HS Eastern Routes and Service Plans

(HS6 and HS10)

HS6/HS10 Routes Mk1A

Following the referendum on EU membership and the decision to disengage from the EU, several changes have been made to the plans for HS rail, most importantly, abandoning GC-gauge, and building all new infrastructure to standard UK loading gauge. This has, in most cases, very little impact on the routes proposed, but significant impact on the service plans. In certain cases it is now proposed to include sections of classic route in the HS route, rather than building exclusively new throughout. (Note that this is different from the previous proposals to run classic compatible services on classic lines, **beyond** the HS route; this actually incorporates classic sections, upgraded as appropriate, in the HS route itself.) Appendix F lists all specific changes of route, for HS6/HS10 and associated routes, principally HS8, which are also, of course, incorporated in the various route sections, following.

Because of the significant changes introduced at Mk1A, the latest versions of all the Mk1 plans (v5.3 in the case of HS6/HS10) have been preserved, available in an archive section on the website.

HS6/HS10 Routes Mk2

As noted above, the Mk1A changes have, in general, little impact on the routes proposed (but great impact on the service plans). HS6/HS10 are, to some degree, exceptions to this, in that they make extensive use of existing classic alignments. For HS6 at Mk1A, all new infrastructure above Cambridge is postponed, with the exception of the direct line avoiding the Thetford loop. Everywhere else, the relevant sections of the classic routes are incorporated into HS6. The alignments are excellent, (the landscape is very easy, of course,) and should be easy to upgrade to 140mph line speed, at least as far as the Thetford bypass, and 100mph thereafter to Norwich. Likewise for HS10, the classic GN/GE line between Sleaford and Gainsborough, and the GC route between Gainsborough and Barnetby are incorporated into HS10. Again, the alignments are excellent, and should be easy to upgrade. Extensive work will still be needed at Lincoln, to provide the necessary capacity at that very cramped and inadequate station. The Mk1A versions of HS6/HS10 may thus be viewed as a cut-down version of the original proposals, much quicker and very much less expensive to implement, but nonetheless delivering a large proportion of the advantages of those proposals.

It is expected that Mk1A will, in the present case, deliver so many of the benefits of the original proposals, for much less expense, that this will form a satisfactory long-term solution. However, if further capacity is needed, (on the incorporated classic sections,) then HS6/HS10 Mk2 is proposed, which is effectively the reinstatement of those parts of the original plans removed for Mk1A, on a piecemeal basis, as and when the build-up of traffic on Mk1A makes extra capacity desirable, (one such instance, between Ely and Peterborough, is already foreseen). If this were implemented in full, we would end up with the original design, but having enjoyed years of service from the MK1A version in the interim. This all comes about from abandoning GC-gauge. The original plans required so much new infrastructure, because it all had to be to GC-gauge. Building to UK loading gauge instead allows so much existing, first rate infrastructure to be incorporated.

The current document thus retains all the original content, but rearranged to emphasise what is Mk1A and what is now Mk2.

The Purpose, Background and Method

This article refers to and should be read in conjunction with my article 'Towards a High Speed **Network**'. That article makes the case for developing a network plan for all the HS routes which will eventually be needed, and, as a contribution to getting the discussion started, gives my own thoughts of what such a network should look like. Naturally, this involves describing a number of routes, in varying but superficial detail. This lays me open to the charge, something on the lines of 'That's all very easy to say, but how would you actually go about doing it?' Accordingly, a decent respect to the opinions of the interested public requires that I should go into more detail on the individual routes. The present article deals with HS6, the route from London to Norwich and King's Lynn, and HS10, the Lincolnshire route, from London to Hull and Cleethorpes, sharing the route of HS6 from London to Ely and HS8 thence to Thurlby Junction, north of Peterborough.

The general route is decided on strategic and business grounds, thus which locations are to be served. This gives the general alignment, at a very high, superficial level. I plan the detailed route using Ordnance Survey maps, taking careful account of the shape of the landscape, from the contours. I note the location of all significant infrastructure, thus tunnels (generally, over about a quarter mile in length), viaducts and major river crossings. I simultaneously make a virtual tour of the route from my computer, via satellite maps, to make sure, as far as possible, that there is actually room for my lines where I wish to put them, and that, for example, a housing estate has not materialised in an inconvenient location since the (paper) map was published. (I understand that the images used by satellite maps are up to a maximum of three years old, so not exactly real-time, but still pretty good.) I make a great effort to avoid any housing. I'm blasé about demolishing warehouses – after all, all that's required there is to build a (better) new one nearby, and the owners will be very happy. But I regard demolishing housing (or even getting very close to it) as a thoroughly bad idea; people just don't like it, and I understand their feelings. If ever I must (knowingly) propose to demolish housing, I will point out the fact.

These considerations apply in extreme form when, as in the present case, the route starts from London. Here there are simply no free routes available. The design has to follow an existing route, widened where there is space for it, (this involves searching, via satellite maps at a high magnification, where there is space to fit extra tracks within the existing alignment or where there is adjoining space to widen the alignment,) with recourse to tunnelling where there isn't.

In general I try to follow an existing alignment, railway or motorway, (or, very occasionally, of a non-motorway road,) if there is a suitable one available, simply because it's there already, in the right place, with good layout, (somebody else has done all the hard work!) and, except in a very few places, there's plenty of room available adjacent to it. (In this context, motorways are particularly helpful. Nobody wants to live close to one, so house builders don't develop new estates at the side of motorways, leaving plenty of space available for new railways.) Also, most importantly, it minimises disruption, and so I (optimistically, perhaps) expect it to maximise public support and minimise opposition.

When I am following an existing alignment, (this obviously includes taking over the route and trackbed of a former railway, now closed,) I don't generally worry about gradients, confident that they will be well within the capacity of HS trains. Very occasionally, when following a motorway or (more likely) non-

motorway road, the contour pattern suggests that there might be a problem, and then I do check the gradients, (and state what these are, in the route plan). When I am obliged to design a completely new alignment, then the gradient profile forms part of the design, and will be stated, (unless, from the contours, it's obviously essentially level, or undulating but with no significant underlying change of level). The present article contains no gradients, as the new alignments – north of Thetford and in south Lincolnshire – are essentially level.

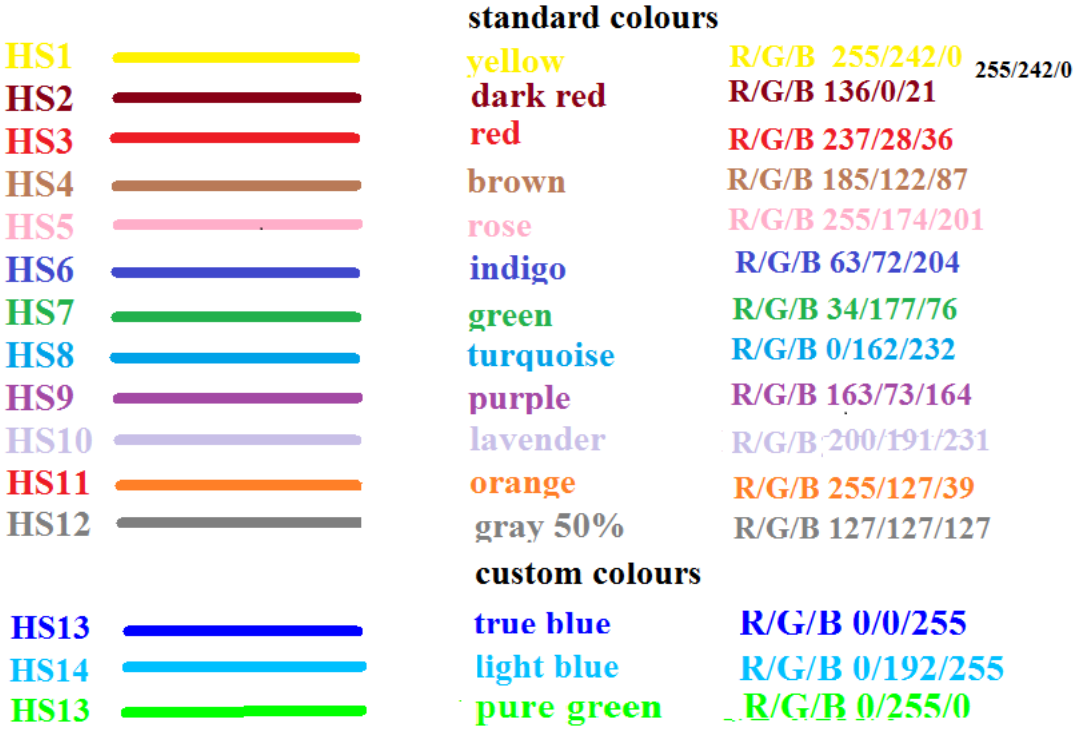
I believe that this approach gives a route which in general terms is practicable and satisfies the requirements, though obviously a lot of work, especially detailed surveying on the ground, would be needed to turn it into an implementable design. Specifically, I can say nothing about cuttings and embankments, though I may note that a particular piece of landscape is strongly undulating, so cuttings and embankments will be required. Also, when I take the route alongside an existing railway or motorway alignment, I don't attempt to design it in any detail around (particularly motorway) junctions, although I do note on which side it runs, and wherever it is necessary to cross over to the other side.

The Maps

Naturally, the chosen route must be illustrated with maps. I briefly describe the route, giving the map reference of all significant points (invariably of tunnel end points and significant river bridges), but the accompanying maps are the real definition. Mapping software can be very expensive, but fortunately the Ordnance Survey makes available, free of charge, the OS OpenData product suite, of which I use two components, the 1:250000 Scale Colour Raster data set and the Strategi Dataset. The former comes as a set of TIFF files, each containing one of the standard National Grid 100km Reference squares. These are easily converted into Microsoft Paint files and edited. These are, in other words, pure graphics, and are the basis of the detailed maps in the 'Route' section. The maps reproduced in the text all represent an area 20km in width (unless noted otherwise) and 10 km high (if the detail I wish to show will fit within that, but otherwise as high as necessary). They do actually contain contours, but not many; the scale is too small for contours to be really informative. For the present purposes, this scale is adequate; if you need more detail, use them as an index to the corresponding 1:50000 Landranger or 1:25000 Explorer maps.

The Strategi Dataset contains GIS (Geographical Information Systems) data, which has to be processed by special software; I have used the Open Source QGIS product. This has been used to produce an overall map of HS6/HS10, including sections of other routes over which HS6/HS10's services run. These overall maps come at the end of the 'Route' description, and also show HS6's classic compatible services on classic lines (these are shown as dotted lines; there are none for HS10). Also included there are maps of the overall HS Network.

In all the maps I use the following colour scheme for the various routes:



As the various route plans have been developed, the maps have been updated, so now they show all routes, as relevant. The maps in the present article are thus not limited to HS6.

The Service Plans

The Route section of this document describes the complete lines in their final, full configuration (as far ahead as the plans consider). The service plans explain how that final state is reached: the order in which sections are opened, and the services which run on these partial configurations. The aim is always to get useful services running as soon as possible, to maximise return on the investment.

The service plans deliberately envisage maximum frequencies, to give an impression of just how much the system **could** accommodate. Initial services would certainly not be so intensive, probably no more than half of the frequencies quoted.

A standard HS station has two island platforms, thus two platformed tracks in each direction. If some of the services passing through the station are non-stop, then the main line must pass through the layout without adjacent platforms, either through the centre of the alignment, in tunnel below or on viaduct above, or the station must be on a branch loop off the main line, which thus bypasses it completely. In fact, all HS6/HS10 stations are served by all services, so don't need overtaking/avoiding lines. At the end(s) of a route, the traffic density may not be sufficient to warrant this level of provision, so a single island platform (or two single platforms within some other arrangement) would suffice; this is the case with HS10 (i.e. north of Thurlby Junction) throughout, except at Lincoln, which requires a lot of extra capacity.

The point of insisting on two platforms in each direction is **either** to enable cross-platform interchange between different services, (both HS or HS and RM,) **or** to maximise capacity, (especially when all services stop at the station,) by allowing a second train to arrive at the station before the preceding train

has departed. (It also promotes resilience, if a failing train can make it at least as far as the next station, to be taken out of service.)

Several service plans are developed, reflecting the piecemeal development of the network. As new sections open, further services come into operation. In all cases, consideration is given to maximum loadings – which section(s) are fully loaded and thus determine the maximum service frequencies. I used to take 16tph as the maximum throughput, but, following new capacity calculations (expounded in appendix B of the article 'Same Speed Railways', which do include the effect of junctions,) I am now considerably more relaxed on this, and will countenance loadings of up to 24tph. (The quoted appendix contains my justification for this choice.) As stated above, the service plans deliberately quote maximum frequencies; initial services will almost certainly be to lower frequencies.

In the present article, HS5, the route from London to Brighton and other Sussex / Hampshire / Kent locations, must also be considered, in the service plans, as HS6/HS10's services are all almost all inter-regional with HS5.

Two types of services are contained in the plans, those featuring High Speed trains, which travel on HS6/HS10 for at least part of their journey, and those featuring Regional Metro (semi-fast) services on the corresponding classic route(s). Connections between the services (both HS and RM) are shown for the relevant interchange stations (the connections are usually cross-platform), together with the clock-face hourly departure plan. (Note that these plans are **representative**; the **actual** times are determined by the coordination of interchanges at multiple locations).

It is important always to bear in mind that the HS network is **not** a separate, stand-alone system, but an integral part of the complete railway network, hence the importance I attach to showing precisely how HS services interact with classic (RM) ones. (In this context it is worth pointing out that if, when HS lines come into service, the current ridiculous and illogical franchising system is still in operation, it will be necessary to include the corresponding classic route(s) in the same franchise as a HS route, with a strict contractual obligation on the franchisee to ensure close integration of HS and classic services. It certainly won't happen otherwise.)

Estimated Journey Times

Following the service plans, estimated journey times are produced for all GC-gauge services. The assumptions and approximations made are explained.

HS6/HS10 Routes – Introduction and Assumptions

HS6 and HS10 closely follow existing alignments, railway and motorway, for the most part.

HS6 begins at Pancras Cross, which it shares with HS3. Between there and Stratford HS North, the former International, it shares the route of HS1; HS6's own route begins at Stratford. By the time HS6 opens, Pancras Cross will be a through station, and all northbound services will originate from locations in Sussex, West Kent and Hampshire, except for a few services originating at St. Pancras (East) – the 'Javelin' platforms – which serve ECML destinations.

Appendix A gives full details of Pancras Cross and its surroundings.

HS6 is extended from Ely to Peterborough and beyond by HS8, and HS10 diverges from HS8 above Peterborough, to serve Lincoln and Hull.

The maximum speed for HS6 and HS10 is 300kph, 187.5mph, throughout the new infrastructure, and 225kph, 140mph, mostly, on the incorporated, upgraded classic sections.

HS6 Route – Junctions

There are various junctions on the route of HS6, enabling connections with other HS and classic routes. These are identified in the description of the route, but it is convenient to list them all here, together with their map references and identifying remarks, since, when discussing the capacity/loading of different sections of route, the end points are usually junctions (occasionally stations). The junction names are my own suggestions.

• Canley St.	TQ300831	HS6 diverges from HS3 immediately north of Pancras Cross (in tunnel).
• York Way	TQ302841	HS6 joins HS1 just before entrance to the London (No. 1) Tunnel.
• Hitchcock Lane	TQ387848	HS6 diverges from HS1 at platform ends at Stratford International (i.e. without rejoining HS1 main line).
• Lakenheath	TL718863	Thetford avoiding line diverges from classic route immediately before Lakenheath station.
• Roudham Heath	TL935874	Thetford avoiding line re-joins classic route immediately to the east of the A11(T) crossing.
• [Stanground	TL205978	HS8 joins classic route alignment south of Peterborough, and, at Mk1A, merges with it, thence to Ely North Junction.]
• [Pellett Hall	TF148042	Connection from HS8 to classic ECML.]

HS10 Route – Junctions

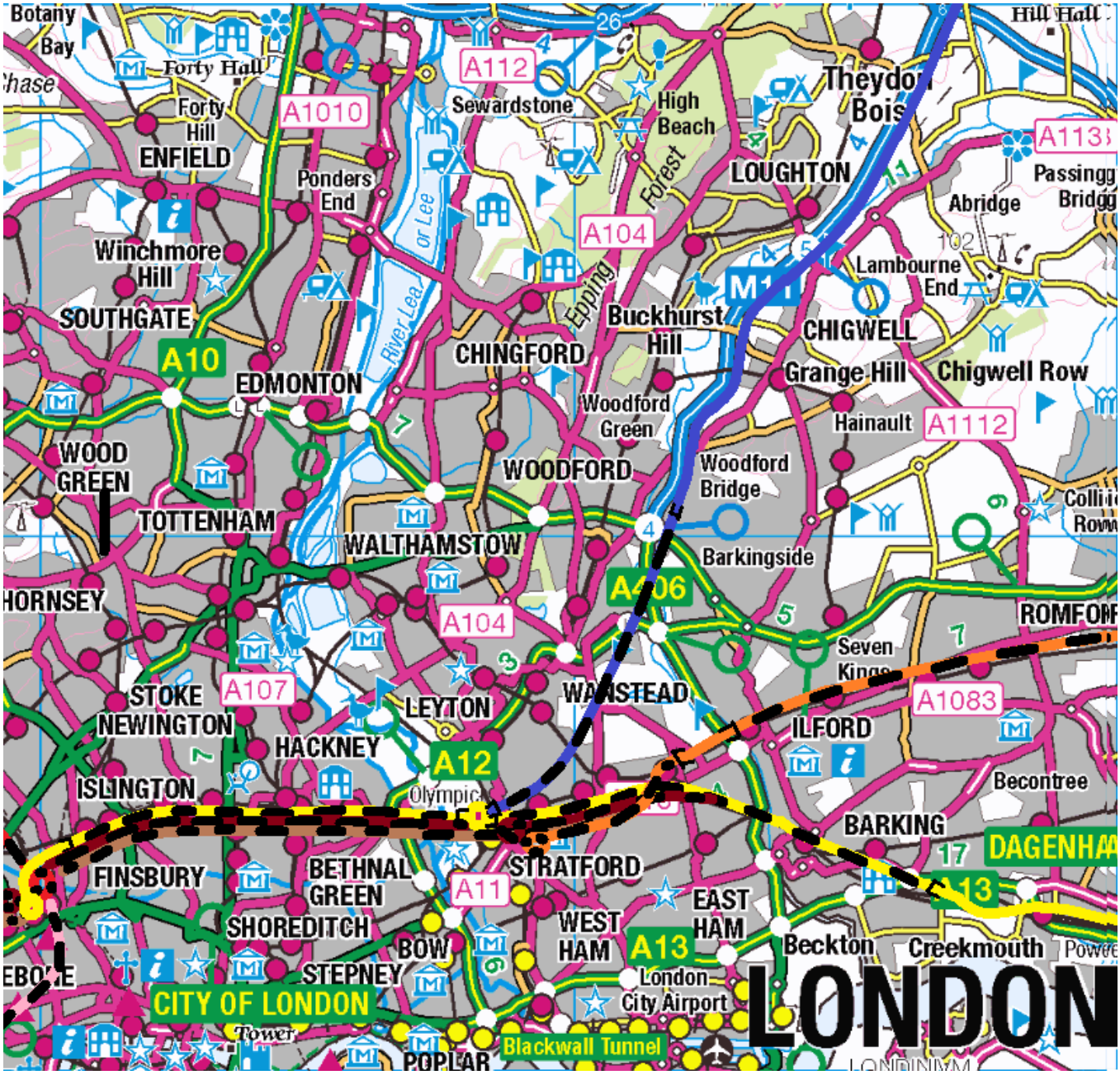
- Thurlby TF084168 HS10 diverges from HS8 main line from Peterborough to Nottingham.
- Warren Wood SK823879 HS10 diverges from the classic route just before Gainsborough Lea Rd. station.
- Gainsborough HS SK819895 HS10 joins the classic route from Retford, immediately before Gainsborough Central station.
- Brigg TA030079 Classic route to Grimsby diverges from HS10.
- Goxhill TA097218 Local metro services between North Lincolnshire and Hull join HS10.

There are various other links between HS6/HS10 and classic lines, for operational purposes and not intended for regular services, so not relevant in the present context.

There now follows the definition of the actual route, in several logical sections. Note that the maps illustrate the Mk2 state.

1. *Pancras Cross / St. Pancras East – Cambridge*

HS6 begins at Pancras Cross station, diverging immediately from HS3 at Canley St. Junction, (TQ300831, in tunnel,) emerging from tunnel and joining HS1 at York Way Junction, (TQ302841,) immediately before the entrance to the London Tunnel. It shares the route of HS1 as far as Stratford HS North, (the former Stratford International, which it never was,) taking the platform lines and diverging from HS1 at the platform ends, at Hitchcock Lane Junction, at TQ387848, so it doesn't re-join the HS1 main lines. It then enters its own 4½ mile tunnel, emerging at TQ419911, on the east side of the alignment of the M11. It follows the east side of the M11 all the way to Cambridge, with one significant diversion, for Stansted Airport.



1.1 Pancras Cross – Theydon Bois

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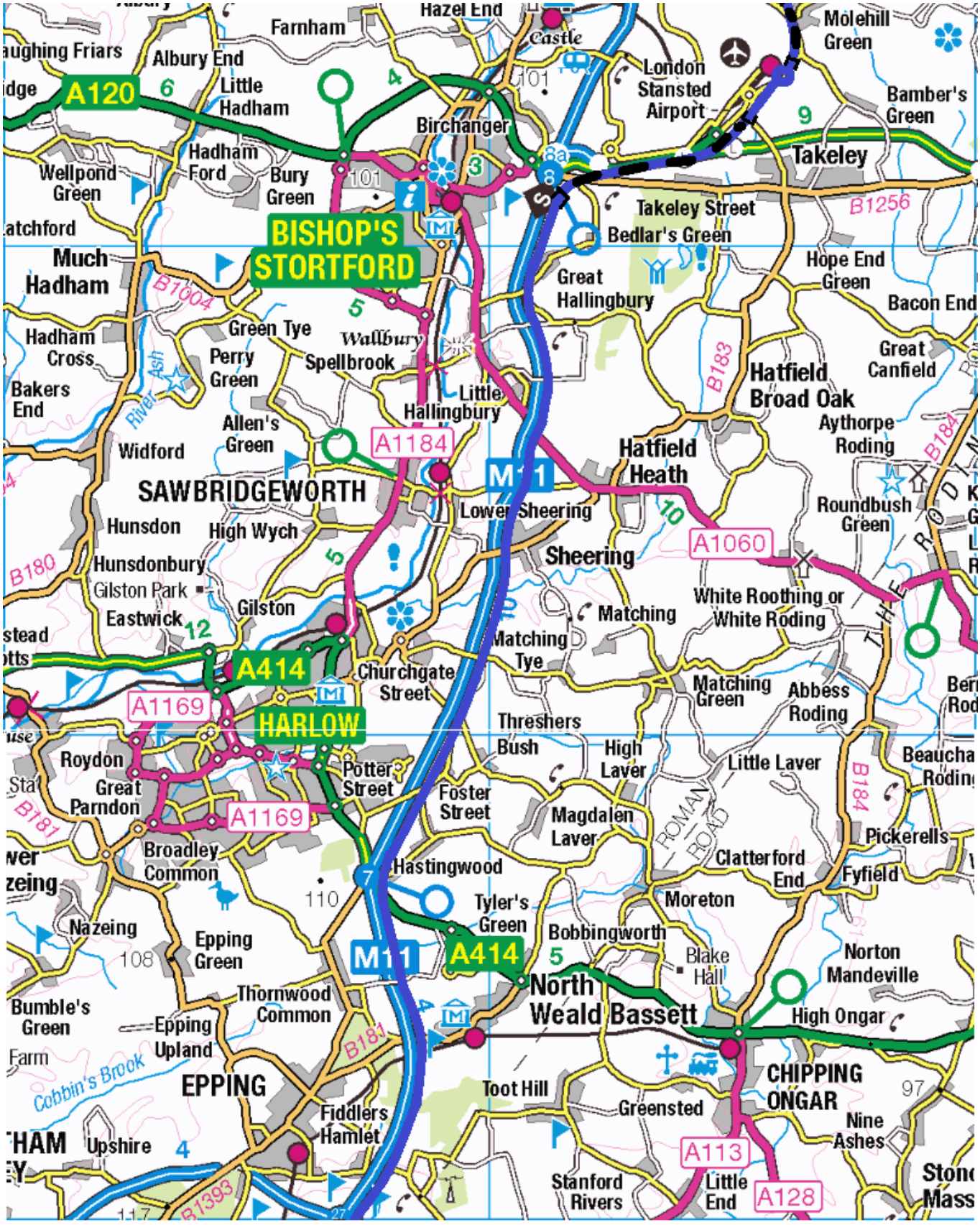
Diverging at TL514210 and immediately entering a 2½ mile tunnel, it emerges at TL550228, shortly before the existing airport station, and then continues from TL557236 in a further 1 mile tunnel, emerging at Molehill Green, TL561248. It curves to the west, crossing the B1051 at TL544270 and re-joins the east side of the M11 at TL529276, and stays with that until Cambridge, where it diverges at Junction 11 and

follows the west side of the A1309, past Trumpington Park & Ride to TL444544, where it joins the south side of the (presumably reopened by then!) line from Bedford to Cambridge, switching to the east side of the overall alignment as this merges with the line from London. The HS platforms are on the east side of Cambridge station.



1.2 Epping – Stansted Airport

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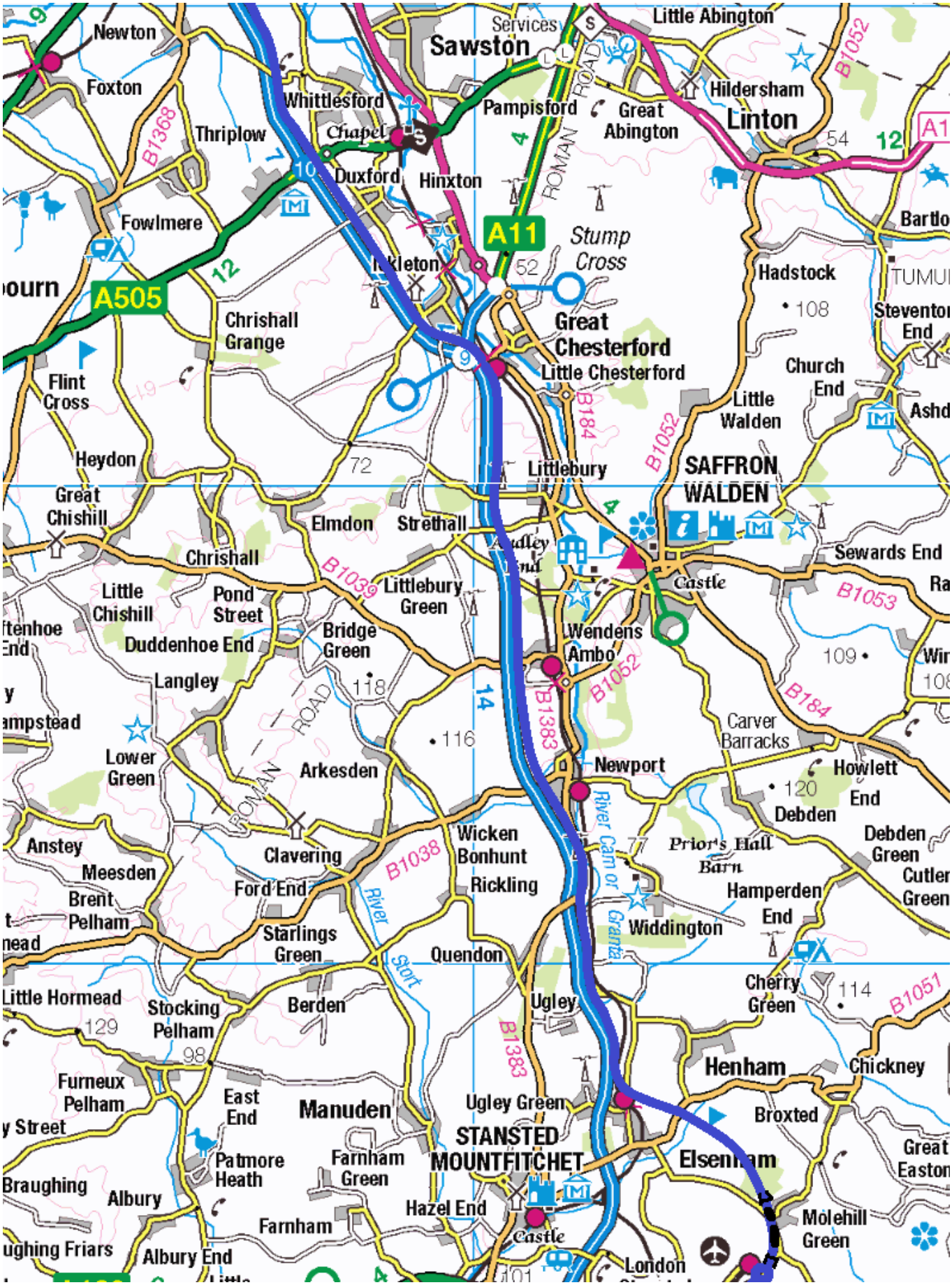

1.3 Stansted Airport – Duxford

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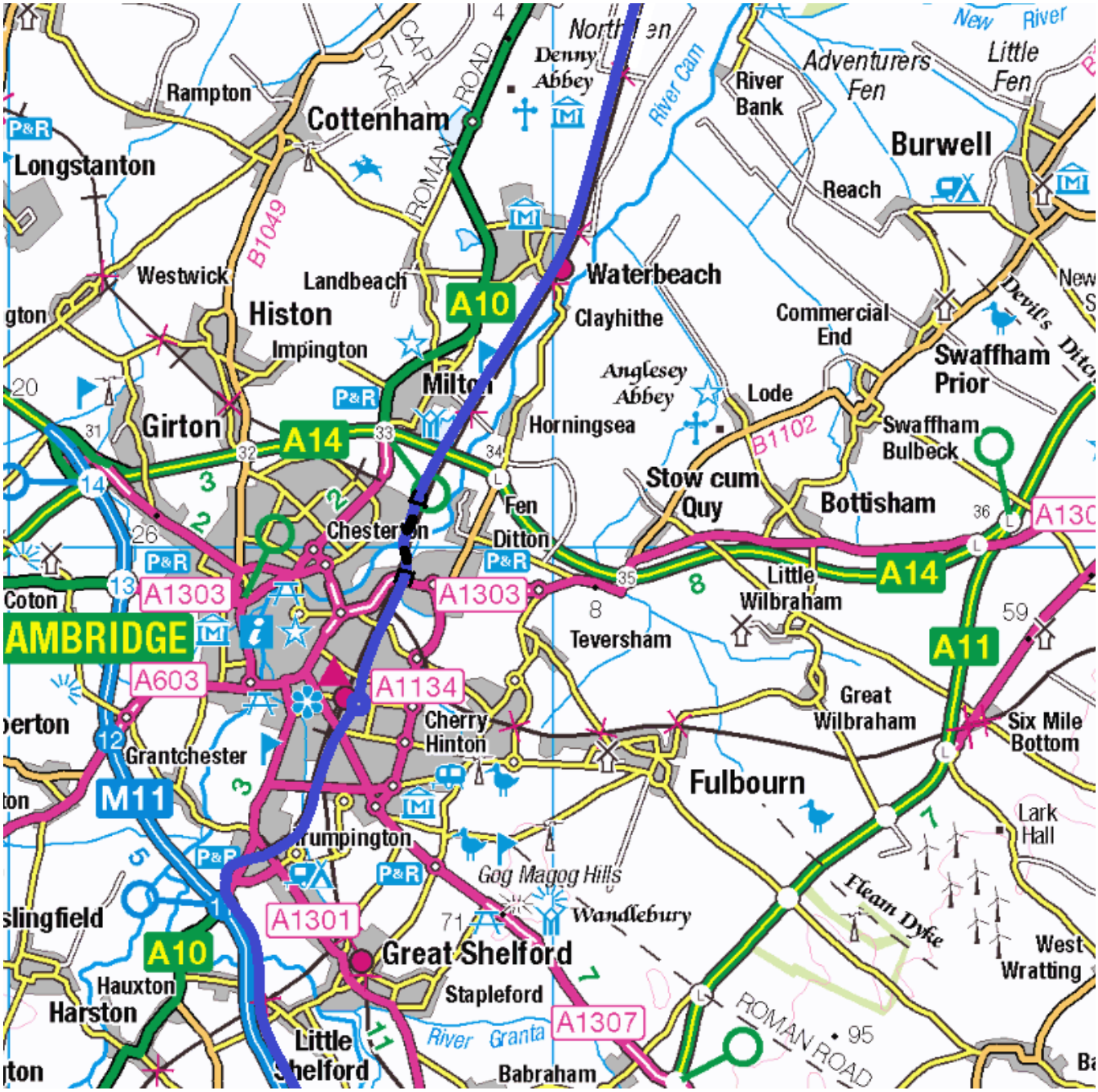


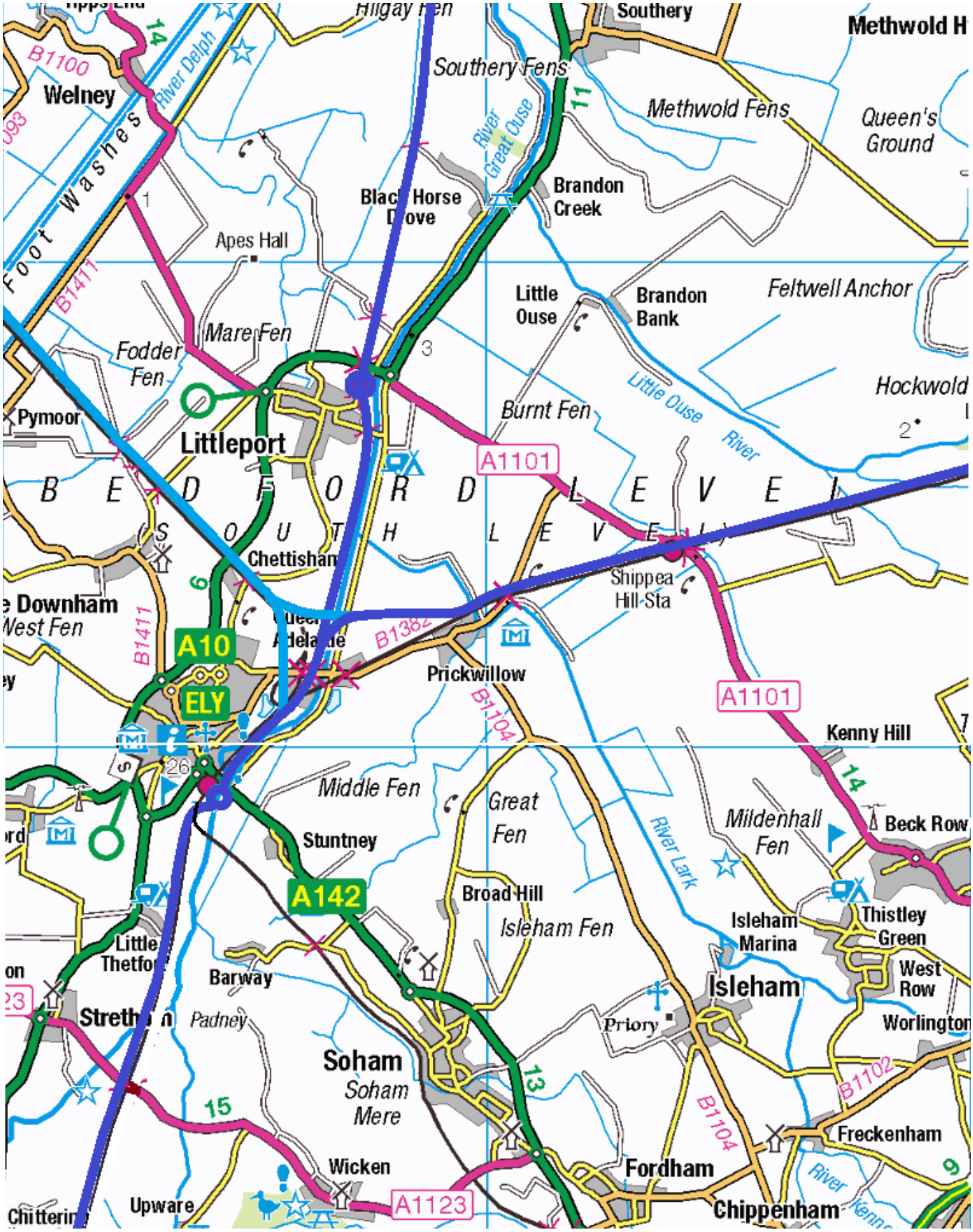
1.4/2.1 Little Shelford – Waterbeach Contains Ordnance Survey data © Crown copyright and database right 2013

2. *HS6 Cambridge – Ely, King's Lynn and Norwich*

At Mk1A, HS6 merges with the classic route at Cambridge, and follows this thenceforward to King's Lynn and (with a short section of new infrastructure to avoid the Thetford loop, as described below,) to Norwich. Refer to Appendix B for the Mk1A track layout at Ely. (The following describes the Mk2 configuration, which is all new infrastructure, and corresponds to the original Mk1 design; all new infrastructure being necessary to accommodate GC-gauge trains. This being no longer the case, I don't seriously think Mk2 will be necessary, but include it here, for completeness.)

Leaving Cambridge on the east side of the classic alignment, HS6 enters a ¾ mile tunnel under the Cam at TL472595, emerging at TL474606, on the west side of the alignment. It follows the west side until

TL539785, where it switches to the east side of the alignment, just after the line from Ipswich has joined. The HS platforms are on the east side of Ely station,



2.2 Chittering – Southery

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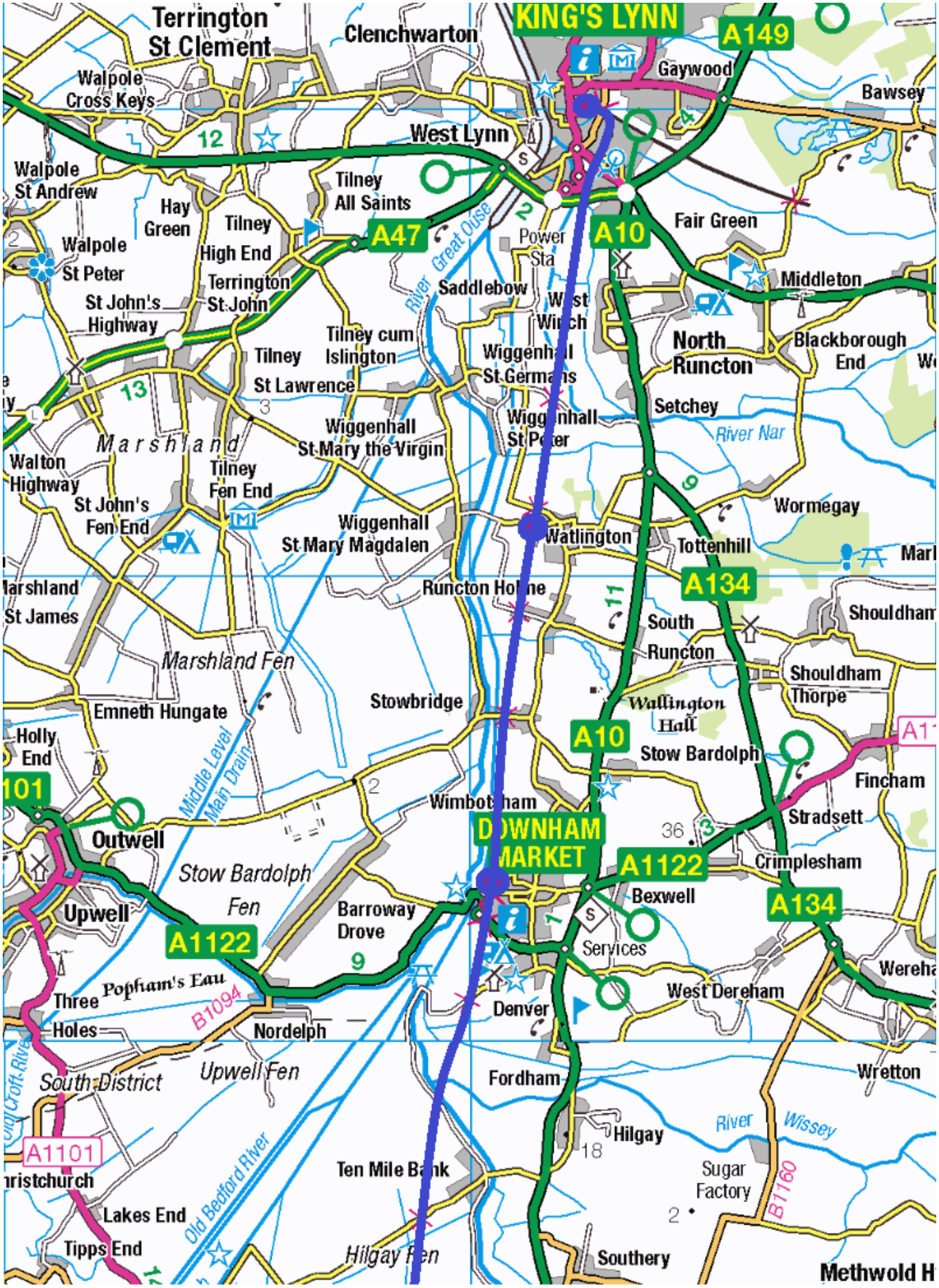
HS6 proceeds north of Ely on the east side of the classic alignment. At Ely HS South Junction (TL562812), HS6 crosses over the diverging classic route to Norwich, HS8 diverges from HS6 (for Ely



2.3 Ten Mile Bank – King's Lynn

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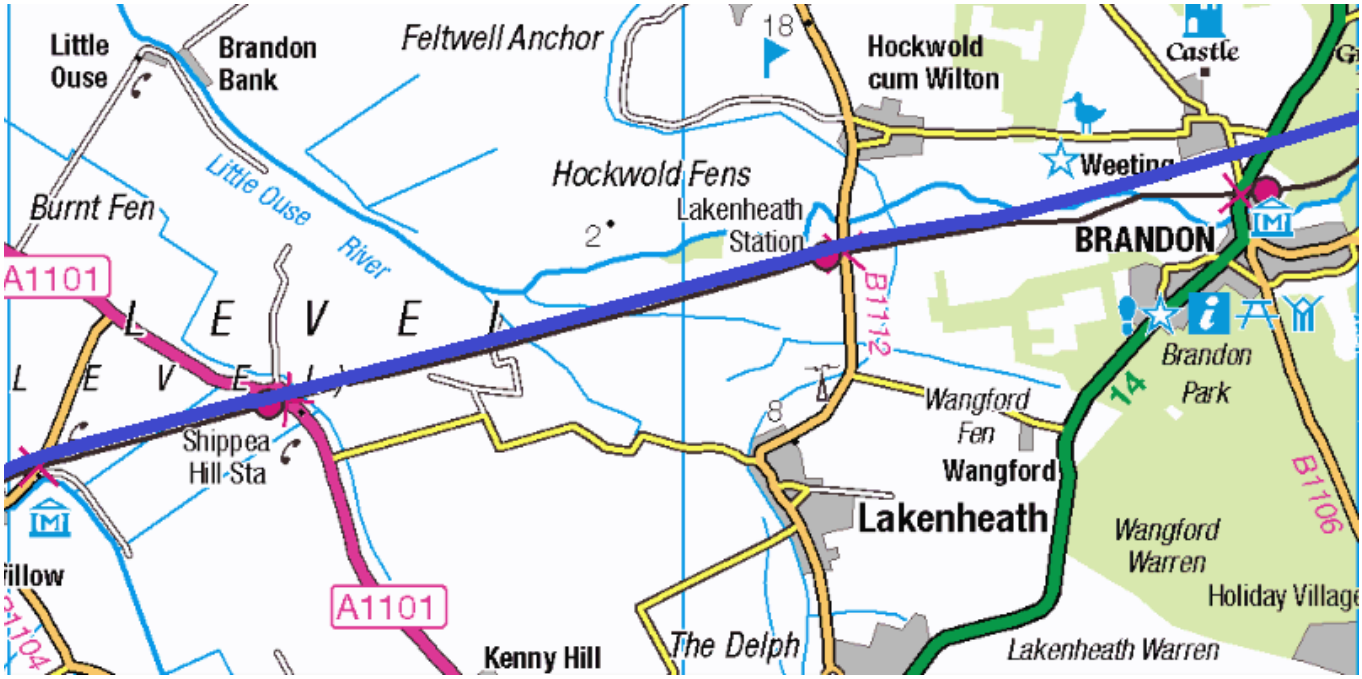
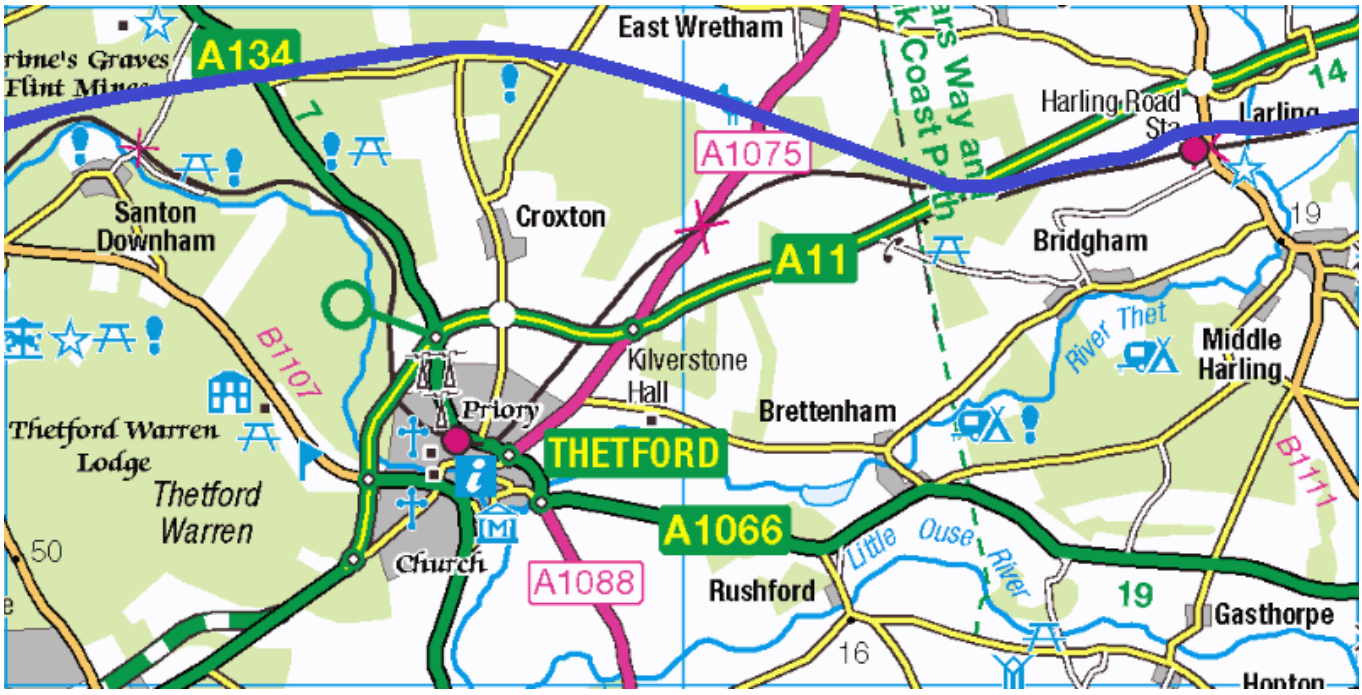
HS North Junction and Peterborough, and for HS10 at Thurlby Junction,) and HS6 takes over (as a branch) the classic route to King's Lynn, redoubled as necessary and enlarged to GC gauge throughout.

The main line of HS6 follows the north side of the classic route to Norwich, and is joined by HS8 (to Norwich) at Ely HS East Junction (57380820).



2.4 Shippea Hill – Brandon Contains Ordnance Survey data © Crown copyright and database right 2013

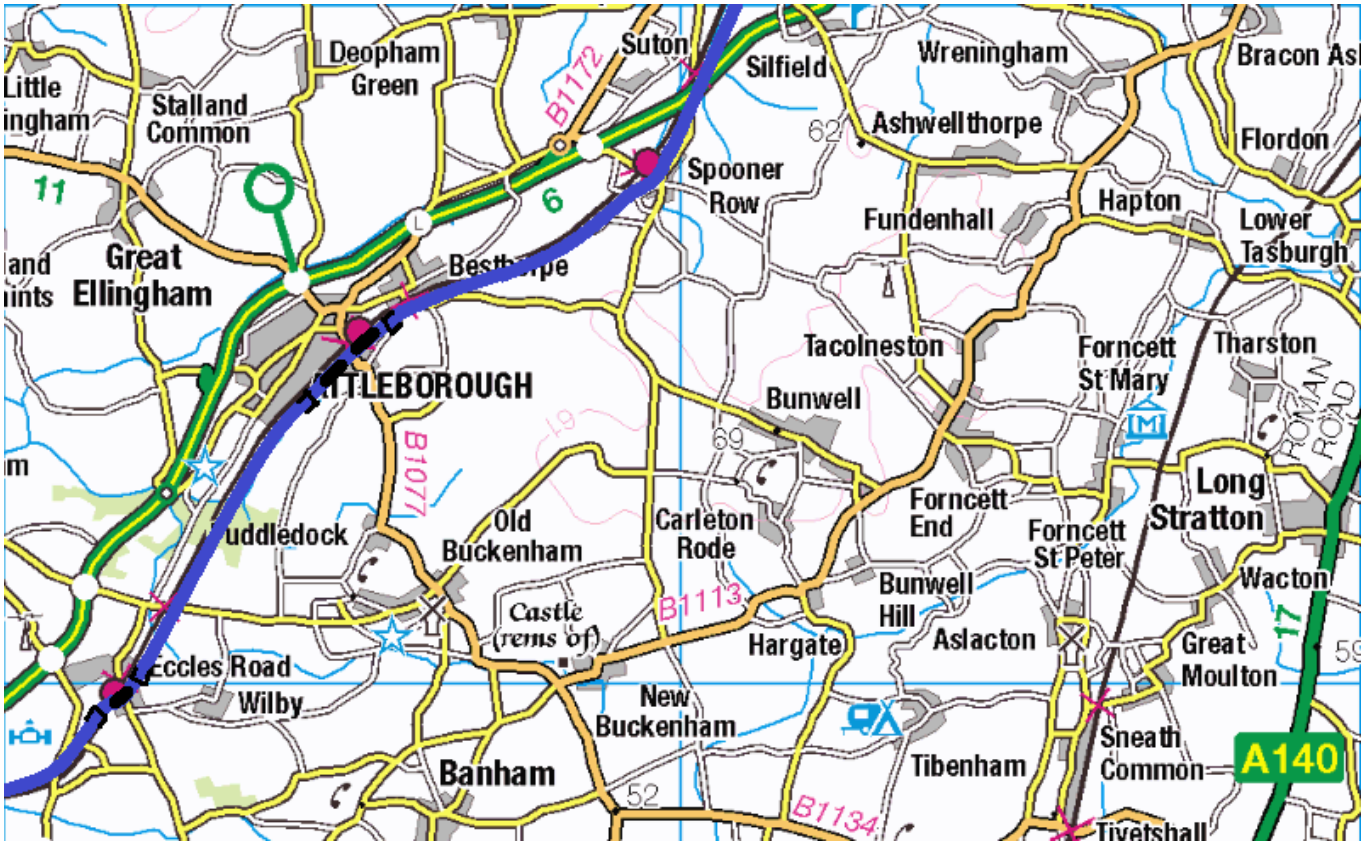
HS6 follows the north side of the classic alignment to Norwich as far as Brandon. There is a major diversion between Lakenheath and east of Thetford to improve the alignment. It diverges from the classic alignment at TL718863, passing to the north of Brandon station, crossing the A1065 at TL788881 and thereafter following closely the Harling Drove track, crossing the A134 at TL839879, the 1075 at TL911883 and finally rejoining the classic alignment at TL935874. A slight slewing to the north at Harling Road station avoids the houses there. (This route passes to the north of Croxton Hill, whereas the line through Thetford passes to the south.)



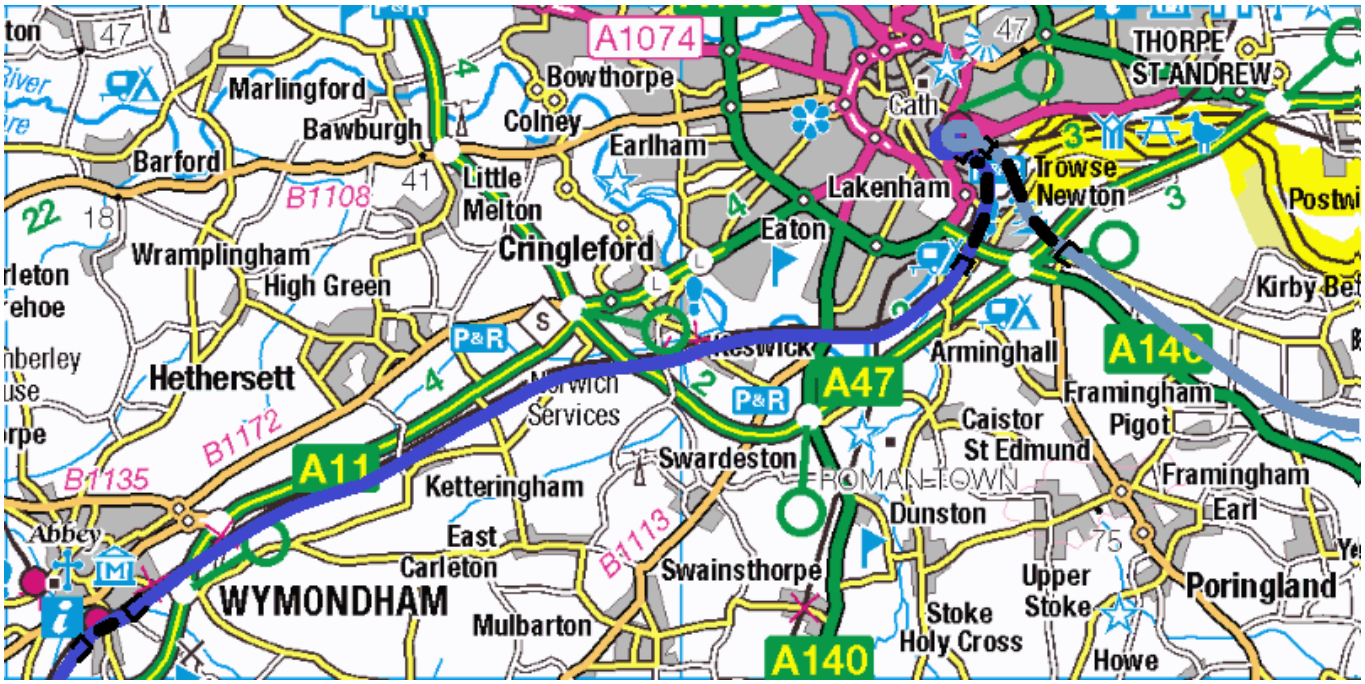
2.5 Santon Downham – Harling Road Contains Ordnance Survey data © Crown copyright and database right 2013

At Mk1A, new infrastructure is provided, as described above, between Brandon Junction (TL770872) and Roudham Heath Junction (TL93587).

I believe it will be unavoidable to demolish perhaps 2 houses at Heath Crossing (TM015896).



2.6 Eccles Road – Suton Contains Ordnance Survey data © Crown copyright and database right 2013



2.7 Wymondham – Norwich Contains Ordnance Survey data © Crown copyright and database right 2013

At Eccles Road, a short, ¼ mile tunnel under the station between TM018900 and TM019902 allows HS6 to switch to the south side of the alignment, and avoid a few houses there, and a **lot** of houses on the north side at Attleborough, a few miles later. Attleborough also needs a ½ mile tunnel under the station itself,

between TM047946 and TM053951. HS6 slews slightly to the south east at Spooner Row, to avoid a row of (non-domestic) buildings, and has a ½ mile tunnel under Wymondham, between TG112009 and TG118012. It continues along the south side of the alignment to Trowse Newton, where it enters a 1 mile tunnel at TG241064, emerging at Carrow Road, TG243080, just before Norwich station, where the HS platforms are on the south side. These are shared with the (much later) HS12.

3. HS10 Thurlby Junction – Lincoln

HS10 shares the routes of HS6, from London to Ely HS South Junction, and HS8 thence to Thurlby Junction (TF084168).

It diverges from HS8 and curves around the west side of Bourne, on a new alignment, crossing the A151 at TF080198, and the A15 at TF096221. It joins the alignment and takes over the trackbed of the long closed line between Bourne and Sleaford at TF104228. This it follows to Sleaford, with a few minor variations, to avoid demolitions. It is slewed a short distance east at Morton (TF106268), and again at Poynton (TF121318). It takes a more substantial diversion at Billingborough, also straightening the alignment, between TF117332 and TF093392, crossing Birthorpe Road at TF110338. It diverges finally from this alignment at TF086439, veering right and crossing to the east side of the Spalding – Lincoln line, and joining the alignment at TF087450. It follows east side of the alignment until Dunston, with a diversion at Ruskington, to avoid demolitions, diverging at TF088489, crossing minor roads at TF090504 and TF092512, rejoining the alignment at TF089520. Just before Dunston, at TF065623, it crosses to the south west side of the alignment (thus far, the obstructions have been overwhelmingly on the west side, but from now on they are overwhelmingly on the north east side). It will be necessary to relocate the odd warehouse on the approach to Lincoln, but no houses.

At Mk1A, new infrastructure is provided between Thurlby Junction and (the existing) Sleaford South Junction, where it merges with the GN/GE joint line between Sleaford and Lincoln, including both the Sleaford avoiding line and the loop through Sleaford station. See Appendix C for the track layout at Lincoln.

3.1 Thurlby Junction – Spanby

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3.2 Scredington – Blankney

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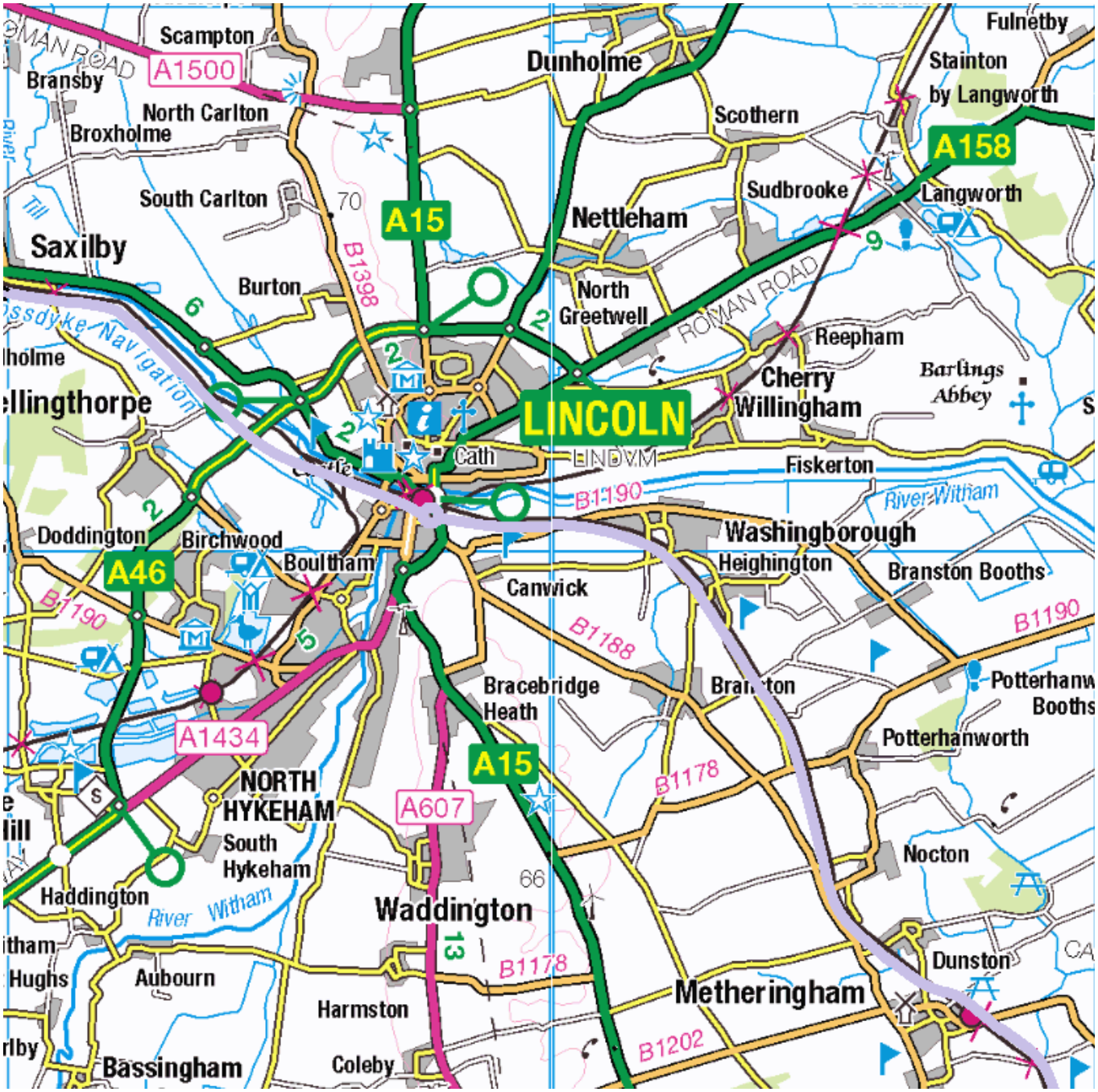

3.3 Metheringham – Saxilby

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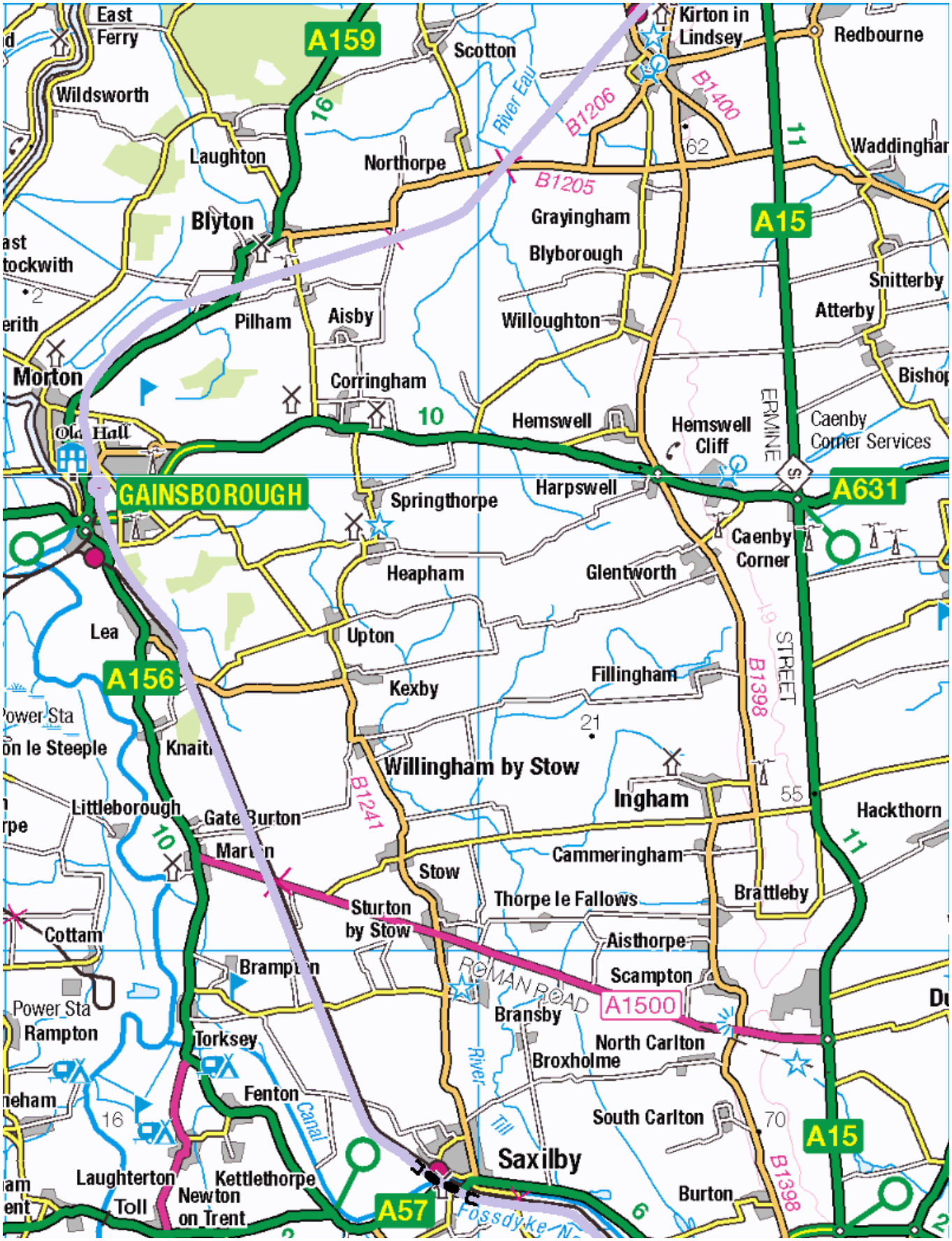
4. HS10 Lincoln – Hull

The HS platforms are located on the south side of Lincoln station. A small amount of demolition is unavoidable, in the critical section between High Street and Brayford Wharf East. Beyond there, the line is 4 track, but in this critical section, the line is just double track. A few commercial properties in the High Street will have to be relocated, and also, astonishingly, a couple of buildings belonging to the University of Lincoln. These are, presumably, fairly new buildings, and have been built far too close to the railway – particularly as there seems to be ample unused space behind them.

HS10 follows the south side of the alignment (with a bridge over the route to Newark) until Saxilby. Here a ¾ mile tunnel is required under the Fossdyke navigation, (and to avoid significant demolition,) between SK900750 and SK890753. It continue along the south / west side of the alignment until just before Lea, at



4.1 Saxilby – Kirton in Lindsey

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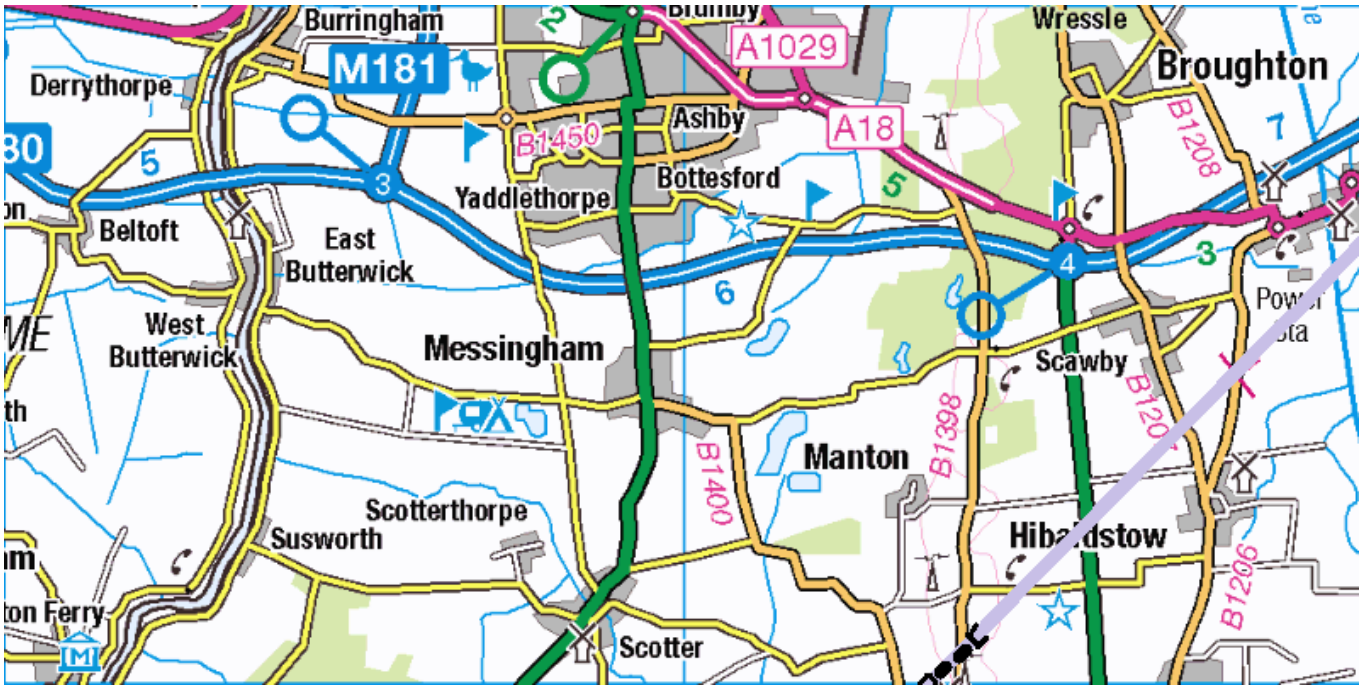
SK535865, where it crosses to the east side. It diverges just before Gainsborough Lea Road station, at SK825879, crossing Foxby Lane at SK822865 and the A631 at SK820892, before joining and taking over the alignment of the Gainsborough – Grimsby line at Gainsborough HS Junction, SK819895, just before

Gainsborough Central station (enabling connections from the classic route). This line is currently almost disused, but it has a good alignment and it's in the right place, so take it over. And provide a HS service for Gainsborough and Brigg, which is now quite a reasonable size.



4.2 Hibaldstow – Scawby

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HS10 diverges from the Classic trackbed at Brigg Junction, TA030079, just before the junctions at Barnetby; a classic compatible service to Cleethorpes diverges from HS10 here. HS10 crosses the line from Doncaster via Scunthorpe, and heads on a new alignment directly to Goxhill Junction, on the line from Grimsby to New Holland and Barton-upon-Humber. It crosses the A180 at TA058114, a minor road at TA065134, the A1077 at TA099150, Thornton Road at TA091189, and College Road at TA090202, arriving at Goxhill Junction (TA097218) where there is a connection from the classic route. HS10 immediately enters a 4½ mile tunnel under the Humber, emerging at TA080288, just before Paragon station.

This last section under the Humber is shared with classic traffic, in particular, a metro service between Cleethorpes and Hull.

At Mk1A, HS10 continues along the classic route between Lincoln and Warren Wood Junction (SK825879), just before Gainsborough Lea Rd. station, where, as described above, it diverges via a short section of new infrastructure to join and merge with the classic Retford – Grimsby route at Gainsborough HS Junction (SK819895). It diverges from the classic route at Brigg Junction (TA030079), and has new infrastructure (unsurprisingly) thence to Hull, as described above.

4.3 Brigg – Hull

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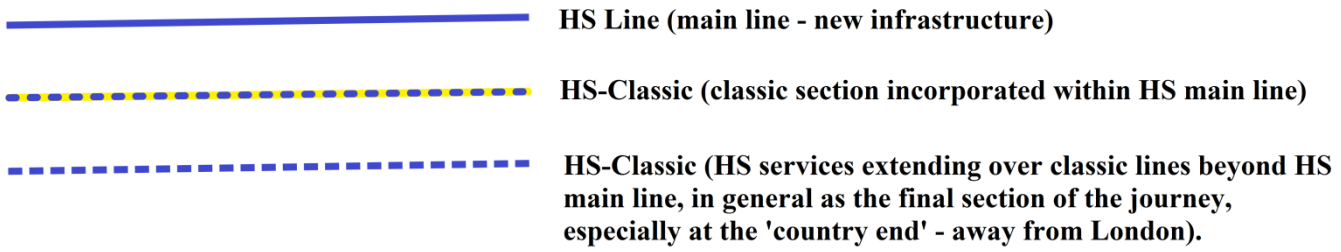
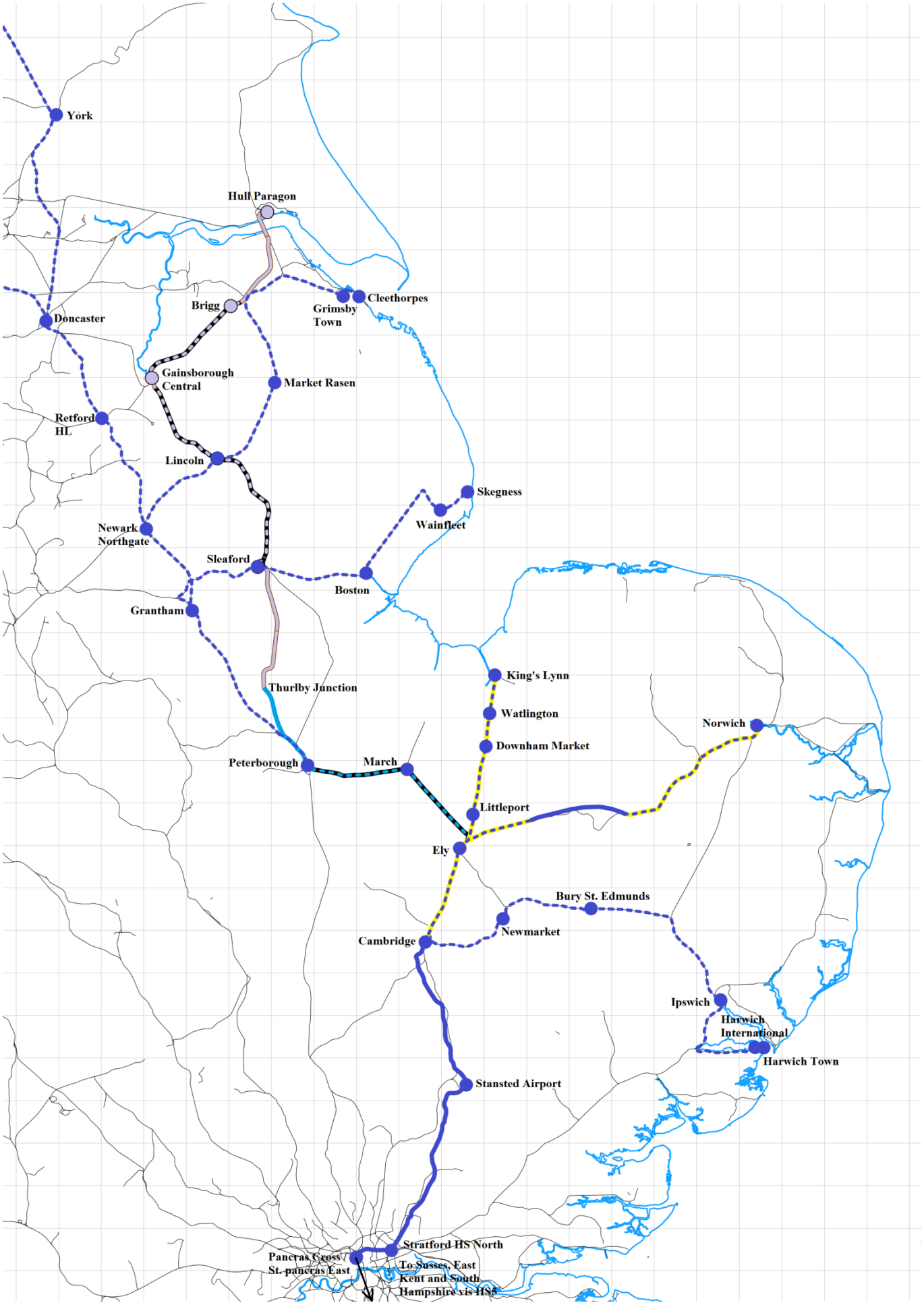
Overall Maps

There follow maps of the overall HS6/HS10 routes (and portions of other associated HS routes used by HS6/HS10 services). At Mk1A, those portions of the main lines of HS6/HS10 which incorporate sections of classic route, and the sections of HS6/HS10 HS-Classic services extending over classic routes beyond the HS6/HS10 main lines, are shown as dotted lines, but differently. The following schematic should clarify:



If the full Mk2 is implemented, there will no longer be any sections of classic route incorporated within the HS6/HS10 main lines; it will all be new infrastructure. Accordingly, the middle of the above line symbols is no longer used. The connections between HS and classic routes will all remain, of course, no longer used by scheduled services, but immensely valuable for operational flexibility, in particular when engineering work is carried out on the main line. (The preceding is not in fact the case for HS6/10 Mk2. It is expected that most of the incorporated classic sections will remain in main line use.)

The first two maps show the HS6/HS10 routes (south and north sheets) at Mk1A. They show the alignments changed from Mk1, including sections of classic route incorporated into HS6/HS10. These are followed by the full Mk2 versions of the same sheets. Finally the maps of the overall network are presented, in Mk1A and extended form. Note that these will be updated over the coming months as the various Route and Service Plans articles are reissued incorporating the Mk1A changes.



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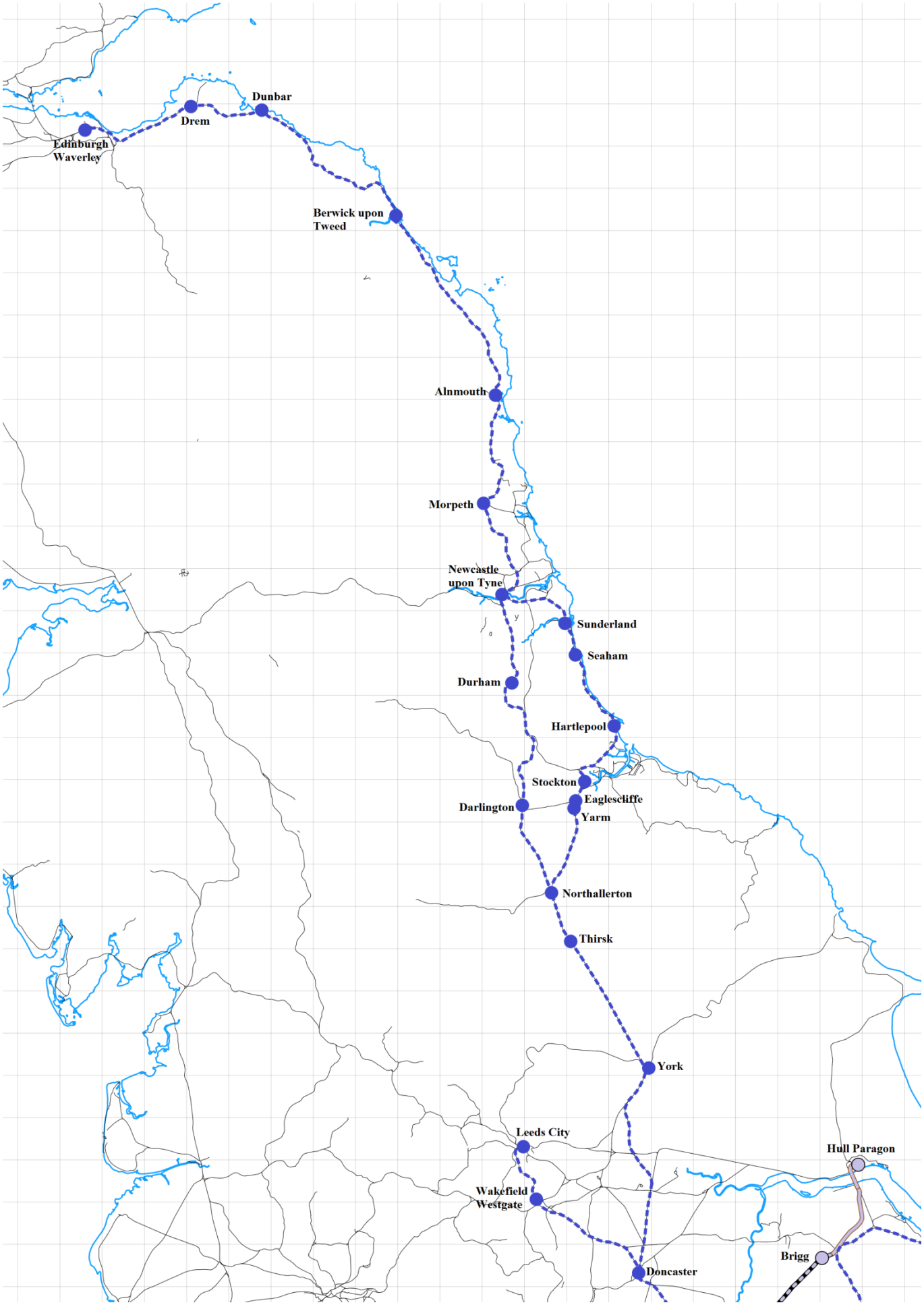

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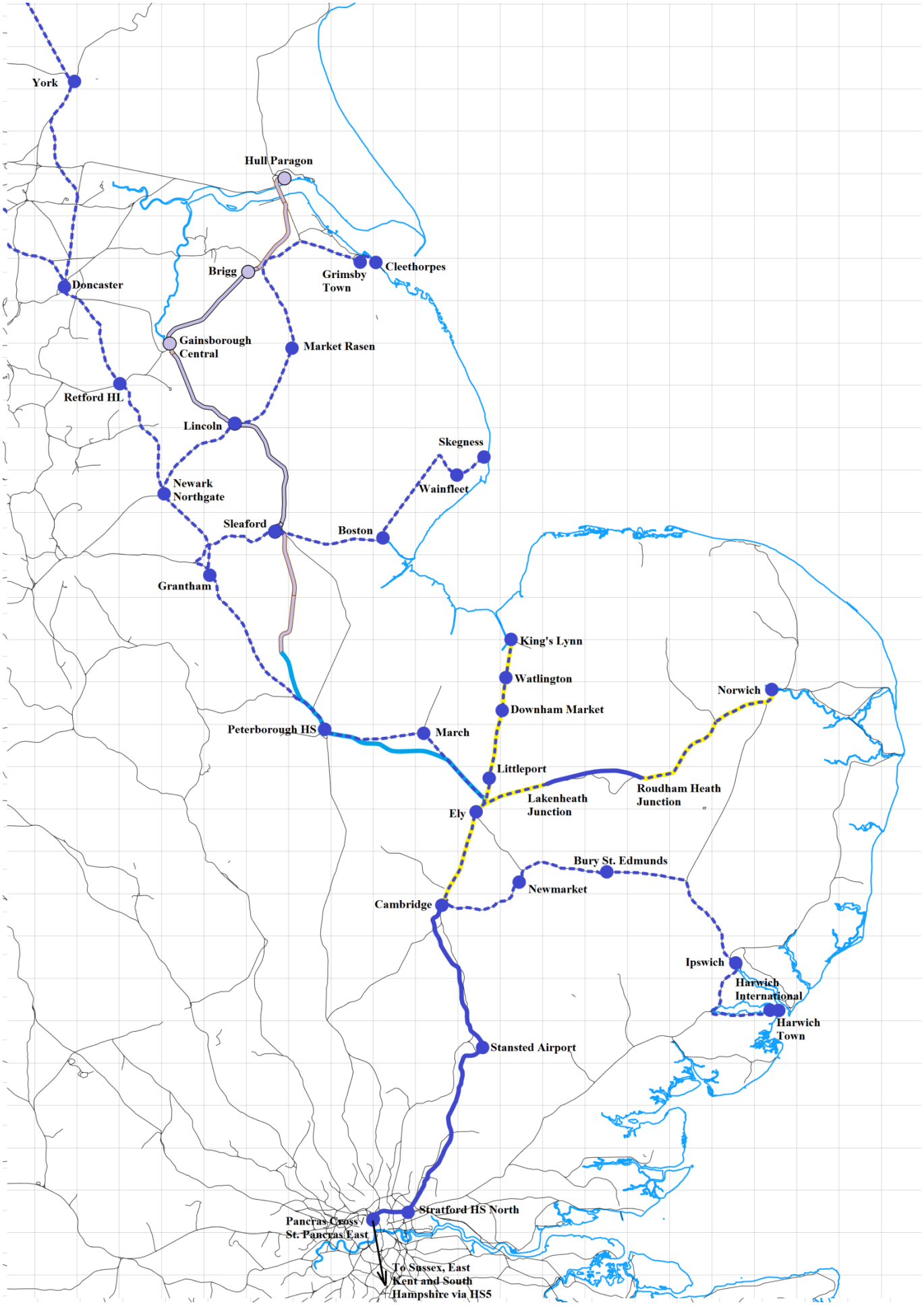

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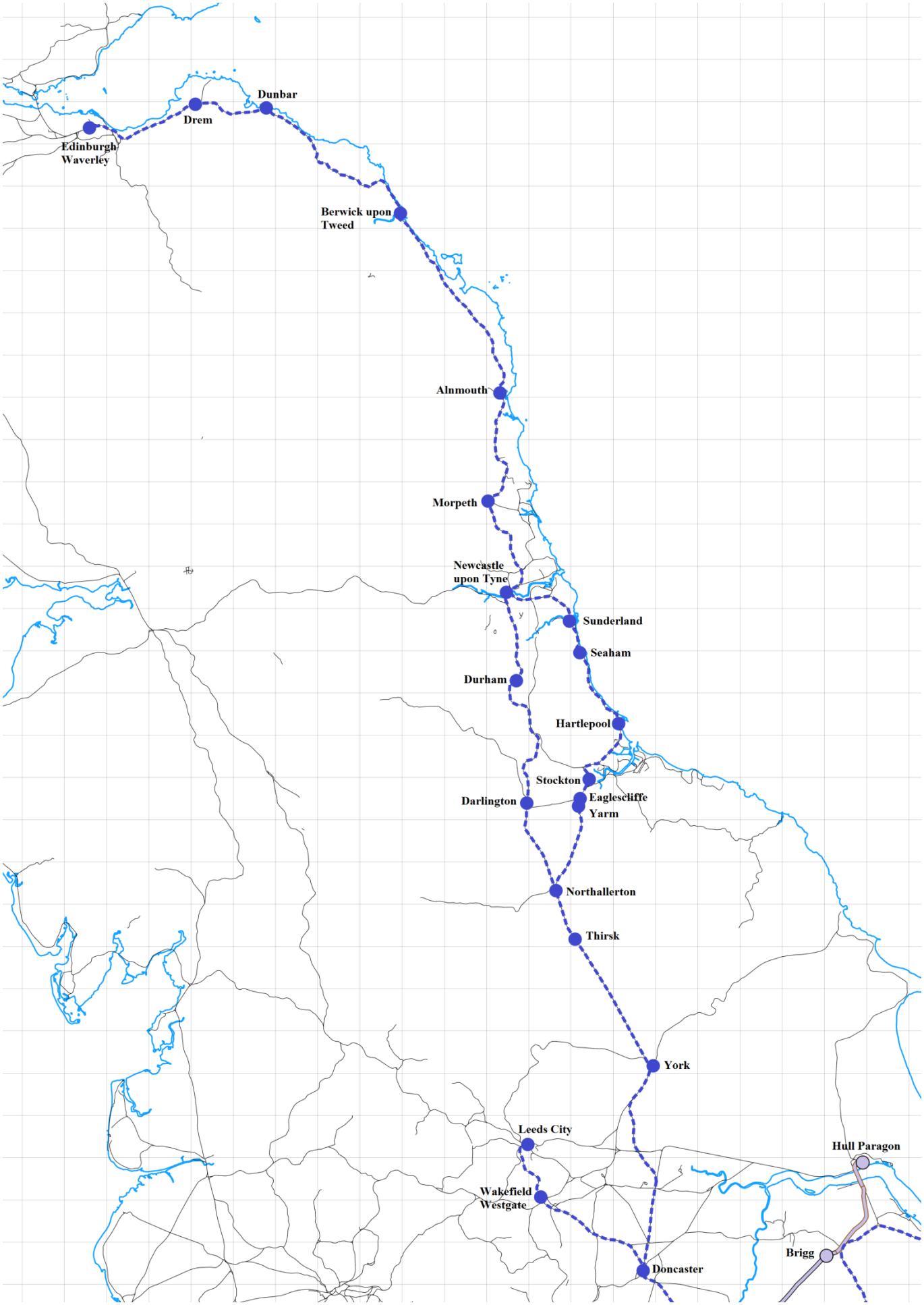

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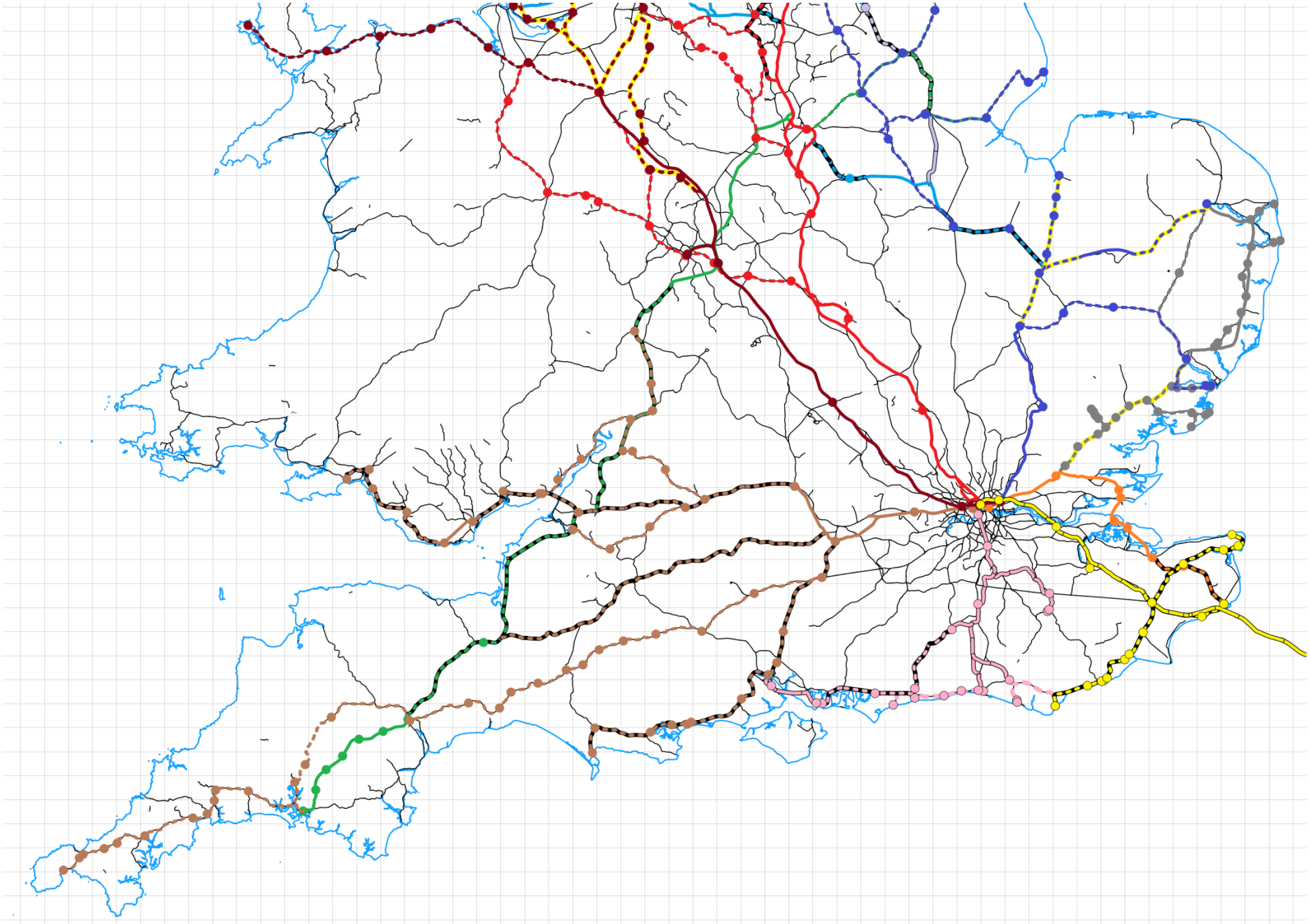

Complete HS Network, South Sheet

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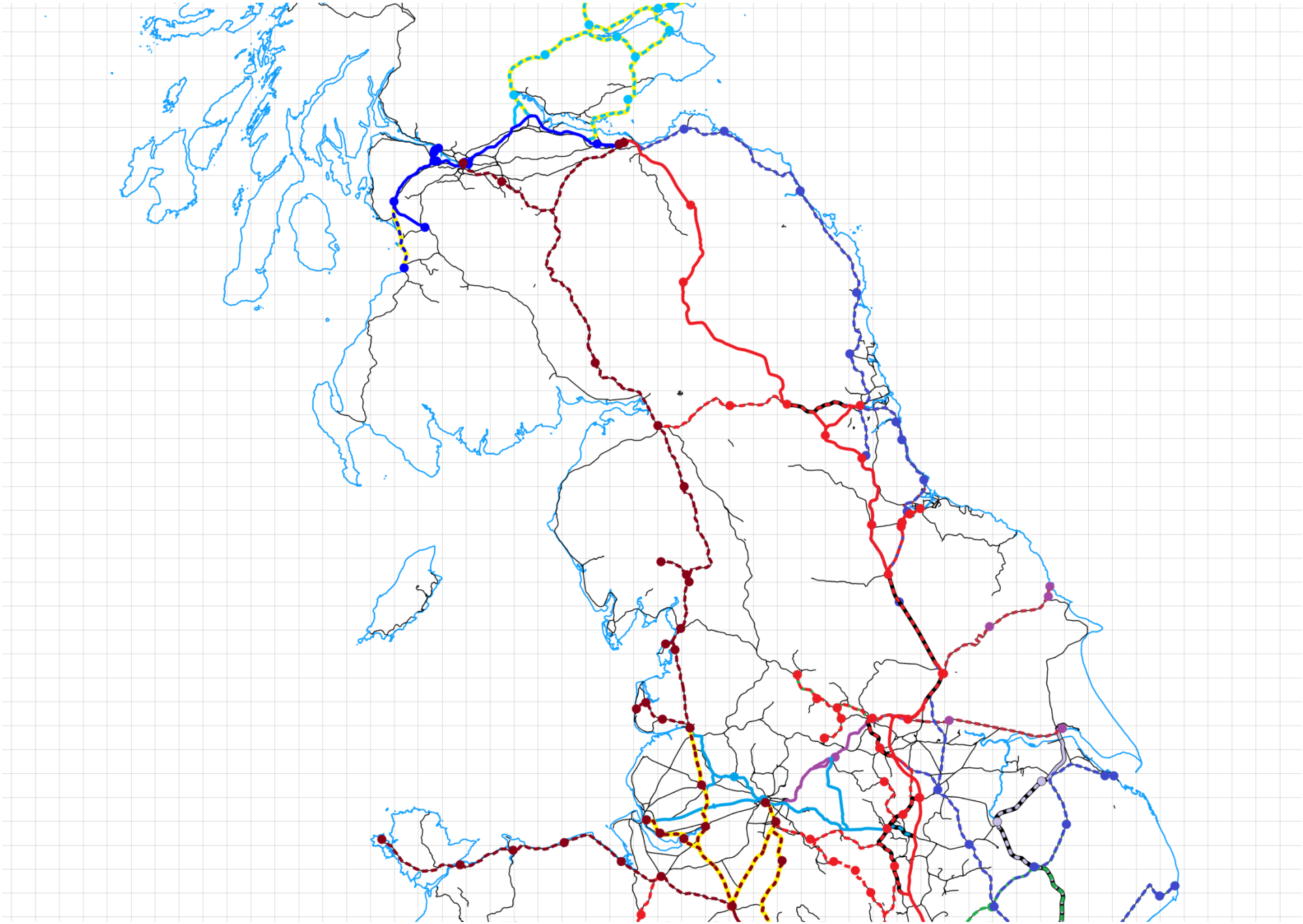

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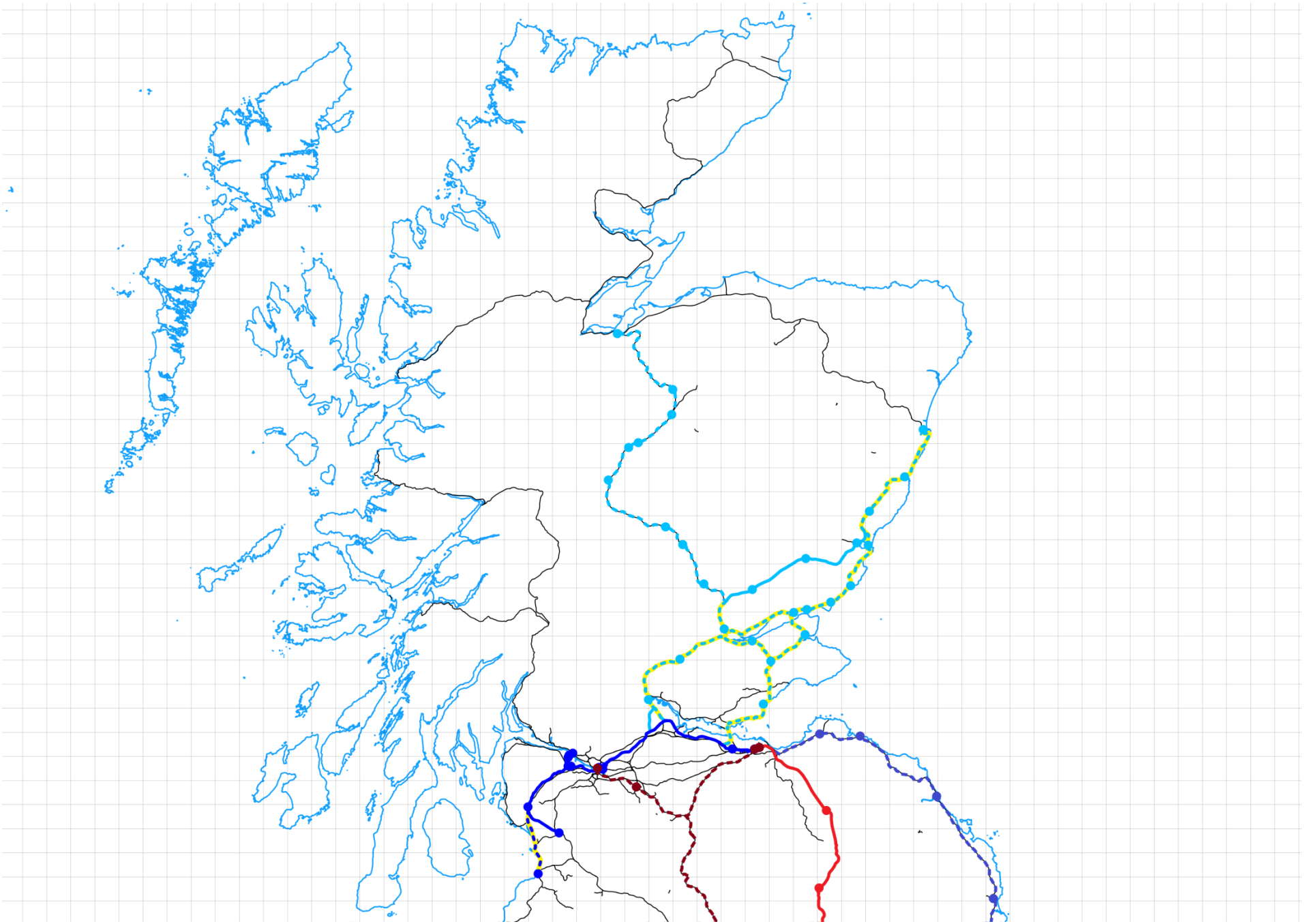

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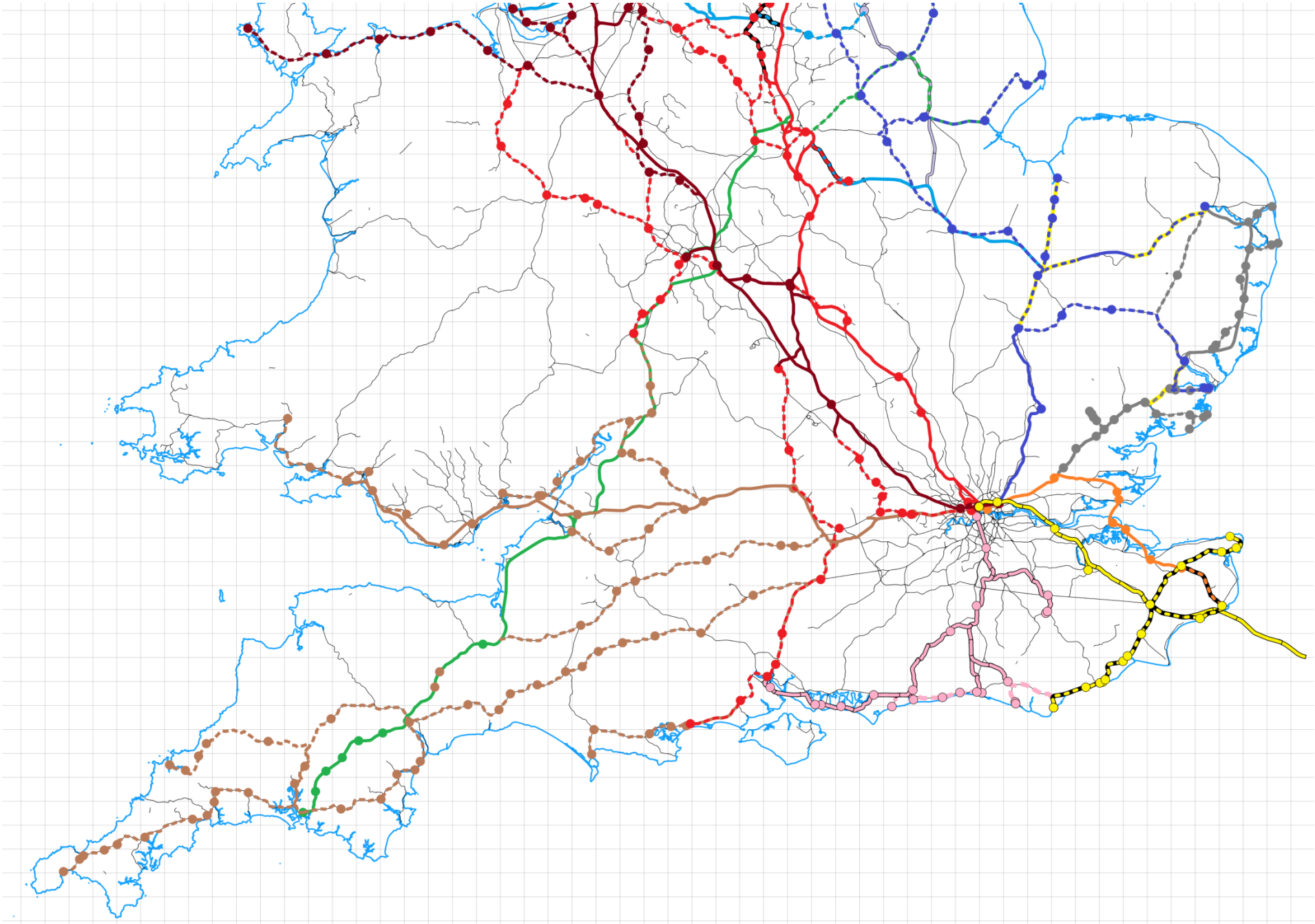

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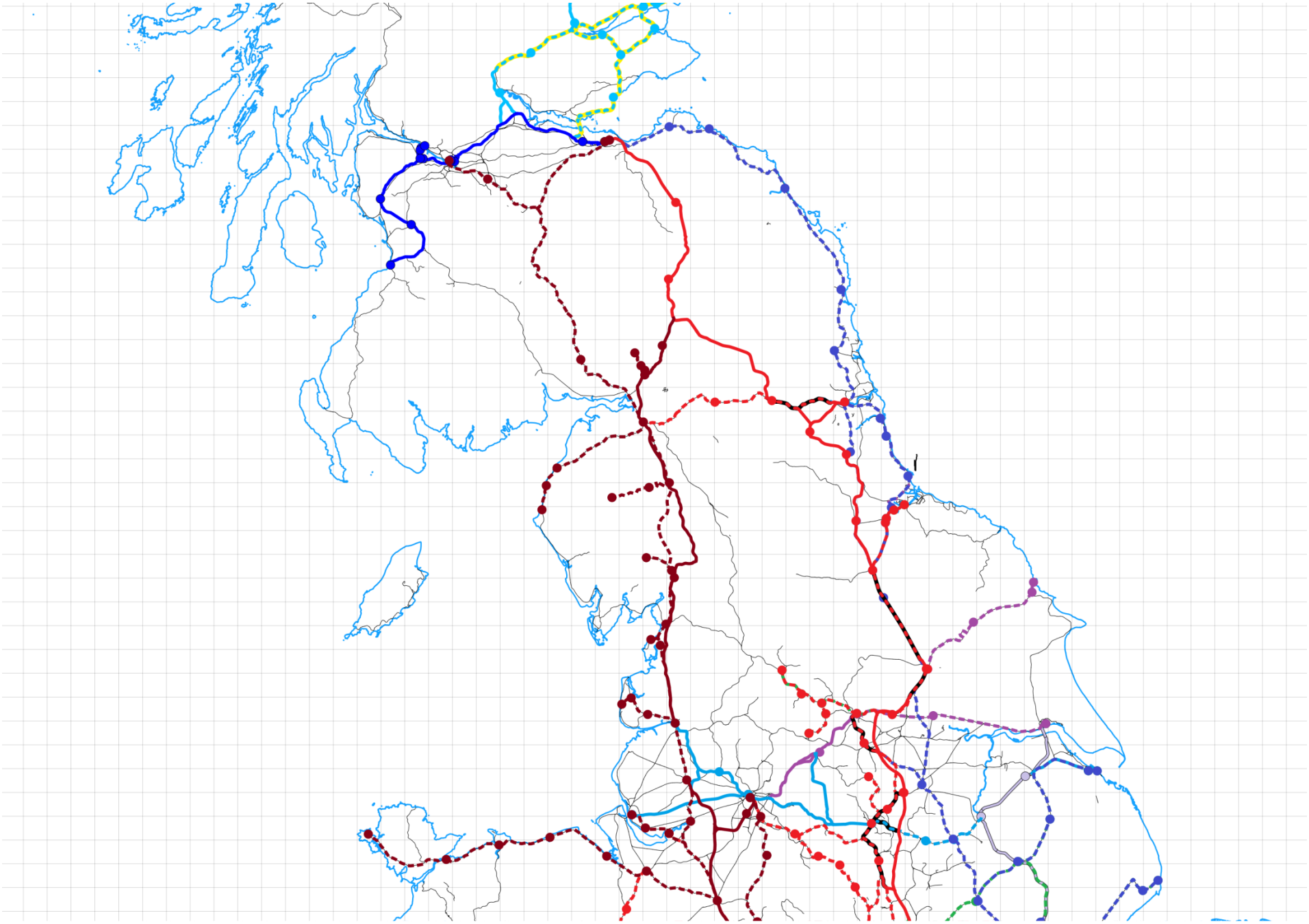

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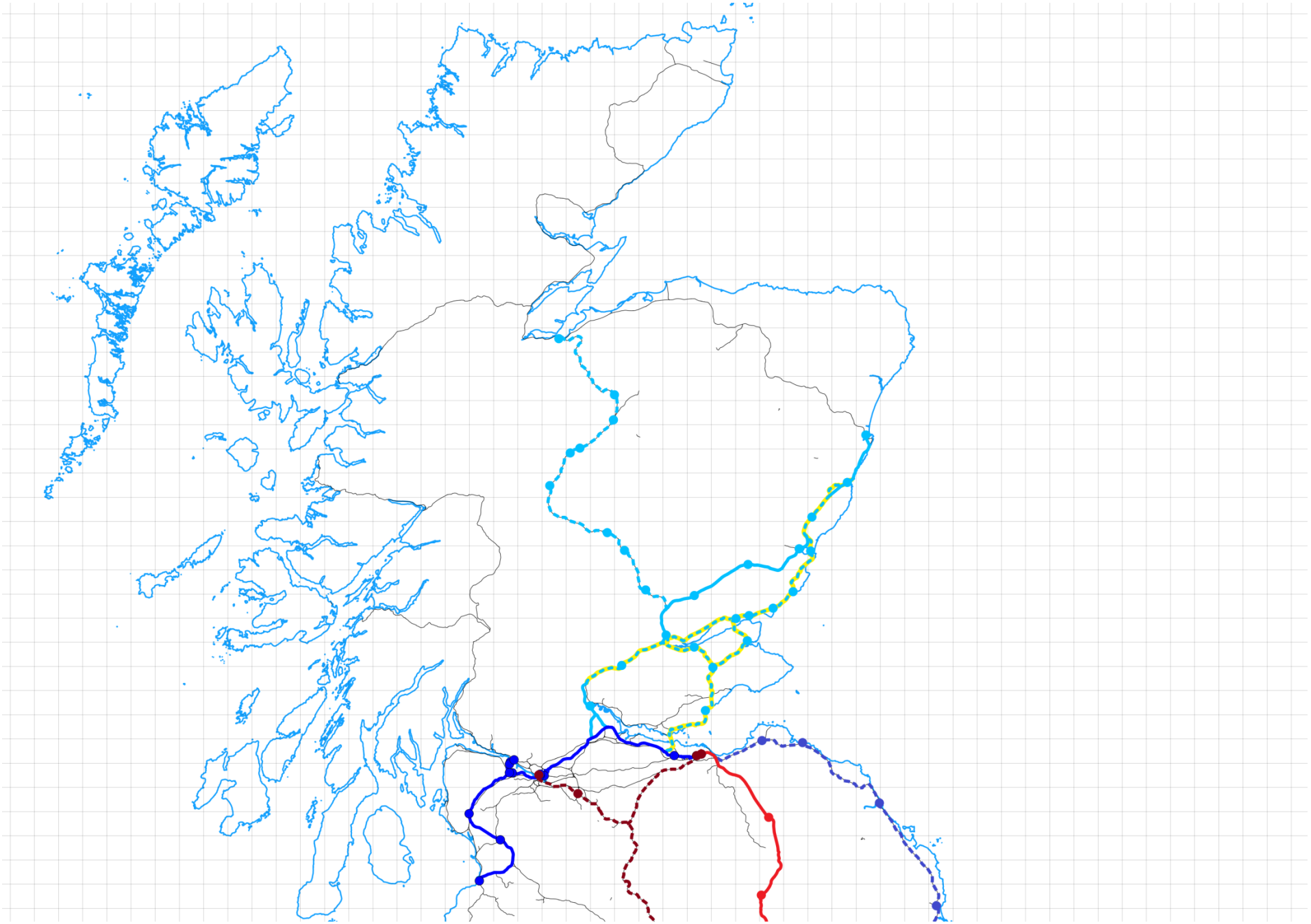

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The Service Plans

A new service plan comes into effect when some significant change takes place which causes a change to the service loadings of one or more sections of HS6/HS10 themselves. This most commonly occurs when a new section of HS6 or HS10 opens, but it may also be a consequence of a change on some other HS route.

The service plans use the following notation:

- tph trains per hour
- H High Speed train – at least part of the journey being on the HS main line
- R Regional Metro train, semi-fast service
- RS Regional Metro train, stopping service (all stations)

High Speed trains invariably travel over classic lines also (even if only those sections incorporated in the HS main line). Regional Metro services generally travel their entire journey over classic lines, though this is not an absolute requirement; but if they do travel over any HS section, they must be formed of HS stock – obviously!

Occasionally other notations are used; these will be defined when used.

As was mentioned earlier, the service plans deliberately envisage maximum frequencies. The results may thus seem, at least initially, somewhat optimistic.

Service Plan 1

The first service plan comes into operation when:

- HS6 opens in full between Pancras Cross and Cambridge (new infrastructure), services extending over classic tracks to King's Lynn and Harwich
- the Southampton branch of HS5 opens, as far as Portsmouth & Southsea

The two services are provided:

- 2tphH [Portsmouth & Southsea –>] Pancras Cross – Stratford HS North – Stansted Airport – Cambridge – Ely – Littleport – Downham Market – Watlington –King's Lynn
- 2tphH [Chichester –>] Pancras Cross – Stratford HS North – Stansted Airport – Cambridge – Newmarket – Bury St. Edmunds – Ipswich – Harwich International – Harwich Town

(As always, we open a new section as soon as possible, to get services running.)

Regional Metro:

- 2tphR Harwich Town – Harwich International – Ipswich – Bury St. Edmunds – Ely – March – Peterborough – Stamford – Oakham – Melton Mowbray – Leicester – Hinckley – Nuneaton – Coleshill Parkway – Birmingham New Street – University – Bromsgrove – Droitwich Spa – Worcester Shrub Hill
- 2tphR Morecambe – Lancaster – Preston – Leyland – Chorley – Horwich Parkway – Bolton – Salford Crescent – Manchester Oxford Rd. – Manchester Piccadilly – Stockport – Chinley –

Sheffield Midland (reverse) – Chesterfield – Alfreton and Mansfield Parkway – Langley Mill – Nottingham – Melton Mowbray – Oakham – Stamford – Peterborough – March – Ely (split/joins):
– (reverse) Thetford – Wymondham – Norwich
– Cambridge – Stansted Airport

Representative Hourly Non-Cross-Platform Interchange Pattern at Ely:

00H [Portsmouth –>] Pancras Cross – King's Lynn
R Harwich Town – Birmingham New St.
R Morecambe –Norwich

It imposes the following loadings on HS6:

- Pancras Cross – Canley Street Junction 4tph*
- Canley Street Junction – York Way Junction 4tph
- St. Pancras (East) – York Way Junction 0tph
- York Way Junction – Hitchcock Lane Junction 8tph**
- Hitchcock Lane Junction – Cambridge 4tph
- Cambridge – Ely HS North Junction 2tph***
- Ely North Junction – King's Lynn 2tph***
- Ely North Junction – Brandon Junction 0tph***
- Brandon Junction – Roudham Heath Junction 0tph
- Roudham Heath Junction – Norwich 0tph***
- Ely North Junction – Stanground Junction 0tph***
- Stanground Junction – Peterborough 0tph
- Peterborough HS – Pellett Hall Junction 0tph
- Pellett Hall Junction – Thurlby Junction 0tph
- Thurlby Junction – Sleaford South Junction 0tph
- Sleaford South Junction – Lincoln 0tph***
- Lincoln – Warren Wood Junction 0tph***
- Warren Wood Junction – Gainsborough HS Junction 0tph
- Gainsborough HS Junction – Brigg Junction 0tph***
- Brigg Junction – Goxhill Junction 0tph
- Goxhill Junction – Hull Paragon 0tph***

* HS6/HS10 services only. There will also be HS3 services between Pancras Cross and Canley Street Junction.
** I'm allowing for 4tph international traffic on HS1.
*** HS6/HS10 services only. There will also be classic services on these sections.

Service Plan 2

This service plan comes into operation when:

- HS6 opens between Brandon and Roudham Heath junctions (new infrastructure), services extending over classic tracks between Ely North and Brandon junctions, and beyond Roudham Heath Junction to Norwich
- HS8 opens between Ely North Junctions and Nottingham (over classic tracks between Eln North and Stanground junctions)
- HS5 opens between Portsmouth and Southampton

The remaining services are introduced. The full service is:

- 2tphH [Southampton –>] Pancras Cross – Stratford HS North – Stansted Airport – Cambridge – Ely – Norwich
- 2tphH [Southampton –>] Pancras Cross – Stratford HS North – Stansted Airport – Cambridge – Ely – Peterborough (temporary, until HS10 opens)
- 2tphH [Portsmouth –>] Pancras Cross – Stratford HS North – Stansted Airport – Cambridge – Ely – Littleport – Downham Market – Watlington –King's Lynn
- 2tphH [Chichester –>] Pancras Cross – Stratford HS North – Stansted Airport – Cambridge – Newmarket – Bury St. Edmunds – Ipswich – Harwich International – Harwich Town
- 2tphH Norwich – Ely (reverse) – Peterborough (temporary, until HS10 opens)
- 2tphH HS8/HS7/HS4 Norwich – Ely (reverse) – Peterborough – Nottingham – Derby – Birmingham Interchange – Worcester Shrub Hill – Cheltenham Spa – Bristol Parkway HS – Cardiff HS – Cardiff Airport – Port Talbot parkway – Swansea HS
- 2tphH HS8/HS3 Norwich – Ely (reverse) – Peterborough – Nottingham – Sheffield HS – Manchester HS – Manchester Victoria LL – Bolton – Preston
- 2tphH [Bognor / Littlehampton –>] Stratford HS North – Stansted Airport – Cambridge – Ely – March – Peterborough – Grantham (splits / joins) – :
  – Newark – Lincoln – Market Rasen – Grimsby Town – Cleethorpes
  – Sleaford – Boston – Wainfleet – Skegness
- 2tphH St. Pancras (East) – Stratford HS North – Stansted Airport – Cambridge – Ely – Peterborough – Doncaster – York (splits / joins) – :
  – Darlington – Durham – Newcastle – Morpeth – Alnmouth – Berwick – Dunbar – Drem – Edinburgh Waverley
  – Thirsk – Northallerton – Yarm – Eaglescliffe – Stockton – Hartlepool – Seaham – Sunderland - Newcastle
- 2tphH St. Pancras (East) – Stratford HS North – Stansted Airport – Cambridge – Ely – Peterborough – Grantham – Newark – Retford – Doncaster – Wakefield Westgate – Leeds City

Note that the HS8 services were already, prior to this service plan, running west of Nottingham. The two services Bognor – Cleethorpes and Littlehampton – Skegness run joined together between Arundel and Grantham. (They could easily be varied, alternately Bognor – Skegness and Littlehampton – Cleethorpes, since they could equally well arrive in either order at Arundel and depart in either order from Grantham, and vice versa.)

Regional Metro:

- 2tphR Harwich Town – Harwich International – Ipswich – Bury St. Edmunds – Ely – March – Peterborough – Stamford – Oakham – Melton Mowbray – Leicester – Hinckley – Nuneaton – Coleshill Parkway – Birmingham New Street – University – Bromsgrove – Droitwich Spa – Worcester Shrub Hill
- 2tphR Morecambe – Lancaster – Preston – Leyland – Chorley – Horwich Parkway – Bolton – Salford Crescent – Manchester Oxford Rd. – Manchester Piccadilly – Stockport – Chinley – Sheffield Midland (reverse) – Chesterfield – Alfreton and Mansfield Parkway – Langley Mill – Nottingham – Melton Mowbray – Oakham – Stamford – Peterborough – March – Ely (split/joins):
  – (reverse) Thetford – Wymondham – Norwich
  – Cambridge – Stansted Airport
- 2tphRS Cambridge – Chesterton – Waterbeach – Ely – Shippea Hill – Lakenheath – Brandon – Thetford – Harling Road – Eccles Road – Attleborough – Spooner Row – Wymondham – Norwich
- 2tphRS Ipswich – Needham Market – Stowmarket – Elmswell – Thurston – Bury St. Edmunds – Kennett – Ely – Manea – March – Whittlesea – Peterborough

Service Plan 2A

This service plan comes into operation when HS10 opens between Thurlby Junction and Hull.

The Southampton – Peterborough and Norwich - Peterborough services are extended to Hull:

- 2tphH {Southampton –>] Pancras Cross – Stratford HS North – Stansted Airport – Cambridge – Ely – Peterborough – Sleaford – Lincoln – Gainsborough Central – Brigg – Hull Paragon.
- 2tphH Norwich – Ely (reverse) – Peterborough – Sleaford – Lincoln – Gainsborough Central – Brigg – Hull Paragon.

Representative Hourly Cross-Platform Interchange Pattern at Ely (note that this includes both directions):`

00H	[Southampton –>] Pancras Cross – Hull	4)	
H	Preston (reverse at Ely) – Norwich	5)	(cross-platform)
RS	Norwich – Cambridge	8)	
RS	Peterborough – Ipswich	9)	(cross-platform)
R	Stansted Airport – Morecambe (Norwich portion joins)	1	
05H	Hull – Southampton	6)	
H	Norwich – Preston	7)	(cross-platform)
RS	Ipswich – Peterborough	2)	
RS	Cambridge – Norwich	3)	(cross-platform)
10H	Edinburgh / Newcastle via Hartlepool – St Pancras (East)	8)	
H	Norwich (reverse at Ely) – Swansea	9)	(cross-platform)

R	Harwich – Worcester	4)	
H	[Portsmouth –>] Pancras Cross – King's Lynn	5)	(cross-platform)
R	Morecambe – Stansted Airport / Norwich (Norwich portion splits and reverses)	10	
15H	Norwich (reverse at Ely) – Hull	2)	
H	[Southampton –>] Pancras Cross – Norwich	3)	(cross-platform)
H	Leeds – St Pancras (East)	6)	
H	Clee/Skeg – Pancras Cross [–> Bognor / Littlehampton]	7)	(cross-platform)
20H	Hull (reverse at Ely) – Norwich	8)	
H	Norwich – Pancras Cross [–> Southampton]	9)	(cross-platform)
H	[Bognor / Littlehampton –>] Pancras Cross – Clee/Skeg	4)	
H	St. Pancras (East) – Leeds	5)	(cross-platform)
25H	St. Pancras East – Edinburgh / Newcastle via Hartlepool	2)	
H	Swansea (reverse at Ely) – Norwich	3)	(cross-platform)
H	King's Lynn – Pancras Cross [–> Portsmouth]	6)	
R	Worcester – Harwich	7)	(cross-platform)
R	Norwich – Morecambe portion (parks off Ipswich line)	10	

– repeating at 30, 35, 40, 45, 50 and 55 minutes past.

See appendix B for the contraflow track layout at Ely, to make this interchange as convenient as possible.

The following is the hourly **calling pattern** at Peterborough. With the one exception noted, these are not cross-platform, and do not provide a guaranteed interchange – even where meaningful.

00H	[Southampton –>] Pancras Cross – Hull	
05H	Norwich – Preston	
R	Norwich / Stansted – Morecambe	
10H	Norwich - Swansea	
15H	Norwich – Hull	(HS platforms)
R	Harwich – Worcester	(ECML platforms)
20H	St. Pancras (East) – Leeds	) These both use the ECML platforms, so a cross-platform conn-
RS	Ipswich – Peterborough	) ection from the stopping service is both possible and meaningful.
25H	St. Pancras (East) – Edinburgh / Newcastle	(HS platforms)
H	Bognor / Littlehampton – Cleethorpes / Skegness	(ECML platforms)

– repeating at 30, 35, 40, 45, 50 and 55 minutes past.

The above pattern is derived from the pattern at Ely, (services **to** Peterborough only,) on the assumption that services stopping at March take 5 minutes longer, and the stopping service (with a further two stops) 15 minutes longer than the non-stop services.

Representative Hourly Non-Cross-Platform Interchange Pattern at Sleaford

00H [Southampton –>] Pancras Cross – Hull
H [Littlehampton –>]Pancras Cross – Skegness

15H Norwich – Hull
(no connection)

– repeating at 30 and 45 minutes past.

Representative Hourly Cross-Platform Interchange Pattern at Lincoln:

00H [Southampton –>] Pancras Cross – Hull
H [Bognor –>] Pancras Cross – Cleethorpes

15H Norwich – Hull
(no connection)

– repeating at 30 and 45 minutes past.

(Yes – it's the same as Sleaford; just different portions of the same trains. It is assumed that the Cleethorpes portion can get from Grantham to Lincoln, stopping at Newark, in the same time as the Skegness portion can get from Grantham to Sleaford, and the Hull train from Sleaford to Lincoln.) See appendix C for the contraflow track layout at Lincoln, to make this interchange as convenient as possible.

Service plan 2 overall imposes the following loadings on HS6 and HS10:

- Pancras Cross – Canley Street Junction 10tph*
- Canley Street Junction – York Way Junction 10tph
- St. Pancras (East) – York Way Junction 4tph
- York Way Junction – Hitchcock Lane Junction 18tph**
- Hitchcock Lane Junction – Cambridge 14tph
- Cambridge – Ely station 12tph***
- Ely station – Ely HS North Junction 24tph****
- Ely North Junction – King's Lynn 2tph***
- Ely North Junction – Brandon Junction 8tph***
- Brandon Junction – Roudham Heath Junction 8tph
- Roudham Heath Junction – Norwich 8tph***
- Ely North Junction – Stanground Junction 14tph***
- Stanground Junction – Peterborough (ECML) 4tph
- Stanground Junction – Peterborough HS 10tph
- Peterborough HS – Pellett Hall Junction 10tph
- Pellett Hall Junction – Thurlby Junction 8tph
- Thurlby Junction – Sleaford South Junction 4tph
- Sleaford South Junction – Lincoln 4tph***

- Lincoln – Warren Wood Junction 4tph***
- Warren Wood Junction – Gainsborough HS Junction 4tph
- Gainsborough HS Junction – Brigg Junction 4tph***
- Brigg Junction – Goxhill Junction 4tph
- Goxhill Junction – Hull Paragon 4tph***

* HS6/HS10 services only. There will also be HS3 services between Pancras Cross and Canley Street Junction.
** I'm allowing for 4tph international traffic on HS1.
*** HS6/HS10 services only. There will also be classic and possibly other HS services on these sections.
**** The loading between Ely station and Ely North Junction reflects the fact that all services between Norwich and Peterborough contribute **in both directions** (6tph each way) because they reverse at Ely. This section is, unsurprisingly, 4-track. See appendix C for the layout at Ely.

Estimated Journey Times

The conditions governing acceleration, deceleration, behaviour at junctions and line capacity of high speed lines are dealt with exhaustively in appendix B of the article 'Same Speed Railways'. Technically-minded readers, who want all the hard details, should look there. Only the required results are quoted here.

The following calculations are only approximate. Distances, to the nearest km, are derived from my own maps. However, comparing my estimated distances with actual distances, where these are appropriate, leads me to believe they are accurate to within 3%.

The crudest approximation is the assumption that, once line speed has been reached, that speed (300kph on new infrastructure,) is maintained until it becomes necessary to decelerate for a junction or a station stop. These times are accumulated over the journey, and a notional wait time of 3 minutes added for each intermediate station stop.

The results are, in any case, valuable in giving a **feel** for the journey times possible.

My estimated distances (between stations) are:

- Pancras Cross – Stratford HS North 8km (*)
- Stratford HS North – Stansted Airport 45km (300kph)
- Stansted Airport – Cambridge 37km (300kph)
- Ely – Brandon Junction 18km (225kph)
- Brandon Junction – Roudham Heath Junction 24km (300kph)
- Roudham Heath Junction – Norwich 40km (200kph)
- Peterborough – Pellett Hall Junction (*) 6.3km (225kph)
- Peterborough – Sleaford 52km (300kph)
- Brigg – Hull Paragon 25km (300kph)
- Warren Wood Junction – Gainsborough Lea Rd. 0.7km (200kph)
- Warren Wood Junction – Gainsborough Central 1.7km (200kph)

(*) Pellett Hall Junction is 1 mile north of the current Werrington Junction – take as 80m40ch from King's Cross. The time from Peterborough to Doncaster via 6.3km of HS8, joining the ECML at Pellett Hall Junction, is taken to be the same as travelling all the way along the ECML.

The above are all distances on HS6 or HS10 new infrastructure. (The last two, short distances are measured directly from the relevant 1:25000 OS map, and are very accurate. The distance Lincoln – Gainsborough Central is thus exactly 1km greater than Lincoln – Gainsborough Lea Rd.) In addition, they share the following sections of classic routes, whose lengths are known exactly!

- St. Pancras International – Stratford HS North 9.5km (*)
- Cambridge – Ely 23.7km (225kph)
- Ely – Littleport 9.0km (200kph)
- Littleport – Downham Market 16.3lkm (200kph)
- Downham Market – Watlington 7.7km (200kph)
- Watlington – King's Lynn 8.1km (200kph)
- Ely – March 48.8km (225kph)
- March – Peterborough 24.0km (225kph)
- Peterborough – Grantham 46.8km (225kph)
- Grantham – Sleaford 24.5km (200kph)
- Sleaford – Boston 27.1km (200kph)
- Boston – Wainfleet 30.6km (200kph)
- Wainfleet – Skegness 8.1km (200kph)
- Grantham – Newark Northgate 23.6km (225kph)
- Newark Northgate – Lincoln 26.6km (200kph)
- Lincoln – Market Rasen 23.8km (200kph)
- Market Rasen – Grimsby Town 46.8km (200kph)
- Grimsby Town – Cleethorpes 5.2km (160kph)
- Sleaford – Lincoln 34.1km (200kph)
- Lincoln – Gainsborough Lea Rd. 25.1km (200kph)
- Lincoln – Gainsborough Central 26.1km (200kph)
- Gainsborough Central – Brigg 26.5km (225kph)
- Newark Northgate – Retford HL 29.8km (225kph)
- Retford HL – Doncaster 27.9km (225kph)
- Doncaster – Wakefield Westgate 31.9km (200kph)
- Wakefield Westgate – Leeds City 16.2km (160kph)
- Peterborough – Doncaster 127.7km (225kph)
- Doncaster – York 52.4km (225kph)
- York – Thirsk 35.7km (225kph)
- Thirsk – Northallerton 12.5km (225kph)
- Northallerton – Yarm 19.6km (225kph)
- Yarm – Eaglescliffe 4.1km (*)
- Eaglescliffe – Stockton 4.9km (*)
- Stockton – Hartlepool 18.7km (160kph)
- Hartlepool – Seaham 20.8km (160kph)
- Seaham – Sunderland 8.3km (160kph)

- Sunderland – Newcastle 19.6km (160kph)
- Northallerton – Darlington 22.9km (200kph)
- York – Darlington 71.0km (225/200kph)
- Darlington – Durham 35.5km (200kph)
- Durham – Newcastle 22.6km (200kph)
- Newcastle – Morpeth 26.7km (200kph)
- Morpeth – Alnmouth 29.3km (200kph)
- Alnmouth – Berwick 51.7km (200kph)
- Berwick – Dunbar 45.7km (200kph)
- Dunbar – Drem 18.2km (200kph)
- Drem – Edinborough Waverley 28.6km (200kph)

The line speeds are chosen as follows:

- All new HS6/HS10 infrastructure has a line speed of 300kph (except Pancras Cross / St. Pancras East – Stratford HS North, which aren't long enough to reach that speed, for which 225kph is chosen).
- All sections of the ECML classic routes from Peterborough to Northallerton are upgraded to a line speed of 225kph. The sections of GEML between Bambridge and Eky, Ely and Brandon Junction, and Ely and Peterborough are likewise upgraded to 225kph.
- The ECML between Doncaster and Wakefield Westgate, and above Northallerton, is upgraded as necessary to a line speed of 200kph. The sections of GEML between Roudham Heath Junction and Norwich, and Ely and King's Lynn, likewise the GE/GN route between Sleaford and Gainsborough, and also the route between Grantham and Skegness via Sleaford, are also upgraded to 200kph.
- 160kph is taken as the line speed everywhere else, when nothing higher seems reasonable; no respectable railway should ever be slower than this.
- Those sections marked (*) are between Adjacent Stations, where the distance is insufficient for the line speed to be reached. The times between stations are given below, for a regime of acceleration switching to deceleration without any intervening steady speed.

Acceleration/deceleration distances and times (taken from 'Same Speed Railways' appendix B) are:

- Acceleration from stationary to 300kphtakes 11.57km and 278 seconds
- Deceleration from 300kph to stationary takes 6.945km and 167 seconds
- Time to travel from Pancras Cross to Stratford HS North (start to stop) is 292 seconds
- Time to travel from St. Pancras East to Stratford HS North (start to stop) is 318 seconds
- Time to travel from Yarm to Eaglescliffe (start to stop) is 210 seconds
- Time to travel from Eaglescliffe to Stockton (start to stop) is 229 seconds

The procedure in calculating journey times between station stops is to take the two values of acceleration / deceleration distance, and the two times, as given in the first 2 lines of the above list, and sum them, thus acceleration / deceleration takes 11.57 + 6.95 = 18.52km and 278 + 167 = 445 seconds at line speed 300kph. The distance value is subtracted from the inter-station distance, and the remaining length is assumed to be travelled at line speed, taking time = distance / speed. This time is then added to the acceleration / deceleration time to obtain the actual journey time between the stations. This is all very laborious (error-prone, too!) to perform manually, so I have developed spreadsheets to do the work and

present the results. For those sections less than 18.5km in length, the time-calculating formula in the spreadsheet cell is replaced by the actual value, as given in the above list. The various section times are accumulated to obtain the overall journey times. One further refinement: a standard wait time of 3 minutes is assumed at stations, and this is added into the accumulated time at each stop.

We now proceed to the results.

1. Pancras Cross – Norwich / King's Lynn (4/7 stops):

Section	Distance (km)	Cumulative Distance (km)	Start - Stop Time (minutes)	Cumulative Journey Time (minutes)	Elapsed Time from London, inc. Station Wait Times
Pancras Cross - Stratford HS North	8.0	8.0	4.9	4.9	4.9
Stratford HS North - Stansted Airport	45.0	53.0	12.7	17.6	20.6
Stansted Airport - Cambridge	37.0	90.0	11.1	28.7	34.7
Cambridge - Ely	23.7	113.7	9.1	37.8	46.8
Ely - Brandon Junction	18.0	131.7	6.5	44.3	
Brandon Junction - Roudham Heath Junction	24.0	155.7	5.1	49.4	
Roudham Heath Junction - Norwich	40.0	195.7	12.9	62.4	74.4
Ely - Littleport	9.0	122.7	5.2	43.0	55.0
Littleport - Downham Market	16.3	139.0	7.4	50.3	65.3
Downham Market - Watlington	7.7	146.7	4.8	55.1	73.1
Watlington - King's Lynn	8.1	154.8	4.9	60.0	81.0

Current fastest time (minutes) from London [and the above values] to:

- Stansted Airport 45 [21]
- Cambridge 46 [35]
- Ely 67 [47]
- Norwich 110 [74]
- Littleport 74 [55]
- Downham Market 83 [65]
- Watlington 89 [73]
- King's Lynn 97 [81]

2. Pancras Cross – Hull Paragon / Skegness / Cleethorpes (9/10/11 stops):

Section	Distance (km)	Cumulative Distance (km)	Start - Stop Time (minutes)	Cumulative Journey Time (minutes)	Elapsed Time from London/Norwich, inc. Station Wait Times
Pancras Cross - Stratford HS North	8.0	8.0	4.9	4.9	4.9
Stratford HS North - Stansted Airport	45.0	53.0	12.7	17.6	20.6
Stansted Airport - Cambridge	37.0	90.0	11.1	28.7	34.7
Cambridge - Ely	23.7	113.7	9.1	37.8	46.8
Ely - Peterborough	72.8	186.5	22.2	60.0	72.0
Peterborough - Sleaford	52.0	238.5	14.1	74.1	89.1
Sleaford - Lincoln	34.1	272.6	12.7	86.8	104.8
Lincoln - Gainsborough Central	26.1	298.7	10.3	97.1	118.1
Gainsborough Central - Brigg	26.5	325.2	9.8	106.9	130.9
Brigg - Hull Paragon	25.0	350.2	8.7	115.6	142.6
Ely - March	48.8	162.5	15.8	53.6	65.6
March - Peterborough	24.0	186.5	9.2	62.7	77.7
Peterborough - Grantham	46.8	233.3	15.3	78.0	96.0
Grantham - Sleaford	24.5	257.8	9.8	87.8	108.8
Sleaford - Boston	27.1	284.9	10.6	98.4	122.4
Boston - Wainfleet	30.6	315.5	11.6	110.0	137.0
Wainfleet - Skegness	8.1	323.6	4.9	114.9	144.9
Grantham - Newark Northgate	23.6	256.9	9.1	87.1	108.1
Newark Northgate - Lincoln	26.6	283.5	10.4	97.5	121.5
Lincoln - Market Rasen	23.8	307.3	9.6	107.1	134.1
Market Rasen - Grimsby Town	46.8	354.1	16.5	123.6	153.6
Grimsby Town - Cleethorpes	5.2	359.3	3.9	127.5	160.5

Current fastest time (minutes) from London [and the above values] to:

- Stansted Airport 45 [21]
- Cambridge 46 [35]
- Ely 67 [47]
- March 85 (1 change) [66]
- Peterborough 45 [72]
- Sleaford 102 (1 change) [89]
- Lincoln 120 (1 change) [105]
- Gainsborough 112 (Lea Rd., 1 change) [118]
- Hull Paragon 146 [143]
- Grantham 60 [96]
- Sleaford 102 (1 change) [109 – via Grantham]
- Boston 126 (1 change) [122]
- Wainfleet 153 (1 change) [137]
- Skegness 166 (1 change) [145]
- Newark Northgate 73 [108]
- Lincoln 120 (1 change) [122 – via Newark]
- Market Rasen 136 (1 change) [134]
- Grimsby Town 165 (1 change) [154]
- Cleethorpes 181 (1 change) [161]

3. St. Pancras East – Leeds / Newcastle /Edinburgh (10/15/15 stops):

Section	Distance (km)	Cumulative Distance (km)	Start - Stop Time (minutes)	Cumulative Journey Time (minutes)	Elapsed Time from London/Norwich, inc. Station Wait Times
Pancras Cross - Stratford HS North	8.0	8.0	4.9	4.9	4.9
Stratford HS North - Stansted Airport	45.0	53.0	12.7	17.6	20.6
Stansted Airport - Cambridge	37.0	90.0	11.1	28.7	34.7
Cambridge - Ely	23.7	113.7	9.1	37.8	46.8
Ely - Peterborough	72.8	186.5	22.2	60.0	72.0
Peterborough - Grantham	46.8	233.3	15.3	75.2	90.2
Grantham - Newark Northgate	23.6	256.9	9.1	84.3	102.3
Newark Northgate - Retford HL	29.8	286.7	10.7	95.0	116.0
Retford HL - Doncaster	27.9	314.6	10.2	105.2	129.2

Doncaster - Wakefield Westgate	31.9	346.5	12.0	117.3	144.3
Wakefield Westgate - Leeds City	16.2	362.7	8.1	125.3	155.3
Peterborough - Doncaster	127.7	314.2	36.8	96.8	111.8
Doncaster - York	52.4	366.6	16.7	113.5	131.5
York - Thirsk	35.7	402.3	12.3	125.8	146.8
Thirsk - Northallerton	12.5	414.8	6.1	131.9	155.9
Northallerton - Yarm	19.6	434.4	8.0	139.9	166.9
Yarm - Eaglescliffe	4.1	438.5	3.5	143.4	173.4
Eaglescliffe - Stockton	4.9	443.4	4.0	147.4	180.4
Stockton - Hartlepool	18.7	462.1	9.0	156.4	192.4
Hartlepool - Seaham	20.8	482.9	9.8	166.2	205.2
Seaham - Sunderland	8.3	491.2	5.1	171.3	213.3
Sunderland - Newcastle	19.6	510.8	9.3	180.6	225.6
York - Northallerton	48.2	414.8	14.6	128.1	
Northallerton - Darlington	22.9	437.7	7.8	135.9	156.9
Darlington - Durham	35.5	473.2	13.1	149.0	173.0
Durham - Newcastle	22.6	495.8	9.2	158.3	185.3
Newcastle - Morpeth	26.7	522.5	10.5	168.8	198.8
Morpeth - Alnmouth	29.3	551.8	11.2	180.0	213.0
Alnmouth - Berwick	51.7	603.5	18.0	198.0	234.0
Berwick - Dunbar	45.7	649.2	16.2	214.1	253.1
Dunbar - Drem	18.2	667.4	7.9	222.1	264.1
Drem - Edinburgh Waverley	28.6	696.0	11.0	233.1	278.1

Current fastest time (minutes) from London [and the above values] to:

- Stansted Airport 45 [21]
- Cambridge 46 [35]
- Ely 67 [47]
- Peterborough 45 [72]
- Grantham 60 [90]
- Newark Northgate 73 [102]
- Retford 81 [116]
- Doncaster (stopping) [129]
- Wakefield Westgate 115 [144]
- Leeds City 131 [155]
- Doncaster non-stop from Peterborough 94 [112]
- York 110 [132]
- Thirsk 135 [147]
- Northallerton 144 [156]
- Yarm 174 (1 change) [167]
- Eaglescliffe 162 [173]
- Stockton 181 (2 changes) [180]
- Hartlepool 182 [192]
- Seaham 218 (1 change) [205]
- Sunderland 210 [213]
- Darlington (non-stop from York) 139 [157]
- Durham 177 [173]
- Newcastle 169 [185]
- Morpeth 206 [199]
- Alnmouth 219 [213]
- Berwick upon Tweed 217 [234]
- Dunbar 259 (1 change) [253]
- Drem 307 (1 change) [264]
- Edinburgh Waverley 257 [278]

HS6/HS10 Mk2 Enhancements

As a result of the preceding service plan developments, it has been realised that one and only one of the possible Mk2 enhancements is definitely worthwhile, and that is, in fact, the section of HS8 between Ely and Peterborough. That is the section most heavily loaded, for which extra capacity would be valuable. The previous analysis largely ignored the classic service loadings, and completely ignored the fact that this section also forms part of one of the most important freight routes, between Felixstowe and Nuneaton.

A further possible reinstatement is the section between Sleaford and Gainsborough, depending how freight develops, and enhancement between Gainsborough and Brigg, to raise the line speed.

Rerouting all the HS services except one over the new infrastructure also allows a useful time differential to be introduces between that one service not rerouted, [Brighton –>] Pancras Cross – Cleethorpes / Skegness, and the St. Pancras East – Leeds City service, which it otherwise immediately follows, and provides for more robust connections at Peterborough.

Service Plan 3

This is exactly the same as SP2 except that the only HS service now serving March is the. [Brighton –>] Pancras Cross – Skegness / Cleethorpes; all the other services between Ely and Peterborough take the new, direct route

The full service is:

- 2tphH [Southampton –>] Pancras Cross – Stratford HS North – Stansted Airport – Cambridge – Ely – Norwich
- 2tphH {Southampton –>] Pancras Cross – Stratford HS North – Stansted Airport – Cambridge – Ely – Peterborough HS – Sleaford – Lincoln – Gainsborough Central – Brigg – Hull Paragon.
- 2tphH [Portsmouth & Southsea –>] Pancras Cross – Stratford HS North – Stansted Airport – Cambridge – Ely – Littleport – Downham Market – Watlington –King's Lynn
- 2tphH [Chichester –>] Pancras Cross – Stratford HS North – Stansted Airport – Cambridge – Newmarket – Bury St. Edmunds – Ipswich – Harwich International – Harwich Town
- 2tphH Norwich – Ely (reverse) – Peterborough HS – Sleaford – Lincoln – Gainsborough Central – Brigg – Hull Paragon.
- 2tphH HS8/HS7/HS4 Norwich – Ely (reverse) – Peterborough HS – Nottingham – Derby – Birmingham Interchange – Worcester Shrub Hill – Cheltenham Spa – Bristol Parkway HS – Cardiff HS – Cardiff Airport – Port Talbot parkway – Swansea HS
- 2tphH HS8/HS3 Norwich – Ely (reverse) – Peterborough HS – Nottingham – Sheffield HS – Manchester HS – Manchester Victoria LL – Bolton – Preston
- 2tphH [Bognor / Littlehampton – Arundel –>] Pancras Cross – Stratford HS North – Stansted Airport – Cambridge – Ely – March – Peterborough – Grantham (splits / joins) – :
  – Newark – Lincoln – Market Rasen – Grimsby Town – Cleethorpes
  – Sleaford – Boston – Wainfleet – Skegness
- 2tphH St. Pancras (East) – Stratford HS North – Stansted Airport – Cambridge – Ely – Peterborough – Doncaster – York (splits / Joins) – :

– Darlington – Durham – Newcastle – Morpeth – Alnmouth – Berwick – Dunbar – Drem – Edinburgh Waverley
– Thirsk – Northallerton – Yarm – Eaglescliffe – Stockton – Hartlepool – Seaham – Sunderland - Newcastle

- 2tphH St. Pancras (East) – Stratford HS North – Stansted Airport – Cambridge – Ely – Peterborough – Grantham – Newark – Retford – Doncaster – Wakefield Westgate – Leeds City

Note that the [Bognor / Littlehampton –>] Pancras Cross – Skegness / Cleethorpes via March service runs directly into Peterborough (ECML) station, and that the St. Pancras (East) – Leeds City service joins the classic route at Stanground Junction, and also serves Peterborough (ECML) station, but the St. Pancras (East) – Edinburgh / Newcastle via Hartlepool service continues along HS8, serving Peterborough HS station, joining the ECML at Pellett Hall Junction.

Regional Metro:

- 2tphR Harwich Town – Harwich International – Ipswich – Bury St. Edmunds – Ely – March – Peterborough – Stamford – Oakham – Melton Mowbray – Leicester – Hinckley – Nuneaton – Coleshill Parkway – Birmingham New Street – University – Bromsgrove – Droitwich Spa – Worcester Shrub Hill
- 2tphR Morecambe – Lancaster – Preston – Leyland – Chorley – Horwich Parkway – Bolton – Salford Crescent – Manchester Oxford Rd. – Manchester Piccadilly – Stockport – Chinley – Sheffield Midland (reverse) – Chesterfield – Alfreton and Mansfield Parkway – Langley Mill – Nottingham – Melton Mowbray – Oakham – Stamford – Peterborough (ECML) – March – Ely (split/joins): – (reverse) Thetford – Wymondham – Norwich
  – Cambridge – Stansted Airport
- 2tphRS Cambridge – Chesterton – Waterbeach – Ely (splts / joins) –:
  – Shippea Hill – Lakenheath – Brandon – Thetford – Harling Road – Eccles Road – Attleborough – Spooner Row – Wymondham – Norwich
  – Manea – March – Whittlesea – Peterborough (ECML)

The cross-platform interchange pattern at Ely is exactly the same as at SP2, so is not repeated.

The following is the hourly **calling pattern** at Peterborough. These are not cross-platform, and do not provide a guaranteed interchange – even where meaningful.

00H	[Southampton –>] Pancras Cross – Hull	(HS platforms)
RS	Ipswich – Peterborough	(ECML platforms)
05H	Norwich – Preston	(HS platforms)
H	Bognor / Littlehampton – Cleethorpes / Skegness	(ECML platforms)
10H	Norwich – Swansea	
15H	Norwich – Hull	
R	Norwich / Stansted Airport – Morecambe	
20H	St. Pancras (East) – Leeds	
25H	St. Pancras (East) – Edinburgh / Newcastle	(HS platforms)
R	Harwich – Worcester	(ECML platforms)

– repeating at 30, 35, 40, 45, 50 and 55 minutes past.

The above pattern is derived from the pattern at Ely, (services **to** Peterborough only,) on the assumption that services travelling via March take 15 minutes longer, and the stopping service (with a further two stops) 25 minutes longer than the non-stop services (which now use the new route avoiding March).

Representative Hourly Non-Cross-Platform Interchange Pattern at Sleaford

00H [Southampton –>] Pancras Cross – Hull
(no connection)

15H Norwich – Hull
H [Littlehampton –>] Pancras Cross – Skegness

– repeating at 30 and 45 minutes past.

Representative Hourly Cross-Platform Interchange Pattern at Lincoln:

00H	[Southampton –>] Pancras Cross – Hull	(platform 4)
H	(HS7) Birmingham HS – Cleethorpes	(platform 5)
RS	Peterborough – Doncaster via Spalding	(platform 1 – arrives 55, departs 05)

15H Norwich – Hull
H (HS7) Birmingham HS – Skegness

23H [Bognor –>] Pancras Cross – Cleethorpes
(no connection)

– repeating at 30, 45 and 53 minutes past.

Service plan 2 overall imposes the following loadings on HS6 and HS10:

- Pancras Cross – Canley Street Junction 10tph
- Canley Street Junction – York Way Junction 10tph
- St. Pancras (East) – York Way Junction 4tph
- York Way Junction – Hitchcock Lane Junction 18tph
- Hitchcock Lane Junction – Cambridge 14tph
- Cambridge – Ely station 12tph
- Ely station – Ely HS North Junction 24tph
- Ely North Junction – King's Lynn 2tph
- Ely North Junction – Brandon Junction 8tph
- Brandon Junction – Roudham Heath Junction 8tph
- Roudham Heath Junction – Norwich 8tph
- Ely North Junction – Stanground Junction (direct) 12tph
- Stanground Junction – Peterborough HS 10tph
- Ely North Junction – Stanground Junction (via March) 2tph
- Stanground Junction – Peterborough (ECML) 4tph
- Peterborough HS – Pellett Hall Junction 10tph
- Pellett Hall Junction – Thurlby Junction 8tph
- Thurlby Junction – Sleaford South Junction 4tph
- Sleaford South Junction – Lincoln 4tph
- Lincoln – Warren Wood Junction 4tph
- Warren Wood Junction – Gainsborough HS Junction 4tph
- Gainsborough HS Junction – Brigg Junction 4tph
- Brigg Junction – Goxhill Junction 4tph
- Goxhill Junction – Hull Paragon 4tph

Estimated Journey Times

The only change in the estimated distances (between stations) is:

- Ely – Peterborough 45km (300kph)

There are no changes from Mk1A in the timings of services to Norwich and King's Lynn, and nor to Skegness / Cleethorpes. The new tables thus give the Hull and ECML services only.

2. Pancras Cross – Hull Paragon (9 stops):

Section	Distance (km)	Cumulative Distance (km)	Start - Stop Time (minutes)	Cumulative Journey Time (minutes)	Elapsed Time from London/Norwich, inc. Station Wait Times
Pancras Cross - Stratford HS North	8.0	8.0	4.9	4.9	4.9
Stratford HS North - Stansted Airport	45.0	53.0	12.7	17.6	20.6
Stansted Airport - Cambridge	37.0	90.0	11.1	28.7	34.7
Cambridge - Ely	23.7	113.7	9.1	37.8	46.8
Ely - Peterborough	45.0	158.7	12.7	50.5	62.5
Peterborough - Sleaford	52.0	210.7	14.1	64.6	79.6
Sleaford - Lincoln	34.1	244.8	10.5	75.1	93.1
Lincoln - Gainsborough Central	26.1	270.9	8.9	84.0	105.0
Gainsborough Central - Brigg	26.5	297.4	9.0	93.0	117.0
Brigg - Hull Paragon	25.0	322.4	10.6	103.6	130.6

Current fastest time (minutes) from London [and the above values] to:

- Stansted Airport 45 [21]
- Cambridge 46 [35]
- Ely 67 [47]
- Peterborough 45 [63]
- Sleaford 102 (1 change) [80]
- Lincoln 120 (1 change) [93]
- Gainsborough 112 (Lea Rd., 1 change) [105, Central]
- Hull Paragon 146 [131]

3. St. Pancras East – Leeds / Newcastle /Edinburgh (10/15/15 stops):

Section	Distance (km)	Cumulative Distance (km)	Start - Stop Time (minutes)	Cumulative Journey Time (minutes)	Elapsed Time from London/Norwich, inc. Station Wait Times
Pancras Cross - Stratford HS North	8.0	8.0	4.9	4.9	4.9
Stratford HS North - Stansted Airport	45.0	53.0	12.7	17.6	20.6
Stansted Airport - Cambridge	37.0	90.0	11.1	28.7	34.7
Cambridge - Ely	23.7	113.7	9.1	37.8	46.8
Ely - Peterborough	45.0	158.7	12.7	50.5	62.5
Peterborough - Grantham	46.8	205.5	15.3	65.8	80.8
Grantham - Newark Northgate	23.6	229.1	9.1	74.8	92.8
Newark Northgate - Retford HL	29.8	258.9	10.7	85.5	106.5
Retford HL - Doncaster	27.9	286.8	10.2	95.8	119.8
Doncaster - Wakefield Westgate	31.9	318.7	12.0	107.8	134.8
Wakefield Westgate - Leeds City	16.2	334.9	8.1	115.8	145.8
Peterborough - Doncaster	127.7	286.4	36.8	87.3	102.3
Doncaster - York	52.4	338.8	16.7	104.1	122.1
York - Thirsk	35.7	374.5	12.3	116.4	137.4
Thirsk - Northallerton	12.5	387.0	6.1	122.5	146.5
Northallerton - Yarm	19.6	406.6	8.0	130.5	157.5
Yarm - Eaglescliffe	4.1	410.7	3.5	134.0	164.0
Eaglescliffe - Stockton	4.9	415.6	4.0	138.0	171.0
Stockton - Hartlepool	18.7	434.3	9.0	146.9	182.9
Hartlepool - Seaham	20.8	455.1	9.8	156.7	195.7
Seaham - Sunderland	8.3	463.4	5.1	161.8	203.8
Sunderland - Newcastle	19.6	483.0	9.3	171.1	216.1
York -	48.2	387.0	14.6	118.7	

Northallerton					
Northallerton - Darlington	22.9	409.9	7.8	126.5	147.5
Darlington - Durham	35.5	445.4	13.1	139.6	163.6
Durham - Newcastle	22.6	468.0	9.2	148.8	175.8
Newcastle - Morpeth	26.7	494.7	10.5	159.3	189.3
Morpeth - Alnmouth	29.3	524.0	11.2	170.5	203.5
Alnmouth - Berwick	51.7	575.7	18.0	188.5	224.5
Berwick - Dunbar	45.7	621.4	16.2	204.7	243.7
Dunbar - Drem	18.2	639.6	7.9	212.6	254.6
Drem - Edinburgh Waverley	28.6	668.2	11.0	223.6	268.6

Current fastest time (minutes) from London [and the above values] to:

- Stansted Airport 45 [21]
- Cambridge 46 [35]
- Ely 67 [47]
- Peterborough 45 [63]
- Grantham 60 [81]
- Newark Northgate 73 [93]
- Retford 81 [102]
- Doncaster (stopping) [120]
- Wakefield Westgate 115 [135]
- Leeds City 131 [146]
- Doncaster non-stop from Peterborough 94 [102]
- York 110 [122]
- Thirsk 135 [137]
- Northallerton 144 [147]
- Yarm 174 (1 change) [158]
- Eaglescliffe 162 [164]
- Stockton 181 (2 changes) [171]
- Hartlepool 182 [183]
- Seaham 218 (1 change) [196]
- Sunderland 210 [204]
- Darlington (non-stop from York) 139 [148]
- Durham 177 [164]
- Newcastle 169 [176]

- Morpeth 206 [189]
- Alnmouth 219 [204]
- Berwick upon Tweed 217 [225]
- Dunbar 259 (1 change) [244]
- Drem 307 (1 change) [255]
- Edinburgh Waverley 257 [269]

Appendix A – Pancras Cross and the Inter-Regional Connections

General

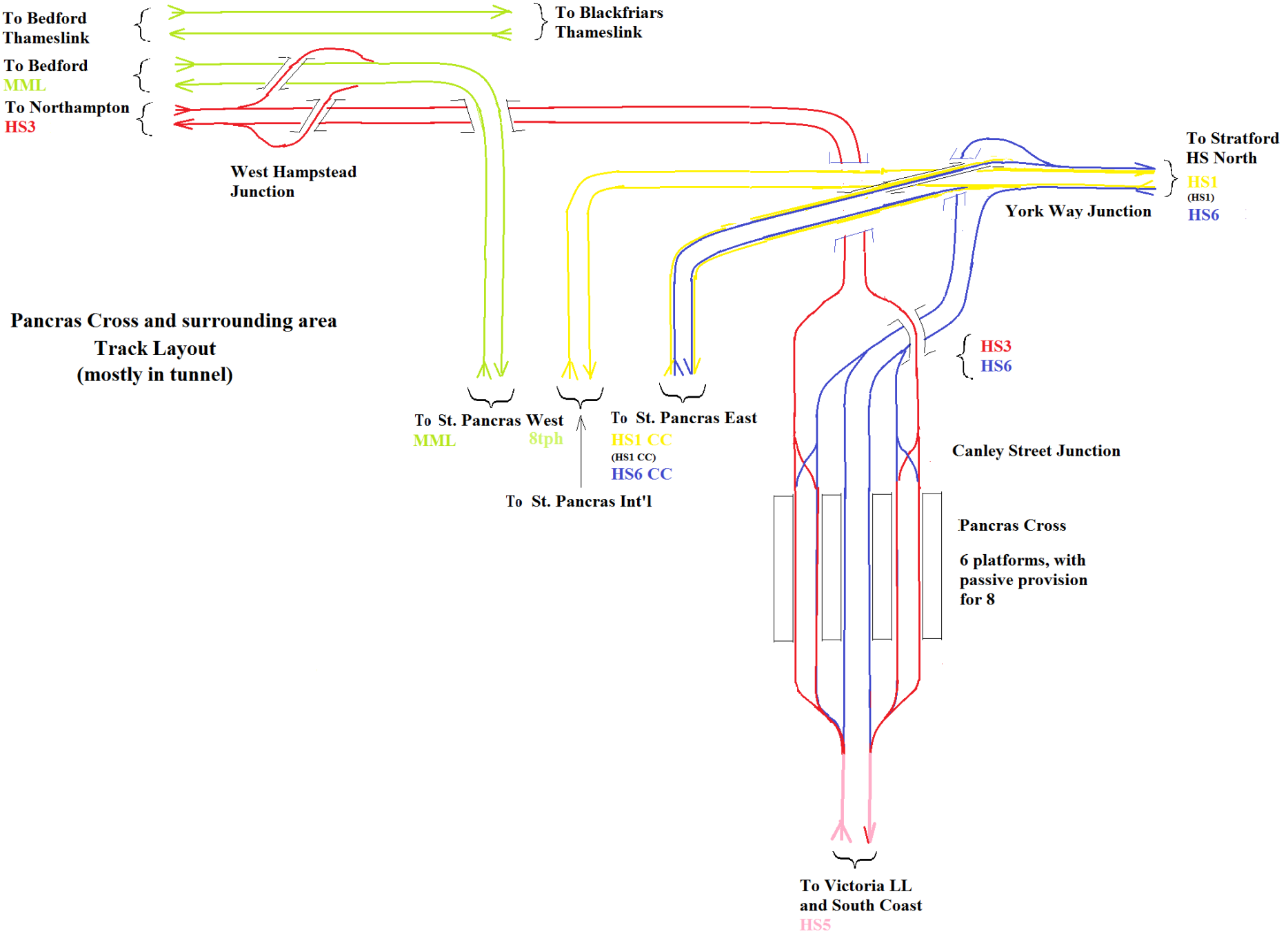
By routing the HS-C services of HS3 into St. Pancras West (the MML platforms), and of HS6 into St. Pancras East (the 'Javelin' platforms), and all the UHS and HS Metro services of both routes through Pancras Cross and on to HS5, superlative cross-London inter-regional HS services are enabled, between Scotland, the North East, Yorkshire and the East Midlands (HS3), likewise West Anglia and Lincolnshire (HS6/HS10), and Sussex, West Kent and Hampshire. Given the service loadings of the London end of HS3 and of HS6/HS10, balancing exactly those of HS5, a single tunnel in each direction and 6 platform faces, (passive provision for 8,) would suffice. That a single Pancras Cross station, with a single pair of approach tunnels, would serve two HS inter-regional routes should seriously enhance its business case.

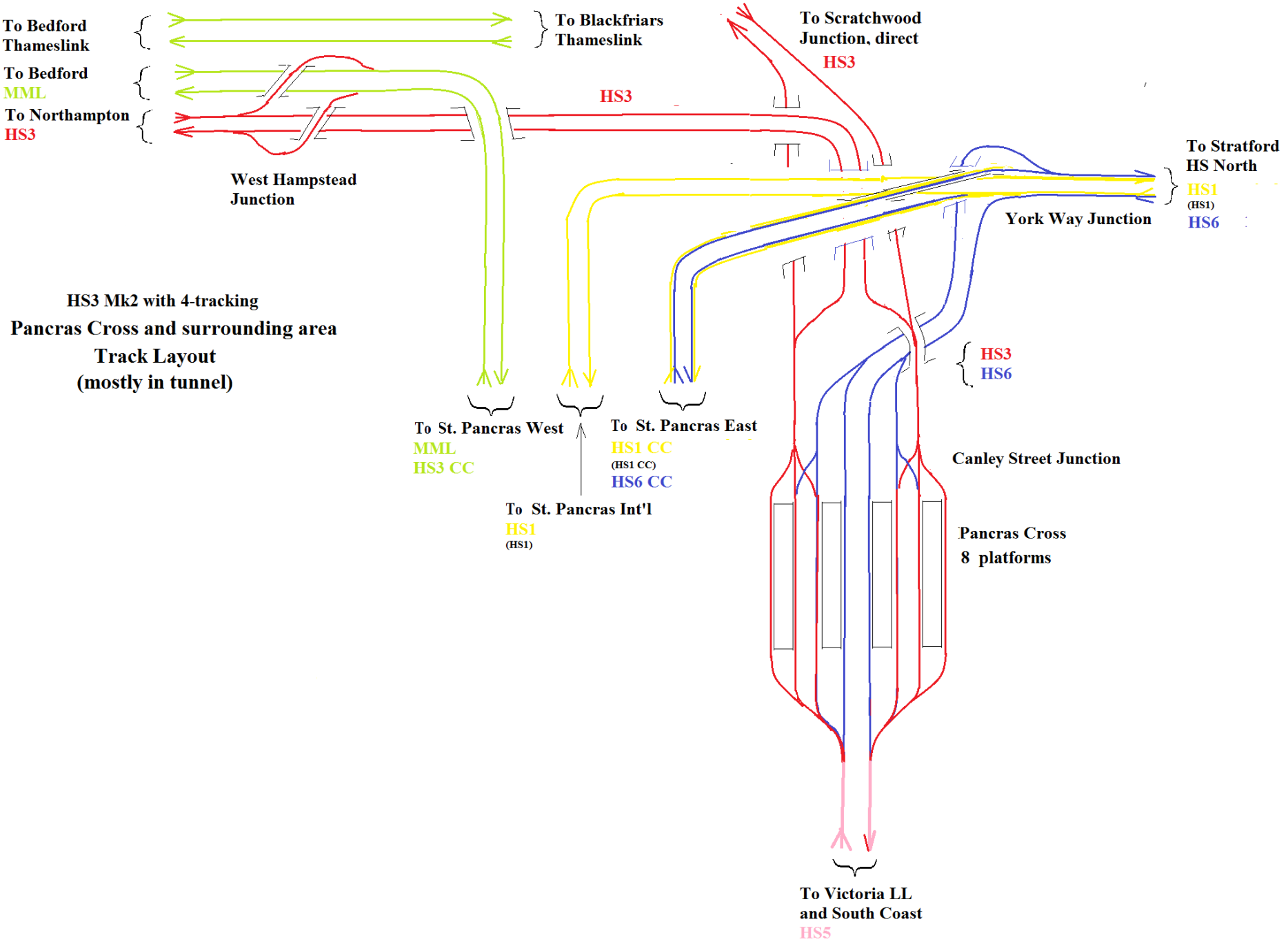
The track diagram of Pancras Cross and its surroundings is on the next two pages. The layout is not especially complicated, but there are a few points to note. The second version, for HS3 Mk2 with 4-tracking, is extra futuristic and speculative.

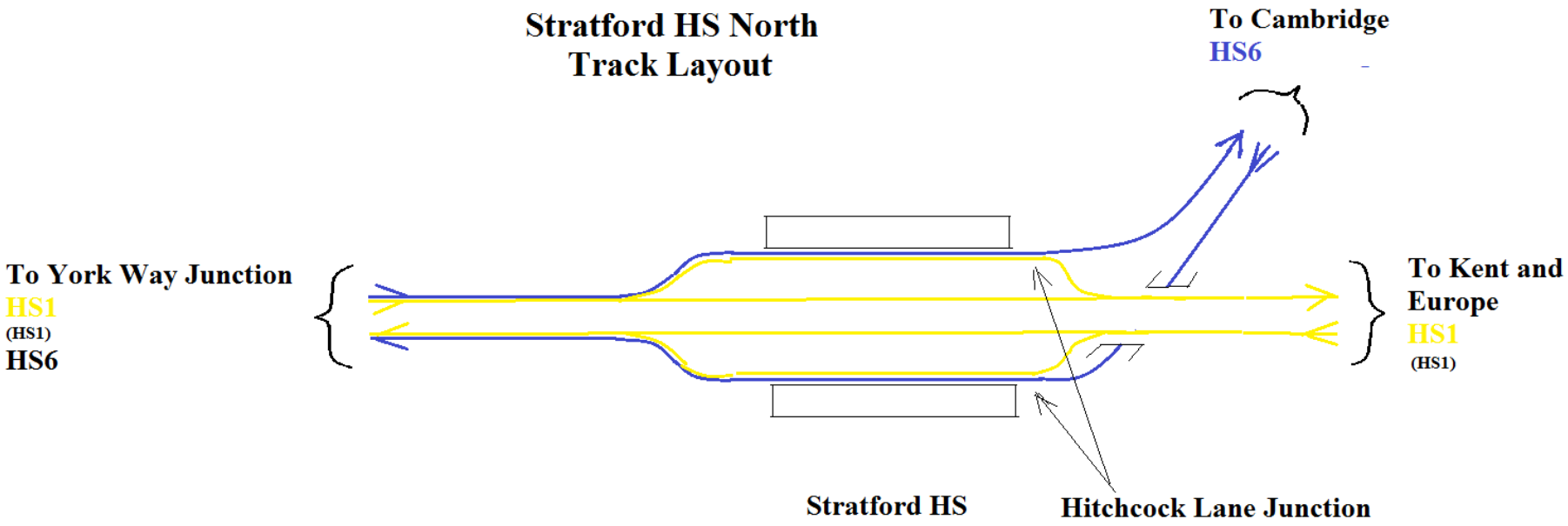
The middle two platform faces at Pancras Cross would ordinarily be used by HS6 trains and the two outer pairs by HS3. The scissors crossovers are provided for operational flexibility, but should not normally be used. I would like to see **passive** provision for 8 platforms, as is indicated in the diagram.

HS6's HS Metro services from Pancras Cross, and its HS-C services from St. Pancras East, all join HS1's route from St. Pancras International, at York Way Junction. They then all share the same tracks as far as Stratford HS North station (formerly Stratford International, which it never was). The track diagram for Stratford HS North is deliberately simplified, omitting the extra through tracks and the connection to Temple Mills. The station exists already, and has a single platformed track in each direction (a rather inadequate provision; it may well prove necessary to add extra platform faces on the outside). This is served by all HS6/HS10 services. HS1's international services pass through the centre, as they always have. (HS1's inter-regional services join HS1 later, from Euston Cross at Woodgrange Road Junction.) HS6 diverges from HS1 at Hitchcock Lane Junction, immediately east of the station, without rejoining the main lines of HS1.

Since (most of) the above was written, the Mk2 version of HS3's route has been developed. The first track diagram of Pancras Cross still accurately depicts HS3 Mk2 in its initial state, before 4-tracking. The second track diagram shows the enhanced provision after 4-tracking. It is assumed that by then (c.2060, perhaps), automatic train control will enable 24tph and more in each direction over the 2-track section south of Pancras Cross (all the way to East Croydon, in fact).

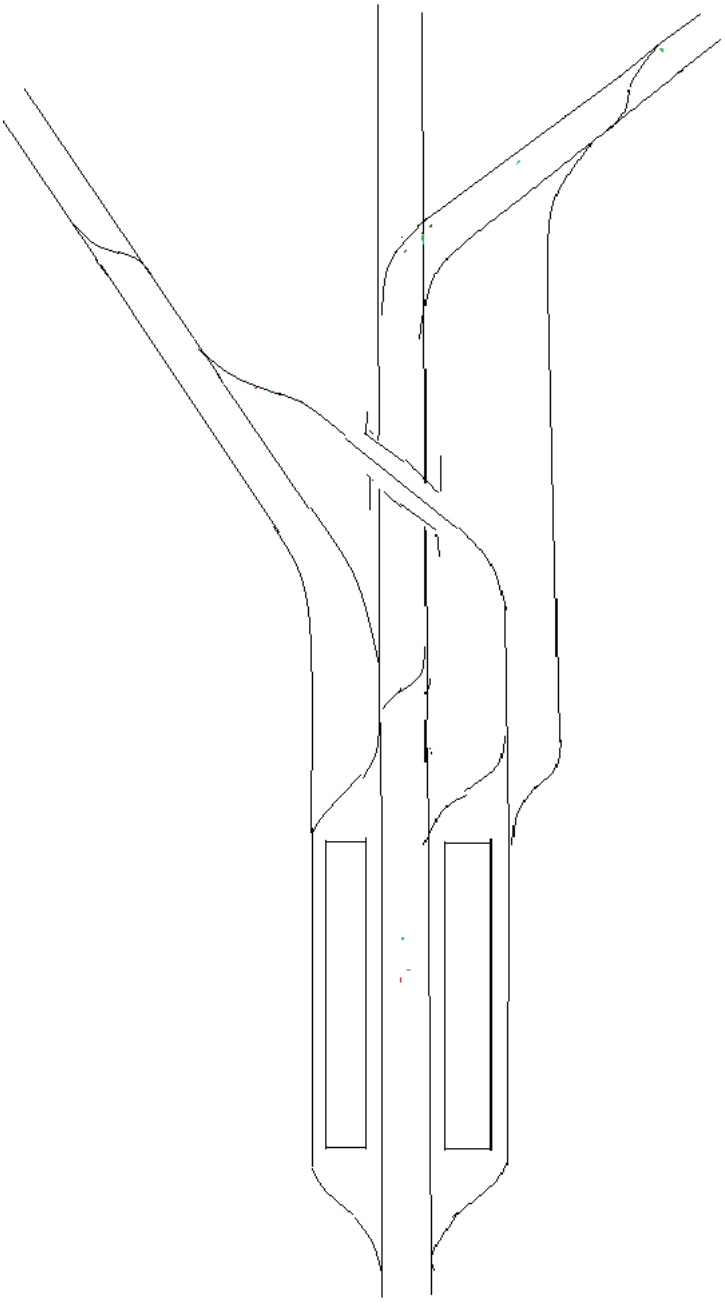

To Bedford
Thameslink
To Blackfriars
Thameslink
To Bedford
MML
To Northampton
HS3
West Hampstead
Junction
To Stratford
HS North
HS1
(HS1)
HS6
York Way Junction
Pancras Cross and surrounding area
Track Layout
(mostly in tunnel)
HS3
HS6
To St. Pancras West
MML
8tph
To St. Pancras East
HS1 CC
(HS1 CC)
HS6 CC
To St. Pancras Int'l
Canley Street Junction
Pancras Cross
6 platforms, with
passive provision
for 8
To Victoria LL
and South Coast
HS5


To Bedford
Thameslink
To Bedford
MML
To Northampton
HS3
To Blackfriars
Thameslink
To Scratchwood
Junction, direct
HS3
HS3
West Hampstead
Junction
To Stratford
HS North
HS1
(HS1)
HS6
York Way Junction
HS3 Mk2 with 4-tracking
Pancras Cross and surrounding area
Track Layout
(mostly in tunnel)
HS3
HS6
To St. Pancras West
MML
HS3 CC
To St. Pancras East
HS1 CC
(HS1 CC)
HS6 CC
Canley Street Junction
To St. Pancras Int'l
HS1
(HS1)
Pancras Cross
8 platforms
To Victoria LL
and South Coast
HS5


Stratford HS North
Track Layout
To Cambridge
HS6
To York Way Junction
HS1
(HS1)
HS6
To Kent and
Europe
HS1
(HS1)
Stratford HS
Hitchcock Lane Junction

Appendix B – Ely Track Layout and Interchange Schematics

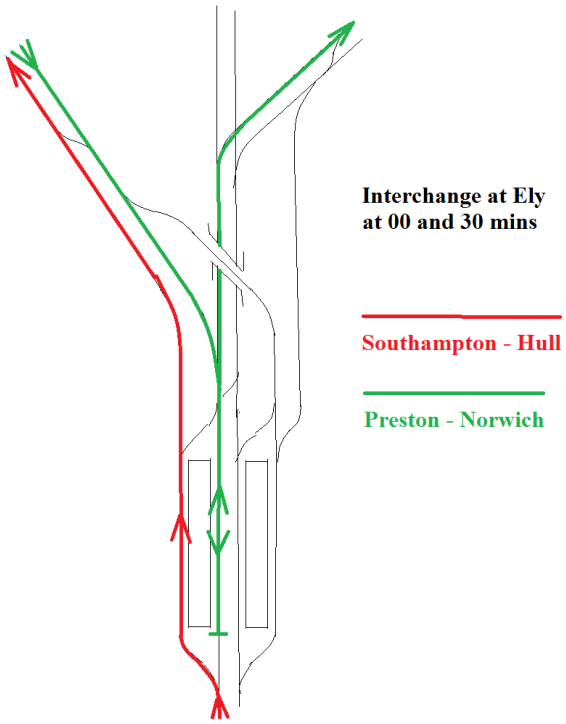
The track layout at Ely has to accommodate a very complicated traffic pattern. All the Norwich services except one – Norwich – Pancras Cross [–> Southampton] – reverse at Ely, and all these (reversing) services have to provide a cross-platform connection there. The following is a simplified exposition of the interchange pattern, illustrated using a simplified track layout:

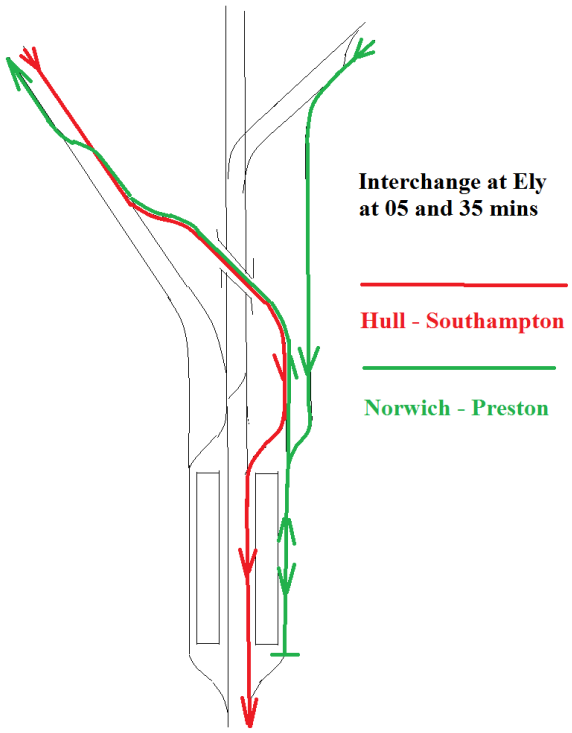


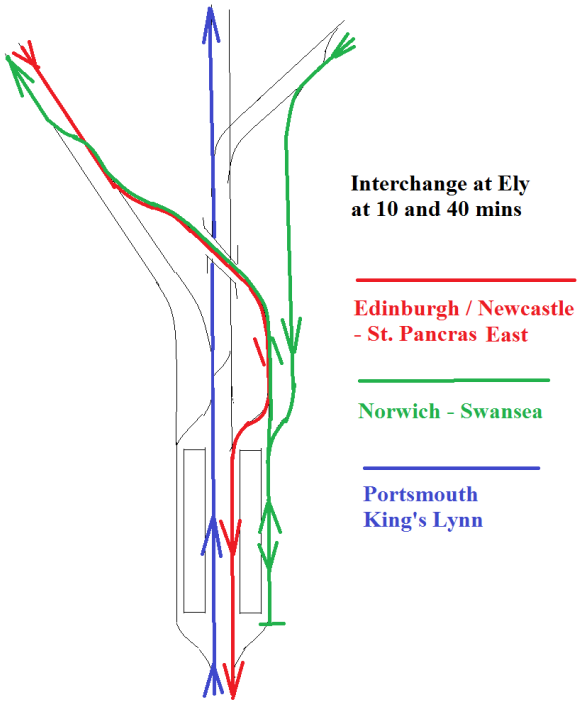
The schematics following indicate the calling pattern at 5 minute intervals. Only the HS services are shown. One service, coloured red, is the through service, with which the reversing service, coloured green, makes a cross-platform connection. In most (4 out of 6) cases, a third service is also present, coloured indigo, which does not make a cross-platform connection with another HS service, but will, in the complete specification, with a regional metro semi-fast or stopping service.

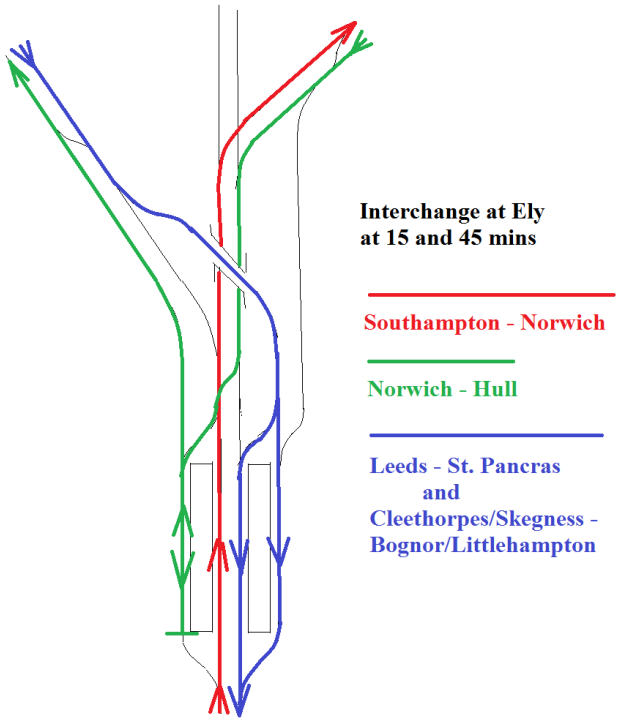
Note that only a single flyover is required, to ensure that there are no conflicting movements. The individual services are identified alongside the schematic, and the direction(s) of travel clearly indicated. Where services appear to cross one another, or run in opposite directions along the same section of track, one is always arriving and the other departing, so they are never in the same place at the same time.

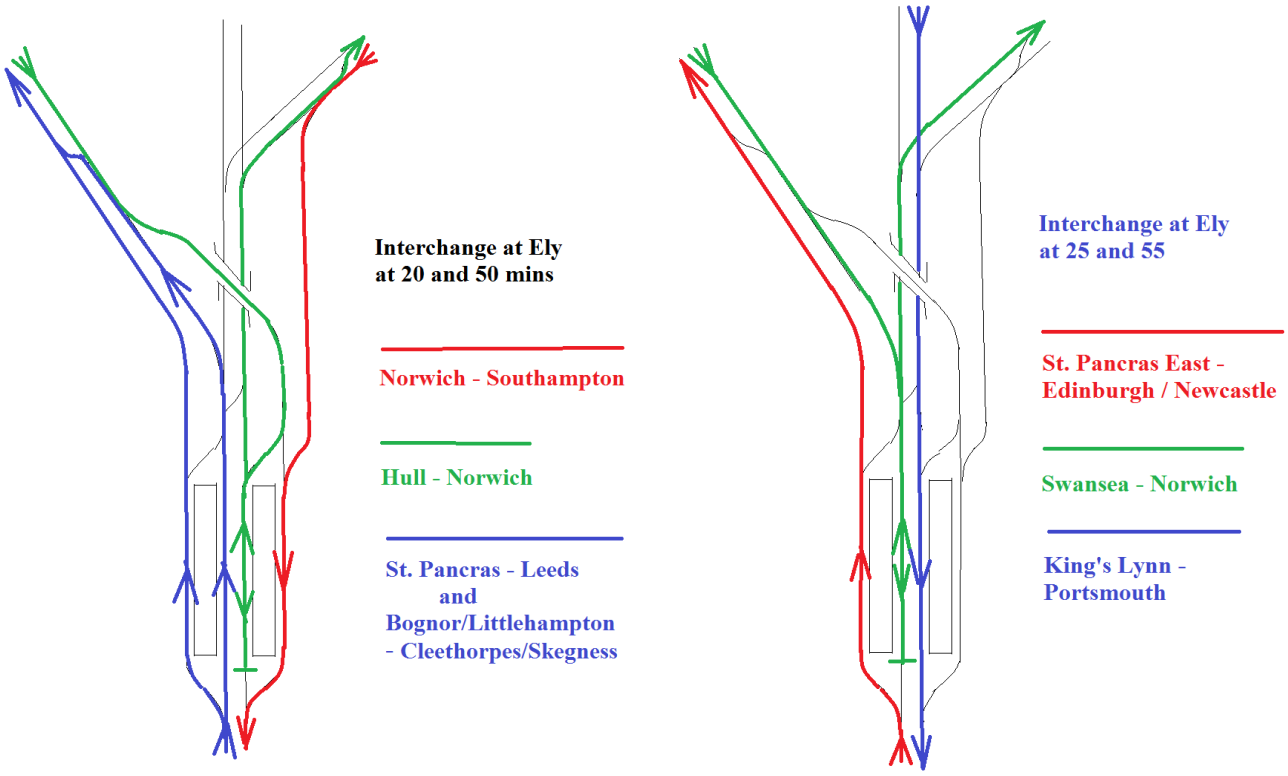
One effect needs clarifying. The services St. Pancras (East) – Leeds and Bognor / Littlehampton – Cleethorpes / Skegness, run in sequence on the same track, at the minimum time separation. They serve the same stations between Stratford HS North and Grantham, except that the latter serves March, and the former doesn't. They occupy adjacent platforms at Ely, and change order there, thus, Bognor / Littlehampton – Cleethorpes / Skegness arrives at Ely immediately before the following St. Pancras – Leeds, but departs immediately after it, since it serves March. The arrival / departure order is the same southbound.


Interchange at Ely
at 00 and 30 mins
Southampton - Hull
Preston - Norwich


Interchange at Ely
at 05 and 35 mins
Hull - Southampton
Norwich - Preston


Interchange at Ely
at 10 and 40 mins
Edinburgh / Newcastle
- St. Pancras East
Norwich - Swansea
Portsmouth
King's Lynn


Interchange at Ely
at 15 and 45 mins
Southampton - Norwich
Norwich - Hull
Leeds - St. Pancras
and
Cleethorpes/Skegness -
Bognor/Littlehampton

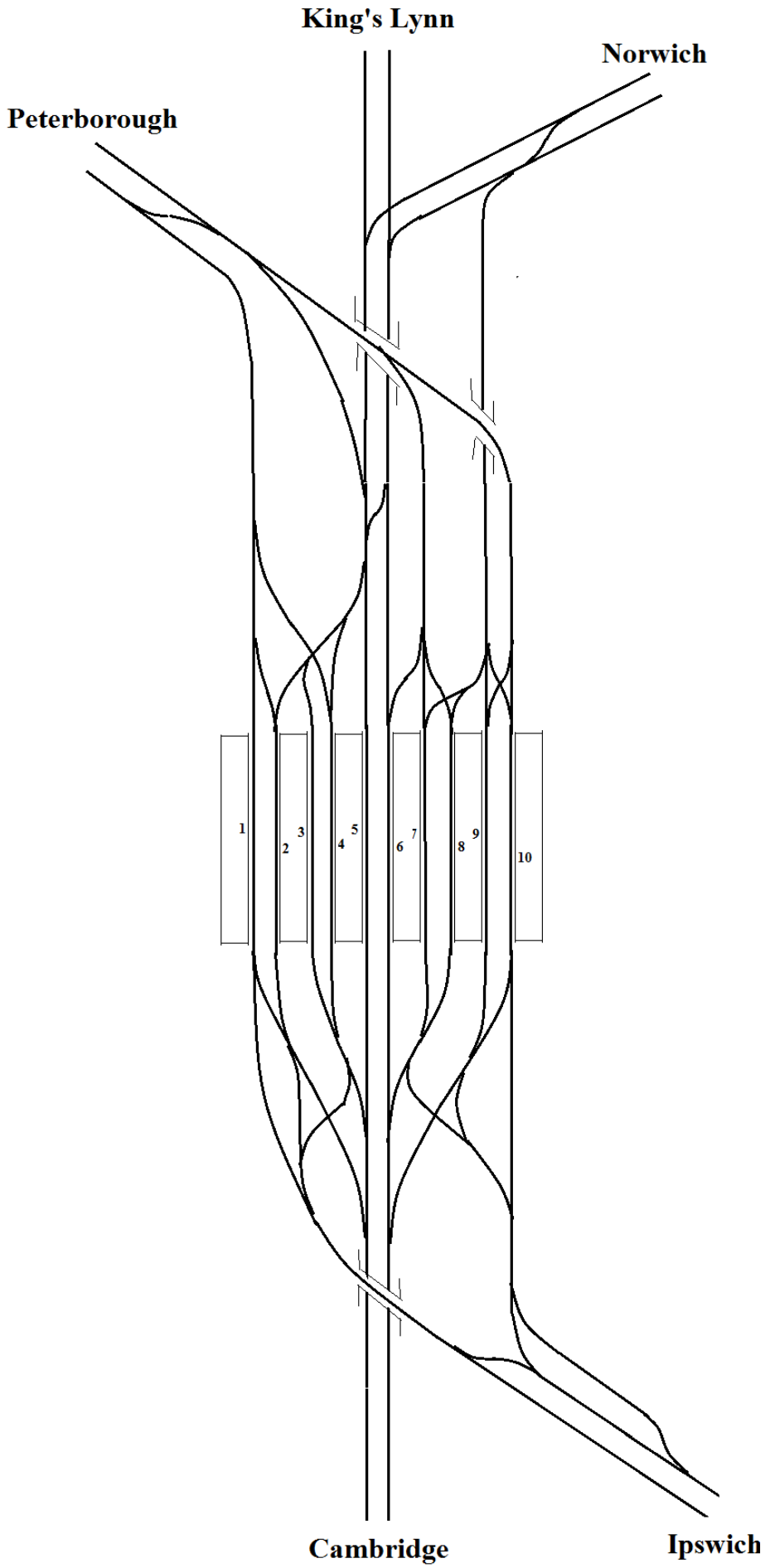


The regional metro services always arrive before the HS ones and depart after, naturally, since in most cases they use the same track as a following HS service on arrival / preceding HS service on departure.

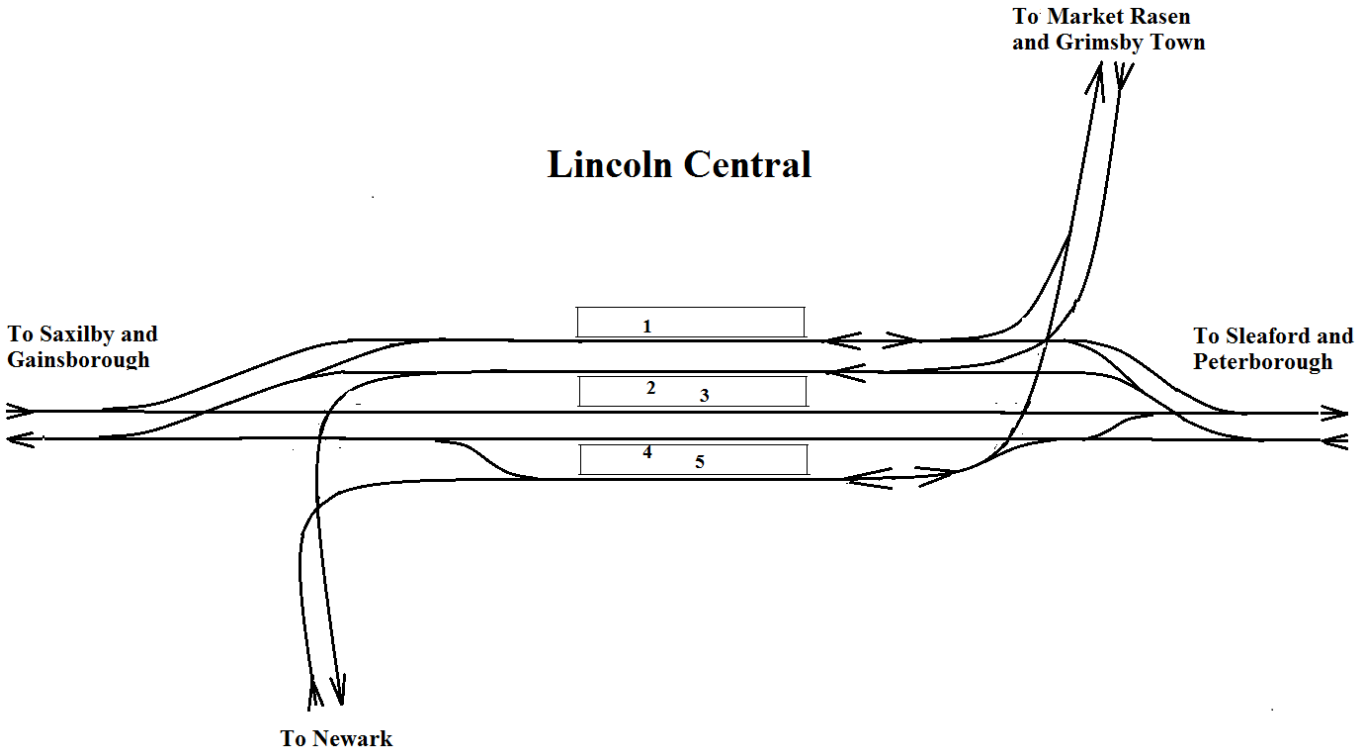
The above exposition is purely illustrative, to demonstrate that it is possible to run such a complicated service with such a simple layout. In practice, the service intensity is such that it would be impossible to operate with so few platforms, even if operation were completely automatic: 5 minutes is just too short to process each set of trains calling.

The real layout, which follows, has, accordingly, twice as many platforms (plus an extra two on the outsides, thus 10 in total; the outside lines are normally used mainly by freight trains). The island platforms are used in alternating pairs, which ensures that each set of trains calling has up to 10 minutes available to clear. The actual platform usage is specified in Service Plan 2A, (same at SP3,) where the complete interchange pattern, HS and RM, in both directions, is specified.

The simplified exposition, above, is readily extended to the full service pattern. For irreconcilables, unprepared to accept such an assurance, the full schematics are expounded in appendix G, which is published as a separate document, since this stuff will be of no interest to most readers.


King's Lynn
Norwich
Peterborough
1
2
3
4
5
6
7
8
9
10
Cambridge
Ipswich

Appendix C – Lincoln Central Track Layout



This looks more complicated than it is. All the junctions are flat junctions – no need for flyovers. The services with cross-platform interchange at Lincoln approach and depart in opposite directions, thus the HS10 services to Hull approach platform 4 from the east and the HS7 services to Cleethorpes and Skegness approach platform 5 from the west, and vice versa at platforms 3 and 2 respectively. They therefore never get in each other's way. Clearly, **both** interchanges cannot take place **simultaneously**, or there **would** be conflicting movements.

There will certainly be several other crossovers, for operational convenience. The above shows only those required to support the contraflow arrangement.

Appendix D – Distance Table for East Anglia and Lincolnshire

Distance Table for East Anglia and Lincolnshire		
St. Pancras East to:		km
Stratford HS North		9.5
Cambridge to:	miles:chains	km
Ely	14:58	23.7
Norwich	68:37	110.2
Littleport	20:28	32.7
Downham Market	30:36	49.0
Watlington	35:18	56.7
King's Lynn	41:23	64.8
March	30:24	48.8
Peterborough	45:18	72.8
Peterborough to:	miles:chains	km
Grantham	29:09	46.8
Sleaford	44:24	71.3
Boston	61:11	98.4
Wainfleet	80:14	129.0
Skegness	85:18	137.1
Newark Northgate	43:59	70.4
Lincoln	60:21	97.0
Market Rasen	75:03	120.7
Grimsby Town	104:10	167.5
Cleethorpes	107:30	172.8
Sleaford to:	miles:chains	km
Lincoln	21:14	34.1
Gainsborough Lea Rd.	36:62	59.2
Gainsborough Central to:	miles:chains	km
Brigg	16:39	26.5

The source of the above data is ‘Track Atlas of Mainland Britain’ (TRACKmaps 2009). The values are given in miles and chains (80 chains = 1 mile), except for the HS1 distances, which are given in km. I’ve encountered considerably worse problems, deriving these distances for other routes. Even so, the section between Peterborough and Skegness involved three changes of datum, in two cases involving abrupt changes of mileage, reflecting sections of route that no longer exist. No-one seems ever to have considered it worthwhile to change the mileage posts – they all still reflect the original routes as built, whatever has happened in the interim. So it was still a sufficiently tedious process to make it worth preserving the results, so that I don’t ever have to do it again.

Appendix E – Distance Table for ECML

Distance Table for ECML		
King's Cross to:	miles:chains	km
Peterborough	76:47	123.2
Grantham	105:38	169.7
Newark Northgate	120:08	193.2
Retford HL	138:49	223.0
Doncaster	155:77	250.9
Wakefield Westgate	175:65	282.9
Leeds City	185:70	299.1
York	188:40	303.3
York to:	miles:chains	km
Thirsk	22:16	35.7
Northallerton	29:76	48.2
Yarm	42:10	67.8
Eaglescliffe	44:55	71.9
Stockton	47:59	76.8
Hartlepool	59:30	95.5
Seaham	72:24	116.3
Sunderland	77:35	124.6
Newcastle via Hartlepool	89:48	144.2
Darlington	44:10	71.0
Durham	66:13	106.5
Newcastle direct	80:16	129.0
Newcastle to:	miles:chains	km
Morpeth	16:50	26.7
Alnmouth	34:69	56.1
Berwick upon Tweed	67:00	107.8
Dunbar	95:32	153.5
Drem	106:57	106.7
Edinburgh Waverley	124:37	200.3

Apart from the section from Northallerton to Newcastle via Hartlepool, the above distances were trivially easy to derive, from data at King’s Cross, York and Newcastle (though the section above Berwick is measured from Edinburgh).

Appendix F – Changes at Mk1A and Mk2

The changes of route at Mk1A, from Mk1, are as follows:

- HS6 merges with the classic GE route between Cambridge and Ely
- – also between Ely and King's Lynn
- – also between Ely and Brandon Junction
- – also between Roudham Heath Junction and Norwich

(New infrastructure is retained between the new junctions at Brandon and Roudham Heath, for the Thetford avoiding line.)

- HS8 merges with the classic GE route between Ely and Peterborough (Midland side). There is a connection with the classic route north of Peterborough, at Pellett Hall Junction.
- The various HS junctions at Ely are cancelled, as is the line avoiding Ely station, between HS North and East Junctions. All services to and from HS8 now call at Ely, with reversal as necessary.
- HS10 merges with the classic GE/GN Joint route between (the existing) Sleaford South Junction and Lincoln station.
- It now includes the loop through Sleaford station, as well as the avoiding line; normal scheduled services will now call additionally at Sleaford.
- The layout at Lincoln is rationalised, no longer requiring flyovers.
- HS10 continues merged with the classic route between Lincoln and Warren Wood Junction, shortly before Gainsborough Lea Rd. station.
- A short length of new infrastructure links between Warren Wood Junction and the (already proposed at Mk1) Gainsborough HS Juncxtion.
- HS10 takes over the classic GC route (since virtually nothing else uses it) between Gainsborough Central and Brigg Junction. Thereafter the Mk1 layout continues.

At Mk2, the new infrastructure as at Mk1 between Ely and Peterborough is reinstated. This will have serious capacity benefits. As of now, probably none of the other Mk1 proposals omitted at Mk1A will prove justified. The only possible exception foreseen is the GE/GN Joint line, which may justify extra capacity if freight loadings increase significantly. (The maps show the new infrastructure between Sleaford and Brigg – just enhancement to the classic infrastructure between Gainsborough and Brigg, to raise the line speed.) The Lincoln avoiding line is reinstated, primarily for freight.

Appendix Q – Journey Times for Line Speed 225kph, 140mph

The article ‘Line Capacity vs. Speed for High Speed Railways’ points out (in the section ‘Consequences of the Results’) that a good case can be made for a line speed of 225kph, 140mph, because this offers a good compromise between speed and line capacity (theoretical capacity 49tph at 225kph with basic Train Separation Distance as compared with 29tph at 360kph with extended TSD). Even more important is the fact that this is just within the current (as at 2014) Turnout Limit Speed of 230kph, 144mph. This is the maximum speed at which trains can diverge from the main line of a HS railway, using the fastest available pointwork. What this means is that diverging trains can leave the main line at full line speed; there is no need to decelerate on the main line before diverging. This means that the Extended Train Separation Distance standard, which allows diverging trains to decelerate on the main line, without affecting a following straight-ahead train, which continues at full line speed, is no longer necessary, which allows major simplification in the operation of HS railways. (Note that these preceding remarks apply only to routes where **overtaking** takes place – specifically to HS2, HS3, HS4 and HS14. They do not apply to routes with an HS-Metro service pattern. But the journey times for line speed 225kph is of interest for all routes.)

This new appendix Q is being added to every Route and Service Plans article, to show what the effect would be for the journey times of the various services. No recommendation is actually being made for this change, but it is important that the supporting information be available to allow a reasoned decision to be made.

1. Pancras Cross – Norwich / King's Lynn (4/7 stops):

Section	Distance (km)	Cumulative Distance (km)	Start - Stop Time (minutes)	Cumulative Journey Time (minutes)	Elapsed Time from London, inc. Station Wait Times
Pancras Cross - Stratford HS North	8.0	8.0	4.9	4.9	4.9
Stratford HS North - Stansted Airport	45.0	53.0	14.8	19.6	22.6
Stansted Airport - Cambridge	37.0	90.0	12.6	32.3	38.3
Cambridge - Ely	23.7	113.7	9.1	41.4	50.4
Ely - Brandon Junction	18.0	131.7	6.5	47.9	
Brandon Junction - Roudham Heath Junction	24.0	155.7	6.6	54.6	
Roudham Heath Junction - Norwich	40.0	195.7	12.9	67.5	79.5
Ely - Littleport	9.0	122.7	5.2	46.6	58.6
Littleport - Downham Market	16.3	139.0	7.4	53.9	68.9
Downham Market - Watlington	7.7	146.7	4.8	58.7	76.7
Watlington - King's Lynn	8.1	154.8	4.9	63.6	84.6

Current fastest time (minutes) from London [and the Mk2 times] [and the above values] to:

- Stansted Airport 45 [21] {23}
- Cambridge 46 [35] {38}
- Ely 67 [47] {50}
- Norwich 110 [74] {80}
- Littleport 74 [55] {59}
- Downham Market 83 [65] {69}
- Watlington 89 [73] {77}
- King's Lynn 97 [81] {85}

2. Pancras Cross – Hull Paragon / Skegness / Cleethorpes (9/10/11 stops):

Section	Distance (km)	Cumulative Distance (km)	Start - Stop Time (minutes)	Cumulative Journey Time (minutes)	Elapsed Time from London/Norwich, inc. Station Wait Times
Pancras Cross - Stratford HS North	8.0	8.0	4.9	4.9	4.9
Stratford HS North - Stansted Airport	45.0	53.0	14.8	19.6	22.6
Stansted Airport - Cambridge	37.0	90.0	12.6	32.3	38.3
Cambridge - Ely	23.7	113.7	9.1	41.4	50.4
Ely - Peterborough	45.0	158.7	14.8	56.2	68.2
Peterborough - Sleaford	52.0	210.7	16.6	72.8	87.8
Sleaford - Lincoln	34.1	244.8	11.9	84.7	102.7
Lincoln - Gainsborough Central	26.1	270.9	9.7	94.4	115.4
Gainsborough Central - Brigg	26.5	297.4	9.8	104.3	128.3
Brigg - Hull Paragon	25.0	322.4	9.4	113.7	140.7
Ely - March	48.8	162.5	15.8	57.2	69.2
March - Peterborough	24.0	186.5	9.2	66.4	81.4
Peterborough - Grantham	46.8	233.3	15.3	81.6	99.6
Grantham - Sleaford	24.5	257.8	9.8	91.4	112.4
Sleaford - Boston	27.1	284.9	10.6	102.0	126.0
Boston - Wainfleet	30.6	315.5	11.6	113.7	140.7
Wainfleet - Skegness	8.1	323.6	4.9	118.6	148.6
Grantham - Newark Northgate	23.6	256.9	9.1	90.7	111.7
Newark Northgate - Lincoln	26.6	283.5	10.4	101.1	125.1
Lincoln - Market Rasen	23.8	307.3	9.6	110.7	137.7
Market Rasen - Grimsby Town	46.8	354.1	16.5	127.3	157.3
Grimsby Town - Cleethorpes	5.2	359.3	3.9	131.2	164.2

Current fastest time (minutes) from London [and the Mk2 times] {and the above values] to:

- Stansted Airport 45 [21] {23}
- Cambridge 46 [35] {38}
- Ely 67 [47] {50}
- Peterborough 45 [63] {68}
- Sleaford 102 (1 change) [80] {88}
- Lincoln 120 (1 change) [93] {103}
- Gainsborough 112 (Lea Rd., 1 change) [105, Central] {115}
- Hull Paragon 146 [131] {141}