C: Rail Extension Technical Report includes an additional cost estimation methodology for rail operations and maintenance. These costs were calculated based on the total annual cost per train mile of two existing Amtrak state-supported routes for fiscal year 2022, as recommended by Amtrak. Annual operations and maintenance costs for Extend Rail scenarios were calculated by multiplying the cost per train mile for the Amtrak services by the number of train miles operated in each of the Extend Rail scenarios. This method resulted in lower costs but given that conversion to Amtrak-operated service is not guaranteed, these results are provided for reference only. A comprehensive discussion of operating considerations related to the Extend Rail scenarios is included in Appendix C.
- **Express Bus** – Annual operations and maintenance costs for express bus scenarios were calculated using a standard resource estimation methodology developed by Metro Transit Service Development. Metro Transit's resource estimation tool calculates the daily and annual revenue hours required to operate one or more bus routes based on their average roundtrip travel time, frequency, and standard layover and recovery requirements (15 percent, with a minimum of seven minutes per one-way trip). Total annual revenue hours are multiplied by Metro Transit's 2023 fully allocated cost per bus revenue hour. This cost, estimated at $176.24, is based on 2021 agency-wide average operating costs and includes Metro Transit's standard inflation rate of 3.15 percent per year. Annual operations and maintenance costs for express bus scenarios include additional service on special event days (the same service as provided in the Extend Rail scenario).

Cost Effectiveness

Cost effectiveness is defined as the total operations and maintenance cost per passenger trip in each scenario. To generate relative comparisons across modes and service levels, this measure is

calculated by dividing the total annual operations and maintenance cost for each scenario by the total estimated annual ridership in the 2022 base year, as reported in the ridership section.

Fare Recovery

Fare recovery is defined as the percentage of operations and maintenance costs covered by fares. Fare recovery was calculated by dividing the total estimated annual fare revenue for each scenario by the total annual operations and maintenance costs. Annual fare revenue was calculated by multiplying the average fare per passenger trip for each mode by the total annual trips forecast for each scenario in the 2022 base year. Average fares per passenger trip are calculated as follows:

- **Commuter Rail** – Average fare per passenger trip for commuter rail is assumed to be consistent with the Northstar average for 2019, at $3.39 per trip. This value was calculated by dividing Metro Transit's 2019 total commuter rail revenue by the total number of unlinked trips on commuter rail, as reported to the National Transit Database.
- **Extend Rail** – Average fare per passenger trip for trips at existing Northstar stations are assumed to be the same as for commuter rail ($3.39 per trip). Average fares for passenger trips originating at the St. Cloud station are assumed to be offered at the same cost per passenger mile as trips originating in Big Lake, for a total of $10.47. Average fare per passenger trip across all Extend Rail trips is estimated as a weighted average based on ridership, resulting in $3.41 in the base scenario and $3.42 in the high scenario.
- **Express Bus** – Average fare per passenger trip for express bus is assumed to be consistent with the Metro Transit bus average for 2019, at $1.33 per trip. This value was calculated by dividing Metro Transit's 2019 total bus revenue by the total number of unlinked trips on bus service, as reported to the National Transit Database.

Capital Costs

Capital costs include direct costs associated with construction or equipment procurement, as well as additional costs involved in transitioning between modes, such as full or partial repayment of federal grants. The assumptions applied for each mode are described as follows:

- **Commuter Rail** – No additional capital costs are assumed in either commuter rail scenario, since all infrastructure and equipment necessary for operations have been built and/or procured.
- **Extend Rail** – Capital costs for both Extend Rail scenarios include rail infrastructure improvements previously identified in MnDOT's Northstar Commuter Rail Extension Feasibility Assessment conducted in 2020. These include the following:
    - **St. Cloud Improvements** ($25.9 million in 2025 dollars): Track improvements at and near the existing St. Cloud Amtrak station would enable midday layover of rail trainsets. This would allow freight trains and Amtrak's Empire Builder service to bypass stopped Northstar trains when needed. These improvements are included in both the Extend Rail Base and Extend Rail High scenarios.

  - **Big Lake Track Connection** ($9.6 million in 2025 dollars): A single new track connection just north of the existing Big Lake station would allow trains traveling to and from St. Cloud to serve the station without reversing direction. The current station platform is located on a siding that is only accessible from the south. This connection is included in both the Extend Rail Base and Extend Rail High scenarios.
  - **Big Lake Station Expansion** ($31.1 million in 2025 dollars): The addition of two new platforms at the Big Lake station would allow trains to serve Big Lake from BNSF's mainline tracks without needing to travel onto the existing station siding. This improvement would reduce the potential impact of Extend Rail trips on freight rail operations, as northbound trains would no longer need to cross the southbound tracks to reach the station siding. This improvement is included in the Extend Rail High scenario only due to the greater number of trips and potential conflicts.
  - Other capital elements from the Northstar Commuter Rail Extension Feasibility Assessment, such as additional bypass track between Big Lake and downtown Minneapolis, were not included, since the Extend Rail scenario definitions do not include underlying commuter rail trips terminating in Big Lake.
  - Further revisions to capital costs would be expected if Extend Rail is selected as the preferred transit service type. These costs could include items associated with a potential conversion to Amtrak service, such as equipment changes and/or connections to the Amtrak national network.
- **Express Bus** – No direct capital costs are assumed in the express bus scenarios. Bus service would use existing Northstar park-and-ride stations, and Metro Transit has indicated it would not need to purchase additional buses to run the service. However, the express bus scenarios do carry substantial costs associated with the cessation of rail service, including the decommissioning of Northstar rail assets and repayment of federal grants. Considerations for these costs are considered separately from direct capital costs and are described below.

Additional potential costs that apply to one or more scenarios are defined along with their methodologies as follows:

- **Ongoing Costs** – Ongoing costs are defined as financing costs related to original Northstar construction in the form of outstanding bonds. These costs must be repaid under all scenarios.
- **Decommissioning Costs** – Decommissioning costs are related to the closing and securement of rail assets that will be retained but no longer used. These assets include the Big Lake operations and maintenance facility (OMF), as well as station platforms and/or vertical circulation elements at each station site. Decommissioning costs apply only to the express bus scenarios.
- **Repayment Costs** – Repayment costs are costs associated with the discontinuation of commuter rail service, and potentially in Extend Rail scenarios depending on operating characteristics and FTA discretion.
  - **Extend Rail scenarios** assume planned service complies with FTA New Starts FFGA, with no repayment required. This may require a waiver from FTA due to the schedule differences between rush-hour oriented commuter rail and bidirectional

Extend Rail trips. Similarly, Extend Rail scenarios assume operations with existing Northstar equipment, with no conversion to Amtrak fleet.

  - **Express Bus scenarios** assume some FTA repayment will be required. Due to uncertainty regarding FTA's potential decisions regarding the appropriate utilization of Northstar assets, a range of repayment values is given. At minimum, FTA's share of rolling stock sold (estimated at $10.6 million) would need to be repaid. A moderate repayment could be based on the federal share of the net book value of Northstar assets, estimated at $73.4 million as of June 30, 2022. At maximum, FTA could require the repayment of all $161.9 million in federal funding for the project, though full repayment is expected only in exceptional cases. Penalties for rail termination assume adequate notice of six months if terminating with a contract period, or one year if terminating at the end of a five-year contract term.

- **Sale/Disposal of Assets** – In the event that real property or rolling stock assets are sold and full FTA repayment is not required, it is assumed that the non-federal portion (51.0 percent) of the sale price would be returned to the project partners.
- **Penalties** – Penalties include any contractual payments to non-federal partners in the case of cessation of rail service. These may include mandatory penalties for early termination, or fees that may be avoided if adequate termination notice is given.

Subsidy per Passenger

Subsidy per passenger is calculated by dividing the annual operations and maintenance costs (minus fare revenue) by the estimated annual ridership in each scenario for the 2022 base year. Results are expressed in terms of dollars, reflecting the combined public subsidy for the average passenger trip.

Accessibility and Equity

Table 9 describes the specific evaluation criteria and their corresponding measures that were applied for accessibility and equity. Relative levels of equity of the service scenarios are determined by two metrics: rides by people from zero-car households and ability of BIPOC and low-income populations to access downtown Minneapolis using each service mode at different travel time thresholds.

Table 9. Accessibility And Equity Evaluation Criteria, Measures, and Data Sources

Evaluation Criteria	Measures	Data Source(S)
Service to Transit-Reliant Populations	Number of trips by zero-car households (weekday)	STOPS ridership forecasting model output
Access to Downtown Minneapolis	Number of people with access to downtown Minneapolis in 15-minute incremental thresholds.	American Community Survey (ACS) 2016-2020, Open Street Map, StreetLight LBS data
Access For BIPOC and Low-Income Populations	Number of BIPOC and low-income individuals with access to downtown Minneapolis in 15-minute incremental thresholds.	American Community Survey (ACS) 2016-2020, Open Street Map, StreetLight LBS data

Methods

Measurement of rides by people from zero-car households is done using the ridership forecast models. A full description of the data inputs and assumptions for those models can be found in the Ridership Estimates Methods section of this report. Trips from zero-car households are counted only on services evaluated for this study.

Travelsheds are generated using grid centroids every 1 kilometer for auto access to transit and every 250 feet for walk and bike access. Travelsheds comprise the combined access and ride time involved in a trip from a given centroid to downtown Minneapolis. Wait time is excluded from the total travel time as passengers on an infrequent commuter/express transit service will arrive at a station as needed to board a given train or bus. For all scenarios, only Northstar project transit routes (i.e., only the Northstar rail line in rail scenarios and Northstar bus routes 1, 2, and 852 in the express bus scenarios) are considered while non-project transit routes are excluded.

Travelshed cutoffs are based on travel behavior trends in Metro Transit's 2016 On-Board Survey (OBS), such that nearly all historic Northstar trip origins are captured within the travelshed. For park-and-ride trips, travelsheds are limited to a 10-mile station radius and maximum 30-minute drive time. For bike access trips, travelsheds are limited to a 2.5-mile station radius and maximum 30-minute bike time. For walk access trips, travelsheds are limited to a 15-minute walkshed.

Population totals and demographic breakdowns for accessibility are apportioned by area from census tracts to grid features grouped by 15-minute increments. These totals represent the population (or sub-population) within a prospective travelshed in line with previously observed travel patterns (i.e., the population for which Northstar service is a competitive transit option for travel to downtown Minneapolis).

Results

Service to Transit-Reliant Populations

Table 10 shows the 2019 weekday forecasted trips from zero-car households by service scenario. For all scenarios, estimates remain at or below 50 trips by zero-car households, similar to the 40 daily trips observed in the 2016 On-Board Survey. These trips comprise only a small portion of overall estimated ridership, indicating that the majority of riders in the Northstar Corridor have access to a vehicle.

Table 10: Trips from Zero-Car Households by Service Scenario

SERVICE SCENARIO	2019 TRIPS FROM ZERO CAR HOUSEHOLDS	PERCENT OF TOTAL TRIPS
Commuter Rail Base	20	1.1%
Commuter Rail High	40	1.6%
Extend Rail Base	25	0.7%
Extend Rail High	50	1.3%
Express Bus Base	10	1.1%
Express Bus High	30	3.3%

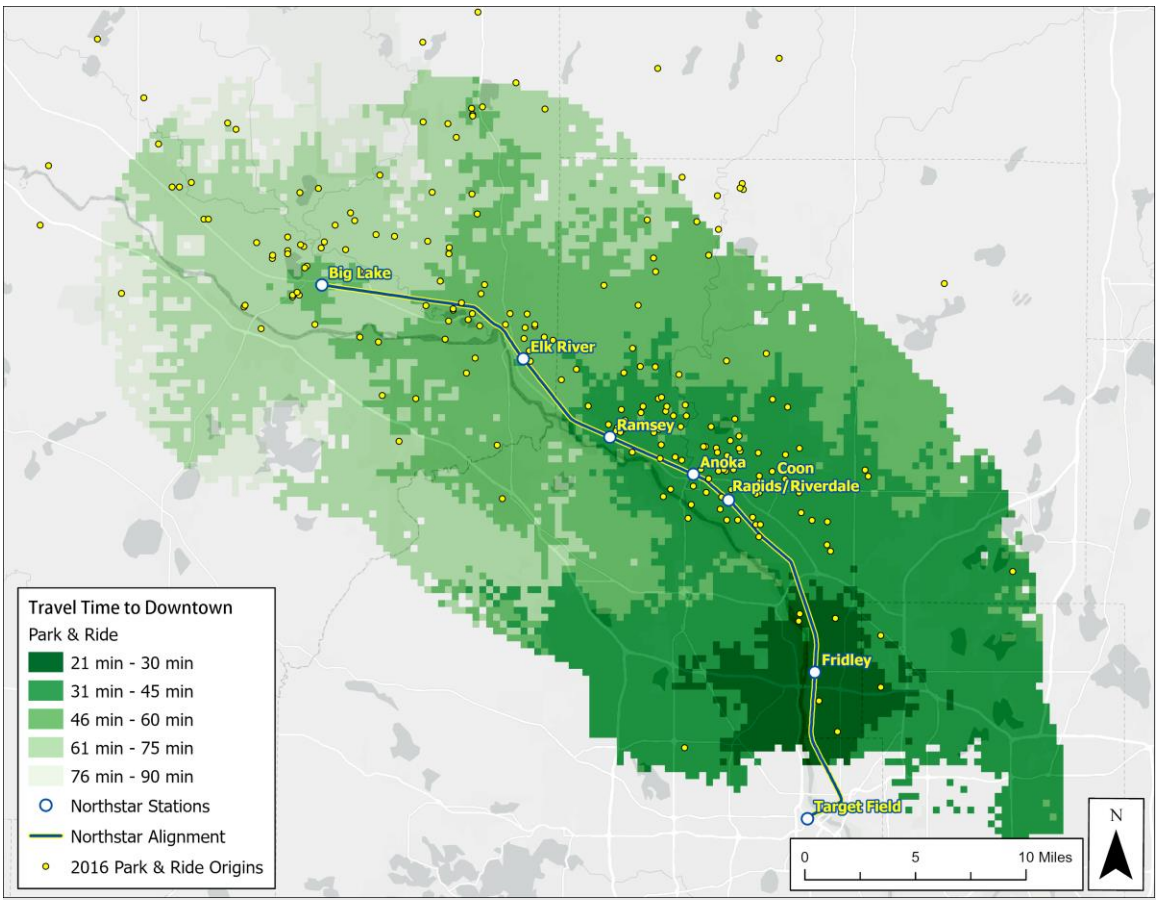
Accessibility Results by Service Scenario

The following section comprises spatial and tabular representations of access to downtown Minneapolis for all transit service modes. Results are not differentiated between base and high scenarios as the infrequent nature of commuter rail service necessitates passengers to plan to arrive at specific times. The traditional method of taking the median of sequential 1-minute travel time iterations would severely obfuscate the utility of a service as average wait times will be far higher than can be expected of any prospective passenger, especially for a commuter/express service. The aforementioned exclusion of wait time from the analysis renders accessibility results identical between different frequency scenarios. Thus, results are shown by mode to emphasize differences in vehicle travel time and new station locations rather than variations in frequency.

Commuter Rail Scenarios

Park-and-ride accessibility for commuter rail scenarios is represented by the travelshed shown in Figure 4 and tabular demographic totals in Table 11. The travelshed indicates that residents in relatively close proximity to Fridley are able to access and ride Northstar to downtown Minneapolis with 30 minutes. Residents within close proximity of Coon Rapids/Riverdale Station, Anoka Station, and Ramsey Station can access downtown Minneapolis within 45 minutes, save for areas on the west bank of the Mississippi River from which the drive to Northstar stations is less direct. Residents near Elk River Station and very near to Big Lake Station can access downtown Minneapolis within one-hour. The majority of the residents in the remaining area can access downtown Minneapolis within 75 minutes, while those in the far outskirts take up to 90 minutes to access downtown.

Figure 4. Total travel time to downtown Minneapolis – Commuter Rail – Park & Ride



The majority of the population within the defined park-and-ride travelshed are within 45 minutes of downtown by transit in the commuter rail scenario. This is also true for BIPOC and low-income populations. BIPOC populations represent a higher percentage of total population in the travelshed in the 30-minute threshold corresponding primarily to Fridley station. This percentage decreases in subsequent thresholds.

Table 11. Access to downtown Minneapolis for BIPOC and Low-Income Populations – Commuter Rail – Park & Ride

TIME THRESHOLD	TOTAL POPULATION	BIPOC POPULATION	LOW-INCOME POPULATION
30 min	170,183	81,688	20,422
45 min	720,476	237,757	57,638
60 min	843,843	253,153	64,827
75 min	926,103	259,309	65,430
90 min	934,721	261,722	67,507

Bike + transit accessibility for commuter rail scenarios is represented by the travelshed shown in Figure 5 and tabular demographic totals in Table 12. The relative size of bikesheds is a product of denser network geometries that facilitate faster and more complete bike access. The majority of populations with access to downtown Minneapolis is encompassed within the 60-minute threshold. The 45-minute threshold encompasses all of the Fridley bikeshed and a portion of the Anoka and Coon Rapids bikesheds.

Figure 5. Total travel time to downtown Minneapolis – Commuter Rail – Bike + Transit

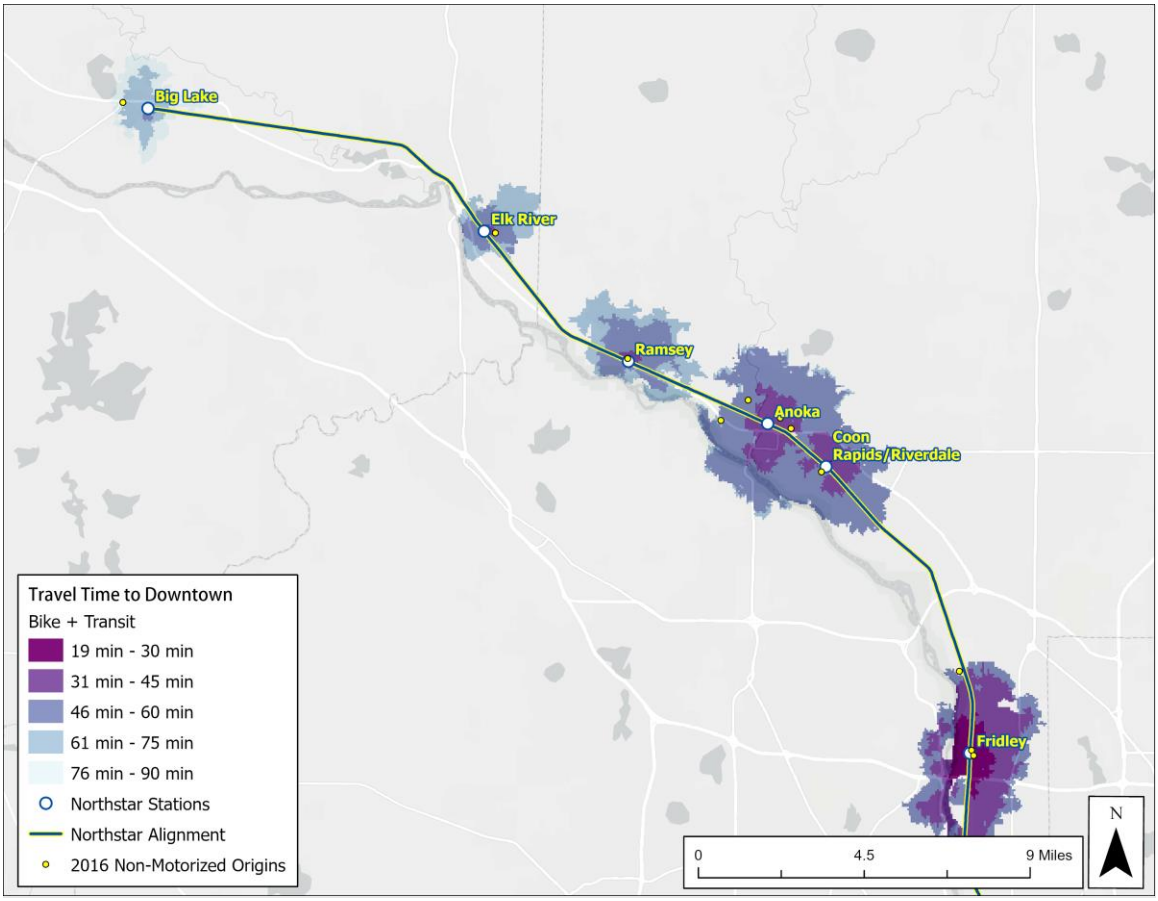


Table 12. Access to downtown Minneapolis for BIPOC and Low-Income Populations – Commuter Rail – Bike + Transit

TIME THRESHOLD	TOTAL POPULATION	BIPOC POPULATION	LOW-INCOME POPULATION
30 min	5,544	2,550	222
45 min	33,704	12,133	3,370
60 min	79,494	24,600	5,938
75 min	84,828	24,643	5,984
90 min	85,481	24,789	6,360

Walk + transit accessibility for commuter rail scenarios is represented by the travelshed shown in Figure 6 and tabular demographic totals in Table 13. The majority of populations within the travelshed is encompassed within the 45-minute threshold, principally due to the relative decrease in population density further out from downtown Minneapolis. While BIPOC populations within the travelshed are in similar proportion to overall population as in the previous access modes, low-income populations within the travelshed are minimal.

Figure 6. Total travel time to downtown Minneapolis – Commuter Rail – Walk + Transit

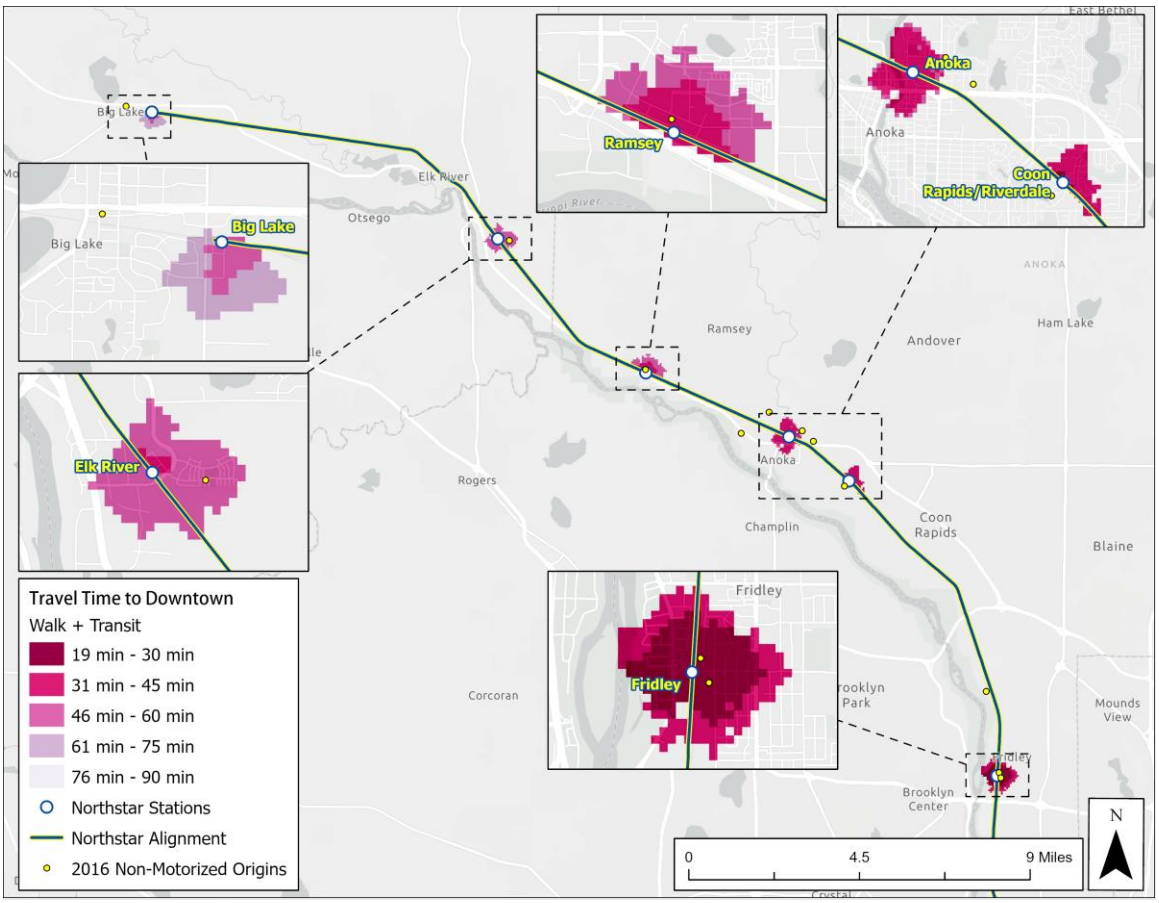


Table 13. Access to downtown Minneapolis for BIPOC and Low-Income Populations – Commuter Rail – Walk + Transit

TIME THRESHOLD	TOTAL POPULATION	BIPOC POPULATION	LOW-INCOME POPULATION
30 min	1,408	690	0
45 min	3,903	1,405	78
60 min	4,415	1,457	88
75 min	4,488	1,436	90

Extend Rail to St. Cloud Scenarios

Park-and-ride accessibility for Extend Rail scenarios is represented by the travelshed shown in Figure 7 and tabular demographic totals in Table 14. Results for Extend Rail scenarios are shown for St. Cloud station area only, as results are identical to the commuter rail scenarios for the Big Lake to Minneapolis segment of the corridor. The travelshed indicates that the area roughly comprising downtown St. Cloud and the immediate station area are within 90 minutes from downtown Minneapolis while the majority of the driveshed is within 105 minutes, with the remainder falling within 120 minutes. BIPOC and low-income populations within the St. Cloud station driveshed are marginal compared to the rest of the corridor.

Figure 7. Total travel time to downtown Minneapolis – Extend Rail – Park & Ride

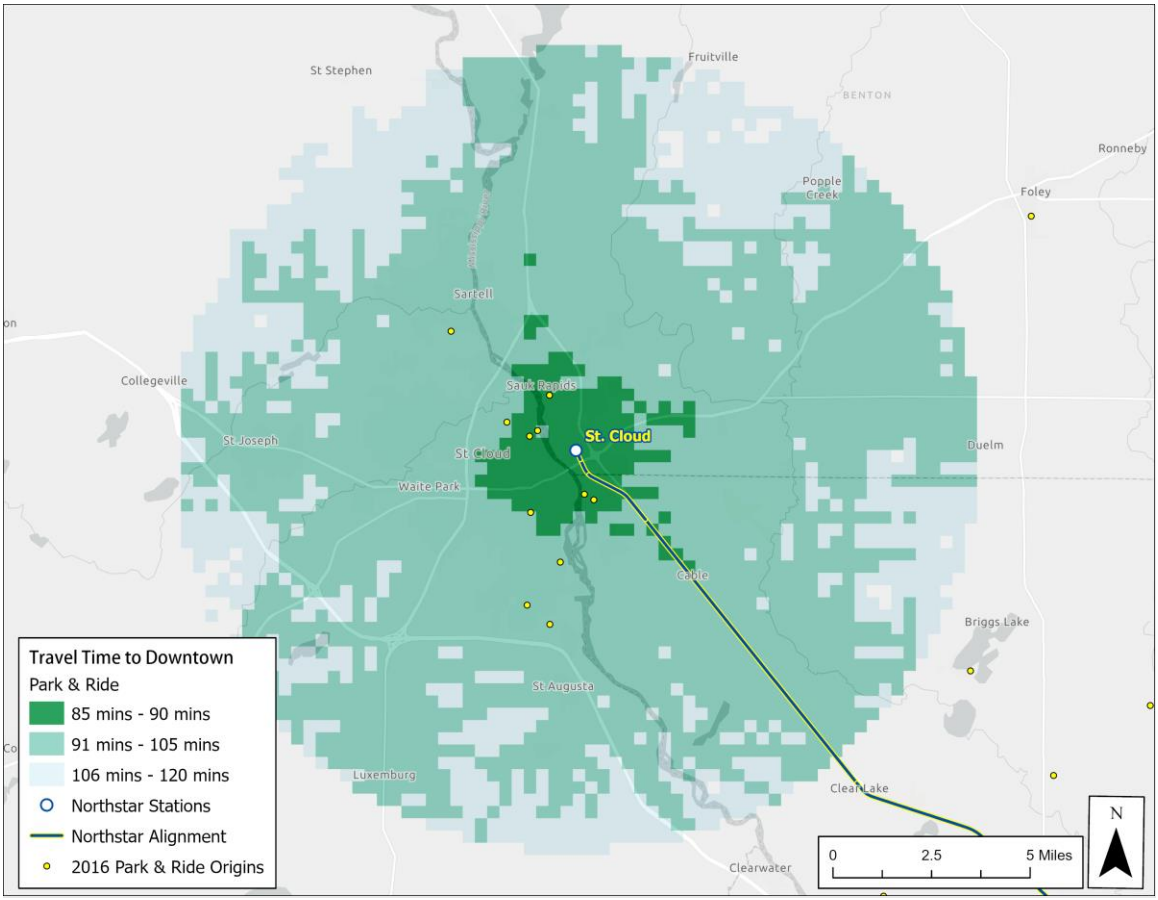


Table 14. Access to downtown Minneapolis for BIPOC and Low-Income Populations – Extend Rail – Park & Ride

TIME THRESHOLD	TOTAL POPULATION	BIPOC POPULATION	LOW-INCOME POPULATION
90 min	961,462	269,209	76,917
105 min	1,054,868	280,911	84,389
120 min	1,080,426	284,814	86,434

Bike + transit accessibility for Extend Rail scenarios is represented by the travelshed shown in Figure 8 and tabular demographic totals in Table 15. The dense network geometry of the St. Cloud area leads to a relatively large bikeshed extending as far as Sauk Rapids. The majority of the St. Cloud bikeshed can access downtown Minneapolis within 105 minutes.

Figure 8. Total travel time to downtown Minneapolis – Extend Rail – Bike + Transit

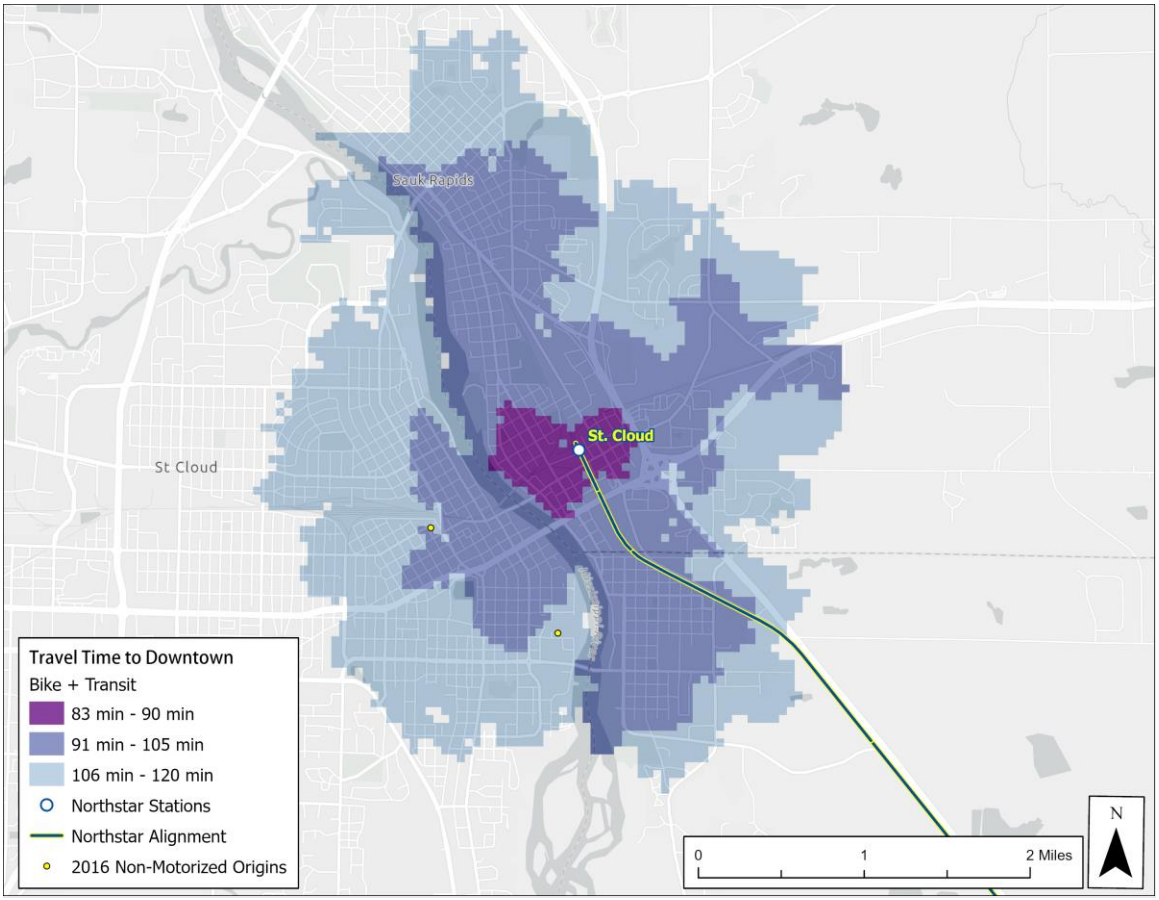


Table 15. Access to downtown Minneapolis for BIPOC and Low-Income Populations – Extend Rail – Bike + Transit

TIME THRESHOLD	TOTAL POPULATION	BIPOC POPULATION	LOW-INCOME POPULATION
90 min	90,051	26,115	6,304
105 min	100,205	28,057	9,018
120 min	115,229	31,112	11,523

Walk + transit accessibility for Extend Rail scenarios is represented by the travelshed shown in Figure 9Figure 4 and tabular demographic totals in Table 16. The St. Cloud station walkshed is not large, and does not extend far enough to encompass downtown St. Cloud. This is partly due to the

incomplete pedestrian network geometry in a partly industrial context, and partly due to the siting of the prospective rail station at the existing Amtrak station facility.

Figure 9. Total travel time to downtown Minneapolis – Extend Rail – Walk + Transit

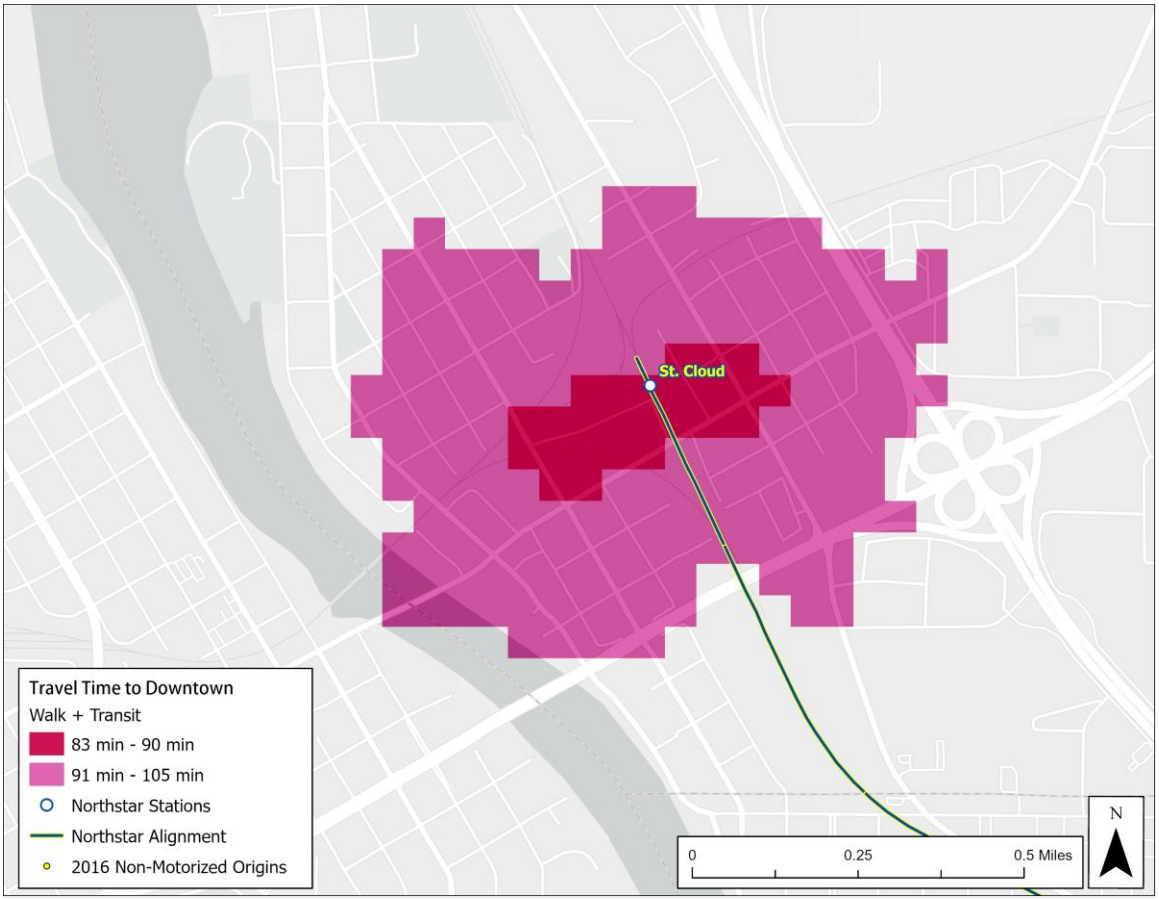


Table 16. Access to downtown Minneapolis for BIPOC and Low-Income Populations – Extend Rail – Walk + Transit

TIME THRESHOLD	TOTAL POPULATION	BIPOC POPULATION	LOW-INCOME POPULATION
90 min	3,643	969	123
105 min	4,183	1,148	300

Express Bus Scenarios

Park-and-ride accessibility for express bus scenarios is represented by the travelshed shown in Figure 10 and tabular demographic totals in Table 17. Travel times are considerably longer than in the rail scenarios due the relatively slower transit travel time of the express bus service. The majority of the population within the travelshed is encompassed by the 45-minute threshold, which only extends

out from Fridley and does not encompass Anoka nor Coon Rapids stations as in the rail scenarios. These stations are instead encompassed by the 60-minute travel time threshold.

Figure 10. Total travel time to downtown Minneapolis – Express Bus – Park & Ride

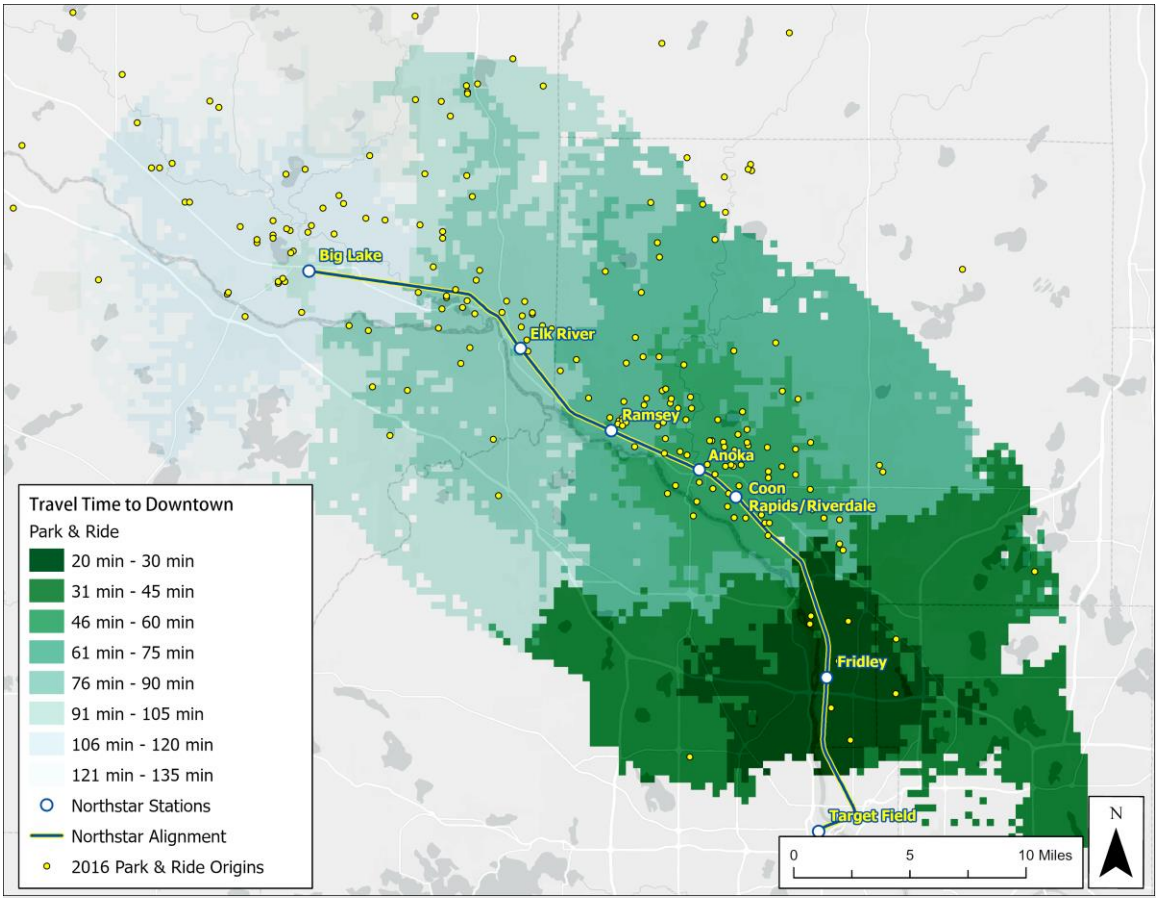


Table 17. Access to downtown Minneapolis for BIPOC and Low-Income Populations – Express Bus – Park & Ride

TIME THRESHOLD	TOTAL POPULATION	BIPOC POPULATION	LOW-INCOME POPULATION
30 min	170,183	81,688	20,422
45 min	537,524	202,293	49,919
60 min	655,713	223,059	56,429
75 min	779,716	244,784	61,417
90 min	838,013	250,582	63,064
105 min	884,510	255,121	64,479
120 min	895,314	255,948	64,938
135 min	930,893	259,149	66,719

Bike + transit accessibility for express bus scenarios is represented by the travelshed shown in Figure 11 and tabular demographic totals in

Table 18. Results are similar to that of rail but with longer transit travel times. The majority of the population within the travelshed is encompassed in the 75-minute threshold.

Figure 11. Total travel time to downtown Minneapolis – Express Bus – Bike + Transit

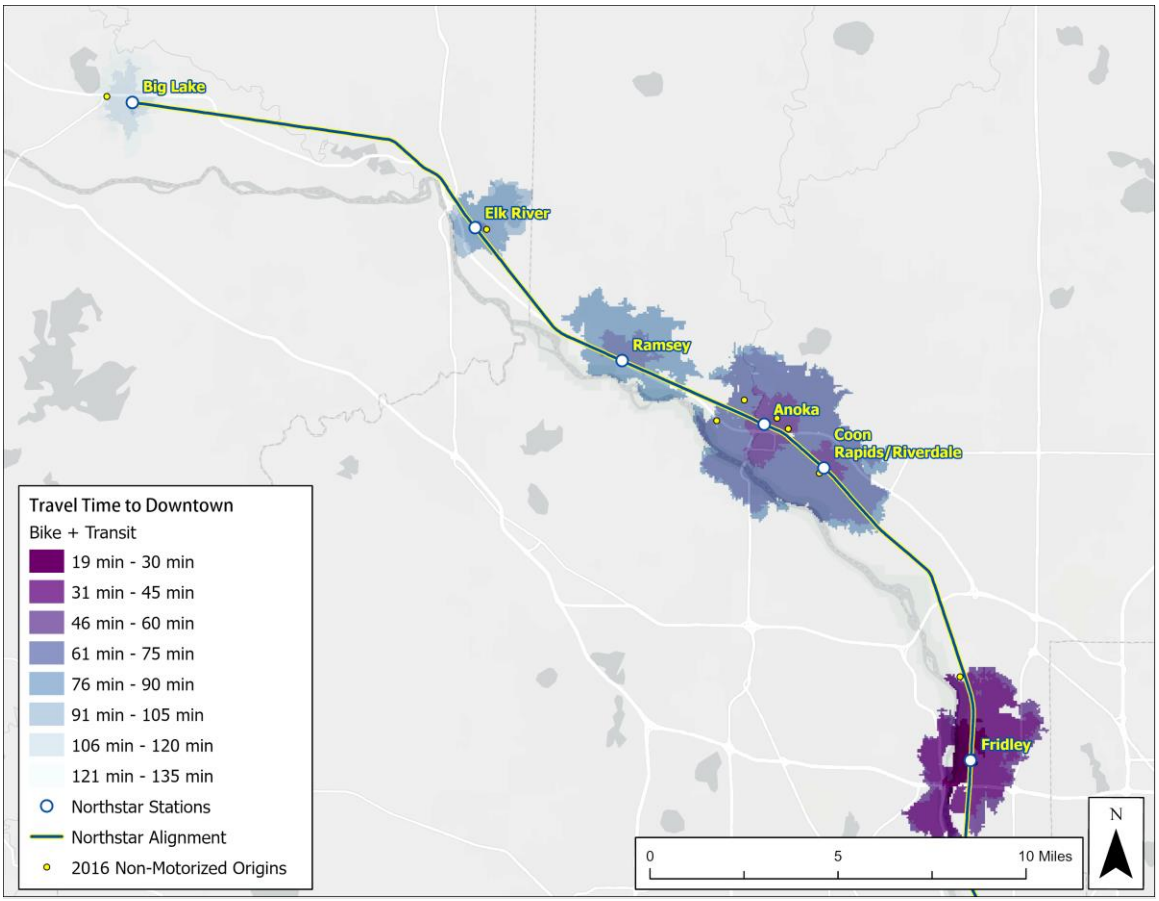


Table 18. Access to downtown Minneapolis for BIPOC and Low-Income Populations – Express Bus – Bike + Transit

TIME THRESHOLD	TOTAL POPULATION	BIPOC POPULATION	LOW-INCOME POPULATION
30 min	3,329	1,567	57
45 min	23,387	11,300	2,861
60 min	35,021	14,752	3,809
75 min	66,824	20,540	4,826
90 min	76,178	21,482	4,941

TIME THRESHOLD	TOTAL POPULATION	BIPOC POPULATION	LOW-INCOME POPULATION
105 min	76,550	21,483	4,941
120 min	77,116	21,484	4,941
135 min	77,837	21,485	4,941

Walk + transit accessibility for express bus scenarios is represented by the travelshed shown in Figure 12 and tabular demographic totals in

Table 19. Results resemble that of rail scenarios but with longer transit travel times. The majority of the population within the travelshed is encompassed by the 45-minute threshold, but only marginally. This is again a product of decreasing population densities in the station areas further out from downtown Minneapolis.

Figure 12. Total travel time to downtown Minneapolis – Express Bus – Walk + Transit

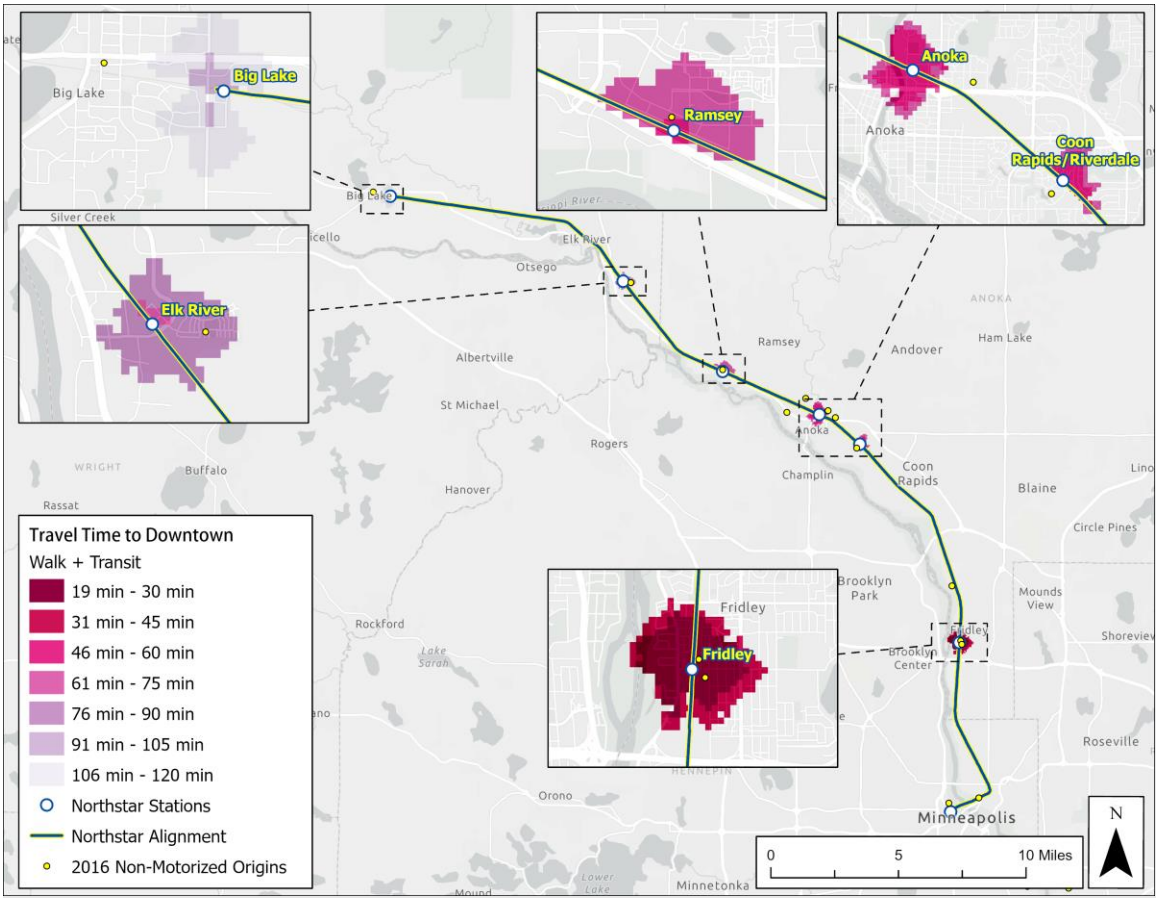


Table 19. Access to downtown Minneapolis for BIPOC and Low-Income Populations – Express Bus – Walk + Transit

TIME THRESHOLD	TOTAL POPULATION	BIPOC POPULATION	LOW-INCOME POPULATION
30 min	1,663	828	2
45 min	2,459	1,216	34
60 min	3,601	1,421	76
75 min	4,359	1,516	94
90 min	4,498	1,516	94
105 min	4,517	1,516	94
120 min	4,658	1,516	94