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1 YELLOW TUNNEL ALTERNATIVE

1.1 GENERAL OVERVIEW

The Yellow Alternative is a cut and cover tunnel located on the same alignment as the existing I-81 viaduct, along Almond Street. An alignment within the Almond Street corridor is the only potentially viable alignment for a cut and cover tunnel, without major property takings. However, even on this corridor construction would significantly impact street traffic, I-81 traffic, the I-81 viaduct, utilities and adjacent businesses and residences. Some construction could occur with the existing I-81 viaduct remaining open, but an extended closure of I-81 (likely more than a year) would be required to demolish the viaduct, complete the connections at each end, and for other works.

To minimize impact to I-81 during construction it may be possible, at the south end, to construct the cut and cover tunnel to the east of the viaduct (similar to Green), or west (similar to Orange – and as shown on the Yellow plan, below). However, it would likely be preferable to construct the north end and south end ramps concurrently during a long-term closure of I-81. The alignment would be the same as the existing I-81 viaduct, per the fly-through description is provided below.

Where the highway transitions from below grade to above grade, near Harrison Street, it would be difficult to accommodate pedestrian crossings (bridges or underpasses). At the north end the I-690 connecting ramps would be the same as existing.

- Advantages of Yellow Alternative
  - Maintains existing connections to I-690
  - Relatively short tunnel
- Disadvantages of Yellow Alternative
  - Long-term closure of I-81 during construction
  - Disruption to city streets during construction
  - Harrison Street closed permanently (see profile below)
  - Buried valley crossing the alignment result in deep retaining walls and high construction cost
  - Piling through existing footings could be problematic
  - Significant utility relocations
  - The cost and disruption associated with cut and cover work along Almond Street/I-81 were the primary reasons for eliminating this option from further study.
1.2 ALTERNATIVE FLY-THROUGH DESCRIPTION

The Yellow Tunnel Alternative is a cut and cover tunnel that follows the existing I-81 alignment.

It starts in the south adjacent to Martin Luther King East, and continues generally north in a cut and cover tunnel, passing under the railroad. Construction of this section would require the temporary closure of I-81, and demolition of the existing structure.

Significant utility relocations would be required along Almond Street, especially near the Steam Plant.

North of the railroad the cut and cover would follow the line of the existing viaduct. Some elements of the tunnel could be constructed in the existing viaduct in operation, but significant disruption to traffic on city streets.

Construction of other elements would require significant underpinning of the existing structure, if it were to remain in operation. Completion of the cut and cover structure, and tie-in at each end, would require temporary closure of I-81.

The tunnel would rise up at the north end, coming above grade near Harrison Street, and meeting the existing viaduct connections to I-690 near Genesee Street. Harrison Street would be permanently blocked.
2 GREEN B TUNNEL ALTERNATIVE

2.1 GENERAL OVERVIEW

The Green 'B' Tunnel Alternative is generally aligned immediately east of the I-81 viaduct. From the southern limit, adjacent to Martin Luther King East, it is identical in plan alignment to the Green Alternative until East Fayette Street. It then deviates from the Green Alternative by continuing northwards to a similar north portal as the Red Alternative. A fly-through description is provided below.

A single double-deck tube is considered preferable to twin tunnels due to the physical constraints along Almond Street (viaduct to the west; hospital and hotel to the east). The out-to-out width of twin tunnels is approximately 110-ft, which would be difficult to accommodate.

It may be possible to deepen the profile of the tunnel, such that it could be aligned below the existing viaduct. However, this would likely require the viaduct to be taken out of service during tunnel mining, as was done for the Alaskan Way Viaduct when the TBM passed below. It would also increase the risk of encountering and existing pile.

- Advantages of Green 'B' Alternative
  - Has negligible impact on I-690
  - No permanent street closures
  - Generally passes under public land
- Disadvantages of Green 'B' Alternative
  - No connection to I-690
  - Relatively long tunnel
  - Passes under multiple low-rise buildings around Burnet Avenue.
  - Passes close to hospitals and Crowne Plaza
  - Construction of northern tunnel approaches would be disruptive to I-81 traffic
  - Limited space for TBM launch at either portal

The tunnel would be functionally be identical to the Red Alternative, but would have higher construction risk, passing under more properties and close to others. The Red Alternative would be a similar 'base' cost, but with a lower risk of delay and cost increases. For this reason, Green 'B' was eliminated from further study.

FIGURE 2: Green B Tunnel Alternative
2.2 ALTERNATIVE FLY-THROUGH DESCRIPTION

The Green ’B’ Tunnel Alternative is generally aligned immediately east of the I-81 viaduct. From the southern limit, adjacent to Martin Luther King East, it is identical in plan alignment to the Green Alternative until East Fayette Street.

It bends to the east to clear the existing I-81 alignment immediately south of the railroad. The southern end of the bored tunnel would be at this location. To achieve this geometry requires reverse curves on the through-tunnel.

The bored tunnel would pass under the Pioneer Homes housing project and immediately adjacent to the Update Medical University Hospital, beneath the I-81 northbound off-ramp to Adams Street.

The alternative would continue northbound in bored tunnel under Almond Street, passing close to the high-rise Crowne Plaza Hotel.

Whereas the Green Alternative tunnel ends at this location and connects into I-690, the Green ’B’ tunnel continues along Almond Street.

Green ’B’ continues as a bored tunnel to pass, at depth, below I-690 and below private properties and buildings in the vicinity of Burnet Street.

The bored tunnel then follows a similar alignment to the northern end of the Red alternative, connecting into I-81 at a similar point.
3 PURPLE TUNNEL ALTERNATIVE

3.1 GENERAL OVERVIEW

The Purple Tunnel Alternative demolishes both the I-81 and I-690 viaducts, and replaces them with tunnels. Some existing interstate-to-interstate connections could potentially be maintained (the viability of this was not fully vetted; NB I-81 to EB I-690 would likely not be maintained, not the reverse move).

The I-690 tunnel would replace the existing viaduct throughout downtown Syracuse. In combination with removing the I-81 viaduct, this option would place most sections of interstate underground, freeing up surface space for development and improving livability. Numerous ramps would descend into the tunnel, which would still have some remaining impact on the surface, along with potential emergency exits and ventilation buildings.

The I-81 tunnel starts in the south adjacent to Martin Luther King East. A TBM would mine northwest and north, following alignment of the Red Alternative to Genesee Street, where the bored tunnel ends. Cut and cover construction would start there, with cut and cover ramp-tunnels connecting into the I-690 tunnel. The I-81 tunnel would continue under the I-690 tunnel, to daylight near Butternut Street.

The I-690 tunnel starts in the east near Beech Street and heads west, generally beneath Erie Boulevard. A cut and cover tunnel would be required for the I-690 tunnel. It would not be possible to fit three lanes plus on/off ramp lanes into bored tunnels. A fly-through description is provided below.

A complicated series of cut and cover interchanges would be required to maintain existing connections between I-81 and I-690. Eliminating some or all connections could result in significant cost savings.

- Advantages of Purple Alternative
  - Eliminates all interstate viaducts from downtown Syracuse
  - Removes all underground impact

- Disadvantages of Purple Alternative
  - Major reconstruction of both I-81 and I-690
  - High cost
  - Significant disruption during construction to traffic and adjoining properties
  - Significant property acquisition and sub-surface easements required
  - Significant utility relocations.

This option was eliminated from further study, primarily due to the cost. The I-690 section alone could cost 2- to 3-times the cost of the I-81 options carried forward. Overall project costs could be 3- to 4-times more than focusing on I-81 alone. Furthermore, the disruption to traffic and people during construction would be more widespread and last much longer.

FIGURE 3: Purple Tunnel Alternative
3.2 ALTERNATIVE FLY-THROUGH DESCRIPTION

The I-690 tunnel starts in the east near Beech Street and heads west. It diverges from the existing I-690 alignment, ramping down into a cut and cover tunnel that runs under Erie Boulevard. The tunnel would require too many lanes for a bored tunnel. A stacked cut and cover tunnel would minimize its footprint, and minimize property takings.

The tunnel would stay under Erie Boulevard, south of the existing I-690 alignment, as far as the existing I-81 viaduct.

At I-81, the I-690 tunnel would turn north, into the existing interchange areas near State Street.

Underground ramps to I-81 (shown in white) could potentially be constructed using cut and cover, but at considerable cost, and causing significant disruption.

A complicated series of cut and cover interchanges would be required to maintain existing connections between I-81 and I-690. Eliminating some connections could result in significant cost savings.

The I-81 tunnel would pass under the I-690 tunnel, to daylight near Butternut Street.

The I-81 bored tunnel starts in the south (not shown) adjacent to Martin Luther King East and trends to the northwest, following the Red Alternative to Genesee Street, where the bored tunnel ends.

I-81 cut and cover construction would start here, with cut and cover tunnels potentially turning east and west to connect into the I-690 tunnel.

The I-690 cut and cover tunnel would rise up to meet the existing highway alignment close to West Street. New interchange ramps and other reconstruction would be required at West Street. Flow of the Onondaga Creek would be maintained.
4 SHORT DEPRESSED HIGHWAY ALTERNATIVE

4.1 GENERAL OVERVIEW

The Short Depressed Highway Alternative would be aligned along the same alignment as the existing I-81 viaduct. I-81 northbound would bridge over the railroad and then descend into a depressed highway. It would then rise up to meet the I-690 ramps. A fly-through description is provided below.

The purpose of examining this alternative was to determine the shortest practical depressed highway. However, this Alternative is too short. It starts and ends at a viaduct, and except for one cross-street (Adams) all other cross streets are permanently blocked due to the highway either ramping down or ramping up. See the profile, below.

The deep section of depressed highway is too short to allow adjacent streets (Almond Street) to be cantilevered, which limits the space for a community grid spine road. Also, there is insufficient space at each end to make connections between I-81 and the community grid.

- Advantages of Long Depressed Highway Alternative
  - Short
  - Lower cost
  - MLK Boulevard could remain open

- Disadvantages of Long Depressed Highway Alternative
  - Extended closure of I-81 during construction
  - Major disruption to city streets during construction
  - Multiple city streets closed permanently
  - Limited (or no) connections to community grid
  - Buried valley crossing the alignment result in deep walls and disproportionately high cost
  - Significant utility relocations, especially near Steam Plant
  - Piling through existing footings could be problematic
  - Snow removal difficult
  - Perpetuates the division of the university area from downtown

This option was eliminated from further study, primarily due to the required permanent closure of multiple city streets.

FIGURE 4: Short Depressed Highway Alternative
4.2 ALTERNATIVE FLY-THROUGH DESCRIPTION

The Short Depressed Highway is an open-cut depressed highway that follows the existing I-81 alignment.

It has a similar plan alignment as the Yellow Tunnel Alternative, except that it starts north of the railroad.

The existing bridge over the railroad would be reconstructed, and the roadway would then slope down to the north, to descend below city street level.

Almond Street would be divided, with northbound traffic located to the east of the depressed highway, and southbound traffic to the west. Due to the shorty length, and ramping down and up, I-81 would not been deep enough to permit Almond Street to be cantilevered over the interstate. Almond Street would run along either side.

The roadway would rise up near Genesee St to meet the existing ramps connecting into I-690.
5 LONG DEPRESSED HIGHWAY ALTERNATIVE

5.1 GENERAL OVERVIEW

The Long Depressed Highway is an open-cut depressed highway that follows the existing I-81 alignment. It has the same plan alignment as the Yellow Tunnel Alternative described above. In profile the south end is similar to the Yellow alternative, and the north end is similar to the Long Depressed Highway alternative.

Compared with the Short Depressed Highway Alternative, this alternative can remain at the full depth long enough for most transverse city streets to remain open. However, Harrison Street would be closed permanently. Burt Street would also be closed for the community grid connection to I-81 — similar to other Alternatives. Community grid at street level would be maintained by splitting Almond Street northbound and southbound, and cantilevering each direction over I-81 (see Appendix E). A fly-through description is provided below.

Some construction could occur with the existing I-81 viaduct remaining open, but an extended closure of I-81 (likely more than a year) would be required to demolish the viaduct, complete the connections at each end, and for other works.

Pedestrian traffic would only be able to cross the depressed highway at cross streets, or other pedestrian bridges. Where the highway transitions from below grade to above grade, near Harrison Street, it would be difficult to accommodate pedestrian crossings (bridges or underpasses). At the north end the I-690 connecting ramps would be the same as existing. These elements would form a barrier that would perpetuate the division between the university area and the downtown area.

- Advantages of Long Depressed Highway Alternative
  - Maintains existing connections to I-690
  - MLK Boulevard could remain open
  - Relatively short

- Disadvantages of Long Depressed Highway Alternative
  - Extended closure of I-81 during construction
  - Major disruption to city streets during construction
  - Harrison Street closed permanently
  - Buried valley crossing the alignment result in deep walls and high cost
  - Significant utility relocations, especially near Steam Plant
  - Filling through existing footings could be problematic
  - Snow removal difficult
  - Perpetuates the division of the university area from downtown

This option was eliminated from further study for two principal reasons: the requirement for an extended closure of I-81 during construction, and because the resulting depressed highway, ramps and viaducts would perpetuate the division between the university area and the downtown area.

FIGURE 5: Long Depressed Highway Alternative
5.2 ALTERNATIVE FLY-THROUGH DESCRIPTION

The Long Depressed Highway is an open-cut depressed highway that follows the existing I-81 alignment.

At the south end the depressed highway would pass under the railroad in a cut and cover tunnel. The community grid would pass over the railroad, and ramp down to grade.

Community grid at street level would be maintained by splitting Almond Street northbound and southbound, and cantilevering each direction over I-81 (see Appendix E).

The highway would rise up at the north end, coming above grade near Harrison Street and meeting the existing viaduct connections to I-690 near Genesee Street.
APPENDIX N: CASE STUDIES
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2 WATERVIEW TUNNEL, AUCKLAND, NEW ZEALAND  2
3 A1 SPARVO HIGHWAY TUNNEL, ITALY  3
4 M30 SOUTHERN BYPASS TUNNEL, MADRID, SPAIN  4
5 ALASKAN WAY TUNNEL, SEATTLE, WA  5
6 EURASIA TUNNEL, ISTANBUL, TURKEY  6
7 A86 TUNNEL, PARIS, FRANCE  7
KEY ASPECTS OF THIS PROJECT ARE:

- **Location:** Miami, Florida
- **Client:** Florida Dept. of Transportation, Miami-Dade County, City of Miami
- **Delivery:** Public-Private Partnership
- **Years built:** (2010-2014)
- **Tunnel Type:** Automotive, Twin tubes
- **Length:** 4,200 feet per tunnel
- **Interior diameter:** 39 ft.
- **TBM diameter:** 42’-4” ft.
- **TBM Type:** Modified EPB
- **Max surface settlement:** 0.3”
- **Ground type:** Sand, silty sand, silt, limestone
- **Tunnel Type:** Twin tubes
- **Vertical vehicular clearance:** 15 ft.
- **Fixed firefighting (deluge) system. Hazardous vehicles are prohibited.**

The Port of Miami Tunnel Project was conceived to relieve congestion in downtown Miami due to port related traffic. The project consists of twin bored tunnels constructed between Watson Island and Dodge Island.

Construction began in May 2010, and the hybrid EPB Tunnel Boring Machine was launched on November 2011 from Watson Island heading eastbound and breaking through on July 2012. The TBM was repositioned and launched again on October 2012 heading westbound and was completed in May 2013. The project was open to traffic starting August 2014.

Several structures were identified as having a risk of damage from settlement, including a seawall, pedestrian bridge, storage shed, and swimming pool within the influence zone. Additionally, the TBM was required to pass close beside drilled piles supporting a two-span bridge abutment. Extremely porous and soft limestone discovered demanded that EPB TBM be adopted to safely mine without confinement overpressure. In addition, a specially developed mortar was injected into the porous coral to stabilize it during tunneling. Soil above shallow portal zones was treated using soil mixing.

The Florida Department of Transportation and MAT Concessionaire LLC reached a settlement in a dispute of how much the state must pay for unanticipated work on the project. The limestone found was extremely porous and many gaps in the rock needed to be filled with grout. The Resolution Board ruled modifications to the TBM were not compensable but the grouting costs were compensable. MAT and FDOT negotiated a settlement to an additional $58.5 million from project’s contingency fund. The contingency fund was set up in advance with defined criteria for the concessionaire’s access to funds. The dispute and settlement did not delay the work and the project remained on track to open in May 2014.

**REFERENCES**

- [www.portofmiamitunnel.com/project-overview/project-overview-1](www.portofmiamitunnel.com/project-overview/project-overview-1)
- Comparison of Predicted Versus Observed Structural Displacements, Rapid Excavation and Tunneling Conference Proceedings 2013
2 WATERVIEW TUNNEL, AUCKLAND, NEW ZEALAND

KEY ASPECTS OF THIS PROJECT ARE:

- Location: Auckland, New Zealand
- Client: Transit New Zealand
- Years built: (2011-2017)
- Tunnel Type: Automotive, Twin tubes
- Length: 5,200 ft per tunnel
- Interior diameter: 39 ft.
- TBM diameter: 47’-2”
- TBM Type: EPB
- Settlement: Negligible
- Ground type: alluvial soils and sandstones
- Lanes: 3 lanes per tunnel
- Vertical vehicular clearance: 16 ft.
- Fixed firefighting (deluge) system

Bored tunnels were announced as the preferred option for the Waterview tunnel in 2008. The New Zealand Transport Agency released report findings which showed that tunnel emissions would have negligible effect on the local air quality. These findings were disputed by representatives of the Waterview Primary School.

Tunnel segments were reinforced by a combination of steel fibers and reinforcing bars.

Tunnel opening is expected in July 2017, after a delay of 3 months. The primary reason delay was cited as being systems installation and testing.

REFERENCES

- www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=11845437
3 A1 SPARVO HIGHWAY TUNNEL, ITALY

KEY ASPECTS OF THIS PROJECT ARE:

- Location: Between Bologna and Florence, Italy
- Client: Autostrade per l’Italia S.p.A.
- Years built: (2011-2013)
- Length: 1.55 miles each tunnel (3.1 miles total)
- Tunnel Type: Automotive, Twin tubes
- Interior diameter: 44.6 ft.
- TBM diameter: 51.2 ft.
- TBM Type: EPB
- Ground type: clay, argillite, and sandstone
- Volume Loss: (Unknown – mountainous)
- Lanes: 2 lanes plus full shoulder, each way

The Galleria Sparvo tunnel consists of two parallel tubes, each with a two-lane road and a third emergency lane. The contractor opted for an EPB Shield with a diameter of 51.2 ft. which represented a new world record for excavation diameter during the project’s duration. Extremely complex geological conditions comprised heterogeneous material with spalling behaviour and hard rock inclusions. Both open and closed-face tunnelling methods were used. Operating the TBM was a challenge for the crew as it had to be in closed EPB mode to help control methane gas release even though it was methane explosion protected. After the first drive broke through in July 2012, it took a U-turn to drive the second tube in the opposite direction in just fifteen days. In order to make the U-turn, an air propelled transporter was used to lift the massive TBM (in pieces) by a few millimeters. This allowed trucks to pull and guide the TBM into its new position.

Despite the gassy ground, the segments only used a single EPDM gasket.

REFERENCES

- www.worldhighways.com/sections/key-projects/features/italys-strategic-tunnel-link
4 M30 SOUTHERN BYPASS TUNNEL, MADRID, SPAIN

KEY ASPECTS OF THIS PROJECT ARE:

- Location: Madrid, Spain
- Client: Local Madrid Road Authorities & Telvent Consultancy
- Years built: (2005-2008)
- Length: 11,800 ft, each tube
- Lanes: 2 lanes each way
- Tunnel Type: Automotive, Twin tubes
- Interior diameter: 44’-3”
- TBM diameter: 49’-1”
- TBM Type: EPB (two machines)
- Volume Loss: 0.1 to 0.4 %
- Ground type: alluvial deposits, fissured hard clay, gypsum, sand

The two TBMs used performed very well - one from Herrenknecht and one from Mitsubishi. Both performed well ahead of schedule. However, the Mitsubishi machine which was nearly six months late in being delivered on site. The Herrenknecht TBM completed its drive in eight months — a month ahead of schedule. The Mitsubishi, once started, completed its similar length drive through exactly the same ground, about a month quicker than the Herrenknecht machine.

Portal Zones (very shallow cover) had compensation grouting and mortar pile improvement.

REFERENCES

- www.acciona.us/projects/construction/railways-and-tunnels/m-30-southern-bypass-madrid
- www.khl.com/magazines/international-construction/detail/item8390/Pushing-the-limits
ALASKAN WAY TUNNEL, SEATTLE, WA

KEY ASPECTS OF THIS PROJECT ARE:

- Location: Seattle, Washington
- Client: Washington State Department of Transportation
- Delivery: Public-Private Partnership
- Years built: (2013-2019)
- Length: 2 miles
- Tunnel Type: Single Stacked Tube
- Interior diameter: 52 ft.
- TBM diameter: 57'-3"
- TBM Type: EPB
- Volume Loss: 0.2%
- Ground type: glacial sands, silts, clay, High groundwater table
- Lanes: 2 lanes upper, 2 lanes lower
- Vertical vehicular clearance: 15 ft.

In 2009 government officials decided to replace the Alaskan Way Viaduct with a deep-bore tunnel. The Alaskan Way Tunnel project is being delivered as a public-private-partnership (PPP) between the contracting team of Dragados USA and Tutor Perini, known as Seattle Tunnel Partners, and client Washington State Department of Transportation.

Boring began in July 2013 with the largest diameter tunnel boring machine (TBM) to date. Although originally scheduled for completion in December 2015, the project was halted in December 2013 when it was discovered that the TBM had damaged several of its cutting blades after encountering a steel monitoring-well casing installed during planning for the project. A 120-ft deep recovery pit was dug from the surface over the next two years in order to access and lift the machine for repair and partial replacement. In December 2015, the TBM resumed tunneling but met with another delay due to a sinkhole near the launch pit above the TBM. Tunneling resumed on February 2016 and broke through the exit pit on April 2017. The project is expected to be complete in early 2019. An estimated $223 million in cost overruns were reported as a result of the two year stoppage.

It is anticipated that installing internal structures and systems will take up to two years. This is longer than would be typical for a twin bore tunnels. Installing internal structures

REFERENCES

- http://www.wsdot.wa.gov/Projects/Viaduct/
EURASIA TUNNEL, ISTANBUL, TURKEY

KEY ASPECTS OF THIS PROJECT ARE:

- Location: Istanbul, Turkey
- Client: Turkish Ministry of Transport, Maritime Affairs and Communications
- Delivery: Public Private Partnership (Design-Build-Operate-Transfer)
- Years built: (2011-2016)
- Length: 16,400-ft
- Tunnel Type: Single Stacked Tube
- Interior diameter: 39’-4”
- TBM diameter: 45 ft.
- TBM Type: Skurry
- Vertical vehicular clearance: 9’-10” (cars and van only)
- Volume Loss: unknown – underwater crossing
- Ground type: Alluvial sediment (sandy), sedimentary bedrock

The Eurasia Tunnel opened in December 2016 providing a double deck tunnel under the Bosphorus, thereby connecting the European and Asian parts of Istanbul. With the new tunnel travel was cut to five minutes.

The contractor and Concessionaire was Yapi Merkezi Construction in joint venture with SK Engineering and Construction. The Concessionaire will build and operate the facility for a concession period of 26 years, after which tunnel ownership will pass to the government.

The alignment is located in a seismically active region. The tunnel has been designed to withstand earthquakes up to 7.5 on Richter scale by using two flexible seismic joints. Double EPDM gaskets were used to resist 300-ft head of groundwater water.

Tunneling progressed well, with TBM breakthrough on August 22nd 2015. Tunnel operation started in December 2016.

Longitudinal ventilation was provided by jet fans in the ceiling of each roadway, working in conjunction with two ventilation buildings. The upper roadway deck was cast in situ and the lower deck was formed from precast concrete panels. The decks rested on corbels dowelled into the tunnel lining. The space beneath the lower deck accommodated electrical and mechanical systems, and utilities.

REFERENCES

- Elements of the Istanbul Strait Highway Tunnel, Rapid Excavation and Tunneling Conference, 2015
Key aspects of this project are:

- **Location**: Paris, France
- **Client**: French State
- **Delivery**: Public-Private Partnership
- **Years built**: (1994-2011)
- **Length**:
  - **East Tunnel VL1**: 15,300 ft; open to traffic in July 2009
  - **West Tunnel VL2**: 17,400 ft; open to traffic in January 2011
- **Tunnel type**: Single-Stacked Tube
  - **East Tunnel VL1**: Single tube with two decks. Two lanes + full shoulder each deck, for cars only.
  - **West Tunnel VL2**: Single tube with one deck. Two lanes (one lane each way). All vehicles.
- **Interior diameter**: 34 ft
- **TBM diameter**: 38 ft
- **TBM Type**: Slurry and EPB (convertible)
- **Vertical vehicular clearance**: East Tunnel VL1: 8'-5"; West Tunnel VL2: 14'-9"
- **Ground type**: Fontainebleau Sands, Chalk, Plastic Clay, Rough Limestone, Marl

The A86 Tunnel is the final link of the 80 km ring road around Paris, France and is the world’s longest urban motorway tunnel. It cuts the journey from Malmaison to Versailles to only ten minutes rather than 45 minutes. It includes two tunnels, the East Tunnel with two decks for small vehicles, and the West Tunnel for all vehicles. The double-deck tunnel has two lanes plus a full shoulder on each level. It was due to open in October 2007, but was delayed until July 2009. The West Tunnel has just two lanes total. It was due to open in December 2009 but was delayed until January 2011.

Transverse ventilation was provided, with two double-deck tube (VL1) having a separate pair of fresh air and extraction ducts for the upper and lower tunnels, as shown above. Some longitudinal ventilation is also provided. The tunnel operations center generally has the following personnel: during the day (6h-22h): 2 supervisors and 6 road patrollers; during the night (22h-6h): 2 supervisors and 4 road patrollers.

The project is a public-private partnership between the French government and a concessionaire led by Vinci. Vinci will own and operate the tunnel until 2086, when it will return to the state.

The bi-level tunnel has an intermediate interchange, for connections to local roads.

**REFERENCES**

- [https://international.fhwa.dot.gov/uts/uts_eu06_02.cfm](https://international.fhwa.dot.gov/uts/uts_eu06_02.cfm)