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Sir Adrian Montague, Chairman
Cross London Rail Links Limited
Butler Place, London SW1H 0PT

Copy to:

Mike Fuhr, Director, Major Projects
Department for Transport, Room 2/8C
Great Minster House 76 Marsham Street, London SW1P 4DR

Peter Hendy, Commissioner
Transport for London
Windsor House, Victoria Street, London SW1

CROSSRAIL BUSINESS CASE

Dear Sir,

I attach a brief note reviewing the business case for the project, based mostly on your review of the project as published in 2004, and subsequent information obtained from CLRL and DfT. Some key assumptions appear ill founded, and some possible methodological errors are identified. The note calculates how corrections would affect the economic case for the project.

I should be interested in your comments. We plan to publish this on our website in due course.

Yours sincerely

A handwritten signature in black ink, appearing to read 'John Prideaux', written over a large, stylized loop.

John Prideaux CBE
Chairman

Reviewing the Crossrail Business Case

By Michael Schabas, Superlink Limited

Cross London Rail Links (CLRL), the promoters of Crossrail, have claimed a benefit/cost ratio for their scheme of about 2:1. Using the Freedom of Information Act, Adrian Montague's review for the Department for Transport, and information published by CLRL, we have evaluated the business case and considered whether it is reasonable and achievable.

CLRL published its *Benchmark Business Case* in September 2003, for a scheme with branches to Heathrow, Kingston, Shenfield and Ebbsfleet. This was the culmination of three years work, at a cost of approximately £50 million.

Adrian Montague was then retained to review the project. Montague evaluated several "options" including the "core" Paddington - Canary Wharf section, and various combinations of branches. For each option, Montague produced estimates of capital costs, total and incremental *OMR* (operating, maintenance and renewals) costs, *OMR Savings* due to reductions in existing services displaced by Crossrail, *Passenger Revenues* and revenue *Abstraction* from existing services. He also presents estimates of transport benefits, mostly time savings and congestion relief, and calculates a cost/benefit ratio consistent with Treasury rules.

Figure 1 Crossrail Options

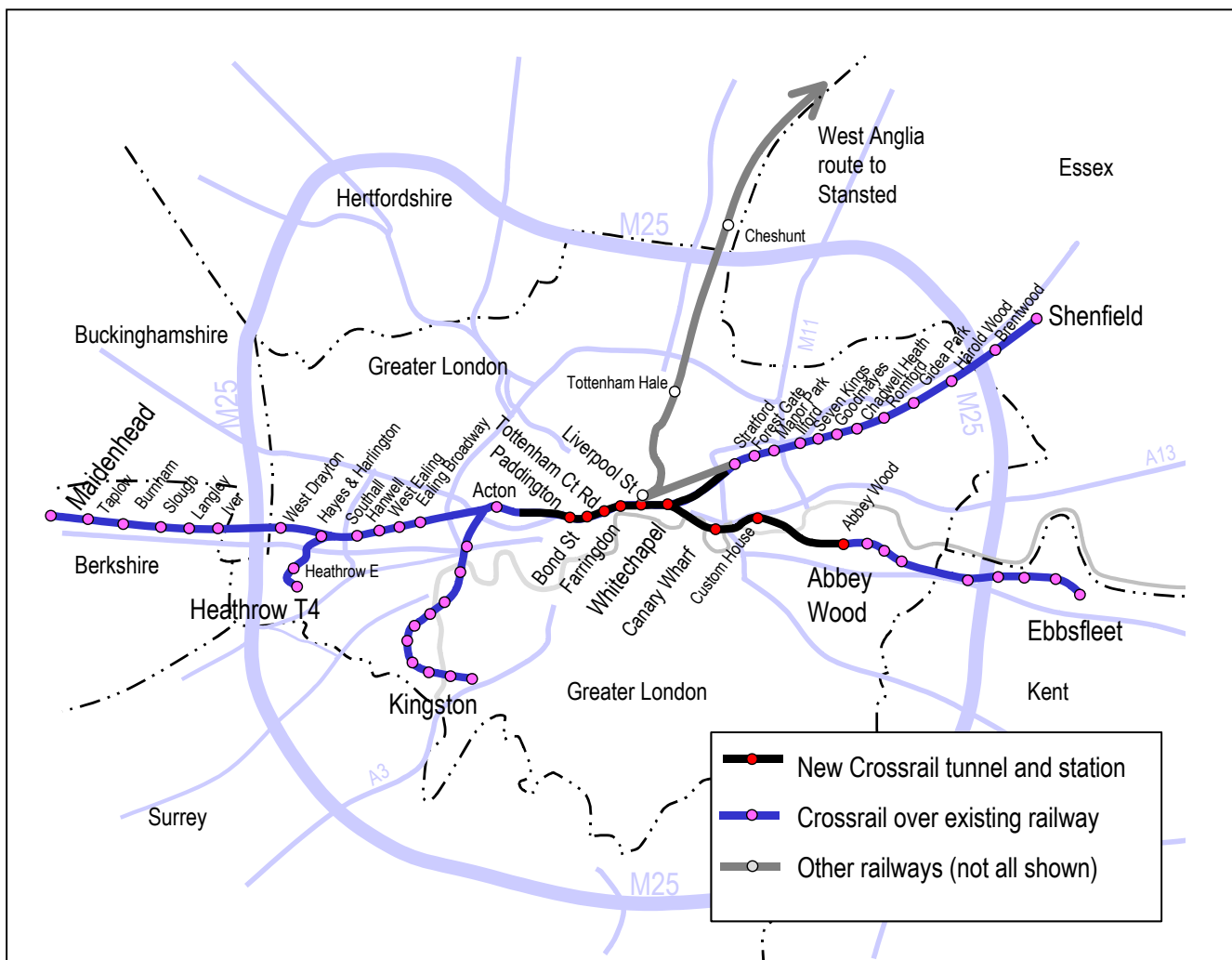




Table 1 Montague's Figures¹

All figures are in millions of £ 2002 Net Present Value	Capital cost	Tax loss	OMR	OMR savings	OMR Net	Total Costs	Revenues	Abstraction	Net Revenues	Net Margin (Funding Gap)	Total Benefits (Transport benefits)	Net benefits	BCR (Treasury)
Benchmark Scheme	8,869	460	4,824	(1,488)	3,336	12,665	7,656	(5,412)	2,244	(10,421)	20,738	8,073	1.99
Paddington to Canary Wharf	5,972	70	1,995	(83)	1,995	7,954	848	(502)	346	(7,608)	2,477	(5,477)	0.3
Whitechapel to Shenfield	879	44	1,304	(683)	621	1,544	2,787	(1,914)	873	(671)	7,070	5,526	10.5
Canary Wharf to Abbey Wood	845	16	221	(14)	207	1,068	969	(710)	259	(809)	3,232	2,164	4.0
Abbey Wood to Ebbsfleet	83	51	205	(39)	166	300	275	(242)	33	(267)	858	558	3.2
Paddington to Heathrow T4	146	185	621	(475)	146	477	1,337	(1,035)	302	(175)	3,573	3,096	20.4
Airport Jct to Maidenhead	658	(21)	129	(240)	(111)	526	1,173	(649)	524	(2)	1,592	1,066	796.1
Acton to Kingston	944	94	478	(194)	284	1,322	1,440	(1,009)	431	(891)	3,528	2,206	4.0
Bill Scheme	8,500	294	4,270	(1,495)	2,775	11,569	7,114	(4,810)	2,304	(9,265)	17,944	6,375	1.94

Most of the columns are self explanatory, but a few require explanation.

All of the figures are *Net Present Values*, discounted to 2002 in accordance with Treasury rules.

Tax loss is a concept explained in the Treasury's "Green Book", and is supposed to reflect effects on public finance of a scheme, for example if consumption is shifted from higher taxed (roads and petrol) to lower taxed activities. Public transport is zero-rated for VAT purposes. Montague acknowledges that there is some confusion as to how *Tax Loss* should be calculated. There is also some question as to the logic of, in effect, "penalising" electric public transport for not generating fuel duty income. Although fuel duty is, legally, a tax, it is also a de-facto charge to reflect social costs of road use such as congestion and air pollution. The Green Book actually states:

"... where the tax regimes applying to different options vary substantially, this should not be allowed to distort option choice." (HM Treasury Green Book 5.55)

This suggests that it should NOT be included in alternatives analysis. In any case it should make little difference to the choice between rail schemes.

¹ Most figures are taken directly, or derived using simple arithmetic, from Montague's Crossrail Review for the Department for Transport, published July 2004. For details of the derivation process see www.Superlink.org.uk. Figures for the Paddington-Canary Wharf option were provided by DfT but not published in Montague's report.

Net Margin is also sometimes called *funding gap*, the net cost to the taxpayer over the lifetime of the project.

Montague refers to *Total Benefits* but it is clear that he is referring to *Transport Benefits*, mostly savings in “generalised journey time” including both actual time savings and reductions in congested journeys, where it might be difficult to get a seat. There may also be some benefits from diversion of road users onto public transport. Transport benefits are estimated using a large “black box” model. These are forecast to be 6 to 9 times net revenues on most segments, but an astounding 26 times revenues for the Ebbsfleet branch. Is there any explanation?

Montague’s *Benefit/Cost Ratio* (BCR) is actually the ratio of *transport benefits* over *funding gap*. In effect, Montague deducts net revenues from costs, and counts the benefits to passengers that are captured by fares a second time. More properly, a BCR should ignore the financial “transfers” that are reflected in fares, rather than double count them. Montague’s “banker’s” BCR, while of interest, could mislead voters and decision makers. It would be quite possible to have a “BCR”, by Montague’s definition, of up to 2:1 for a scheme where benefits did not in fact exceed costs.

2 Initial Comments

It is apparent that the core Cross London tunnel, on its own, is pretty unattractive. It will cost about £6 billion to build, and another £2 billion to operate. It generates about £350 million of new revenue, and transport benefits worth perhaps £2.5 billion. Overall the costs outweigh the benefits by about 3:1. Thus the Government could never support Ove Arup’s “London Regional Metro” scheme, because it relied on an act of faith that, once built, valuable longer distance services would be found to use the cross London tunnel. The British Government does not have that kind of faith in the rail industry.

Montague accepts that it might be possible to operate 22 to 24 trains per hour through the Cross London tunnel. The challenge, then, is to find places to run up to 24 trains east and west of London, where they generate revenues and passenger benefits, while hopefully also achieving other worth policy objectives such as urban regeneration. The cost of the Cross London tunnel exceed benefits by £5.5 billion. With capacity for 48 trains in total from east and west, we need to find branches with an average net benefit of about £160 million per train path if we are to reach an overall scheme BCR of 1.5:1.

In the face of local opposition, the branch to Kingston was subsequently dropped, and Maidenhead added in its place. The financial impacts are substantial. While Kingston had a funding gap of £891 million, Maidenhead has roughly no net cost. Intuitively one can believe that the relatively modest costs to electrify the line from Airport Junction to Maidenhead are offset by the lower cost to operate electric trains, and the higher traffic volumes that will be generated on this route if it is linked into Crossrail.

The Maidenhead and Kingston branches would each generate about half a billion in net revenues. But while the transport benefits on the Maidenhead branch would be about £1.5 bn, 3 times the incremental revenues, benefits from the Kingston branch were estimated at about £3.5 bn or an impressive 8 times incremental revenues. Presumably these were mostly from crowding relief on the line into Waterloo. The “Banker’s” BCR for the Maidenhead branch is absurdly high, almost 800:1, because there are substantial benefits with practically no cost to the taxpayer.

Why was the Maidenhead branch not included in Crossrail's "Benchmark business case"? CLRL has been tasked by the Mayor to design a scheme to serve Greater London and not to encourage or support longer-distance commuting. This is one of the reasons CLRL rejects our Superlink proposals. Montague however appears to have thrown policy out the window, given the financial attractions of the Maidenhead branch. One might also ask why DfT is funding new high speed commuter trains from Ashford over CTRL, if long distance commuting is such an evil thing.

One further change was made in November 2004, when the Ebbsfleet branch was cut back to Abbey Wood. The reason given was operational: CLRL "discovered" that the track from Abbey Wood to Ebbsfleet was only two-track, with three routes converging through Dartford. It is not clear why CLRL was not aware of this earlier.

3 Capital Costs

We have sense-checked Montague's capital cost estimates, of about £8.5 billion, against the £3.5 billion out-turn cost of the Jubilee Line Extension and £6 billion Channel Tunnel Rail Link.

Montague accepts a capital cost estimate of £6.0 billion for the "core" section from Paddington to Canary Wharf. CLRL has stated that underground stations cost about £400m. Crossrail has seven (Paddington, Bond Street, Tottenham Court Road, Farringdon, Liverpool Street, Whitechapel and Canary Wharf), for £2.8 billion. We assume costs of £120m per kilometre for 15 km of underground railway (including track, electrification, signalling), and £100m for a junction under Stepney Green. Adding the £300 million Crossrail is spending getting the Bill into and through Parliament brings the total to £4.7 billion. If we add another 25% for other "Project Costs" (such as engineering design, project management, and property, which are usually left out of engineer's estimates) we get to Montague's total.

For comparison, JLE has 8 underground stations, about half the size of Crossrail stations and so costing about £200m each. It had 3 surface stations, for which we assume costs of £50 million, and 13km of somewhat smaller tunnel costing say £80m per km. JLE included a fleet of new trains, costing about £800m. This comes to £3.6 billion. To this we should add 25% for other project costs, but also take off the same amount to reflect the lower price levels in the late 1990s.

CTRL has one very large underground station at Stratford, and big, complicated "surface" stations at St Pancras and Ebbsfleet. On average, they are probably like Crossrail stations so we figure £1.2 billion for all three. CTRL has 28km of tunnel, slightly larger even than Crossrail but mostly not under dense central London buildings (although the river crossing was not simple). At £100m per km this costs £2.8 billion. CTRL also has 80 km of new surface railway, including some pretty complicated bridges and cuttings through Ashford, across the Medway, and at Ebbsfleet. We figure an average of £20m per km for a total of £1.6bn. Altogether, this comes to £6 billion. Again, we can offset the "other project costs" with inflation.

We have done a similar sense-check for the Crossrail branches and unit costs and find they too are reasonable and consistent for out-turn costs of similar projects.

Curiously, Government Ministers have been speaking of Crossrail costing £15 billion or more. While this may be an accurate estimate of the out-turn cost, after inflation, and including

capitalised operating costs far into the future, we think it paints an excessively negative picture of the cost of the scheme. Costs should be presented in current values, not future nominal expenditures with inflation. We think it is very unusual for Ministers to over-estimate the cost of a scheme and suspect that this indicates less than wholehearted support.

4 Operating Costs

We have in our team several experienced train operators and have developed our own estimates of operating costs, using a rate per car mile and the “dry lease” cost for a 10 car train. We have made adjustments for differing train lengths, and intensities of peak and off-peak services. We have also made assumptions about additional fixed costs for the new infrastructure. It is not cheap to clean, light, pump and ventilate large underground stations, not to mention the cost to operate and maintain lifts and escalators. Our estimates for Crossrail OMR costs are fairly similar to Montague’s, but we think he has greatly over-estimated offsetting savings. We do not have access to CLRL’s own model (despite Freedom of Information, they have refused our requests to see it). But we found a few clues that can explain the differences.

First, CLRL has assumed savings in bus operating costs of about £915 million NPV. This converts to a saving of about £50 million per year or 3% of all London bus services. They have been unable to give any detailed explanation. This figure is apparently the output of a black box model, which assumes small cuts in cost and capacity are possible on lots of routes. Most London bus routes do not run anywhere near Crossrail, so the cuts would need to be concentrated on a smaller number of routes. We think it is unrealistic, to believe that building Crossrail will allow frequency on say the Number 23 bus route to be cut by 20%.

Second, we think there is a flaw in their methodology. We asked CLRL how they came up with their OMR estimates. They said they estimated Crossrail operating costs from the bottom up, much as we have. However they said they assumed offsetting savings in existing services would result in cost saving pro rata to train miles, against total published costs for the current train operator. If this is correct (and this is what they told us) then they are assuming *pro rata* savings in all costs, including Network Rail fixed charges and station capital and operating costs. CLRL’s apparent method is clearly wrong. Crossrail will add new infrastructure that will need to be maintained including tracks and stations, but it won’t allow any significant reduction in the costs to operate and maintain existing infrastructure.

This could explain the Net OMR cost for the Heathrow/M Maidenhead branch. CLRL is actually projecting that Crossrail OMR costs will be £11m cheaper than the do-nothing option. Electric traction is cheaper to run than diesel. However, Crossrail is also assuming a doubling of train lengths, mostly to match the required train length for the higher volumes in the east. There will be a significant Net OMR cost.

On the Shenfield branch, however, Montague’s estimate of OMR costs is much *higher* than ours. It turns out that this figure includes not just the cost to operate the actual Crossrail trains, but also 6 additional peak hour trains that Crossrail believes can be operated from Stansted Airport and the outer West Anglia network into Liverpool Street, using platforms released by diverting Shenfield trains into the Crossrail tunnel. We do not think this is possible. Platform capacity at Liverpool Street is not the only constraint, nor even the most important constraint, on peak capacity on the West Anglia routes. CLRL has been unable to provide any convincing evidence,

such as an indicative working timetable, to support their assertion that Crossrail will enable this increase of about 50% in peak capacity through Tottenham Hale.

The only way to operate additional peak trains from Stansted and the outer West Anglia network, while still offering a reasonable mix of fast and slow trains, is to provide additional tracks. But the cost to four track the Lea Valley Line, certainly several hundred millions of pounds, has not been included in the Crossrail estimates. Indeed, CLRL has been unable to tell us whether they have even included the costs to reconfigure the Liverpool Street “throat” as would certainly be required to make use of the platforms released by Crossrail.

5 Revenues

We have also done a “sanity check” of CLRL’s revenue forecasts. We have converted Montague’s figures, which are for a 60 year Net Present Value, into a “design year” around 2020. We have compared with this with *do minimum* revenues, derived from rail industry data for current revenues, adjusting for fares policy, underlying growth in demand, and capacity constraints. From this we get an implied uplift in revenues on each route. The method is not perfectly accurate, and we have had to make various assumptions. However the analysis highlights the approximate uplift in rail travel that CLRL is expecting Crossrail to generate.

CLRL is forecasting net revenues of £332m for the 4 train per hour “slow” service to Heathrow. This is incremental on the existing 2 tph service. It corresponds to an uplift of about 10% on a 2020 “base case” market of about £170m for all rail services to Heathrow. CLRL has provided us with detailed figures showing that Crossrail will increase the rail mode share to Heathrow by 0.9%. Note that Crossrail trains will be significantly slower than Heathrow Express, calling at several station between Hayes and Paddington, although they should be faster and more comfortable than the Piccadilly Line. Critically, Crossrail trains are not going to serve the new Terminal 5, which will be used by about half of all passengers at the airport. Of course, the Heathrow branch will also carry passengers from Hayes, Southall, and Ealing, but these are already mature built-up areas with reasonable connections onto the tube. We think the CLRL estimate of incremental revenues for the Heathrow branch is optimistic.

CLRL’s estimates imply roughly a 50% increase in passenger revenues on the Maidenhead branch, and from the Dartford - Abbey Wood section of the North Kent line. These seem reasonable. On each route, passengers will benefit from direct trains to Canary Wharf, the City and West End, with substantial real journey times savings as well as an avoided interchange.

However, CLRL’s figures imply an even higher 75% growth in revenues on the Shenfield branch. This makes little sense. For passengers on this branch travelling to the City, Crossrail will offer little or no time saving. Indeed some trips will be slightly longer. Semi-fast trains from Romford and beyond will be replaced with an all-stations service. Crossrail trains will call at an extra station at Whitechapel. And for the 50% who currently walk from Liverpool Street to their job, the Crossrail station will be less convenient, deep underground with long escalators. The only explanation for the forecast revenues from the Shenfield branch is that they also include the growth in revenues assumed to be generated by the 6 additional peak hour trains from Stansted and the West Anglia network. But, as we have explained above, we don’t think these trains can actually operate. Without the additional trains, our estimate of incremental revenues from the Shenfield branch is reduced by two-thirds, and transport benefits would reduce roughly *pro rata*.

Without the Stansted and West Anglia services, the Shenfield branch makes no sense. The net benefit per peak train path of £119 million does not make enough of a contribution to pay for its share of the cross-London tunnels. And for many existing passengers, the £1.3 billion expenditure will actually make their journeys longer and less attractive.

6 Conclusions

We have adjusted Montague's figures to reflect the conclusions of our analysis.

Table 2 Montague's Figures "Corrected"

All figures are in millions of £ 2002 Net Present Value	Capital cost	Tax loss	OMR Net	Total Costs	Net Revenues	Net Margin (Funding Gap)	Total Benefits (Transport benefits)	Net benefits	Net benefits per path	BCR (Treasury)	BCR (Economic)
Bill Scheme (Montague)	8,500	0	2,775	11,569	2,304	(9,265)	17,944	6,375		1.9	1.6
Paddington to Canary Wharf	5,972	0	1,995	7,967	346	(7,621)	2,477	(5,490)		0.3	0.3
Whitechapel to Shenfield	879	0	386	1,265	333	(932)	2,697	1,432	119	2.9	2.1
Canary to Abbey Wood	845	0	207	1,052	259	(793)	3,232	2,180	182	4.1	3.1
Paddington to Heathrow	146	0	146	292	302	10	3,573	3,281	820	N/a	12.2
Airport Jct to Maidenhead	658	0	141	799	524	(275)	1,592	793	132	5.8	2.0
Bill Scheme (corrected)	8,500	0	2,875	11,375	1,764	(9,611)	13,571	2,196		1.4	1.2

CLRL's business case appears to depend, critically, on the claim that it will enable additional services from West Anglia and Stansted into London. CLRL has been unable to provide technical evidence to support this claim. Without these trains, the economic BCR drops 1.2:1, indicating that the project is barely worthwhile.

CLRL has not found enough places to run trains east and west to justify the expensive cross-London tunnel. The funding gap, of almost £10 billion, is too high, and the net benefits - barely £2 billion, are too small to justify the disruption and risk of the scheme.