

An Amtrak Acela Express passes maintenance-of-way equipment as it emerges from Baltimore's B&P Tunnel in June 2012. Plans to replace the tunnel await funding. Mitch Goldman



The overshadowed tunnel

B&P Tunnel is Amtrak's Baltimore bottleneck, but replacement is stalled in planning stage
by Dan Zukowski

Along the Northeast Corridor, where the dangerously decrepit Hudson River tunnels are media superstars, Amtrak's Baltimore & Potomac Tunnel is the B-list celebrity struggling for attention.

It predates the Manhattan-entry tubes by nearly four decades, and is also in serious need of replacement. Water undermines the

B&P Tunnel floor, seeps through tunnel walls and leaks from utility lines, while cracks and chips mar its bricks and mortar.

As is the case with the Hudson tunnels, a plan exists to replace the B&P Tunnel — one which would have cost \$4.5 billion when selected by the Federal Railroad Administration in 2017 — but so far, not a shovel has been turned.

More than 140 trains squeeze through the two-track tunnel, just south of Baltimore Penn Station, each weekday. They

include 55 MARC commuter trains, 34 Acela trips, 54 regional and long-distance Amtrak trains, and one daily Norfolk Southern local round trip.

"As service has grown, the two-track tunnel has constrained the scheduling of trains passing through Baltimore Penn Station and the B&P Tunnel," Amtrak spokeswoman Beth Toll tells TRAINS. "The design of the tunnel and Charles Interlocking connecting the tunnel to Baltimore Penn Station also cause severe conflicts supporting the turning of MARC commuter trains back to Washington in the face of through Amtrak and MARC trains."

The tunnel's tight curves restrict passenger trains to 30 mph and freights to 20 mph. It takes an Amtrak regional train more than 6 minutes to traverse the 1.4-mile tunnel.

'Functionally obsolete'

The FRA defines the B&P Tunnel as "functionally obsolete." But when built, it was both an engineering masterpiece and a savvy business move befitting what was then the nation's second-largest city.

Benefiting from its natural harbor, Baltimore became an early magnet for manufacturing and shipbuilding. The city was the birthplace of U.S. railroading, where the Baltimore & Ohio Railroad was chartered in 1827 and began operation in 1830.

By the 1870s, the city was home to nearly 270,000 people. In 1873, the year the B&P Tunnel was completed, Baltimore's Pimlico race track held the first Preakness Stakes, part of horse racing's Triple Crown.

The B&O, with its early start, controlled rail traffic to, through, and within Balti-

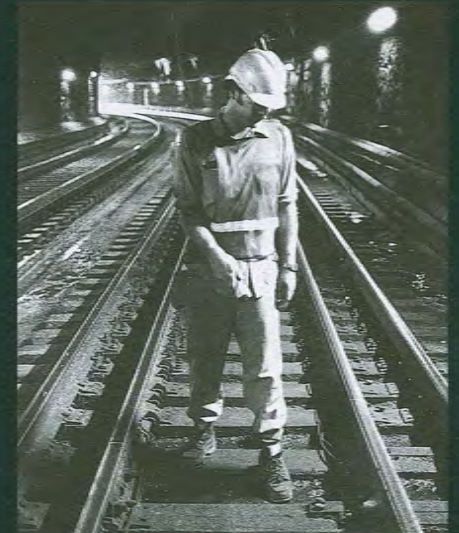


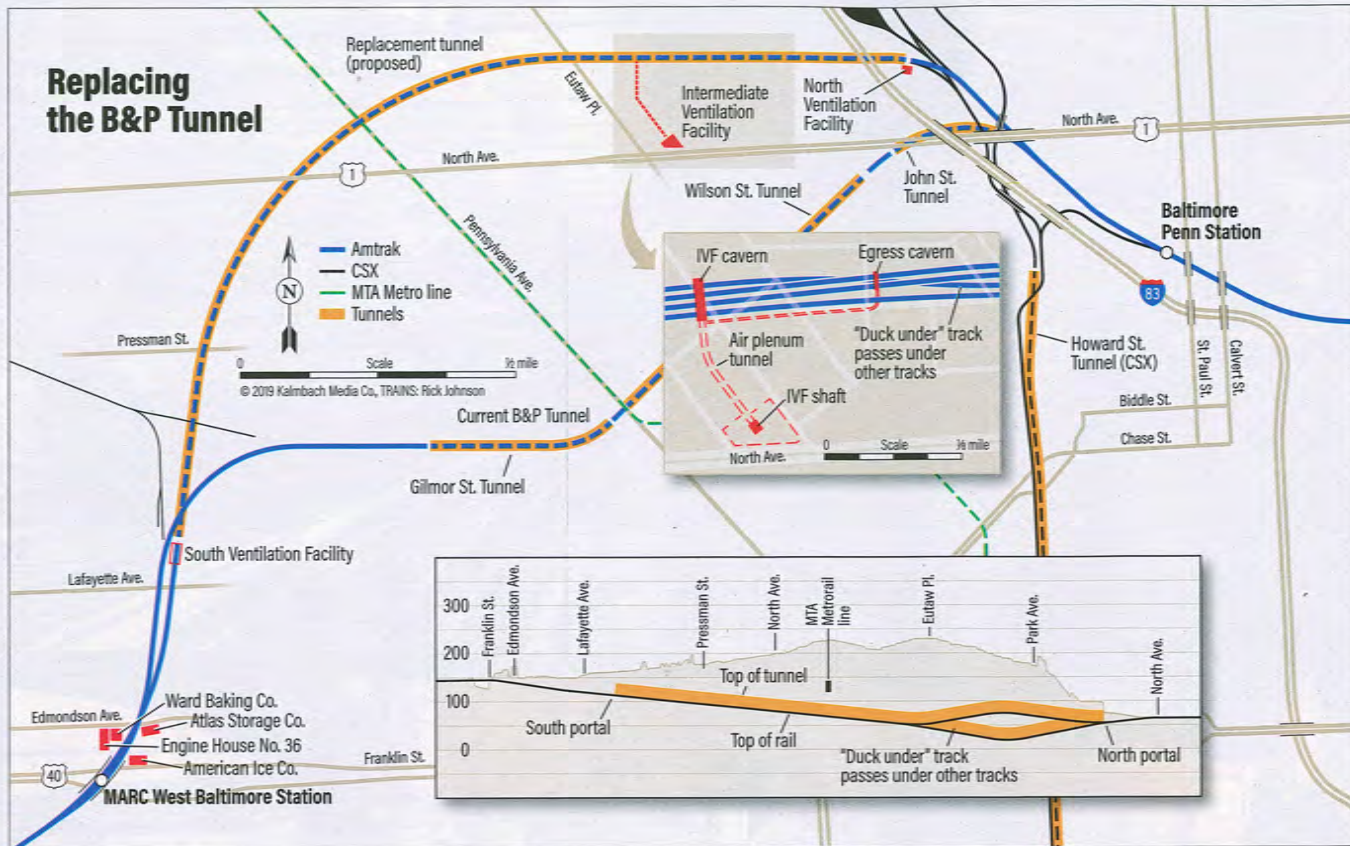
TOP: AEM-7 No. 900 leads train No. 175 through the gap between the Wilson and John Street tunnels, two of the three parts of the B&P Tunnel, on Aug. 9, 1984. Three photos, Fred W. Fralley
ABOVE: Maintenance crews work outside the B&P's north portal. The single tunnel with two tracks in close proximity make maintenance work difficult; the planned replacement will have four single-track tunnels. **BELOW RIGHT:** An Amtrak maintenance employee conducts a visual inspection of tracks inside the B&P Tunnel on Aug. 9, 1984.

more. But the Pennsylvania Railroad's first chief engineer and third president, John Edgar Thomson, having already forged the line's westward expansion and taken control of railroads in New Jersey, turned his sights south.

Since before the Civil War, the PRR had relied on the independent Philadelphia, Wilmington & Baltimore Railroad to handle north-south traffic. For its connection to Harrisburg, Pa., Thomson had wrested control of the Northern Central Railway Co., but that still left the Pennsy to rely on a connection with the Baltimore & Ohio to get traffic through to Washington. The B&O was not about to help a rival road.

William Bender Wilson, in his 1895 book, "History of the Pennsylvania Rail-





road Company,” described the situation: “The Baltimore and Ohio Railroad Company adopted an arbitrary course relative to the interchange of travel and traffic, and threw all kinds of obstacles in the way of the Northern Central transacting business with Washington City. It refused to sell through tickets, or check baggage through from there to points on or via Northern Central, or to accept such going there, and so arranged its schedules that connections were rendered uncertain.”

Northern Central served passengers to Washington only by handing them an envelope of cash with which to purchase a separate B&O ticket. And the B&O set exorbitant freight rates to discourage prospective customers.

Thomson saw that he had to have his own line to the nation’s capital. In 1866, he gained control of the Baltimore & Potomac Railroad, chartered in 1853 but not completed. The Pennsylvania Railroad moved quickly to construct the B&P to Washington, touting the line in PRR’s 1871 annual report as it was being built. The report declared “there will be an unbroken railroad” from Baltimore to the nation’s South.

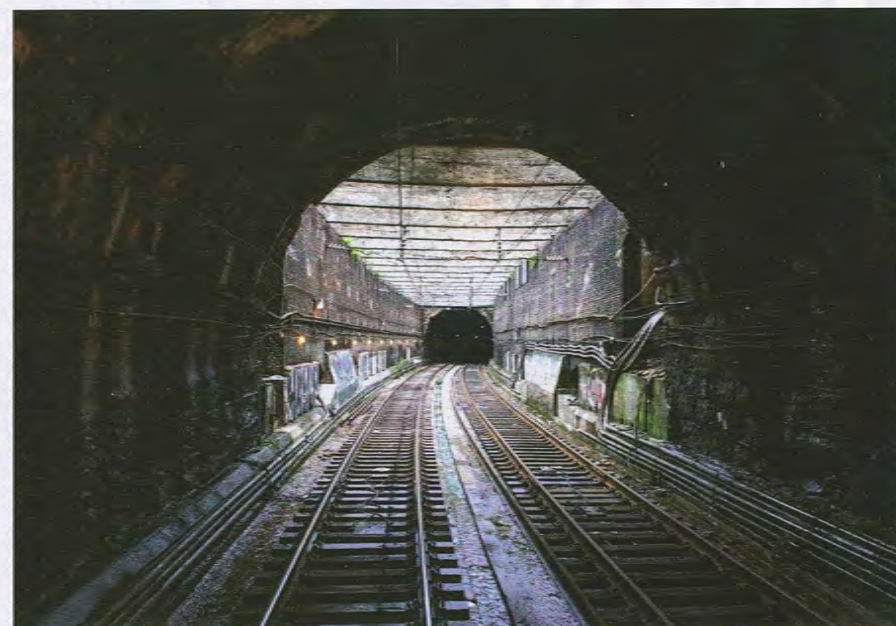
Tunnel construction cost \$2.5 million, or about \$54 million in current dollars. “The materials used in its construction are the best that could be procured,” boasts “The Pennsylvania Railroad: Its Origin, Construction, Condition, and Connections,” an 1875 book written by William B. Sipes and

published by the PRR.

The author details how the tunnel was built: solid masonry side walls of Cockeysville marble, the same stone used for the Washington Monument. Five courses of brick line the roof arch. Beneath the tunnel floor, an inverted brick arch — essentially a roof turned upside down — was added to strengthen the structure and stabilize it in the wet earth. Construction

required 15 million bricks and 1.25 million feet of masonry.

The first train through the tunnel, a northbound originating in Richmond, Va., arrived early on June 29, 1873. Through service from New Jersey to Washington began with two daily round trips, with a third added the following month. By the end of the year, trains would carry through sleepers to Chicago, St. Louis, and Buffalo.



An on-board view of the gap between the Wilson Street and John Street tunnels. Inspections found the Wilson Street tunnel is in the worst shape of the three tunnel segments. Amtrak

A history of modifications

In the subsequent 147 years, the tunnel has undergone numerous modifications. In 1916, the floor was lowered to create an additional 2.5 feet of clearance. In the early 1930s, the tunnel floor was further lowered by about a foot for the installation of overhead catenary lines, ready for the Pennsy’s coming GG1 locomotives to whoosh passengers to Washington.

More work was done in 1953 and from 1981 to 1983, each time again lowering the floor. This included replacing the floor and repairing the tunnel lining, but was intended only as a temporary fix.

Ownership changed hands to Penn Central in 1968 when the Pennsylvania merged with the New York Central, and then to Amtrak in 1976 as part of the federal reorganization of troubled northeast railroads that created Conrail.

The tunnel’s 19th-century builders encountered the wet earth, quicksand, and underground springs that still plague the tunnel. Decades of neglect have combined with ever-increasing train traffic to create mounting troubles.

In 2014, Amtrak was forced to perform emergency repairs as the concrete floor continued to settle due to water infiltration. Toll says that many problems cause delays, including “defects with the track profile due to drainage in the tunnel and the deterioration of the concrete slab.”

The 7,545-foot B&P Tunnel is actually three tunnels connected by two open cuts. Southbound trains leaving Penn Station enter the 1,152-foot John Street Tunnel on an 8-degree curve. They emerge to a 200-foot cut and then enter the 3,653-foot Wilson Street Tunnel. Another 350-foot cut, followed by the 2,190-foot Gilmor Street Tunnel, brings trains to West Baltimore.

Amtrak asked engineering firm Parsons Corp. to conduct a thorough visual inspection including all three tunnels and the two open sections. Inspectors found the Wilson Street Tunnel to be in the worst condition: actively leaking, seeping water from the floor, showing breaks in the bench wall, and with the cement mortar delaminating. They found similar conditions in the John Street Tunnel, although confined to a smaller area. Both are missing long rows of brick.

With two tracks enclosed in one 27-foot-wide bore, busy with trains day and night, maintenance and repair work goes slowly and often creates delays. The FRA projects that the frequency and magnitude of repairs will only continue to increase, impacting operations and raising maintenance costs.

The Pennsylvania Railroad was justifiably proud of its tunnel builders in the early 1870s, but the bore was not engineered for the demands of high speed trains alongside frequent commuter runs.

Its useful life has passed.

In 2017, the FRA looked at 16 alternatives for replacing the tunnel, narrowed that to four — including a no-build, do-nothing option — then issued its Record of Decision.

A plan to rebuild the existing tunnel was discarded. It would require complete shut-down or single-track running during construction, and leave in place the severe constraints of two-track operations. By 2050,

2½ hours of cumulative delays for Amtrak and MARC are expected daily.

The alignment selected by the FRA envisions a 2-mile tunnel and a rebuilt West Baltimore MARC station. Overall, 3.67 miles of new four-track main line will carry trains at higher speeds on more gentle curves.

Southbound trains leaving Baltimore Penn Station will enter a reconstructed Charles Interlocking, taking seven station

ES44DC No. 5445 leads an eastbound intermodal train toward the entrance to Baltimore’s Howard Street Tunnel in November 2011. Michael T. Burkhart



More big bores

CSX also has a tunnel project in Baltimore, after completing one in Washington, D.C.

THE B&P TUNNEL ISN’T THE ONLY significant tunnel needing replacement in Baltimore. In fact, it’s one of just three major tunnel projects in a relatively small area, if you include one in Washington, D.C. Here’s a look at the others:

- The Howard Street Tunnel is Baltimore’s other project. The 1.4-mile tunnel, built by the Baltimore & Ohio in 1895, is a bottleneck for CSX Transportation and a problem for the Port of Baltimore, because it has insufficient clearance to handle double-stack container trains. Once estimated with a price tag in the billions of dollars, the cost is currently set at \$466 million thanks to a CSX plan, which would allow trains to continue operating while the clearance is increased by notching the ceiling and lowering the floor.

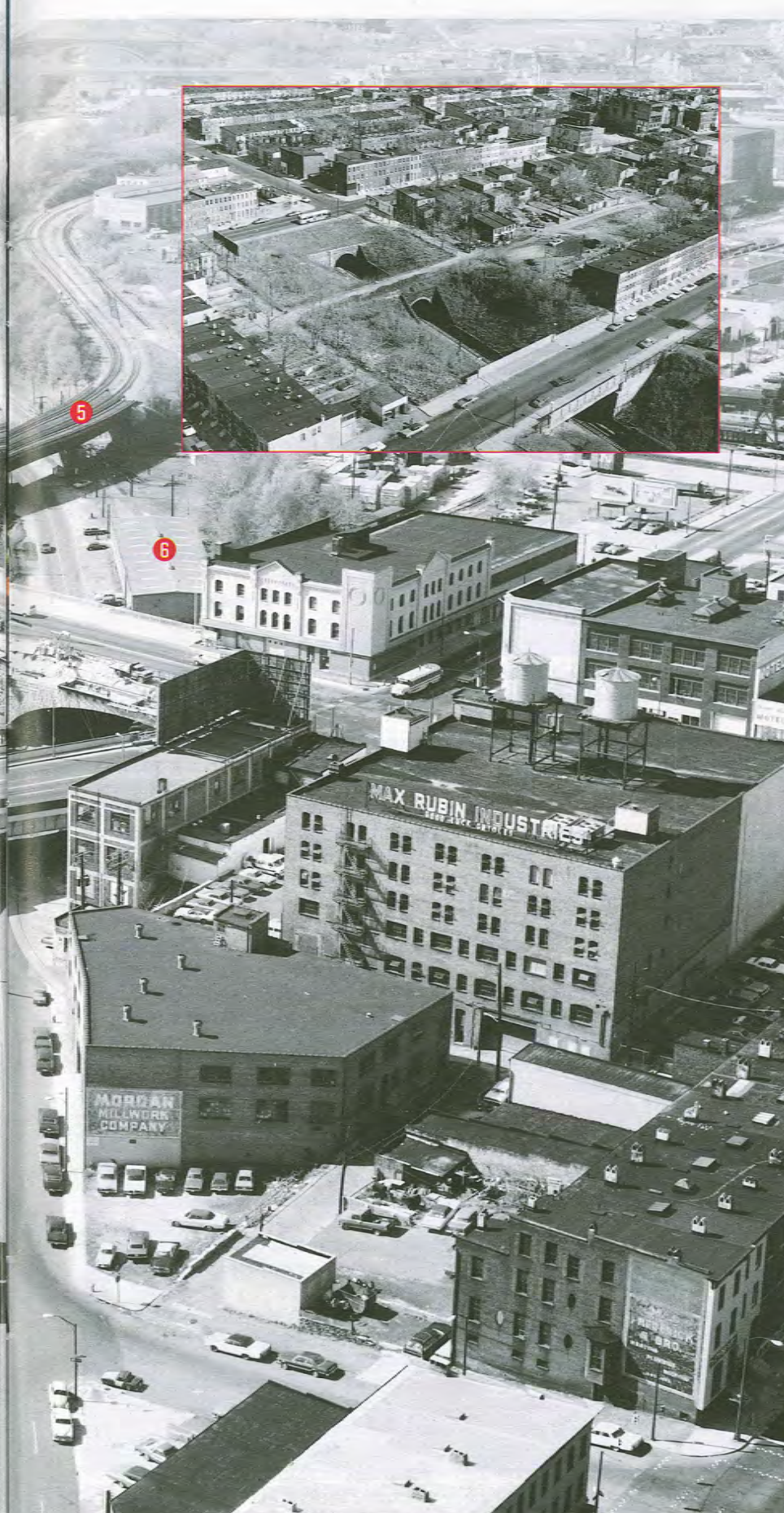
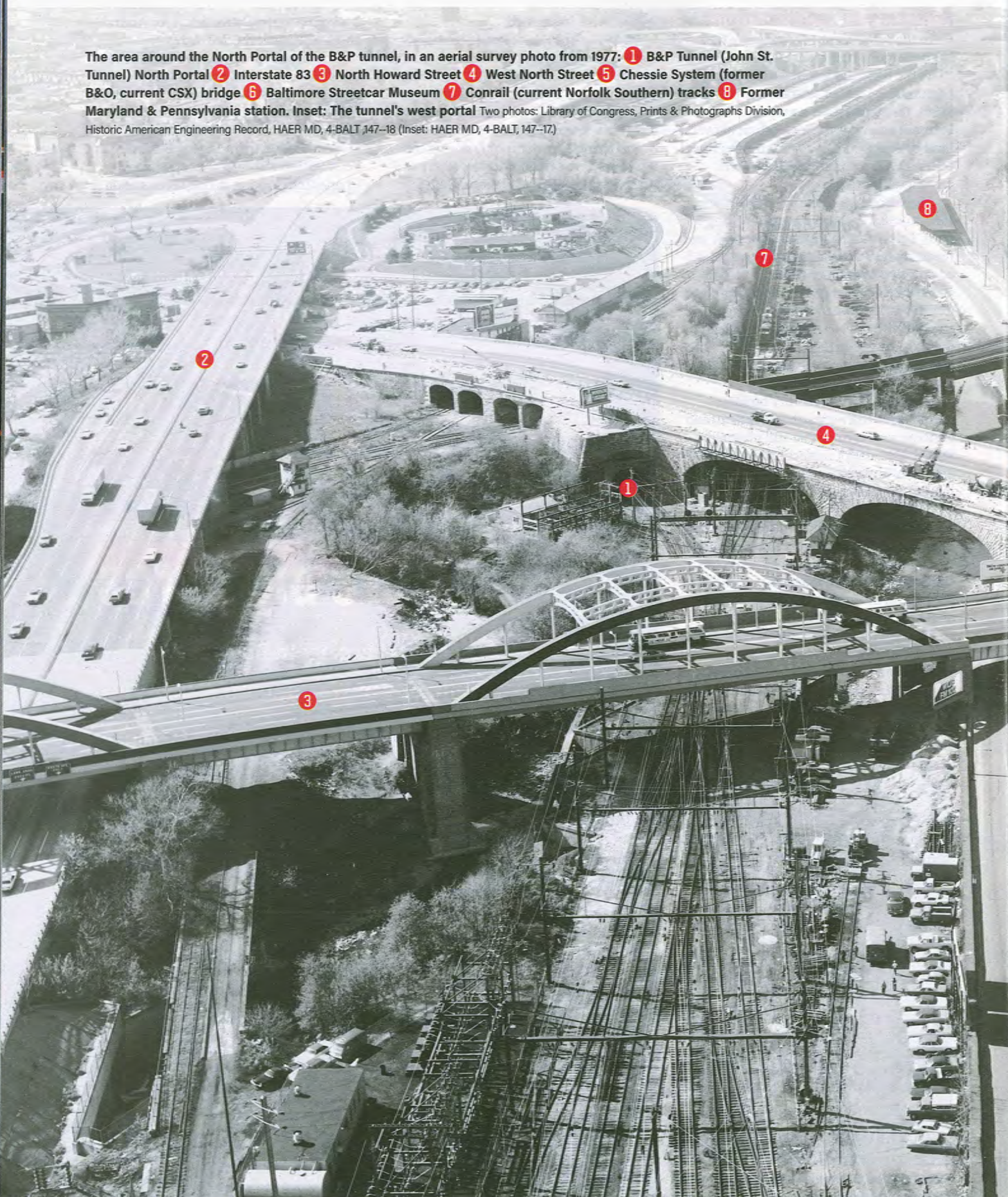
The port says the project would allow it to handle 100,000 more containers a year, with the additional traffic adding more than 7,800 jobs to the state economy.

Much of the funding is now in place, but no start date has been announced. Funding has been a challenge. At one point, CSX committed \$135 million, but in November 2017, under then-CEO E. Hunter Harrison, the railroad said it was no longer interested in the project. It reversed that decision in December 2018 under current CEO James Foote, but with a reduced commitment of \$91 million. The state of Maryland has pledged \$147 million and the federal government contributed a \$125 million grant — but that still leaves a \$103 million shortfall. In July 2019, Maryland Gov. Larry Hogan said he was negotiating with all parties involved to find the additional funds.

- Also on CSX, the Virginia Avenue Tunnel in Washington, D.C., is notable because it’s complete. [See “National Gateway Realized,” February 2017.] It took a 3,788-foot, single-track tunnel too small for double-stack and hi-cube cars and replaced it with two tunnels with sufficient clearance. This was a two-step process. First, a new tunnel was built adjacent to the existing bore, then the original tunnel was demolished and rebuilt. The project began in May 2015, was completed in fall 2018, and cost \$250 million.

— David Lassen

The area around the North Portal of the B&P tunnel, in an aerial survey photo from 1977: 1 B&P Tunnel (John St. Tunnel) North Portal 2 Interstate 83 3 North Howard Street 4 West North Street 5 Chessie System (former B&O, current CSX) bridge 6 Baltimore Streetcar Museum 7 Conrail (current Norfolk Southern) tracks 8 Former Maryland & Pennsylvania station. Inset: The tunnel's west portal Two photos: Library of Congress, Prints & Photographs Division, Historic American Engineering Record, HAER MD, 4-BALT, 147-18 (Inset: HAER MD, 4-BALT, 147-17).



tracks to four mainline tracks using No. 10 and No. 15 switches. The new interlocking is designed to reduce conflicting movements.

A massive stone pier supporting a CSX bridge needs to be relocated to accommodate the new Northeast Corridor four-track alignment. After passing under the rebuilt span, trains will slip through the new tunnel's North Portal just east of the North Avenue light rail station. Light rail service will not be disrupted by the construction.

Each track will reside in a separate bore. And there will be a fifth tunnel: an 8-foot-wide, 10.5-foot-high emergency exit passageway, parallel to the main tunnels. It leads to ground level at both portals and a midway location.

The tunnel arcs gradually to the south. Three of the four tracks, designated A, 1, and 2, begin a 1.75% descending grade. Track 3 descends further and more steeply on a 1.82% grade, curving inward to duck under tracks 1 and 2 and become the outer southbound track.

Amtrak's Toll explains that many MARC trains turn back at Baltimore, so their northbound and southbound tracks are adjacent at Penn Station. South of the tunnel, however, MARC trains use the outside tracks to make their station stops.

Dominic Oliveti, a principal engineer at Parsons, speaking at an industry conference, said, "To avoid at-grade conflicts through the Charles Interlocking just south of Penn Station, we devised this way to sort the trains underground."

After climbing a 1% grade from the tunnel's low point, the four tracks exit the South Portal at Riggs Avenue.

The current route restricts trains to 55 mph through a compound curve in West Baltimore, known as Curve 381, which prohibits high-level platforms at the MARC station. The curve will be eased and the current track-center spacing of 13 feet will be increased to 15 feet to enable Acela trains to operate at up to 100 mph. The station will be rebuilt with 800-foot, high-level platforms, allowing faster boarding.

South of the station, just beyond the Gwynns Falls Bridge, the new alignment will rejoin the existing Northeast Corridor right-of-way. There, a new universal interlocking to be called "Gwynns," comprised of four No. 20 crossovers and two No. 15 crossovers, will be installed.

Modern methods

The tools of tunnel building in 1873 — explosives and steam drills — will give way to tunnel boring machines, or TBMs.

Those machines will face hard rock, soft soil, and a mix of the two in a city that's beset by frequent sinkholes that have closed streets, highways, and the light rail line. The problems are compounded by storm water



An artist's conception of the new concourse planned as part of the redevelopment of Baltimore Penn Station. While the station project is not tied to the tunnel plan, it does allow for infrastructure and the anticipated additional capacity resulting from the new tunnel. Penn Station Partners

and ground water that bleeds into tunnels and under roadbeds.

One or more tunnel boring machines will scoop out the major portion of the four rail tunnels. As the machines progress, their cutter heads bore out a perfect circle, pulling back removed rock and soil as hydraulic cylinders force the bores forward.

Meanwhile, precision-made, precast concrete lining segments are continuously carried forward and assembled into a circular ring, which is pressed against the exposed tunnel wall. Each ring is then bolted to the previous ring, forming a continuous, unbroken lining. The process repeats as the tunnel boring machine advances.

For the long, constant-radius arc required by the new tunnel, the tunnel boring machine operator steers using a computer interface, by applying slightly more pressure to one side of the cutting head.

Tunnel boring machines are quieter, create less vibration, and protect the streets and structures overhead better than other tunneling methods, an important consideration for the mostly residential community above the new tunnel. But near tunnel portals, excavation by cut-and-cover is called for.

From the surface, wood timbers or steel piles are placed to shore up the walls and street, after which the concrete floor slab can be laid and sidewalls completed. Cut-and-cover will also be used for ventilation facilities and vertical exit shafts.

Some utility structures and the cross-

passages between tunnels will require controlled blasting into the tunnel face.

\$5 billion price tag

Amtrak now quotes a \$5 billion price tag for the replacement tunnel, up from the FRA's \$4.5 billion estimate in 2017. The cost will likely continue to climb with each year that passes. Once started, the project could take up to 12 years.

But the start of construction is far off.

Toll says Amtrak has allocated \$12 million of its fiscal year 2020 federal funding to advance design work on the B&P project. She notes the railroad has met with CSX engineering regarding the proposed modification to the freight railroad's bridge near the North Portal and have worked on design development, project delivery strategy, and construction staging issues.

"The exact amount that Amtrak dedicates to the B&P Tunnel Replacement Project is dependent on the amount of federal funding that may be provided by Congress to Amtrak through the annual appropriations process," Toll says. Amtrak has also applied for grants under the Federal-State Partnership for State of Good Repair Program and the Consolidated Rail Infrastructure and Safety Improvements program.

Maryland commuters, as much as Amtrak passengers, remain at the mercy of the delays and slow crawl of trains through the existing tunnel. MARC commuter trains,

operated by the Maryland Department of Transportation, carry 9 million passengers a year. But MDOT spokesman Jim Joyner confirmed to TRAINS that the agency does not currently have a role in the project.

Plans for the new tunnel have encountered some community opposition.

The FRA estimates 22 residential buildings need to be demolished, 15 of them occupied. An additional 13 businesses and four places of worship will have to relocate.

At a series of open houses and other meetings in 2016, residents expressed concerns about noise and about potential emissions from the three ventilation facilities planned for the new tunnel. Of particular concern was the intermediate vent facility, to be located in a residential neighborhood. It has been relocated, at additional cost, to the edge of the neighborhood.

Historic structures along Curve 381 posed challenges to crafting the final alignment, which threads between four such buildings in West Baltimore, beyond the South Portal.

"By keeping an open dialogue with historic resource specialists and stakeholders, we produced an alignment that both respects the historic neighborhoods and resources while meeting Amtrak's needs and requirements," Olivetti says.

Community members also asked what would happen to the current tunnel. Amtrak tells TRAINS it will continue to own the existing B&P Tunnel and rights-of-way,

which would be closed but "reserved for potential future rail transportation use."

And while the new tunnel is planned primarily for passenger trains, some community members expressed fears of a potential increase in diesel-powered freight trains, potentially hauling hazardous material. While possible, a substantial increase in freight operations is not likely.

Unlike the 19th-century B&P Tunnel, its replacement will be built to accommodate AAR Plate H clearance, to handle double-stack container cars and trilevel auto carrier cars. However, clearance restrictions elsewhere along the Northeast Corridor limit access. Further, the FRA notes that the window to insert slower freights into this busy corridor, in a future with even greater frequency of Amtrak and MARC trains, will be much tighter than it is today.

Baltimore's population now exceeds 600,000, its port is the nation's 11th busiest, and Baltimore Penn Station is Amtrak's eighth busiest, handling more than a million passengers a year. One-third of Amtrak's ticket revenue and one-fifth of all its passenger trips pass through Baltimore.

The station dates to 1911 and has seen some improvements and renovations in recent years. It's due for major redevelopment and expansion in a public-private partnership with Penn Station Partners.

Amtrak's Toll says that while the station redevelopment is separate from the tunnel project, "The planning and design currently underway does take into account the future rail infrastructure and anticipated additional capacity."

Improving the corridor

Between Washington and Baltimore, Amtrak is upgrading 31 miles of track and replacing the Landover Interlocking with



A MARC train exits the tunnel shortly before its arrival at Baltimore Penn Station. While MARC would be a major beneficiary of the new tunnel, it has no role in the project. Mitch Goldman

the Hanson Interlocking, which is under construction. Track 1, which was not upgraded during the 1970s-era Northeast Corridor Improvement Project, is now being improved to prepare for the new Acela fleet. Amtrak says these projects will allow trains to operate at higher speeds with better ride quality.

Those improvements, north and south of the current tunnel, will reduce delays and provide a better passenger experience, but the bottleneck in between remains.

A 2011 joint FRA/MDOT report, requested by Congress, projects an 18% increase in MARC operations through the B&P Tunnel from 2020 to 2050. Amtrak also foresees greater train frequency.

The limiting factor is whether a new tunnel gets built. The report is clear: "Con-

cerning the B&P Tunnel, there is no realistic No-Build Scenario. The physical condition of the tunnel requires that it be rebuilt or replaced within the next 10-20 years."

Almost a decade has gone by since those words were written. It's now in the hands of Amtrak and Congress. "With the environmental work completed, Amtrak is now leading this effort as owner of the asset," Toll says. "Amtrak views the B&P Tunnel Replacement Project as critical to its continuing efforts to modernize the Northeast Corridor."

With its annual budget request restricted by law to \$1.8 billion, Amtrak could only beg for a pittance of funds above its authorization level to ever so slightly inch the tunnel project forward by \$20-50 million, if Congress were to charitably increase the railroad's appropriation.

Dreaming about big-budget infrastructure legislation, Amtrak included the tunnel replacement in its fiscal 2020 request among a list of supplemental projects, penciling in \$3.1 billion in additional federal funds needed. Gridlock in Washington makes that improbable.

But it is undeniable that Amtrak has an even more urgent priority: the Gateway program to add a new tunnel under the Hudson River, modernize and repair the two existing tunnels, and replace the outdated, unreliable Portal North Bridge. A not-unlikely failure of one of those tunnels would cripple the Northeast Corridor and quickly become an international symbol for America's crumbling infrastructure.

The B&P Tunnel holds no similar danger of failing. But left as is, it will continue to hamper Amtrak and MARC service, while hitting taxpayers with ever-rising repair costs. **I**



An Amtrak Metroliner emerges from the B&P Tunnel on the morning of Feb. 7, 1981. The tunnel underwent major work, including lowering of its floor, from 1981 to 1983. Tom Nelligan