

Appendix B: Renaissance Planning Report – North Avenue Rising – Dedicated Lanes – Ladders of Opportunity Connectivity Analysis

North Avenue Rising – Dedicated Lanes Ladders of Opportunity Connectivity Analysis

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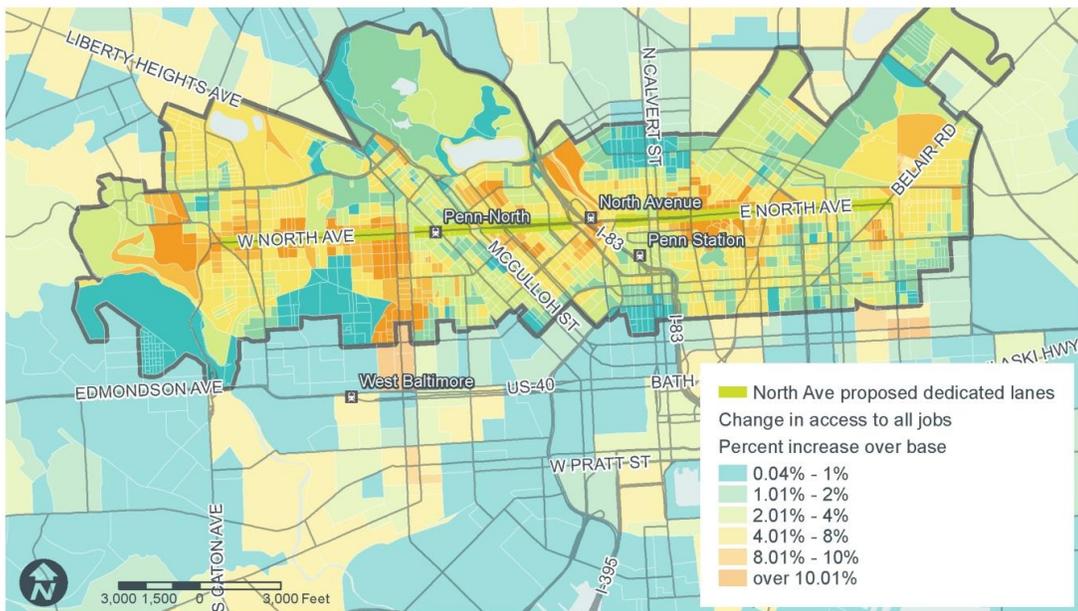
North Avenue Rising -- Dedicated Lanes

Ladders of Opportunity Connectivity Analysis

Summary

The dedicated lanes included in the North Avenue Rising project will provide substantial and equitable increases in access to job opportunities and essential services for residents along the corridor as well as the broader population of Baltimore. Faster bus service and more reliable operations will provide faster and more direct access to jobs and services for all residents, especially disadvantaged populations. The corridor is a majority minority area in which nearly 90% of the population is non-white, and roughly a third of households live below the poverty line.

The most pronounced effects of improved transit operations will be felt in the farthest western and eastern reaches of the corridor where minority and low-income populations are most concentrated, providing a 4.8% corridor-wide increase in access to jobs for minorities compared to 3.8% for whites, equating to roughly 7,500 additional jobs reachable for the average minority resident in the corridor. For households living in poverty, a similar increase in job access is expected. These benefits extend far beyond the North Avenue vicinity due to connections with rail services and bus routes that provide access throughout the region. The North Avenue dedicated lanes are expected to increase job accessibility regionally by more than 2.8%, or more than 2,500 additional jobs for the typical Baltimore resident.



Increase in access to jobs in the North Avenue corridor

Technical Documentation

Process overview

This study measures the accessibility benefits expected to result from the implementation of dedicated bus lanes on North Avenue in Baltimore. Accessibility is a measure of how many activities of interest can be reached from a given zone of origin, weighted by how easily they can be reached. Destinations that are nearby and can be reached quickly are easily accessible and more attractive than destinations that are far away. This study focuses on accessibility by transit in Baltimore and in the North Avenue corridor specifically, and it looks at differences in accessibility for several different segments of the population.

To measure the potential accessibility impact of dedicated bus lanes on North Avenue, this study compares the number of jobs accessible by transit from all origins in the Baltimore Link (“Link”) service area in the “base” (no bus lanes) and “build” (bus lanes added) conditions. The accessibility impacts are reported first in terms of total jobs reachable and also in terms of mid-skill jobs reachable by transit. Mid-skill jobs are defined as those requiring education or training beyond a high school diploma but not a four-year college degree. The total and mid-skill jobs accessibility comparisons are provided for the entire Link service area as well as for the North Avenue corridor. Given this focus on providing access to jobs, the study is focused on the AM peak travel period (7 a.m. to 9 a.m.).



Locations of proposed dedicated lanes along North Avenue

To model transit service in the base condition, GTFS¹ schedule data were provided by MTA representing the proposed Link service to be implemented in the near future. For the build condition, the same GTFS feed was used, but speed enhancements were modeled in the schedule to make travel times shorter between stops on routes using the proposed dedicated bus lanes. The assumed speed improvement was one minute of travel time savings for every mile of travel on dedicated lanes. No assumptions were made about potential related operational or route design changes, such as the number of trips made by a given transit vehicle or frequency of service. The service as designed in the base condition is simply assumed to be faster when transit lanes are available. The GTFS data were used to develop travel time skims, modeling the ‘best available’ route (including walk access, walk egress, and transfer walk and wait times) for the AM peak period. The travel time data were used to develop a travel time decay factor defining the “ease” of accessing jobs at each destination. The travel time decay formula used was:

$$d = 1.50 * e^{-0.046*t}$$

Where **d** is the travel time decay factor, **e** is the exponential constant, and **t** is the transit travel time in minutes. The result of the decay calculation was capped at 1.00 and was multiplied by the number of activities (jobs, mid-skill jobs) at each destination. Then the results were summed for each origin to determine the total accessibility score for all origin zones in the study.

Results were then summarized with respect to the general population as well as for specific disadvantaged population groups (and their complementary “advantaged” population groups) to assess the equity of the benefits expected from the proposed improvement.

Analysis

Zonal geography and land use

Accessibility analysis requires the definition of a zonal geography for aggregating land use activities (housing, jobs, etc.) and creating the travel time skims used to define ease of access. For this study, census block groups were used as the base zonal unit of analysis. Block groups provide a level of aggregation roughly analogous to a “neighborhood” and are appropriately sized for analysis of regional transit travel.

However, to provide a finer level of detail and more precisely model walk access and egress in the immediate vicinity of North Avenue, block groups were disaggregated to the block scale. This disaggregation was done for any block group having a portion of its area within a half-mile of a proposed dedicated transit lane.

The blended (block/block group) zonal geography was populated with total jobs and mid-skill jobs to provide two meaningful views into the transit accessibility provided by the Baltimore Link system and the improvements in transit accessibility that could be expected if dedicated transit lanes were implemented on North Avenue. The jobs data provided represent 2012-13 conditions and do not reflect recent major jobs expansions, such as the new Amazon fulfillment center on Broening Highway.

¹ General Transit Feed Specification – the global standard for sharing open transit data



Blended zonal geography (blocks and block groups) and locations of jobs (all jobs vs. mid-skill jobs)

Travel time improvements

To estimate the travel time improvements resulting from the dedicated transit lanes in the build condition, transit stops in the vicinity of North Avenue were analyzed to determine what portion, if any, of travel between two stops would utilize the dedicated lanes. Then, the GTFS schedule data were queried to determine which of these stop-to-stop pairs were actually part of the Link service design. For all stop-to-stop segments found utilizing the dedicated lanes, the travel time between the stops was reduced at a rate of one minute per mile² of travel on dedicated lanes. This stop-to-stop time savings was accumulated along a given trip such that downstream stops were also served more quickly.

For example, a trip on route A proceeds from stop X to stop Y in 2 minutes in the base condition. In the build condition, this portion of the trip would run on dedicated transit lanes for half a mile. The improved travel time would be 1.5 minutes (2 minutes in the original minus 30 seconds saved due to the dedicated lanes). From stop Y, the trip proceeds to stop Z, taking 1 minute in the base condition. The segment from stop Y to stop Z will not utilize dedicated lanes, but the arrival time at stop Z will still be advanced by 30 seconds in the schedule, reflecting the 30 seconds saved upstream between stops X and Y. Thus, the dedicated lanes reduce travel time between stops X and Y as well as between stops X and Z, but they have no impact on the elapsed time between stops Y and Z.

Updating the schedule using the one minute per mile rate raised the potential issue of travel time between stops becoming negative. The GTFS feed developed for the build

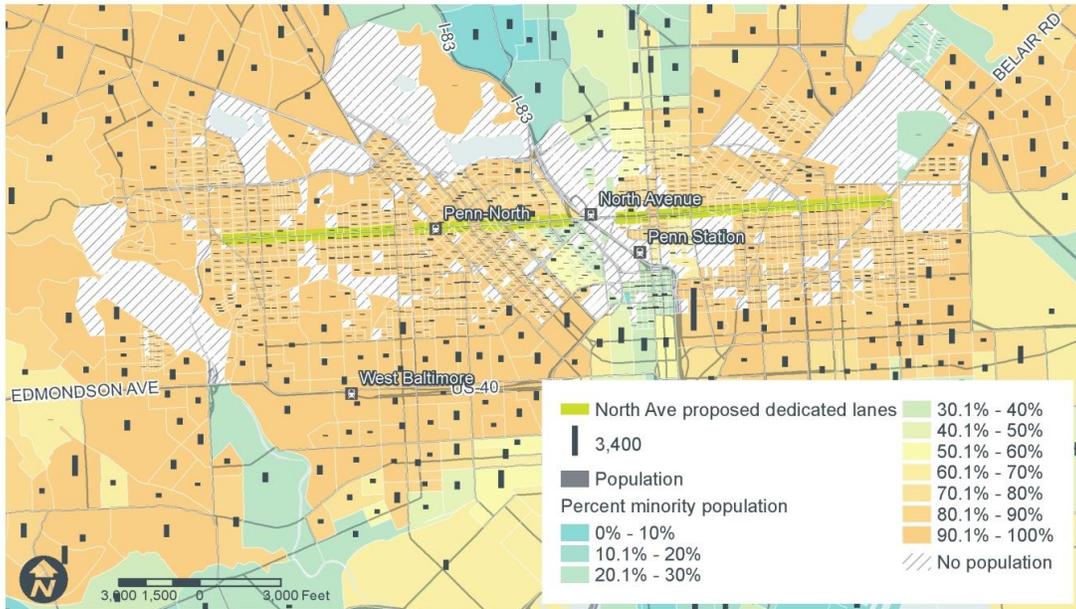
² Per Transit Capacity and Quality of Service Manual, 3rd Edition (2013), page 6-29 (see Exhibit 6-24)

condition was therefore run through a third-party validation software that (among other things) detects “time travel” problems with the feed, and none were found.

Disadvantaged populations analysis

To evaluate the demographic equity of the accessibility impacts from dedicated bus lanes, accessibility outcomes were summarized using weighted average scores for several different segments of the population in the Link service area generally³ and in the North Avenue corridor specifically. The focus of the equity analysis was on population segments generally considered “disadvantaged” (low income groups and minorities).

The weighted average of transit accessibility scores in the base and build scenarios were developed based on each zone's share of a given population group. For example, zone A represents one percent of the entire minority population found within the study area. It's transit accessibility score in the base condition is 183,000. It's contribution to the weighted average base score for minorities is $183,000 * 0.01$ or 1,830. This process is repeated and summed for all zones to reflect the average condition for the entire population in the study area. The weighted scores are then compared to determine the relative differences in transit accessibility experienced by different segments of the population and how the proposed dedicated transit lanes will impact these various groups.



Population and percent minority by zonal geography in the North Avenue corridor

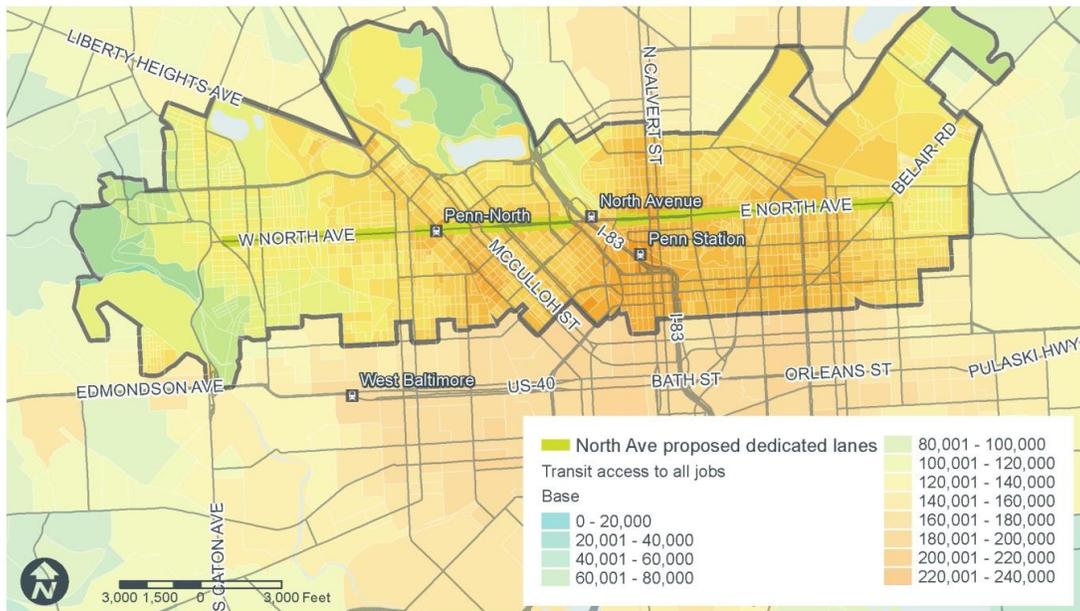
³ For purposes of the demographic analysis, the Link service area was limited to block groups within a half-mile of a Link transit stop and focused only on block groups in Baltimore City or Baltimore County.

The North Avenue corridor is a majority minority area in which nearly 90% of the population is non-white, and roughly a third of households live below the poverty line. These conditions mean that the corridor is poorer and has a larger share of minorities than the Link service area as a whole, which is about 50% non-white with just under 15% of households living in poverty.

Findings

The proposed dedicated transit lanes provide increased transit accessibility to all jobs and mid-skill jobs throughout the Link service area. The median expected increase in access to all jobs was 2.8 percent over the base condition; for mid-skill jobs it was 2.5 percent. Within the North Avenue corridor, however, the median expected increase was 3.7 percent for all jobs and 3.5 percent for mid-skill jobs. The North Avenue corridor is more sensitive to the speed provided by the dedicated lanes due to their immediate proximity – accelerating travel times to nearby opportunities that are favored by the decay formula – and because of the use of a finer-grained scale of analysis (blocks rather than block groups) along the corridor.

In the base condition, minorities have typically better transit accessibility conditions than whites throughout the region, but the relatively small white population in the North Avenue corridor has better transit accessibility than minorities in the corridor. This is true for all jobs and mid-skill jobs in roughly equal proportion. The white population in the North Avenue corridor is concentrated primarily around the University of Baltimore and the Maryland Institute College of Art, which are right in the center of the corridor and adjacent to Penn Station. Being so near a transit hub, this part of the corridor is more transit accessible than its eastern and western extremities.

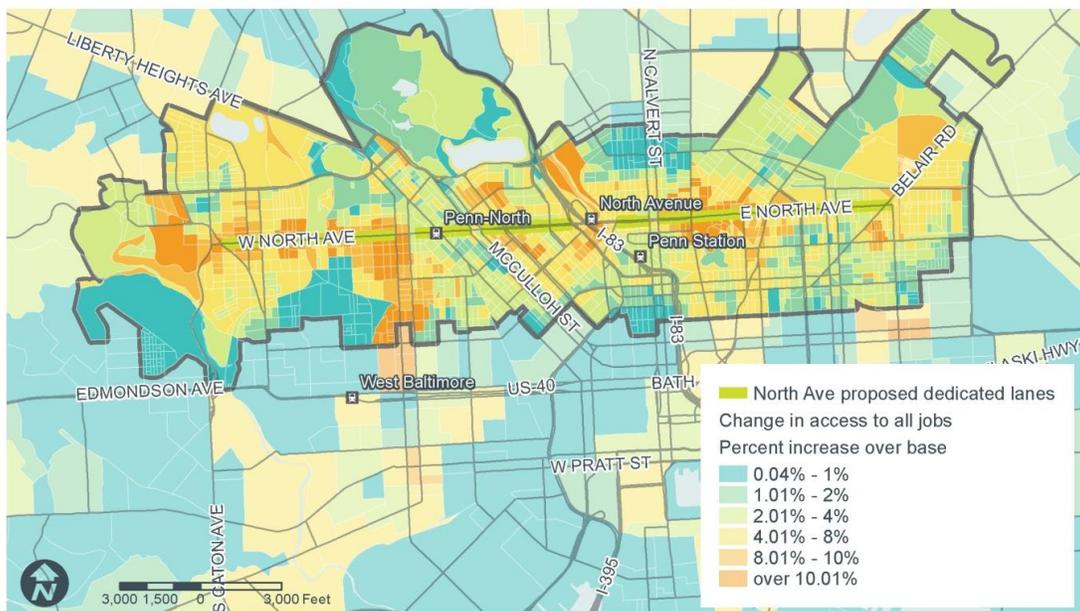


Access to jobs by transit in the North Avenue corridor

From an income perspective, the base condition is more equitable. Households earning below the poverty line have transit accessibility values roughly equal to (and slightly higher than) households earning more. At the regional scale, households below the poverty line have transit accessibility values that far exceed those of higher earning households. This reflects the tendency for middle and upper income households to elect to live in low density, suburban locations that are difficult to serve with transit.

In the build condition, transit accessibility increases slightly for all population segments. The weighted-average increase for minorities is estimated to be about 2.5% compared to 1.6% for whites. This translates to about 2,350 additional commute opportunities reachable by transit (roughly 600 mid-skill positions) for the average person among minorities compared to 1,030 (260 mid-skill) for the typical white resident. Within the North Avenue corridor, the increases are estimated at 4.8% for minorities compared to 3.8% for whites. This indicates that the improved east-west speed provided by the dedicated transit lanes will help to rectify some of the imbalance in transit accessibility within the corridor. Since North Avenue is in a highly urban setting, minor increases in service speed can have significant impacts on the opportunities reachable by transit. The 4.8% increased accessibility equates to roughly 7,500 additional job opportunities (1,950 mid-skill) for an average minority resident in the corridor.

Similar increases are expected for low income households in the corridor. Low income households in the North Avenue corridor already have slightly higher transit accessibility scores, and the dedicated transit lanes will provide an improvement for low income households that is slightly better than the improvement estimated for other households.



Increase in access to jobs in the North Avenue corridor

Overall the expected increase in transit accessibility appears to be both significant and equitable, primarily within the North Avenue corridor but also throughout the Link service area.

Data

GTFS data were provided for the base condition by MTA via MDOT. The feed provided was run through GTFS validation software that uncovered several problematic records in the stop_times table. Specifically, some stop times records had arrival times that were earlier than the departure time from the previous stop. These were isolated incidences that were relatively easy to repair. The feed was updated by Renaissance to interpolate arrival times for these records.

The GTFS feed representing the build condition was developed by Renaissance based on the (repaired) base GTFS feed. The stop_times table was updated for trips utilizing at least some portion of the proposed dedicated transit lanes. The locations of “all jobs” were obtained from the Central Maryland employment dataset, which has been used in MDOT’s past accessibility studies. The dataset combines InfoUSA points reflecting private and government jobs not with the US Department of Defense with MWCOG & BMC TAZ data to cover employment at DOD sites. Some manual modifications were made to these data to account for large employment campuses (National Institute of Health, e.g.).

Mid-skill jobs data were obtained from LEHD for 2013 at the block level. In LEHD, jobs are reported by educational attainment status using four categories – 1. Less than high school, 2. High school diploma or equivalent, 3. Some college or associate degree, and 4. Bachelor’s or advanced degree. Mid-skill jobs were defined for this study as those in category 3 above. The block level data were summarized to the block group level and joined at the appropriate scale to match the blended zonal geography used in the analysis.

The locations of proposed transit lanes were provided by MTA via MDOT using Google Maps.

Disadvantaged populations data were obtained from the American Community Survey via American FactFinder at the block group level. The ACS tables collected include:

ID	TITLE	YEAR	DATA SET
B02001	Race	2014	2014 ACS 5-year estimates
B17017	Poverty Status in the Past 12 Months by Household Type by Age of Householder	2014	2014 ACS 5-year estimates
B16002	Household Language by Household Limited English Speaking Status	2014	2014 ACS 5-year estimates