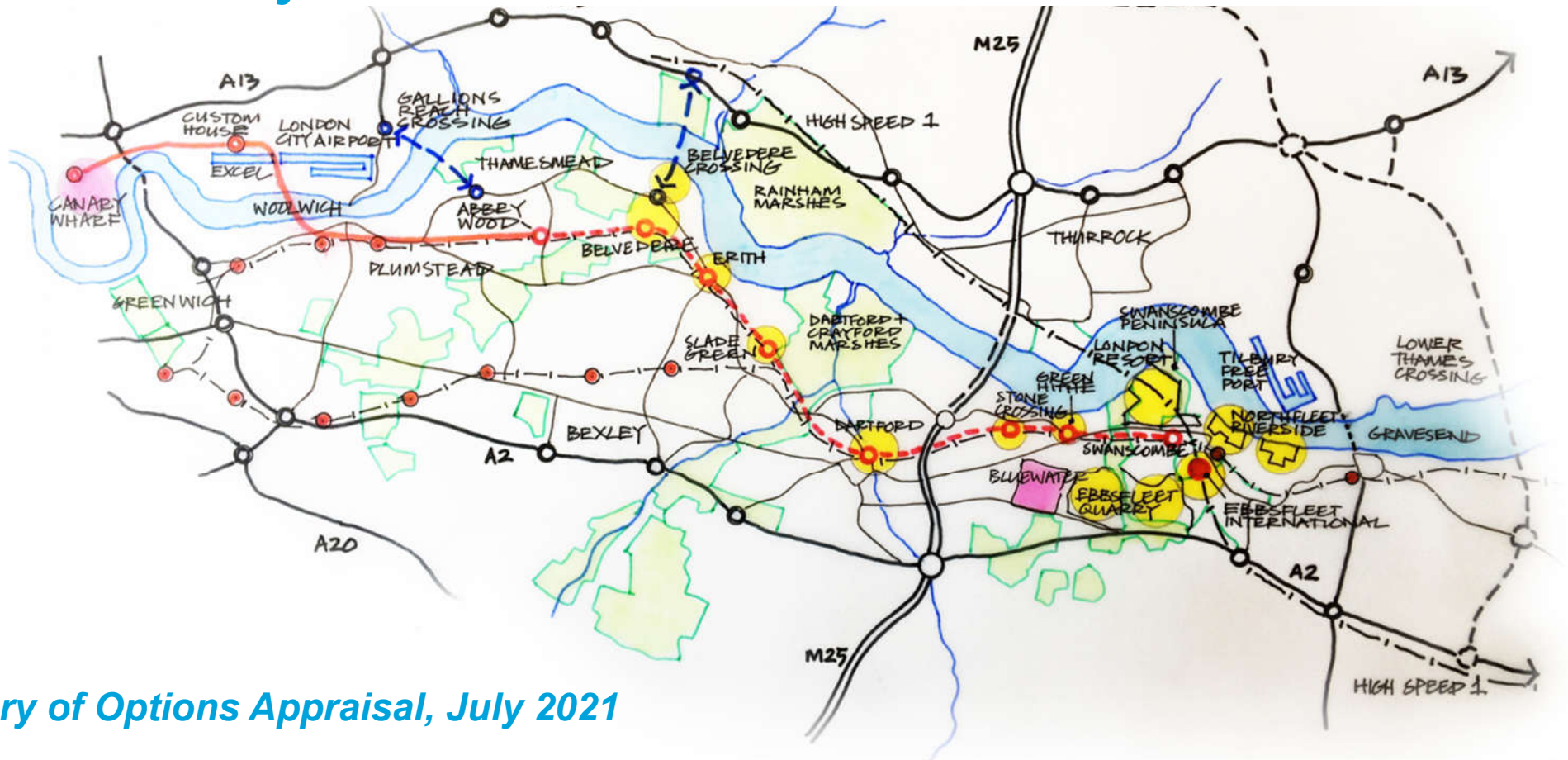


Study into Proposed Transport Enhancement Options between Abbey Wood and Ebbsfleet



Summary of Options Appraisal, July 2021

ATKINS Jacobs

THE C2E PARTNERSHIP



Contents

This pack summarises the options assessment undertaken since the January-March 2021 public consultation. The pack is structured as follows:

- **Introduction**
- **Step 1: Sift from five to three Options**
- **Step 2: Option Variant Testing (Optimisation Phase)**
- **Step 3: Low Cost Option Variant Testing (Further Optimisation Phase)**
- **Summary of Proposed Options (the three options to be considered in this second consultation)**
- **Next Steps**
- **Technical Annexes:**
 - Annex A - Assessment Results for each Objective and CSR – five options to three options
 - Annex B - Variant Options - Specifications
 - Annex C - Variant Options - Conclusions



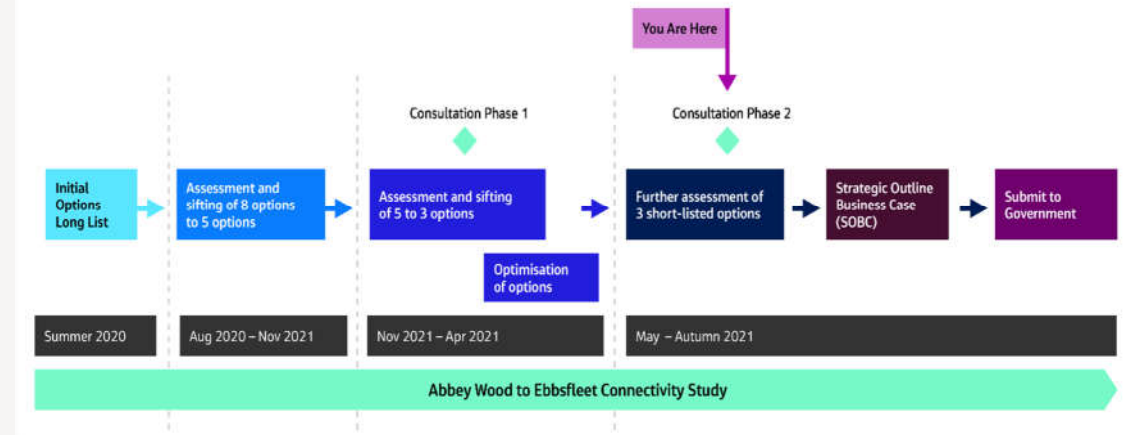
Introduction



Option Development Approach

The following summary sets out the different stages of work undertaken to date:

- **Summer 2020:** a longlist of 30 potential options to improve transport capacity and connectivity were assessed, with eight options chosen to be taken forward for further assessment

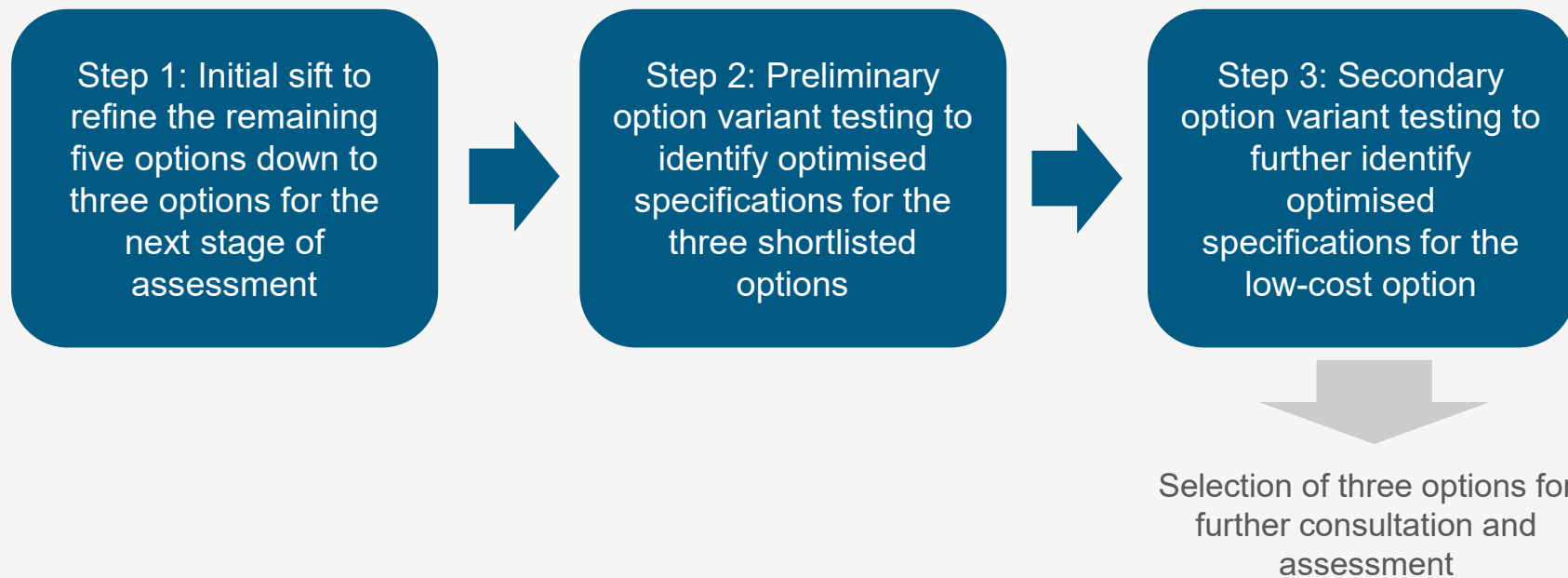


- **Autumn 2020:** The study consultant team reviewed the eight short-listed options from the Summer 2020 longlist and developed service specifications to enable completion of initial options assessment and sifting. Five options were then chosen to be taken forward for further assessment. This work was shared in the previous public consultation (Jan-Mar 2021) and benefitted from liaison with key stakeholders.
- **Spring/Summer 2021:** The five remaining options were taken forward for further assessment, and refined to propose three options to be taken forward for the next stage of review. This latest assessment has been shared as part of this current public consultation with details provided on the following pages. The options will be reviewed further following receipt of consultation feedback and through continued liaison with key stakeholders.



Spring 2021 Options Assessment

The **Spring 2021 assessment** (the work carried out since the previous consultation) was undertaken across a three step process:



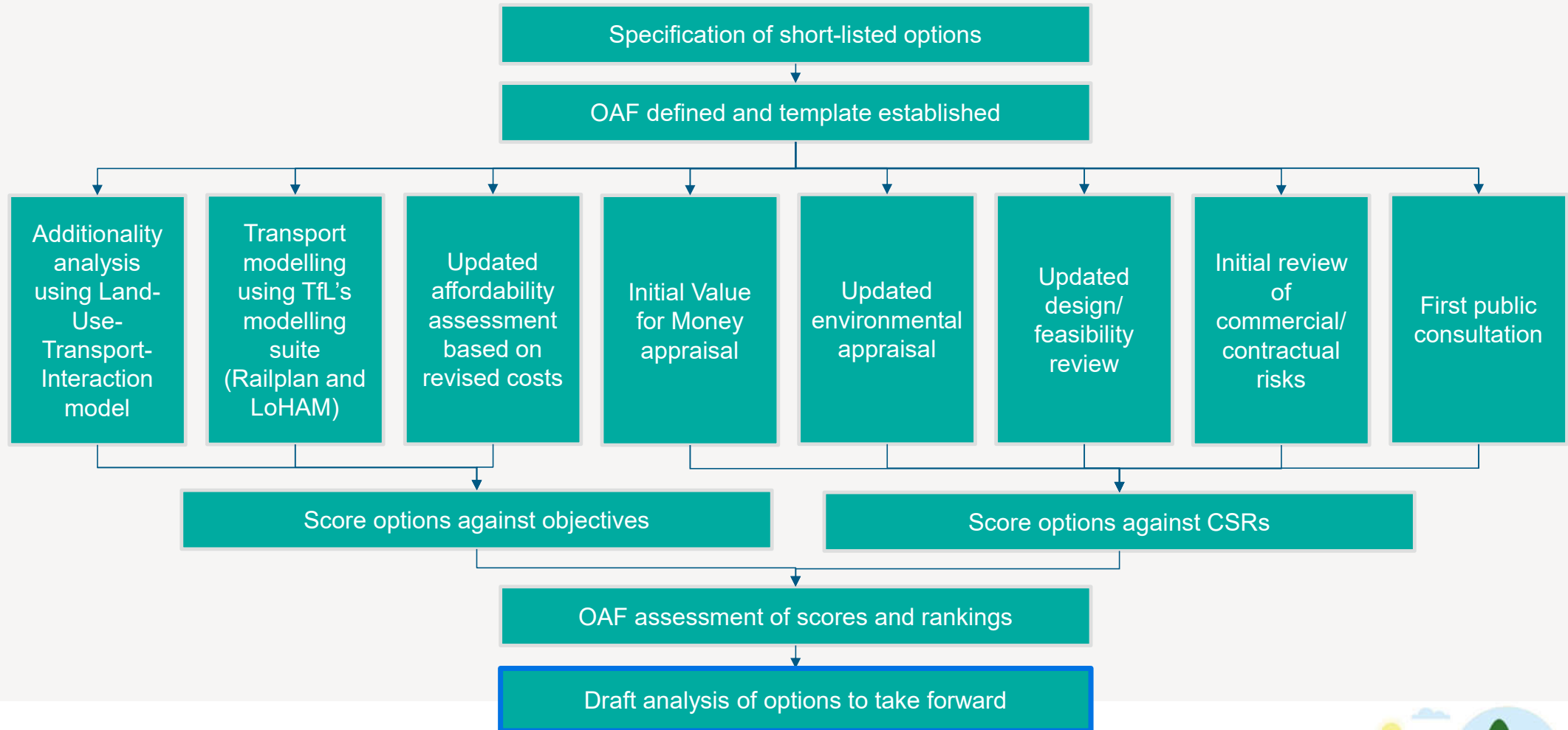
How the Options Appraisal Framework (OAF) Works

The assessment of the five options has been undertaken following an approach in line with DfT Early Assessment and Sifting Tool (EAST) Guidance:

- All short-listed schemes have been scored against each project objective and Critical Success Requirement (CSR), which are presented in the later slides
- Some objectives / CSRs divided into components
- All schemes scored on a 5-point scale (1 for the worst performing score, 5 for the best performing score) to allow for consistency and comparability of results
- Mix of quantitative and qualitative (professional judgement-based) scores
- Review of option complementarity to inform scheme definition for subsequent assessment



Options Appraisal Framework (OAF) Work Flow Process



Objectives and Critical Success Requirements (CSRs)

Objectives

A. **Support ambitious and sustainable housing growth and regeneration** in the Bexley Riverside-North Kent Corridor (“the Corridor”) by increasing the deliverability of development sites through improved public transport accessibility.

B. **Support employment growth, intensification and productivity**, by improving public transport connectivity to major employment centres, services and amenities including Central London’s key employment locations (City, West End and Docklands), and within the Corridor.

C. **Deliver an uplift in the quality and capacity of public transport** to address current and future travel demands in the Corridor, by reducing travel times (including the impact on the intermediate stations which aren’t served by HS1), to major employment centres, services and amenities; improving service frequency, reliability and resilience; and reducing congestion and crowding.

D. **Support climate change and zero carbon goals and targets and environmentally sustainable growth**, by incentivising modal shift from private to public transport, providing alternatives to existing and new car-based travel demand within the Corridor (including from established urban areas and new key development sites) and enabling integrated transport and spatial planning in the corridor.

E. **Improve connectivity from the Corridor to key strategic and international gateways**.

F. **Affordability** - intervention must be affordable and have realistic funding prospects.

Critical Success Requirements (CSRs)

1. **Value for Money (VfM)** – scheme must offer medium to high VfM to the UK tax payer.

2. **Infrastructure delivery** – scheme must be considered technically feasible and deliverable at a satisfactory level of risk.

3. **Implementation disruption to transport network** – should be considered acceptable as defined by the relevant transport delivery body and DfT.

4. **Operational delivery** – scheme should be defined as operationally feasible and deliverable at a satisfactory level of risk.

5. **Resilience to future demands** – scheme should offer reasonable resilience to future demands identified in agreement with the relevant transport delivery bodies, in particular with reference to impacts on existing rail and highways network.

6. **Environmental impact** – scheme must be deliverable at an acceptable level of impact.

7. **Land and property impacts** – scheme must be deliverable at an acceptable level of impact.

8. **Stakeholder acceptability** – scheme must have stakeholder support, feasibility/operational risks must be acceptable to stakeholders.



Categories for each Objective and CSR using the 5-Point Scale

Outcomes

Component / Score	1	2	3	4	5
Objective A: housing unlocked (number of new units)	Very low impact	Low impact	Medium impact	High impact	Very high impact
Objective A: socio-distribution (total generalised minutes saved for trips to top 20% IMD areas)	Very low impact	Low impact	Medium impact	High impact	Very high impact
Objective B: employment unlocked (number of new jobs)	Very low impact	Low impact	Medium impact	High impact	Very high impact
Objective B: impacts on London's labour catchment (net land value uplift)	Very low impact	Low impact	Medium impact	High impact	Very high impact
Objective C: public transport connectivity (total generalised minutes saved across model areas)	Very low impact	Low impact	Medium impact	High impact	Very high impact
Objective D: climate change ¹ (total generalised minutes saved)	Same metric as Objective C				
Objective E: gateways connectivity (total generalised minutes saved to int gateways from corridor)	Very low impact	Low impact	Medium impact	High impact	Very high impact
CSR5: future resilience (crowding change in hours across model network)	Very low resilience	Low resilience	Medium resilience	High resilience	Very high resilience

¹ 'Mode shift' was used to indicate how well each option supports climate change and zero carbon goals and targets and environmentally sustainable growth. Mode shift was not explicitly modelled at this stage, therefore the identified journey time savings have been used as a 'proxy' for estimating mode shift potential (i.e. how much the option would incentivise people to switch to making journeys by public transport, rather than car).

Deliverability

Component / Score	1	2	3	4	5
CSR1 (Value for Money)	Very poor / poor VfM	Low VfM	Medium VfM	High VfM	Very high VfM
CSR2 (infrastructure delivery)	Very high risk	High risk	Medium risk	Low risk	Very low risk
CSR3 (implementation disruption)	Very high risk	High risk	Medium risk	Low risk	Very low risk
CSR4 (operational delivery)	Very high risk	High risk	Medium risk	Low risk	Very low risk
CSR6 (carbon review)	Greatest total carbon equivalent impact	Scaled up from 1-5			Least total carbon equivalent impact
CSR6 (environmental features)	Very high risk	High risk	Medium risk	Low risk	Very low risk
CSR7 (land and property impacts)	Very high risk	High risk	Medium risk	Low risk	Very low risk
CSR8 (stakeholder engagement)	Significant stakeholder issues	Scaled up from 1-5			Highly acceptable
Objective F (affordability)	Most challenging	Scaled up from 1-5			Most affordable
Commercial / contractual risk	Very high risk	High risk	Medium risk	Low risk	Very low risk



Inputs for Objective Scoring

- Objectives A and B (unlocking housing and employment) are based on outputs from the Land-Use Model Influenced by Transport (LUMIT), as well as updated masterplanning and viability work, in turn, drawing on outputs from TfL's Railplan public transport assignment model and the London Highway Assignment Model (LoHAM)
- Objective A (socio-distributional impacts) has been assessed using changes in connectivity reported by the Railplan model, to and from areas in the corridor with high levels of deprivation, reported as Indices of Multiple Deprivation (IMD)
- Objectives C, D and E (public transport connectivity) and CSR5 (resilience to future demands) are based on outputs from the Railplan model, while the assessment of the Bus Rapid Transit option also draws on outputs from LoHAM
- Objective F is based on further analysis of potential sources of funding, considering LUMIT outputs on net additional housing and employment space growth; feedback from consultation with local authorities and the GLA; and consideration of other potential mechanisms which were not considered in the previous assessment – both local sources and central government



Inputs to Critical Success Requirement Scoring

- CSR1 (VfM) is based on indicative quantified Cost-Benefit Analysis (CBA) utilising updated cost information and monetised outputs from the Railplan model, plus off-model techniques
- CSRs 2, 3, 4 and 7 (engineering and operational feasibility) scores have been amended based on emerging outputs from the latest operational and engineering feasibility studies
- CSR6 (environmental impacts) is based on an updated environmental appraisal, including an additional embodied carbon review
- CSR8 (stakeholder acceptability) is based on the outputs from technical stakeholder and public consultation activities undertaken (not considered in the previous assessment)
- A new separate element has also been introduced and scored to capture the issue of commercial and contractual risks related to delivering each option (for example related to the requirement to revise or adapt service delivery or rolling stock contractual arrangements)

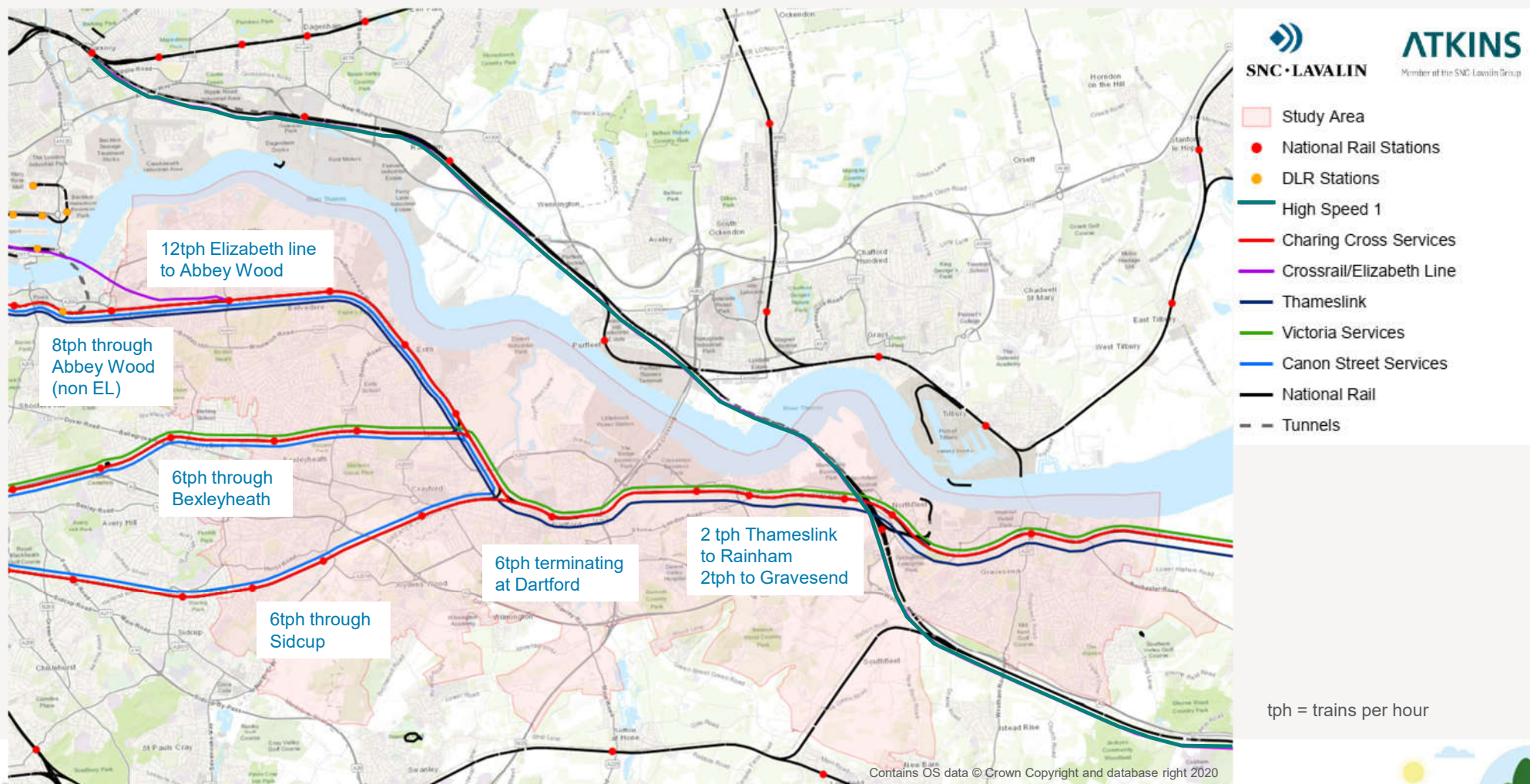


Step 1: Sift from five to three options

This step involved assessment of the five options as presented at the previous consultation stage to determine the relative 'performance' of the options against the objectives and Critical Success Requirements and to identify which options to discount from further consideration. See Annex A – slide 52 – for more details on the scoring of options.



2031 Reference Case – Assumed Rail Network

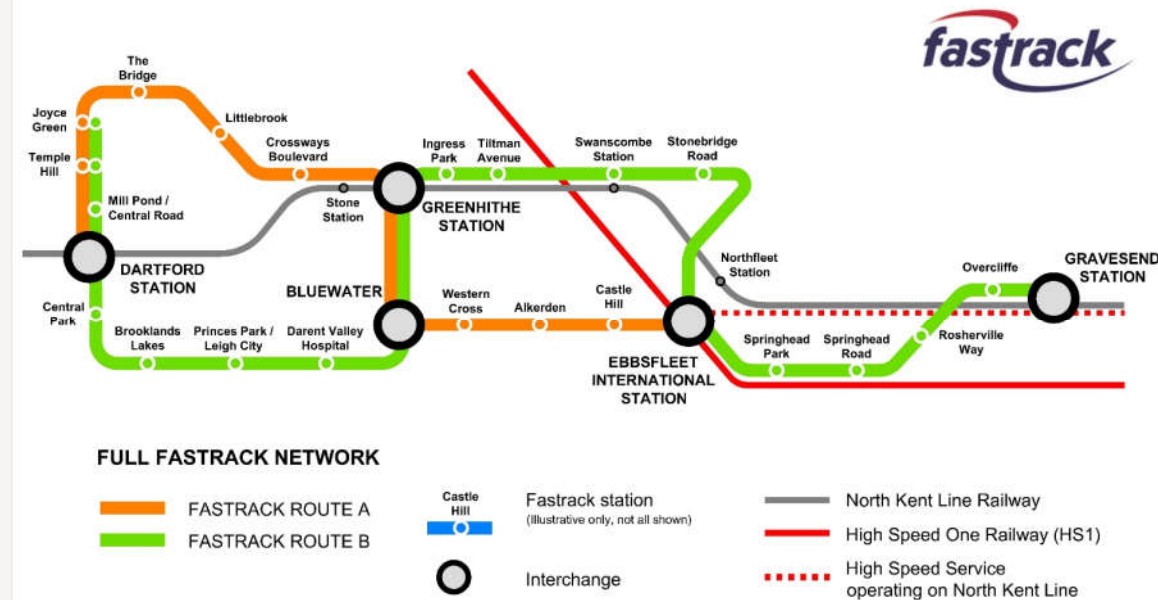


2031 Reference Case - Bus Rapid Transit Network

Base case = BRT (Fastrack) Dartford - Bluewater - Gravesend

- Existing routes A and B, plus committed BRT infrastructure between Bluewater and Ebbsfleet via Eastern Quarry. On completion route A extends from Bluewater via Eastern Quarry to Ebbsfleet then Gravesend via Northfleet Embankment, expected by end 2022
- Fastrack is part segregated, part on street with priority
- 6 buses per hour on each of routes A and B (as at present). This is considered appropriate for a “turn up and go” service. 40-seat buses: seated capacity is 240 seats / hour / direction
- Current average journey times to nearest rail station = 5-7 minutes
- Current operating speed c. 25 kph
- Average spacing between stops c. 500 metres
- BRT frequency can be scaled up to meet demand. The current frequency of 6bph could comfortably increase to 12 or 18 using existing infrastructure

Fastrack ‘Do Minimum’ Network



REV 2 NOV 2018



Arriva Kent Thameside Local Bus and Fastrack Network in the Study Area (2020)



Options Summary

Option Category	Option No.	Option Summary	Service Uplift	Preliminary Cost Categorisation										
Crossrail Extension	C4	Crossrail extension to Ebbsfleet (all mixed running from Abbey Wood)	Crossrail 6tph extended from Abbey Wood to Northfleet	<table><tr><td>Very Low</td><td>Low</td><td>Moderate</td><td>High</td><td>Very High</td></tr><tr><td>(<£0.4bn)</td><td>(£0.4bn-£0.8bn)</td><td>(£0.8bn-£1.6bn)</td><td>(£1.6bn-£3.2bn)</td><td>(>£3.2bn)</td></tr></table>	Very Low	Low	Moderate	High	Very High	(<£0.4bn)	(£0.4bn-£0.8bn)	(£0.8bn-£1.6bn)	(£1.6bn-£3.2bn)	(>£3.2bn)
	Very Low	Low	Moderate	High	Very High									
	(<£0.4bn)	(£0.4bn-£0.8bn)	(£0.8bn-£1.6bn)	(£1.6bn-£3.2bn)	(>£3.2bn)									
C5 + A2	Crossrail extension to Dartford (segregated Abbey Wood to Dartford); extension to Northfleet of existing National Rail services terminating at Dartford	Crossrail 12tph (10tph off-peak) to Dartford, calling all stations. National Rail 8tph (4tph off-peak) extended to Northfleet, calling all stations	<table><tr><td>Very Low</td><td>Low</td><td>Moderate</td><td>High</td><td>Very High</td></tr><tr><td>(<£0.4bn)</td><td>(£0.4bn-£0.8bn)</td><td>(£0.8bn-£1.6bn)</td><td>(£1.6bn-£3.2bn)</td><td>(>£3.2bn)</td></tr></table>	Very Low	Low	Moderate	High	Very High	(<£0.4bn)	(£0.4bn-£0.8bn)	(£0.8bn-£1.6bn)	(£1.6bn-£3.2bn)	(>£3.2bn)	
Very Low	Low	Moderate	High	Very High										
(<£0.4bn)	(£0.4bn-£0.8bn)	(£0.8bn-£1.6bn)	(£1.6bn-£3.2bn)	(>£3.2bn)										
C5 + Shared Running	Crossrail extension to Dartford (segregated Abbey Wood to Dartford); some services then extended to Northfleet via shared running with National Rail services	Crossrail 12tph (10tph off-peak) Abbey Wood to Dartford, calling all stations. Crossrail 6tph running on to Northfleet (calling all stations).	<table><tr><td>Very Low</td><td>Low</td><td>Moderate</td><td>High</td><td>Very High</td></tr><tr><td>(<£0.4bn)</td><td>(£0.4bn-£0.8bn)</td><td>(£0.8bn-£1.6bn)</td><td>(£1.6bn-£3.2bn)</td><td>(>£3.2bn)</td></tr></table>	Very Low	Low	Moderate	High	Very High	(<£0.4bn)	(£0.4bn-£0.8bn)	(£0.8bn-£1.6bn)	(£1.6bn-£3.2bn)	(>£3.2bn)	
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Other Rail	E1	Amendments to National Rail services between Abbey Wood and Northfleet to deliver an additional 6tph between Dartford and Northfleet	2tph new shuttle between Abbey Wood and Northfleet, calling all stations 2tph Dartford terminators extended to Northfleet, calling all stations. 2tph former circular service diverted from Bexleyheath Line to Northfleet, calling all stations.	<table><tr><td>Very Low</td><td>Low</td><td>Moderate</td><td>High</td><td>Very High</td></tr><tr><td>(<£0.4bn)</td><td>(£0.4bn-£0.8bn)</td><td>(£0.8bn-£1.6bn)</td><td>(£1.6bn-£3.2bn)</td><td>(>£3.2bn)</td></tr></table>	Very Low	Low	Moderate	High	Very High	(<£0.4bn)	(£0.4bn-£0.8bn)	(£0.8bn-£1.6bn)	(£1.6bn-£3.2bn)	(>£3.2bn)
Very Low	Low	Moderate	High	Very High										
(<£0.4bn)	(£0.4bn-£0.8bn)	(£0.8bn-£1.6bn)	(£1.6bn-£3.2bn)	(>£3.2bn)										
BRT	G1 / G2	BRT Abbey Wood to Ebbsfleet on new BRT infrastructure / existing highways, consisting of two routes (Abbey Wood to Ebbsfleet via Dartford/Bluewater, and Slade Green to Ebbsfleet via Greenhithe) .	Minimum frequency 6 buses per hour.	<table><tr><td>Very Low</td><td>Low</td><td>Moderate</td><td>High</td><td>Very High</td></tr><tr><td>(<£0.4bn)</td><td>(£0.4bn-£0.8bn)</td><td>(£0.8bn-£1.6bn)</td><td>(£1.6bn-£3.2bn)</td><td>(>£3.2bn)</td></tr></table>	Very Low	Low	Moderate	High	Very High	(<£0.4bn)	(£0.4bn-£0.8bn)	(£0.8bn-£1.6bn)	(£1.6bn-£3.2bn)	(>£3.2bn)
Very Low	Low	Moderate	High	Very High										
(<£0.4bn)	(£0.4bn-£0.8bn)	(£0.8bn-£1.6bn)	(£1.6bn-£3.2bn)	(>£3.2bn)										



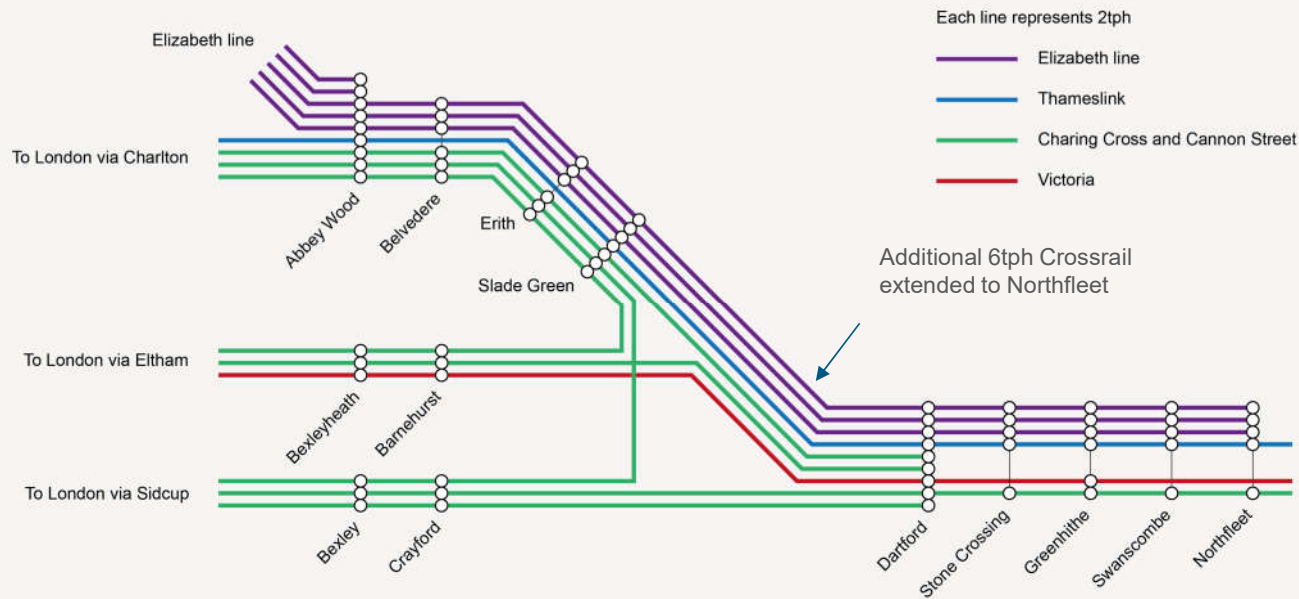
Option Specifications

Description of the five options that have been assessed (i.e. the options under consideration during the first public consultation)



Option C4

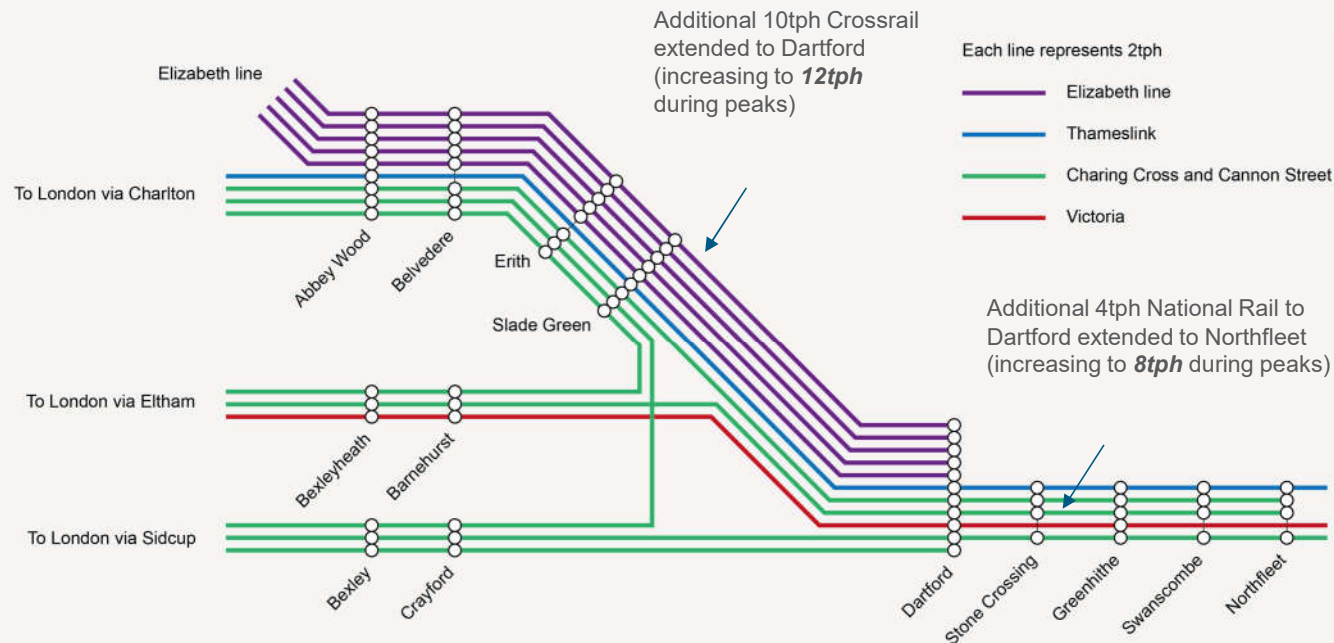
Option 'C4' would involve extending six Elizabeth line (Crossrail) trains per hour (at peak times) from Abbey Wood station to Northfleet station. These trains would call at all stations between and would mainly utilise current rail tracks, with some targeted infrastructure works to allow the extra trains to use the tracks.



Option C5+A2

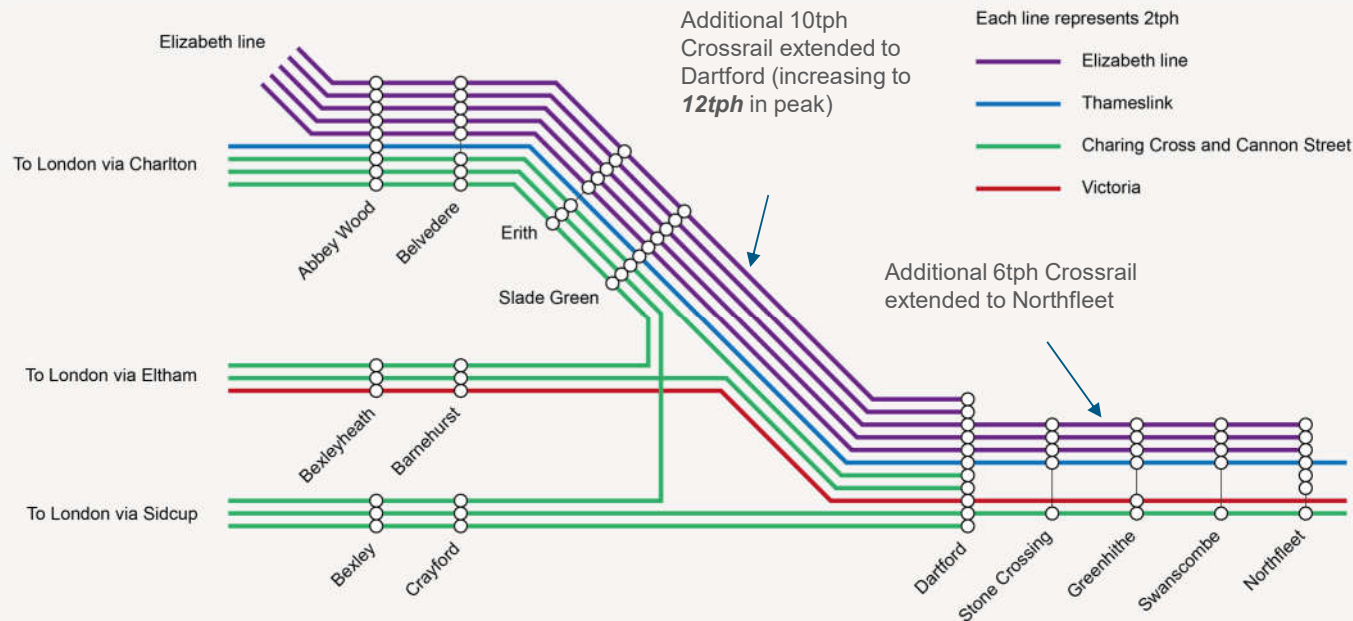
Option 'C5+A2' would involve two improvements to rail services in the study corridor, as follows:

- All 12 Elizabeth line trains per hour (at peak times) would be extended from Abbey Wood to Dartford station, where they would all terminate – these trains would all use new rail tracks constructed alongside the current tracks
- Existing National Rail trains currently terminating at Dartford would also be extended to Northfleet station and would operate on existing tracks



Option C5+SR [Shared Running]

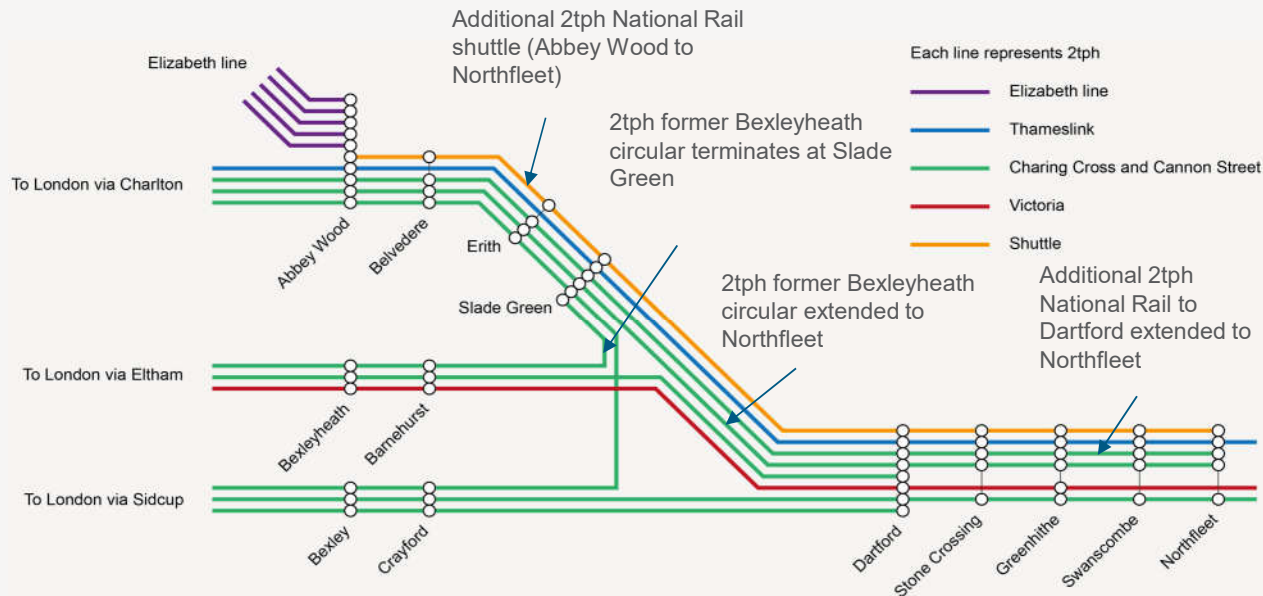
Option 'C5 + Shared Running' would involve extending all 12 Elizabeth line trains per hour (at peak times) from Abbey Wood station to Dartford station, with six of those trains continuing to Northfleet station between Abbey Wood and Dartford, the trains would run on new rail tracks constructed alongside the current tracks, allowing more trains to operate – east of Dartford, the trains continuing to Northfleet would run on existing tracks with some targeted infrastructure works to allow this



Option E1 (Other Rail)

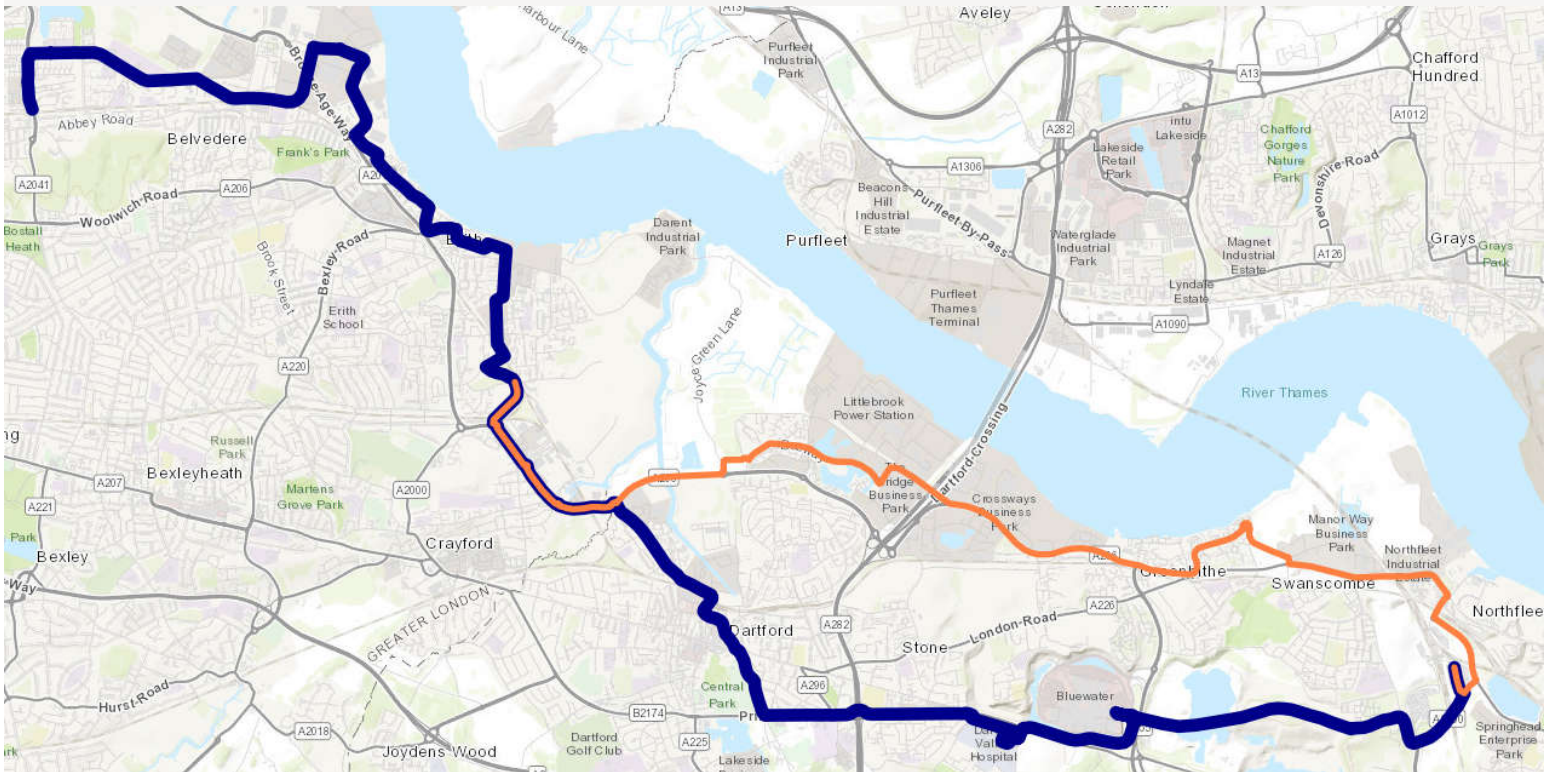
Option 'E1' would involve the following improvements to National Rail services along the corridor:

- A new shuttle service of two trains per hour running between Abbey Wood and Northfleet
- The extension to Northfleet of existing National Rail services currently terminating at Dartford (two trains per hour)
- The severing of Cannon Street-Bexleyheath Line circular services (two trains per hour) at Slade Green, with the tail via Abbey Wood extended from Slade Green to Northfleet and the other tail becoming a service between London and Slade Green via Bexleyheath



Option G1/G2 (BRT)

Option 'G1/G2' would involve a new Bus Rapid Transit (BRT) service consisting of two new routes, one operating between Abbey Wood and Ebbsfleet International via Erith, Slade Green, Dartford and Bluewater; and one operating between Slade Green and Ebbsfleet International via Stone Crossing and Greenhithe.



Each service would run at a 10-minute headway between 07:00 and 19:00 on Mondays to Saturdays, with 20-minute headway services during early mornings, late evenings and on Sundays and Public Holidays.



Summary of Assessment Outcomes and Deliverability

The options were objectively assessed against the study objectives and Critical Success Requirements (CSRs).

Based on analysis of combined 'unweighted' scores for '**outcomes**' (objective A-E and CSR5):

- All Crossrail extension options (C4, C5+A2, C5+SR) would deliver a step-change in outcomes compared to E1 and G1/G2
- C5+SR demonstrated the highest scoring overall, driven by transport impacts (Objectives C, D, E) and housing (Objective A)
- As noted earlier, G1/G2 outcomes differ from rail schemes – with the benefits largely derived from shorter 'in-corridor' journeys, in contrast to rail providing improved connectivity to areas beyond the corridor

Sensitivity tests were undertaken involving the application of weightings to the different objectives (in particular, increasing the weighting of Objective A - housing growth). This resulted in minimal changes to overall ranking, however, it did improve the performance of C4 relative to C5+A2, emphasising the additional housing forecast associated with option C4. It also progressively reduces the combined outcome scores for E1 and G1/G2, due to their relatively poor performance against Objective A

Based on analysis of combined 'unweighted' scores for '**deliverability**' (all CSRs excluding CSR5):

- E1 would result in lowest risk overall
- C5+SR would have significantly higher risks than all other options (particularly for infrastructure delivery and operational feasibility)
- VfM demonstrated a substantial challenge for all options at this stage, although more work to be undertaken to value housing benefits



Summary of Assessment Outcomes vs Affordability

The relative performance of the options was also considered by comparing how well the options scored for 'outcomes' relative to their 'affordability'.

Based on analysis of combined outcome scores (unweighted) compared with affordability scores:

- The relative strength of option C4 was highlighted, demonstrating strong performance in terms of outcomes and with less affordability risk than C5 options
- C5+A2 and C5+SR were assessed as similar in terms of objectively scored outcomes, but do have different risk profiles and development benefits. They were also both considered to be challenging in terms of affordability
- E1 and G1/G2 were also found to have similar objectively assessed outcome scores, but deliver quite different types of outcomes. The BRT (G1/G2) option was assessed to be more affordable, much of which is because it does not have quite such a significant negative operational deficit. They were both noted to be 'low-cost' alternative options (when compared to Elizabeth line options), which may have complementary benefits if delivered as a combined scheme



Options Comparison - Further Analysis

Following the initial assessments, the options were further compared, to identify key risks and opportunities for further improvements into the next stage of assessments:

Comparing C5+A2 and C5+SR:

- Whilst C5+SR generates greater transport and housing benefits across the corridor than C5+A2 (which results in a slightly improved affordability score), this should be weighed against the much greater risks C5+SR presents
- It may not be prudent to take through two shared running options to the final stage – if any type of shared running of Elizabeth line services is found to create unacceptable levels of residual risk, after mitigation, this could mean that both options would have to be discounted later
- Taking through C5+A2, which is fully segregated, along with C4 as a shared running scheme, would help to mitigate these risks
- C5+A2 is expensive and delivers fewer benefits (transport and housing) than C5+SR, which presents very significant challenges to how it could be funded.

Comparing E1 and G1/G2:

- G1/G2 outperforms E1 on some of the scheme objectives and CSRs. However, there does appear to be significant potential for optimisation of the E1 option
- BRT also performs a different role to the other rail-based options, providing more local connectivity to support the strategic connectivity provided by rail
- Even though option E1 does not perform particularly well in its current form, there is not enough evidence at this stage to rule out the concept of incremental improvements to rail services
- There is potential to consider BRT and E1 as a hybrid low-cost option. There could be synergies that generate benefits that are more than the sum of the individual schemes
- Both options together could also be delivered earlier and in a more incremental way than the Elizabeth line options

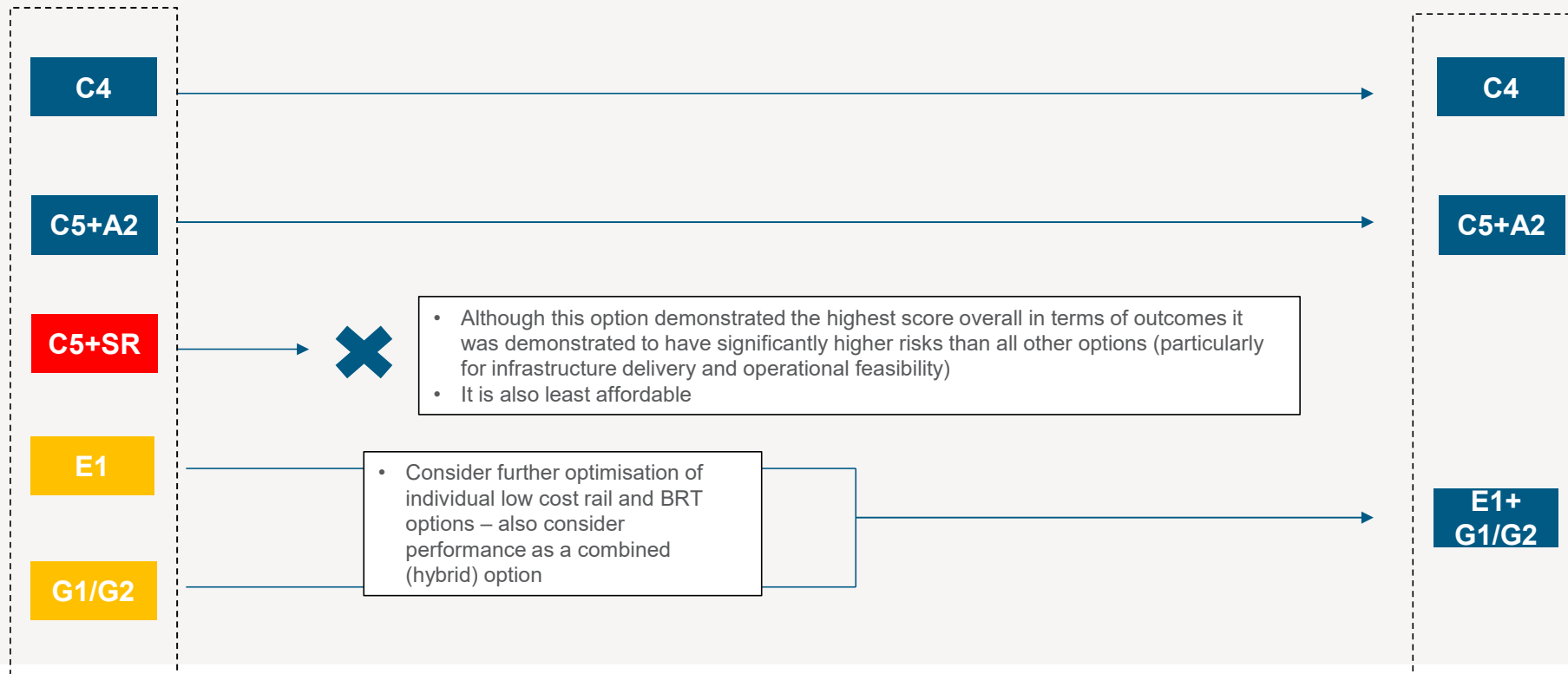


Options to 'Sift Out'

Based on the assessment and sift process of outcomes and deliverability analysis at this stage (as presented on the previous slides), the following options were removed as part of a 'sift' (i.e. not progressed any further), for the key reasons stated below:

Options 'shortlist' (Autumn 2020) –
as per previous consultation

Remaining Options from Sift
(Spring 2021)



Step 2: Option Variant Testing – Optimisation Work

Following the assessment and sifting of the previous five options down to three - and prior to full assessment of the three options taking place for the Strategic Outline Business Case - further work was undertaken to explore how the options could be 'optimised' to further improve benefits and/or reduce costs and potentially improve affordability.



Option Optimisation Approach

Prior to the next stage of modelling and design for the three proposed options to be taken forward to the next stage of appraisal, further work was undertaken to explore whether the performance of the remaining options could be improved in various ways:

- **Option C4:** previously tested with 6 Elizabeth line tph, with no changes to SouthEastern (SE) and Thameslink services. Investigations considered:
 - If train frequency could increase to 8tph with some rationalisation of existing services (aiming to increase benefits whilst continuing to mitigate Elizabeth line service performance risks)
 - More radically, if the balance of services between Elizabeth line and SE/TL in the corridor could be used as a means of reducing scheme cost
- **Option C5+A2:** investigations considered:
 - If there is the potential to consider an optimum service specification in order to facilitate cost reductions/improved specification of 'A2' component east of Dartford
- **Low Cost Option (E1, G1/G2):** investigations considered:
 - How to improve E1 service provision, as well as optimise the alignment of G1/G2 to support new development
 - Whether E1+BRT, not previously considered, has potential to offer a credible option
- Proposed option variants for investigation were discussed with key stakeholders including the C2E Partnership delivery team, Network Rail, TfL and others. *The 'options variants' that were considered are presented on the following pages (also refer to Annex B – slide 62 - for more details).*
- This testing of the option variants considered the change in infrastructure requirements and relative change in capital expenditure, transport modelling outputs, Cost Benefit Analysis, view on change in additionality and affordability scoring, and a high-level review of option variants against the Objectives and CSRs.



Option Variants for Assessment

C4 variant	Service description (refer to Annex B for maps)	Rationale
C4a	EL at 6tph to Northfleet. All circular SE services are severed and will start/terminate at Dartford instead.	Reduce infrastructure cost by reducing operational conflicts necessitating infrastructure measures
C4b	EL at 8tph, 4tph terminate at Gravesend, 4tph terminate at Northfleet All circular SE services are severed and will start / terminate at Dartford instead. 2tph existing Victoria to Gravesend curtailed at Northfleet 2tph existing Gravesend via Sidcup curtailed at Dartford	Increase transport benefits without increasing infrastructure cost by reducing operational conflicts necessitating infrastructure measures
C4c	8tph EL extended, 4tph terminate at Gravesend, 4tph terminate at Northfleet All circular services are severed and will start/terminate at Dartford instead. 2tph Thameslink curtailed at Dartford 2tph existing Charing Cross to Gravesend via Sidcup extended to Rainham 2tph existing Victoria to Gravesend curtailed at Northfleet	Increase transport benefits without increasing infrastructure cost by reducing operational conflicts necessitating infrastructure measures
C4d	12 tph EL extended – 4tph to Gravesend, 4tph to Northfleet, 4tph Slade Green [2tph off-peak] All South Eastern and Thameslink services terminate at Abbey Wood 4tph via Bexleyheath terminate at Dartford (any circular services diverted to Dartford) 2tph Victoria – Gravesend via Bexleyheath extended to Rainham (this could evolve to be a re-routing of the Thameslink instead) 6tph via Sidcup terminate at Dartford (any circular services diverted to Dartford)	Significantly reduce infrastructure cost by reducing operational demands/conflicts on route necessitating infrastructure measures while maximising EL offer in corridor to drive benefits. More closely aligns with EL service substitution/re-casting approach taken on current Crossrail scheme branches due to be operated.



Option Variants Being Assessed

C5+A2 variant	Service description	Rationale
C5+A2a	C5 service assumed as per the current stage of assessment A2 has Thameslink services stopping all stations between Dartford and Northfleet	Increase benefits by enhancing eastern service enhancement and connection with Elizabeth line
E1+BRT variant	Service description	Rationale
E1+BRT	<p>E1: All circular services are severed. Former circular services via Abbey Wood will be extended to Northfleet. All other circular services will start/terminate at Dartford instead. 2tph Cannon Street to Dartford via Abbey Wood will be extended to Gravesend calling all stations. Charing Cross to Gravesend via Sidcup curtailed at Dartford.</p> <p>BRT: Prior Abbeywood to Ebbsfleet via Bluewater service to now to terminate at Bluewater Some revised routing to offer more direct routes with reduced general traffic interaction while enhancing integration with development masterplans</p>	<p>On E1 element increase benefits by enhancing eastern service enhancement and connection with Elizabeth line</p> <p>On BRT element seek to reduce operating mileage, deliver improved journey time performance and align with masterplan development</p>
BRT variant	Service description	Rationale
BRTa	As per BRT in E1+BRT	Need to consider BRT stand-alone as an option if E1+BRT presents poor outcomes/ value. Reflects good BRT performance at very low cost at the current stage of assessment.



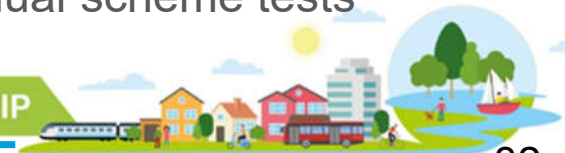
Summary of Approach to Assessment

- Variant testing was undertaken as a partial assessment, with professional judgement applied for most indicators, with scores derived from the assessment completed to date (including feasibility, environmental risks, and additionality assessment)
- The Options Assessment Framework (OAF) was adapted where required to accommodate new option variants and to obtain revised scores
- While new costs were derived, the assessment of overall affordability was not included
- Transport outputs were derived from new model runs for Objectives C,D and E and CSR5 (headline scores only), plus CSR1 (VfM), while modelling inputs for Objectives A and B were estimated from results completed to date



Summary of Assessment Outcomes

- **C5+A2a** is the best performing option variant across all 'outcome' objectives/CSRs (unweighted), driven by the highest overall travel time saving from the Railplan model
- **C4a, C4b and C4c** performance is very similar:
 - Additionality impacts expected to exceed **C5+A2a**, but lower overall travel time savings
 - **C4b and C4c** result in higher time savings than **C4a**, but additional benefit marginally off-set by increase in crowded hours across network (CSR5).
 - The diversion of the 'circular' SouthEastern services coming from the Crayford and Barnehurst lines would change how passengers using these lines would interchange with Elizabeth Line services (*assessed further on next slide*).
- **C4d** performs less well compared to other Crossrail options, with a lower order of time saving, plus larger increase in crowded hours reported across network
- **E1a/BRT** option variants are still the worst performing options, although a hybrid option delivers some marginal improvement in outcomes compared with individual scheme tests



Summary of Assessment Outcomes

- Options **C4a-C4d** require the diversion of the existing 'circular' services from the Crayford and Barnehurst lines into Dartford. This frees up some capacity on the existing tracks running between Abbey Wood and Dartford to allow for the extension of up to 8tph Elizabeth line services.
- Passengers using the Crayford to Abbey Wood & Barnehurst to Abbey Wood 'circular' SouthEastern services would lose the possibility of direct interchange with Elizabeth line services at Abbey Wood (as will be the case for passengers making these journeys in the 'Reference Situation' (Reference Case)). Instead, these services would be diverted to terminate at Dartford. Passengers using the SouthEastern services on the Crayford/Barnehurst lines wishing to change to the Elizabeth line would instead need to travel east to Dartford and interchange there for direct Elizabeth line services into Central London.
- Initial, high-level analysis of transport modelling data has been undertaken to understand the impact of this change – identifying journey times for interchange from stations along these lines to Elizabeth line services, allowing comparison between interchange at Abbey Wood under the 'Reference Situation' and interchange at Dartford under Options C4a/b/c/d.
- The initial analysis suggests the interchange at Dartford could increase journey times by up to approximately +5mins relative to the 'Reference Situation'. However, the modelling includes a 'time penalty' to account for the inconvenience of interchange and in some cases the modelling suggests the actual start-end journey times experienced may be shorter than when interchanging at Abbey Wood from the 'circular' services.
- Furthermore, the number of people making these journeys (i.e. the 'demand') - and therefore the number of people affected by the diversion of the circular services - was found to be small. This aligns with the equivalent journey by car being much faster.
- The overall benefits associated with Options **C4a-C4d** are therefore considered to outweigh the small disbenefit associated with the relatively small potential increase in journey/interchange times, which would only be experienced by a relatively small number of passengers.



Summary of Assessment Deliverability

- **C5+A2a** retains the same infrastructure assumed within the original option specifications, so is still demonstrating the worst performance in terms of delivery
- **C4a-c** shows marginal improvement from the original C4 option (better VfM and slightly lower risk due to reduced infrastructure provision)
- **C4d** shows minor VfM improvement driven by significant reductions in network operating costs. Presents infrastructure delivery risks associated with re-provision of Dartford station on the same site (though alternative infrastructure options may exist to mitigate this). Stakeholder acceptability also down-scored due to significant reduction/substitution of Southeastern services involved
- **E1a** demonstrates an increase in delivery risks associated with the variant due to additional infrastructure provision assumed
- **BRTa** has the lowest risk of all variants assessed in terms of delivery



Summary of Assessment Outcomes vs Affordability

- No change to affordability scores in comparison to the original option assessments, with very marginal changes in terms of 'outcome v affordability' as a result of the changes to 'outcome' scores presented in the previous slides
- **C4** variants offer best proposition in terms of balance of good 'outcomes' with moderate affordability risks
- **C5+A2a** and **BRTa/E1a** involve the following trade-offs:
 - **C5+A2a** would deliver strong 'outcomes' but is very challenging in terms of affordability
 - **BRTa** is more straight-forward in terms of affordability but does not deliver many corridor objectives
 - **E1a** the worst performing in terms of limited 'outcomes' combined with challenging affordability

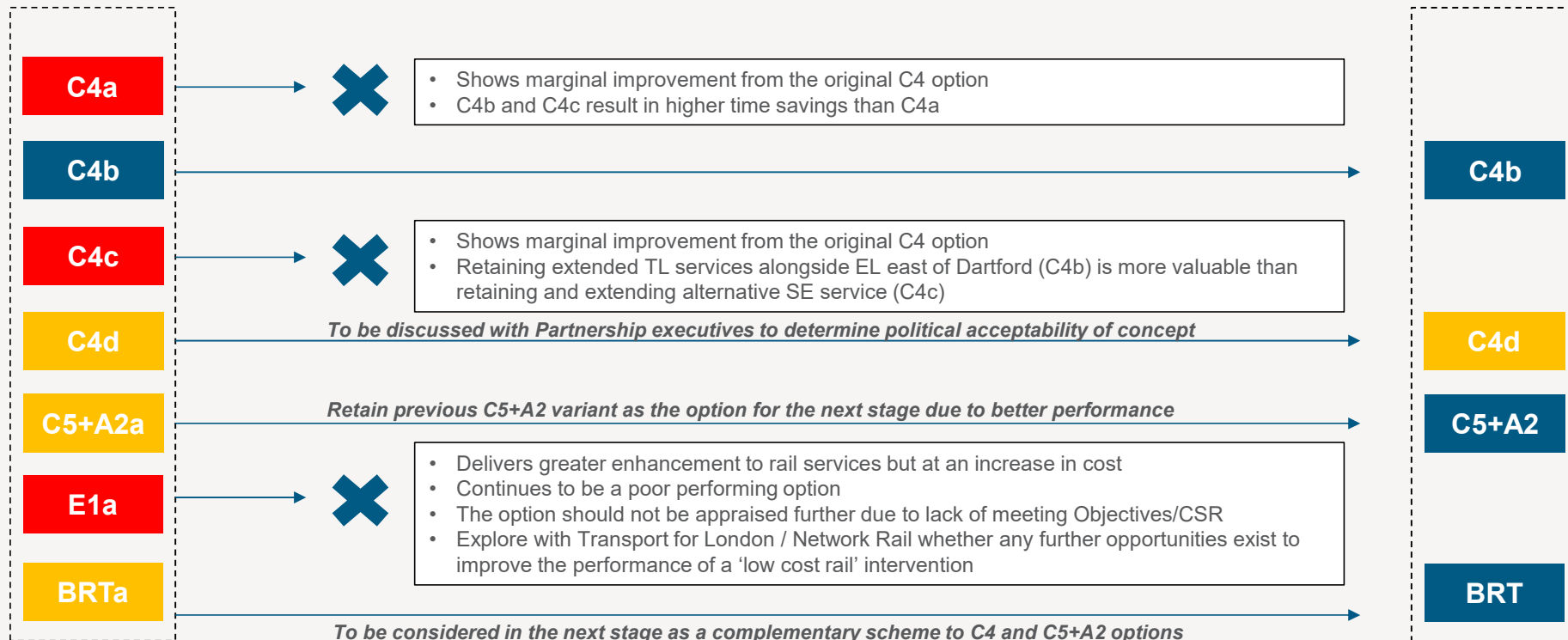


Options to 'Sift Out'

Based on the assessment and sift process of outcomes and deliverability analysis at this stage, the following options were removed as part of a 'sift' (i.e. not progressed any further), for the key reasons stated (see *Annex C:slide 83*):

Option Variants

Remaining Options from Sift



Step 3: Low Cost Option Variant Testing

Following the testing of option variants, further discussions were held with key stakeholders to explore any further opportunities to improve the performance of the 'low cost' option (either an improved 'low cost rail' or Bus Rapid Transit scheme, or potentially a combination of the two).



Basis for further optimisation consideration

Further discussions were held with the following key stakeholders:

- Transport for London and Network Rail regarding low cost rail option (E1 variants) specification (12th May)
- Transport for London and Kent County Council regarding BRT option specification (17th May)
- These meetings sought to identify the scope to further optimise options in advance of starting the next stage of appraisal in support of delivering the SOBC



BRTa option specification considerations

- Further review and discussion with stakeholders highlighted that the BRTa option reduced benefits relative to the original BRT option (G1/G2)
- Further investigation was carried out to understand the impact of no longer operating the southern BRT route from Abbey Wood between Bluewater and Ebbsfleet (as per G1/G2)
- Analysis indicated that this did reduce public transport demand and benefits associated with that section of route by greater than 20% and this loss in benefits was not offset by the value of capital cost reduction
- The latest information also suggested that the housing development close to Bluewater could be well served by other bus measures via other means of public transport
- However, the other route changes proposed for the BRTa option align better with the development aspirations and it was concluded that these should be retained.

Conclusion on BRT specification

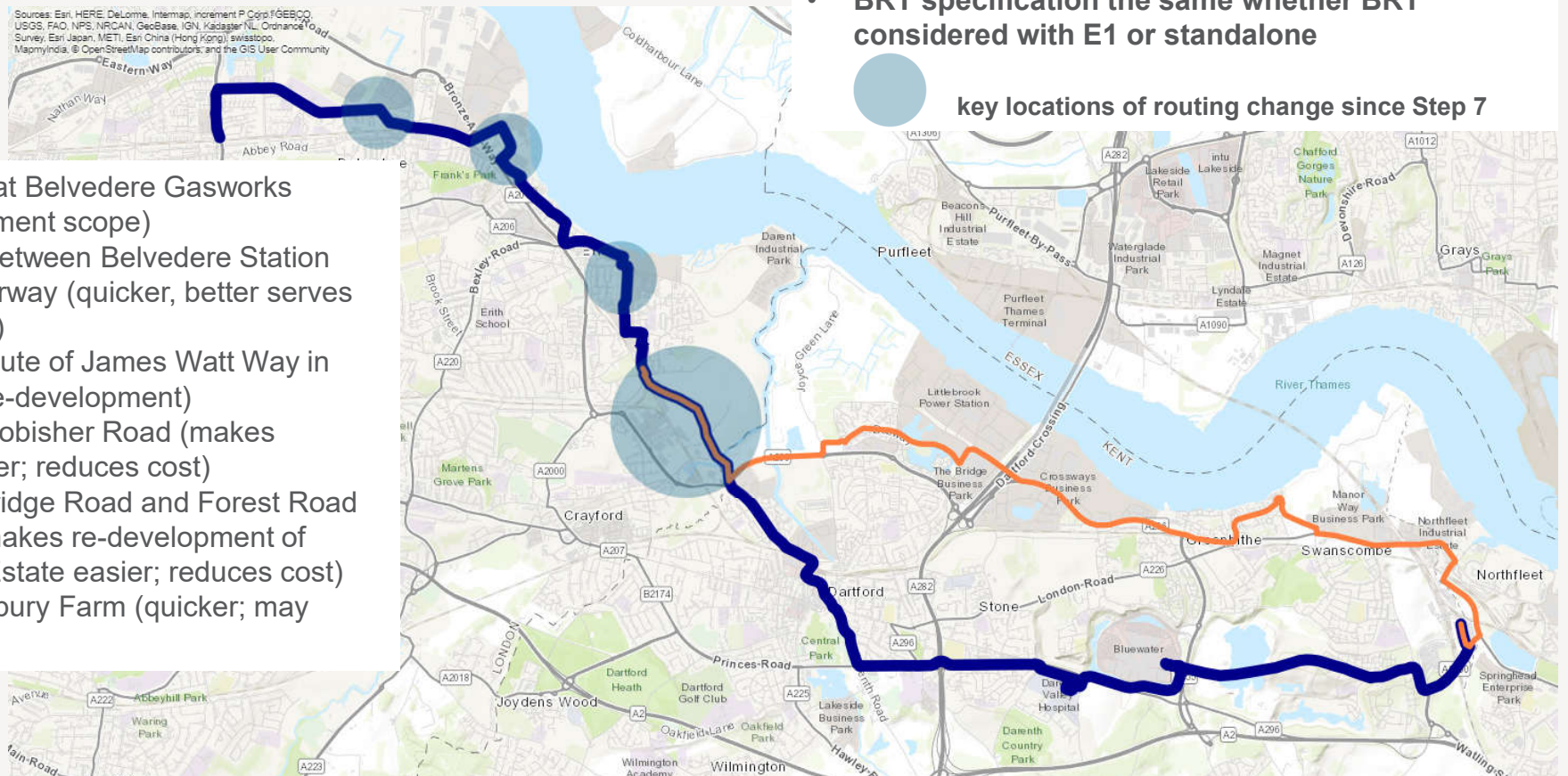
- It was concluded that the BRT option specification that should be taken forward for the next stage of appraisal should be as per BRTa, but with the route from Abbey Wood to Ebbsfleet via Bluewater retained (for the reasons mentioned above), taking advantage of existing infrastructure as proposed in the original BRT option (G1/G2).
- This revised BRT option specification was referred to as **BRTb**.

Variant BRTb – Route map for revised BRT option

- Revised routing at Belvedere Gasworks (reduced development scope)
- Shorter routing between Belvedere Station and Church Manorway (quicker, better serves new development)
- Follows revised route of James Watt Way in Erith (Morrisons re-development)
- Re-routing via Frobisher Road (makes development easier; reduces cost)
- Re-routing via Bridge Road and Forest Road in Slade Green (makes re-development of Power Industrial Estate easier; reduces cost)
- Routing via Howbury Farm (quicker; may reduce cost)

- BRT specification the same whether BRT considered with E1 or standalone

key locations of routing change since Step 7



E1a option specification considerations

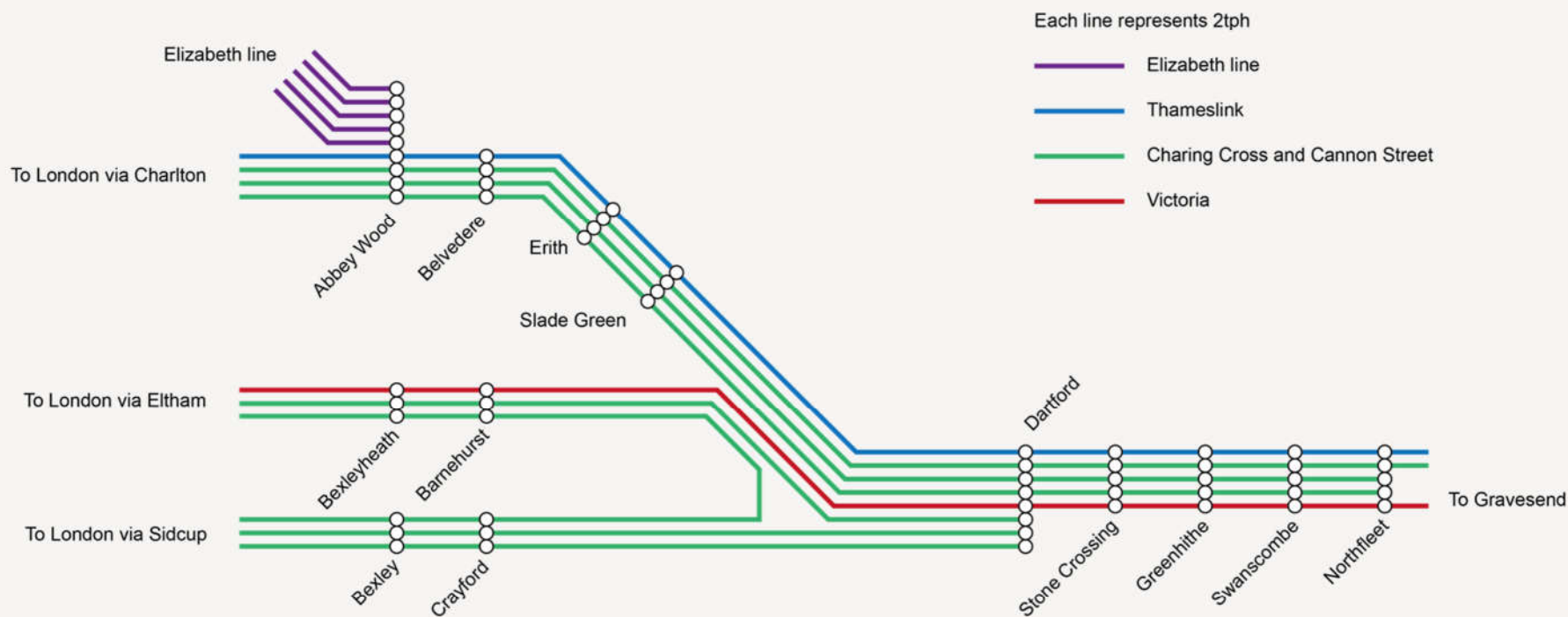
- TfL identified an “E1b” variant that focused on significantly reducing the cost of the option while maintaining the principles of the service specification:
- The basic service proposition for E1b remains the same as E1a except 2tph from the Barnehurst and Crayford branches which terminate at Dartford are linked to provide a new circular service using existing infrastructure
- This reduces the number of trains approaching Dartford from the west from 20tph to 16tph, still an enhancement on the reference case of 4tph. This potentially negates need for a four-track approach to Dartford scheme (substantial cost saving)
- This also simplifies movements in the Crayford Creek Junction area, avoiding the requirement for this grade separation scheme (substantial cost saving)

Conclusion on E1a specification

- E1b results in a very significant reduction in required infrastructure works, and large costs savings as a result of no longer requiring the 4-track approach to Dartford
- Option E1b is consequently estimated to cost significantly less (approx. two thirds less) of the cost estimate for E1a
- It must be stressed that this is on the assumption that a workable timetable can be arrived at for the E1b specification. Although this has not yet been assessed, it is considered that there is reasonable potential to achieve this



Variant E1b – Line diagram showing revised ‘low cost rail’ option



Summary of Proposed Options

Following the three steps of option assessment as described in the preceding sections, the C2E Partnership agreed the specification of the three shortlisted options that will now be taken forward for further development, modelling and assessment – and which form the subject of this stage of consultation.



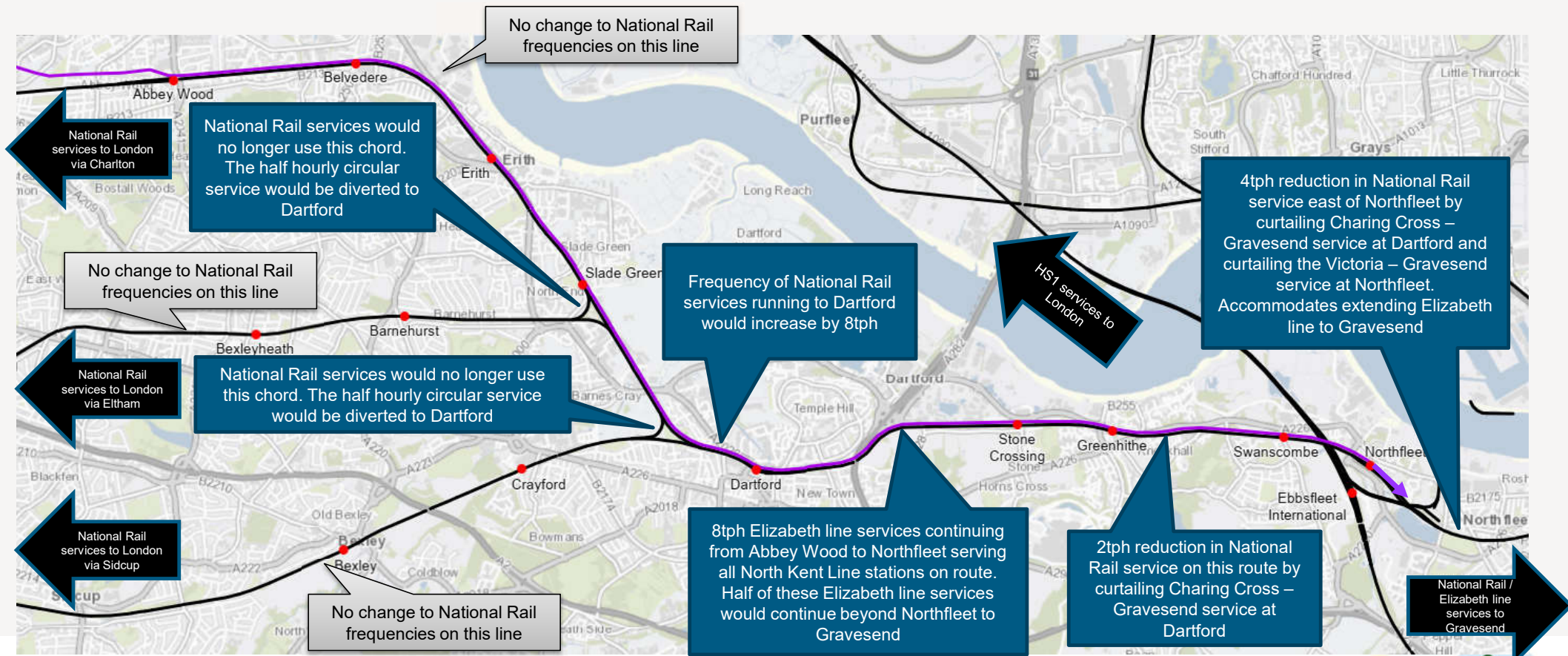
Summary of Options to Progress to Next Stage

The outcomes of this current stage of the study assessment process has led to the following three options being progressed for further assessment during the next stage of the study. Maps/diagrams are presented on the following pages.

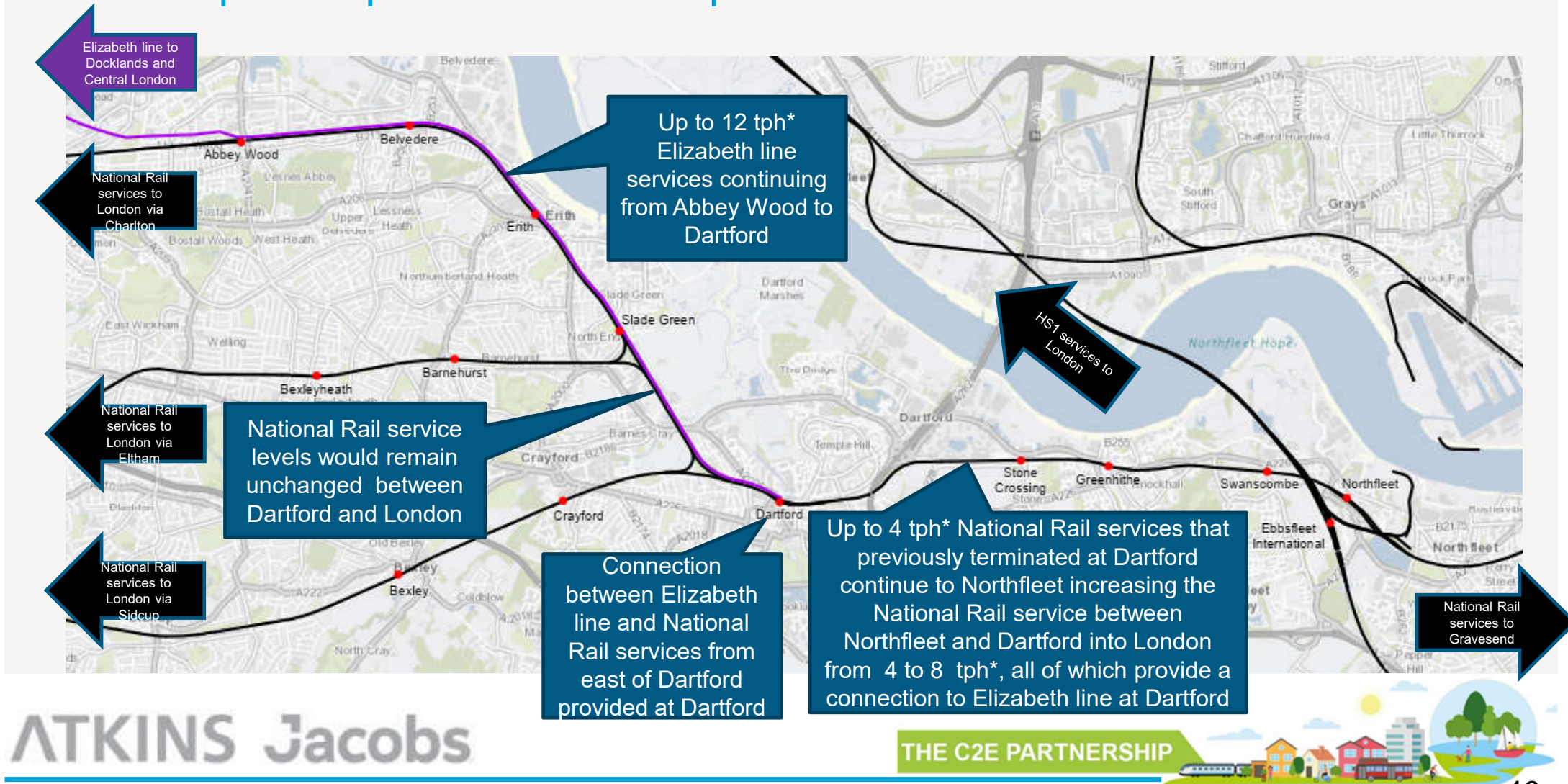
Ref.	Elizabeth Line (Crossrail Extension) Options		Low Cost Option
	C4b	C5+A2	E1b + BRTb
Description	<ul style="list-style-type: none"> - Elizabeth line extension from Abbey Wood to Northfleet/Gravesend at 8tph (4tph terminate at Northfleet, 4tph continue east to terminate at Gravesend) calling at all stations - All circular SouthEastern services (Crayford/Barnehurst to Slade Green/Abbey Wood) are severed and will start/terminate at Dartford instead - 2tph existing Victoria to Gravesend curtailed at Northfleet - 2tph existing Gravesend via Sidcup curtailed at Dartford - Thameslink services will retain current “skip stations” stopping pattern through the corridor, and therefore is assumed to not stop at Belvedere, Erith, Stone Crossing or Swanscombe stations 	<ul style="list-style-type: none"> - Elizabeth line extension to Dartford (segregated Abbey Wood to Dartford) – 12tph (10tph off-peak) calling all stations - Extension to Northfleet of existing National Rail services terminating at Dartford, providing 8tph National Rail services (4tph off-peak) between Dartford and Northfleet, calling all stations - Thameslink services will retain current “skip stations” stopping pattern through the corridor, and therefore is assumed to not stop at Belvedere, Erith, Stone Crossing or Swanscombe stations - Note: specification remains the same as option in the current stage of assessment 	<p>‘Hybrid’ option combining National Rail service improvements with new Bus Rapid Transit (BRT) service</p> <p>E1b component</p> <ul style="list-style-type: none"> - Extension to Northfleet of existing National Rail services currently terminating at Dartford (2tph); - 2tph existing circular services each from the Barnehurst and Crayford branches (to London via Abbey Wood) are severed and instead linked using existing infrastructure to provide a new circular service - Direct services running between Abbey Wood and Dartford increased to 8tph (increase of 4tph) - Frequency of National Rail services running east of Dartford would increase by 4tph through extension of services from Dartford to Northfleet - Thameslink services will retain the reference case “skip stations” stopping pattern east of Dartford and therefore is assumed to not stop at Stone Crossing or Swanscombe stations. West of Dartford Thameslink is now assumed to make additional stops at Belvedere and Erith, consistent with housing additionality potential at these locations <p>BRTb component</p> <ul style="list-style-type: none"> - New Bus Rapid Transit (BRT) service consisting of two new routes, one operating between Abbey Wood and Ebbsfleet International via Erith, Slade Green, Dartford and Bluewater; and one operating between Slade Green and Ebbsfleet International via Stone Crossing and Greenhithe. <p>Note: some route changes/optimisations specified relative to the ‘G1/G2’ option in the current stage of assessment</p>



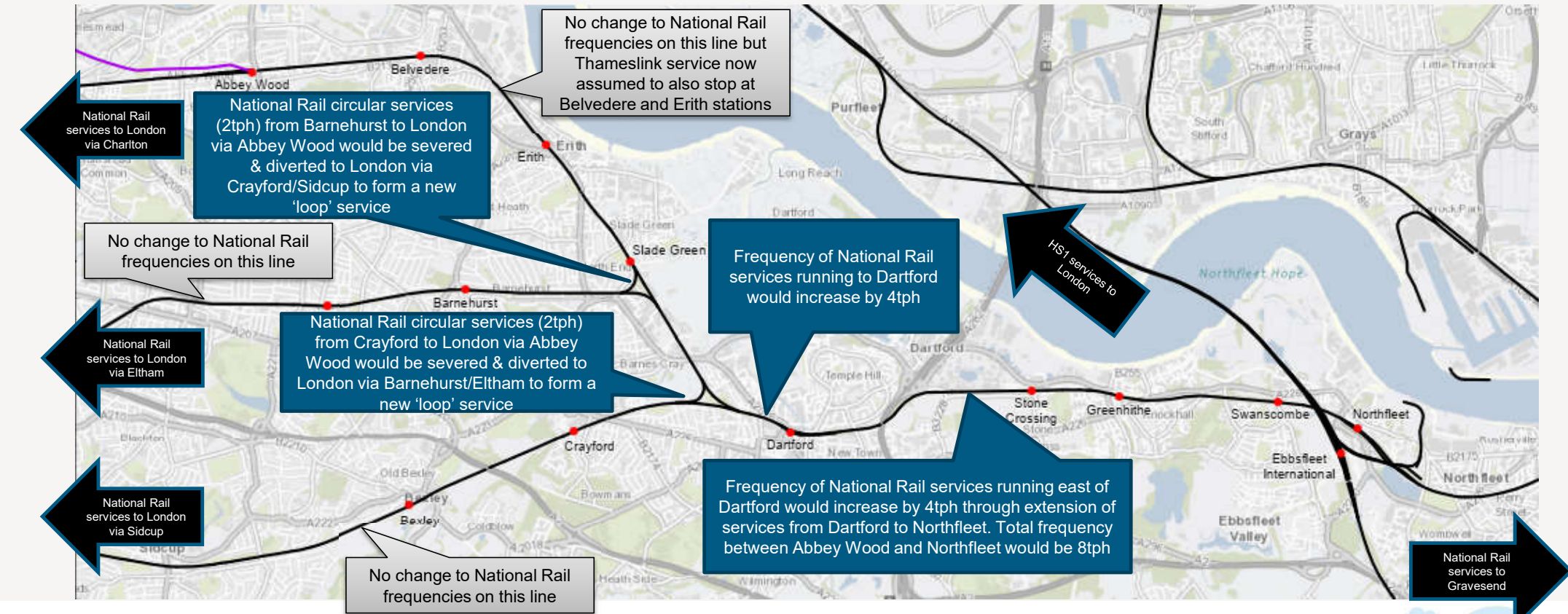
C4b Option Specification - Map



C5+A2 Option Specification - Map



E1b – Map



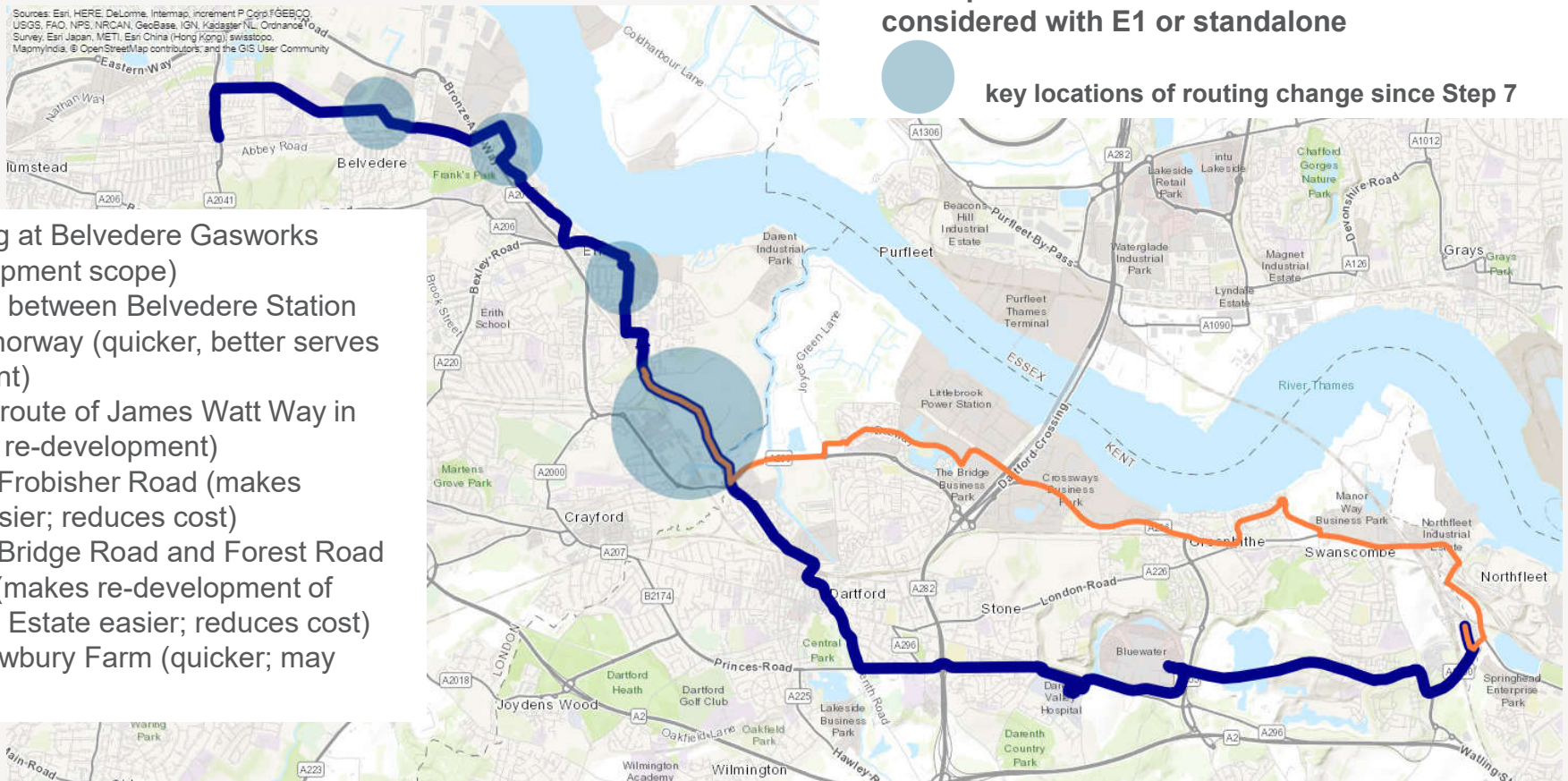
BRTb service specification – route map

- Revised routing at Belvedere Gasworks (reduced development scope)
- Shorter routing between Belvedere Station and Church Manorway (quicker, better serves new development)
- Follows revised route of James Watt Way in Erith (Morrisons re-development)
- Re-routing via Frobisher Road (makes development easier; reduces cost)
- Re-routing via Bridge Road and Forest Road in Slade Green (makes re-development of Power Industrial Estate easier; reduces cost)
- Routing via Howbury Farm (quicker; may reduce cost)

- BRT specification the same whether BRT considered with E1 or standalone



key locations of routing change since Step 7



Next Steps

This section sets out the next steps for the Abbey Wood to Ebbsfleet Connectivity Study, following the selection of the three short-listed options.



Next Steps

- **The C2E Partnership and their consultants will now progress further work on developing and assessing the short-listed options – this will include:**
 - The completion of a second phase of public consultation
 - Further development of feasibility studies focused on understanding in more depth the key risks associated with the delivery of each option, including operational specification/performance risk analysis and infrastructure requirements and deliverability – this will include further discussions with TfL and Network Rail concerning the operational issues associated with shared running options
 - Development of an initial standalone high-level design for each short-listed option, which will support further feasibility assessment to address key issues broadly in line with the principles of a proportionate study focused on option selection for SOBC purpose
 - Refinement of timetable and service assumptions for each scheme, with a focus on optimising the overall balance of benefits vs costs while also mitigating identified delivery risks
 - Further forecasting of the transport outcomes of each scheme (based on assumed timetables) using TfL's modelling suite (inclusive of demand modelling of options to forecast the potential mode shift effects of each option more comprehensively)



Next Steps

- Refinement of capital cost estimates (based on the initial designs) and operating, maintenance and renewal costs and revenue forecasts facilitating updated affordability analysis, based on emerging designs and transport modelling inputs
- Further iteration of the 'additionality' modelling undertaken, informed by site-specific masterplanning, viability appraisals and employment growth study
- Further testing of the impact of the proposed London Resort development on the appraisal of options
- The refinement of quantified Value for Money estimates for each option, drawing on cost and revenue inputs, monetised transport user benefits, and dynamic development benefits
- Preparation and submission of a Strategic Outline Business Case (SOBC) to be submitted to Government in Autumn 2021.



Annex A

Assessment Results for each Objective and CSR –

Five options to three options



Key Elements of Scoring - Objective A

Components of **Objective A** in relation to the following:

- Housing unlocked
- Additionality land value uplift (translated to net land value uplift)
- Socio-distributional (regeneration)

Info	Elizabeth Line Extension			Other Rail	BRT
	C4	C5+A2	C5+SR	E1	G1/G2
Description of option	Crossrail Extension Abbey Wood to Northfleet (shared running).	C5 - Crossrail Extension Abbey Wood to Dartford only (segregated) & A2 - Extend services from Dartford to Northfleet. Enabled by infrastructure investment.	C5 - Crossrail Extension Abbey Wood to Dartford only (segregated), with some Crossrail services then extended from Dartford to Northfleet via shared running with National Rail services on the North Kent Line.	National Rail shuttle from Abbey Wood to Northfleet/ Ebbsfleet (shared running).	G1/G2 Hybrid - Abbey Wood / Dartford / Darent Valley Hospital & Bluewater via existing Fastrack infra east of Dartford.
Estimated number of new additional housing units unlocked, sourced from additionality model & LUMIT	5.0	4.0	5.0	1.0	1.0
Socio-distributional impacts from enabling local transport access to services and jobs, particularly in deprived areas [forecast based on modelled 3-hour morning peak]	4.0	5.0	5.0	1.0	1.0
To what extent does the scheme increase land-value within 1km of key development sites, thus increasing the viability of the sites for development?	5.0	3.0	5.0	1.0	1.0



Key Elements of Scoring - Objective B

Components of **Objective B** in relation to the following:

- Jobs unlocked
- The impact on London's labour catchment

Info	Elizabeth Line Extension			Other Rail	BRT
	C4	C5+A2	C5+SR	E1	G1/G2
Description of option	Crossrail Extension Abbey Wood to Northfleet (shared running).	C5 - Crossrail Extension Abbey Wood to Dartford only (segregated) & A2 - Extend services from Dartford to Northfleet. Enabled by infrastructure investment.	C5 - Crossrail Extension Abbey Wood to Dartford only (segregated), with some Crossrail services then extended from Dartford to Northfleet via shared running with National Rail services on the North Kent Line.	National Rail shuttle from Abbey Wood to Northfleet/ Ebbsfleet (shared running).	G1/G2 Hybrid - Abbey Wood / Dartford / Darent Valley Hospital & Bluewater via existing Fastrack infra east of Dartford.
Estimated number of new additional jobs unlocked within the corridor, sourced from LUMIT	3.0	4.0	4.0	2.0	2.0
To what extent does the scheme increase London's effective labour market catchment (whole area)? [forecast based on modelled 3-hour morning peak]	4.0	5.0	5.0	1.0	1.0



Key Elements of Scoring - Objectives C, D, E and CSR5

Components of **Objective C, D, E and CSR5** in relation to the following:

- Public transport connectivity
- Climate change (modal shift)
- Connectivity to international gateways
- Resilience to future demands

Info	Elizabeth Line Extension			Other Rail	BRT
	C4	C5+A2	C5+SR	E1	G1/G2
Description of option	Crossrail Extension Abbey Wood to Northfleet (shared running).	C5 - Crossrail Extension Abbey Wood to Dartford only (segregated) & A2 - Extend services from Dartford to Northfleet. Enabled by infrastructure investment.	C5 - Crossrail Extension Abbey Wood to Dartford only (segregated), with some Crossrail services then extended from Dartford to Northfleet via shared running with National Rail services on the North Kent Line.	National Rail shuttle from Abbey Wood to Northfleet/ Ebbsfleet (shared running).	G1/G2 Hybrid - Abbey Wood / Dartford / Darent Valley Hospital & Bluewater via existing Fastrack infra east of Dartford.
Objective C (public transport connectivity – overall gen. time saving from Railplan)	3.0	5.0	5.0	1.0	2.0
Objective D (climate change/mode shift – latter not modelled so Objective C score used as proxy)	3.0	5.0	5.0	1.0	2.0
Objective E (connectivity to international gateways – gen. time saving from Railplan)	5.0	5.0	5.0	4.0	2.0
CSR5 (resilience to future demands – overall change in crowded minutes)	3.0	2.0	2.0	3.0	3.0



Key Elements of Scoring - Objective F

Components of **Objective F** in relation to the following:

- Overall affordability
- Headline 'affordability' score based on capital costs, net operating surplus/deficit and 'complexity' of potential funding mechanisms required.

Info	Elizabeth Line Extension			Other Rail	BRT
	C4	C5+A2	C5+SR	E1	G1/G2
Description of option	Crossrail Extension Abbey Wood to Northfleet (shared running).	C5 - Crossrail Extension Abbey Wood to Dartford only (segregated) & A2 - Extend services from Dartford to Northfleet. Enabled by infrastructure investment.	C5 - Crossrail Extension Abbey Wood to Dartford only (segregated), with some Crossrail services then extended from Dartford to Northfleet via shared running with National Rail services on the North Kent Line.	National Rail shuttle from Abbey Wood to Northfleet/ Ebbsfleet (shared running).	G1/G2 Hybrid - Abbey Wood / Dartford / Darent Valley Hospital & Bluewater via existing Fastrack infra east of Dartford.
Capital cost range 1 = highest capital cost 2 3 4 5 = lowest capital cost	3	2	2	5	5
Overall affordability headline score 5 = Most affordable 4 3 2 1 = Most challenging	3	1	2	2	4



Key Elements of Scoring - CSR1

Components of **CSR1** in relation to the following:

- VfM (based on calculated BCR at Levels 1 and 3, with and without Wider Economic Impacts (WEIs) and development additionality net LVU)
- Based on cost information developed for Objective F and monetised benefits derived from COVID Central Case model outputs including Railplan and LUMIT
- Options were also considered with the inclusion of London Resort (assumed to be in both the without and with option situation) at both Level 1 and Level 3
- Headline score for CSR1 based on Level 3 benefits

Info	Elizabeth Line Extension			Other Rail	BRT
	C4	C5+A2	C5+SR	E1	G1/G2
Description of option	Crossrail Extension Abbey Wood to Northfleet (shared running).	C5 - Crossrail Extension Abbey Wood to Dartford only (segregated) & A2 - Extend services from Dartford to Northfleet. Enabled by infrastructure investment.	C5 - Crossrail Extension Abbey Wood to Dartford only (segregated), with some Crossrail services then extended from Dartford to Northfleet via shared running with National Rail services on the North Kent Line.	National Rail shuttle from Abbey Wood to Northfleet/ Ebbsfleet (shared running).	G1/G2 Hybrid - Abbey Wood / Dartford / Darent Valley Hospital & Bluewater via existing Fastrack infra east of Dartford.
What is likelihood of scheme delivering medium to high VfM at Level 1?	1.0	1.0	1.0	1.0	2.0
What is the likelihood of delivering a high/medium VfM at Level 1 with London Resort?	2.0	1.0	1.0	1.0	4.0
What is the likelihood of delivering a high/medium VfM at Level 3 (inc. WEIs and DD net LVU) headline score	2.0	2.0	2.0	1.0	1.0
What is the likelihood of delivering a high/medium VfM at Level 3 (inc. WEIs and DD net LVU) with London Resort	2.0	2.0	2.0	1.0	4.0

Key Elements of Scoring - CSR2, 3, 4 & 7

Components of **CSR2, 3, 4 and 7** in relation to the following:

- CSR2, 3 and 7 are based on a qualitative review from the engineering team with regards to infrastructure delivery, implementation disruption and land/property impacts
- CSR4 based on timetable analysis by rail operations team

Info	Elizabeth Line Extension			Other Rail	BRT
	C4	C5+A2	C5+SR	E1	G1/G2
Description of option	Crossrail Extension Abbey Wood to Northfleet (shared running).	C5 - Crossrail Extension Abbey Wood to Dartford only (segregated) & A2 - Extend services from Dartford to Northfleet. Enabled by infrastructure investment.	C5 - Crossrail Extension Abbey Wood to Dartford only (segregated), with some Crossrail services then extended from Dartford to Northfleet via shared running with National Rail services on the North Kent Line.	National Rail shuttle from Abbey Wood to Northfleet/ Ebbsfleet (shared running).	G1/G2 Hybrid - Abbey Wood / Dartford / Darent Valley Hospital & Bluewater via existing Fastrack infra east of Dartford.
CSR2 – Infrastructure delivery risks	2.0	1.0	1.0	3.0	3.0
CSR3 – Implementation disruption to transport network risks	2.0	2.0	1.0	3.0	3.0
CSR4 – Operational delivery risks	3.0	5.0	1.0	3.0	3.0
CSR7 – Land and property impacts	3.0	2.0	1.0	3.0	3.0



Key Elements of Scoring - CSR6

Components of **CSR2, 3, 4 and 7** in relation to the following:

- Embodied carbon assessment undertaken using the Rail Carbon Tool (scoring directly related to forecast emissions)
- Appraisal by environmental team on environmental impacts

Info	Elizabeth Line Extension			Other Rail	BRT
	C4	C5+A2	C5+SR	E1	G1/G2
Description of option	Crossrail Extension Abbey Wood to Northfleet (shared running).	C5 - Crossrail Extension Abbey Wood to Dartford only (segregated) & A2 - Extend services from Dartford to Northfleet. Enabled by infrastructure investment.	C5 - Crossrail Extension Abbey Wood to Dartford only (segregated), with some Crossrail services then extended from Dartford to Northfleet via shared running with National Rail services on the North Kent Line.	National Rail shuttle from Abbey Wood to Northfleet/ Ebbsfleet (shared running).	G1/G2 Hybrid - Abbey Wood / Dartford / Darent Valley Hospital & Bluewater via existing Fastrack infra east of Dartford.
Embodied carbon review	3.0	2.0	2.0	4.0	5.0
Interaction with environmental features	3.0	2.0	2.0	4.0	3.0



Key Elements of Scoring - CSR8

Components of **CSR8** in relation to the following:

- Stakeholder acceptability, based exclusively on public consultation survey results up to 11/02/2021 (814 responses in total)
- 96% of respondents in support of the Crossrail extension options, 70% would use regularly to commute into work
- 56% of respondents in support of the National Rail option, 61% would use regularly to commute into work
- 22% of respondents in support of the BRT option, 14% would use regularly to commute into work
- OAF also includes second component of CSR8 related to 'technical stakeholder acceptability'

Info	Elizabeth Line Extension			Other Rail	BRT
	C4	C5+A2	C5+SR	E1	G1/G2
Description of option	Crossrail Extension Abbey Wood to Northfleet (shared running).	C5 - Crossrail Extension Abbey Wood to Dartford only (segregated) & A2 - Extend services from Dartford to Northfleet. Enabled by infrastructure investment.	C5 - Crossrail Extension Abbey Wood to Dartford only (segregated), with some Crossrail services then extended from Dartford to Northfleet via shared running with National Rail services on the North Kent Line.	National Rail shuttle from Abbey Wood to Northfleet/ Ebbsfleet (shared running).	G1/G2 Hybrid - Abbey Wood / Dartford / Darent Valley Hospital & Bluewater via existing Fastrack infra east of Dartford.
Public consultation response	4.0	4.0	5.0	3.0	2.0
Technical stakeholder acceptability	TBC	TBC	TBC	TBC	TBC



Key Elements of Scoring - commercial and contractual risk

Components of **commercial and contractual risk** in relation to the following:

- Headline score based on average of 10 sub-elements related to commercial and contractual risk

Info	Elizabeth Line Extension			Other Rail	BRT
	C4	C5+A2	C5+SR	E1	G1/G2
Description of option	Crossrail Extension Abbey Wood to Northfleet (shared running).	C5 - Crossrail Extension Abbey Wood to Dartford only (segregated) & A2 - Extend services from Dartford to Northfleet. Enabled by infrastructure investment.	C5 - Crossrail Extension Abbey Wood to Dartford only (segregated), with some Crossrail services then extended from Dartford to Northfleet via shared running with National Rail services on the North Kent Line.	National Rail shuttle from Abbey Wood to Northfleet/ Ebbsfleet (shared running).	G1/G2 Hybrid - Abbey Wood / Dartford / Darent Valley Hospital & Bluewater via existing Fastrack infra east of Dartford.
Commercial / contractual risk headline score	3.6	3.6	3.6	4.8	4.2
Operating concessions / franchises / contracts	3	3	3	4	2
Operating company staff employment contracts	4	4	4	4	4
Track access agreements	4	4	4	5	4
Station access agreements	4	4	4	5	5
Depot access agreements	4	4	4	5	5
Rolling stock / fleet leases	3	3	3	5	5
Rolling stock / fleet maintenance agreements	3	3	3	5	5
Rolling stock / fleet manufacturing and/or modification agreements	2	2	2	5	5
Highway infrastructure access arrangements	5	5	5	5	5
Customer proposition: Fares and Ticketing	4	4	4	5	2



Annex B

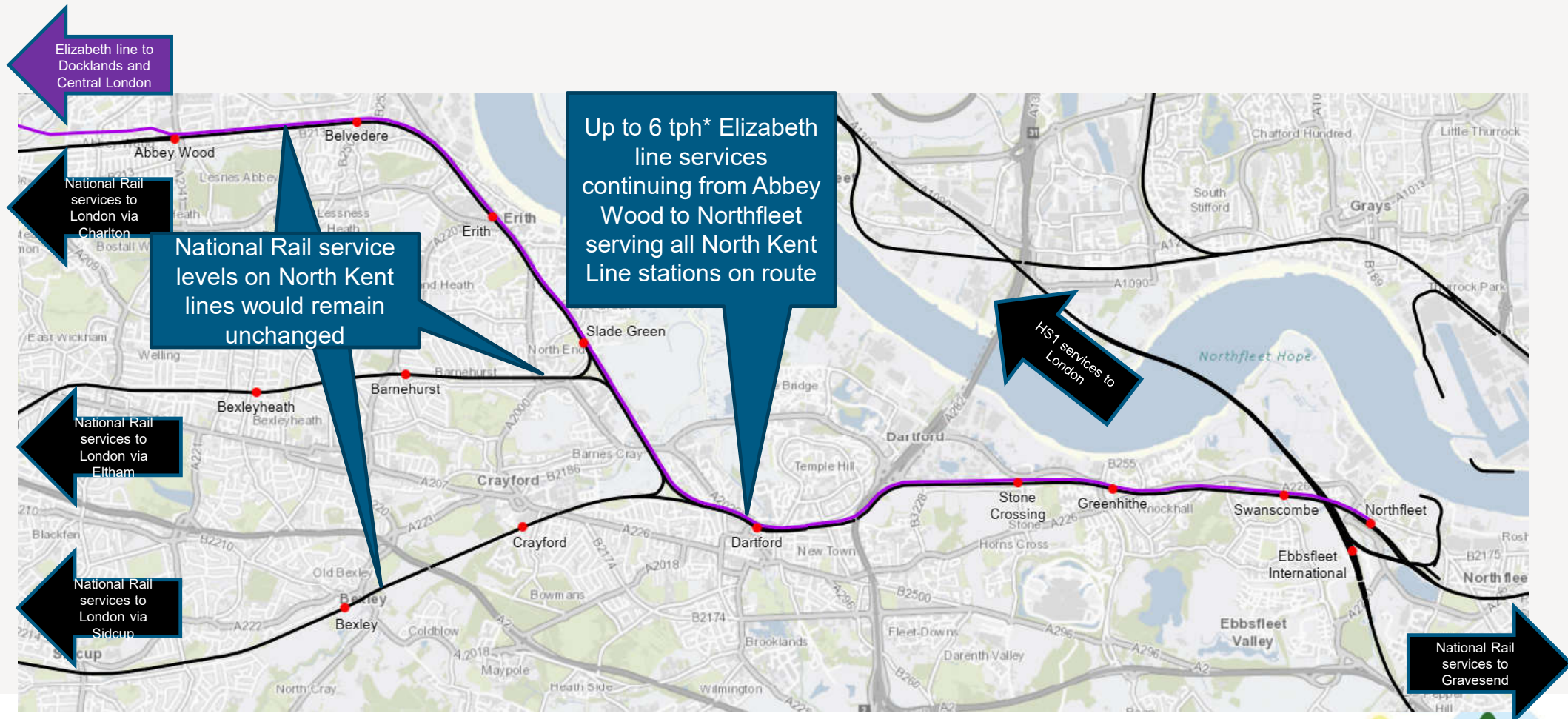
Variant Options - Specifications



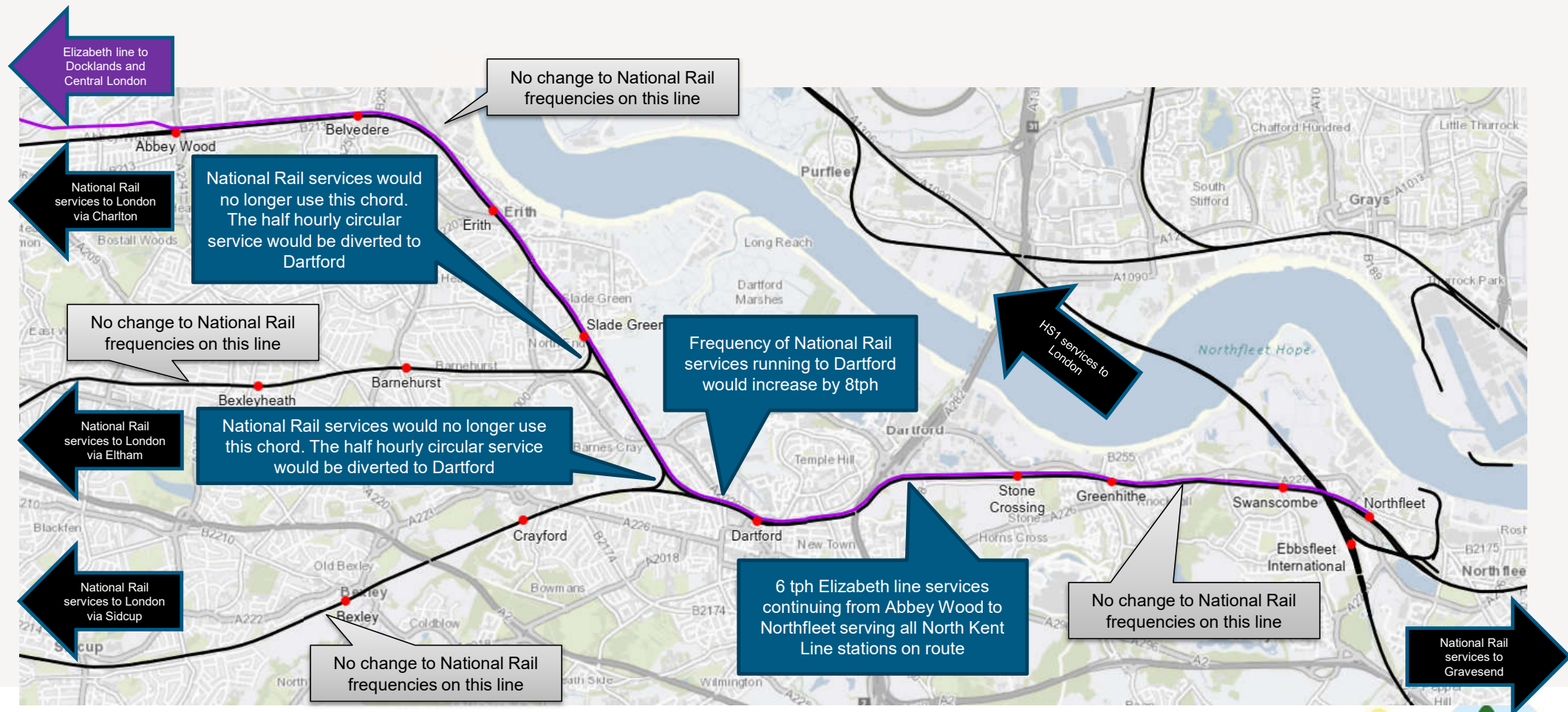
C4 Variants



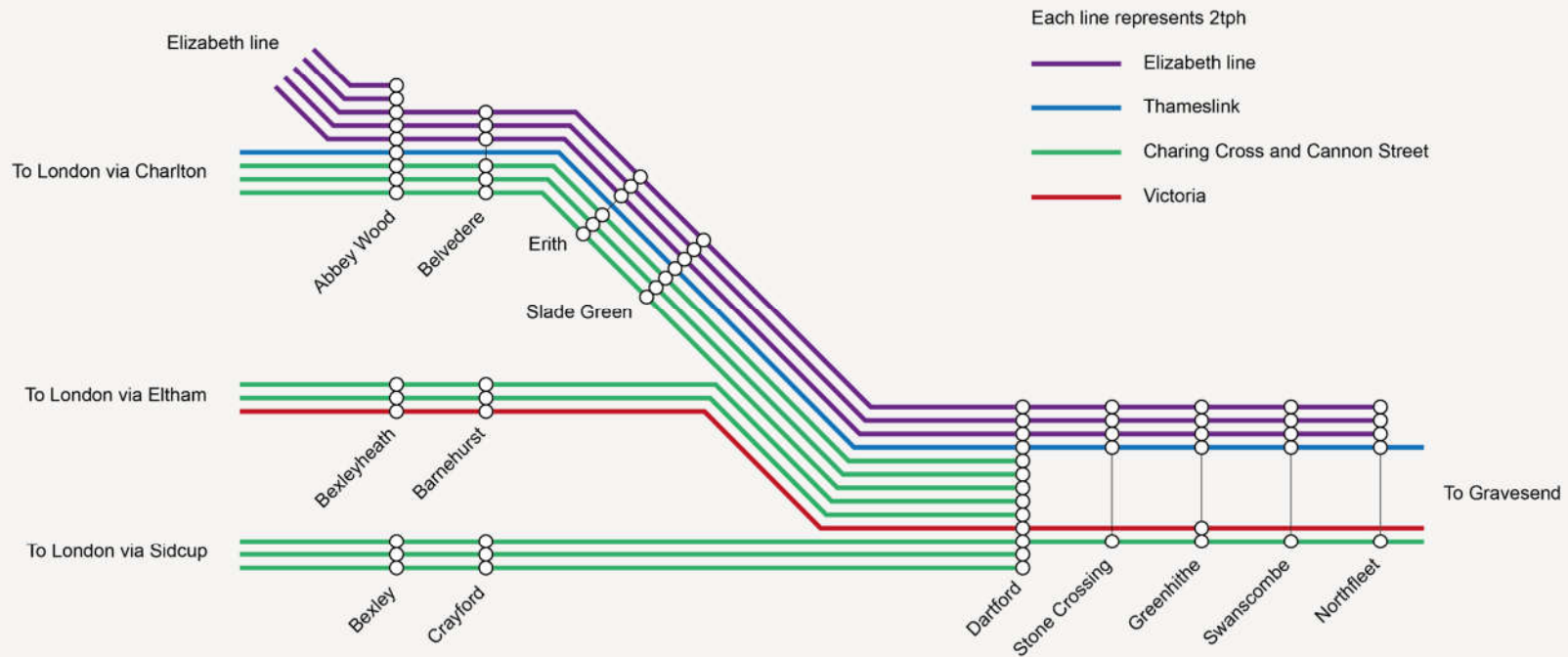
C4 (original option) – 6tph Elizabeth Line



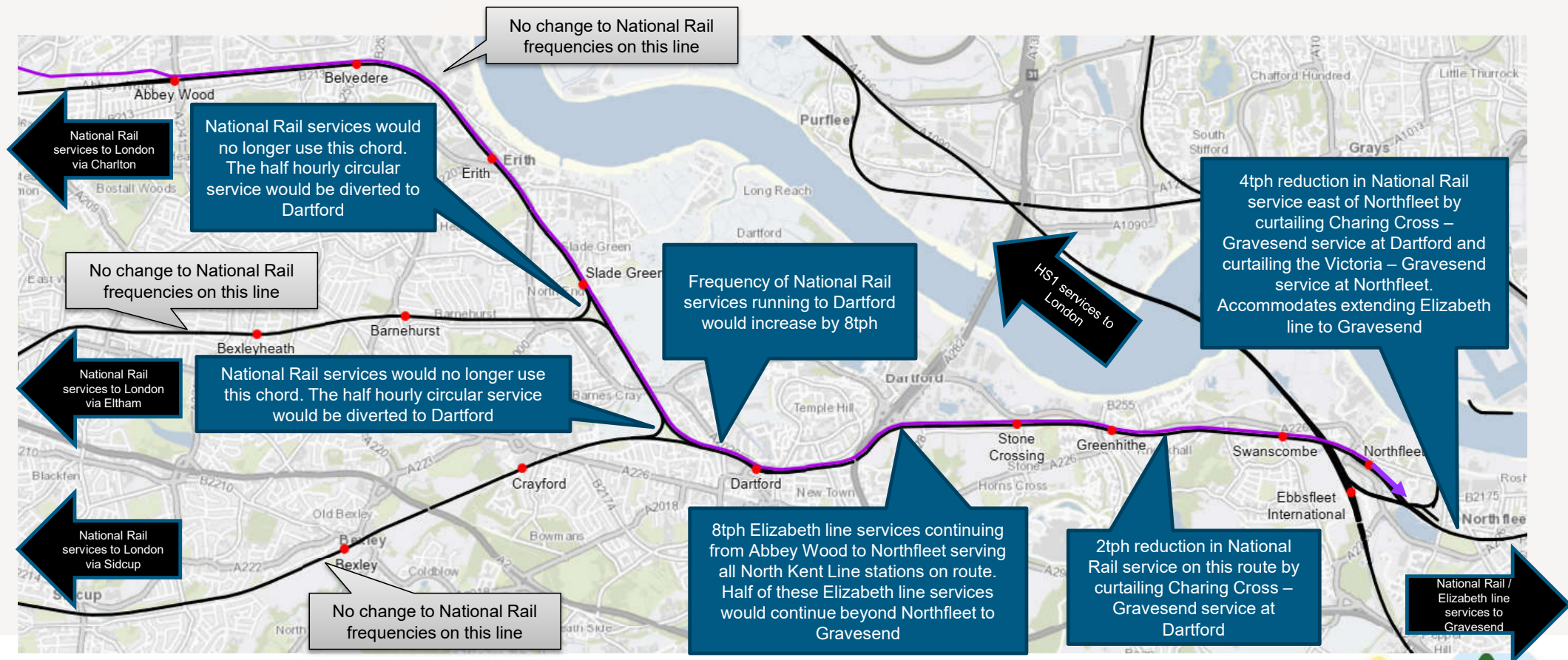
Variant C4a –6tph EL with alteration to SouthEastern & Thameslink



Variant C4a – 6tph EL with alteration to SouthEastern & Thameslink



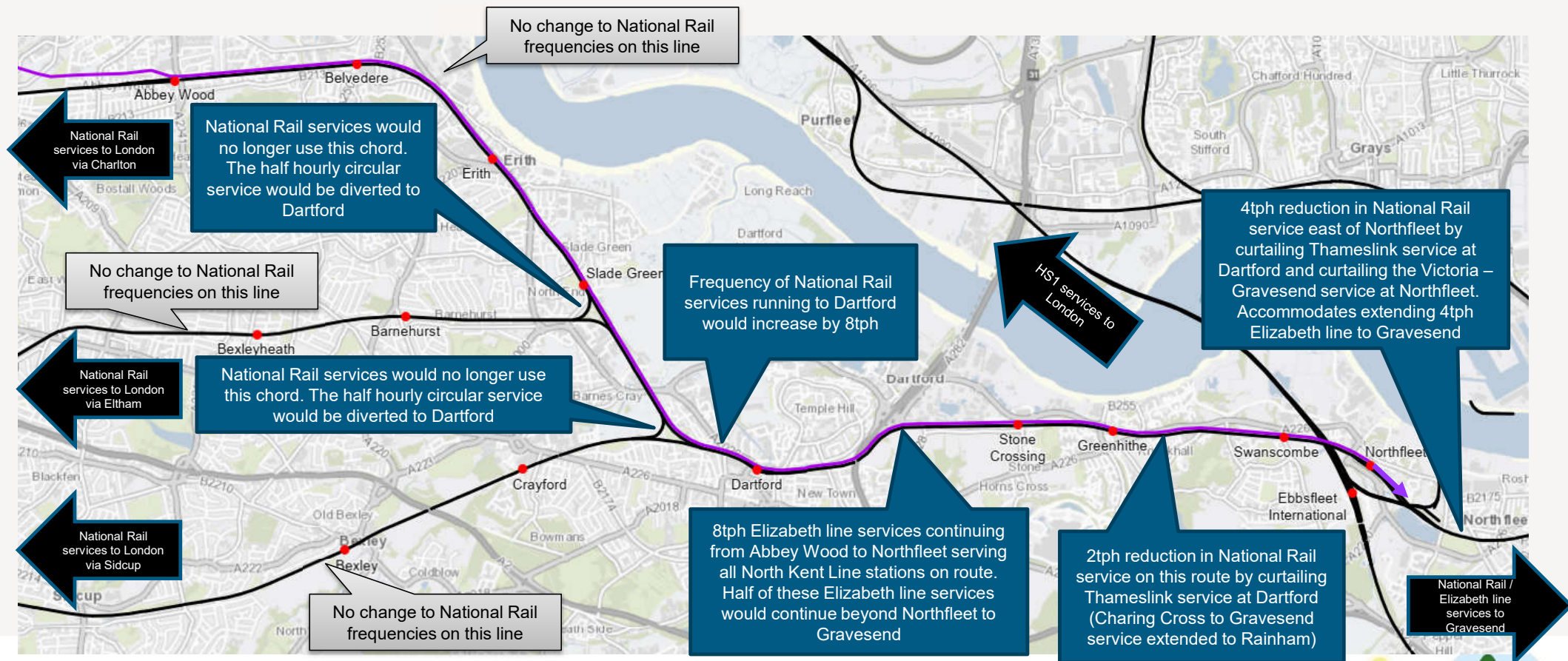
Variant C4b – 8tph EL with alteration to SouthEastern & Thameslink



Variant C4b – 8tph EL with alteration to SouthEastern & Thameslink



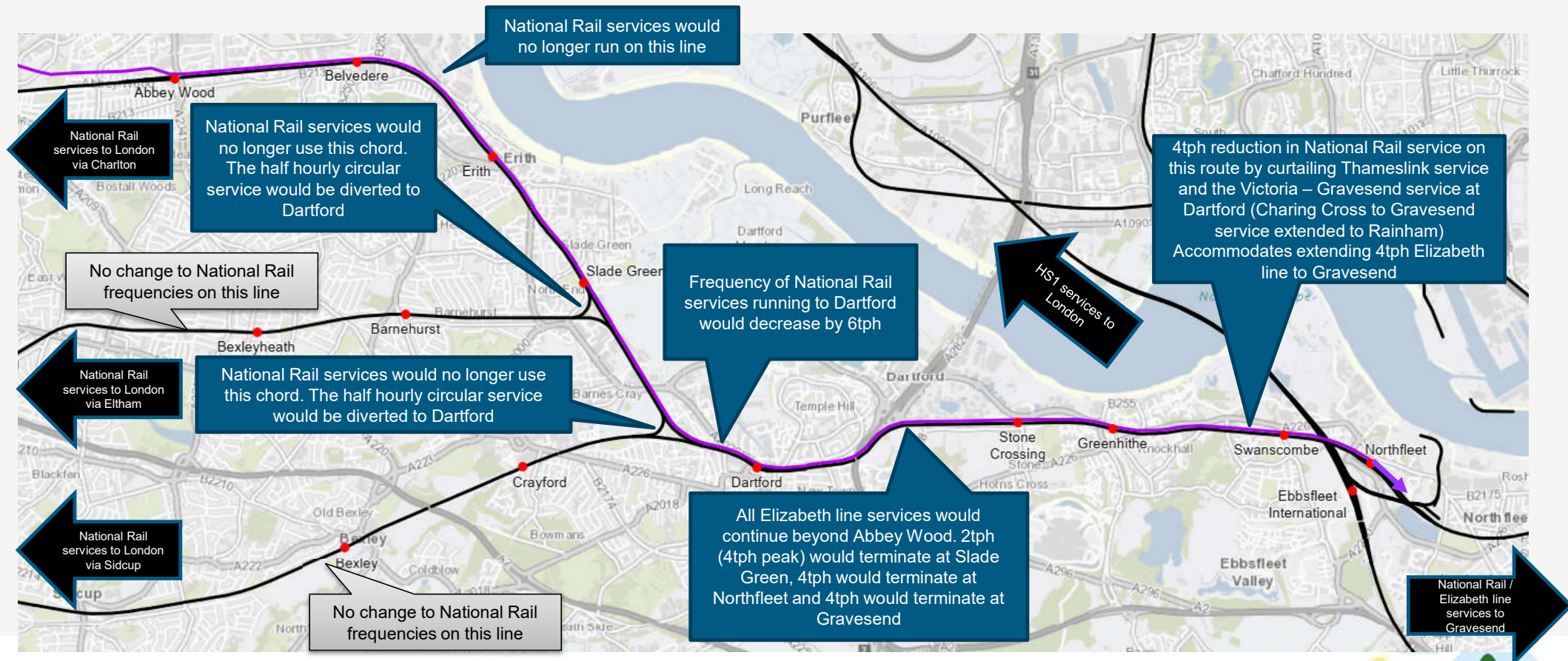
Variant C4c – 8tph EL with alteration to SE and TL (alternative)



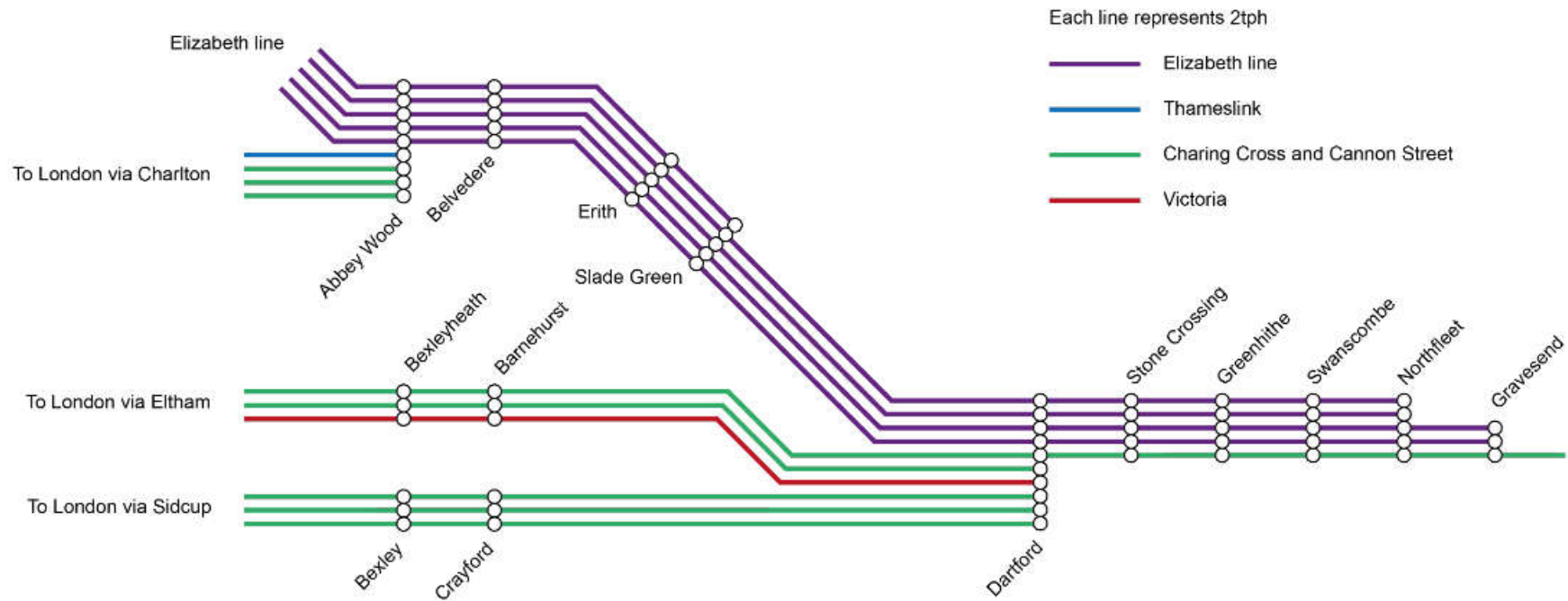
Variant C4c – 8tph EL with alteration to SE and TL (alternative)



Variant C4d – 8tph EL with significant substitution of SE and TL



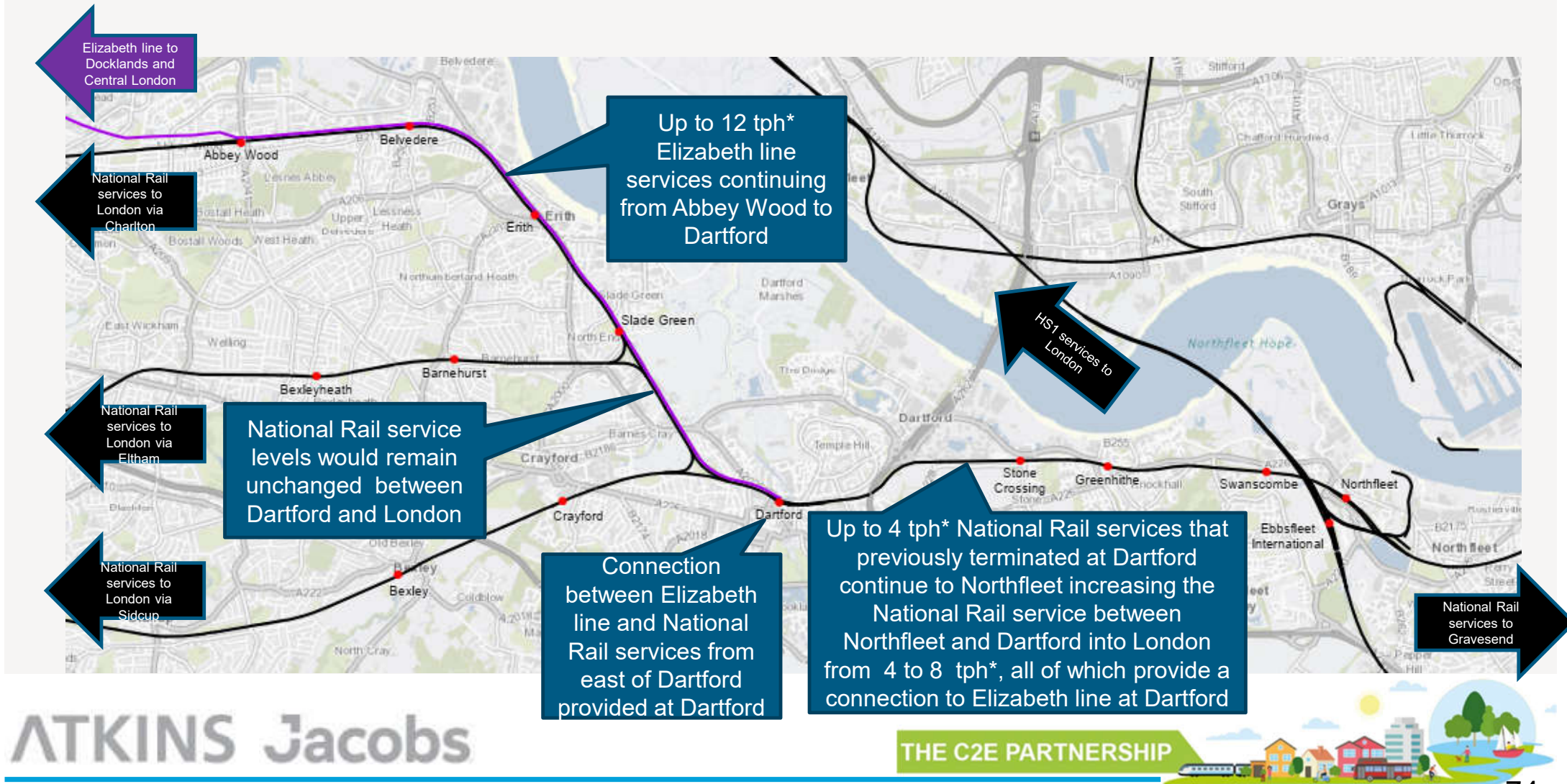
Variant C4d – 8tph EL with significant substitution of SE and TL



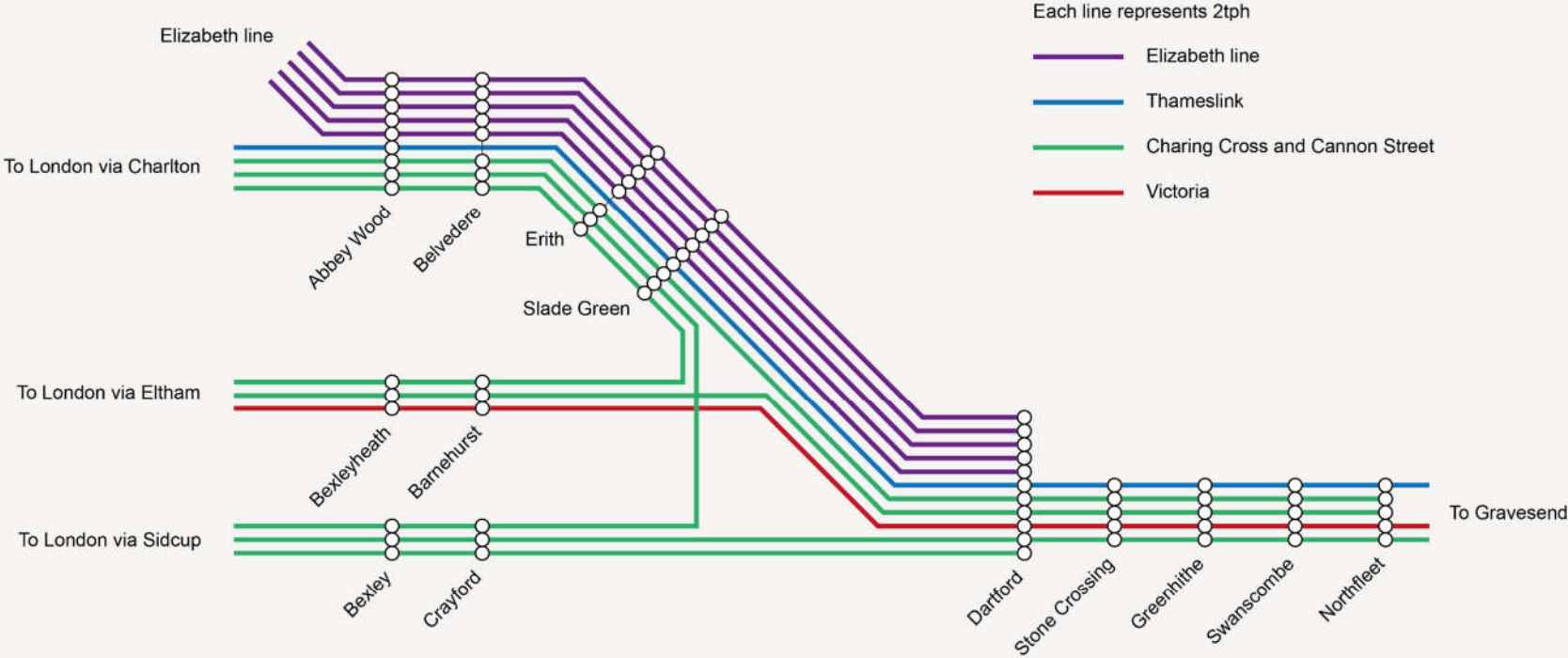
C5+A2 Variants



C5+A2a (original option - with additional Thameslink calls east of Dartford)



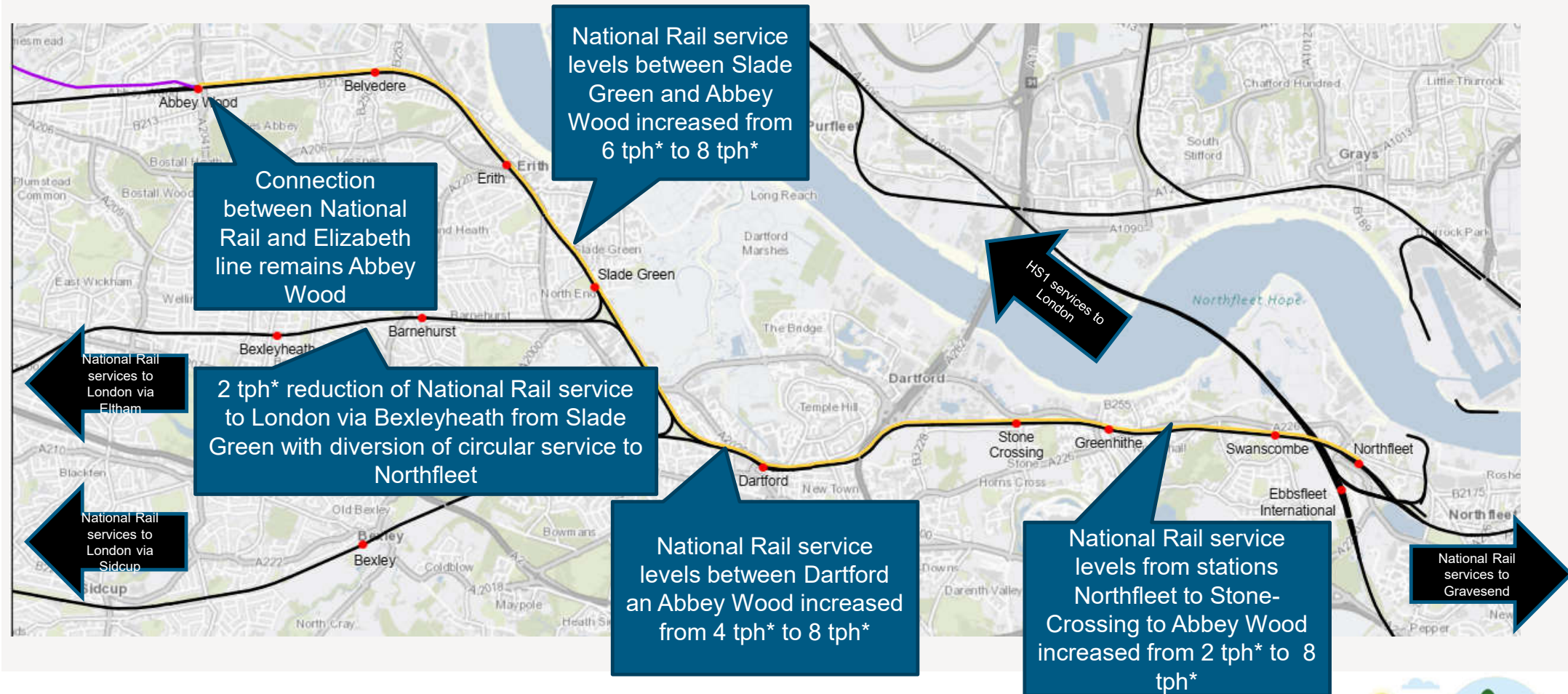
Variant C5+A2a – with additional Thameslink calls east of Dartford



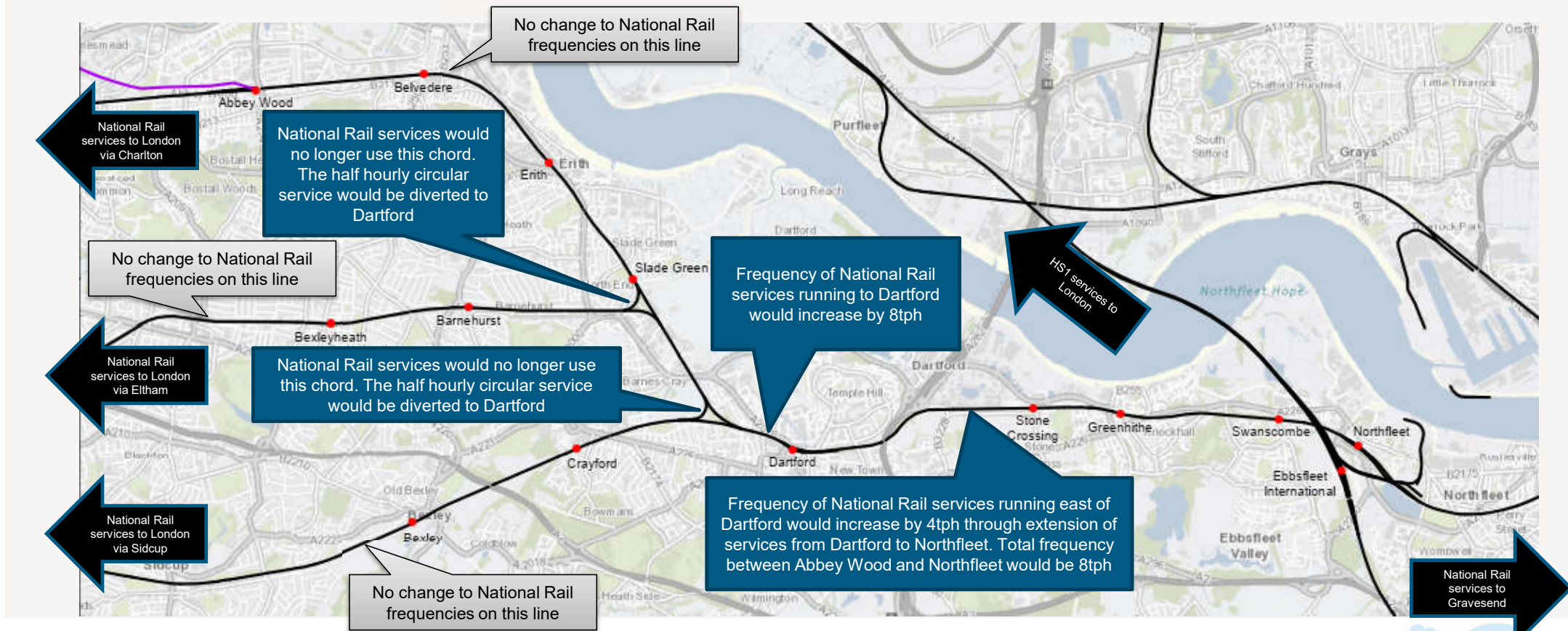
E1 Variants



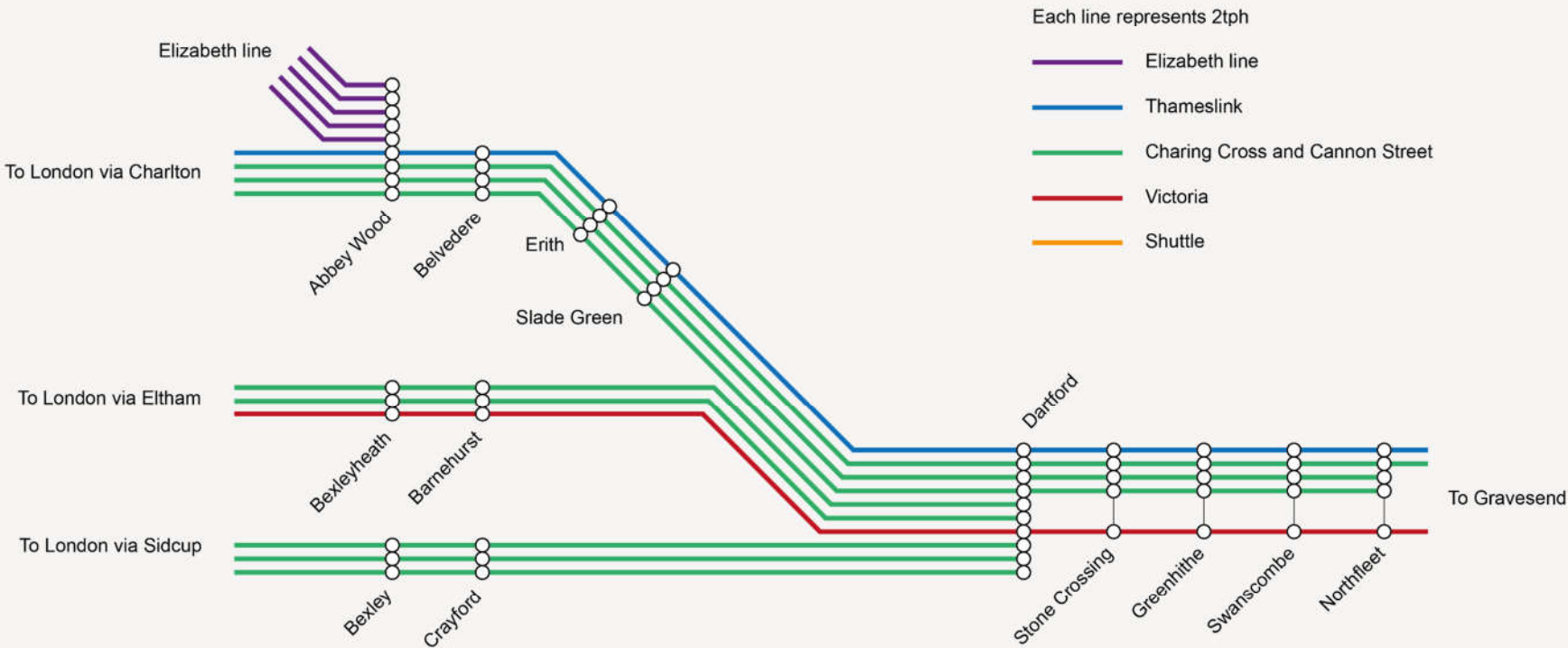
E1 (original option) – Low Cost Rail



Variant E1a – Low Cost Rail



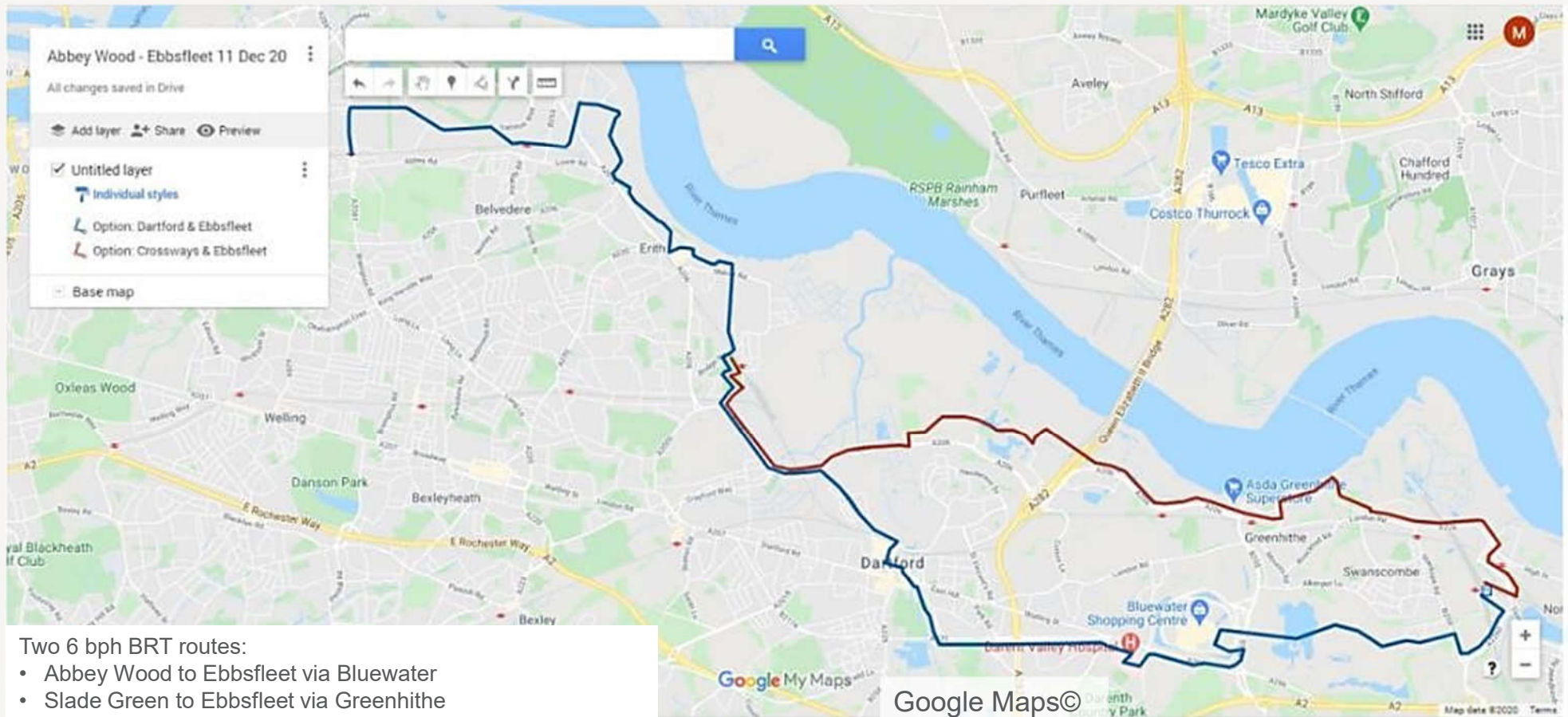
Variant E1a – Low Cost Rail



G1/G2 Variants



G1/G2 (original option) – BRT

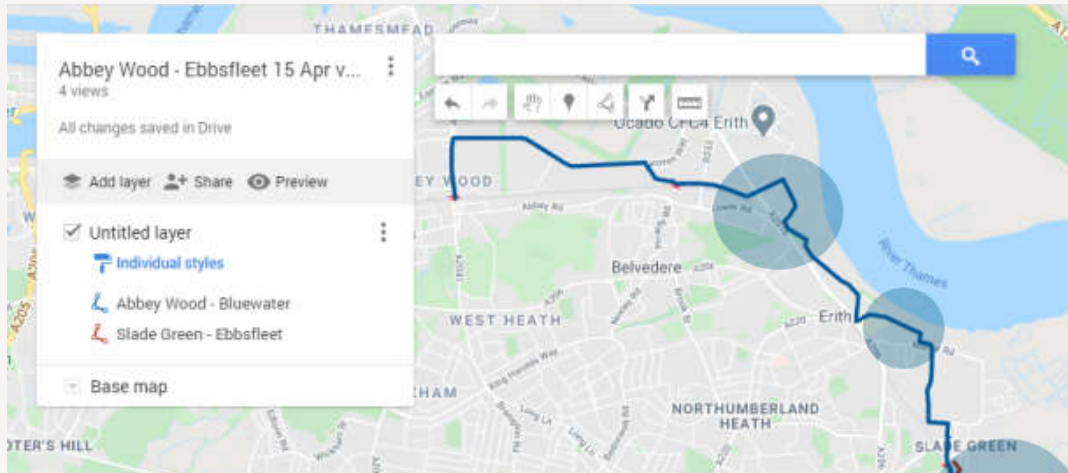


Two 6 bph BRT routes:


- Abbey Wood to Ebbsfleet via Bluewater
- Slade Green to Ebbsfleet via Greenhithe

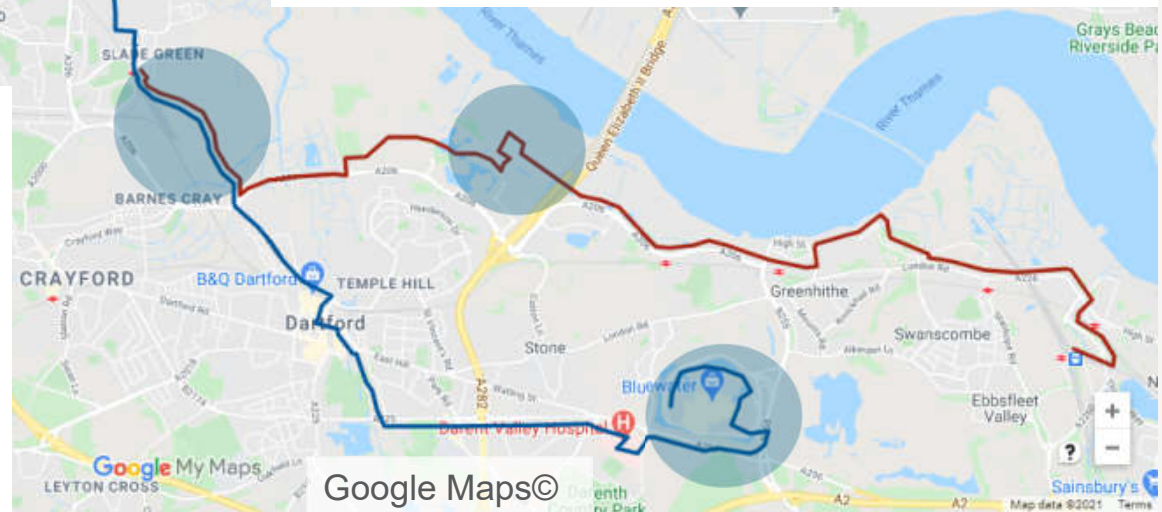


Variant BRTa



- Revised routing at Belvedere Gasworks (reduced development scope)
- Shorter routing between Belvedere Station and Church Manorway (quicker, better serves new development)
- Follows revised route of James Watt Way in Erith (Morrisons re-development)
- Re-routing via Frobisher Road (makes development easier; reduces cost)
- Re-routing via Bridge Road and Forest Road in Slade Green (makes re-development of Power Industrial Estate easier; reduces cost)
- Routing via Howbury Farm (quicker; may reduce cost)

- Minor diversion to serve new distribution centre near Crossways Business Park
- Removes route between Bluewater and Ebbsfleet; instead, route now serves proposed residential development at Bluewater (reduces operating cost; serves new development; reduces duplication with Fastrack Reference Case)
- **BRT specification the same whether BRT considered with E1 or standalone**
- **Marking denotes a key location of routing change** 



Annex C Variant Option Results of Assessment



Option optimisation variant conclusions

- **C4 optimisation variants**

- **Variant C4a:** with EL service still at 6tph, this variant has a marginal impact on the performance of C4 through capital cost reduction secured by diverting SE Circular services to Dartford.
- **Variants C4b/C4c:** moving to an 8tph C4 scheme with services extended to Gravesend, improves benefits more significantly and can also be delivered at a reduced cost, more significantly enhancing VfM. Also improves additionality. Retaining extended TL services alongside EL east of Dartford (C4b) more valuable than retaining and extending alternative SE service (C4c). Variants need to be accommodated by diversion of SE circular services to Dartford.
- **Variant C4d:** more radical re-casting of SE and TL services in corridor offers significant opportunity to further enhance the EL service offer in the corridor at a further reduced capital cost, and with a very significant saving in rail network operating costs. Variant has potential to very significantly enhance the VfM position, improve affordability and generate greater additionality from C4. Also significantly reduces scale of EL-SE/TL shared-running and associated operational performance risk to EL and SE/TL services. Does require acceptance of a very significant reduction in the SE service offer in the corridor in favour of EL service provision to accommodate it.

- **Conclusions**

- **C4b variant to be taken forward as the primary C4 type option for the next stage of SOBC appraisal, recognising this requires acceptance of potential to divert SE Circular services to Dartford**
- **C4d variant to be further considered by C2E Partnership as could be presented in SOBC as a C4 variant with potential to improve VfM, affordability and reduce operational feasibility risk but with loss of some current rail journey opportunities from/to the study corridor**



Option optimisation variant conclusions

- **C5+A2 optimisation variants**

- **Variant C5+A2a:** TL services from Dartford calling all stations east of Dartford rather than replicating existing stopping pattern reduces scheme benefits and revenues due to longer through-passenger journey times. Unlikely to be offset by development additionality. Remains poorer VFM and significantly less affordable than C4 and delivers lower additionality. Will consider value engineering opportunities to reduce cost of segregated EL route and works to support A2 as part of the next stage of feasibility work

- **Conclusion**

- **Retain previous C5+A2 variant as the option for the next stage SOBC appraisal recognising maintaining faster TL services offers better performance**
- option provides the fall-back Crossrail option to C4 given shared-running risks

- **E1 and G1/G2 optimisation variants**

- **E1a:** delivers greater enhancement to rail services but at an increase in cost. Continues to be a poor performing option
- **BRTa:** updated modelling has highlighted overstated short distance benefits flagged as a risk in this current stage. Benefits have consequently reduced with costs only marginally being reduced with routing changes
- **E1a+BRTa:** combination of rail enhancement plus BRT does not deliver a step change in the benefits delivered and combined cost is significant. VFM and affordability performance is very poor as are expected additionality outcomes

- **Conclusions**

- **Work now undertaken in the study is sufficient to demonstrate E1 option should not be appraised further as a scheme for meeting the agreed objectives and CSRs. Components might be considered as part of a wider Do Minimum rail investment strategy (NKL upgrades/ TfL “Metroisation”) towards C4 delivery**
- **BRT should be considered in the next stage as a complementary scheme to C4 and C5+A2 options. Stand alone BRT appears the most credible low cost option to retain**

