

# Network Rail Track Renewals in Control Period 4

Site Inspection and Review of items proposed for renewal on Primary Routes in 2009/10 to assess the justification for the timing and the proposed engineering specification.

Richard Spoons Associates Ltd

### ***Contents Amendment Record***

This report has been issued and amended as follows:

<b>Issue</b>	<b>Revision</b>	<b>Description</b>	<b>Date</b>	<b>Initial</b>
0	01	Draft Report compiled	8 <sup>th</sup> August 2008	RS
0	02	Minor changes	14 <sup>th</sup> August	RS
0	03	Minor amendments to table and text	18 Sep 08	RS

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## 1. *Remit*

Undertake sample site visits of track renewal sites planned for 2009/10 on Primary routes, to determine if there is any evidence that NR's track renewals on primary routes are premature.

Sample to include all five Territories, target 10 days of site visits and four sites per day.

NR's problem statements to be reviewed for each site. Sample should avoid deferred track renewal proposals wherever possible.

For each track renewal proposal an assessment is to be made as follows:

- whether the NR problem statement justifies the renewal
- whether the observed asset condition and likely degradation rates justifies the renewal
- whether the specification for the renewal is justified

## 2. Introduction

This report summarises the findings of forty visually inspected sections of permanent way on Network Rail's main line infrastructure (Primary Routes). The sites were selected by the Network Rail engineering staff who had been given the ORR remit (see above) in advance. The inspections were undertaken under normal traffic conditions during the spring and summer of 2008 and with pre planned on-site safety arrangements.

Ballasted railway track, with either wood or concrete sleepers, has a service life expectancy that is affected by many factors. Those that have the most impact on the higher speed routes on Network Rail's network, which are the subject of this report, are the annual tonnage passing over the track and the original components that made up the track system when it was installed.

All plain line on these Primary Routes is made up from continuously welded rail, however not all the sleepers in older track sections are necessarily concrete, and with both concrete and wooden sleepers there remain a variety of fastening types, with associated sleeper pad thicknesses, securing the rail to the sleeper.

The visual inspection process that results in a judgement to renew a section of track or a switch and crossing unit is in normal circumstances the culmination of work by railway engineers responsible for its day to day maintenance who produce 'problem statements' (these state the technical reasons why the track in question is proving more expensive than normal to maintain) and track engineers whose role is to compile an annual workbank of track volumes. All track in these provisional workbanks will have met their respective engineering renewal criterion for their location and use. For Network Rail the final decision on the annual volumes of track to be renewed is based on a financial business case and is generally taken one year before the year in which the track will be renewed.

The inspections undertaken and described in this report were of track that had, in the main, been put forward by local maintenance and track engineering managers, for inclusion in the 2009/10 renewal programme. The delivery programme volumes for 2009/10 had not been finalised or authorised at the time of the inspections.

The principal factors that can give two sections of the same track type, installed in the same year, different service lives have been stated above. However, to factors such as annual tonnage and track type, must be added the following:

- Actual maximum speed of trains over the track
- Is the track straight, on a regular curve or transition
- evidence of increased maintenance activity to maintain the track system performance
- recent rail defect history
- recent track geometry recordings

- poor geometry and evidence that intervals between interventions have reduced in the last 3 years
- wet beds evident
- ballast contaminated with fines so as to prevent good drainage
- drains not working
- indentation on sleepers/timbers due to worn pads
- rail gall
- rail sidewear
- rolling contact fatigue
- cracked sleepers
- loose fastenings
- is the track in a cutting
- is the track on an embankment
- what is the prevailing vegetation
- is the track in an incline or falling grade
- is it still possible to maintain good geometry by tamping
- do the fastenings appear sound and is there evidence of maintenance to pads and insulators
- age of rail and type of welds. Any evidence of rails being changed due to defects
- any evidence of voiding observed by passing trains
- whilst an increase in maintenance activity can be expected in the last few years of serviceable life, reduced performance of the track system is not acceptable on a Primary Route

For switches and crossings the following should be added:

- have switches and/or crossings been changed and when
- what are the joint conditions like at crossings (if not fully welded) and at insulated block joints
- how many timbers have been changed
- is the gauge good and consistent
- any evidence of rolling contact fatigue in the rails
- is the approach alignment good
- do any baseplates move under passing trains

### 3. Findings

For each site visited the following documents were requested:

- The Problem Statement. This document is compiled by the Maintenance Engineer. It describes in detail the factors that are making day to day maintenance of the track between specific mileages difficult and possibly beyond the resources held by the Maintenance Depot.
- The Renewal Specification. This document is compiled by the Territory Track Renewals Engineer and, based on the Problem Statement and a site visit, describes the renewal scope and material specification. This should be compliant with the Track Policy for the route, taking into account the speed and annual tonnage of traffic.

Finally, an opinion is given on whether the observed asset condition and observed likely degradation rates justified the renewal in 2009/10. The consultant's opinion on the justification or otherwise (deferral) for including the sections of track inspected in Network Rail's programme of track renewals for 2009/10 took into consideration the desirability of selecting items for the 2009/10 programme which had up to three years of reliable service life at the time of inspection. Including items which have such condition in the 2009/10 programme minimises any risk of impact upon route performance should the particular item be renewed in the last period of the renewal year rather than the first. Certain items were inspected for 2010/11 and 2011/12 programmes.

The findings for each site are described in the Appendix on page 11. The following table is a Summary.

#### Switches and Crossings

Site	Problem Statement OK?	Renewal Justified in 2009/10?	Specification Change or Deferral	Comments
Templehirst	Yes	Yes	No	
Barham	Yes	No.	Yes	Change Specification
Diss	Not available	No	Yes	Change Specification
Crewe Basford Hall Jct	Yes	N/A	Yes.	2011/12 proposal Defer - Possible Remodelling
Wamphray	Not Available	Yes	No	
Heywood Road Jct	Yes	No, if TSR remains. Yes, if 100 mph PSR possible	No	Subject to network Change issue

## Plain Line sites

Site	Problem Statement OK?	Renewal Justified in 2009/10?	Specification Change or Deferral	Comments
Holgate	Yes	Yes	No	
Benningbrough	Yes	Partially	Yes	Rerail only 2009/10
Pilmoor	Yes	Yes	No	
Market Harborough	Yes	Yes	No	
Kettering South	Yes	N/A	No	2010/11 proposal
Wellingborough	Yes	Yes.	Yes	Split in two or three? Additional drainage
Clapham	Yes	Yes	No	
Barham	Yes	No	Yes	Defer to CP5
Moulton	Yes	Yes	No	
Milford Down	Yes	Yes	No	
Milford Up	Yes	N/A	Yes	2010/11 proposal; Additional Drainage
Basingstoke	Yes	Yes	No	
Surbiton	Yes	Yes	No	
Waterloo (Plats 3 & 4)	Yes	N/A	No	2011/12 proposal Consider slab track
Hartford	Yes	N/A	No	2011/12 proposal
Minshull Vernon	Yes	N/A	Yes	2011/12 proposal Defer to CP5
Crewe Coal yard North	Yes	N/A	No	2011/12 proposal
Wolverhampton Dn	Yes	Partially	Yes	Rerailing only 2009/10 Split in two?
Wolverhampton Up	Yes	Partially	Yes	Rerailing only 2009/10 Split in two?
Albion	Yes	Partially	Yes	Rerailing only 2009/10 Split in two?
Kings Norton	Yes	Yes.	No	
Northfield	Yes	Yes	No	
Symington	Yes	Yes	No	
Abington	Yes	Yes	No	
Dalmakether	Yes	No	Yes	Defer to CP5
Edinburgh	Yes	N/A	No	2010/11proposal Consider shallow depth sleepers
Portobello	Yes	Yes	No	
Monktonhall	Yes	Yes	Yes	Extend item and review trackbed Spec
Penmanshiel	Yes	Yes	No	Rerailing item
Corsham	Yes	Yes	No	
Defford (1)	Yes	Yes	No	
Bredon	Yes	Yes	No	
Defford (2)	Yes	N/A	No	2010/11proposal
Crawfords	Yes	N/A	No	2010/11proposal
Prouts Bridge	Yes	N/A	No	2010/11proposal
Berkley Road	Yes	N/A	No	2010/11proposal

## **4. Conclusions**

- 4.1** There was evidence, in the relatively small sample of sites visited on Primary Routes, that the majority of 2009/10 track renewal workbank contained items of work that were justified on the basis of engineering requirements to maintain a safe, reliable and low maintenance dependent infrastructure.
- 4.2** At the time of the commencement of inspections (February 2008) Network Rail's track engineering function had finalised the 2009/10 workbanks through a peer review process, however, there were still some discussions continuing within engineering that could lead to a change in the workbanks before they are financially authorised.
- 4.3** Network Rail's planning procedures have a 'no change' policy on work programmes. Items that may fall out of a programme cannot be reinstated for two years. Whilst this policy reduces the replanning costs (an S&C renewal typically takes 80 weeks to plan from the day it enters a workbank) it does mean that items are put into a workbank with judgement that there are a minimum of two years of serviceable life after the planned year of renewal. A performance benefit of this policy is that today few track renewal items on Primary Routes have a condition of track speed restriction imposed before they are renewed. This policy may result in asset lives being shortened by one or two years.
- 4.4** Two plain line renewal items out of 25 peer-reviewed proposals for 2009/10 were regarded as suitable from an engineering perspective for deferral to CP5 without impacting upon train performance.
- 4.5** Four sites were inspected where the Problem Statement cited rail sidewear as the driver for renewal. Consideration should be given to a complete review of the track geometry for all sites where rail is being renewed close to or at the safe limit for sidewear. This is to establish that there are no improvements possible to the track geometry to maximize future track life, including the specification for rail head hardness and the future maintenance regime.
- 4.6** The samples of Network Rail's Trackbed Investigation reports reviewed varied in content and detail. In one case the reported facts did not match the inspected site evidence, resulting in a shortfall in the extent of work proposed. The second matter observed is more general. The consultants reports do not all make firm or specific recommendations, leaving options open to the client. It is not clear how Network Rail either accept or challenge these recommendations, nor how they are turned into specific engineering requirements for the track renewals delivery organisation and the contractor.
- 4.7** The engineering judgment to include switch and crossing renewals in a particular workbank is more complex than for plain line. This is because the individual components, especially the switch rails and crossing units, wear out

and are changed at least once in the life of the unit. This often leaves the ballast condition and resultant track geometry as the single driver to justify renewal.

- 4.8** Of the five S&C sites inspected for renewal in 2009/10, three (Templehirst, Wamphray and Heywood) were considered to have the correct renewal specification.
- 4.9** Two switch and crossing units inspected during the compilation of this report (Barham and Diss) were found to be in particular locations where the service life could be extended from between 5 and 10 years by an engineering lead programme of refurbishment. Such a specialist programme would need to have a clear minimum engineering specification to raise the remaining overall service life rather than reject the proposal and return the unit to the maintenance function. The cost of such work and the resultant service life are further judgements that should be taken into account in deciding whether or not to completely or partially renew in a particular year.
- 4.10** The 'proposal to renew' procedure that requires the maintenance function to prepare and submit 'Problem Statements' through Area Track Engineers to the Territory Engineer's Track Renewals teams was seen to be working well, however, further improvements are expected during CP4 as the 'track renewal end to end process' is rolled out.
- 4.11** The quality of Track Renewal Specification documents reviewed was generally good. During the site inspections significant change to the proposed Renewal Specification was considered necessary for only two items (Benningbrough and Monktonhall).
- 4.12** At several sites where the driver for renewal was blocked drains or formation failure beneath the ballast layer, the root cause of the problem was poor quality of track renewal work executed in the last ten years. This demonstrates a need to secure robust Trackbed Investigation reports and provide sound site supervision during the execution phase of more complex specifications.
- 4.13** The quality of track renewal specifications could be improved by the provision of whole life cost information for varying types of track asset renewals. This would be particularly beneficial at sites like Benningbrough, where rail, sleeper and ballast had differing residual asset lives.

## 5. Appendix – Site Inspection Notes

### 5.1 LNE Inspections

#### Templehirst Junction

Templehirst junction is a crossover and single lead in the 125 mph up and down main lines to enable trains access to Selby from Doncaster , and vice versa, at 70 mph.



Figure 1 Templehirst Junction looking south

The junction was installed in 1981 when the original route of the ECML between York and Doncaster was rebuilt to the west to allow coal to be mined under the old route. The bearers are hardwood timber, now showing evidence of delamination, and rails 113A flat bottom. Over 50% of the ironwork has been replaced with evidence of refurbishment in 2002. The driver for renewal in 2009/10 is the quality of the geometry, which is poor, and this is leading to the likelihood of component failures. The ballast is heavily contaminated with coal spillage. During the inspection a broken insulated stretcher bar was found and reported. Renewal in 2009/10 will result in an asset service life of 29 years. The existing crossover sits on an underbridge. This contributes to the geometry problems due to the irregular stiffness of the sub-base. The

renewal specification is for modern materials compliant with NR track policy. An investigation is being made to relocate the junction off the underbridge.

#### Potential for deferral

None. The current poor track geometry and difficulty maintaining satisfactory geometry for 125 mph operations due to the coal dust contamination in the ballast, any deferral beyond 2009/10 will result in further component failures and a consequential impact on performance and maintenance costs.

### **Holgate Down Fast**

This is a plain line total renewal proposal for 752 yards of the down main line as it approaches York station from the south. Line speed is 90 mph; however speed reduces at the northern end as trains slow for the station stop.



**Figure 2 Down Fast at Holgate. North end of site looking towards York Station**

The category 3 track carries over 13 equivalent million gross tones per annum (EMGTPA) and was installed in 1964 with the now obsolete AD fastenings and also obsolete F14 concrete sleepers. The 110A rail condition is not good and it is the age of rail that is driving the renewal. The track geometry is satisfactory despite dirty ballast. Records show that the ballast was renewed in 1989.

Due to track access restrictions at this location, the renewal will have to be undertaken during a Christmas period when York station can be closed.

This renewal is one where new rail would not be laid on the old F14 sleepers as the fastening is now obsolete. Renewal of the sleepers drives reballasting and opportunity will be taken to unblock and renovate the track drain during the renewal, planned for 2009/10.

Expected asset life for cat 3 track of this type is 45 years.

#### Potential for deferral

Up to two years if this achieves a more efficient delivery programme on this route.

### **Beningbrough Down Slow**

The proposal for just over a mile of this 70 mph line on the ECML north of York is for rerailing and ballast renewal.



**Figure 3. Down Slow at Beningbrough**

The ECML north of York is generally flat, straight with the two 125 mph fast lines complemented by 70 mph slow lines that tend to carry the freight traffic. At Beningbrough the down slow is category 3 and the EGMPA just under 11. The site proved to be quite interesting. 109lb 1958 rail sits on 1972 F27 sleepers. It can be assumed that the track was renewed in 1972 with serviceable cwr and new sleepers. Clearly the ballast has become dirty and in two specific locations the renewal specification is for total ballast excavation,

sub-base protection and drainage. There was evidence of poor top at these locations, but generally the geometry was good.

After the inspection a detailed rail failure report was provided, confirming that rail renewal was now due.

The expected life of the sleepers is 45 years. There was no evidence of sleeper deterioration, leading to an expected sleeper renewal year in 2017. It is therefore suggested that the specification for this site be changed to rerail only in 2009/10 and treat the poor top by maintenance with stoneblower.

Should it prove necessary to treat the poor formation at the two sites within the overall mileage of the proposal, they should be dealt with in isolation.

Resleeper and reballast by ballast cleaner can then be considered in 2017.

#### Potential for deferral

The current specification could not be justified. The site inspection leads to a recommendation to renew the rail in 2009/10, but defer the reballasting. The rail defect history was provided and showed the detection of 22 removable defects in the last seven years. Deferral of the reballasting into CP5 would make this a potential ballast and sleeper renewal item, which is considered to be a more efficient means to manage the asset life of this particular site.

### **Pilmoor Up Slow**

The proposal for 1112 yards of this 70 mph line on the ECML south of Thirsk is for total renewal.



**Figure 4. Up slow at Pilmoor**

This stretch of the up slow was installed in 1959. Most, but not all of the 1959 rail was replaced in 1979. The track type is the same as that at Holgate. AD

fastenings on F19 concrete sleepers. However, here, the fastenings are in a very poor condition and there are several of the F19 sleepers with cracks through the holes for the fastenings. Just south of the photograph the line curves gently to the east. Here the fastening condition is not as good as the straight. Maintenance work will be required before the track is renewed in 2009/10. The driver for the renewal is the condition of the fastenings. At the York end of the 1959 sleepers is a short length of 1970 F27 sleepers that but up to F40 cwr laid in 1990. It makes economic sense to renew this short length of track (137 yards) at the same time.

#### Potential for deferral

None. The fastening condition is such that deferral should not be considered.

## Market Harborough



**Figure 5. The up main, south of Market Harborough, clearly showing formation failure**

The proposal is for reballasting, formation renewal and lineside drainage on the up main from 82 m 268 yards to 82 m 980 yards in 2010/11. The rail was renewed in 2000, most likely as a result of rolling contact fatigue, and the sleepers appear in good condition although they are a variety of F23, F27 and EF33. Track geometry varies throughout the site, there being some poor top and line at 82¼ mp and again at the northern end of the site (82½ - 82¾). The existing cess drain was flowing, and there was evidence of earlier formation renewal and the use of shallow depth sleepers. Network Rail's notes state that part of the site was reballasted in 1997. If this is so, then, without formation treatment and care in producing water gradients from the ballast/formation interface to the existing drains has resulted in the need for the correct engineering solution to be applied 13 years later. The line at this location has a maximum permissible speed of 75 mph.

The specification is for formation renewal and drainage from 82m 268y to 82m 830y and track reballast between 82m 830y and 82m 980y; localised sleeper renewal and respacing to 30/length, otherwise existing rail and sleepers to be reused. This is an efficient material specification, however, it may be that overall efficiency will lead to the renewal of the existing sleepers, as selective renewal and on-site respacing is very time consuming. If this is the case, consideration should be given to the use of shallow depth sleepers.

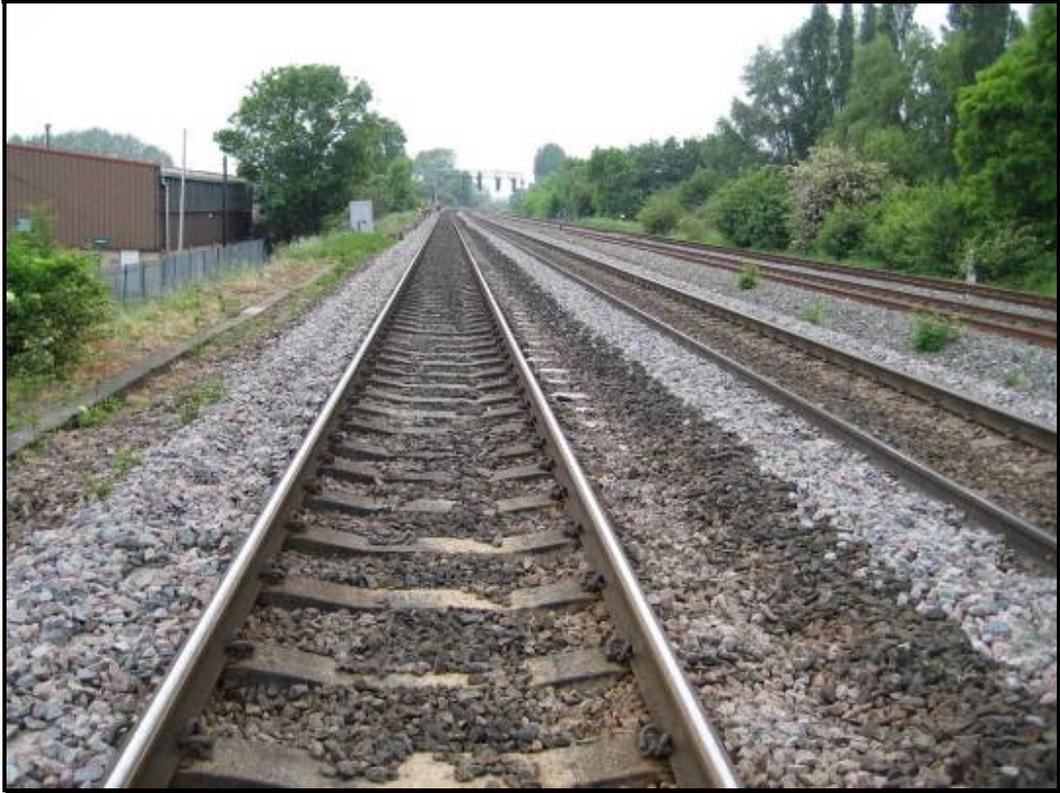
From site inspection, and scrutiny of the last 12 months of recorded track geometry, further investigation should be undertaken northwards from 82m 830y to the fronts of the trailing connection in the up main to determine the root cause of the poor geometry. If this is associated with the formation and drainage conditions, then the work proposed should be extended. If there are other reasons then appropriate maintenance work should be arranged.

#### Potential for deferral

None. The current poor track geometry and difficulty in maintaining satisfactory geometry, even for 75 mph operations, due to what appears to be an inability of water to leave the track and enter the drainage system, will lead to difficulty in preventing possible condition of track speed restrictions if not treated in the early part of 2010.

### **Kettering South**

This is a proposal for 20010/11 to totally renew 570 yards of the down main just south of Kettering station between 70m 1220y and 71m 30y. Associated with the track renewal is 370 yards of formation renewal and 526 yards of line side drainage. The line speed is 100 mph with trains braking for a 90 mph PSR approaching Kettering station. The site commences off Kettering South Junction and is on straight track. The original driver for this proposal is the failed drainage system at the southern end of the site. The northern end of the site abuts 1990 cwr on F40 sleepers.



**Figure 6. Kettering. View looking north from the four foot of the down main at the southern end of the site. 71 MP in the mid distance. Slow lines to the right.**

The track was installed in 1972 with 113A cwr; F27 sleepers and 401 pandrol fastenings. 7.5 mm pads were installed in 1995. The adjacent up main is the same age. Ballast conditions look good on the surface; however, trial holes have revealed an old formation treatment with Terram sheet overlaying sand. at the south end where there is an old drainage system leading up to and through overbridge No. 55 at 70m 1480y.

The track geometry data shows very poor standard deviation values for both top and line for the 220y off the S&C and through the under bridge. Top remains poor up to the 71 MP, after which both top and line revert to the 'good' standard.

The ballast conditions are not exceptionally bad, even though the trial holes only show localised failure of the sand/Terram treatment. Therefore improvements to the geometry should be possible for the two eighths of a mile that are in the poor and very poor categories by using a stoneblower. Similar maintenance treatment to the adjacent up line is also recommended.



**Figure 7. Kettering. View looking south towards Kettering South Junction. Note the existing drainage manholes in the up cess, six foot and down cess.**

It is recommended that a detailed track drainage scheme for both up and down lines is designed with associated formation treatment, particularly from the S&C and through the overbridge. When this is ready for implementation renewal of the rail, sleepers and ballast is justified from the S&C and up to the 1990 F40 cwr at 71m 30y on the down line. A separate proposal for the up line should be considered for later in CP4 such that its renewal and associated formation treatment will tie into that constructed for the down line.

#### Potential for deferral

Up to two years whilst the drainage and formation treatments are scoped and designed for both up and down lines.

### **Wellingborough**

Wellingborough station is located on a long curve on the Midland Main Line. Accordingly there is a Maximum Permissible Speed of 80 mph on the approach and through the station. The maximum superelevation of the track is 150 mm and in 2000 both high rails of the two main lines had to be renewed due to severe rolling contact fatigue cracks. With diesel traction on the route, the high superelevation leads to oil spillage in the tracks through the station which creates problems for track geometry maintenance.



**Figure 8**

**Figures 8 and 9. The line curves to the left as trains leave Wellingborough for Bedford. The up main is nearest to the camera. Below. The up main line approaching Wellingborough station from the north.**



**Figure 9**

The proposal is to renew the up main line from 64m 1346y to 65m 660y in 2009/10. Associated with the renewal is formation treatment over the full length of track renewal and two independent drainage items. One new drain will run to the south of the station in the up cess and a second from the station to the north, also in the up cess. (Note the drain to the cess of the up goods line, which is ineffective to the existing up main, in the picture above)

Track geometry data over the last 12 months shows track generally in the satisfactory band. The only exceptions are a specific twist defect just south of the station (which can be seen in the centre of picture 4) and the length of straight track between the north end of the curve through the station and the next curve in the opposite direction which commences at 65m 800y and includes a trailing and facing connection from the up and down slow line. The long wave top and alignment is of lower quality through the platforms. This may well be partly due to the poor drainage and partly due to constraints in lifting and sluing when undertaking geometry maintenance with stoneblower.

The existing track was renewed in two or three periods; 1989 through the platform with hardwood sleepers and pan 11 baseplates and 1993 rail on F27 and F40 sleepers with e1809 clips to the north and some older 1976 F27 to the south. Associated with the less than satisfactory long wave alignment through the platform is evidence of intermittent rail sidewear, which in some instances looked to be approaching the point at which replacement rail should be procured. (It was not possible to gain access to the track in the platform to take measurements).

There appeared to be two drivers to this renewal, both equally critical. The first is the sidewear. The curve through the station, as the photographs show, is long, and rerailling will be due in the next three years, despite the evidence of working lubricators. The second is the problem of maintaining track geometry at the south of the station, where the formation is weak, there is evidence of slurry at 64m 1650y, and track drainage to the up cess south of the station is no longer effective.

#### Potential for deferral

The only concern with this proposal is that it is a large volume of work and may be suitable for it to be divided into two or three work items. 1) the formation renewal and drainage to the south of the station; 2) the renewal through the station and 3) the renewal and drainage from the north of the station up to the facing connection at 65m 660y. Item 1) is urgent; item 2) is driven by sidewear and item 3) is the 3<sup>rd</sup> priority.

All work should be completed in CP4.

## Clapham

The proposal is to renew 1718 yards on the down main north of Bedford. The track is straight and sits on a high embankment. Line speed is 110 mph, however, trains are generally travelling slightly slower as they accelerate from Bedford station some 2 miles to the south. Originally proposed for 2008/9, it is now in the workbank for 2009/10.



**Figure 10. Down Main at Clapham. Note voided sleepers, indicative of extending machine maintenance intervals too far.**

This stretch of the down main was installed in 1966; however the rails were renewed in 1991, except between 52m 340y and 52m 737y, where 1966 rail is insitu. The fastenings are SHC and sleepers F19. The track geometry records show either good or satisfactory bands for all four top and alignment parameters. Ballast is dry but crushed with fines. Maintenance is by stoneblower. Many sleepers are slightly voided. This has the consequence of accelerating the wear between sleeper, pad, rail foot and fastening, resulting in reduced tension that can lead to rail movement in extreme hot and cold ambient temperatures between night and day.

### Potential for deferral

None. This is a low risk site should the drive for efficient work packaging move it into 2010/11.

## 5.2. Southern Inspections

### Barham S&C

The proposal is for the renewal of a crossover and single lead into the up sidings which serve an industrial sand processing plant.



Figure 11. Barham S&C looking north from the fourfoot of the up fast

The crossover was installed in 1970 and is a vertical 113A layout on hardwood timber. The trailing single lead into the up sidings was installed in 1979. All the ironwork on the crossover has been renewed between 1982 and 2005. Retimbering to the up facing switches took place in 2005 when the left hand switch and crossing were renewed. Lateral restraining plates were fitted at the same time to improve stability in hot weather. The hardwood timbers are heavily laminated, and there is evidence of some baseplate indentation to the timbers.

As the photograph above shows the layout sits on a good straight track alignment. The one engineering condition that does give concern is the ballast and sub base. A failure of the formation on the down main has occurred opposite the up main facing switch. Also there is evidence of several years of work digging out dirty and fouled ballast. The track geometry recordings on the up and down main lines show that the values of standard deviation for 35m chord top exceeded 4 (poor) at the end of 2000. Repairs were carried out however intervention is necessary once per annum to hold the geometry

in the satisfactory band. The renewal specification is for a like for like replacement with 113A rail and concrete bearers. This is supported in order to minimize cost and take account of the improved reliability of the track system due to its alignment and reduced utilization. The site investigation report specifies formation treatment to improve track bed stability. Further benefits are available by removing the overburden on the embankment cesses.

One option for this site would be to undertake life extension of the track system using a proven technique such as that developed by Sersa. This would only defer the renewal into CP5 due to the formation and ballast condition. Modelled life of S&C in cat 2 track with 15 EMGTPA is 35 years.

#### Potential for deferral

Yes. There is considered to be a potential for deferral for a minimum of five years (i.e. into CP5) by adopting an engineering specification for life extension and this work being carried out by a competent workforce with the resultant improvements measured for compliance with track engineering maintenance standards.

### **Barham Plain Line**

The proposal is to renew 489 yards of plain line to the north of the S&C item above on the down main line.



**Figure 12. Down line Barham showing the problem with slag ballast used by BR in the 1960's**

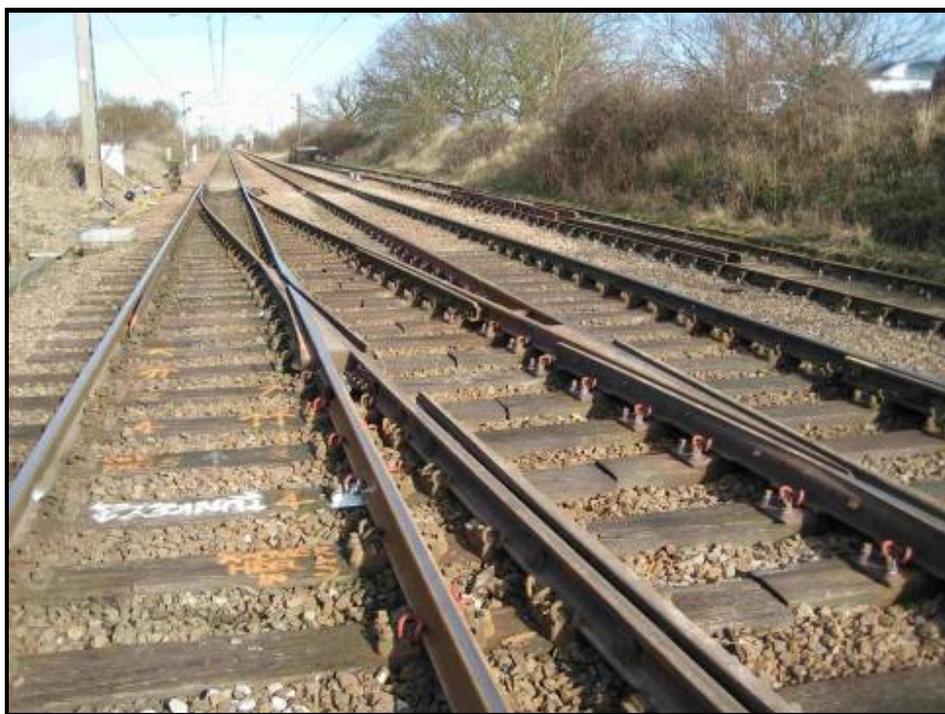
This track is early 110A rail (with SMW welds), F23 concrete sleeper cwr installed in 1966. At the time the Eastern Region of British Rail used slag (a byproduct of the steel industry) as ballast. This material was usually very small in size and this has contributed to an acceleration of fines in the ballast bed, which under concrete sleepers leads to ballast attrition and the formation of 'wet beds' affecting track stability. The sleeper pads had been renewed with 'H' pads. These are now showing signs of wear. The track geometry through the proposal is in the good and satisfactory band for all parameters, despite the poor ballast conditions. Modelled life for pre 1975 rail and sleepers on cat 2 track is 35 years. The renewal specification is for G44 sleepers under NR60 rail, compliant with Network rail's policy and is supported. Ballast renewal by traxcavation due to presence of slag. Subject to a risk assessment for the possibility of rail breaks in the 1966 rail, the item has another 5 years of life before renewal.

#### Potential for deferral

Yes. Subject to a risk assessment for the possibility of rail breaks in the 1966 rail, the item may have another 5 years of life before renewal. From the rail defect information supplied by Network Rail, there is no apparent evidence of rail fatigue that would not support the potential for deferral.

### **Diss S&C**

The proposal is to renew the S&C to the north of Diss station, which consists of a trailing crossover and a facing lead into the up sidings. Approximately 200 yards to the south on the up main is a trailing connection from the up main, also into the up sidings.



**Figure 13. Diss S&C and up siding from the down main line looking north**

The crossover in the main lines was installed in 1973. It is a vertical timbered layout with 113A rail and hardwood timbers. The switches are original, but the crossings were renewed in 1990 and 2005. The general condition is good, helped by the straight alignment of the main lines and the fact that train speeds are low as all passenger trains are running at slow speed for their stop at the station.

The facing connection into the up siding was installed in 1976 to the same specification as the crossover. The switches are original; however the crossing was changed in 2002. The trailing connection into the up siding was installed in 1973. The right hand switch was renewed in 2000 and the crossing in 1990.

The overall condition of the four units is good and renewal in CP4 cannot be justified. The weakest components are the timbers which have started to delaminate. There was no evidence of baseplate indentation found. This is an example of a layout on a 100 mph route which is not subject to normal wear and tear from traffic as there is very little through freight and all passenger trains stop at Diss station.

It was noted that some replacement ironwork had been ordered and was lying in the sidings area. This layout is ideal for life extension treatment.

#### Potential for deferral

Yes. Due to the proximity of this site to Diss station, which results in lower speeds, this layout is ideal for life extension treatment as described for Barham S&C above.

#### **Moulton**

This proposal is to totally renew an item of timber sleepered cwr laid in 1961. The geometry is very good on a large radius curve.



Figure 14. Moulton plain line on the up main approximately 15 miles north of Diss

This is an interesting section of the Norwich to London main line. The annual tonnages are relatively low for a 100 mph main line and the track has been well maintained with good natural drainage. However, the hardwood timbers are now badly decayed in places and the Mills fastenings are working loose. The rail is 110A flat bottom now showing 5mm head wear. The item is 351 yards long and will be renewed with G44 sleepers and NR60 rail in 2009/10. The site specification includes an additional 198 yards of reballasting to the south on a 2006 renewal of sleepers and rails where Balfour Beatty's New Construction Train put the new materials on the old ballast bed.

#### Potential for deferral

None. Due to the severe decay evident in the sleepers and the age of rail, deferral should not be considered.

### **Milford Down Line**

The proposal is for the complete renewal of 1046 yards between 35m 1041y and 36m 390y with additional rerailing of 63 yards in 2009/10.



**Figure 15. Milford down line looking south toward Milford station.**

The existing track was installed in 1963 and is jointed with 24 wood sleepers per length; 110A rail and predominately Pan2 baseplates secured with chair screws. The track is in a shallow cutting and lies in a gentle curve at the London end before a straight section as Milford station is approached. There is a short cess drain between 36m 154y and 36m 308y.

The general condition for this 45 year old track was acceptable; however, closer examination showed that several components of the track system were reaching the end of their asset lives. The ballast was dry and consisted of crushed ballast with fines below the sleepers, no longer able to deliver good results from maintenance tamping. Many sleepers showed signs of decay and there was evidence of indentation at the baseplate seat. New chair screws had been installed under maintenance in 2003. The rail joints were visibly dipped. Records showed four locations where rail end dip angles had required remedial attention in the last 18 months. There had been 12 rail defects removed in the last 10 years. Track geometry recorded data confirmed the observed good line and level together with the dipped joints. At the Milford station end a crossover had been removed in the last two years and replaced with plain line. This renewal will include rerailing through this site to remove several joints and an old breather switch.

#### Potential for deferral

None based on the age of the rails and the general condition of the rail joints and sleepers.

### **Milford Up Line**

This proposal is the combination of two consecutive items from the 2008/09 programme that are now transferred to 2010/11. The new item runs from 36m 1320y to 36m 214y and includes the track over the road level crossing and through Milford Station.



**Figure 16. Up line approaching Milford level crossing and station**

The problem statement identifies the principle driver for this renewal is the ballast condition. The track was installed in 1964 and is cwr on F24 concrete sleepers with pandrol fastenings at the north end and through the platform from 36m 214y to 36m 545y. From 36m 545y to 36m 1320y at the south end it is jointed track with spiked baseplates and Heyback fastenings on wood sleepers. There was no evidence of concrete sleeper deterioration; however, the wood sleepers are showing signs of decay. The rail is 110A. The cwr is in good condition; however the jointed section has had 9 dip angle exceedences and 5 rail defects removed in the last 18 months. Recently the level crossing surface has been renewed around the old cwr track and to the north of the station a turnout which formed a crossover to the down line has been removed and replaced with plain line. Through the station there is a six foot drain. Ballast conditions are very poor immediately south of the station and at two locations south of the station the ballast has broken down leading to the classic "wet bed" (see picture above). In the jointed track the ballast is crushed and dirty. The track geometry is now maintained by stoneblower. Consideration should be given to providing a drain in the up cess from the level crossing south for 200 yards. Alternatively the shoulder ballast should be removed completely to a level that coincides with the 1:30 crossfall at the ballast/formation interface to allow water to drain away.

#### Potential for deferral

None due to the condition of the jointed track and the ballast condition leading up to the station from the south. It is recommended that attention be given to retaining and using the six foot drainage through the station, ensuring an optimum alignment through the level crossing and providing water drainage from the track south of the station.

### **Basingstoke Down Fast**

The proposal is to renew 575 yards on the down fast between Basingstoke station and Worting Junction in 2009/10. There are four tracks leading up to Worting Junction. The down fast and down slow are separated from the up fast and up slow by a tenfoot. The route speed is 100 mph although the linespeed at this location is 90mph. The site proposed for renewal commences at 49m 1412y and abuts the London end of Worting Junction at 50m 229y. The earliest material indicates an original installation year of 1963. The 110A rail sits on Pan 11 baseplates secured to wood sleepers. EGMTPA have increased since the BR class 442 multiple units which operated the services to Bournemouth have been replaced by heavier class 444/450 units. There is evidence of the track system coming to the end of its economic life with gall in the rail foot over the baseplates and several baseplates spikes are loose with corresponding indentation on the sleepers. Sleeper condition is poor with evidence of decay on the surface. Ballast is crushed and dirty with fines, resulting in stoneblower being the only effective geometry maintenance tool. The track alignment is on a gentle curve leaving Basingstoke station then running straight up to Worting Junction, which, together with a naturally draining formation and shared route tonnage with the slow line, is the reason this site has lasted for 45 years. Geometry traces

recorded in May 2008 show good alignment but less than good twist and top traces with some general gauge widening. EGMTPA is 11.0.

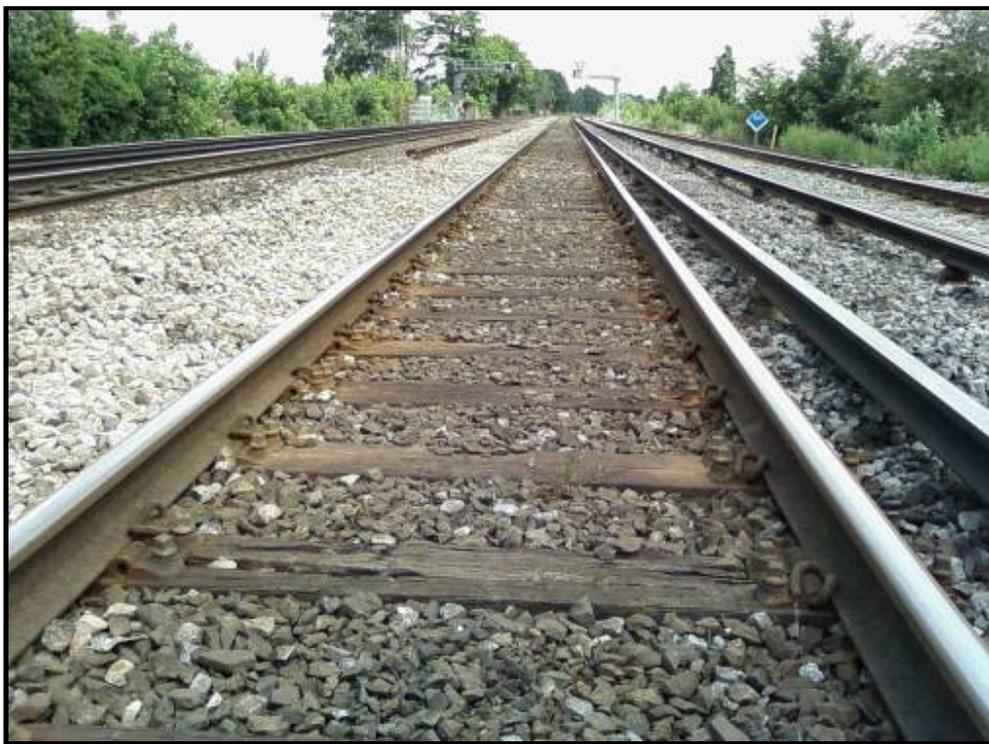


Figure 17. Basingstoke down fast looking toward London.

#### Potential for deferral

None, due to the general condition of the track system.

#### **Surbiton**

This proposal is to totally renew an item of timber sleepers cwr laid in 1968 on the up slow between Esher and Surbiton in 2009/10. Line speed is 85mph and the general alignment is straight. EGMTPA is 27.0 shared with the up fast. The track is on an embankment with good natural drainage. The extent is from 13m 563y to 12m 841y, where the plain line abuts the trailing end of a facing crossover from the adjacent up fast as the lines approach Surbiton Station. The existing material is 113A cwr with Pan6 baseplates on wooden sleepers. Ballast is limestone with no evidence of slurry indicating good drainage. The driver for renewal is the very poor condition of the sleepers. In certain sections the condition is such that strengthening repairs should be considered, especially if assurance cannot be given that the work will be programmed in April or May of 2009.



Figure 18. General sleeper condition at Surbiton is very poor.

#### Potential for deferral

None. Due to the severe decay evident in the sleepers, deferral should not be considered.

#### **Waterloo Station**

These two proposals are to renew the jointed tracks in platforms 3 and 4 at Waterloo Station in 2011/12. In both cases the drivers for renewal are dirt and contamination from continual use by trains since the tracks were installed in the late 1960s.



Figures 19 and 19. Waterloo Station platforms 3 (left) and 4 (right)

Network Rail has plans to improve capacity at Waterloo station during CP4. This may entail closing platforms 1 and 2, thereby creating room to lengthen platforms 3 and 4. This would be the ideal opportunity to renew the tracks in these platforms and create a reduced maintenance track system, possibly with slab track.

Potential for deferral

Renewal of both platform tracks should be included in 2011/12 and aligned to the Waterloo Station capacity improvement project.

## 5.3. LNW Inspections

### Crewe Basford Hall Junction

Basford Hall Junction is situated just south of Crewe station and it comprises five crossovers and two single leads enabling traffic to enter and leave the fast and slow lines and access/egress the Crewe Independent lines and Crewe yard.

The proposal was for the complete renewal of 52B and 52A points in 2011/12. The points form the up exit road from the Independent line and the sidings complex. 52A points are the trap providing flank protection when the down slow points are set normal.

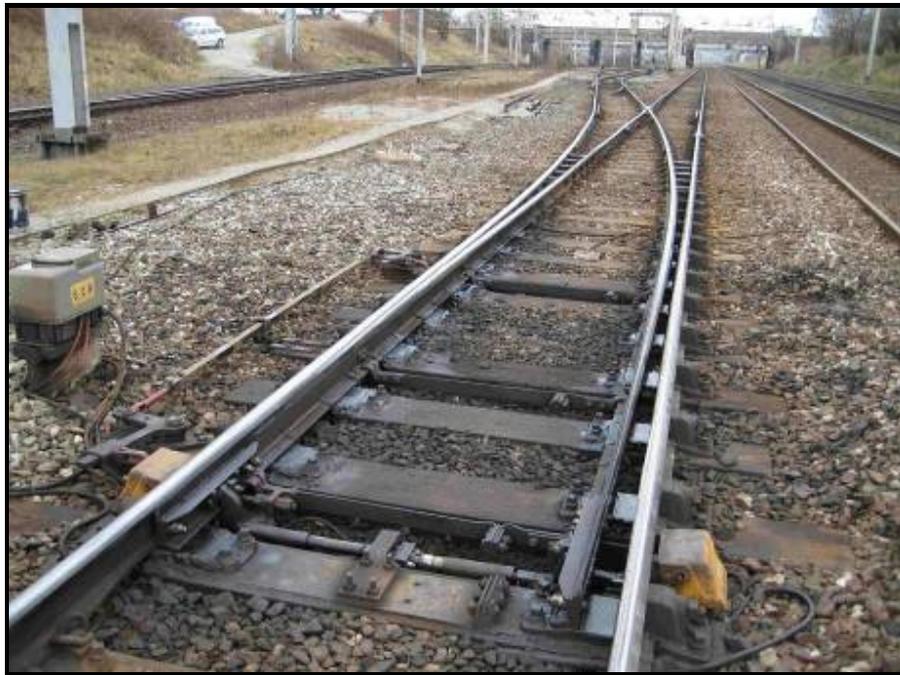


Figure 20. Basford hall junction 52B points looking north.

The layout was installed in 1971 and is made up of 113A vertical rail on hardwood timber bearers. The switches to 52B points were renewed in 1998 (LHS) and 2001 (RHS). The crossing was renewed in 2003. Both sets of switches were renewed at the trap points; LHS in 1987 and RHS in 2005. The ballast conditions are poor with no effective drainage system. The timbers are showing signs of delamination and several have been changed. This is a slow speed high tonnage connection.

#### Potential for deferral

The proposal can be deferred from 2011/12 from a review of engineering criteria without risk of component failure or derailment, providing the current levels of maintenance care is continued. The track layout at Crewe was completely renewed, north and south of the station, in a major 49 day

blockade in 1985. Renewal is now being considered again by Network Rail as the layout approaches the end of its life. The future of 52A and B points may well be wrapped up in the future strategy for this important section of the WCML.

## Hartford

North of Crewe the WCML is predominantly a two track railway. However there are short stretches of four lines and Hartford is one of them. The proposal is to 400 yards of the up fast between 171 miles 180 yards and 170 miles 1540 yards.



Figure 21. Hartford Up Fast looking north

As can be seen from the photograph, the track is straight concrete sleepered cwr with Pandrol fastenings. The rail is 1982 113A FB and the F23 sleepers 1969. This item was most probably relayed in 1969 and rerailed in preparation for the introduction of the Advanced Passenger Train in 1983/4. Records show it was reballasted by ballast cleaner in 1989. The track geometry is good except for one eighth of a mile under the overbridge where SDs of 2.57 for 35 metre top and 5.0 for 70 metre alignment were noted.

### Potential for deferral

The item was being inspected for the 2011/12 workbank. The 1982 rail should still have some serviceable life by then, however the sleepers will be beyond their expected life and the ballast is already showing signs that it can no longer meet its purpose. Deferral beyond 2012 is not, therefore, recommended.

## Minshull Vernon.

The first section of four tracks north of Crewe station continues for approximately six miles until Winsford is reached. Minshull Vernon is located south of Winsford and the item inspected on the up fast is 1100 yards long between 162m 660y and 163mp. The proposal is for 2011/12.



Figure 22. Minshull Vernon up fast looking south

The item is on a straight alignment with a ten foot space to the down fast and a six foot to the up slow. The Network Rail records showed the age of rail as 1978. However, site inspection found only 1985 113A rail on F27BS concrete sleepers with Pandrol e1809 clips and 7.5 mm pads.

The geometry recordings showed the track to be in the 'good' quality band except for the 300 yards at the northern end where 35 metre top and 70 metre alignment had been consistently in the satisfactory band. This may be due to ballast memory.

### Potential for deferral

Consideration for renewal in late CP5 or early CP6 is recommended due to age and condition.

## Crewe Coal Yard North

The down slow line north of Crewe generally takes all the northbound freight traffic until it can be fitted into the flights of high speed passenger trains

heading north at Winsford South Junction. The renewal proposal for 2011/12 is the first mile of the down slow between 159 mp and 160 mp.



**Figure 23. Crewe Coal Yard North Down Slow renewal site**

The track was last renewed in 1981 with 113A rail on F27 concrete sleepers. The engineering components appear in good condition. The problem is the formation and drainage which are producing poor track quality at two distinct locations through the site. As the inspection party walked from north to south, the first poor piece of geometry was in the eighth of a mile between 159m 1100 yards and 159m 880 yards. The poor top can be seen in the foreshortened picture above. Quality then improved until the last eighth of a mile was reached between 159m 220 yards and the 159 mp. The 35metre and 70 metre top was in the poor category. Matters were not helped by underbridge No. 3 with most likely a shallow depth of ballast on the through deck.

As we were looking at potential items for the 2011/12 workbank, a detailed job specification had not been prepared. The inspection confirmed the need to undertake work to the formation and drainage in 2011/12. The exact extent will be determined by a detailed soils investigation.

#### Potential for deferral

Remedial action will be required to improve the track geometry and provide a remaining service life without a TSR until 2012.

## Wolverhampton North (Down)

Between Wolverhampton station (12m 75ch) and Bushbury Junction (14m 43ch) the primary route from Rugby to Penkridge has several curves with particular Permissible Speed Restrictions. The proposed track renewal item at Wolverhampton (Bushbury) viaduct on the down line extends from Wolverhampton North junction at 13m 815y to 13m 1580y, which abuts 1984 cwr on Bushbury viaduct. The route speed is 75 mph, however, through the approximately 1100 metre curve there is a 60 mph PSR. The original proposal was for rerailing only, however, as the original construction date is 1966, it has now been upgraded to a complete renewal of rail sleepers and ballast.



**Figure 24. Down line looking towards Wolverhampton North Junction from approximately 13m 1100y.**

The predominating feature of this site is the sidewear to the high rail. There is evidence of rerailing at various times in the life of the track, and current rail age varies with an age range from 1966 to 1996. As a consequence the site has a large number of Thermit welds on the high rail. 11 rail defects have been removed in the last 10 years. Sleepers are shallow depth EF25 in fairly good condition. Where rerailing has been undertaken new pads, insulators and clips have been fitted. Also 7.5 mm pads have been installed under maintenance. The ballast conditions are typical for a site of this age, although there was no evidence of slurry, just crushed limestone with fines. Geometry is good to the eye. This is confirmed by examining the recorded data, with all eighths in the 'good' band except on the viaduct, where the SDs are 'satisfactory'.

The recommendation for this site is that a detailed study be undertaken to establish if the correct geometry of the track is insitu. Is the superelevation optimum for the speed of trains and radius of curvature? The rate of sidewear would seem to be giving a rail life of less than 25 years, despite lubrication. The current Network rail criteria for transposing rails should be reviewed and considered for this site. For example, can overall longer rail life be achieved by transposing at medium sidewear, rather than rerailling as the safety limit is reached for rail head cross section?

If optimum management of the rail can be achieved, total renewal can follow later in CP4.

### Potential for deferral

Management of the sidewear in the next 18 months is essential. Total renewal could be put back to the end of CP4. A final decision is dependant on the results of the investigation into the optimum track geometry and line speed at this location.

## **Wolverhampton North (Up)**

This proposal is to renew the up line between Bushbury Junction and Wolverhampton North Junction, opposite the item above. The extent is slightly longer, from 14m 852y to 13m 795y and includes all the plain line between Bushbury Junction and Wolverhampton North Junction, including the track over Bushbury viaduct.

The track dates from 1966 and is very similar to the down line, with sidewear being the predominant feature. Like the down line it was proposed for rerailling in 2008/9 and then upgraded to a complete renewal for 2009/10.

The high rail was replaced in 1984, except between the viaduct north end and Bushbury Junction. Since then some short lengths have been replaced under maintenance. Sleepers are a mix of mostly EF25 in good condition for their age, although at several locations they were out of square. Repadding has been undertaken with new clips and insulators where recently rerailed.

Geometry is good. Ballast conditions are crushed limestone and fines. No slurry spots evident, confirmed by the site investigation notes.



**Figure 25. View from the down line looking towards Bushbury viaduct. Note old rails in both cesses from maintenance rerailing due to sidewear.**

### Potential for deferral

Management of the sidewear in the next 18 months is essential. Total renewal could be put back to the end of CP4. A final decision is dependent on the results of the investigation into the optimum track geometry and line speed at this location, as discussed for the down line above.

### **Albion**

This renewal proposal is for 998 yards of the up main line between Wolverhampton and Birmingham New Street on the Penkridge to Rugby route. The proposed mileage is from 6m 799y to 5m 1561y and the year is 2009/10. The line speed is 75mph, however, due to the curvature, between 6m 440y and 5m 1540y there is a PSR of 60mph.

The track was installed in 1969 with F23 sleepers. At the southern end there is a short length of new G44 sleepers installed in 2002, however the rail and ballast were not renewed. There is still some 1969 rail on the low leg, however, the high rail is either 1993 (low mileage end) or 2001 (high mileage end) due to the heavy sidewear, despite evidence of working lubricators. Ballast is dirty with fines, but no evidence of slurry. Track geometry is generally good, with some minor long wave misalignment approaching an underbridge. As a consequence of rerailing for sidewear with 60ft rails there are many thermit welds on the high rail.



Figure 26. Albion. Up Fast looking south. The 60 PSR sign is at 6m 440y.

Total renewal at this location should be before the two sites at Wolverhampton North due to the sharper radius and stress on the fastenings under the high rail. However, as with two Wolverhampton North sites, a detailed investigation should be conducted into the design of the track geometry. Is it optimum for the speed and traffic to maximize life of the high rail? Consideration should also be given to using a head hardened steel in the high rail when it is renewed and a maintenance policy of transposing rails at a defined level of sidewear in the future.

#### Potential for deferral

Management of the sidewear in the next 18 months is essential. Total renewal could be put back towards the end of CP4. A final decision is dependant on the results of the investigation into the optimum track geometry and line speed at this location.

### **Kings Norton**

Kings Norton lies on the Birmingham to Gloucester route. It is also a junction where this route and the Birmingham West Suburban Line meet. Four tracks then continue south west for approximately four miles until Longbridge is reached. The 2009/10 renewal item is on the up fast from 46m 1731y to 47m 1044y. The specification is complete renewal. Line speed is 90 mph, and EGMPA is 20.0.



Figure 27. Kings Norton Up Main looking towards the high mileage (south west)

The track was installed in 1969 with early F27 sleepers. Geometry is straight in the low mileage with a gentle curve to the high mileage. Quality has been held with recent use of a stoneblower. The sleepers are starting to show fine stress cracks and there is a record of over 40 minor rail defects being removed over the last 10 years. The ballast is very poor and water is unable to drain naturally from the ballast/formation interface. Consideration should be given to the design and installation of a drain to the six foot between the up and down main lines.

#### Potential for deferral

None. This item could deteriorate very quickly in the event of a long period of heavy rain.

### **Northfield**

This item is on the same route as Kings Norton above. It is on the up main line and the mileage is from 47m 1220y to 49m 350y. Line speed is 90 mph and the renewal proposed for 2009/10 is the complete section of plain line between Kings Norton Junction and Halesowen Junction. The track was installed in 1969 with F27 early sleepers and 110A rail. It is now maintained by stoneblower due to the poor ballast conditions. The poorest track geometry observed was under the overbridge at 47m 1530y which shows poor and very poor consecutive eighths for 35m top on the NMT outputs. There is some very slight sidewear on the high rail, but this is not the principle driver of the renewal, which is the general poor condition of the track

system and the high number of minor rail defects (approximately 80) removed in the last 10 years.



**Figure 28. Northfield Up Main looking towards Longbridge**

Potential for deferral

None. This item should be renewed after the item at Kings Norton as the ballast conditions at Northfield are not quite as poor.

## 5.4 Scotland

### Symington

The proposal is to totally renew 880 yards of the down main line.



Figure 29. Symington renewal site looking north. Overbridge 359 at 65 miles 59 ch.

The existing track was installed in 1967. It has F23 concrete sleepers; however the rail was renewed in 1987. The geometry is in the good band except for the northern end of the site where it runs into the switches and crossings at the Emergency Ground Frame.

Although the track was in good geometric condition on the day of inspection, it is maintained by stoneblower as the prevailing ballast conditions are poor. The cess drainage did not appear blocked.

The rails had been ground recently and maintenance work had been carried out replacing pads, clips and nylons.

Several of the F23 sleepers were cracked and approximately one in eight had been changed. The annual tonnage is 14 EMGTPA.

A trackbed investigation report has been produced for the renewal and it confirms the poorer ballast conditions north of overbridge 359.

Inclusion in the 2009/10 workbank is supported, however the site could be maintained and renewal deferred up to 20011/12 in order to manage an efficient renewal programme on this route.

### Potential for deferral

Up to two years if this achieves a more efficient delivery programme on this route.

## **Abington**

This is a plain line total renewal on the up fast for 2,350 yards. The line speed is split between a 105 PSR to the north and 120 mph EPS to the south. The track category is 1A and the EGMPA 18.5.



**Figure 30. Abington, looking north**

The existing track was installed in 1965 and rerailed in 1987. Pads and fastenings have been renewed in the last year. The ballast conditions are poor, with many voided sleepers caused by the rails having 'rail memory'. Rail memory is a track phenomenon whereby over time on heavily trafficked routes, the track tends to form a horizontal longitudinal profile to mirror the stiffness of the sub-base. Once this happens the rail head develops a longitudinal profile similar to long wave corrugation. This in turn creates loading and unloading of successive sleepers, particularly if they have a spacing of 24 per 60 feet, the original BR specification for cwr in the 1960s. Evidence of this problem can usually be found where ballast at the sleeper ends vibrates as the sleeper is successively loaded and unloaded and sharp angled stones turn to pebbles, leaving a white dust deposit in the process. Over time the track geometry quality reduces and the long term correct

engineering solution is to renew the whole track system. Track memory is prevented by ensuring at renewal of the ballast that the level of excavation of the old material exactly follows the new design longitudinal profile of the track by the use of beacon lasers.

Track geometry through the renewal is generally in the good band, except for 1340 yards in the middle of the proposal where the 35 metre chord top quality gradually reduces to poor and very poor for 440 yards.

Ballast condition and sleeper age are put forward as the drivers for renewal in the Problem Statement. This is correct, as the sleepers are now over 40 years old and several are cracked and have been changed. Evidence they are near the end of their economic lives. The rail, however, still has 10 years of serviceable life and Network rail should ensure that it is cascaded to a secondary renewal where the specification is suitable.

#### Potential for deferral

Up to two years if this achieves a more efficient delivery programme on this route.

### **Wamphray Junction**

This S&C renewal proposal is for the two back to back crossovers at Wamphray, between Lockerbie and Beattock.



**Figure 31. 2B and 2A points looking north.**

The junction was last renewed in 1970. It is sighted on straight track and is used in emergencies and for engineering work. All the switches and crossings have been renewed in the last eight years, except the trailing switches to 2A points in the down main. Two small isolated instances of RCF were noted. One is on the up cess rail in the check rail area and the other is

in the up six foot rail just beyond the switch tip in the gauge face of the running rail. Both are marked and inspected on a regular basis. The track geometry information shows the plain line either side of the junction to be in the good band. Only one eighth of a mile has poor standard deviations for 35m alignment on the up and that is the eighth that includes both switches. On the down both top and line are on the border between poor and satisfactory for the same eighth.

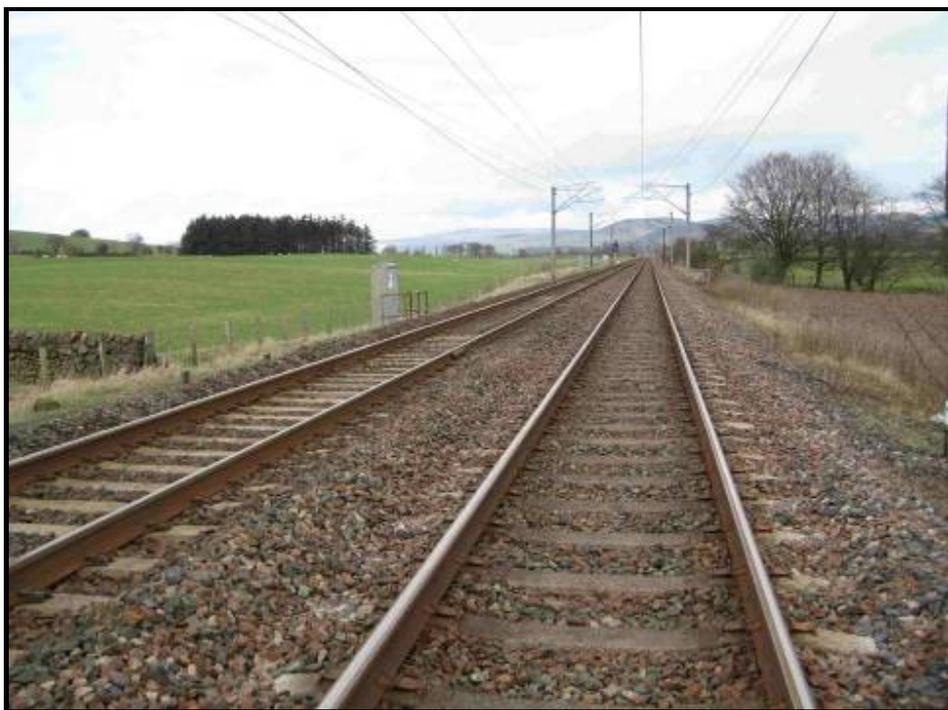
The renewal specification is for a like for like renewal with modern equivalent materials. Network Rail's modelled renewal year for this site in their Business Plan would be 33 years or 2003. However, the overall good condition of this junction at Wamphray, and the fact that so much ironwork has been replaced in the last 8 years, suggests that 2009/10 is a little premature.

#### Potential for deferral

Up to two years if this achieves a more efficient delivery programme on this route.

### **Dalmakethar**

The third plain line renewal item inspected in Scotland is a proposal to totally renew 1,334 yards on the up line between 33miles and 32 miles 426 yards. The existing track was installed in 1965.



**Figure 32. Dalmakethar up line looking north**

The track is early CWR with F19 concrete sleepers and SHC fastenings laid at 700 mm centres (26 per 60 foot) in 1967. The track is straight and the recent records of track quality show all parameters in the good band. Rail age is 1967. The track is on a slight embankment giving good drainage to the cess. This is a stretch of railway appearing to give no undue problems to the

maintenance team. The fastenings are old and may be losing the required tension to hold the rail in hot weather, although no signs of movement were noticed. The nylons and pads had been changed, albeit some time ago. In a less favourable location more signs of distress in the sleepers would be expected.

#### Potential for deferral

Yes. This proposal could be deferred to CP5 based on the condition observed during the inspection. For track of the same age, that which lies in a straight line will generally have a longer service life than that on curves. Good natural drainage also helps promote a longer service life. This site has both.

### **Edinburgh Waverley Station**

The proposal is to totally renew 349 yards through platform 8 in 2010/11.



**Figure 33. Platform 8 (Down Suburban) looking south**

The existing track dates back to 1957 with wood sleepers and mills clips to the east and elastic spikes to the west. Spot maintenance replacements have been made with newer rail and pandrol fastenings. Drainage is ineffective, especially at the ends of the platform. At the west end original drainage seems to have been blocked by recent track renewals and is under investigation. Oil spillage and general detritus is prevalent in the four foot. There are over 20 locations where signal cables cross the track. Maintenance is difficult, and is largely lifting and packing joints, tightening bolts and dealing with water during heavy rainstorms. The area looks very untidy and is not becoming of a modern station in a capital city. Track geometry is not a major issue due to the low speeds. The current specification is for G44 sleepers. Consideration should be given to shallow depth sleepers to reduce track construction depth.

#### Potential for deferral

Up to two years if this achieves a more efficient delivery programme in this difficult area for access. Associated drainage should be included.

### **Portobello**

This is a plain line total renewal on the down East Coast Main Line over 1180 yards between 2m 1242y and 3m 638y (Portobello Jct) with a line speed is 90 mph. Traffic is largely passenger with an EGMTPA of 24.0.



Figure 34. Portobello looking north

The existing track was installed in 1971. At the low mileage end there are some early concrete sleepers with Pan 9 baseplates. These are showing signs of working loose. The remainder is F27 which have been repadded with 7.5 mm pads. The item was originally proposed for renewal in 2007/08 and the new NR60 rails unloaded in preparation. It has now been placed in the 2009/10 programme. The high rail was renewed in 2002 due to RCF. There are isolated top defects visible to the eye which may be due to a need for machine maintenance, especially between 3mp and 3¼mp. The general alignment is good, including through the reverse curve at the low mileage end. Ballast conditions appear good too. This site is considered ideal for ballast cleaning.

#### Potential for deferral

The driver for renewal in 2009/10 is the poor condition of the pan 9 baseplated section. The high mileage end has poor geometry and inclusion as one item is justified on the basis of construction efficiency. It would be beneficial if the 2002 rail could be recovered for re-use.

### **Monktonhall South**

This is a plain line renewal item for 2009/10 on the up East Coast Main Line from just east of Monktonhall Junction (6MP) to 6m 845y, just before overbridge 29. Line speed is 95 mph over the western section between 6mp

and 6m 590y. East of 6m 590y the line speed returns to 125 mph. EMGTPA is 24.5. The eastern end of the site abuts a recent renewal with Cen 60 rail and G44 sleepers. It would appear that when this renewal was undertaken a few years ago, the specification included a geotextile and possibly new drainage to link into the existing. It would now appear to have been an inadequate formation protection layer, as the top through overbridge 29 is very poor.

The renewal proposal has two distinct engineering specifications. The western low mileage section from 6mp to 6m 575y is proposed for total renewal with 300 mm ballast. The outfall from the cess drain that runs from overbridge 29 is at 6m 520y. The eastern section to 6m 845y is proposed for complete renewal with formation treatment. A copy of the Network Rail's Trackbed Investigation report for this item has been reviewed. It is dated 17<sup>th</sup> August 2007. The report contains a trackbed design based on what appears to be a desk top analysis of 20 auger bored samples taken to a depth just exceeding 1 metre below rail level through the site. It specifically states that "no drainage system was encountered. The investigated trackbed material appeared to be free draining".

From the site inspection in June 2008, the recommended specification and extent of the high mileage end of this site is not the correct engineering solution. There is a need for a full and detailed soils investigation of the track bed from 6m 660y to 6m 1100y to be undertaken. Between these limits the report has identified soft homogenous fine soils one metre below rail level with a bearing pressure value lower than 40Kn/m<sup>2</sup>. This further work is likely to result in both a design for a more robust formation protection layer than a geotextile, and associated renewal of the existing cess drainage system, which was observed to have standing water during the visit in June 2008. Furthermore, the extent of the formation work will now extend the site into the new G44 Cen 60 track and through the overbridge.

The drivers for renewal of the track in the lower mileage are more general. The track is 1975 cwr with F27 sleepers. Maximum cant is 150mm and the high rail has slight sidewear. There is evidence of high rail renewal in 1985 and more recently in 2004. Track quality is good once into the plain line and off the S&C.

The recommendation for this proposal is 1) urgently undertake an soils investigation through the old station and overbridge 29 to define the type and extent of formation treatment necessary; 2) carry out this work and the track renewal from 6m 575y to 6m 845y in 2009/10; 3) renew from 6mp to 6m 575y later in CP4.



Figure 35. Monktonhall looking east through the site of the former Inveresk station, showing cess drains and poor top through overbridge 29



Figure 36. Monktonhall looking east, between 6MP and 6¼MP with underbridge 28 in the distance



Figure 37. Inveresk station in 1964. The picture was taken from the down side at a point opposite that for figure 36 above. © J L Stevenson

#### Potential for deferral

This proposal should be split. The track renewal, formation treatment and drainage should be undertaken in 2009/10. The plain line renewal from 6mp to 6m 575y could be carried out later in CP4, especially if this creates the necessary track access to deliver the full and correct engineering specification to the eastern mileage.

### **Penmanshiel**

This is a rerailling proposal for the up East Coast Main Line over 1028 yards from 39m 136y to 39m 1164y. Between Innerwick (34½mp and Berwick upon Tweed (67mp) the East Coast Main Line geography presents gradients and curved alignment such that the maximum line speed varies between 70mph and 90mph. One of the sharpest curves was constructed in 1979 to take the line round the collapsed Penmanshiel tunnel. Here the maximum speed is 70 mph with a series of reverse curves and a maximum track superelevation of 150mm. The present rails were installed in 2002 on F27 sleepers laid in 1975. Up to 25mm surface RCF was also observed on the high rail, despite evidence of rail grinding. Notwithstanding good rail lubrication, sidewear on the high rails has to be measured regularly in order for the maintenance engineers to predict a date and time for rerailling. The evidence from readings taken since the rail was installed new, together with the inspection, confirmed that even with this well maintained track, rerailling of both high and low rails would be necessary in 2009/10.



Figure 38. Penmanshiel up line looking north from 39½ MP. The old tunnel is in the centre of the picture with the 'new' alignment sweeping to the right.



Figures 39 and 40.

The picture on the left (Figure 39) shows sidewear on the high rail and evidence that the foot is pushing outwards, whilst that on the right (Figure 40) shows lipping on the low rail and pressure of the rail foot against the nylon insulators. These site conditions suggest that the superelevation of the track may be optimum for both passenger trains travelling at the maximum permissible speed and freight trains running at a speed which causes proportionally higher vertical forces on the low rail.

#### Potential for deferral

None. Consideration should be given to using harder and therefore longer lasting rail steel in this location.

## 5.5 Western

### Heywood Road Junction

Heywood Road Junction is situated on the main line from Reading to the west of England. It allows trains to by-pass Westbury and continue towards Castle Cary and Exeter. Trains taking the right hand junction when travelling from Reading are able to call at Westbury station. The main line to Taunton has a line speed of 100 mph, whilst the Westbury junction is restricted to 50 mph.



Figure 40. Heyward Road Junction looking towards Westbury from the down side.

The layout proposed for renewal in 2009/10 comprises a main to main crossover and a double junction with switch diamonds designed for 100mph in the normal direction and 50 mph in the reverse. It was installed in 1978 using a vertical 113A design on hardwood timbers.

There are two Temporary Speed Restrictions (TSRs) in force. On the up main the 30/80 TSR applies for the first 5 chains of the 110 PSR as trains traverse the trailing connection of the double junction and the facing connection of the crossover. The reason for the TSR is track geometry. On the down line the 30/80 TSR is in the direction of Taunton which has a line speed of 100 mph. Again, the reason for the TSR is track geometry, although in this case it is not due to condition but design. The down main line to Taunton (known as the Westbury Avoiding line) was originally approved by

the BR civil engineer of the day for 100 mph line speed. An analysis by Network Rail has shown that the maximum permissible speed through the junction in the normal direction should not exceed 80 mph. The general track geometry is not helped by the recently renewed underbridge that carries the railway over the Heyward Road. The track over the bridge deck appears to be high in comparison to the junction to the west and the crossover to the east. There are 16 units of either switches or crossings in the layout. 9 have been changed between 1991 and 2004. The general condition of the hardwood timbers is satisfactory. Several have been replaced. The layout sits on an embankment giving good natural drainage to the ballast. The toe of the up side embankment has been strengthened by the construction of a retaining wall. Similar work is planned for the down side. Lateral restraining plates have been fitted to all switch timbers.

Based on the inspected condition, and with the maximum speed through the junction restricted to 80 mph, renewal in 2009/10 does not appear essential from an engineering perspective. The renewal specification states that the renewal design for trains using the Westbury Avoiders cannot exceed 80 mph and that a Network Change will need to be approved to change the TSR on the down side to a PSR for passenger traffic. This process will take some time to complete and may require Network Rail to do more work to demonstrate that 100 mph is not economically possible within the constraints of the site. From a railway business perspective an early resolution of the PSR question will give clarity over the renewal dates, which will inevitably be driven by track access to do the work.

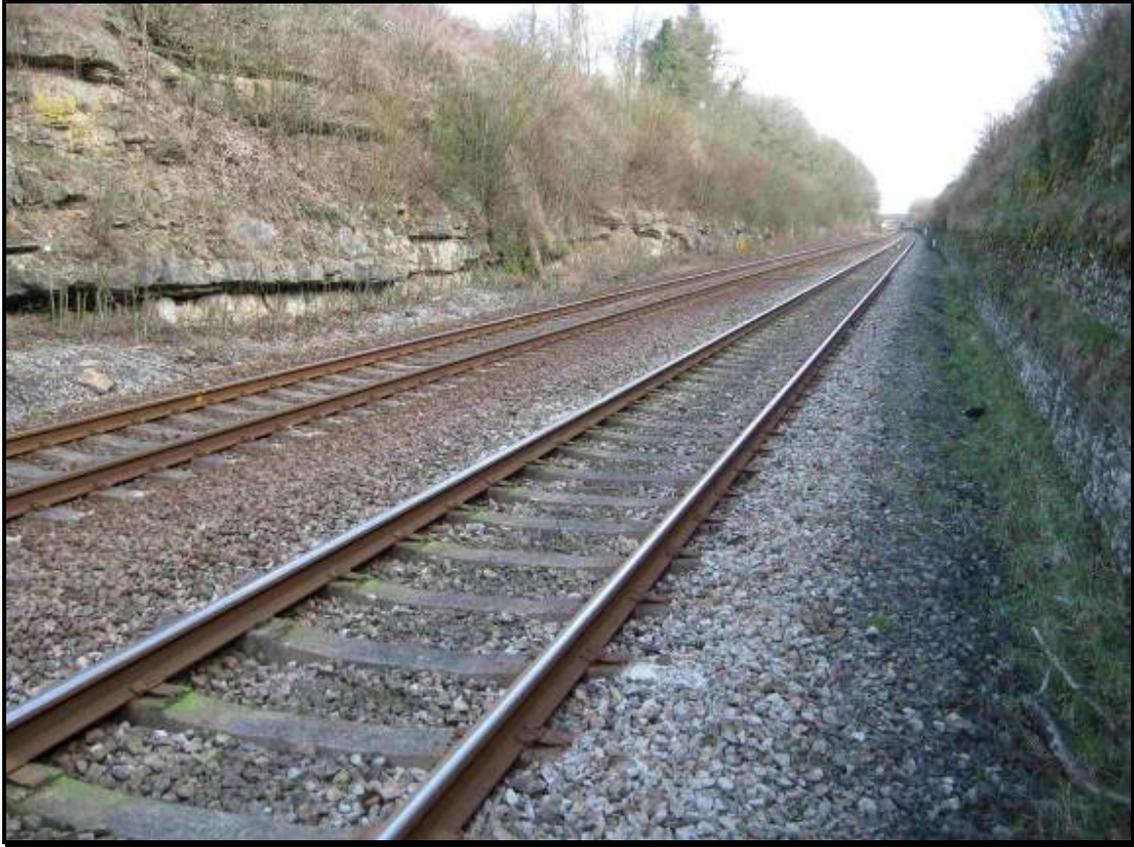
Track category is 1 and the EGMTPA 16.8. Network Rail's modelled life of the layout indicates renewal in 2012.

### Potential for deferral

The junction already has TSRs in place effectively restricting the maximum speeds of all passenger trains to 80 mph. At these speeds the existing layout could be maintained for at least 5 years. The seven original switch and crossing units may need to be changed. What should drive the progression of this renewal is the determination of the Network Change to change the PSR from 100 to 80 mph on the Westbury Avoiding Lines. Should this lead to a deferral some specialist engineering support should be given to improving the geometry of the junction. Good geometry extends component life.

## **Corsham**

Corsham is a small village just to the east of Box Tunnel on the Great Western Main Line (GWML) from London to Bristol. The renewal proposal is a plain line item on the down fast for 683 yards.



**Figure 41. Corsham. Down line looking towards London**

The item is on a straight alignment in a cutting leading up to the east portal of Box Tunnel. Installed in 1966 this early cwr item has F19 sleepers and SHC fastenings. There is a history of rail defects. The ballast is dirty; however, the observed track geometry is good. Water can drain naturally to the cess and there is a drain in the six foot.

The track category is 1 and the EMGTPA 10.5. It is the relatively low annual tonnage and well drained ballast that has contributed to this section of track giving such good service. Now the track is starting to show that age with dipped welds and contaminated ballast. The modeled service life is 35 years for sleepers and 40 years for rail. Both will be exceeded when this item is renewed in 2009/10.

#### Potential for deferral

None. Deferral is not recommended due to the potential weakness in the already dipped SmW welds in 1966 rail which could lead to rail failures. SmW is the trade name of a welding process used by BR from the 1950s. The process relied on the judgment of the welding team to ensure the correct pre heat had been given to the rail ends before the molten Thermit portion was dropped into the mould. In 1974 a new process with fixed pre heat parameters and a larger Thermit portion was introduced. This, the SkV process, produced a more reliable weld and SmW was discontinued. It follows that older cwr from before 1974 has welds that are more prone to failure.

## Defford

The line from Bristol to Birmingham runs north from Cheltenham towards Worcester. The renewal item at Defford was deferred from the 2006 programme and is on the down line and in two sections. The southern section is from 73m 1733 yards to 74 miles 352 yards and the northern section, which includes the river bridge, is from 73m 1045 yards to 73m 1424 yards.



Figure 42. Defford down line renewal site over the river Avon bridge looking south

The section of track between 73m 1733 yards and 74m 352 yards is 1969 rail, F23 sleepers and limestone ballast. At the southern end the line moves into cutting and there is a lineside drain. The drivers for renewal are the dirty limestone ballast and rail which is now prone to defects being 39 years old. The section to the north which includes the hardwood sleepered track over the bridge also moves into cutting at the north end with cess drains. The hardwood sleepers are starting to decay with some showing severe decay. The track is straight over the river bridge and there are no signs of lateral movement at the Pan 11 baseplate seat. As the photograph shows, the geometry is good, although there is some rail memory leading to poor top in places. The current line speed is 100 mph, although there are considerations being given to raise this to 110 mph. Track category is 1 and the EMGTPA figure is 16.4.

## Potential for deferral

Up to two years if this achieves a more efficient delivery programme on this route.

### **Bredon**

Bredon is approximately 3 miles south of Defford. The proposal here is on the up line in a cutting and through an overbridge. The line speed is 100 mph and track category 1. The site for renewal is 594 yards.



**Figure 43. The track proposed for renewal is the farthest from the camera**

The track is 1966 110A cwr on F19 concrete sleepers and SHC fastenings. For some time the track under the overbridge has been giving problems due to severe ballast attrition. The photograph shows dirty ballast heaped on the bank by the bridge abutment. Matters were exacerbated in 2005 when the down line was renewed and the cross drain from the six foot to the down cess damaged. Correct attention to the drainage and formation at this location is essential if value for the renewal in 2009/10 is to be realised.

## Potential for deferral

None. This item should be undertaken in 2009/10 due to the failure of the drainage system and the track formation through the underbridge. From site observation the local maintenance team will be making regular visits to keep this section of the renewal in good condition to prevent a temporary speed restriction before renewal.

## **Defford**

The line from Bristol to Birmingham runs north from Cheltenham towards Worcester. The renewal item at Defford is from 73m 220y to 73m 1034y on the down line, located in a north-south cutting where there is a drainage system in both cesses with an outfall into the river Avon at the high mileage (south) end of the site. The proposal is for a complete renewal of the track system with a formation treatment layer and associated drainage improvements in 2010/11.



**Figures 46 and 47. Defford down line looking north (21) and damaged concrete sleepers from a derailment many years ago (22). The formation problems are in the vicinity of the overbridge.**

The track was installed in 1967 on F23 sleepers. It was rerailed in 1998 and Pan e1809 clips and new 10mm pads fitted. The sleepers are 24 per 60'-0" and have been damaged due to a derailed wheelset being run through the site. Several sleepers have been changed with F27 types and many of the original sleepers are now showing hairline cracks. The ballast conditions are very poor but dry with crushed limestone and fines except through the overbridge and to the north, where the formation has failed and there is water causing slurry and poor to very poor recorded track geometry. In 1998 a renewal was undertaken through the overbridge on the up line. This resulted in the cross drain at the overbridge being damaged. Repairs were ineffective and slowly the system silted up and became blocked. This then has resulted in the formation under the down line to fail causing problems in maintaining acceptable geometry with the risk of temporary speed restrictions in times of heavy rainfall.



**Figure 44. Defford. View of the down line from the up showing evidence of manual repairs to the slurried ballast where the drainage system has broken down.**

The proposed terminating yardage at the south end of the site is 73m 1034y. There is an adjacent renewal on the down line that commences at 73m 1045y that Network Rail plan to renew in 2009/10. In considering risks to the Performance Regime by the imposition of temporary speed restrictions, this item carries a greater risk and should be carried out first. The Network Rail Consultant's Trackbed Investigation and Design report is thorough and its recommendations should be considered as a minimum solution to ensure maximum asset life when the track is renewed. Further survey and design work is required to establish the invert of the new cess drain between 73m 275y and 73m 745y and control measures should be put in place to ensure the new crossfall levels are tied into the drain invert.

#### Potential for deferral

None due to the poor condition of the sleepers and formation failure at the low mileage end of the site. If possible this site should be executed in 2009/10.

## Crawfords

Crawfords down line renewal proposal for 2010/11 is situated just south of Bromsgrove on a right hand curve sandwiched between the down goods and up main in a north south cutting. The line speed is 90mph and the EGMTPA 22.5. There is a ten foot drain which structurally in good condition but is in need of maintenance to clear the clogging of clay fines and become fully functional again.



**Figure 45. Crawfords Down line looking south showing poor top.**

The item is 396 yards long from 56m 1232y to 56m 1628y and the specification is for total renewal with associated formation protection works. The track was installed in 1970 at the south end with F27 sleepers. At the north end a renewal of rail sleepers and ballast was undertaken in 2002, but the required formation protection was not carried out.



Figure 46. Picture 25. Crawfords from the overbridge looking north. Note the new cwr in the foreground and the drainage in the ten foot.

The driver for the renewal as stated in the Problem Statement is formation failure. This is supported from site evidence of the very poor track geometry. A detailed Trackbed Investigation Report is included in the reviewed documentation. This shows that a form of formation protection with an impermeable geotextile had been installed between 56m 1350y and 56m 1584y, however this had been inadequate to prevent the wet and softened fine soils from moving up and around the membrane and coming to within 100mm of the sleeper bottom.

Further site design work is recommended to establish the drain invert and ensure that the ten foot drain is suitable to take water from the top of the new formation protection layer as proposed.

#### Potential for deferral

None. This is another site where poor quality of work undertaken in recent years has resulted in a greater volume of future work than would have been necessary, had the original specification been adhered to. The track installed in 2002 should be reused after the new formation has been installed.

### **Prouts Bridge**

Prouts Bridge is located in a north south cutting between Standish and Gloucester. The renewal proposed is from 99m 220y to 99m770y on the up line for 2010/11. The line speed is 100mph and the EGMPA 12.5.



**Figure 47. Picture 26. Prouts Bridge up line from 99m 580y towards 99m 220y showing poor top and evidence of manual removal of slurried ballast.**

The up line was installed in 1968 and is 110A cwr on F23 sleepers laid at 26 per 60'-0". The limestone ballast is crushed and dirty. The drainage system comprises two independent six foot drains. As the six foot is wide it is questionable how effective they would be if they were free flowing to drain both tracks. The track geometry is particularly poor between 99m 220y and 99m 500y. Geometry maintenance is by stoneblower. There are two drains in the wide six foot, one from 99m 220y to 99m 407y and the other from 99m 495y to 99m 770y. They are in poor condition with standing water and it is surprising that they are not connected. The trial hole data in the Trackbed Investigation Report shows standing water and slurry at 99m 550y, with the remaining holes confirming crushed and fouled limestone ballast.

The specification is for a renewal of the track system and formation together with new drainage to connect the two six foot independent systems. It is recommended that a further survey be undertaken to ensure that the formation ballast interface will hydraulically interface with the existing and new drain inverts.

#### Potential for deferral

None. This site will have deteriorated further by March 2011.

## Berkley Road Up and Down

Berkley Road Junction at 107m 1540y is where the single line to Sharpness leaves the main Gloucester to Bristol line. The renewal proposals for 2010/11 are on the up and down lines. Due to common problems with drainage and formation failures they are reviewed together. The line speed is 100mph and EMGTPA 10.0 on each line.



**Figure 48. Both tracks are proposed for renewal. The up line is in the foreground. Note the evidence of manual treatment to the slurried ballast on the down.**

The up track is 1964 110a cwr on F19 sleepers at 26 per 60'-0" with SHC fastenings. Ballast is limestone and granite which is now contaminated with fines and soft silt where the formation has softened and penetrated into the upper ballast layer. The site was ballast cleaned in 1997, however poor and very poor geometry exists over the 440y between the S&C and 107m 1100y due to the poor drainage and soft subsoils. The specification is for new Cen 60 rail, G44 sleepers and 300mm ballast overlying a new formation protection layer with associated new drains to the up cess from 107m 1419y to 107m1210y. The renewal high mileage end abuts existing new G44 plain line track installed when the S&C at Berkley Road Junction was renewed.

The down line is 1989 113A cwr on F27 sleepers. Track components are in good condition. The driver for renewal is the very poor and wet ballast conditions and ineffective cess drainage. The specification is for a complete renewal of the track system with a formation protection layer. No requirement for new drains is stated. This must be questioned. Unless the drainage system in the down cess can be cleaned and proven to be working before the track renewal work commences, provision for a new down cess drain tied into the design levels of the formation protection layer should be made.



Figure 49. The up line looking away from Berkley Road Junction.

#### Potential for deferral

None. These items should, if at all possible, be designed, planned and executed together as one renewal of the whole track system including drainage and formation protection.

## **6. ACKNOWLEDGMENTS**

This report was compiled with the help and support of Network Rail's Track Engineering and Maintenance functions. In particular, thanks are due to the five Territory Track Renewals Engineers.