TECHNICAL NOTE

CHINGFORD TO STRATFORD RAIL SERVICE – OPERATIONAL FEASIBILITY REVIEW

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1. INTRODUCTION

1.1 Background

1.1.1 In 2009, Waltham Forest Council, commissioned an appraisal of a proposal to introduce a direct rail service between Chingford and Stratford, requiring reinstatement of the abandoned Hall Farm curve, connecting the Chingford branch with the direct Tottenham Hale – Stratford route (at Lea Bridge Junction, north of Lea Bridge station). This appraisal was undertaken by Systra, then known as MVA Consultancy.

1.1.2 An earlier report, undertaken by Hyder Consulting and Maines Consulting in 2002, had demonstrated the technical feasibility of this reinstatement; the 2009 Appraisal confirmed that the demand for such a service would be sufficient to support a strong business case for the scheme.

1.1.3 The 2009 Appraisal also confirmed that, against the background of the passenger train services and other train movements (principally freight) operating at that time, it would be operationally feasible to introduce such a service, at a frequency of generally 4 trains per hour (tph).

1.2 Objective

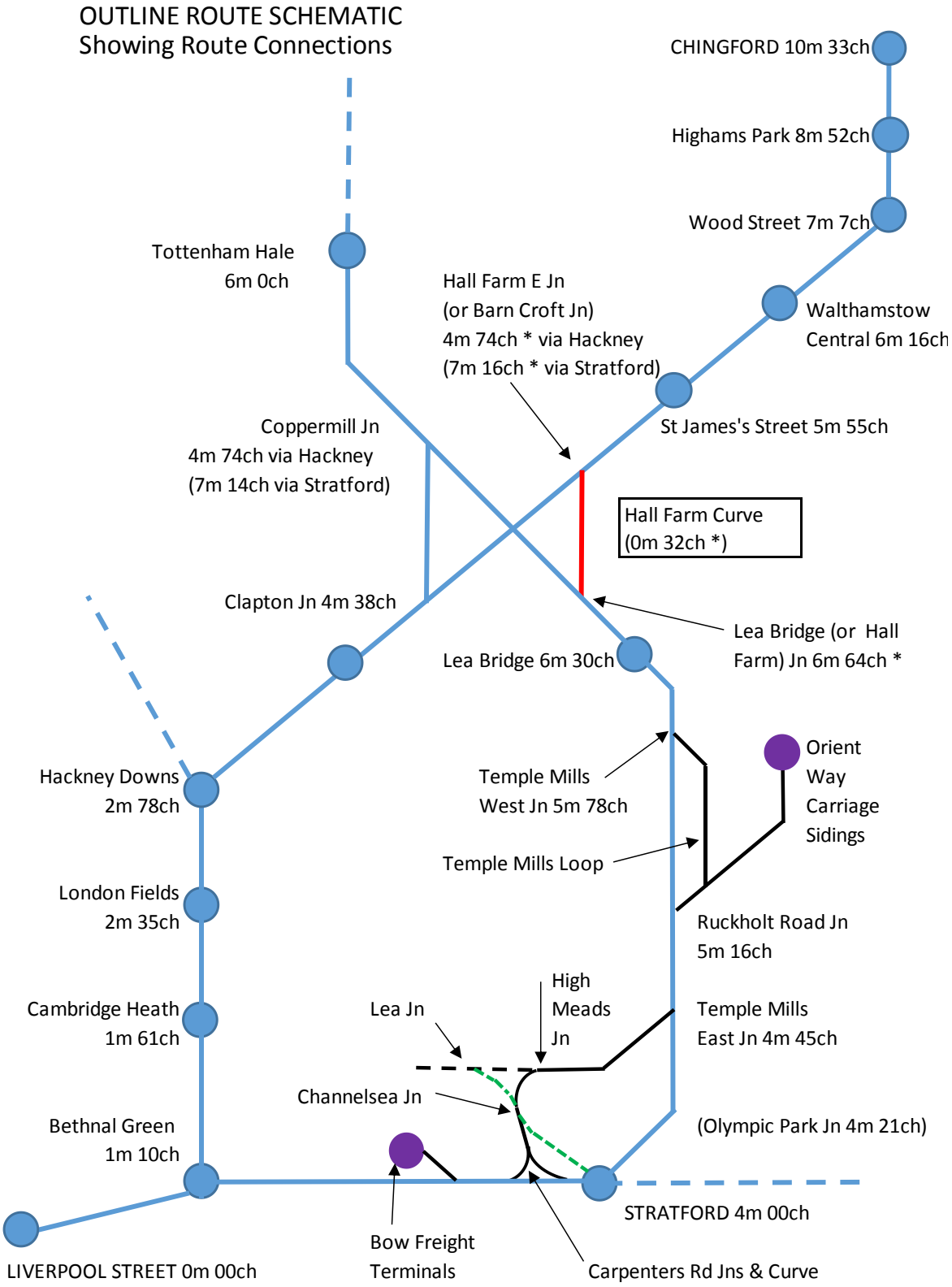
1.2.1 SYSTRA Ltd has been commissioned by Waltham Forest Council in September 2016 to undertake a fresh assessment as to the operational feasibility of a 2tph service, in the light of significant changes to railway infrastructure and train service / operating patterns which have taken place since 2009 and which are planned for the medium-term future. The principal changes identified are:

- In 2011, a major new carriage stabling and maintenance facility was opened on the site of the former Temple Mills freight yard, that is, on the east side of the Stratford to Tottenham Hale route, replacing the former facility at Thornton Fields;
- The frequency of the passenger train service along the Stratford to Tottenham Hale route, already increased from 1 to 2tph, is planned to be increased to 4tph by 2019;
- Meanwhile, Lea Bridge station reopened in May 2016.

1.2.2 It must be noted that for this assessment we do not have a specific planned 2018 timetable available over which the Chingford – Stratford service can be overlaid in the same way as it was on the existing timetable in the 2009 study. It has therefore been necessary to develop our own timetable at a high level to demonstrate whether or not all the planned services plus the additional Chingford – Stratford service can, at least in principle, be accommodated.

1.3 Approach

1.3.1 Existing and already planned levels of service (frequencies) for the various components of traffic over the respective sections of existing line, across the whole of the 'traffic day' (i.e., when passenger trains operate), Mondays to Fridays, were reviewed, principally using the current (May – December 2016) Network Rail Working Timetables (WTTs) but supplemented by recent actual running data (various dates in September 2016) from Realtime Trains. From this, the traffic day was subdivided into periods with different operating / traffic characteristics, with specific reference to the routes directly or indirectly relevant to the proposed new service.

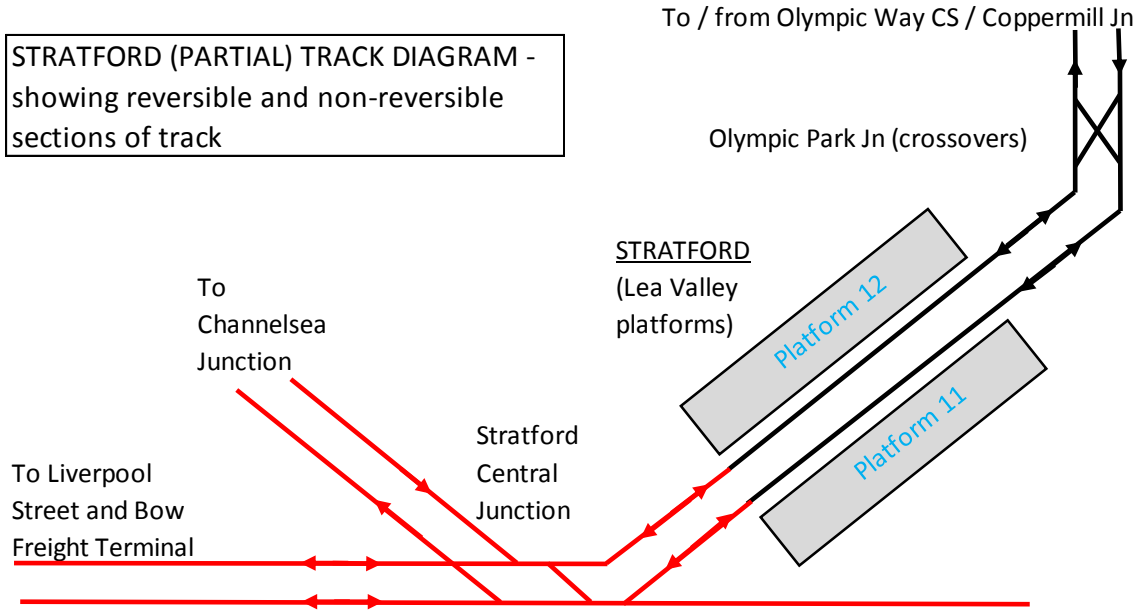


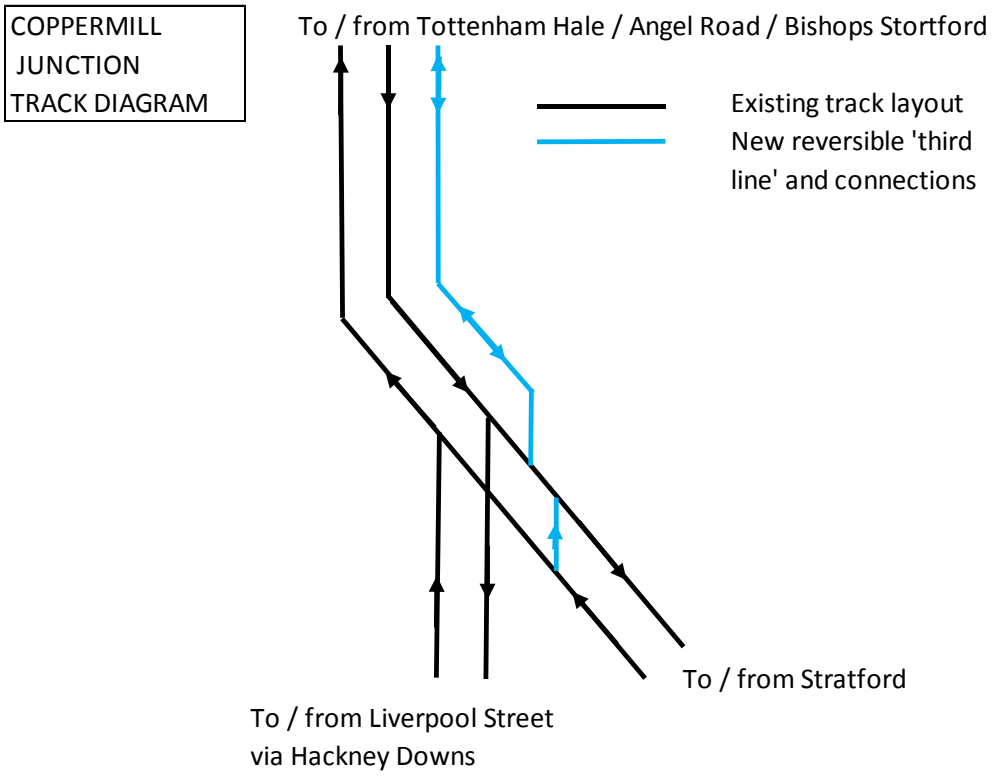
1.3.2 'Pinch point' locations were identified, by analysis of movements, existing and planned, from the various platforms, crossovers, junctions etc. on the route, where desired throughput would be the most demanding.

1.3.3 For each period of the day as identified in 1.3.1, a scheduling pattern (sample hour timetable) was compiled (designed), to balance optimal throughput and even service intervals – for the morning peak, two operating scenarios were designed, for reasons explained below.

1.3.4 Within this process, constraints and trade-offs were identified, where compromises were desirable or essential for the operator (LOROL / Abellio Greater Anglia) or transport authority (TfL / DfT), principally regarding layovers and service 'self-containment', but also considering alternative routeings for non-passenger movements.

1.3.5 The scheduling patterns for respective periods are illustrated in both graphical and tabular form, in Appendices 1 to 4.





2. SERVICE / OPERATIONAL PATTERNS (2016)

2.1 Passenger services

2.1.1 Over the northern part of the route, between Clapton (/ Hall Farm East Junction) and Chingford, services run at generally 4 trains per hour (tph) with generally even intervals: this is **not** increased at peak hours. Chingford has two platforms (nos. 2 and 3) which can be used for both inward and outward passenger services: this provision is ample for this level of service.

2.1.2 Our previous report demonstrated that the operational feasibility of running a further 4tph over the Chingford branch to Stratford. None of the assumptions upon which this finding was based have changed since 2009 or are planned to change by 2018, so we have concluded this this position will still hold for the 2018 timetable and that no further detailed analysis of the Chingford branch itself is necessary in this report.

2.1.3 Between Tottenham Hale (/ Coppermill Junction / Lea Bridge Junction) and Stratford, 2tph, at mostly even intervals (adjusted around the beginning / end of peak periods), run to / from (generally) Bishops Stortford. These all operate via the most direct route in the Stratford area, arriving at / departing from the north-east end of platforms 11 and 12, over the crossovers known as Olympic Park Junction. These trains all terminate at / start from Stratford, principally platform 11 - though some use platform 12 to make space for the occasional non-passenger working which needs to use platform 11. At present, generous layovers, of around 20 minutes, are the norm; hence, platform 11 is generally 'dedicated' to this service, with empty / freight movements routed through platform 12.

2.1.4 No passenger services currently operate via the alternative route (through High Meads Junction and Stratford Central Junction) to approach / depart from the western end of Stratford station. This route is believed to be usable by passenger services – it certainly has been so used at various periods in the recent past – but no such scheduled use is proposed in this review.

2.1.5 London Overground's North London Line services, from Richmond / Clapham Junction to Stratford, operate at up to 8tph in the peaks, and use recently-constructed platforms 1 and 2. This route crosses the one mentioned in 2.1.3 above, at Channelsea Junction; and, while not directly affecting the core routes under review, it is significant within the complete picture insofar as it constrains availability / usable capacity of alternative routeings.

2.1.6 Great Eastern Main Line services, between Liverpool Street / Crossrail and points east of Stratford, use different platforms and tracks and need not be considered for this review.

2.2 Empty Coaching Stock (ECS)

2.2.1 At the beginning of the [passenger] traffic day, and of the weekday evening peak period, empty trains run into Liverpool Street from the principal carriage stabling facility for the area, Orient Way Carriage Sidings (OWCS), which are on the east side of the line between Lea Bridge and Stratford stations. Flows in the opposite direction operate at the ends of the morning peak and the [passenger] traffic day. These flows need to operate at up to 8tph, for periods of around 1.5 hours during the traffic day. At present these all operate through Stratford station, principally platform 12; however, an alternative route exists via Channelsea Junction and High Meads Junction, though this does 'cross' the busy North London route (see 2.1.4).

2.2.2 At the times when these flows operate, they are the dominant flows over the route between Stratford and Ruckholt Road Junction (the track connection for Orient Way Carriage Sidings). At present, the passenger service, which runs at only 2tph, can be accommodated simultaneously with little difficulty.

2.2.3 Additional movements take place, to 'turn' train sets or for driver training / route knowledge, from (and back to) Orient Way sidings, via Stratford station – outward by one of the routes (2.1.2 or 2.1.3 above) and back the other. These are operated at off-peak times.

2.3 Freight / Infrastructure Services

2.3.1 Other movements – principally freight but also track measurement or railhead treatment trains – operate over any and every route in this area. Principal flows are between the Great Eastern main line (east of Stratford) and the North London line, though lesser flows do operate over the Stratford – Coppermill Junction route. However, very few are scheduled through this area during the peaks; and the flows over this route are never greater during the daytime than 2tph.

2.3.2 Of the freight flows over this route, i.e. south of Coppermill Junction, only very few are routed through Stratford station. Most are routed, south of Temple Mills East junction, via High Meads Junction, to / from either the North London Line via Lea Junction, or the freight terminal at Bow via Channelsea Junction.

3. ADDITION OF PLANNED AND PROPOSED PASSENGER SERVICES

3.1 The additional services

3.1.1 It is already planned that an additional service of 2tph will operate all day between Stratford and either Tottenham Hale or Angel Road. (The northern terminus is immaterial to this review). A key part of the project to introduce this service is the construction of what would be a 'third line' (track) northwards from Coppermill Junction, to the east side of the existing Lea Valley route, so that these services would not conflict with, or absorb capacity from, those running to or from Liverpool Street (directly, via Hackney Downs). The principal impact of this, in relation to the proposed Chingford – Stratford service, will be to double the frequency of the existing service between Coppermill Junction and Stratford. It is assumed that they will be timed to provide a combined frequency with the existing services of every 15 mins between Stratford and Tottenham Hale – or, if not feasible to schedule this exactly, then as close as possible, e.g. 17 mins then 13 mins.

3.1.2 The proposed Chingford – Stratford service would then be an overlay of an additional, stand-alone, service of 2tph, upon this increased service south of Lea Bridge Junction, and upon the existing 4tph on the Chingford branch northeast of Hall Farm East Junction.

3.2 Key assumptions and parameters

3.2.1 The following conventions have been adopted in accordance with guidance published by Network Rail (Timetable Planning Rules for Anglia Route), and with scheduling good practice:

- Minimum headways are 3 minutes: that is, at least 3 minutes must elapse before a train can follow a previous one along a section of track in the same direction.
- As the maximum permitted speed is relatively low along the route south of Coppermill junction – 40 mph – all trains run at the same speed for scheduling

purposes, e.g. a passenger train would not 'catch up' with (be delayed by) a preceding freight train.

- 3 minutes are allowed for 'fouling moves' – that is, if one train is to cross the path of another at a junction, a gap of 3 minutes must be scheduled between each such movement. This would be analogous to a 'right turn' on the highway, and would require a 6-minute gap between consecutive 'oncoming' trains, for there to be sufficient time to schedule such a 'crossing' move.
- Similarly, 3 minutes must elapse for 'terminal platform re-occupation', i.e. between one train departing from a platform and the next one arriving in the opposite direction.
- Minimum layovers or 'Turnrounds' – the time between arrival of a train at a station, and departure of the same train in the opposite direction - for trains up to 8 cars, to be 6 minutes.

3.2.2 In some locations, it is permissible for slightly shorter intervals to be scheduled. However, (a) it so happens, in this review, that where this is the case, it is generally of no benefit to exploit it; and (b) good practice – in the interests of service reliability – is to allow greater margins than these as far as possible.

3.3 Off-peak

3.3.1 Current proposals are that the frequencies of the respective services will remain constant throughout the traffic day; that is, there will be no 'peaks' in the usual sense of increased frequency of the passenger train services. However, at certain periods of the day, Mondays to Fridays, movements of empty trains into and out of service are strongly dominant flows. The implications of this are discussed in subsequent sections of this Note (3.4, 3.5).

3.3.2 Please see Appendix 1 for illustration of the points in this section. Over the section of route between Chingford and Hall Farm East Junction, an increase from the current 4tph to 6tph may easily be accommodated. There would only be two conflicting moves per hour, as the (Down) Stratford to Chingford service crosses the path of the (Up) Chingford to Liverpool Street service. The additional demand for platform capacity at Chingford may be satisfied in one of two ways: either (a) scheduling the Liverpool St service to use one platform, constraining the turnaround time for these to maxima of 12 minutes (15 mins service interval minus 3 mins platform reoccupation time), while the Stratford service uses the other of the two usable platforms; or (b) procure a modest upgrade of the signalling capability, such that trains from Platform 1 can proceed in passenger service over the particular crossover necessary for this move. As neither option would require scheduling at any location at a level close to capacity, and hence there exists ample provision for any minor scheduling adjustments which may be necessary to avoid conflicting movements, it is concluded that scheduling over this section of route of the service levels under consideration would not pose significant issues; therefore, further analysis (specific scheduling exercise) over this section is not necessary for the purposes of this study.

3.3.3 However, over the section from Lea Bridge Junction to Stratford, a much greater variety of services / movements are involved, as described in 2.1.2, 2.2, and 2.3 above. The following scheduling matters are illustrated in the timetable graph at Appendix 1.

3.3.4 Non-passenger services traverse this route through Stratford at all times of day, albeit with varying frequencies: therefore, even without the addition of a Chingford service, it would not be feasible for the 20-minute layovers currently scheduled for the existing 2tph service to be perpetuated with the increase to 4tph (described in 3.1.1) – as this would require the occupation of both platforms 11 and 12 for the greater part of every hour. We therefore schedule the 4tph to/from Tottenham Hale / points north to use platform

11, with layovers of 10 or 11 minutes. The consequent timings at Coppermill Junction would schedule a northbound train to 'turn right' onto the new third line there, as described in 3.1.1, crossing over the southbound line just before the passage of a southbound train over the same junction, posing a reliability risk: however, reducing the layovers at Stratford to 9 or 8 minutes would provide an additional 1 or 2 minutes margin, so that is an option (not illustrated).

3.3.5 This leaves platform 12 to be shared between the Chingford service and any non-passenger movements. Here, a similar layover (10 minutes or so) for the Chingford service would be sufficiently robust for recovery of small delays, while leaving the platform vacant for sufficiently long periods - nearly 20 minutes each half-hour - to accommodate non-passenger movements.

3.3.6 Although it may be feasible and could be helpful to schedule the Chingford services close behind or in front of the Tottenham Hale services, the presence of the intermediate station on the common route at Lea Bridge leads to an initial aim of splitting a 15-minute interval between the Tottenham Hale services approximately equally, such that each Chingford service runs 7 – 8 minutes after, and before, adjacent Tottenham Hale services. However, a similar situation as described above (3.3.4) arises with this service, in that the northbound train to Chingford would be due to vacate the new Hall Farm curve only 3 minutes before the next southbound train is due to occupy it. If this curve is constructed as double track there would be no conflict between these services; but if it is single track, this 3 minutes would be the minimum allowance, posing a similar reliability risk. Again, shortening of the layovers by one or two minutes would provide similar mitigation to that risk, while exacerbating another.

3.3.7 This scheduling scenario for the passenger services provides two paths for non-passenger workings through Stratford, generally using platform 12, which may be used in either direction, in each 30-minute cycle: these may be in the same direction or opposite directions. The illustration shows the paths (purple dashed lines) used in the Down / northbound direction in the first 30-minute cycle, and in the Up / southbound direction in the second cycle (30 to 59 minutes). With at least 7 minutes between consecutive passenger trains, and the need to allow 3 minutes between trains, a non-passenger train can be run in any gap between passenger trains, as long as a platform is available at Stratford at the required time.

3.3.8 Additional or alternative paths for non-passenger trains exist which avoid Stratford's platforms 11 and 12, as described in 2.1.3 and 2.3.2 above: these are depicted in dashed green lines in the diagram (Appendix 1). Such southbound movements do cross over the path of northbound movements from / via Stratford at Temple Mills East junction; but at the assumed frequencies of the various other flows, these movements may be scheduled fairly easily so as to avoid delaying other services.

3.3.9 A small number of non-passenger movements, as described in 2.2.3 above, are constrained by track layout to use Platform 11 – which, we assume, would normally be fully occupied by the Tottenham Hale services, posing an apparent problem. However, the proposed schedule provides, every 30 minutes, an opportunity to 'switch roles' between platforms 11 and 12, between departure of a Tottenham Hale service and the next arrival of same, while the Chingford service is not in the station. This would cause platform 12 to be fully utilised by the Tottenham Hale services so that platform 11 can be used by non-passenger movements and the Chingford service – until the roles or uses are 'switched back' at the next opportunity in the cycle.

3.3.10 Other than as described in 3.3.8, all non-passenger moves have been described as traversing the whole route between Stratford and Coppermill Junction: their only points of confliction (crossing over / passing through locations occupied by another train) are

Stratford station itself, and at the junction of the new Hall Farm Curve, where a northbound Chingford train crosses the path of a southbound train from Coppermill junction. The modes of operation at Stratford have been described; and, as can be best understood from the diagram (Appendix 1), the various other scheduling constraints mean that a southbound non-passenger movement would not be scheduled at that location at that point in the cycle anyway.

3.3.11 However, as described in 2.2, a significant component of non-passenger movements consists of empty trains into and out of Orient Way Carriage Sidings (OWCS). Although the majority of these occur within certain peaks (3.4 and 3.5 below), some do take place in the off-peak periods. As OWCS are on the east side of the line, southbound movements out of the sidings constitute a 'left turn', simply using the southern portion of any of the various paths described above (dashed lines from top left to bottom right in the diagram). Hence, any such northbound movements constitute 'right turns' (over Ruckholt Road Junction), and therefore require the 6-minute gap between southbound workings, as explained in 3.2.4 above.

3.3.12 If a delay occurs to an empty train proceeding into the depot, this is better than a delay to an empty train going to form a passenger train at Liverpool Street; so the layout at least provides the easier move for the more important flow.

3.3.13 Within the 30-minute cycle, the non-passenger path which runs in the middle of the wider (15-minute) interval between Down / northbound passenger trains, in the assumed service pattern, puts the train at this junction right in the middle of a 7-minute interval between Up /southbound passenger trains, ideally timed for the ('crossing') move into the carriage sidings.

3.3.14 Moreover, if a second such movement (i.e., into OWCS) is required in one 30-minute cycle, this can potentially be accommodated either by routeing through Channelsea Junction while the Chingford service is in the platform at Stratford; or by using the earlier of the two paths through Stratford. In the latter case this would require rescheduling (or delay) of the southbound service from Tottenham Hale into Stratford by about 3 minutes (dashed BLUE line on the diagram), but this would not be a significant issue.

3.3.15 However, although a particularly even service pattern has been assumed (3.1.1) to be preferred for the passenger services, it may be noted that this is not a constraint, and any viable 6tph passenger service would easily accommodate 2 to 4 such empty (or other non-passenger) movements per off-peak hour, with little or no recourse to [pathing] adjustments (see 3.4.7 below).

3.3.16 We conclude that at off-peak periods, a 2tph Chingford – Stratford service can be accommodated, within / alongside all other planned or anticipated movements, with only a minimal level of adjustment necessary to resolve mutual impacts / constraints.

3.4 Morning Peak

3.4.1 On Mondays to Fridays, towards the end of the morning peak (specifically from approx. 08.30 to 09.45), it is necessary to accommodate a relatively intensive flow of empty passenger trains through Stratford, peaking at a rate of 8 trains per hour, from Liverpool Street to OWCS, as described in 2.1. This contrasts with the passenger service of 6tph in total.

3.4.2 The principal dynamics for this period are that:

- In the Down (northbound) direction, 8tph run from Liverpool Street to OWCS, which, with the passenger service, totals 14tph;

- Between the 8tph into OWCS, need to be scheduled – to cross this flow (in gaps at least 6 minutes wide) – the Up / southbound passenger service of 8tph; while
- The minimum interval between consecutive trains into OWCS is 4 minutes.

The scheduling graph, for a preferred option, for this period is shown in Appendix 2.

3.4.3 Hence, the key pinch point for this period will be Ruckholt Road Junction, where the 'crossing moves' take place (8 Down trains 'crossing' 6 Up trains); at least 3 or 4 minutes need to be scheduled between each movement; and a margin of recovery needs to be allowed, by scheduling trains through at less than 100% of theoretical capacity, to minimise the extent to which a small delay would perpetuate and / or 'ripple out' across the network.

3.4.4 As 14 trains, 4 minutes apart, would keep the junction occupied for 56 minutes of the hour, then clearly it is necessary to schedule movements at this location first, and adjust timings elsewhere – by holding or 'slowing' them as it is not possible to accelerate them - to the extent necessary to 'fit' at those locations.

3.4.5 In essence, the scheduling here is based upon:

- Passenger train passes (both directions);
- Allow at least 3.5 minutes gap, then empty train (into OWCS) passes;
- If the next working needs to be another empty train, allow 4 minute gap before that movement; else, or then,
- Allow at least 3.5 minutes gap, then repeat this 'mini-cycle'.

3.4.6 Projecting these movements north and south, and adopting the same method of platform allocation for Stratford, we find a higher incidence of passenger train movements which, if not adjusted, would conflict with each other, i.e. at Coppermill Junction (trains to 'Third Line'), and Lea Bridge Junction (trains to / from Chingford would pass on, or too close to, the new connection). Retiming affected Up / southbound trains a little earlier, and / or Down / northbound ones a little later – such as by extending the dwell times at Lea Bridge station – eliminates these potential conflictions.

3.4.7 Also, the need for some departing (Down / northbound) passenger trains to wait to follow empty trains, means that the subsequent arriving passenger train may be delayed in its approach, awaiting the vacation of the platform: adjustments which recognise and cater for this are known as "pathing time", built into the schedules in the form of slight extension to journey / running times, and are common and necessary practice. However, layovers are not eroded below 10 minutes, and service intervals remain close to the off-peak standards.

3.4.8 However, the need to accommodate the Chingford service – with viable layovers – in the platform otherwise used for passage of the empty trains, does reduce, by 2tph, the number of empty train movements which may pass through Stratford station. A solution which would be likely to be viable, would be to route two empty movements per hour via Channelsea / High Meads junctions, before re-joining the principal route at Temple Mills East Junction. These would have to 'cross' the North London Line service (2.1.4), during its own peak (8tph each direction); however, (a) even during peaks, paths or 'gaps' are scheduled to accommodate intervening joining / diverging / 'crossing' non-passenger moves; and (b) there are sections of route (Carpenters Road curve and the High Meads loop) where such movements can be held awaiting their 'paths' across or at respective junctions, without delaying movements taking other routes.

3.4.9 Hence, it would be feasible in theory to schedule the required levels of passenger and empty train movements, through this period of the day, i.e. when the scheduling is at its

most demanding, or 'tight', although this will require a high degree of compromise between conflicting operational objectives, principally:

- Minimisation of 'displacement' of passenger service times from off-peak patterns;
- Maintenance of even intervals;
- Optimisation of layovers (turn-round times);
- Minimisation of pathing time in its various forms, for empty as well as passenger movements;
- Adequacy of 'spare' time between conflicting movements so as to maintain robustness and hence reliability.

3.4.10 As already outlined, the quantity and combination of movements to be accommodated would approach the theoretical limits; and as such, Network Rail – or other stakeholders (Train Operating companies) – may not be content to schedule such a service pattern. In essence, the part of the route deemed to be 'full' would be Ruckholt Road Junction to Stratford station. In that event, a compromise option would be to operate a service over the new curve, as far as Lea Bridge station, where passengers between the Chingford branch and Stratford would need to change into / from the Tottenham Hale services. Under current assumptions / operations, this arrangement would apply in lieu of arrivals into Stratford (from Chingford) between approximately 08.20 and 10.00. The scheduling graph, for this option, is shown in Appendix 3. Operationally, the train from Chingford would terminate ('de-train' the passengers) in the southbound platform of Lea Bridge; proceed empty forward to Temple Mills Loop, layover / reverse there; and move to the northbound platform, departing in passenger service to Chingford. This option may offer significantly lower passenger benefits compared to running the service through to Stratford, due to passengers for Stratford having to change trains at Lea Bridge, and this may make the business case for this option unattractive.

3.4.11 Depending on the signalling arrangements and restrictions, this may not be entirely straightforward, because the southern exit of this (Temple Mills) loop is also the crossover used by trains proceeding into / out of OWCS, and safety interlockings may prohibit such movements occurring simultaneously; however, even in that event, a number of 'windows' will exist per hour for such a movement.

3.4.12 Hence, during this morning peak period, any increase in train service levels will impose increasing levels of mutual 'interference' between empty and passenger train movements, principally at two 'pinch points'.

3.4.13 **However this analysis demonstrates that, *in principle*, the 2tph Chingford – Stratford service, along with the planned 2tph increase in the Tottenham Hale services can be accommodated into schedules which are compliant with the Planning Rules, but which require some considerable operational adjustments and trade-offs that may not be acceptable to other stakeholders.**

3.4.14 Although we consider that these adjustments will not result in unacceptable degree of erosion of reliability margins, train operators and other stakeholders may be concerned about the risks to their train services. This analysis has demonstrated that 6tph (each direction) passenger service with 8tph empty into Orient Way Carriage sidings, is a maximal combination (i.e. it would not be possible to further increase one of these flows without a balancing reduction of the other).

3.5 Evening Peak

3.5.1 Correspondingly with the morning peak situation, on Mondays to Fridays, a similarly intensive flow of empty passenger trains, from OWCS to Liverpool Street, needs to be accommodated, again at up to 8tph, and passing through Stratford between

approximately 16.30 and 17.45. Again, this contrasts with the passenger service of 6tph in total.

3.5.2 Current practice is to schedule 6 minutes between consecutive departures from OWCS, which has the effect of increasing the occupancy of the Up / southbound line at Ruckholt Road Junction. However, as there are no 'crossing' moves here, only 'merging', the Down / northbound passenger service can be scheduled through this location without any constraints imposed by the empty train workings.

3.5.3 In this pattern of flows, the platform working convention adopted for the other times of the day – Chingford service and non-passenger trains using platform 12, and the (4tph) Tottenham Hale service using platform 11 – would require that departure movements of the latter would have to cross the dominant flow constituted by the former, and thereby be constrained to the gaps within it. However, if we swap the platform usage over, the departures of the Tottenham Hale service from platform 12 will be parallel, not conflicting, with the empty train movements now routed via platform 11. The scheduling graph for this period is shown in Appendix 4.

3.5.4 Thus, the Chingford service will need to share platform 11 with these empty train movements, and hence its layovers will be constrained by the need to keep that platform unoccupied for enough time each cycle (30 minutes) to permit the passage of sufficient Up empty trains. The minimum permitted layover time is 6 minutes (see 3.2.6); however, we find that here 7 or 8 minutes can be scheduled relatively easily.

3.5.5 Hence, throughout the evening peak period, a 2tph Chingford – Stratford service can be accommodated, within / alongside all other planned or anticipated movements, with a minimal level of adjustments necessary to resolve mutual impacts / constraints.

4. WIDER CONSIDERATIONS

4.1.1 Through its timetable planning processes, Network Rail seeks to facilitate to the greatest extent possible the safe and reliable operation of train services required or desired by train operators. Where this traffic on offer approaches or exceeds the maximum possible throughput for any given location, this requires a balance to be struck between the throughput / volume scheduled, and the degree of margin / contingency – which may be thought of as 'spare minutes per hour' necessary or desirable to absorb minor delays which may be experienced by any trains approaching such pinch points. Specifications for this are not published; therefore, while we base this analysis on professional train scheduling knowledge and experience, any such analysis, does not constitute any guarantee of acceptability by Network Rail.

4.1.2 Representations of timetables in this Note are to be understood as being relative to whatever time may be chosen as the start time, or reference time, for the cycle. For example, "25" should not be taken as "25 minutes past any hour", but as "25 minutes into each cycle". Although the cycles are 30 minutes, this analysis shows two consecutive cycles for clarity, i.e. a whole hour, and the graphic portrayals do show "00" to "59"; but "35" may be read as "05", etc.

4.1.3 It must be noted that, to arrive at a complete 'set' of timetables for routes in the area, overlays / interworkings already need to be balanced / optimised between at least these routes or flows:

- Liverpool Street to [points north of] Tottenham Hale;
- Liverpool Street to Chingford;

- Stratford to [points north of] Tottenham Hale;
- Liverpool Street to Orient Way Carriage Sidings (empty workings); and
- Liverpool Street to [points east of] Ilford.

4.1.4 The addition of a Chingford – Stratford service into this mix will interwork with three of these flows. Therefore, the actual 'cycle start times' referred to in 4.1.2, will be determined principally by the timetabling of the services listed in 4.1.3.

4.1.5 Moreover, to determine whether a Stratford – Chingford service would be operable within this larger network, it would be necessary to extend the geographical scope of this study to identify and assess the interactions with and between ostensibly independent services, taking into account respective priorities, constraints, and degrees of flexibility regarding departure times, headways, and so on. For example, to what extent would it be acceptable to vary 4tph services from exact 15-minute intervals – would 20min / 10 min be acceptable? This would be likely to be different for the Stansted Express, from the Enfield services, for example.

4.1.6 There have previously been aspirations to run the planned Stratford to Angel Road service at 4tph, alongside the continuation of the existing 2tph service between Stratford and other, more distant, Lea Valley route destinations - currently, principally Bishops Stortford, though this has been Stansted Airport in the past. But at present the planned service is limited to 2tph by the single track section planned between Tottenham Hale and Angel Road, the 'third line' as described in 3.1.1. If this constraint was overcome and a 4tph Stratford to Angel Road service could be realised, this would conflict with the 2tph Chingford to Stratford service, as it would require the same paths south of Coppermill / Lea Bridge Junctions – because, in essence, although this analysis has demonstrated the feasibility of a total of 6 passenger trains per hour over the common route, it is clear that – at least in peak periods – this would be the upper limit. That is, it would not be possible to operate simultaneously, 2tph Stratford – Bishops Stortford, and 2tph Stratford – Chingford, and **more than** 2tph Stratford – Angel Road – because, although such an analysis was not part of the remit for this work, it can be concluded that such an alternative proposal would encounter principally the same issues and challenges, and would need to adopt essentially the same solutions, as discussed in this Note. It may therefore be that, notwithstanding the operational feasibility and strength of case of a Stratford – Chingford service, it could 'come second' in a potential competition for use of such capacity into Stratford.

4.1.7 In any transport system, any increase in traffic over a given constrained infrastructure will result in a degree of reduction of margins ('spare' time), and hence an increase in reliability risk. This risk increases only slightly where a high level of spare capacity still remains, but sharply where spare capacity is already scarce. This study has demonstrated that at peak periods, at and around Stratford, the reliability risk increase from the addition of this proposed train service would be in a higher bracket; however, informal comparison with other locations on the national rail network, such as Herne Hill, let alone more intensive operations such as the London Underground, shows that this would still be some way short of levels routinely accepted, albeit not welcomed, elsewhere.

5. CONCLUSION AND SUMMARY

5.1.1 The following conclusions are subject to the assumptions and conventions described earlier in this Note.

5.1.2 A half-hourly (2 trains per hour) rail service can be accommodated, without difficulty, at all 'off-peak' times, to run between Chingford and Stratford, over a reinstated Hall Farm Curve. With respect to the dimension of frequencies of trains, it is noted that the

Chingford Branch itself (from Clapton Junction) does not have such a peak, as services operate at a maximum frequency of 4 tph all day. That is, the service could be accommodated at all times over this part of its route.

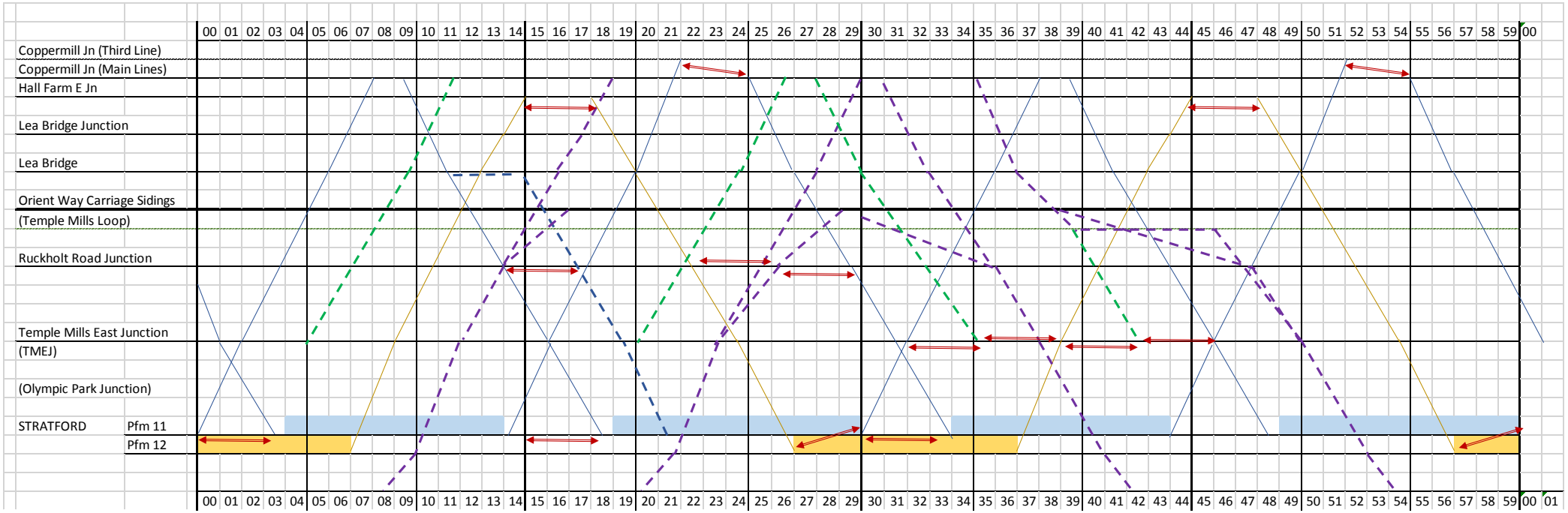
5.1.3 On the Stratford to Tottenham Hale route, however, peak periods have been identified as those times of the day, Mondays to Fridays, during which flows at rates exceeding two, and up to eight, empty trains per hour are required to run into or out of Orient Way Carriage sidings. During the evening peak, when the flow of empty trains is out of these sidings, the combined (with passenger services) 'peak direction' flow, and sufficient time for layovers of the terminating passenger trains, can be accommodated at Stratford, with a reasonable degree of resilience; there is no significant degree of conflicting movements.

5.1.4 However, during the morning peak, the flow of empty trains crosses the southbound line to access these sidings, and hence the scheduling of both the southbound and northbound passenger services is very restricted by the need to interleave them between the (dominant) empty train workings. This does require a high degree of compromise between the priorities of the flows; nevertheless, acceptance of this does enable viable scheduling of all flows, though the scheduled throughput would be at or near the limits of capacity.

5.1.5 Overall, this analysis has demonstrated that a 2tph Chingford – Stratford service is, *in principl*e, plannable with some operational adjustments during the peaks. However further analysis is required before its deliverability can be confirmed. In particular, a more extensive timetabling exercise is required that considers a wider area of the network and how constraints on these routes may affect the timing of services on the critical section of route between Stratford and Coppermill Junction. Work also needs to be undertaken to establish whether the operational compromises identified will be acceptable to operators and other stakeholders.

5.1.6 It is, furthermore, also demonstrated that if the Hall Farm Curve were to be reinstated as a single track instead of double, this would impose considerable risks to reliability, especially at the times (peaks) when this would be most problematical - in addition to the scheduling constraints that would be imposed throughout the day. It is therefore strongly recommended that a reinstated connection should be built as double track.

APPENDIX 1 – TRAIN SCHEDULING REPRESENTATION: OFF-PEAK



SCHEME

Blue = Tottenham Hale (Bishops Stortford / Angel Road) services

Gold = Chingford service

Purple dotted = freight / empty stock path via Pfm 12 (or 11 if passenger workings 'switched').

Green dotted = additional or alternative freight / empty stock path via High Meads (hence not shown south of TMEJ).

Red double-ended arrows denote minimum time spacing requirements between conflicting or 'crossing' (northbound with southbound) movements

First half hour shows nonpassenger workings in Down direction (Stratford to Lea Bridge etc), second half hour shows Up paths.

TO NOTE:

1 Other than Stratford platforms, the main pinch point on this pattern is that, with layovers of approx 10 mins, the up & down Chingford services would cross close to the reinstated curve.
If the curve is single track (or has single lead junction(s)), the second of these has to be scheduled to traverse it at least 3 mins after the first has done so.
Any increase in this margin would (a) reduce the layover, and (b) impact the regularity of the intervals with the other service(s).

2 Up (SB) xx09.5 or xx39.5 ex Coppermill Jn would need to be held at Lea Bridge (or signal protecting Ruckholt Rd Jn) for 3 mins if conflicting path into OWCS (Orient Way Carriage Sidings) is used (hence dotted blue line).

3 If the second of the Up nonpassenger paths [per half-hour] is required for a working from north of Orient Way, it will have to run ahead of the xx39.5 passenger service from Coppermill Jn,
- and be held in Temple Mills loop while the latter passes. If it were to follow that passenger working, it would conflict at Lea Bridge Jn with a down Chingford service.
If it were to precede that passenger working beyond TMEJ, it would conflict with the next departure from Stratford Pfm 11.

4 At Coppermill Jn, the only conflicts relating to the train movements under consideration, are those where a Down train runs to the Third Line, and crosses the path of Up trains from the Main lines
(or, awaits the vacating of the Third Line by the preceding Up train therefrom).
Hence, these are the only movements explicitly shown as using the Third Line.

5 To accommodate nonpassenger workings constrained to use Pfm 11, the usages of Pfms 11 & 12 can be swapped / swapped back after the xx15 or xx45 departures.

6 Although most of the ECS moves from Liverpool St to OWCS take place between 08.30 and 09.30 through Stratford (accommodated as per AM Peak sheet), or after midnight, a few closely-spaced ones run after 21.30.
It may be necessary to operate the AM Peak pattern for half an hour or so, around this time, accordingly.

CONVENTIONAL TIMETABLE FORMAT: OFF-PEAK

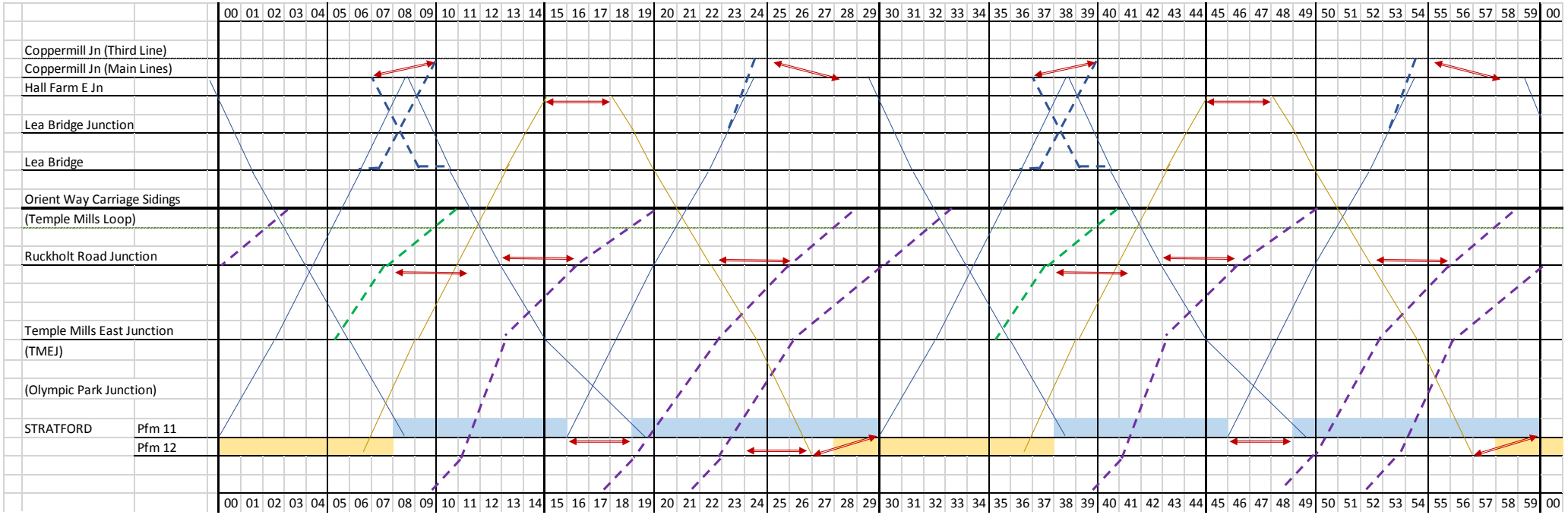
UP	P1	PC	P2*	P3	PC	P4	F1	F2a	E2b	PC	F3a	F3b/4a	P5	F3b/4a	F4b	P6	PC	P1
CHINGFORD		10:55		11:06	11:10					11:25						11:36	11:40	
St. James's Street		11:06		11:17	11:21					11:36						11:47	11:51	
Hall Farm E. Junction		11/07		11/18	11/22					11/37						11/48	11/52	
Clapton		11:08		|	11:23					11:38							11:53	
Tottenham Hale	10:53	|	11:07½	|	|	11:23	11/26	11/29½		|	11/33	11/33	11:37½				|	11:53
Coppermill Junction	10/55	|	11/09½	|	|	11/25	11/28	11/31½		|	11/35	11/35	11/39½				|	11/55
Lea Bridge Junction	10/56	|	11/10½	11/19	|	11/26	11/29	11/32½		|	11/36	11/36	11/40½			11/49	|	11/56
Lea Bridge	10:57	|	11:11½	11:20	|	11:27	11/30	11/33½		|	11/37	11/37	11:41½	<-----		11:50	|	11:57
Temple Mills Loop		Via Hackney Downs			Via Hackney Downs					Via Hackney Downs		11:39½		11:46				Via Hackney Downs	
Orient Way CS									11:29			----->			11:41				
Ruckholt Road Jn	10/59½		11/14	11/22½		11/29½	11/32½	11/36	11/36		11/39½		11/44	11/48	11/48	11/52½		11/59½
Temple Mills E. Jn.	11/01½		11/16	11/24½		11/31½	11/34½	11/38	11/38		11/41½		11/46	11/50	11/50	11/54½		12/01½
High Meads Jn		|		|		11/36½			|	11/43½							
STRATFORD Pfm 12		|		|			11/41	11/41	|				11/53	11/53	11:57	|	
Pfm 11	11:04	|	11:18½		|	11:34				|			11:48½				|	12:04
Bow Depot		|			|			11:47		|				11:59			|	
Liverpool Street		11:21			11:36				11:51	11:51					12:03		12:06		
Forms departure:	11:14		11:30	11:37		11:44							12:00			12:07		12:14

P2*: Note - If Down path E2a (below) is used, it conflicts with Up P1 at Ruckholt Rd Jn: so P1 Up is held at Lea Bridge for 3 mins and runs later into Stratford.

DOWN	PC	P1	F1a	E1b	P2	PC	E2a*	F2b	P3	F3	F4a	E4b	PC	P4	P5	PC	P6	P1
Arrived		10:48½			10:57				11:04					11:18½	11:27		11:34	11:48½
Liverpool Street	10:48			10:50		11:03	11:00					11:12	11:18			11:33		
Bow Depot	|					|		11:04			11:16						
STRATFORD Pfm 11	|	11:00				|			11:14				|	11:30		|	11:44	12:00
Pfm 12	|				11:07	|	11/10	11/10½			11/22	11/22	|		11:37	|		
High Meads Jn	|		11/02	11/02		|				11/17			|			|		
Temple Mills E. Jn.	Via Hackney Downs	11/02	11/05	11/05	11/09	Via Hackney Downs	11/12	11/12½	11/16	11/20	11/24	11/24	Via Hackney Downs	11/32	11/39	Via Hackney Downs	11/46	12/02
Ruckholt Road Jn		11/04	11/07	11/07½	11/11		11/14	11/14½	11/18	11/22	11/26	11/26		11/34	11/41		11/48	12/04
Orient Way CS				11:11			11:17					11:29						
Temple Mills Loop																		
Lea Bridge	|	11:06	11/09		11:13	|		11/16½	11:20	11/24	11/28		|	11:36	11:43	|	11:50	12:06
Lea Bridge Junction	|	11/07	11/10		11/14	|		11/17½	11/21	11/25	11/29		|	11/37	11/44	|	11/51	12/07
Coppermill Junction	|	11/08	11/11			|		11/18½	11/22	11/26	11/30		|	11/38		|	11/52	12/08
Tottenham Hale	|	11:10	11/13			|		11/20½	11:24	11/28	11/32		|	11:40		|	11:54	12:10
Clapton	10:58					11:14			LL				11:28			11:44	LL	
Hall Farm E. Junction	11/01				11/15	11/17							11/31		11/45	11/47		
St. James's Street	11:02				11:16	11:18							11:32		11:46	11:58		
CHINGFORD	11:14				11:27½	11:30							11:44		11:57½	12:00		

LL = Runs to (new) Local Line (or Third Line) at Coppermill Junction. See above re path E2a*.

APPENDIX 2 – TRAIN SCHEDULING GRAPHIC REPRESENTATION: MORNING PEAK (1: PREFERRED)



SCHEME

Blue = Tottenham Hale (Bishops Stortford / Angel Road) services

Gold = Chingford service

Purple dotted = freight / empty stock path via Pfm 12 (or 11 if passenger workings 'switched').

Green dotted = additional or alternative freight / empty stock path via High Meads (hence not shown south of TMEJ).

Red double-ended arrows denote minimum time spacing requirements between conflicting or 'crossing' (northbound with southbound) movements

Shaded cells = platform occupied for layover / reversal

TO NOTE:

1 Other than Stratford platforms, the main pinch point on this pattern is Ruckholt Rd Jn, with the need to cross 8tph of empty trains into OWCS, at 4 min headways
- over the 6tph passenger service in the opposite direction, with at least 3 mins (pref. more) between conflicting moves.
This accounts for 50 mins junction occupation per hour.

2 To avoid eroding 'crossing paths', it is desirable / necessary for northbound 'through' (passenger) movements here to take place close to the times of the southbound ones.
This has therefore required some adjustments of the passenger services (to run a few mins earlier / later than off-peak) to achieve this.
In particular, the small adjustment in the Chingford service at the Stratford end results in a conflicting move over the new [Hall Farm] curve; therefore, the timings are adjusted further in that area to resolve this.

3 This does require that at least one of the empty trains per half-hour from Liverpool St to OWCS, be rerouted from Carpenters Rd Sth Jn via High Meads Jn
Although the additional running time is minimal, the key issue here is that it crosses the NLL service of London Overground, operating at 8tph each direction at that time, at Channelsea Jn.
However, current scheduling practice for this service is for EB services to pass WB at, or very close to, Channelsea Junction, maximising the number of viable paths for such 'crossing' movements:
offering 4 at 6.5 mins each and 4 at 8.5 mins each: the latter are certainly sufficient to pass empty coaching stock with minimal performance impact.

4 An alternative strategy is for the southbound Chingford service to be rerouted via High Meads [and undertake the crossing move, albeit in the opposite direction].
This has been explored, but as it produces an additional conflicting move at a busy location [TMEJ], this was found less satisfactory.

5 In this pattern, the services to /from north of Tottenham Hale would 'naturally' pass at Coppermill Jn; however, those Down trains proceeding to the Third Line would conflict with Up services. Dashed lines show the required adjustments.

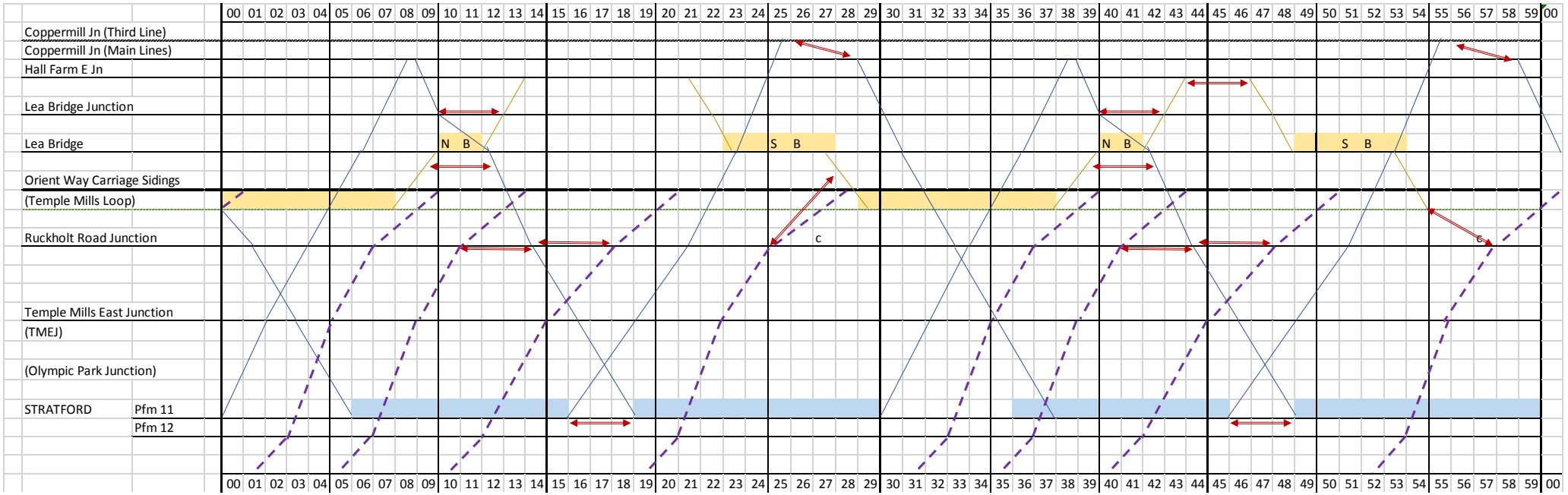
UP	P1	PC		P2	P3	PC		P4	PC		P5	P6	PC		P1

CHINGFORD		08:55			09:06	09:10			09:25			09:36	09:40			
St. James's Street		09:06			09:17	09:21			09:36			09:47	09:51			
Hall Farm E. Junction		09/07			09/18	09/22			09/37			09/48	09/52			
Clapton		09:08			|	09:23			09:38			|	09:53			
Tottenham Hale	08:56½	|		09:06½	|	|		09:26½	|		09:36½	|	|		09:56½
Coppermill Junction	08/59½	|		09/08½	|	|		09/29½	|		09/38½	|	|		09/59½
Lea Bridge Junction	09/00½	|		09/09½	09/19	|		09/30½	|		09/39½	09/48	|		10/00½
Lea Bridge	09:01½	|		09:10½	09:20	|		09:31½	|		09:40½	09:50	|		10:01½
Temple Mills Loop		Via Hackney Downs				Via Hackney Downs			Via Hackney Downs				Via Hackney Downs			
Orient Way CS																
Ruckholt Road Jn	09/04			09/13	09/22½			09/34				09/43	09/52½			10/04
Temple Mills E. Jn.	09/06			09/15	09/24½			09/36				09/45	09/54½			10/06
High Meads Jn		|			|	|			|				|		
STRATFORD Pfm 12		|			09:27	|			|			09:57	|		
Pfm 11	09:08½	|		09:19½		|		09:38½	|		09:49½		|		10:08½
Bow Depot		|				|			|				|		
Liverpool Street		09:21				09:36			09:51					10:06		
Forms departure:	09:16			09:30	09:37			09:46				10:00	10:07			10:16

DOWN	**P1**	*E1*	**P2**	PC	*E2*	**P3**	*E3*	*E4*	PC	**P4**	*E5*	**P5**	PC	*E6*	**P6**	*E7*	*E8*	PC
Arrived	08:49½		08: 57			09:07				09:19½		09: 27			09:37			
Liverpool Street		*08:48*		09:03	*08:58*		*09:04*	*09:10*	09:18		*09:18*		09:33	*09:28*		*09:34*	*09:40*	09:48
Bow Depot				|					|			|					|
STRATFORD Pfm 11	09:00			|		09:16			|	09:30			|		09:46			|
Pfm 12			09:07	|	*09/11*		*09/19*	*09/23*	|			09:37	|	*09/41*		*09/49*	*09/53*	|
High Meads Jn		*09/02*		|					|		*09/32*		|				|
Temple Mills E. Jn.	09/02	*09/05*	09/09	Via Hackney Downs	*09/13*	09/18	*09/21½*	*09/25½*	Via Hackney Downs	09/32	*09/35*	09/39	Via Hackney Downs	*09/43*	09/48	*09/51½*	*09/55½*	Via Hackney Downs
Ruckholt Road Jn	09/04	*09/07½*	09/11		*09/16½*	09/20	*09/26*	*09/30*		09/34	*09/37½*	09/41		*09/46½*	09/50	*09/56*	*10/00*	
Orient Way CS		*09:11*			*09:20*		*09:29*	*09:33*			*09:41*			*09:50*		*09:59*	*10:03*	
Temple Mills Loop																		
Lea Bridge	09:06		09:13	|		09:22			|	09:36		09:43	|		09:52			|
Lea Bridge Junction	09/07		09/14	|		09/23			|	09/37		09/44	|		09/53			|
Coppermill Junction	09/08			|		09/24			|	09/38			|		09/54			|
Tottenham Hale	09:10			|		09:26			|	09:40			|		09:56			|
Clapton				09:13		LL			09:28				09:43		LL			09:58
Hall Farm E. Junction			09/15	09/17					09/31			09/45	09/47					10/01
St. James's Street			09:16	09:18					09:32			09:46	09:49					10:02
CHINGFORD			09:28	09:30					09:44			09:58	10:00					10:14

LL = Runs to (new) Local Line (or Third Line) at Coppermill Junction.

APPENDIX 3 – TRAIN SCHEDULING GRAPHIC REPRESENTATION: MORNING PEAK (2: ALTERNATIVE; not depicted in tabular form)



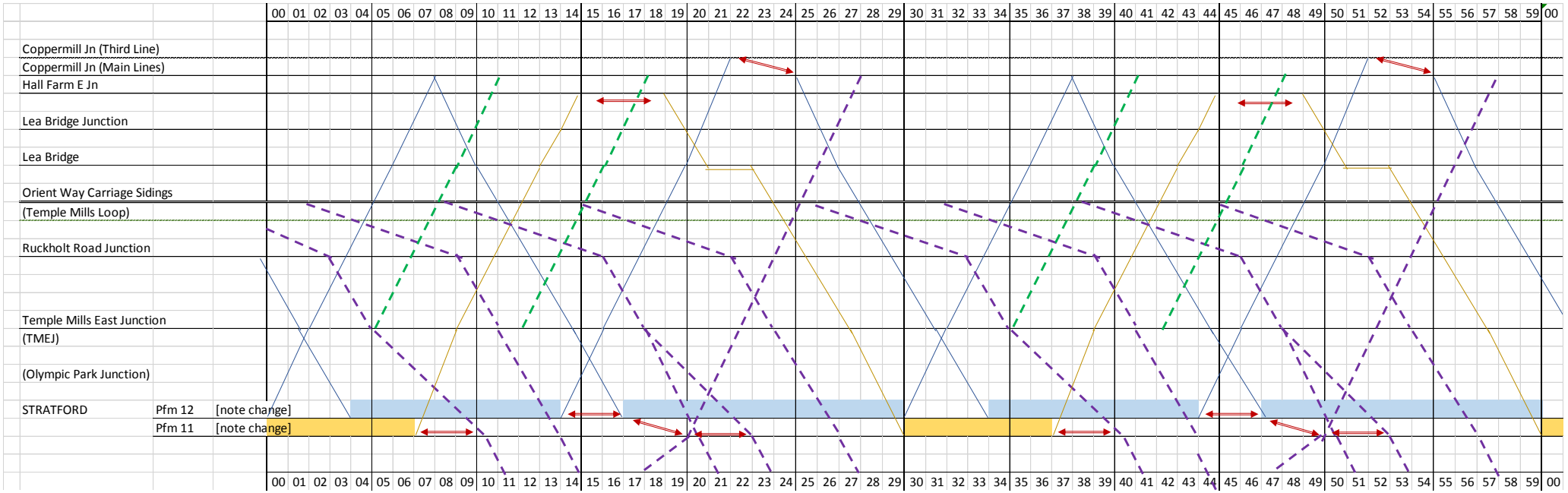
SCHEME
Blue = Tottenham Hale (Bishops Stortford / Angel Road) services
Gold = Chingford service
Purple dotted = freight / empty stock path via Pfm 12 (or 11 if passenger workings 'switched').
Green dotted = additional or alternative freight / empty stock path via High Meads (hence not shown south of TMEJ).

Alternative solution avoiding use of Channelsea Jn / Stratford platform for Chingford service, only option is to reverse at / near Lea Bridge.
Passengers from / to Chingford would change at Lea Bridge into following / from preceding 'Tottenham Hale' services.
A 'sub-option' would be to swap the Chingford service with part of the Tottenham Hale service, to give 2tph through to/from Stratford for each route - with the other 2tph Tottenham Hale services reversing Lea Bridge instead.
- with the other 2tph Tottenham Hale services reversing Lea Bridge instead.

Assumes no additional infrastructure at Lea Bridge [to accommodate reversers], and that new Lea Bridge Jn is of conventional layout; and that neither of the tracks between there and Lea Bridge station will be reversibly signalled.
The conclusion of these assumptions is that the only location at which to reverse SB to NB (Up to Down) north of Ruckholt Rd Jn will be Temple Mills Loop.

TO NOTE:
1 It would be reasonable to assume that a southbound arrival into Temple Mills Loop will not be permissible at the same time (within +/- 3 mins?) of a movement over Ruckholt Rd Jn
2 Although the directly conflicting movements at Ruckholt Rd Jn are reduced by 2 per hour, the 'indirect' conflicting moves at Temple Mills West Jn (entry into Temple Mills Loop from north end) imposes further restriction on the timings of the Chingford service, bearing in mind also the need to allow several minutes for detrainment of terminating trains at Lea Bridge.
3 The northbound 'starting' service, which would closely follow one from Stratford, emerges from the loop close to the time of a southbound train passing Coppermill Jn: these workings conflict with each other at both TMWJ and Lea Bridge Jn. Therefore, the timings are further adjusted so that they pass each other between these locations (i.e., in Lea Bridge station); however, slight extensions to journey times of both are inevitable.
4 Depending on the chosen scheduling tactic for the 4th ECS path in the half-hour, i.e. as early as possible after the preceding NB passenger trip or as late as possible before the following one, either
a The movement into TM Loop will occur at the 'last minute' before the following southbound passenger train for Stratford, or
b The ex-Chingford train will need to traverse the Hall Farm Curve at the earliest possible time after the preceding nortbound (ex Lea Bridge) service.
Either way, the timings are tighter than desirable. However, as this 'peak', defined by the passage of ECS moves, only lasts one hour, then this may be acceptable.
5 Note : both of the above variants are illustrated, one in each half-hour.

APPENDIX 4 – TRAIN SCHEDULING GRAPHIC REPRESENTATION: EVENING PEAK



SCHEME
Blue = Tottenham Hale (Bishops Stortford / Angel Road) services
Gold = Chingford service
Purple dotted = freight / empty stock path via Pfm 12 (or 11 if passenger workings 'switched').
Green dotted = additional or alternative freight / empty stock path via High Meads (hence not shown south of TMEJ).
Red double-ended arrows denote minimum time spacing requirements between conflicting or 'crossing' (northbound with southbound) movements
Shaded cells = platform occupied for layover / reversal

TO NOTE:

1 Although current practice is to use Pfm 11 for the (2tph) passenger service and route the empty trains [to Liverpool St] via Pfm 12, this does create conflicting movements between the (up) ECS moves and the (down) departures from Pfm 11.
At 2tph for the latter the impact / constraint is minimal; but for 4tph or more it becomes more of an issue.
The general strategy at these frequencies is therefore to route the ECS moves through Pfm 11, and as many [terminating] passenger trains as possible into Pfm 12:
Thus, the arriving passenger trains are 'with the flow' into Stratford, and then do not conflict with it on departure.
Note that the 'changeover' can take place after xx15 or xx45 departure within the Offpeak pattern, setting up the platform working immediatley prior to the commencement of these ECS workings.

2 The principal detrminant of this period is the flow of Up trains, interspersing empty movements from OWCS to Liverpool St with the 'local' passenger workings into Stratford.
Stratford platform capacity is as always a significant issue: however, by using Pfm 12 for 4tph of reversals and by careful scheduling, it is feasible
to schedule four through empty movements, and one passenger train reversal with about 7 mins layover, per 30 mins, in Pfm 11.

3 Moreover, as the ECS moves in this direction / peak do not conflict with any other movements (other than platform reoccupation at Stratford), there is much more 'usable capacity' over this route.
[as compared with the AM peak situation].

4 Contra-flow' non-passenger movements (i.e., in the Down direction) in this pattern are easily accommodated, as long as they are not routed via Stratford station.
Additionally, by only slight retiming of an (Up) empty stock working path, one non-passenger movement in the Down direction may be accommdated through Stratford (Platform 11) each 30-minute cycle (at xx.20).

UP	P1	PC	E1	E2	P2	E3*	E4	P3	PC	P4	PC	E5	E6	P5	E7	E8	P6	PC
CHINGFORD		16:55						17:07	17:10		17:25						17:37	17:40
St. James's Street		17:06						17/18	17:21		17:36						17/48	17:51
Hall Farm E. Junction		17/07						17/19	17/22		17/37						17/49	17/52
Clapton		17:08						|	17:23		17:38						|	17:53
Tottenham Hale	16:53	|			17:06			|	|	17:23	|			17:36			|	|
Coppermill Junction	16/55	|			17/08			|	|	17/25	|			17/38			|	|
Lea Bridge Junction	16/56	|			17/09			17/20	|	17/26	|			17/39			17/50	|
Lea Bridge	16/57	|			17:10			17c23	|	17:27	|			17:40			17c53	|
Temple Mills Loop		Via Hackney Downs							Via Hackney Downs		Via Hackney Downs								Via Hackney Downs
Orient Way CS			16:56	17:02		17:09	17:15					17:26	17:32		17:39	17:45			
Ruckholt Road Jn	16/59½		17/03	17/09	17/12½	17/16	17/22	17/25½		17/29½		17/33	17/39	17/42½	17/46	17/52	17/55½		
Temple Mills E. Jn.	17/01½		17/05	17/11	17/14½	17/18	17/24	17/27½		17/31½		17/35	17/41	17/44½	17/48	17/54	17/57½		
High Meads Jn		|								|							|	
STRATFORD Pfm 12	17:04	|			17:17				|	17:34	|			17:47				|	
Pfm 11		|	17/10	17/13½		17/20½	17/26½	17:30	|		|	17/40	17/43½		17/50½	17/56½	18:00	|	
Bow Depot		|						|		|							|	
Liverpool Street		17:21	17:20	17:24		17:31	17:37		17:36		17:51	17:50	17:54		18:01	18:07		18:06	
Forms departure:	17:14				17:30			17:37		17:44				18:00			18:07		

Notes: c = Arrives 2 minutes earlier. * = If Down freight path F3/F6 required, (Up Empty) E3/E7 held at or after Temple Mills E Jn and runs 3 minutes later thereafter.

DOWN	PC	P1	F1	P2	PC	F2	P3	F3	PC	P4	F4	P5	PC	F5	P6	F6	P1
Arrived		16:47		16:57			17:04			17:17		17:27			17:34		17:47
Liverpool Street	16:48				17:03				17:18				17:03				
Bow Depot	|				|		17:14	|				|			17:44	
STRATFORD Pfm 11	|			17:07	|		17/20	|			17:37	|			17/50	18:00
Pfm 12	|	17:00			|		17:14	|	17:30			|		17:44		
High Meads Jn	|		17/02		|	17/09		|		17/32		|	17/39			
Temple Mills E. Jn.	Via Hackney Downs	17/02	17/05	17/09	Via Hackney Downs	17/12	17/16	17/22	Via Hackney Downs	17/32	17/35	17/39	Via Hackney Downs	17/42	17/46	17/52	18/02	
Ruckholt Road Jn		17/04	17/07	17/11		17/14	17/18	17/24		17/34	17/37	17/41		17/44	17/48	17/54	18/04	
Orient Way CS																		
Temple Mills Loop																		
Lea Bridge	|	17:06	17/09	17:13	|	17/16	17:20	17/26	|	17:36	17/39	17:43	|	17/46	17:50	17/56	18:06	
Lea Bridge Junction	|	17/07	17/10	17/14	|	17/17	17/21	17/27	|	17/37	17/40	17/44	|	17/47	17/51	17/57	18/07	
Coppermill Junction	|	17/08	17/11		|	17/18	17/22	17/28	|	17/38	17/41		|	17/48	17/52	17/58	18/08	
Tottenham Hale	|	17:10	17/13		|	17/20	17:24	17/30	|	17:40	17/43		|	17/50	17:54	17/50	18:10	
Clapton	16:58				17:13		LL		17:28				17:13		LL			
Hall Farm E. Junction	17/01			17/15	17/17				17/31			17/45	17/17					
St. James's Street	17:02			17:16	17:18				17:32			17:46	17:18					
CHINGFORD	17:14			17:28	17:30				17:44			17:58	17:30					

LL = Runs to (new) Local Line (or Third Line) at Coppermill Junction. See above re path E2a*.