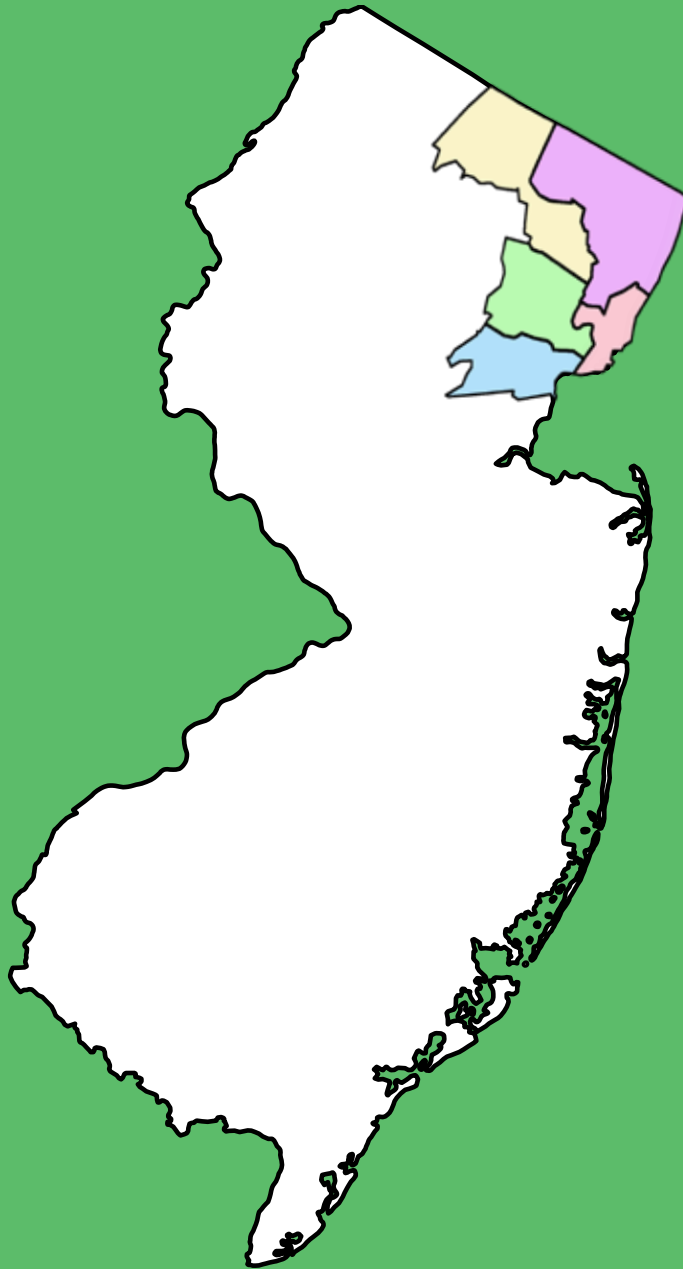


Clean Transportation for All:

Building a Frequent Service Bus Network
for Northeastern New Jersey



SIERRA CLUB
NEW JERSEY CHAPTER

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Table of Contents

Executive Summary	1
Ch. 1 – Introduction	5
What is this study, and why did we do it?	
Ch. 2 – Methodology	7
Ch. 3 – Results	11
Poverty and Frequent Bus Service	15–19
Eastern Hudson County	22–23
Essex County and E. Union County	24–27
Bergen County	28–29
Passaic County	30–31
Ch. 4 – Peer Comparison	33
Ridership Change	36
Promotion	38
Operational Measures	40

Ch. 5 – Recommendations	43
Promote and expand frequent service	45
Expand the frequent service network	49
Rework NJT’s online and mobile resources	52
Other recommendations	53
Operational recommendations – speed and reliability	53
Expand study of frequent bus service	54
Ch. 6 – Conclusion	55
Glossary	58–59
Appendices	60
Appendix 1A – current frequent service corridors	60
Appendix 1B – potential frequent service corridors	65
Appendix 2 – rail service frequency evaluation	73
Endnotes and References	74

Executive Summary

New Jersey Sierra Club (NJSC) has completed a study of **frequent weekday bus service** in Bergen, Essex, Hudson, Passaic, and Union Counties, with the complementary goals of increasing bus ridership and reducing car vehicle miles traveled (VMT). Both goals are critical to addressing **climate change** and promoting **environmental justice**. Promoting and expanding frequent bus service would reduce car dependence, resulting in **cleaner air** locally and **fewer greenhouse gases** globally. New Jersey Transit (NJT) can act now to take an essential step toward the **just and sustainable future** New Jersey needs.

NJSC considered NJT's inter- and intrastate bus routes, bus routes operated by private carriers, and rail transit. This picture of northeastern New Jersey's **extensive frequent service network** led to two main recommendations for NJT: to aggressively **promote** the network, and to **expand** the frequent service network to routes that can be easily incorporated.

To identify the current and potential frequent service network, NJSC used the industry standard of 15-minute headways. In other words, NJSC identified routes where riders **wait no more than 15 minutes** between buses, as well as routes where that standard could be easily met. During **weekdays (6:00 AM–8:00 PM)**, frequent service provides the **backbone** for a frequent service network. NJT can expand on this backbone to provide **"show up and go"** service during **weeknights and weekends** – riders will not have to plan around timetables, because if they miss a bus, another will come along very soon.

Transit agencies around the country have pursued similar strategies to great success (see the report's Peer System

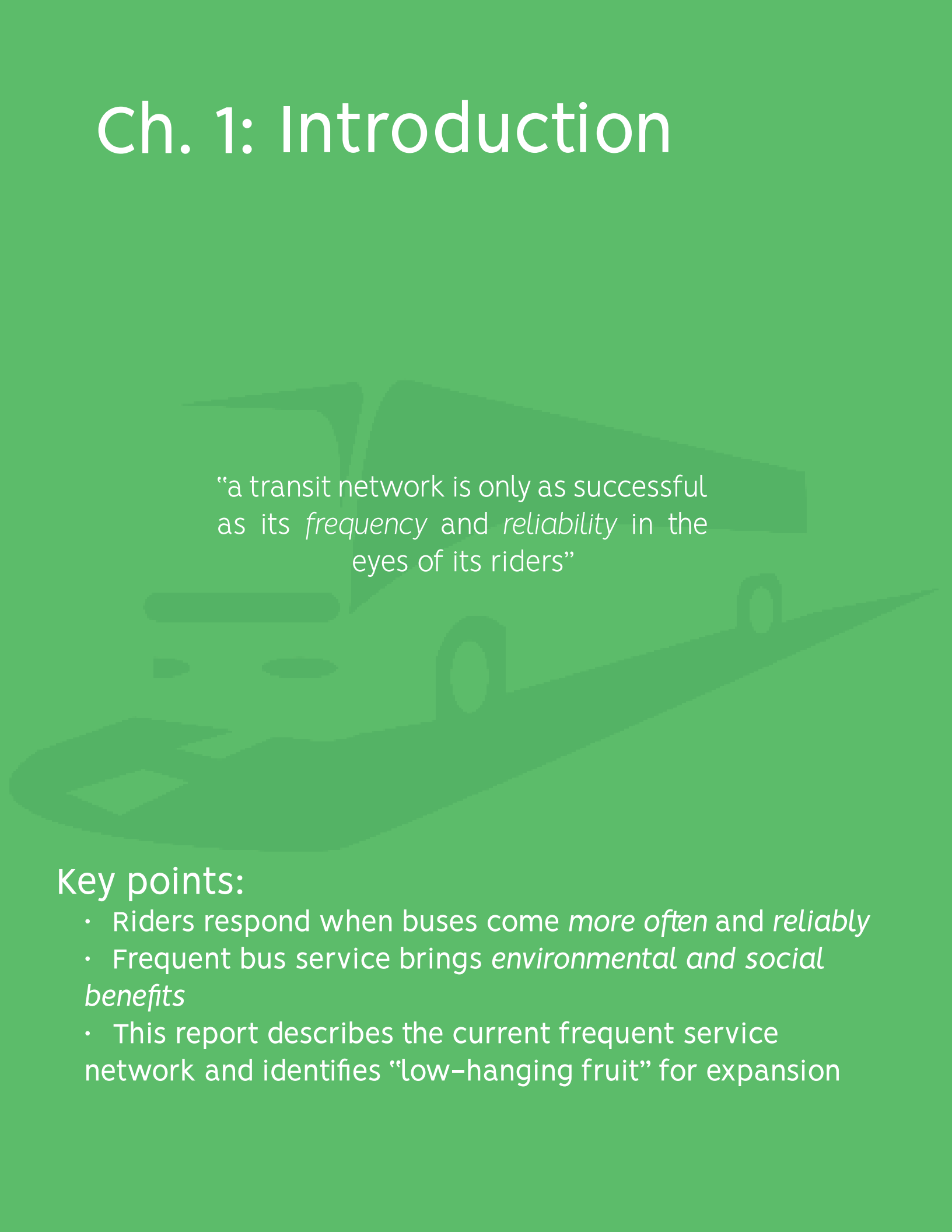
Comparison). Assuming their experience holds true for New Jersey, New Jersey Transit (NJT) could experience **2–3% ridership increases**—on some routes, this would amount to **tens of thousands of additional trips per year**, producing revenue to further expand frequent service and improve NJT’s finances.

Key findings and recommendations included the following:

- Out of roughly 60 candidate corridors, **14 corridors** were identified as corridors that **currently provide frequent service**. Newark and nearby municipalities in Essex and Union Counties accounted for 10, while southern Hudson County accounted for 4.
- **16 corridors** were identified as corridors that **could provide frequent service with minimal investment**. Hudson County accounted for 7 of the corridors, Bergen County for 3, Essex County for 4, and Passaic County for 2.
- NJSC advocates **aggressive promotion** of the frequent service network. In addition, NJSC urges NJT to create **promotional materials** describing the frequent service network, for distribution online, at bus stops, and at major destinations (e.g. malls and hospitals) and to **engage** communities that will benefit.
- Related recommendations for **NJT’s digital presence** are included in an accompanying report. These recommendations will ensure NJT’s riders can easily and reliably access service information, helping to **build rider confidence** that is essential to successful **“show up and go”** transit service.
- NJSC urges NJT to work with NJDOT, counties, and municipalities to improve bus runtime and on-time performance through measures like **bus priority lanes** and **traffic signal priority**. These measures will ensure that the scheduled service that riders expect reflects the actual service that they experience.

Northeastern New Jersey’s backbone of frequent bus service can be inexpensively and quickly expanded to benefit many more people. To fight climate change, reduce air pollution, and advance environmental justice, NJSC strongly encourages NJT to promote and expand the frequent bus network, as outlined in the following report.

Ch. 1: Introduction



“a transit network is only as successful as its *frequency* and *reliability* in the eyes of its riders”

Key points:

- Riders respond when buses come *more often* and *reliably*
- Frequent bus service brings *environmental and social benefits*
- This report describes the current frequent service network and identifies “low-hanging fruit” for expansion

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Introduction

What is this study, and why did we do it?

Public transportation can build thriving communities and prosperous economies, but a transit network is only as successful as its **frequency** and **reliability** in the eyes of its riders. As the most densely populated state in the nation, it is even more crucial that New Jersey's public transportation system address this motivating factor for its riders, both to build the trust and confidence of its 263,925 daily bus riders and to realize significant environmental benefits.¹

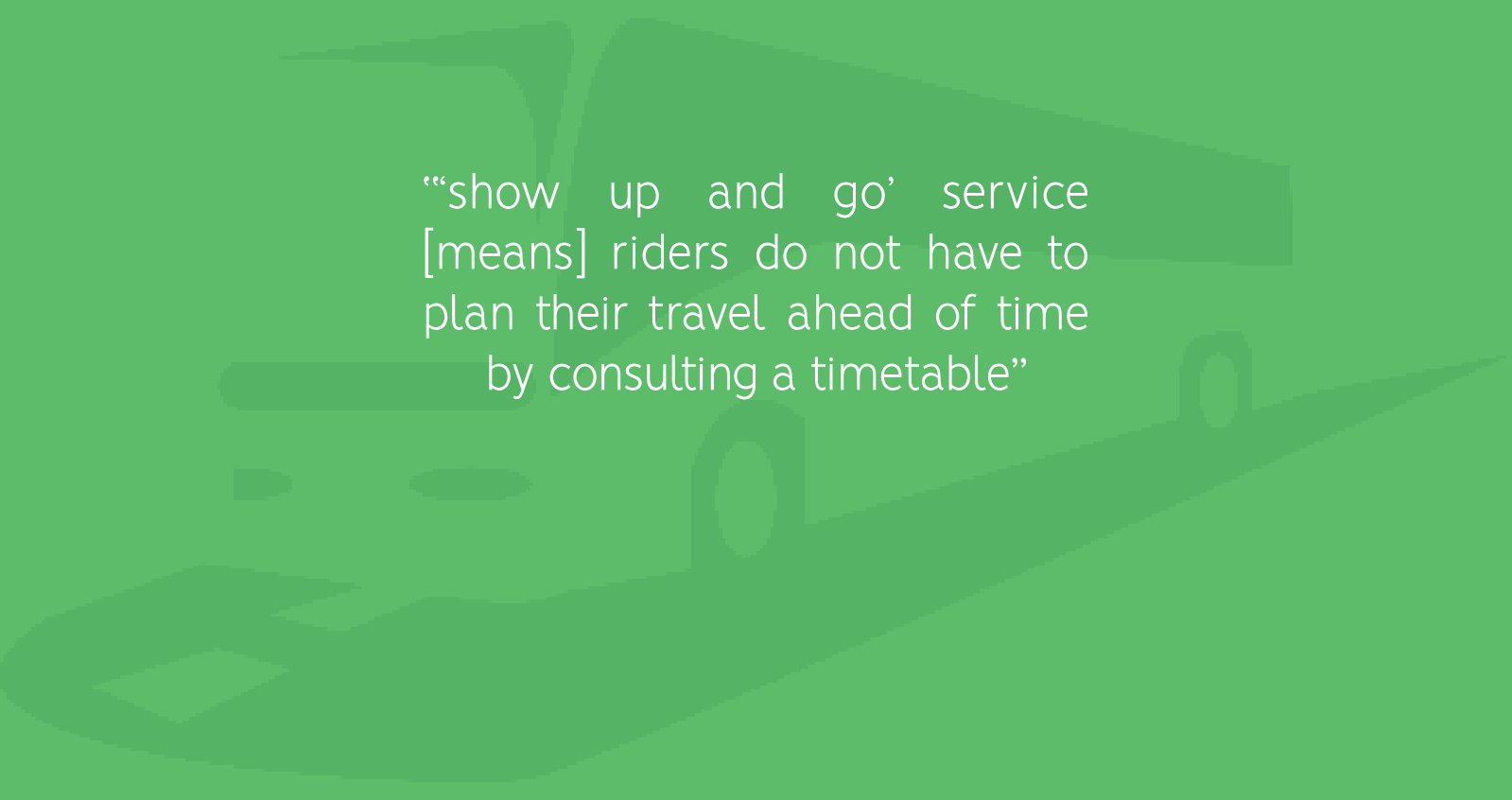
In his book *Human Transit*, public transportation consultant Jarrett Walker notes that "to be useful, transit must exist in both space and time."² While geographic **coverage** is key to maximizing the reach of New Jersey Transit (NJT)'s bus service, without seriously considering the **frequency** of that service, **key demographics are prevented from making use of its network**. As such, NJT should advertise not only the location of their routes, but the **timeliness** of those services as well, in a way that makes clear the frequency of a stop's bus schedules. **More people will ride a bus that comes every 10 minutes than will ride one that comes every 20 minutes**.

There are clear benefits to transit agencies, to the environment, and to society as a whole from increased use of public transit, and many agencies have adopted frequent service networks to achieve that goal. Houston, for example, saw a **ridership increase of 3%** by aggressively publicizing its

redesigned bus network.³ Applied to NJT's 69.9 million bus riders in northern New Jersey in FY 2018, a 3% ridership improvement would see an additional **2.1 million new trips**.⁴ From an environmental standpoint, assuming the distance of the average bus ride is 3 miles and that each additional bus ride is a car trip not taken, this would translate into an annual **reduction in automotive vehicle miles traveled (VMT) of 6.3 million miles**. Not only would such a measure benefit urban communities by reducing greenhouse gas emissions and air pollution along our most traveled transit corridors, it would also improve the profile of NJT's bus service and demonstrate its commitment to the communities served.

The purpose of this study is to encourage NJT to **increase access to frequent bus service** in the study area by publicizing and adding to the existing frequent service network. NJSC set out to determine which routes are "low-hanging fruit" for inclusion in the existing frequent service network – the Methodology section, below, briefly describes how NJSC did so.

Ch. 2: Methodology



“show up and go’ service
[means] riders do not have to
plan their travel ahead of time
by consulting a timetable”

Key points:

- “Frequency” defined as 15-minute headways, weekdays 6:00 AM to 8:00 PM
- Based on this standard, NJSC identified a “backbone” of weekday frequent bus service

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Methodology

Our methodology involved three basic steps: (1) define a **frequency standard**; (2) analyze the **existing bus network** in northeastern New Jersey against that standard; and (3) assess where **additional service or slight schedule modifications** could expand the scope of the current frequent service network.

Frequency standards

In many of the reviewed peer systems, the standard for frequent bus service is **15-minute headways or better** – in other words, service where **a bus arrives at least every 15 minutes** at each stop. Ideally, bus service at this frequency allows riders to start to think of the bus as a “show up and go” service, or one where riders do not have to plan their travel ahead of time by consulting a timetable. Especially if provided consistently all day long, this level of service results in a bus network that riders can rely on as a **convenient, ever-present travel option**.

This report focuses on weekday frequent service as the potential **backbone** of a frequent bus network in northeastern New Jersey. **For our purposes, “frequent” service is provided along any lengthy (roughly 1 mile or greater) stretch of road where a bus stops every 15 minutes or better, between 6:00 AM and 8:00 PM on weekdays.** To be truly comprehensive, a frequent service network should meet similar standards of frequency on **weekends** and into the late **evening**. However, NJSC’s aim was to assess the backbone provided by weekday service between 6 AM and 8 PM, a period when large amounts of work-related travel takes places and when service improvements could have the largest impact.

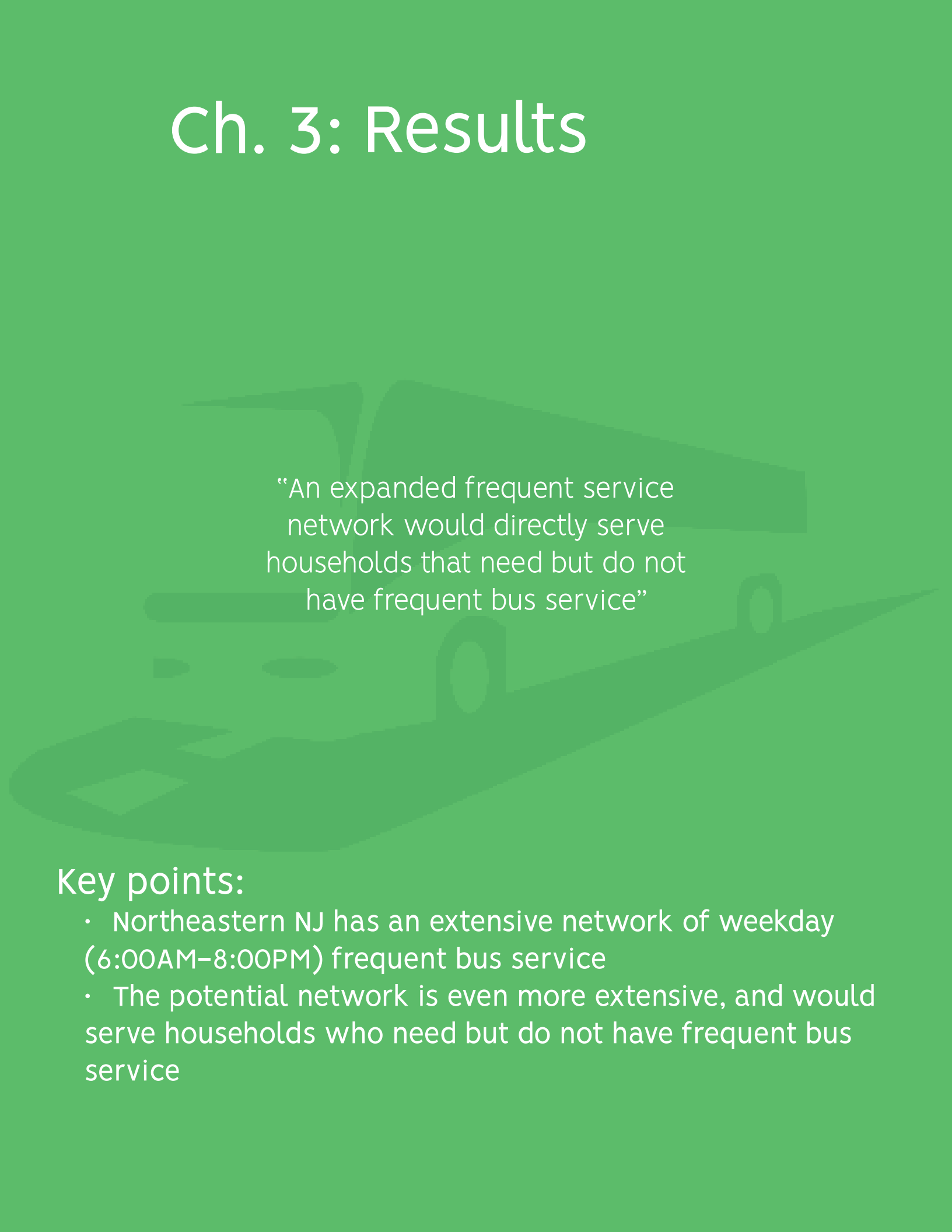
Identifying the current and potential network

With a frequency standard defined, NJSC evaluated bus routes in northeastern New Jersey according to how close they come to meeting that standard. NJSC collected **autumn 2019 schedule information** from NJT and other carriers in the study area. (NJT does not currently host schedule information for other carriers on its website or mobile app – related recommendations are included in the accompanying report, **“Improving Access to New Jersey Public Transit Information”**.) Based on the timetables, NJSC **identified bus routes** that, individually or in combination, provide a frequency of service that could allow 15-minute headways or better.

With this smaller set of routes and corridors identified, NJSC **examined each route’s timetable** to answer two questions: does service currently meet the 15-minute standard? And, if it does not, how could service be changed or supplemented to reach frequency?

For example, a particular bus stop served by multiple routes might see 6 departures in an hour. These departures could be scheduled to provide 10-minute headways (at 6:00 PM, 6:10 PM, 6:20 PM, 6:30 PM, 6:40 PM, and 6:50 PM), but they could also be scheduled in a way that would not meet the frequency standard (with departures at 6:00 PM, 6:05 PM, 6:10 PM, 6:20 PM, 6:30 PM, and 6:50 PM). The **results** section below provides a summary of this timetable-by-timetable analysis.

Ch. 3: Results



“An expanded frequent service network would directly serve households that need but do not have frequent bus service”

Key points:

- Northeastern NJ has an extensive network of weekday (6:00AM–8:00PM) frequent bus service
- The potential network is even more extensive, and would serve households who need but do not have frequent bus service

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Results

The **full results** of the frequency analysis are provided in **Appendix 1**, describing each corridor and its characteristics. A brief overview is provided here to contextualize the recommendations in the next section.

NJT and the several private operators in northeastern New Jersey **currently provide an extensive network of frequent bus service**. In terms of complexity and geographic scope, the network is on par with or exceeds the similar weekday networks highlighted in the peer comparison. Currently, frequent service is provided most comprehensively in Newark and its environs in Essex county, as well as along some corridors in eastern Hudson County.

However, this network **could be inexpensively and conveniently expanded** to be even more comprehensive. The potential network highlighted in the maps on the following pages would provide more extensive coverage of Essex and Hudson Counties, while expanding service in dense and growing parts of southeastern Passaic and southern Bergen Counties.

Equally important, the expanded network would connect **major destinations** that are currently unconnected by frequent bus service. **Paterson, Clifton, and Passaic**, each among the state's densest municipalities, would be connected along Main Avenue. In Newark, the **99 crosstown** would provide frequent service between **several major hospitals** and other medical service providers. An expanded frequent service network would facilitate these types of connections throughout the study area,

linking transportation facilities, schools, medical facilities, recreational centers, and more.

Notably, the current and potential frequent service networks pass through many tracts with high levels of poverty. The maps on the following pages show this relationship for the entire study area. In Hudson County, for example, the current network (in darker green) passes through Census tracts where as many as **35% of residents have poverty-level incomes**.

But the study area also has tracts without consistently frequent weekday bus service, and many of these tracts are home to large numbers of low-income households. NJSC's analysis shows that the potential frequent service network would serve many of these tracts. An expanded frequent service network would **directly serve households that need but do not have frequent bus service**. In southern Hudson County, for example, a frequent service network would put many households in reach of rapid public transit that do not now live near the PATH or one of the several currently frequent bus routes.

Poverty and Frequent Bus Service – Hudson County



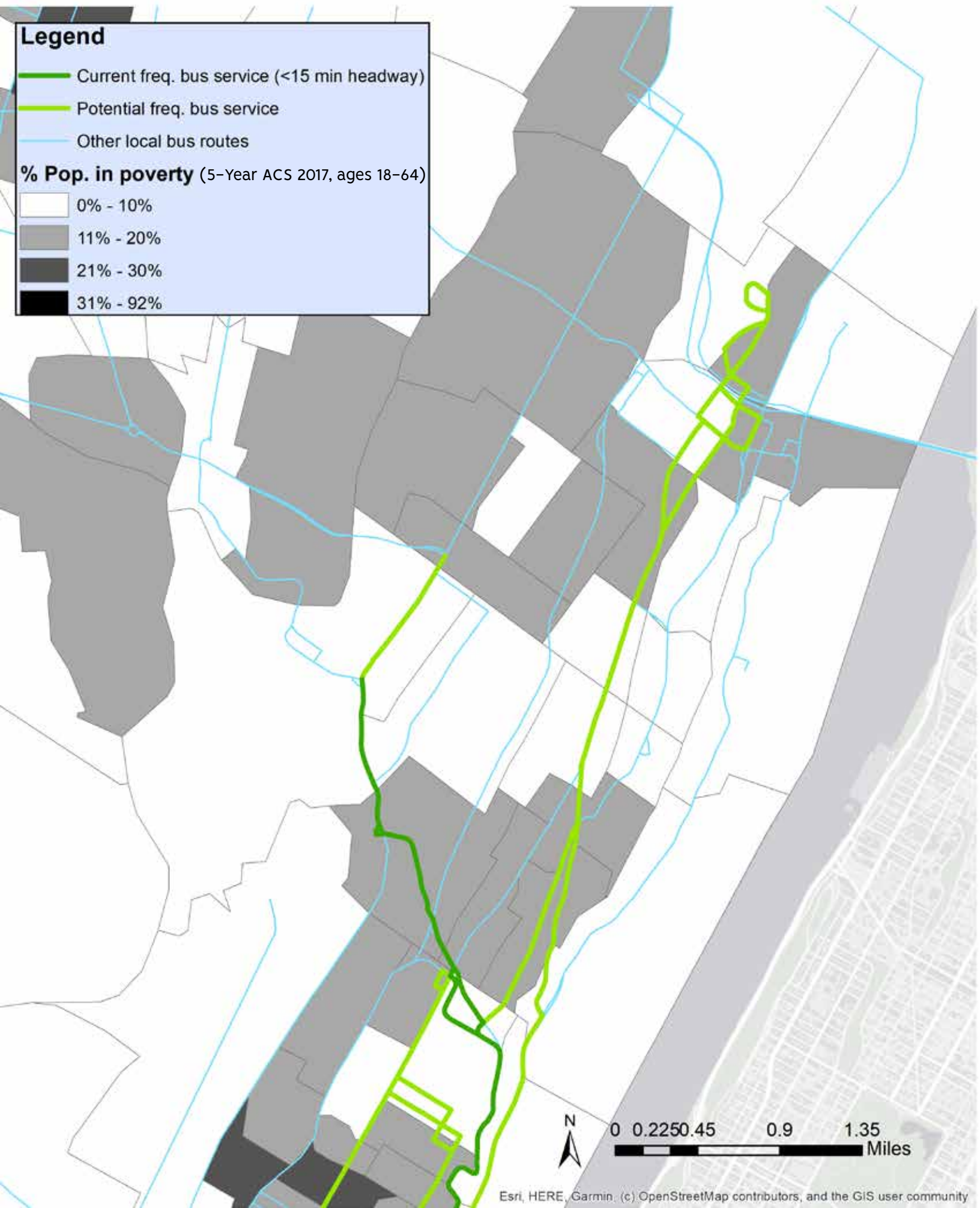
Poverty and Frequent Bus Service – Bergen County

Legend

- Current freq. bus service (<15 min headway)
- Potential freq. bus service
- Other local bus routes

% Pop. in poverty (5-Year ACS 2017, ages 18-64)

0% - 10%
11% - 20%
21% - 30%
31% - 92%



Poverty and Frequent Bus Service – Essex and Eastern Union Counties

Legend

— Current freq. bus service (<15 min headway)

— Potential freq. bus service

— Other local bus routes

Rail stations

● PATH

● HBLR

Rail lines

— Commuter rail

— PATH (frequent)

— HBLR (frequent)

— HBLR (infrequent)

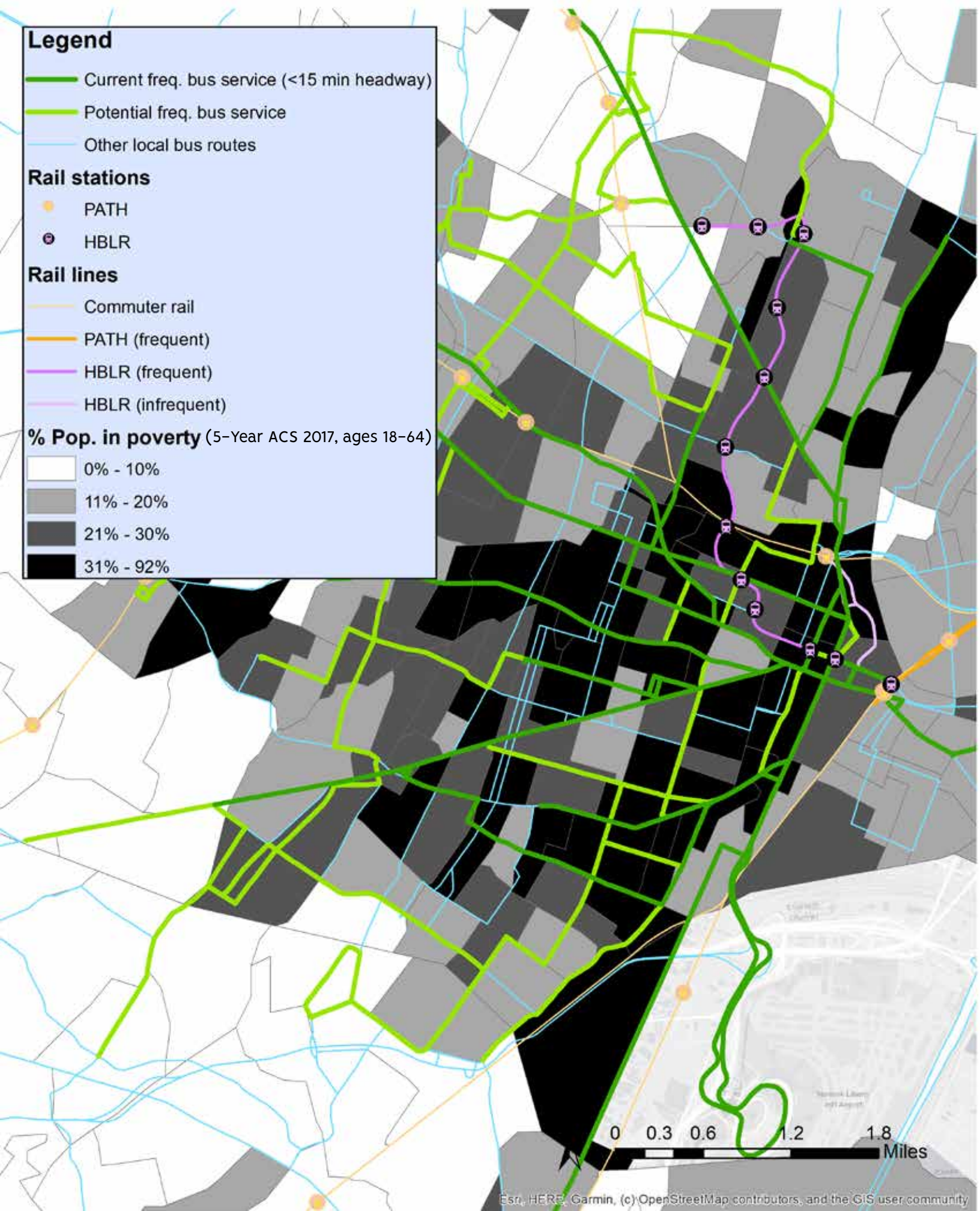
% Pop. in poverty (5-Year ACS 2017, ages 18–64)

0% - 10%

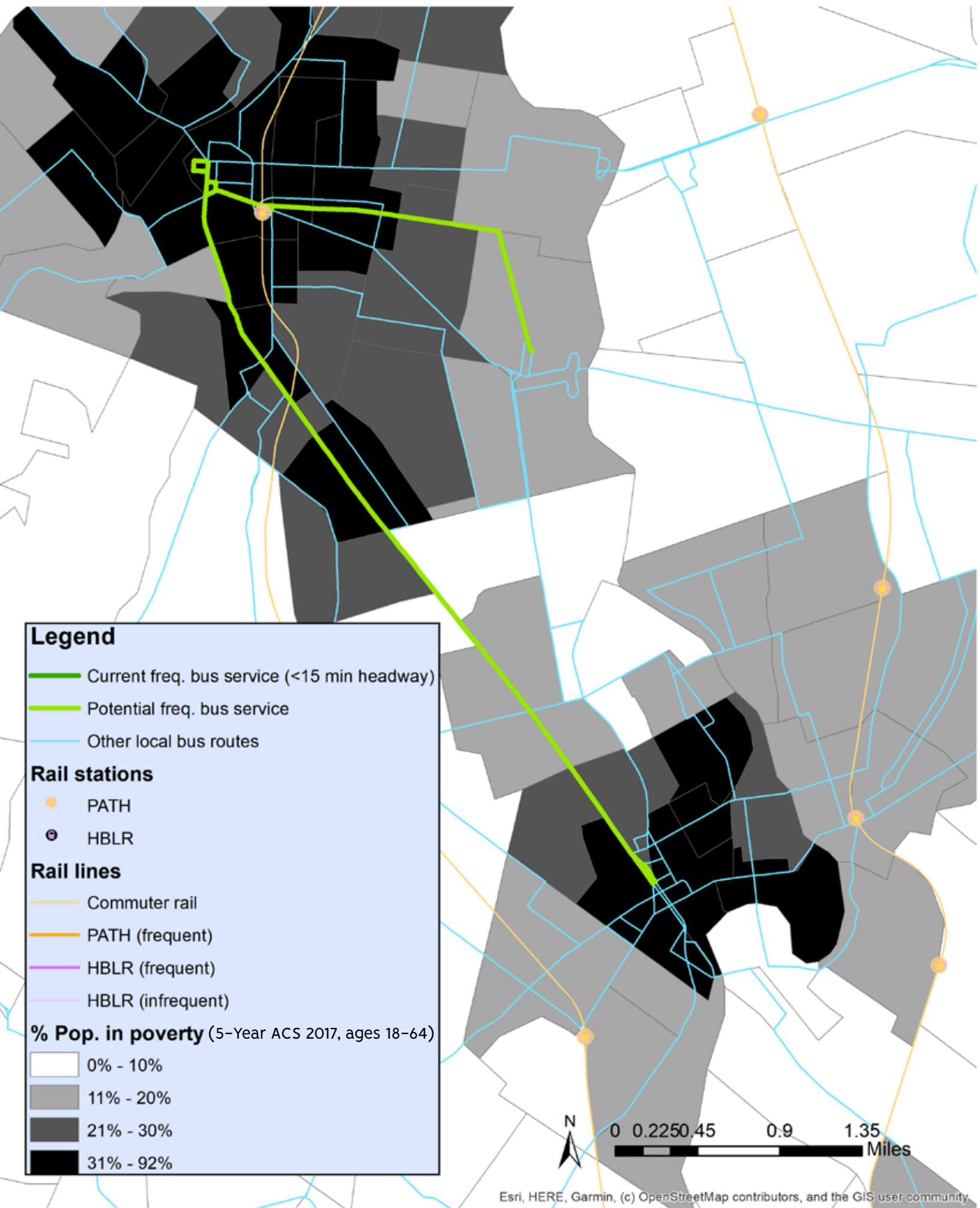
11% - 20%

21% - 30%

31% - 92%



Poverty and Frequent Bus Service – Passaic County



Legend

- Current freq. bus service (<15 min headway)
- Potential freq. bus service
- Other local bus routes

Rail stations

- PATH
- HBLR

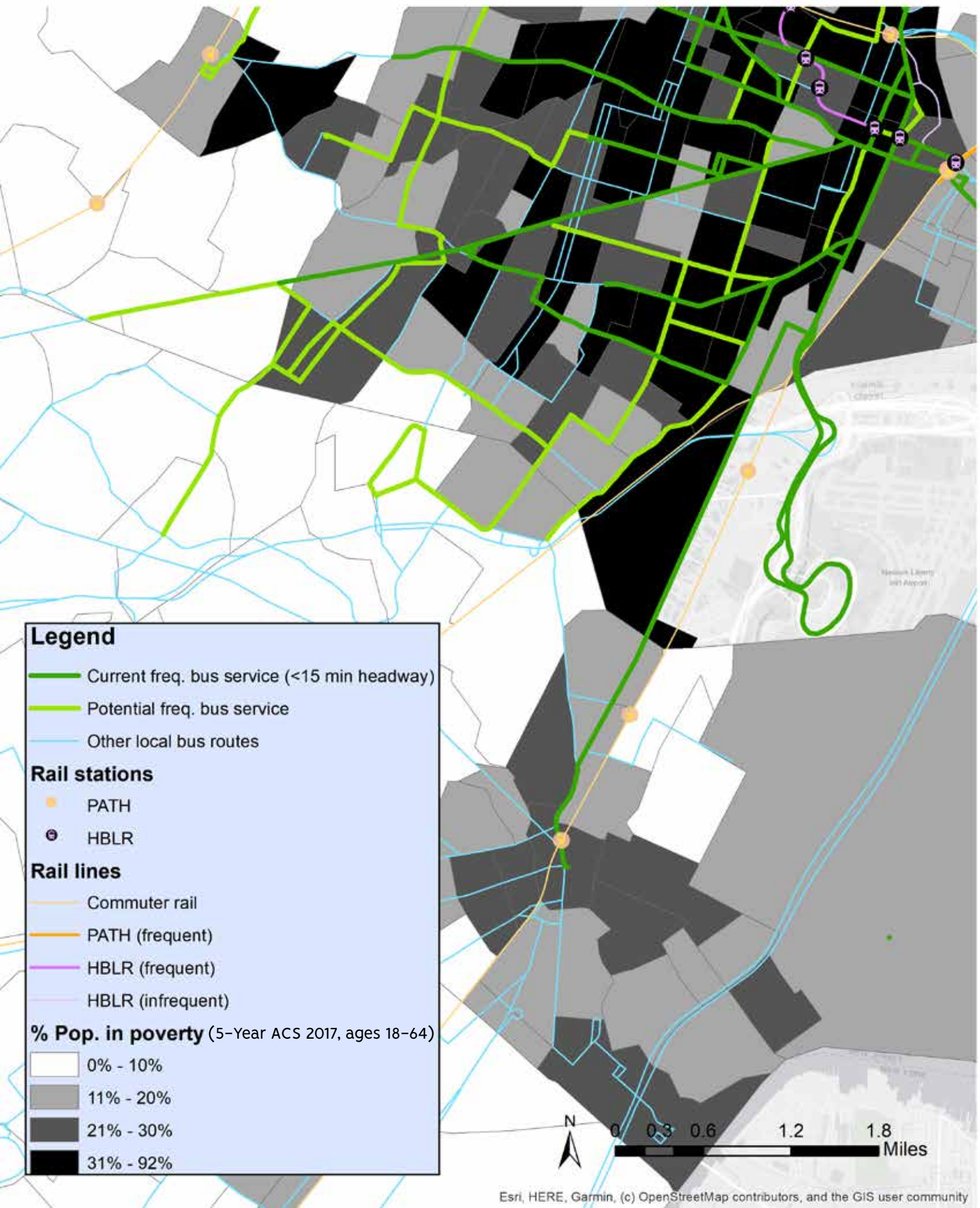
Rail lines

- Commuter rail
- PATH (frequent)
- HBLR (frequent)
- HBLR (infrequent)

% Pop. in poverty (5-Year ACS 2017, ages 18-64)

- 0% - 10%
- 11% - 20%
- 21% - 30%
- 31% - 92%

Poverty and Frequent Bus Service – Union County



Legend

- Current freq. bus service (<15 min headway)
- Potential freq. bus service
- Other local bus routes

Rail stations

- PATH
- HBLR

Rail lines

- Commuter rail
- PATH (frequent)
- HBLR (frequent)
- HBLR (infrequent)

% Pop. in poverty (5-Year ACS 2017, ages 18-64)

- 0% - 10%
- 11% - 20%
- 21% - 30%
- 31% - 92%

0 0.3 0.6 1.2 1.8 Miles

In general, our analysis produced **2 types of routes or corridors** that stand out as potential candidates for inclusion in a frequent service network:

1. Routes or corridors that meet the frequency standard, except for small portions of the 6:00 AM – 8:00 PM weekday period. In other words, these are routes or corridors with **gaps in frequent service**.
2. Routes or corridors on which **service is usually close to but not quite frequent**, during 6:00 AM – 8:00 PM on weekdays. These are routes where frequent service could be provided by adjusting the schedules of preexisting routes, so that coordinated 15-minute headways are provided.

Both categories are **easy and relatively inexpensive to incorporate** into the existing network of 15-minute bus service, since they only require a small number of additional trips or coordinated scheduling of existing trips to reach frequency. Below, NJSC has provided county-by-county tables and maps describing northeastern NJ's frequent service network, as it currently exists and as it could exist under NJSC's recommendations. Afterwards, NJSC provides a brief, thematic review of how peer agencies have tried to build their frequent service networks, before making specific recommendations.

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Eastern Hudson County

Cities	Corridor Name	Route List
HUDSON COUNTY – POTENTIAL		
Bayonne, Jersey City	JFK Boulevard (south Hudson)	10, 119
North Bergen, Guttenberg, West New York, Union City	Bergenline Avenue (north of 48th Street in Union City)	22, 84B, 156, 159
Jersey City	Newark Avenue	80, 84B, 84P
Hoboken	Washington Street	22, 89, 126
Jersey City, Hoboken	Route 87 Corridor	87 (supplemented by: 22, 84, 85, 86, 119)
Union City, Jersey City	Bergenline Avenue south of 30th Street (NJ-495)	22, 84, 86
Jersey City	Ocean Avenue	6, 81
HUDSON COUNTY – CURRENT		
Weehawken, West New York, Guttenberg, North Bergen, Fairview, Ridgefield	Boulevard East, Fairview Avenue, Broad Avenue	128, 165, 166, 168
Jersey City	West Side Avenue	30 (A&C Society Hill), (supplemented by: A&C Montgomery & West Side, 80, 1)
Jersey City, Bayonne	Bergen Avenue	33 (A&C Bergen Avenue)

Essex County and E. Union County

Cities	Corridor Name	Route List
ESSEX AND UNION COUNTIES – POTENTIAL		
Bloomfield, E. Orange, Newark, Irvington, Union	Stuyvesant Avenue Crosstown	94
Newark	Clifton Avenue, Irvine Turner Boulevard Crosstown	99
Newark, Hillside	Broad Street, Clinton Avenue, Elizabeth Avenue	59, 66
Newark, Irvington	Chancellor Avenue, Bergen Street	39
Newark, Irvington	16th Street to Ivy Hill	1
Newark, East Orange, Orange	W. Market Street, Main Street	21

Essex County and E. Union County

Cities	Corridor Name	Route List
ESSEX AND UNION COUNTIES – CURRENT		
Newark, Irvington	Newark Penn Station via Springfield Avenue	25 (supplemented by: 1, 70)
Newark	Ferry Street, Springfield Avenue, 16th Avenue	1
Newark	South Orange Avenue	31 (CoachUSA)
East Orange, Newark, Elizabeth	CoachUSA 24 Orange-Elizabeth: Central Ave., Broad St., Frelinghuysen Ave., Newark Ave.	24 (CoachUSA)
Newark	Market Street, Roseville Avenue	34
Newark	Clinton Hill (Newark) to North Newark (Newark) via Clinton Ave. and Broady	13
Irvington, Newark	Irvington to Mount Prospect Avenue, Forest Hill (Newark)	27
Newark	Mount Prospect Avenue, Heller Parkway	27, 99
Newark, Bloomfield, Montclair	Bloomfield Avenue	11, 28, 29
Elizabeth, Newark	Newark Penn Station to EWR	62
Orange, West Orange	W. Orange extension of NJT 21 – W. Market Street, Main Street	21

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Essex County and Eastern Union County

Legend

- Current freq. bus service (<15 min headway)
- Potential freq. bus service
- Other local bus routes

Rail stations

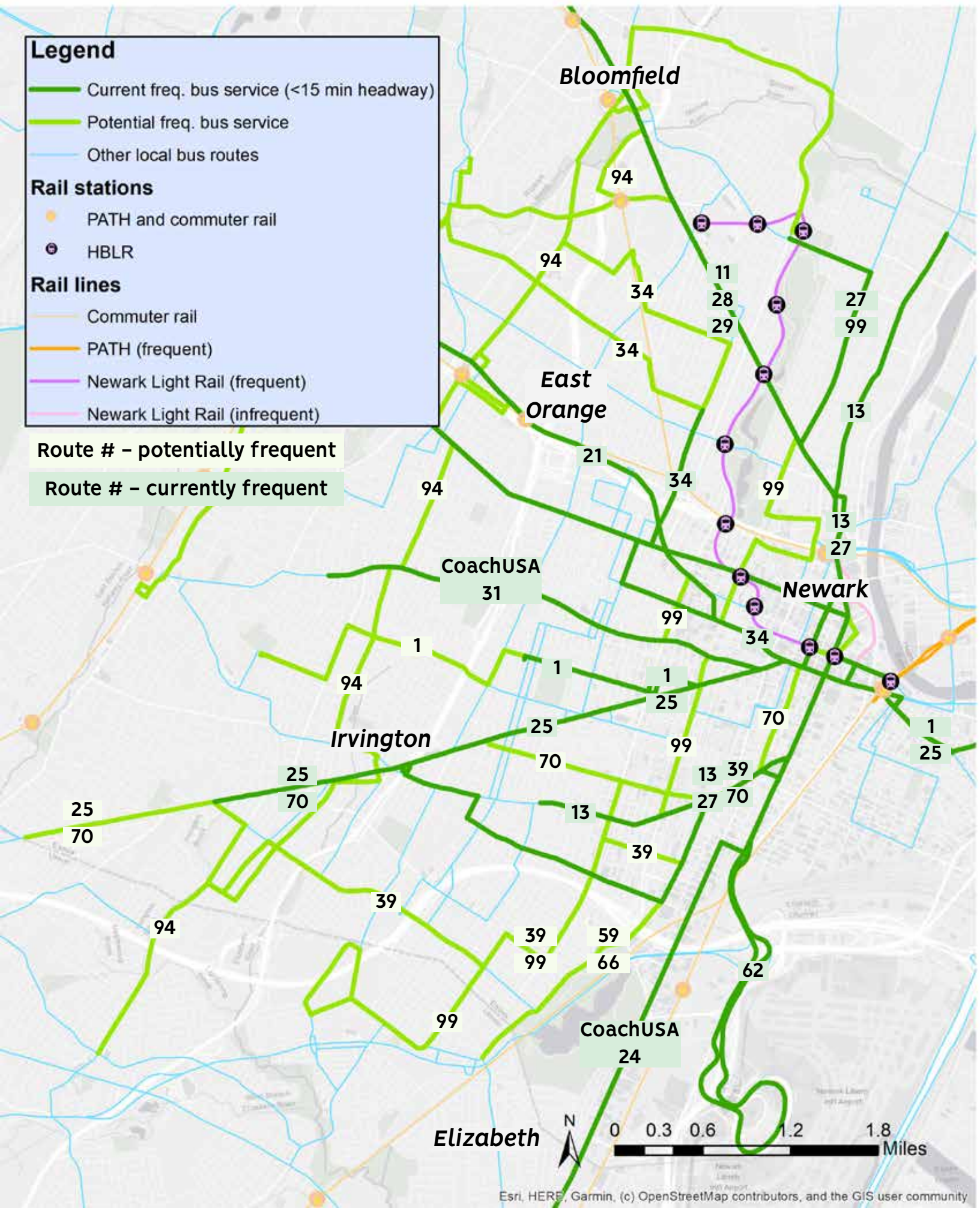
- PATH and commuter rail
- HBLR

Rail lines

- Commuter rail
- PATH (frequent)
- Newark Light Rail (frequent)
- Newark Light Rail (infrequent)

Route # - potentially frequent

Route # - currently frequent



Cities	Corridor Name	Route List
BERGEN COUNTY – POTENTIAL		
Edgewater, North Bergen, Weehawken	Port Imperial Boulevard, River Road	158, 156R, 159R
Fort Lee, Fairview, Cliffside Park	Anderson Avenue between Fort Lee and Fairview	159
BERGEN COUNTY – CURRENT		
North Bergen, Fairview, Ridgefield	Between North Bergen and Ridgefield along Fairview and Broad Avenues.	165, 166

Legend

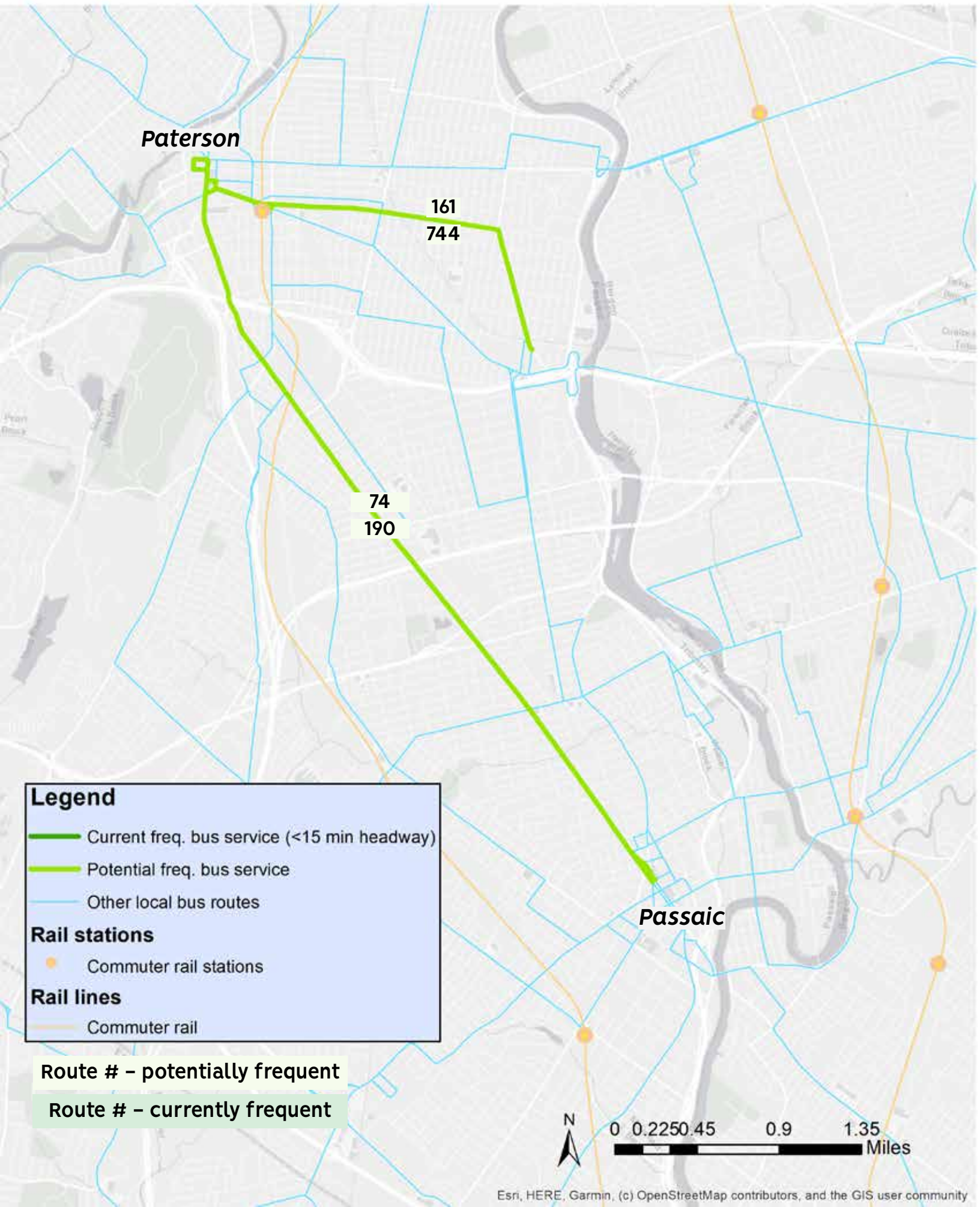
- Current freq. bus service (<15 min headway)
- Potential freq. bus service
- Other local bus routes

Route # - potentially frequent

Route # - currently frequent



Cities	Corridor Name	Route List
PASSAIC COUNTY - POTENTIAL		
Paterson, Clifton, Passaic	Main Avenue	74, 190
Paterson	Park Avenue, Vreeland Avenue	161, 744



Legend

- Current freq. bus service (<15 min headway)
- Potential freq. bus service
- Other local bus routes

Rail stations

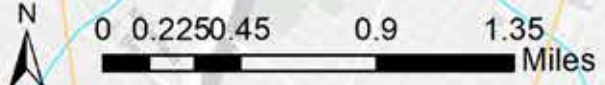
- Commuter rail stations

Rail lines

- Commuter rail

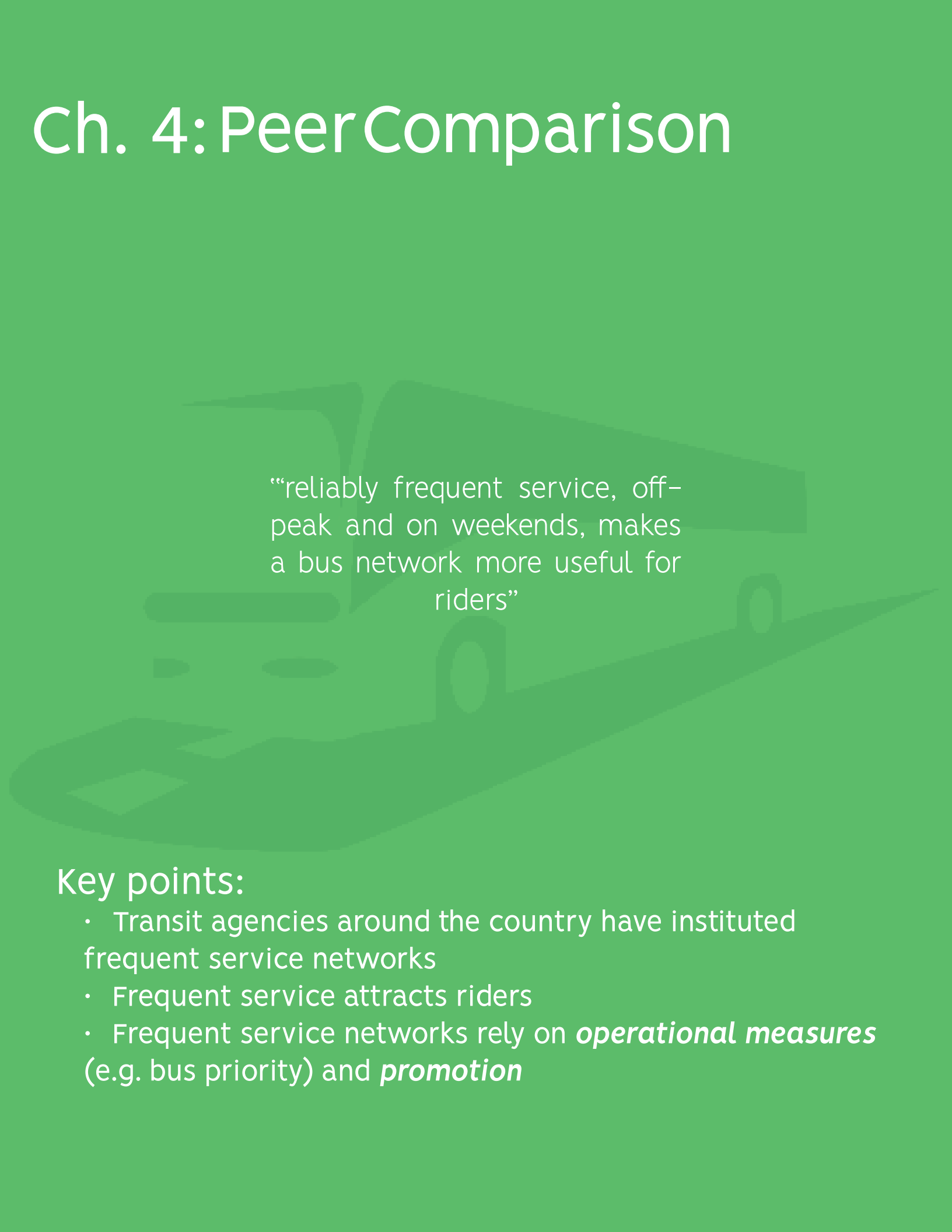
Route # - potentially frequent

Route # - currently frequent



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Ch. 4: Peer Comparison



“reliably frequent service, off-peak and on weekends, makes a bus network more useful for riders”

Key points:

- Transit agencies around the country have instituted frequent service networks
- Frequent service attracts riders
- Frequent service networks rely on *operational measures* (e.g. bus priority) and *promotion*

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Peer Comparison

To better serve existing riders, attract new riders, and build a more sustainable transportation system, many of NJT's **peer agencies** around the country have launched frequent bus service networks. Although varied in scope, many of these efforts have been credited with **reversing ridership declines** during a challenging time for transit agencies nationwide. If New Jersey is to have a just and sustainable future, NJSC believes a robust network of frequent bus service is essential. The experience of NJT's peer agencies provides a proof of concept, and NJSC believes NJT can join its peers at the forefront of the **growing movement for widespread frequent bus service**.

NJSC reviewed the experiences of transit agencies in 4 regions: **Seattle, Richmond, Portland, and Minneapolis–St. Paul**. Agencies in each of these regions have implemented frequent service networks, from Richmond's redesign focused around just a few frequent corridors to Philadelphia's with more than a dozen. The results of NJSC's review are presented thematically below.



Ridership Change

In almost every case, agencies have adopted frequent service networks in order to **reverse yearly ridership declines**. The table below shows ridership trends for select one-year periods among **agencies that have made frequent service a cornerstone of their response to ridership declines**:

City	Agency	System-wide bus ridership change (period)*
Pittsburgh, PA ⁵	Port Authority of Allegheny County	+ 2% (2018–2019)
Richmond, VA	Greater Richmond Transit Company	+ 17% (2018–2019)
Minneapolis–St. Paul, MN ⁶	Metro Transit	– 4% (2017–2018)
Seattle, WA ⁷	King County Metro	+ 4.1% (2015–2016)
Portland, OR ⁸	TriMet	– 1–2% (2018–2019)
Houston, TX ⁹	Metropolitan Transit Authority of Harris County (METRO)	+ 3.3% (2015–2016)
Austin, TX ¹⁰	Capital Metro	+ 4.5% (2018–2019)

Agencies in Pittsburgh, Seattle, Richmond, Houston, and Austin have all reported recent ridership increases, ranging widely in size. Richmond’s **17% increase** has been attributed to its reimagining of bus service in the relatively small region – GRTC now oversees a **network of frequent local buses** that feed into a central “Richmond Pulse” BRT line.¹¹ As might be expected given their larger size, the other regions reviewed all experienced smaller percentage increases in ridership. Still, faster increases on high-frequency routes was a commonly

* The year-to-year trends highlighted here are intended as an illustration of recent ridership trends, and should not be taken as the result of new frequent service networks alone.

reported trend. Austin's MetroRapid bus service, for example, experienced a ridership increase of **18.8%** between May 2018 and May 2019.

Several other regions have **experienced year-over-year ridership declines** despite an emphasis on frequent service, suggesting the many different factors that influence bus ridership. Portland's 1-2% decrease, for example, has been ascribed in part to **gentrification** and the suburbanization of poverty.¹² Core, relatively lower-income transit riders are pushed by housing prices to less-dense areas, where public transit is not available to serve their needs. Despite these declines, all the regions that experienced declines remain committed to expanded frequent service networks. TriMet is continuing its two decade-long project of reorienting its bus network to provide frequent, all-day service, while SEPTA (another agency experiencing recent ridership declines) has begun to install frequent service maps at major bus stations in advance of an overall redesign.¹³

Overall, the comparison also shows that **frequent service is not a panacea**. Many factors, from gas prices to local economic conditions, affect bus ridership. However, comparing ridership changes among different agencies shows that frequent service networks have been **associated with ridership increases**, sometimes very large ones. To give a sense of what kinds of measures contribute to the success stories, below we provide a brief review of measures often enacted alongside frequent service networks.

Promotion

An emphasis of frequent service networks, whatever their size, is the design and use of **visual aides for riders**. The visual aides call particular attention to the frequent service network, usually by indicating frequent routes with **thicker lines, brighter colors**, or more prominent placement than other routes. SEPTA's recently-adopted frequent service map (below) is an effective example. The map is pared down, showing only trolley lines,



SEPTA's "15-minute transit network map"¹⁵

and frequent bus lines, with **connections** between all three clearly identified. SEPTA's frequent service initiative also launched with a website: <http://www.septa.org/frequency/>. The site allows riders to consult the pared down map used as an example here, a more detailed map that nonetheless follows a similar design scheme, and simplified timetables that depict frequent service as the overlap of multiple, individual routes.

Richmond, Virginia's new system map also provides a helpful comparison, demonstrating the range of designs available to agencies that want to engage and educate riders about the new initiative. The Richmond Pulse Bus Rapid Transit line is a focal point of the new system, and features high frequency bus service in a dedicated lane with new, visually-

appealing stops. Befitting its role in Richmond's redesigned system, the Pulse is depicted as a thick green line, with the frequent local corridors (and the route numbers that make them up) depicted as thick red lines radiating out from the BRT line in the center. Every other agency reviewed for this report has developed a similar map, which usually is at the



GRTC System Map¹⁶

center of an agency's promotional efforts. Agencies who have successfully used frequent service networks to regain ridership (e.g. in Seattle and Houston) make the **visualization of routes according to frequency** fundamental to all the materials they produce.

Operational Measures

In addition to promotional measures, agencies have made **service improvement** a cornerstone of their frequent service networks. Ranging from simply providing more (and more frequent) service to improving how that service is provided, these measures ensure that riders are provided **frequent, dependable bus service**.

Sometimes, as in the case of Houston's METRO and New York's MTA, this involves a **wholesale redesign** of an agency's bus network to prioritize frequent service. Both redesigns focus on providing frequent, all-day service, and both emphasize measures to which other systems have attributed their success. In particular, agencies provide a **backbone** of frequent, weekday service, which attracts significant off-peak ridership. Even more ambitiously, networks like Houston's involve **little to no difference between weekday and weekend frequencies**. This kind of reliably frequent service, off-peak and on weekends, makes a bus network more useful for riders who use the bus for purposes other than peak-hour commuting.

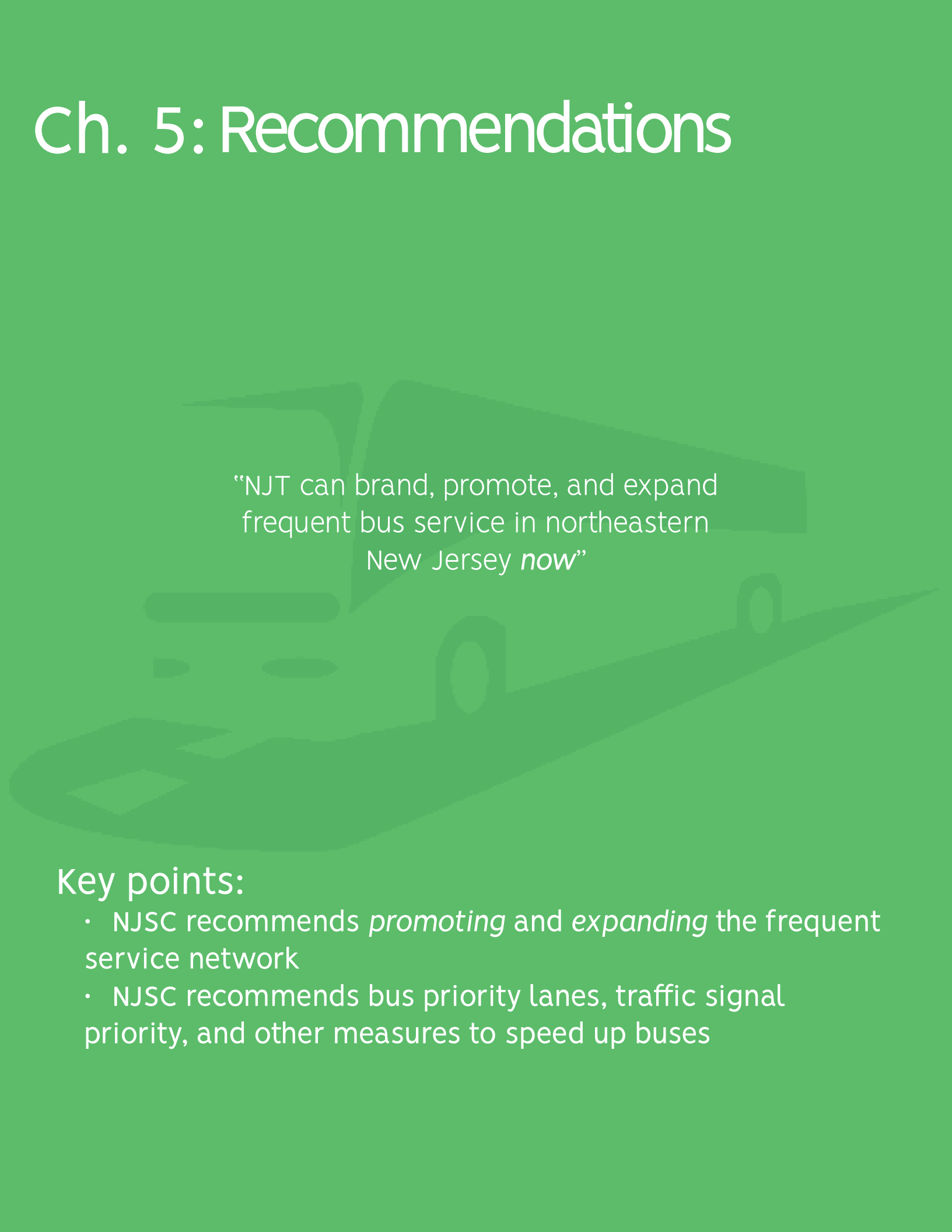
Just as often, though, agencies choose to target particular routes and corridors for service increases. Portland, for example, is only the latest city to test "pop-up bus lanes" as tools for quickly and inexpensively increasing bus speeds and reducing bus bunching. As in similar recent initiatives, this most recent pop-up lane decreased bus delays by as much as 76%.¹⁴ Although they vary widely, agencies' frequent service networks also often involve upgrades to fare payment technology and traffic signals, both of which can ensure buses run more quickly.

NJSC's review of peer systems suggests that **riders respond to frequent service**, when it is provided, promoted, and

reliable. Though a longer-term redesign would undoubtedly be beneficial, NJT and other carriers in northeastern New Jersey already provide an extensive network of frequent, weekday service. In other words, **northeastern New Jersey already has the “backbone” for a frequent service network**. As the recommendations below detail, this service could be **quickly, inexpensively, and easily expanded**, providing a wide range of social, environmental, and financial benefits.

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Ch. 5: Recommendations



“NJT can brand, promote, and expand frequent bus service in northeastern New Jersey *now*”

Key points:

- NJSC recommends *promoting* and *expanding* the frequent service network
- NJSC recommends bus priority lanes, traffic signal priority, and other measures to speed up buses

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Recommendations

In light of the results of our frequent service assessment and peer comparison, we provide recommendations below in two parts. First, we lay out recommendations for expanding and promoting NJT's frequent bus service. Second, we describe our assessment of and recommendations for NJT's website and app. Last, we make several recommendations related to operations and to further study of frequent bus service in northeastern New Jersey.

Promote and expand frequent service

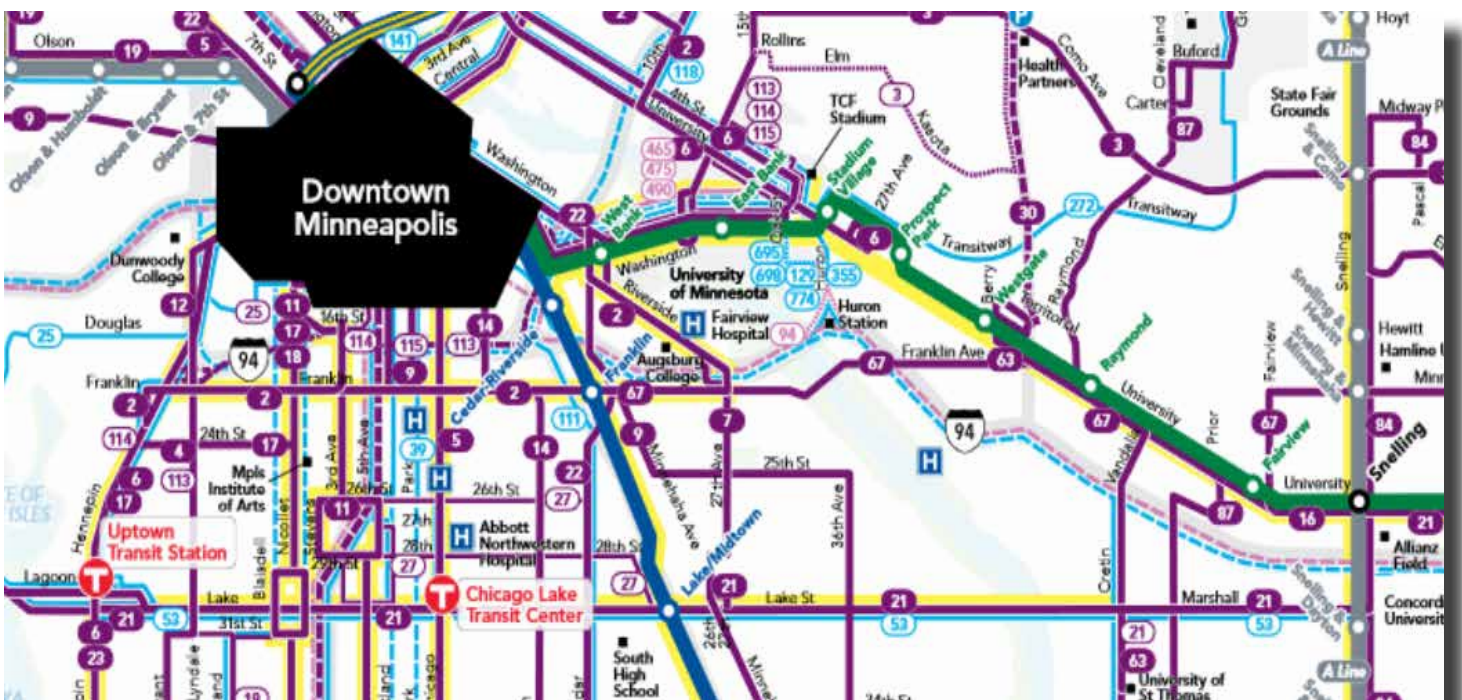
The purpose of this study is to suggest ways to promote frequent bus service in northeastern New Jersey, as well as to expand the extent of frequent bus service in the region. To those ends, we recommend that NJT implement a frequent bus network by (a) promoting NJT's existing frequent bus service, in part through a **marketing and signage campaign**, (b) creating a **pilot program** that seeks to convert some of our identified "potential" routes into frequent service routes, and (c) creating a **long-term plan** to conduct a statewide frequency analysis, convert existing lines, and create new lines where needed to meet frequent service standards.

Promote the existing frequent service network

Given the extensive frequent bus service already provided in northeastern New Jersey, NJSC's first recommendation is that NJT **aggressively promote** the existing network. In particular, NJSC recommends that NJT create bus network maps, rider guides, and corridor-specific timetables. These aids could be quickly and relatively cheaply produced, and would be essential to making the network **more legible** to riders.

Create frequent service maps

Produce a **frequent service map** of bus service in northeastern New Jersey, including all frequent bus service operated by NJT and by private carriers. Several examples are mentioned in the peer system comparison, including Portland's, Minneapolis–St. Paul's, and Richmond's.¹⁷ In addition, the Twin Cities uses a map like the one below to display their frequent



Minneapolis–St. Paul's Map¹⁹

service network in the context of other transit service in the region. The yellow highlighting **distinguishes** the frequent bus network, while showing how it **connects** to and supplements other transit service.

Modify and create new rider guides

Modify NJT's existing "**rider guides**" for major hubs like Newark Penn Station, New York Penn Station, and Secaucus, among others.¹⁸ Highlight frequent bus service on these guides, and produce additional guides for major components of the frequent bus service network.

The cost and complexity of producing frequent service rider



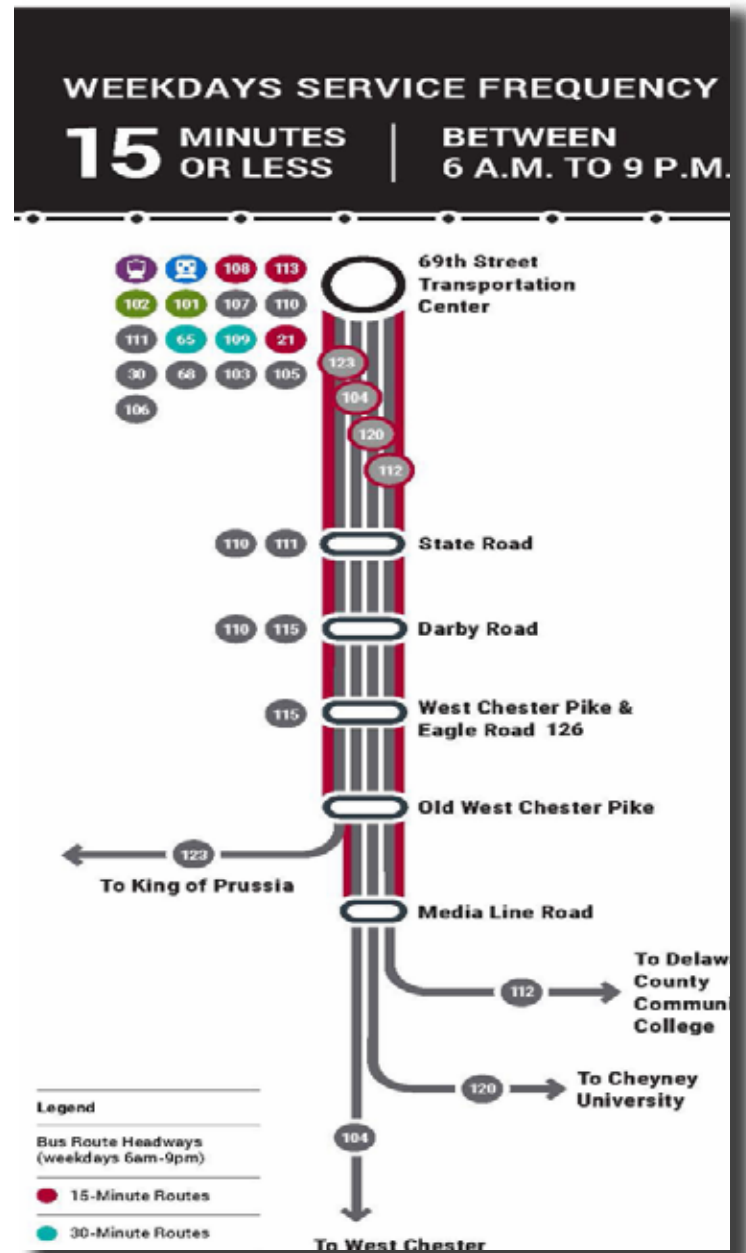
guides should be minimal, if based on the several existing rider guides (at left, for example). If possible, create new guides for major corridors not near major train stations.

NJT's Hoboken Station Area Map

Create frequent service “timetables” and diagrams

Although not the primary source of information for riders planning trips on public transit, timetables and other documents can still play an important role in helping riders understand **how a frequent service network works** and where it is provided.

SEPTA, for example, has created strip diagrams like the one at right. The diagram concisely indicates **major stops with frequent bus service**, subtly **identifies individual routes**, and shows the **major destinations** linked by the frequent service network. Combined with pared-down frequent service maps, diagrams like these give a good sense of the frequent service network with just a glance. Realizing this, SEPTA is **incrementally installing its new map** and schedules to gauge rider reception. At relatively little cost, NJT could do the same, perhaps by drawing on **timetables for routes like the 128**, which already shares a schedule with other routes on the JFK Boulevard East corridor.



SEPTA Frequency Diagram²⁰

Expand the frequent service network – low-hanging fruit

In general, our analysis produced **2 types of routes or corridors** that stand out as potential candidates for inclusion in a frequent service network, with **4 corridors in category 1 and 13 in category 2:**

1. Routes or corridors that meet the frequency standard, except for small portions of the 6:00 AM – 8:00 PM weekday period. In other words, these are routes or corridors with **gaps in frequent service**.
2. Routes or corridors on which **service is usually close to but not quite frequent**, during 6:00 AM – 8:00 PM on weekdays.

Both categories are **easy and inexpensive to incorporate** into the existing network of 15-minute bus service, since they only require a small number of additional trips or coordinated scheduling of existing trips to reach frequency. NJSC's **recommendations** for doing so are provided in the next section.

Based on the breakdown of potential corridors presented in the **Results** section, more specific recommendations can be made about how to achieve 15-minute frequencies on each corridor. As noted, achieving frequency along these corridors should be fairly **easy and cost-effective**. If service along a corridor is not quite frequent due to short gaps in frequent service or due to uncoordinated schedules, frequency could be fairly easily and quickly achieved over several scheduling cycles.

Fill gaps in frequent service

Provide a small number of **additional trips** to fill gaps in frequent service, where those gaps are short and where filling them would result in consistent <15-minute headways from 6:00 AM to 8:00 PM on weekdays. Mostly in Hudson County, **four candidate corridors** fit this description, and are listed below:

- Washington Street, Hoboken – 126, 89, 22
- JFK Blvd. (south Hudson) – 10, 119
- Stuyvesant Avenue and Clinton Avenues, between Union and Bloomfield – 94
- MLK Blvd., Main St. btw. Newark and Orange – 21

Adjust scheduling on routes that are almost frequent

Adjust scheduling on existing routes to achieve <15-minute frequency. Often, the corridors in this category have a level of aggregate service that suggests existing frequent service—in other words, they run roughly 4 trips per hour, corresponding roughly to a 15-minute frequency. However, routes in this category can be scheduled such that they leave gaps in service larger than 15 minutes. Four buses may, for example, be scheduled to arrive at a stop at 2:14 PM, 2:24 PM, 2:28 PM, and 2:40 PM. If the next bus arrives at 3:14 PM, the four trips have produced a maximum wait time of 34 minutes. Although there may be good reason for such a schedule, our recommendation is to prioritize achieving <15-minute frequency in scheduling service along the following corridors:

- Chancellor Ave., Clinton Ave. – 39, 99
- Broad St., Clinton Ave., Elizabeth Ave. – 59, 66
- Newark Ave. – 80, 84, 86

- Clifton Avenue Crosstown – 99
- Ocean Avenue – 6, 81
- Route 87 Corridor – 87
- Bergenline Ave. (N. Hudson) – 22, 84P, 156, 159
- Bergenline Ave., New York Ave., Palisade Ave. – 22, 84, 86, 119
- Port Imperial Boulevard / River Road – 158, 156R, 159R
- Anderson Ave. btw. Fort Lee and Fairview – 159
- Lemoine Ave. and Rte. 9W in Linwood – 156, 186
- Main Ave. between Paterson and Passaic – 74, 190
- Park Ave. and Vreeland Ave. – 151, 161, 744

In the optimistic scenario where all of the above corridors are adjusted to achieve 15-minute headways, the result would be a **robust network of frequent bus service**, often connecting locations in dense parts of the region that are not currently served by frequent mass transit. Large municipalities like Paterson and Passaic would be linked by the network as outlined here, and traveling quickly by bus within Hudson, Essex, Union, and Bergen Counties would no longer mean relying on a relatively small number of frequent routes.

Expand the frequent service network – long-term

In the long term, the existence of a **coherent network** is important. When riders know they can use the bus system to reach many different destinations, each individual corridor is more useful. This is the reasoning behind NJSC’s recommendation to consider **crosstown routes** like the 94 and 99 in Newark for inclusion in the frequent service network.

As noted in the peer comparison, cities like Houston

and New York are pursuing this goal with a total network redesign. But the experience of agencies like SEPTA shows that a wholesale redesign is not necessary before branding and promoting a frequent service network. **NJT can brand, promote, and expand frequent bus service in northeastern New Jersey now.** Moreover, NJSC recommends that NJT use the frequent bus network like SEPTA has: as the first step in a longer process to broaden frequent bus service region-wide.

NJSC recommends that NJT also use its frequent service network as a springboard to a **broader study** of the bus network in northeastern New Jersey. Despite the costs in time and money, a long-term network reassessment would ensure that the shape of the frequent bus network is determined not by ease of implementation, but by the **region-wide need and demand for bus service.**

Rework NJT's online and mobile resources

NJT's recent website and app redesign makes the agency's web presence much more suitable than it used to be to promoting a frequent bus network. The site's landing page now emphasizes **real-time information** and **status alerts**, and the menu bar is a much improved way to access **maps** and information about **major destinations**. In short, the redesign is in the spirit of the frequent bus networks surveyed at the start of the report – make public transit reliable, easy to understand, and easy to use, and more people will use it.

However, many feature improvements could be made to the website in tandem to the implementation of a frequent service network, to further modernize NJT's digital resources and make them more accessible to current and potential riders.

These recommendations are outlined in NJSC’s supplementary report “**Improving Access to New Jersey Public Transit Information.**”

Other recommendations

Operational recommendations – speed and reliability

If frequency is **achieved on paper**, it may not be on the road. That is, buses might not hold to their scheduled 15-minute headways if they are delayed by traffic, weather, boarding passengers, or many other potential causes. Although mostly beyond the scope of this report, these factors deserve mention, because they could have a direct impact on the success of a frequent service network in northeastern New Jersey. Some measures to reduce delays are suggested below:

- To reduce delays due to traffic, **implement bus-only or bus-priority lanes**, especially at parts of the frequent service network where traffic delays have the most significant effect on bus speed. Boston’s MBTA, for example, has had notable success with 6 month – 1 year “pilot” bus lanes on congested roads.²¹ Emulating this example would have almost no upfront cost.
- Implement **transit signal priority** measures that would, for example, adjust traffic signal cycles so that buses can pass more quickly through congested intersections.
- To reduce delays due to passenger boarding, implement **all-door boarding**, where possible, on routes that make up part of the frequent service network. In addition to many agencies outside the US, San Francisco’s Muni has adopted this practice on all its bus routes, to great success.²²
- To reduce delays due to passenger boarding, implement

off-board ticketing on routes that make up part of the frequent service network. When passengers have their tickets before boarding, they spend less time lining up, showing their ticket to the driver, or buying tickets from the driver.

A variety of other measures would pair well with the measures above, while improving bus runtimes in their own right. In particular, “smart” fare media, fare integration, and travel demand management (e.g. congestion pricing) would directly affect the frequent service network. In keeping with this report’s focus on **easily achievable** improvements, these measures were not considered.

Expand study of frequent bus service

Expand consideration of northeastern New Jersey’s frequent bus network to **weeknights** and **weekends**. Many of the frequent and almost-frequent corridors considered in this report are likely also frequent or almost-frequent during these periods. If so, expanding the frequent service network to weeknights and weekends would not only be easy, but would also make the network an even more attractive alternative to the car.

A plausible standard for “frequency” during those periods would be 30 minute headways from 8:00 PM to 11:00 PM on weeknights, 15 minute headways from 7:00 AM to 7:00 PM on Saturdays, 30 minute headways from 7:00 PM to 11:00 PM on Saturday nights, 15 minute headways from 9:00 AM to 6:00 PM on Sundays, and 30 minute headways from 6:00 PM to 11:00 PM on Sunday nights.

Conclusion

Providing frequent bus service to attract riders is not a new concept. Cities from Seattle to Philadelphia have implemented frequent service bus networks, often to significant success. Ridership declines stall or reverse, transit agency revenues increase, and the public's trust in the reliability of their bus network improves. Maybe most important, public transit as a whole becomes a more attractive option. This is a success that NJT and the residents of northeastern New Jersey would benefit greatly from, if what has worked in cities around the country also works here.

After analyzing northeastern New Jersey's bus routes to identify current frequent service, NJSC found that the region's bus network already has many of the characteristic features of a frequent bus network: routes are **frequent**, operating with headways of 15 minutes or better, and they are **connected**, serving locations that people need and want to go to, like downtowns, employment districts, and universities and colleges.

With this **backbone** in place, NJT has the resources to formalize the network through a **branding and planning campaign**. Moreover, NJSC's analysis identified many routes that would make good candidates for an even broader frequent network, built on the existing backbone. NJT has the opportunity to communicate to its riders its **commitment to frequent, reliable bus service**, and to make the frequent service network more widely known, bringing more riders into the system.

NJSC makes two main recommendations: to **promote** the existing frequent service network, and to **expand** the network using the identified candidates routes. In a separate but related report, NJSC also argues that NJT's on-line, printed, and call-center communications with the public should be redesigned and made more accurate and consistent across all hardware and software platforms. Taken together, these measures would put NJT at the head of a growing movement for expanded frequent bus service.

NJSC believes it is vital that NJT take such a position. The threat of **climate change** becomes more real every year in coastal states like New Jersey, and the legacy of car-oriented planning continues to harm the **health** of marginalized communities in the state. To address these problems, it is crucial that NJT provide a convenient, **truly competitive alternative to personal vehicles**, which account for 57% of all greenhouse gas emissions from transportation. With a frequent bus network, NJT has a tool that could be key not only in reducing that figure, but also in bringing in more revenue, halting ridership declines, reducing vehicle miles traveled, and creating a **clean transportation system for all** in northeastern New Jersey.

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Glossary

Bus priority (/bus priority lane):

“Bus priority” describes a set of techniques for improving the speed and reliability of bus service, often by making changes to road design and traffic signals. “Bus priority lanes” are a notable example, in which traffic lanes allow buses as well as limited non-bus traffic (e.g. bicyclists and turning cars).

Corridor:

A combination of different **bus routes** that overlap to provide service along the same stretch of road. When bus routes overlap to form a “corridor,” the service they provide can be coordinated to provide better **headways** (see definition below).

Frequency/headway:

“Frequency” describes the number of bus trips per hour in one direction on a route (see “trips per hour,” below). “Headway” is similar, but describes service in terms of minutes between consecutive bus departures at a particular stop. From a rider’s perspective, the headway represents the maximum amount of time that might be spent waiting for the next bus. For this study’s purposes, a route provides **frequent service if a bus comes every 15 minutes**, i.e. if a route has 15-minute headways or better. **“Better” headways are lower headways.**

Study area:

The area of the state for which this frequency analysis was conducted. The study area consists of Essex County, eastern Union County, southeastern Passaic County, southern Bergen County, and Hudson County.

Glossary

Trips per hour:

Sometimes abbreviated “tph,” trips per hour is a measure of the overall frequency of a transit service. For example, a bus route that runs 6 buses along a corridor between 3:00 PM and 4:00 PM will have 6 trips per hour. If the buses were evenly spaced, this would correspond to a **headway** of 10 minutes.

Trunk:

The portion of a bus route over which almost every trip operates. For example, a bus route may have a “trunk” closer to the city center, but “branch” to serve different destinations after a certain distance. **Frequencies** on the trunk will be higher and **headways** will be better.

Appendices

Appendix 1A – current frequent service corridors

Cities	Corridor Name	Route List	Corridor Description	Frequency assessment
Hudson County				
Union City, West New York, Guttenberg, North Bergen, Fairview, Ridgefield	Boulevard East, Fairview Avenue, Broad Avenue (to/from PABT)	128*, 165, 166, 168	Between PABT and Broad Ave at Hendricks Causeway in Ridgefield. (Operates in Bergen County in North Bergen, Fairview, and Ridgefield.)	Frequent, weekdays 6am- 8pm.
Jersey City	West Side Avenue	30 (A&C Society Hill), (supplemented by: A&C Montgomery & West Side, 80, 1)	West Side Avenue, between Danforth Avenue and Journal Square.	Frequent, weekdays 6am- 8pm.
Jersey City, Bayonne	Bergen Avenue	33 (A&C Bergen Avenue)	Primarily Bergen Avenue, between 53rd St. and Broadway in Bayonne and Journal Square.	Frequent, weekdays 6am- 8pm.

* indicates route only partially covers corridor

Cities	Corridor Name	Route List	Corridor Description	Frequency assessment
Essex County and Union County				
Newark, Irvington	Newark Penn Station via Springfield Avenue.	25 (supplemented by: 1, 70)	Between Newark Penn Station and Irvington/Maplewood border, along Market Street and Springfield Avenue.	Frequent, weekdays 6am–8pm. (Gaps in early evening).
Newark	Ferry Street, Springfield Avenue, 16th Avenue at 20th Street	1	From Chapel St./Fleming Ave. in Ironbound to 16th St. at 20th St. (Newark/Irvington border).	Frequent, weekdays 6am–8pm. (Gaps late morning and mid afternoon toward Ivy Hill).
Newark	South Orange Avenue	31 (CoachUSA Newark–S. Orange route)	Between Newark Penn Station and South Orange border.	Frequent, weekdays 6am–8pm.
East Orange, Newark, Elizabeth	CoachUSA 24 Orange–Elizabeth Central Avenue, Broad Street, Frelinghuysen Avenue, Newark Avenue	24 (CoachUSA Orange–Elizabeth route)	From Central Avenue at Harrison Street in East Orange, along Central Avenue, Broad Street (Newark), Frelinghuysen Avenue, and Newark Avenue, until Jersey Street in Elizabeth.	Frequent, weekdays 6am–8pm.

Cities	Corridor Name	Route List	Corridor Description	Frequency assessment
Newark	Market Street, Roseville Avenue	34	Out of Newark Penn Station along Market St., 12th Ave., and Roseville Ave. (until branch at 4th Avenue).	Frequent, weekdays 6am–8pm.
Newark	Clinton Hill to North Newark	13	Trunk between Verona Ave. at Broadway and Clinton Place at Clinton Ave. in Clinton Hill (time point 3).	Frequent, weekdays 6am–8pm.
Irvington, Newark	Irvington to Mount Prospect Avenue	27	Trunk between Irvington Terminal and Mt. Prospect Ave south of Heller Parkway.	Frequent, weekdays 6am–8pm.
Newark, East Orange, Orange	W. Market Street, Main Street	21	Between Newark and West Orange, mostly along Main St. and MLK Blvd.	15-min 6am–8pm, except for several midday trips. Extension of frequent service to W. Orange may be warranted by new development along Main St.
Newark	Mount Prospect Avenue	27, 99	Mount Prospect Avenue between Bloomfield Ave. and Heller Parkway at N 6th Street.	Frequent, weekdays 6am–8pm.

Cities	Corridor Name	Route List	Corridor Description	Frequency assessment
Newark, Bloomfield, Montclair	Bloomfield Avenue	11, 28, 29, 72*	Bloomfield Avenue between downtown Newark and Bloomfield Avenue at Park Street (Montclair).	Frequent, weekdays 6am-8pm.
Elizabeth, Newark	Newark Penn Station to EWR	62	Between downtown Newark at Newark Penn Station and EWR airport, along Broad Street in Newark.	Frequent, weekdays 6am-8pm.

* indicates route only partially covers corridor

Appendix 1B – potential frequent service corridors

Cities	Corridor Name	Route List	Corridor Description	Frequency assessment
Hudson County				
Bayonne, Jersey City	JFK Boulevard (south Hudson)	10, 119	JFK Boulevard between Bayonne and Journal Square. Some jitney competition.	Potentially frequent. 119 can fill midday gaps in 10's 15-min service. Removing off-peak stop restriction on the 119 northbound from Bayonne to JSQ might be necessary to provide frequent local service.
North Bergen, Guttenberg West New York, Union City	Bergenline Avenue (north Hudson)	22, 84B, 156, 159	Bergenline Avenue between 90th Street and 48th Street. Extensive jitney competition.	Potentially frequent. Where the 22's and 84B's coordinated headways do not currently provide frequent service, the combination of 20-40 min headways would allow for scheduling a combined 10-min headway.

Cities	Corridor Name	Route List	Corridor Description	Frequency assessment
Jersey City	Newark Avenue	80, 84B, 84P	Newark Avenue between JSQ and Palisade Avenue.	Potentially frequent. 80 has consistent <15-min headways except 11am-1pm, when 20-minute service on each route could be coordinated to provide frequency.
Hoboken	Washington Street	22, 89, 126	Entirety of Washington Street in Hoboken.	Potentially frequent. 126 provides 15-min service except 11am-2pm. 22 and 89 trips during this period could be rescheduled to provide 15-min service.
Jersey City, Hoboken	Route 87 Corridor	87, (supplemented by: 22*, 84*, 85*, 86*, 119*)	Between Gates Ave. in Jersey City and Hoboken Terminal.	Potentially frequent. 87 provides 15-min service all day except for some trips 6am-8am from Hoboken and 6pm-8pm from Gates Avenue.

* indicates route only partially covers corridor

Cities	Corridor Name	Route List	Corridor Description	Frequency assessment
Union City, Jersey City	Bergenline Avenue south of 30th Street (NJ- 495)	22*, 84*, 86*	Partial overlap of indicated routes between Jersey City and Union City. Much jitney competition.	Potentially frequent. Individual 20–60 min headways should allow for scheduling 15– min headways, combined.
Jersey City	Ocean Avenue	6, 81	Ocean Ave. between Neptune Avenue and Communipaw Ave.	Potentially frequent. Now, individual 30– min headways could be coordinated to provide 15-minute headways.

* indicates route only partially covers corridor

Cities	Corridor Name	Route List	Corridor Description	Frequency assessment
Bergen County				
Edgewater, North Bergen, Weehawken	Port Imperial Boulevard, River Road	158, 156R, 159R	Port Imperial Blvd. and River Rd., between Lincoln Tunnel and Gorge Road (to/from PABT). Rapid growth makes it an attractive candidate.	Potentially frequent. Supplemental trips (e.g. short 159R trips starting at Winston Towers, or short 156R short trips starting at Gorge Rd. and) needed late morning outbound and midday and evening inbound.
Fort Lee, Fairview, Cliffside Park	Anderson Avenue	159	Anderson Avenue between Fort Lee and Fairview. Growing area without midday express service - remedied by long 159R trips.	Potentially frequent. Off-peak 20-30 min headways could be supplemented with long 159R trips (compare recommendation for Port Imperial Road corridor).

Cities	Corridor Name	Route List	Corridor Description	Frequency assessment
Essex County				
Bloomfield, E. Orange, Newark, Irvington, Union	Stuyvesant Avenue Crosstown	94	Crosstown route along Stuyvesant Ave., Clinton St., and Prospect Ave., between Union and Bloomfield.	Potentially frequent. Consistently frequent between Irvington and Bloomfield except for 6am–7am and 6pm–8pm. Some 15-min headways in early evening through Union.
Newark	Clifton Avenue, Irvine Turner Boulevard Crosstown	99	Crosstown route between Forest Hill and Hillside. Allows access to several major hospitals without needing to transfer in downtown Newark.	Potentially frequent. 15-min service except 11am–1pm and 7pm–8pm.
Newark, Hillside	Elizabeth Avenue, N. Broad St. (Hillside)	59, 66 (supplemented by 27 in downtown Newark)	From downtown Newark along Clinton and Elizabeth Aves. Serves a dense corridor of high-rises.	Potentially frequent. Individually, 59 and 66 have 30-min headways off-peak, which if coordinated could achieve 15-min headways.

Cities	Corridor Name	Route List	Corridor Description	Frequency assessment
Newark, Irvington	Chancellor Avenue, Bergen Street	39	Irvington–Newark, mostly along Chancellor and Clinton Aves.	Potentially frequent. 17–18 min headways consistently 6am–8pm.
Newark, Irvington	16th Street to Ivy Hill	1	Beginning where current frequent service ends on the 1 at 16th St., along 16th Ave. and 10th Ave. to Ivy Hill.	Potentially frequent. Frequent service for most of the day, except for several trips midday.
Orange, W. Orange	W. Orange extension of NJT 21 – W. Market Street, Main Street	21	Beginning where current frequent service ends on the 21, from Main St. at Day St. in Orange to West Orange.	Potentially frequent. Consistent 20–minute headways, which could be supplemented to better serve new development along Main St.

Cities	Corridor Name	Route List	Corridor Description	Frequency assessment
Passaic County				
Paterson, Clifton, Passaic	Main Avenue	74, 190	Between Paterson and Passaic along Main Ave. Heavy jitney competition.	Potentially frequent. Individual 10–20 min headways all day could be coordinated to provide 15-min headways.
Paterson	Park Avenue and Vreeland Avenue	161, 744	Park Ave. and Vreeland Ave. out of downtown Paterson until 21st Ave.	Potentially frequent. 161 (and 151 during peak) provide 15-min headways except for midday. 30-min headways of 744 provide opportunity for coordinated scheduling.

Appendix 2 – rail service frequency evaluation

Cities	Route	Frequency assessment
Bayonne, Jersey City, Hoboken	Hudson–Bergen Light Rail (8th St. – Hoboken)	Frequent between Liberty State Park station and Pavonia/Newport station.
Hoboken, Weehawken, Union City, North Bergen	Hudson–Bergen Light Rail (Hoboken – Tonnelle)	Frequent between 2nd Street station and Tonnelle Avenue station.
Bayonne, Jersey City, Hoboken	Hudson–Bergen Light Rail (West Side – Tonnelle)	Frequent between Liberty State Park station and Pavonia/Newport station (south of Hoboken), and between 2nd Street station and Tonnelle Avenue station (north of Hoboken).
Newark, Bloomfield	Newark Light Rail (Newark City Subway)	Frequent 6am–8pm weekdays.
Newark	Newark Light Rail (Broad Street Extension)	Not frequent. Despite the recent extension of 10-minute service to a longer portion of the day (6:30am–9:30am and 3:30pm–8:00pm), 30-minute headways remain for a long portion of the 6am–8pm period. ²³
Newark, Harrison, Jersey City	PATH (Newark – WTC)	Frequent 6am–8pm weekdays.
Hoboken, Jersey City	PATH (Hoboken – WTC)	Frequent 6am–8pm weekdays.
Jersey City	PATH (Journal Square – 33rd St.)	Frequent 6am–8pm weekdays.
Hoboken	PATH (Hoboken – 33rd St.)	Frequent 6am–8pm weekdays.

Endnotes and References

- 1 See p. 69 of the 2018 annual report, available at the following link: https://www.njtransit.com/pdf/NJTRANSIT_2018_Annual_Report.pdf.
- 2 Walker, J. (2012). Human transit: How clearer thinking about public transit can enrich our communities and our lives. Island Press. P. 87.
- 3 See the following Vox article summarizing the ridership changes observed soon after the implementation of Houston's redesign: <https://www.vox.com/2016/1/28/10852884/houston-bus-ridership/>.
- 4 See the following link to an NJT page discussing their annual customer survey, in which weekday ridership figures are mentioned: https://www.njtransit.com/var/var_servlet.srv?hdnPageAction=SurveyEXTo. The frequent service network discussed in this report considers more than just NJT's routes, so the figure is an underestimate.
- 5 See the following Tartan story, discussing the Port Authority buses' 1.95% 2018–2019 ridership change: <http://thetartan.org/2019/2/18/news/port-authority>.
- 6 See the following release from Metro Transit, documenting record ridership on Minneapolis–St.Paul's BRT and light rail lines amid declines on bus lines in general: <https://www.metrotransit.org/light-rail-bus-rapid-transit-lines-set-annual-ridership-records>.
- 7 See the following CityLab story for a discussion of bus ridership trends in Seattle and their potential causes: <https://www.citylab.com/transportation/2017/10/how-seattle-bucked-a-national-trend-and-got-more-people-to-ride-the-bus/542958/>.
- 8 See the following discussion of TriMet's recent ridership trends: <https://www.oregonlive.com/commuting/2019/04/even-as-ridership-dips-trimet-gets-favorable-ratings-across-region.html>.
- 9 See the following Texas Tribune story, discussing the early results of Houston's bus network redesign: <https://www.texastribune.org/2016/12/08/texas-transit-agencies-eye-bus-changes-after-rider/>.
- 10 See the following Austin Business Journal Story, discussing recent rider-

ship figures as reported by Capital Metro: <https://www.bizjournals.com/austin/news/2019/06/25/capital-metro-ridership-bounces-back-from-years-of.html>.

11 See GRTC's press release about and brief analysis of their increased ridership figures: <http://ridegrtc.com/news-initiatives/press-releases/grtc-reports-17-ridership-increase-during-past-year>

12 See the following Streetsblog story for more discussion of the relationship between rising rents and transit ridership: <https://usa.streetsblog.org/2017/11/15/rising-rents-lead-to-falling-bus-ridership-in-portland/>.

13 See the following story discussing Portland's bus lanes: <https://bikeportland.org/2019/11/26/portlands-cheap-and-easy-bus-lane-projects-are-working-quite-well-308032>. See the following Philadelphia Inquirer and Curbed stories discussing SEPTA's bus ridership decline and the agency's attempts to respond: <https://www.inquirer.com/transportation/septa-bus-ridership-transit-loss-20190326.html>; <https://philly.curbed.com/2019/7/11/20690300/septa-unveils-new-transit-map-ridership>.

14 See the following TriMet webpage for a discussion of the agency's historical approach to designing its bus network: <https://trimet.org/history/trimetstory.htm>

15 <http://m.septa.org/frequency/img/2019-high-frequency-map.pdf>

16 <http://ridegrtc.com/planning-your-trip/system-map>

17 The Portland, Minneapolis, and Richmond system maps can be found at the following links: <https://trimet.org/schedules/frequent-service.htm>; https://www.metrotransit.org/Data/Sites/1/media/maps_schedules/99613_highfreq-map.pdf; http://ridegrtc.com/media/main/1_System-Map_25x37_181218_Approved.pdf.

18 An example rider guide for the area around Newark Penn Station can be found at the following link: <https://www.njtransit.com/pdf/maps/sam/107samap.pdf>.

19 <https://www.metrotransit.org/Data/Sites/1/media/pdfs/system-map.pdf>

20 <http://www.septa.org/frequency/>

21 A Muni report on the implementation of all-door boarding can be found at the following link: <https://www.sfmta.com/sites/default/files/agendaitems/2014/12-2-14%20Item%2014%20All%20Door%20Boarding%20Report.pdf>.

22 See the following link for the list of private carriers: https://www.njtransit.com/sf/sf_servlet.srv?hdnPageAction=BusPCTo.

23 See New Jersey Transit's announcement about the service change: https://www.njtransit.com/sa/sa_servlet.srv?hdnPageAction=ServiceAdjustmentTo&AdjustmentId=20861.