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**C. Eliff**
Senior Designer, W S Atkins Rail Limited

# Rails around London—in search of the railway M25

C. Elliff

**The transport infrastructure of London and the south-east of England is suffering increasing congestion as traffic levels rise, year by year. The traditional response of constructing new roads no longer appears sustainable, and solutions must be found elsewhere. Rail transport is now accepted as the optimum environmentally friendly means of moving large volumes of passengers and freight, and several schemes have been proposed either to enhance existing routes, or to create new ones. This paper outlines the author's vision for a new circumferential railway, around the western side of London, to provide main-line railway links to Heathrow and Gatwick airports, and a freight bypass for Channel Tunnel traffic. Entitled the Grand Junction Link, it would effectively become the 'railway M25'.**

## 1. INTRODUCTION

An efficient transport infrastructure is vital for the prosperity and quality of life of any country or region. All too often, however, congestion and needless pollution prevail, and this can exact a heavy cost in poor health and lost business opportunities. This is the threat that faces London and the south-east of England. The problem is not merely a regional issue; with the UK's principal trading routes to the European Community passing through the metropolitan area, the region's problems of gridlocked roads and overstretched railways can affect the entire country.

Government has at last recognised[1] that the traditional response of constructing new roads is no longer viable; the environmental cost is too high and the traffic generation effect is ultimately self-defeating. Railways are seen as the only realistic alternative to roads, and policy is now directed to transferring traffic from road to rail, wherever possible.

Any such policy will only succeed with the consent of the public, and of the business community. There will be resistance to the perceived loss of personal control and convenience, to the higher direct costs, and to the policy 'incentives' such as road pricing and higher vehicle and fuel taxes that will inevitably be applied. It is essential that the railway system can offer users of private transport an attractive alternative of comparable quality.

A flexible railway network, aligned to the needs of a sprawling twentieth-century metropolis, is required. The existing radial system, basically unchanged from the nineteenth century, is still focused on central London; it provides few of the circumferential links necessary to adequately serve the multitude of modern suburban centres and major airports, particularly Heathrow and Gatwick. With no development of new rail networks to match the post World War II road building programme, road transport has largely taken over inter-suburban flows of passengers and goods.

The motorway system, and in particular the M25, was created to allow long-distance road traffic to avoid the congestion of central London; it has greatly eased the passage of traffic from the outlying regions of Britain to the Channel Tunnel (or ports) and onwards to the Continent. The railway system, on the other hand, has had no such advantages; even with recent developments, such as Thameslink (1988) and improvements to the west/north London lines for Channel Tunnel traffic, London's 'hub and spoke' network lacks the necessary rail links between central termini. This requires passengers to transfer to the Tube, and freight to struggle through congested inner London bottlenecks, particularly Clapham Junction. Without efficient cross-London railway links, many potential passenger and freight flows arising from the opening of the Channel Tunnel have instead been diverted to the roads.

It is against this background that the railway system of London and the South-East must now be developed. Railway planners have been quick to perceive the deficiencies of the existing network, and have been no less quick to propose solutions. Notable among the proposals are the following schemes, which are also illustrated in Fig. 1 (Table 1 provides a key to the abbreviations used in the figure).

(*a*) *Channel Tunnel rail link (CTRL).* Construction of the CTRL will allow the Eurostar service to Paris and Brussels to claim a greater share of cross-Channel inter-city traffic from the airlines. With the second stage completed to St Pancras, offering the possibility of through-services to the Midlands and the North (or direct connections), it will still have little direct impact on road congestion, other than a marginal reduction in road traffic to Heathrow and Gatwick. It should be noted that the new railway will be steeply graded, similar to the French TGV lines, and will offer little opportunity for freight traffic.

(*b*) *Thameslink 2000 and CrossRail.* These schemes, to improve

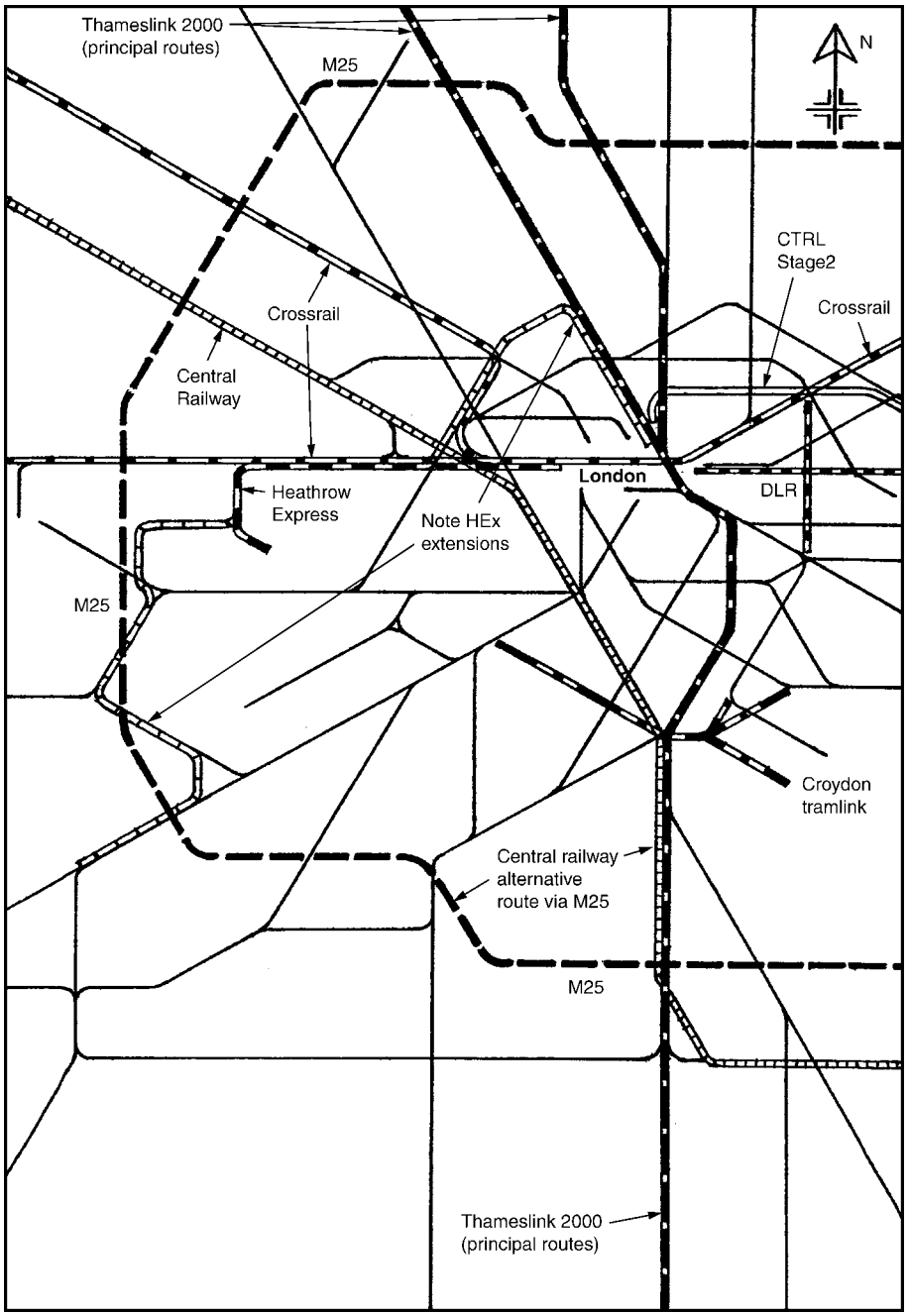


Fig 1. New railways proposed and completed: London and the South-East

north–south links and provide east–west links across central London, would allow more efficient 'hub and spoke' operation of the network, and thus would attract some car users on inter-suburban journeys onto trains. However, CrossRail remains on the drawing board, while the current public inquiry gives hope for the future progress of Thameslink 2000. As with the CTRL, these lines have little or no potential for freight traffic.

(c) *Croydon Tramlink, Docklands light railway (Lewisham extension).* These light rail schemes are now in operation, and have provided much more comprehensive local rail networks for Croydon and Docklands. Both should have significant impacts on local inter-suburban congestion. Of all the passenger schemes considered in this paper, Croydon Tramlink is likely to have the greatest impact on road traffic by virtue of the fact that its construction will create new axes of rail travel that did not exist before in any coherent sense. This is only possible with tight-radiused streets running in town centres.

(d) *Heathrow Express.* The express rail connection from Paddington to Heathrow follows the Great Western main line and reaches the heart of the airport via a new tunnelled spur. It offers airline passengers a faster, higher quality alternative to the London Underground Limited (LUL) Piccadilly Line (previously the only rail link to the airport); but it is limited by its lack of either westward connections, to Reading and beyond, or convenient connections to the City of London from its terminal at Paddington.

The British Airports Authority (BAA), which operates Heathrow Express, has recently investigated the possibility of a parallel service to St Pancras, with the potential for CTRL and Thameslink connections (to give a total of eight trains per hour to central London). However, its strategy for improving rail access on other axes is to establish dedicated bus links from interchange stations, such as the new Feltham Gateway. Although a worthwhile development, this is unlikely to attract motorists out of their cars in sufficient numbers to bring about a significant reduction in traffic congestion.

If Terminal 5 is constructed, Heathrow Express could be extended under the new terminal, returning onto the Great Western main line via a west-facing link; a circuitous link to the southern network could also be provided. But even with connections as far as Reading and St Pancras, Staines and Woking, Heathrow Express would offer connections

| Abbr. | Meaning | Abbr. | Meaning |
|---|---|---|---|
| BL | Brighton Line (Connex South Central) | Le | Leatherhead |
| | | LGW | Gatwick Airport |
| CJ | Clapham Junction | LHR | Heathrow Airport |
| Cr | Croydon | MET | Metropolitan (Chiltern Line) |
| CTRL | Channel Tunnel Rail Link | | |
| DLR | Docklands Light Railway | MML | Midland Main Line |
| Do | Dorking | NJ | Northolt Junction |
| ECML | East Coast Main Line (GNER, WAGN) | Re | Redhill |
| | | Ri | Richmond |
| Fe | Feltham | StA | St Albans |
| Gu | Guildford | Sl | Slough |
| GCR | Great Central Railway (Chiltern Line) | St | Staines |
| | | T4 | Terminal 4 (Heathrow) |
| GER | Great Eastern Railway (Great Eastern, Anglia) | T5 | Terminal 5 (Heathrow) |
| | | SWML | South-Western Main Line (South West Trains) |
| GWR | Great Western Railway (First Great Western) | | |
| | | Wa | Watford |
| GJL | Grand Junction Link | WCML | West Coast Main Line (Virgin, Silverlink) |
| Ha | Hatfield | | |
| HEx | Heathrow Express | Wi | Windsor |
| HH | Harrow | WJ | Willesden Junction |
| HI | Heathrow Interchange | WL | Windsor Line |
| Ki | Kingston | Wo | Woking |

Table 1. Key to abbreviations used in the figures

only to the South Western and Great Western networks; there would be no effective connections to the northern main lines or to the South Central or South Eastern networks.

(*e*) *Central Railway*. The railways of Britain must contend with two major handicaps in winning international freight traffic from road haulage. First, the network has only limited capacity (and none whatsoever at peak periods) for Channel Tunnel freight traffic passing through London. Second, the limited British structure gauge does not permit many of the larger Continental wagons, constructed to 'Bern Gauge', to operate in this country; this causes many Continental freight flows to be diverted to road haulage.

These problems were addressed in the recent proposal to construct the 'Central Railway', a new dedicated freight route from the North and the Midlands to the Channel Tunnel. To the north of London, the route would follow underused or disused lines along the former Great Central route, but major new construction would be required for the crossing of London—a combination of tunnelling under London's West End and a new parallel alignment alongside the Brighton Line through south London, as far as Redhill. The route would then continue eastwards to the Channel Tunnel via Tonbridge and Ashford.

The new construction through the developed areas of south London could only be accomplished with mass destruction of houses, gardens and businesses; the proposal was greeted with a storm of protest which persuaded Parliament to reject the scheme in 1996. The backers of the Central Railway have recently indicated[2] that a new application, shortly to be submitted later this year, will offer an alternative bypassing alignment; this would closely follow the M25, and cross the North Downs via a 12 km long tunnel.


Fig. 2. A frequent bus service provides connection to Heathrow from the new Feltham Gateway Station

The above-described proposals have a common feature: they largely follow nineteenth-century railway alignments which do not necessarily match contemporary traffic flows, and thus can only be of limited effectiveness in reducing current congestion. New cross-London services, such as Rugby–Gatwick and Colchester–Basingstoke, have exploited the upgrading of the west and north London lines, but these can only offer

Fig. 3. Heathrow Express EMU at Paddington Station


Fig. 4. London-bound Heathrow Express train rejoining Great Western Main Line at Hayes

a limited solution. New rail routes are needed, focused on the major suburban centres and the airports.

For any 'heavy rail' solution (i.e. discounting tramways), reserved alignments are required throughout; the necessary clear corridors, to avoid unacceptable destruction of property or uneconomic lengths of bored tunnelling, can only be found in the semi-developed outer suburbs of London. This consideration dictated the location of the M25, and it applies equally to any new trunk railway.

## 2. THE GRAND JUNCTION LINK

The foregoing paragraphs have identified major limitations or drawbacks in the Heathrow Express and the 1996 Central Railway schemes. These could be addressed by the following developments

- a north–south passenger route to serve Heathrow Airport and complement Heathrow Express
- a freight route to bypass London, skirting the southern and western suburbs (as envisaged in the current Central Railway proposals); this would eliminate the need for the controversial cross-London section.

The alignments of both routes are broadly coincidental in the M25 corridor; there are clear advantages in combining the two routes, at least in part, and it is on this basis that the Grand Junction Link (GJL) is conceived, as an orbital trunk route, effectively the 'railway M25'. It would be centred on Heathrow and would extend to the Brighton Line and Redhill–Tonbridge line in the south, and to the West Coast Main Line (WCML) in the north, with a circumferential link to the Midland Main Line (MML) and East Coast Main Line (ECML). The route is illustrated in Figs 5 and 8.

Much of the necessary work to enable the north–south alignment of the GJL to pass through the central terminal area of Heathrow Airport has, fortuitously, already been accomplished in the Heathrow Express scheme. However, major work would still be required to connect into the Heathrow Express tunnels and to create a bypassing alignment for the freight route.

## 3. PASSENGER SERVICES

It is evident that the GJL could do far more than merely enable journeys to Heathrow Airport to transfer to public transport. With suitable spur connections to the main lines that it intersects, it could constitute a new network, offering opportunities for a vast range of new outer suburban and longer-distance passenger journeys that previously could only be easily undertaken by road. A range of possible routes is indicated in Fig. 11 and is listed in Table 2.

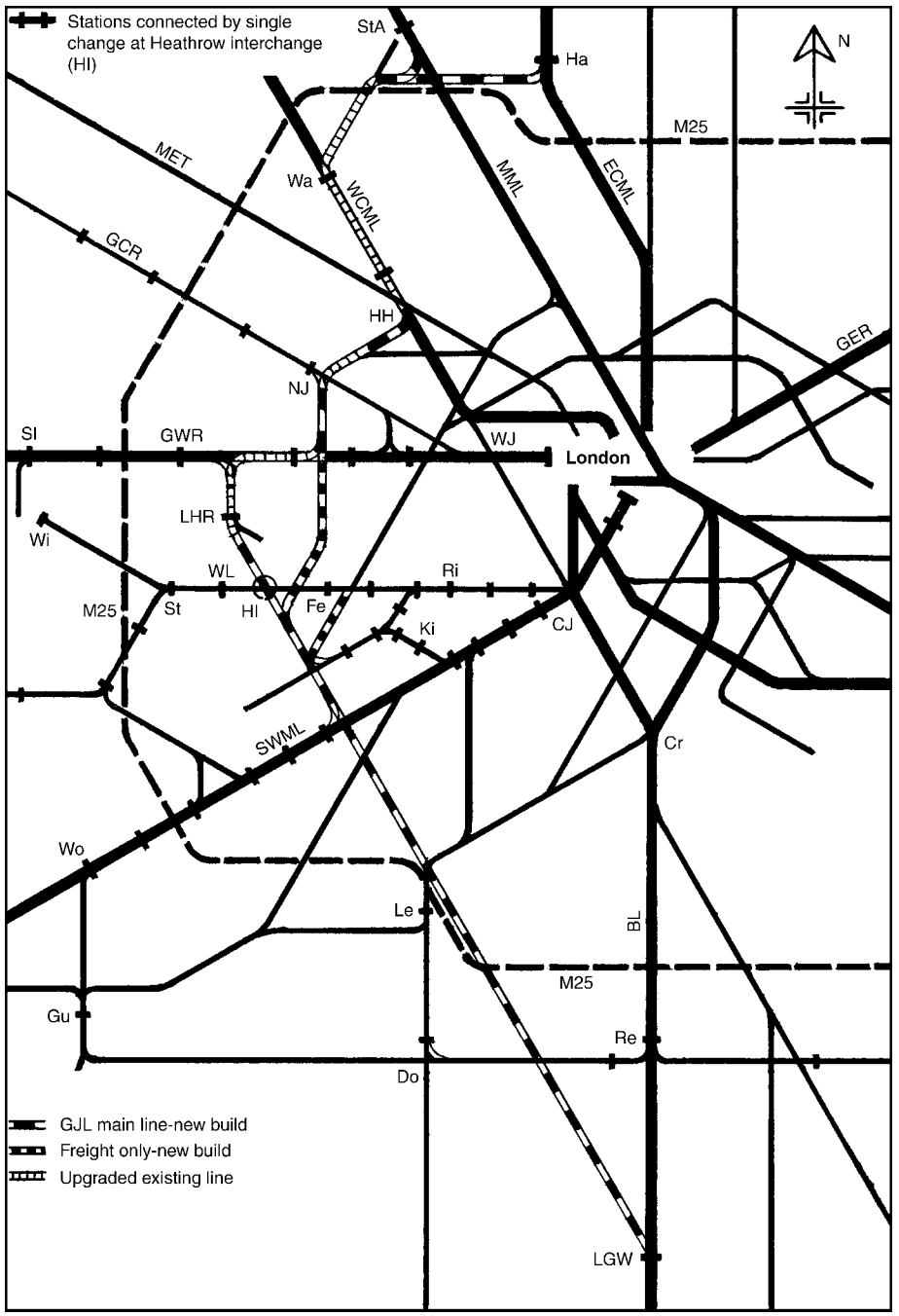


Fig. 5. Grand Junction Link and existing networks: Heathrow connections

Completion of CrossRail would allow access to the entire East Anglian network; an additional route, offering great benefits to both CrossRail and the GJL, would become possible; this is shown as route 2# in Fig. 11.

The existing Brighton–Manchester and Rugby–Gatwick services could be combined, and rerouted via the GJL to take in Gatwick, Heathrow, Birmingham and Manchester airports; this 'Airports Express' service, shown in Fig. 4 as route 1, would optimise long-distance connections to airports, and reduce the need for bus transfers when planes are diverted. A similar long-distance service could also run to Paris or Brussels via the Channel Tunnel; this would allow Heathrow to compete for interContinental traffic to France and Belgium, and would provide an alternative and more attractive route for a possible Regional Eurostar service to Manchester. This is shown as route 1# in Fig. 11.

The full potential of the new network is illustrated by Fig. 5; this shows the suburban stations that would be connected by either a through-journey, or a single change of trains at the proposed 'Heathrow Interchange' station, to be sited adjacent to the A30 near the southern perimeter of the airport. This station would be the appropriate interchange point, rather than Heathrow Central, which lacks the necessary waiting facilities. Additionally, Heathrow Interchange, as the main hub for domestic services, would offer connections to the Waterloo–Staines ('Windsor') Line, and would be better placed for any future pathing of Reading-bound trains via Terminal 5.

With the exception of Heathrow Interchange, new stations on the Grand Junction Link are not proposed.

## 4. BENEFITS TO AIRPORT OPERATIONS

Having considered conventional passenger traffic, the opportunity for a different type of journey—*between* airports, rather than *to* airports—must not be overlooked. Heathrow and Gatwick are only 44 km apart, equating perhaps to a 20-minute journey; the GJL would allow a far quicker, and more reliable interchange than is currently possible by congestion-prone roads. It would be possible to extend certain of the Heathrow Express services (currently four trains per hour from Paddington, but likely to double with the proposed St Pancras service) as far as Gatwick, and thus, with the GJL Brighton Line services, offer a connection at perhaps ten-minute frequencies.

With such a metro-style service, Gatwick could effectively become Heathrow's third runway, available (unlike Heathrow) for night flights. This would greatly enhance the status of Gatwick, currently regarded as the second-best option, more useful for charter flights. It would also eliminate the duplication between Heathrow and Gatwick as parallel destinations for

Fig 6. Brighton–Manchester–Glasgow 'Sussex Scot' service, pictured on the West London Line at Kensington Olympia, would be diverted onto the Grand Junction Link via Heathrow

Fig. 7. Connex Rugby–Gatwick service at Kensington Olympia

short-haul flights. The GJL could unlock the full potential of Gatwick as a commercial airport, concentrating on UK and EC destinations, with charter flights relocated to Luton or Stansted.

With Luton Airport Parkway station now opened, it would be worthwhile to provide a link to Luton Airport from Heathrow (a Luton–Gatwick link via Thameslink already exists). The distance would be greater, on generally slower speed lines; 40 mins for a 57 km journey would be a reasonable estimate.

The GJL would provide efficient links to either airport from most UK population centres, without the need for a time-consuming and inconvenient cross-London tube transfer. Enhanced rail links should bring about significant reductions in journeys to the airports by other modes of transport, principally private car and internal UK flights. It has been a long-standing policy aim of the BAA to promote public transport in favour of car-based journeys to the airports and consequently allow more profitable redevelopment of land currently used for car parking. Similarly, a reduction in demand for internal UK flights would free up runway slots for international flights.

### 5. FREIGHT SERVICES

The GJL would allow Channel Tunnel freight traffic, *en route* to the northern main lines, to bypass central London with enhanced speed and reliability. The likely time saving, between the Channel Tunnel route (at Redhill) and the West Coast Main Line (near Harrow), is at least 30 min, but the more important gain would be in reliability; with no paths available for freight trains through the Clapham Junction area during peak hours, any delay elsewhere which causes a timetabled path to be lost can result in delays lasting hours. This situation will only worsen in future as traffic increases.

The freight route is indicated in Fig. 12. It would deviate from the passenger route only at the following locations.

- The direct passenger route over the North Downs would be too steep for freight; this would be directed instead via Dorking, along a new east to north chord (see the Central Railway proposed tunnel in item (*e*) of Section 1).
- A bypassing tunnel at Heathrow would keep freight traffic clear of the underground Central and Interchange stations.
- Connections to the Heathrow International Cargo Centre and to the proposed freight terminal at Colnbrook should also be considered.
- A connection near Feltham to the Windsor Line would allow access to the freight yards alongside the WCML between Willesden and Wembley.

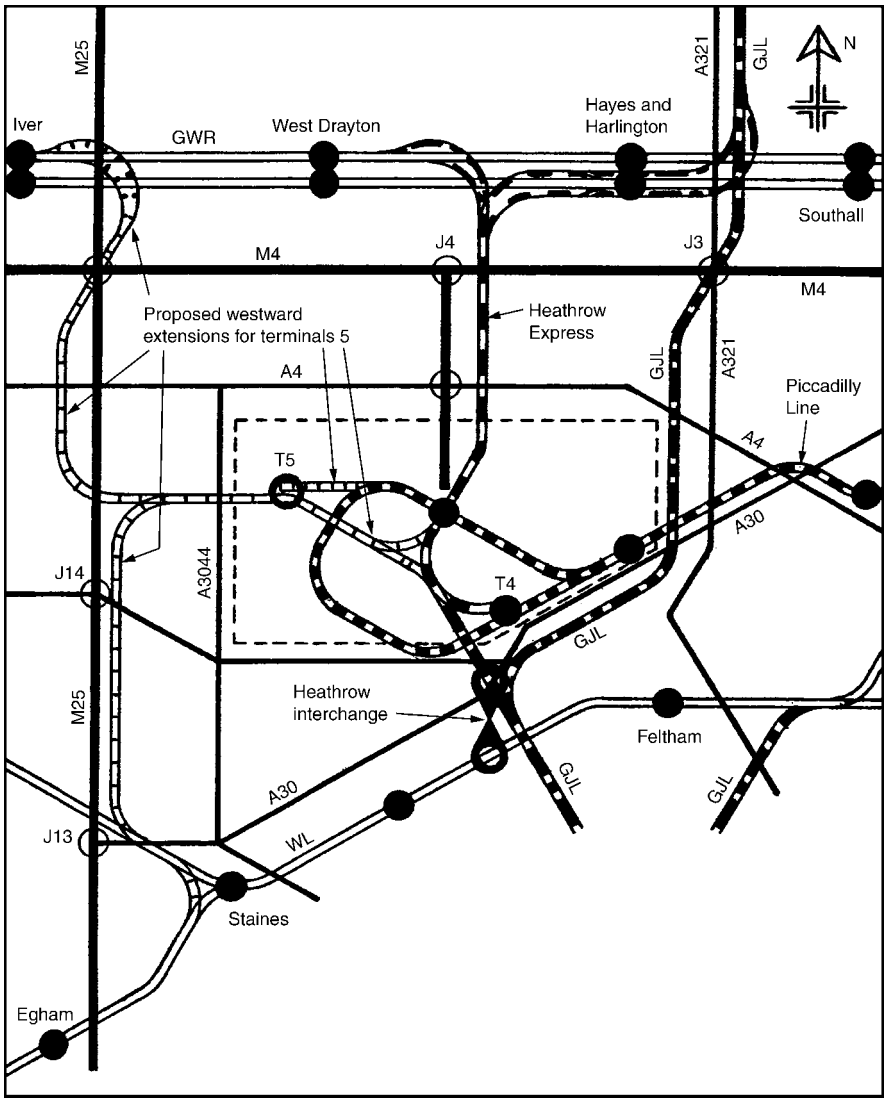


Fig. 8. Grand Junction Link and other railways around Heathrow Airport


Fig. 9. A freight spur connection might be established to the World Cargo Centre at Heathrow

All types of freight wagon are currently envisaged, for example 'piggybacks'—9 ft 6 in containers on standard flatbed wagons and intermodal wagons—could operate on the GJL, if constructed to Bern Gauge.

## 6. OPERATING PHILOSOPHY

As noted previously, the GJL would effectively constitute a 'railway M25'. Unsurprisingly, the intensity of rail traffic would assume the same M25 proportions, particularly on sections of line close to Heathrow. If the ten services illustrated in Fig. 11 and Table 2 were to run at hourly frequencies, and if the enhanced Heathrow Express service to Paddington and St Pancras were also considered, a total of 18 trains per hour would be operating on the lines north of Heathrow—an average headway of just 3 min 20 s.

On the section south of the airport, between Heathrow Interchange and the junction to the South-Western Main Line, similarly intense rail traffic could apply; although some Heathrow Express services would terminate at Terminal 4, their paths would be taken by slower speed and longer freight trains. The intense traffic through Heathrow Interchange would almost certainly dictate its construction with four platforms. Clearly, a sophisticated signalling system, coupled with high reliability permanent way and power supply systems, is essential.

Owing to its extensive interfaces with the existing railway, the GJL would be constructed as a conventional double-track railway—that is, driver- (rather than auto-) operated trains with standard four-aspect (rather than in-cab or moving block) signalling for 160 kph (100 mph)

Fig. 10. Cross-London container freight train at Kensington Olympia

passenger traffic would comprise electric multiple units with dual-voltage capability to match the different overhead line and conductor rail systems to the north and south of London (the usual track circuitry problems would apply at interfaces). These could operate in maximum eight-car formation, a criterion which is determined by the platform length available at Heathrow Central Station; this appears to be reasonable, given that the route will not be subject to significant peak flows. Only the Regional Eurostar might ideally require the operation of longer trains. Freight traffic would operate in the traditional loco-hauled format.

maximum speed. It would vary from the conventional only in the following respects

- bidirectional signalling and wide-spaced tracks to facilitate maintenance/renewal work on one track while the other would remain open to traffic
- 'intelligent' signalling system to be developed, to guide driver control of train speed and thus optimise passage of trains through junctions and minimise signal checks
- construction to Bern Gauge—the wide track spacings described above would be fully compliant
- rolling stock to be compatible with the high platforms at Heathrow Central, for level wheelchair and trolley entry; Heathrow Interchange would be constructed to match
- grading of the passenger-only section over the North Downs to TGV standards at 1:40. Elsewhere, a 1:100 ruling gradient would apply for combined freight and passenger operation.

Given the constraints of surrounding development, the route would of necessity be heavily curved; the maximum practicable speed in the suburban area would be ~160 kph (100 mph) for passenger traffic, and 130 kph (80 mph) for freight (for equilibrium speed running). The required line capacity is only achievable if all trains run at similar speed, and there would be little profit in employing tilting trains for higher speeds. In the more rural areas, the slacker curves would permit greater speeds, although the severe gradients of the North Downs section may well restrict speeds from the point of view of both tractive effort and energy costs. Junctions at higher-speed locations would comprise flyovers, to ease flows and eliminate potential conflicting movements.

For the operating speeds and mixed traffic envisaged, and for environmental reasons, the only practicable motive power system would be 25 kV a.c. overhead electrification; if technically feasible, all new stock should have a regenerative braking capability. It is assumed that rolling stock for

## 7. ENVIRONMENTAL ISSUES

The GJL scheme will only be acceptable to the public if the closest attention is given to all environmental issues, and all practicable measures are taken to minimise the environmental cost. The understandable emotive issues will apply: the destruction of homes and property, the nuisance of noise, and the destruction of open space and wildlife habitat. Fortunately, it appears that the GJL could be constructed with minimal demolition of residential property.

Much of the route will be constructed close to suburban development, and continuous noise reduction barriers, or earth bunds, would have to be provided at these locations. In particularly sensitive locations, cut-and-cover tunnels—or immersed tubes for river crossings—could be required. See Fig. 13 and Table 3.

Ground conditions are hugely influential upon the cost and feasibility of any transport scheme, be it road or railway; the greater the need to bury the line below ground level, the greater the consequence of poor ground conditions. Ground problems are most likely to occur in the water-bearing gravels of the Thames floodplain, particularly at the crossings of the Thames and the Mole, and in the tunnelled crossings of Heathrow Airport. The issue of track, and land drainage, must not be forgotten. It will be vital to install adequate track drains, and equally vital to ensure that the drained depression formed by the new line does not become a sump, drawing down the local water table.

## 8. IMPROVEMENTS TO THE EXISTING NETWORK

It would not be possible to establish a new trunk route such as the GJL without there being profound implications for the operation of the surrounding railway network—aside from the question of the disruption that would certainly arise at the construction of underbridge or overbridge crossings of existing lines.

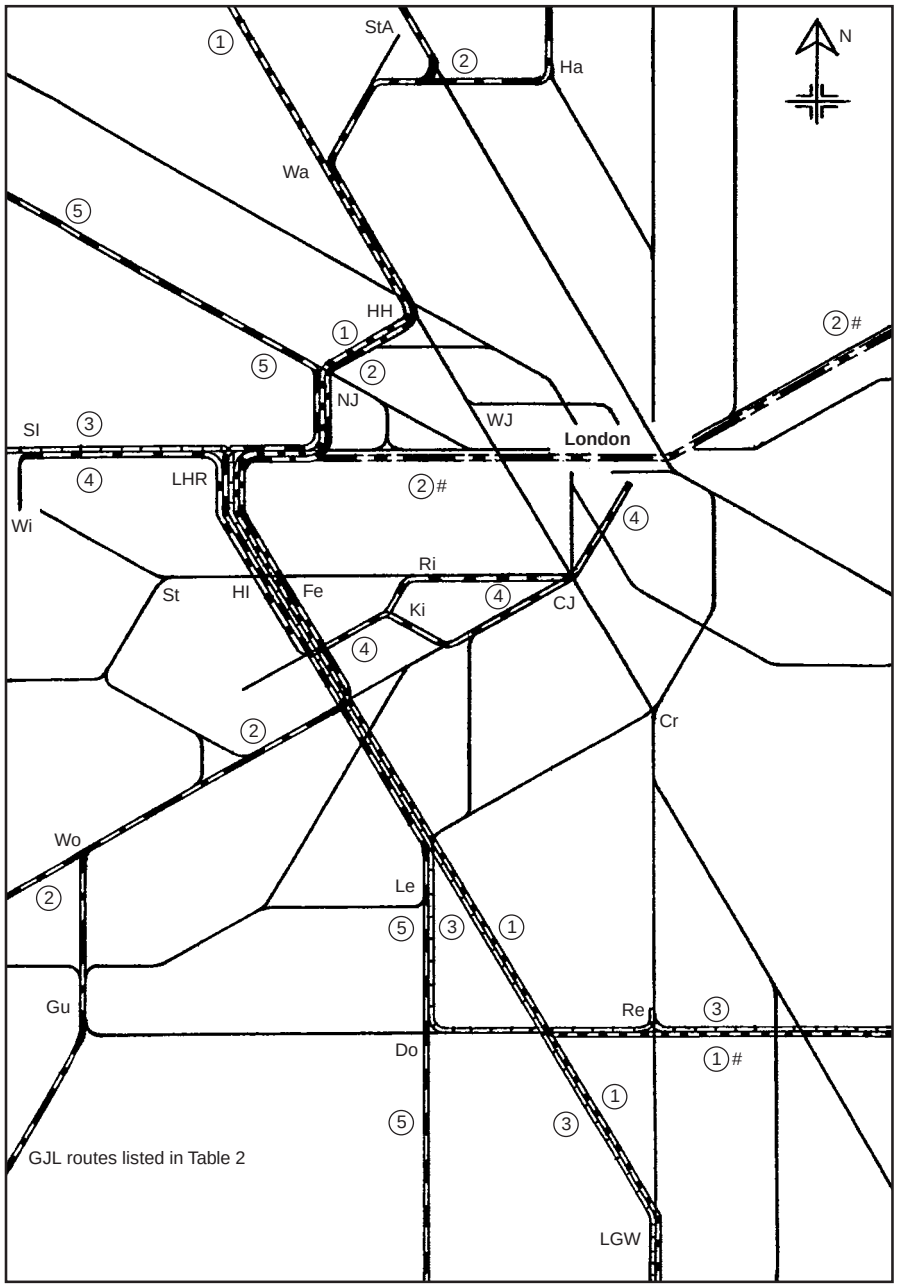


Fig. 11. Grand Junction Link passenger routes

These longer-term implications generally concern the potential increase in traffic flows on existing lines, feeding the GJL—issues of compromised line and infrastructure capacity, and of aggravating existing problems of disruption to road traffic at level crossings. The major issues can be summarised as follows.

- *WCML slow lines—Harrow to Watford.* GJL services running onto the WCML slow lines at Harrow would give rise to line capacity problems northwards, at least as far as Watford Junction. This would have to be addressed in the proposed WCML upgrade. The possibility exists to develop an alternative freight route from Northolt Junction to Bletchley, via Aylesbury, to avoid the most intensively trafficked section of the WCML; the route is still intact, albeit in need of major refurbishment in the abandoned northern section. In the longer term, the Central Railway project should further relieve WCML line capacity problems.
- *Welwyn Viaduct.* GJL services running onto the ECML north of Hatfield would further exacerbate the acute line capacity problems currently experienced at Welwyn, where

| Route No. | Projected frequency | Route description |
|---|---|---|
| 1 | 1 train per hour | Brighton–Gatwick–Heathrow–Watford–Birmingham–Manchester |
| 1# | Infrequent | Channel Tunnel–Heathrow–Watford–Birmingham–Manchester |
| 2 | 3 trains per hour | Southampton–Woking–Heathrow–Watford–Luton–Bedford<br>Portsmouth–Woking–Heathrow–Watford–Stevenage–Cambridge<br>Woking–Heathrow–South Ruislip (Northolt Junction) |
| 2# | Conditional upon completion of CrossRail | Portsmouth/Southampton–Heathrow–CrossRail–Ipswich–Norwich |
| 3 | 2 trains per hour | Eastbourne–Gatwick–Heathrow–Slough–Reading<br>Thanet–Ashford–Tonbridge–Heathrow–Slough–Reading |
| 4 | 2 trains per hour | Waterloo–Kingston–Heathrow–Slough<br>Waterloo–Richmond–Heathrow–Slough |
| 5 | 1 train per hour | Littlehampton–Leatherhead–Heathrow–High Wycombe |

Table 2. Proposed grand junction link passenger services

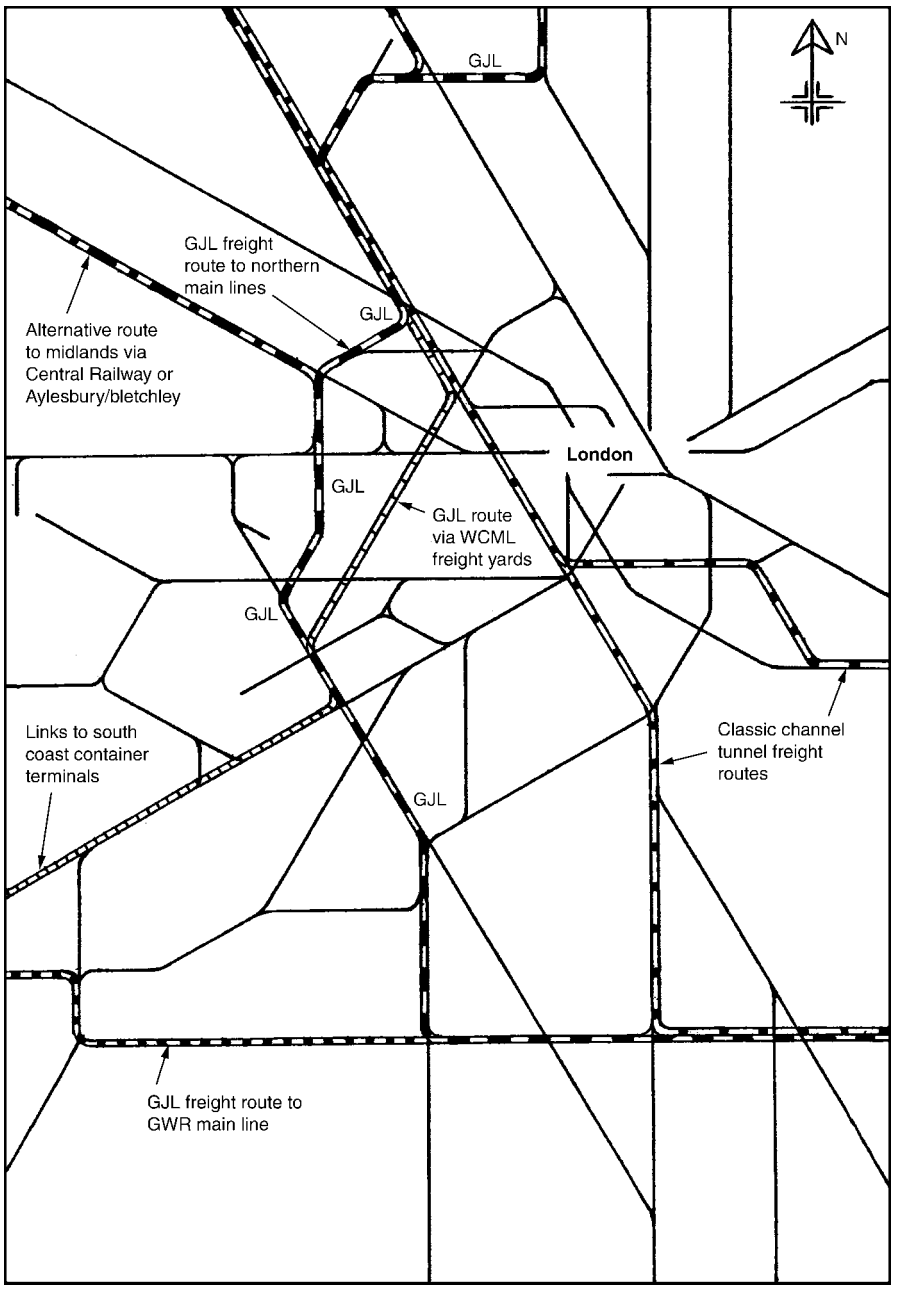


Fig. 12. Grand Junction Link freight routes

the four tracks narrow down to two, to pass over the viaduct and through the tunnels to the north. This long-standing problem is to be addressed in the forthcoming ECML upgrade.

- *a.c. electrification on Channel Tunnel routes.* With a.c. overhead electrification reaching as far south as Reigate under the GJL scheme, and with the Channel Tunnel similarly electrified, it would be logical to electrify the 92 km of d.c. third rail route between Reigate and Dollands Moor to the same system. This would eliminate the requirement for dual voltage in freight locomotives, and the risk of overloading the strained d.c. traction current system.

## 9. FINANCING OF THE PROJECT

This paper makes no attempt to estimate the cost of constructing the 72 km of new electrified double-track railway, with associated spur lines (21 km) and upgraded existing route (87 km), that comprise the Grand Junction Link. Likewise, the cost of new dedicated rolling stock has not been estimated. For the purposes of this paper, the following assumptions have been made.

- The investment costs will be measured in billions of pounds rather than millions. This scale of financing would require the formation of consortia involving financial houses, construction companies and railway operators.
- The operating revenues alone will be insufficient to achieve an adequate rate of return on the investment (although no problem is anticipated in covering direct operating costs). This is the experience of recent publicly-floated railway schemes, for example the Channel Tunnel and the Rail Link; costs are driven upwards by considerations of environmental protection, construction within the developed conurbation and harmonisation with the existing infrastructure.
- Public sector borrowing requirement and taxation/spending considerations will prevent the Government from taking overall responsibility for financing the scheme.
- With the likelihood that the asset to be created would be privately owned, a conventional Private Finance Initiative (PFI) arrangement (whereby the asset is ultimately transferred to the public sector) would not be appropriate.

Despite the enormous economic and environmental benefits that the GJL will bring about, it is likely that its costs will frighten away investors if conventional financing is attempted. What is required is an innovative method of financing that acknowledges the full value of the GJL, with the various beneficiaries contributing to the investment costs in due proportion. The various values and benefits can be summarised as follows.

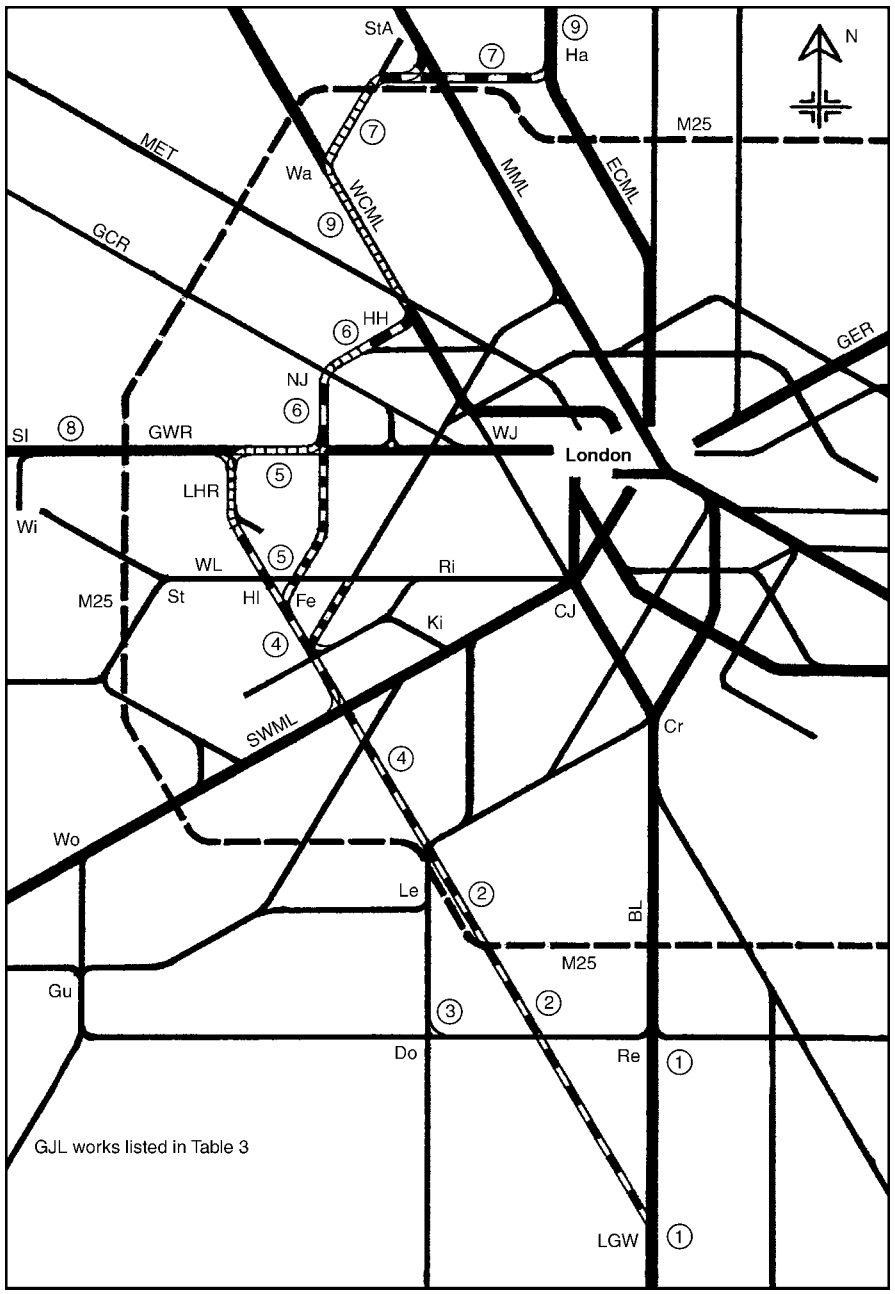


Fig. 13. Grand Junction Link major works and enhancements to existing network

based short-term entities, the EWS freight company has national coverage, and is not subject to a limited franchise. Hence it may have a greater interest in financing the scheme. Alternatively, the Central Railway, with a direct interest in promoting a national freight route, might wish to invest in the GJL.

- *Simplified, more efficient use of Heathrow and Gatwick airports*. By offering improved public access to, and between the airports, increased value to the BAA operation will accrue, in terms of increased landing charge revenue and more efficient use of assets. The BAA already perceives the benefits of public transport improvements, both for airport users and staff; it is now the sole owner of the Heathrow Express operation. Clearly, the opportunity exists to derive a significant contribution from the BAA.
- *Environmental benefits*. The diversion of traffic from road to rail, and the consequent reductions in pollution and traffic congestion, are clear environmental benefits, and the beneficiary in this case is the public at large, particularly the inhabitants of London and the South-East. In the modern age of strict accounting, and acute political sensitivity to rates of direct taxation, this no longer provides sufficient justification for the Government to unlock Treasury funds; it is necessary instead either to levy targeted taxes, for example fuel tax on a simple 'polluter pays' principle, and divert this revenue to the GJL project, or to identify more quantifiable benefits, to which a financial value can be adduced.

- *Commercial revenues from passenger operation*. Although the direct beneficiaries would be the train operating companies (TOCs) which sell the tickets, their franchise periods are insufficiently long to justify their interest in a massive long-term infrastructure investment such as the GJL. Either Railtrack, or a separate private company created to promote the GJL, would be better placed to invest, and recoup the passenger revenues via track access charges. Partnering deals, linked to franchise extensions, such as the Virgin–Railtrack deal for the West Coast Main Line upgrade, should be considered.
- *Commercial revenues from freight operations*. As for passenger operations, freight traffic could pay track access charges to the infrastructure owner, be it Railtrack or the GJL consortium. Unlike passenger TOCs, which are regionally-

The idea of shadow tolls has been pioneered in road PFI schemes; on a similar basis, the Government could pay a toll on each passenger using the GJL, the toll being related to the incremental cost of the road improvements that would have been necessary, and the pollution that would have been caused, if that passenger had not chosen to use the GJL. In the future, when automated motorway tolling becomes a technically feasible proposition, toll revenue from the M25 could be diverted to the GJL as the environmentally friendly alternative.

| Route No. | Title | Route description |
|---|---|---|
| 1 | Brighton Line works | GJL deviates from Brighton Line immediately north of Gatwick, passing SW of Horley alongside A23<br>New E–W chord at Redhill, linking Guildford and Tonbridge lines. Brighton slow lines diverted onto flyover, major modifications to Redhill station |
| 2 | North Downs Crossing | GJL in tunnel under North Downs escarpment. GJL constructed alongside M25 on north ramp |
| 3 | Freight route via Dorking | Redhill–Dorking and Dorking–Leatherhead lines upgraded for overhead electrification and increased structure gauge<br>New E–N chord constructed at Dorking |
| 4 | SW suburban area | GJL constructed on weaving alignment through outer suburban area<br>Tunnels under Rivers Thames and Mole, extensive cut and cover, noise bunds etc. at sensitive locations |
| 5. | Heathrow Airport | GJL proposals in Heathrow area shown in Fig. 3<br>Passenger route connects into Heathrow Express tunnels<br>Freight routes follow east side, bypassing alignment |
| 6 | NW suburban area | GJL constructed alongside A312 Hayes bypass, extensive environmental protection including tunnelling required to reach Northolt Junction<br>Northolt junction remodelled for N–S traffic, short length of GCR upgraded<br>GJL joins WCML at Northwick Park via tunnel under Harrow Hill |
| 7 | WCML–ECML Link | Watford–St Albans line upgraded to double track<br>GJL constructed alongside M25 and joins ECML south of Hatfield |
| 8 | Electrification works | GWR to Reading, GCR to High Wycombe overhead electrified |
| 9 | Line capacity issues | Extensive works required to improve ECML and WCML line capacity |

Table 3. Proposed Grand Junction Link works

## 10. CONCLUSIONS

This paper has demonstrated that the creation of the GJL as the 'railway M25' would bring about huge improvements to the railway network, and revolutionise the transport infrastructure of London and the South-East. The network would effectively be brought into the twenty-first century, at last able to offer attractive public transport alternatives for passengers and freight on a huge range of journeys previously dominated by private road transport. Major economic and environmental benefits would accrue in many areas, particularly reductions in congestion and pollution, and improvements in accessibility to public transport of Heathrow and Gatwick airports.

Although the required investment would be huge, so would the benefits. This paper has identified a means by which the core funding, corresponding to the division of equity (with appropriately geared loans), might be generated.

There is a clear linkage between the financial and environmental issues, that must be recognised. The scheme can only be viable, in financial terms, with the Government's 'environmental' contribution topping up the shortfall in commercial funding. Accordingly, it is vital, in terms of both governmental politics and the need to retain the support of the active environmental lobby, that the scheme carries no major environmental costs. This principle has underpinned the development of the scheme so far, particularly in the avoidance of significant destruction of residential property, and in the routing of the GJL where possible along existing transportation corridors.


Fig. 14. The route of the Grand Junction Link would follow sections of the M25

It will require a supreme effort to develop the GJL as a viable project, and to attract the necessary support—public, financial and political. But in 2001, with the Government searching for radical ideas to address the country's environmental and transportation problems, the timing could be right; the CTRL is now under construction and Railtrack, and other interested bodies, are actively consider-

ing the establishment of new strategic railway routes.

This paper concludes with a final thought. The title of the scheme, the Grand Junction Link, is fortuitous; although it derives from the island of the same name at the proposed crossing of the River Thames, it should not be forgotten that it was the Grand Junction Railway of 1837 that linked the London and Birmingham Railway with the Liverpool and Manchester, and thus created the first national railway network. Could history repeat itself?

## REFERENCES


1. Department of the Environment, Transport and the Regions. Government White Paper *A New Deal for Transport: Better for Everyone*. The Stationery Office, London, 1998. (This proposed the establishment of the Strategic Rail Authority and the Commission Integrated Transport, *inter alia*.)
2. Central Railway website @ www.central-railway.co.uk, visited 29/6/00.


Please email, fax or post your discussion contributions to the secretary: email: hollow_k@ice.org.uk; fax: +44 (0)20 7799 1325; or post to Kathleen Hollow, Journals Department, Institution of Civil Engineers, 1–7 Great George Street, London SW1P 3AA.