Green Line LRT:
Job Accessibility Impacts in
Minneapolis and Saint Paul

Final Report

Prepared by:

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This report presents the results of an analysis of accessibility to jobs for all Census blocks in Minneapolis and Saint Paul, MN, before and after the start of Green Line LRT service. Accessibility, also referred to as “connectivity,” measures the potential for interactions between people and destinations in different locations. The accessibility metric used in this analysis is the number of jobs that can be reached by transit within 30 minutes of travel during the 7–9 AM period. For example, from an individual block it might be possible to reach 10,000 jobs within 30 minutes by transit on average between 7 and 9 AM.

Residents of Saint Paul experience the greatest increase in access to jobs: a year after the opening of the Green Line, workers in Saint Paul can, on average, reach over 2,000 more jobs within 30 minutes by transit than they could previously — a 5.3% increase.

This analysis suggests that had the Green Line been implemented without any supporting changes to the regional bus network, accessibility benefits would have been limited to areas near the new rail stations. The relatively low residential density of the area means that a single transit line (whether bus or rail) can reach only a small minority of residents. A well-designed network of routes can provide access to a much larger area, and can help distribute the benefits of new investments like the Green Line throughout the community.
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Executive Summary

This report presents the results of an analysis of accessibility to jobs for all Census blocks in Minneapolis and Saint Paul, MN, before and after the start of Green Line LRT service. Accessibility, also referred to as “connectivity,” measures the potential for interactions between people and destinations in different locations. The accessibility metric used in this analysis is the number of jobs that can be reached by transit within 30 minutes of travel during the 7–9 AM period. For example, from an individual block it might be possible to reach 10,000 job within 30 minutes by transit on average between 7 and 9 AM.

Accessibility is evaluated for three scenarios. The 2014 scenario uses actual transit schedules as of April 2014, prior to the start of Green Line service. The 2015 scenario uses actual transit schedules as of April 2015, which reflects the new Green Line LRT service as well as changes to the regional bus network, including those described in Metro Transit’s Central Corridor Transit Service Study Final Report. Finally, a hybrid scenario uses schedules from 2014, modified to include current Green Line service and changes to parallel bus routes, but no changes to other bus routes. The study area for this analysis is the cities of Minneapolis and Saint Paul, MN. Accessibility was evaluated for 10,446 Census blocks with this area.

The map on the following page illustrates the changes in access to jobs by transit for every block in Minneapolis and Saint Paul between April 2014 and April 2015. Residents of Saint Paul experience the greatest increase in access to jobs: a year after the opening of the Green Line, workers in Saint Paul can, on average, reach over 2,000 more jobs within 30 minutes by transit than they could previously — a 5.3% increase. Broad areas of western Saint Paul saw increases in accessibility, with the greatest percentage increases occurring in the areas surrounding Lake Como, along Lexington Parkway, and along University Avenue between Raymond and Vandalia Avenues. Within these areas, many individual blocks saw accessibility increases of over 50%. In the location with the largest increase — along Dale Street North just south of Larpenteur Avenue — the number of jobs reachable within 30 minutes by transit more than doubled.

By comparing the hybrid scenario with both 2014 and 2015, it is possible to estimate the accessibility impacts of the Green Line itself separately from the impacts of changes to connecting routes in the regional bus network. This analysis suggests that had the Green Line been implemented without any supporting changes to the regional bus network, accessibility benefits would have been limited to areas near the new rail stations. The relatively low residential density of the area means that a single transit line (whether bus or rail) can reach only a small minority of residents. A well-designed network of routes can provide access to a much larger area, and can help distribute the benefits of new investments like the Green Line throughout the community.
Accessibility change between 2014 and 2015 scenarios

Change in number of jobs within 30 minutes by transit

- < -100%
- -100% – -50%
- -50% – -25%
- -25% – -10%
- -10% - +10%
+ 25% – +50%
+ 10% – +25%
+ 50% – +100%
> +100%
1 Overview

This report presents the results of an analysis of accessibility to jobs for all Census blocks in Minneapolis and Saint Paul, MN, before and after the start of Green Line LRT service. Accessibility refers to a measure of the potential for interactions between people and destinations in different locations. The accessibility metric employed in this analysis is the number of jobs that can be reached by transit within 30 minutes of travel during the 7–9 AM period.

Accessibility is evaluated for three scenarios. The 2014 scenario uses actual transit schedules as of April 2014, prior to the start of Green Line service. The 2015 scenario uses actual transit schedules as of April 2015, which reflects the new Green Line LRT service as well as changes to the regional bus network, including those described in Metro Transit’s Central Corridor Transit Service Study Final Report [2]. Finally, a hybrid scenario uses schedules from 2014, modified to include current Green Line service and changes to parallel bus routes, but no changes to other bus routes. The study area for this analysis is the cities of Minneapolis and Saint Paul, MN. Accessibility was evaluated for 10,446 Census blocks with this area.

Accessibility evaluation relies on detailed travel time calculations and demographic data. Section 2 describes the data sources used and the methodology that was applied to calculate job accessibility. The results of this analysis are presented in Section 3.

1.1 About the Green Line

The Green Line is a light rail transit route operated by Metro Transit that runs eleven miles between downtown Minneapolis and downtown Saint Paul, MN. It connects and interlines with the Blue Line in downtown Minneapolis, and also serves the University of Minnesota, the Minnesota state capitol, the University Avenue commercial corridor, and several major sport and event facilities. The Green Line was constructed at a cost of $957 million between 2010 and 2014; it opened on June 14, 2014.

2 Methodology

This analysis follows the methodology used to evaluate transit accessibility to jobs in the Accessibility Observatory’s Access Across America series of reports, with data sources updated to reflect Green Line LRT service and other changes in the regional transit network. The following sections provide a brief overview of this methodology, which is described more fully in Access Across America: Transit 2014 Methodology. [3, 4]

2.1 Data

Transportation Network Data

Data describing the pedestrian network in Minneapolis were obtained from OpenStreetMap, an open-access online database of transportation network data and other information. The data used in this analysis was retrieved from OpenStreetMap in April 2015 and includes features with “footway,” “pedes-
“pedestrian,” and “residential” tags. These reflect dedicated pedestrian-only features as well as sidewalks associated with typical city streets.

Schedules published by Metro Transit and the Minnesota Valley Transit Authority were used to describe the transit network before and after the start of Green Line LRT service. Metro Transit’s schedule datasets include descriptions of service provided by other operating agencies; together, these datasets reflect all fixed-route transit service in the region. Three different network scenarios were analyzed; these are described below.

**2014 Scenario**  The 2014 scenario is based on actual weekday service schedules published in April 2014. April was chosen because it is the last month prior to the start of Green Line service which includes all transit service operating during the school year. (Beginning in May, service on some routes is modified or reduced to reflect lower ridership to academic destinations during the summer months.)

**2015 Scenario**  The 2015 scenario is based on actual weekday service schedules published in April 2015, just under one year since the start of service on the Green Line. This scenario reflects the post-Green Line transit network, and includes additional service changes beyond the new Green Line LRT service itself. A significant number of changes to local and express bus routes were implemented by Metro Transit simultaneously with the start of Green Line service, and were designed to integrate the existing bus network with the new light rail line. These changes are described in the *Central Corridor Transit Service Study Final Report* [2]. The 2015 schedule also includes some transit service changes not related to the Green Line or the Central Corridor Service Study.

**Hybrid Scenario**  The hybrid scenario was created by combining elements of the 2014 and 2015 scenario networks. It is intended to represent a hypothetical scenario where the Green Line is added and bus routes parallel to the Green Line are modified, but no other changes are made to the regional bus network. This scenario was constructed as follows:

1. Start with 2014 schedules.
2. Remove all data for routes 16 and 50.
3. Add route 16 data from 2015 schedules.

Routes 16 and 50 require special handling because they largely follow the same alignment as the Green Line, running between downtown Minneapolis and downtown Saint Paul along University Avenue. Route 16 is a local route, stopping approximately at every block, and route 50 was essentially a limited-stop variant of route 16. When Green Line service began, route 50 was eliminated and the service frequency of route 16 was adjusted to reflect its new role as a local connector to the Green Line. This scenario assumes that even if no other changes were made to the regional bus network, these changes would still have been made.
Employment Data

Data describing the distribution of employment in the region are drawn from the U.S. Census Bureau’s Longitudinal Employer-Household Dynamics program (LEHD). The LEHD Origin-Destination Employment Statistics (LODES) datasets for 2011, the most recent available at the time of this analysis, provide Census block-level estimates of employee home and work locations. LODES is updated annually and is based on payroll records collected at the state level — in this case, by the Minnesota Department of Employment and Economic Development. LODES data are created by an algorithm designed to produce data which are statistically similar to the underlying data, and which converge to the same distribution when aggregated. [5]

2.2 Accessibility Calculation

The accessibility results presented in this report were calculated using a cumulative opportunities accessibility metric. In this approach, the accessibility level of a given origin location is determined by the number of opportunities that can be reached within a given travel time threshold. This analysis adopted a travel time threshold of 30 minutes, and therefore the accessibility metrics represent the number of jobs that can be reached from each origin within 30 minutes.

Origins and Destinations

Census blocks, defined in 2010 by the U.S. Census bureau, were used as origin and destination points for this analysis. In urban areas, Census blocks typically correspond to “city blocks” — small areas enclosed by roads. The origin set was comprised of the centroid points of all Census blocks within Minneapolis and Saint Paul, MN that contained some amount of land, for a total of 10,446 origin points. To avoid understating the accessibility of blocks at the edge of this area, the destination set included blocks in a slightly wider area.

Travel Time Calculation

Travel time calculations considered all components of travel by transit, including time spent walking to a stop or station, time spent waiting for a trip departure, time spent traveling on a transit vehicle, and time spent walking to a destination after alighting. An unlimited number of transfers was allowed, and time spent walking to and waiting for transfers was included.

This analysis used the assumption that all walking portions of a trip take place at a speed of 5 kilometers per hour (3.1 miles per hour). On-vehicle travel time was derived directly from published transit timetables, under an assumption of perfect schedule adherence.

Jobs that can be accessed by walking only are included in the accessibility totals; a transit component is not strictly required. This allows the most consistent application and interpretation of the travel time calculation methodology. The shortest walking path from an origin to a transit stop/station in some cases passes through potential destinations where job opportunities exist; these destinations were included even though transit is not required to access them.

Accessibility by transit is strongly dependent on departure time because of the scheduled nature of transit service. For example, if a transit route’s service frequency is 20 minutes, then immediately after
a vehicle departs all destinations become 20 minutes “farther away.” To address this and to reflect the influence of transit service frequency on accessibility, travel times were calculated repeatedly for each origin-destination pair using each minute between 7:00 and 8:59 AM as the departure time.

**Cumulative Opportunities Calculation**

Using the travel time calculations described above, a set of destinations reachable within 30 minutes was identified for each origin and departure time, and the jobs located at the reachable destinations were aggregated to arrive at a single accessibility data point for that origin and departure time. For each origin, the accessibility data for all 120 departure times were then averaged to provide a single accessibility value indicating the number of jobs that can be reached from that origin within 30 minutes, on average, between 7 and 9 AM. These are the values presented and discussed in the following sections.

**Person-Weighted Average Accessibility**

The cumulative opportunities accessibility metric presented here is a *locational* metric rather than an *individual* metric [1] — it describes properties of places within Minneapolis and Saint Paul, rather than properties of their residents. The value of accessibility, however, is only realized when it is experienced by people. To reflect this fact, when accessibility is averaged across multiple blocks in a larger area each block’s contribution is weighted by the number of workers in that block. The result is a single metric that represents the accessibility value experienced by an average worker in that area.

### 3 Results

The following sections discuss the accessibility results in each scenario, as well as the changes between each pair of scenarios. Table 1 through Table 3 provide the specific accessibility results, and the maps in Figure 1 through Figure 3 illustrate accessibility changes for each scenario at the block level.

#### 3.1 2014 vs. 2015

Table 1 describes the accessibility changes between the 2014 and the 2015 scenarios, and Figure 1 maps these changes at the block level. This comparison evaluates the full change in accessibility between April 2014 and April 2015 using the actual operating schedules at each time.

**Table 1:** Job accessibility changes, 2014 to 2015

<table>
<thead>
<tr>
<th>Location</th>
<th>2014</th>
<th>2015</th>
<th>Change</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minneapolis</td>
<td>95,242</td>
<td>93,771</td>
<td>-1,470</td>
<td>-1.5%</td>
</tr>
<tr>
<td>Saint Paul</td>
<td>40,446</td>
<td>42,582</td>
<td>+2,136</td>
<td>+5.3%</td>
</tr>
<tr>
<td>Combined</td>
<td>72,160</td>
<td>72,209</td>
<td>+49</td>
<td>+0.1%</td>
</tr>
</tbody>
</table>
Change in number of jobs within 30 minutes by transit

< -100%
-100% – -50%
-50% – -25%
-25% – -10%
-10% - +10%
+25% – +50%
+10% – +25%
+50% – +100%
> +100%

Figure 1: Accessibility change between 2014 and 2015 scenarios
Residents of Saint Paul experience the greatest increase in access to jobs: a year after the opening of the Green Line, workers in Saint Paul can, on average, reach 2,136 more jobs within 30 minutes by transit than they could previously — a 5.3% increase. Broad areas of western Saint Paul saw increases in accessibility, with the greatest percentage increases occurring in the areas surrounding Lake Como, along Lexington Parkway, and along University Avenue between Raymond and Vandalia Avenues. Within these areas, many individual blocks saw accessibility increases of over 50%. In the location with the largest increase — along Dale Street North just south of Larpenteur Avenue — the number of jobs reachable within 30 minutes by transit more than doubled. Saint Paul’s east side, in contrast, was largely unaffected by transit changes over the past year.

Most areas of Saint Paul near the Green Line route saw increases in accessibility, with two notable exceptions: access to jobs decreased markedly along Snelling Avenue just south of University Avenue, and along North Marion Street between University Avenue and I-94. These are the most visible impacts of changes to route 94, an express bus route using I-94 to connect downtown Minneapolis and downtown Saint Paul. In the 2014 schedules, all trips on route 94 stopped at Snelling Avenue and some visited North Marion Street and the capitol area. With the start of Green Line service, these stops were removed and most route 94 trips now run non-stop between downtown Minneapolis and downtown Saint Paul.

For residents of Minneapolis, transit changes between 2014 and 2015 amounted to a marginal decrease in access to jobs. The most prominent areas of decreased job access are in far northeastern Minneapolis and in south Minneapolis between I-35 and Hiawatha Avenue. Even within these areas, accessibility decreases are fairly minor, rarely exceeding 15% in individual blocks. Some areas of Minneapolis saw modest increases in accessibility including parts of the Longfellow community along 36th Avenue South as well as the Prospect Park neighborhood and nearby areas. Overall, access to jobs for Minneapolis residents decreased by 1.5%.

It is important to recognize that the accessibility changes in most areas of Minneapolis are not directly related to the Green Line project. The study area for Metro Transit’s Central Corridor Transit Service Study Final Report [2] includes only a small part of Minneapolis, beginning downtown and extending east along the Green Line alignment. Thus, the changes in job access for Minneapolis residents are mostly attributable to schedule and service changes made for other reasons.

### 3.2 2014 vs. Hybrid Scenario

Table 2 describes the accessibility changes between the 2014 and the hybrid scenarios, and Figure 2 maps these changes at the block level. This comparison evaluates the accessibility changes that are derived solely from the addition of Green Line service and changes to routes 16 and 50.
Table 2: Job accessibility changes, 2014 to Hybrid

<table>
<thead>
<tr>
<th>Location</th>
<th>2014</th>
<th>Hybrid</th>
<th>Change</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minneapolis</td>
<td>95,242</td>
<td>94,630</td>
<td>-611</td>
<td>-0.6%</td>
</tr>
<tr>
<td>Saint Paul</td>
<td>40,446</td>
<td>41,267</td>
<td>+821</td>
<td>+2.0%</td>
</tr>
<tr>
<td>Combined</td>
<td>72,160</td>
<td>72,152</td>
<td>-7</td>
<td>0.0%</td>
</tr>
</tbody>
</table>
Change in number of jobs within 30 minutes by transit

Figure 2: Accessibility change between 2014 and hybrid scenarios
The accessibility changes related directly to the Green Line show up prominently near Green Line station locations. The blocks with the greatest increase in job access — up to 86% — surround the Raymond Avenue station. Accessibility increases also extend north and south along Lexington Parkway and Victoria Street. In some specific areas, accessibility decreases as a result of changes to route 16 and the elimination of route 50. Most notable are the small area of Minneapolis south of I-94 and east of the Mississippi River, which lost a possible connection to route 50 at the Huron Transit Station, and blocks immediately adjacent to the intersection of University Avenue and Cleveland Avenue, which had been served by route 50 but are now halfway between the nearest Green Line stations. Averaged over all workers in Saint Paul, the transit changes in this scenario amount to a 2% increase in the number of jobs reachable within 30 minutes.

Overall, accessibility changes in the hybrid scenario are limited to the areas immediately adjacent to Green Line stations. This reflects the fact that this scenario includes none of the modifications to the regional bus network which were designed to integrate the new rail line into the surrounding areas by providing connecting transfers. These findings suggest that had the Green Line been implemented without any supporting changes to the regional bus network, accessibility benefits would have been limited to areas near the new rail stations.

### 3.3 Hybrid Scenario vs. 2015

Table 3 describes the accessibility changes between the hybrid and the 2015 scenarios, and Figure 3 maps these changes at the block level. This comparison evaluates the accessibility changes derived from changes to the regional bus network, above and beyond the changes related directly to the Green Line and routes 16 and 50.

<table>
<thead>
<tr>
<th>Location</th>
<th>Hybrid</th>
<th>2015</th>
<th>Change</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
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<td>93,771</td>
<td>-859</td>
<td>-0.9%</td>
</tr>
<tr>
<td>Saint Paul</td>
<td>41,267</td>
<td>41,582</td>
<td>+1,315</td>
<td>+3.2%</td>
</tr>
<tr>
<td>Combined</td>
<td>72,152</td>
<td>72,209</td>
<td>+56</td>
<td>+0.1%</td>
</tr>
</tbody>
</table>
Figure 3: Accessibility change between hybrid and 2015 scenarios
In contrast to the hybrid scenario discussed above, the accessibility increases here are seen in a much wider area including most of western Saint Paul. This reflects the extensive changes made to several bus routes to provide more frequent service and more effective transfers to the Green Line. Additionally, a new local bus route serves Lexington avenue and connects with the Green Line; that road had previously lacked transit service. Lexington Avenue stands out as a corridor of increased access to jobs.

Overall these changes amount to a 3.2% increase in the number of jobs that can be reached within 30 minutes by the average Saint Paul worker — a greater increase than was achieved by the Green Line alone. The relatively low residential density of the area means that a single transit line (whether bus or rail) can reach only a small minority of residents. A well-designed network of routes can provide access to a much larger area, and can help distribute the benefits of new investments like the Green Line throughout the community.

In Minneapolis, the transit changes in this scenario generate both increases and decreases in job accessibility. Most of the Longfellow community sees a gain in accessibility while areas of far north-east Minneapolis, and south Minneapolis between I-35 and Hiawatha Avenue, see minor decreases in accessibility. As discussed above, it is unlikely that these changes are directly related to the Green Line project.

4 Conclusion

Providing access to jobs is a core function of any urban transportation system. This analysis measured access to jobs in Minneapolis and Saint Paul, MN before and after the start of service on the Green Line light rail route. It quantified how much that project, and related changes to the regional bus network, changed residents’ ability to reach jobs by transit.

Those changes were greatest in Saint Paul, where most of the Green Line’s stations are located: a year after the opening of the Green Line, workers in Saint Paul can, on average, reach over 2,000 more jobs within 30 minutes by transit than they could previously — a 5.3% increase. Because this city-wide average includes areas that are far from the Green Line, it can obscure the fact that in locations near Green Line stations and connecting transit routes, accessibility often increased by over 50%, and in a few locations more than doubled. In Minneapolis, changes were minor, and in most cases were due to service or schedule changes unrelated to the Green Line project.

By comparing the hybrid scenario with both 2014 and 2015, it is possible to estimate the accessibility impacts of the Green Line itself separately from the impacts of changes to connecting routes in the regional bus network. This analysis suggests that had the Green Line been implemented without any supporting changes to the regional bus network, accessibility benefits would have been limited to areas near the new rail stations. The relatively low residential density of the area means that a single transit line (whether bus or rail) can reach only a small minority of residents. A well-designed network of routes can provide access to a much larger area, and can help distribute the benefits of new investments like the Green Line throughout the community.

It is important to recognize some of the limitations of this purely accessibility-based evaluation. Transit systems can provide many effects beyond access to jobs, and the full effectiveness of transit systems reflects a range of properties such as reliability and passenger comfort that are not included in this analysis. It is likely that the rail-based Green Line provides far more reliable travel times than did routes
16 and 50, which operated in mixed traffic; this study does not investigate that potential improvement. Additionally, the cumulative opportunities accessibility metric used here, and the selected 30-minute threshold, do not reflect potential travel time improvements to jobs that could already be reached in less than 30 minutes. Despite these limitations, accessibility-based analysis provides a straightforward way to evaluate and communicate some of the important effects of changes in urban transportation systems, and allows this study to quantify some benefits of the Green Line and describe how they are distributed throughout the region.
References


