HUDSON TUNNEL

DRAFT ENVIRONMENTAL IMPACT STATEMENT AND DRAFT SECTION 4(f) EVALUATION

APPENDIX 2

Project Alternatives and Description of the Preferred Alternative

2-1: Alternatives Development Report

U.S. Department of Transportation
Federal Railroad Administration

NJTRANSIT
The Way To Go.®

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Alternatives Development Report

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Hudson Tunnel Project
Alternatives Development Report

April 2017

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1. INTRODUCTION

1.1. PURPOSE OF THIS REPORT

The Federal Railroad Administration (FRA) and NJ TRANSIT are preparing an Environmental Impact Statement (EIS) to evaluate the Hudson Tunnel Project (the "Proposed Action" or the "Project"). The Project is intended to preserve the current functionality of the Northeast Corridor's (NEC) Hudson River passenger rail crossing between New Jersey and New York and strengthen the resilience of the NEC. This report describes the alternatives development process that was followed to identify the Build Alternative(s) to be analyzed in the Draft EIS (DEIS) for the Hudson Tunnel Project.

The Federal Council on Environmental Quality's National Environmental Policy Act (NEPA) regulations (40 CFR Parts 1500-1508) state that Federal agencies should "Use the NEPA process to identify and assess the reasonable alternatives to proposed actions that will avoid or minimize adverse effects of these actions upon the quality of the human environment" (§ 1502.2). The regulations call for EISs to "rigorously explore and objectively evaluate all reasonable alternatives, and for alternatives which were eliminated from detailed study, briefly discuss the reasons for their having been eliminated" (§ 1502.14). FRA's *Procedures for Considering Environmental Impacts* (64 Fed. Reg. 28545, May 26, 1999) outline a process that identifies all potentially reasonable alternatives and evaluates their impacts in increasing detail as the number of alternatives decreases through the screening process.

After describing the purpose, need, goals, and objectives of the Proposed Action, this report presents the multi-step alternatives development and evaluation process conducted for the Hudson Tunnel Project. In summary, the process involved developing an initial "long list" of potential alternatives, comprising many different possible means of maintaining the current level of passenger rail service across the Hudson River, and conducting a high-level qualitative evaluation to determine which of those alternatives were feasible, reasonable, and met the Proposed Action's purpose and need. The result of that evaluation was a single Build Alternative concept with a range of alignment options. These alignment options were then evaluated against a more detailed set of quantitative and qualitative criteria meant to determine which alignment option best meets the Project purpose, need, goals, and objectives. The identified alignment option was incorporated into the Build Alternative concept that then was identified as the Preferred Alternative for the Hudson Tunnel Project.

1.2. PROJECT BACKGROUND

The existing NEC rail tunnel beneath the Hudson River is known as the North River Tunnel.[1] **Figure 1** illustrates the location of the North River Tunnel and its approach tracks. This tunnel is used by Amtrak for intercity passenger rail service and by NJ TRANSIT for commuter rail service. The tunnel operates at capacity to meet current demands. As shown in the figure, the approach to the tunnel begins east of NJ TRANSIT's Secaucus Junction Station in Secaucus, New Jersey (which is 5 miles east of Newark Penn Station). East of Secaucus Junction Station,

[1] "North River" is an alternate name for the Hudson River, based on an early Dutch name for the river.

3/31/2017

Existing Northeast Corridor *Existing North River Tunnel*

0 5,000 FEET

HUDSON TUNNEL PROJECT

Project Location
Figure 1

the NEC has two tracks that approach the tunnel on a raised embankment through the New Jersey Meadowlands in Secaucus and North Bergen, New Jersey. Tracks enter a tunnel portal at the western face of the Palisades[2] in North Bergen, passing beneath Union City and Weehawken, New Jersey, and the Hudson River before emerging at Penn Station New York (PSNY) in New York City. The North River Tunnel has two separate tubes, each accommodating a single track for electrically powered trains, and extends approximately 2.5 miles from the tunnel portal in North Bergen to PSNY.

Superstorm Sandy in October 2012 inundated the North River Tunnel and today the tunnel remains compromised. The North River Tunnel is currently safe for use by Amtrak and NJ TRANSIT trains traveling between New Jersey and New York City and beyond. However, it is in poor condition as a result of the storm damage and has required emergency maintenance that disrupts service for hundreds of thousands of rail passengers throughout the region. At present, regular maintenance and repair work is being conducted every weekend, with one tube of the North River Tunnel closed for maintenance for a 55-hour window beginning on Friday evening and ending early on Monday morning. Despite the ongoing maintenance, the damage caused by the storm continues to degrade systems in the tunnel and can only be addressed through a comprehensive rehabilitation of the infrastructure and systems in the tunnel. The damage caused by Superstorm Sandy is compounded by the tunnel's age and the intensity of its current use, resulting in frequent delays due to component failures within the tunnel. The North River Tunnel is more than 100 years old and was designed and built to early 20th-century standards; the tunnel's age in combination with the damage caused by flooding result in the need to upgrade systems and infrastructure throughout the tunnel.

To perform the needed rehabilitation of the existing North River Tunnel, each tube of the tunnel will need to be closed for more than a year. If no new Hudson River rail crossing is provided, closing a tube of the tunnel for rehabilitation would reduce the number of trains that could serve PSNY to a fraction of current service, because the single remaining tube would have to support two-way service. For that reason, to ensure rehabilitation is accomplished without notable reductions in weekday passenger rail service, the Proposed Action would provide capability for rail service crossing the Hudson River and connecting to and from the existing tracks at PSNY so that (1) the existing level of train service can be maintained while the damaged tubes are taken out of service one at a time for rehabilitation, and (2) redundant capability is available once both tunnels are in service.

2. PURPOSE AND NEED

2.1. PROJECT PURPOSE

The purpose of the Proposed Action is to preserve the current functionality of Amtrak's NEC service and NJ TRANSIT's commuter rail service between New Jersey and PSNY by repairing the deteriorating North River Tunnel, and to strengthen the NEC's resiliency to support reliable service by providing redundant capability under the Hudson River for Amtrak and NJ TRANSIT NEC trains between New Jersey and PSNY. These improvements must be achieved while maintaining uninterrupted commuter and intercity rail service and by optimizing the use of existing infrastructure.

[2] The Palisades are a line of steep cliffs that run along the western side of the Hudson River from northeastern New Jersey into southern New York State. In North Bergen and Union City, the Palisades are approximately 300 feet above the land to their west and east.

2.2. PROJECT NEED

The existing North River Tunnel is a critical NEC asset and is the only intercity passenger rail crossing into New York City from New Jersey and areas west and south.[3] The tunnel is more than 100 years old and was designed and built to early 20th-century standards. Service reliability through the tunnel has been compromised because of the damage to tunnel components caused by Superstorm Sandy, which inundated both tubes in the North River Tunnel with seawater in October 2012, resulting in the cancellation of all Amtrak and NJ TRANSIT service into New York City for five days. While the tunnel was restored to service and is now safe for travel, chlorides from the seawater remain in the tunnel's concrete liner (the inner lining of the tunnel) and bench walls (the low walls on both sides of the track in each tube which provide walkways and contain utility conduits), causing ongoing damage to the bench walls, imbedded steel, track, and signaling and electrical components.

The damage caused by Superstorm Sandy is compounded by the tunnel's age and the intensity of its current use (operating at capacity to meet current demand), resulting in frequent delays due to component failures within the tunnel. With no other Hudson River passenger rail crossing into PSNY, single-point failures can suspend rail service, causing delays that cascade up and down the NEC and throughout NJ TRANSIT's commuter system, disrupting service for hundreds of thousands of passengers. Service disruptions will continue and will over time happen more frequently as the deterioration related to the seawater inundation continues and components fail in an unpredictable manner.

Because of the importance of the North River Tunnel to essential commuter and intercity rail service between New Jersey and New York City, rehabilitation of the existing North River Tunnel needs to be accomplished without notable reductions in weekday service, which would be unacceptable. Removing one tube in the existing North River Tunnel from operation without new capacity in place would reduce weekday service to volumes well below the current maximum capacity of 24 peak direction trains per hour.

In addition, the existing two-track North River Tunnel is operating at its full capacity and does not provide redundancy for reliable train operations during disruptions or maintenance. Any service disruption therefore results in major passenger delays and substantial reductions to overall system flexibility, reliability and on-time performance. This condition is exacerbated by the need to perform increased maintenance to address damage caused by Superstorm Sandy or other variables such as age. These maintenance demands are difficult to meet because of the intensity of rail service in the tunnel. Efforts to maintain the North River Tunnel in a functional condition currently require nightly and weekend tunnel outages with reductions in service due to single-track operations. Train service is adjusted to allow one tube of the North River Tunnel to be closed each weekend for regular maintenance for a 55-hour window beginning on Friday evening and ending early on Monday morning.

In summary, the Proposed Action will address the following critical needs:

- *Improve the physical condition and rehabilitate the existing North River Tunnel*. Both tubes in the North River Tunnel were inundated with seawater during Superstorm Sandy in October 2012, resulting in the cancellation of all Amtrak and NJ TRANSIT service into New York City for five days. The more than 100-year-old North River Tunnel has been compromised as a result of the storm damage and service reliability has suffered.
- *Preservation of existing NEC capacity and functionality during rehabilitation of existing North River Tunnel*. The need to maintain existing levels of rail service is critical as it supports

[3] Port Authority Trans Hudson (PATH) rail service also crosses the Hudson River from New Jersey into New York City, but serves local New Jersey and New York commuters, not intercity or regional rail passengers.

intercity, regional, and local mobility and associated economic benefits regionally and nationally.

- *Strengthen the NEC's resiliency to support reliable service by providing redundant capability at the critical Hudson River crossing, so as to reduce commuter and intercity rail delays caused by unanticipated events or routine maintenance.* The lack of redundant capability across the Hudson River means that any service outage, either unplanned or for planned maintenance, results in substantial reductions to NEC reliability and on-time performance. Once the Project is constructed, maintenance can take place without these service disruptions.

2.3. GOALS AND OBJECTIVES

Five goals, listed below, were developed to guide the development and evaluation of alternatives to address the purpose and need for the Project. The objectives listed for each goal further define the goals and provide specific and measurable means by which to evaluate the Project alternatives.

Goal 1: Improve service reliability and upgrade existing tunnel infrastructure in a cost-effective manner.

- Objective 1.1: Reduce infrastructure-related delays due to poor condition of the North River Tunnel following Superstorm Sandy.
- Objective 1.2: Rehabilitate the North River Tunnel to modern system standards.

Goal 2: Maintain uninterrupted existing NEC service, capacity, and functionality by ensuring North River Tunnel rehabilitation occurs as soon as possible.

- Objective 2.1: Optimize use of existing infrastructure.
- Objective 2.2: Use conclusions from prior planning studies as appropriate and to the maximum extent possible.
- Objective 2.3: Avoid regional and national economic impacts associated with loss of rail service.

Goal 3: Strengthen the NEC's resiliency to provide reliable service across the Hudson River crossing, facilitating long-term infrastructure maintenance and enhancing operational flexibility.

- Objective 3.1: Construct additional tracks to allow for continued NEC rail operations during maintenance periods and unanticipated human-caused and natural events.

Goal 4: Do not preclude future trans-Hudson rail capacity expansion projects.

- Objective 4.1: Allow for connections to future capacity expansion projects, including connections to Secaucus Junction Station through to the Portal Bridge over the Hackensack River, and connections to station expansion projects in the area of PSNY.

Goal 5: Minimize impacts on the natural and built environment.

- Objective 5.1: Avoid/minimize adverse impacts on communities and neighborhoods.
- Objective 5.2: Strive for consistency with local plans and policies.
- Objective 5.3: Preserve the natural and built environment to the extent practicable.

3. PRELIMINARY EVALUATION OF ALTERNATIVES

The initial step in the development of alternatives for the Hudson Tunnel Project was to compile a "long list" of potential alternatives based on prior studies, current analyses, and input received during the scoping period, and to evaluate them for their ability to meet the Project purpose and need, and, if so, for feasibility and reasonableness.

The long list of alternatives was evaluated against a two-tiered set of criteria:

1. First, each alternative was assessed for its ability to meet **purpose and need**, including project goals and objectives as well as established design criteria (engineering and operational factors); and
2. Alternatives that were found to meet purpose and need were then assessed in terms of **feasibility** (i.e., whether the alternative can feasibly be constructed and operated given engineering, constructability, and rail operations considerations) and **reasonableness** (i.e., an alternative may not be reasonable if it would have a likelihood for substantial impacts, a protracted construction time, an unacceptably high cost or great environmental impact relative to other alternatives, or operational characteristics that are unacceptable).

Alternatives that were found to meet the Project purpose and need and to be feasible and reasonable were carried forward for further development and evaluation.

3.1. ALTERNATIVES CONSIDERED IN PREVIOUS STUDIES: ACCESS TO THE REGION'S CORE PROJECT

Detailed engineering studies and environmental documentation were prepared for a new Hudson River passenger rail tunnel as part of the Access to the Region's Core (ARC) Project. Between 1995 and 2010, the ARC Project evaluated several options for construction of a new tunnel under the Hudson River in combination with an expansion of station capacity in Midtown Manhattan to accommodate predicted future growth in commuters.

As defined in the ARC Project's 2007 DEIS, the purpose of the ARC Project was to: (1) increase trans-Hudson commuter rail capacity between Secaucus Junction Station and midtown Manhattan to accommodate projected growth of rail passengers; (2) enhance customer convenience and reduce travel time with more one-seat ride service; (3) increase rail system reliability within ARC project limits; and 4) maintain system safety and security.

The ARC Project's NEPA alternatives analysis began with a Major Investment Study (MIS), consistent with Federal Transit Administration/Federal Highway Administration regulations related to analysis of transportation project in accordance with NEPA. The MIS identified and evaluated a wide range of alternatives, and ultimately recommended a smaller number for consideration in the project's EIS. Following the MIS, a DEIS was completed in 2007 that evaluated a single Build Alternative. A Supplemental DEIS (SDEIS) analyzed a substantially modified Build Alternative; this alternative, with certain refinements, was carried forward into the ARC FEIS and ultimately approved in the project's Record of Decision (ROD) from the Federal Transit Administration. The ARC Project was cancelled in 2010.

3.1.1. ARC MIS ALTERNATIVES

As outlined in the MIS Summary Report published in 2003 for the ARC Project, the ARC MIS process began in 1995 and represented a joint planning effort by the Port Authority of New York & New Jersey (PANYNJ), the New York Metropolitan Transportation Authority, and NJ TRANSIT to examine an identified future need for increased transit capacity providing access to Midtown Manhattan. The MIS was conducted in three phases over eight years.

During Phases 1 and 2, the study identified and evaluated 137 alternatives, including bus, light rail, subway, PATH, commuter rail, ferry, new technologies, and auto, for improving access to Midtown Manhattan. These alternatives were evaluated through multiple screening steps. The

MIS analyses concluded that the commuter rail mode serving PSNY and Grand Central Terminal offered the best approach to meeting future capacity needs. An alternative that provided a through operation for NJ TRANSIT, Long Island Rail Road (LIRR), and Metro-North Railroad between Penn Station and Grand Central Terminal was selected as best meeting ARC's goals following Phase 2 of the ARC MIS.

In Phase 3, the MIS identified near-term capacity improvements that could provide some capacity relief while a long-term build alternative was developed; in addition, the recommended build alternative was further evaluated and developed. The near-term capacity improvements recommended were related to improving train storage capacity in Manhattan west of PSNY. For the long-term build alternative, the MIS identified and evaluated four build alternatives. All four alternatives included two additional tracks on the NEC between Secaucus and PSNY, including a new trans-Hudson passenger rail tunnel, and a loop track at Secaucus to connect NJ TRANSIT's Hoboken Division lines to PSNY. The four alternatives each also included different improvements at PSNY. Two alternatives created a rail link between PSNY and Grand Central; one created new tracks and platforms beneath existing PSNY; and one alternative provided a new East River tunnel connecting to PSNY with new train storage facilities at Sunnyside Yard in Queens.

Given the ARC Project's focus on capacity expansion, none of the alternatives identified during the MIS process, including those recommended for advancement to the ARC DEIS phase, would meet the purpose and need for the Proposed Action for the Hudson Tunnel Project, which is to preserve existing functionality of NEC service for Amtrak and NJ TRANSIT between New Jersey and New York by repairing the deteriorating North River Tunnel while maintaining uninterrupted commuter and intercity rail service on the NEC. However, the new Hudson Tunnel component of the ARC Project without the capacity-expanding elements (such as improvements at PSNY, new loop tracks at Secaucus, and new connections from PSNY to Grand Central Terminal or to Sunnyside Yard in Queens) would meet the purpose and need for the Hudson Tunnel Project. It would also be feasible and reasonable and therefore was carried forward for further consideration.

3.1.2. ARC SCOPING AND DEIS ALTERNATIVES

The ARC Project's EIS process began with a scoping process that considered the alternatives recommended in the MIS as well as additional alternatives suggested by the public. These alternatives included a range of options to increase capacity at PSNY and to introduce other capacity expansions, such as use of higher capacity train cars and introduction of new ferry service. Some of the recommended near-term alternatives have since been implemented, such as NJ TRANSIT's use of higher capacity bi-level cars and the extension of the West End Concourse in PSNY to provide passenger access to Platforms 3 through 6. Based on the alternatives evaluation conducted during its scoping process, the ARC DEIS assessed one Build Alternative: two new tracks along the NEC, beginning just east of Secaucus Junction Station and continuing in a new passenger rail tunnel beneath the Palisades and Hudson River to both existing PSNY and new station under West 34th Street between Sixth and Eighth Avenues, with tail tracks extending to Fifth Avenue. The alternative also included numerous ancillary facilities, including eight fan plants (two in New Jersey and six in Manhattan), a new rail storage yard in New Jersey to support the substantial increase in rail capacity this alternative would create, and additional rail infrastructure in New Jersey (loop tracks at Secaucus) that would have created direct access to PSNY from several NJ TRANSIT lines (Main, Bergen County, and Pascack Valley Lines) that currently require a passenger transfer at Secaucus Junction Station. This alternative's new surface tracks along the NEC included one on the north side of the NEC for westbound trains and one on the south side for eastbound trains. The track on the north side of the NEC crossed beneath the NEC embankment through a tunnel, so that it could connect to the new tunnel, which began at a portal in the western-facing slope of the Palisades about 200 feet south of the existing North River Tunnel's portal.

The ARC DEIS Build Alternative was intended to allow an increase in rail passenger capacity, and included numerous elements in support of that capacity increase. The capacity-expanding components of the ARC Project are not consistent with the Hudson Tunnel Project purpose and need, which does not include addressing a long-term need for increased passenger rail capacity in the region. This future need, while important, is not part of the purpose or scope of the Hudson Tunnel Project. Moreover, the addition of capacity expansion elements to the scope of the current Project would result in a notably longer schedule for implementation, which would then contradict the urgent need for rehabilitation of the North River Tunnel to occur as soon as possible. However, the alignment concept of the new tunnel and the connections to PSNY do meet the Project purpose and need and are feasible and reasonable. These components of the ARC DEIS Build Alternative are carried forward as part of the alternatives evaluated for the Hudson Tunnel Project (see Section 3.2 below).

3.1.3. ARC SDEIS/FEIS BUILD ALTERNATIVE

Following completion of the ARC DEIS in 2008, modifications were made to the ARC Build Alternative to address potential environmental impacts and engineering concerns associated with the DEIS Build Alternative. Engineering investigations conducted for the ARC Project identified geological conditions at the site of the proposed new 34th Street Station that resulted in the need for a deeper cavern beneath 34th Street. With a deeper cavern, the tunnel alignment was also lowered, which reduced the ARC Project's impact on the Hudson River and Manhattan bulkhead resulting from the DEIS Build Alternative's shallow alignment. The modified Build Alternative was evaluated in an SDEIS and FEIS completed in 2008.

Because of its deeper profile, the SDEIS/FEIS Build Alternative could not connect to existing PSNY, and connected instead to a new, stub-ended deep station beneath 34th Street (which no longer had tail tracks extending to Fifth Avenue). Smaller modifications were also made, including the elimination of one station entrance, and adjustments to fan plants and station entrances. With the elimination of connections to existing PSNY, the ARC SDEIS/FEIS Build Alternative was intended to be used by NJ TRANSIT trains, and not by Amtrak.

For the SDEIS/FEIS Build Alternative, the connections to the NEC tracks were modified to address potential disruptions to NEC operations associated with the DEIS Build Alternative's alignment. In the SDEIS/FEIS Build Alternative, both new surface tracks in New Jersey were on the south side of the NEC, to avoid the need to construct a tunnel beneath the NEC to bring the westbound track to the north side of the corridor. Other design refinements were also made to the surface alignment in New Jersey to minimize impacts.

Like the ARC DEIS Build Alternative, the SDEIS/FEIS Build Alternative was intended to allow an increase in rail passenger capacity, and included numerous elements in support of that capacity increase. The capacity-expanding components of the ARC Project are not consistent with the Hudson Tunnel Project purpose and need, which does not include addressing a long-term need for increased passenger rail capacity in the region.

Because it would not connect to the existing tracks at PSNY, the ARC SDEIS/FEIS Build Alternative does not meet the current Project purpose and need. With this alternative, existing levels of Amtrak and NEC service to PSNY could not be maintained while rehabilitation of the North River Tunnel is under way.

In addition, the ARC SDEIS/FEIS Build Alternative alignment without the capacity-related features of that project would not be feasible. A deep tunnel beneath the Hudson River to a stub-ended cavern beneath 34th Street would theoretically allow NJ TRANSIT to divert its trains from the existing North River Tunnel so as to allow rehabilitation to take place (leaving Amtrak train operations in a single tube of the North River Tunnel). However, since the deep 34th Street cavern would be stub-ended, without a connection to Sunnyside Yard in Queens, the ARC alignment's operation relies on a new midday storage yard in New Jersey (which was included in the ARC SDEIS/FEIS Build Alternative) to maintain train operations. The site evaluated for the

midday storage yard is no longer available for that use, since it is now planned for development as part of the NJ TRANSITGRID project, a critical resiliency initiative for the NJ TRANSIT system. Since the ARC SDEIS/FEIS Build Alternative does not meet the purpose and need for the Project and is no longer feasible, it was eliminated from further consideration. Relevant components that do meet the Project purpose and need were integrated into Build Alternative for the Project.

3.2. ALTERNATIVES PRESENTED IN THE PROJECT'S SCOPING DOCUMENT

On May 2, 2016, the FRA announced its intent to prepare an EIS for the Project by publishing a Notice of Intent (NOI) in the Federal Register. Publication of the NOI initiated the scoping period for the Project. Scoping is an initial step in the NEPA process during which the public and agencies are provided an opportunity to review and comment on the scope of the EIS, including the Proposed Action's purpose and need, alternatives to be studied in the EIS, environmental issues of concern, and methodologies for the environmental analysis. The scoping period for the Project was held from May 2 through May 31, 2016. During this time, a Scoping Document was made available, scoping meetings were held, and comments were solicited on the Project purpose and need, alternatives to be considered, and analyses to be conducted for the Project's EIS.

The Scoping Document for the Proposed Action identified the purpose and need for the Project and goals and objectives that would guide the development and evaluation of alternatives to address purpose and need. The Scoping Document noted that FRA and NJ TRANSIT will assess a reasonable range of alternatives in the EIS, including a No Action Alternative and a reasonable range of different Build Alternatives identified through an alternatives development process.

3.2.1. NO ACTION ALTERNATIVE

NEPA requires examination of a "No Action" Alternative (sometimes referred to as a "No Build Alternative"), which is an alternative to examine the conditions that would exist if the proposed action were not implemented. The No Action Alternative serves as a baseline against which the potential benefits and impacts of Build Alternatives can be compared. The No Action Alternative includes independent planned and funded projects likely to be implemented by the Project's analysis year of 2030. It also includes those projects that are necessary to keep the existing North River Tunnel in service and provide continued maintenance as necessary to address ongoing deterioration and maintain service. The No Action Alternative does not address the purpose and need for the Project because it does not preserve the current functionality of passenger rail service between New Jersey and PSNY, does not repair the deteriorating North River Tunnel, and does not strengthen the NEC's resiliency to support reliable passenger rail service by providing redundant capability under the Hudson River. It is carried forward, as required by NEPA, to allow comparison of the Build Alternatives against the No Action Alternative in the evaluation of environmental impacts conducted for the EIS.

3.2.2. BUILD ALTERNATIVE COMPONENTS PRESENTED IN THE SCOPING DOCUMENT: NEW TUNNEL CONNECTING TO PSNY APPROACH TRACKS

The Scoping Document identified the Proposed Action as consisting of a new tunnel connecting the existing NEC tracks east of Secaucus Junction Station in New Jersey to the existing tracks leading into PSNY, together with the subsequent rehabilitation of the existing North River Tunnel. The Scoping Document further noted that any Build Alternatives carried forward for detailed analysis in the EIS would be anticipated to include the following major elements:

- A new NEC rail tunnel beneath the Hudson River, extending from a new tunnel portal in North Bergen, New Jersey to PSNY. The new rail tunnel, like the existing North River

Tunnel, would consist of two separate single-track tunnels, or "tubes," which are collectively referred to as one tunnel.

- A ventilation building above the tunnel on each side of the Hudson River to exhaust smoke during emergencies.
- Modifications to the existing NEC tracks in New Jersey and additional track on the NEC to connect the new tunnel to the NEC.
- Modifications to connecting rail infrastructure at PSNY to connect the new tunnel's tracks to the existing tracks at PSNY.
- Rehabilitation of the existing North River Tunnel, one tube at a time.

Once the North River Tunnel rehabilitation is complete, both the old and new tunnels would be in service, providing redundant capability and increased operational flexibility for Amtrak and NJ TRANSIT.

These elements of the Proposed Action presented in the Scoping Document would meet the purpose and need for the Project, as they would rehabilitate the North River Tunnel while maintaining uninterrupted commuter and intercity rail service and also provide redundant capacity under the Hudson River for Amtrak and NJ TRANSIT. Based on information available during review of the long list of alternatives, these Project elements to be included in any Build Alternatives are feasible and reasonable. Therefore, these components have been carried forward for further development and evaluation.

3.3. ALTERNATIVES PROPOSED DURING SCOPING

During the scoping period, a number of comments were received on Build Alternatives that should be considered for the Project. Those are described and evaluated below.

In addition, many commenters during the scoping process made comments on the procedures to be followed for the environmental review and the methodologies to be used for the EIS analyses. Some commenters urged the need for implementing the Project as quickly as possible, given the urgent need to repair the North River Tunnel—which is consistent with the purpose and need and goals and objectives for the Project. One commenter asked that the schedule be expedited through the use of the alignment evaluation, engineering work, and environmental impact assessment that were undertaken for the ARC Project, with small modifications as appropriate. As noted above in the discussion of the ARC Project, many components of the ARC DEIS and SDEIS/FEIS Build Alternatives have been carried into the new Build Alternative for the Project. Other commenters requested that the Project should be conducted in a cost-effective manner, which is also consistent with the goals and objectives for the Project. All comments are summarized and responded to in the Hudson Tunnel Project Scoping Summary Report.

Comments that specifically suggested Build Alternatives for consideration are discussed in this section of this report.

3.3.1. ALTERNATIVES FOR MANHATTAN TERMINAL OPTIONS

During scoping, commenters requested that different alternatives for connections to Manhattan terminals be considered, such as a connection through PSNY to Grand Central Terminal.

However, since the purpose of the Project is to preserve existing functionality of NEC service for Amtrak and NJ TRANSIT between New Jersey and New York by repairing the deteriorating North River Tunnel while maintaining uninterrupted commuter and intercity rail service on the NEC, the proposed Project must connect to the existing tracks leading into PSNY. No changes east of that point, including any expansion to PSNY, will be included in this Project, since those would not meet the purpose and need for the Project. Such connections can be evaluated as part of a separate, future proposal.

One of the Project goals is that the Build Alternative(s) should not preclude future trans-Hudson rail capacity expansion projects, and that the Project should therefore allow for connections to future capacity expansion projects, including station capacity projects in the area of PSNY. The Proposed Action will be designed to allow for future connections to expansions to PSNY on both the north and south side of existing PSNY, to the extent feasible.

3.3.2. ALTERNATIVE CONNECTIONS IN SECAUCUS

A commenter requested that the Build Alternatives should incorporate improvements to the three single-track bridges that cross the freight railyard immediately east of Secaucus Junction Station to provide access to the four tracks at the station. While the scope of the Hudson Tunnel Project does not include this segment of the NEC or the Secaucus Junction Station, the Project would not affect or preclude improvements here at a later date as a separate project.

3.3.3. ALTERNATIVE WITH ADDITIONAL STATION IN NEW JERSEY

Commenters requested that a new NEC station be provided along the Project route in New Jersey, such as at the Project's New Jersey ventilation shaft site, where substantial construction would already be required. The commenters noted that a new station would provide redundant capability, enhance the resiliency of the regional transportation network to service disruptions, and provide expanded transportation options for Hudson River communities.

A new station in New Jersey would not meet the purpose and need for the Project, which is to preserve the current functionality of Amtrak's NEC service and NJ TRANSIT's commuter rail service between New Jersey and PSNY by repairing the deteriorating North River Tunnel; and to strengthen the NEC's resiliency to support reliable service by providing redundant capability under the Hudson River for Amtrak and NJ TRANSIT NEC trains between New Jersey and the existing PSNY. An additional station in New Jersey along the new tunnel route would reduce the capacity of the NEC. Having trains stop at the station would mean that the tunnel could not process the same number of trains in the peak periods, since train time through the tunnel would be slower (because each train would either be stopping at the station or waiting behind trains making the station stop). By adding time for stopped trains within the tunnel, this alternative would reduce the capacity of the NEC to process trains. The existing tunnel is currently operated at its peak capacity, approximately 24 trains in the peak direction. Any reduction to this number of trains per hour is not consistent with the purpose and need for the Project.

In addition, once the new tunnel and rehabilitation of the existing tunnel are both complete and trains into and out of PSNY are operating using four tracks under the Hudson River, the need to stop certain trains at a new station stop along the tunnel route would greatly reduce the operational flexibility and redundancy of the new system, because trains headed to and from that station stop would have to use the new tunnel and would not have the option of using the existing tunnel, which does not have a stop in the same location. This would also be counter to the Project purpose and need, since this alternative would not add redundancy for tunnel operations. Finally, a new station stop along the tunnel route would also add to the travel time for thousands of rail passengers each day who are making trips by rail to and from New York City from destinations farther than Hoboken, which is not consistent with goals and objectives for the Project.

Since a new station would be counter to the Project purpose and need, it is not included in the Build Alternative(s) for the Proposed Action. Such an alternative is not precluded by the Project, however, and may be pursued later as a separate project.

3.3.4. ALTERNATIVE SOUTHERN ROUTING

One commenter requested consideration of a routing for the new tunnel between Newark Penn Station and PSNY using a more direct route between Newark and PSNY than the existing NEC or alignment options near the NEC.

As shown in **Figure 2**, this alternative would branch off from the existing NEC to follow the Morris & Essex (M&E) line along the north side of the former Kearny Yard (a large freight railyard on the Kearny Point / Koppers Coke peninsula along the Hackensack River). Just west of the Hackensack River, the alignment would diverge from the M&E line to continue due east toward Manhattan (rather than southward toward Hoboken Terminal), passing through the former "Koppers Coke" industrial site. The alignment would cross the Hackensack River over a new drawbridge and then continue through an industrial area south of Norfolk Southern's Croxton Yard, passing through an active power plant (PSEG's Hudson Generating Station), across a number of freight railroad lines, and through a natural area before entering a tunnel at approximately Tonnelle Avenue (US Routes 1 & 9). To enter the tunnel, the alignment would not be able to take advantage of the rise of the Palisades, which are not present in this location, but instead would have to excavate a cut through developed residential properties in Jersey City, New Jersey. The commenter who presented this alternative during scoping also suggested inclusion of a new station, the "Jersey Junction" station, which would be directly south of Secaucus Junction Station and would allow transfers between this alignment and the Main and Bergen County and Pascack Valley lines.

The southern routing would provide a more direct route between Newark Penn Station and PSNY and potentially a slightly shorter tunnel than the Proposed Action as presented in the Project's Scoping Document. However, it would present a number of serious obstacles, including the following:

- This alternative would require high-speed connecting tracks between the NEC and M&E lines, in a complex area where NJ TRANSIT has its Meadows Maintenance Complex and a major railroad electrification substation.
- This alternative would occupy land on the Koppers Coke peninsula (north of Kearny Yard) that is currently planned for redevelopment by the NJ TRANSITGRID power grid project and therefore is not available.
- This alternative would require a new movable bridge over the Hackensack River, introducing a new project element that would require additional design and permitting. Moreover, introduction of a movable bridge would reduce train travel speeds on this route.
- This alternative would not serve Secaucus Junction Station and therefore would not meet the Project need of serving NJ TRANSIT's existing routes.
- This alignment would require construction directly through an existing, operating PSEG power plant, requiring closure of the plant or substantial modification to it, which could adversely affect power supply in the region and would greatly increase the cost of the alternative.
- This alternative would have substantial construction disruption to residential communities in Jersey City where the tunnel would begin, since the Palisades cliff is no longer present in this area and the tunnel would have to descend in a cut.

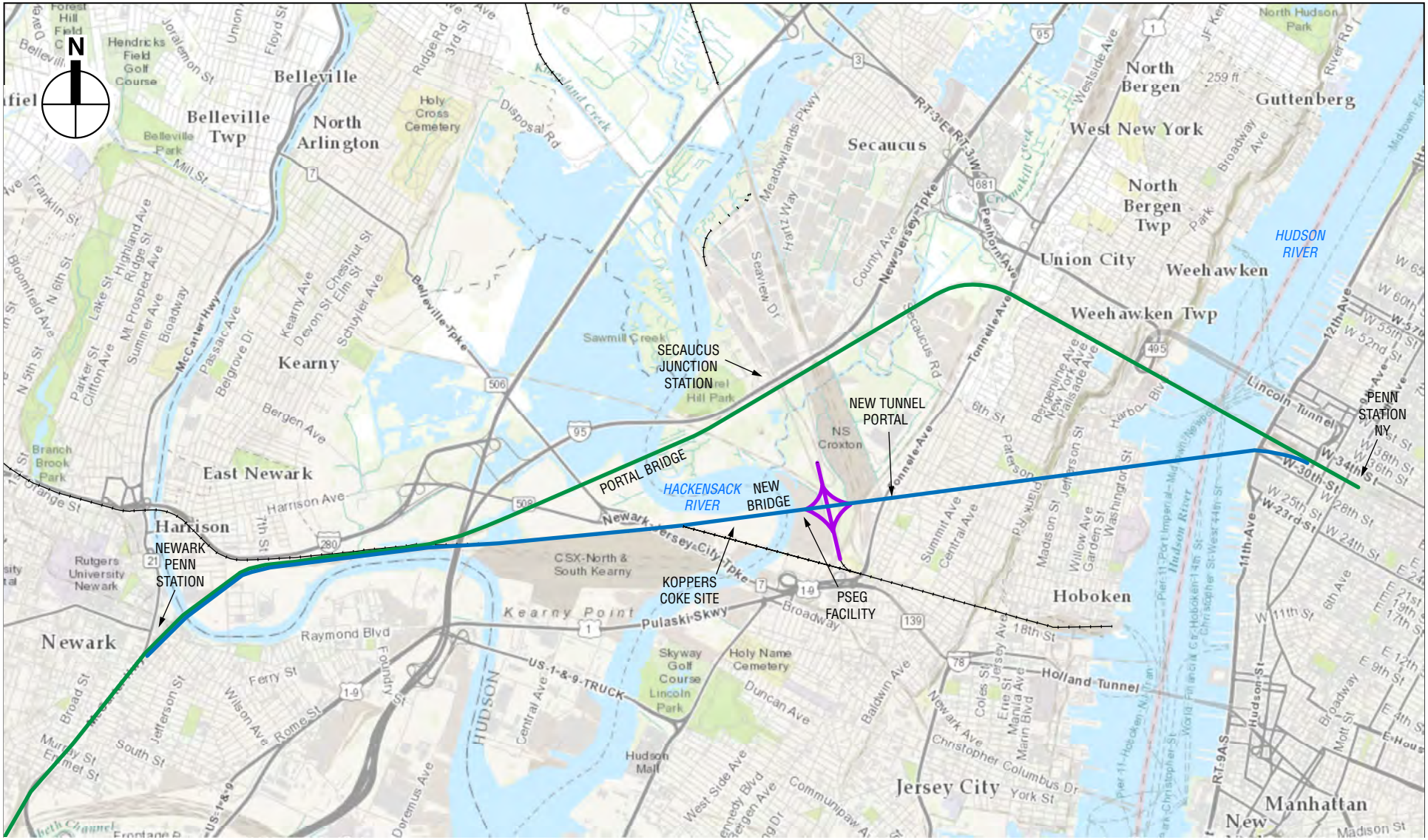
While this alternative would meet the purpose and need for the Project, based on the serious obstacles outlined above, this alternative is not reasonable and may not be feasible, and has been eliminated from further consideration.

3.3.5. ALTERNATIVE ROUTING NEAR HOBOKEN TERMINAL

Some commenters requested consideration of a southerly routing for the new connection between Penn Station Newark and PSNY, so that it brings trains to the Hoboken Terminal area, where a new tunnel would carry trains to Manhattan.

Several commenters suggested that trains could follow the route of PATH trains through Journal Square and then along former rail freight rights-of-way, running close to the route of the Holland Tunnel (I-78) and then crossing beneath the Hudson River to a new terminal near Canal Street, rather than into PSNY. However, without a connection to PSNY, this alternative would not meet

3.31.17



HUDSON TUNNEL

Alternative Southern Routing

Figure 2

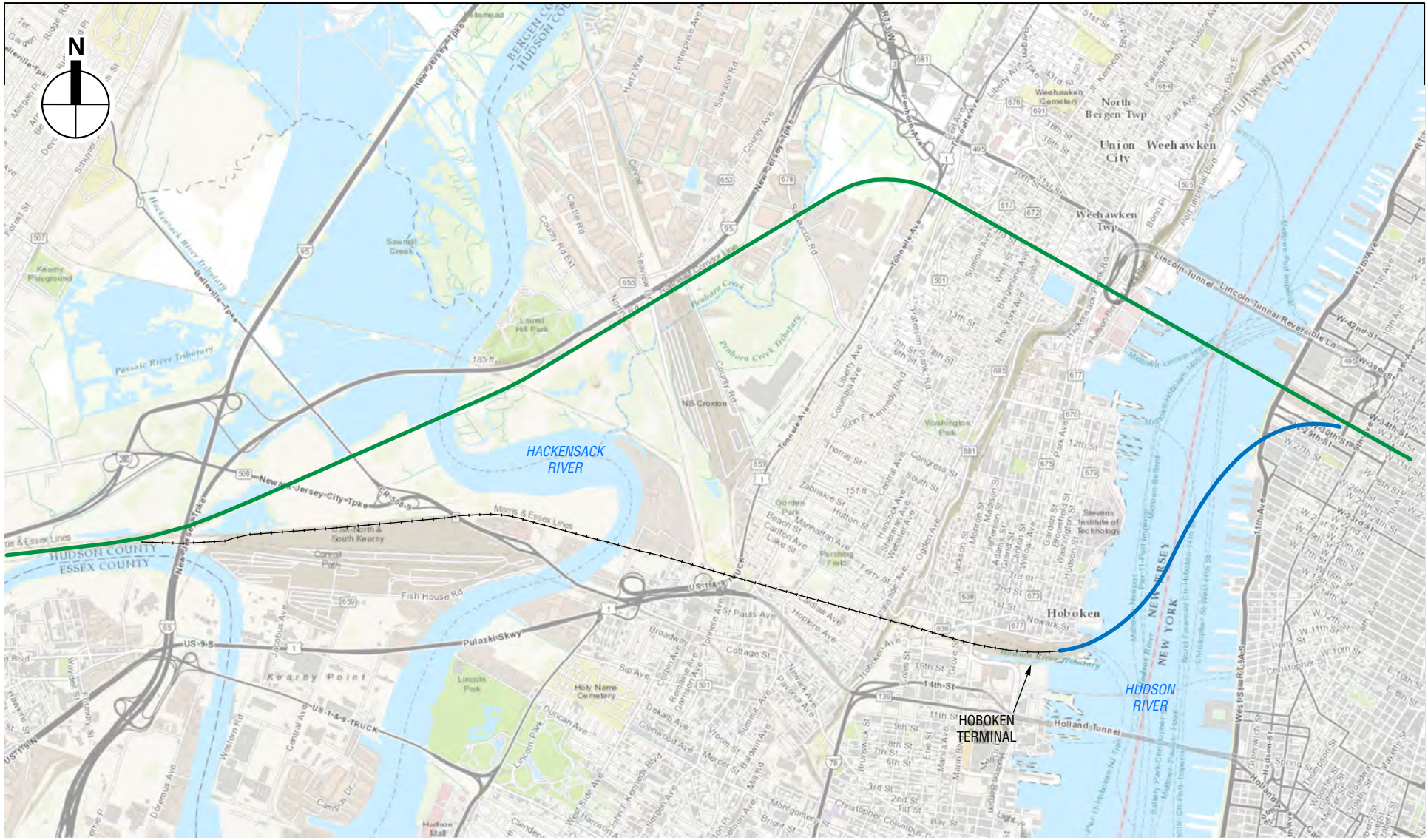
the purpose and need for the Proposed Action. In addition, this alternative would not be reasonable and may not be feasible, because it would require fitting tracks within the PATH right-of-way, which may not have capacity for new tracks, and would require acquisition of extensive private property in New Jersey for the right-of-way and in Manhattan for the new terminal. Therefore, this alternative has been eliminated from further consideration.

One commenter proposed a routing extending along the existing M&E line to a new station to be created just south of Hoboken Terminal, and then continuing in a 2.3-mile-long tunnel to the existing tracks at PSNY (see **Figure 3**). This alternative could also include a future through connection from PSNY to Grand Central Terminal. As envisioned by the commenter, a new Hoboken station would be created and the existing Hoboken Terminal would no longer serve trains. All trains currently terminating at Hoboken Terminal could continue on to PSNY (and eventually Grand Central Terminal) instead. However, while this alternative might meet the purpose and need for the Project by creating a new connection to PSNY, it would not be reasonable, given its much greater scope, longer routing and longer tunnel segment, greater environmental impact, and likely higher cost than the Proposed Action presented in the Project's Scoping Document. In addition, without an expansion to the capacity at PSNY, this alternative may not be operational feasible. As noted above, an alternative may not be reasonable if it has the likelihood of substantial impacts, a protracted construction time, an unacceptably high cost or great environmental impact relative to other alternatives, or operational characteristics that are unacceptable. In addition, this alternative would face additional obstacles that would increase its impacts and make its operational characteristics more challenging, and could increase the time required for design, environmental review, permitting, and construction:

- This alternative would require high-speed connecting tracks between the NEC and M&E lines, in a complex area where NJ TRANSIT has its Meadows Maintenance Complex and a major railroad electrification substation.
- If all trains that currently terminate at Hoboken Terminal were instead routed to PSNY, this alternative would require substantial expansion at PSNY, which is not a part of the Proposed Action and does not meet the purpose and need for the Project.
- This alternative's river tunnel would be substantially longer than that of the Proposed Action, raising the possibility of additional impacts in the Hudson River from construction.
- This alternative's longer tunnel would increase train travel time between Newark and PSNY, effectively reducing the capacity of the NEC to process trains.
- This alternative would require sharp curves exiting Hoboken station and approaching the Manhattan shoreline, which would reduce train speeds.
- This alternative would require far more railroad infrastructure, and therefore would have a higher cost, than the Proposed Action presented in the Project's Scoping Document.
- This alternative would require larger ventilation structures for the longer tunnel, which may be difficult to site on the New Jersey and Manhattan shorelines.
- Construction adjacent to Hoboken Terminal could result in adverse effects to that station, which is historic. In addition, if train service to Hoboken Terminal were terminated as suggested by the commenter, this would constitute an adverse effect to that historic structure by removing the train terminal from its original context.

For these reasons, an alternative that reroutes trains farther south, close to Hoboken Terminal, would not meet the Project goals of improving service reliability in a cost-effective manner (Goal 1); of ensuring that the North River Tunnel rehabilitation occurs as soon as possible (Goal 2); and of minimizing impacts on the natural and built environment (Goal 3). Given the likely delays to the project schedule and increased cost and impacts to the community, this alternative is not reasonable and has been eliminated from further consideration.

12.14.16



HUDSON TUNNEL

Alternative Routing via Hoboken Terminal

Figure 3

3.3.6. SHARED PASSENGER AND FREIGHT RAIL TUNNEL

This alternative would consist of a new NEC tunnel between New Jersey and PSNY that could accommodate both passenger and freight trains. Commenters suggested that once the Hudson Tunnel Project is complete and four tracks are available beneath the Hudson River, there would be sufficient capacity to support overnight freight service. They thought that this alternative would result in better benefits per dollar invested and could help to subsidize the cost of the tunnel construction (through revenue from track access fees paid by the private railroads).

A shared passenger rail and freight tunnel beneath the Hudson River would not meet the purpose of the Hudson Tunnel Project, which is related to passenger service rather than freight service, and in fact would be in conflict with the purpose and need. Specifically, a tunnel that meets the Project purpose and need by connecting to PSNY cannot feasibly accommodate freight trains, whereas a tunnel that can accommodate freight trains could not feasibly connect to PSNY and therefore does not meet the purpose and need for the Project. The reasons for these conclusions are as follows:

1. The tunnel diameter proposed for the Project is not large enough to accommodate freight trains:
   - The proposed new passenger rail tunnel would have an inside diameter of approximately 25 feet and an outer diameter of approximately 28 feet to provide appropriate clearances for Amtrak and NJ TRANSIT passenger trains and enough space for bench walls (in which certain utilities are located), overhead contact system (to provide electric power to the trains), and emergency evacuation paths.
   - However, to accommodate freight trains, the tunnel would have to be larger in diameter. To accommodate freight trains with double-stacked containers, which are typical on the nation's freight system today, the tunnel's interior diameter would have to be increased to approximately 30 feet, for a total tunnel diameter of approximately 33 feet.
2. The tunnel diameter cannot be increased to accommodate freight trains for the following reasons:
   - The new tunnel included in the Hudson Tunnel Project must connect to existing tracks leading into PSNY and must maintain a grade appropriate for NJ TRANSIT's passenger trains as well as Amtrak's fleet. Given the train lengths (and resulting weight) of NJ TRANSIT's commuter trains serving PSNY, grades should not exceed 2.1 percent for the tunnel design. This is the steepest grade for NJ TRANSIT's trainsets in terms of operational reliability. With a grade of no more than 2.1 percent and the need to connect to existing tracks leading into PSNY, the new tunnel must be relatively shallow beneath the Hudson River and its navigation channel to allow a connection to the existing tracks that lead into PSNY
   - The passenger tunnel as proposed, which connects to PSNY and maintains a slope of no more than 2.1 percent, reaches the Manhattan shoreline at a fairly shallow depth below the river bottom, requiring ground improvement in this area. The tunnel cannot be shallower, because of concerns about ground stability (generally, tunnels that are bored through soft soils should have soil above the tunnel that are equivalent to half the tunnel's diameter or greater to avoid the potential for tunnel failure during construction) and because of a requirement of the U.S. Army Corps of Engineers (USACE) that the tunnel be at least 11 feet below the authorized depth of the navigation channel in the river and 7 feet below present bottom of the river.[4]
   - A tunnel that accommodates freight trains would have to be larger in diameter than a passenger tunnel, which is not feasible because it would either 1) result in a shallower

[4] Based on letter from Stephan A. Ryba, Chief, Regulatory Branch, USACE, dated November 17, 2016.

tunnel so as to meet the approach tracks at PSNY (which is not feasible because of concerns about tunnel stability and intrusion into the navigation channel); or 2) require a deeper tunnel under the Hudson River for tunnel stability, but then could no longer connect to PSNY because of the steep grade required to do so.

- Further, freight trains, which are longer and heavier than passenger trains, require even less steep grades than passenger trains, which would mean that the tunnel would have to be shallower than the proposed tunnel to connect to PSNY (which is not feasible because of concerns about tunnel stability and intrusion into the navigation channel).

3. Physical clearance constraints east of the tunnel through Manhattan, at and through PSNY, under the East River to Queens, and west of the tunnel in New Jersey could not feasibly accommodate freight movement or would add an unreasonable level of complexity, require additional coordination with third parties, and add potentially prohibitive costs to the Project, as outlined below:

   - Due to its horizontal and vertical clearance restrictions, PSNY does not have the ability to accommodate any freight car other than completely obsolete designs no longer in service (AAR Plate B).
   - The existing East River tunnel connecting PSNY to Queens limits equipment height to 14 feet 6 inches from top of rail, much lower than virtually any freight car design. By comparison, the standard double-stack freight requires either 20 feet 6 inches or 21 feet depending upon whether it conforms to East Coast or national standards.
   - West of PSNY in Manhattan, an even more significant clearance restriction is the existing overhead bridges at Ninth, Eighth, and Seventh Avenues.
   - West of the tunnel portal in New Jersey, passing beneath Tonnelle Avenue on the way to and from the tunnel portal would be a major obstacle, given the tight clearance there. Raising Tonnelle Avenue would require extensive grade changes on heavily trafficked Routes 1 and 9, and lowering the alignment below Tonnelle Avenue would mean that the Project's bridge over the adjacent New York Susquehanna and Western/Conrail freight lines would have to be lower, which would result in clearance conflicts for that freight rail line.
   - Only an entirely new alignment from New Jersey to Queens, completely clear from PSNY, could accommodate freight operations, which would not meet the purpose and need for the Project.

4. The current state of the industry standard for freight movement in the United States is based on the use of diesel locomotives, not electric ones. If freight trains were to use electric locomotives in order to use the new tunnel, rail yards on either side of the tunnel would have to be developed that would accommodate switching of diesel-powered locomotives to electrically powered units—an inherently expensive and inefficient operation. Therefore, this is not reasonable.

5. If the tunnel were designed to accommodate both passenger and freight service, it could not feasibly accommodate much freight traffic in any case. The proposed passenger tunnel would not have excess capacity that could readily be used for freight service. Given the heavy utilization of the NEC's Hudson River crossing and PSNY by passenger trains (typically from 5 AM to 2 AM), very limited time windows would be available for freight trains. Freight service could only use the new tunnel at night, to avoid interfering with normal passenger rail service to and from PSNY. Given these constraints, no more than one to two freight trains per night could operate.

6. If the tunnel were designed to accommodate both passenger and freight service, this would require unreasonable modifications to the design of the tunnel. Use of the tunnel for freight trains would require much larger ventilation capacity and fan plant size to account for the

greater fire heat release rate of a freight train in comparison to a passenger train. This would likely require more property acquisition to accommodate the Project's fan plants on either side of the tunnel, with greater fan noise that could be a concern to surrounding land uses during periodic scheduled maintenance and testing. Therefore this is not reasonable.

7. Freight trains require much longer distances to slow down and stop than passenger trains (about 4.5 to 5 times longer, depending on train speed). The tunnel's signal system would have to be designed with much longer signal blocks to accommodate this distance, which would greatly reduce the capacity of the tunnel to accommodate passenger trains. A conceptual solution to avoid such a reduction in capacity would be to install a separate freight signaling system to be used only during the limited window for freight operations. However, the need to install and maintain two signal systems instead of one could lead to added operational issues, especially concerning enforcement of Positive Train Control (PTC) requirements, and potential confusion by train operators, resulting in safety concerns. Therefore, this alternative would be counter to the Project purpose, as the new tunnel would have reduced capacity and would therefore be incapable of providing fully redundant capability for the NEC Hudson River crossing.

For these reasons, this alternative would not meet the Project purpose and need; it would also be infeasible and unreasonable. It has been eliminated from further consideration.

3.3.7. SHARED PASSENGER RAIL TUNNEL AND NO. 7 SUBWAY LINE

Commenters suggested that when completed, space within the four-track tunnel that would result from the Hudson Tunnel Project could be used to accommodate both passenger rail and an extension of the No. 7 subway line, to allow the subway to reach Secaucus Junction Station. One commenter noted that for this alternative, it should be assumed that future technology will mature so that subway and commuter rail train sets can safely share track.

To meet the purpose and need for the Project, the Hudson Tunnel Project will preserve existing functionality of NEC service for Amtrak and NJ TRANSIT between New Jersey and New York by repairing the deteriorating North River Tunnel while maintaining uninterrupted commuter and intercity rail service on the NEC. It will also strengthen the NEC's resiliency to support reliable service by providing redundant capability under the Hudson River for Amtrak and NJ TRANSIT NEC trains between New Jersey and PSNY. Increasing opportunities for commuting to and from New York is not part of the Hudson Tunnel Project purpose and need. Consideration of the No. 7 extension and/or other capacity expansion elements between New Jersey and New York are beyond the scope of this Project and do not meet the Project purpose and need. In addition, creating a connection from the existing No. 7 subway line and the Hudson Tunnel Project would be difficult and potentially infeasible, given the difference in elevation between the No. 7 subway line tunnel and the Hudson Tunnel Project. The No. 7 train has two storage tracks (referred to as "tail tracks") in two separate tunnels that extend beneath Eleventh Avenue in Manhattan from the south end of the subway line's 34th Street terminus station to 25th Street. Those two tunnels pass approximately 35 feet beneath, and perpendicular to, the Hudson Yards Right-of-Way Preservation Project that Amtrak is developing adjacent to the West Side Rail Yard to preserve a location for a rail connection to PSNY beneath a large new development that is planned above the rail storage yard. To create a connection between No. 7 train tunnel and the right-of-way preservation alignment would require extensive and complex construction beneath Manhattan that would not be reasonable, due to the additional cost, time required, and potentially extensive construction impacts, and may not be feasible. Therefore, this alternative does not meet the Project purpose and need and is not a reasonable alternative; it has been eliminated from further consideration.

3.3.8. PASSENGER RAIL TUNNEL WITH BICYCLE LANE

This alternative would include a bicycle lane within the new rail tunnel, to allow a bicycle crossing of the Hudson River.

Inclusion of a bike lane to the rail tunnel does not support the Project purpose and need, which is to preserve existing functionality of NEC service for Amtrak and NJ TRANSIT between New Jersey and New York by repairing the deteriorating North River Tunnel while maintaining uninterrupted commuter and intercity rail service on the NEC. The addition of a bike lane would require a substantial increase in the width of the tunnel. Since the tunnel would be created using a tunnel boring machine, which creates a circular tunnel, an increase in the width of the tunnel would mean that the diameter of the tunnel would have to increase. This would therefore require that the tunnel alignment be lower beneath the Hudson River in order to provide adequate soil cover above the tunnel for a stable structure (to maintain soil stability, a minimum of half the tunnel diameter should be provided above the crown of the tunnel, and therefore a larger tunnel requires greater cover above it for stability). With a lower tunnel, however, the tunnel alignment could not meet the existing tracks that connect to PSNY while maintaining a slope at or below the maximum allowable grade required for NJ TRANSIT passenger rail operations. Therefore, the resulting tunnel would not meet the purpose and need for the Project. In addition, providing pedestrian or bicycle access to a rail tunnel would raise safety issues for the bicyclists and pedestrians and security issues for the tunnel infrastructure itself. Therefore, the addition of a bike route or walkway contrary to the Project purpose and need and is infeasible, and has been eliminated from further consideration.

3.3.9. NEW TUNNEL WITH SINGLE TRACK / PHASED TUNNEL CONSTRUCTION

The new rail tunnel included as part of the Hudson Tunnel Project is proposed to consist of two separate single-track tunnels (“tubes”). (The North River Tunnel also consists of two separate tubes.) Each new single-track tube would be bored separately by a tunnel boring machine. Once the tunnel is completed and the two new tracks are operational, the existing North River Tunnel would be rehabilitated. Several commenters suggested an alternative that would involve completing only one new tube (containing one track) beneath the Hudson River before beginning the rehabilitation of the North River Tunnel. The second new tube could be added in a later phase, after the North River Tunnel work was complete. This alternative was proposed as a way of accelerating completion of the North River Tunnel repair.

An alternative with only one new tube beneath the river would have less ability to meet the Project purpose of preserving existing functionality of NEC service for Amtrak and NJ TRANSIT between New Jersey and New York by repairing the deteriorating North River Tunnel while maintaining uninterrupted commuter and intercity rail service on the NEC. With this alternative, when the North River Tunnel is being rehabilitated, trains would operate in the single new tube and a single remaining tube of the North River Tunnel. For the period when the first tube of the North River Tunnel is being rehabilitated, trains would be operating in an un-rehabilitated tube of the tunnel, which would be at risk of ongoing instability similar to conditions today. If a maintenance issue arose, as they do frequently today, the tube would need to be closed for repairs and trains on the NEC would have to operate in only the single tube of the new tunnel, resulting in notable reductions in train service on the NEC. Since the North River Tunnel and tracks frequently require unplanned maintenance to address ongoing deterioration, having no second new tube accommodate the remaining train traffic from the North River Tunnel would mean that this alternative would not provide reliable service. Therefore, this alternative does not meet the purpose and need for the Project, which is to rehabilitate the North River Tunnel while maintaining uninterrupted commuter and intercity rail service.

In addition, an alternative with only one new tube beneath the river would not provide the same level of safety for passenger as a tunnel with two tubes. The tunnel with two tubes would provide cross passages approximately every 800 feet for the length of the new tunnel, connecting the two separate tubes. The cross passages are provided to comply with the requirements of the National Fire Protection Association (NFPA)’s life-safety standard, NFPA Standard 130. They would allow passengers to walk from one track to the other in the event of an emergency evacuation and would provide separate ventilation zones in the event of a smoke condition. An

alternative with only one tube would not have cross passages. This alternative would not meet the requirements of NFPA 130 related to fire life-safety requirements for new transit systems, because absent cross passages it would not provide adequate safe haven for passengers in the event of an emergency in the new tunnel.

Finally, an alternative with only one new tube beneath the river would not accelerate completion of the North River Tunnel repair as the commenters suggest. The Project's construction staging is currently being developed to achieve an accelerated completion date. The schedule assumes that the new tunnel is constructed using two tunnel boring machines operating simultaneously, with the second machine starting approximately three months after the first. Thus an alternative with only one tube would save only three months from the Project's construction schedule. Further, phasing the construction of the second tube at a later date would still require installations within access facilities and shafts to be constructed for two tracks. Actual construction of the second tube would require interrupting operation of the first track to make required connections to track and support systems. The Project would need a new construction shaft for tunneling operations as the initial shafts will have been outfitted with required railroad systems. This requirement would further increase the Project cost and delay the construction schedule and therefore would not be reasonable.

3.3.10. BRIDGE ALTERNATIVE

This alternative suggested during scoping, referred to as the Empire State Gateway project, would include twin, multi-span suspension and cable-stay bridges carrying passenger rail and connecting New Jersey, Manhattan, and Queens (see **Figure 4**). As envisioned by the commenter, this alternative would begin above I-495 in New Jersey, cross the Hudson and East Rivers at least 212 feet above high tide, cross at least 120 feet above the streets of Midtown above 38th and 39th Streets, and then reconnect with I-495, Sunnyside Yard, and the Hell Gate Bridge in Queens, completely separating the NEC and NJ TRANSIT trains from the LIRR. The commenter envisions a tunnel beneath the Palisades (see Figure 4) transitioning to a multi-level bridge supported by 1,000-foot-tall (100 stories) suspension towers at the New Jersey and Manhattan shorelines of the Hudson River, at a midpoint in Midtown Manhattan (approximately Sixth Avenue), and at the Manhattan and Queens shorelines of the East River.

The twin bridges, one for eastbound traffic and the other for westbound traffic, would each have four levels: a first level for utilities (power, water, gas and telecommunications), a second level with two tracks on each bridge to be used by Amtrak and NJ TRANSIT, a third level for future Maglev (high-speed) trains and two lanes for buses, limousines, and light rail, and a fourth level for pedestrians and bikes on a "Skyline Trail." Trains would be served by a new station in Midtown Manhattan between 38th and 39th Streets equidistant between Grand Central Terminal and PSNY. This alternative would remove Amtrak trains from the North River Tunnel, Penn Station, and the East River Tunnel and would remove buses from I-495 and the Lincoln Tunnel.

According to the commenter, this alternative could use prefabricated technology to allow completion of the twin bridges within five years of groundbreaking. This commenter also believes that this alternative could be financed through private funding generated by tolls, telecommunication fees, and real estate development projects attracted by this new infrastructure.

This alternative would not meet the purpose and need of the Project, which is to preserve the current functionality of Amtrak's NEC service and NJ TRANSIT's commuter rail service between New Jersey and PSNY by repairing the deteriorating North River Tunnel while maintaining uninterrupted commuter and intercity rail service on the NEC, and to strengthen the NEC's resiliency to support reliable service by providing redundant capability under the Hudson River for Amtrak and NJ TRANSIT NEC trains between New Jersey and the existing PSNY. The suggested alternative would not allow trains to reach PSNY and therefore could not maintain uninterrupted service on the NEC while the North River Tunnel is being repaired. With a station located equidistant to Grand Central Terminal and PSNY, it would provide only limited

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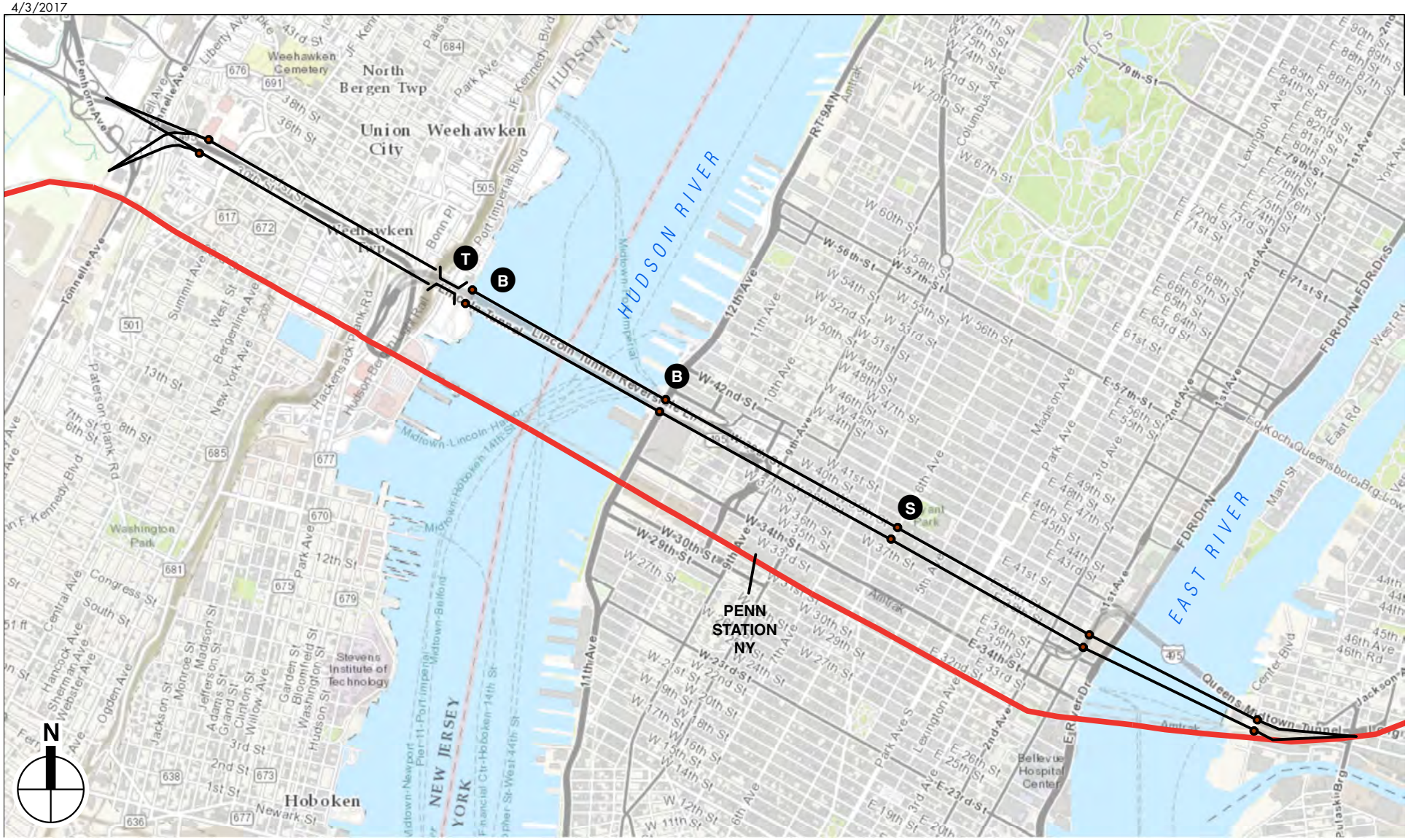


Bridge Alignment

1,000-foot Suspension Towers

Existing Northeast Corridor

T *Weehawken Tunnels*

B *Suspension Tower with Building Development*

S *Empire State Gateway Station*

HUDSON TUNNEL PROJECT

Bridge Alternative

Figure 4

interconnectivity with other modes of transportation. Moreover, construction of the two-track bridge with an elevated station would greatly limit the capacity of the NEC to process trains, in comparison to the 19 tracks at PSNY available to NEC trains. This would result in a degradation of rail service into New York during the reconstruction of the existing North River Tunnel. All trains using the new bridge would have to be moved east to Sunnyside Yard in Queens to allow arriving trains from New Jersey to detrain passengers.

In addition, this alternative is unreasonable and likely infeasible because of the substantial obstacles it would face related to environmental review, permitting, and approval, most likely resulting in a much longer development schedule than the Proposed Action. These would include the following:

- This proposal does not have a feasible station location in midtown Manhattan. A new station would require substantial property acquisition in the densely developed urban core of Manhattan. A block-long station between 38th and 39th Streets would be required to accommodate high capacity elevators/escalators, egress stairs, and passenger circulation and security. Further, it is unclear how an aerial station would be designed and constructed to meet the 120-foot-high tracks.
- The bridge structure would require further property acquisition along the route for structural supports. Additionally, a bridge 120 feet (12 stories) above street level would limit the development of buildings adjacent to the bridge along the entire route, and particularly adjacent to its towers.
- The width of crosstown streets through Manhattan, at 60 feet from building line to building line, is not wide enough to accommodate the envisioned bridges without substantial adverse impacts to traffic flow, pedestrian activity, and adjacent buildings facing those streets.
- Because of the elevation differential between the Manhattan station and Sunnyside Yard in Queens, the bridge would need to begin a downward slope immediately east of the Midtown station in order to make the track connection to Sunnyside Yard. Such a slope would likely affect navigation in the East River.
- Land is not readily available at the sites proposed for the new support towers. In New Jersey, the towers would have to be placed in an area of Weehawken occupied by the Lincoln Tunnel's ventilation structure, the Hudson-Bergen Light Rail, and a waterfront park—and directly above the Lincoln Tunnel itself. In Manhattan, the towers on the Hudson River shoreline would also be directly above the Lincoln Tunnel and could interfere with the Lincoln Tunnel ventilation building along the water's edge. Along the East River, the towers on both the Manhattan and Queens sides of the river would be directly above the Queens-Midtown Tunnel; the Queens towers would be placed with the newly developed large-scale residential neighborhood known as Queens West / Hunters Point.
- This proposal would have substantial community and environmental impacts to the residential properties on the Palisades in New Jersey and residential and commercial properties in New York City from the massive structures that would be placed very close to existing buildings and from the train operations on those structures within a few feet of these adjacent buildings.
- Certain elements of this alternative are likely infeasible. For example, a vehicular component would require a minimum of four lanes with breakdown lanes per bridge, which would be difficult to accommodate within the available 60-foot right-of-way. Bridge pylons and foundations would take up most of the right-of-way and limit surface traffic below.

In terms of cost, this alternative would likely be substantially more expensive than a tunnel option. It would have to be twice as long as a tunnel because it would cross both the Hudson and East Rivers. Additional substantial costs would include property acquisition for the bridge pylons and Manhattan station; roadway work connecting to I-495 and the NJ Turnpike; and design, construction, and operation of the new elevated station.

Beyond the specific bridge project discussed here, any bridge alternative would fail to meet the purpose and need for the Project, and would also fail to meet the feasibility and reasonableness criteria. Connections from the NEC would have to begin far west of the Palisades in order to maintain the grade of no more than 2.1 percent required for the Hudson Tunnel Project while bringing the bridge deck above the height required for maritime navigation in the Hudson River. This would require extensive construction through New Jersey, adding substantially to the cost, construction duration, and potential for community disruption and environmental impact of the project. Once in Manhattan, trains on a high bridge could not connect to the existing tracks at PSNY, which are below the grade of Manhattan streets. Tracks could not slope down at a grade of no more than 2.1 percent, as is required for passenger trains, from a bridge high enough to cross the Hudson River without impeding navigation to meet the existing tracks at PSNY.

A bridge alternative would not meet the purpose and need for the Project, is likely infeasible, and also may not be considered a reasonable alternative given its potential for much higher cost and greater environmental impacts than the Proposed Action. Therefore, this alternative was eliminated from further consideration.

3.4. ALTERNATIVES FOR REHABILITATION OF THE NORTH RIVER TUNNEL

The purpose of the Proposed Action is to preserve the current functionality of Amtrak's NEC service and NJ TRANSIT's commuter rail service between New Jersey and PSNY by repairing the deteriorating North River Tunnel. To perform the needed rehabilitation of the existing North River Tunnel, each tube of the tunnel will need to be closed for more than a year. However, rehabilitation needs to be accomplished without notable reductions in weekday passenger rail service. Therefore, the Proposed Action would provide capability for rail service crossing the Hudson River and connecting to and from the existing tracks at PSNY so that (1) the existing level of train service can be maintained while the damaged tubes are taken out of service one at a time for rehabilitation, and (2) redundant capability is available once both tunnels are in service.

Alternatives for the rehabilitation of the North River Tunnel were developed and evaluated by Amtrak and included:

- Rehabilitating only the center portion of the tunnel's two tubes, where the damage from Superstorm Sandy to the bench walls and ballast was most severe; or
- Rehabilitating both tubes at the same time, to expedite the Project schedule.

3.4.1. REHABILITATION OF PORTIONS OF THE NORTH RIVER TUNNEL TUBES

Superstorm Sandy inundated both tubes in the North River Tunnel with seawater in October 2012, resulting in the cancellation of all Amtrak and NJ TRANSIT service into New York City for five days. Seawater rose to above the top of rail for approximately 3,200 feet of the tunnel's north tube and 2,300 feet of the south tube. The flood level reached above the height of the bench walls at the tunnel's lowest point. About 1,900 feet of bench wall in the north tube and 800 feet of bench wall in the south tube were inundated. While the tunnel was restored to service and is now safe for travel, chlorides from the seawater remain in the tunnel's concrete liner, bench walls, and ballast, causing ongoing damage to these elements as well as to imbedded steel, track and third rail systems, and signaling, mechanical and electrical components.

The most serious damage affects the concrete bench walls, which run the length of the tunnel and provide emergency egress and maintenance access to trains and track. Ducts housed inside the bench walls contain electrical wiring, utility cables, and other essential equipment. As a result of the seawater inundation, the bench walls have longitudinal cracks, severe spalls with exposed steel, and corrosion of embedded steel elements. As a result of steel corrosion that has caused the concrete to spall, the continuous bench walls and duct work cannot perform reliably

or be repaired. While the tunnel is structurally sound and safe for continuing passenger rail use, these conditions necessitate that the existing bench walls be replaced with new bench walls. These should be constructed at the proper height to meet current fire-life safety standards (National Fire Protection Association (NFPA) 130). This replacement should occur portal to portal, since it is not practical to construct the middle portion of a bench wall at different height than the two ends, given that the bench wall operates as one continuous system providing emergency egress and housing duct work inside.

In addition, the North River Tunnel's rock ballast is coated with chlorides remaining from the seawater that flooded the tunnel. The existing rail system in the North River Tunnel consists of rock ballast, treated timber ties, running rail and third rail. Full removal of the chlorides from the ballast, including from the inaccessible surfaces, is not physically possible; therefore, the ballast needs to be entirely removed. This requires removal of the tie and rail systems as well, in order to remove the ballast.

The damage to the bench walls and ballast/track necessitates full portal-to-portal replacement of these elements, which form integrated systems running the length of the tunnel. Moreover, both systems would need to be reconstructed to meet modern standards including fire and life safety; it would be both impractical and unsafe to reconstruct a portion of either system to a higher standard while other portions remain constructed to an older, incompatible standard.

Therefore, rehabilitation of only a portion of the North River Tunnel's tubes does not meet the Project purpose and need and was not carried forward for further consideration.

3.4.2. REHABILITATION OF BOTH NORTH RIVER TUNNEL TUBES AT THE SAME TIME

In this alternative, both tubes of the North River Tunnel would be closed at the same time, to expedite the construction schedule for the rehabilitation. However, in this alternative, adequate capacity could not be provided in the new tunnel's two tubes to accommodate Amtrak's and NJ TRANSIT's full peak hour service.

While the new tunnel included in the Hudson Tunnel Project would have two tracks under the Hudson River, these tracks would not have the same flexibility in their connections to the platform tracks at PSNY as the North River Tunnel's tracks do. The two tracks of the North River Tunnel access the PSNY platforms via two parallel tracks, so that eastbound and westbound trains do not conflict when moving between the tunnel tracks and the platform tracks. The two tracks of the new Hudson Tunnel would access the PSNY platform tracks via a single track that would be shared by eastbound and westbound trains and would not provide access to the northernmost PSNY platforms, creating a high potential for conflicts that could result in congestion, delays, and a reduction in capacity if the new Hudson Tunnel tracks were required to carry the full existing traffic of the North River Tunnel and to provide access to all station platforms in PSNY. Therefore, this alternative would not meet the purpose and need for the Project and was not carried forward for further consideration.

3.5. SUMMARY OF LONG LIST OF ALTERNATIVES

A total of 15 alternatives were evaluated in the preliminary screening of the long list of alternatives. Of those, the No Action Alternative was retained for further evaluation in the DEIS and a single Build Alternative, comprised of certain reasonable and feasible components of the 15 initial alternatives that also met the purpose and need, was carried forward; that Build Alternative was the Proposed Action presented in the Project's Scoping Document, a new two-track tunnel close to the North River Tunnel with subsequent full-length rehabilitation of the existing tunnel, staged one tube at a time. That Build Alternative was retained for further development and evaluation in the consideration of the short list of alignment options. The alternatives considered in the long list are summarized in **Table 1** below.

Table 1
Evaluation of Long List of Alternatives

Alternative	Evaluation	Result
No Action Alternative	Required by NEPA	Carried forward for analysis in DEIS
ARC MIS Alternatives	Do not meet purpose and need for the Project	Eliminated
ARC Scoping and DEIS Alternatives	Some components of the ARC DEIS Build Alternative meet purpose and need for the Project and are feasible and reasonable; other components do not	Relevant components that do meet the Project purpose and need integrated into Build Alternative for the Project
ARC SDEIS/FEIS Build Alternative	Some components of the ARC SDEIS/FEIS Build Alternative meet purpose and need for the Project; other components do not and/or are not feasible	Relevant components that do meet the Project purpose and need integrated into Build Alternative for the Project
Build Alternative components presented in Scoping Document: New Tunnel Connecting to PSNY Approach Tracks	Meet purpose and need for the Project and is feasible and reasonable	Carried forward for further development and evaluation
Alternatives for Manhattan Terminal Options	Does not meet purpose and need for the Project	Eliminated; not precluded by Project and can be evaluated in a separate, future project
Alternative Connections in Secaucus	Does not meet purpose and need for the Project	Eliminated; not precluded by Project and can be evaluated in a separate, future project
Alternative with Additional Station in NJ	Does not meet purpose and need for the Project	Eliminated; not precluded by Project and can be evaluated in a separate, future project
Alternative Southern Routing	Could meet the purpose and need for the Project but is not reasonable and is potentially infeasible	Eliminated
Alternative Routing near Hoboken Terminal	Could meet the purpose and need for the Project but is not reasonable	Eliminated
Shared Passenger and Freight Rail Tunnel	Does not meet purpose and need for the Project and is not reasonable or feasible	Eliminated
Shared Passenger Rail Tunnel and No. 7 Subway Line	Does not meet purpose and need for the Project and is not reasonable and may not be feasible	Eliminated
Passenger Rail Tunnel with Bicycle Lane	Does not meet purpose and need for the Project and is infeasible	Eliminated
New Tunnel with Single Track / Phased Tunnel Construction	Does not meet purpose and need for the Project and is not reasonable	Eliminated
Bridge Alternative	Does not meet purpose and need for the Project, is not reasonable, and is likely infeasible	Eliminated
Rehabilitation of Portions of the North River Tunnel Tubes	Does not meet purpose and need for the Project	Eliminated
Rehabilitation of Both North River Tunnel Tubes at the Same Time	Does not meet purpose and need for the Project	Eliminated

4. REFINED SCREENING: SHORT LIST OF ALIGNMENT OPTIONS

Upon completion of the initial alternatives review, as shown in **Table 1**, a single Build Alternative concept remained that met the purpose and need for the Project, and was feasible and reasonable: the new two-track tunnel close to the North River Tunnel with rehabilitation of the existing tunnel (see description in Section 4.1). Components of the ARC DEIS and SDEIS/FEIS Build Alternative were integrated into the Build Alternative to be carried forward for further analysis. No other alternatives evaluated as part of the long list of alternatives were advanced. This Build Alternative had a range of possible alignment options in the segment between the New Jersey tunnel portal and the Manhattan Hudson River bulkhead. The alignment options were then further developed and evaluated to identify which option best met the Project goals and objectives.

4.1. BUILD ALTERNATIVE CONCEPT

As described above in Section 3.2.2, the Build Alternative would consist of a new tunnel connecting the NEC to PSNY, together with rehabilitation of the North River Tunnel. The new tunnel would include two new tracks extending from the NEC in New Jersey, continuing in a tunnel beneath the Palisades and the Hudson River to connect to the existing approach tracks that lead into PSNY. To meet the purpose and need for the Project, the Build Alternative would have to meet certain design requirements.

4.1.1. CONNECTIONS TO EXISTING INFRASTRUCTURE

To meet the Project purpose and need, the Build Alternative must maintain current levels of train service on the NEC for Amtrak and NJ TRANSIT while the North River Tunnel is being rehabilitated. To do this, the Build Alternative must connect into the existing NEC on its west and east ends, as follows:

- On the west, the Build Alternative must connect to the NEC in New Jersey in a way that allows operational flexibility for trains moving between the NEC and the new tunnel. Therefore, to provide a new route close to the NEC that maximizes the use of existing infrastructure, maintains flexible and redundant NEC rail operations for Amtrak and NJ TRANSIT, and minimizes the potential for environmental and community impact associated with new right-of-way, the Build Alternative's two new tracks should be immediately adjacent to the existing NEC, using existing Amtrak right-of-way where possible, and connect to the NEC as close as possible to the tunnel portal while providing switches between tracks for operational flexibility. New approach tracks on the south side of the NEC would avoid the need for tunneling beneath or flying over the NEC, and therefore would have fewer potential environmental impacts than new approach tracks on the north.
- On the east, the Build Alternative must connect to the array of approach tracks that lead into PSNY, which provide access to PSNY Station Tracks 1 through 18. Connecting to these tracks allows trains to reach existing PSNY platforms and is essential to maintaining the NEC's current capacity and functionality. The only location where a new connection can be made is at the southern end of the PSNY approach tracks, because areas farther north are occupied by the existing tracks from the North River Tunnel, Amtrak's Empire Line (which heads north to Albany), and tracks connecting to LIRR's West Side (John D. Caemmerer) Yard. The connection point on the southern end of the approach tracks would make use of the Hudson Yards Right-of-Way Preservation Project being constructed by Amtrak along the southern edge of the West Side Yard to preserve a rail right-of-way beneath the extensive overbuild project that is planned to be constructed on a platform above the rail complex. Any other connection point would conflict not only with the existing rail infrastructure but also with the foundations and supports for this platform.

These connection points narrow the area where the Build Alternative can be located to a relatively small area. Specifically, the new tunnel cannot be located north of the North River Tunnel because of the need to connect to the existing approach tracks to PSNY on the south end of PSNY.

4.1.2. REQUIREMENTS FOR TRAIN OPERATIONS

To accommodate train operations for Amtrak and NJ TRANSIT trains, the Build Alternative's tunnel must meet the following design requirements:

- The tunnel must have a grade (slope) of no more than 2.1 percent, needed for efficient operation of Amtrak and NJ TRANSIT passenger trains. As noted above, given the train lengths (and resulting weight) of NJ TRANSIT's commuter trains serving PSNY, grades should not exceed 2.1 percent for the tunnel design. This is the steepest grade for NJ TRANSIT's trainsets in terms of operational reliability.

- Design speed of 60 to 80 miles per hour (mph), consistent with the tunnel's terminus at the junction of numerous intersecting tracks approaching or exiting PSNY. The tunnel may support 80 mph operation in some areas, but peak period trains would typically operate at a maximum of 60 mph under normal peak conditions.
- Maintain and facilitate the existing eastbound capacity into PSNY at the Tenth Avenue portal of 24 trains per hour, with a signal design system that can accommodate a design capacity of 30 trains per hour in both directions at Tenth Avenue in Manhattan.
- The tunnel must provide appropriate clearances for Amtrak and NJ TRANSIT passenger trains and enough space for bench walls (which house certain utilities and provide emergency egress from the tunnel), overhead contact system (to provide electric power to the trains), and ventilation plenums[5]. This requires tunnels with an inside diameter of approximately 25 feet and an outer diameter of approximately 28 feet.
- An approximately 130-foot-diameter ventilation shaft on the New Jersey side of the river tunnel, east of the Palisades. The vertical ventilation shaft must be directly connected to the tunnel, because it must serve as an emergency exit and air shaft between the tunnel and the surface[6]. The ventilation shaft should not be in the Palisades portion of the route because the depth of the tunnel beneath the surface (250 to 300 feet at this location) would complicate ventilation systems operations and would make access and egress during emergencies difficult. In addition, the area on top of the Palisades is characterized by dense development that would make identification of a feasible site without substantial impacts to the built and natural environment challenging.
- Construction staging area at the ventilation shaft site in New Jersey with a minimum footprint of approximately 92,000 square feet. This area would be used for staging and other construction activities related to the tunnel construction. The site must allow for construction of the large-diameter shaft and delivery, operation, and logistical support of the tunneling operation through the shaft, including removal of excavated materials and delivery of materials.
- An associated fan plant at or near the ventilation shaft in New Jersey with a minimum footprint of 18,400 square feet. The fan plant site must be large enough to accommodate equipment, including exhaust fans and intake ducts.
- An approximately 130-foot-diameter ventilation shaft on the Manhattan side of the river tunnel. This shaft must also be located directly above the tunnel, so it can serve as an emergency exit and air shaft between the tunnel and the surface.
- Construction staging area at the ventilation shaft site in Manhattan with a minimum footprint of approximately 100,000 square feet, to be used for construction of the ventilation shaft and the Manhattan segment of the tunnel.
- An associated fan plant at or near the ventilation shaft in Manhattan with a minimum footprint of approximately 20,000 square feet.
- An additional fan plant to be located at the Manhattan tunnel portal, just east of Tenth Avenue in the PSNY rail complex to provide ventilation for the segment of new tunnel east of the larger fan plant near the river.

4.1.3. CONSTRUCTION METHODS

The new tunnel would be constructed predominantly using Tunnel Boring Machine technology, with construction staging areas located at the tunnel portal and ventilation shaft site in New Jersey. The staging area at the tunnel portal would also be used for rehabilitation of the existing

[5] A plenum is a chamber that houses air flow as part of a ventilation system.

[6] In contrast to the ventilation shafts, the Project's fan plants are best placed directly above the tunnel but can be offset from the tunnel if necessary, in which case they would be connected to the tunnel by a plenum that carries air between the tunnel and the fan plant.

tunnel once the new tunnel is complete. A construction staging site would also be located at the ventilation shaft site in Manhattan. In-water construction activities would be required to harden river bottom soils in a portion of the Hudson River where the tunnel alignment would be relatively shallow beneath the Hudson River. This would occur in one location, which is within the federal navigation channel (a portion in the main channel and a portion in the adjacent side channel) near the Manhattan shoreline.

4.2. BUILD ALTERNATIVE ALIGNMENT

The geographic considerations that constrain the Build Alternative's new tunnel, discussed above in Section 4.1, limit the potential Project alignment at its western and eastern ends, where it must connect to the NEC and the existing tracks at PSNY, respectively. Given those constraints, the alignment for the Project's new tunnel would be as follows.

4.2.1. NEW JERSEY SURFACE ALIGNMENT

To provide a new route close to and south of the NEC that maximizes the use of existing infrastructure, maintains flexible and redundant NEC rail operations for Amtrak and NJ TRANSIT, and minimizes the potential for environmental and community impact associated with new right-of-way, the Build Alternative's two new tracks would be immediately adjacent to the existing NEC, using existing Amtrak right-of-way where possible and providing switches between existing and new tracks for operational flexibility. The two new tracks would gradually curve away from the existing NEC right-of-way moving eastward, to connect to a tunnel portal in the west face of the Palisades close to the existing North River portal.

Therefore, west of the Palisades, the Build Alternative's surface tracks would include:

- Modifications to the existing NEC tracks and interlocking east of Secaucus Junction Station in Secaucus, New Jersey where two new tracks would diverge from the two existing NEC tracks;[7] and
- Two new surface tracks parallel to the south side of the NEC from the interlocking in Secaucus, New Jersey, to a new tunnel portal near Tonnelle Avenue (US Routes 1 and 9), in North Bergen, New Jersey, approximately 600 feet south of the North River Tunnel portal.

4.2.2. NEW JERSEY AND HUDSON RIVER TUNNEL ALIGNMENT

From the portal in the western face of the Palisades, the Build Alternative would include a new tunnel with two tracks in two separate tubes extending from east of Tonnelle Avenue beneath the Palisades (North Bergen and Union City, New Jersey) and beneath the adjacent waterfront area east of the Palisades (Weehawken or Hoboken, New Jersey), continuing beneath the Hudson River to Manhattan. East of the Palisades, the Build Alternative would have a vertical ventilation shaft connecting to the tunnel and associated fan plant building located above or near the tunnel to provide fresh air to the tunnel and to exhaust smoke during emergencies. Several different alignment options are possible for this portion of the Build Alternative. These were evaluated and a preferred alignment option was identified, as discussed in Section 4.3 below.

4.2.3. MANHATTAN TUNNEL ALIGNMENT

From the Manhattan bulkhead to PSNY, the Build Alternative would consist of a new tunnel with two tracks that would extend beneath Hudson River Park, across Twelfth Avenue (also known as New York State Route 9A), across the western end of the block located between Eleventh and Twelfth Avenues and West 29th and West 30th Streets (Manhattan Block 675), and across West 30th Street, where it would join the Hudson Yards Right-of-Way Preservation Project. The Build Alternative would then continue through the right-of-way preservation project, to connect to

[7] An interlocking is a system of switches and signals that allows trains to make connections from one track to another.

the existing approach tracks that serve PSNY. This right-of-way preservation project, which was the subject of a separate environmental review, provides the only feasible route for the new tracks to connect to the existing tracks at PSNY beneath the Hudson Yards overbuild development. If any other alignment were available, it would require extensive acquisition of private property and disruption to existing land uses.

This portion of the alignment would include a vertical ventilation shaft connecting to the tunnel and an associated fan plant building located above or near the tunnel to provide fresh air to the tunnel and to exhaust smoke during emergencies. The only available site for such a ventilation shaft and fan plant building is on Block 675, since the area west of that block is parkland and the area east of that block is currently either being developed with a large-scale development or is already developed. Additional tunnel ventilation would also be provided for the portion of the new tunnel east of Block 675 through a smaller fan plant.

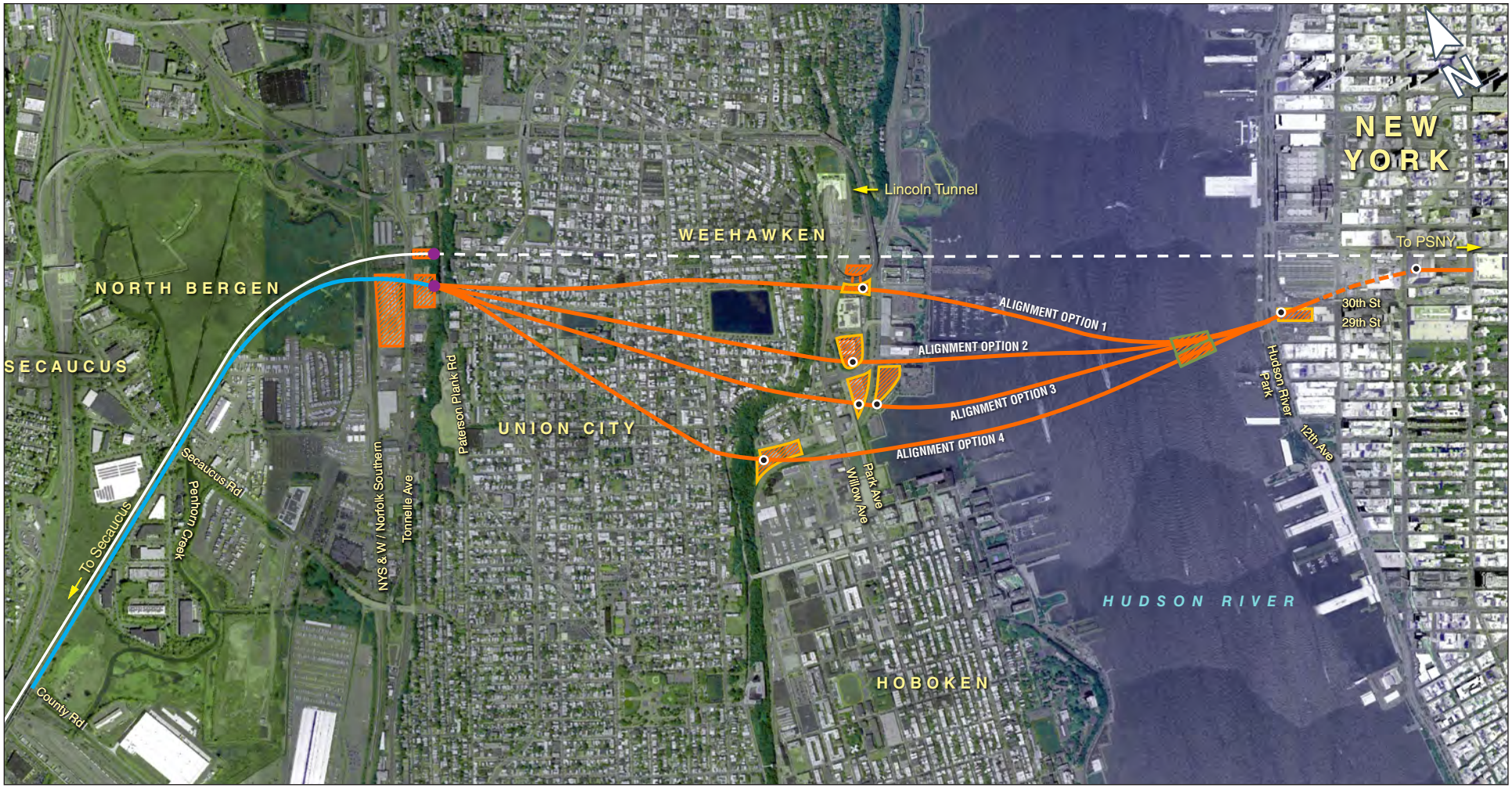
4.3. ALIGNMENT OPTIONS FOR TUNNEL BETWEEN NEW JERSEY PORTAL AND MANHATTAN BULKHEAD

Multiple alignment options are possible for the Build Alternative's tunnel between its portal at Tonnelle Avenue and the Manhattan shoreline. To identify the tunnel routing that best meets the Project goals and objectives, four conceptual alignment options were identified that met the locational and design criteria outlined above. As described in more detail below and shown in **Figure 5**, the options were established based on potential locations where the New Jersey ventilation shaft and fan plant could be sited. The ventilation shaft must be located directly above the tunnel and east of the Palisades, in an area where few undeveloped properties exist. The location of the ventilation shaft therefore determines the alignment of the tunnel between the tunnel portal and the waterfront area of New Jersey east of the Palisades. The ventilation shaft site would also be used as a construction staging site.

The four alignment options considered ranged from the shortest available route, a route parallel to the existing NEC in the North River Tunnel (Alignment Option 1) to the longest route considered, a route that would follow a horizontal alignment close to that of the ARC Project so as to use property NJ TRANSIT acquired for the ARC Project's shaft site as the shaft site for the Hudson Tunnel. Between those two alignment options, two other alignment options were identified, to determine whether other potential routes would offer any benefits relative to the shortest route (Option 1) and the route using the ARC property (Option 4). The four alignment options are described below, beginning closest to the existing North River Tunnel and moving southward (refer to **Figure 5**):

- **Alignment Option 1:** Tunnel alignment close to the existing North River Tunnel, with a ventilation shaft site near the Lincoln Tunnel Helix in Weehawken.
- **Alignment Option 2:** Tunnel alignment south of Option 1, with a shaft site north of 19th Street near JFK Boulevard East in Weehawken.
- **Alignment Option 3:** Tunnel alignment south of Option 2, with a shaft site south of 19th Street near the Hudson-Bergen Light Rail (HBLR) in Weehawken. As discussed below, two potential shaft sites were identified for this alignment.
- **Alignment Option 4:** Tunnel alignment south of Option 3, with a shaft site south of 18th Street in Hoboken. This option would follow the same horizontal alignment in New Jersey identified in the ARC Project's DEIS and SDEIS/FEIS Build Alternatives, and would use the same shaft and staging site in Hoboken as the ARC Build Alternatives.

All four alignment options would reach the Manhattan shoreline of the Hudson River at the same point.



Existing Northeast Corridor

Existing North River Tunnel

Amtrak Right-of-Way Preservation

Tunnel Alignment Option

Tunnel Portal

New Surface Tracks

Ventilation Shaft Site & Construction Staging Area

Construction Staging Area

In-Water Construction

New Ventilation Facilities

HUDSON TUNNEL PROJECT

Alignment Options

Figure 5

4.3.1. ALIGNMENT OPTION 1

As shown in **Figure 6**, Alignment Option 1 would be parallel to and just south of the existing North River Tunnel alignment. It would pass to the south of the Lincoln Tunnel Helix (the curved ramp on I-495 that brings vehicles to and from the Lincoln Tunnel portal) and beneath the Lincoln Harbor marina on the Weehawken waterfront in New Jersey. The shaft site for Alignment Option 1 would be located on a site adjacent to the south side of the Lincoln Tunnel Helix, in Weehawken. This site is part of a property occupied by an office building at 300 JFK Boulevard East. The shaft site includes approximately 50 parking spaces for that building as well as a billboard structure. The shaft site at 300 JFK Boulevard East would not be large enough for all required construction activities; therefore, Alignment Option 1 would also use a site within the Lincoln Tunnel Helix for construction staging, a property that is currently owned by the PANYNJ and is used by NJ TRANSIT as a bus parking and staging lot for its trans-Hudson bus operations into and out of the Port Authority Bus Terminal in New York City.

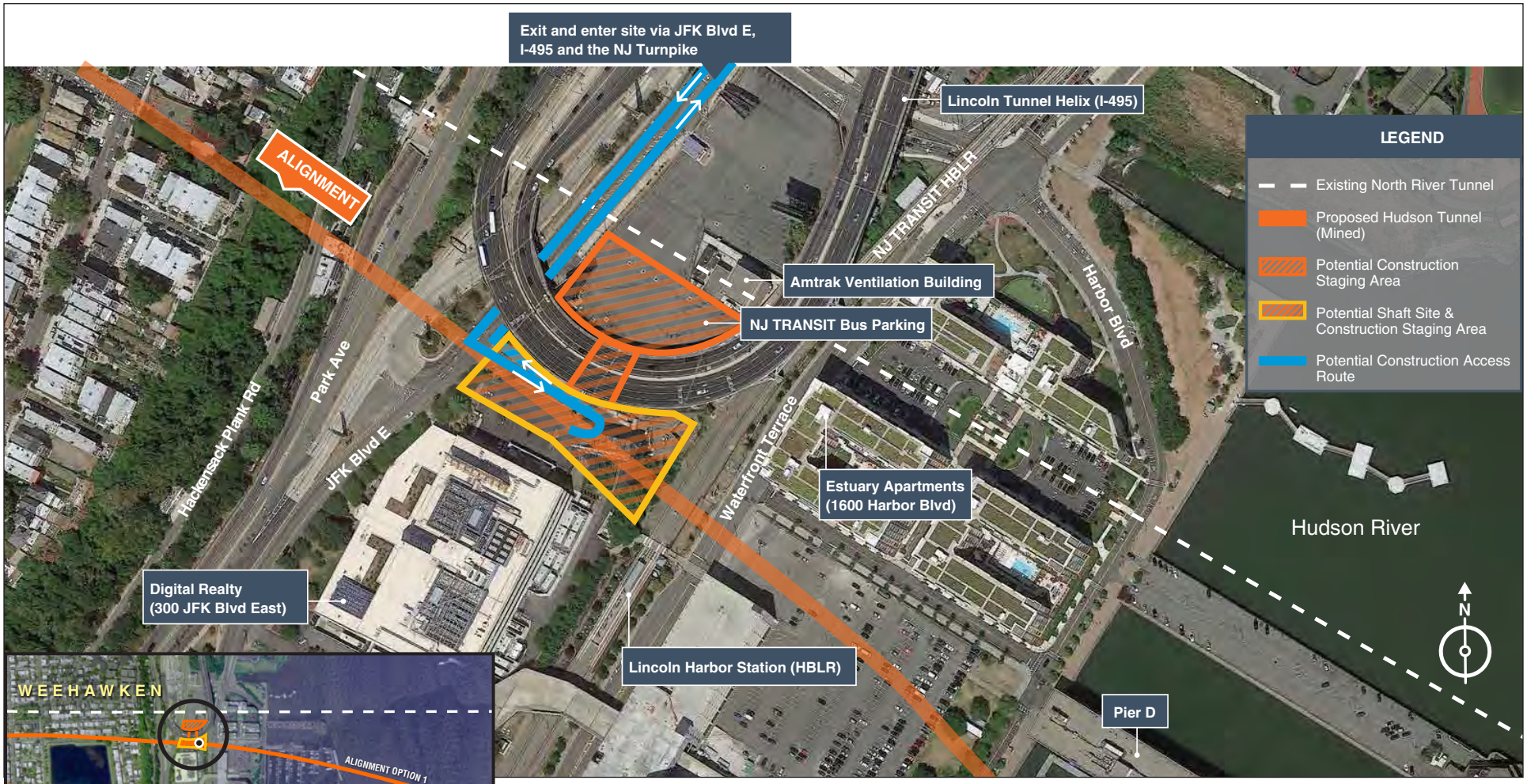
Potential haul routes to provide access for construction vehicles in Alignment Option 1 would be via the NJ Turnpike, I-495, and JFK Boulevard East. Vehicles entering either site would make a left turn from JFK Boulevard East into the site. Vehicles leaving the site would follow the same route in reverse. Potential haul routes are subject to refinement based on impact analyses to be conducted in the Hudson Tunnel Project EIS and discussions with local officials and the nearby community.

Use of this site would require acquisition of portions of five properties: Block 34.01 Lot 1 and Block 34.03 Lots 10, 11.02, 11.04, and 11.05. Collectively, these would provide approximately 2.3 acres for the shaft site and construction staging area.

The Lincoln Tunnel Helix and the entrance to the Lincoln Tunnel together have been determined by the New Jersey Historic Preservation Office to be eligible for listing on the State and National Registers of Historic Places as the Approach to Lincoln Tunnel Historic District. This alignment option would introduce a tall vent structure adjacent to this historic district.

NJ TRANSIT's Weehawken bus parking and staging site within the Lincoln Tunnel Helix is an important component of the region's trans-Hudson bus service. An aerial photograph of the lot is shown in **Figure 7**. Because the number of buses sufficient to accommodate evening demand cannot be stored at the Port Authority Bus Terminal, buses must be routed to the terminal from remote locations. If buses leave those locations too early, they arrive at the Port Authority Bus Terminal before the facility can process them, and must be directed to circulate on local roadways around the terminal, where they are often caught in (and contribute to) significant traffic congestion. If buses leave remote locations too late, they will not reach the Port Authority Bus Terminal in time to begin revenue service. The bus parking/staging area within the Lincoln Tunnel Helix is an important element of the bus staging system, especially to serve the evening peak period. The facility can hold approximately 160 buses, which are held on site until just before they are needed to operate in revenue service from the Port Authority Bus Terminal, at which time they are sent through the Lincoln Tunnel. Because the lot is located at the mouth of the Lincoln Tunnel, buses may be dispatched with a higher degree of precision than would be possible if dispatching were to occur at a location farther from the tunnel. Although buses do not have an exclusive lane through the Lincoln Tunnel, because their journey begins essentially at the mouth of the Lincoln Tunnel, they bypass any traffic on either Route 495 approaching the Lincoln Tunnel, and the Lincoln Tunnel Helix, or the traffic on the local approach roads to the Tunnel. This allows the buses to be dispatched in a timely manner, thereby avoiding the congestion and circulation problems in Manhattan that are described above.

Should the Weehawken parking lot be used during the construction of the Hudson Tunnel Project, it would force the relocation of the bus storage and staging function, which would adversely affect the bus operations at the Port Authority Bus Terminal by decreasing the reliability of bus service. With 160 buses at the staging site and assuming 50 passengers per bus, this could adversely affect an estimated 8,000 daily commuters.



Area Location

HUDSON TUNNEL PROJECT

Alignment Option 1:
New Jersey Ventilation Shaft and Construction Staging

Figure 6

Area Location

HUDSON TUNNEL PROJECT

Aerial Photograph of NJ TRANSIT Bus Staging Lot

Figure 7

In addition, the New Jersey Department of Transportation (NJDOT) and PANYNJ are planning to reconstruct the Lincoln Tunnel Helix. The preliminary engineering for the Helix reconstruction project will begin shortly, and therefore any construction activities associated with this project will likely occur in the same timeframe as the construction for the Hudson Tunnel Project. With Alignment Option 1, there is substantial possibility of conflict between the two construction projects, including the possibility that the Helix reconstruction could need the site at 300 JFK Boulevard for its own construction staging. In addition, should the Helix reconstruction involve an expansion of the Helix to facilitate roadway reconstruction, this expansion could interfere with the Hudson Tunnel Project's fan plant under Alignment Option 1.

4.3.2. ALIGNMENT OPTION 2

As shown in **Figure 8**, Alignment Option 2 would be south of Option 1. The shaft site and staging area for Alignment Option 2 would be located in the vicinity of 19th Street and JFK Boulevard East in Weehawken. The full-block site (Block 34.03, Lot 9.01) is currently occupied by a five-story office building at 1919 Park Avenue and associated surface parking lot.

Use of the site would require acquisition of the entire parcel and demolition of the office building on the site and its parking lot. This 210,000-square-foot building is currently occupied by four financial services businesses with an estimated 400 to 500 employees, assuming a standard rate of 250 square feet per employee.

The site would provide approximately 3.2 acres for the shaft site and construction staging area. Potential haul routes for access for construction vehicles in Option 2 would be via the NJ Turnpike, I-495, and JFK Boulevard East. Vehicles entering the site would make a left turn from JFK Boulevard East onto 19th Street, then another left turn onto Lincoln Harbor Road and a final left turn into the parking lot of 1919 Park Avenue. Vehicles leaving the site would follow the same route in reverse. Potential haul routes are subject to refinement based on impact analyses to be conducted in the Hudson Tunnel Project EIS and discussions with local officials and the nearby community.

4.3.3. ALIGNMENT OPTION 3

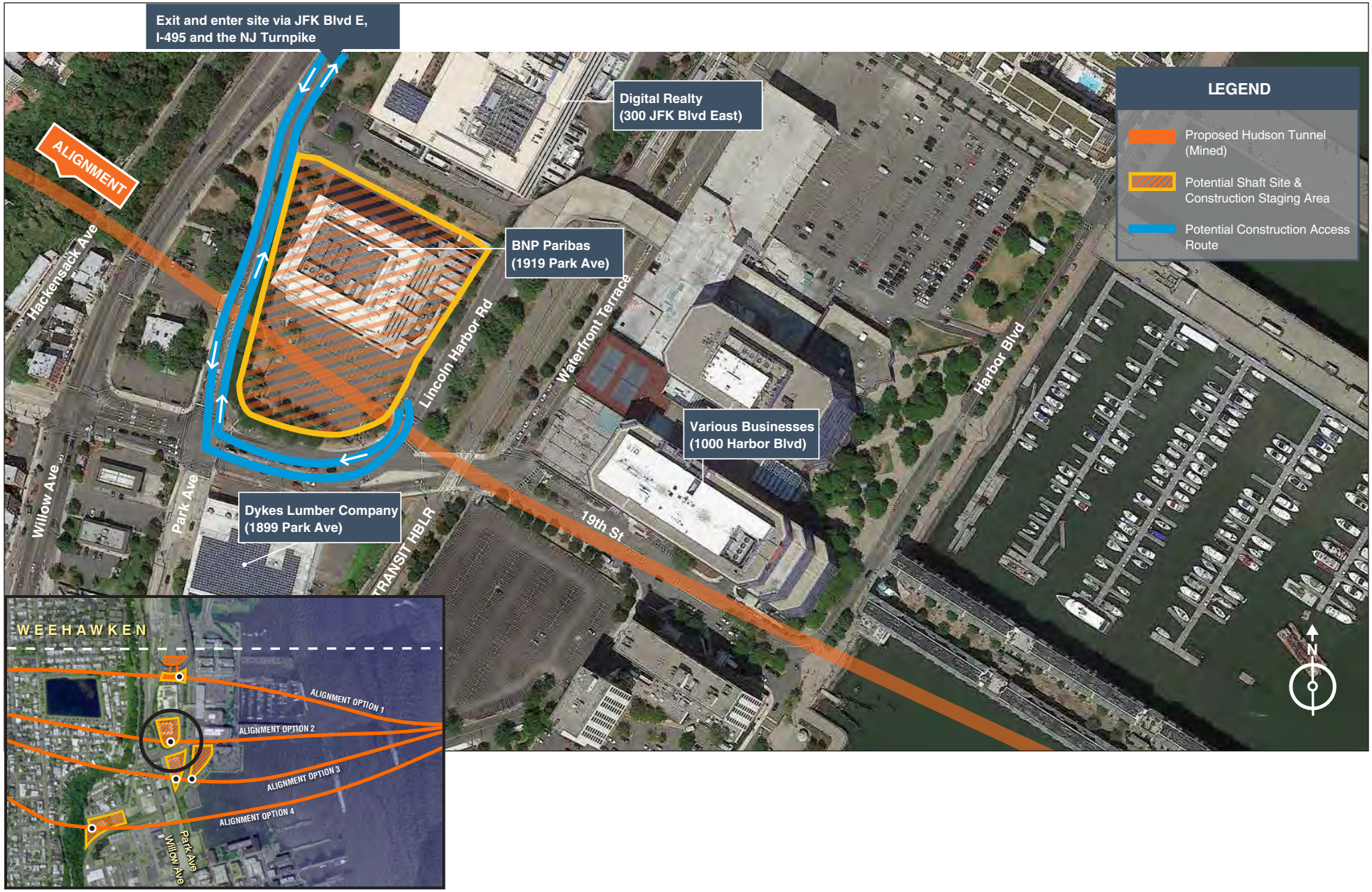
As shown in **Figure 9**, Alignment Option 3 would curve farther south than Alignment Option 2. For this option, two potential shaft site and staging area locations were identified and evaluated.

The first potential site for this alignment option's shaft site and staging area is located at 1899 Park Avenue, just west of the HBLR right-of-way in Weehawken. This full-block site, consisting of Block 34.03, Lots 7, 7.02, and 8, contains a single-story commercial building that is currently occupied by Dykes Lumber Company as a warehousing and retail showroom facility. The company makes and sells moldings and other building materials. The total single-story site is about 70,000 square feet and employs an estimated 70 to 100 people at this location.

Use of the site would require acquisition of all three lots comprising the site, and would require that the single-story commercial building on the site be demolished. The site would provide approximately 2.4 acres for the shaft site and construction staging area.

Potential haul routes for access for construction vehicles at the Dykes Lumber site would be via the NJ Turnpike, I-495, and JFK Boulevard East. Vehicles entering the site would make a left turn from JFK Boulevard East onto 19th Street, then a right turn into the site. Vehicles leaving the site would follow the same route in reverse. Potential haul routes are subject to refinement based on impact analyses to be conducted in the Hudson Tunnel Project EIS and discussions with local officials and the nearby community.

The second potential site for this alignment option's shaft site and staging area is located at 800 Harbor Boulevard, just east of the HBLR right-of-way in Weehawken. The full-block site, consisting of Block 34.03 Lot 4.01, was fully occupied until approximately 2014 by a three-story office building totaling approximately 150,000 square feet and an adjacent four-level parking structure. The office building was connected by an above-grade enclosed passage over 19th

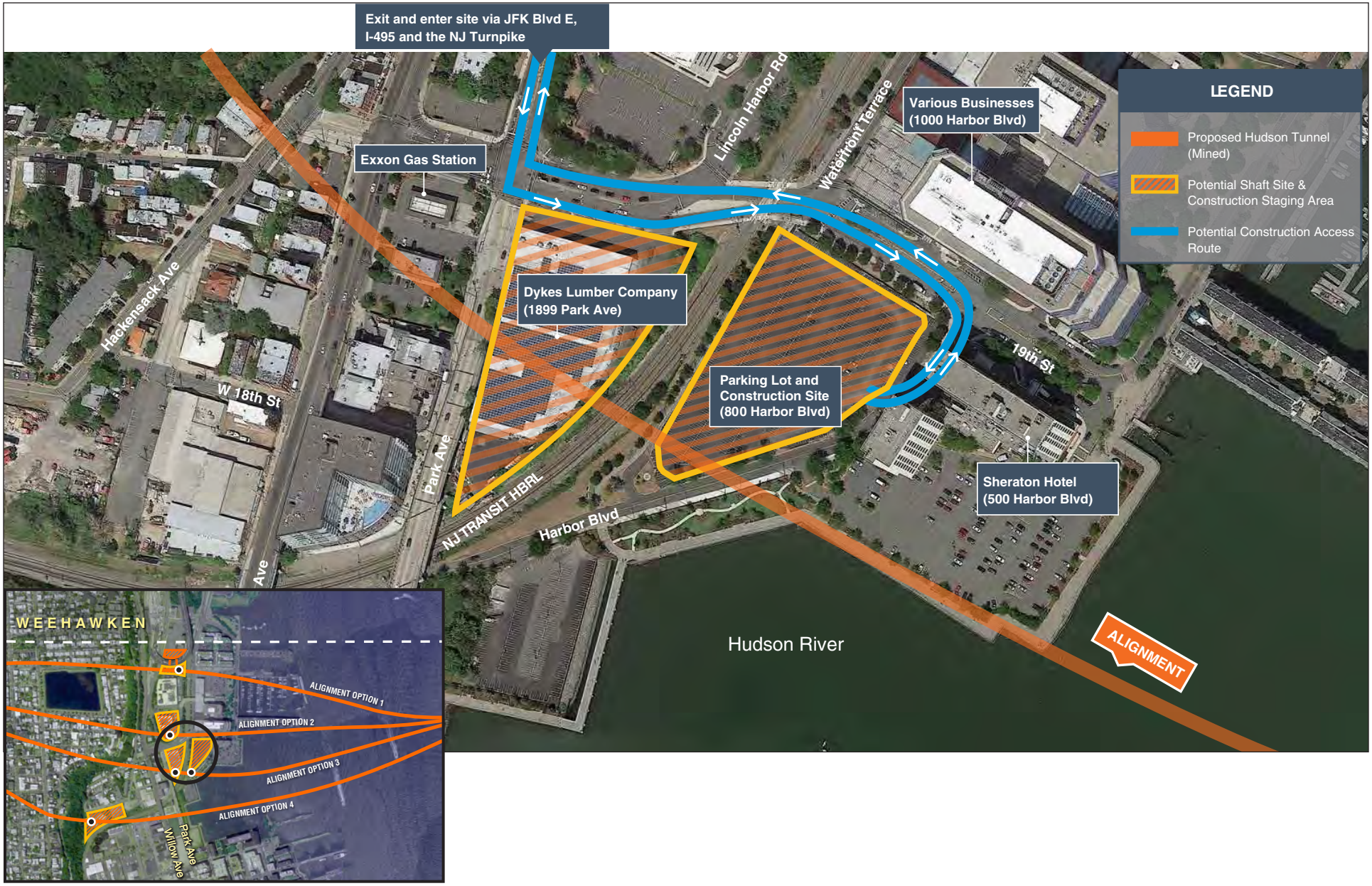


Area Location

HUDSON TUNNEL PROJECT

Alignment Option 2:
New Jersey Ventilation Shaft and Construction Staging

Figure 8



Area Location

HUDSON TUNNEL PROJECT

Alignment Option 3:
New Jersey Ventilation Shaft and Construction Staging
Figure 9

Street to an office building on the other side of the street. These two buildings have recently been demolished and construction has begun on a building on a portion of the site; the remainder of the lot is currently being used for surface parking. Marketing materials prepared by Hartz Mountain, a major developer in the area, for the larger Lincoln Harbor area (which includes this site) indicates that this site is planned for residential use.[8] Information on the timing for such redevelopment is not known.

Use of the site would require acquisition of the entire parcel. The site would provide approximately 2.4 acres for the shaft site and construction staging area. Use of the site for a shaft site and fan plant would preclude at least a portion of the planned future residential development; given that redevelopment of the site has already begun, it is no longer feasible to use this property for a shaft site and staging area without acquiring and demolishing the new development that is being built there. Approximately one acre (one-third of the total lot area) would remain available for development upon completion of Project construction work. The site would provide approximately 2.4 acres for the shaft site and construction staging area.

Access for construction vehicles at the 800 Harbor Boulevard site would be via the NJ Turnpike, I-495, and JFK Boulevard East. Vehicles entering the site would make a left turn from JFK Boulevard East onto 19th Street and cross the HBLR, then make a right turn onto Harbor Boulevard and another right turn into the site. Vehicles leaving the site would follow the same route in reverse. As noted above, potential haul routes are subject to refinement based on impact analyses to be conducted in the Hudson Tunnel Project EIS and discussions with local officials and the nearby community.

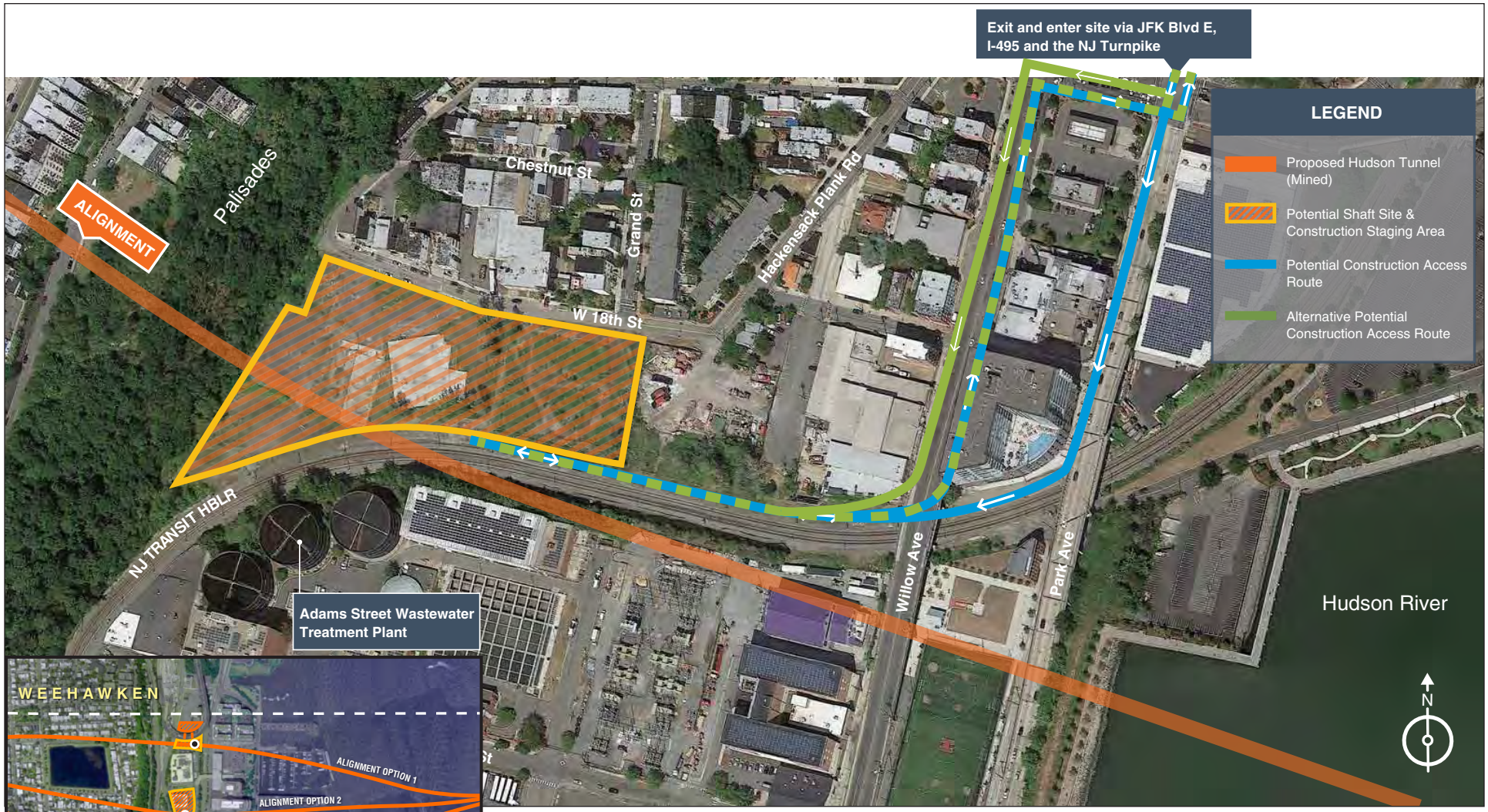
4.3.4. ALIGNMENT OPTION 4

As shown in **Figure 10**, Alignment Option 4 would curve farther south than Option 3, following the horizontal alignment of the former ARC Project. The shaft site and staging area for Option 4 would be located on the south side of 18th Street in Hoboken, just north of the HBLR right-of-way, and adjacent to the eastern face of the Palisades. Just north across West 18th Street is a predominantly residential neighborhood known as The Shades. The site (consisting of Block 136, Lot 6.02; Block 142, Lot 1; Block 143, Lots 2 and 3; Block 144, Lots 2 through 19; and Block 145, Lots 1.2, 2, 3, 4, 10, 11, 12.1, and 12.2, all in Hoboken; Block 2, Lots 1, 2, and 3 in Weehawken; and Block 192.01, Lot 1 in Union City) is owned by NJ TRANSIT and was originally acquired as the location of the shaft site and staging area for the ARC Project. The site was previously occupied by light industrial buildings but is currently vacant.

This site would provide approximately 2.0 acres for the shaft site and construction staging area.

Access for construction vehicles in Alignment Option 4 would be via a temporary access route that would be constructed parallel to and north of the HBLR tracks along property controlled by NJ TRANSIT. There are two options for truck routes to connect to this access road (see **Figure 10**). The first would use the Park Avenue service road (adjacent to the Park Avenue viaduct) for trucks traveling to the shaft site and the northbound Willow Avenue service road (adjacent to the Willow Avenue viaduct) for trucks leaving the shaft site. This route was developed and approved for the ARC Project and NJ TRANSIT acquired permanent easements across Block 11, Lot 5 for the route. Since that time, a new 10-story apartment building has been constructed adjacent to the proposed construction access route between Willow Avenue and Park Avenue, but the haul route remains feasible within NJ TRANSIT's easement. Trucks traveling to the shaft site would pass close to the residential building within the easement area. The residential building is currently using the easement area as a private dog run and sidewalk, which would have to be removed for the duration of construction. Another access road option was also considered, to determine whether a better route was available that would not affect the dog run and sidewalk. In the second access road option, trucks traveling to the shaft site would

[8] http://www.hartzmountain.com/Pages/LincolnHarbor.aspx; map of Lincoln Harbor accessed December 2016.



Area Location

HUDSON TUNNEL PROJECT

Alignment Option 4:
New Jersey Ventilation Shaft and Construction Staging

Figure 10

use the southbound Willow Avenue service road rather than the Park Avenue service road. In this option, a vacant one- and two-story warehouse structure located on Block 146, Lot 2 at 1714 Willow Avenue may have to be acquired and demolished to create enough space for turning trucks. Potential haul routes are subject to refinement based on impact analyses to be conducted in the Hudson Tunnel Project EIS and discussions with local officials and the nearby community.

4.4. EVALUATION OF TUNNEL ALIGNMENT OPTIONS

The four short-list alignment options were comparatively evaluated using a series of screening criteria developed to identify which alignment option best meets the Project goals and objectives. As discussed above, Project goals were established to guide the development and evaluation of alternatives that address the purpose and need. The goals related to improving service reliability and repairing the existing tunnel; maintaining uninterrupted NEC service by ensuring the Project occurs as soon as possible; strengthening the NEC's resiliency and operational flexibility; not precluding future trans-Hudson rail capacity expansion projects; and minimizing impacts on the natural and built environment.

The alternatives evaluation compared the four alternative options for the tunnel alignment between the New Jersey tunnel portal and the Manhattan bulkhead. The evaluation considered areas where the alignments would or could potentially differ in terms of Project goals and objectives. Since the four alignment options would be the same over the surface portion of the alignment in New Jersey and in Manhattan those segments were not considered in the comparison. In addition, based on the analyses conducted for the ARC Project, no significant impacts would occur related to the alignment of the deep rock tunnel beneath the Palisades for areas directly above the tunnel, so that was not a factor in the comparison.[9]

Each alignment option was evaluated against criteria representing components of the Project goals and objectives, with a determination made as to how well the option met the criterion, as follows:

- Option meets criterion well;
- Option somewhat meets criterion;
- Option performs least well relative to other options, and may fail to meet criterion; or
- Option fails to meet criterion with major negative issue; if other options are available, they should be pursued instead.

Tables 2 and 3 present the results of this evaluation, using colors to represent each option's "score" relative to each criterion. Using this screening process, the alignment option that most successfully meets the purpose, need, goals, and objectives of the Project was identified.

[9] Since the Palisades tunnel would be constructed entirely below ground, with no access points from above, the only potential issues from this tunnel would be related to vibration during construction or train operation. The ARC Project's DEIS Build Alternative and SDEIS/FEIS Build Alternative included a tunnel constructed through the rock of the Palisades at approximately the same depth as the tunnel for this Project's Build Alternative. The ARC DEIS, SDEIS, and FEIS concluded that vibration from tunneling activities may be perceptible for a short time (less than two months) at lower locations on the Palisades over the tunnel (i.e., near Paterson Plank Road), but vibration levels would be low and would not result in building damage. At other locations on the Palisades, the tunnel would be well over 100 feet deep, and at some locations close to 300 feet deep. At that depth, vibration would be barely perceptible and no building damage would occur. The ARC EIS documents also concluded that once trains were operating in the new tunnel, vibration levels would be low (similar to the existing NEC rail tunnel that runs beneath Union City today) and no adverse impact would occur. (Noise and vibration effects of the Hudson Tunnel Project Build Alternative will be analyzed in the Hudson Tunnel Project EIS.)

Table 2
Alignment Options - Screening Results

Project Goal	Evaluation Criteria		Option 1	Option 2	Option 3	Option 4
1: Improve service reliability and upgrade existing tunnel infrastructure in a cost-effective manner.	1A. Rehabilitate the North River Tunnel to modern system standards and improve its resilience to future storm damage.					
	1 Option should meet design criteria.		All options are assumed to meet the Project's design criteria			
	1B. Minimize capital cost for new crossing.					
	1 Option should minimize the cost of acquisition to the extent practicable.		Partial acquisition of parking lot associated with office building: $1.2 M based on fraction of 2017 assessed value proportional to size of property needed	Full acquisition of office building and parking: $23.9M assessed value for property in 2017	Assuming full acquisition of parking lot now under construction: $18.7M assessed value (or, alternatively, $2.85M if Dykes Lumber site) in 2017	No acquisition required for shaft site and staging area (or small acquisition, assessed value $871,000, could occur depending on truck access route used)
	2 Option should minimize construction cost to the extent practicable.		Cost for tunnel construction was compared between each tunnel alignment. The cost is affected by tunnel length and also by schedule, since delays to the construction start would result in cost escalation (assumed to be 3.5% per year)			
		Tunnel length:	11,532 feet (5,850 Palisades; 5,682 River)	11,538 feet (5,767 Palisades; 5,771 River)	11,756 feet (5,955 Palisades; 5,801 River)	12,365 feet (5,099 Palisades; 7,266 River)
		Base construction cost for tunneling:	Option 1 has the lowest tunneling cost	Tunneling 1% more than Option 1	Tunneling 2% more than Option 1	Tunneling 8% more than Option 1
		Tunneling cost with 1-year delay to Options 1, 2, and 3:	Option 1 has the lowest tunneling cost	Tunneling 1% more than Option 1	Tunneling 2% more than Option 1	Tunneling 4% more than Option 1
		Tunneling cost with 2-year delay to Options 1, 2, and 3:	Option 1 has the lowest tunneling cost	Tunneling 1% more than Option 1	Tunneling 2% more than Option 1	Tunneling 1% more than Option 1
2: Maintain uninterrupted existing NEC service, capacity, and functionality by ensuring North River Tunnel rehabilitation occurs as soon as possible.	2A. Develop the project as rapidly as possible, minimizing delays.					
	1 Option should minimize time required for property acquisition.		Portions of five properties	Full acquisition of one property	Full acquisition of one property	No acquisition required (or small acquisition could occur depending on truck access route used)
	2 Option should minimize time required for easement acquisition.		211 easements	246 easements	189 easements	147 easements
	3 Option should minimize time required for permitting.		All options assumed to require similar amount of time for permitting. Option 4 may have simplified permitting in NJ by modifying ARC permits			
	4 Option should minimize time required for new riparian rights acquisition.		No riparian rights have been acquired			Small area of riparian rights already acquired
	5 Option should minimize time required for remediating hazardous materials.		Contaminated historic fill likely based on a review of past uses; could require approx. 1 year for remediation (time would vary depending on specific contamination identified)			Historic contaminated fill was present; remediation nearing completion
	6 Option should minimize pre-construction schedule risk.		Risk associated with availability of key properties (NJ TRANSIT bus layover area must be relocated), marina riparian rights	Risk associated with availability of key properties		Lower pre-construction schedule risk because some key planning work already complete and shaft site has already been acquired and is vacant
	7 Option should minimize construction duration.		2,563 days (7 years) for construction between portal and bulkhead	2,563 days (7 years) for construction between portal and bulkhead	2,577 days (7 years, 1 month) for construction between portal and bulkhead	2,623 days (7 years, 2.5 months) for construction between portal and bulkhead
	8 Option should optimize use of existing infrastructure.		All options would connect to existing infrastructure in the same way, minimizing the length of new track			
3: Strengthen the NEC's resiliency to provide reliable service across the Hudson River crossing, facilitating long-term infrastructure maintenance and enhancing operational flexibility.	3A. Maximize NEC service reliability and redundancy.					
	1 Option should minimize travel time between Allied Interlocking (Secaucus) and A Interlocking (PSNY).		Slightly shorter travel time than Option 4: savings of 16 seconds EB/11 seconds WB (EB and WB average 13.5 seconds)	Slightly shorter travel time than Option 4: savings of 16 seconds EB/12 seconds WB (EB and WB average 14 seconds)	Slightly shorter travel time than Option 4: savings of 13 seconds EB/9 seconds WB (EB and WB average 8 seconds)	—
	2 Option should minimize the cost to operate and maintain the new tunnel.		Shorter tunnel length results in savings of up to $100,000 per year vs. Option 4			—
	3B. Design new Hudson Tunnel to modern system standards and ensure its resilience to future storm damage.					
	1 Option should meet design criteria.		All options are assumed to meet the Project's design criteria			
4: Do not preclude future trans-Hudson rail capacity expansion projects.	4A. Option should not preclude future trans-Hudson rail capacity expansion projects.					
	1 Option should allow for connections to Secaucus Junction Station and through to the Portal Bridge.		All options are assumed to allow for these connections			
	2 Option should allow for connections to station expansion projects in the area of PSNY.		All options are assumed to allow for these connections			

Table 2
Alignment Options - Screening Results

Project Goal	Evaluation Criteria	Option 1	Option 2	Option 3	Option 4
5: Minimize impacts on the natural and built environment (construction-period impacts).	5A. Avoid disruptions to transit services.				
	1 Option should avoid construction impacts to Hudson-Bergen Light Rail (HBLR) system.	Requires small area of underpinning	Requires small area of underpinning	Requires small area of underpinning	Underpinning; construction and haul routes adjacent to HBLR ROW
	2 Option should avoid construction impacts to trans-Hudson bus operations.	Displacement of bus staging area within Lincoln Tunnel Helix would result in unacceptable impact to NJ TRANSIT trans-Hudson bus operations serving the Port Authority Bus Terminal, affecting approximately 7,500 daily trans-Hudson commuters	No impacts	No impacts	No impacts
	5B. Minimize neighborhood construction impacts.				
	1 Option should avoid construction activities near sensitive land uses where possible.	Near residential areas atop the Palisades; residential buildings on Waterfront Blvd; office at 300 JFK Blvd East	Near residential areas atop the Palisades; office at 300 JFK Blvd East	Near residential areas atop the Palisades; office at 1000 Harbor Blvd; Sheraton Hotel	Immediately adjacent to residential uses
	2 Option should minimize the number of truck trips during construction.	78,300 total trips	78,900 total trips	81,300 total trips	89,900 total trips
	3 Option should avoid traffic conflicts related to haul routes.	Difficult left turn across JFK Blvd East (requires NJDOT and Weehawken approvals)	Difficult left turn across Lincoln Harbor Rd or 19th St (requires NJDOT and Weehawken approvals)	Utilizes normal traffic patterns	Utilizes normal traffic patterns; requires removal of dog park and sidewalk OR possible corner of building
	4 Option should minimize adverse construction effects relative to future plans.	Would likely conflict with reconstruction of Lincoln Tunnel Helix	No conflicts	Likely to conflict with construction at 800 Harbor Blvd	No conflicts
	5C. Minimize impacts to environmental justice communities.				
	1 Option should avoid construction activities near environmental justice communities.	EJ communities in Weehawken (near staging area) and atop the Palisades	EJ communities in Weehawken (near staging area) and atop the Palisades	EJ communities in Weehawken (near staging area) and atop the Palisades	EJ communities in Weehawken (near staging area) and atop the Palisades
	5D. Minimize impacts to Waters of the United States.				
	1 Option should minimize construction impacts to Waters of the United States.	Impacts to Hudson River bed, Meadowlands, New York Hudson River bulkhead	Impacts to Hudson River bed, Meadowlands, New York Hudson River bulkhead	Impacts to Hudson River bed, Meadowlands, New York Hudson River bulkhead	Impacts to Hudson River bed, Meadowlands, New York Hudson River bulkhead
5: Minimize impacts on the natural and built environment (permanent / operational impacts).	5E. Minimize need for permanent displacement of active uses.				
	1 Option should minimize displacement of active residential uses.	No displacement	No displacement	Displaces new building currently being constructed	No displacement
	2 Option should minimize displacement of active non-residential uses.	Displaces portion of parking lot at 300 JFK Blvd East	Displaces existing occupied office building	One shaft site option displaces building under construction at 800 Harbor Blvd; the other displaces active existing business at Dykes Lumber	No displacement
	3 Option should minimize adverse effects to future plans (be consistent with local plans and policies).	Fan plant location may interfere with Lincoln Tunnel Helix location	No conflicts	One shaft site option precludes majority of a planned residential development at 800 Harbor Blvd (construction at this site has begun)	No conflicts
	5F. Avoid permanent disruptions to transit services.				
	1 Option should avoid impacts to HBLR.	No impacts	No impacts	No impacts	No impacts
	2 Option should avoid impacts to trans-Hudson bus operations.	No impacts	No impacts	No impacts	No impacts
	5G. Minimize environmental impacts related to project's above-ground structures.				
	1 Option should minimize number of adjacent historic structures.	1 adjacent historic structure: NJ 495 approach to Lincoln Tunnel Historic District (which includes Helix and Lincoln Tunnel entrance)	No listed historic structures adjacent	No listed historic structures adjacent	No listed historic structures adjacent
	5H. Minimize impacts to environmental justice communities.				
	1 Option should avoid permanent above-ground structures near environmental justice communities.	EJ communities in Weehawken (near staging area) and atop the Palisades	EJ communities in Weehawken (near staging area) and atop the Palisades	EJ communities in Weehawken (near staging area) and atop the Palisades	EJ communities in Weehawken (near staging area) and atop the Palisades
	5I. Minimize impacts to Waters of the United States.				
	1 Option should minimize permanent impacts to Waters of the United States.	Impacts to Hudson River bed, Meadowlands	Impacts to Hudson River bed, Meadowlands	Impacts to Hudson River bed, Meadowlands	Impacts to Hudson River bed, Meadowlands

Option meets criterion well.
Option somewhat meets criterion.
Option performs least well and may fail to meet criterion.
Option fails to meet criterion with major negative issue; if other options are available, they should be pursued instead.

Table 3
Alignment Options - Summary of Screening Results

Project Goal	Evaluation Criteria	Option 1	2	3	4
1: Improve service reliability and upgrade existing tunnel infrastructure in a cost-effective manner.	1A. Rehabilitate the North River Tunnel to modern system standards and improve its resilience to future storm damage.				
	1 Option should meet design criteria.				
	1B. Minimize capital cost for new crossing.				
	1 Option should minimize the cost of acquisition to the extent practicable.				
	2 Option should minimize construction cost to the extent practicable.				
2: Maintain uninterrupted existing NEC service, capacity, and functionality by ensuring North River Tunnel rehabilitation occurs as soon as possible.	2A. Develop the project as rapidly as possible, minimizing delays.				
	1 Option should minimize time required for property acquisition.				
	2 Option should minimize time required for easement acquisition.				
	3 Option should minimize time required for permitting.				
	4 Option should minimize time required for new riparian rights acquisition.				
	5 Option should minimize time required for remediating hazardous materials.				
	6 Option should minimize pre-construction schedule risk.				
	7 Option should minimize construction duration.				
	8 Option should optimize use of existing infrastructure.				
3: Strengthen the NEC's resiliency to provide reliable service across the Hudson River crossing, facilitating long-term infrastructure maintenance and enhancing operational flexibility.	3A. Maximize NEC service reliability and redundancy.				
	1 Option should minimize travel time between Allied Interlocking (Secaucus) and A Interlocking (PSNY).				
	2 Option should minimize the cost to operate and maintain the new tunnel.				
	3B. Design new Hudson Tunnel to modern system standards and ensure its resilience to future storm damage.				
	1 Option should meet design criteria.				
4: Do not preclude future trans-Hudson rail capacity expansion projects.	4A. Option should not preclude future trans-Hudson rail capacity expansion projects.				
	1 Option should allow for connections to Secaucus Junction Station and through to the Portal Bridge.				
	2 Option should allow for connections to station expansion projects in the area of PSNY.				
5: Minimize impacts on the natural and built environment (construction-period impacts).	5A. Avoid disruptions to transit services.				
	1 Option should avoid construction impacts to HBLR.				
	2 Option should avoid construction impacts to trans-Hudson bus operations.				
	5B. Minimize neighborhood construction impacts.				
	1 Option should avoid construction activities near sensitive land uses where possible.				
	2 Option should minimize the number of truck trips during construction.				
	3 Option should avoid traffic conflicts related to haul routes.				
	4 Option should minimize adverse construction effects relative to future plans.				
	5C. Minimize impacts to environmental justice communities.				
	1 Option should avoid construction activities near environmental justice communities.				
	5D. Minimize impacts to Waters of the United States.				
	1 Option should minimize construction impacts to Waters of the United States.				
5: Minimize impacts on the natural and built environment (permanent / operational impacts).	5E. Minimize need for permanent displacement of active uses.				
	1 Option should minimize displacement of active residential uses.				
	2 Option should minimize displacement of active non-residential uses.				
	3 Option should minimize adverse effects to future plans (be consistent with local plans and policies).				
	5F. Avoid permanent disruptions to transit services.				
	1 Option should avoid impacts to HBLR.				
	2 Option should avoid impacts to trans-Hudson bus operations.				
	5G. Minimize environmental impacts related to project's above-ground structures.				
	1 Option should minimize number of adjacent historic structures.				
	5H. Minimize impacts to environmental justice communities.				
	1 Option should avoid permanent above-ground structures near environmental justice communities.				
	5I. Minimize impacts to Waters of the United States.				
	1 Option should minimize permanent impacts to Waters of the United States.				

Option meets criterion well.
Option somewhat meets criterion.
Option performs least well and may fail to meet criterion.
Option fails to meet criterion with major negative issue; if other options are available, they should be pursued instead.

4.4.1. COMPARATIVE EVALUATION OF ALIGNMENT OPTIONS

This section summarizes and compares the four alignment options' performance relative to the evaluation criteria and each other. The purpose of this evaluation was to identify the alignment option that best meets the Project goals and objectives. **Tables 2 and 3** provide the supporting information related to the evaluation and illustrate how each alignment option scored for each of the criteria.

Goal 1: Improve service reliability and upgrade existing tunnel infrastructure in a cost-effective manner.

All four alignment options would meet this goal, but Option 2 would have a higher cost for property acquisition than the others (because of the need to acquire a fully occupied office building), while Option 4, which would use property already acquired for the ARC Project, would have the lowest cost for property acquisition. Capital cost for tunnel construction would vary among the options, depending on tunnel length, since a longer tunnel would have a higher construction cost, and on the time required to acquire property and obtain permits, since faster construction would have less potential for cost escalation, or the increase in the price of construction materials, labor, and financing over time.

- **Criterion: Option should meet design criteria.** Under any alignment option, the design for the Project would meet applicable design criteria.
- **Criterion: Option should minimize the cost of acquisition to the extent practicable.** Alignment Option 4 met this criterion best, because it would not require acquisition of any properties for its shaft, fan plant, or construction staging sites in New Jersey (other than possible acquisition of a small property for use as part of a potential construction access road in one option being considered), whereas the other alignment options would need to acquire properties for their shaft, fan plant, and construction staging sites. The current (2017) assessed values were reviewed for each shaft site/staging area and compared as a proxy for actual acquisition cost. Alignment Option 2 would perform least well of the four options, because it would require full acquisition of an occupied office building. Alignment Option 3 would require acquisition of either a property currently under construction with new development or a property fully occupied by a business, and therefore only somewhat met this criterion. Option 1 would require acquisition of a small parking lot, which would have a relatively low price, based on the need for only a small area of a larger property, and therefore met this criterion. (For Option 1, a proportion of the assessed value was assumed as the acquisition cost, based on the proportion of the property that would be required.)
- **Criterion: Option should minimize construction cost to the extent practicable.** The primary factor determining cost differences among the four tunnel alignment options is alignment length. Options 1 and 2 are approximately the same length (11,535 feet), while Option 3 is slightly longer (11,760 feet) and Option 4 is the longest (12,365 feet, or 830 feet longer than Options 1 and 2). Tunnel costs also vary for the rock tunnel beneath the Palisades versus the soft tunnel east of the Palisades and beneath the river, which costs more per foot than the rock tunnel. As shown in **Table 2**, the tunneling for Option 1 would be the cheapest; tunneling for Option 2 would cost approximately 1 percent more than Option 1, tunneling for Option 3 would cost approximately 2 percent more than Option 1, and tunneling for Option 4 would cost approximately 8 percent more than Option 1. However, construction cost may also be affected by the potential for delays in construction start, since a later construction year would introduce higher cost escalation. Alignment Options 1, 2, and 3 may not be able to start construction as quickly as Option 4, because they require acquisition of properties for shaft sites and staging areas and because they may require additional remediation and other pre-construction work (as discussed in Goal 2 criteria below) compared to Option 4, for which studies have already been conducted and remediation and other actions have already been undertaken (see discussion below). Delays to construction start would mean that the construction occurs in later years, which would increase the

overall cost of the Project, because of inflation (increases in labor and material costs, financing, etc.). In this case, the cost difference between the longer options (Options 3 and 4) would be reduced in comparison to the shorter options (Options 1 and 2) and could potentially be eliminated altogether depending on the delay.

Goal 2: Maintain uninterrupted existing NEC service, capacity, and functionality by ensuring North River Tunnel rehabilitation occurs as soon as possible.

Option 4 best met this Project goal, because by using approximately the same tunnel alignment through New Jersey as the previously approved ARC Project, it would require less time for pre-construction activity, including acquisition of properties and easements, and remediation of hazardous materials. With more approvals already obtained and properties already acquired, Option 4 would also have less pre-construction schedule risk than the other alignment options.

- **Criterion: Option should minimize time required for property acquisition.** Alignment Option 4 performs best, because it would not require acquisition of any properties for its shaft, fan plant, or construction staging sites in New Jersey, whereas the other alignment options would need to acquire those sites. (Option 4 could require acquisition of a small property for an optional truck access route, but if this site cannot be acquired, Option 4 can proceed without it.)
- **Criterion: Option should minimize time required for easement acquisition.** All four alignment options would require acquisition of easements where the tunnel would pass beneath private property. NJ TRANSIT has already acquired a number of the easements that would be required for Option 4, and therefore this option meets this criterion best. The other three alignment options somewhat meet this criterion.
- **Criterion: Option should minimize time required for permitting.** All alignment options were assumed to require a similar amount of time for permitting and were found to somewhat meet this criterion. Option 4 may be able to simplify the permitting process in New Jersey by modifying an existing ARC wetlands permit issued by the New Jersey Department of Environmental Protection, but this would not likely result in substantial time savings overall compared to the other three alignment options.
- **Criterion: Option should minimize time required for new riparian rights acquisition.** In New Jersey, the State of New Jersey owns the riparian rights, meaning rights to land where tidal waterways are present or were formerly present; projects that require the use of such land must acquire the rights from the state through a grant or license. All four alignment options would require acquisition of riparian rights from New Jersey and therefore were found to somewhat meet this criterion. While NJ TRANSIT acquired the riparian rights needed for the ARC Project, Option 4 does not cross the Hudson River in the exact same location as the ARC SDEIS/FEIS Build Alternative and therefore would require acquisition of different riparian rights.
- **Criterion: Option should minimize time required for remediating hazardous materials.** Alignment Option 4 performs best for this criterion, because hazardous materials on this site were investigated during the ARC Project and remediation is currently nearing completion. The other three options are likely to have contaminated fill material, which is a common problem on sites in the New Jersey Hudson River waterfront, and would require remediation (estimated to require approximately one year at any given site).
- **Criterion: Option should minimize pre-construction schedule risk.** In addition to the time required for property acquisition, obtaining easements, and the other factors noted above, each of these activities also poses a risk of delays associated with unknowns. Alignment Options 1, 2, and 3 are subject to schedule risk due to the need for acquisition of key properties, and local coordination in Weehawken (for example, related to truck access or other construction issues). Option 1 is subject to the greatest schedule risk due to its need for relocation of the NJ TRANSIT bus layover facility at the proposed staging site as well as the need to acquire riparian rights beneath a marina; for this reason, Option 1 was found to

perform least well. Option 4 performs best for this criterion, since many of the pre-construction activities are already complete, as noted above.

- **Criterion: Option should minimize construction duration.** Each of the alignment options would take approximately seven years to construct; variation between the four options amounts to a maximum of 2.5 months, which is a minimal difference. While Option 4 would have a longer tunnel than the other alignment options, this was not found to result in notable differences in construction duration. All options are considered to meet this criterion well.
- **Criterion: Option should optimize use of existing infrastructure.** Each option would connect to the existing NEC just east of Secaucus Junction Station, minimizing the need for new track, and would connect to the Hudson Yards Right-of-Way Preservation Project beneath the Hudson Yards development in the same location. All options are considered to meet this criterion well.

Goal 3: Strengthen the NEC's resiliency to provide reliable service across the Hudson River crossing, facilitating long-term infrastructure maintenance and enhancing operational flexibility.

All alignment options would meet this Project goal equally well. While Option 4 would have a longer tunnel than the other alignment options, this would not result in notable differences in travel time.

- **Criterion: Option should minimize travel time between Allied Interlocking (Secaucus) and A Interlocking (PSNY).** All alignment options would meet this criterion well by improving travel time relative to the existing North River Tunnel. Option 4 has the longest tunnel, and therefore would have the longest train travel time of the alignment options, estimated at 10 to 15 seconds slower than the fastest options. Travel times for the other options vary slightly, but would generally be similar. However, the modeled travel time savings of 10 to 15 seconds with Options 1, 2, and 3 in comparison to Option 4 would not be meaningful given the existing and planned operational environment at PSNY. While trains operating at the maximum design speed through the tunnel would have different potential total travel times, in reality, controlling signals at Tenth Avenue near PSNY would result in a uniform speed step-down for eastbound trains approaching PSNY. This would reduce the difference between different travel times farther west (for example, from the Hudson Tunnel portal to the middle of the Hudson River) as trains are slowed to reach a common location at a common point in time, based on PSNY dispatching and operational issues. In reality, therefore, the four alignment options would likely have little or no difference in travel times between Secaucus Junction Station and PSNY.
- **Criterion: Option should minimize the cost to operate and maintain the new tunnel.** Due to their shorter length, Options 1, 2, and 3 would have a small savings in operations and maintenance cost compared with Option 4. All options are considered to meet this criterion well.
- **Criterion: Option should meet design criteria.** Under any alignment option, the design for the Project would meet design criteria.

Goal 4: Do not preclude future trans-Hudson rail capacity expansion projects.

All alignment options met this Project goal, since all would not preclude future capacity expansion projects.

- **Criterion: Option should allow for connections to Secaucus Junction Station and through to the Portal Bridge.** All alignment options would have the same connections to the NEC in New Jersey, and would be designed to accommodate future capacity expansion initiatives there.
- **Criterion: Option should allow for connections to station expansion projects in the area of PSNY.** All alignment options would also have the same connections to the Hudson Yards Right-of-Way Preservation Project in Manhattan and to the existing tracks at PSNY.

All options would be designed to accommodate future capacity expansion projects at and near PSNY.

Goal 5: Minimize impacts on the natural and built environment.

Construction-period impacts

With respect to construction-period impacts, Alignment Option 4 would perform slightly better overall than Options 2 and 3. Option 1 would have two major impacts related to NJ TRANSIT bus operations and the Lincoln Tunnel Helix reconstruction (described below). Therefore, Alignment Option 1 fails to meet those criteria with a major negative issue indicating that if other options are available, they should be pursued instead.

- **Criterion: Option should avoid construction impacts to HBLR.** All alignment options would need to underpin the HBLR in small areas where the tunnel alignment passes beneath the HBLR right-of-way. Option 4 would have additional impacts associated with construction activities and haul routes being located immediately adjacent to the HBLR right-of-way, and therefore was considered less successful in meeting this criterion. Therefore, Options 1, 2, and 3 were found to meet this criterion well while Option 4 would somewhat meet the criterion.
- **Criterion: Option should avoid construction impacts to trans-Hudson bus operations.** As described above, Option 1 would require the displacement of NJ TRANSIT's commuter bus staging operations within the Lincoln Tunnel Helix during its construction period. This would result in unacceptable impacts to NJ TRANSIT trans-Hudson bus operations serving the Port Authority Bus Terminal, affecting approximately 7,500 daily trans-Hudson commuters. For this reason, Option 1 should not be pursued if other viable options are available.
- **Criterion: Option should avoid construction activities near sensitive land uses where possible.** Each of the alignment options has the potential to temporarily affect nearby uses due to noise, traffic, and other impacts associated with construction. The shaft sites and staging areas for all options are located in proximity to residential areas atop the Palisades. Additionally, the Option 1 shaft site is located near residential buildings on Waterfront Boulevard and the office building at 300 JFK Boulevard East. The Option 2 shaft site is also located in proximity to the office building at 300 JFK Boulevard East. The eastern option for the Option 3 shaft site is located near the Sheraton Hotel at 500 Harbor Boulevard and the office building at 1000 Harbor Boulevard. Each of these options was therefore found to somewhat meet this criterion. Option 4 performed least well because it is located immediately adjacent to residential uses.
- **Criterion: Option should minimize the number of truck trips during construction.** All four alignment options would result in substantial numbers of truck trips arriving at and departing from the construction staging area during the multi-year construction period. Because of its greater length, Option 4 would require more truck trips during construction than the other three options and therefore was found to meet this criterion least well. The other three options, although of different lengths, would have comparable numbers of truck trips and therefore were found to meet the criterion well.
- **Criterion: Option should avoid traffic conflicts related to haul routes.** Alignment Option 3 would perform best for this criterion, since its truck access and egress routes (i.e., haul routes) would use normal traffic patterns. Option 4 was found to somewhat meet this criterion, because its haul route would utilize normal traffic patterns, but the potential construction route could necessitate the removal of a private dog run and sidewalk on property where NJ TRANSIT has an easement, or a portion of a vacant warehouse building located at 1714 Willow Avenue. The proposed haul routes for Options 1 and 2 require difficult left turns that would need to be approved by NJDOT and the Township of Weehawken; both options were found to perform least well and potentially not meet this criterion.

- **Criterion: Option should minimize adverse construction effects relative to future plans.** As described above, construction of Alignment Option 1 would conflict with the reconstruction of the Lincoln Tunnel Helix, which like the Proposed Action is a regionally important trans-Hudson transportation project. This conflict is considered a major negative issue, indicating that if other viable options are available, they should be pursued instead. Option 3 was found to potentially fail to meet this criterion because its construction activities would conflict with the current construction and planned future construction of new residential buildings at 800 Harbor Boulevard, possibly delaying that project by years (or, alternatively, if the Dykes Lumber site were pursued instead, this would require displacement of an active business, which would be a major negative issue) addressed by a different criterion below). Construction of Options 2 and 4 would not conflict with any future plans and therefore would meet this criterion.
- **Criterion: Option should avoid construction activities near environmental justice communities.** All options' shaft sites and staging areas are located in some proximity to environmental justice communities located in Weehawken (east of the Palisades) and in Union City (atop the Palisades). Therefore, construction activities for all options could affect environmental justice communities. Therefore, all options were found to somewhat meet this criterion.
- **Criterion: Option should minimize construction impacts to Waters of the United States.** All options would have construction impacts within the Hudson River near the Manhattan shoreline because of the need to harden the soils above a small section of the tunnel. The amount of soils to be hardened would be the same for all four tunnel alignments, since all four alignments would have the same length of tunnel with shallow cover above. While all options would minimize these impacts to the extent practicable, no option could completely avoid these impacts. In addition, all alignment options would have the same surface alignment through the New Jersey Meadowlands, which would result in impacts to wetlands there.

Permanent / operational impacts

With respect to permanent impacts associated with operation of the completed project, Option 4 would perform better overall than the other three alignment options. Option 2 would have one issue for which it fails to meet the criterion with a major negative issue indicating that if other options are available, they should be pursued instead. Option 3 would have one criterion for which it performs least well and may fail to meet the criterion.

- **Criterion: Option should minimize displacement of active residential uses.** None of the alignment options would displace any active residential uses; therefore, all options would meet this criterion.
- **Criterion: Option should minimize displacement of active non-residential uses.** Option 4 could displace a dog run that is part of a residential property and is located within an easement held by NJ TRANSIT; it would not require the displacement of any uses for its shaft/fan plant/staging site and therefore would meet this criterion best. As discussed earlier, Option 2 would require acquisition and demolition of an occupied, five-story office building, a major issue indicating that if other viable options are available, they should be pursued instead. Options 1 and 3 would somewhat meet this criterion, since both would require displacement of parking areas. Option 1 would permanently displace a portion of the parking lot at 300 JFK Boulevard East, an area containing approximately 50 parking spaces, which may adversely affect that building's operations. Option 3 would displace the active Dykes Lumber Company business, or, alternatively, would displace an active parking lot used by adjacent buildings and future development being constructed on the site, addressed in a criterion above.

- **Criterion: Option should minimize adverse effects to future plans (be consistent with local plans and policies).** Alignment Options 2 and 4 would perform best for this criterion. Option 3 would perform least well and may fail to meet this criterion, because its fan plant would preclude at least a portion, and most likely the entirety, of the planned residential development at 800 Harbor Boulevard (currently in construction). Option 1 was found to somewhat meet this criterion, because its fan plant may interfere with the reconstructed Lincoln Tunnel Helix.
- **Criterion: Option should avoid impacts to HBLR.** None of the options would have any permanent impacts to the HBLR and therefore all were found to meet this criterion.
- **Criterion: Option should avoid impacts to trans-Hudson bus operations.** None of the options would have any permanent impacts to trans-Hudson bus operations and therefore all were found to meet this criterion. The impact that would occur to NJ TRANSIT's trans-Hudson bus operations during construction of Option 1 would not remain once construction is complete. The NJ TRANSIT bus parking area would be used only for construction staging (and not the permanent shaft site) and could be returned to its bus storage use after construction.
- **Criterion: Option should minimize number of adjacent historic structures.** This criterion identified the potential for adverse contextual impacts to historic resources. A fan plant's location adjacent to a historic structure does not necessarily mean that an adverse impact would occur, but adjacency was used as a sensitivity test for possible impacts to nearby historic resources. The fan plant sites for Alignment Options 2, 3, and 4 are not adjacent to any known historic structures, and therefore these three options would meet this criterion. Option 1 would somewhat meet the criterion, because it would be adjacent to the I-495 Approach to Lincoln Tunnel Historic District (determined to be eligible for listing on the State and National Registers of Historic Places), which includes the Lincoln Tunnel Helix and the entrance to the Lincoln Tunnel.
- **Criterion: Option should avoid permanent above-ground structures near environmental justice communities.** All options' fan plants would be located in some proximity to environmental justice communities east of the Palisades (in Weehawken) and atop the Palisades (in Union City), but adverse impacts are not likely from the new fan plant; therefore, all options were found to somewhat meet this criterion.
- **Criterion: Option should minimize permanent impacts to Waters of the United States.** All alignment options would have the same permanent impacts to the Meadowlands and Hudson River riverbed; therefore, all options received were found to somewhat meet this criterion.

4.4.2. CONCLUSION

As described above, the screening process was used to identify which alignment option best meets the goals and objectives of the Project overall. Any option that was identified as failing to meet an evaluation criterion with a major negative issue was particularly noted, since that result indicates that if other options are available, they should be pursued instead. Based on this evaluation, the following alignment options are recommendation for elimination:

- Alignment Option 1 would result in substantial negative impacts on NJ TRANSIT's trans-Hudson bus operation serving the Port Authority Bus Terminal and providing service to thousands of commuters (Goal 5, Criterion: Option should avoid impacts to trans-Hudson bus operations). It would also have the potential for major conflicts with the Lincoln Tunnel Helix reconstruction, both during construction and upon completion (Goal 5, Criterion: Option should minimize adverse construction effects relative to future plans). In addition, Option 1 may introduce delays to the Project schedule associated with the need to acquire new property for the shaft site and staging area and to conduct other pre-construction activity. For these reasons, Option 1 is considered to be seriously flawed and is not recommended for further consideration.

- Option 2 would require the acquisition and demolition of an existing, occupied, five-story office building (Goal 5, Criterion: Option should minimize displacement of active non-residential uses). In addition, Option 2 may introduce delays to the Project schedule associated with the need to acquire new property for the shaft site and staging area and to conduct other pre-construction activity. Option 2 has no substantial advantages over Option 4 and would not reduce potential environmental impacts relative to Option 4. For these reasons, Option 2 is considered to be seriously flawed and is not recommended for further consideration.
- Option 3 would perform similarly to Option 4 in some areas, but would not minimize construction delays (Goal 2). In addition, Option 3 would preclude the development of at least a portion of a major planned residential development currently under construction at 800 Harbor Boulevard (Goal 5: Criterion: Option should minimize adverse effects to future plans [be consistent with local plans and policies]) or, alternatively, would require displacement of the active commercial use at Dykes Lumber Company (Goal 5, Criterion: Option should minimize displacement of active residential uses). In addition, Option 3 may introduce delays to the Project schedule associated with the need to acquire new property for the shaft site and staging area and to conduct other pre-construction activity. Option 3 has no substantial advantages over Option 4. Therefore, Option 3 is not recommended for further consideration.

Based on the refined screening evaluation, Option 4 best meets the Project goals and objectives. While it would have a slightly longer tunnel and therefore slightly longer construction duration and train travel times, these differences were not found to be meaningful. As outlined above, tunnel construction would be approximately 2.5 months longer (on top of a seven-year schedule for Option 1); travel time would be essentially equivalent between alignment options once other factors related to congestion at and near PSNY are considered. Option 4 also has the most advantages, namely:

- Least potential for delays to the Project schedule, because of the property acquisition, investigation, and remediation already conducted for the ARC Project;
- Minimal impacts to existing transit and other transportation services; and
- Least impact related to displacement of active uses (residential, business, and future residential), since NJ TRANSIT has already acquired the properties needed for the New Jersey shaft site and staging areas.

Based on the evaluation criteria, and in particular the key factors mentioned here, this evaluation recommends that Alignment Option 4 be progressed as the tunnel alignment for the Preferred Alternative.

5. PREFERRED ALTERNATIVE TO BE ANALYZED IN THE EIS

5.1. DESCRIPTION OF THE PREFERRED ALTERNATIVE

Incorporating Alignment Option 4 as the tunnel alignment for the Preferred Alternative, the Preferred Alternative for the Project would consist of a new two-track tunnel parallel to the existing tunnel extending from the NEC in Secaucus, New Jersey, beneath the Palisades (North Bergen and Union City) and the Hoboken waterfront area, and beneath the Hudson River to connect to the existing ladder tracks at PSNY. New ventilation shafts and associated fan plants would be located above the tunnel in New Jersey and New York for regular and emergency ventilation and emergency access. Once the new tunnel is complete, the Project would also include rehabilitation of the existing North River Tunnel, one track at a time. Following that rehabilitation, the NEC would have four tracks (two in the new tunnel and two in the North River

Tunnel) between New Jersey and New York under the Hudson River, which would provide operational flexibility and redundancy for Amtrak and NJ TRANSIT rail operations.

Figure 11 illustrates the Preferred Alternative. As shown in the figure, major components of the Preferred Alternative would include:

- Two new surface tracks parallel to the south side of the NEC beginning at the realigned Allied interlocking in Secaucus, New Jersey just east of NJ TRANSIT's Secaucus Junction Station.
- A new tunnel with two tracks in two separate tubes beneath the Palisades and the Hoboken waterfront area east of the Palisades, continuing beneath the Hudson River to Manhattan. In New Jersey, the tunnel would begin at a portal in the western slope of the Palisades, just east of Tonnelle Avenue (US Routes 1 and 9). The new tunnel portal would be approximately 600 feet south of the existing tunnel portal, which is also located in the western slope of the Palisades.
- A ventilation shaft and associated fan plant building in Hoboken, New Jersey on land NJ TRANSIT previously acquired for the ARC Project.
- Beneath the Hudson River, the new tunnel's two new tracks in two separate tubes would be approximately 2,500 feet south of the existing tunnel at the New Jersey shoreline and approximately 1,000 feet south of the existing tunnel at the Manhattan shoreline.
- Two new tracks continuing through the Manhattan bulkhead, beneath Hudson River Park and Twelfth Avenue to meet Amtrak's underground Hudson Yards Right-of-Way Preservation Project beneath the Hudson Yards overbuild project at the Western and Eastern Rail Yards in Manhattan.
- A ventilation shaft and fan plant building near Twelfth Avenue between West 29th and 30th Streets (Block 675) in Manhattan.
- Two new tracks and associated rail systems to be added by the Project to the Hudson Yards Right-of-Way Preservation Project.
- A new fan plant beneath or near the building at 450 West 33rd Street (also known as the Lerner Building), which is located between 31st and 33rd Streets at Tenth Avenue and spans across the rail right-of-way.
- Track connections east of Tenth Avenue to the existing approach tracks into PSNY.
- Rehabilitation of both tubes of the existing North River Tunnel.

The alternatives evaluation conducted for the Project and described above did not identify any other Build Alternatives that met the purpose and need for the Project. Several tunnel alignment options for the Build Alternative were identified, and the screening analysis identified the former ARC Project's horizontal alignment as preferred because of the advantages provided by previous studies conducted and actions taken (such as property acquisition, investigation, and remediation). Shorter alignments are available, but these all have significant disadvantages in comparison to Option 4, while not providing notable benefits from the reduced tunnel length. Therefore, the conclusion of this alternatives evaluation is that the Preferred Alternative identified in this report should be the single Build Alternative evaluated in the DEIS for the Hudson Tunnel Project.

5.2. LEAST ENVIRONMENTALLY DAMAGING PRACTICABLE ALTERNATIVE

The Preferred Alternative identified in Section 5.1 above would require permits from the U.S. Army Corps of Engineers (USACE) under Section 404 of the Clean Water Act and Section 10 of the Bridges and Harbors Act because it would require construction work within wetland areas of the Meadowlands and Hudson River, and potentially because of construction activities in Hoboken that would affect a wetland area. As part of its review of the Project, the USACE must

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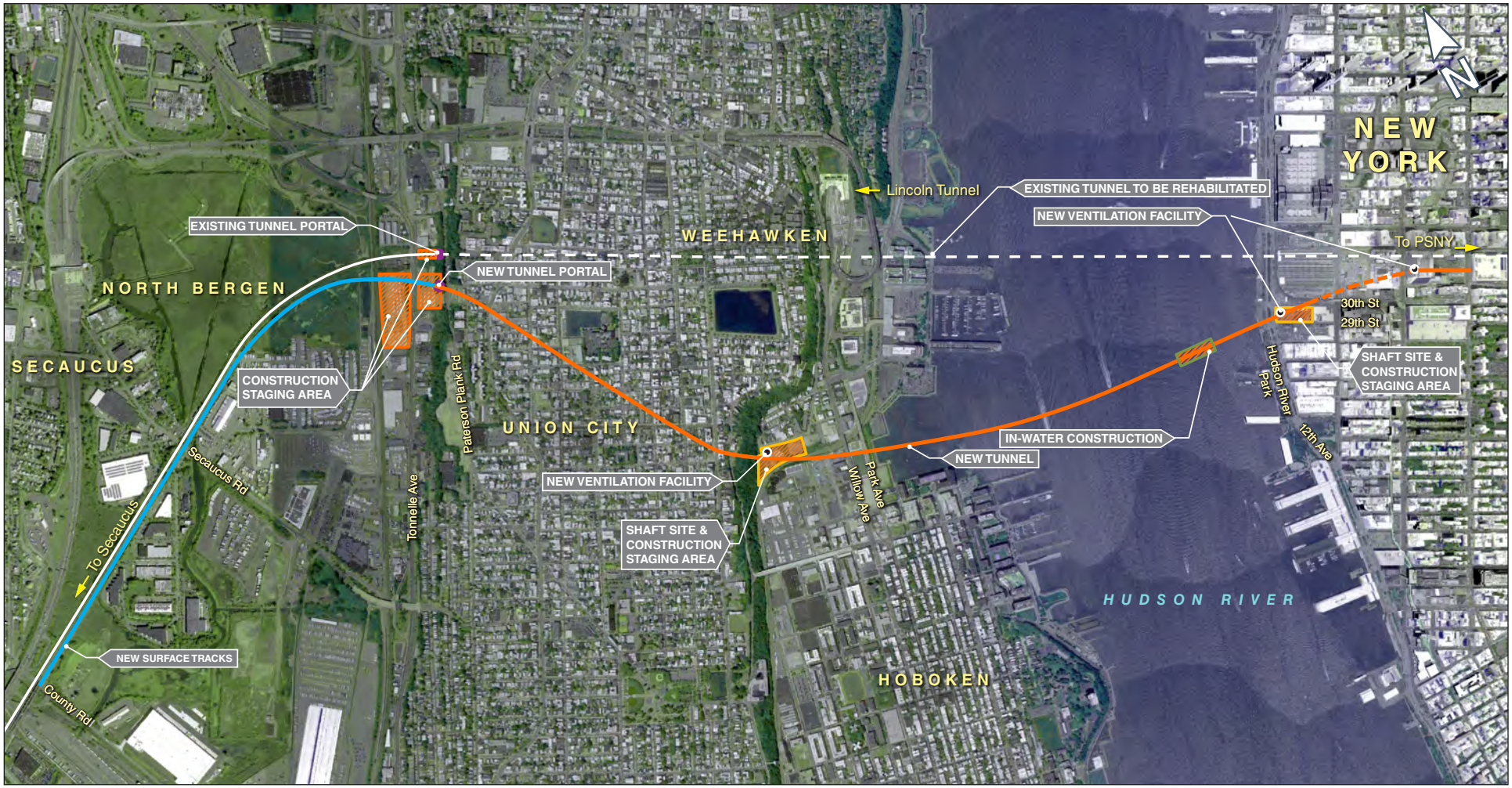

Existing Northeast Corridor

Existing North River Tunnel

Amtrak Right-of-Way Preservation

Tunnel Alignment

Tunnel Portal

New Surface Tracks

Ventilation Shaft Site & Construction Staging Area

Construction Staging Area

In-Water Construction

New Ventilation Facilities

HUDSON TUNNEL PROJECT

Preferred Alternative

Figure 11

determine whether the Preferred Alternative is the "least environmentally damaging practicable alternative" of all alternatives that meet the purpose and need for the Project. As described in the applicable regulations (40 CFR 230.10(a), "… no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences." In this context, practicable is defined in 40 CFR 230.3, "The term practicable means available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes."

As described above in Section 4.2, the only Build Alternative that meets the purpose and need for the Project is a new two-track tunnel beneath the Palisades and Hudson River connecting the NEC in New Jersey to the existing approach tracks to PSNY.

That alternative's alignment in New Jersey through the Meadowlands is constrained by the need to connect to the existing tracks of the NEC, which already run through the Meadowlands, and to allow operational flexibility between the existing tracks and new tracks. For that reason, the Build Alternative's two new tracks should be immediately adjacent to the existing NEC, using existing Amtrak right-of-way where possible, and connect to the NEC as close as possible to the new tunnel portal while providing switches between tracks for operational flexibility. Due to the location of the Build Alternative's connection to PSNY's approach tracks, approach tracks to the new tunnel on the south side of the NEC in New Jersey would avoid the need for tunneling beneath or flying over the NEC, and therefore would have fewer potential environmental impacts than new approach tracks on the north.

Four tunnel alignment options were evaluated, and the options that places a tunnel ventilation shaft and associated construction staging area in Hoboken was selected as the preferred alignment options after consideration of benefits and impacts of each of the alignment options.

The Build Alternative would require a small area of construction activity in the Hudson River where hardening of river bottom soils is required because of the shallow cover above the tunnel as it rises to meet the existing approach tracks at PSNY. This would be required regardless of tunnel alignment selected.

A full discussion in support of the USACE's least environmentally damaging practicable alternative will be provided in permit documents submitted to the USACE during the permitting process.

5.3. PUBLIC OUTREACH RELATED TO IDENTIFICATION OF THE PREFERRED ALTERNATIVE

5.3.1. OUTREACH CONDUCTED

Following identification of the Preferred Alternative, information about the alternative was made publicly available via the Project's website (www.hudsontunnel.com). FRA and NJ TRANSIT held meetings and briefings with key stakeholders, including the Project's Cooperating and Participating Agencies, key stakeholders, and interest groups. In addition, two public open houses were held in which information was available about the Hudson Tunnel Project, its purpose and need, its environmental review and anticipated schedule, and the Preferred Alternative. The meetings were held on November 10, 2016, at Secaucus Junction Station in Secaucus, New Jersey, and November 17, 2016, at the Hotel Pennsylvania in Manhattan, New York. Staff from FRA, NJ TRANSIT, Amtrak, and their respective consultant teams were available to answer questions and provide information.

At the November 10, 2016 open house, the following were in attendance:

- 61 members of the public
- 2 agency representatives

- 2 elected officials
- 2 media representatives

At the November 17, 2016 open house, the following were in attendance:

- 109 members of the public
- 24 agency representatives
- 1 elected official

5.3.2. COMMENTS RECEIVED

During the fall 2016 public meetings about the Preferred Alternative, many attendees expressed support for the Project during informal conversations. Others asked questions and sought information or clarification related to aspects of the Project. Approximately 30 written submissions were received at and following the November 2016 (through January 2017) public open houses related to the Preferred Alternative, via comment sheets at the open houses, via the Project's website (www.hudsontunnel.com), and via email to the FRA and NJ TRANSIT. The comments are summarized below.

Preferred Alternative

- A number of attendees and commenters supported the Preferred Alternative alignment and had general questions on the Project details.
- One commenter suggested that Alignment Option 1 (closest to the NEC) would be best for future high-speed rail.
- One commenter asked for more information on the Manhattan end points of the Preferred Alternative alignment.
- One commenter asked what steps the Project is taking to avoid flooding in the existing and future tunnels, and recommended that this information be included in the DEIS.
- One commenter suggested that the Project consider building a bridge over the HBLR tracks to connect Weehawken and North Hoboken as a project amenity.

Other Alternatives

- Several commenters stated that the Preferred Alternative is flawed because it does not include capacity-enhancing components and fails to consider its effect relative to future capacity improvements. Some commenters believe that future capacity enhancement projects are unlikely to be pursued, and therefore capacity enhancements should be included in the Hudson Tunnel Project now.
- One commenter stated that the alternatives evaluation process was flawed, because it did not provide an assessment of the cost and capacity of each alternative.
- One commenter reiterated comments provided during Scoping, requesting that the Project evaluate new multi-modal, twin suspension bridges connecting New Jersey and New York, over 38th and 39th Streets in Manhattan, termed "Empire State Gateway."
- One commenter reiterated comments provided during Scoping, requesting that the Project evaluate the four-track ARC alignment along the NEC that had one track on the north side of the NEC and the other on the south. He stated that a four-track railroad is more flexible and has higher capacity than two separate two-track railroads, and updating a two-track railroad into a four-track can be done in a series of smaller scope projects that would provide incremental increases in train capacity, reliability, and/or redundancy.
- This commenter reiterated his recommendation during scoping that the Project's Goal 4 be revised to "Maximize the opportunity to build cost-effective trans-Hudson rail capacity expansion and service quality improvement projects…." And "Allow for the most cost-effective connections possible to future rail capacity expansion and service quality improvement projects…" The commenter also recommended that a 6th goal be added to

"Maximize the opportunity to add peak hour trans-Hudson train capacity in increments by providing an alignment that makes possible building a series of smaller scope projects, each adding some train capacity."

- A commenter suggested that the alternatives evaluation include the costs and independent utility of building both tubes as a single project and as separate projects. The commenter suggested that tunnel alignments be evaluated on how they impact the performance of the total set of possible trans-Hudson improvement projects east and west of the tunnel in terms of increased capacity, reliability, and redundancy.
- One commenter reiterated comments provided during Scoping, recommending that a passenger station be provided at the New Jersey ventilation shaft to serve NJ TRANSIT and HBLR riders. Another commenter recommended that stations be added in North Hoboken and South Union City to serve growth in those areas and provide additional revenue to NJ TRANSIT and Amtrak.
- One commenter recommended an alternate route from Newark to Jersey City along the PATH right-of-way and then diverting from the PATH right-of-way past Journal Square to follow the former Harsimus Branch right-of-way near the Holland Tunnel approach, leading to a new terminal station near Canal Street in Manhattan. One commenter stated that as a property owner of former right-of-way near the Holland Tunnel approach (the 6th Street embankment), he could expedite the Project via this routing to minimize the need for condemnation.
- One commenter requested that the Project be revised to allow for future through-running of train service east of PSNY.

Project Schedule and Funding

- Commenters asked for more information on the Project schedule and when the new tunnel would be completed. Commenters also expressed concern that the Project will take too long to complete, and could incur additional delays. One commenter was concerned about Project funding in light of the election.

Public Outreach

- One commenter stated the importance of public outreach meetings. Another suggested that public meetings be held in Hoboken and Weehawken. One commenter asked whether the Project has reached out to Hoboken residents about concerns over construction impacts, and to Weehawken residents who will be impacted by the ventilation shaft.
- A few commenters requested that future meetings feature a video or other media presentation. One recommended a panel discussion with Q&A. Another recommended that paper copies of the display boards be provided to attendees.
- One commenter recommended the establishment of a stakeholder committee similar to the Regional Citizens' Liaison Committee for ARC and Portal Bridge EISs.
- One commenter recommended that the Project provide information about which entity will be responsible for what aspect of the Project, and if a new entity needs to be formed, what its role will be.

Overall Support

- Most commenters expressed support for the Project. Several expressed the need for broader consensus building to expand support.

Miscellaneous Comments

- One commenter requested information on how minority- and women-owned firms can get involved in the Project.
- A commenter recommended that the Project consider steel railroad ties when replacing the tracks.

Responses to Comments

Overall, the comments provided after the release of the Preferred Alternative do not change the results of the alternatives evaluation conducted. General responses to the comments summarized above are as follows:

- To respond to commenters who suggested other alternatives or reiterated comments made during Scoping, additional information on alternatives proposed during Scoping and how those were evaluated has been provided in this report.
- Regarding comments requesting additional information on the Project or additional public outreach for the Project, additional, more detailed information on the Project is being developed and will be part of the Draft EIS, and additional outreach will be conducted throughout the NEPA process for this Project.

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