# SHORTLIST OPTIONS ASSESSED

**APPENDIX** 

# The shortlisted options assessed were:

# 1. **ULEV only (<75g/km)**

 Full 2 way access restriction - ULEVs only (i.e. vehicles that emit less than 75g/km)

# 2. ULEV in zero emission mode only

Full 2 way access restriction ULEVs in zero emission mode

#### 3. No Diesel vehicles

Full 2 way 'no diesel vehicles' – diesel ban

# 4. One-way only (westbound), all-vehicles

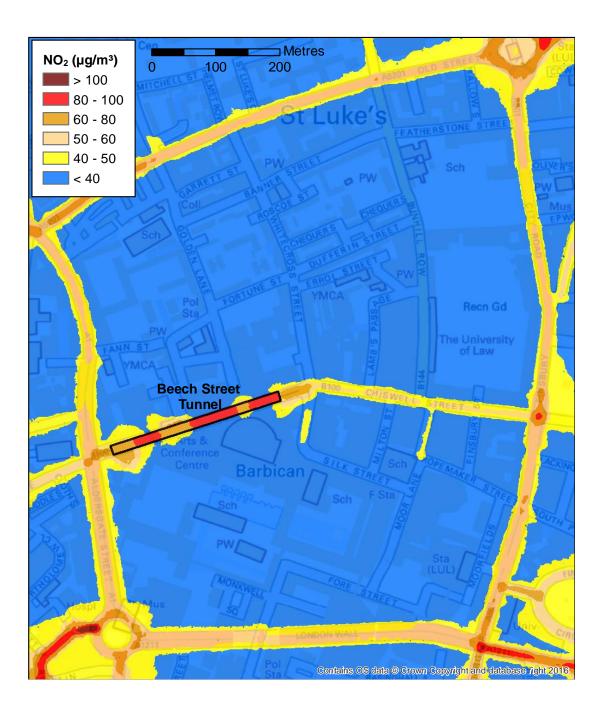
One way westbound traffic (eastbound closure) – no traffic type restrictions westbound

# 5. ULEV only (<75g/km) from Golden Lane

 Retain access for all vehicles as far as Golden Lane + (1.) Full 2 way access restriction - ULEVs only (i.e. vehicles that emit less than 75g/km)

# 6. ULEV only (<75g/km) and one-way only (westbound)

One way westbound traffic (eastbound closure) – westbound ULEVs only (i.e. vehicles that emit less than 75g/km)



# Annual average NO<sub>2</sub> concentration for 2019 ULEZ baseline scenario

## **Scenario Modelling Assumptions**

- Some trip reductions: 7% private cars, 8% vans, 4% coaches. (based on TfLs ULEZ Consultation report)
- For the air quality modelling the ULEZ 2020 forecast fleet compositions have been used as a proxy onto 2019

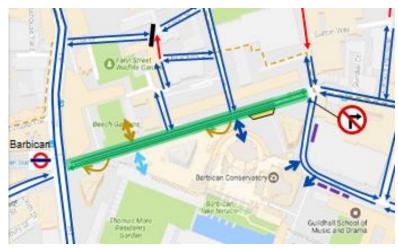
## **Air Quality Modelling Updates**

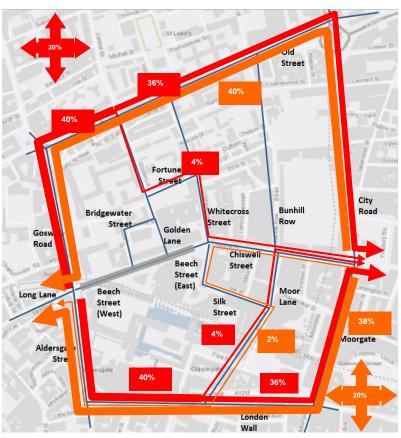
- As part of the model verification CERC reduced the traffic speed assumptions in Beech Street from 21 km/hr (as included in the LAEI) to 10km/hr to match the measured and modelled concentrations; which has the effect of increasing emissions.
- Have now applied the same assumption to Beech Street 2019 scenarios for consistency, slightly increasing concentrations across all scenario.
- Note that we have assumed that none of the 2019 future scenario proposals have any impact on the average traffic speed (and consequently emissions).





# SCENARIO 1 – ULEV ONLY(<75G/KM)





## **Scenario Modelling Assumptions**

#### **Beech Street**

Compliant baseline traffic flows:

- Cars assumes 5% will be compliant, so retain access. Based on forecast ULEV uptake in 2020, and allowing for particularly high forecast localised uptake (Forecast share of total car stock the City13.8% by 2025, WSP|EE 2015 study for TfL)
- Private Hire assumes the same as cars but with an additional 2% uptake, due to incentive schemes and already high levels of petrol hybrid ownership (24%).
- Black Taxis assumes 30% will be ZEC, based on TfL's forecast that 27% of the fleet will be ZEC by 2020, and likely to be higher in the City.
- **Vans/LGV** assumes limited numbers of compliant vehicles (2%) due to more limited availability of models on the market.
- Buses are all assumed to comply. Route 153 to be EVs and double deck buses (Route 76) to be hybrids by 2019/20.
- Compositions of compliant vehicles reflects forecast fleet of 75g/km or less vehicles (i.e. a proportion are hybrids)

#### **Wider Network**

Redistribution of displaced traffic from Beech Street around the wider network

#### Eastbound traffic

- 40% via Goswell Road, 36% continuing via Old Street/ City Road, 4% routing via Golden Lane/ Fortune Street/ Whitecross Lane
- 40% via Aldersgate Street, 36% on via London Wall/ Moorgate,
   4% via London Wall/ Moor Lane/ Chiswell Street

#### Westbound traffic

- 40% via City Road/ Old Street
- 38% via Moorgate/ London Wall, 2% via Chiswell Street/ Moor Lane/ London Wall

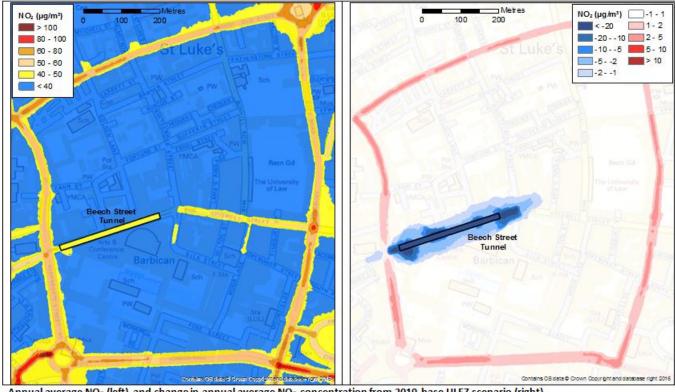
#### Redistributed beyond localised network





# SCENARIO 1 – ULEV ONLY(<75G/KM)

#### Scenario 1



Annual average NO2 (left) and change in annual average NO2 concentration from 2019 base ULEZ scenario (right)

## **Headline Traffic Flow Changes**

#### Westbound

- from 4,264 to 855 vehicles (24 hrs)
- 3,409 vehicles redistributed

- from 3,673 to 624 vehicles (24hrs)
- 3,048 vehicles redistributed

- **Effectiveness Significant improvement in** air quality - only fractionally over limits. Directly promotes ULEV uptake. Significant reduction in exposure to pedestrians/ cyclists throughout.
- **Deliverability/ timescales** Requires DfT Authorisation of 'ULEV', suitable access options & related advanced restriction signs on approaches. Agreement of additional enforcement codes.
- **Stakeholders** Minimal disruption to local residents/businesses. Non-regular visitors and deliveries/collections may face additional administration.
- Risk Likely to require bespoke software to be developed.
- Wider Impacts Few compliant vehicles so results in significant redistribution. 8% increase in annual NOx emissions on surrounding roads - though relatively dispersed. Fits with wider transport strategies but is not consistent with congestion reduction.
- Flexibility/ Scope for up-scaling Limited fixed infrastructure, can be redeployed elsewhere. Repeatable elsewhere over small areas.

Likely	Likely effectiveness in achieving objective				Deliverability	Cost	Risk			Wider		Flexibility/ Scope for up- scaling		
Air qu	uality	Promotion of ULEV uptake, particularly amongst taxis	improvements,	Timescales, consents, permissions		Capital, operation and	Technological maturity, technical obsolescence , legal issues	Safety	Impact on the transport network performance	Air quality impacts of displaced traffic	Fit with wider transport strategies/ schemes	Streetscene impacts	Flexibility/ versatility	Scope for up- scaling
9	)	9	8	5	5	6	6	6	1	3	3	4	6	7





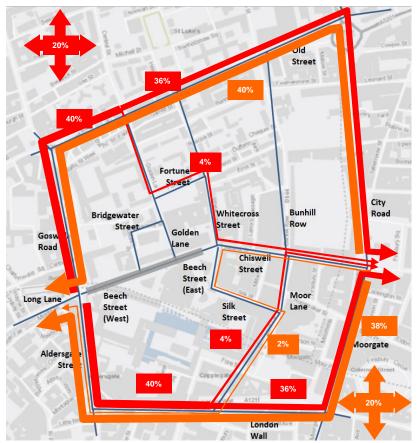


#### **Scenario Modelling Assumptions**

#### **Beech Street**

Compliant baseline traffic flows:

- As per S1, except it is assumed 20% of compliant ULEV cars and private hires would not be able to comply with ZEC requirements
- Composition of compliant vehicles assumes all are operating in EV mode.



#### **Wider Network**

Redistribution of displaced traffic from Beech Street around the wider network

#### Eastbound traffic

- 40% via Goswell Road, 36% continuing via Old Street/ City Road, 4% routing via Golden Lane/ Fortune Street/ Whitecross Lane
- 40% via Aldersgate Street, 36% on via London Wall/ Moorgate, 4% via London Wall/ Moor Lane/ Chiswell Street

#### Westbound traffic

- 40% via City Road/ Old Street
- 38% via Moorgate/ London Wall, 2% via Chiswell Street/ Moor Lane/ London Wall

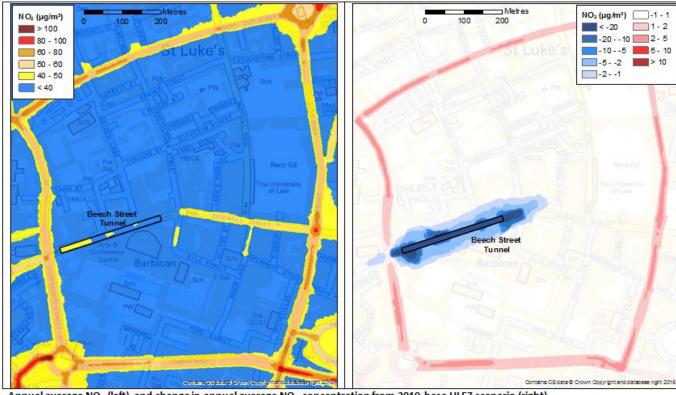
#### Redistributed beyond localised network





# SCENARIO 2 - ULEV IN ZERO EMISSION MODE ONLY

#### Scenario 2



Annual average NO2 (left) and change in annual average NO2 concentration from 2019 base ULEZ scenario (right)

#### **Headline Traffic Flow Changes**

#### Westbound

- from 4,264 to 837 vehicles (24 hrs)
- 3,427 vehicles redistributed

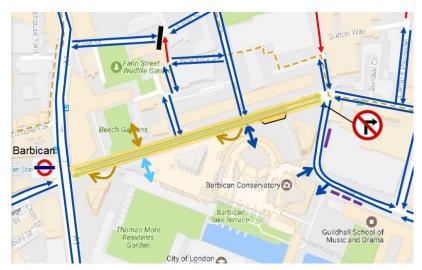
- from 3,673 to 605 vehicles (24hrs)
- 3,068 vehicles redistributed

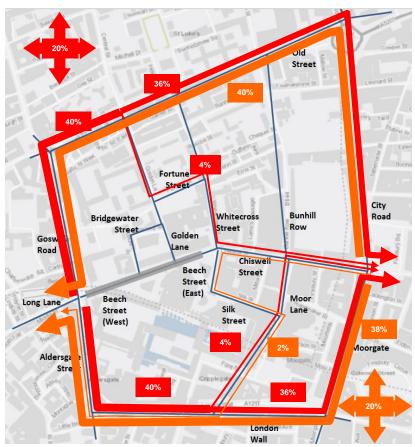
- Effectiveness Significant improvement in air quality - partly within limits and only fractionally over at the eastern end. Directly promotes ULEV uptake (BEVs+non-mild hybrids). Significant reduction in exposure to pedestrians/ cyclists throughout.
- **Deliverability/ timescales Creating brand.** Approval likely to take longer. Feasibility subject to agreement with TfL/GLA.
- Stakeholders Fewer vehicles permitted than under ULEV only schemes. Minimal disruption to local residents/businesses. Non-regular visitors and deliveries/ collections more effected.
- Cost Likely higher set up and operation costs in developing new ZEZ brand and dynamic emissions sensors are deployed.
- Risk Greater technological risk, particularly if dynamic emissions sensors are used to enforce restrictions.
- Wider Impacts Fewest compliant vehicles so results in the greatest redistribution. 8% increase in annual NOx emissions on surrounding roads - relatively dispersed.
- Flexibility/ Scope for up-scaling Limited fixed infrastructure. Greater scope for scaling up in principle, dynamic emissions may be cost prohibitive.

Likely effectiveness in achieving objective				Deliverability	Cost	Risk			Wider	Flexibility/ Scope for up- scaling			
Air quality	Promotion of ULEV uptake, particularly amongst taxis	improvements,	Timescales, consents, permissions		Capital, operation and maintenance		Health & Safety	Impact on the transport network performance	impacts of displaced	Fit with wider transport strategies/ schemes	Streetscene impacts	Flexibility/ versatility	Scope for up- scaling
10	10	10	2	5	3	2	6	1	3	3	4	5	7









## **Scenario Modelling Assumptions**

#### **Beech Street**

Compliant baseline traffic flows:

- Assumes 49% of cars will be compliant based on forecast proportion of diesels in feet, and the same for private hire but with an additional 2% uptake, due to incentive schemes/ petrol hybrid ownership.
- Taxis assumes only the 30% that have switched to ZEC will be compliant, and that the rest are diesels as per forecast fleet compositions.
- Vans, LGVs, and HGVs are all assumed to diesels except the 2% EVs.
- Composition of compliant vehicles reflects forecast fleet for vehicles excluding diesels in 2019 (i.e. petrol, hybrids and EVs).

#### **Wider Network**

Redistribution of displaced traffic from Beech Street around the wider network

#### Eastbound traffic

- 40% via Goswell Road, 36% continuing via Old Street/ City Road, 4% routing via Golden Lane/ Fortune Street/ Whitecross Lane
- 40% via Aldersgate Street, 36% on via London Wall/ Moorgate, 4% via London Wall/ Moor Lane/ Chiswell Street

#### Westbound traffic

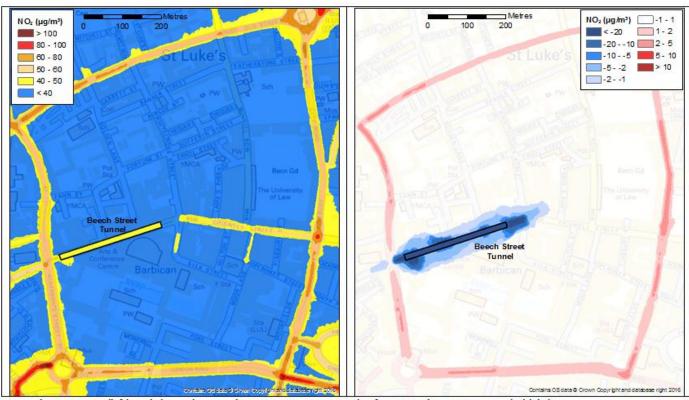
- 40% via City Road/ Old Street
- 38% via Moorgate/ London Wall, 2% via Chiswell Street/ Moor Lane/ London Wall

#### Redistributed beyond localised network





#### Scenario 3



Annual average NO2 (left) and change in annual average NO2 concentration from 2019 base ULEZ scenario (right)

#### **Headline Traffic Flow Changes**

#### Westbound

- from 4,264 to 1,943 vehicles (24 hrs)
- 2,321 vehicles redistributed

#### **Eastbound**

- from 3,673 to 1,684 vehicles (24hrs)
- 1,988 vehicles redistributed

Effectiveness - Significant improvement in air quality. Limited direct promotion of ULEVs - though may work in combination with other incentives. Significant reduction in exposure to pedestrians/ cyclists throughout Deliverability - DfT authorisation of sign required, and suitable access options & related advanced restriction signs on approaches and agreement of additional enforcement codes.

**Stakeholders** - Minimal disruption to local residents/ businesses. Non-regular visitors and deliveries/collections may face some additional administrative burden on businesses, though fewer vehicles are effected than in other scenarios.

**Risk** - Likely to require bespoke software to be developed.

**Wider Impacts** - Results in redistribution of 51% of cars and most vans, LGVs.7.3% increase in annual NOx emissions on surrounding roads - though relatively dispersed.

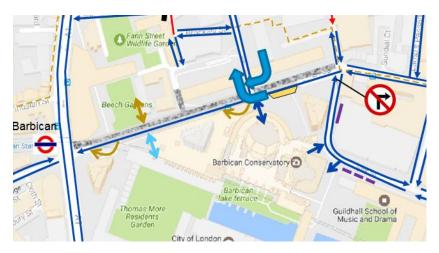
 Flexibility/ Scope for up-scaling - Limited fixed infrastructure, can be redeployed elsewhere. Repeatable elsewhere over small areas.

Likely effectiveness in achieving objective				Deliverability	Cost	Risk		Wider Impacts				Flexibility/ Scope for up- scaling	
Air quality	Promotion of ULEV uptake, particularly amongst taxis	weltare improvements, reduced	Timescales, consents, permissions	onsents, stakeholders – o		Technological maturity, technical obsolescence , legal issues	Safety	Impact on the transport network performance	network displaced strategies/ impacts			Flexibility/ versatility	Scope for up- scaling
8	3	8	3	6	6	6	6	3	4	3	4	6	7





# SCENARIO 4 - ONE-WAY ONLY (WESTBOUND)

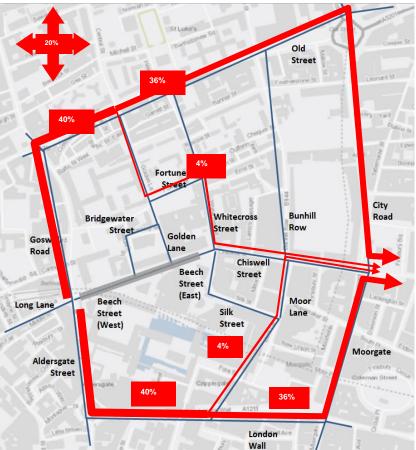


## **Scenario Modelling Assumptions**

#### **Beech Street**

Compliant baseline traffic flows:

- Assumes all accesses currently only accessible to eastbound traffic would be reconfigured, and that westbound flows/profiles are unchanged.
- Composition of compliant vehicles reflects forecast fleet for vehicles in 2019 (accounting for the ULEZ).



#### **Wider Network**

Redistribution of displaced traffic from Beech Street around the wider network

#### Eastbound traffic

- 40% via Goswell Road, 36% continuing via Old Street/ City Road, 4% routing via Golden Lane/ Fortune Street/ Whitecross Lane
- 40% via Aldersgate Street, 36% on via London Wall/ Moorgate, 4% via London Wall/ Moor Lane/ Chiswell Street

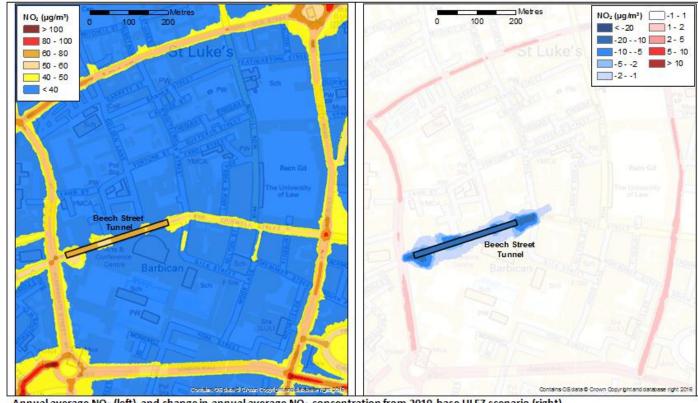
#### Redistributed beyond localised network





# SCENARIO 4 - ONE-WAY ONLY (WESTBOUND)

#### Scenario 4



Annual average NO2 (left) and change in annual average NO2 concentration from 2019 base ULEZ scenario (right)

#### **Headline Traffic Flow Changes**

#### Westbound

- from 4,264 to 4,264 vehicles (24 hrs)
- vehicles redistributed

- from 3,673 to 0 vehicles (24hrs)
- 3,673 vehicles redistributed

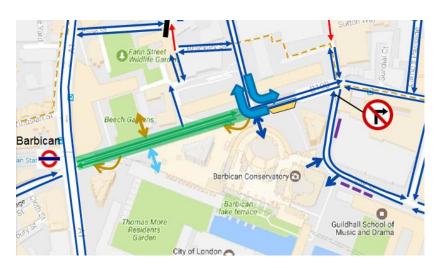
- Effectiveness Improvement in air quality remains well over limits. No promotion of ULEV uptake. Exposure amongst pedestrians/ cyclists is still well over legal limits throughout.
- **Deliverability** Standard TMO protocols and consultations. Reconfiguration of access arrangements. Measures could be implemented on a temporary basis relatively quickly in principle.
- Stakeholders Some reductions in accessibility from the east.
- **Cost** Potentially higher upfront capital costs to implement, but lower ongoing costs
- Risk Conventional engineering.
- Wider Impacts Results in the least redistribution of traffic onto the wider network, and none westbound. 3.8% increase in annual NOx emissions on surrounding roads - though relatively dispersed
- Flexibility/ Scope for up-scaling Could be implemented as a trial closure Once completed is relatively inflexible, limited scope for repeating more widely.

Likely eff	Likely effectiveness in achieving objective			Deliverability	Cost	Risk		Wider Impacts				Flexibility/ Scope for up- scaling		
Air qua	Promotion ULEV upt particula amongst t	welfare improvements	Timescales, consents, permissions		Capital, operation and	Technological maturity, technical obsolescence , legal issues	Safety	Impact on the transport network performance	Air quality impacts of displaced traffic	Fit with wider transport strategies/ schemes	Streetscene impacts	Flexibility/ versatility	Scope for up- scaling	
5	0	5	7	5	2	9	6	4	5	4	6	4	1	





# SCENARIO 5 - ULEV ONLY FROM GOLDEN LANE (<75G/KM)6

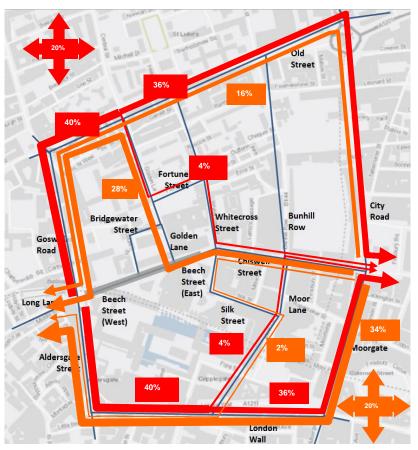


## **Scenario Modelling Assumptions**

#### **Beech Street**

Compliant baseline traffic flows:

As per S1, except Beech Street East flows are assumed to be as per the 2019 Base with ULEZ flows



#### **Wider Network**

Redistribution of displaced traffic from Beech Street around the wider network

#### Eastbound traffic

- 40% via Goswell Road, 36% continuing via Old Street/ City Road, 4% routing via Golden Lane/ Fortune Street/ Whitecross Lane
- 40% via Aldersgate Street, 36% on via London Wall/ Moorgate, 4% via London Wall/ Moor Lane/ Chiswell Street

#### Westbound traffic

- 16% via City Road/ Old Street
- 28% via Chiswell Street/ Golden Lane
- 34% via Moorgate/ London Wall, 2% via Chiswell Street/ Moor Lane/ London Wall

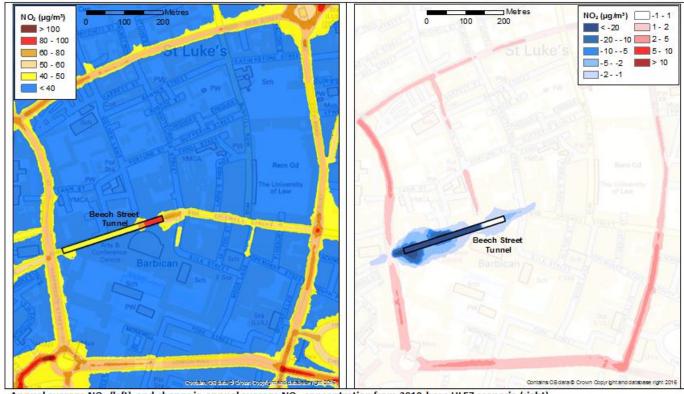
#### Redistributed beyond localised network





# SCENARIO 5 - ULEV ONLY FROM GOLDEN LANE (<75G/KM)7

#### Scenario 5



Annual average NO2 (left) and change in annual average NO2 concentration from 2019 base ULEZ scenario (right)

#### **Headline Traffic Flow Changes**

#### Westbound

- from 4,264 to 855 vehicles in the western section, and unchanged from 4,009 in the eastern section (24 hrs)
- **3,409** vehicles redistributed from western section, **0** from east

- from 3,673 to 3,673 vehicles in the eastern section, and from 2,933 to 583 in the western section (24hrs)
- **0** vehicles redistributed from eastern section, **2,350** from west section.

- Effectiveness Significant improvement in air quality - only fractionally over limits on western end. Eastern end remains well over limits. Directly promotes ULEV uptake. Significant reduction in exposure to pedestrians/ cyclists - though well over legal limits on the unrestricted eastern end.
- Deliverability Golden Lane/ visitor car park junction may need to be re-designed, but not complex. DfT Authorisation of 'ULEV' required, and suitable access options & related advanced restriction signs on approaches.
- Stakeholders Fewer vehicles restricted than under ULEV only schemes applied to the full extent of the street.
- Risk Likely to require bespoke software to be developed.
- Wider Impacts Few compliant vehicles so results in significant redistribution particularly westbound traffic via Golden Lane. 6.7% increase in annual NOx emissions on surrounding roads - though relatively dispersed so only small increases.
- Flexibility/ Scope for up-scaling Limited fixed infrastructure, can be redeployed elsewhere. Repeatable elsewhere over small areas.

Likely effecti	Likely effectiveness in achieving objective			Deliverability		Risk		Wider Impacts				Flexibility/ Scope for up- scaling		
Air quality	Promotion of ULEV uptake, particularly amongst taxis	welfare improvements, reduced	Timescales, consents, permissions		Capital, operation and	Technological maturity, technical obsolescence , legal issues	Safety	Impact on the transport network performance	Air quality impacts of displaced traffic	Fit with wider transport strategies/ schemes	Streetscene impacts	Flexibility/ versatility	Scope for up- scaling	
7	8	6	6	5	6	6	6	2	4	3	4	6	7	





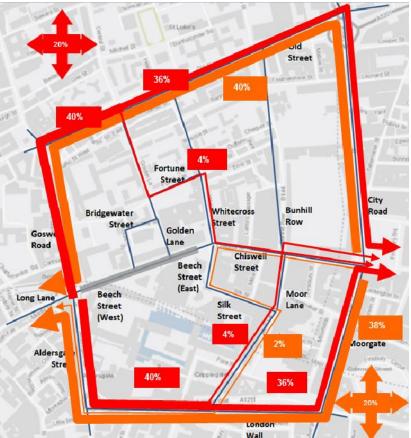


## **Scenario Modelling Assumptions**

#### **Beech Street**

Compliant baseline traffic flows:

As per S1, except all eastbound traffic is restricted as per S4, with the street operating one-way westbound only for ULEVs.



#### **Wider Network**

Redistribution of displaced traffic from Beech Street around the wider network

#### Eastbound traffic

- 40% via Goswell Road, 36% continuing via Old Street/ City Road, 4% routing via Golden Lane/ Fortune Street/ Whitecross Lane
- 40% via Aldersgate Street, 36% on via London Wall/ Moorgate, 4% via London Wall/ Moor Lane/ Chiswell Street

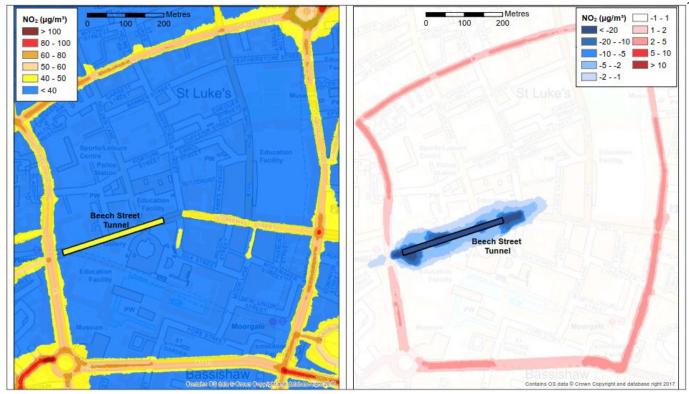
#### Westbound traffic

- 40% via City Road/ Old Street
- 38% via Moorgate/ London Wall, 2% via Chiswell Street/ Moor Lane/ London Wall

#### Redistributed beyond localised network







#### **Headline Traffic Flow Changes**

#### Westbound

- from 4,264 to 855 vehicles (24 hrs)
- 3,409 vehicles redistributed

- from 3,673 to 0 vehicles (24hrs)
- 3,673 vehicles redistributed

- **Effectiveness Significant improvement in air** quality - only fractionally over limits. Directly promotes ULEV uptake. Significant reduction in exposure to pedestrians/ cyclists.
- **Deliverability/ timescales** Requires DfT Authorisation of 'ULEV', suitable access options & related advanced restriction signs on approaches. Agreement of additional enforcement codes. Lane closure requires standard TMO protocols and consultations. Reconfiguration of access arrangements. Measures could be implemented on a temporary basis relatively quickly in principle.
- Stakeholders Some reductions in accessibility from the east.
- Risk Conventional engineering, but likely to require bespoke software to be developed for enforcement.
- Wider Impacts Few compliant vehicles so results in significant redistribution. 8.8% increase in annual NOx emissions on surrounding roads - though relatively dispersed. Good fit with the Cultural Hub proposals, but not consistent with congestion reduction.
- Flexibility/ Scope for up-scaling Could be implemented as a trial closure Once completed is relatively inflexible, limited scope for repeating more widely.

Likely effecti	Likely effectiveness in achieving objective			Deliverability		Risk		Wider Impacts				Flexibility/ Scope for up- scaling		
Air quality	Promotion of ULEV uptake, particularly amongst taxis	weltare improvements, reduced	Timescales, consents, permissions		Capital, operation and	Technological maturity, technical obsolescence , legal issues	Safety	Impact on the transport network performance	Air quality impacts of displaced traffic	Fit with wider transport strategies/ schemes	Streetscene impacts	Flexibility/ versatility	Scope for up- scaling	
9	9	9	4	5	5	5	5	1	2	6	6	4	5	





# AIR QUALITY MODELLING – SUMMARY COMPARISON

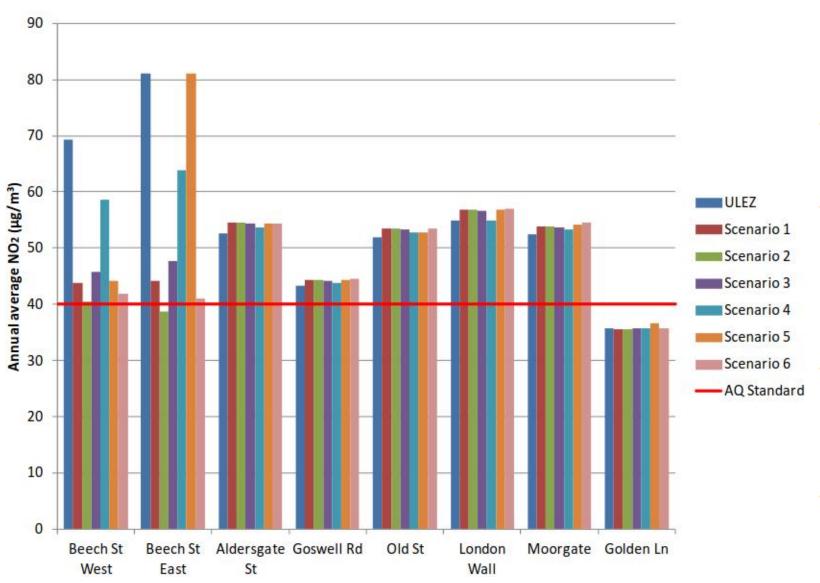
Measured NO <sub>2</sub> concentrations at Bee Street	ech	NO <sub>2</sub> - Annual average
Air Quality Standard		< 40
Measured 2015		89
Measured 2016		84
2016 with Beech Street zero emission	42	
2019 Base (with ULEZ)	West	69
2019 Dase (WILLI OLEZ)	East	81
Scenario 1 - ULEVs only	West	44
Scenario 1 - OLEVS Only	East	44
Scenario 2 - ULEVs in zero	West	40
emission mode only	East	39
Scenario 3 - Full 2 way 'no diesel	West	46
vehicles'	East	48
Scenario 4 - One way westbound	West	59
traffic	East	64
Scenario 5 - Retain access for all	West	44
vehicles as far as Golden Lane	East	81
Scenario 6 - ULEV Only one way	West	42
westbound traffic	East	41

- Concentrations of NO<sub>2</sub> fall as a consequence of the ULEZ and changing fleet composition in 2019, but remains above the air quality standard of 40 μg/m<sup>3</sup>.
- Even with emissions from Beech Street reduced to zero in 2016, likely to still exceed the air quality standard
- Scenario 2 is the most effective, closely followed by Scenario 6.
- Scenarios 1, 3 and part of 5 all achieve significant reductions.
- Scenarios 4 and part of 5 fall short of the desired improvements in air quality.





# AIR QUALITY MODELLING



Annual average NO<sub>2</sub> concentrations at representative locations for each Scenario

- Scenario 2 is the most effective in reducing Annual NOx emissions in Beech Street (-96%).
- Scenarios 6, 1 and 3 are also highly effective
  - Scenarios 1, 6 and 2 correspondingly result in the largest increases in Annual NOx emissions on the wider network (+8%)
  - Though the impact of the displaced traffic on air quality on the wider network is marginal.
- Beech Street tunnel traps and amplifies the impacts of emissions – so not a zero sum equation.





			1	2	3	4	5	6	7	8	9		10	11	12	13
			Likely effe	ctiveness in ach	nieving objective	Deliv	erability	Cost	Risk			Wider Im	pacts		Flexibility/ up-sc	
	Multi-Criteria Assessment			Promotion of ULEV uptake, particularly amongst taxis	Health and welfare improvements, reduced exposure	consents,	Acceptability to stakeholders – inconvenience	Capital, operation and maintenance	Technological maturity, technical obsolescence, legal issues	Health & Safety	Impact on the transport network performance	Air quality impacts of displaced traffic	Fit with wider transport strategies/schemes	impacis	Flexibility/	
Unweighted Score	Weighted Score	Shortlisted Scenarios	15.0%	15.0%	10.0%	15.0%	15.0%	5.0%	2.5%	2.5%	5.0%	2.5%	5.0%	2.5%	2.5%	2.5%
73.0	61.8	1.) ULEV Only (<75g/km)	9	9	8	5	5	6	6	6	1	3	3	4	6	7
67	59	2.) ULEVs in zero emission mode	10	10	10	2	5	3	2	6	1	3	3	4	5	7
68	51	3.) Full 2 way 'no diesel vehicles'	8	3	8	3	6	6	6	6	3	4	3	4	6	7
67	45	4.) One way westbound	5	0	5	7	5	2	9	6	4	5	4	6	4	1
71	58.5	5.) ULEV Only (<75g/km) from Golden Lane	7	8	6	6	5	6	6	6	2	4	3	4	6	7
75	62.3	6.) ULEV Only (<75g/km) Westbound only	9	9	9	4	5	5	5	5	1	2	6	6	4	5

- **Scenario 1** (ULEV Only) performs well in both the weighted and un-weighted assessment, scoring well on effectiveness in realising strategic objectives, without the added delivery challenges of S2.
- **Scenario 2** (ULEVs in zero emission mode) performs well, particularly in its effectiveness at realising strategic objectives, but is less deliverable, more costly and higher risk.
- **Scenario 3** ('no diesel vehicles') is highly effective in addressing air quality, whilst displacing less traffic. But contributes little towards a key strategic objective for promoting ULEV uptake.
- **Scenario 4** (One-way only (westbound)) delivers relatively poorly against all key objectives, despite scoring more favourably in deliverability, risk and with lesser wider impacts.
- Scenario 5 (ULEV Only from Golden Lane) is partly successful in achieving the key objectives, and potentially more deliverable with fewer private accesses to manage within the scheme, but may result in undesirable re-routing via Golden Lane.
- **Scenario 6** ULEV Only (<75g/km) Westbound only performs bestin both the weighted and un-weighted assessment, scoring well on effectiveness in realising strategic objectives, and fit with wider strategies by facilitating the Cultural Hub proposals.