Bath Eastern Park and Ride Site Options

Bathampton Parkway

Review of Dorian Baker report dated 6th February 2012

Revision 01

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1 Executive Summary

Halcrow have been requested by Bath and North East Somerset Council to undertake a high level review of a proposal for a new Bath Eastern Park and Ride site at Bathampton Junction, as included in a report dated 6th February 2012 produced by Mr Dorian Baker.

Due to cost limitations, our review looks at the engineering, operational and cost issues associated with the report at a very high level.

To keep our review focused we have restricted our comments to the original proposal for a park and ride scheme and avoided commenting on any of Network Rail's long term plans and strategies in the area.

In summary;

- There are some considerable engineering technical problems to be addressed.
- There are considerable problems with the operations of layout as proposed.
- The engineering costs are very expensive.
- In addition to the above, there are considerable issues to be addressed regarding land take, road layout operations, housing blight, business relocation and compensation costs.
- It is highly unlikely that any funding would come from the railway companies.
- This scheme needs to be considered carefully against the various bus park and ride options before any further work is undertaken.

2 Introduction

Halcrow have been requested by Bath and North East Somerset Council to undertake a high level review of a proposal for a new Bath Eastern Park and Ride site at Bathampton Junction, as included in a report dated 6th February 2012 produced by Mr Dorian Baker.

Our review looks at the engineering, operational and cost issues associated with the report.

It must be borne in mind that due to cost limitations our review has been undertaken with certain restrictions as follows:

- It has not been possible to visit the site

- We have no accurate survey or access to existing as built drawings/plans - we have had to rely on Mr Baker's drawings (pdfs not to scale) and aerial photographs.

- It has not been possible to liaise with Network Rail to ascertain their overall strategy / plans for this area.

- It has not been possible to look into a possession strategy except as a very high level assessment of likelihood.

3 General Overview of Report

3.1 General Approach

The general approach in Mr Baker's report raises the following issues:

- To maximise the amount of land available for the car park and to provide a platform that is mostly on the straight it is proposed to move the tracks including the mainline junction to the west of their current position.

- The case for moving the junction is then further justified by suggesting weaknesses in the existing layout that could be resolved by his proposed new alternative one which ties in with his platform proposal.

- Nevertheless another more complex layout is proposed over and above the original option.

- Other issues then dealt with include regional route and electrification issues. However, these are not directly relevant to this scheme and have no impact on the viability of the track layout proposals in respect of their ability to serve the park and ride facility or the local Bathampton area..

- To keep our review focused we have restricted our comments to the original proposal for a park and ride scheme and avoided commenting on any of Network Rail's long term plans and strategies in the area.

3.2 Permanent Way

Whilst the report demonstrates some significant engineering knowledge, (e.g. the comments on concrete strength on page 15 the assumptions regarding

permanent way (track) engineering appear to be based on a more limited understanding –specific issues in this respect are made in section 4.

There are two major drawbacks to the scheme from a P Way point of view. From analysis of the drawing provided, the radii of the proposed curve appears to be somewhere in the region of approximately 390m radius. In addition, from information extracted from the railway industry Five Mile Line Diagrams the new platform would be located on land almost immediately adjacent to the track on an existing < 1 in 330 gradient. This is in contravention of the track design handbook NR/L2/TRK 2049, which states:

> *"Station platforms shall not be located on horizontal curves with radii less than 1000m*"; and
>
> *"Wherever possible, platforms shall be located with an average gradient not steeper than 1 in 500. It is permissible for platforms to be located on track with average gradients steeper than 1 in 500 provided trains are not planned to terminate or reverse at the platform"*

It is worth noting that the length of platform appears to over-cater for the use of two car units suggested in the document. The platforms appear to be much longer than required. However, this may not be a problem as there are a number of regional and inter-regional services in the area.

It is possible that detailed design may be able to improve on the existing situation and/or a dispensation may be obtained, but it is by no means certain. This one aspect alone may prevent the approval of the scheme.

3.3 Signalling

The report produced by Mr Baker contains little if any reference to either the existing Signalling arrangements in the Bathampton and Bath Spa areas, or what new equipment would be necessary to accommodate his suggested park and ride service.
The Signalling alterations required by his report can be sub-divided into three geographical areas, plus their controlling signal box. All three are currently controlled from Bristol Power Box, via a conventional Entrance / Exit (NX) panel and free wired interlockings to E10K standards. As discussed below, all signalling equipment in the area covered by this report is due to be replaced as part of the Great Western Mainline Electrification project, (due for completion in 2019).

1) Great Western Up/Down Mainlines in the Bathampton Junction area &
2) Up / Down Trowbridge lines in the Bathampton Junction area.

The report states that "there is a once in a generation opportunity to amend the layout at Bathampton, as part of the work associated with the Great Western Main Line Electrification project". Whilst this is correct, in that the Signalling equipment will be entirely replaced by this project, Mr

Bakers report appears to presume that the substantial changes to track, signalling and electrification which he recommends at Bathampton Junction would be completed and funded as part of this far larger project. Presuming that Network Rail is willing to incorporate into Great Western Electrification the suggested substantial alterations to the junction is a major assumption, the funding of it even more so.

Comparing the new and old layouts simply by numbers of switches and crossings does not address the additional and possibly excessive complexity of the new layout, for signalling purposes. The addition of the central bi-directional loop appears to add little functionality compared to the existing layout and it is unlikely it would in practice be used for either of the “advantages” quoted by Mr Baker. (Train preparation and passing of Freight trains). Constraints on signal overlaps forced by the revised junction layout would still require an appropriate train planning path to be provided to cross the Great Western Down Main, or be forced to wait in the loop whilst the protecting signal release times off. This would require approach control of the protecting signal, so potentially slowing the speeds of trains routed off the GWR Up into the central loop.

Similarly the proposal for a bay platform sited in between the Up & Down Trowbridge lines adds unnecessary complication to the layout and the island platform arrangement would prevent Regional services on the Up Trowbridge line from calling at Bathampton. Signalling into a bay platform necessitates the slowing of the approach speed of the terminating train, which in this case would result in a slow running speed across the GWR Down Main. A simplified layout could minimise this whilst reducing the number of new point ends to be provided.

The re-alignment of the Up/Dn Trowbridge lines, in order to avoid demolition of the existing Bathampton Interlocking Signalling Relay Room, is not relevant unless the re-signalling of the Great Western Main Line was not to go ahead. This project will entirely replace the contents of the relay room and most likely demolish the building as a cost saving measure.

Lastly, the suggestion to provide a light rail line adjacent to the Great Western Down Main should be treated with caution. Although there is no track here at present, all the signalling equipment cabinets and associated cable routes are presently located on this side of the line. Re-Signalling of the Great Western Main Line may or may not replicate this arrangement. The addition of new track here could potentially require the re-location of and consequent re-testing of all of the main line signalling equipment adjacent to the light rail.

Re-signalling of this layout to the track diagram provided in Mr Bakers report would require the removal of two existing main signals and the provision of approximately 6 new main signals, together with all associated track circuiting, train protection equipment and signage. 7 ends of points (or switches) would require removal and 7 new ends of points installing, (in different positions). Costs for this work to be done as a separate project,

(rather than being provided gratis as part of GWML Electrification), can be found in Appendix C.

3) Bath Spa Station and Westmorland Road Sidings:

There is also an almost complete absence of detail in M Bakers report regarding the arrangements at the western end of the new rail service, other than to state that any new service "would make its western reversal at the existing Westmorland Road sidings." Unfortunately these sidings do not currently have any provision for the reversing of trains back into Bath Spa Station, there being no signal at the eastern end of the loop. Also the points at this end of the loop would require conversion from unpowered "spring" points, to powered points controlled from Bristol Power Box. Again, cost for the provision of this equipment can be found in Appendix C.

4) Bristol Power Box:

Should this scheme be implemented other than part of GWML electrification, significant alterations would be required to Bristol power box control panel and it's associated signal interlocking. Also, data transmission equipment between Bristol PSB and Bathampton / Westmorland road interlockings would require increased capacity to control the extra signalling equipment.

3.4 Telecommunications

New signal post telephones (SPTs) will be mounted on posts on the approach to the new platform signals. They shall be jumpered to the main cabling and terminated at the controlling signalling centre.

The SPTs shall be connected to the concentrator at the controlling signalling centre. New line cards will be installed as necessary and the touchscreen reprogrammed or key panel relabelled in agreement with the Local Operations Manager.

Train despatch at the new station may require the installation of a Driver Only Operation (DOO) CCTV system. Whereby a new monitor bank shall be designed and installed at the end of the platform, cameras shall be installed along the platform to allow the driver to assess the platform / train interface before finishing station operations.

Due to the need to connect systems and services at the new station to the Fixed Telecoms Network (FTN), copper and fibre cables would be laid alongside the alignment to the new station. This necessitates the installation of a new troughing route to protect the cables. This route would be suitable to house any signalling, telecoms or other low voltage cables.

The fibre cable would be jointed with a minimum number of spliceless joints, housed within cable joint bays. The copper cable would be jointed and terminated on the lineside to ensure tail cables are kept to within limits described by FTN standards.

Transmission equipment and various modems required for data services would be located within an equipment rooms at the new station.

Existing cables and routes along side the current alignment would require slewing to the new.

Station information and Security Systems (SISS) will be installed at the station in accordance with the requirements of the Train Operating Company, Network Rail and the Equality Act 2010. The Customer Information Systems covering the station shall be required to be connected to the CIS network to enable passengers to receive real time visual and audio information about train running.

CCTV cameras shall be fitted to give coverage of the public areas of the station, including the station car park. Recording equipment shall be located within an equipment room at the station and the system configured to transmit recordings on request.

A passenger help point will also be installed on the platform.

3.5 Civil Engineering

The civil engineering works immediately associated with the 'railway' part of this scheme are the provision of a 200m island platform and a footbridge to access the platform from the car park. There are problems with the proposed location of the platform which have already been discussed in section 3.2. The footbridge provision should be relatively straightforward.

3.6 Electrification

The Great Western electrification scheme covers inter-city routes to Bristol via both Bristol Parkway and Bath. It does not cover the electrification of local or regional routes that share these routes for any part of their journeys. While an aspiration exists for electrification of local services, there is no concrete business case as yet, and Bristol Metro Phase 1 assumes diesel operation at its inception. On this basis, while any potential trains to Bathampton will run under the wires between there and Bristol Temple Meads, the other legs of the local service pattern will require diesel operation and therefore there need currently be no expectation of electrification of any Bathampton park and ride facility.

3.7 Operations

The layout proposed by the Baker report for the bay platform, incorporating turnback, is over-complex. A simpler layout could be achieved with the same operational effect, but this would still be subject to the risk and issues associated with alignment constraints (gradient and curve) and the need to acquire land and carry out civil works to make it up to the right level.

We note that it is suggested by Mr Baker that the park and ride site be served by a rail shuttle service to Bath Spa station. We do not regard this as being operationally feasible in itself. Bath Spa station has very limited capacity for turning trains back and the nature and layout of turnouts at Bath do not allow turning back from/to the east. The site might possibly be served by other existing and proposed services. These would be:

- Existing regional services that link Westbury and Bath hourly.
- The Bristol Metro Phase 1 new service terminating at Bath, provided that it can be extended to serve Bathampton.

Early work on Bristol Metro Phase suggested that an operationally robust turnback for Bath would require running to Bathampton to turn around there. However, further work has concluded that this is not necessary to make the Metro Phase 1 service to Bath work reliably. It remains potentially feasible to extend this service to Bathampton, but given that the Bathampton turnback is no longer required for Bristol Metro the park and ride scheme's overall income stream would have to cover the additional operational and infrastructure costs.

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3.8 Possession Strategy

Comments from Mr Baker outside of his report implied that the implementation of signalling alterations could be staged over no more than 2 weekend possessions. We do not agree with this conclusion and believe the true figure would be considerably greater. However, to provide a comprehensive staging strategy as evidence of this would be beyond the remit of this study, and would require significant further investigation.

4 Critique of Specific Points in Report

Page number and paragraph	Original comment	Halcrow response
1.1	A scheme to provide a Park & Ride railway station and high capacity car park, largely on existing railway land at Bathampton Junction.	Is there evidence that can be provided to show that ownership of the land has been established, and that it is available for purchase and change of use?
1.6	If a car park site could be identified near to the railway junction at Bathampton at which a railway station could be built, then the rail journey into Bath Spa main line railway station would be about 3.75 minutes - based on current Westbury line train operating timetables.	We would say that this is approximately right. Time would be 3½ minutes at best or 4 minutes at worst.
2.1	To the south of the existing road and railway corridor at Bathampton an area of "brown land", the site of the original Bathampton Station, could provide a site area of 3.1 hectares in the angle of the railway junction and its embankments.	Part of this scheme bisects an existing timber yard which would presumably have to be relocated. Also see 1.1 above.
2.2	To make up the site area, the greater part would be achieved by moving track switches that form the "railway junction" about 200 metres to the west so that two parcels of "brown land" that are, today, divided by the railway branch to Trowbridge can be utilised as a single area of about 1.9 ha.. A further 1.2 ha of land would be taken from the Green Belt, mainly land of Bathampton Farm in the angle of the railway junction, to the south of the A4 Batheaston Bypass and the GWML railway corridor.	It is not at all clear how easily this movement 200m west could be achieved. Apart from the land take issues already referred to, the tracks would move closer to existing properties and most likely necessitate road layout alterations. In addition it is not by any means proven that they could be located where suggested, not least because of possible clearance issues to the existing Mill Lane over-bridge. Also, The potential

		of this development being in Green Belt land would make the proposed development extremely difficult to get planning permission for.
2.3	The existing railway operational infrastructure at Bathampton Junction includes a “signalling relay room”, on the south side of the main line tracks, opposite the “down main” track connection to the railway to Trowbridge and Salisbury. By moving the track switches 200m to the west it is possible to avoid the need to completely demolish and re-site this relay room and the complex signalling apparatus that it houses.	As mentioned in the main text, the contents of this relay room will be entirely replaced by GWML re-signalling. It is highly likely that they will then demolish the relay Room to save on paying rates on the permanent structure. (Any replacement will be re-locatable and therefore rates free). Consequently this proposal is effectively pointless.
2.4	Rearranging the railway junction in this way, moving the entry to the switches about 200 metres to the west, would also enable the speed capability of the track fittings to be improved. Today speed through this junction for trains travelling from Trowbridge is limited to 50 mph and for those travelling towards Trowbridge the speed limit is 40mph. A new junction, using switches that permit faster speeds, could be built to deliver a speed limit of 65mph for trains in both of these directions. This is seen as a very desirable objective by Network Rail and the train operators.	The existing speeds referred to appear to be correct. However, just increasing the junction speed does not automatically increase speed or capacity. The through line speeds on both any main or branch line are dependent on many other things than just turnout speed. Adjacent track geometry, signalling, train performance and many other features can affect overall line speed at a particular location. In this particular case, the speed of trains towards Trowbr-idge are constrained by the track layout and the cons-equent signalling arrange-ments regardless of any improvements in track geometry. From an operational timetabling perspective, capacity and performance tend to be optimised when train running speed is uniform,

		regardless of the absolute maximum speed. This section of the inter-city route will not be the highest speed route, given the approach to Bath Spa station meaning that, say, a 125mph line speed could not be exploited. Line speed at the junction therefore needs to be sufficiently uniform, or of a suitable range that trains on diverging/converging routes can be timetabled effectively. In the case of the proposed park and ride all trains approaching and departing from or to the west will be running at a relatively low speed because of the platform stop, so a higher speed turnout is not necessarily essential to the success of a park and ride scheme here.
2.5	Journey time between a new Bathampton Parkway Station at this site and Bath Spa Station would be about 3.75 minutes - considerably faster than an articulated bus travelling via London Rd. The Joint Local Transport Plan included support for a 30minute clock face interval service pattern over the railway route between Bristol, Bath and points on the Trowbridge line so that a 30 minute interval service to a new station could be provided without any additional train services other than those currently planned.	We would concur with the rail journey time, but are unable to comment on the bus journey time. It should be noted though that a 30 minute interval service is probably the most that could be achieved by rail, entailing a longer wait for park and ride users. In comparison a more frequent bus link, while having a longer travel time could reduce waiting time for users. This trade off would need to be fully examined before a decision on mode is made in any such scheme.
2.6	A new “Bathampton Station” would be built on the new alignment of the Trowbridge line,	Agree completely with this statement.

	at the south side of the new car park. Building a new railway station alongside a new track alignment before these tracks are put into use by trains, enables the station to be built at very, very, much less cost than building alongside a "live" railway.	
3.1	The new infrastructure is in the angle of the railway junction, with the Trowbridge line tracks moved westward to enable the existing area of brown land of the original Bathampton Station site to be utilised as a single plot and to ease the radii of curvature of railway tracks through the curve and at the junction fittings.	The proposed curves are very similar to the existing. There is no significant improvement.
8.3	• Weaknesses of the existing layout are that:	
	• The route through three switches between the Up Main and the Up Trowbridge including two reverses of curvature on un-canted track with the result that speed through this junction is limited to 40mph.	• There is nothing unusual in this and it is not correct to imply that it is just the reverses that limit the speed. As stated above, other technical and operational factors will also determine the appropriate junction speed.
	• The existing layout of the Down connection from the Trowbridge line onto the Down Main also includes two reverses of curvature which, although less severe than the Up direction curves, limit speed to 50mph through the junction in the Down direction.	• As above
	• All Up Trowbridge trains leave the Up Main at a 'facing cross-over' at which they cross to the Down Main. This means that for each Up Trowbridge train, the working time-table must	• This is normal at flat junctions. The new layout offers no advantage and possibly increases the difficulty in getting Trowbridge trains off the

	provide co-incident train-paths in the Up Main and in the Down Main at Bathampton Junction; • If a Trowbridge train is held in the Up Loop it must rejoin and cross the Up Main again before it can cross to the Down Main and take the connection to the Up Trowbridge line, hence it still requires coincident paths in the Up Main and in the Down Main.	Up GWML. Only grade separation would avoid this, and the report does not propose or seek to justify such a solution. We do not see a specific need for grade separation. • This is only an issue if there is no choice but to path such a train via the Up Loop. However, this is unlikely as to slow into and accelerate from the loop would take more capacity than pathing it straight across the junction.
8.4	Any changes that a Bath & North East Somerset scheme might wish to propose that affect the main line railway need to be put forward quickly and start their progress through the railway industry assessment, design and installation process as soon as possible because once the forthcoming re-signalling and electrification schemes are at their own planning and installation stages, the shape of the railway track layout at Bathampton Junction will become fixed for a generation.	It is unlikely that the proposed infrastructure changes could be accelerated to become a part of the current infrastructure development plans. The only local scheme that has achieved this is Bristol Metro Phase 1, which is now a priced option in the Great Western franchise ITT. Other phases of Bristol Metro would need to be developed later, and this scheme would probably have to follow a similar process. It would certainly be unacceptable to Network Rail, DfT and the TOCs that the cost of any of these proposed changes at Bathampton should be borne as part of the GWML electrification and resignalling works. Any development and works cost relating to the park and ride would have to be fully borne by the scheme

13.6	The pre-feasibility design for a new railway permanent way layout at Bathampton Junction is based on using SG2O.25 RT6O inclined Switch & Crossing (S&C) units ("points") that can be used at up to 125mph on the through track and at up to 65mph on the turn-out track. This would offer Network Rail and the train operator a considerable improvement over 40mph Up or 50mph in the Down direction at Bathampton Junction today. The geometry has been designed with transition lengths to achieve the required curves entering the Trowbridge Line. S&C design for connections to a bay platform or pair of side platforms at Bathampton Parkway or Park & Ride Station can be completed when a train service pattern is more clearly known. The track layout at the station should be designed to serve the train service rather than be allowed to become a constraint on the train service that can be operated. The GWML track fittings and transition curves shown on the January 2012 pre-feasibility design would be appropriate to a range of design options for track connections in the station area.	In theory, any geometry of S & C unit can be suitable for running at 125mph on the through track – this comment is a red herring as such a speed capability is not needed at this location. Please also refer to comments to 2.4 above. We have not been provided with and are unaware of any documentation described as the 2012 pre-feasibility design, and therefore cannot comment on it. We have commendted on the layout and proposals contained in the report with which we have been provided.

5 Conclusion

There are various problems with the proposal as listed below:

- Horizontal and vertical track alignments are not suitable for a platform at this location.

- The additional complexity of the proposed new layout appears to add little functionality compared to the existing layout and may make some operations more difficult.

- The proposal for a future light rail line could potentially have a major impact on the re-signalling of the GWML.

- There is no current provision to enable the reversal of a shuttle service at Bath Spa Station.

- Journey times to Bath may not be competitive with a bus based park and ride at the same site.

- Considerable alterations to the telecommunications will be required to provide all the modern facilities necessitated by a new station, PA. CCTV etc.

- There are considerable issues to be addressed regarding land take, road layout operations, housing blight, business relocation and compensation costs.

It is highly unlikely that any of the proposed changes at Bathampton would be provided / funded as part of the GWML electrification and resignalling works, or as part of Bristol Metro Phase 1.

6 Recommendations

This scheme need to be considered carefully against the various bus park and ride options at Bath east before any further work is undertaken.

Appendix A Line Diagram of Bathampton Junction Area

(Showing amendments as proposed in D. Baker report)

Appendix B Aerial photograph of proposed location

Appendix C Costs

(+/- 50%)

Note: This does not include land purchase, demolition / removal of timber yard or compensation costs to land / building / business owners.

Permanent Way

(Note that we have estimated for what we believe to be the minimum requirements to meet the Dorian Baker scheme)

1900m of new plain line and formation		£1,250,000
1 no sliding buffer stop		£15,000
7 no CV 9 ¼ turnouts		£1,050,000
1 no EV 21 xover		£300,000
2 no EV15 turnouts		£500,000
Slue 1800m of ex plain line		£170,000
Drainage	Provisional Sum	£5,000

Civil Engineering

New island platform 200m x 5m wide	provisional sum	£870,000
New footbridge (including ramps)	provisional sum	£200,000
New lifts	provisional sum	£200,000
	sub-total	**£4,605,000**

Signalling

Signalling Alterations at Westmorland Road Sidings

New TPWS OSS Arm & Trigger loops for "Down Main" signal provided	£17,000
New TPWS TSS Arm & Trigger loops for "Down Main" signal provided	£13,000
New "Up/Dn Goods Loop" Red/Yellow/Green/Yellow signal with Route Indicators	£44,000
New "Down Main" Red/Yellow/Green/Yellow signal with Route Indicators	£44,000
New AWS supressed magnet provided for "Down Main" signal	£21,000
New AWS supressed magnet provided for "Up/Dn Goods" signal	£21,000
New Points Machine	£44,000
Panel Alterations	£44,000
Interlocking alterations	£110,000
New locations, x 4	£115,000
	£473,000

Signalling Alterations - Bathampton Jn

Provision of TPWS TSS for 7 Signals	£91,000
New Track joints x 20	£506,000
Old Track joint bonded out x 10	£122,000
New AWS supressed magnet provided x 5	£103,000
New Signal Red/Yellow/Green/Yellow signal with Route Indicators x 7	£308,000
New TPWS OSS Arm & Trigger loops x 6	£124,000
New HVI Track Circuit x 12	£325,000
Sign boards to provide x 10	£14,000
New TI21 Track Circuit x 12	£360,000
Panel Alterations	£110,000
New Points Machine x 8	£354,000
New TPWS OSS Arm & Trigger loops for Buffer Stop provided	£17,000
New Buffer Stop to be lit	£2,000
Interlocking alterations	£220,000
New Locations, x 24	£687,000
Removals of redundant points, signals tracks, TPWS, AWS	£220,000
Altered Locations x 24	£343,000
	£3,906,000
sub-total	**£4,379,000**

Telecommunications	Subtotal	£75,000
	Grand Total	£9,059,00

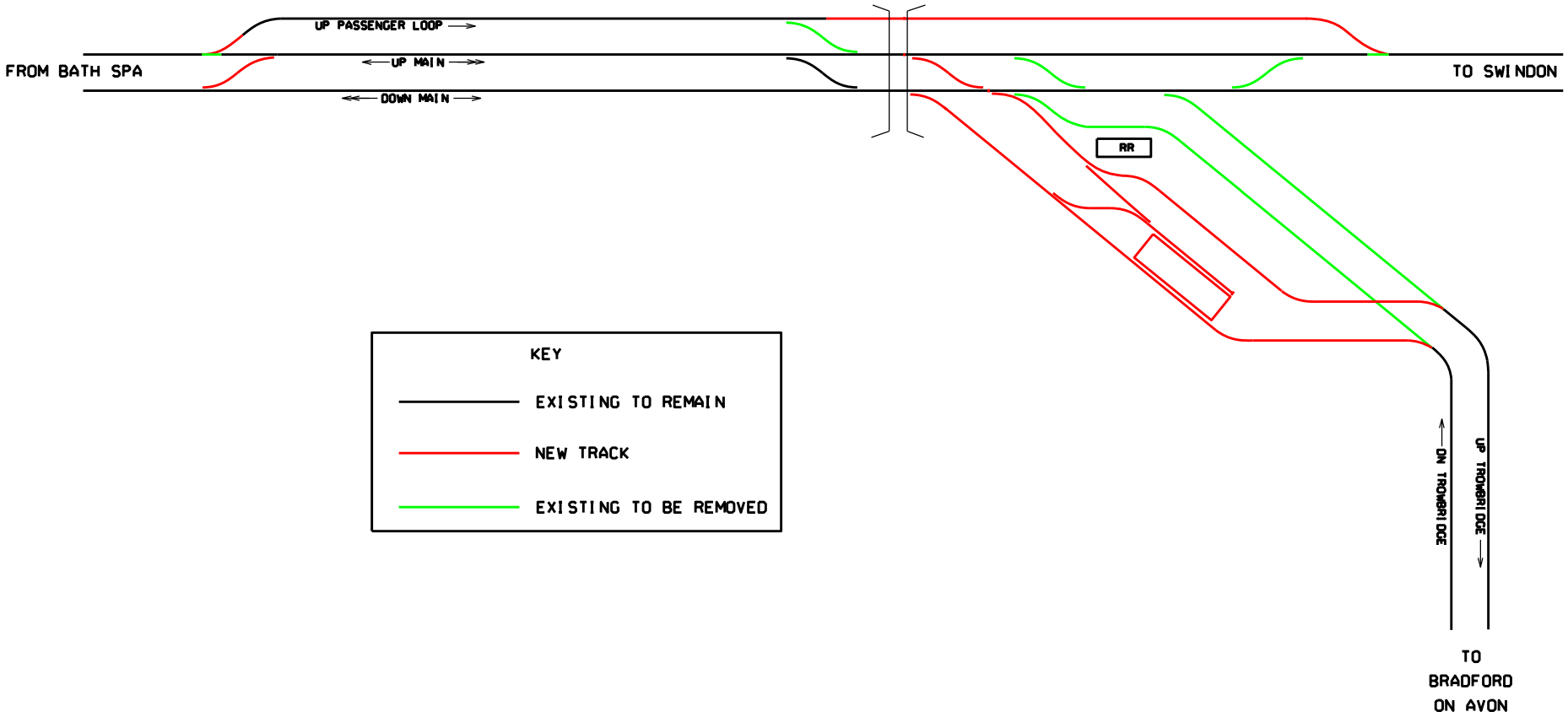
Appendix D Dorian Baker report dated 6 February 2012

Google earth

feet 1000

meters 400

BATHAMPTON JUNCTION AREA - ORIGINAL LAYOUT WITH AMENDMENTS TO D. BAKER REPORT



KEY

EXISTING TO REMAIN

NEW TRACK

EXISTING TO BE REMOVED

Key Plan

Notes

Rev	By	Chkd	Approvd	Date	Description
-	--	-	-	---/--	Preliminary Issue

Status: PRELIMINARY

Client: —

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Halcrow
A CH2M HILL COMPANY

Project: Bathampton Study

Drawing: Bathampton P/Way Line Diagram

Sheet 1 of 1

Drawn by: RT	Date: 01/02/2013
Checked by: PH	Date: 01/02/2013
Approved by: --	Date: --/--/--
Drawing No.: Bathampton/Pway/LineSketch01	Revision: 00
Drawing Scale: As Shown	CAD Ref.: ---.dgn

Bathampton Parkway.

A scheme to provide a Park & Ride railway station and high capacity car park, largely on existing railway land at Bathampton Junction.

The scheme is to provide a new Bathampton Park & Ride railway station at a new bay platform track as part of the carrying out of works to rebuild the railway track layout at Bathampton Junction to improve its flexibility and capacity in preparation for 25kV AC overhead line electrification. Adjacent to this station a new car park on three levels would be built mainly on railway land of the original station yard and in the angle between the two existing railways, with the lowest level at about that of the base of the embankment, outside the flood plain.

A proposal prepared by:
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BATH BA1 5SH
Telephone: 01225 333 641

Date: 6th February 2012

Draft 2.

1. Introduction

- **The need for a Park & Ride scheme to serve the East side of the City of Bath.**

Bath today has Park & Ride car parks with bus services into the centre of the city for car users approaching from the north, the west and the south but not from the east. A particular challenge for a Park & Ride scheme on the east side of the city is that a bus service between the car park and the central area would need to use London Road, the most congested, slowest moving route into the centre, despite the in-bound bus lane.

A car park site was proposed at Bathampton Meadows on the north side of the A4 Batheaston Bypass and Great Western railway corridor. The site would have taken approximately 4.8 hectares from the Green Belt, currently all green fields clearly visible from the surrounding hills. It has been estimated that a P&R bus service from a Bathampton Meadows car park site should take 14 minutes for the journey into a central area terminus but might take up to 20 minutes during peak periods.

If a car park site could be identified near to the railway junction at Bathampton at which a railway station could be built, then the rail journey into Bath Spa main line railway station would be about 3.75 minutes - based on current Westbury line train operating time-tables.

The electrification of the Great Western Main Line (GWML) provides a once-in-a-lifetime window of opportunity for the development of stations and track improvements on the route, including a feasible station site at Bathampton.

2. A new Park & Ride car park and public transport terminal facility at Bathampton Junction.

■ **A feasible car park site to the south of the A4 highway and the GWML railway.**

To the south of the existing road and railway corridor at Bathampton an area of "brown land", the site of the original Bathampton Station, could provide a site area of 3.1 hectares in the angle of the railway junction and its embankments. Here a part-buried structure of up to three levels of car parking could be arranged with the top floor just below existing railway track level, hidden behind the existing railway embankment. A total of approximately 7.3 ha. of car parking over the 3 levels, spaces for of the order of 3000 cars, could be provided.

To make up the site area, the greater part would be achieved by moving track switches that form the "railway junction" about 200 metres to the west so that two parcels of "brown land" that are, today, divided by the railway branch to Trowbridge can be utilised as a single area of about 1.9 ha.. A further 1.2 ha of land would be taken from the Green Belt, mainly land of Bathampton Farm in the angle of the railway junction, to the south of the A4 Batheaston Bypass and the GWML railway corridor.

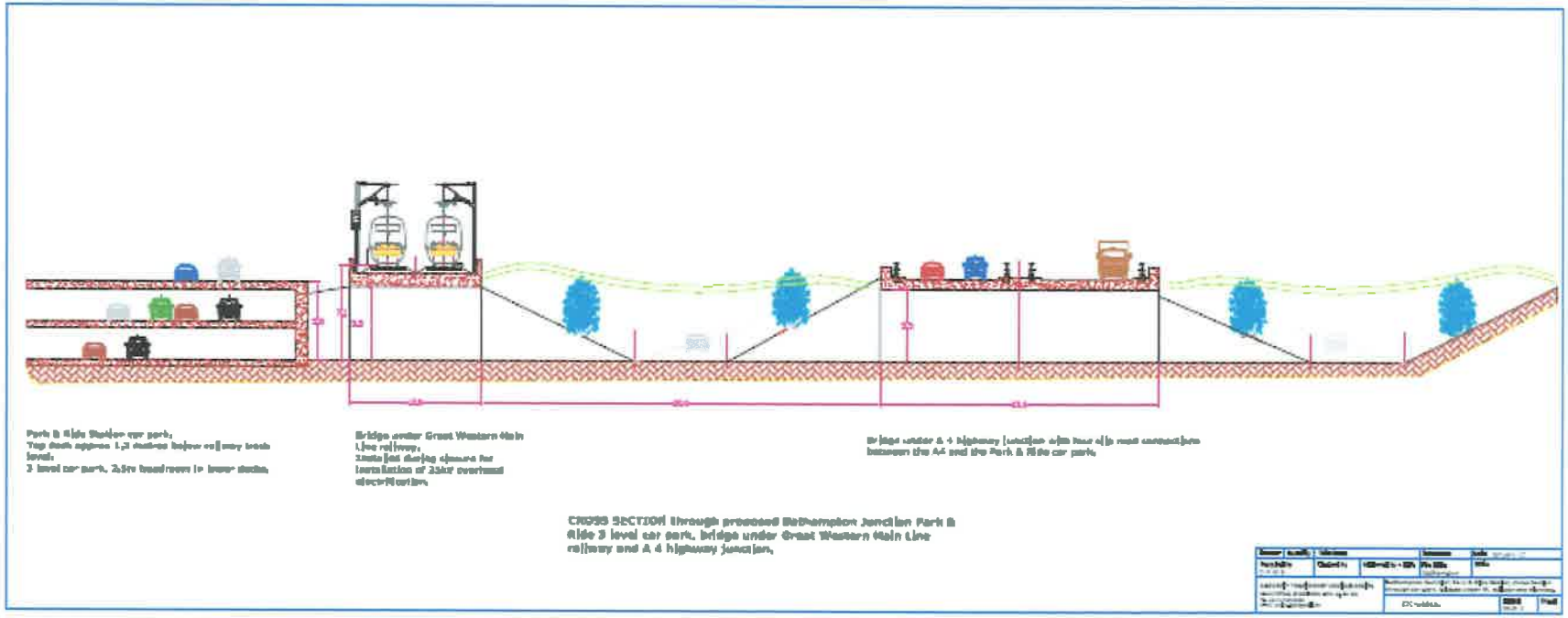
The existing railway operational infrastructure at Bathampton Junction includes a "signalling relay room", on the south side of the main line tracks, opposite the "down main" track connection to the railway to Trowbridge and Salisbury. By moving the track switches 200m to the west it is possible to avoid the need to completely demolish and re-site this relay room and the complex signalling apparatus that it houses.

Rearranging the railway junction in this way, moving the entry to the switches about 200 metres to the west, would also enable the speed capability of the track fittings to be improved. Today speed through this junction for trains travelling from Trowbridge is limited to 50 mph and for those travelling towards Trowbridge the speed limit is 40mph. A new junction, using switches that permit faster speeds, could be built to deliver a speed limit of 65mph for trains in both of these directions. This is seen as a very desirable objective by Network Rail and the train operators.

Journey time between a new Bathampton Parkway Station at this site and Bath Spa Station would be about 3.75 minutes - considerably faster than an articulated bus travelling via London Rd. The Joint Local Transport Plan included support for a 30minute clock face interval service pattern over the railway route between Bristol, Bath and points on the Trowbridge line so that a 30 minute interval service to a new station could be provided without any additional train services other than those currently planned.

A new "Bathampton Station" would be built on the new alignment of the Trowbridge line, at the south side of the new car park. Building a new railway station alongside a new track alignment before these tracks are put into use by trains, enables the station to be built at very, very, much less cost than building alongside a "live" railway. Platforms of this new station would be approximately 300metres from the canal bridge at The George in Bathampton and could therefore also provide direct services to Bath and Bristol for this community. It would also be worthwhile to up-grade the existing footpath over the 600metres to the A4 roundabout, midway between Batheaston and Bathford, so as to offer these two communities a very attractive new public transport option for getting into Bath or Bristol.

The proposed Bathampton Park & Ride railway station and car park.
The new infrastructure is in the angle of the railway junction, with the Trowbridge line tracks moved westward to enable the existing area of brown land of the original Bathampton Station site to be utilised as a single plot and to ease the radii of curvature of railway tracks through the curve and at the junction fittings.



Section through the proposed Park & Ride 3 level car park, the existing Great Western Main Line railway embankment and the existing A4 dual carriageway Batheaston Bypass.

The section illustrates the relationship of the proposed car park top level to that of the existing railway.

3. Environmental impacts compared, initial indications, I.

■ Comparison of net land area taken from the Green Belt.

The two drawings below show,

- Figure 1: the area of land taken from Green Belt for a Bathampton Meadows Park & Ride scheme, total: 4.8 hectares
- Figure 2: the area of land taken from Green Belt for a Bathampton Park & Ride Station scheme, net of 1.9ha redundant railway "brown land" utilised, total: 1.2 hectares.

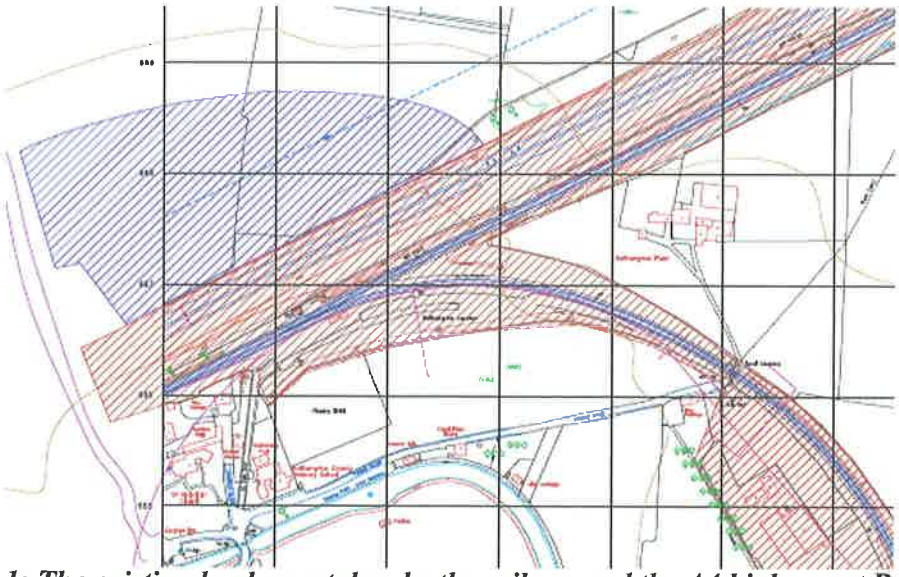


Figure 1: The existing land area taken by the railway and the A4 highway at Bathampton Junction, hatched tan, and the formerly proposed Bathampton Meadows Park & Ride site to the north of the road and railway corridor, hatched blue.

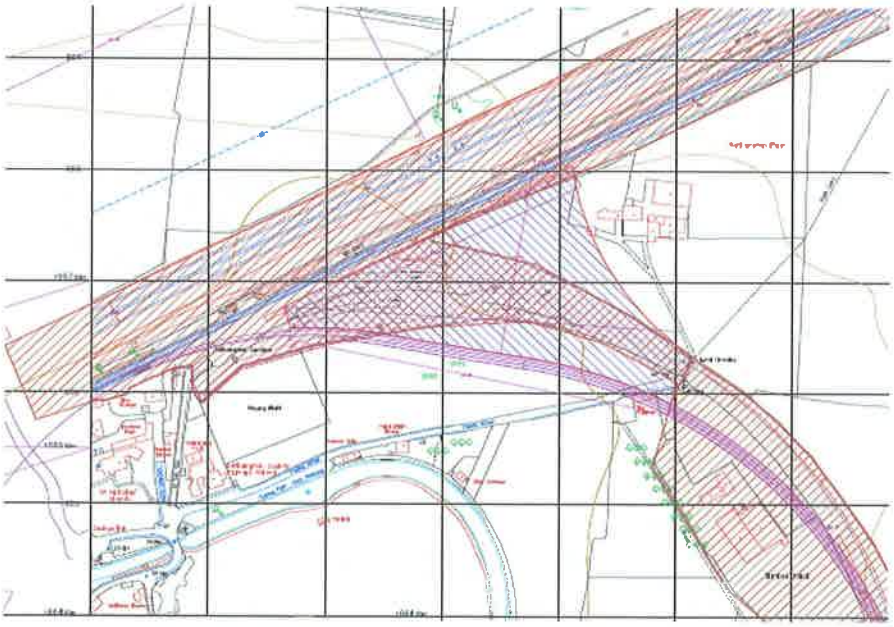


Figure 2: The existing land area taken by the railway and the A4 highway at Bathampton Junction, hatched tan, and a Park & Ride site and railway station in the angle between the two railway routes, hatched blue, showing the redeployment of unused railway land to provide the car park and station site.

4. Environmental impacts compared, initial indications, II.

■ Visual and Noise impacts.

A road link between the A4 Batheaston Bypass and a Bathampton Park & Ride Station car park to the south of the main line railway could pass under the railway at a point where railway track level and highway carriageway level are approximately 7 metres above feasible lower basement car parking level. It is therefore possible to achieve a link to and from the A4 eastbound carriageway passing under the railway and under this dual carriageway road, and thereby avoid the visual and noise impacts that would have been so unacceptable with the earlier "A46 to A36 Link Road" scheme.

The length of the A4 Batheaston Bypass alongside and parallel to the Great Western Main Line railway between Bathampton Junction and the Batheaston bridges, cannot be seen from most viewing points in Batheaston, as shown for example by the pictures published by "Save Bathampton Meadows". An earth bund was constructed on the north side of this length of highway to contain noise from the road and preserve the character of the views southward over the green belt lands of Bathampton Meadows as far as the railway.

The Bathampton Meadows Park & Ride scheme proposed in the Bath Transport Package would have been:
(a) clearly visible, and
(b) clearly audible within the area that the A4 bund was intended to protect.
In fact the bund would have been breached by the new road access into the car park with the result that not only noise associated with the car park but also: noise from the existing highway would have found a new path directly towards the settlement of Batheaston.

It is also note-worthy that an important reason why the even earlier proposal for an A46 to A36 link road from this point on the A4 to the A36 near "Dry Arch", Bathampton, was rejected was that the grade separated junction at the A4 would have included slip roads and a bridge rising above the A4 and out of its protective environmental bund. A further span was then to cross above the railway, then continuing southwards on a tall bank or viaduct, continuing to gain height as it crossed the canal to reach a junction with the A36 at a level approximately 30metres above that of the railway at Bathampton Junction. All parts of this proposed link road would have been clearly visible from many vantage points in Batheaston and Bathford and the surrounding hills and its highway noise would not have been contained.

In complete contrast, the link road into a Bathampton Park & Ride Station car park in the angle between the Great Western Main Line and the Trowbridge Line railways would be completely hidden and inaudible from viewpoints in the Batheaston area.

Bathampton Farm.
Railway track and its ballast can be seen on the left side of the picture, at about the level of gutters on the farm house.
Lowest floor of the proposed three level car park would be at about farm house ground floor and outside paved area level, top level of the car park would be a little below existing rail level.

5. The existing railway track layout at Bathampton Junction.

The existing track layout at Bathampton Junction includes, in railway terminology, the following features:

- an Up Loop on the Up side of the GWML with exit to rejoin the Up Main ahead of;
- a Facing cross-over in the ML between the exit from the Up Loop and the Up Trowbridge turnout;
- a Trailing cross-over to the London side of the Trowbridge line connections;
- a second Facing cross-over, Bristol side of the exit from the Up Loop.

These connections give the railway infrastructure operator train routing options:

- an Up Loop on the Up side of the GWML in which Up trains can be held before continuing on the Up Main or before taking the Up Trowbridge line;
- 'facing' and 'trailing cross-overs' in the main line to enable Up ML or Down ML trains to cross to operate 'wrong road' or cross from 'wrong road' working or to reverse from either direction at Bathampton Junction;
- the connections also enable either the Up or Down Trowbridge Line to be operated as a bi-directional single track.

Weaknesses of the existing layout are that:

- The route through three switches between the Up Main and the Up Trowbridge including two reverses of curvature on un-canted track with the result that speed through this junction is limited to 40mph;
- The existing layout of the Down connection from the Trowbridge line onto the Down Main also includes two reverses of curvature which, although less severe than the Up direction curves, limit speed to 50mph through the junction in the Down direction;
- All Up Trowbridge trains leave the Up Main at a 'facing cross-over' at which they cross to the Down Main. This means that for each Up Trowbridge train, the working time-table must provide co-incident train-paths in the Up Main and in the Down Main at Bathampton Junction;
- If a Trowbridge train is held in the Up Loop it must rejoin and cross the Up Main again before it can cross to the Down Main and take the connection to the Up Trowbridge line, hence it still requires coincident paths in the Up Main and in the Down Main.

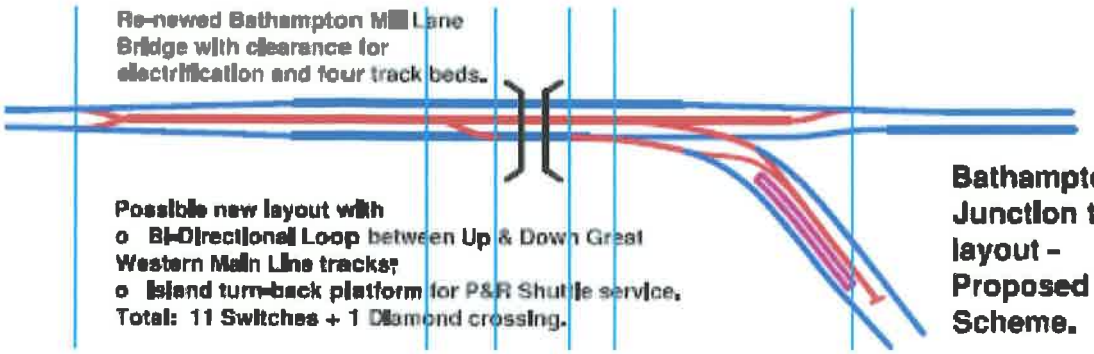
Any changes that a Bath & North East Somerset scheme might wish to propose that affect the main line railway need to be put forward quickly and start their progress through the railway industry assessment, design and installation process as soon as possible because once the forthcoming re-signalling and electrification schemes are at their own planning and installation stages, the shape of the railway track layout at Bathampton Junction will become fixed for a generation.

6. The proposed initial railway track layout at Bathampton Junction.

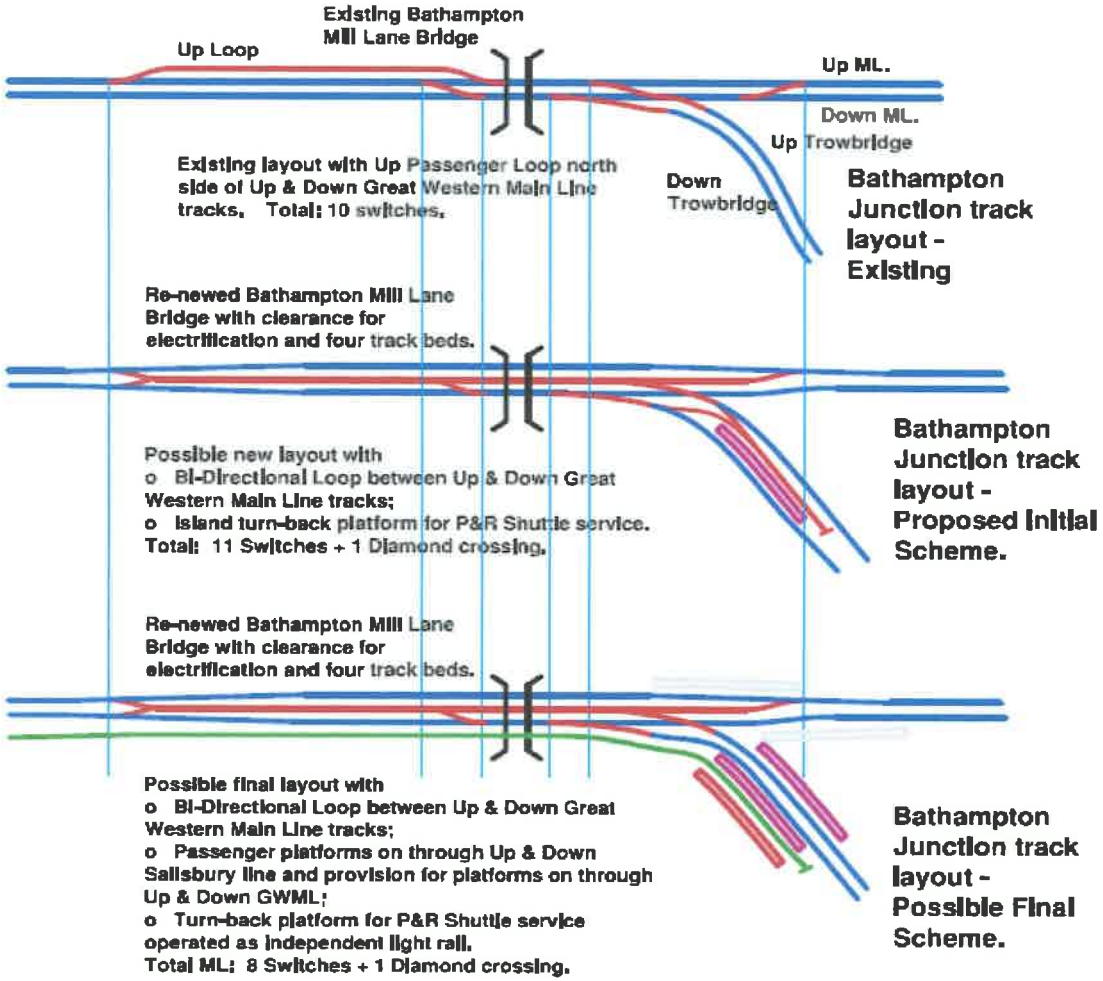
- **Shuttle service option.**

The proposed layout will provide:

- In the GWML, a central, bi-directional, loop available for Up or Down traffic, either Main Line or Trowbridge Line;
  - Up or Down passenger trains would be able to pass a freight train or slower passenger train moving in any of the four directions;
- 'facing' and 'trailing cross-over' connections to the Up Main and Down Main to enable Up ML or Down ML trains to cross to operate 'wrong road' or cross from 'wrong road' working or to reverse from either direction at Bathampton Junction;
  - this is as the existing layout but with the additional benefits of:
    - being able to hold a reversing train in the central loop between its leaving the first track and joining the second, including to enable train staff to prepare the train for reversal off the running line before the train joins its new route;
    - being able to hold an Up Trowbridge train off the Up Main to await a train-path to enable it to cross the Down Main; coincident train-paths in both tracks of the GWML would no longer be required.
- Connections to a central bay platform for trains terminating and reversing at Bathampton Parkway;
  - train staff of a Bath - Bathampton shuttle would be able to prepare a newly arrived train for its return journey at the same time as passengers leave and join their 'park & ride' transport.
  - while in the 'bay' track the train will have left the Up Trowbridge but will not have interrupted or joined the Down Trowbridge and it will not interrupt the Up Trowbridge track again when it leaves, using the Down Trowbridge.
- Connections between the Up & Down GWML tracks and the Up & Down Trowbridge tracks with a speed capability of 60 mph, 20mph and 10mph faster than the existing Up and Down connections respectively.



Bathampton Junction track layout - Proposed Initial Scheme.



Diagrams of the existing and feasible alternative track layouts at Bathampton Junction

7. Train service and rolling stock options.

■ Shuttle service option.

A simple, high passenger capacity, shuttle service operating between Bathampton P&R and Bath Spa stations would make its eastern reversal at the new bay platform at Bathampton and its western reversal at the existing Westmoreland Road sidings.

The most efficient rolling stock option would be a two-car d.m.u. (diesel multiple unit) or, with electrification of Westmoreland Road siding as well as Bathampton bay platform, e.m.u. (electric multiple unit) with seating simplified to provide a longitudinal bench seating arrangement, as in many London Underground "Tube" trains, along each side of the interior of each car together with hand-holds for standing passengers for the 3.75 minute journey between Bath Spa and the Bathampton Park & Ride station. A two-car unit of this layout would offer about 100 seats plus standing room for a further 240, total: up to 340 passengers, or LUL crush load standard, total: up to 440 passengers.

Initial draft working time-table input data would be as follows:

- Train standing in Bathampton, reverse control, passengers alight & board: 3.0 min
- Journey to Bath Spa, Down platform, allow: 4.0 min
- Passengers alight Bath Spa: 0.5 min
- Train moves forward into Westmoreland Rd sidings, allow: 1.0 min
- Reverse control in Westmoreland Rd sidings, allow: 3.0 min
- Await signal to cross Down Main and move into Bath Spa Up platform: 2.5 min
- Passengers board Bath Spa, Up platform: 1.0 min
- Journey to Bathampton P&R bay platform, allow: 4.0 min
- Total cycle time: 19.0 min

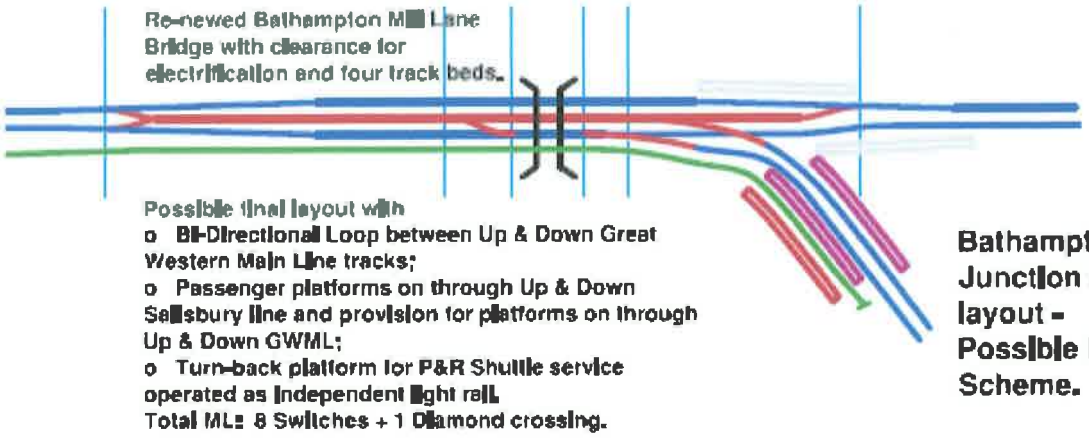
For a service operating over a part of the main line, in amongst long distance main line trains, to provide a robust operating time-table it should be assumed that one two-car train would be able to provide a 30 minute perodicity service, one train service to Bathampton P&R every 30 minutes and one service from the P&R station into Bath Spa every 30 minutes. A second two-car set would enable a 15 minute interval shuttle service to be provided throughout the day.

■ Regional service option.

An alternative, simpler, track layout can be defined if all services between Bath Spa station and Bathampton Park & Ride station can be provided by regional train services calling at Bathampton. At present the operator of the Bristol to Portsmouth and Weymouth services finds that there is not always sufficient make-up time in the working time-table to allow trains to make an additional stop even if Freshford and Avoncliff are not served by these trains. The south coast services operated today would only provide three trains every two hours, one train to Portsmouth every hour, one train to Weymouth every two hours, which is very much less frequent than is needed to support a Park & Ride service.

If this group of services were re-cast with a regular pattern of four trains per hour to Bradford-on-Avon, certain trains continuing via Westbury to Portsmouth, Weymouth, and perhaps to Radstock and Melksham, a 15 minute interval service to and from Bathampton Park & Ride could be provided.

In this option no bay platform with connections to the Up Trowbridge and to the Down Trowbridge are required on the main line railway.



Bathampton Junction track layout - Possible Final Scheme.

- **Long term Light Rail option.**

A further option with this main line track arrangement is that an additional track could be provided for an independent light rail route using the original Down Goods Loop track bed between Mill Lane Bridge and a point 800metres to the west and a further strip of un-used land of the original Bathampton Station yard around the beginning of the curve to a third platform at the new Bathampton Park & Ride station.

In order to make "passive provision" for this type of development to be added at a later stage, perhaps 20 years time, all that is need now is to ensure that the Mill Line bridge is rebuilt as a four track-width bridge, across the existing four-track-width railway right of way at this point.

A light rail route developed into the central area of the city from a western terminus at the Bathampton P&R station could certainly provide a tram every 15 minutes into and through the central area, 4 services per hour. In the long term, this would be more attractive than a service calling at Bath Spa main line station, the southern-most corner of the central area of the city, requiring Park & Ride travellers to mix with users of long distance main line trains as they pass through the station. Nevertheless, the less attractive option of using Bath Spa main line station is likely to be the "least risk" means of commencing a rail-based P&R scheme.

- **Regional route options.**
  - **Using Bradford-on-Avon North & East Junctions into the future.**

Into the longer term, the restoration of the Bradford Junctions, discussed below with Electrification works, would enable two Bristol (or Portishead) services to run to Chippenham via two other West Wilts towns, establish regular train services at Melksham - and avoid the need for a Bathampton scheme to build platforms on the GWML, thereby implying that services calling at Bathampton could have a significant impact on the GWML working time-table as trains make the additional stop. Rather, the Bathampton scheme would be able to avoid competing with Corsham's bid for slots in the GWML working T-T to enable some trains to stop there. Perhaps the future electrified Bristol-London via Bath and Chippenham services with improved acceleration would be able to call at Corsham whereas that type of rolling stock would be inappropriate for a local service calling at Bathampton Park & Ride.

An ideal service would therefore be

> [Portishead when this length is ready]-Portbury - Ashton Gate P&R -Bedminster - Bristol TM -Keynsham -Oldfield Park- Bath Spa - Bathampton Jcn P&R- (Freshford)-(Avoncliff)-Bradford-on-Avon -Melksham-Chippenham.

This would give Melksham a regular train service and enable the request stops at Freshford and Avoncliff to be served only by local trains; and allow Weymouth and Portsmouth services to cease calling at these in favour of calling at Bathampton P&R. This would provide 4 trains per hour each way at Bathampton until the local service could be upgraded to 4 per hour.

In order to avoid problems with the main line time-table as local trains via Melksham re-join the ML at Thingley for the last 2 miles 14 chains to Chippenham, and avoid the cost and time-table impacts of Up local trains crossing the Down Main, then crossing back at Chippenham as they reverse, the solution would be to give them their own bi-directional third track between Thingley and the original Down side platform at Chippenham (at present an unused platform) where these local trains would terminate and reverse. The right of way and all but one of the under-line bridges are already wide enough because the Gt Western company had at one time envisaged a four track railway here.

Just east of Thingley, the new A350 Ceppen Way is four tracks wide as is Saltersford Lane and the A4 at Chippenham Bath Rd roundabout, and a minor road linked to St Peter's Court. Just one under-line bridge at Lowden Hill would need to be widened. At the biggest structure, Chippenham Viaduct, there is a wide gap between the two running lines one option would be to slue the Down Main to the centre of the viaduct then lay a new track on the Down side of the right of way, a the (Down-side) Bi-Directional Melksham.

The foregoing is an option for the development of railway routes in the Bath & NE Somerset and West Wiltshire area. It becomes a policy making and planning issue for the long term that needs to be considered now, ahead of the electrification work, if only to ensure that it would at least be possible to install a third track for a West Wilts local service at a later date, after electrification. To permit the third track to be installed later, what is needed at this stage is to ensure that Network Rail installs the OL Electrification fittings between Chippenham and Thingley with spans that cross a three-track width.

Given each hour:
(i) existing 2 Cardiff-Bristol-Bath-Bradford-Trowbridge-Westbury >> south coast;
(ii) 2 Corsham stops on ML services to Oxford; and
(iii) 2 Portishead- Bristol- Bath- Bradford- Melksham- Chippenham local services;
then the last logical service to add to the Bath &NES and West Wilts rail map would be:
(iv) (Swindon)-Chippenham-Melksham-Trowbridge-Westbury-[Frome-(then when all running well - Radstock, but with a re-sited station at Frome)] or: Westbury-Salisbury

■ **Track design.**

The pre-feasibility design for a new railway permanent way layout at Bathampton Junction is based on using SG20.25 RT60 Inclined Switch & Crossing (S&C) units ("points") that can be used at up to 125mph on the through track and at up to 65mph on the turn-out track. This would offer Network Rail and the train operator a considerable improvement over 40mph Up or 50mph in the Down direction at Bathampton Junction today. The geometry has been designed with transition lengths to achieve the required curves entering the Trowbridge Line. S&C design for connections to a bay platform or pair of side platforms at Bathampton Parkway or Park & Ride Station can be completed when a train service pattern is more clearly known. The track layout at the station should be designed to serve the train service rather than be allowed to become a constraint on the train service that can be operated. The GWML track fittings and transition curves shown on the January 2012 pre-feasibility design would be appropriate to a range of design options for track connections in the station area.

If the OLE team only needed a shorter blockade to fit out Box Tunnel and the rest of this length, say just four weeks, then an alternative bridge construction sequence at the new under-line bridge utilising a short "blockade" would be:

(i) remove a short length of the tracks;
(ii) install structural abutments using contiguous bored piling;
(iii) lay bridge decks for the two tracks onto these abutments;
(iv) put the tracks back ready for reopening;
(v) then excavate out from inside the bridge structure and complete finished surfaces after train services have re-commenced.

Similarly, if West Wilts wanted to build Corsham Station this would be the moment. Station construction costs in normal working hours would be reduced to about one third the cost of trying to build it between operational train services and with short weekend possessions.

To achieve a construction programme as outlined during a blockade for electrification works it would vital to open discussions with the Network Rail possessions planning team for the OLE scheme as soon as possible and put forward a proposal that they should

(i) wire the South Wales Direct first, with the connection Bristol Parkway to Temple Meads and the new electric train depot, then
(ii) open the new Bristol TM- Bristol Pkwy-London service and
(iii) leave the HSTs operating the old route but via Bradford-on-Avon during a blockade of the Box Tunnel length between Bathampton and Thingley Junctions.

9. Appendix: Box Tunnel and Other civil engineering work that will be required for the Electrification scheme.

■ Structure Gauge clearance for Overhead Line Equipment.

The railway maintains a standardised database of surveys of all over-line, under-line and beside-the-line structures which can be interrogated using an industry standard program known as "Clear Route". This survey data indicates the following challenges for Over-Head Line Electrification Equipment (OHLE or OLE) to be installed over the length of the Great Western Main Line within Bath & NES.

Sydney Gardens group of structures.

- Through Sydney Gardens East Tunnel 106ml 24ch-28ch and through Sydney Gardens West Tunnel 106ml 29ch-33ch - the tunnel beneath Bathwick Hill and Raby Place. These structures were built by Brunel for broad gauge track and 16ft tall locomotive chimneys and despite all the ballast that has been added over 175 years there is still quite generous clearance for OHLE supported from centre line of tunnel intrados, as measured from the existing track levels.
- Sydney Gardens Bridge 106ml 10ch is a bit more of a problem, at least 300mm track lowering needed (but see below on OHLE), which will be more than enough for:
- Sydney Gdns Footbridge 106ml 14ch, and then also;
- Sydney Wharf Bridge 106ml 22ch.

This group of structures should not require "slab track" in order to achieve required clearance.

Slab track.

Slab Track is a concrete pavement structure founded on compacted firm formation or directly on a rock formation. It is normally poured using "slip form" technique. The concrete structure is up to 300mm less deep between formation level and finished running rail level than conventional ballasted track using sleepers.

For OHLE and the electrically live pantograph of a 25kV AC electric train to pass under an over-line structure, bridge or tunnel, requires of the order of 500mm more vertical clearance at centre line than is required for trains without overhead electrical power supply. [However, please note the complete analysis is more complex than this, including: the shape of the top of standard passenger train rolling stock is arched, the pantograph is a horizontal fitting about 2.2m wide with a requirement for electrical clearance, rather than simply passing clearance, that is also dependant on the elasticity of the OHLE against which it bears].

Things made of concrete, like slab track, may have a high compressive strength but when the concrete is first poured and the cement has only just been mixed with water it has no strength at all. Cement gains strength up to a maximum at about 28 days from pouring. It is common practice on construction jobs to remove "shuttering" (the mould) the day after concrete has been poured but 1 day old concrete can do little more than carry its own weight, it cannot have new loads imposed on it, neither can it be subjected to vibration such as drilling for rail fastenings or ground-borne vibration from traffic on an adjacent track. This means that when "slab track" - a continuous concrete base on which the steel railway track components are assembled is poured it must:

(i) be given time to "cure" before it can be drilled for rail fixing and then run over, and

(ii) not be subjected to direct or ground borne vibration levels that could cause micro-cracking of concrete that has not yet developed adequate strength.

For these reasons railway routes must be closed for relatively extended periods if a length is to be rebuilt as "slab track" . There are various techniques for reducing the closure time a little but they do not escape from the fundamental requirement to let the concrete foundation cure and reach strength before it can be run on by 120 tonne locomotives.

Hence, it will be particularly important for the Wales/ Bristol to south coast train services, Wales - Bristol - Bath - Bradford-on-Avon - Westbury etc, that NR try to avoid any need for "slab track" in the Sydney Gardens area and the associated line closure whilst it is installed. These services would be broken in two if there were to be a "blockade" at Sydney Gardens.

More Bathonians will be concerned about extended interruption of our main line services to London, but during the electrification programme disruption of services on this route will be fairly inevitable. However, as described above, it is possible for the impact of medium term closure of Box Tunnel to be mitigated.

Box Tunnel.
The Sydney Gardens group of structures should not need "slab track" and all the "track possession" impacts that this technique implies, but the survey data does indicate that the 1mile 1452yard Box Tunnel does include some more difficult lengths. The problems might be resolved by excavating out all track ballast through the whole length of the tunnel, further excavation through rock to a new formation level, then lay "slab track" throughout the length of the tunnel. (It may also be important to keep in mind that "slab track" can be very noisy and transmit more ground-borne vibration than conventional track on ballast - it will be important to consider what is kept in the adjacent caverns today.)

A weakness of this approach is that clearance for OHLE is really only particularly tight at two discrete lengths, around 99ml 45ch 10yds and around 99ml 19ch 12yds where low arch structures have been inserted at a date after original construction in order to support a failed or failing length of the intrados of the excavation and/or tunnel structure. However, the real problem is that at about the position of the first interior buttress arch there is an underground river and pool passing under the railway which constrains scope for excavation of the track bed formation downwards - unless a new "under-line" bridge structure is to be built at this point within the tunnel. We do not have the exact chainage of this underground river and pool, but it would be a reasonable assumption that this was the cause of a failure of the tunnel structure above and explain the need for one of the interior buttress arches.

In addition, at 99ml 46ch 12yds, 99ml 49ch 15yds and 99ml 52ch 9yds amongst others, there are bulges in the tunnel intrados that may be stable rock intrusions or may be failed brick-lining, and all may warrant structural attention before 25kV OLHE is installed.

Taken together, this indicates that it may be more beneficial to examine all of the failed lengths in detail and re-construct these support arch structures in such a way as to allow adequate clearance above track on ballast at about the level of the tracks today, and deal properly with the "bulges" in the intrados, rather than say too quickly that "slab track" will fix the problem. - There is even the risk that over-zealous track-bed excavation might make matters worse at the underground river and pool.

West of Bath Spa Station.
The Brougham Hayes bridge is listed by NR as "R" for "reconstruct" or since it is a steel structure the engineers might be thinking of "raising" it, jacking it up using hydraulic jacks then reconstruct abutment supports and the highway pavement to meet both ends afterwards. The Bath & NES Highways Engineer should keep a close watch on what is proposed to be carried out. As anyone who drives up - or down - Brougham Hayes knows, the existing bridge already presents a hump with a sharp corner (and a busy road junction) to the south and a zebra crossing outside Hayesfield Lower School to the north. If the bridge is simply raised the problems associated with the hump: poor driver sight lines and a steepened gradient northbound approaching the zebra crossing at the school, will be exacerbated. If the bridge is removed and replaced with a completely new structure it will be advisable to utilise a skinny structure making efficient use of available structural depth to provide a raised soffit (under-side) without raising the highway. NR should have opened discussion of the options and their impacts with the Bath & NES Highway Engineer.

Track lowering at Brougham Hayes may have been ruled out because of the need to lower all the sidings and crossover connections in the Westmoreland Rd yard area. However, at Brook Road (107-76-0) track is to be lowered, given the shape of the bridge and the survey data, probably by as much as 400mm. With no track lowering at Brougham Hayes, 600m away, this would be an acceptable track gradient but the platforms of Oldfield Park Station would need to be rebuilt. It might be more sensible not to touch the platforms of Oldfield Park Station but to spend the money thus saved on rebuilding Brook Road Bridge with a new wider carriageway and a pavement for pedestrians on both sides - even if the B&NES Highway Engineer were to choose to keep the road as one way, southbound only. Again, NR should have discussed the options and their impacts with the Local Authority.

The Somerset & Dorset bridge at 108miles 9chains is not on the list noted down but is definitely foul of gauge. Perhaps the NR engineer is coupling it in his mind with the adjacent "Hayters" Bellots Rd bridge (108-09-0). Track lowering will have implications for track drainage and I think I remember (from 30-something years ago) there were drainage problems in this length in cutting between Brougham Hayes and the beginning of the Twerton Viaduct.

■ **Over-Head Line Equipment, its construction and appearance.**
View from the "green rim".
The railway has not been installing steel gantry structures at sequential plain line OHLE support locations for many years. Standard form of construction is to use "head span" cable stayed arrays supporting the catenary that in turn supports the 25kV contact wire. The catenary cable structure has itself also been simplified over the years, particularly where line speed is under 100mph. This should mean that over the most sensitive length in terms of the view of the central area of the city from the "green rim", the curve around the Cricket Ground, over St James Bridge, through the station and then over the Skew Bridge, it will be possible to keep the "knitting" fairly unobtrusive. The mast, cable and strut support system could be further reduced in its visual impact if carbon fibre support cables and compressive strut members were to be used. I do not know whether NR's OHLE designers have thought about using these types of modern materials but we might draw to their attention that the Secretary of State for Business was recently in Bristol opening a new R&D facility aimed at making this area and the UK world leaders in the use of these modern structural materials as well as the more widely known new technologies.

Sydney Gardens.
Within the Sydney Gardens length, discussed above, the visual impact issues will be different. Not the problems associated with the view from the "green rim" some distance away, but rather the problems of appearance from nearby and appearance of detail when associated with architectural detail within Sydney Gardens. A system of "overhead contact bar" was first developed a number of years ago by a Swiss company for installation in tunnels where clearance is limited and has recently been approved for high speed train operations. This equipment has been approved for use on the railway here in Britain and has been adopted at a few particularly difficult locations. Through the Sydney Gardens length the overhead contact bar system would enable the OHLE structure to be considerably simplified and thereby greatly reduce the visual impact on this particular part of our valued environmental and architectural heritage. At the same time, use of the overhead contact bar system through the Sydney Gardens group of structures would tighten down the structural depth required for the OHLE system, thereby reduce the extent of track lowering required, and make it certain that "slab track" would not be required here.

In conclusion on Electrification through the Bath area.
If Bath & NES can arrange some consultative meetings with NR on the impacts of their proposals on our local environment, that is to say: an interactive discussion and exchange of views and proposals rather than just NR telling Bath & NE Somerset what they (NR) are going to do, I would be very happy to attend as a Bath & NES railway engineering consultant. Over the years whilst I have been doing this sort of thing for the deep sea ports and others we have actually been able to achieve quite a lot in terms of changes to schemes designed by or for the railway infrastructure operator without adequate consideration of impacts on other parties, my clients. Bath is a World Heritage City, but it is also worth noting that UNESCO considered listing the whole of Brunel's Great Western Railway as a World Heritage Site and as such even the NR "permitted development rights" are constrained to respect the historic status of this railway and should, reasonably, therefore be expected to respect ours too.

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