The Bulletin

Electric Railroaders' Association, Incorporated

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The Bulletin

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This Month's Cover Photo:
Flemish Transport Company (VV-Vlaamse Vervoermaatschappij, and branded as "De Lijn") PCCs 7093 (La Brugeoise et Nivelles, 1966) and 7022 (La Brugeoise et Nivelles, 1961) are seen here at the Eilandje-MAS terminal just to the north of central Antwerp on May 2, 2019. These venerable PCCs had been providing reliable service for 53 and 60 years!
Jeff Erlitz photograph

REMNANTS OF HURRICANE IDA WREAK HAVOC ACROSS THE REGION

AREAS NORTH AND WEST OF THE CITY HIT HARDEST

View looking north of all four Hudson Line tracks covered with debris from a mudslide near Greystone station on Metro-North's Hudson Line.
Metro-North photograph

The remnants of Hurricane Ida swept through the NYC region on September 1, dropping almost eight inches of rainwater on the standard measuring devices located within the confines of Central Park, Manhattan. Almost four inches of that rain fell within a 75-minute span between 9:30 and 10:45 PM, inundating many sections of the city, including portions of the subway system.

At 10 PM, as over six trains became stalled in rapidly rising floodwaters, NYC Transit ordered a safety shutdown of the entire system. By 10:40 PM, the 7 line was the first one that was confirmed as safe to operate over its entire length. Other lines soon returned to service but only in the portions that were not flooded or had systems damaged by floodwaters. One example was the 2, 4, 5 and 6 lines in the Bronx that were cut off from Manhattan when 149th Street flooded along most of its length, forming a floodwater wall running east-west, effectively preventing any train service from resuming. It took most of the day on Thursday, September 2 to pump out, then repair and restore the power and signal systems to allow service to be

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Remnants of Hurricane Ida Wreak Havoc Across the Region

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resumed. Very limited service was available across much of the system as key sections were still flooded out.

Press reports showed numerous spectacular photos and videos of stations where mezzanines, stairways and track areas flooded with several feet of fast running water. One video at 28th Street-Seventh Avenue showed a gusher of water under high pressure blasting out of what looked like a manhole leading from the drainage systems of the station. Sewer pipes draining all the catch basins on the streets above were overwhelmed and water pressure in the sewer pipes built up to the point where the water burst upward at its lowest point, the subway station, and formed the infamous geyser seen on the TV news.

By Friday, September 3, service on most lines had been restored. The 1, 3, 7, B, C, D, E, F, J, L, M, Q, R, W, Z and Franklin Avenue and Rockaway Shuttles were running normally. On the 4, train service was restored to all stations but was limited due to storm damage and a signal problem in the Bronx. 5 trains were temporarily suspended between Flatbush Avenue-Brooklyn College and Bowling Green due to signal issues at Newkirk Avenue. 2 trains operated with delays in both directions. 6 service resumed but was extremely limited with a suspension of service between Parkchester and 149th Street-Grand Concourse due to the deposit of a very heavy clay-like residue on the signal apparatus and tracks in the tunnels south of Whitlock Avenue. This required additional time to clear out. Metro-North Railroad cross-honored *MetroCard*s and OMNY at Wakefield, Williams Bridge, Fordham, Botanical Garden, Tremont, Melrose and Harlem-125th Street. Northbound A trains operated local from Euclid Avenue to Hoyt-Schermerhorn Streets. All services were restored in time for the morning rush hour on Tuesday, September 7. (***New York Post***, September 2)

The Long Island Rail Road suspended service across its entire system around 10 PM on Wednesday, September 1, as a safety precaution as the remnants of Hurricane Ida swept across Long Island. Damage assessments turned out to be less than feared and service was restored on Thursday, September 2 on all lines except the Port Washington Branch, which experienced floodwaters several feet deep in the area of the Great Neck station. Crews pumped out the floodwaters and service was restored by Friday, September 3. (The Patch.com, September 3)

On September 3, Metro-North announced that following the unprecedented rainfall associated with the remnants of Hurricane Ida, it anticipated restoring service on the full length of the New Haven Line and on the Harlem Line as far as Southeast. Trains operated on an enhanced weekend schedule beginning at approximately 5 AM. North End Access at Grand Central Terminal was expected to reopen at 6:30 AM.

View looking east on the Hudson Line of tracks covered with debris from a mudslide near Greystone station. Two automobiles were caught in this landslide, one of which can partly be seen near the top.
Metro-North photograph

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THE BOARD OF DIRECTORS EXPRESSES ITS DEEPEST APPRECIATION FOR 2 MEMBER DONATIONS IN AUGUST, 2021

AMOUNT	DONOR(S)
$40	Carsten Senf
$25	Andrew Bata

ERA is a 501(c)(3) tax exempt corporation. Your donations are fully tax deductible and can be made either with your 2021 renewal, or by using our donation form on our website: www.erausa.org/donate. Your donation helps to maintain ERA's 87-year-long tradition of traction education and entertainment!

Remnants of Hurricane Ida Wreak Havoc Across the Region

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Metro-North crews worked early Thursday morning and throughout the day to clear flooding and mudslide conditions and remove downed trees and debris across all three of its East-of-Hudson lines. Crews were able to clear more than ten inches of water at two critical substations that allow Metro-North to run electric service in time for the morning. On the Harlem Line, crews eliminated high-water conditions along the line, in addition to clearing debris from a collapsed wall at the Williams Bridge station in the Bronx.

On the New Haven Line, high water and mudslide conditions were most prevalent between Rye and Norwalk. Crews were able to clear debris, water and mud from tracks, and inspect and test switches, signals and power.

Service on the Hudson Line, where damage was the most severe, remained suspended. Crews continued to work expeditiously to clear mudslide and track washout conditions.

Crews also continued cleanup efforts on the New Canaan and Danbury Branches, where service was not expected to be back on Friday morning. Substitute bus service on the Waterbury Branch associated with ongoing infrastructure work was to resume.

Metro-North cross-honored tickets between the Hudson and Harlem Lines and waived the surcharge for onboard fares. Metro-North also expected to run shuttle service between Grand Central and Yankee Stadium for the following night's 7:05 PM baseball game.

On its West-of-Hudson lines, crews were able to remove downed trees, and expected the Port Jervis Line to run a normal weekday schedule. Service on the Pascack Valley Line remained suspended.

On September 4, the following restoration of services were announced:

- Harlem Line: Resumed service Friday; full service expected for Tuesday morning rush
- New Haven Line: Resumed service Friday; full service expected for Tuesday morning rush
- Danbury Line: Service was expected to be restored the next day
- New Canaan Line: Service is expected to be restored tomorrow
- Hudson Line: Crews were working toward establishing limited service early the next week
- Wassaic Line: Crews were working toward establishing limited service early the next week.
- Waterbury Line: Substitute bus service associated with ongoing infrastructure work was to resume
- Pascack Valley Line: Resumed limited service.
- Port Jervis Line: Resumed service Friday

(MTA press releases, September 3 and 4)

On Monday, September 6, Metro-North announced that Hudson Line service would resume for the morning commute on Tuesday, September 7. The first trains to operate since the remnants of Hurricane Ida unleashed record-setting rains in the region on the evening of Wednesday, September 1, were to begin operating Tuesday shortly after 4 AM. Trains were to operate every half hour in each direction during main commute times and hourly at other times to all stations from Croton-Harmon south. Poughkeepsie service was to be hourly at all times.

Following initial post-storm inspections and clearance of trees, vegetation and debris from the tracks, crew members and contractors spent several days restoring slopes and ballast that had been washed out by floodwaters at multiple locations throughout the Hudson Line, installing 600 cubic yards of heavy stone fill to stabilize areas surrounding tracks for safe operation. Much of the work was at Greystone, where waters cascaded down from Warburton Avenue creating a mudslide onto the tracks.

The railroad will operate with two of its four tracks in service between Riverdale and Tarrytown, where the northbound express and local tracks remain out of service. Bridge plates were installed that connected northbound platforms to operating tracks, bridging tracks that are out of service.

The work to restore the line also allowed for Amtrak *Empire Corridor* service to resume along with the *Lake Shore Limited, Maple Leaf,* and other trains that use the line, and it allowed CSX to resume freight service, including the transportation of waste generated in the Bronx out of New York City for deposit in landfills. (MTA press releases, September 6)

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NEW YORK METROPOLITAN AREA

METROPOLITAN TRANSPORTATION AUTHORITY

The Metropolitan Transportation Authority (MTA), New York State Department of Transportation (NYSDOT) and New York City Department of Transportation (NYCDOT) announced that on Thursday, September 23, the agencies would begin holding 13 public meetings on the proposed congestion pricing program, formally known as Central Business District Tolling. The meetings allow the public to learn more about the initiative and offer comments. They will be held virtually.

Ten of the 13 meetings allowed members of the public throughout the 28-county Study Area in New York, New Jersey and Connecticut to learn about the program and

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environmental review process and provide comments. The additional three meetings were to provide a special focus on individuals and stakeholder groups in identified Environmental Justice communities, who were to have opportunities to receive information about the proposed program and its potential impacts — positive or negative — on minority or low-income populations.

The 10 general interest public meetings were to focus on different geographic areas within the region, but anyone from any area could participate in any meeting. Those who signed up to comment had up to two minutes each to speak.

Environmental Justice community members were able to learn about or comment on the proposed program and Environmental Assessment process. Members of Environmental Justice communities learned about the Environmental Justice Technical Advisory Group that is being created as part of the effort and how they can join an Environmental Justice Stakeholder Working Group or suggest someone else.

The feedback gathered in the public meetings will be part of the Environmental Assessment required by the United States Department of Transportation's Federal Highway Administration (FHWA) that will be published for public review. Following the release of the Environmental Assessment, there will be additional public meetings for comment specifically on the document.

The Central Business District Tolling Program was authorized by the State of New York in April, 2019 and modeled on urban congestion pricing programs around the world to reduce traffic congestion and raise needed revenue to improve public transportation. Other cities across the world that have similar programs have also experienced improved air quality. If approved by FHWA, the CBDTP would be the first such program in the United States. (MTA press release, September 21)

MTA New York City Transit

The MTA announced its Live Subway Map has won Fast Company's Innovation by Design Award for 2021 in the Cities category and is a finalist in the User Experience, General Excellence, Mobility and Best Design North America categories. The first-of-its-kind map gives riders the power to navigate the subway system like never before — allowing riders to plan their trips more easily by taking into account service changes and seeing train movements as they happen in real-time. The creation of the map was the byproduct of an 18-month-long public-private partnership between the MTA, the Transit Innovation Partnership and Brooklyn-based global design and technology firm Work & Co.

The beta version of the Live Subway Map launched in October, 2020 and has been a key tool for keeping riders informed with up-to-the-minute service information. Work & Co designed and developed the web-based digital tool on a completely pro bono basis with the goal of making the lives of New Yorkers easier. Highly customer-friendly, the map allows customers to navigate the system in an intuitive and digital way. Customers will no longer have to read through printed station signage to determine how they should travel throughout the system. (MTA press release, September 21)

The New York City subway set a new pandemic-era ridership record on September 14, for the second consecutive day. The subway system carried just over 2.9 million customers, breaking the previous pandemic-era high of 2.76 million who rode the system the previous day. In addition to the strong subway totals, MTA and New York City Transit buses carried some 1.31 million riders. The combined subways and buses total of more than 4.2 million represents a one-day pandemic-era record for New York City Transit ridership. In addition to the encouraging totals on subways and buses, both commuter railroads moved more than 100,000 customers. The news comes just days after the Authority formally launched "Welcome Back New York," a robust public messaging campaign aimed at urging New Yorkers to return to the system.

More than 120,000 customers took Metro North on the 14th, the second-highest day of the pandemic. The previous high of over 122,000 came on the 13th. LIRR ridership reached just under 145,000 on the 14th, the third highest day of the pandemic after setting a record of nearly 151,000 on Friday, September 10, and then recording just under 148,000 on the 13th.

Prior to the pandemic, average weekday ridership totals routinely exceeded 5.5 million in the subway system. That figure fell by 95 percent to a low of roughly 300,000 daily trips last April as the number of COVID-19 cases peaked in the New York City area. (MTA press release, September 15)

MTA Long Island Rail Road

View looking north on Willis Avenue on September 3.
Glen Sager/LIRR photograph

On September 3, the LIRR reopened Willis Avenue to traffic in the village of Mineola. This was the last of eight grade crossings that were eliminated as part of the Main Line Third Track project. In addition to the Main Line, Willis Avenue now also goes underneath the Oyster Bay Branch. Willis Avenue is less that 600 feet east of the

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junction of the Oyster Bay Branch with the Main Line. (MTA press release, September 3)

View looking southeast of the demolition of Nassau Tower in Mineola on September 18.
Gregory Grice photograph

On Saturday, September 18, after nearly 100 years, Nassau Tower in Mineola was demolished to make room for the Main Line's third track. Efforts to save the tower and relocate it somewhere else never materialized.

This was the second tower located here and was placed into service on April 25, 1923. The original tower, put into service on March 4, 1905, was demolished in a freight train derailment on December 31, 1922. Originally, all LIRR towers had numbers and not names or "call letters." This one was known as Tower 45 from its inception to sometime in 1907 when it was renamed "MT."

Both the original tower, which was constructed of brick, and its replacement, constructed of wood, contained 52-lever US&S/Saxby & Farmer mechanical interlocking machines. On April 23, 1937, MT was renamed "Fair" due to its proximity to the site of the annual Nassau County Fair. After not quite a year and a half, Fair was again renamed, this time to "Nassau."

On November 17, 1975, a small push-button control panel, made by the Bristol Division of Acco Industries Incorporated, was placed in service in the tower to remotely control Locust Interlocking, at the end of double track on the Oyster Bay Branch.

Between September 29 and October 6, 1976, the two mechanically operated switches were converted to electrical operation with GRS Model 5H switch machines, still being controlled, though, from the old "Armstrong" levers. The one movable-point frog crossing, however, was converted to electro-pneumatic operation with a US&S Style A-5 switch machine. This, of course, necessitated installing an air compressor outside the tower along the right of way.

The following month, on November 5, 1976, another small push-button control panel, this one made by Quindar Electronics Incorporated, was installed to remotely control the Bellerose portion of Queens Interlocking.

On May 9, 1996, all three interlocking machines in Nassau Tower (S&F, Bristol and Quindar) were replaced with a new control panel made by US&S. This panel controlled not only the junction of the Oyster Bay Branch with the Main Line (right outside the tower windows) but also the new remote controlled interlockings east of New Hyde Park (Nassau 1), west of Carle Place (Nassau 3) and south (railroad west) of East Williston (Nassau 4). Nassau Interlocking itself was renamed "Nassau 2." Locust Interlocking was also on this control panel. Oddly, though, the track indications on the Oyster Bay Branch from east of East Williston to west of Locust Valley were never placed in service on the panel.

This was the arrangement until May 8, 2020, when the US&S control panel was replaced with an "Office Control System," a fancy name for a computer workstation controlling the interlockings. It may have been Alstom's PTM Office Control System but we are not certain of this.

Finally, on July 11, 2020, control of Nassau's interlockings was transferred to the Jamaica Central Control and the tower was officially removed from service. The shingles on the outside of the tower contained asbestos and were painted in lead-based paint, a "double whammy" that needed to be abated before the tower was demolished. That work was accomplished about two weeks before it came down.

NJ Transit

On Friday September 3, NJ Transit reported that three of its lines had resumed operations following the aftermath of Hurricane Ida's remnants: the Northeast Corridor (including Amtrak services between Boston and Washington, D.C.), Morris & Essex and Atlantic City

Aerial view of Raritan Valley train that became disabled and then prevented a flood gate from closing properly.
newjerseyglobe.com photograph

Lines.

The Montclair-Boonton, Gladstone, Pascack Valley and Raritan Valley Lines required another day for crews to restore service. Of interest is a photo (above) of a Raritan Valley Line train stalled out in Bound Brook, NJ

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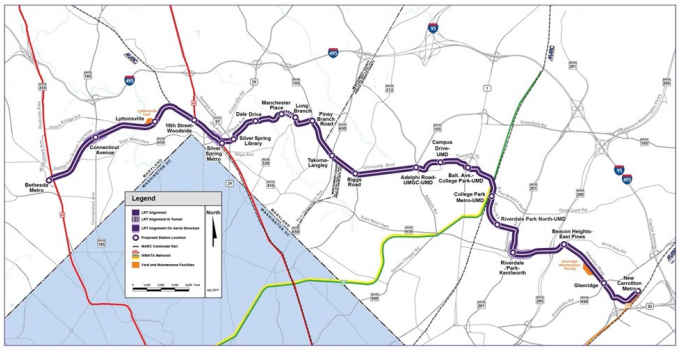
(NJ Transit multilevel coaches 7022 and 7727). Unfortunately, it turns out that this train stalled out at a very poor choice of locations, preventing one of three floodgates installed after Superstorm Sandy to protect the city of Bound Brook from flooding. The result of this train blocking the ability of the floodgate from closing was the flooding of a portion of the town.

The Newark City Subway was also operating normally while the River Line was operating but with some delays. The Hudson-Bergen Light Rail was back to regular service with exception of the Tonnelle Avenue northern terminus. LRVs were turned at the deep underground station at Bergenline Avenue with substitute bus services providing a shuttle service to Tonnelle. (NJ Transit press releases, September 2-4)

Other Systems

Washington, D.C. area

Officials behind the Maryland's Purple Line project are going to take even longer to have a new design-build contractor in the dirt.



Purple Line alignment map.
Purple Line website

Not long after saying one would be in place by the end of 2021, Maryland's Board of Public Works on September 15 approved a February, 2022 deadline. The extension will give prospective bidders more time to complete due diligence activities on the project, which is about 50% complete. Maryland State Transportation Secretary Gregory Slater also said the additional time will allow the bidders to know exactly what needs to be done on the project moving forward and how future work will be tied into work already completed. The solicitation process was supposed to be complete at the end of September.

The Maryland Department of Transportation continues to monitor a small construction effort on the $2 billion project, which is now more than two years behind schedule.

The short list of bidders are Halmar International, Maryland Transit Solutions (a joint venture of Dragados USA Inc. and OHL USA) and a joint venture of Tutor Perini and Lunda Construction Company.

The Board also approved advancing Purple Line Transit Partners (PLTP), the state's private concessionaire partner which has led the search for a new contractor, as much as $375 million to pay off an initial round of public activity bonds issued in 2016 to get construction underway. Slater said the bond payment money would not be added to the total cost of the project. It pays for completed work now than over the course of PLTP's 30-year operations and maintenance concession. (***Railway Track & Structures***, September 16)

Cleveland, Ohio

LRV 842 (Breda Costruzioni Ferroviarie, 1981) operating on the Waterfront Line.
Mass Transit photograph

The Greater Cleveland Regional Transit Authority's (RTA) Waterfront Line service has been suspended indefinitely due to safety concerns related to the Waterfront Line Bridge.

The bridge is located on the East Bank of the Flats and extends over Front Street and the Norfolk Southern Rail tracks.

During a routine inspection conducted in 2018, stress fractures were identified. As a result, monitoring of the bridge began and traffic was restricted (one train crossing at a time). Last October, service along the Waterfront Line was suspended due to a track rehabilitation project at Tower City.

This past summer, before the planned resumption of service, the bridge underwent an extensive inspection. This inspection was conducted by Hardesty & Hanover. Preliminary results released in August recommended four interim support towers be built to stabilize the bridge. Additionally, the consultant advised service remain suspended until a permanent solution was designed and built.

Ruhlin Construction has been awarded an emergency contract to construct the towers, scheduled to be completed by late October. Hardesty & Hanover has begun design work on the permanent solution. Time frame for the total rehabilitation of the bridge is approximately two years. A total of $6 million from Greater Cleveland RTA's Federal Transit Administration federal formula grants has been budgeted for the project.

For Browns fans attending home games this season, Greater Cleveland RTA will not be able to provide alternate service due to normal game day congestion and street closures. Fans riding the Red, Green or Blue

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Lines to Tower City are directed to walk north on W. 3rd Street to FirstEnergy Stadium.

The Waterfront Line was opened on July 10, 1996, designated as a legacy project for the city of Cleveland's Bicentennial. The Line serves to link Greater Cleveland RTA's Red, Blue and Green Lines from Tower City to attractions along the East Bank of the Flats and North Coast Harbor.

Greater Cleveland RTA says it apologizes for any inconvenience this closure may cause. However, the safety of riders, staff and the general public remains the top priority. (***Mass Transit***, September 9)

Denver, Colorado

Silverliner V 4027-4028 (Hyundai Rotem, 2015).
RTD-Denver.com photograph

The Denver Regional Transportation District (RTD) marked one year of operation for its N Line commuter rail service.

Since beginning operations on September 21, 2020, N Line trains have traveled more than 310,000 in-service miles between Union Station and the Eastlake-124th station in Thornton.

On September 21, Denver RTD hosted a customer appreciation event handing out masks and hand sanitizer on the N Line platform (Track 2) at Union Station.

The N Line is a visible symbol of progress and growth for the North Metro region, attracting new businesses and encouraging transit-oriented development. The line, which serves Denver, Commerce City, Northglenn and Thornton, is the first commuter rail service operated by RTD. Denver Transit Partners operates RTD's three other commuter rail lines: the University of Colorado A Line, and the B and G Lines. The agency continues to maintain and operate its own light rail and bus service.

Like all FasTracks commuter rail lines, the N Line features wireless positive train control (PTC) technology as a key safety precaution. The system was built into the new rail to reduce the risk of catastrophic train accidents. RTD says it is the first transit agency in the United States to build PTC technology into a new rail system from the ground up.

A year in, RTD reports that N Line service availability and on-time performance are consistently above 90 percent, which is a good place for a new railroad to be in, according to RTD Deputy Assistant General Manager for Commuter Rail Allen Miller.

Miller notes that seven railroads around the country have opened with the new PTC technology and are running in the 70 percent to 90 percent range for on-time performance.

The corridor will eventually extend to North Adams County and include two additional stations. The remaining 5.5 miles of the corridor will be built as funds become available. The entire 18.5-mile N Line is part of RTD's 2004 voter-approved FasTracks program to expand transit across the Denver metro region. (***Mass Transit***, September 21)

Austin, Texas

Over $312 million has been approved for the Project Connect venture in Austin, Texas.

The Austin Transit Partnership unanimously passed the amount on September 15, and the money will be used to start the MetroRail Orange and Blue Line designs.

More than 50% of the budget will go toward the Orange and Blue Lines. The Orange Line is a 20-mile route that will run north and south through downtown Austin, while the Blue Line will take passengers from downtown to the Austin-Bergstrom International Airport. Design work for 30% of the projects is expected by the summer of 2022.

Another $600,000 was added to the budget for community engagement. The Austin Transit Partnership wants to create a mobile experience center for residents. To make sure residents and small businesses will not be displaced by Project Connect development, a $300 million anti-displacement fund will be one of the main budget items. The Austin Transit Partnership has already approved $42 million of the fund, which will be transferred to the city of Austin. (***Railway Track & Structures***, September 16)

San Francisco, California

The San Francisco Municipal Transportation Agency (SFMTA) will operate Muni Metro subway service to midnight as part of its ongoing rail recovery and COVID-19 Muni service expansion that starts October 2.

Monday through Saturday, the last trains will depart their terminals before midnight and will reach the end of the subway tunnel, in either direction, by midnight. The last eastbound Muni Metro train will depart daily at 11:50 PM and last westbound train at 12 AM.

Sunday night service will run until approximately 10 PM.

Since May, 2021, rail service has run until 9 PM daily, allowing maintenance crews more time to conduct vital, ongoing maintenance work. Extending Metro Muni service through the subway until midnight allows SFMTA to provide late-night service connections to Bay Area Rapid Transit, while preserving a large part of its late-night subway maintenance window.

To do this necessary and critical maintenance work,

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crews need several hours without trains in the tunnels. Prior to the pandemic, the subway maintenance window was too short, causing work to be delayed or deferred. The subway shutdown during the pandemic allowed SFMTA to advance this work significantly. (***Mass Transit***, September 8)

The last BART C2 car was decommissioned in August in the Hayward Shop.
Mass Transit photograph

Bay Area Rapid Transit (BART) has officially retired the last of the 1990s-era C2 train cars.

The C2s had more than their share of issues affecting riders and workers and were strategically targeted to be the first cars in the legacy fleet completely decommissioned. The last one was scrapped in August.

C2s were the most likely to have HVAC breakdowns leading to hot cars and rider misery. The Operator's cab was cramped with failure-prone sash windows. Engineers and mechanics had to come up with do-it-yourself fixes for problems like overshooting windshield wipers and passenger doors that popped off their tracks, taking cars out of service and causing delays.

However, the C2 cars (and their close cousin, C1s, which are next on the list for fully decommissioning as BART replaces its fleet) had some important distinctions that made them significant in BART history. Because of their versatility to be placed anywhere in a multiple-car train, they ushered in the modern era of train dispatch efficiency. And riders knew them as the first to have a blue interior color palette, instead of the 1970s vintage brown and orange of BART's early days.

The ABCs of BART Cars

BART's legacy fleet includes three series of cars, known as the A cars, B cars and C cars (C1 and C2), which are in the process of being decommissioned to make way for new Fleet of the Future cars.

A cars have the iconic slanted end for the lead car with the Operator's cab, and can only be used at the end of a train. B cars, known colloquially as "cattle cars," can only be used in the middle of a train set; they do not have an Operator's cab. C cars have been the switch-hitters of the BART fleet; they can be used as a lead car and have an Operator's cab, but they can also be set up to work as middle cars without an Operator. (Lead cars at BART are called "trail" cars when they are on the other end of the train set; the trail becomes the lead at the end of the line when the train reverses direction.)

Putting Maintainers to the Test

Dave Hardt, BART's chief mechanical officer for Rolling Stock and Shops, said the C2s brought out the best in the people who maintain BART's trains, pushing them to find ingenious solutions to myriad problems.

"Near the bitter end before the Fleet of the Future cars started arriving, there were a few days when I personally recall walking into Hayward Shop and literally every shop space was occupied by a C2 car," Hardt said.

"When I think of the C2s, I remember the cab's sash windows that had this crazy spring mechanism that was supposed to make it easier to raise and lower but was very difficult to adjust and maintain; it would jam. Also, the windshield wiper, when it would rain, it would overtravel off the windshield and land on the side of the car, and not be able to swipe back the other way," he said. Maintainers came up with fixes for both.

"We ended up retrofitting a bunch of the cars with a window we designed in-house that worked much better and was easier to maintain. For the wipers, our engineers designed a bracket, a retaining clip, that kept them from over traveling off the windshield."

And then there were the passenger doors.

"Another specific to the C2 cars, our mechanics knew it all along, the door track and the guide that keeps the door on the track was an issue. We noticed in our analysis that door delays for C2s were far more frequent and more severe than for any other type of car. When a patron would force the door open or a piece of luggage or bicycle would get stuck, the door would literally pop off the track. Unlike other types of cars [with a lockout mechanism that would let the door be blocked off to keep the train moving and prevent delays], you couldn't keep the train moving for safety reasons. After a lot of painstaking effort, one of our engineers came up with a replacement guide for the door, a Teflon guide that was similar in design to the one on the C1 cars, and we replaced them all."

Another issue that affected overall performance of the C2 cars was the APSE system, or auxiliary power supply equipment, which takes the 1,000-volt d.c. power supplied by the electrified third rail and converts it to a.c. power that keeps the air conditioning, compressors and other control systems on the car running.

"On the C2s you have an unreliable power source for literally everything on the car," Hardt said. "Its performance was so intermittent and difficult to diagnose. When we had an APSE sitting in the shop uncovered you could see a bird's nest of wire terminations in that thing. It was so difficult when it did fail to find out what had failed.

"We fixed what we could on them," Hardt said. "There were some things that we couldn't realistically fix within typical budgetary restraints. Once we were into the pro-

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curement for the Fleet of the Future, we didn't want to overinvest in the old cars. So, we ended up making incremental low-cost improvements."

Ushering In a New Era of Efficiency

The C2s may have been bad news for maintainers, but they were instrumental in helping BART modernize and maximize efficiency of how trains are put together and sent out again from rail yards, ultimately benefiting the riding public by allowing BART to more easily match train length to rider demand at any particular time.

There were 80 C2 cars in all, and they arrived in the years between 1990 and 2004. The vast majority, 61 of those cars, arrived in the year 1995. (***Mass Transit***, September 3)

San Jose, California

LRV 906 (Kinki Sharyo, 2002) leads a two-car train on the Blue Line. ***Mass Transit*** photograph

Santa Clara Valley Transportation Authority's (VTA) light rail system is now fully operational.

The Green Line, from Diridon to Winchester, was the last segment of the system to be reactivated after a nearly four-month shutdown following a deadly mass shooting at the Guadalupe Light Rail Division May 26.

Part of the Green Line from Old Ironsides to Diridon began running trains September 12. Prior to that, as Santa Clara VTA light-rail employees made their way back to work in the wake of the tragedy, Santa Clara VTA's Orange Line and part of the Blue Line opened August 29, with the full Blue Line opening September 4. The Diridon to Winchester expansion means the entire light rail system is once again fully operational.

Trains on the Blue Line from Baypointe to Santa Teresa will run from 5 AM to midnight on weekdays every 20 minutes until 8 PM when they will run every 30 to 45 minutes. The Green and Orange Line schedules are 5:30 AM to midnight on weekdays every 20 minutes, with 30-minute headways after 8 PM.

Crews are still working to repair one of two crossing gates damaged by automobiles last month at the intersection of Moorpark and Race Streets, near the Race Street station. Until the work is completed, as an added safety precaution, trains going through that intersection will stop and sound their horns before proceeding.

Santa Clara VTA thanked its passengers for their patience and support as it emerges from an unspeakable tragedy. The agency noted employees are still grieving, but most are glad to be back at work, providing the service the community depends on.

Free fare for light rail will continued through September 30. (***Mass Transit***, September 30)

Los Angeles, California

The Gold Line extension in California was paired with the wrong partner, so Washington was called in to see if more officials could work together to get it done.

In early September, California lawmakers defeated a state funding bill that would have supplied a 3.3-mile extension, which would connect Pomona to Montclair, with some needed cash. The L Line funding, however, was tied in with money for high-speed rail construction, which is probably why the bill was turned down. A nine-mile leg from Azusa to Pomona is currently under construction and is 36% complete. Work has been stalled on the Pomona to Montclair segment.

Rep. David Price (D-North Carolina), who is Chairman of the Transportation, Housing and Urban Development Appropriations Subcommittee and also is a member of the House Appropriations Committee, was touring the extension route on September 14 with Rep. Norma Torres (D-Pomona). Both Price and Torres believe money from the $1 trillion infrastructure bill that was passed by the Senate weeks ago would help the Gold Line Extension.

The Pomona to Montclair extension, which may not open for two years after the original finish date of 2028, will cost $540 million, and the cost of the full extension sits at $2.16 billion, which is $500 million over budget.

Local officials are expected to approach the state for funding next year. (***Railway Track & Structures***, September 15)

Seattle, Washington

Sound Transit has begun full simulated service on the Northgate Link extension a month before the opening of the new service.

Now, all Link trains continue without riders from the University of Washington station to Northgate. During peak service hours, people in the Northgate area will see trains running every eight minutes in each direction along the elevated tracks.

The activities are part of pre-revenue service that began this month.

During simulated service, most riders will not notice any differences during testing, but UW riders will notice some small changes. Instead of using both tracks to board trains, riders will board at the southbound track only and the northbound track will become drop-off only.

Trips between Capitol Hill and UW will also be a little faster, as trains will no longer slow down to switch tracks just south of UW.

As the train testing gets underway, Sound Transit is also preparing for major changes in line names. In October, Link becomes the 1 Line, Tacoma Link becomes

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Rail News in Review

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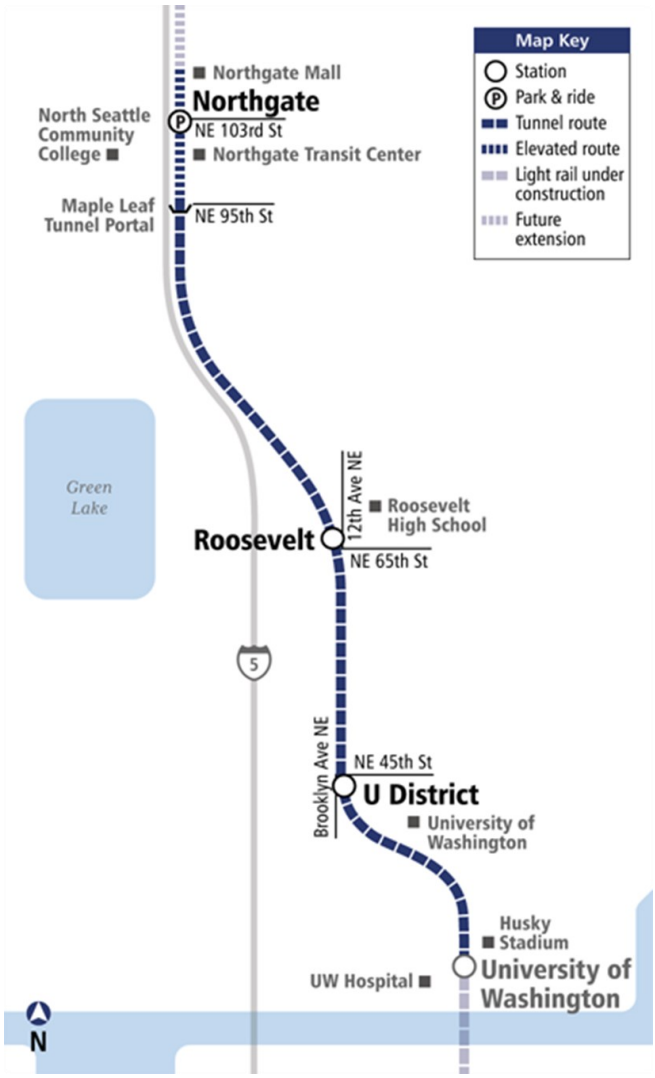
the T Line, and Sounder South and Sounder North become the S and N Lines, respectively. When East Link opens in 2023, it will operate as a new 2 Line.

These changes are already visible aboard 1-Line (Link) vehicles and on station maps. Riders will soon see new overhead signs, area maps, schedules and other rider information change as well.

Rider information for T Line (Tacoma Link) and S and N Line (Sounder) riders will also begin to change over the coming weeks.

The Northgate Link extension will offer riders reliable, traffic-free trips of only 14 minutes between Northgate and downtown Seattle. In addition to the elevated station at Northgate, trains will stop at new underground stations serving Seattle's U District and Roosevelt neighborhoods. Of the 4.3-mile extension, all but 0.8 miles of elevated track at Northgate are located underground. (***Mass Transit***, September 3)



Map of Sound Transit's Northgate extension.
Sound Transit map

Hamilton, Ontario, Canada

Rendering of Hamilton's LRT.
Metrolinx

Hamilton, Ontario City Councilmembers on September 8 agreed to sign a memorandum of understanding (MOU) with Metrolinx and the Province to advance a light rail transit project that was axed in 2019, CBC News reported. On September 15, the members ratified their decision to re-initiate the project, according to Metrolinx.

The 8.7-mile, 17-station line would connect the Eastgate Square shopping mall and downtown Hamilton with McMaster University (see map below), and be separated from regular traffic. It would integrate with local HSR bus service, and connect with local bike share, and GO bus and rail service at the Hamilton GO Centre.

Map of the Hamilton LRT.
Metrolinx map

City Councilmembers on September 8 voted 11-3 to sign the MOU; the vote was ratified on September 15. According to Metrolinx, the Councilmembers "authorized the Mayor and City Manager to sign an agreement that will allow Metrolinx and its partner, the city of Hamilton, to re-initiate the transit project. Metrolinx will now work with the city of Hamilton to establish a project team and collaboratively progress into procurement and delivery of the project."

The new MOU "will be 'binding and enforceable,' a staff report says, and essentially lock Hamilton into accepting LRT," according to a September 8 CBC News report, which noted that information on "issues such as operating costs, which Hamilton will have to cover, and

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farebox revenue, which Hamilton will keep" is still to come for the C$3.4 billion project.

Metrolinx reported on September 15 that the project would also include "a significant investment in public infrastructure," such as roads, sidewalks, bridges, water mains, sewers, electrical distribution (hydro), telecommunications, natural gas, traffic control signals and streetlights. The agency said early works construction, such as utility relocations, is expected to start in early 2022.

Project Background

Ontario Transportation Minister Caroline Mulroney in December, 2019 announced the cancellation of Hamilton's DBFOM (design, build, finance, operate, maintain) light rail project, claiming that the previous Liberal government's C$1 billion budget figure low-balled the project's cost.

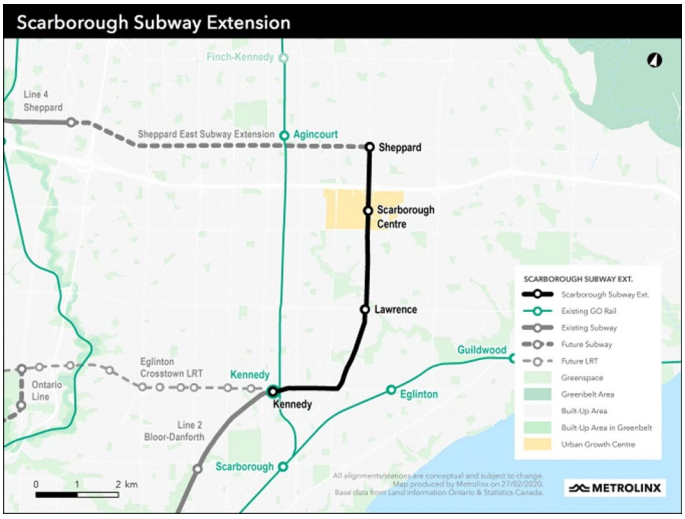
An artist's rendering of the Hamilton LRT project.
Metrolinx rendering

In January, 2020, the Province created the Hamilton Transportation Task Force to "help shape the future of high priority transit in Hamilton by providing new proposals," according to the Ministry of Transportation. "Within two months, the Task Force submitted its report providing recommendations on future transportation infrastructure for the city of Hamilton. The Task force noted a higher-order transportation option, such as an LRT, to be their preferred option." Metrolinx in November, 2020 completed "a technical review of the Task Force's recommendations to determine what options were possible, which has been received and reviewed by the Ministry of Transportation. The technical review indicates a C$1 billion LRT system funded solely with provincial capital would not be of sufficient length to be a viable project to benefit the people of Hamilton. The report suggests a longer LRT, for example running from McMaster and extending beyond Downtown Hamilton to Gage or further, could be a viable option pending federal funding. A feasible LRT project is therefore only possible if the federal government partners with the Province."

On February 9, 2021, the government of Ontario announced its continued commitment to investing C$1 billion in a LRT project in Hamilton. And on May 13, 2021, the governments of Ontario and Canada each committed C$1.7 billion to move the project forward.

Note: Hamilton Street Railway is the historic name of the city's public transportation agency, even though streetcar service ended more than a half-century ago, replaced with buses. (***Railway Age***, September 16)

TORONTO, ONTARIO, CANADA



Map of the 4.85-mile Scarborough Subway Extension.
Metrolinx map

Procurement has begun on the second major contract for the Scarborough Subway Extension project with the release of a Request for Qualifications (RFQ) by Infrastructure Ontario (IO) and Metrolinx looking for interested teams to design and build the Stations, Rail and Systems (SRS) package for the project.

The project will extend the Toronto Transit Commission's (TTC) Line 2 by 4.85 miles into Scarborough and the province is pursuing two separate contracts for the project to speed construction. A contract to design, build and finance the extension's tunnel was awarded to Strabag AG in May and a ground-breaking ceremony for the project was held in June.

The RFQ outlines the contract's scope of work including:

- Three new subway stations, with associated bus terminal facilities
- Eight emergency exit buildings and other required emergency and life-safety facilities
- Transition section between the Kennedy station and the tunnel boring machine extraction shaft at Eglinton Avenue East and Midland Avenue
- Installation, testing and commissioning of all systems equipment including track, ventilation, signals, communications, integrated control system, traction power and all other permanent mechanical and electrical systems
- Four traction power substations; and
- Integration with TTC infrastructure at the Kennedy station, as well as with the advance tunnel

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infrastructure works.

IO and Metrolinx say the SRS package is being delivered using a progressive design build delivery model where a "development partner" will be selected to work collaboratively with IO and Metrolinx during a design phase before finalizing the design-build contract.

Metrolinx is planning for each station on the three-stop Scarborough Subway Extension to be important transport hubs that connect to surface routes, helping passengers to move seamlessly through a broader transit network.

IO and Metrolinx will evaluate submissions and expect to announce a shortlist of qualified proponents who will be invited to respond to a request for proposals in early 2022. (***Mass Transit***, September 20)

WARSZAWA, POLAND

Tramwaje Warszawskie has started revenue operation on a 0.8-mile extension of tram routes 2 and 17 from Nowodwory to Winnica in the north of the city.

The double-track line has been laid along a newly built section of ulica Światowida. Both the road and tram line have been built by Balzola at a cost of 75 million złoty, under a contract signed in 2019.

A turning loop and scissors crossover for reversing double-ended trams have been provided at the Winnica terminus, which opened for traffic on September 4.

In the longer term, ZTM hopes to extend the line by a further 492 feet, closer to the junction with ulica Modlińska, where a new interchange is to be developed. This would incorporate a suburban bus station and park-and-ride facilities, as well as a larger turning loop. (***Metro Report International***, September 13)

120Na "Duo" 3502 (PESA, 7/2012) at the Winnica tram terminus on September 4, 2021.
Railway Gazette International photograph

42ND STREET SHUTTLE'S HISTORIC TRANSFORMATION COMPLETE

by Subutay Musluoglu

(Photographs by the author)

After decades of discarded plans and deferred budgets, followed by 24 months of construction, on September 7 New York City Transit (NYCT) unveiled the completed reconstruction of the IRT 42nd Street Shuttle Ⓢ. The result is being hailed as a historic transformation, and by the looks of it, that truly appears to be the case. The Shuttle's unique physical arrangement and its operations have finally been rationalized.

The Times Square end of the Shuttle is now a single island platform serving the legacy Contract One Tracks 1 and 4, and from the platform's east end a passageway to the IND 42nd Street-Sixth Avenue station has been opened, allowing for in-system transfers to the ⒷⒹⒻⓂ. The Grand Central end has been similarly altered, creating one extra-wide island platform. The Shuttle is now operated by two six-car R-62A trains, a 20% capacity improvement over the previous service provided by a mix of one four-car train and two three-car trains.

The Shuttle is a vestige of New York City's first subway line, which opened as the IRT on October 27, 1904. The First Subway was oriented on a curve turning off 42nd Street north onto Broadway on its route from City Hall in Lower Manhattan to 145th Street in Harlem. The station at 42nd Street and Broadway was built directly on the curve as a local-only stop.

During the Dual Contracts era the IRT Lexington Avenue Subway was extended north and the IRT Seventh Avenue Subway was extended south, truncating the 42nd Street segment of the First Subway. This yielded the so-called "H System," with Shuttle operations starting in September, 1918 on Tracks 1, 3 and 4, while Track 2 was removed from regular service.

While leading a mostly uneventful life since then, various proposals were repeatedly floated over the years to alter the Shuttle, ranging from installing continuous conveyor belts, moving walkways and a failed experiment at automation in 1962-64. (The April 21, 1964 fire in the Grand Central Shuttle station destroyed the interlocking tower, as well as the two trains there. Rather than rebuild the interlocking, the crossovers from Track 1 to Track 2 to Track 3 were replaced with hand-operated switches and the connections to Track 2 were permanently removed). Every concept was eventually ruled out for engineering and operational infeasibilities and high costs. In recent years Shuttle services were provided by one four-car train on Track 3 and two three-car trains on Tracks 1 and 4 during peak times, with one less train during off-peak hours when Track 4 would be

42nd Street Shuttle's Historic Transformation Complete

(Continued from page 12)

closed for service.

As MTA Capital Programs brought an infusion of funding for reviving the subway system, NYCT hoped to properly rehabilitate the Shuttle and improve its operations. The Grand Central end received a modest rehabilitation in the mid-1990s during the third Capital Program, mostly involving upgrades to station finishes, communications and electrical systems, stairways and other components. In 2003 the completion of the new 300 Madison Avenue office tower on the southeast corner of E. 42nd Street and Madison Avenue provided a new street entrance on the south side of 42nd Street just west of the intersection.

At the other end, the majority of the Times Square Station Complex was extensively reconstructed over two separate phases starting in the late 1990s and running through the mid-2000s. The work was carried out in conjunction with the overall redevelopment of the Times Square district, with new office towers built all around the intersections of W. 42nd Street, Seventh Avenue and Broadway, each featuring signature entrances to the station complex below.

The platforms for the BMT Broadway, IRT Flushing and IRT Seventh Avenue Lines were rehabilitated, and the mezzanines and passageways linking them all were dramatically rationalized and enlarged, rectifying deficiencies dating back to the Dual Contracts era. Elevators were installed for full ADA accessibility to the three lines.

Left out was the Shuttle side of the complex, which remained essentially unaltered for several decades. Its unique physical configuration, especially the curved line structure, posed a particularly complex challenge requiring its own dedicated project. To that end, NYCT and its outside consultant developed an ambitious design which would have substantially shifted the station to the east, centered on a single island platform serving Tracks 1 and 3 on a new tangent track structure, permitting longer, five-car trains.

The design included ADA accessibility and new street entrances on the northeast corner of W. 42nd Street and Broadway. Another entrance would be included mid-block between Broadway and Sixth Avenue on the north side of W. 42nd Street as part of a transfer passageway over to the IND 42nd Street-Sixth Avenue station, adding a significant passenger amenity in the heart of the subway system. Easements for the two entrances had been secured when the 151 W. 42nd Street office tower was built on the northeast corner in the late 1990s, while the structural envelope for the mid-block entrance and transfer passageway under W. 42nd Street's north sidewalk would be provided by the yet-to-be-built Bank of America Tower.

Achieving all this would have required a substantial cut-and-cover excavation eastward from Broadway to facilitate an extensive rearrangement of the Shuttle's steel framework, an extremely delicate and risky procedure underneath one of the busiest streets in the city. Various utility relocations were also required, including the relocation of two major water mains and a large, century-old sewer.

Needless to say, all this would have been extremely disruptive to Shuttle operations, and costly - $170 million was budgeted in the MTA 2005-09 Capital Program but as costs rose and other projects became more pressing, the Shuttle rebuild was deferred in January, 2006.

The need to address the Shuttle's issues did not wane, so planning began anew in 2014, this time on a modified design which shifted the platform less dramatically and placed it instead between Tracks 1 and 4, using space occupied by Tracks 2 and 3. The revised scheme greatly reduced the number of steel columns needing to be reframed, completely eliminating the need for any street excavation or utility relocation. The design was also operationally superior for enabling the use of six-car trains. With $240 million available in the 2015-19 Capital Program, construction began on August 16, 2019.

The work proceeded in phases under several General Orders during which operations shifted among the three service tracks with alternating closures. A major and historic milestone was achieved on November 7, 2020, when Track 3 was officially abandoned and removed from service. The last passenger trips occurred just before midnight on Friday, November 6.

As construction proceeded, the transfer passageway presented challenges. Similar to the 2008 design, a stairway was to descend from the platform to an underpass to be mined underneath Track 4, from which stairs would ascend to the corridor over to Sixth Avenue. The mining operation presented significant construction risk and operational impacts. Furthermore, the Durst Organization, owners of the Bank of America Tower, who were to partially fund the connection and maintain it in perpetuity, no longer wanted the passageway on their property. An alternative means of realizing the transfer had to be pursued, with the Durst Organization contributing towards its cost.

The result is quite elegant from an engineering standpoint, and actually achieves the objective in a more beneficial way from a customer standpoint. The entire Track 3 envelope has been enclosed as far as Sixth Avenue, with the passageway contained within. Two stairways descend down to each of the IND platforms, using some of the volume of what had previously been Track 2.

While the new platform at Times Square still retains a slight curve, it is wide and orderly in appearance when compared to the Shuttle's previous state. Additional work yet to be completed include a new fare control area with a street stair and elevator adjacent to 1 Times Square on the west side of Broadway just north of W. 42nd Street.

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42nd Street Shuttle's Historic Transformation Complete

(Continued from page 13)

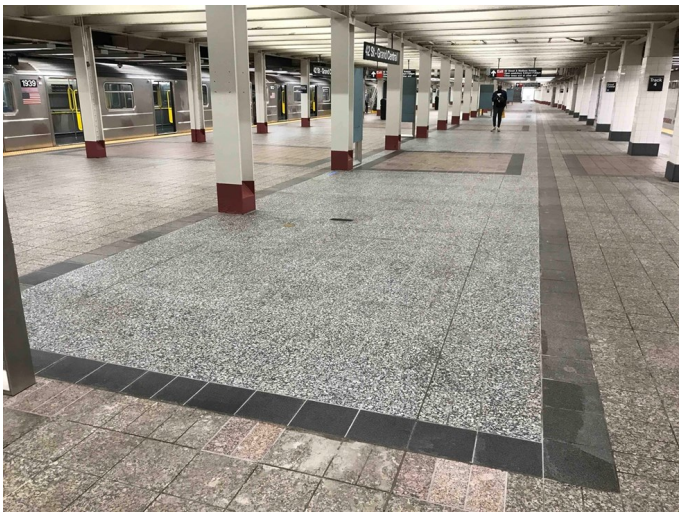
Over at Grand Central, the Track 3 trackway has been completely filled in and slabbed over, creating an extra-wide island platform unlike any other in the city. At the west end, the stairway up to the Madison Avenue mezzanine has been correspondingly widened, while at the east end the fare control areas were renewed with funding from the recently completed One Vanderbilt Avenue tower.

With two trains going back and forth, shuttle train operations are now consistent. The true test of the net capacity increase gained by a total of 12 cars vs. the previous 10 cars will have to wait until more users return to the system post-pandemic.

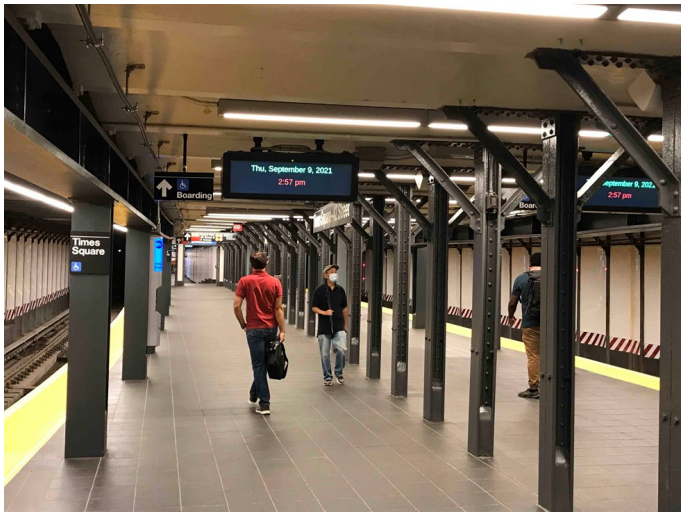
For continued shop moves, Track 4 retains its connection to the Seventh Avenue Line, and Track 1 retains its connection to the Lexington Avenue Line. Incidentally, the R-62A consists that were observed in operation on September 9 were as follows:

On Track 1: S-1955-1939-1932-1935-1933-1936-N
On Track 4: S-1949-1908-1948-1947-1944-1943-N

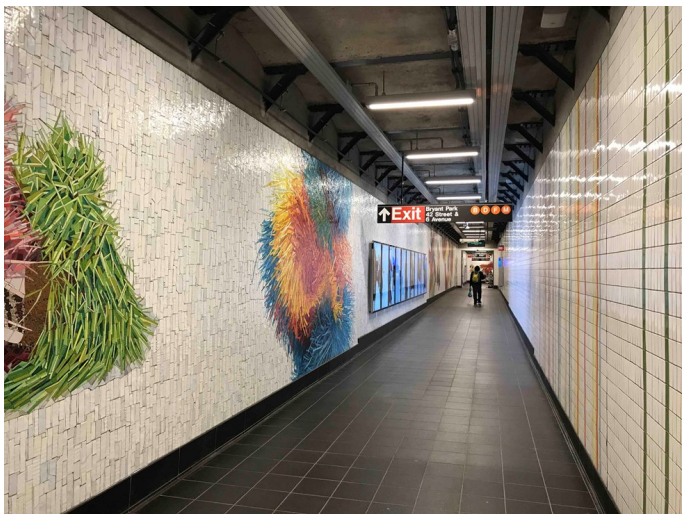
A visit to the Shuttle to see this historic transformation is highly recommended.



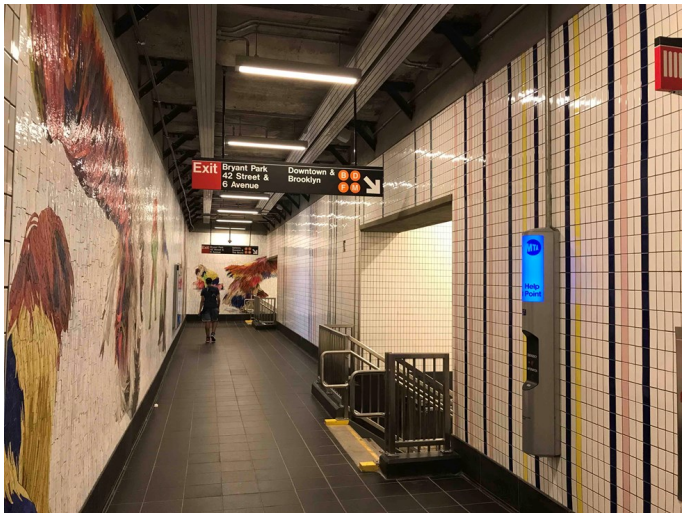
View looking down the length of the extra-wide Shuttle platform at Grand Central, with Track 1 on the left and Track 4 on the right. Track 3, now permanently slabbed over, is represented by a distinct floor tile motif. (September 9, 2021)



The new Shuttle island platform at Time Square. Track 4 is on the left and Track 1 is on the right. The new transfer passageway to the IND Sixth Avenue Line is just visible at the end of the platform. (September 9, 2021)



View looking east in the new transfer passageway to the IND Sixth Avenue Line. The new artwork by Nick Cave, *"Every One,"* is rendered in mosaic tile along the north wall of the passageway. (September 9, 2021)



A view of the stairways from the transfer passageway down to the IND Sixth Avenue Line platforms. (September 9, 2021)

40 YEARS OF HIGH-SPEED RAIL IN FRANCE
by Michael Bunn

2021 marks the 40th anniversary of the inauguration of high-speed rail services in France, and indeed by the time this **Bulletin** *is in the hands of our readers, that important milestone will have been reached. To mark this significant achievement of railway engineering, this month we feature the following examination of the French high-speed rail program and Le Train à Grande Vitesse (TGV), written by Michael Bunn, the Secretary and Treasurer of the U.K.-based French Railways Society.*

First-generation TGV 68 in original orange livery at Chambéry in 1991.
Steve Sachse photograph, French Railway Society archive

On September 27,1981, the first TGV in commercial high-speed service left the Gare de Lyon in Paris. It was the culmination of 15 years of planning, design, construction, and testing. During the 1960s, the Société Nationale des Chemins de fer Français (SNCF - French National Railways) needed to address the problem of capacity and line speed on its main line from Paris to the southeast of France, Switzerland and Italy – the former Ligne Imperiale of the Paris-Lyon-Méditerranée Railway (PLM).

With the completion of the line's electrification in 1962, there was a conflict between the modern generation of fast and powerful electric locomotive hauled trains and the slower steam powered services. The majority of the line was quadruple track but between Saint Florentin and Dijon there remained two sections of double track, totaling about 68 miles, including the Blaisy Bar tunnel.

SNCF planners and engineers considered two possible solutions. They could upgrade the existing line, including quadrupling the remaining double-track sections, including resignaling, saut de moutons (flyovers) at key junctions, and a second Blaisy Bar tunnel. Alternatively, they could build a completely new dedicated high-speed line, electrified at 25 kV AC, with connections to existing routes.

When the accountants analyzed the costs of the two proposals, it was found that the new line would cost only 40% of upgrading the existing route. Thus, the French high-speed rail line concept was born. A new high-speed rail network, with city center to city center services, would also help SNCF to face up to the competition from domestic airlines and the growing autoroute network.

TGV-Postale set 3 at Paris-Sud-Est Depot on September 13, 1990.
Graham Clark photograph, French Railway Society archive

To operate over the new high-speed services, an entirely new generation train would be required and as such, engineers at SNCF engineers and the noted French manufacturer Alstom (originally Alsthom) designed *Le Train à Grande Vitesse* (TGV), capable of operating over the existing classic lines south of Paris electrified with 1.5 kV DC overhead catenary and the new dedicated line, which would be equipped with the more efficient 25 kV 50 Hz AC, while negotiating the ruling gradient of 1:28 at speeds of up to 168 mph. The trains would be outfitted with both conventional and cab signaling systems.

The early development of the TGV was based on an articulated train set with gas turbine-electric power cars and three coaches. Following its completion in 1972, TGV 001 successfully undertook over 5,000 test runs, totaling 310,685 miles and in the process set a world rail speed record of 197.59 mph for this type of traction. Despite its success in trials, the use of gas turbine propulsion was doomed by the rapid rise in oil and gas costs following the conflicts in the Middle East.

Attention therefore turned to electricity. Under a project named "Zebulon" a converted Class Z7100 EMU was utilized to test pantographs, suspension systems and traction motors. All the lessons learned led to the completion of the prototype electric TGV in 1976. The new train consisted of two power cars and an articulated eight coach train set. Unlike the gas turbine version, the two power cars were not coupled to the coaches by means of articulation but as conventional locomotives, which would enable them to be more easily detached for maintenance purposes.

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40 Years of High-Speed Rail in France

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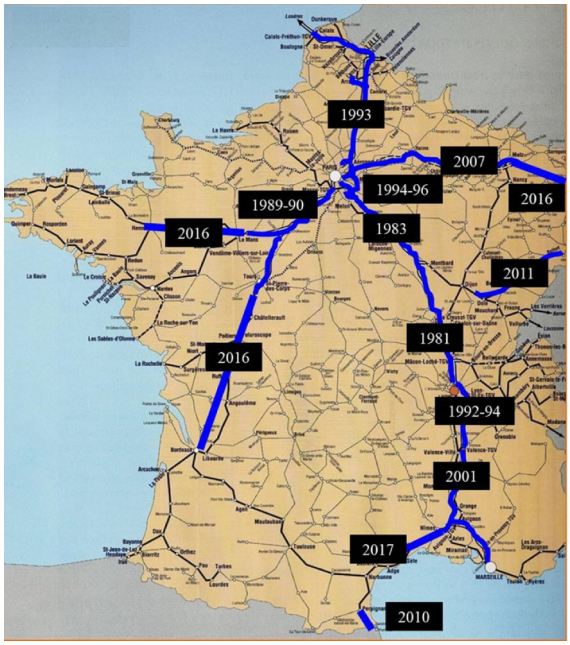
LGV-1 and TGV-PSE

The decision to proceed with construction of the first high-speed line — Ligne à Grande Vitesse 1 (LGV-1, also referred to as the Sud-Est Line) — was given in 1976 by means of the Declaration d'Utilité Publique. Civil engineering works commenced later that year, with track laying starting in 1979. *(Note: The Declaration d'Utilité Publique is a legal action similar in intent to the "Record of Decision" issued in the United States by the Federal Railroad Administration or Federal Transit Administration, which authorizes the go-ahead on a major rail project receiving federal funding.)*

The first phase of LGV-1 from Saint Florentin in Burgundy to Sathonay, to the north of Lyon, was completed in November, 1980. The opening of the second phase of LGV-1 from Lieusaint (south of Paris) to Saint Florentin was delayed until 1983, so that construction works would coincide with those of the A5 autoroute which runs alongside it through the Seine-et-Marne département. The new Lyon Part-Dieu station was opened at the same time. The legacy PLM line between Gare de Lyon and Lieusaint was used.

LGV-1 is 254 miles in length, has a ruling gradient of 1:28, with minimum radius curves of 1.98 miles. It is electrified at 25 kV AC, drawing from the national grid with sub stations every 32 miles. TVM300 (Transmission voie-machine) cab signalling was installed which provided a headway of 5 minutes with 4 blocks of 1.3 miles each, allowing for a line speed of 168 mph. The two phases of LGV-1 posed no particular engineering challenges to the construction teams, with no tunnels and the line being built through open Burgundian countryside.



Les Lignes à Grande Vitesse de France — with opening dates.
Map created by Michael Bunn

To provide extra capacity for the new TGV services at the Gare de Lyon in Paris, a two-level underground station was built under the adjacent Rue de Bercy. The two-track lower level would form part of RER Line A and the four-track upper level would serve as a terminus for suburban traffic until 1995 when the connection of RER Line D to Chatelêt-Les-Halles was completed. Two out-of-town stations were built at Le Creusot-Montceau-les-Mines-Montchanin and Macon-Loché.

Construction of the TGV-PSE (Paris Sud-Est) trainsets started in 1978. They were powered by truck mounted traction motors, with a total output of 6,450kW providing a power to weight ratio of 22.46 hp/ton. To keep within the required 17-ton axle load limit, the traction motors were applied to the 12 trucks of the two power cars and those on the outer ends of the trainset coaches.

As with all the TGVs built over the past 40 years, the trainsets have been manufactured by the Alstom group, with the power cars being manufactured at their Belfort plant and the coaching sets assembled at Aytré, near La Rochelle. And in a reality difficult to imagine today, the first TGVs were comprised of components manufactured exclusively in France, supplied by familiar railway names such as Creusot, De Dietrich, Faiveley, Jeumont-Schneider, Oerlikon, and others. A total of 111 orange liveried TGV-PSE trainsets were produced, eight of which were also supplied with 15 kV AC capability for operating into Switzerland. Seating capacity was 368, of which 110 are in first class.

On February 26, 1981, during trials, a new world rail speed record of 236.36 mph was set by TGV 016. Commercial services started seven months later with a 2 hour 40 minute journey to Lyon. Until the opening of Phase 2 of LGV-1, TGVs travelled over the existing PLM classic line as far as Saint Florentin, in Burgundy, where they would join phase one of the LGV-1 as far as Sathonay to the north of Lyon. As more TGV units rolled off the production line, SNCF was able expand the 'offer' of services which were extended beyond Lyon to the Mediterranean and via Dijon to Switzerland.

From 1983 the second phase of LGV-1 from Lieusaint to Saint Florentin was opened, bringing about a reduced journey time of hours 10 minutes from Paris to Lyon. To speed up services to Marseille and beyond a section of the classic line through the Rhone Valley was upgraded to 124 mph working. That same year, SNCF introduced dedicated services for skiers to the Alpine resorts during the main ski season, under the TGV Neige branding ("niege" means snow).

In 1984, the first of the TGV La Poste units entered service between dedicated postal stations at Paris Charolais, Macon, Lyon and Cavaillon. These units were externally similar to the TGV-PSE sets but without windows and featured a bright yellow La Poste livery which earned them the nickname "Le Canari." They were capable of carrying 88 tons of palletized letters and parcels, operating over the LGV-PSE during off-peak times.

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40 Years of High-Speed Rail in France

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Two TGV-PSE sets departing from Marseille-Saint Charles with a service to Paris Gare de Lyon on May 8, 2006.
Michael Bunn photograph

LGV-2 and TGV Atlantique

In 1985, construction work began on the second high-speed line LGV-2, better known as the Atlantique Line. As construction was proceeding, a major milestone was reached in 1989 when the 100 millionth passenger was carried by the TGV on the LGV-Sud Est Line.

LGV-2 opened in two phases, the first from Paris Gare Montparnasse to Connerré, near Le Mans in 1990 and the second from Courtalain junction to Saint Pierre-des-Corps on the outskirts of Tours in 1991. The second phase included an out of town station at Vendôme-Villiers-sur-Loir and it was near here where a new world rail speed record of 320.19 mph was set by TGV-A set 325 on May 18, 1990. Line length is 144 miles to Tours and 32 miles on the branch to Le Mans.

Greater environmental consideration was required for the construction of LGV-2, which necessitated the building of nine miles of tunnels and track enclosure, primarily in the Île-de-France region and under the vineyards of Vouvray. LGV-2 was built to a ruling gradient of 1:40, with minimum radius curves of 2.6 miles. Outbound trains are only allowed to attain the maximum line speed once clear of the 2.98-mile Villejust tunnel, from where TGVs would then pass through the flat landscape of the Centre region's wheat fields.

To serve the line a fleet of 109 ten-coach TGV Atlantique train units were built with visually identical power cars to the PSE trains but benefitting from a new generation of electric traction motors. Only eight 1,100kW motors were required to provide the Atlantiques with a superior power to weight ratio of 26.56 hp/ton to the earlier PSE units. A new livery of blue and silver grey was introduced.

The original Atlantique sets provided a seating capacity of 485 and a number of new interior features. With no need to use the outer ends of the coach sets for traction motors, the resulting extra space was taken up by a conference salon at the first-class end, while an "espace enfants" was provided for small groups at the other end. Other variations to the PSE sets were the creation of a first-class club coach with a semi-compartment arrangement and a dedicated bar/lounge coach. From the outset, an intensive service of TGVs operated over the LGV-A serving the major towns of Brittany, Angoulême, Bordeaux, Nantes, Poitiers, Toulouse, Tours, etc.

LGV Nord

The third high-speed line — the LGV Nord (LGV-N) — opened in 1993, with a connection to the Channel Tunnel in 1994. The 207-mile-long line was built as part of the European high-speed rail network to provide high speed rail services between Paris Gare du Nord and Belgium, Germany, and Holland, as well as the United Kingdom via a branch through Lille and the Channel Tunnel. It also serves the towns of Arras, Douai, Dunkerque, Lens, Valenciennes by way of connecting spurs at Croisilles, while the classic lines to Calais and Boulogne were simultaneously electrified, enabling some TGVs to be extended there from Lille.

The most significant engineering works on LGV-N are the triangular junctions of Fréthin and Vémar and the 4,921-foot-long viaduct at La Verberie in the Oise département. Three stations were built on the line at Calais Fréthun, Lille Europe, which handles over 7 million passengers per year, and at Haute Picardie which, by contrast, handles only about a third of a million passengers per year – one of the lowest footfalls of any dedicated TGV station. Within railway circles the Haute Picardie TGV station is unkindly known as la Gare de Betteraves, as it is surrounded by sugar beet fields.

LGV-N and subsequent LGVs were equipped with the TVM-430 signalling system which enables TGVs to operate at speeds up to 186 mph. Domestic high-speed train services were provided by TGV-PSE units, cascaded from LGV-1 and from 1994 by the more powerful Reseau TGV sets which would primarily be used on inter-regional journeys. To operate the London to Paris and London to Brussels services a special version of the TGV was produced, the Eurostar (UK Class 373).

In order to meet the Channel Tunnel's stringent fire regulations, the 373s are made up of two half sets each consisting of a power car and 9 trailers. This formation allows detaching and removing one section of the train from the other should the need arise from an emergency inside the Tunnel. With twelve 1,020kW truck mounted traction motors, the Class 373 has a power to weight ratio of 21.74 hp/ton, making it the least powerful of the TGV family.

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Jack May's Vienna-Bratislava-Ukraine travelogue will continue in the November, 2021 issue.

40 Years of High-Speed Rail in France

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A line-up of the various TGV train classes at the Villeneuve Saint-Georges depot south of Paris, with a couple of celebrities among them, on October 15, 2006. From left to right are: TGV Duplex 241 (1995-2007); TGV PBKA 4305 (1996-98); TGV-PSE 16, which set a world rail speed record of 236.36 mph on February 26, 1981 (1978-1986); *Eurostar* 3201 (also known as UK Class 373; 1992-1993), TGV Atlantique 325, which set a world rail speed record of 320.19 mph on May 18, 1990 (1988-91), and an additional set, difficult to identify but possibly TGV-Réseau 4530 in special livery denoting it as the high-speed line inspection train.
Didier Delattre photograph

A shorter version of the *Eurostar* train consisting of two half-sets, comprised of a power car and seven trailers, was also introduced, originally intended for regional services from the U.K. to Paris and Brussels. The services never came to fruition, though three of the sets were operated for several years by the Great North Eastern Railway for services between London King's Cross and Yorkshire. In 2007 all six sets were transferred to SNCF to operate domestic services on the LGV-N from Paris to Calais, Dunkerque, Lille, and Valenciennes.

For services between Paris, Brussels and Amsterdam, the triple voltage TGV-PBA sets were built, and these were later followed by the introduction of quadruple voltage PBKA sets for services into Germany (the K is for Köln — Cologne). Since 1995 the PBA and PBKA sets have worn an attractive maroon and grey livery following the service rebranding to Thalys.

Before the close of the 1990s, two additional projects were undertaken. One was the LGV-Rhône Alpes, from Lyon to the east and south to Valence. Opening in two phases between 1992 and 1994, it brought high-speed services 75 miles closer to the Mediterranean. Built essentially as an extension of LGV-1, it featured a new station at Satolas (Lyon Airport) with a distinct design by the architect Santiago Calatrava. Later renamed Lyon-Saint Exupéry, the station's headhouse bears some resemblance to the World Trade Center Transportation Hub in New York City designed by Mr. Calatrava 20 years later.

With the first three LGVs each operating exclusively to and from three Paris termini, the “LGV Interconnexion” project was proposed as a means to offer a wider range of timetabled services operating interchangeably from any terminal over any LGV. Equally as important, the project would provide operational flexibility by allowing for rerouting trains during service disruptions, coping with higher holiday travel and seasonal peaks, and facilitate the move of TGV sets among the three lines for shop moves. Implemented between 1994-96, the three LGVs were linked with a 56-mile-long half ring line through the eastern Parisian suburbs. A portion of the line operates on the legacy Grande Ceinture — the "Great Belt" line around Paris.

The connection facilitated inter-regional high-speed train services throughout France and to adjoining countries. Two new stations were opened at Charles de Gaulle Airport and Marne-le-Vallée (Disneyland Europe). It effectively moved the start of LGV-1 to Creteil, about 6.2 miles out from the Gare de Lyon. Provision was made for a link between the Interconnexion and the LGV-Est which would open in 2007 (more on that later).

In the next installment we will continue the TGV story in the 21st Century so far.

(Continued next issue)

LONDON UNDERGROUND EXTENDS THE NORTHERN LINE
by Subutay Musluoglu

On September 20, the London Underground grew by two stations and 1.8 miles in length with the opening of an extension to the Northern Line from Kennington to Battersea Power Station, with an intermediate station at Nine Elms.

These are the first new Northern Line stations to open in 80 years, bringing the number of stations on the London Underground network to 272 (exactly 200 less than New York City). Both stations are equipped with elevators for step-free access (as ADA is referred to in London), which increases the number of such stations to 88 on the Underground (compared to 119 in New York City).

Under construction since November, 2015, the £1.1 billion project was constructed by the joint venture of Ferrovial Construction Laing O’Rourke under a design-build contract. It was finished £160 million under budget despite cost pressures brought on by the pandemic.

Planning for the extension dates back to 2008, when proposals were first considered for the redevelopment of a wide swath of land around the decommissioned landmark Battersea Power Station, an imposing and recognizable feature on the London skyline. Fans of the rock band Pink Floyd know it as the centerpiece of the cover of the 1977 album *Animals*.

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London Underground Extends the Northern Line

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The regeneration of this part of the south bank of the Thames has been a long-standing objective of city planners and property developers. The area around Nine Elms has already seen increased development, including the New Covent Garden market and the new United States Embassy, which opened in 2017. At Battersea, the station vicinity is dotted with rising office and residential buildings, while the power station itself is being repurposed as a vast multi-use complex with homes, offices, retail, restaurants and recreation spaces.

Ultimately, the extension will support around 25,000 new jobs and more than 20,000 new homes in the area, as announced by Transport for London, the overall regional transportation authority and the parent agency of London Underground.

The extension's twin 17-foot-diameter tunnels were built with two tunnel boring machines which were launched in March and November, 2017. Track installation was completed in 2019, allowing for an engineering train to travel the full line in June of that year. Power was supplied to the stations in November, 2020 and the track was energized in December in advance of the start of dynamic testing. Trial operations and route familiarization training for drivers began in July this year. Both stations are distinguished by extra wide platforms, large mezzanines, high ceilinged spaces and signature headhouses for street access.

Those familiar with the London Underground, and with the configuration of the Northern Line in particular, will know that the line is very unique among the world's legacy metro lines. Today's line is actually a combination of two separate antecedent railways, starting with the City & South London Railway which opened in 1890 as the world's first electrically powered underground railway. (The world's first underground railway, London's Metropolitan Line, opened in 1863 as a steam powered railway running in a shallow partially covered trench with intermittent openings for ventilation purposes. Electrification was inaugurated in 1905.)

The City & South London Railway tunnels were built as deep tubes, mined by hand through London's famous blue clay, highly favorable for tunneling. Subsequent extensions (and the abandonment of one station and a portion of the 1890 alignment) were constructed in phases until 1907.

That same year saw the opening of the Charing Cross, Euston & Hampstead Railway, which later became the second major component of the Northern Line. Additional line segments and extensions were built between 1923 and 1941. All these various pieces were cobbled together to form a highly unique line noted for having two separate north-south routes across the city center, with two separate parallel tunnel crossings under the River Thames.

The eastern, older route is known as the Bank Branch (routed via the Bank station under the City of London financial district), while the western route is referred to as the Charing Cross Branch.

In the north, the two routes join up at a highly complex underground junction adjacent to, and named for, the Camden Town station. North of Camden Town, the line splits again with one branch to High Barnet, with its own stub branch to Mill Hill East, and a second branch to Edgeware.

On the south bank of the Thames, the two routes come together at the Kennington station, with the Bank Branch continuing south of there to the line's southern terminal at Morden, while the Charing Cross Branch terminates at a separate set of platforms at Kennington with a reversing loop beyond.

Needless to say, scheduling and operating daily services over the Northern Line is a great ongoing challenge, a constant balancing act of matching demand and passenger loads while ensuring there are adequate services to the three northern terminals and the two southern terminals. Service disruptions at any given location have the potential to wreak havoc with the entire line, especially at Camden Town junction. (It has been proposed over the years to split the Northern Line into two separate lines; however, this would be impossible to achieve without a massive and costly rebuilding of the Camden Town junction)

In recent years the installation of Communications Based Train Control, upgrading all interlockings, and a renewal of the line's entire rolling stock fleet have gone a long way towards increasing service reliability. Several of the line's oldest stations, originally built with narrow island platforms and thus strained to capacity in modern times, have been dramatically expanded with new concourses, passageways and street access. At a few stations, new parallel running tunnels were built to allow for platform enlargements.

It is off the aforementioned Kennington loop that the extension to Battersea was constructed. As such, all services to and from Battersea will be via the Charing Cross Branch, with six trains per hour in the peak period and five trains per hour off-peak. By mid-2022 as more new housing is completed and demand increases, the service frequency will be doubled, with peak period service growing to 12 trains per hour, while off-peak service will be increased to ten trains per hour.

The Kennington station itself received a number of capacity improvement measures, including the mining of new passageways to augment the existing links between the two sets of platforms, to accommodate the anticipated increase in the number of transfers between the two branches.

Notwithstanding the opening of stations at Heathrow Terminal 5 on the Piccadilly Line in March, 2008, and Wood Lane on the Circle and Hammersmith & City Lines in October, 2008, the Northern Line extension is considered to be the first major expansion of the Underground in the 21st Century. The last significant expansion of the Underground occurred in 1999 when the Jubilee Line was extended from Green Park to Stratford in three stages over the course of that year.

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London Underground Extends the Northern Line

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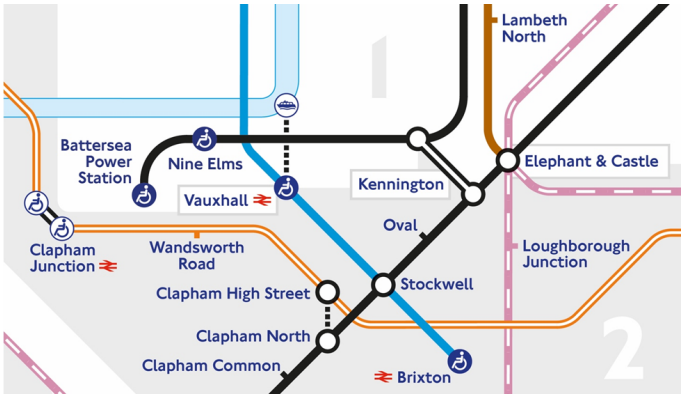
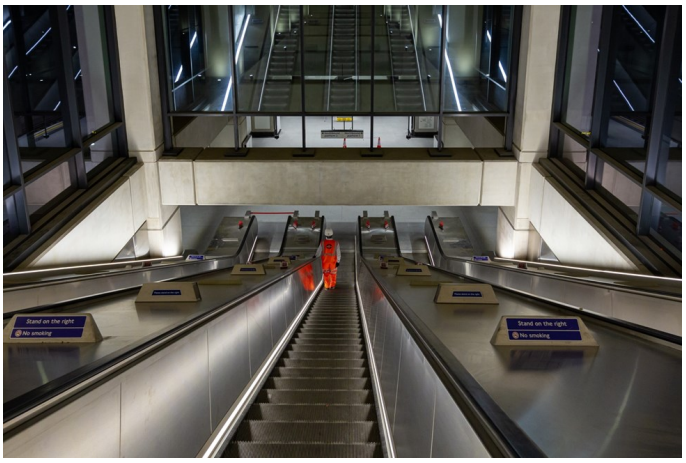


The Northern Line extension with new stations at Nine Elms and Battersea Power Station.
Transport for London map



View down the escalator shaft at the Nine Elms station.
Transport for London photograph

A view of the Nine Elms station platform with a 1995 Tube Stock train stopped during a training run.
Transport for London photograph

The station headhouse for Battersea Power Station, with clear signs of the ongoing property development in the area. The landmark Battersea Power Station cannot be missed in the right background.
Transport for London photograph

Celebrating the Northern Line extension with the world-famous Underground roundel in balloon form, which also pays homage to Pink Floyd's 1977 album *Animals*, which has as its cover image a giant inflatable pig floating among the smokestacks of Battersea Power Station.
Transport for London photograph