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Appendix F

CAPABILITY MODELLING

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*Group Strategy - Capability Analysis
MetroWest Phase 2
Report*

Rhys Bowen

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Abbreviations	
Acronym	Meaning
LTPP	Long Term Planning Process
BTM	Bristol Temple Meads
WSM	Weston-super-Mare

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Abbreviations	
Acronym	Meaning
SRT	Sectional Running Time
TRT	Theoretical Running Time
NR	Network Rail
CAT	Capability Analysis Team
Unit	Refers to one train service unless otherwise stated

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1. Executive Summary

The MetroWest scheme is a proposal to radically alter the train service provision in the greater Bristol area, in order to support economic growth.

Phase 2 aspires to widen the geographical scope of the project by reopening the Henbury Line to an hourly passenger service, re-opening stations at Henbury, North Filton and on Filton Bank, plus increasing MetroWest service frequencies at Yate and Weston Milton.

Given four-tracking of Filton Bank and assuming improvements to Bristol East Junction, the key finding from this tranche of work is that the Phase 2 service specification can be broadly achieved in the Bristol area, without adversely affecting cross boundary services and freight aspirations. This means that further development of the service options can be driven by the connectivity requirements of the stakeholders.

This report focuses on the two main capacity questions; whether the connection to Henbury is achieved by a loop connection (via the Severn Beach line) or a spur, and whether it is feasible to extend the Weston-super-Mare to Parkway service towards Yate and beyond. The implications on infrastructure and unit number requirements are explored for each scenario. A view is also given on the performance risks of each of the options.

The infrastructure requirements of the loop option include doubling of Hallen Marsh Junction and additional crossover(s) on the Henbury Line in order to retain the capability to regulate freight in this area; it would have high levels of performance risk and also require significant platform capacity at Temple Meads.

The Henbury spur would prove to be less of a constraint in capacity terms (particularly at Bristol Temple Meads), it will have a lower operational cost as fewer units are needed to form a compliant timetable and poses less of a performance risk than the loop option. The spur option requires a bay platform at Henbury and a crossover to enable correct line running.

In terms of capacity, an additional path to Yate (and Gloucester) can be achieved. Given the constrained nature of Westerleigh Junction, this path is effectively fixed, which in turn defines the unit number and infrastructure requirements.

In order to achieve a robust extension of the Weston-super-Mare to Parkway service to Yate, one additional unit and infrastructure interventions at Yate are required. To extend it to Gloucester a minimum of two additional units are required, however no infrastructure interventions are needed.

2. Introduction

This report details the analysis that has been completed by the Capability Analysis Team (CAT) into the second phase of the MetroWest scheme. It is a relatively high level summary, commensurate with the current (GRIP 2) stage of the project.

The two major avenues of investigation that are addressed in this report

- The introduction of a Henbury – Temple Meads service
- The extension of the current Weston-super-Mare to Bristol Parkway service to Yate (and Gloucester)

There are a number of scenarios in both of the aspirations. These are examined for their operational feasibility, robustness, impact on current and proposed services, and to understand the infrastructure requirements for each. The aim of these comparisons is to provide evidence by which a decision on a preferred post Phase 2 service specification can be chosen. This will include journey time, evenness of pattern and service level comparisons for each scenario as well as emerging infrastructure requirements.

Commentary is provided on the perturbed operation of each scenario, in order to compare the performance risks of these options.

Finally, the appendices of this report contain a summary of the analysis that has been conducted. This includes the following information, broken down by scenario where appropriate:

- Timetables.
- Infrastructure requirement.
- Unit number requirements.
- Service levels by station.
- Sensitivities in services levels by station, including additional stops at Weston Milton

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2.1. Background

MetroWest (previously named Greater Bristol Metro) is a proposed scheme in the West of England offering new and improved rail services across the region around Bristol, with the objectives of achieving modal shift to public transport and supporting economic growth. The scheme is promoted by West of England Partnership on behalf of North Somerset Council, Bath and North East Somerset Council, South Gloucestershire Council and Bristol City Council.

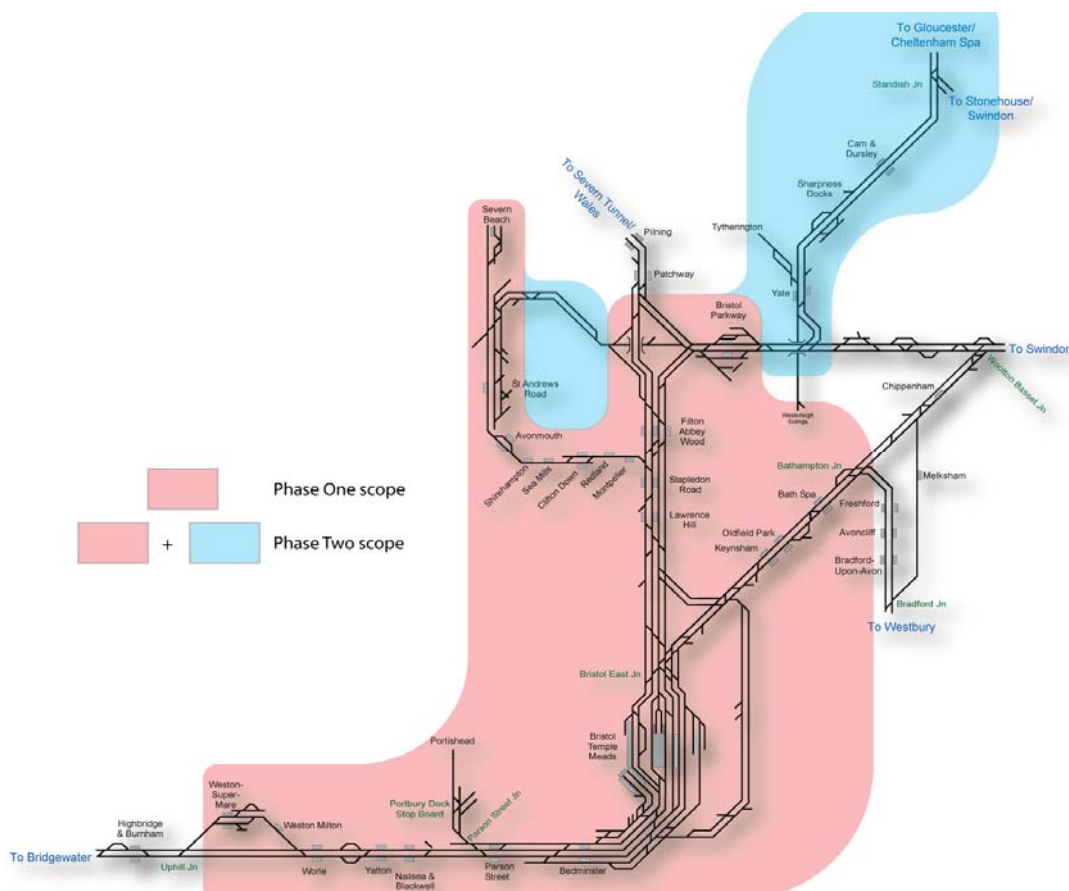


Figure 1 - Geographical scope of the MetroWest scheme

The MetroWest scheme is split into several phases of deliverables. Phase 1 includes re-opening of the Portishead Line for passenger services and improving service frequencies on the Severn Beach and Bath Spa Lines. Phase 2 includes improving service frequencies between at Yate and Bristol Parkway, and the introduction of passenger services on the Henbury Line with new station(s) on Filton Bank. Other phases include opening of other stations, such as Portway P&R.

The Phase 2 findings in this report are based on the extension of all of the Phase 1 work

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that has been completed to date. These include:

- HALCROW analysis of Phase One service options (Greater Bristol Metro Final report)
- Network Rail Capability Analysis and Economic Analysis teams primary Phase One work (MetroWest Interim report)
- Further Network Rail Capability Analysis team analysis of Phase One service options (MetroWest Phase One addendum report)

3. Analysis & Findings

The committed programme of improvements to the Great Western Line has been assumed in the base case (for 2019); this includes four-tracking of Filton Bank, main line electrification, Bristol area re-signalling and a 4th platform at Bristol Parkway. In addition, it has been assumed that improvements to Bristol East Junction are implemented; this is a pre-requisite for Phase 2.

For simplicity, and because they deal with mutually exclusive areas, the following section can be split into two broad parts:

- Henbury Line services
- Extension of the Weston-super-Mare - Bristol Parkway service to Yate or Gloucester

Finally, there is commentary on the emerging Phase 2 service pattern as a whole (in terms of unit numbers, performance implications etc.) and the service provision at new and existing station within the study area.

3.1. Phase 1 Options

The latest findings from the analysis of the Phase 1 connectivity options have resulted in the development of two distinct service patterns. These are shown below:

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Option 5b

Option 6b

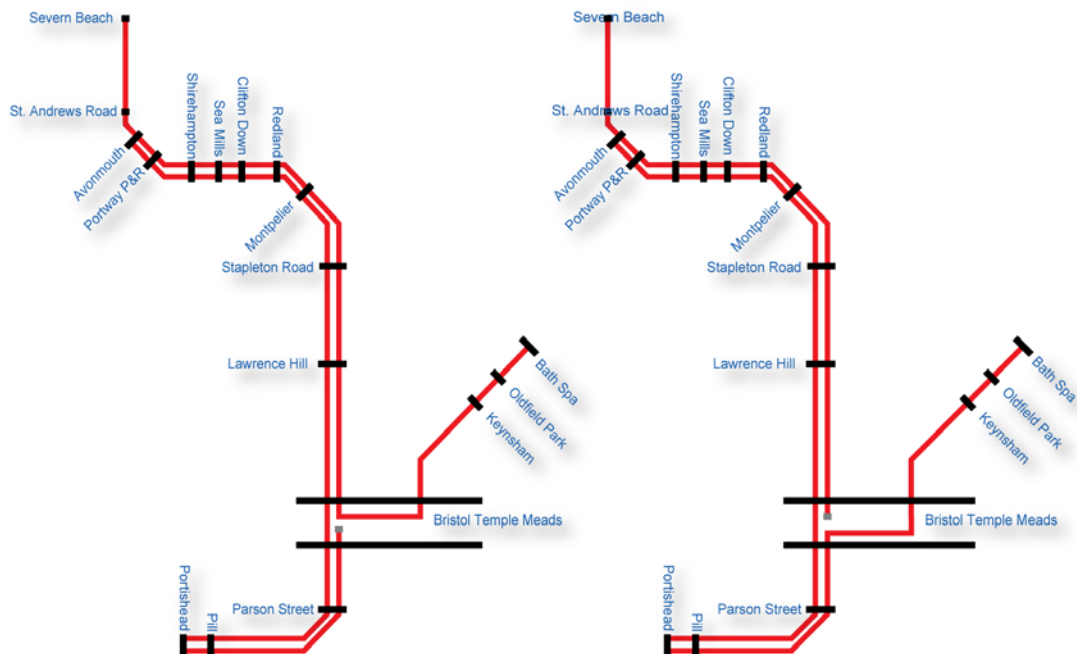


Figure 2 - Phase 1 connectivity options

Given the similarities, in terms of service pattern and network capability requirements, it has been determined to use both timetable options as bases for Phase Two analysis.

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It is worth revisiting how these timetables were constructed as their structure is the critical influence on the achievement of the Phase 2 outcomes (in terms of service specification);

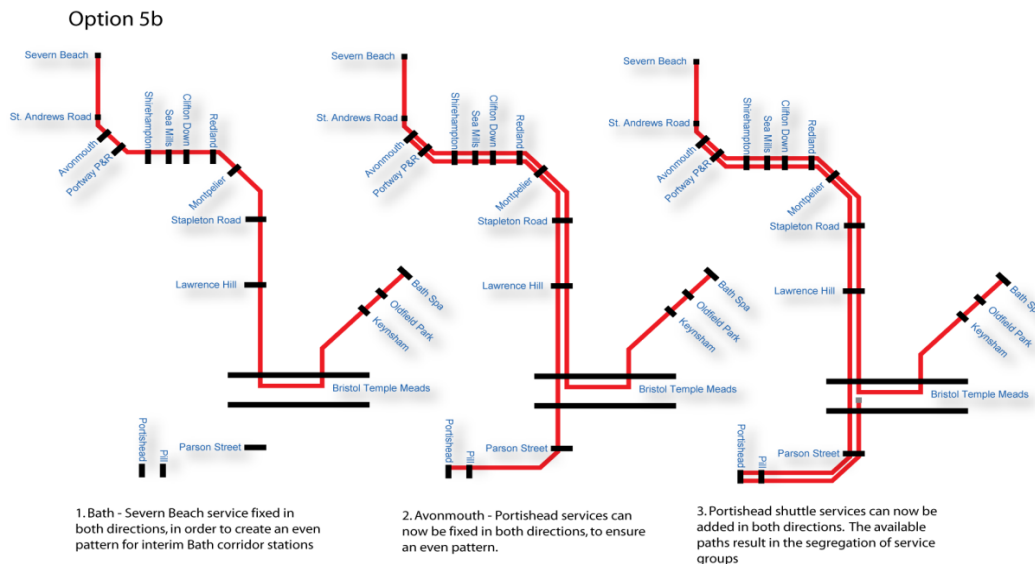


Figure 3 - Phase 1, Option 5b development process

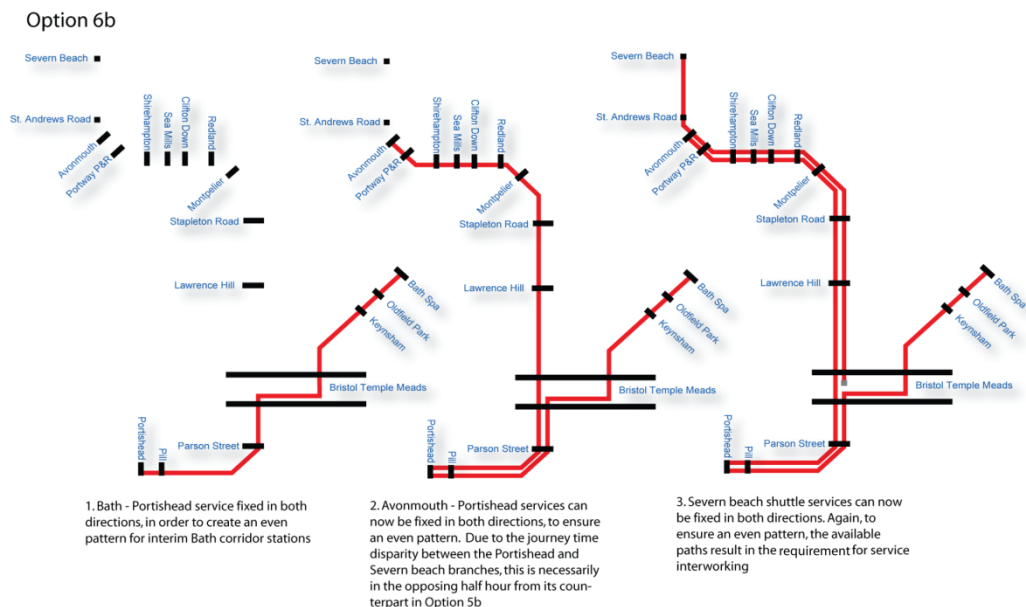


Figure 4 - Phase 1, Option 6b development process

The requirement to achieve even service patterns on the Portishead, Severn Beach and Bath routes, in tandem with the infrastructure constraints in this area drive the pattern of the timetable, so that for each connectivity scenario there is only one suitable timetabling solution.

3.2. Phase 2; Henbury Line Services

For Phase 2 the inclusion of passenger services on the Henbury Line present broadly two service options; a loop service which operates between the Henbury and Severn Beach Lines or a spur service which solely operates on the Henbury Line. Analyses have been completed with both loop and spur scenarios on top of the Phase 1 options 5b and 6b. The new service would serve new stations at Henbury, North Filton and on Filton Bank (Constable Road and/or Ashley Hill), plus existing stations as appropriate:-

- Loop – Temple Meads, Lawrence Hill, Stapleton Road, Montpelier, Redland, Clifton Down, Sea Mills, Shirehampton, Portway P&R, Avonmouth, Filton Abbey Wood;
- Spur - Temple Meads, Lawrence Hill, Stapleton Road, Filton Abbey Wood.

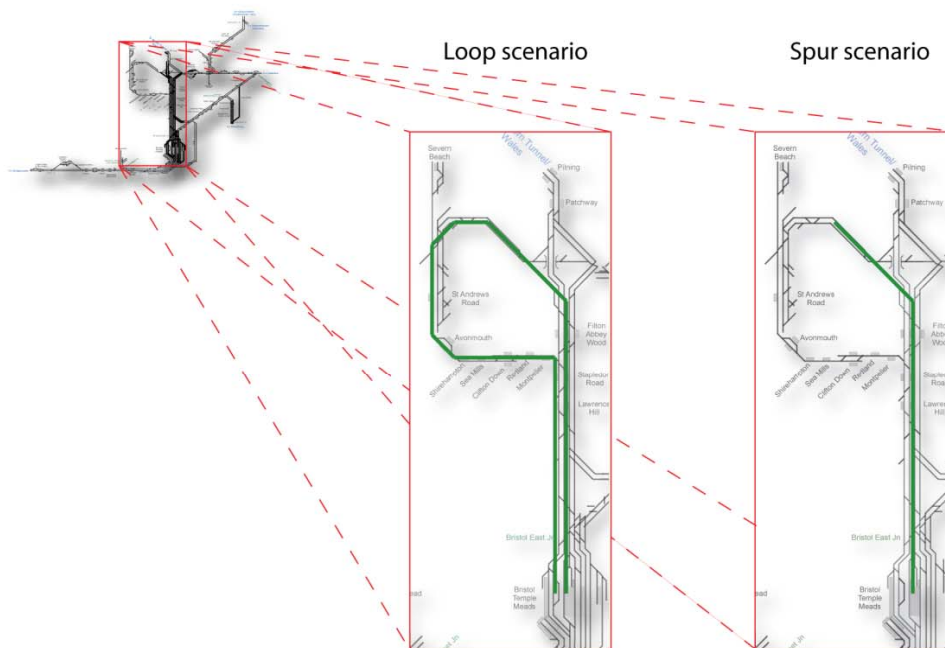
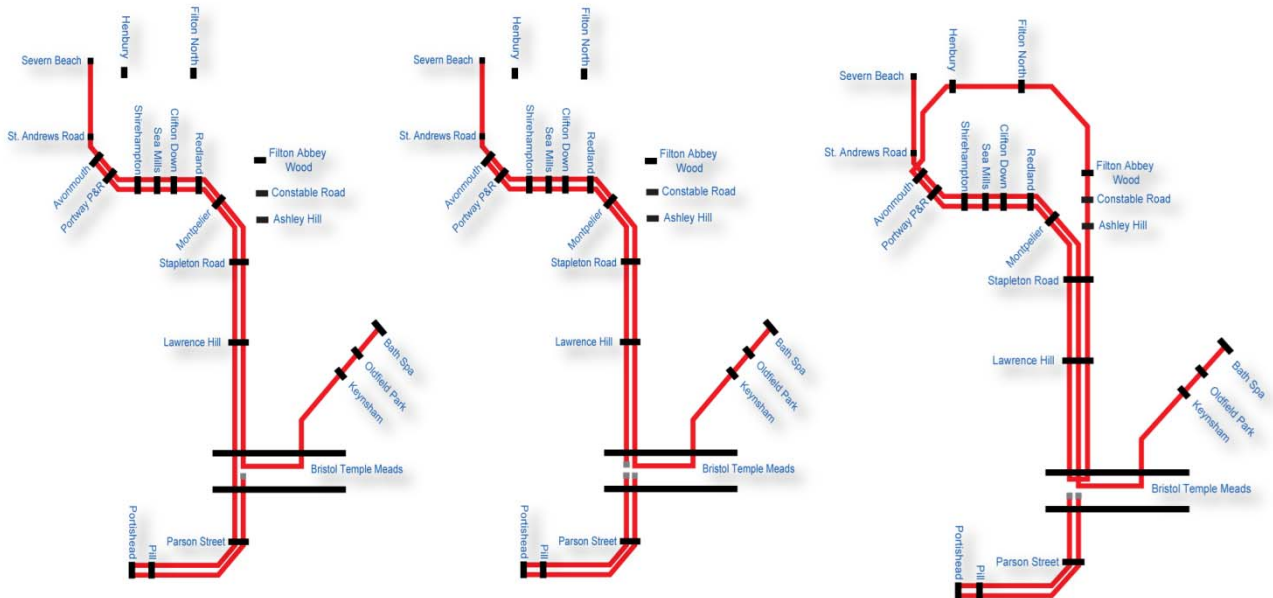


Figure 5 - Scope of Henbury line extension

3.2.1. Henbury Line as an loop service

As with the latest findings of the Phase 1 analysis, each solution (Option 5b and Option 6b) is a reflection of the other, which in turn limits the shape and capability of the Phase 2 timetable. The method in which the Phase 2 loop timetables were constructed is shown overleaf.

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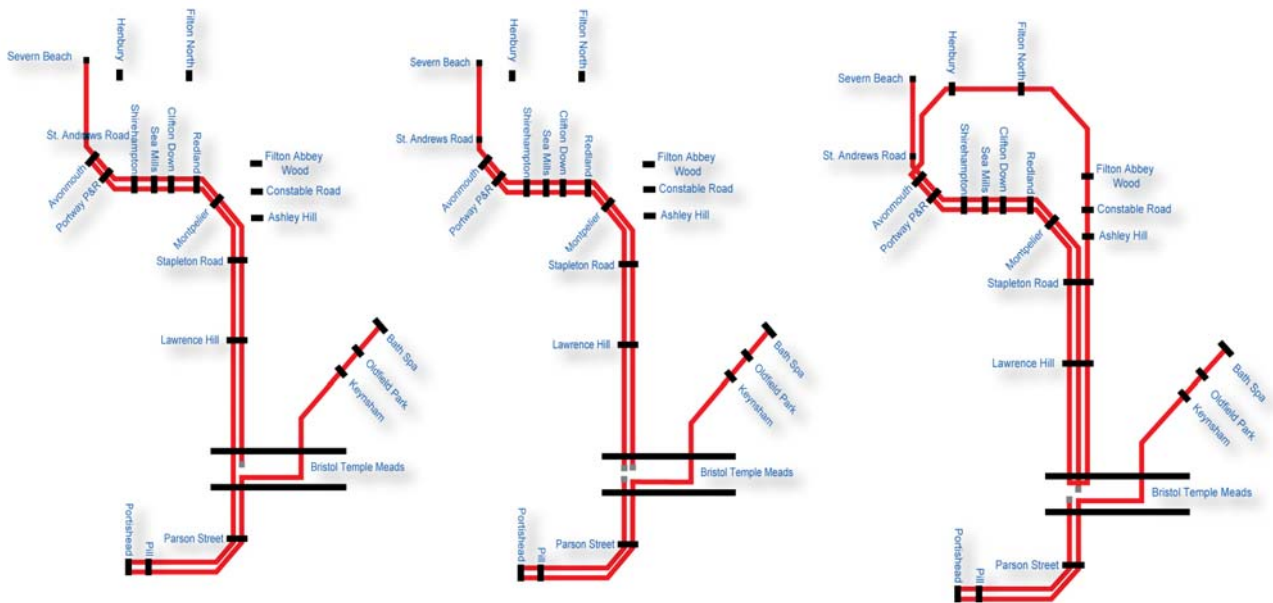


Option 5b service pattern, the timetable pattern was taken from the capability analysis Phase One work.

The Portishead - Avonmouth service was severed at Bristol Temple Meads. This is primarily because an extended loop service is a high performance risk, it also simplified the timetabling process.

The Avonmouth spurs were then backtimed to create the loop services. SRTs were calculated from Railways TRTs where appropriate.

Figure 6 - Phase 2, timetable construction process from Option 5b base



Option 6b service pattern, the timetable pattern was taken from the capability analysis Phase One work.

The Portishead - Avonmouth service was severed at Bristol Temple Meads. This is primarily because an extended loop service is a high performance risk, it also simplified the timetabling process.

The Avonmouth spurs were then backtimed to create the loop services. SRTs were calculated from Railways TRTs where appropriate.

Figure 7 - Phase 2, timetable construction process from Option 6b base

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The timetabling options for the loop services in both timetables are constrained due to the fixed timings of the services to/from the Severn Beach Line (which form the Henbury Loop service) and the availability of paths on the Filton Bank to/from Bristol Temple Meads. This coupled with the constrained platforming options at Bristol Temple Meads results in a timetable with little flexibility.

Both loop service options (5b and 6b) require the severing of one of the 2tph Portishead services at Bristol Temple Meads from the Severn Beach Line, this results in option 5b having no through service from the Portishead Line at Bristol. In both cases this is due to the significant performance implications of maintaining a link between the Portishead Line and the Severn Beach Line with the inclusion of a loop service which would be required to operate on all three lines.

For each option, 5b and 6b the following indicative departure times at Bristol and Henbury of a Loop service result;

Phase 2 timetable based on Phase 1 Option 5b

DEPARTURES FROM HENBURY		
DESTINATION		DEPT.
BRISTOL TEMPLE MEADS (VIA FILTON NORTH)		XX:18
BRISTOL TEMPLE MEADS (VIA AVONMOUTH)		XX:54

DEPARTURES FROM BRISTOL TEMPLE MEADS		
DESTINATION	DEPT.	ORIGIN
SEVERN BEACH	XX:11	BATH SPA
BRISTOL TEMPLE MEADS (TO HENBURY)	XX:32	TERMINATES
BRISTOL TEMPLE MEADS (TO AVONMOUTH)	XX:40	TERMINATES

Phase 2 timetable based on Phase 1 Option 6b

DEPARTURES FROM HENBURY		
DESTINATION		DEPT.
BRISTOL TEMPLE MEADS (VIA FILTON NORTH)		XX:34
BRISTOL TEMPLE MEADS (VIA AVONMOUTH)		XX:36

DEPARTURES FROM BRISTOL TEMPLE MEADS		
DESTINATION	DEPT.	ORIGIN
SEVERN BEACH	XX:25	BATH SPA
BRISTOL TEMPLE MEADS (TO HENBURY)	XX:14	TERMINATES
BRISTOL TEMPLE MEADS (TO AVONMOUTH)	XX:57	TERMINATES

Figure 8 - Henbury, Bristol Temple Meads departure boards

It can be seen that option 5b is a reflection of option 6b, where the loop service (in both directions) arrives from Avonmouth and Filton Abbey Wood at similar times within the hour at Bristol Temple Meads, option 6b results in the services arriving at Henbury (in both directions) at similar times within the hour. Due to the arrivals in both options at either Bristol Temple Meads or Henbury being at similar times within the hour, the departures from Bristol Temple Meads or Henbury are broadly 22 minutes apart.

This means for example in option 5b the loop service going in both directions (towards Avonmouth and Filton Abbey Wood) is required to depart from Bristol Temple Meads at similar times. For option 6b this results in services at Henbury towards Bristol Temple Meads departing at the same time; one via Filton Bank and the other via Avonmouth.

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The following table shows the indicative journey times of the loop services;

	Unconstrained	Phase 2 (5b)	Phase 2 (6b)
Clockwise	49½	63	63½
Anticlockwise	54	66½	67½
BTM – Severn Beach	35	36½	36½
Severn Beach – BTM	38½	40½	40

Figure 9 - Projected Henbury line journey times, based on Railsys technical running times

Clearly, the journey time between North Filton/Henbury and Bristol Temple Meads via Avonmouth would be significantly longer than via Filton Bank; therefore this train would not cater for journeys to central Bristol. The purpose (and potential value of) of a Henbury-Bristol service via Avonmouth, is solely local connectivity. The value of delivering these local connections through rail should be assessed and compared against the cost of implementation.

3.2.2. Henbury Line as an Spur Service

The spur scenario involves overlaying the Henbury service on the Phase 1 timetable as a shuttle service between Henbury and Bristol Temple Meads (via Filton Abbey Wood). The position of this service within the timetable pattern is, in contrast to the loop option, flexible and mainly reliant on the availability of paths on the Filton Bank Relief Lines. This option allows for the proposed Phase 1 (Option 5b) cross-Bristol link from the Portishead Line to Avonmouth to be retained.

The table below shows the indicative journey time for an all stations stopping service between Henbury and Bristol Temple Meads in each timetable scenario:

	Option 5b-Spur	Option 6b-Spur
Journeytime to BTM (mins)	18	18
Journeytime from BTM (mins)	18	18

Figure 10 - Journey times for the Henbury spur service

These timings fall well within the hour necessary to operate this service with one unit. Operationally, a short turnaround at Bristol Temple Meads is desirable in order to reduce the constraint on platform capacity. This would require a relatively long turnaround (circa. 15 minutes) at Henbury. In order to avoid conflicting with freight operations a bay platform off the running lines is advisable, for example:

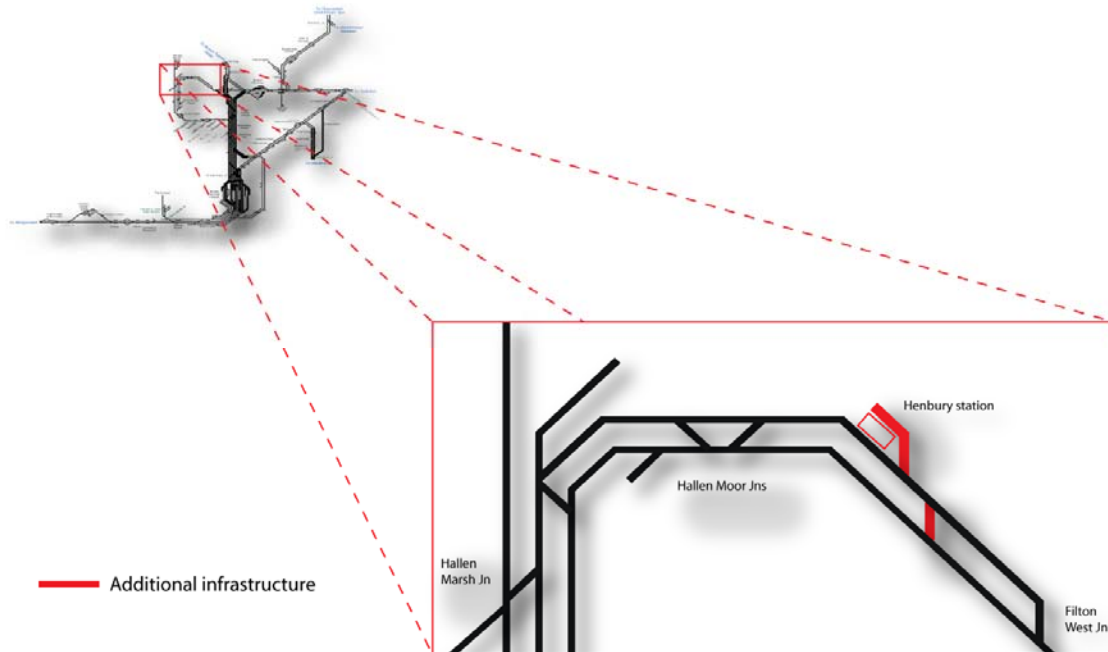


Figure 11 - Henbury turnback example

3.2.3. Operational findings consistent between base options

It should be noted that both Option 5b and Option 6b maintain their symmetrical nature in relation to each other, which results in the majority of the capability and operational findings being consistent across both options.

The following table shows the projected journey times from Henbury to Bristol Temple Meads in each scenario. It should be noted that, due to the constrained nature of a loop timetable, the Henbury – Temple Meads via Filton Bank journey time is significantly longer (6½ minutes) than the equivalent journey in the spur scenarios.

	Option 5b-loop	Option 6b-loop	Option 5b-Spur	Option 6b-Spur
Journey time (mins)	24½/44	24½/46	18	18

Figure 12 - Indicative Henbury - Bristol Temple Meads journey times

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The minimum required numbers of units are shown below. Figure 13 shows:

- The spur option requires a minimum of one extra unit, over the Phase 1 minimum requirement.
- The loop option requires a minimum of three extra units, over the Phase 1 minimum requirement.

Phase 1 – 5b	Phase 1 – 6b	Phase 2 – 5b		Phase 2 – 6b	
		Loop option	Spur option	Loop option	Spur option
6	6	9	7	9	7

Figure 13 - Minimum number of unit by scenario

How the units are worked within each individual pattern varies, in order to achieve workable timetables. This will lead to operational differences which will need to be revisited during the development process.

The performance implications are mostly consistent across both base options used to construct the Phase 2 timetable (5b and 6b). The performance risk of each scenario is determined by the connectivity of each pattern. The diagram below attempts to demonstrate the implications of each scenario.

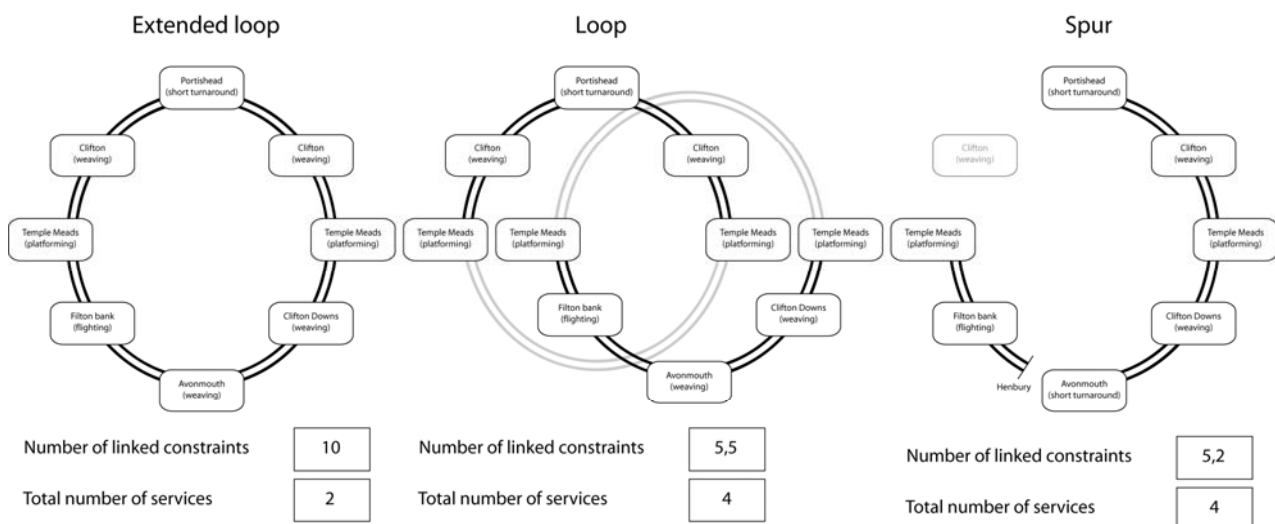


Figure 14 - Performance implications of extended loop, loop and spur scenarios

Each link represents a potential, though not equal, constraint. The different sub-diagrams show how these constraints are linked within the timetable. Both the spur and the loop scenarios offer a break in this chain, which acts as a firewall to reduce inherited delay in perturbed conditions, as does the number of services needed to run each option. The extended loop to Portishead links all these constraints and results in a timetable that would

result in more reactive delay, as a failure to achieve any one of the links will result in a delay loop that cannot be recovered without cancelling services.

3.2.4. Operational differences between base options

As was seen in the Phase 1 work the scenarios continue to differ in how the units are worked, which affects the platform usage at Bristol Temple Meads in particular. For example the Phase 2 timetable derived from Option 5b results in four units being used for the loop service (two active units, two with extended dwells at Bristol Temple Meads). The timetable based on Option 6b only used three units for the loop, with both directions interworked. This is off-set however by Phase 2 (6b) requiring an extra unit for the Portishead spur. Both option 5b and option 6b have the same total minimum unit number requirements.

This has an additional consequence of determining how train units are used within the MetroWest pattern. This does not affect the number of units required for each scenario, but will have a major impact on the way services operate, particularly with regards to platform capacity and managing turnarounds at Bristol Temple Meads.

3.2.5. Implications on Severn Beach Line level crossings

The impact of the services on the level crossings in the Avonmouth area has also been assessed. The key factor here is that the loop option will increase the number of closures and therefore the down time of the St Andrews Road level crossing. The number of closures and down time over the West Tower Gate remains the same as Phase 1 in both scenarios.

		West Tower Gate	St Andrews Road
Loop	Movements over Level crossing (daily)*	68	68
Spur	Movements over Level crossing (daily)*	68	34

* Based on the modelled pattern operating between 0600 and 2300

Figure 15 - Projection of movements over level crossings in the Avonmouth area

3.2.6. Impact on Henbury Line freight services

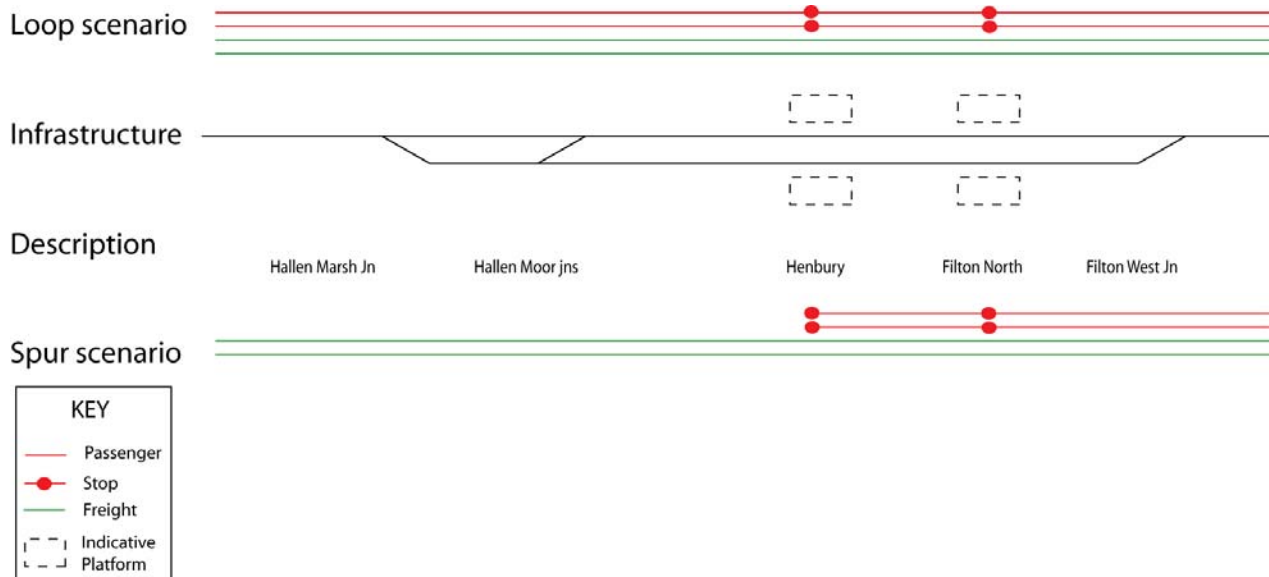


Figure 16 – Total assumed Henbury line service level by scenario, off peak hour, (services in both directions shown)

The diagram above depicts the total service level on the Henbury Line in both scenarios. In order to assess the impact of passenger service on freight operations the following sections need to be examined:

- Freight regulation on the Henbury line
- Capacity of the Henbury Line
- Capability of Filton West Junction to sustain an uplift of 1 tph in each direction

And, in addition, in the case of the loop scenario:

- The capability of Hallen Marsh/Hallen Moor Junctions

And, in addition, in the case of the spur scenario:

- Platforming arrangements at Henbury

3.2.6.1. Freight regulation on the Henbury line

Analysis of current operational data suggests that the Henbury route is used for the regulation of freight services. Given the incremental increase in service level this regulation can be continued to some extent, however further consultation with Freight Operators and the Port Authority is needed to ensure that adequate regulation provision is available.

3.2.6.2. Capacity of the Henbury line

		Loop scenario	Spur scenario
Line occupation	Single direction (mins)	12	5
	Both directions (mins)	24	10

Figure 17 - Projected hourly occupation time of the Henbury lines

The table above shows the estimated total line occupation of the Henbury Line passenger services in both operating scenarios over a standard off-peak hour. These occupations times will be split by directional line, for example the loop scenario will occupy the down Henbury Line for 12 minutes and the up Henbury Line for 12 minutes, giving a total occupation of 24 minutes in both directions. Note that the spur scenario does not include any potential turnaround time at Henbury; it assumes that the service terminates off the running lines at Henbury in a bay platform/siding. In terms of plain line capacity neither scenario will adversely affect the projected freight service level, as can be seen in the diagrams on the following page:

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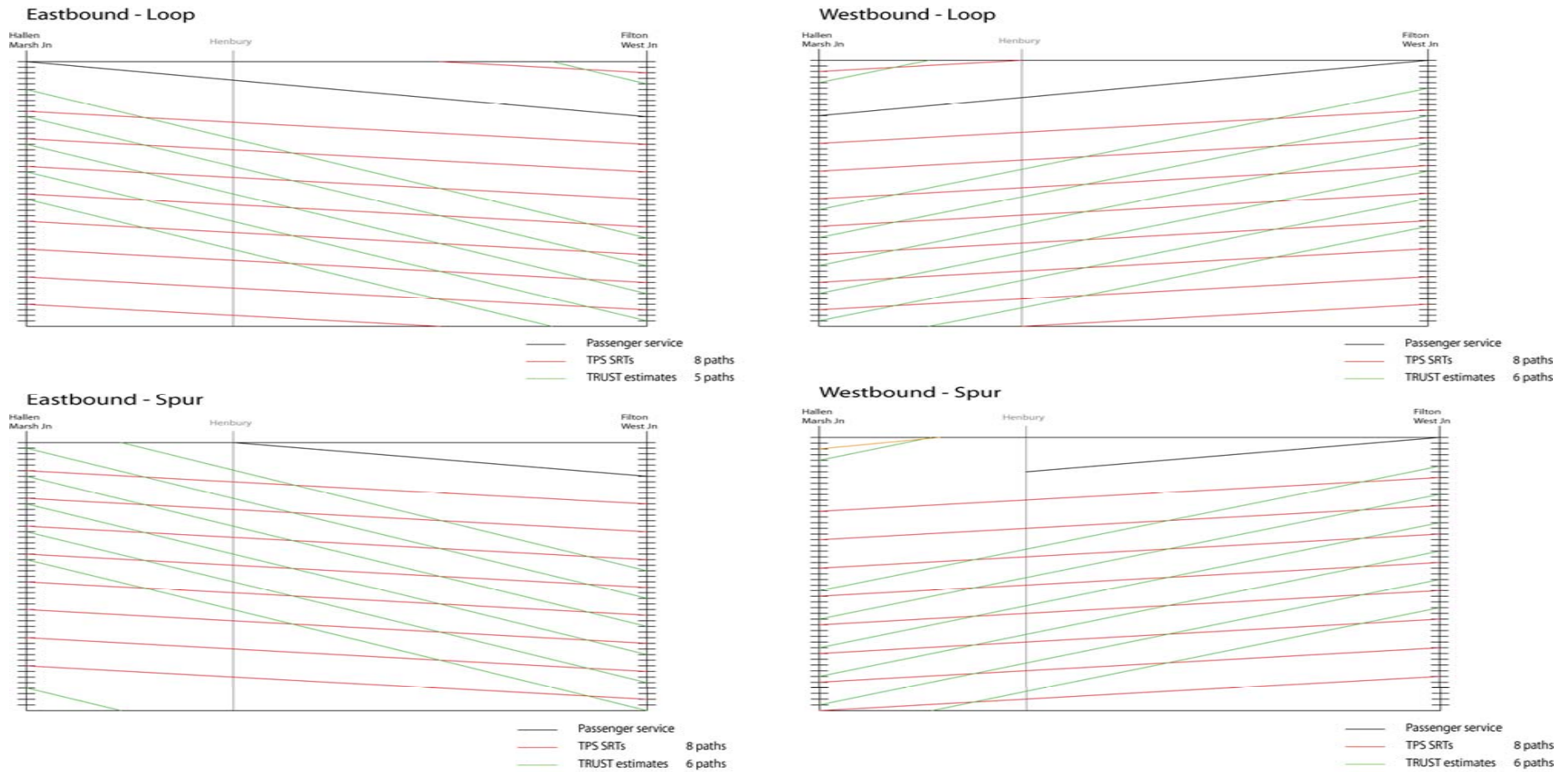


Figure 18 - Availability of paths on the Henbury line

These diagrams are a projection of the paths available to freight on the Henbury line. They show a simplified standard hour train graph between Hallen Marsh and Filton West Jn. The black line shows the expected operation of the passenger service in the standard hour. The coloured lines show a theoretical freight path based on two estimates of freight running times. It is important to note that they are based on an estimated headway of 5 minutes and do not take into account signalling arrangement or regulation aspirations. Figure 7 demonstrates that, even for the most conservative freight run times and estimated headways, there will still be at least 5 freight opportunities available per hour in each direction between Filton West Junction and Hallen Marsh Junction.

3.2.6.3. Capability of Filton West Junction

Given the four tracking of Filton Bank and the required pattern of the timetable, the addition of two moves over Filton West Jn and onto the Relief Lines every hour will not adversely affect the capability of the junction.

3.2.6.4. Capability of Hallen Marsh Junction

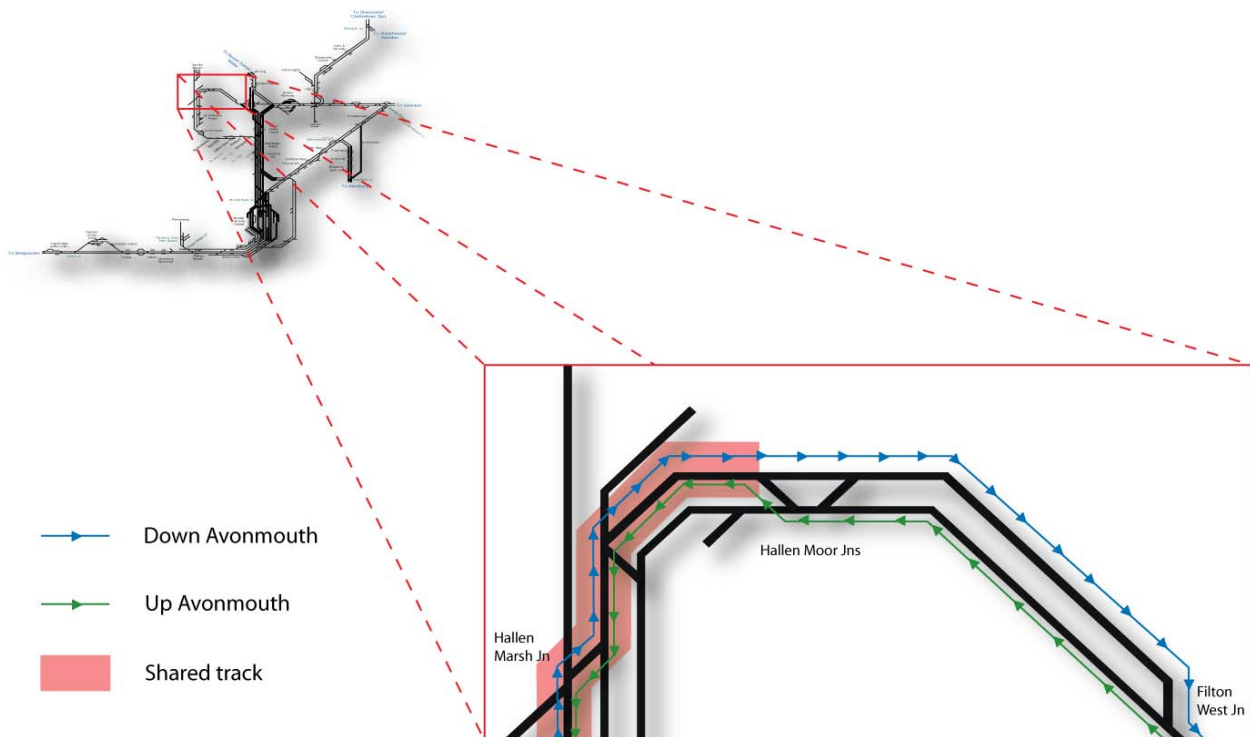


Figure 19 - Highlighting the Hallen Marsh capacity issues

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Figure 19 shows the potential routeings of passenger and freight services over the Hallen Marsh Junction area in the loop service scenario. The capability of this junction is limited by the need for reverse line running for both Up Avonmouth and Up LPG terminal services from Hallen Moor East Junction. Given the increased service level of the loop service, the mix of service types and the constraining nature of the Severn Beach Line, it is recommended that this constraint is removed in order to improve the performance implications of the loop service. One potential solution is shown below:

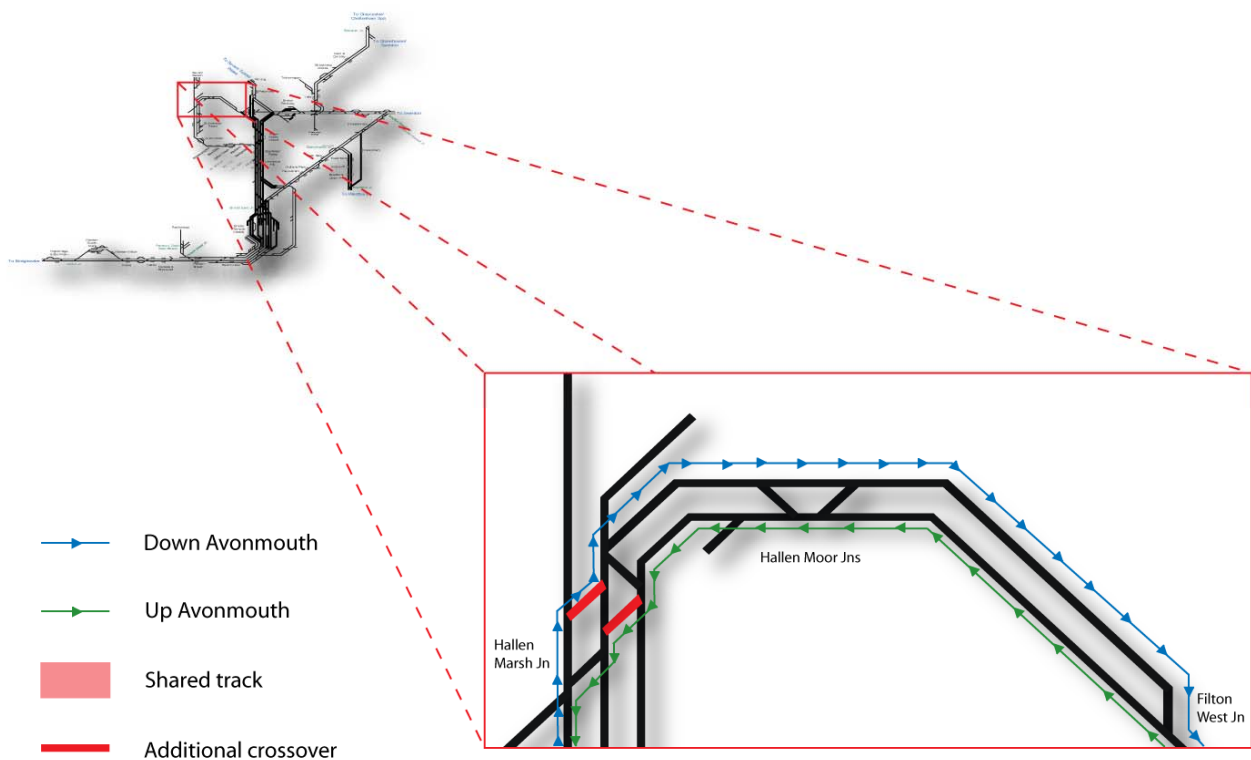


Figure 20 – One example of an improved Hallen Marsh Jn, this example would provide parallel access to/from the Portbury Coal Terminal whilst a passenger services crosses to/from the Henbury Line from/to the Severn Beach Line. Further improvement to the layout could provide parallel access to/from Bennets Sidings by doubling Holesmouth Junction.

3.3. Extension of the Weston-super-Mare to Bristol Parkway service

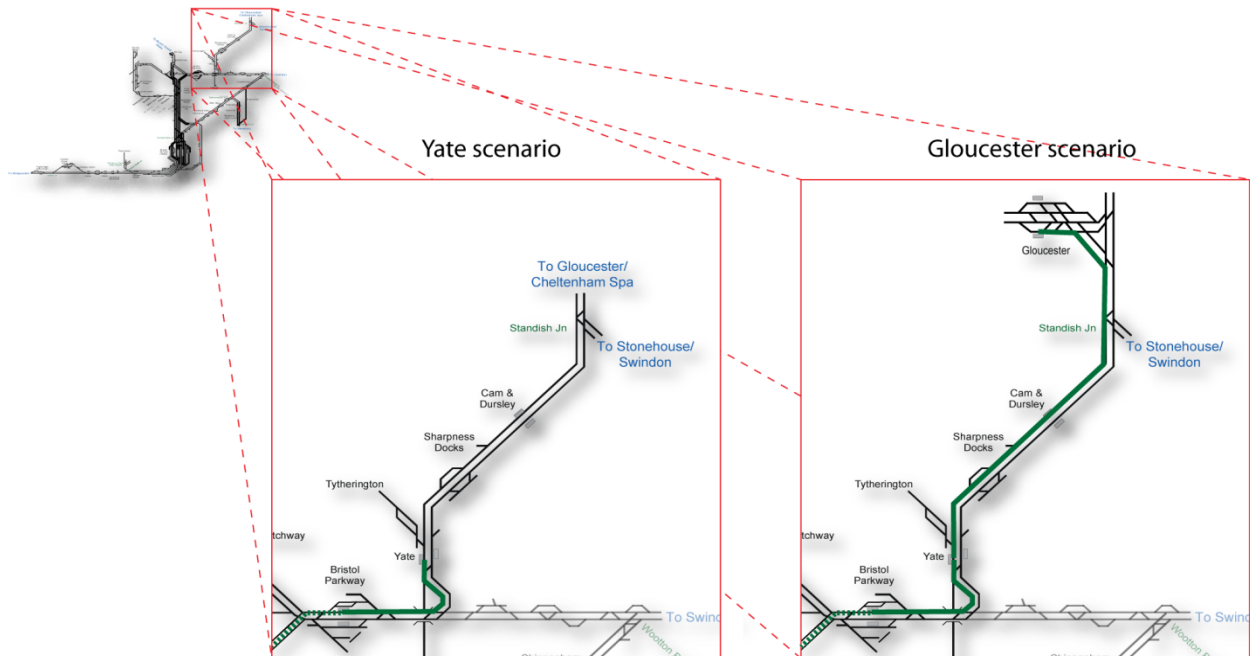


Figure 21 - Scope of the Weston-super-Mare - Bristol Parkway extension

This section of the report addresses the implications of extending the existing Weston-super-Mare service north-eastward beyond Bristol Parkway. The diagram above summarises the scope and options for this service. Services would stop at all existing intermediate stations, but not stations on the Filton Bank with only relief line platforms, as they are assumed to run on the Filton Main Lines. The hourly service provision is shown in Appendix D and the aspiration to increase the stopping frequency on the Filton Bank is addressed in Appendix E.

The key constraint that limits the path of this service beyond Bristol Parkway is Westerleigh Junction. Figure 22 below is a junction diagram showing an indicative service pattern for Westerleigh Junction for 2019. This is based on the Iteration 5 Crossrail 2019 timetable pattern, which includes the additional London – Bristol IEP services. It demonstrates that there are three feasible ‘spare’ paths in the Up direction (towards Swindon) and one in the down direction (towards Bristol). In the context of the MetroWest pattern only the green paths (one in each direction) are available for the Weston-super-Mare service extension to Yate from Bristol Parkway. There is some flexibility in that the highlighted freight path highlighted in green and the Weston-super-Mare services can be switched. This gives two potential up paths and one down path.

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The Up (i.e. towards Yate) path in Figure 22 is the critical factor in determining the achievable turnarounds at Yate and Gloucester, and the unit numbers required for this service. The following diagram (Figure 23) illustrates the potential options that this provides. (Indicative journey times are shown in Figure 24 below):

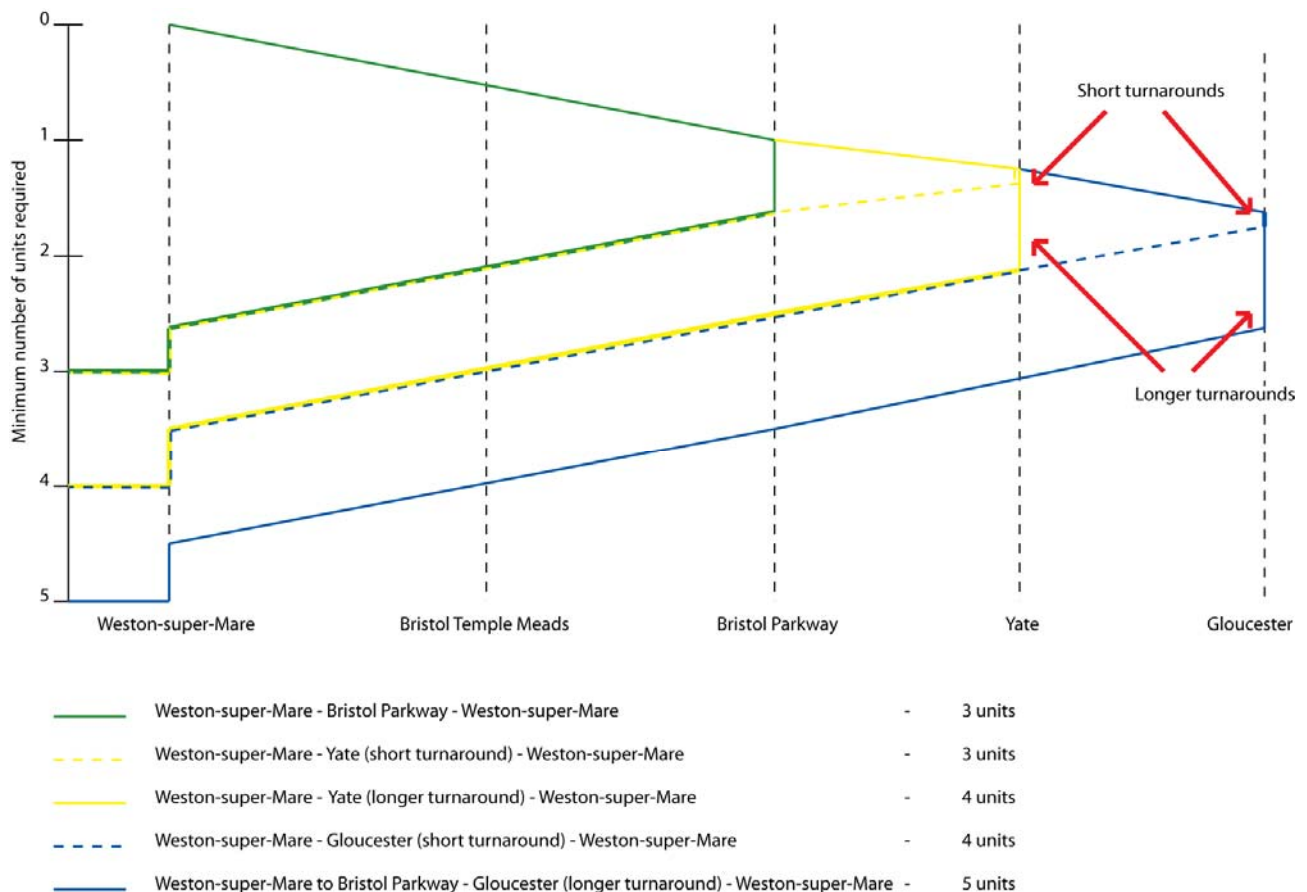


Figure 23 - Unit requirements by Yate/Gloucester extension scenario

It should be noted that these findings are consistent across all potential rolling stock, as the journey times for class 158s, class 150s and class 165s do not materially differ between any of the locations on this route. In terms of trade offs these iterations give four possible options, indicative examples of which are shown on the following page Figure 24;

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	Yate			Gloucester		
	Class 158	Class 150	Class 165	Class 158	Class 150	Class 165
No change to paths						
Freight/Parkway service switched						

Figure 24 - Extension of Weston-super-Mare service, unit numbers and turnaround projections

While these options are all achievable in timetable terms and compliant with the planning rules, the requirement for short turnarounds at both Yate and Gloucester in two of the scenarios is a significant performance risk, which is explored further below.

3.4. Historical performance of the Weston-super-Mare – Bristol Parkway service

Analysis of the historical performance of the Weston-super-Mare – Bristol Parkway service over the last 12 months is summarised in Figure 25 below. Note that the analysis is historical and does not include future proposed infrastructure interventions or timetable changes, and therefore doesn't provide a complete picture of this services future performance. It is provided here to illustrate the potential performance risk of short turnarounds at Yate or Gloucester.

Route	Percentage of service arriving late at Bristol Parkway	Average lateness of these arrivals (nearest minute)
Weston-super-Mare – Bristol Parkway	27.6%	18

Figure 25 - Historical performance of the Weston-super-Mare - Parkway service

This means that, if the extended Weston-super-Mare – Bristol Parkway service performs as today 28 percent of services would not achieve the required turnaround in either of the short turnaround scenarios, thereby causing further accrual of delay and operational complications, for example impacting upon through service at Yate. In practice, any delay to the Yate services will be higher because of the greater distance covered and the constrained nature of Westerleigh Jn.

This suggests that the benefits (in terms of unit numbers) of extending this service on short turnarounds will be significantly off-set by the services performance in practice.

This leaves 2 viable options remaining.

1. Weston-super-Mare – Bristol Parkway – Yate, with a longer turnaround at Yate
2. Weston-super-Mare – Bristol Parkway – Yate – Gloucester with a longer turnaround at Gloucester

As stated previously, the 'switched' path meets the aims to achieve an ~30-minute interval at Yate, but results in a short turnaround at Yate or Gloucester; taking all these factors in account suggests the net number of units required to extend to Yate will be +1 and to Gloucester +2. ,

3.4.1. Potential infrastructure/operational requirements
3.4.1.1. Yate

The diagram below represents the current infrastructure arrangements in the Yate area. As can be seen the capability for train turnrounds, without wrong line running, does not currently exist.

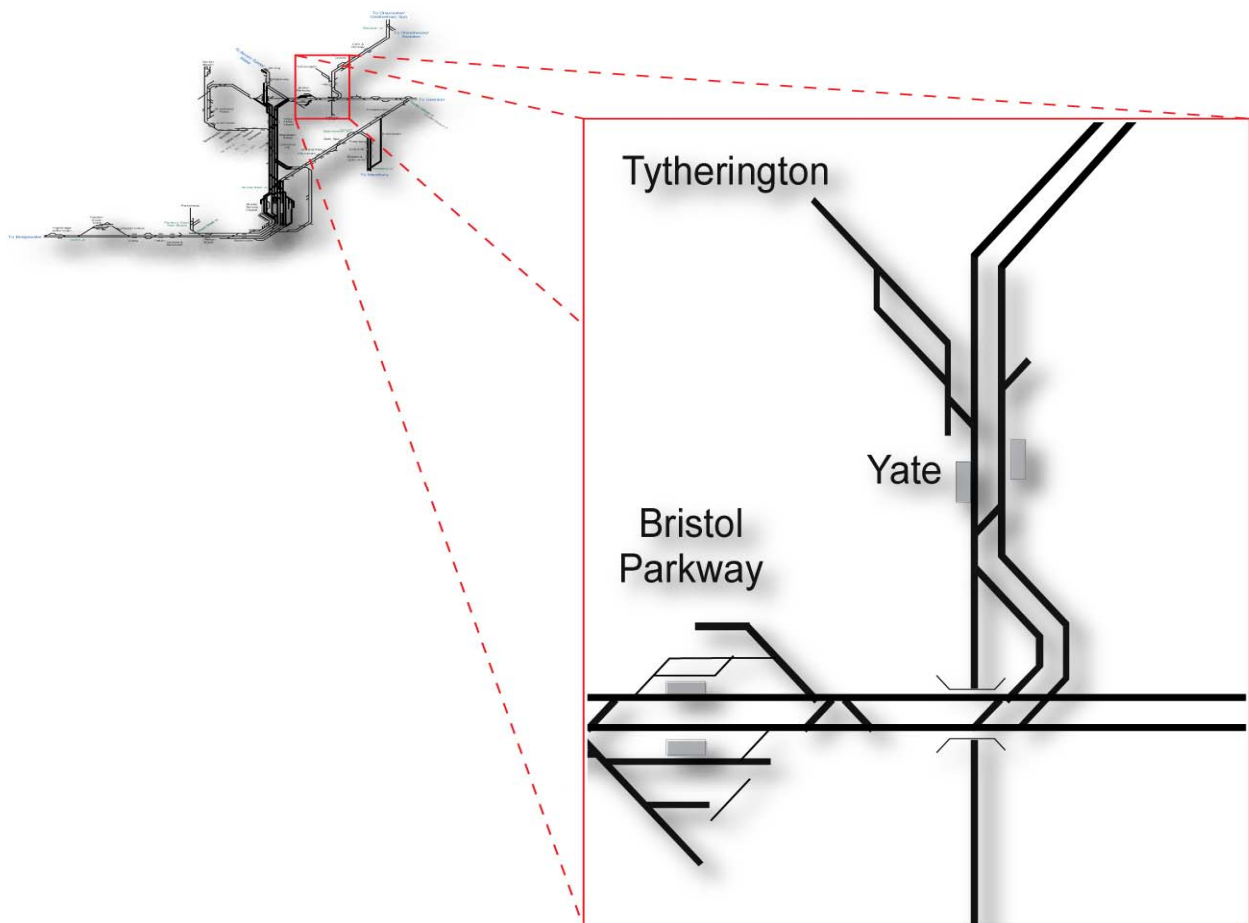


Figure 26 - Illustration of the infrastructure in the Yate area

There are a number of possibilities to achieve this capability:

1. If the turnaround at Yate is short the service would need to turnaround on the running lines by necessity. This approach introduces performance risk to through services in this area. This would require either an additional crossover (to allow the move from the Up Charfield to the Down Charfield) or relevant resignalling and bidirectional capability on the Down Charfield line. This is dependent on which platform is used at Yate.

2. If the turnaround is longer, this would enable the service to turnaround off the main running lines. This could be achieved with a new bay platform, or a turnback siding; in either case, the capability to access the Down Charfield from the Up Charfield would be required in order to avoid wrong line running.

3.4.1.2. Gloucester

Extending this local path beyond Yate presents an opportunity to remove the need for turnaround capability in the Yate area, and offer an additional service to and from Gloucester, at additional operational costs.

Additional services between Bristol and Birmingham have been clearly identified as a long term aspiration under the Long Term Planning Process which is currently underway within Network Rail and the wider industry. High level analysis has concluded that an additional path to and from Gloucester was achievable with no infrastructure interventions, assuming it makes use of the limited opportunities at Westerleigh Junction as outlined above

The capability of Gloucester station was not assessed in detail during this work. High level analysis indicates that an additional terminating service could be accommodated. Depending on the dwell length, some operational concessions may need further investigation.

3.4.1.3. Extension of the service beyond Gloucester

Given that one scenario suggests a long turnaround at Gloucester, the feasibility of further extension of this service has been suggested. Both the journey time (circa. 12 minutes in either direction) and the current platforming capability suggest that the services in this option could extend to Cheltenham with no additional unit requirements.

3.5. Weston Milton

The service pattern for Weston Milton station is currently hourly in the off peak with some additional stops during the peak and the aspiration is to secure additional stops to provide a half hourly all day service. The existing Weston-super-Mare to Parkway service already calls at Weston Milton (providing the hourly service).

Securing additional stops at Weston Milton is a specification rather than a timetabling/capacity issue and as such, has not to be addressed in the context of this report. However, Appendix E contains a technical note that explains how an alteration to the service specification provides the opportunity to address this issue in future timetable development phases during Control Period 5 (up to 2019).

For example, the service specification for the Intercity Express service between Paddington and Weston-super-Mare indicates intermediate station stops between Bristol Temple

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Meads and Weston-super-Mare, including Weston Milton. Furthermore, as the passenger demand at Weston Milton increases over the coming years, as a result of the build out of major housing development at Weston New Villages, there is potential for commercially driven enhancements by train operators, to the calling pattern of other train services operating in this part of the network. In summary, the most practical approach for securing additional stops for Weston Milton would be to pursue this enhancement directly with operators, out-with the scope of Phase 2.

4. Conclusions

The key conclusion for this work is that the capacity exists to deliver the Phase 2 service specification in a number of different ways. This means that the factors used to shape the final timetable can be a balance of inherent performance risk, desired connectivity and operational and capital cost assessments.

The Phase 1 pattern used as a base for this timetable is an example of where these connectivity trade-offs begin to occur. The operation and capital cost of translating Option 5b and Option 6b to a Phase 2 service level are likely to be very similar (owing to the reflected symmetry of these patterns). The significant performance risk of linking the Henbury loop services to the Portishead services at Bristol Temple Meads means that the option to connect Portishead services to the Severn Beach Line services is unacceptable. With Phase 1 Option 5b this would mean the 2tph Portishead services are required to terminate at Bristol Temple Meads, and for Option 6b only allowing for 1 of 2tph continuing to Bath Spa, with the 2ndtph terminating at Bristol Temple Meads.

Putting aside these trade-offs, the preferred options for the two broad service pattern questions are presented below in terms of performance, their impact on infrastructure and unit number requirements.

In the case of the Henbury Loop or Spur question, the loop is a much higher risk option than a spur service. The following factors have been used to reach this conclusion:

- The performance risk of a loop service linked to an extended loop service to Portishead is prohibitive. The number of linked constraints will inevitably result in a perturbed service which will have very little opportunity for recovery. Furthermore given that the arrivals and departures at Bristol Temple Meads are tied to each other, this has the added risk of spreading delay to the wider Bristol and Western areas. The spur service, by contrast, can be run in isolation and as such has a much smaller performance risk.
- Given the journey time and the weaving requirements, a stand-alone loop service would inevitably result in idle units sitting in Bristol Temple Meads for an extended period of time. This will result in additional strain on the platform capacity that is problematic to accommodate, even in unperturbed scenarios.
- Providing the infrastructure is available for an extended dwell at Henbury, the spur option can be timetabled to have a short dwell at Bristol Temple Meads, thereby limiting the impact on platform capacity.
- In timetabling terms, the spur service requires two less units to run than a loop service, with a consequent relative reduction in operational costs.
- Freight service can be regulated into and out of Avonmouth dock to west of Henbury (i.e. between Henbury and Hallen Marsh Jn) in the spur scenario. Additional crossovers would be required to achieve similar opportunities for regulation in the

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- loop option, and this would also increase the performance risks by increased wrong line running for all services.
- There are infrastructure costs involved in both options. While a bay platform and crossover at Henbury are quite straightforward to design, the doubling of Hallen Marsh Jn may be more complex and has the potential to have a greater disruptive effect as the project is implemented.

Furthermore there are a couple of factors outside of the capability/performance sphere that recommend a spur service over a loop:

- The journey time between Henbury and (e.g.) Clifton Down by rail does not compare favourably to the journey time by other modes of public transport (i.e. bus); the value of connecting these areas by rail may not be as high as a result (but this will be tested through the demand forecasts).
- The increased usage of St Andrews Road level crossing will produce a capacity constraint for access to Avonmouth Docks. It is also a potential safety concern as an increase in both the number of closures and down time can only increase the risk of the crossing being used incorrectly.

The conclusions regarding the choice of option for the extension of the Weston-super-Mare - Bristol Parkway service are more evenly balanced. The key factors that will guide this choice are unit numbers (operational cost) versus infrastructure (capital) costs. The recommendations below are based on the performance implications of the various scenarios and the wider service strategy in the area.

- Both scenarios that project short turnarounds at Yate or Gloucester are significant performance risks, based on the current performance of the Weston-super-Mare to Bristol Parkway service. Given that Westerleigh Jn is a key constraint in the Western region, persistent lateness of this service will be unpalatable to Network Rail and train/freight operators.
- The extension to Gloucester has been identified as a strategic goal for the region; whilst an extension to Yate could be seen as an interim step, it could result in infrastructure being provided at Yate that would become obsolete in the medium- to long-term.
- If the extension to Gloucester is to be pursued, it is likely that this can be further extended to Cheltenham Spa without further unit implications.

5. APPENDICES

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APPENDIX A. Timetable options

This appendix contains overview timetables for an off-peak hour for the following timetables:

- MetroWest Phase Two Loop Option (Based on Phase One Option 5b)
- MetroWest Phase Two Loop Option (Based on Phase One Option 6b)
- MetroWest Phase Two Spur Option (Based on Phase One Option 5b)
- MetroWest Phase Two Spur Option (Based on Phase One Option 6b)
- MetroWest Phase Two Yate extension Option - Short turnaround (Based on Phase One Option 5b)
- MetroWest Phase Two Yate extension Option - Longer turnaround (Based on Phase One Option 5b)
- MetroWest Phase Two Gloucester extension Option - Short turnaround (Based on Phase One Option 5b)
- MetroWest Phase Two Gloucester extension Option - Longer turnaround (Based on Phase One Option 5b)

In the Henbury spur timetables the 'clockwise' and 'anti-clockwise' nomenclature is only used to allow for comparison with the loop scenarios.

These are indicative of the service level and 'shape' of the timetable in each scenario and should be used for development and illustrative purposes only. The timetable process is, by necessity, in an early iterative stage and as such these projections do not represent any offer of service provision.

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Loop Scenario (based on Option 5b)																							
clockwise		Origin	BTM	BTM	anti-clockwise		Origin	Severn Beach	BTM	Destination		BTM	BTM	Destination		BTM	BTM	Destination		BTM	BTM		
		Destination	Severn Beach	BTM			Destination	BTM	BTM			BTM	BTM			BTM	BTM			BTM	BTM		
Bristol Temple Meads	arr				Bristol Temple Meads	arr																	
	dep		xx:11	xx:40½		dep							xx:32½										
Lawrence Hill	arr		xx:12½	xx:42	Lawrence Hill	arr							xx:34										
	dep		xx:13½	xx:43		dep							xx:35										
Stapleton Road	arr		xx:15	xx:44½	Stapleton Road	arr							xx:36½										
	dep		xx:16	xx:45		dep							xx:37½										
Montpellier	arr		xx:19	xx:47½	Ashley Hill	arr							xx:39										
	dep		xx:19½	xx:48		dep							xx:40										
Redland	arr		xx:21	xx:49	Constable Road	arr							xx:41										
	dep		xx:21½	xx:49½		dep							xx:42										
Clifton Down	arr		xx:23½	xx:51	Filton Abbey Wood	arr							xx:45½										
	dep		xx:25½	xx:55½		dep							xx:46½										
Sea Mills	arr		xx:29	xx:59	Filton North	arr							xx:50										
	dep		xx:29½	xx:00		dep							xx:51										
Shirehampton	arr		xx:32½	xx:03½	Henbury	arr							xx:54										
	dep		xx:33	xx:04½		dep							xx:55										
Portbury P&R	arr		xx:34	xx:05	Severn Beach	arr																	
	dep		xx:35½	xx:06		dep		xx:27															
Avonmouth	arr		xx:36½	xx:08	St Andrews Road	arr		xx:33	xx:02½														
	dep		xx:37½	xx:09		dep		xx:33½	xx:03½														
St Andrews Road	arr		xx:40½	xx:11	Avonmouth	arr		xx:36½	xx:06														
	dep		xx:41	xx:12		dep		xx:37½	xx:09														
Severn Beach	arr		xx:47½		Portbury P&R	arr		xx:38½	xx:10½														
	dep					dep		xx:39	xx:11½														
Henbury	arr			xx:18½	Shirehampton	arr		xx:41½	xx:12½														
	dep			xx:19½		dep		xx:42	xx:13½														
Filton North	arr			xx:22½	Sea Mills	arr		xx:45	xx:17														
	dep			xx:23½		dep		xx:45½	xx:18														
Filton Abbey Wood	arr			xx:27	Clifton Down	arr		xx:50	xx:22														
	dep			xx:31		dep		xx:50½	xx:26														
Constable Road	arr			xx:32	Redland	arr		xx:52½	xx:27½														
	dep			xx:33		dep		xx:53	xx:28½														
Ashley Hill	arr			xx:35	Montpellier	arr		xx:54½	xx:29½														
	dep			xx:36		dep		xx:55	xx:30½														
Stapleton Road	arr			xx:38	Stapleton Road	arr		xx:00	xx:33½														
	dep			xx:39		dep		xx:00½	xx:34½														
Lawrence Hill	arr			xx:40	Lawrence Hill	arr		xx:02	xx:36														
	dep			xx:41		dep		xx:02½	xx:37														
Bristol Temple Meads	arr			xx:43	Bristol Temple Meads	arr		xx:07	xx:39														
	dep					dep																	

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Loop Scenario (based on Option 6b)							
clockwise	Origin	BTM	BTM	anti-clockwise	Origin	Severn Beach	BTM
	Destination	Severn Beach	BTM		Destination	BTM	BTM
Bristol Temple Meads	arr			Bristol Temple Meads	arr		
	dep	xx:25½	xx:57½		dep		xx:14
Lawrence Hill	arr	xx:58	xx:59	Lawrence Hill	arr		xx:15½
	dep	xx:29	xx:00		dep		xx:16
Stapleton Road	arr	xx:30½	xx:01½	Stapleton Road	arr		xx:17½
	dep	xx:31½	xx:02½		dep		xx:18½
Montpellier	arr	xx:34½	xx:05	Ashley Hill	arr		xx:20
	dep	xx:35	xx:06		dep		xx:20½
Redland	arr	xx:36½	xx:07	Constable Road	arr		xx:21½
	dep	xx:37	xx:08		dep		xx:22
Clifton Down	arr	xx:39	xx:09½	Filton Abbey Wood	arr		xx:26
	dep	xx:40	xx:11½		dep		xx:26½
Sea Mills	arr	xx:43½	xx:15	Filton North	arr		xx:30
	dep	xx:44	xx:16		dep		xx:31
Shirehampton	arr	xx:47	xx:19½	Henbury	arr		xx:34
	dep	xx:47½	xx:20½		dep		xx:35
Portbury P&R	arr	xx:48½	xx:21	Severn Beach	arr		
	dep	xx:49	xx:22		dep	xx:13	
Avonmouth	arr	xx:51	xx:24	St Andrews Road	arr	xx:19	xx:42½
	dep	xx:52	xx:25		dep	xx:19½	xx:43½
St Andrews Road	arr	xx:55	xx:27	Avonmouth	arr	xx:22½	xx:46
	dep	xx:55½	xx:28		dep	xx:23½	xx:50
Severn Beach	arr	xx:02		Portbury P&R	arr	xx:24½	xx:51½
	dep				dep	xx:25	xx:52½
Henbury	arr		xx:34½	Shirehampton	arr	xx:27½	xx:53½
	dep		xx:35½		dep	xx:28	xx:54½
Filton North	arr		xx:38½	Sea Mills	arr	xx:31	xx:58
	dep		xx:45		dep	xx:31½	xx:59
Filton Abbey Wood	arr		xx:48½	Clifton Down	arr	xx:36	xx:03
	dep		xx:49		dep	xx:38	xx:09
Constable Road	arr		xx:50	Redland	arr	xx:40	xx:10½
	dep		xx:50½		dep	xx:40½	xx:11½
Ashley Hill	arr		xx:52½	Montpellier	arr	xx:42	xx:12½
	dep		xx:53		dep	xx:42½	xx:13½
Stapleton Road	arr		xx:55	Stapleton Road	arr	xx:47	xx:16½
	dep		xx:55½		dep	xx:47½	xx:17
Lawrence Hill	arr		xx:56½	Lawrence Hill	arr	xx:49	xx:18½
	dep		xx:57½		dep	xx:49½	xx:19½
Bristol Temple Meads	arr		xx:00	Bristol Temple Meads	arr	xx:52½	xx:21½
	dep				dep		

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Spur scenario (based on Option 5b)									
clockwise	Origin	BTM	BTM	Henbury	anti-clockwise	Origin	Severn Beach	Avonmouth	BTM
	Destination	Severn Beach	Avonmouth	BTM		Destination	BTM	BTM	Henbury
Bristol Temple Meads	arr				Bristol Temple Meads	arr			
	dep	xx:11	xx:36½			dep			xx:32½
Lawrence Hill	arr	xx:12½	xx:39		Lawrence Hill	arr			xx:34
	dep	xx:13½	xx:39½			dep			xx:35
Stapleton Road	arr	xx:15	xx:41		Stapleton Road	arr			xx:36½
	dep	xx:16	xx:42			dep			xx:37
Montpellier	arr	xx:19	xx:45		Ashley Hill	arr			xx:38½
	dep	xx:19½	xx:45½			dep			xx:39
Redland	arr	xx:21	xx:47		Constable Road	arr			xx:40
	dep	xx:21½	xx:47½			dep			xx:40½
Clifton Down	arr	xx:23½	xx:49½		Filton Abbey Wood	arr			xx:44
	dep	xx:25½	xx:51½			dep			xx:44½
Sea Mills	arr	xx:29	xx:55		Filton North	arr			xx:48
	dep	xx:29½	xx:55½			dep			xx:48½
Shirehampton	arr	xx:32½	xx:58½		Henbury	arr			xx:51½
	dep	xx:33	xx:59			dep			
Portbury P&R	arr	xx:34	xx:59½		Severn Beach	arr			
	dep	xx:35½	xx:00½			dep	xx:27		
Avonmouth	arr	xx:36½	xx:02½		St Andrews Road	arr	xx:33		
	dep	xx:37½				dep	xx:33½		
St Andrews Road	arr	xx:40½			Avonmouth	arr	xx:36½		
	dep	xx:41				dep	xx:37½	xx:09½	
Severn Beach	arr	xx:47½			Portbury P&R	arr	xx:38½	xx:11½	
	dep					dep	xx:39	xx:12½	
Henbury	arr			xx:59½	Shirehampton	arr	xx:41½	xx:13½	
	dep					dep	xx:42	xx:14	
Filton North	arr			xx:02½	Sea Mills	arr	xx:45	xx:17½	
	dep			xx:03		dep	xx:45½	xx:18	
Filton Abbey Wood	arr			xx:06½	Clifton Down	arr	xx:50	xx:22	
	dep			xx:07		dep	xx:50½	xx:27½	
Constable Road	arr			xx:08	Redland	arr	xx:52½	xx:29½	
	dep			xx:08½		dep	xx:53	xx:30	
Ashley Hill	arr			xx:10½	Montpellier	arr	xx:54½	xx:31½	
	dep			xx:11		dep	xx:55	xx:32	
Stapleton Road	arr			xx:12½	Stapleton Road	arr	xx:00	xx:37	
	dep			xx:13		dep	xx:00½	xx:37½	
Lawrence Hill	arr			xx:14	Lawrence Hill	arr	xx:02	xx:39	
	dep			xx:15		dep	xx:02½	xx:39½	
Bristol Temple Meads	arr			xx:17½	Bristol Temple Meads	arr	xx:07	xx:42½	
	dep					dep			

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Spur scenario (based on Option 6b)									
clockwise	Origin	BTM	BTM	Henbury	anti-clockwise	Origin	Severn Beach	Avonmouth	BTM
	Destination	Severn Beach	Avonmouth	BTM		Destination	BTM	BTM	Henbury
Bristol Temple Meads	arr				Bristol Temple Meads	arr			
	dep	xx:25½	xx:52½			dep			xx:32½
Lawrence Hill	arr	xx:58	xx:55		Lawrence Hill	arr			xx:34
	dep	xx:29	xx:55½			dep			xx:35
Stapleton Road	arr	xx:30½	xx:57		Stapleton Road	arr			xx:36½
	dep	xx:31½	xx:58			dep			xx:37
Montpellier	arr	xx:34½	xx:01		Ashley Hill	arr			xx:38½
	dep	xx:35	xx:01½			dep			xx:39
Redland	arr	xx:36½	xx:03		Constable Road	arr			xx:40
	dep	xx:37	xx:03½			dep			xx:40½
Clifton Down	arr	xx:39	xx:05½		Filton Abbey Wood	arr			xx:44
	dep	xx:40	xx:09			dep			xx:44½
Sea Mills	arr	xx:43½	xx:12½		Filton North	arr			xx:48
	dep	xx:44	xx:13			dep			xx:48½
Shirehampton	arr	xx:47	xx:16		Henbury	arr			xx:51½
	dep	xx:47½	xx:16½			dep			
Portbury P&R	arr	xx:48½	xx:17		Severn Beach	arr			
	dep	xx:49	xx:18			dep	xx:13		
Avonmouth	arr	xx:51	xx:20		St Andrews Road	arr	xx:19		
	dep	xx:52				dep	xx:19½		
St Andrews Road	arr	xx:55			Avonmouth	arr	xx:22½		
	dep	xx:55½				dep	xx:23½	xx:53½	
Severn Beach	arr	xx:02			Portbury P&R	arr	xx:24½	xx:55½	
	dep					dep	xx:25	xx:56½	
Henbury	arr			xx:59½	Shirehampton	arr	xx:27½	xx:57½	
	dep					dep	xx:28	xx:58	
Filton North	arr			xx:02½	Sea Mills	arr	xx:31	xx:01½	
	dep			xx:03		dep	xx:31½	xx:02	
Filton Abbey Wood	arr			xx:06½	Clifton Down	arr	xx:36	xx:06	
	dep			xx:07		dep	xx:38	xx:14	
Constable Road	arr			xx:08	Redland	arr	xx:40	xx:16	
	dep			xx:08½		dep	xx:40½	xx:16½	
Ashley Hill	arr			xx:10½	Montpellier	arr	xx:42	xx:18	
	dep			xx:11		dep	xx:42½	xx:18½	
Stapleton Road	arr			xx:12½	Stapleton Road	arr	xx:47	xx:23½	
	dep			xx:13		dep	xx:47½	xx:24	
Lawrence Hill	arr			xx:14	Lawrence Hill	arr	xx:49	xx:25½	
	dep			xx:15		dep	xx:49½	xx:26	
Bristol Temple Meads	arr			xx:17½	Bristol Temple Meads	arr	xx:52½	xx:29	
	dep					dep			

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Weston-super-Mare - Bristol Parkway extension scenarios

Up Gloucester	Origin	Weston Super Mare	Weston Super Mare	Weston Super Mare	Weston Super Mare	Weston Super Mare
	Destination	Bristol Parkway	Yate	Yate	Gloucester	Gloucester
	Comment		Short turnaround	Longer turnaround	Short turnaround	Longer turnaround
Weston-super-Mare	arr					
	dep	xx:27½	xx:27½	xx:43½	xx:27½	xx:43½
Bristol Temple Meads	arr	xx:48½	xx:48½	xx:04½	xx:48½	xx:04½
	dep	xx:10½	xx:10½	xx:26½	xx:10½	xx:26½
Bristol Parkway	arr	xx:27½	xx:26½	xx:42½	xx:26½	xx:42½
	dep		xx:29½	xx:45½	xx:29½	xx:45½
Yate	arr		xx:36½	xx:52½	xx:36½	xx:52½
	dep				xx:37½	xx:53½
Gloucester	arr				xx:11½	xx:27½
	dep					

Down Gloucester	Origin	Bristol Parkway	Yate	Gloucester
	Destination	Weston Super Mare	Weston Super Mare	Weston Super Mare
	Comment			
Gloucester	arr			
	dep			x05
Yate	arr			xx:39
	dep		xx:40	x40
Bristol Parkway	arr	xx:49	xx:49	xx:49
	dep	xx:51	xx:51	xx:51
Bristol Temple Meads	arr	xx:06	xx:06	xx:06
	dep	xx:08½	xx:08½	xx:08½
Weston-super-Mare	arr	xx:49	xx:49	xx:49
	dep			

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Weston-super-Mare - Bristol Parkway extension scenarios

Up Gloucester	Origin	Weston Super Mare	Weston Super Mare	Weston Super Mare	Weston Super Mare	Weston Super Mare
	Destination	Bristol Parkway	Yate	Yate	Gloucester	Gloucester
	Comment		Short turnaround	Longer turnaround	Short turnaround	Longer turnaround
Weston-super-Mare	arr					
	dep	xx:27½	xx:27½	xx:43½	xx:27½	xx:43½
Bristol Temple Meads	arr	xx:48½	xx:48½	xx:04½	xx:48½	xx:04½
	dep	xx:10½	xx:10½	xx:26½	xx:10½	xx:26½
Bristol Parkway	arr	xx:27½	xx:26½	xx:42½	xx:26½	xx:42½
	dep		xx:29½	xx:45½	xx:29½	xx:45½
Yate	arr		xx:36½	xx:52½	xx:36½	xx:52½
	dep				xx:37½	xx:53½
Gloucester	arr				xx:11½	xx:27½
	dep					

Down Gloucester	Origin	Bristol Parkway	Yate	Gloucester
	Destination	Weston Super Mare	Weston Super Mare	Weston Super Mare
	Comment			
Gloucester	arr			
	dep			x05
Yate	arr			xx:39
	dep		xx:40	x40
Bristol Parkway	arr	xx:49	xx:49	xx:49
	dep	xx:51	xx:51	xx:51
Bristol Temple Meads	arr	xx:06	xx:06	xx:06
	dep	xx:08½	xx:08½	xx:08½
Weston-super-Mare	arr	xx:49	xx:49	xx:49
	dep			

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APPENDIX B. Infrastructure requirement matrix

This appendix contains a matrix of the required infrastructure for each of the Phase Two service specification options (Loop, Spur and WsM – Bristol Parkway extension options)

	Phase One scheme	Henbury connection	Eastern extension	Platform facing (Portishead)	Platform facing (Pill)	Platform facing (Clifton Down)	Interim Signal on Portishead Down	Doubling Parson Street Jn	Platform facing (Portway Park and Ride)	Bathampton Turnback sidings	Signalling/bidirectionality adjustments at Severn Beach	Platform facings (Ashley Hill)	Platform facings (Constable Road)	Henbury bay platform	Relevant bi-directionality at Henbury	Crossover east of Henbury	Through platform facings (Henbury)	Yate bay platform	Relevant bi-directionality/signalling arrangement at Yate	Reopening the Tytherington lines for turnaround purposes	
Phase One	Option 5b	n/a	n/a	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	Option 6b	n/a	n/a	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Phase Two	Option 5b	Henbury Spur	n/a	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	Option 6b	Henbury Spur	n/a	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	Option 5b	Henbury Loop	n/a	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	Option 6b	Henbury Loop	n/a	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	Option 5b	n/a	Extension to Yate (short turnaround)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	Option 6b	n/a	Extension to Yate (long turnaround)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	○	○	○
	Option 5b	n/a	Extension to Gloucester (short turnaround)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Option 6b	n/a	Extension to Gloucester (long turnaround)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Option 5b	Henbury Spur	Extension to Yate (short turnaround)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Option 6b	Henbury Spur	Extension to Yate (long turnaround)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	○	○	○
	Option 5b	Henbury Loop	Extension to Gloucester (short turnaround)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Option 6b	Henbury Loop	Extension to Gloucester (long turnaround)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

- ✓ Required
- At least one option required
- ✗ Not required

APPENDIX C. Minimum unit number requirement matrix

This appendix contains a matrix of the minimum unit numbers required to timetable each of the Phase 2 service specification options (Loop, Spur and WSM – Bristol Parkway extension options). It should be noted that these numbers do not take into account perturbation, unit maintenance or any other operational requirements.

		Phase One		Henbury connectivity	
		Option 5b	Option 6b	Henbury Spur	Henbury loop
Phase One	Option 5b	+6		+7	+9
	Option 6b		+6	+7	+9
WSM - BPW extension	Yate (short turnaround)	+6	+6	+7	+9
	Yate (Longer turnaround)	+7	+7	+8	+10
	Gloucester (short turnaround)	+7	+7	+8	+10
	Gloucester (Longer turnaround)	+8	+8	+9	+11

APPENDIX D. Service levels

This appendix contains a summary of the MetroWest local service levels for stations in the MetroWest Phase 2 area versus current provision. These tables are based on the indicative weekday inter-peak timetables created for the NR CAT work.

	Station	Current	Post Phase One	Post Phase Two
To Bristol Temple Meads (direct services only)	Ashley Hill	n/a	n/a	1
	Avonmouth	1.5	2	2
	Bath Spa	4.5	5.5	5.5
	Bedminster	1	3	3
	Bristol Parkway	2	2	2
	Cam & Dursley	1	1	2(g), 1(y)
	Clifton Down	1.5	2	2
	Constable Road	n/a	0	1
	Filton Abbey Wood	4	4	5
	North Filton	n/a	n/a	1
	Gloucester	1	1	2(g), 1(y)
	Henbury	n/a	n/a	1
	Keynsham	1	2	2
	Lawrence Hill	~2	3	4
	Montpelier	1.5	2	2
	Nailsea & Blackwell	2	2	2
	Oldfield Park	1	2	2
	Parson Street	1	3	3
	Pill	n/a	2	2
	Portishead	n/a	2	2
	Portway Park & Ride	n/a	2#	2#
	Redland	1.5	2	2
	Sea Mills	1.5	2	2
	Severn Beach	0.5	1	1
	Shirehampton	1.5	2	2
	St Andrews Road	0.5	1	2
	Stapleton Road	~2	3	4
	Weston Milton	1	2	2
	Weston-super-Mare	2	3	3
	Worle	2	2	2
	Yate	1	1	2
	Yatton	2	3	3

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	Station	Current	Post Phase One	Post Phase Two
From Bristol Temple Meads (direct services only)	Ashley Hill	n/a	n/a	1*
	Avonmouth	1.5	2	2
	Bath Spa	4.5	5.5	5.5
	Bedminster	1	3	3
	Bristol Parkway	2	2	2
	Cam & Dursley	1	1	2(g), 1(y)
	Clifton Down	1.5	2	2
	Constable Road	n/a	n/a	1
	Filton Abbey Wood	4	4	5
	North Filton	n/a	n/a	1
	Gloucester	1	1	2(g), 1(y)
	Henbury	n/a	n/a	1
	Keynsham	1	2	2
	Lawrence Hill	~2	3	4
	Montpelier	1.5	2	2
	Nailsea & Blackwell	2	2	2
	Oldfield Park	1	2	2
	Parson Street	1	3	3
	Pill	n/a	2	2
	Portishead	n/a	2	2
	Portway Park & Ride	n/a	2#	2#
	Redland	1.5	2	2
	Sea Mills	1.5	2	2
	Severn Beach	0.5	1	1
	Shirehampton	1.5	2	2
	St Andrews Road	0.5	1	2
	Stapleton Road	~2	3	4
	Weston Milton	1	2	2
	Weston-super-Mare	2	3	3
	Worle	2	2	2
Yate	1	1	2	
Yatton	2	3	3	

KEY

(y) - WsM - BPW extended to Yate

(g) - WsM - BPW extended to Gloucester

APPENDIX E. Technical Note; Service Provision in the MetroWest Area

This technical note has been included in this report to address the questions regarding service provision at individual stations in the MetroWest area. There are two key strands of question that have been asked:

- How the service provision stated in Appendix D is achieved within each MetroWest option, particularly with regards to Weston Milton station.
- Sensitivities regarding routing of services on the Filton bank, i.e. service provision above that stated in Appendix D.

These two points are addressed below:

E.I. Clarification of stated service level

Appendix D contains a breakdown of the number of direct connections between Bristol Temple Meads and each individual station. Where stations do not currently exist the number represents that projected number of connections, passive provision has been allowed within the timetables in order to achieve these stops.

While it appears that the quantum of these calls broadly deliver the required outputs of the timetable development process, the interactions between the various proposals are complex. The following information explains how these stops can be achieved within the timetable structure.

Both Metrowest Phase 2 options explored in this report use the Crossrail Iteration 5 service specification as a background timetable. This service specification states that the Intercity Express service between Paddington and Weston-super-Mare would call at intermediate stations between Bristol Temple Meads and Weston-super-Mare, including Weston Milton. The means that the uplift in service level is realised within each MetroWest timetable iteration. In future timetables, which will necessarily be constructed during the MetroWest scheme development, it is likely that these stopping patterns will be rationalised. In terms of capacity the number of stops stated in Appendix D are achievable in future timetable iterations.

E.II. Potential service provision above that stated in Appendix D

Further aspirational queries have been submitted as to the potential of increasing the number of stops at stations on the Filton Bank (in all scenarios) and Cam & Dursley (in the Gloucester extension scenario).

In order to include more calls on the Filton Bank it would require the Weston-super-Mare service to cross to the relief lines at Bristol Temple Meads (East or West Jn) and cross back

at Filton Jn. This would introduce 4 more crossing moves per hour, which would inevitably impact performance. Further rationalisation of the service specification (ie calls in the Wales services) may achieve these aspirations without these performance implications.

A key constraint on an extended Weston-super-Mare service is its path across Westerleigh Jn. In order to achieve further calls, either on the Filton Bank or North of Yate, it would be necessary to flex its path either side of this junction. This would require significant timetable rebuilding and potentially a recast of the timetable in the area.