

HS1 Route and Service Plans

HS1 Route 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.)

The only changes as far as HS1 is concerned are that the extensions to Dover and Hastings no longer require new infrastructure, and that the extension to Maidstone is built to UK loading gauge. The Hastings services are extended through to Eastbourne, replacing the former classic-compatible service, which is no longer required, given that all trains are now, in effect, classic-compatible.

Because of the significant changes introduced at Mk1A, the latest versions of all the Mk1 plans (v6.3 in the case of HS1) have been preserved, available in an archive section on the website.

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 could look like. Naturally, this involved 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 HS1, the route from London to Kent and East Sussex (and the Channel Tunnel, of course – 4tph of international traffic is allowed for). Unlike the other articles in this series, the route here is already in service, except for the connections with other HS lines, and three small but important additions. I have reproduced the maps, to the usual standards, but not changed them in any way, other than the HS connections and these three additions. What I have changed are the service plans, to integrate HS1 with the rest of the network, HS and classic.

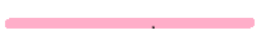




The Maps

Naturally, the chosen route must be illustrated with maps. I briefly describe the route of the additions, 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 HS1, including sections of other routes over which HS13/HS14's services run. These overall maps come at the end of the 'Route' description, and also show HS1's classic compatible services on classic lines (these are shown as dotted lines). Also included there are maps of the overall HS Network.

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

		standard colours	
HS1		yellow	R/G/B 255/242/0 255/242/0
HS2		dark red	R/G/B 136/0/21
HS3		red	R/G/B 237/28/36
HS4		brown	R/G/B 185/122/87
HS5		rose	R/G/B 255/174/201
HS6		indigo	R/G/B 63/72/204
HS7		green	R/G/B 34/177/76
HS8		turquoise	R/G/B 0/162/232
HS9		purple	R/G/B 163/73/164
HS10		lavender	R/G/B 200/191/231
HS11		orange	R/G/B 255/127/39
HS12		gray 50%	R/G/B 127/127/127
		custom colours	
HS13		true blue	R/G/B 0/0/255
HS14		light blue	R/G/B 0/192/255
HS13		pure green	R/G/B 0/255/0

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 HS1.

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. All domestic services stop at all the stations on the main line of HS1, so need no overtaking provision – there is a physically separate station at each for international traffic.

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.

Two types of services are contained in the plans, those featuring High Speed trains 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). HS1 is, however, unusual in that there are few **formal** cross-platform connections planned between HS and RM services, but given the frequency of services in the entire area served by HS1, this is scarcely a deficiency; good, **informal** connections between HS and RM are available at Dover, Hastings, Ashford, Maidstone and Ebbsfleet. One formal connection that **is** prescribed is at Minster, with the East Kent coastal services.

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.

An allowance of 4tph is made for international traffic.

Estimated Journey Times

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

HS1 Route – Junctions:

There are various junctions on the route of HS1, enabling connections with other HS and classic routes. It is convenient to list them here, together with map references and identifying remarks, since when discussing the capacity/loading of the different sections of route, the end points are usually junctions (occasionally stations). The junction names are my suggestions.

One feature of the following list needs clarification: Pilgrims' Way Junction, for the Maidstone branch, is given as north / south. Such junctions are normally the junctions of station loops, and are where the services stopping at that station diverge from / re-join the main line. Their location is precisely defined by the acceleration / deceleration rates of the trains. (They decelerate more rapidly than they accelerate, which is just as well.) The junction where a service re-joins the main line, having accelerated up to the turnout limit speed from a stop is thus further from the station than the junction where trains diverge, at the turnout limit speed, and decelerate to standing at the platform. (**Very** roughly the acceleration distance is about 50% greater than the stopping distance.) Pilgrims' Way is a special case, in that it is the junction of a (short) station branch, rather than a station loop, and the length of the branch is sufficient, at 4.5km, to accommodate all the deceleration required – 4.1km – from the junction turnout speed – 230kph – to standstill. Accordingly Pilgrims' Way South Junction coincides with the route junction for Maidstone. But acceleration from zero to turnout speed requires 6.8km, hence Pilgrims' Way North Junction, where trains from Maidstone join the main line, should be 2.3km nearer to London than the South junction. Unfortunately, Pilgrims' Way is special in another, less favourable respect. The South junction follows closely the south portal of North Downs Tunnel. The North junction, as prescribed, would actually be inside the tunnel – about 0.5km before the northern portal. Thus the North junction must be located a little further north, above the tunnel portal. The northbound, accelerating line has its own, individual tunnel, of course, unfortunate but unavoidable.

- | | | |
|----------------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| • York Way | TQ300831 | Connections from Pancras Cross and St. Pancras East join HS1. |
| • Hitchcock Lane | TQ387848 | HS6 diverges from HS1 at platform ends at Stratford HS North station. |
| • Stratford HS South | TQ387847 | HS4 diverges from HS2 immediately east of Stratford HS South, and metamorphoses into HS11. (The given location is approximate – it's underground!) |
| • Woodgrange Road | TQ416853 | HS2 merges with HS1. (The given location is approximate – it's underground!) |
| • Pilgrim's Way | TQ746633 | (North) Northbound services, having started from Maidstone HS, join the main line. |
| | TQ751603 | (South) Southbound services, terminating at Maidstone HS, diverge from the main line. |

In addition Ashford West and East Junctions allow domestic services to diverge from / re-join the HS1 main line to serve Ashford (non-international) station. There needs to be an additional junction immediately east of the station, to allow HS1 services to reach the Hastings line, which is not at present possible. A new junction at Saltwood would be desirable to allow HS services to gain the classic line just before Dollands Moor Yard, but this is not essential as they could continue along the classic line from Ashford (it's only c.10miles).

There are various other links between HS1 and classic lines, for operational purposes and not intended for regular services, so not relevant in the present context.

HS1 Route

1. Inter-Regional HS Connections:

The type of traffic with which this article is primarily concerned is HS Inter-Regional services from HS2, via Euston Cross, and joining HS1 at Woodgrange Road Junction. Appendix A gives full details of Euston Cross and its approaches.

In addition, HS1 shares track between York Way Junction and Stratford HS North with HS6, whose services come from both Pancras Cross and St. Pancras East (the ‘Javelin’ platforms). Appendix B gives full details of Pancras Cross and its surroundings. Full details of HS6’s services are contained in the article ‘HS Eastern Routes and Service Plans (HS6 and HS10)’.

2. Maidstone Branch:

At Pilgrim’s Way Junction (route junction at TQ751603) the Maidstone branch diverges from the main line. It immediately crosses to the west side of the A229, following that for 1 mile until junction 6 with the M20. It diverges from the A220 at TQ753587, crosses the M20 at TQ751584 and the Medway at TQ750581, and joins the east side of the alignment of the Strood – Paddock Wood line at TQ748574. This it follows to Maidstone Barracks station, which is in exactly the right location, just where the line from Otford Junction to Ashford crosses. The HS platforms are on the east side of Barracks station, and new platforms are provided on the Ashford line.

3. Hastings Branch:

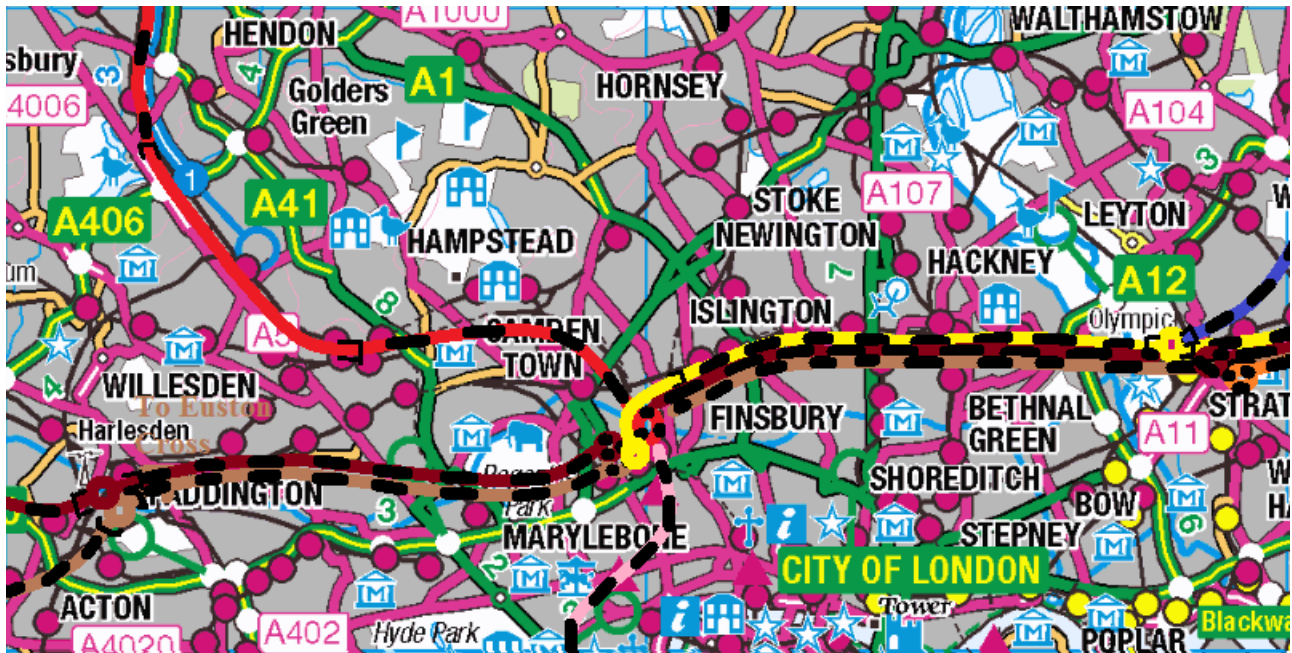
There is a connection between HS and classic tracks at Ashford West Junction, but a further junction to the Hastings line is required. HS1 simply takes over the line to Hastings and redoubles it. Now that GC-gauge has been discarded, there is no reason why HS1’s services should not extend through to Eastbourne, where there is adequate room for new platforms.

4. Dover Branch:

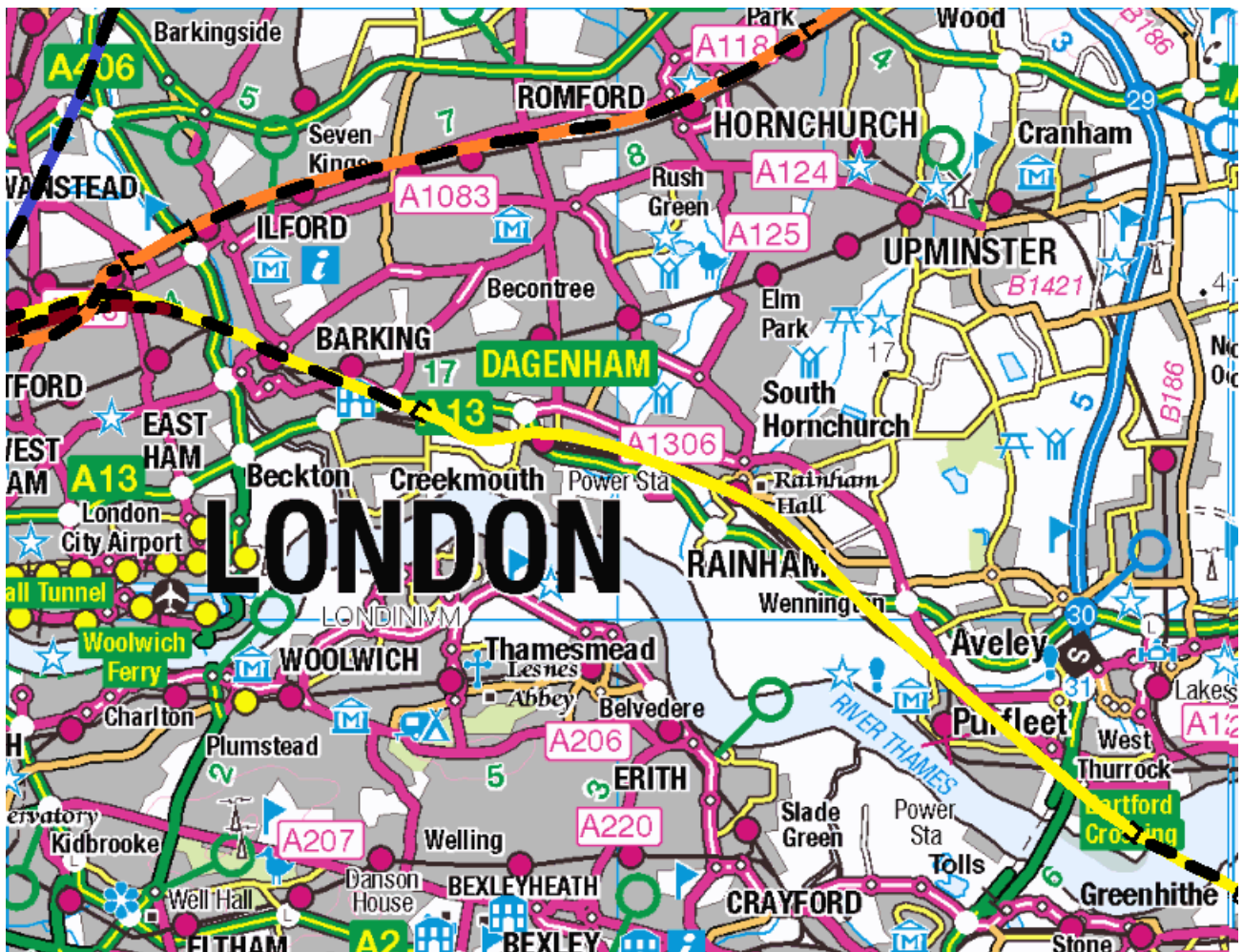
With GC-gauge now discarded, the former plenitude of possibilities on this section reduces naturally to just one, merging with the existing classic route through to Dover, either all the way from Ashford, or via a new connection between HS and classic routes at Saltwood. This allows Folkestone to be served also.

5. Thanet Branch:

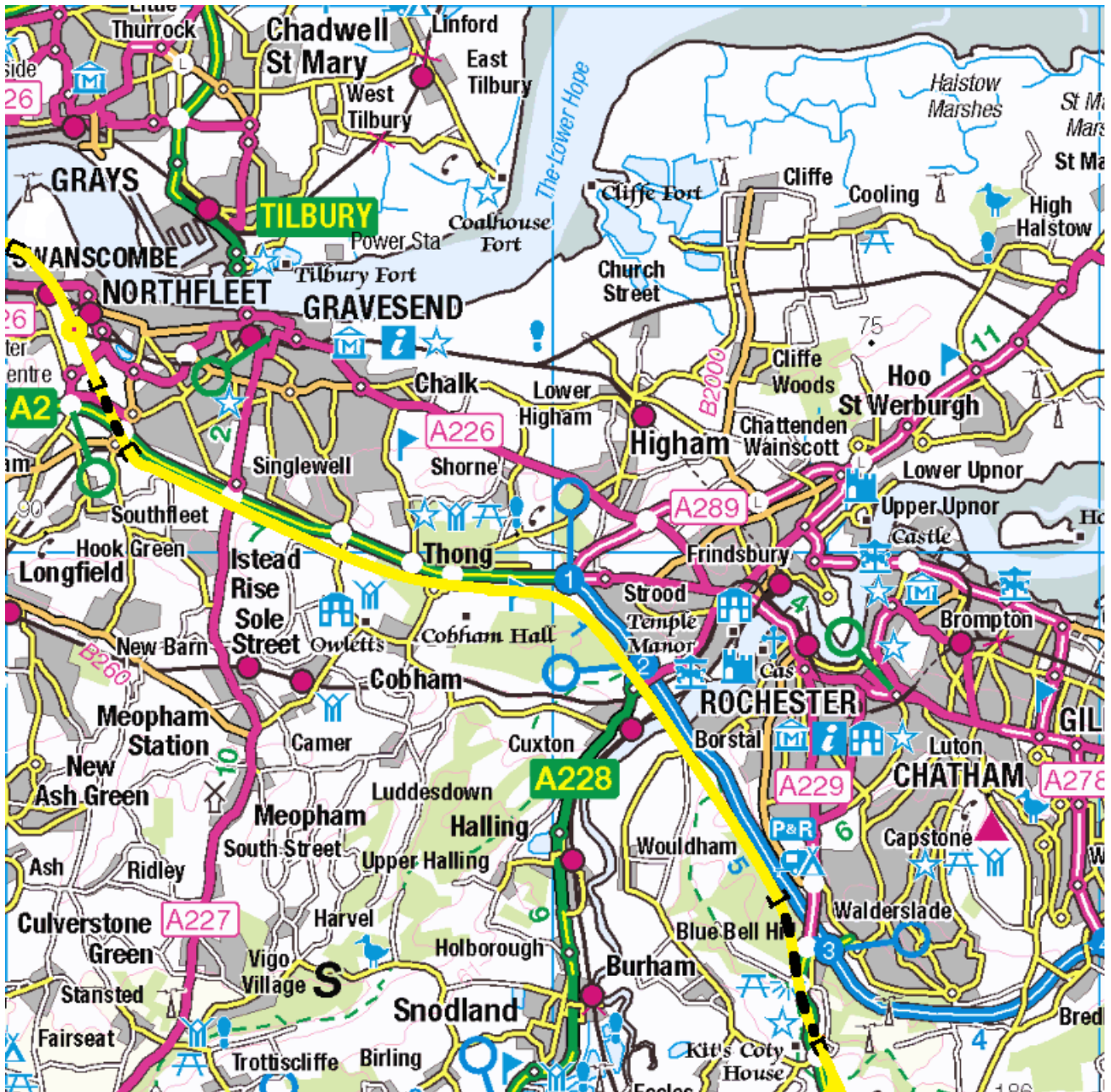
This is over classic lines exclusively, with minimal upgrading.



1. St. Pancras Int'l – Stratford HS North Contains Ordnance Survey data © Crown copyright and database right 2013

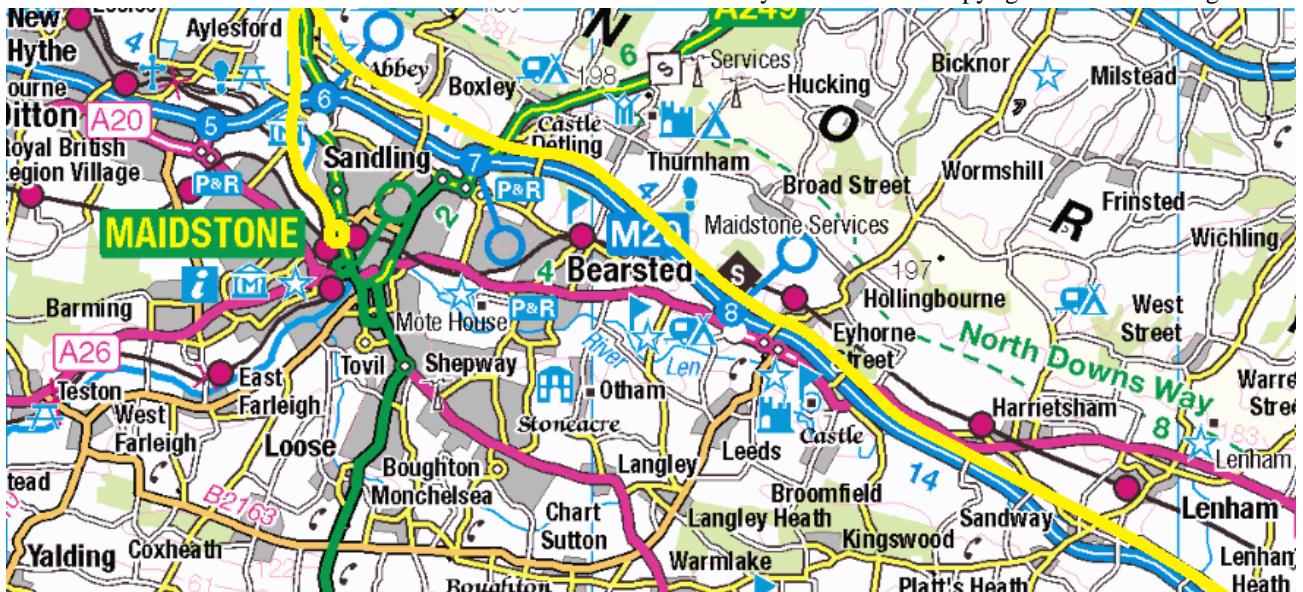


2. West Ham – Greenhithe Contains Ordnance Survey data © Crown copyright and database right 2013



3. Swanscombe – Walderslade

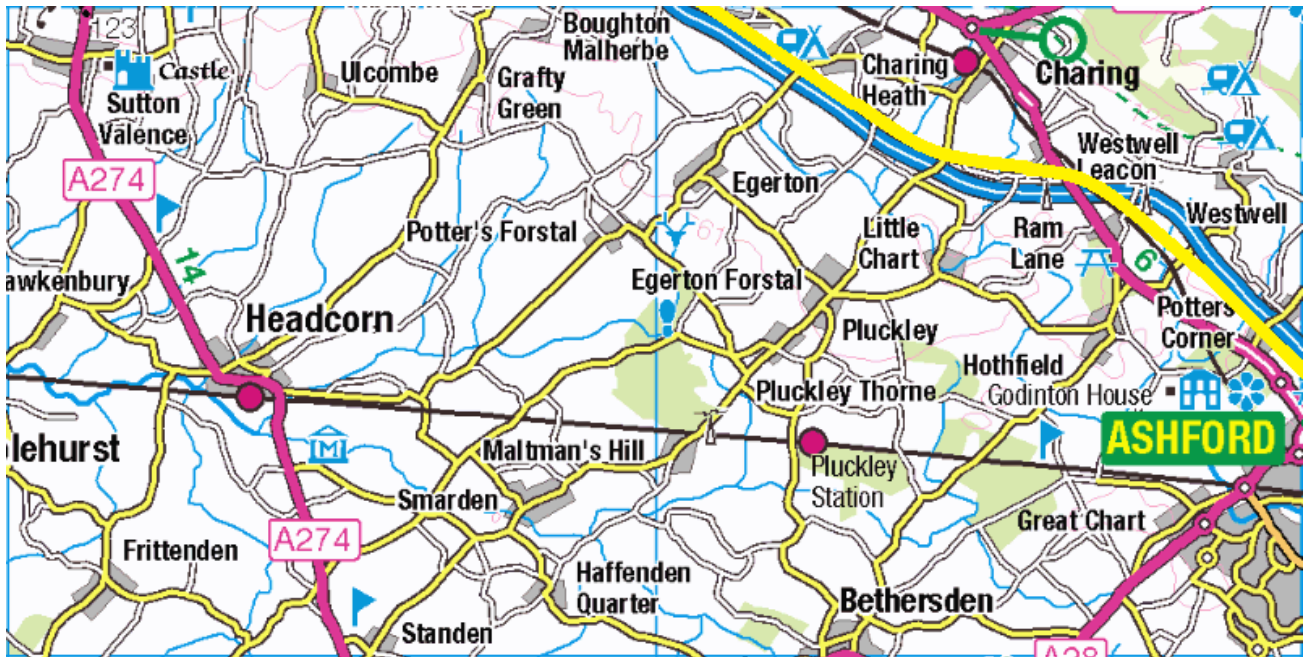
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4. Aylesford – Lenham

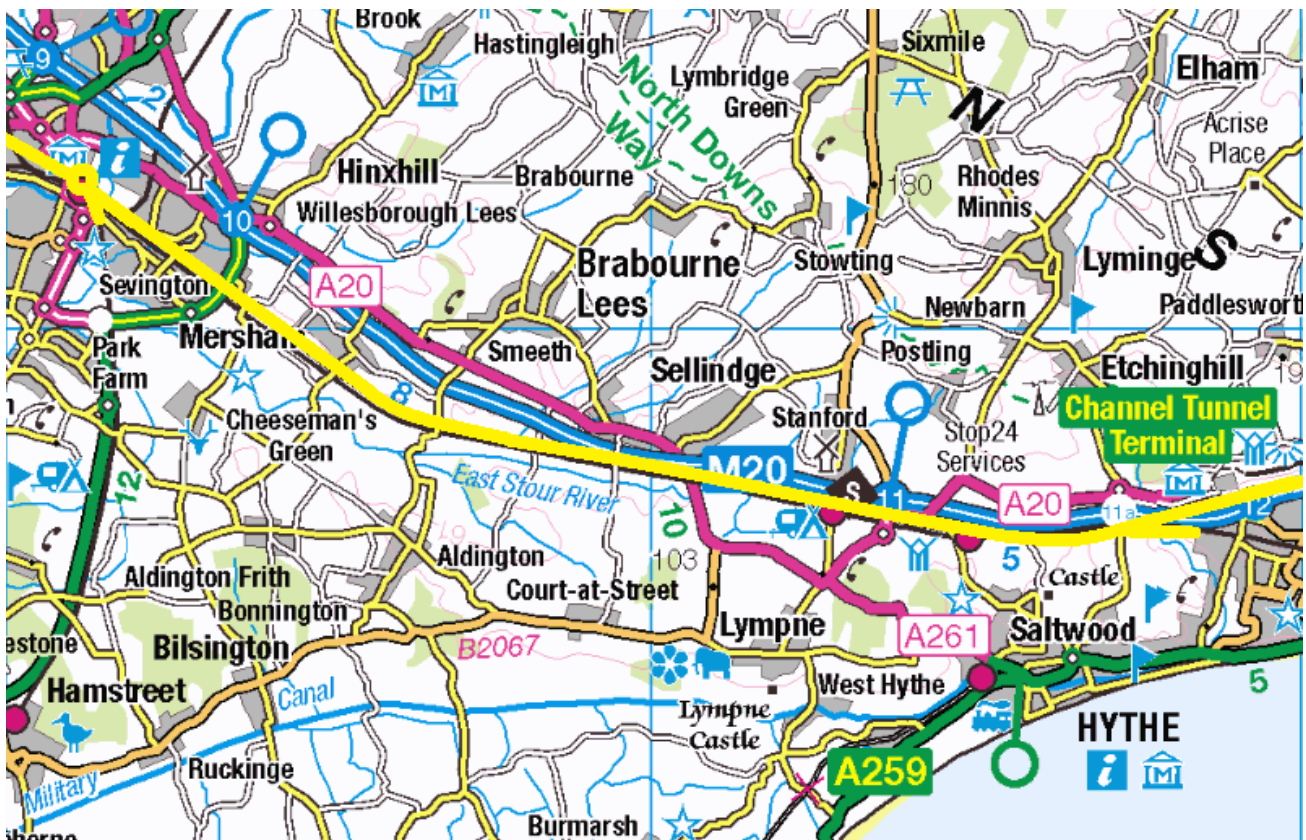
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(Note that this map is wider than 20km (c.22km))



5. Charing – Ashford

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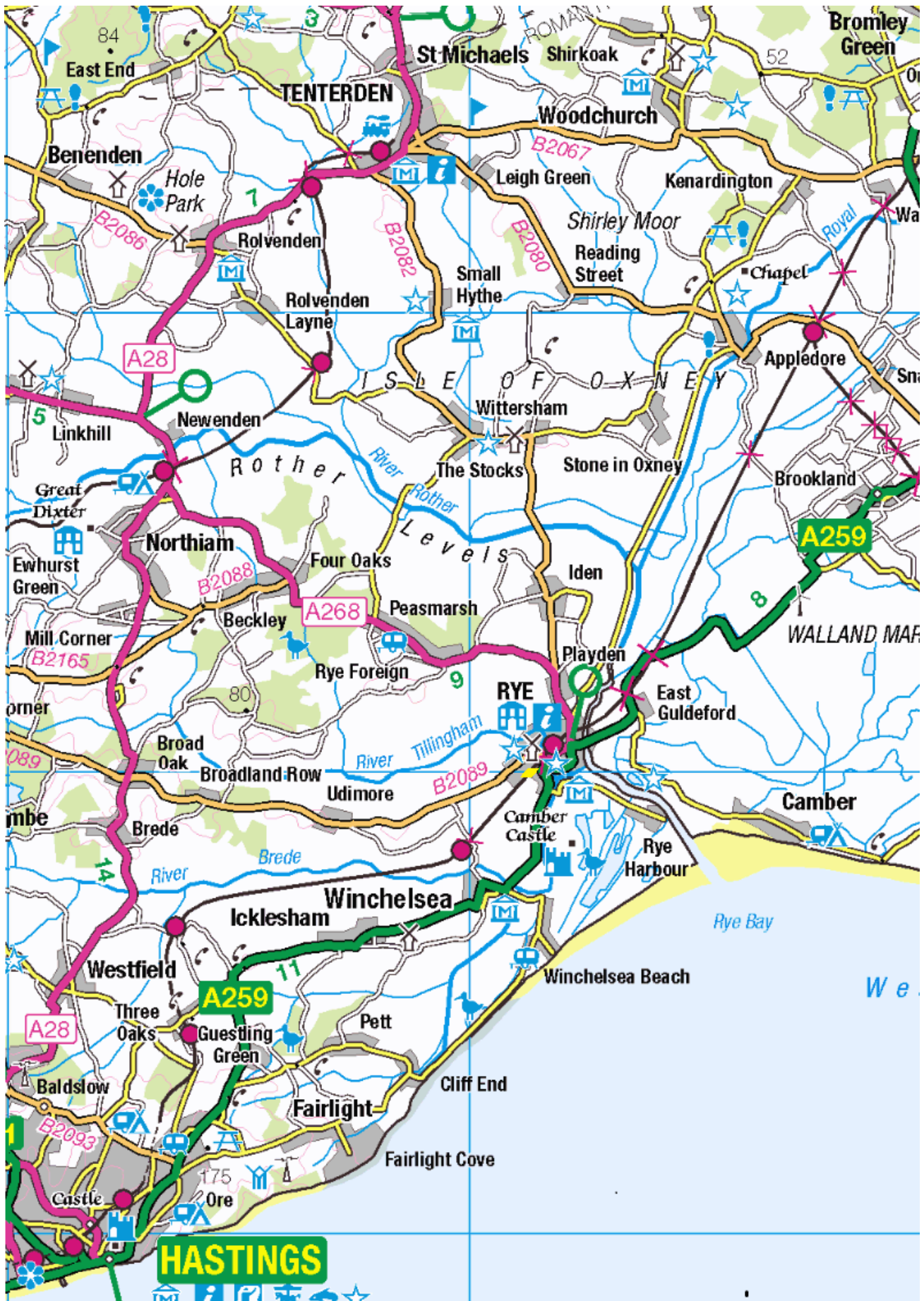
6. Ashford – Channel Tunnel

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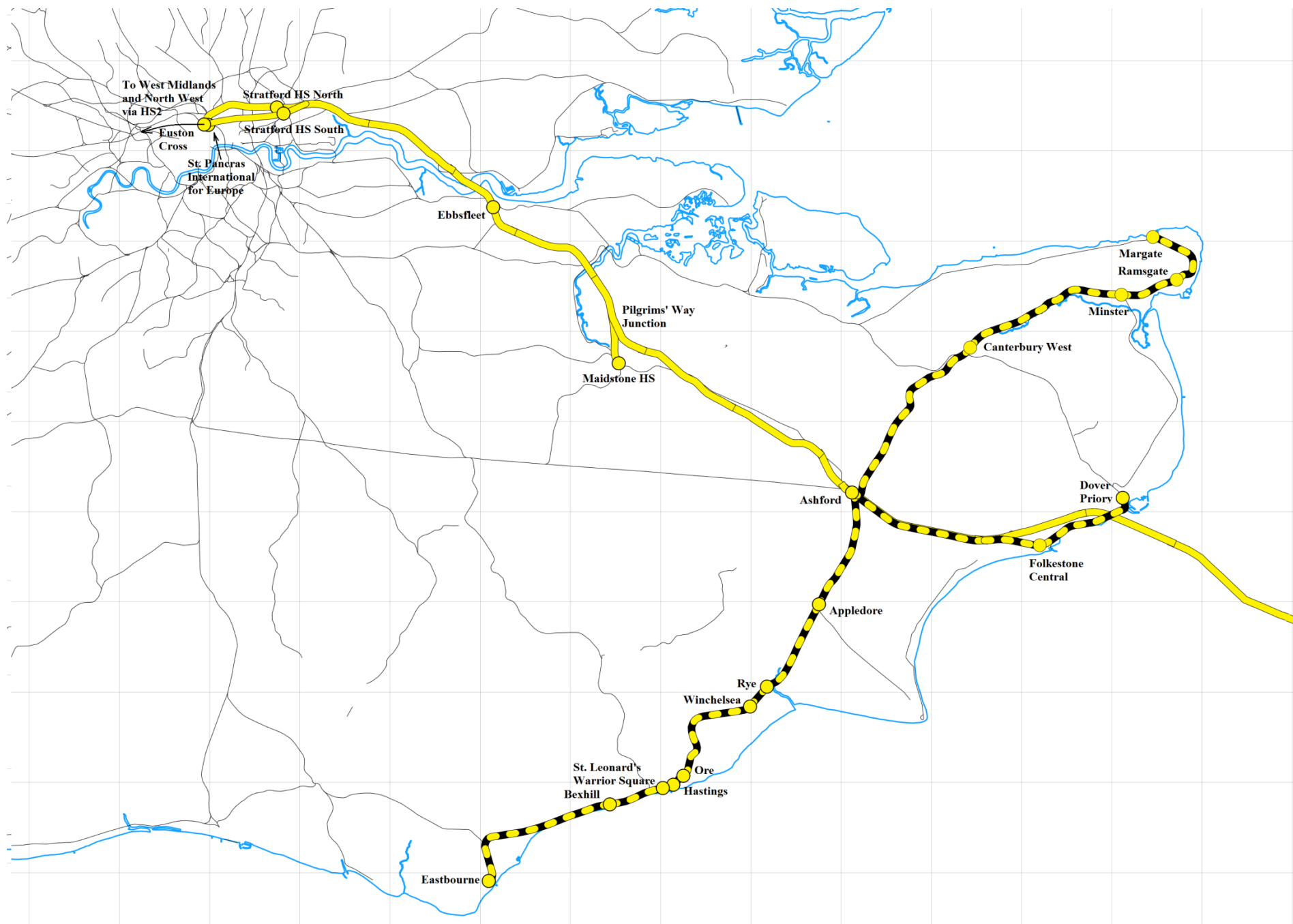
7. Folkestone – Dover

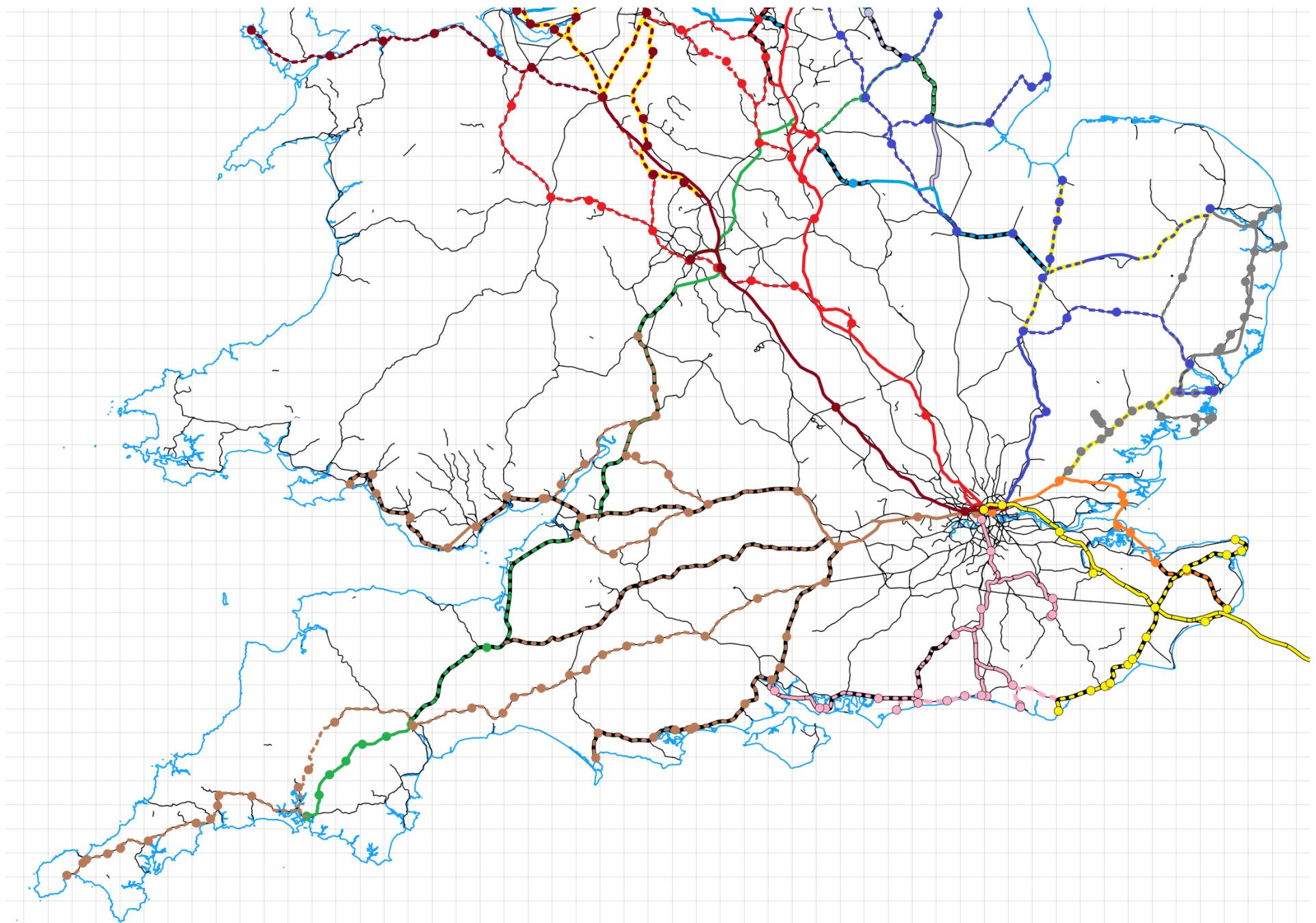
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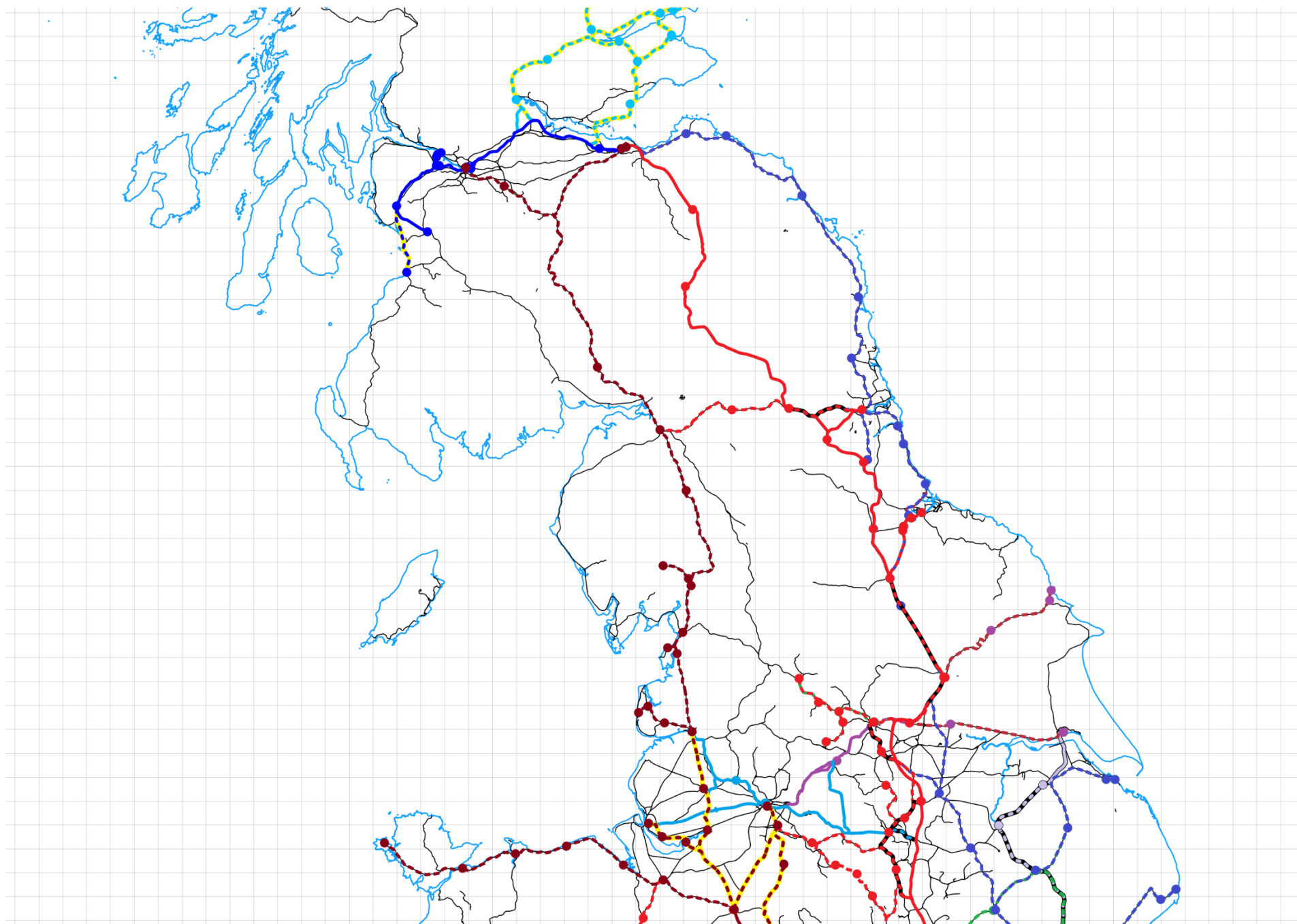


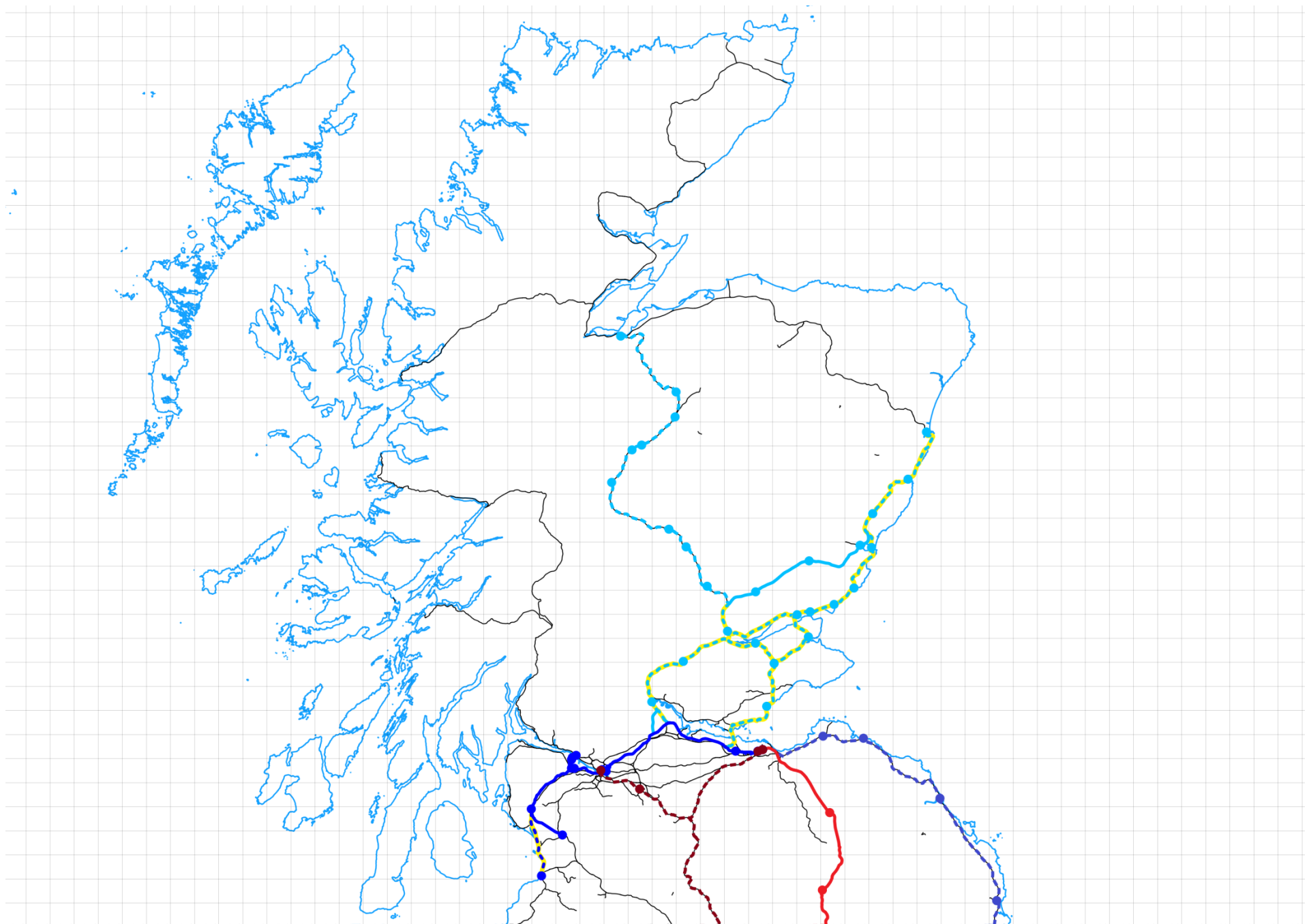
8. Bromley Green – Hastings

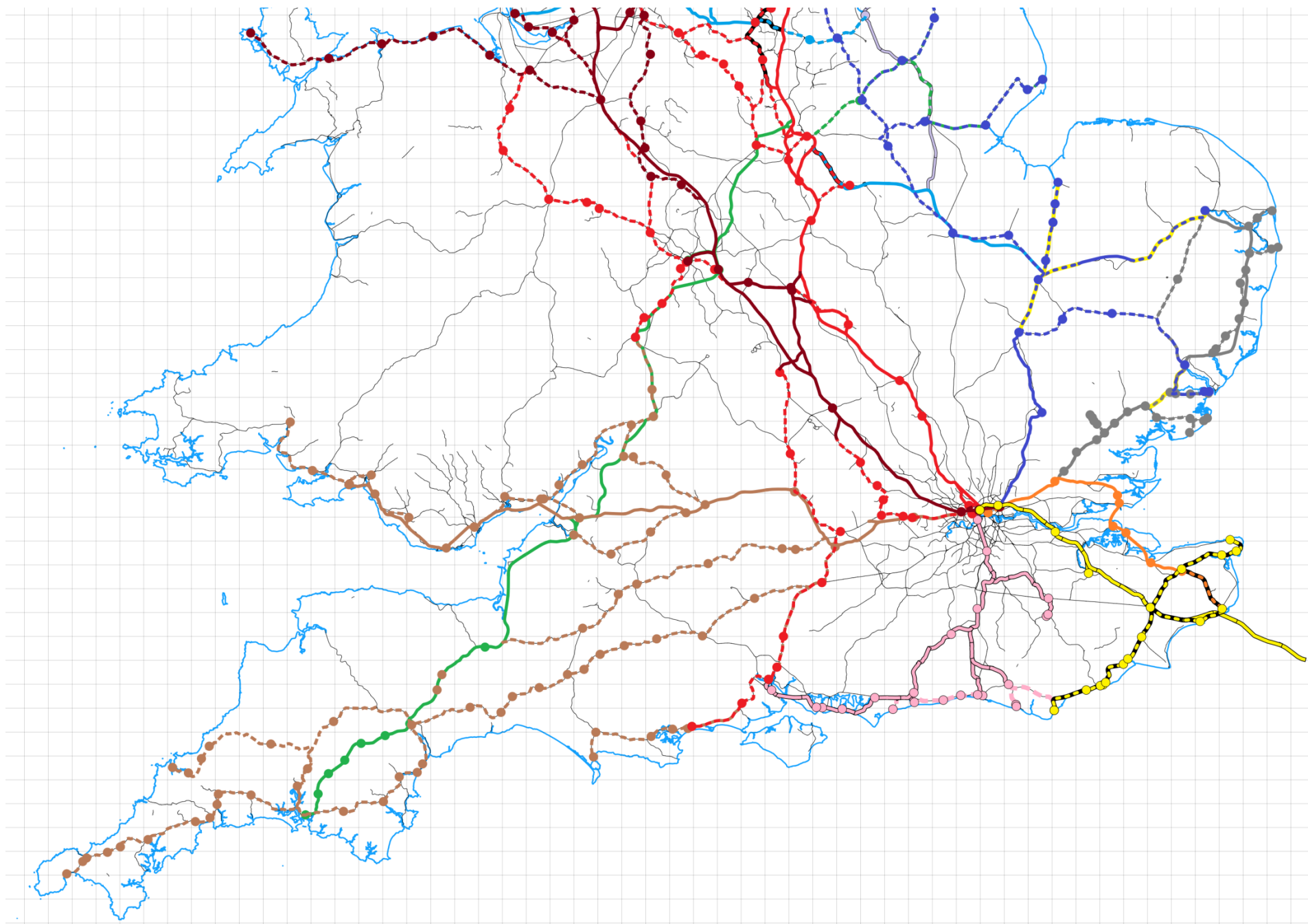
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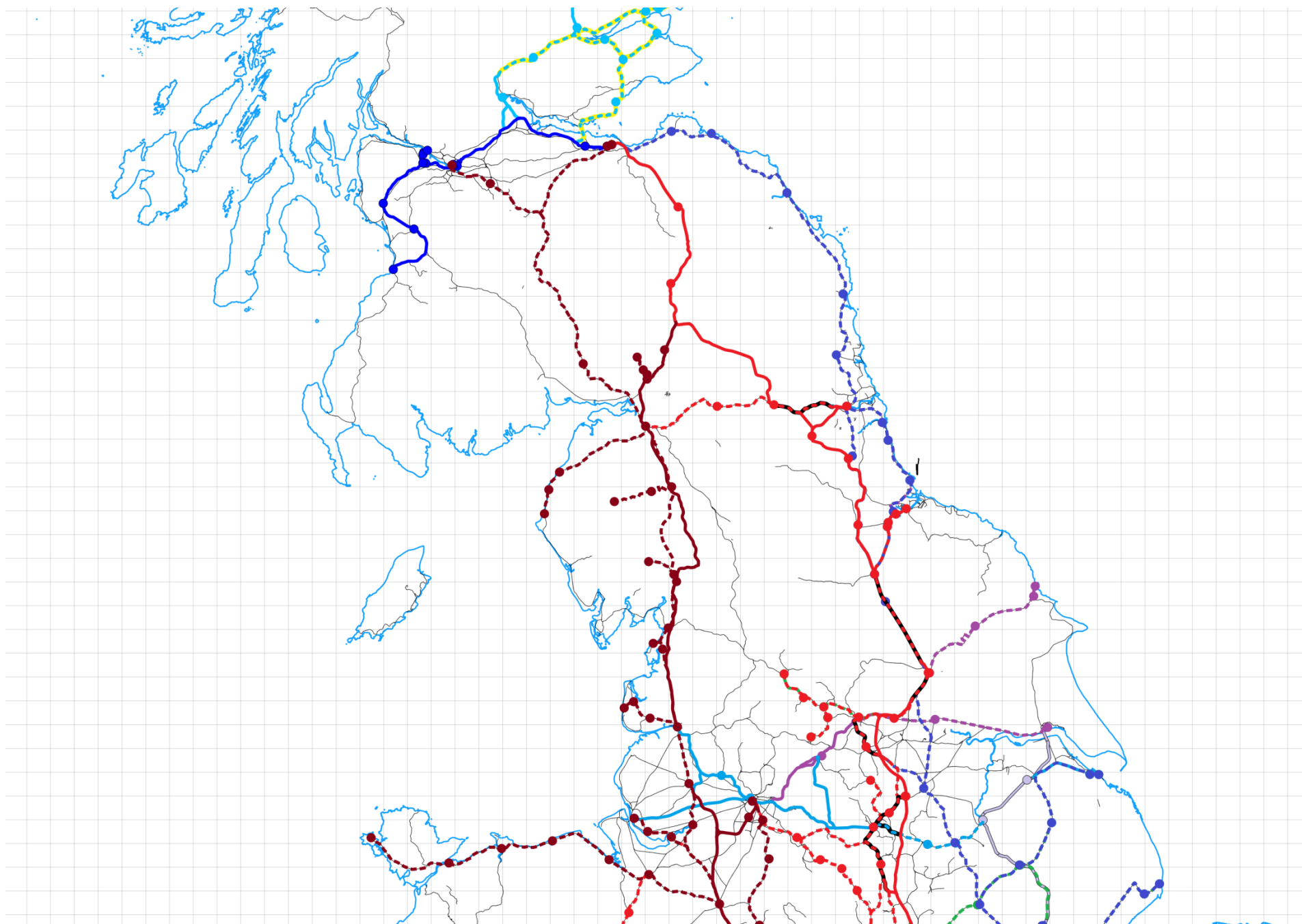


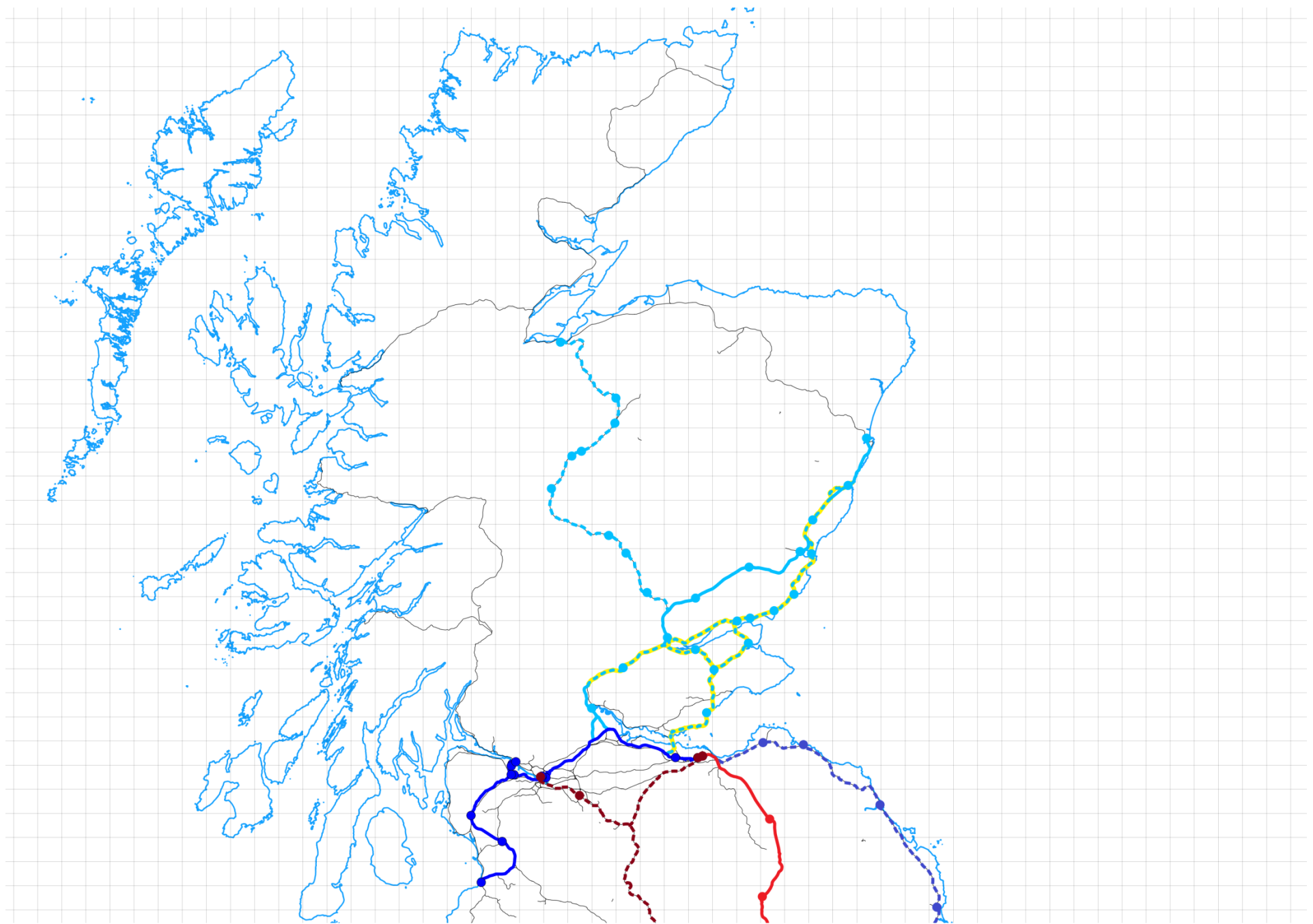












The Service Plans

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 HS1 itself. This most commonly occurs when a new section of HS1 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)

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

Service Plan 1

The first service plan comes into effect when:

- HS1's branches to Maidstone HS, Dover Priory, Margate and Hastings open.
- HS2 phase 2B opens from Crewe HS South Junction to Manchester and Wigan, and from Old Oak Common North Junction through Euston Cross to Woodgrange Road Junction, where it merges with HS1. (This is Service Plan 3 of HS2.)

The full service on HS1/HS2 is thus:

- 4tphH [Birmingham HS →] Euston Cross – Stratford HS South – Ebbsfleet – Maidstone HS
- 4tphH [Manchester HS →] Euston Cross – Stratford HS South – Ebbsfleet – Ashford – Dover Priory
- 2tphH [Liverpool Lime Street →] Euston Cross – Stratford HS South – Ebbsfleet – Ashford – Appledore – Rye – Winchelsea – Ore – Hastings St. Leonard's Warrior Square – Bexhill - Eastbourne
- 2tphH [Manchester Piccadilly via Stoke on Trent →] Euston Cross – Stratford HS South – Ebbsfleet – Ashford – Canterbury West – Minster – Ramsgate – Margate
- 2tphH [Blackpool / Windermere – joins / splits at Preston →] Euston Cross – Stratford HS South – Ebbsfleet – Ashford – Canterbury West – Minster – Ramsgate – Margate

In addition HS1's suggested international services are:

- 1tphH St. Pancras Int'l – Paris Gare du Nord.
- 1tphH St. Pancras Int'l – Ebbsfleet Int'l – Ashford Int'l – Fréthun – Lille Europe – Paris Gare du Nord
- 1tphH St. Pancras Int'l – Ebbsfleet Int'l – Ashford Int'l –Lille Europe – Brussels Midi – Brussels Nord – Antwerp – Rotterdam Centraal – Schipol Airport – Amsterdam Centraal
- 1tphH St. Pancras Int'l – Ebbsfleet Int'l – Ashford Int'l –Lille Europe – Brussels Midi – Brussels Nord – Liège Guillemins – Aachen Hbf – Cologne Hbf

The following RM (stopping) service is specified explicitly:

- 4tphRS Dover Priory – Martin Mill – Walmer – Deal – Sandwich – Minster (reverse) – Ramsgate – Dumpton Park – Broadstairs – Margate

Representative Hourly Cross-Platform Interchange Pattern at Minster:

00H [Manchester Piccadilly via Stoke on Trent →] Euston Cross – Margate

RS Margate – Dover

15H [Blackpool / Windermere – joins / splits at Preston →] Euston Cross – Margate

RS Margate – Dover

– repeating at 30 and 45 minutes past. Refer to appendix D for the revised layout at Minster.

The following loadings are imposed on HS1:

- | | | |
|-------------------------------|---------------------------------|-------|
| • Euston Cross | – Stratford HS South Junction | 14tph |
| • Stratford HS South Junction | – Woodgrange Rd. Junction | 14tph |
| • St. Pancras International | – Hitchcock Lane Junction | 4tph |
| • Hitchcock Lane Junction | – Woodgrange Rd. Junction | 4tph |
| • Woodgrange Rd. Junction | – Pilgrim’s Way Junction | 18tph |
| • Pilgrim’s Way Junction | – Maidstone HS Station | 4tph |
| • Pilgrim’s Way Junction | – Ashford West Junction | 14tph |
| • Ashford West Junction | – Dollands Moor West Junction | 4tph |
| • Ashford West Junction | – Ashford (UK domestic) station | 10tph |
| • Ashford station | – Dollands Moor West Junction | 4tph |
| • Dollands Moor West Junction | – Dover Priory Station | 4tph |
| • Dollands Moor West Junction | – Europe | 4tph |
| • Ashford station | – Eastbourne | 2tph |
| • Ashford station | – Margate | 4tph |

Service Plan 2

This service plan comes into effect when:

- HS8 and HS9 open between Manchester HS and Liverpool / Bolton and Preston. A connection is made between HS2 at Bamfurlong Junction and HS8 at Gibb Farm Junction making available a new HS route between London and Preston.
- HS4 has opened between Old Oak Common West and East Junctions, and HS11 between Woodgrange Road East Junction and Manor Park Junction. This affects only the section loading between Euston Cross and Woodgrange Road East Junction.

There is just the one new service:

- 2tphH [Preston →] Euston Cross – Stratford HS South – Ebbsfleet – Ashford – Appledore – Rye – Winchelsea – Ore – Hastings St. Leonard’s Warrior Square – Bexhill – Eastbourne

The loadings imposed on HS1 are now:

• Euston Cross	– Stratford HS South Junction	16tph
• Stratford HS South Junction	– Woodgrange Rd. Junction	16tph
• St. Pancras International	– Hitchcock Lane Junction	4tph
• Hitchcock Lane Junction	– Woodgrange Rd. Junction	4tph
• Woodgrange Rd. Junction	– Pilgrim's Way Junction	20tph
• Pilgrim's Way Junction	– Maidstone HS Station	4tph
• Pilgrim's Way Junction	– Ashford West Junction	16tph
• Ashford West Junction	– Dollands Moor West Junction	4tph
• Ashford West Junction	– Ashford (UK domestic) station	12tph
• Ashford station	– Dollands Moor West Junction	4tph
• Dollands Moor West Junction	– Dover Priory Station	4tph
• Dollands Moor West Junction	– Europe	4tph
• Ashford station	– Eastbourne	4tph
• Ashford station	– Margate	4tph

Service Plan 3

This service plan comes into effect only if and when the extra-futuristic HS2 Mk3 is implemented, specifically the Coventry Variant. This introduces an HS Metro services between Birmingham and Euston Cross, via Coventry, continuing onto HS1 and terminating at Gillingham. This involves no changes whatsoever to HS1's infrastructure, using the existing connection from Ebbsfleet station to Springfield Rd. Junction on the North Kent line to Strood and Rochester. This junction exists already, but has not been used in the earlier proposals; it is assumed that it has been maintained for operational flexibility, although carrying no regular, scheduled service.

There is just the one, new service:

- 4tphH [Birmingham HS (via Coventry) →] Euston Cross – Stratford HS South – Ebbsfleet – Gravesend – Strood – Rochester – Chatham – Gillingham

The loadings imposed on HS1 are now:

• Euston Cross	– Stratford HS South Junction	20tph
• Stratford HS South Junction	– Woodgrange Rd. Junction	20tph
• St. Pancras International	– Hitchcock Lane Junction	4tph
• Hitchcock Lane Junction	– Woodgrange Rd. Junction	4tph
• Woodgrange Rd. Junction	– Ebbsfleet station	24tph
• Ebbsfleet station	– Springfield Rd. Junction	4tph
• Springfield Rd. Junction	– Gillingham	4tph
• Ebbsfleet station	– Pilgrim's Way Junction	20tph
• Pilgrim's Way Junction	– Maidstone HS Station	4tph
• Pilgrim's Way Junction	– Ashford West Junction	16tph
• Ashford West Junction	– Dollands Moor West Junction	4tph
• Ashford West Junction	– Ashford (UK domestic) station	12tph

- Ashford station – Dollands Moor West Junction 4tph
- Dollands Moor West Junction – Dover Priory Station 4tph
- Dollands Moor West Junction – Europe 4tph
- Ashford station – Eastbourne 4tph
- Ashford station – Margate 4tph

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. Accurate distances are available over most of the routes, as they are already in operation. (See appendix C for the precise values.) In the few other cases, distances, to the nearest km, are derived from my own maps.

The crudest approximation, usually, is the assumption that, once line speed has been reached, that speed (300kph) is maintained until it becomes necessary to decelerate for a junction or a station stop. In fact, given the excellent alignments of this particular route, I am considerably more confident of this assumption than on certain other routes (Trans-Pennine, in particular).

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

My estimated distances (between stations) are:

- Euston Cross – Stratford HS South 8km (160kph)
- Stratford HS South – Ebbsfleet 26.69km (300kph)
- Ebbsfleet – North Downs Tunnel (s. portal) 15.07km (300kph)
- N.D.T.(s.p.) i.e. Pilgrims’ Way s.Jn. – Maidstone 4.5km (<=230kph #)
- Ebbsfleet – Maidstone 19.57km (300kph)
- Ebbsfleet – Ashford 54.34km (300kph)
- Ashford – Folkestone Central 22.20km (225kph)
- Folkestone Central – Dover Priory 11.87km (225kph)
- Ashford – Appledore 13.7km (225kph)
- Appledore – Rye 10.98km (225kph)
- Rye – Winchelsea 2.93km (*)
- Winchelsea – Ore 13.28km (160kph)
- Ore – Hastings 1.45km (*)
- Hastings – St. Leonard’s W. Sq. 1.26km (*)
- St. Leonard’s W. Sq. – Bexhill 5.77km (160kph)
- Bexhill – Eastbourne 16.46km (160kph)
- Ashford – Canterbury West 22.89km (160kph)
- Canterbury West – Minster 8.44km (160kph)
- Minster – Ramsgate 6.50km (160kph)
- Ramsgate – Margate 8.28km (160kph)

• Northfleet / Ebbsfleet – Strood	14.74km	(160kph)
• Strood – Rochester	1.67km	(*)
• Rochester – Chathan	0.89km	(*)
• Chatham – Gillingham	2.61km	(*)

The line speeds are chosen as follows:

- The existing HS1 has a line speed of 300kph (assumed throughout).
- The Maidstone branch is new infrastructure, but trains to Maidstone will enter it at 230kph (as set by the pointwork #) and then decelerate down to zero. The line speed can thus decrease linearly from 230kph to zero over the length of the branch. (Going the other way, starting from Maidstone, the speeds will be c60% of these figures, since average acceleration is c.60% of average deceleration.)
- Between Ashford and Dover and between Ashford and Rye, the alignments are good and the distances between stations are sufficient for a line speed of 225kph (140mph) to be attained and maintained for some distance, (this means a distance greater than c.10.5km). It is assumed that the infrastructure has been enhanced to support this speed.
- 160kph is taken as the line speed 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 a speed of even 160kph to be reached, (thus, anything less than c.5.3km). 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 300kph takes 11.57km and 278 seconds
- Deceleration from 300kph to stationary takes 6.945km and 167 seconds
- Time to travel from Rye to Winchelsea (start to stop) is 176 seconds
- Time to travel from Ore to Hastings (start to stop) is 124 seconds
- Time to travel from Hastings to St. Leonard’s (start to stop) is 115 seconds
- Time to travel from Strood to Rochester (start to stop) is 134 seconds
- Time to travel from Rochester to Chatham (start to stop) is 98 seconds
- Time to travel from Chatham to Gillingham (start to stop) is 199 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, for a line speed of 300kph, (different values obviously apply at other line speeds,) and sum them, thus acceleration / deceleration takes $11.57 + 6.95 = 18.52\text{km}$ and $278 + 167 = 445$ seconds. The distance value is subtracted from the inter-station distance, and the remaining length is assumed to be travelled at line speed, taking $\text{time} = \text{distance} / \text{speed}$. 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. (Adjacent Station times are added manually.) 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 intermediate stations, and this is added into the accumulated time at each stop.

*HS Euston Cross – Maidstone / Dover / Eastbourne / Margate / Gillingham
(2/4/9/6/5 stops):*

Section	Distance (km)	Cumulative Distance (km)	Start - Stop Time (minutes)	Cumulative Journey Time (minutes)	Elapsed Time from London, inc. Station Wait Times
Euston Cross - Stratford HS South	8.00	8.00	5.0	5.0	5.0
Stratford HS South - Ebbsfleet	18.69	26.69	7.4	12.4	15.4
Ebbsfleet - Maidstone HS	19.57	46.26	7.6	20.0	26.0
Ebbsfleet - Ashford	54.34	81.03	14.6	27.0	33.0
Ashford - Folkestone Central	22.20	103.23	8.7	35.7	44.7
Folkestone Central - Dover Priory	11.87	115.10	5.9	41.6	53.6
Ashford - Appledore	13.70	94.73	6.4	33.4	42.4
Appledore - Rye	6.86	101.59	4.6	38.0	50.0
Rye - Winchelsea	1.86	103.45	2.9	41.0	56.0
Winchelsea - Ore	8.20	111.65	5.1	46.0	64.0
Ore - Hastings	1.45	113.10	2.1	48.1	69.1
Hastings - St. Leonard's	1.16	114.26	1.9	50.0	74.0
St. Leonard's - Bexhill	5.77	120.03	4.1	54.1	81.1
Bexhill - Eastbourne	16.46	136.49	8.1	62.3	92.3
Ashford - Canterbury West	22.89	103.92	10.6	37.5	46.5
Canterbury West - Minster	18.44	122.36	8.9	46.4	58.4
Minster - Ramsgate	6.50	128.86	4.4	50.9	65.9
Ramsgate - Margate	8.28	137.14	5.1	55.9	73.9
EbbsFleet / Northfleet - Strood	14.74	41.43	7.5	19.9	25.9
Strood - Rochester	1.67	43.10	2.2	22.2	31.2
Rochester - Chatham	0.89	43.99	1.6	23.8	35.8

Chatham - Gillingham	2.61	46.60	3.3	27.1	42.1
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Current fastest time (minutes) from London [and the above values] to:

• Ebbsfleet	17	[15]
• Maidstone	56	[26]
• Ashford	36 (Javelin – direct)	[33]
• Folkestone	57 (Javelin – direct)	[45]
• Dover	64 (Javelin – direct)	[54]
• Rye	64 (Javelin – 1 change)	[50]
• Winchelsea	82 (Javelin – 1 change)	[56]
• Hastings	94/96 (direct / Javelin 1change)	[69]
• Bexhill	107/106 (direct / Javelin 1 change)	[81]
• Eastbourne	81 (Javelin – direct)	[92]
• Canterbury	60 (Javelin – direct)	[47]
• Ramsgate	79 (Javelin – direct)	[66]
• Margate	91 (Javelin – direct)	[74]
• Strood	31 (Javelin – direct)	[26]
• Rochester	35 (Javelin – direct)	[31]
• Chatham	38 (Javelin – direct)	[36]
• Gillingham	42 (Javelin – direct)	[42]

Appendix A – Euston Cross and the Inter-Regional Connections

General

By routing the HS-C services of HS2 and HS4 into Euston and Paddington, respectively, and all the UHS and HS Metro services of both routes through Euston Cross, and on to HS1 and HS11/HS12, superlative cross-London inter-regional HS services are enabled, between the West Midlands / North West and Kent / East Sussex, and between South Wales / West Country and North Kent / East Anglia. The HS-C services HS11/HS12 are routed into Liverpool Street. The UHS and HS Metro services of HS1 (not the international ones) and HS11/HS12 balance exactly those of HS2 and HS4. There is thus no need for any rebuilding work at the four terminal stations to accommodate these trains. (Euston certainly needs rebuilding because it's such a disgusting mess, but it need not expand significantly beyond its current footprint, Paddington needs nothing more than a good clean and a fresh coat of paint, St. Pancras and Liverpool Street probably need nothing at all.) Given the service loadings of the London end of HS2 and HS1, and of HS4 and HS11/HS12, a single tunnel in each direction, with a minimum of 6 platforms, (passive provision for 8,) at Euston Cross, should suffice. That a single Euston Cross station, with a single pair of approach tunnels, would serve two HS inter-regional routes should seriously enhance its business case. I would like to see **passive** provision for 8 platforms, as is indicated in the diagrams.

The following sections illustrate the significant locations on the Euston Cross cross-London, inter-regional route. The track diagrams all use the colour scheme:



Old Oak Common

Old Oak Common station is on two levels, (3 actually, including London Overground, but that, although important, is not relevant in the current context):

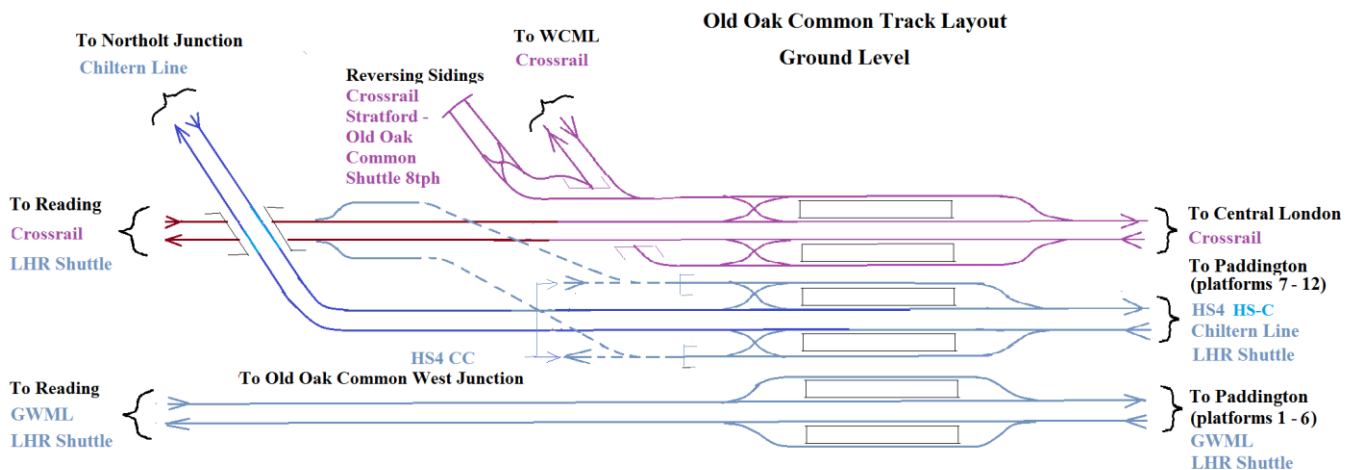
Ground Level, consisting of three sets of four platforms, serving the routes:

- GWML (Classic, long distance, and Heathrow Shuttle services,) on the fast lines.
- HS4 HS-C and Chiltern Line services, also some Shuttle services, on the relief lines, all of which diverge immediately west of the platforms, the HS-Cs to join HS4 at Old Oak Common West Junction, at the low level, the Chiltern Line services to Northolt Junction and the Shuttle services to join Crossrail on the relief lines west of Old Oak Common.

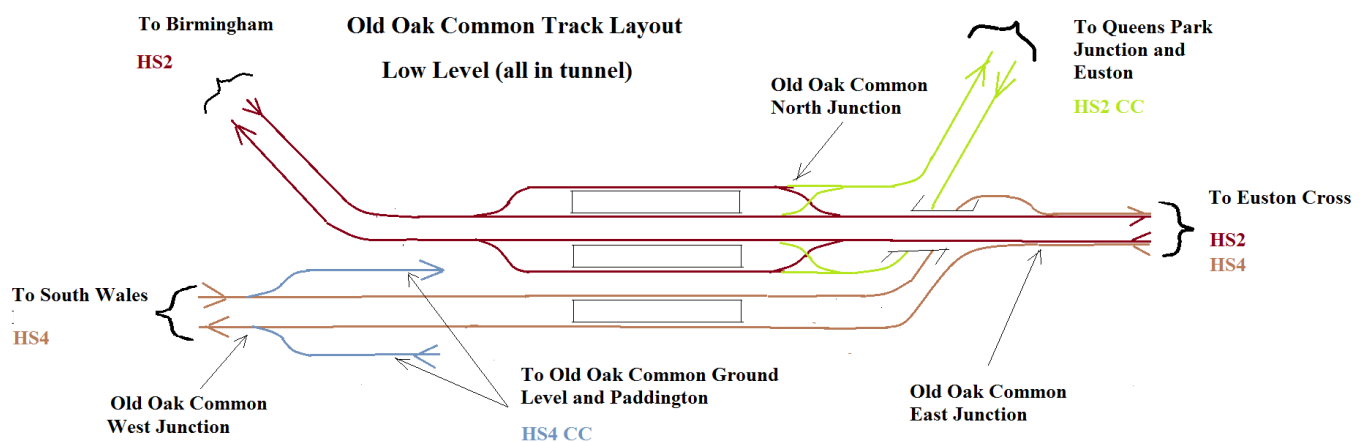
- Crossrail, of which the arm to the WCML and the Stratford Shuttle reversing sidings diverges immediately west of the platforms, and the GWML arm takes over the relief lines.

Low Level, consisting of HS2 (all services), and HS4 (UHS services).

Ideally, these should be one above the other, with the passenger entrances and circulating area between them, with lifts, escalators and stairs directly to all platforms. In order for HS2 and HS4 services to share the same pair of tracks, the HS-C services must first diverge, those of HS4 **before** the LL station (heading east), at Old Oak Common West Junction (then using the GWML platforms at ground level), and those of HS2 immediately after the LL station, at Old Oak Common North Junction. HS2 and HS4 merge shortly after that, at Old Oak Common East Junction. HS2's London-bound HS-C trains join the WCML at Queens Park Junction. In the original Euston Cross plans, this was seen as actually at Queens Park (since there was then no need to get them off HS2 as soon as possible after Old Oak Common). In fact Queens Park Junction (I'll keep the name as it's already in the literature) would best be located immediately west of the Kensal Green tunnels – there's plenty of room for it there, and it's only about ½ mile from Old Oak Common North Junction.

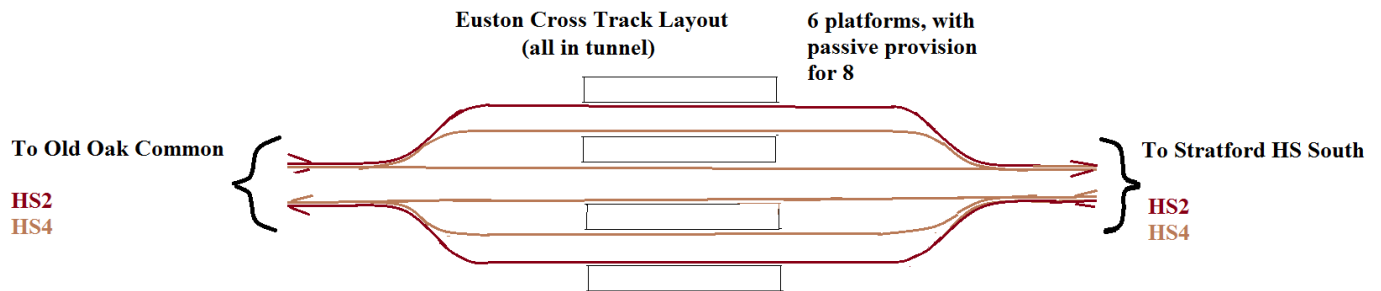


See the article 'GWML Service Plans' for a full explanation of the services between Paddington and Old Oak Common; as is clear from the diagram, the arrangement is rather complex.



Euston Cross

This is trivial, a two track route widening to serve 6 platforms. The middle two platform faces would ordinarily be served by HS4 trains, and the two outer pairs by HS2.



Stratford HS South

HS2/HS4 follow, in tunnel, the alignment of HS1, but a little to the south of it, from north of St. Pancras to Stratford. Thus whereas HS1/HS6 arrive at Stratford HS North station (the former Stratford International, which it never was,) HS2/HS4 arrive at Stratford HS South station, underneath Stratford (Regional) station. This is similar to Euston Cross – the route widens to serve 6 platforms, with HS4 occupying the middle two – but afterwards the HS4 tracks diverge from the HS2 tracks at Stratford HS South Junction, and HS4 metamorphoses into route HS11. The scissors crossovers are provided for operational flexibility but should not normally be used.

HS11 emerges from tunnel on the north side of the GEML and is joined by a connection from the classic route, at Manor Park Junction.

HS2 continues to Woodgrange Road Junction in Forest Gate, where it merges with HS1.

Stratford HS South corresponds in many respects to Old Oak Common. Both are served by all the GC-gauge inter-regional services, and afford convenient interchange with Crossrail. The Crossrail tracks are likewise in the high level station, having taken over the former slow lines, thus providing cross-platform interchange with the LT Central Line. Stratford HS South is on the Shenfield branch of Crossrail, and thus has a 12tph service, but additionally is served by the 8tph shuttle between Stratford and Old Oak Common.

Appendix B – Pancras Cross and the Inter-Regional Connections

General

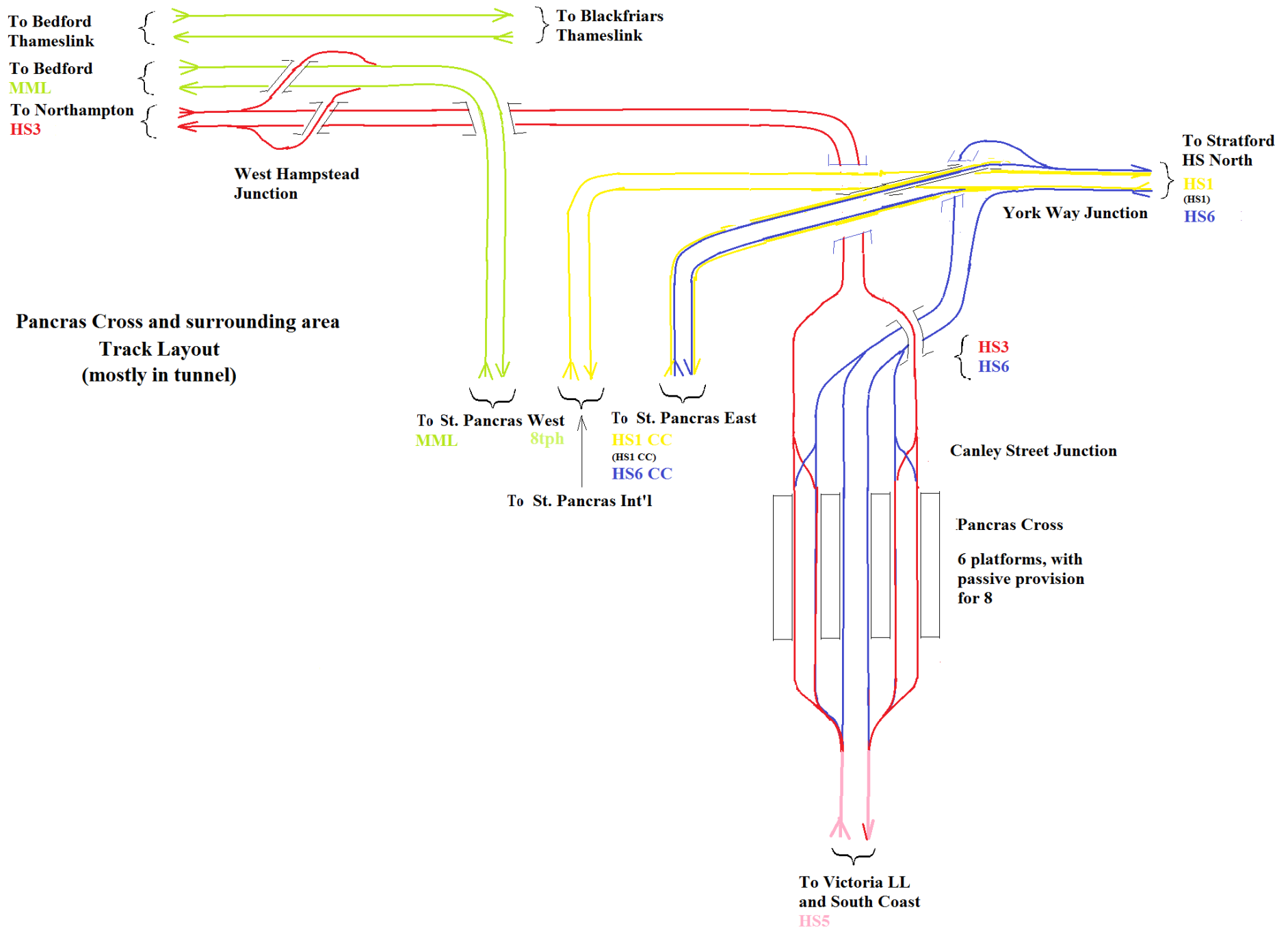
By routing the HS-C services of HS3 into St. Pancras West (the MML platforms), and of HS6 into St. Pancras East (the 'Javelin' platforms), and all the UHS and HS Metro services of both routes through Pancras Cross and on to HS5, superlative cross-London inter-regional HS services are enabled, between 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.

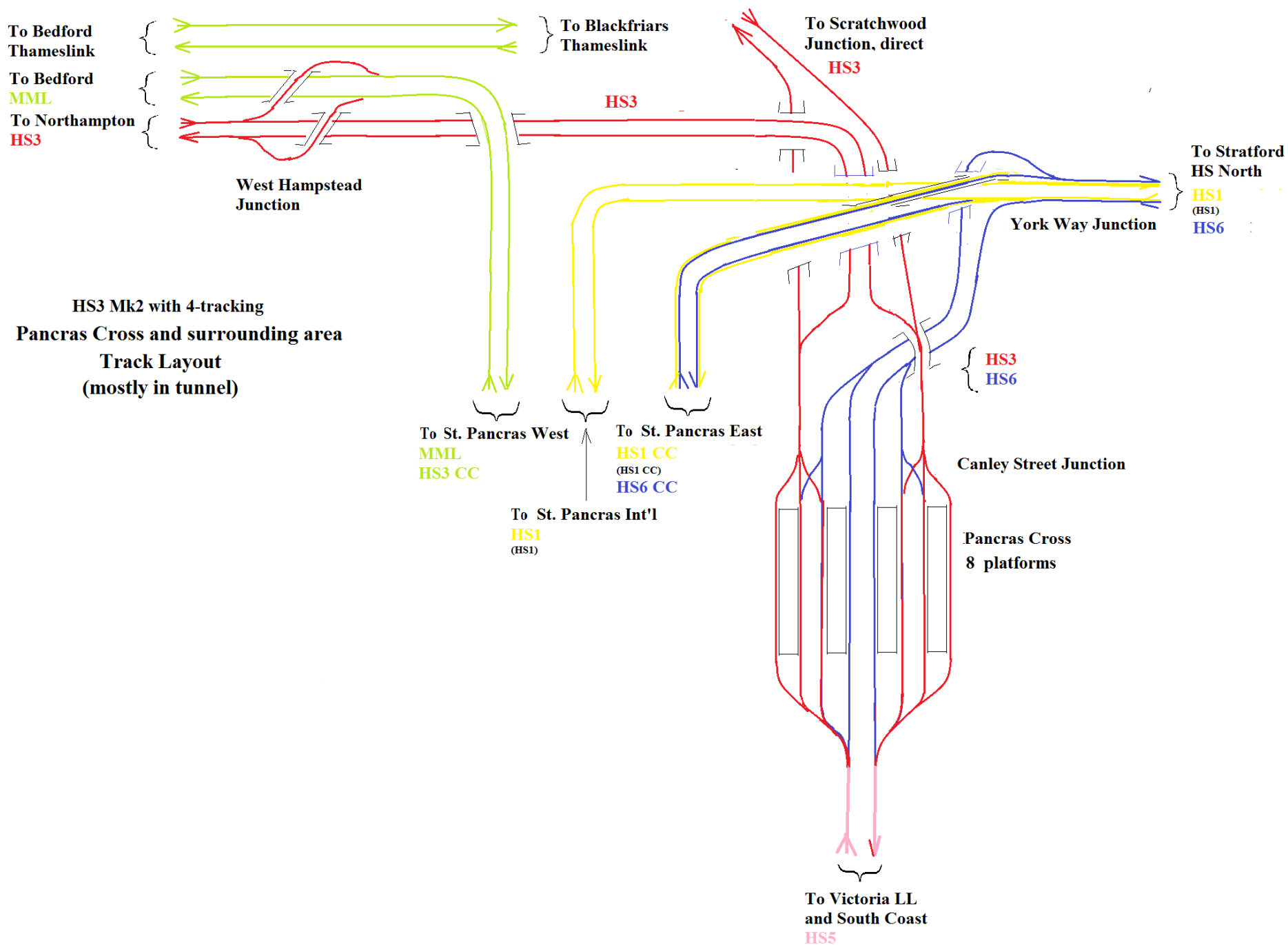
The track diagram of Pancras Cross and its surroundings is on the next two pages. The layout is not especially complicated, but there are a few points to note. The second version, for HS3 Mk2 with 4-tracking, is extra futuristic and speculative.

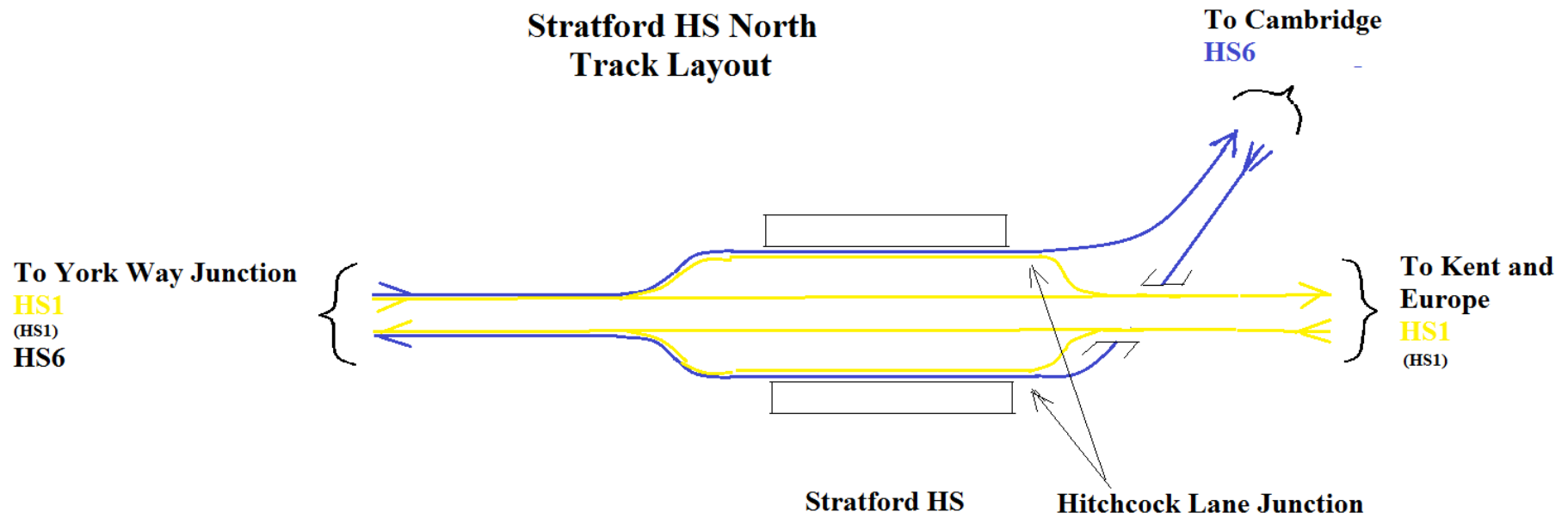
The middle two platform faces at Pancras Cross would ordinarily be used by HS6 trains and the two outer pairs by HS3. The scissors crossovers are provided for operational flexibility, but should not normally be used. I would like to see **passive** provision for 8 platforms, as is indicated in the diagram.

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).







Appendix C – Distance Table for HS1 and Other Lines

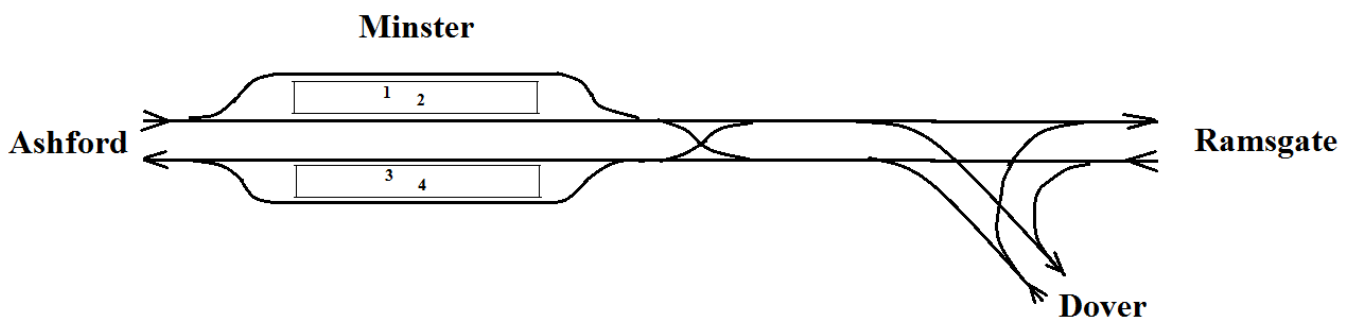
Distance Table for HS1		
St. Pancras International to:	miles:chains	km
Stratford HS North		9.47
Ebbsfleet		36.16
North Downs Tunnel South Portal		51.23
Ashford West Junction		88.31
Ashford station (assumed!)		90.50
Ashford East Junction		92.72
Dollands Moor West Junction		105.67
Distance Table for Other Lines		
Ashford station to:	miles:chains	km
Appledore	8:41	13.70
Rye	15:27	24.68
Winchelsea	17:13	27.61
Ore	25:33	40.89
Hastings	26:25	42.34
St. Leonard's Warrior Square	27:03	43.50
Bexhill	30:76	49.27
Eastbourne	40:68	65.73
Saltwood Junction	10:29	16.67
Folkestone Central	13:64	22.20
Dover Priory	21:14	34.07
Canterbury West	14:18	22.89
Minster	25:55	41.33
Ramsgate	29:58	47.83
Margate	34:70	56.11
Ebbsfleet / Northfleet station to:	miles:chains	km
Strood	9:13	14.74
Rochester	10:16	16.41
Chatham	10:60	17.30
Gillingham	12:30	19.91

The source of the above data is 'Track Atlas of Mainland Britain' (TRACKmaps 2009). The values for HS1 are given directly in km, but for classic lines are given in miles and chains (80 chains = 1 mile). Oddly enough, the source gives distances for HS1 to Ashford West and East Junctions, but not to the station itself – I assume this is mid-way between them. Ashford station is 56m 9ch from Charing Cross via Paddock Wood (this is 90.29km, almost identical to my assumed value of 90.50 km from St. Pancras). The distances thence to Dover Priory (nearly) and to Hastings are given to the same datum. However the immediate approach to Dover Priory is measured from Victoria via Gillingham and Canterbury East (because it was built by the London, Chatham and Dover railway rather than by the South Eastern, why do you think?) – this accounts for the final 50chains!!! Similarly Ashford – Ramsgate is SER, whereas Margate – Ramsgate is LCDR. The section from Hastings to Bopeep Junction (all 1m 44ch of it – you couldn't make this stuff up!) is measured from Charing Cross via Tunbridge Wells, and the final section west of Bopeep Junction has its datum at Brighton (because it was built by the London, Brighton and South

Coast railway, rather than the South Eastern, naturally). All in all, this stuff is so damn tedious that, having worked it out once, I'm documenting and preserving the results so that I don't ever have to do it again.

For the distances to Gillingham, I am assuming that Ebbsfleet and Northfleet are effectively the same station, and thus take Northfleet's distance from Charing Cross, 21m 69ch, as the datum. (The document **implies** this, but, irritatingly, doesn't state it explicitly.)

Appendix D – Station Arrangements at Minster



This really is quite trivial. Two extra platform faces and a scissors crossing are really all that's required in addition to what exists already.

RS Services from Ramsgate to Dover use the scissors crossing to reach platform 1, where they reverse, making a cross-platform connection with the HS1 service from London to Margate, providing connections from London to Sandwich, Deal, Walmer and Martin Mill. RS services from Dover to Margate use platform 4, where they reverse, making a cross-platform connection with the HS1 service from Margate to London, providing connections to London from Martin Mill, Walmer, Deal and Sandwich, using the scissors crossing on departure. Traffic levels are such that flat crossings throughout are entirely adequate.