Crossing the Hudson
How to Increase Transit Capacity and Improve Commutes

A Report of The Fourth Regional Plan
August 2017
This report highlights key recommendations from A Region Transformed, RPA's fourth regional plan for the New York-New Jersey-Connecticut metropolitan area. The full plan will be released in November 2017.

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We are living on borrowed time.

The links between New York and New Jersey face a growing crisis of capacity, connectivity, and potential collapse. Each of the three primary trans-Hudson facilities—the Northeast Corridor rail tunnel that serves all Amtrak and New Jersey Transit trains into Manhattan; Penn Station; and the Port Authority Bus Terminal—suffer frequent service failures, serve far more people than they were designed to handle, and need major repairs to prevent a catastrophe. The derailments, delays and emergency repairs at Penn Station this summer are mild compared to what will happen if one of the tunnels under the Hudson River fails before replacement tunnels can be built. Losing such a vital part of the regional network would have ripple effects across the entire metropolitan region, affecting everyone who commutes by any mode across the Hudson River, businesses on both sides that rely on these connections, and communities that thrive because of our robust metropolitan economy.

Each day over 1.6 million people commute into Manhattan, the 21st century’s leading global city. For the last 25 years, more and more of those people have been coming from west of the Hudson River. Over that time, the number of jobs in Manhattan has only increased by about 75,000, and the number of daily commuters traveling from New Jersey grew by 70,000, from 250,000 to 320,000.

As a result, rail trips in and out of Penn Station have nearly tripled in the last 25 years, bus trips have grown by 83%, and PATH ridership is up by 27%. RPA’s research projects that this trend will continue over the next two decades, requiring far more capacity than the existing facilities can provide. Work trips to Manhattan could increase by 72,000, or 24%, by 2040, while trips to all of New York City could increase by 148,000, a 38% increase, as job growth in the other New York City boroughs rises even faster.

Our current system of trains, buses, subways, ferries and roads does not have enough capacity to serve another 72,000 — let alone another 150,000 — commuters every day. Without that capacity, overcrowding and delays will get even worse and jobs will depart to other regions.

Furthermore, the rail network fails to serve many communities in New Jersey, forcing commuters to rely on buses to a much greater degree than other parts of the metropolitan region. And commuter rail services from all directions terminate in Manhattan, rather than directly connecting the suburbs to each other, which limits the destinations that passengers can get to without transferring and reduces the number of trains that operate in peak periods.

To date, only piecemeal solutions have been proposed to address these problems. Amtrak has proposed the Gateway project: two new tracks under the Hudson River connecting New Jersey to Penn station. Gateway solves the immediate maintenance needs of the tunnels and doubles capacity in the Northeast Corridor, but will not meet long-term demand and limits service options by maintaining Penn Station as a terminus, rather than allowing through running between New Jersey and Long Island. The Port Authority’s proposal for a much larger Midtown bus terminal would accommodate projected bus passengers, but at a very high cost with unacceptable impacts on the neighboring community. And it locks in bus service for many areas of New Jersey, rather than providing more direct, reliable and efficient rail service. And current plans to improve Penn Station and build Moynihan Station would make some improvements in circulation and the passenger experience, but would not be able to handle the additional riders brought in by Gateway.

Each of these projects has been planned and studied in isolation of the others. Rather than looking holistically at the links across the Hudson River, and where people are coming from and going to, the agencies have been focused on solving their individual problems. It shouldn’t surprise anyone that they haven’t been able to come up with a comprehensive solution.

A much better outcome could be achieved through a series of complementary investments that address the problems of the system as a whole. These investments can address the inadequacies of the current facilities; create capacity for much more robust economic growth; and greatly improve service and reduce travel times on both sides of the Hudson River. The investments would be phased in to address the most urgent problems first and provide flexibility for the timing and type of future investments.
The first priority is to immediately begin construction of Gateway. The new tunnels must be in place before the existing tunnels fail. Simply put, this is the highest infrastructure priority for the nation. The entire Northeast Corridor relies on that connection. The federal government must honor its commitment to provide half the funding for this nationally-significant project that serves one-fifth of the nation’s economy, and the Gateway Development Corporation needs to move ahead as quickly as possible with environmental permitting and engineering to begin construction.

At the same time, the Port Authority should partner with New York State and New York City to build a second bus terminal in the basement of the Javits Convention Center with underground connections to the #7 subway station at Hudson Yards. A new facility in the basement of the Javits Convention Center would have many advantages over other proposals. It can be built very quickly — an important consideration since both Penn Station and the existing bus terminal are at risk of failing. It would be much less expensive than building a new bus terminal. It does not require the demolition of the existing PABT, but would complement it with better service to the Hudson Yards and other destinations that would reduce the demand on the PABT, which would be renovated to extend its useful life another 20 to 30 years. And the additional capacity the Javits bus terminal provides could also be used to serve both new commuters and existing intercity buses — many of which now park on city streets.

This plan also provides many benefits to the Javits Convention Center. The Javits Center is currently expanding to the north, but even with this expansion, there is still unmet demand for Class A conference facilities — as opposed to the Class B exhibition space on the basement floor. Building a bus terminal in the Javits basement would be part of a comprehensive plan to expand and modernize the Javits Center, including increased accessibility; expanding premium meeting and ballroom space onto Pier 76; and improving truck marshalling, loading and parking.

Once the Gateway tunnels and Javits bus terminal are both complete, the next priority is to expand capacity under the Hudson River by converting Gateway to a higher-capacity, through-running service. Instead of terminating at 7th Avenue, Gateway should extend east, underneath Manhattan and the East River with two new tunnels, to connect to Sunnyside Yards in Queens. Instead of simply doubling commuter rail capacity under the Hudson River, “Gateway East” would increase capacity by 138%. It would also have much broader regional benefits, including through service between NJTransit and the Long Island Railroad and MetroNorth.

To serve all these additional riders, Penn Station needs to once again become a gateway for New York and the region. We should construct a grand Penn Station complex — including Moynihan Station and a “Penn South” expansion — to create a unified 31st to 34th street station. Eventually, Madison Square Garden should move to a nearby site and a new, open Penn Station would be built to serve as a true regional hub, with direct and more frequent service to New Jersey, Long Island, the Hudson Valley and Connecticut.

These actions can be phased in, and each step builds on the previous investment. This plan would provide enough capacity until mid-century, when trans-Hudson demand will once again begin to surpass combined rail and bus capacity and the existing PABT will have surpassed its useful life. At that point, another phase can add more capacity, either by rebuilding the bus terminal or planning for the fifth and sixth tunnels under the Hudson River.

Both sides of the Hudson River benefit from their proximity to each other — to the extraordinary jobs and vitality of New York City and the workforce and communities in New Jersey. We are cheating the clock by relying on connections that are more than a hundred years old. To prosper in this century, we need to make bold plans once again. Here is the way — now all we need is the will to do it.
Figure 1: Existing Trans-Hudson Transportation System
Source: Regional Plan Association
The transportation networks that cross the Hudson River and link New Jersey and New York are critical to the economy of both states. The transit connections, which carry nearly 400,000 people a day, are at serious risk. They are old, deteriorating, and unable to handle current and anticipated demands.

Two of the key elements of this network are especially at risk: the rail tunnel under the Hudson River that leads into Penn Station, and the Port Authority Bus Terminal (PABT). Each weekday the Hudson River Tunnel (HRT) carries some 330 NJ Transit commuter trains and 150,000 people — triple the number of passengers since 1990. Amtrak’s Northeast Corridor, which is the heart of Amtrak’s national network and its only profitable market, runs another 100, intercity trains carrying 21,000 people a day.

Superstorm Sandy badly damaged both tubes of this aging tunnel, which is threatened by a shutdown if conditions worsen. Each year it becomes more likely that one of these tubes will need to be closed for significant repairs, forcing tens of thousands of workers and visitors to find alternative means of travel in a system that is already over capacity. Huge disruptions to all who travel across the Hudson would follow, with disastrous affects to the economies of both states and the entire Northeast Megaregion.

Meanwhile, the PABT is succumbing to years of heavy bus traffic in the terminal and on the ramps leading to it. It was not designed for today’s larger and wider buses. Many of the 14,000 buses traveling through the Lincoln Tunnel each weekday overload onto the city streets surrounding the terminal. The capacity limitations affect the 350,000 passengers daily, up from 233,000 in 1990. Each morning, long lines of buses try to enter the overtaxed Exclusive Bus Lane (XBL) leading to the Lincoln Tunnel, and long lines of passengers wait impatiently to board buses in the evening.

The New York Metropolitan Transportation Council (NYMTC) and the North Jersey Transportation Planning Authority (NJTPA) produce long-range forecasts for the city and region. They both project that population and job growth will result in an increase in work trips of 26% from communities west of the Hudson to New York City by 2040, adding 103,000 trips each way on an average weekday. RPA’s more ambitious growth forecasts estimate that demand could grow by 38%, or 148,000 trips. But the current system does not have spare capacity to handle either of these projections.

Many possible solutions have been suggested, generally starting with new rail capacity under the Hudson River. Amtrak’s proposed Gateway project would enable transit agencies to divert trains from the existing rail tunnels to make repairs and eventually double trans-Hudson rail capacity. Most business, civic and political leaders agree that Gateway should proceed, but funds for the project — which will cost in excess of $20 billion — are not in place.

At the same time, the search for a replacement to the PABT is hampered because the existing facility has two critical features that are difficult to duplicate: direct connections via ramps to the Lincoln Tunnel and the close proximity to ten subway lines. Any replacement not at the current site would forfeit either or both of those advantages. Moreover, the high cost and local impacts raise issues as to whether other solutions might be preferable. For example, the New York City subway #7 or L trains could be extended to add trans-Hudson capacity and relieve bus and rail demand on existing facilities.

All these solutions require consensus among the affected parties — the State of New Jersey and NJ Transit (NJT); Amtrak; the Port Authority of New York and New Jersey; the City and State of New York; the ferry operators; and even the MTA and federal government. All of these alternatives are expensive and require close examination, including agreement on how the solutions will be paid for.
Trans-Hudson Travel Today

Trans-Hudson travel includes many markets — commuters to Manhattan by train, bus, auto and ferry; commuters to other destinations in both directions; through traffic on autos, buses and trains traveling on the Northeast Corridor; and freight moving across bridges, tunnels and barges.

The New York metropolitan area is central to the economy of its three states and to the economy of the nation. Its 23 million people generate $1.8 trillion in gross domestic product, one-fifth of the nation’s economy. At the center of that economy is the Manhattan central business district (CBD), the nine square miles south of 60th Street, where over two million people work.

Trans-Hudson travel is accommodated by several vehicular and rail crossings, as shown in Figure 1. The three rail crossings were built more than 100 years ago during a three-year period from 1907 to 1910, the two PATH tubes in 1908 and 1909 and the Pennsylvania Railroad’s Hudson River tunnel (HRT) in 1910, now used by New Jersey Transit and Amtrak. These were followed by a series of motor vehicle crossings — the Holland Tunnel (1922), George Washington Bridge (1931 and 1962), and the Lincoln Tunnel (three tubes constructed in 1937, 1945 and 1957). The PABT was built in 1950 and expanded in 1979.

New Jersey has only handful of crossings when compared to the numerous bridges and tunnels that connect Manhattan to communities to the north and east, as shown in Figure 2. A few ferry routes, ubiquitous before 1910 still remain to complement these facilities, connecting Manhattan with waterfront communities, with PATH in Hudson County and with NJT in Hoboken.
Each day 7.9 million trips are made into and out of this core from all directions. Three-quarters of these trips use public transit, which makes the enormous concentration known as the Manhattan CBD possible. Any loss of transit capacity threatens its survival.

This growth includes a striking shift away from the automobile and toward public transit, reversing earlier trends. Auto riders are down 14%; transit trips are up 76%. Rail trips in and out of Penn Station have almost tripled, adding just about 120,000 trips. Bus trips have grown rapidly too, up by 207,235 daily, or 83% since 1990. PATH is up 27%, especially on the uptown branch that serves a growing commercial market on Manhattan’s west side south of 34th Street. Meanwhile, ridership on the World Trade Center branch dropped as lower Manhattan’s land uses have become more residential. Ferry travel is up by 147%, but on a much smaller base.

Commuter buses make up a disproportionally large amount of the trips entering the CBD from west of the Hudson relative to travel from Lower Hudson Valley and Long Island. As shown in Figure 4, the bus volumes are over six times greater from New Jersey than other parts of the region.
Several developments can explain the growth in bus travel at the Lincoln Tunnel and rail travel in the HRT Tunnel. In 1970, the Port Authority initiated the innovative and highly successful Exclusive Bus Lane (XBL), which converted an underused outbound lane in the morning for the exclusive use of buses destined for the PABT. Today this 2.5-mile lane carries 30,000 people in the peak hour, more than three times the number of passengers in automobiles in the parallel three inbound lanes. New Jersey Transit constructed the Kearny Connection (now Midtown Direct) in 1996, the Montclair Connection (now Montclair Direct) in 2002, and the Secaucus Transfer (now Secaucus Junction) in 2003. The purpose of these projects was to provide either a one- or two-seat ride to Penn Station in Midtown Manhattan for all NJT rail riders. Each project accomplished the goal of reducing travel times and improving the convenience for tens of thousands of riders and elevating the property values through much of northern New Jersey. It also dramatically increased the number of NJT trips through the Hudson River tunnel each day, from 53,000 in 1990 to 172,000 today. Now over 350 NJT trains use the Hudson River tunnel, more than double the 1990 level.

Figure 5 highlights the growth at Penn Station during peak periods when its inadequacies are most acute. In the 20-year period, ridership has doubled in the peak period, adding more than 21,000 riders.

Figure 6 traces the inexorable climb in number of buses traveling through the Lincoln Tunnel in the morning peak hour, up from 700 to 1,000, adding five more buses on average for each minute in the peak hour.

The growth of service and use of Penn Station and the PABT have pushed them to and beyond their limits. At Penn Station, reliability has suffered with delays a daily occurrence and crowding at the station reaching intolerable and dangerous levels. At the Port Authority Bus Terminal crowding conditions take many forms during both morning and evening commuter periods. In the morning peak, the XBL has reached its maximum capacity and leaves little margin for error. In the evening the difficulty of deploying buses in an outmoded terminal leads to long lines each day as commuters wait to board buses. Making matters even worse, much of the physical infrastructure at both facilities has reached the end of its life and must be replaced or extensively rehabilitated, as demonstrated by failures in and near Penn Station in the summer of 2017.

The distribution of current users of Penn Station is shown in Figure 7. The largest concentrations of these Penn Station bound commuters are in Union, Middlesex, Mercer and Monmouth counties, and to a lesser extent in Morris and Essex (influenced by Midtown Direct) and in Bergen County (influenced by Secaucus Junction).
The transportation facilities across the Hudson River are used to their maximum. Any loss of transit capacity represents a profound crisis and would put intolerable pressure on the remaining facilities used by nearly half million people each day. Such a loss is quite possible and would require one of the two Hudson River Tunnel (HRT) tubes to be closed for extensive multi-year repairs.

Future Demand Will Exacerbate the Crisis

These critical transit facilities are operating above their capacity today. The picture will only become bleaker with the likely increase in demand for trans-Hudson travel and the impact that demand will have in the absence of action. Both the Port Authority and NJT have spent considerable effort in trying to project how much trans-Hudson travel will occur in the next 30 to 40 years, by what mode, on which facilities and during what time of day. New population, labor force and employment projections have been adopted by both New York and New Jersey metropolitan planning agencies and RPA has developed its own projections.

The projection of travel requires making assumptions to address several questions, including:

- How much will we grow? The rate of population and employment growth depends on long-term national and international changes in productivity, migration and relative competitiveness.
- Will people and business continue to choose cities? The recent shift to more recentralized growth patterns, including both job and residential growth in New York City, may or may not continue.
- What about technology? New technologies are changing the frequency and timing of work trips, but how much this will continue is uncertain. More people are working from home or traveling during the off-peak hours.
- Is congestion pushing people away? Recent historical data suggests that some people have shifted their time of travel because of congested conditions at peak times. If congestion is relieved, will these travelers convert to their old habits?
- Will the transit service be provided to meet the growth patterns? If the problems persist in crossing the Hudson by transit, will potential riders choose to locate their homes and businesses elsewhere, to the detriment of both states?
- Where will people live? The relative growth of the labor force living on the two sides of the Hudson is affected by the extent to which housing can be expanded in both urban and suburban areas. The less housing is built in New York City, Long Island and other areas east of the Hudson relative to New Jersey and west of Hudson locations, the greater the growth of trans-Hudson travel is likely to be.
Past Agency Demand Projections
An examination of past projections shows a range of possible results, but under any scenario, transit trips across the Hudson River will grow considerably.

The Access to the Region’s Core (ARC) forecasts made in 2007 with a horizon year of 2030 indicated that even without a new rail tunnel there would be 38% more people crossing the Hudson on transit each weekday than there were in 2005. These forecasts also projected 29% more people using (or trying to use) the existing HRT tunnel and 20% trying to use buses through the Lincoln Tunnel. Remarkably, the growth from 2005 to 2015 has already met this projection to 2030. Penn Station volumes since 2005 are up by 37%, most of it in the last two years. The ARC project forecast that the growth in Penn Station if the ARC tunnel were built would have been 88% more in the course of the day and 133% more in a four hour morning peak period in the 2005-2030 period.

The Port Authority has estimated that the four-hour peak will see between 38% and 50% growth on transit from 2010 to 2040. It also estimated that by 2050 there will be demand for 50% more bus riders in the evening peak hour.

These data are presented in Table 2 with the annual rate of growth for easier comparisons. The overriding message is clear: substantial growth in travel across the Hudson River into Penn Station, into the PABT, on PATH and during all time periods, peak and off peak. This growth, when added to the highly congested current conditions, cannot be met without new capacity. The limited number of crossings and finite roadway capacity in Manhattan inhibit potential surface transportation options, such as on-demand car services and autonomous vehicles. Corridors for public transit that could include these technologies could be designated in the future but a wall of buses or autonomous vehicles would conflict with pedestrian mobility, add to congestion and detract from the city’s environment.

RPA Projections
RPA developed its own trans-Hudson models as described in the Appendix. The mode choice model was applied for the trips from west of the Hudson, including the 14 counties in New Jersey and four in New York State west of the Hudson and the census tracts in Manhattan as far north as 125th Street on the west side and 96th Street in the east side. This area was chosen to be representative of the impacts of various proposals on modal use. Because of this limitation and because the model only considers work trips, the data presented here should not be used to estimate the total number of trips or to evaluate specific transit capacity options, but rather to be illustrative of the direction and magnitude that would result from changes in land uses and transportation services during the peak period.

Table 2: Trans Hudson Projections Comparison

<table>
<thead>
<tr>
<th>Agency</th>
<th>Circumstance</th>
<th>Range</th>
<th>Time Period</th>
<th>Mode</th>
<th>Annual Rate of Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>NJT</td>
<td>Without ARC</td>
<td>2005 to 2030</td>
<td>Daily</td>
<td>All Transit</td>
<td>1.5</td>
</tr>
<tr>
<td>NJT</td>
<td>Without ARC</td>
<td>2005 to 2030</td>
<td>Daily</td>
<td>HRT</td>
<td>1.1</td>
</tr>
<tr>
<td>NJT</td>
<td>Without ARC</td>
<td>2005 to 2030</td>
<td>Daily</td>
<td>Bus/LT</td>
<td>0.8</td>
</tr>
<tr>
<td>NJT</td>
<td>Actual</td>
<td>2005 to 2015</td>
<td>Daily</td>
<td>HRT</td>
<td>3.2</td>
</tr>
<tr>
<td>NJT</td>
<td>With ARC</td>
<td>2005 to 2030</td>
<td>Daily</td>
<td>HRT</td>
<td>2.6</td>
</tr>
<tr>
<td>NJT</td>
<td>With ARC</td>
<td>2005 to 2030</td>
<td>4 hour pm peak</td>
<td>HRT</td>
<td>3.5</td>
</tr>
<tr>
<td>PA</td>
<td>Unconstrained</td>
<td>2010 to 2040</td>
<td>4 hour pm peak</td>
<td>All Transit</td>
<td>1.1 to 1.4</td>
</tr>
<tr>
<td>PA</td>
<td>Unconstrained</td>
<td>2010 to 2040</td>
<td>1 hour pm peak</td>
<td>Bus/LT</td>
<td>1.02</td>
</tr>
</tbody>
</table>


Table 3: Work Trips from West of the Hudson River to Manhattan and New York City, 2015 & 2040

<table>
<thead>
<tr>
<th>Location</th>
<th>2015</th>
<th>2040</th>
<th>Change</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manhattan</td>
<td>301,869</td>
<td>374,526</td>
<td>72,657</td>
<td>24%</td>
</tr>
<tr>
<td>New York City</td>
<td>394,165</td>
<td>542,004</td>
<td>147,839</td>
<td>38%</td>
</tr>
</tbody>
</table>

Source: Regional Plan Association Vision Scenario
Known Deficiencies and Planned Improvements

Table 4: Trans-Hudson Crossings and Facilities

<table>
<thead>
<tr>
<th>Name</th>
<th>Mode</th>
<th>Built</th>
<th>Daily Trips (Both Ways) 2015</th>
<th>Inbound 8am to 9am 2015</th>
<th>Daily Trips Inbound 2015</th>
<th>Daily Trips Outbound 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penn Station/HRT</td>
<td>Rail</td>
<td>1910</td>
<td>194,377</td>
<td>24,662</td>
<td>97,090</td>
<td>97,287</td>
</tr>
<tr>
<td>PATH — Uptown</td>
<td>Rail</td>
<td>1908</td>
<td>135,752</td>
<td>16,712</td>
<td>67,274</td>
<td>68,478</td>
</tr>
<tr>
<td>PATH — Downtown</td>
<td>Rail</td>
<td>1909</td>
<td>109,785</td>
<td>14,230</td>
<td>54,908</td>
<td>54,877</td>
</tr>
<tr>
<td>Lincoln Tunnel/PABT</td>
<td>Bus</td>
<td>1937-1957</td>
<td>426,931</td>
<td>38,275</td>
<td>198,279</td>
<td>228,652</td>
</tr>
<tr>
<td>Ferry</td>
<td>Ferry</td>
<td>NA</td>
<td>34,887</td>
<td>5,005</td>
<td>16,997</td>
<td>17,890</td>
</tr>
</tbody>
</table>


In addition to sheer lack of capacity to handle demand, the aging trans-Hudson facilities have significant deficiencies that affect service and reliability. Table 5 shows the age and ridership for these facilities. In the following sections, their individual problems are described, current plans discussed and some suggestions are made as to how to address remaining deficiencies.
Hudson River Tunnel

The tunnels are comprised of two parallel single-track tubes\(^1\). The New Jersey portals are west of the Palisades, where the tracks emerge and travel along an elevated embankment through the Meadowlands, called the “High-line.”

All these facilities have insufficient capacity for current use and future growth. The tunnels suffer from over 100 years of heavy use, and more recently from damage caused by Superstorm Sandy. To keep the tunnels in safe working condition, Amtrak currently takes one tube out of service every weekend and many evenings for repairs and operates train service in only one tube. However, there is no longer enough time on nights and weekends for all of the maintenance work that needs to be done. In 2014 Amtrak stated that the tunnels had less than 20 years left before they must be closed for rehabilitation, which will take several years. If new tunnel capacity is not built to accommodate the trains that will have to be diverted from the existing tunnel, major service disruptions will ensue.

**Major Deficiencies**

- The Tunnels and Highline (a series of structures that elevate the NEC over the Meadowlands from Secaucus Junction to Newark Penn Station) reached their maximum rush hour capacity years ago and cannot accommodate more trains and passengers. Until new capacity is built to supplement trans-Hudson train travel, the region's economic growth will be artificially capped.

- Several bridges on the Highline are long past the end of their useful life and must be replaced.

- The weight of the Hudson River fluctuates with the tides and as a result, the tunnels compress at high tide and expand at low tide. More than 100 years of this daily abuse has taken a significant toll on the tunnels’ engineering.

- In 2012, the tunnels were flooded with water from the Hudson River for the first time ever by the 14-foot storm surge from Superstorm Sandy. The brackish saltwater was quickly pumped out, but left a coating of chlorides and sulfates which cause long-term corrosion to reinforcing steel and concrete. In 2014, an engineering study found that more than $350 million is needed to fix the damage. Fortunately, the study also found “negligible, if any chemical impact” to the tunnel’s outer cast iron ring, so they can continue to safely support operations for the time being.

**Potential Solutions**

There have been many actions and plans put forth to address capacity and reliability issues at Penn Station and the Hudson River Tunnels. In 1996, RPA's Third Regional Plan, “A Region at Risk,” identified a new set of tunnels under the Hudson River as one of the most important priorities for the metropolitan region. Beginning around that time, NJTransit and Amtrak began collaborating on Access to the Region's Core (ARC). This project was intended to add capacity by building two new deep tunnels into Manhattan with a terminus at 34th Street and 7th Avenue. However, ARC was cancelled by New Jersey Governor Chris Christie in 2010 citing the potential for cost overruns.

Since then, Amtrak has proposed the Gateway Program, a proposal to build new trans-Hudson rail capacity that connects into Penn Station. The complete Gateway program is still in a conceptual design phase. The planning, design and engineering for the tunnel must proceed rapidly to reduce the probability that the existing tunnels will fail before the new ones tunnels are built. The unresolved issues for Gateway that remain between NJT and Amtrak and funding for the over $20 billion project must be addressed soon. Meanwhile, the replacement of the Portal Bridge in the New Jersey Meadowlands, a necessary part of the Gateway project and critical to the reliability of the existing corridor, is designed and ready to be constructed once $1.5 billion in funds is identified.

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\(^1\) Each tube has one track supported by a trough of loose-rock ballast with concrete bench walls alongside it containing electrical and communications conduits. The tubes are built with a 1.5-inch thick cast iron outer ring and a two-foot thick reinforced concrete inner lining.
Penn Station

The original Pennsylvania Station was an architectural landmark that deteriorated over time during the decline of passenger rail service after World War II. To the dismay of many, it was demolished in the 1960s and the Penn Station we know now opened in 1965. Today, it shares space below grade with the foundation columns and structural elements that support Madison Square Garden and an office building.

Penn Station has also reached its maximum practical capacity. The number of daily Amtrak, Long Island Rail Road and NJT passengers that use the station every weekday exceeds 400,000. Countless others pass through the station on foot on their way to one of the four subway lines nearby. The existing Penn Station was only designed for 200,000 daily riders.

Major Deficiencies

- The capacity constraints and complex layout of Penn Station make commuting and intercity rail travel an anxious and overall unpleasant experience for travelers.

- Pedestrians typically back up at stairways and escalators to reach the street level, and preventing trains to leave the station quickly, limiting train operations and capacity.

- Increasing congestion in station and on platforms has raised alarms over safety of passengers; if emergency evacuation was required during the peak, the outcome could be catastrophic.

Potential Solutions

Penn Station must be redesigned. The railroads are engaged in a joint planning study to improve Penn Station, called the New York Penn Station Visioning Study. In a parallel effort, RPA has also been working with the Municipal Art Society in an ambitious collaboration called the Alliance for a New Penn Station, which has recommended that Madison Square Garden be moved to a nearby site to open up Penn Station to a redesign so that many solutions to its circulation problems that are now precluded by the arena and the adjoining office building can be implemented. The New York City Council has required MSG to have a plan for relocation by 2024. RPA has developed a series of recommendations to improve Penn Station that are further detailed in this report.

In 2016, the New York Times editorial page featured a brilliant proposal by Vishaan Chakrabarti and PAU to move MSG to an adjacent site, strip the Garden structure down to its structural elements, and create a beautiful train station within the existing footprint of the Garden. This provocative and elegant design demonstrated the importance of architecture to solving our transit crisis.

Meanwhile, across Eighth Avenue the first phase of Moynihan Station is complete, improving circulation for users of the western end of Penn Station. The second phase would build a new, grand train hall and shift Amtrak’s ticketing and back-end operations from Penn Station, opening up new retail and commercial development opportunities.

Hudson River Tunnel & New York Penn Station

The Pennsylvania Railroad built the Hudson River Tunnels, the original New York Pennsylvania Station and the four East River Tunnels and other connecting infrastructure in Queens. This entire complex opened for service in 1910. The tunnels eliminated the transfer in New Jersey with a direct ride to Midtown and established attractive intercity rail service from points west and south. Today, these tunnels and Penn Station are at the heart of NJT’s rail network and the Northeast Corridor, Amtrak’s busiest rail line operating between Boston and Washington, D.C.
Lincoln Tunnel and Port Authority Bus Terminal

The PABT is the largest bus terminal in the United States. It inhabits prime real estate in Midtown Manhattan, occupying nearly one entire block and half of another bound by 40th and 42nd streets and 8th and 9th avenues. The building is directly connected to ten subway services underground between 8th Avenue and Times Square, the busiest station in the New York City subway system.

This bus service complex includes a 2.5-mile Exclusive Bus Lane that allows morning peak period buses to bypass auto and truck queues at the Lincoln Tunnel, a helix-shaped roadway at the western portals of the tunnel, the six-lane tunnel, a series of ramps connected to the PABT that is separated for the street grid, and the multi-level Port Authority Bus Terminal with 223 bus gates and an auto parking garage.

The XBL opened in 1970. Each morning it carries more than 1,600 buses, 730 in the peak hour in what is normally a westbound lane. A lane in the tunnel extends the XBL for exclusive bus use. It is managed by the Port Authority of New York & New Jersey.

The bus terminal’s main deficiencies are both structural and operational. Many of the terminal’s elements were built more than 60 years ago; they have reached the end of their useful life, and will need to be replaced soon.

Major Deficiencies

- Recent Port Authority studies have identified several major weaknesses in some of the bus terminal’s structural elements, including the foundation slab and ramps to and from the Lincoln Tunnels.

- The lack of PABT capacity causes overflow operations, including NJT and other bus carriers, plus less formal (“jitney”) bus and van services to operate on the neighboring streets. This exposes passengers to the elements, creates congestion on sidewalks and local streets, air and noise pollution and is an eyesore for neighborhood residents.

- Peak hour bus traffic through the Lincoln Tunnel has grown rapidly and is projected to grow from 730 buses to 1,000 by 2040. This leads to backups and delays at its entrance in the Meadowlands. Passengers are losing time and travel reliability suffers.

- There is not enough storage and layover space for buses in Manhattan. The result is that many buses must be stored in New Jersey during the day and then battle rush-hour traffic in the evening using only the two eastbound lanes available to access the PABT. This leads to countless delays for buses and for evening peak period passengers.

- The terminal’s operating deficiencies affect the customer experience. Long lines are the result of unreliable deployment of buses and inefficient design of boarding areas. Waiting areas are insufficient and unpleasant, and expose commuters to bus fumes.

Potential Solutions

Currently ongoing, the Port Authority’s Midtown Bus Master Plan is evaluating long-term solutions to the infrastructure, operational and capacity issues at the PABT. All the alternatives suggested to date are very costly, estimated on the order of $10-$15 billion. In the spring of 2016 the agency launched an international design competition for the bus terminal and five final designs were selected as finalists later that year. Three designs proposed constructing a new 4-5 story terminal on the surface between 9th and 11th Avenues one block from the current site and two suggested subterranean solutions. The most promising scheme proposed repurposing the lower level of the Javits Convention Center as a new terminal and directly tying it directly into the Lincoln tunnel tubes. None of the designs were accepted by the Port Authority Board of Commissioners which has asked staff to explore further less costly options, including revisiting the existing 8th Avenue site. The search for other options is hampered by three realities: the ramps connecting the Lincoln Tunnel and the PABT are immovable and any solutions must keep them in place; any other building site large enough for existing and expanded PABT operations will be enormously expensive; and any relocation will put the PABT passengers further from their destinations and the extraordinary subway connections they now enjoy.
Port Authority Trans-Hudson (PATH)

The Port Authority Trans Hudson (PATH) rapid transit system connects urban areas of Hudson and Essex counties with each other and with Manhattan. It accomplishes the Manhattan connections by providing transfers to the NJT rail system in Newark and Hoboken. The two tunnels under the Hudson take riders to the World Trade Center and to 33rd Street and Sixth Avenue via the Uptown branch stopping at five intervening stations in the West Village and Chelsea.

The recent growth in Hudson County is putting pressure on PATH, particularly on the Uptown branch, which will require additional capacity to serve a growing population. In anticipation of this growth and to improve service, the Port Authority is currently replacing the PATH’s antiquated and unreliable fixed-block signal system with a more advanced system using Communications-Based Train Control (CBTC) and has purchased 350 new, modern railcars with advanced features to operate the new signal system. These two improvements will reduce headways and increase the overall capacity of the system. The first contract for the procurement of the railcars was awarded in 2005 and most of these new cars are now in service. A new Harrison station is currently under construction and the agency is planning a major expansion at Grove Street to improve passenger circulation and surface access. These improvements, combined with CBTC will substantially increase capacity on downtown PATH but they will do little to address the needs of those destined for midtown on the uptown PATH line. The Port Authority was planning to extended platforms at Grove Street, Harrison and Exchange Place stations to accommodate 10 car trains (up from 8) on downtown PATH, but these plans have been delayed.

Major Deficiencies

- Many platforms, especially on uptown PATH, are short and/or narrow reducing the ability to expand to longer trains to add passenger capacity.
- The track configuration (geometry) and interlockings in Jersey City slow trains down and limit throughput.
- Lack of peak hour storage at the Newark Penn Station terminal and inability of inefficient terminal to turn trains quickly limits capacity too.
- PATH is not well integrated with the rest of the region’s urban transit network, especially the NYC subway system. In Manhattan, two Uptown PATH stations lack direct underground connections to nearby NYC subway stations.
- The two systems have different railcars (even though PATH is compatible with NYCT Division A or the “numbered” line cars) and fares are administered separately.

Potential Solutions

For years, various extensions in New Jersey of PATH have been considered. Most prominent is the extension of service from Newark Penn Station to the Newark Airport station on the Northeast Corridor, recommended by Regional Plan Association. The intent is to provide a one-seat ride from lower Manhattan to the airport. The project would include the construction of a new train yard to expand train storage capacity and permit more frequent PATH service. In December 2014, the Port Authority awarded a contract to study the project’s technical feasibility, costs and benefits. To date there has been little progress on the project with just preliminary planning underway. However, other extensions have been suggested including options to physically connect PATH to the NYC subway system.

Figure 8: PATH Extension to NEC Rail Link Station

Source: Regional Plan Association
Hudson River Ferries

Today, there are 16 trans-Hudson ferry routes that serve almost 30,000 two-way passengers on an average day, serving less than 3% of the daily trans-Hudson transit traffic.

Most prominent are:
- The services from Hoboken where local residents and arriving rail passengers board ferries at the rehabilitated ferry terminal.
- The Weehawken service to west 38th Street in Manhattan.
- The services from the Atlantic Highlands that cross Raritan Bay and terminate at the East River near the financial district.

One major advantage of ferries is their ability to serve additional demand in a short period of time. After the 9/11 attacks, the destruction of the World Trade Center and the PATH station below it, and the subsequent suspension of PATH service, ferry ridership nearly doubled. But once PATH service was restored in 2003, ferry ridership returned to earlier levels.

**Major Deficiencies**
Ferries operate in a private sector environment, at least as far as operations go, but the Port Authority has subsidized the construction of docking facilities. To cover operating costs, ferries have had to raise their fares faster than the PATH system, which has reduced ferry ridership.

**Potential Solutions**
Ferries have inherent limitations which constrain their ability to take on a more significant role in the trans-Hudson market. To be most successful they should have the following features:

- Serve a market that conveniently reaches each end of their trip by using ferries and limited last mile connections either by walking or having a ready-made delivery system.
- Serve a market with poor transit options.
- Serve a market willing to pay a premium fare.

These conditions are not often met but where they have been, ferries have thrived. In particular, the growth in development in Hudson County provides reason to believe that ferries can have an expanded trans-Hudson role. However, many situations where ferries can meet these conditions already have ferries in place. Therefore, a larger role for trans-Hudson ferries lies with either new or expanded transportation access to the water’s edge, with increased development near the water’s edge that will expand the market and with public subsidies of ferry operations to keep fares down. In particular, new mobility technologies, such as ride hailing and autonomous vehicles, may provide more convenient access to and from the water’s edge, which could promote more ferry ridership in the future.
What Would Happen if the Hudson River Tunnel Is Closed for Repairs?

The Northeast Corridor tubes under the Hudson River have the capacity to serve 24 trains per hour in each direction. If one tube is lost and only the remaining one is usable, its capacity would be reduced to just six trains in the peak hour, due to the logistics of operating trains in and out of a single tunnel. Operating the current system with two tunnels is already quite complex; operating it with one tunnel is nearly impossible. In this six-trains-per-hour closure scenario, difficult choices will be necessary as to which services are allotted this limited capacity.

One scenario would be to assign all six of those slots to NJT; they carry far more people per train than Amtrak does. In the 6am to 11am inbound trains could be configured with a maximum length and as double-deckers they would carry 1,300 people while Amtrak holds only 300 on Acela trains and 400 on the Northeast Regional.

The ramifications of this scenario for Amtrak would be grave. The Northeast Corridor is by far the most successful intercity rail service in the nation. Today, over 100 trains a day carry over 21,000 people through the Hudson River tunnel to and from Penn Station. In addition to Boston to Washington Acela service, more local regional services are provided by Amtrak as well as trains on eight other long-distance routes, most of which rely on the HRT. The disruption to its schedule and to riders would essentially render it useless as a convenient option throughout the corridor from all points south and west of New York. The loss would add more people at our crowded airports or on highways in the corridor.

How might the NJT riders cope with the loss of service? Some might consider traveling at other times of the day. If all of the 22,640 people that travel into Penn Station between 7:00 and 10:00 a.m. today (2013) were to continue to ride a train to Penn Station in the morning with one tunnel in operation, 22% would have to shift their commutes by one hour, 18% would have to shift by two hours, and 60%, almost 14,000 people, would have to shift three or more hours to find a space available. All of these people would have their daily schedules substantially changed, leading to major individual disruptions at home and in the workplace and for the businesses they work for.

Alternatively, some riders might consider working at home, at least some days in the week. The number of people who are able to do this is likely to be small since many of those that can work at home are probably doing it today. Only 3.8% of NJ workers work at home as of 2010, and others do work at home at least some of the time.

But what about the vast majority who cannot move their times or work at home? Their first choice might be to make use of the six trains if these trains were to operate on the lines they use today. They would have to compete with their fellow passengers for the limited seating. If not, they could seek other transit options including existing or new trains to Newark or Hoboken, where they could transfer to PATH, or in the case of Hoboken, to ferries. They could travel by bus to the already overcrowded PABT or they could drive.
Any of these choices would result in a much poorer trip for the half million people who travel each way across the Hudson each day. For the portion of the 150,000 people traveling to Penn Station each day who are deprived of rail service or who cannot fit on the limited service provided, they would face a more circuitous and time consuming multi-transit trip, resulting in time losses of an hour or more each day. If they chose to drive, their trip would be more unreliable and more expensive. For those who are currently using trains to Hoboken, their trains would be more crowded. If they currently use buses, they will be joined by diverted passengers, worsening the already poor Lincoln Tunnel and PABT experience. And for those now using PATH, crowding would also intensify.

Although this analysis is and should not be definitive as to which rail lines are assigned the precious six trains an hour, a case can be made that the Northeast Corridor trains and possibly the North Jersey Coast line would be the least disruptive choices. But these premium services could be the scene of chaos as passengers swarm to occupy the limited space on trains. The operations on the other lines would revert back to the service they had before the implementation of the three projects that improved their access to Penn Station. In essence, this would be turning the clock back, at least for the duration of the HRT tube closing, to the rail system that existed when NJT took over in 1979. Because ridership has expanded so much, by turning the clock back, the system would no longer accommodate today’s riders, and would be particularly ironic and sad for the tens of thousands of people who benefitted from these investments, and disruptive for the many of whom purchased homes to take advantage of these commuting improvements.

Faced with any of these choices, many would choose to no longer work or live in their current locations. Those who continue to work in Manhattan would be on overcrowded trains, switch to a one hour or more a day addition to their commute or shift travel times by two or more hours. Faced with these options, some may change jobs (probably for lower pay) and go to work in New Jersey, with a net loss in income for New Jersey residents.

For those visiting New York for the day, they may cancel that visit, robbing them of advantages of living in New Jersey and visiting the City. For those who live in New York and work in New Jersey, they may be without a transit option to reach their job. And employers in New York, faced with loss of access to the New Jersey work force, may move out of the region. In the long run, the loss of trans-Hudson capacity for an extended period would be a profound economic loss for both states.

Watch “Tunnel Trouble: Crumbling infrastructure is putting the region at risk.” (October 2015)

https://vimeo.com/143811940
Transportation across the Hudson River into New York City faces a crisis with several interrelated causes — facilities that are already crowded and over capacity, increasing demand and lack of access and resiliency. Each of the three main trans-Hudson facilities—the rail tunnels that serve all Amtrak and New Jersey Transit trains into Manhattan, Penn Station, and the Port Authority Bus Terminal—are over capacity, experience frequent service failures, and much of their physical structure is reaching the end of its useful life. The most urgent need is to repair the two rail tunnels, which can only be done once new tunnels are built without causing massive service disruptions.

Trans-Hudson travel is expected to increase substantially over the next two decades, creating the need for new capacity well beyond what the existing facilities can offer. Work trips alone could increase by about 25% without needed transit investment, and could grow by as much as much as 80% by 2040 with improved transit and land use changes. In addition, the existing network fails to serve many parts of the region, and could be transformed into a much more robust and efficient system. Two problems stand out. Train service from both the west and the east terminates in Manhattan, limiting the destinations that passengers can get to without changing to another train system and constraining the number of trains that operate in periods of peak demand. In many densely-developed parts of New Jersey there is no rail service at all and where it exists service frequencies are often limited. Travel times are slow, resulting in much larger volumes of bus trips than exists from other parts of the region.
Piecemeal solutions have been proposed to address individual problems. The Gateway project would solve the immediate maintenance needs of the rail tunnels and add additional capacity, but would still be insufficient to accommodate long-term transit demand and limit service options by maintaining Penn Station’s position as a terminus for New Jersey Transit and Long Island Rail Road trains. The Port Authority’s proposals for a much larger Midtown bus terminal would accommodate projected bus passengers, but at a very high cost with major negative impacts in the west midtown neighborhood and without making any improvements in service options. New York State’s current plans for improvements at Penn Station and a new Moynihan Station would improve circulation, amenities and the passenger experience within the stations, but would not be transformative nor provide additional capacity for more service.

Each of these proposals — Gateway, a new bus terminal in Midtown Manhattan, and Moynihan Station — serves a specific purpose, but they fail to address the larger capacity and connectivity challenges facing the region. They haven’t been planned in concert with each other, and they fall short of the region’s long-term needs.

A much better outcome could be achieved through a series of complementary investments that addresses the problems of the system as a whole. These investments can address the inadequacies of the current facilities, create capacity for the economy to grow well beyond existing projections and greatly improve service on both sides of the Hudson River. The investments would be phased to address the most urgent problems first and provide flexibility for the timing and type of future investments.

### Phase One: Build Gateway Tunnels and a Bus Terminal in the Basement of the Jacob Javits Convention Center

Construction of two new rail tunnels should begin immediately. At the same time, a second bus terminal in Manhattan can be built in the lowest level of the Jacob Javits Convention Center at a significantly lower cost than replacing the existing Port Authority Bus Terminal. The new Javits terminal could consolidate all intercity buses, taking buses off the streets and freeing up 63 gates at the existing PABT, resulting in an almost 30% increase in gate capacity for commuter buses. This combined with the demand reduction strategies recommended by the Port Authority (see Table 6) would allow the existing PABT to accommodate projected passenger demand to 2040 — the estimated end of its useful life. Some buses could also be diverted to the new Javits terminal, which would provide another option for destinations that could be reached more easily from its location, especially the Hudson Yards. It also creates flexibility and keeps the option of having one or two facilities in Manhattan in the future. This phase could also include a more ambitious overhaul of Penn Station, potentially moving Madison Square Garden and expanding the LIRR concourse.

### Table 6: Summary of Potential PABT Bus Demand Reduction Actions (# of peak hour buses)

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Buses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased Use of Higher-Capacity Buses</td>
<td>15</td>
</tr>
<tr>
<td>Holland Tunnel/Lincoln Tunnel Bus Loop</td>
<td>10</td>
</tr>
<tr>
<td>Expanded Bus Services to Port Imperial Ferry Terminal</td>
<td>10</td>
</tr>
<tr>
<td>Expanded Trans-Hudson Ferry Services</td>
<td>10-20</td>
</tr>
<tr>
<td>Expanded Bus Services to the GWBBS</td>
<td>10-30</td>
</tr>
<tr>
<td>Increased Use of the Holland Tunnel for Direct Downtown Service</td>
<td>20</td>
</tr>
</tbody>
</table>

Source: Trans-Hudson Commuting Capacity Study, PANYNJ, 2016

### Phase Two: Build Gateway East with Through Service at Penn South

Instead of terminating Gateway at 7th Avenue, the project should continue across Manhattan, under the East River, and connect into Sunnyside Yards in Queens. Constructing Penn South with fewer, wider platforms and two new East River tunnels would increase throughput at Penn Station by 30% and greatly expand rail service for New Jersey Transit, Long Island Rail Road and Metro North riders. New direct rail service into Penn Station for Bergen and Monmouth counties would reduce travel times and shift bus riders to rail in these under-served counties, relieving highway congestion and pressure on the bus terminals.

Table 7 indicates the impact of phases 1 and 2, including Gateway East, the Bergen loop and the Monmouth/Ocean/Middlesex rail line. It is assumed that these can be in place halfway to the 2040 horizon for the RPA plan, or 2027. For each of the modes (combining commuter rail and PATH), the number of work trips is shown — 2015, 2027 without any transportation improvements and with the RPA proposed improvements in place. The 2027 conditions were based on the interpolated values derived from the RPA land use Vision for 2040. The “no build” condition in 2027 shows the auto trips growing or “unconstrained.” In reality, auto trips across the Hudson (Lincoln and Holland Tunnels) and auto trips down the Henry Hudson Parkway (many from west of the Hudson) have declined in the peak period over the 2005 to 2015 period and capacity constraints make the...
unconstrained growth unrealistic. Accordingly, the RPA plan alternative distributes the auto trips proportionately across the other modes.

With the RPA plan in place by 2027, the share of trips by rail will grow from 38% today to almost 50%, while bus shares would decline from 33% to 25%. The absolute volume of bus trips would decline by 13% going from 100,000 work trips to Manhattan (south of Harlem) to 88,000. Meanwhile rail trips increase by 47%, spurred a combination of population expansion assumed for the west of Hudson communities and by the improved transit which encourages travel to Manhattan. With these investments, trans-Hudson travel would increase by 31% by 2040. The demand for rail service would grow by an estimated 76%.

Phase Three: Build New Rail Tunnels to Expand Service and Meet Future Capacity Needs

Phases one and two would likely meet capacity needs for the next 20 years. Beyond then, trans-Hudson demand will begin to surpass combined rail and bus capacity, and the existing PABT will have surpassed its useful life, requiring replacement. While a decision does not need to be made at this time, a better option than replacing the bus terminal would be to construct new rail tunnels between New Jersey and Manhattan. This would provide sufficient trans-Hudson capacity for the foreseeable future, divert more passengers from buses, and eliminate the need to rebuild the 42nd Street bus terminal, since the Javits bus terminal would be able to handle the bus demand from New Jersey.

Bus riders would be a far smaller share of the total, and anyone using the existing facility would have much better rail options.

Future phases of the RPA plan for regional rail improvements will be described in *A Region Transformed*, RPA’s fourth plan for the New York-New Jersey-Connecticut metropolitan area. These improvements will not only expand trans-Hudson capacity. They will also dramatically improve rail service throughout the tri-state region, creating the circulation system to support a growing economy, greater access to transit and jobs for low-income and underserved communities, and sustainable development patterns for the next century.

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**Table 7: Work Trips to Manhattan (south of Harlem) Across the Hudson River by Mode — 2015 2027 and 2040, RPA Plan**

<table>
<thead>
<tr>
<th>Year</th>
<th>Description</th>
<th>Total</th>
<th>Rail</th>
<th>Bus</th>
<th>Ferry</th>
<th>Auto</th>
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<tbody>
<tr>
<td>2015</td>
<td>Base</td>
<td>301,869</td>
<td>115,487</td>
<td>100,801</td>
<td>8,667</td>
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<tr>
<td>2027</td>
<td>No Action</td>
<td>335,791</td>
<td>124,351</td>
<td>97,704</td>
<td>9,641</td>
<td>104,095</td>
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<td>2027</td>
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<td>345,476</td>
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<td>2040</td>
<td>No Action</td>
<td>373,526</td>
<td>139,360</td>
<td>110,178</td>
<td>10,724</td>
<td>113,264</td>
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<tr>
<td>2040</td>
<td>RPA Plan (Phases 1 &amp; 2)</td>
<td>395,383</td>
<td>202,924</td>
<td>104,193</td>
<td>11,352</td>
<td>76,914</td>
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<table>
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<tr>
<th>Year</th>
<th>Description</th>
<th>Total</th>
<th>Rail</th>
<th>Bus</th>
<th>Ferry</th>
<th>Auto</th>
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</thead>
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<tr>
<td>2015</td>
<td>Base</td>
<td>100.0</td>
<td>38.3</td>
<td>33.4</td>
<td>2.9</td>
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<td>37.3</td>
<td>29.5</td>
<td>2.9</td>
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<td>51.3</td>
<td>26.4</td>
<td>2.9</td>
<td>19.5</td>
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<table>
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<tr>
<th>Year</th>
<th>Description</th>
<th>Total</th>
<th>Rail</th>
<th>Bus</th>
<th>Ferry</th>
<th>Auto</th>
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<td>2040</td>
<td>No Action</td>
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<td>9.3</td>
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<td>75.7</td>
<td>3.4</td>
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Source: RPA Regional Demand Model
Penn Station New York is overcrowded and a dysfunctional collection of fragmented spaces. The concourses and platforms are too narrow; access to the platforms and vertical circulation elements are inadequate. The station lacks basic amenities like legible uniform signage and sufficient space for waiting passengers. There is little to no presence at the street-level and poor pedestrian circulation on surrounding streets and sidewalks. RPA’s projected increase of an additional 72,000 trans-Hudson work trips to Manhattan by 2040 (much higher when non-work added) would only further compound these problems and push the existing PSNY complex well beyond its ability to serve these commuters and intercity passengers.

The Plan

The New York Penn Station is not a single structure but instead a vast complex encompassing a super-block that extends from 34th Street to 31st Street and 7th to 8th Avenues. This is the core of the station, from where all the tracks are accessible. Over the past several years many plans have been proposed to address these deficiencies and also to expand Penn Station’s footprint. Much of the work underway or that has been completed targets improvements to passenger concourse area and street level, with some limited improvements to the track/platform level. RPA further builds on these proposals, including additional capacity improvement and interventions at the track level. The map below highlights the four areas that are covered in this proposal.

The Penn Station Complex: Four Focus Areas

7th Avenue — Penn Station
A substantial intervention on 7th Avenue is critical to creating a new “front door” for the Penn Station complex. The scheme would create a large indoor-outdoor space centered on 33rd Street, closing part of the street and creating a new plaza that has entrances directly down to a reconfigured A-level LIRR east-west concourse. The reimagined LIRR concourse would be widened and shifted to the north and relocated under the building line allowing for higher

Case Study
What to Do About Penn Station

Figure 12: Penn Station Focus Areas

Source: Regional Plan Association
Note: Penn Station consists of four levels: the C-level/street-level, the B-level/Amtrak waiting room, A-level/LIRR concourse and platform/track level. There are four main east-west concourses, 7th Avenue/Main Gate, Central, Exit and West End.
ceilings and more light. The new entrance on 7th Avenue would include design cues found in traditional train sheds and create a uniform frontage that extends from 31st Street to 34th Street. The current cramped main entrance at 32nd Street would also be widened along with the Hilton passageway (which is only 12 feet in wide in some places). This intervention envisions keeping 2 Penn Plaza, a 50-story office building and its many columns that impact circulation on the eastern side of the station. The central concourse would also be extended to track one (and later to Penn South) and widened and the B-level removed on 2 Penn Plaza, reconfiguring the existing NJT concourse to conform with the elevation at A-level.

8th Avenue — Madison Square Garden
Removal of the sports arena and theatre above the central part of Penn Station has been a long-standing position of RPA. There are many reasons that justify this course of action, ranging from security concerns to bringing much needed natural light and air to the lower levels of the complex. Many of the proposals in the past have suggested relocating Madison Square Garden, demolishing the existing structure and building a new head house with retail and office space (tower).

A proposal by Vishaan Chakrabarti and PAU envisions gutting MSG, removing the floors and exterior curtain wall, and keeping just the structural skeleton of the building clad in glass. This intervention, combined with the complete removal of the B-level concourse beneath MSG, would eliminate over 200 columns from the platforms — freeing up more space for vertical access and passenger queuing. This would open up and remove all of the barriers between the tracks and platforms, retaining only the three north/south transverse concourses (7th Ave, exit and central) and two or eventually three east/west corridors (LIRR concourse and Hilton passageway). The transverse concourses would be completely extended across all tracks. The glass curtain wall would be open at street level to provide 360° access to the station, similar to many traditional stations. The 33rd Street plaza would be extended to 8th Avenue.

RPA also envisions extending the elimination of B-level concourse elimination to 7th Avenue to better distribute passengers. The transverse concourses and Hilton passageway would be widened to open up this congested corridor. Additional vertical circulation drops to the platform to reduce queues and long waits in leaving the platform and the impact of reducing distance from upper concourse must also be evaluated. These schemes must be integrated with Penn South to create a unified experience.

West — Moynihan Station
The plans to convert the Farley post-office building to a new waiting area for intercity passengers were proposed by Senator Daniel Patrick Moynihan in 1993. To date, Phase 1 of the project, which extended and widened the existing LIRR western concourse and add new street-level entrances at the corners of the Farley building is complete. Phase 2, which recently celebrated a groundbreaking, will include conversion of the Farley courtyard into the new waiting room with drops to some of the platforms. It’s location at the western end of the complex limits the number of platforms that will be accessible from the waiting room. However, the future Moynihan station will play a critical role in freeing up space at the existing Penn Station by becoming a receiving site for many of Amtrak’s back-office functions and the main space for those waiting to board intercity trains. It must also include a passageway to 9th Avenue, even if this improvement occurs before the redevelopment of the Farley Annex on the western half of the block.

South — Penn South Expansion
Amtrak has been studying extending Penn Station south to block 780, between 31st and 30th Streets. The most recent proposal would be a station with approximately 8 tracks and 5 platforms of varying widths (there are several configurations). It would be designed initially as a stub-end terminal with 4 out of 8 of its tracks able to run-through to Queens if two tunnels were constructed further to the east at some point in the future. This hybrid approach will limit the capacity benefits of through-running, which could be as high as 33 trains per hour (similar to other systems such as London’s planned CrossRail), and makes it even more unlikely that the tunnels to the east would ever be built. While it is critical that something is done to expand Penn Station’s capacity to take full advantage of the two new tubes that will be constructed, the current approach and segmentation of the project makes it unlikely that the tunnels will ever provide their full potential.

RPA Alterations to Penn South Expansion

- Penn South should be designed with fewer tracks and platforms, which would be much wider than the current proposal. RPA evaluated two configurations, one with 6 track and 3 to 4 platforms and another with two very wide platforms (+60ft) and 4 tracks.

- The two new East River tubes to Sunnyside Yards and connecting tunnels through 31st Street should be constructed as part of the Penn South project to enable through-running from day one.

- A station shell should be constructed at 31st Street and 3rd Avenue

- Penn South should integrate into the revised PSNY configuration at the A-level concourse.

- These improvements would increase throughput to as much as 30 to 33 trains per hour rather than 22 to 24 — a 30% increase in capacity.
A new southern east-west concourse should be constructed running the length of the extension — book-ending the enlarged existing LIRR/northern east-west concourse.

Penn South should be constructed to accommodate higher F-plate and H-plate rail cars, with a height clearance of up to 21 feet to enable the operation of freight in off hours. This might require just one track (the most southern) to reach this vertical clearance, but these dimensions should be extended through at least one of the new eastern tube to Queens. This tube should also include a spur that would allow freight trains to access the Lower Montauk line in Queens.

**Platform/Track Level Improvements**
RPA believes that the following additional improvements should also be taken to increase station capacity, reduce congestion at the platform level and enable through-running regional rail:

- Widen select existing PSNY platforms (central and southern platforms, eastern LIRR platforms remain the same). This would result in the removal of a number of tracks.

- Replace escalators with stairs and elevators on the narrowest platforms to allow for greater vertical capacity. Elevators are also better and safer for passengers with luggage and strollers.

- Maximize vertical circulation, remove B-level and create a uniform A-level across the entire station complex.

- Remove as much structural artifacts as possible to increase existing platform capacity.

- Install high-density signaling system in East River tunnels.

- Create a unified station complex with modern amenities.

The result of these series of investments would be a unified Penn Station complex with modern amenities and the capacity to serve a growing region. New York City and the region would finally have a station that would reflect its status as the economic engine of the nation and gateway to the world. Commuters and intercity riders would finally be treated in a humane fashion, with plenty of space to move around with light and air that will transform Penn Station from a dreary and unpleasant experience to a place to linger and enjoy.
RPA calibrated a regional travel demand model for the purpose of examining the impacts of the RPA projections on travel demand and to test the effects of various transportation solutions. This model was supplemented with a mode choice model for trans-Hudson trips that further subdivides trips by mode of travel—rail, bus, PATH, ferry and auto.

The trans-Hudson model uses as inputs the total number of zone to zone trips from the trip distribution portion of the regional demand model. The distribution model is a gravity model that estimates the number of trips based on the work trips generated in the residential zone, the number of jobs attracted to the work zone, and the weighted transit and auto travel times. The model was calibrated to determine the propensity to travel between two points based on these travel times.

The trans-Hudson mode choice model is based on the principle that people in markets (zonal pairs) faced with similar transit choices will make similar choices in the future. If their choices change they will move to a different cohort that reflects the new choices and will behave accordingly. A simple example might be as follows. If the only transit choice today for a particular trip is a walk to a nearby rail station and then a train ride to Penn Station followed by a short walk to the work site, and there is no bus service from that zone, and if 90% of those with that choice take the train, none use a bus, and the remaining 10% drive, then if a new zonal pair is given a similar set of choices they will behave similarly. Of course, there are many combinations of characteristics for the various modes to be considered in the model.

In the trans-Hudson travel environment the choices are many and more complex. To simulate that complexity, the trans-Hudson zonal combinations for each census tract to census tract pair were evaluated to construct many cohorts. The factors used were a) distance to each transit mode west of the Hudson, b) number of transit transfers necessary on the east side of the river, and c) the ability to ride by train directly to Manhattan without a transfer.

The options for each zone west of the river were evaluated as follows:

<table>
<thead>
<tr>
<th>Station/Stop</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>PATH</td>
<td></td>
</tr>
<tr>
<td>Very near</td>
<td>less than ½-mile</td>
</tr>
<tr>
<td>Near</td>
<td>½ mile to 5 miles</td>
</tr>
<tr>
<td>Far from</td>
<td>beyond 5 miles</td>
</tr>
<tr>
<td>Rail</td>
<td></td>
</tr>
<tr>
<td>Very near</td>
<td>less than ½-mile direct ride to Penn Station</td>
</tr>
<tr>
<td></td>
<td>less than ½-mile transfer to PATH to reach Manhattan</td>
</tr>
<tr>
<td>Near</td>
<td>½-mile to 5 miles direct ride to Penn Station</td>
</tr>
<tr>
<td></td>
<td>½-mile to 5 miles transfer to PATH to reach Manhattan</td>
</tr>
<tr>
<td>Far from</td>
<td>beyond 5 miles direct ride to Penn Station</td>
</tr>
<tr>
<td></td>
<td>beyond 5 miles transfer to PATH to reach Manhattan</td>
</tr>
<tr>
<td>Bus</td>
<td></td>
</tr>
<tr>
<td>Very near</td>
<td>less than ½-mile</td>
</tr>
<tr>
<td>Near</td>
<td>½-mile to 5 miles</td>
</tr>
<tr>
<td>Far from</td>
<td>beyond 5 miles</td>
</tr>
</tbody>
</table>

With 3 PATH options, 6 rail options, and 3 bus options there are theoretically 54 combinations possible for the west of the Hudson transit choices.

A similar process was used for the transfer count east of the Hudson. With three transit modes — bus, rail and PATH and three transfer possibilities — none, one, or two (three is never required for any trip to Manhattan) a total of 27 possibilities exist. When combined with the 54 west of the Hudson, 1,458 cohort possibilities exist. Of course, not all need be represented. In reality, 309 separate unique “splits” were identified.

Once the modal distribution of each cohort was determined it was assigned the values appropriate to the proposal to be tested. For example, if a rail proposal created a rapid transit service within walking distance west of the Hudson, the zonal pairs affected moved from a split with rapid transit (PATH) beyond walking distance to a split with rapid transit (PATH) beyond walking distance to a split with rapid transit (PATH) beyond walking distance. Similarly, if the proposal established a walk to destination in Manhattan, eliminating a subway ride, the split moved from a “one transfer” in Manhattan to a “no transfer” modal split. The assigned splits were done at a census tract to census tract level and the growth rates assigned to the zones were done on an aggregated basis using the 273 zone system from the regional travel demand model.

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1 The zonal pairs for the trans-Hudson model was based on US Census Tract zones

2 Only trips destined to Manhattan below 125th Street on the west side and below 96th Street on the east side were included in this process.
Regional Plan Association is an independent, not-for-profit civic organization that develops and promotes ideas to improve the economic health, environmental resiliency and quality of life of the New York metropolitan area. We conduct research on transportation, land use, housing, good governance and the environment. We advise cities, communities and public agencies. And we advocate for change that will contribute to the prosperity of all residents of the region. Since the 1920s, RPA has produced three landmark plans for the region and is working on a fourth plan due out in 2017. For more information, please visit, www.rpa.org.

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