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Sewta Rail Strategy Update 2013

Appraisal of Extension of Bedlinog Line to Dowlais Top

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Contents

1 Introduction

1.1 Background

The SEWTA Rail Strategy 2013 proposes extending the passenger rail network to Bedlinog via Nelson and Trelewis along the existing freight line from Ystrad Mynach to Cwmbargoed. Merthyr Tydfil Council and Caerphilly Council commissioned this study to examine the practicality / cost and business case implications of extending the proposed service further north to Dowlais Top to the northeast of Merthyr Tydfil. The line is shown in Figure 1 below.

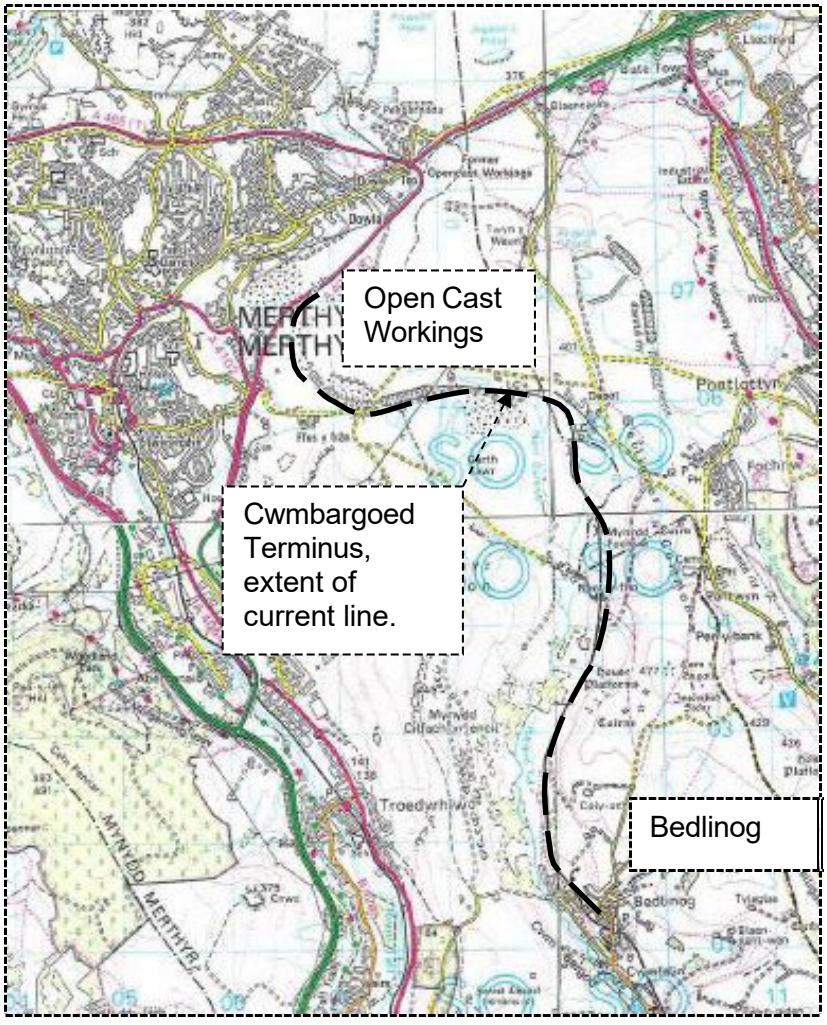


Figure 1 Study Area Issues

The study is required to inform the Merthyr Tydfil Local Development Plan and the issue of retention of the former railway on embankment through the open cast site between Dowlais and Cwmbargoed. There are few residents and business in vicinity of the rail line north of Bedlinog, until it reaches the northern terminus at Dowlais Business Park. A new station there would provide an alternative to the existing services to / from Methyr Tydfil Station (to the west). The existing half hourly service runs to Cardiff via Pontypridd. The proposed new service would run to Cardiff via Ystrad Mynach and Caerphilly, offering alternative journey opportunities.

1.2 Study Requirements

Our approach is consistent with the approach adopted in the previous SEWTA Rail Strategy studies. In particular; undertaking a pre-feasibility assessment of the scheme practicality and costs; forecasting of passenger demands and benefits and; appraisal of the business case. The study has involved specialists in railway design, operations and scheme appraisals.

The study was required to compare the business case with and without further extension of passenger services to Dowlais Top and to provide a report highlighting the key issues and results to inform decision making by the local authorities. The demand forecasts needed to take into account the overlapping catchment areas in Merthyr Tydfil and potential abstraction. The operations assessment needed to make journey time assumptions and identify the requirements for both passenger and freight services and signalling / track requirements. The physical assessment needed to look at the practicality and costs of the line upgrade to passenger use.

A key requirement was the assumption that the passenger services would be operating with the freight services still operating between the Cwmbargoed facility and Aberthaw power station.

1.3 Report Structure

Following this introduction, Section 2 presents the operations assessment and operating costs, Section 3 presents the physical assessment and capital costs, Section 4 presents the demand and revenue forecasts and Section 5 presents the forecast benefits and scheme options appraisal. Section 6 presents the conclusions and recommendations.

2 Operations Assessment

2.1 Introduction

The operations assessment has involved specification of assumptions regarding new stations, line speeds, signalling and infrastructure and section running times for passenger and freight services. Timetable options for one and two trains per hour options have been developed and the Sewta operating cost model applied.

2.2 Assumptions

2.2.1 Stations

Table 2-A shows the new stations that are assumed to be constructed and distance from Ystrad Mynach South Junction. It is assumed that each platform would be of sufficient length for a 4-car train.

Station	Miles (from Ystrad Mynach South Junction)	Description
Ystrad Mynach	0.26	Single platform on the east side connected to the existing platforms by extension of the existing footbridge. PRM-TSI access required into existing car park.
Nelson & Llancaiach	2.44	Single platform on the west side.
Trelewis	3.53	Single platform on the west side.
Bedlinog	6.02	Two side platforms located on passing loop. Access to and between platforms via existing road over-bridge.
Dowlais	11.00 (approx..)	Single platform.

Table 2-A Station Location Assumptions

2.2.2 Line speed

The existing route between Ystrad Mynach South Junction and Cwmbargoed has a maximum speed limit of 20mph throughout. However, from a number of line-side observations the track formation would appear to be in good condition being formed of continuously welded rails laid on concrete sleepers. We believe therefore that the speed limit is maintained at 20mph in order to minimise maintenance expenditure rather than due to the curvature and gradients.

In developing timetables, a line-speed of 20mph would result in very unattractive running times for passenger services. We have therefore made the cautious assumption that the line-speed will be able to be raised to at least 40mph throughout for passenger trains. We also assume that the extension from Cwmbargoed to Dowlais would be limited to 40mph. We have assumed that, to minimise maintenance costs, freight trains would continue to be limited to 20mph.

We also assume that, if the route from Ystrad Mynach South Junction to Dowlais is not electrified, Class 150 diesel trains would be used.

2.2.3 Signalling and Infrastructure

The existing railway between Ystrad Mynach has recently (Sep 2013) been re-signalled and signalling control transferred to the Wales signalling centre at Cardiff. Full signalling and train detection has now been provided on the Cwmbargoed branch which is signalled as one section from Ystrad Mynach to Cwmbargoed. It remains possible for more than one train to be at Cwmbargoed at the same time as a second train can leave Ystrad Mynach once the first has arrived in the loop at Cwmbargoed. Similarly, two successive trains can run in the opposite direction.

In our timetable options we identify what enhancements to signalling and railway infrastructure will be required to deliver that option.

2.2.4 Sectional Running Times - Passenger

We have calculated Sectional Running Times (SRTs) for the new passenger train service based on the inter-station distance, a 40mph line-speed, the gradients and timings from comparator sections of railway having similar physical and operational characteristics.

2.2.5 Sectional Running Times - Freight

We have assumed that there will be a continued requirement for daytime freight paths on the route for continued coal extraction from Cwmbargoed. The current (May 2013) Working Timetable shows six weekday freight paths in each direction over the route, of which four northbound and five southbound operate during passenger service hours (shown in bold in the Table 2-B):

Cardiff Central	*03:33*	***07:01***	***11:04***	***15:04***	***20:55***	*23:50*
Allowances	(1)	(1)	(2)	(3)	(1)	(1)
Cardiff Queen Street	*03:37*	***07:05***	***11:09***	***15:10***	***20:59***	*23:54*
Allowances	(1)	(1)		(1)	(1)	
Heath Jn	*03:42*	***07:10***	***11:13***	***15:15***	***21:04***	*23:59*
Allowances			(1)	(1)		
Caerphilly	*03:52*	***07:20***	***11:24***	***15:26***	***21:14***	*00:09*
Allowances	(2)	(2)		(2)	(5)	(2)
Ystrad Mynach South	04:04	**07:32**	11:34	15:38	21:29	00:21
	04:06	**07:34**	11:36	15:40	21:31	00:23
Cwmbargoed	04:38	**08:06**	**12:08**	**16:12**	**22:03**	00:55
Cwmbargoed	02:31	**05:23**	**10:00**	**14:00**	**17:47**	**20:29**
Ystrad Mynach South	03:21	**06:13**	**10:50**	**14:50**	**18:37**	**21:19**
	03:23	**06:15**	**10:52**	**14:52**	**19:08**	**21:22**
Caerphilly	*03:32*	***06:24***	***11:01***	***15:01***	***19:17***	***21:31***
Allowances	[1]	[1]		[1]	[1](2)	(3)
Heath Jn	*03:43*	***06:35***	***11:11***	***15:12***	***19:30***	***21:44***
Allowances					(5)	[1](6)
Cardiff Queen Street	*03:48*	***06:40***	***11:16***	***15:17***	***19:40***	***21:56***
Allowances		(1)				
Cardiff Central	*03:51*	***06:44***	***11:19***	***15:20***	***19:45***	***21:59***

Table 2-B Existing Freight Paths

The current timings include a stopping allowance at Ystrad Mynach South Junction to collect and deliver the single line token. Now that the resignalling has taken place this allowance is no longer required.

There is an obvious anomaly in the timings in that 32 minutes is required northbound (uphill) from Ystrad Mynach to Cwmbargoed whereas in the opposite downhill direction 50 minutes has been allowed. There is no obvious reason why downhill should be slower. At a maximum speed of 20mph, for a distance of 9 miles and allowing for the gradients, 32 minutes would appear to be appropriate in both directions and we have used that as our freight timing assumption.

Paths are spread through the day such that they are approximately 4 hours apart. In designing passenger timetables we have ensured that as a minimum it would be possible to provide daytime freight paths at least at 4 hourly intervals.

With a passenger service in operation on the route it will be essential that the freight trains are presented at Ystrad Mynach at the correct time. Too early or too late and the train will have to wait for its path, potentially delaying a following Rhymney line train. It is therefore essential that a recessing facility is provided to cater for this eventuality as currently there are no such facilities available north of Cardiff. At Ystrad Mynach there was formerly a northbound goods loop which will need to be restored to use for holding trains as required.

2.3 Timetable Options

We have developed four timetable options:

1. 1tph Ystrad Mynach – Dowlais
2. 1tph Caerphilly – Dowlais
3. 1tph Cardiff Bay – Dowlais
4. 2tph Caerphilly – Dowlais

We estimate that the running time over the single line from Ystrad Mynach South Junction to Dowlais will be 24 minutes northbound and 25 minutes southbound. Therefore there would be sufficient time for an hourly passenger service to operate without the need for any additional infrastructure. The requirement to provide freight paths, however, means that additional infrastructure will be needed to allow the freight trains to pass passenger trains.

The ideal location for a passing loop would be towards the middle of the line and if it was placed at Bedlinog it would also be suitable for a future 2tph passenger service when coal extraction has been completed and freight capacity is no longer required.

The diagrams showing the additional / changed infrastructure to deliver the passenger services along with freight capacity are shown in Appendix A.

Table 2-C summarises the additional / changed infrastructure required.

Item	Description
Extension of the Line from Cwmbargoed to Dowlais	Single line from a new junction to the east of the existing connections at Cwmbargoed along with attendant new and modified signalling.
Freight passing loop at Bedlinog	775m loop to enable a freight train to pass a passenger train. Freight loop to be reversibly signalled. Signalling also effectively divides the Ystrad Mynach to Cwmbargoed section.
Ystrad Mynach Up Goods Loop	Former loop restored to use and appropriate signalling provided.

Table 2-C Outline of Infrastructure Requirements

The developed timetables are shown for standard hours which we assume would operate throughout the day.

2.3.1 One Train Per Hour Timetable Options

(a) Option 1 – 1tph Ystrad Mynach – Dowlais

Table 2-D shows the timetable for an hourly passenger service between Ystrad Mynach and Dowlais with one train being required. At Ystrad Mynach, the gradient is too steep (1:100 falling towards main line) for a train to terminate. It would, however, be possible for the empty train to run forwards into the Down Goods Loop where the line is relatively level where the driver would be able to change ends.

Up		Miles	Miles Cum	Pass 1	Freight	Pass 1
Ystrad Mynach Down Goods Loop	dep			09:53		10:53
Ystrad Mynach South Jn		0.00	0.00	*09:54*	*10:10*	*10:54*
Ystrad Mynach	*dep*	0.25	0.25	09:55		10:55
Nelson & Llancaiach	dep	2.25	2.25	10:00	*10:18*	11:00
Trelewis	dep	1.00	3.25	10:02	*10:22*	11:02
Bedlinog	arr	2.50	5.75	10:07	10:32	11:07
Bedlinog	dep			10X07	10X38	11:07
Cwmbargoed LC		3.25	9.00	*10:14*	*10:51*	*11:14*
Cwmbargoed Loop	arr				10:52	
Dowlais Top	arr	2.00	11.00	10:18		11:18
Down		Miles	Miles Cum	Pass 1	Pass 1	Freight
Dowlais Top	dep	0.00	0.00	10:23	11:23	
Cwmbargoed Loop	dep					11:49
Cwmbargoed LC		2.00	2.00	10:28	11:28	*11:50*
Bedlinog	arr	3.25	5.25	10X35	11:35	12:04
Bedlinog	dep			10:35	11:35	12X10
Trelewis	dep	2.50	7.75	10:40	11:40	*12:20*
Nelson & Llancaiach	dep	1.00	8.75	10:42	11:42	*12:24*
Ystrad Mynach	dep	2.00	10.75	10:47	11:47	
Ystrad Mynach South Jn		0.25	11.00	*10:48*	*11:48*	*12:29*
Ystrad Mynach Down Goods Loop	arr			10:49	11:49	

Table 2-D Timetable Option – Hourly Ystrad Mynach - Dowlais

The freight paths shown are available in alternate hours in each direction. i.e. there is a freight path available every hour in one direction or the other but not both.

(b) Option 2 – 1tph Caerphilly – Ystrad Mynach

Table 2-E shows the timetable for the extension of an hourly passenger service from Ystrad Mynach to Caerphilly. The additional running time means that a second train is required and the turnrounds at Caerphilly would be unduly long. Caerphilly is not an ideal location for trains to turnround from the north as there are no holding facilities and a shunt is required to access the northbound platform.

Up		Miles	Miles Cum	Pass 1	Freight	Pass 2
Caerphilly	dep			09:43	*10:01*	10:43
Aber	dep			09:45		10:45
Llanbradach	dep			09:49		10:49
Ystrad Mynach South Jn		0.00	0.00	*09X53*	*10:11*	*10X53*
Ystrad Mynach	*dep*	0.25	0.25	09:54		10:54
Nelson & Llancaiach	dep	2.00	2.25	09:59	*10:19*	10:59
Trelewis	dep	1.00	3.25	10:01	*10:23*	11:01
Bedlinog	arr	2.50	5.75	10:06	10:33	11:06
Bedlinog	dep			10X06	10X40	11:06
Cwmbargoed LC		3.25	9.00	*10:13*	*10:53*	*11:13*
Cwmbargoed Loop	arr				10:54	
Dowlais Top	arr	2.00	11.00	10:17		11:17
Down		Miles	Miles Cum	Pass 1	2	Pass 2
Dowlais Top	dep	0.00	0.00	10:24	11:24	
Cwmbargoed Loop	dep					11:46
Cwmbargoed LC		2.00	2.00	10:29	11:29	*11:47*
Bedlinog	arr	3.25	5.25	10X36	11:36	12:01
Bedlinog	dep			10:36	11:36	12X09
Trelewis	dep	2.50	7.75	10:41	11:41	*12:19*
Nelson & Llancaiach	dep	1.00	8.75	10:43	11:43	*12:23*
Ystrad Mynach	dep	2.00	10.75	10:48	11:48	
Ystrad Mynach South Jn		0.25	11.00	*10X49*	*11X49*	*12:28*
Llanbradach	dep			10:53	11:53	
Aber	dep			10:58	11:58	
Caerphilly	arr			10:59	11:59	*12:38*

Table 2-E Timetable Option Hourly Caerphilly - Dowlais

As in Option 1, the freight paths shown are available in alternate hours in each direction. i.e. there is a freight path available every hour in one direction or the other but not both.

(c) Option 3 – 1tph Cardiff Bay – Dowlais

With two trains in service there is sufficient time to run through to Cardiff as shown in the timetable in Table 2-F. We have assumed that trains terminate at Cardiff Bay as this is a convenient location operationally.

Up		Miles	Miles Cum	Pass 1	Freight	Pass 2
Cardiff Bay	dep			09:23		10:23
Cardiff Queen Street	dep			09:27		10:27
Heath Jn				*09:30*		*10:30*
Heath High Level	dep			09:32		10:32
Llanishen	dep			09:35		10:35
Lisvane & Thornhill	dep			09:37		10:37
Caerphilly	dep			09:43	*10:01*	10:43
Aber	dep			09:45		10:45
Llanbradach	dep			09:49		10:49
Ystrad Mynach South Jn		0.00	0.00	*09X53*	*10:11*	*10X53*
Ystrad Mynach	*dep*	0.25	0.25	09:54		10:54
Nelson & Llancaiach	dep	2.00	2.25	09:59	*10:19*	10:59
Trelewis	dep	1.00	3.25	10:01	*10:23*	11:01
Bedlinog	arr	2.50	5.75	10:06	10:33	11:06
Bedlinog	dep			10X06	10X40	11:06
Cwmbargoed LC		3.25	9.00	*10:13*	*10:53*	*11:13*
Cwmbargoed Loop	arr				10:54	
Dowlais Top	arr	2.00	11.00	10:17		11:17

Down		Miles	Miles Cum	Pass 1	2	Pass 2
Dowlais Top	dep	0.00	0.00	10:24	11:24	
Cwmbargoed Loop	dep					11:46
Cwmbargoed LC		2.00	2.00	10:29	11:29	*11:47*
Bedlinog	arr	3.25	5.25	10X36	11:36	12:01
Bedlinog	dep			10:36	11:36	12X09
Trelewis	dep	2.50	7.75	10:41	11:41	*12:19*
Nelson & Llancaiach	dep	1.00	8.75	10:43	11:43	*12:23*
Ystrad Mynach	dep	2.00	10.75	10:48	11:48	
Ystrad Mynach South Jn		0.25	11.00	*10X49*	*11X49*	*12:28*
Llanbradach	dep			10:53	11:53	
Aber	dep			10:58	11:58	
Caerphilly	arr			10:59	11:59	*12:38*
Lisvane & Thornhill	arr			11:03	12:03	
Llanishen	arr			11:05	12:05	
Heath High Level	arr			11:08	12:08	
Heath Jn	arr			*11:10*	*12:10*	
Cardiff Queen Street	arr			11:13	12:13	
Cardiff Bay	arr			11:17	12:17	

Table 2-F Timetable Option Hourly Cardiff Bay – Dowlais

2.3.2 Two Trains Per Hour Timetable Option

We have assumed that 2tph would not be in operation until the end of freight operations. The passing loop at Bedlinog would then be used to pass the half hourly passenger services. An additional platform would now be needed at Bedlinog on the former freight loop.

The additional time required for the trains to pass at Bedlinog means that there would be insufficient time for trains to turn round at Ystrad Mynach. Similarly there would be insufficient time to extend trains from Caerphilly to Cardiff unless they were linked with another diesel service.

(a) Option 4 – 2tph Caerphilly – Dowlais

Three trains would be required in service to operate a half-hourly service between Caerphilly and Dowlais. Turnrounds at Caerphilly would be shorter and potentially deliverable albeit with a shunt required.

Up		Miles	Miles Cum	Pass 1	Pass 2	Pass 3	Pass 1
Caerphilly	dep			09:43	10:13	10:43	11:13
Aber	dep			09:45	10:15	10:45	11:15
Llanbradach	dep			09:49	10:19	10:49	11:19
Ystrad Mynach South Jn		0.00	0.00	*09X53*	*10X23*	*10X53*	*11X53*
Ystrad Mynach	*dep*	0.25	0.25	09:54	10:24	10:54	11:24
Nelson & Llancaiach	dep	2.25	2.25	09:59	10:29	10:59	11:29
Trelewis	dep	1.00	3.25	10:01	*10:31*	11:01	11:31
Bedlinog	arr	2.50	5.75	10:06	10:36	11:06	11:36
Bedlinog	dep			10X06	10X36	11X06	11X36
Cwmbargoed LC		3.25	9.00	*10:13*	*10:43*	*11:13*	11:43
Cwmbargoed Loop	arr						
Dowlais Top	arr	2.00	11.00	10:17	10:47	11:17	11:47
Down		Miles	Miles Cum	Pass 1	Pass 2	Pass 3	Pass 1
Dowlais Top	dep	0.00	0.00	10:23	10:53	11:23	11:53
Cwmbargoed Loop	dep						
Cwmbargoed LC		2.00	2.00	10:28	10:58	11:28	11:58
Bedlinog	arr	3.25	5.25	10X35	11X05	11X35	12X05
Bedlinog	dep			10:37	11:07	11:37	12:07
Trelewis	dep	2.50	7.75	10:42	11:12	11:42	12:12
Nelson & Llancaiach	dep	1.00	8.75	10:44	11:14	11:44	12:14
Ystrad Mynach	dep	2.00	10.75	10:49	11:19	11:49	12:19
Ystrad Mynach South Jn		0.25	11.00	*10X50*	*11X20*	*11X50*	*12X20*
Llanbradach	dep			10:54	11:24	11:54	12:24
Aber	dep			10:59	11:29	11:59	12:29
Caerphilly	arr			11:00	11:30	12:00	12:30

Table 2-G Timetable Option Half Hourly Caerphilly – Dowlais

2.4 Operating Costs

The timetable and additional route mileage information was entered into the Sewta Operating Cost Model and run for diesel and electric rolling stock options. The results are shown in Table 2-H assuming extension of the peak services from Caerphilly and operation through to Cardiff Bay in the Interpeak. Operating beyond Bedlinog to Dowlais adds around 40% to the operating costs and operation with electric rolling stock saves around 6% of the annual operating costs.

Option	Annual Operating Cost Hourly	Annual Operating Cost Half Hourly
Caerphilly / Cardiff – Bedlinog (Diesel)	£1,543k	£2,777k
Caerphilly / Cardiff – Bedlinog (Electric)	£1,448k	£2,600k
Caerphilly / Cardiff – Dowlais (Diesel)	£2,144k	£3,958k
Caerphilly / Cardiff – Dowlais (Electric)	£2,030k	£3,748k

Table 2-H Operating Costs for the Alternative Options

3 Engineering Assessment

3.1 Background

The line between Ystrad Mynach South Junction and Dowlais (Cae Harris) was opened in two stages; the section between Ystrad Mynach and Nelson & Llancaiach in 1871 and; the remainder to Dowlais in 1876. There were intermediate stations at Nelson & Llancaiach, Trelewis Platform, Bedlinog and Cwmbargoed. The line was constructed as double track although a section north of Trelewis was reduced to a single line between 1952 and 1957 due to ground movement. After withdrawal of passenger services, the line was singled throughout and cut back to a coal loading point at Cwmbargoed.

Passenger services operated generally as a shuttle either between Ystrad Mynach or Hengoed (High Level) and Dowlais. Services were withdrawn on 15th June 1964.

The current working timetable shows six weekday freight train paths in each direction over the route per day.

Previous studies were undertaken on this route by Jacobs in 2005 and 2011. This envisaged that passenger services would be reinstated only as far as Bedlinog.

The current proposal is to extend the line beyond Cwmbargoed to a new station on the eastern edge at Dowlais near the A4067 and a proposed development site.

Service options to be considered are hourly and half hourly and the options need to make provision for the existing freight paths.

3.2 Existing infrastructure

This description is based on site visits to locations accessible to the public in July and August 2005, March 2011 and October 2013 together with information available from published sources. It should be noted that since the previous reports more information on the route has become available and this is reflected in this report.

3.2.1 Generally

The total length of the line from Ystrad Mynach South Junction to the end of the line at Cwmbargoed is 9m 74c. Former station sites were Ystrad Mynach (0m.20c[1].), Nelson & Llancaiach (2m.43c.), Trelewis Platform (3m. 38c.) and Bedlinog (6m. 14c). Beyond Cwmbargoed there is little remaining of the former alignment due to tip regrading and road improvements that have been made since closure.

The line is characterised by its gradients, including 1 in 145 (6.9 mm/m) through the site of Ystrad Mynach station, 1 in 220 (4.5 mm/m) at Nelson and approximately 7 miles thereafter at gradients between 1 in 40 (25 mm/m) and 1 in 44 (23.8 mm/m) to Cwmbargoed. The summit at Cwmbargoed is claimed to be the highest in South Wales at approximately 1250’ (381m) above sea level.

[1] Distances are quoted in miles and chains in this section –a chain is 1/80th of a mile.

3.2.2 Permanent Way

From the observations the track comprises BS 113A rail on concrete, timber or steel sleepers, the ballast is clean with no evidence of formation failure or general drainage problems.

3.2.3 Signalling

The branch has recently been resignalled with control transferred to the Wales signalling centre at Cardiff. The line between Ystrad Mynach and Cwmbargoed has been signalled as one section with full signalling and train detection. However it should be noted that the signalling cables have simply been laid on the formation rather than in concrete troughs.

3.2.4 Structures

These have not been considered at this stage since the route is maintained for heavy freight traffic and is categorised as RA8[2] by Network Rail. Any works to structures will be consequent on other works.

3.2.5 Station sites

At Ystrad Mynach separate platforms were provided for the branch on the west side of the Rhymney Line platforms on a gradient of 1 in 145 (6.9 mm/m). The land occupied by the former platforms remains within the Network Rail boundary.

At Nelson & Llancaiach the former station site appeared to be under development at the time of the most recent visit in October 2013 with hoardings surrounding the area on the Up side.

At Trelewis Platform the halt was located between Field Street and the over-bridge at the north end on the almost continuous 1 in 42 (23.8 mm/m) gradient that extends from Nelson & Llancaiach to Cwmbargoed. Access to the halt was by inclined footpaths from the bridge approaches.

At Bedlinog the site occupies a ledge approximately halfway up the town and is used currently by a local coach operator as his yard. Access to the Up side of the site is directly from the principle road through the town (B 4255). Access to the former Down platform was via a concrete staircase from road level. Although the site is relatively central, it should be noted that the main road has a maximum gradient of 14% with numerous bends.

3.2.6 Scope of works

The scope of the works for the one passenger train per hour option comprises:

- *The construction of a new section of railway between the end of the existing line at Cwmbargoed and Dowlais (Ffos – y – Fran);*
- *A bi-directional freight loop at Bedlinog;*
- *An Up loop at Ystrad Mynach south of the junction;*
- *Additional signalling associated with the two loops and the connection at Cwmbargoed;*

[2] Freight Gauge / Weight Standard.

- *Upgrading the existing permanent way to allow an increase in the line speed for passenger trains, and;*
- *Provision of new single platform stations with associated works, e.g. car parks, at Dowlais (Ffos – y – Fran), Bedlinog, Trelewis, Nelson & Llancaiach and Ystrad Mynach (TBD).*

The additional scope of the works for the two passenger trains per hour option comprises:

- *Provision of a second (Down) line between Cwmbargoed and south of Trelewis instead of the Bedlinog freight loop, and;*
- *Platforms on both tracks at Bedlinog and Trelewis*

3.3 Cwmbargoed - Dowlais

3.3.1 Alignment

As noted earlier, the original alignment between Cwmbargoed and Dowlais has been lost due to regrading and road improvements. A new alignment has been proposed by Merthyr Tydfil County Borough Council utilising, in part, a temporary haul road, constructed for the open cast mining, to a station site adjacent to the A4060 road on the eastern edge of Dowlais.

At Cwmbargoed it has been assumed that the connection between the existing freight line and the extension to Dowlais would be located on the Cardiff side of the loading point sidings to allow freight operations to continue clear of the passenger line.

Key considerations on the new section of line will be the gradient and curvature since Dowlais is located at a lower level than Cwmbargoed.

Railway Group Standard GC/RT5021 - Track System Requirements – specifies a normal limiting value for track gradient on running lines of 1 in 80 (12.5 mm/m). There are exceptional limiting design values of 1 in 50 (20mm/m) and 1 in 28.6 (35 mm/m). However, the design gradients are required to take into account the following factors:

a) Braking and traction performance of operational and maintenance vehicles likely to use the line.

b) Position of signals and operational regime e.g. requirement to stop and start on the gradient.

c) Projected rail adhesion conditions, including the effect of the weather.

d) The combined effect of gradient and horizontal curvature where the gradient coincides with a small radius horizontal curve.

In the absence of detailed survey data, spot levels on the Merthyr Tydfil CBC drawing have been used in conjunction with an assessment of length of the extension. The levels are 382.8m at Cwmbargoed and 330.1m adjacent to the proposed station site. The distance from the start of the gradient to the proposed station site has been assessed as 2,716m from the drawing. This gives an average gradient of 1 in 51.5 (19.4 mm/m). This makes no allowance for vertical transitions or a level section through the platform

With regard to the horizontal alignment, the Merthyr Tydfil CBC drawing shows a reverse curve of approximately 300m radius excluding transitions.

Considering the factors above, it is recommended that the maximum gradient should not exceed 1 in 50 (20 mm/m) and a level section of a nominal 300m length should be provided on the approach to the platform. This could be achieved by locating the proposed station further to the northeast to lengthen the line and take advantage of the rising ground levels.

For the indicative estimate, the length of new single track railway, clear of the freight terminal connections has been assessed at 3,500m. It is also assumed that all earthworks and any ground stabilisation will be undertaken as part of the land reclamation and remediation works.

3.3.2 Bogey Road Bridge

This bridge was built in the period 2007 to 2009 to allow the construction of a new haul route beneath. The bridge comprises 4 welded steel plate girders with an in-situ composite concrete deck on concrete bank seats. The clear span at bearing level is 53m and the width at haul route level is 29m. The headroom to the haul route varies between 10 and 12.5m. The width of the carriageway is 6m with a 2m footway.

It is proposed that the new railway alignment will pass beneath the bridge when the haul road is no longer required.

For electrification the bridge would require a preferred minimum headroom of 5.1m between top of rail and soffit together with a clear width of 7.5m. Currently the bridge meets these requirements but the headroom needs to be checked against the vertical alignment of the proposed new railway.

Based on an average gradient of 1 in 51.5, the formation level at Bogey Road bridge would be 357m. From the drawing this would require a further excavation of 11m. If the side slopes of the excavation are maintained at the same batter, the width at formation level would be 9m. (Using the flatter average gradient of 1 in 76, the formation level would be 365.5m, requiring further excavation of 3.3m. The formation width would become 21.5m.)

From the drawing, the structure appears fit for purpose although it will be necessary to establish design criteria including design loading capacity and life. The long term stability of the substructure will need to be considered against the properties of supporting rock.

Assuming that it will be necessary to reduce the levels under the bridge, the stability of the slopes will assume even greater importance.

3.3.3 Dowlais Station

The location of the new station has not been defined but it is assumed that it will comprise a single platform with a nominal length of 100m (four-car), waiting shelters, lighting, ticket issuing machines, help point and train information systems. It is assumed that the station will not be manned. Car parking can be provided depending on the final site location and the Client's requirements.

3.4 Ystrad Mynach - Cwmbargoed: One passenger train per hour

3.4.1 Permanent Way

It is assumed that no significant renewals will be required and works will be required to increase the maximum permitted line speed from the current 20 mph to 40 mph. This will possibly require realignment and recanting of curves within the existing boundaries. The existing 15 mph speed restriction at Ystrad Mynach South Junction will have minimal effect on running times due to its proximity to the station. Consequently, no renewals or remodelling of the junction have been included in this proposal although improvements should be considered when the junction is renewed in the future.

3.4.2 Loops

Two freight loops are proposed, a bi-directional loop at Bedlinog on the former Down line formation and the reinstatement of the Up loop south of Ystrad Mynach. At this stage it is assumed that the loops will be 775m long.

Both loops will need to comply with current standards in respect of lateral clearances which could require additional earthworks and realignment of the existing track at Bedlinog.

3.4.3 Signalling

The branch has recently been resignalled with control transferred to the Wales signalling centre at Cardiff. Additional signals will be required to control access and egress from the loops and the coal loading point at Cwmbargoed. This project assumes a long term future for the line and it has been assumed that concrete troughs will be provided to protect the cables which are currently exposed on the sleeper ends. The additional signals are shown in the infrastructure diagrams in Appendix A.

3.4.4 Structures

The line is classified RA8 by Network Rail and it is assumed that no works will be required to existing structures to permit a passenger service.

3.4.5 Stations

All stations will be provided with nominal 100m long (four-car) platforms, waiting shelters, lighting, ticket issuing machines, help point and train information systems. It is assumed that all stations will be unmanned.

(a) Ystrad Mynach

The new platform will be located on the east side of the track on the site of the former down branch platform. It should be noted that this platform would be both on a curve and on a gradient of 1 in 145 (6.9 mm/m). This does not comply with the Railway Safety Principles and Guidance on stations that normally require platforms to be located on straight track and gradients no steeper than 1 in 500 (2mm/m). Both the vertical and horizontal alignments appear to be tied by the junction at the south end of the site and an underbridge over the A472 road and therefore it is likely that derogation from standards will be required.

DDA compliant access can be provided from the existing station car park. It is assumed that no additional car parking will be required.

(b) Nelson & Llancaiach (ST 112961)

Previous reports suggested that the platform would be located on the southwest (Up) side of the track and on the site of the former station. The track is curved through the site although future scheme development may enable the track to be realigned to provide a straight section for the platform. However, it was noted during the site visit in October 2013 that part of the former station site is being developed and it is not clear whether sufficient land will be available to implement the original proposal. This envisaged that sufficient space would be available for the platform and access together with car parking, a set down area and bus interchange if required.

(c) Trelewis

Three possible locations have been considered as follows:

- *North end below Taff Merthyr Garden Village (ST 105978) - There appears to be land available adjacent to the railway, however the accessibility has not been investigated at this stage.*

- *Site of the former Trelewis Platform near the centre of village (ST 106973) – The platform would be on the west (Up) side with pedestrian only access possible from Field Street. Alternative pedestrian access could be provided from the overbridge at the north end of the site. Land may be available for car parking adjacent to the bridge.*

- *South end of village (ST 108967) - There is space for a station with parking on both the north and south sides of the road bridge. Both sites would be on straight track. The south would be preferred since road access appears easier from a minor road on the west side of the railway. However, this site is only 800m north of the proposed Nelson & Llancaiach station.*

All three sites are located on straight track and on the almost continuous 1 in 42 (23.8 m/mm) gradient that extends from Nelson & Llancaiach to Cwmbargoed.

Car parking would be very limited at the first two sites. However, parking for 20 vehicles or more should be achievable at the third site.

3.4.6 Bedlinog

Two possible sites have been considered as follows:

- *The former station site (SO 095012) is located centrally with direct access onto the High Street. However, the site is used by a local coach company as their yard.*

- *Northwest of and adjoining the former station site (SO 093013) there is land within the Network Rail boundary that would be adequate for a platform with access from Station Terrace. An earth bank, which separates this site from Station Terrace, would need to be removed to provide access but the site offers the advantage that it could avoid relocating the user of the former station site.*

For either site option, the platform would be located on both a curve and the 1 in 42 (23.8 m/mm) gradient. Car parking for up to 20 vehicles should be achievable in both cases.

3.5 Ystrad Mynach - Cwmbargoed: Two passenger train per hour

This service option will require the following additional works compared with the one passenger train per hour option:

- *Provision of a second (Down) line between Cwmbargoed and south of Trelewis instead of the Bedlinog freight loop.*
- *Platforms on both tracks at Bedlinog and Trelewis*

3.5.1 Permanent Way

This proposal envisages the reinstatement of the Down line between Cwmbargoed and north of Nelson with a nominal length of 10km. Provision of the second track could require changes to the horizontal and vertical alignment of the existing track, including widening of the formation, drainage and bridge clearance works.

3.5.2 Stations

(a) Bedlinog and Trelewis

Both stations would be located on the double track section and would have two 100m long platforms, each with waiting shelters, ticket issuing machines, help point and train information systems. Additionally both stations would require DDA compliant footbridges to provide full access to the platforms. Other features would remain as for the single platform options. It is assumed that both stations would be unmanned.

3.5.3 Scope Risks

At this stage three areas of potential scope risk have been identified:

- *Additional works to comply with current clearance standards particularly in respect of the reinstatement of the loops or second track e.g. track sluing, formation widening, bridge clearances.*
- *Platform gradients and curvature.*
- *Acceptability of vertical and horizontal alignments between Cwmbargoed and Dowlais.*

The operating assumptions that have been made with reference to signalling on the branch could have significant reliability implications. As such, they may not be acceptable to Network Rail without the provision of additional infrastructure e.g. the provision of an up goods loop south of Ystrad Mynach or a passing loop on the branch.

The Railway Safety Principles and Guidance, published by Her Majesty's Railway Inspectorate, requires platforms to be located on straight track and with a gradient no steeper than 1 in 500. As the average gradient of the line has been assessed as

1 in 75 and, with the exception of Trelewis, all the station sites identified are on curves, it is likely that derogation from these requirements would have to be sought

3.6 Powers and Consents

3.6.1 Transport and Works Act Order

It is assumed that generally the land required permanently, including for the stations, is within Network Rail ownership and the works would be covered under their Permitted Development Rights. However, the status of the former Bedlinog station site is unknown and it may be necessary to obtain powers of compulsory purchase to acquire the site. As the railway is still open to traffic, albeit a limited freight service, it is considered unlikely that the reintroduction of a regular passenger trains would give rise to claims for nuisance, it is assumed therefore that an Order will not be required. The section of line beyond Cwmbargoed is subject to restoration and land ownership and acceptability of the railway and transfer of land will need to be considered further to determine whether ta TWA order is required. It has been assumed that this could be resolved by negotiation.

3.6.2 Her Majesty's Railway Inspectorate (HMRI)

The proposed works will be notifiable to the HMRI under the Railways and Other Transport Systems (Approval of Works, Plant and Equipment) Regulations 1994 [ROTS (AWPE) R]. There are three formal stages in this process:

- *Obtain notification of non-objection to concept (GRIP 4).*
- *Obtain notification of non-objection to proposals (GRIP 5).*
- *Obtain full approval to the completed works (GRIP 7).*

3.6.3 Major Project Notice

GRIP defines a major project as "any engineering, maintenance or renewal project which requires a possession or series of possessions of one or more sections of track extending over either a period of more than one year; or a period that contains two or more Passenger Change Dates". This is unlikely to be applicable to this proposal since the required possessions are unlikely to fall within the above definition.

3.6.4 Network Change

The works on the line will affect the Train Operating Companies (TOC's) and Freight Operating Companies (FOC's) and thus will be subject to the Network Change process. The Network Change Notice is developed during GRIP 4 and agreed during the detail design phase, GRIP 5.

3.6.5 Station Change

This will be required due to the proposed works at Ystrad Mynach.

3.7 Cost and risk

Table 3-A shows the infrastructure requirements for hourly and half-hourly train operations.

Section / Location	Works	Quantity
1 Train Per Hour + Freight		
Cwmbargoed – Dowlais	Plain line, formation and drainage	3.5km
Cwmbargoed	S&C unit	1no.
Cwmbargoed	Convert point to power operation	1no.
Cwmbargoed	New signals inc. detection & control	4no.
Cwmbargoed	Modified or relocated signals	1no.
Dowlais	Fixed distant signal	1no.
Dowlais station	100m platform, waiting shelter, lighting, customer information system, help point, ticket machine,	1no.
Dowlais station	Car park	50 cars
Bedlinog freight loop	Plain line, formation and drainage	750m
	S&C units	2no.
	New signals inc. detection & control	7no.
Ystrad Mynach loop	Plain line, formation and drainage	750m
	S&C units	2no.
	New signals inc. detection & control	1no.
	Modified or relocated signals	1no.
Ystrad Mynach station	100m platform, waiting shelter, lighting, customer information system, help point, ticket machine,	1no.
Nelson & Llancaiach station	100m platform, waiting shelter, lighting, customer information system, help point, ticket machine,	1no.
	Car park	20 cars
Trelewis station	100m platform, waiting shelter, lighting, customer information system, help point, ticket machine,	1no.
	Car park	20 cars
Bedlinog station	100m platform, waiting shelter, lighting, customer information system, help point, ticket machine,	1no.
	Car park	20 cars
Ystrad Mynach – Dowlais	Protective troughs to signal cable [Provisional]	18km
Ystrad Mynach – Cwmbargoed	Realign and upgrade for 40 mph	14.5km
2nd Train Per Hour + Freight		
Cwmbargoed – Nelson Down line	Plain line, formation and drainage	10km
	S&C units	2no.
	New signals inc. detection & control	11no.
Nelson & Llancaiach station	100m platform, waiting shelter, lighting, customer information system, help point, ticket machine,	2no.
	DDA compliant footbridge	1no.
Trelewis station	100m platform, waiting shelter, lighting, customer information system, help point, ticket machine,	2no.
	DDA compliant footbridge	1no.

Table 3-A Detailed Infrastructure Requirements.

Table 3-B shows the breakdown of the capital costs for the scheme options. It should be noted that as the exact locations of the station sites are not known assumptions have been made regarding availability of power supply, availability of land for parking and construction / access. At Dowlais (Ffos-y-Fran) the masterplan is not known so an allowance has been made for highway access.

No allowance has been made for land purchase and it is assumed that the line of the new track between Cwmbargoed and Dowlais (Ffos-y-Fran) will be left suitably graded and rolled by the coal extraction reclamation contractor and no excavation will be required from the track laying contractor.

The estimate allows for management costs for design and construction phases and costs levied by other interested parties. A general contingency of 30% is included.

Element	Cost
1 Train per hour + Freight	
Ystrad Mynach Station	£330,000
Nelson & Llancaiach Station	£340,000
Car Parking (20 vehicles)	£100,000
Trelewis Station	£325,000
Car Parking (20 vehicles)	£100,000
Bedlinog Station	£330,000
Car Parking (20 vehicles)	£100,000
Dowlais (Ffos-y-Fran) Station	£295,000
Car Park (50 vehicles)	£410,000
Trackwork	£5,515,250
Signalling	£1,462,500
Project Cost	**£9,307,750**
Additional Costs for 2 trains per hour + Freight	
2nd Platform at Trelewis	£250,000
DDA Compliant Footbridge, staircases & lifts	£1,050,000
Additional power supply	£50,000
2nd Platform at Bedlinog	£250,000
DDA Compliant Footbridge, staircases & lifts	£1,050,000
Additional Power Supply	£50,000
Additional Trackwork	£9,100,000
Additional Signalling	£1,787,000
Project Cost	**£13,587,000**
Combined Project Costs	**£22,894,750**

Table 3-B Capital Cost Estimates.

4 Demand and Revenue Forecasts

4.1 Introduction

The demand and revenue forecasts have been produced in accordance with previous demand and revenue forecasts for the Sewta Rail Strategy using available rail industry standard models and approaches, focusing on the key demand segments. In particular, use of the rail industry MOIRA model for benefits at existing stations, the Sewta Trip Rate model for the demands for new stations and using the NRTS data to estimate abstraction from existing stations.

4.2 Increased Passenger Demand at Existing Stations

It is assumed that the new services would be introduced after the completion of the Cardiff Area Signalling Renewal (CASR) works. Those works will create additional capacity between Cardiff Queen Street, Cardiff Central and Cogan and result in the ability to provide additional train capacity in the core Cardiff Journey to Work area between Caerphilly and the City. The strategy is to split long trains operating north of Caerphilly and introduce local stopping services between Caerphilly and Cardiff. This will provide a better distribution of peak seat capacity to passenger demand.

It is therefore assumed that the services to Bedlinog / Dowlais would be extensions of the AM and PM peak local services to the existing and new stations north of Caerphilly. In the interpeak it is unlikely that those short service trains will be operating and therefore new services through to Cardiff (and beyond) would be required.

The scheme(s) would therefore result in additional service frequency between Ystrad Mynach and Caerphilly in the peaks (calling at Llanbradach and Aber) and between Ystrad Mynach and Cardiff in the inter peak and off peak periods (calling at Llanbradach, Aber, Caerphilly, Lisvane & Thornhill, Llanishen and Heath High Level).

No ‘post-CASR’ model / timetable was available at the time of the study, so the existing MOIRA model was applied incrementally to ensure that the additional passenger demand and revenues was not overestimated. Specifically,

- *New Base created with half hourly local services over 6 hours of the day between Cardiff and Caerphilly.*
- *Option A: hourly extension of one of the Caerphilly local services to Ystrad Mynach in the peaks plus additional hourly service between Ystrad Mynach and Cardiff in the Interpeak.*
- *Option B: extension of the half hourly Caerphilly local services to Ystrad Mynach in the peaks plus additional half hourly service between Ystrad Mynach and Cardiff in the interpeak.*

The incremental demand impacts are shown in Table 4-A.

Scenario	Net Additional Passengers / Annum
Hourly Extension to Ystrad Mynach	17,676
Half-hourly extension to Ystrad Mynach	35,813

Table 4-A Additional Passenger Journeys Between Existing Stations (2012).

4.3 New Passenger Demand at New Stations

The MOIRA model uses elasticities applied to the change in generalised travel costs to forecast change in demand and revenues. It is not able to forecast the change in demand as a result of the change in accessibility resulting from new stations. The Sewta Trip Rate model is therefore applied for the new stations. This model was calibrated on journeys to Cardiff and Newport based on station catchment and journey quality characteristics for the existing stations in South East Wales. The model details are shown in Appendix B.

The model had been previously employed for the new stations between Ystrad Mynach and Bedlinog and was further applied for a new station at Dowlais (FFos-y-Fran). In this study some operating assumptions for the new service calling at Nelson, Trelewis and Bedlinog were different, so the forecast for those stations were revised. The input data is shown in Table 4-B.

The GIS analysis programme Mapinfo was used to interrogate the catchment population data taking account of the overlap of catchment to avoid double counting. The 2011 census data was used and additional housing developments added as advised by planners in each authority for to calculate future population in the vicinity of the stations. The population inputs to the model for the new stations at Nelson, Trelewis and Bedlinog were also revised using the 2011 census to be in line with Dowlais.

Parameter	Values
Cardiff Model	
Population within 800m	3,193
Terminus (heads of valley) Station	Y
Parking Available	Y
Peak Bus Vehicles per hour	2
Rail In-vehicle Time	53 Mins
Rail Fare (half of return fare)	£3.70
Rail Headway	60 minutes and 30 minutes tested
Newport Model	
Population within 2km	13,073
Terminus (heads of valley) station	Y
Parking Available	Y
Rail In-Vehicles Time (including interchange)	80 minutes
Rail Fare (half of return fare)	£5.05
Rail Headway	60 minutes and 30 minutes tested
Uplift Factor (range) to all Trips	2.46 – 3.71

Table 4-B Trip Rate Model Input Assumptions Dowlais (Ffos-y-Fran) Station

The Cardiff and Newport forecasts are combined and uplifted to all flows using the uplift factor range based on the whole model and shadow station (Ystrad Mynach). The resultant demand forecasts from the trip rate model for the stations is shown in Table 4-C. This also reveals the impact of the heads of valley Terminus Station factor which has been the subject of sensitivity tests.

Station	Annual Passenger Journeys Hourly	Annual Passenger Journeys Half Hourly
Dowlais (Ffos-y-Fran) With Terminus Factor	470,650	782,509
Dowlais (Ffos-y-Fran) Without Terminus Factor	56,631	94,057
Bedlinog	33,623	59,664
Trelewis	47,062	86,558
Nelson	39,746	74,234

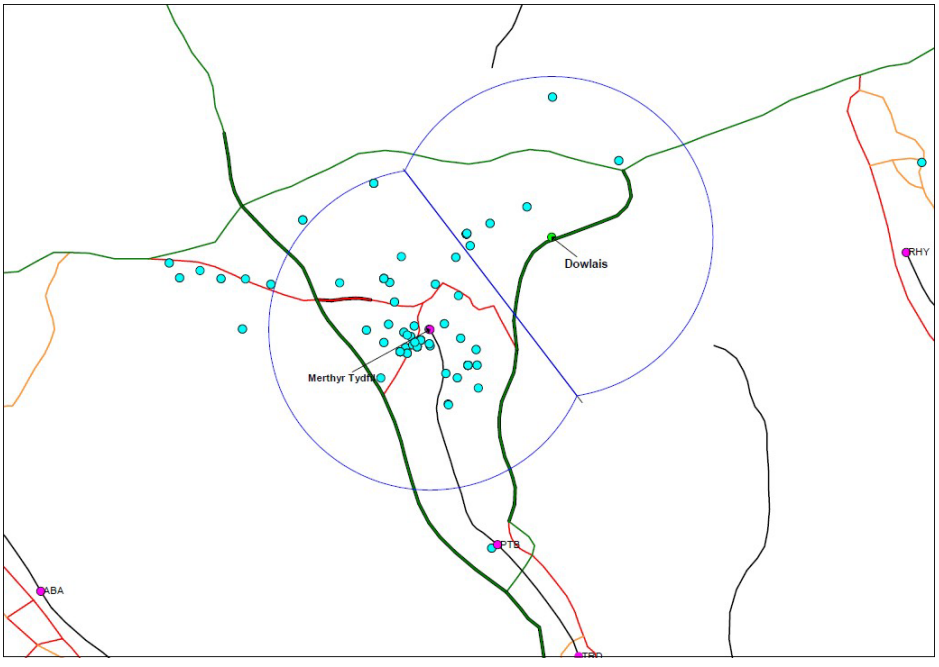
Table 4-C New Station Demand Forecasts – Trip Rate Model.

In addition, the trip rate model was adjusted for with and without parking at Dowlais (Ffor-y-Fran) station to provide an estimate of the car parking requirement. The factor produced a 44% difference in demand and an estimated car parking requirement of between 250 and 450 spaces suggesting that the new station could have a strategic park and ride function.

4.4 Abstracted Passenger Demand

The provision of new stations at Nelson and at Dowlais (Ffos-y-Fran) will abstract passengers who currently access the rail network at Ystrad Mynach and Merthyr Tydfil. It is logical to assume that they will use the new stations which will be closer, but the business case appraisal needs to recognise that those journey are not new.

To estimate the potential abstraction impact the National Rail (Passenger) Travel Survey (NRTS) data was analysed. See figure for Merthyr Tydfil / Dowlais below;



The proportion of the station records inside the catchment of the new station was calculated and that proportion applied to the existing journeys through those stations. The resultant abstraction figures are;

- *Nelson (Ystrad Mynach) = 25,502 journeys per annum;*
- *Dowlais (Merthyr Tydfil) = 80,909 journeys per annum;*

Those abstractions are a high proportion of the new station flows (without the terminus station factor) and reflect the high services levels at the existing stations. It is therefore assumed that half the abstraction would occur for an hourly service and the full abstraction would applied for a half-hourly service.

4.5 Passenger Demand Summary

Table 4-D shows the summary passenger demand for each station / scenario for input to the scheme appraisals.

Element / Scenario	Hourly	Half Hourly
Dowlais (Ffos-y-fran) New Passengers	470,650	782,509
Passengers Abstracted from Merthyr Tydfil	-40,454	-80,909
Bedlinog Passengers	33,623	59,664
Trelewis Passengers	47,062	86,558
Nelson Passengers	39,746	74,234
Abstraction from Ystrad Mynach	-12,751	-25,502
New passengers at existing stations	17,676	35,813
Total	555,552	932,367

Table 4-D Passenger Demand Summary for Hourly and Half Hourly Scenarios.

4.6 Revenue Forecast

The revenue forecasts for each flow were based on the following assumptions;

- *New passengers at existing stations – forecast from MOIRA.*
- *New Station flows - assumed revenue rates for journeys from existing stations.*
- *Abstracted trips – average revenue for that station from MOIRA.*

The forecast revenues are not reported in detail for each flow for commercial reasons. However, the forecasts result in revenue shortfalls in 2015 shown in Table 4-E.

The subsidy requirements for the hourly services are lower than the half hourly services showing that the additional demand forecast do not cover the additional costs, The extension to Dowlais (Ffos-y-Fran) reduces the subsidy slightly – suggesting that the incremental demands generated outweighs the additional costs to extend the services. Conversion to electric operation reduces the subsidy further and, under the demand and revenue growth assumptions, the electric services and services extended to Dowlais could be generating a profit within 10 years.

Scenario	Subsidy 2015	Subsidy 2025
Diesel Operation		
Bedlinog Hourly	£580k	£28k
Bedlinog Half Hourly	£1,094k	£123k
Dowlais (Ffos-y-Fran) Hourly	£557k	-£319k
Dowlais (Ffos-y-Fran) Half Hourly	£1,405k	-£47k
Electric Operation		
Bedlinog Hourly	£404k	-£175k
Bedlinog Half Hourly	£774k	-£246k
Dowlais (Ffos-y-Fran) Hourly	£322k	-£598k
Dowlais (Ffos-y-Fran) Half Hourly	£990k	-£534k

Table 4-E Forecast Subsidy Required – 2015 and 2025

5 Economic Appraisal

5.1 Introduction

For the economic appraisal and comparison of the options the demand and revenue forecasts and operating / maintenance and capital cost is combined with user and non-user benefits within a cost benefit analysis. The economic benefits estimated are;

- *User Time Savings – for existing and new rail passengers;*
- *Rail Safety Benefits (costs) - resulting from the increased use of rail;*
- *External – non-user benefits relating to;*
    - *Traffic decongestion time saving benefits – as a result of the additional rail traffic resulting from the frequency enhancement and the new station some of which will have transferred from making journeys by private car;*
    - *Infrastructure maintenance cost savings as a result of the reduction of traffic on the highway network;*
    - *Accident Savings – resulting from a reduction in trips on the highway as a result of the mode shift to rail, and;*
    - *Environment benefits attributed to improved local air quality, noise and reduced greenhouse gasses relating to the mode switch to rail.*
- *Indirect costs to Government as a result of lost revenue from fuel taxes;*
- *Increase in operating costs and revenues above inflation over the project life.*

5.2 User Time Savings

Two approached were used for estimating user benefits;

- *For new and existing passengers using existing stations the MOIRA model benefits were used;*
- *For the net generated passengers forecast for the new stations an average time saving per journey was used and the value of time applied in line with WebTAG*[3]*.*

The MOIRA model benefits for the hourly and half hourly options are shown in Table 5-A;

[3] WebTAG Unit 3.5.6, Values of Time and Vehicle Operating Costs, October 2013

Option	Time Savings Benefit £ p.a.
Hourly Extension to Ystrad Mynach	£99,081
Half-hourly extension to Ystrad Mynach	£171,995

Table 5-A Benefits to Passengers at Existing Stations, MOIRA (2012)

To determine the likely main trip origins and destinations for the new station at Dowlais (Ffos-y-Fran) a test Moira model timetable was used - extending the new services to the existing Merthyr Tydfil station. The results, shown in Table 5-B, reveal the dominance of Cardiff as the main trip attractor in the region. The model uses elasticities applied to the change in the generalised costs of travel between stations and should be treated with caution where there is a very significant, rather than incremental, change. However, the results appear logical with the majority of the other top flows to stations on the Caerphilly line and other main trip attractors.

Flow	%
Cardiff	74%
Caerphilly	7%
Ystrad Mynach	2%
Bridgend	2%
Llanishen	2%
Aber	2%
Cardiff Bay	1%
Hengoed	1%
Heath High Level	1%
Bargoed	1%
London	1%
Total	91%

Table 5-B Key Flows for Dowlais (Ffos-y-Fran) Forecast From MOIRA

The February 2006 Journey Time and Reliability in the Sewta Region report quoted average differences between average peak journey times into Cardiff to free flow times in the Merthyr Tydfil and Rhymney Corridors. This revealed significant congestion in the Cardiff section of the corridors adding between 13 and 24 minutes delay to free flow journeys and significant variation between the average and worst congested journey times in the range of a further 13 to 17 minutes. These peak highway journey times have been compared with the rail journey times to Cardiff in Table 5-C.

Station	Rail Time	Car Wednesday Average Am Peak Time	Car Maximum Am Peak Time	Rail Time Saving Range
Dowlais (Ffos-y-Fran)	53 mins	57 mins	73 mins	4 to 20 mins
Bedlinog	42 mins	50 mins	67 mins	8 to 25 mins
Trelewis	37 mins	44 mins	61 mins	7 to 24 mins
Nelson	35 mins	44 mins	61 mins	9 to 26 mins

Table 5-C Comparison of Rail and Car Journey Times to Cardiff.

Table 5-D shows the comparison between existing AM peak bus times and the rail time. Whilst buses would serve a greater number of locations in Cardiff and in the Valley which would reduce the time savings shown. The passengers transferring from bus would be likely to receive larger time savings than those travelling by car.

Station	Rail Time	AM Peak Bus Time	Rail Time Saving
Dowlais (Ffos-y-Fran)	53 mins	79 mins	26 mins
Bedlinog	42 mins	102 mins	60 mins
Trelewis	37 mins	68 mins	31 mins
Nelson	35 mins	56 mins	21 mins

Table 5-D Comparison of Bus and Rail Journey Times to Cardiff

This analysis suggests that a 'perceived' generalised time saving of 12 minutes per day assumed in the Sewta Rail Strategy appraisal is relatively cautious. A sensitivity test on this factor is included in the analysis.

The time savings are calculated for the net new station passengers and the value of time of £8.42 per hour in 2010 prices was applied based on guidance and using the proportions of rail passengers traveling for work, commuting and other purposes from the guidance[4].

The resultant user benefits are shown for the main options in Table 5-E.

Scheme Option (Diesel)	User Benefits p.a.
Bedlinog Hourly	£699k
Bedlinog Half Hourly	£1,237k
Dowlais (Ffos-y-Fran) Hourly	£1,018k
Dowlais (Ffos-y-Fran) Half Hourly	£1,715k

Table 5-E User Time Savings for New Station Users.

5.3 Non-User Benefits

The non-user benefits have been assessed using the DfT Guidance on Rail Appraisal: External Costs of Car Use (Transport Analysis Guidance Unit 3.13.2, October 2013) and associated spreadsheets. This procedure produced recommended values for congestion, infrastructure, accident, local air quality and greenhouse gases benefits resulting from the assumed transfer of trips from car for 2010 and 2025.

The appraisal assumes car transfers of 33% of new rail demand and a car occupancy factor of 1.2 to derive the net change in car kms. This is lower than the national factors prescribed in guidance and is based on surveys of Valley Lines passengers who tend to have lower car ownership than the UK average. The forecast of new rail miles was based on an assumed journey length of 23 miles (based on the weighted average distance from Cardiff). The rates used and values derived for the external impacts uses the specified values for Wales. These rates are lower than the UK average and possibly under estimate the impact of congestion in the corridor. The scheme would be expected to deliver significant benefits as most of the car transfers would be from the congested A470 corridor.

[4] WebTAG Unit 3.6.5, Values of Time and Vehicle Operating Costs, DfT, October 2013.

The transfer of journeys from the private car to rail results in a loss of government revenue as a result of the reduction in fuel sales and the resulting reduction in fuel tax income. For this appraisal the value of this factor was estimated using the DfT Guidance on Rail Appraisal: External Costs of Car Use (Transport Analysis Guidance Unit 3.13.2, October 2013) spreadsheet which suggested values of 4.8p / car km in 2010 and 3.7p / car km in 2025.

The Non-User Benefits for the main scheme options for 2010 are shown in Table 5-F.

Scheme Option (Diesel)	Non – User Benefits (2010)
Bedlinog Hourly	£252k
Bedlinog Half Hourly	£444k
Dowlais (Ffos-y-Fran) Hourly	£465k
Dowlais (Ffos-y-Fran) Half Hourly	£777k

Table 5-F Non User Benefits (2010)

5.4 Physical Fitness Impacts

The key factor in the assessment of physical fitness is encouraging people to walk for 36 minutes per day. Passengers who choose to use rail instead of driving to their destination will walk to and from the stations at both ends of their journeys. From the assessment of new passengers generated by the scheme the analysis estimates the number of people that would be likely to receive some health related benefits – dependent on their previous travel mode and existing activity levels associated with their trips or otherwise.

For example; a person transferring from car to rail may undertake new walk trips to and from the stations at each end of each trip, whereas a bus passenger may already walk to and from bus stops so there may be an incremental benefit.

A significant proportion of people gaining this benefit as a result of the scheme reside in the upper Valleys where there is a significant emphasis on this health related objective.

The valuation of the physical fitness impacts concentrates on reduced mortality through encouraging a significant change in activity levels and also reduced absenteeism as a result of a healthier workforce. We have assumed significant changes relate only to commuters.

5.4.1 Reduced Mortality

The benefits of improved physical fitness on mortality are likely to be significant where significant levels of mode shift are expected. The calculation of the reduced mortality benefits is based on the appraisal guidance / values. The full rate of benefit is included assuming an average walk of 10 minutes to / from Cardiff City Centre stations and 8 minutes to and from origin stations on the line.

In addition to reducing the impact to relate to assumed commuters we have also assumed that 15% would still use their car to access the station. This is considered a cautious approach as some other users might gain partial benefit and some abstractions from current park and ride at other stations could walk to the station and gain a partial benefit. On the other hand some car commuters may have a significant walk from their car park to their final destination in Cardiff City Centre. The process of the calculation is;

- *New journeys from car per annum;*
- *New one-way trips from car per annum;*
- *Individuals (assuming annual factor 311);*
- *Assumed reduction to frequent travellers (commuters @ 52.2%);*
- *Assumed car transfer frequent travellers (@33%);*
- *Mean proportion of population who die p.a. from guidance (0.00235);*
- *Expected deaths in the population;*
- *Relative Risk reduction (based on Copenhagen factor (28%));*
- *Reduced mortality p.a.;*
- *The value of a fatality (£1,645,822, 2010 prices) is applied to derive;*
- *Reduced Mortality Benefits p.a.*

5.4.2 Absenteeism Benefits

In addition to reduced mortality benefits there are benefits to users through reduced sickness and morbidity (including reduced obesity and related illnesses). Appraisal guidance recommends inclusion of a value for employer benefits from improved absenteeism as a result of improved health. The calculation of the absenteeism impact using the recommended methodology and values is;

- *New journeys from car per annum;*
- *New one-way trips from car per annum;*
- *Individuals (assuming annual factor 311);*
- *Workers (assuming 55% commuting);*
- *Working hours benefit (0.4 * 8);*
- *Application of value per employee (3.2 * £26.73) to derive;*
- *Reduced Absenteeism Benefits p.a.*

5.5 Economic Appraisal Assumptions

The economic appraisal has been undertaken in accordance with the Guidance on Rail Appraisal. Key assumptions were;

- *2010 price base and 2010 prices, inflating / deflating values using RPI factors;*

- *Capital costs are subject to 66% uplift for optimism bias appropriate for a scheme at GRIP stage 0;*

- *An Optimism bias of 41% is applied to Operating costs (this has a significant impact on the appraisal results and its impact is tested);*

- *Assumed spend is 10% in 2013/14, 35% in 2014/15 and 55% in 2015/16 (in line with the appraisal of other schemes assessed in the Sewta Rail Strategy 2013);*

- *Costs and benefits discounted over 60 years of operation from 2015 to a 2010 base assuming a discount rate of 3.5% for 30 years and 3.0% for the remaining years;*

- *Application of Valley Lines Electrification Market Assessment demand growth of 4.1% per annum to 2021 and 2.1% per annum between 2022 and 2032. The demand is capped in 2032 (Whilst this can be flexed it has been retained as no detailed train capacity analysis has been undertaken);*

- *Assuming value of time growth in accordance with appraisal guidance (WebTAG Unit 3.5.6, October 2013);*

- *Interpolation of the growth in external costs of car use (non-user benefits) between the forecasts for 2010 and 2025 with only rail passenger and value of time growth thereafter;*

- *Application of market price adjustment factor of 19% to the Capital Costs, Operating Costs and Revenues and;*

- *The appraisal takes account of the planned growth in rail fares of RPI +1%. A revenue elasticity of 0.4 is applied to the fares increase to determine revenue growth.*

5.5.1 Appraisal Results – Main Options

The appraisal results are presented for the Diesel and Electric options and the Appraisal Summary Tables of the main options are shown in Appendix C.

(a) Diesel Service Options

Tables 5-G and 5-H show the results from the application of the cost benefit analysis model applied for diesel options for the extension of service to Bedlinog and to Dowlais (Ffos-y-Fran). Table 5-H shows the results without the operating cost optimism bias which are considered robust as a result of validation by ATW.

	Bedlinog Hourly Diesel	Bedlinog Half Hourly Diesel	Dowlais Hourly Diesel	Dowlais Half Hourly Diesel
Present Value Costs (PVC)	£25.82m	£34.83m	£24.76m	£67.67m
Present Value Benefits (PVB)	£51.16m	£149.38m	£77.09m	£129.77m
Net Present Value (NPV)	£25.34m	£114.55m	£52.33m	£62.10m
Benefit Cost Ratio (BCR)	2.0	4.3	3.1	1.9

Table 5-G Appraisal Results – Diesel Options Full Opex OB

	Bedlinog Hourly Diesel	Bedlinog Half Hourly Diesel	Dowlais Hourly Diesel	Dowlais Half Hourly Diesel
Present Value Costs (PVC)	£12.80m	£34.83m	£14.98m	£37.06m
Present Value Benefits (PVB)	£54.09m	£178.08m	£89.47m	£140.07m
Net Present Value (NPV)	£41.29m	£143.25m	£74.49m	£103.01m
Benefit Cost Ratio (BCR)	4.2	5.1	6.0	3.8

Table 5-H Appraisal Results – Diesel Options Without Opex OB

For the all options the optimism bias on operating costs (OPEX OB) results in a significant net subsidy forecast. Without it there is a short term subsidy requirement (eg: for 11 years in the Bedlinog Hourly Diesel option) and no net subsidy forecast over the scheme life. In all cases the removal of the operating cost optimism bias results in a significant increase in the Benefit Cost Ratio (BCR). The inclusion of the optimism bias adds a subsidy line to the costs and negates the revenue affecting the PVC figures.

The BCR of the half-hourly Bedlinog option is higher than the hourly option – though see sensitivity analysis below regarding sensitivity to the Terminus (Heads of the Valleys) factor.

The BCR of the half hourly Dowlais (Ffos-y-Fran) option is consistently lower than for the hourly option – suggesting that the incremental operating and capital costs are not matched by the change in demand and benefits. However, the BCR of the half hourly diesel Dowlais option without optimism bias on operating costs is high enough to secure support.

(b) Electric Service Options

Tables 5-I and 5-J show the appraisal results for the options with electrification. The BCR of all electric options is lower than for the equivalent diesel options. This suggests that the increase in demand (assumed as 5% sparks effect) and the reduced operating costs are not sufficient to cover the additional capital (which assumed an electrification cost or £2m per mile in 2002 prices.

	Bedlinog Hourly Electric	Bedlinog Half Hourly Electric	Dowlais Hourly Electric	Dowlais Half Hourly Electric
Present Value Costs (PVC)	£48.05m	£77.80m	£42.79m	£103.24m
Present Value Benefits (PVB)	£53.71m	£95.50m	£80.94m	£136.26m
Net Present Value (NPV)	£5.66m	£17.70m	£38.15m	£33.02m
Benefit Cost Ratio (BCR)	1.1	1.2	1.9	1.3

Table 5-I Appraisal Results – Electric Options Full Opex OB

	Bedlinog Hourly Electric	Bedlinog Half Hourly Electric	Dowlais Hourly Electric	Dowlais Half Hourly Electric
Present Value Costs (PVC)	£40.51m	£62.65m	£40.37m	£85.58m
Present Value Benefits (PVB)	£61.13m	£107.23m	£99.50m	£157.34m
Net Present Value (NPV)	£20.63m	£44.58m	£59.13m	£71.77m
Benefit Cost Ratio (BCR)	1.5	1.7	2.5	1.8

Table 5-J Appraisal Results – Electric Options Without Opex OB

5.5.2 Sensitivity Analysis

(a) Bedlinog Terminus (Heads of the Valleys) Factor

Unlike the main towns at the Heads of the Valleys there is a little population in the valley to the north of Bedlinog. As a result it may not be appropriate to apply the Terminus (Heads of the Valleys) factor to that station. That has a significant impact on the forecast patronage and revenue of the scheme as demonstrated in the summary appraisal results presented in Table 5-K.

	Bedlinog Hourly Diesel	Bedlinog Half Hourly Diesel	Bedlinog Hourly Electric	Bedlinog Half Hourly Electric
Present Value Costs (PVC)	£36.84m	£79.22m	£61.40m	£101.20m
Present Value Benefits (PVB)	£21.41m	£38.12m	£22.48m	£40.03m
Net Present Value (NPV)	-£15.43m	-£41.10m	-£38.92m	-£61.17m
Benefit Cost Ratio (BCR)	0.6	0.5	0.4	0.4

Table 5-K Appraisal Results – Bedlinog Options – No Terminus Factor Without Opex OB

(b) User Benefits Sensitivity Test

In the 1999 the Ebbw Valley Rail Study undertook surveys of users of Rhymney Valley stations (Caerphilly & Ystrad Mynach) to establish how they would travel if the train service was not available for interpreting the outputs from a previous trip rate model. Those results are applied to the average journey time reductions (assuming two thirds of the bus journey time reduction to determine the average time saving. The rule of half is applied to the generated (would not travel) trips. Table 5-L shows that the average time saving could be significantly higher at 16 minutes.

Alternative Mode	%	Average Time Saving
Bus	54%	23 mins
Car / Taxi	34%	7 mins
Generated (would not travel)	12%	7 mins
Weighted Average		16 mins

Table 5-L Analysis of Time Savings / Alternative Mode

This higher average time saving was applied to the user benefits of the main options and the results are shown in Table 5-M. The alteration to the user time benefits assumption from 12 minutes to 16 minutes per journey made no significant difference to the BCR's.

	Bedlinog Hourly Diesel (No terminus Factor)	Bedlinog Half Hourly Diesel (No terminus Factor)	Dowlais Hourly Diesel	Dowlais Half Hourly Diesel
Present Value Costs (PVC)	£36.84m	£79.22m	£14.98m	£37.06m
Present Value Benefits (PVB)	£21.41m	£38.12m	£89.47m	£140.07m
Net Present Value (NPV)	-£15.43m	-£41.10m	£74.79m	£103.01m
Benefit Cost Ratio (BCR)	0.6	0.5	6.0	3.8

Table 5-M Appraisal Results – Higher User Benefit Rate (without Opex OB)

(c) Dowlais (Ffos-y-Fran) Terminus (Heads of the Valleys Factor)

It was noted that the terminus station factor relevant to a Heads of the Valleys station has a substantial influence on the passenger demand forecast and resultant revenue and user benefits forecasts. The figure presented in Section 4.4 shows that the station would share the market of the head of the valley with Merthyr Tydfil station so the market is likely to be restrained.

The influence of this factor was analysed to determine what level of market share the station would need to attract to provide positive business case results for the scheme. Table 5-N shows the results. At around half of the new station demand for Dowlais Top (Ffos-y-Fran) there remains a relatively strong business case for the scheme.

Level of Terminus Station Factor	BCR Hourly Diesel Dowlais Option
100%	6.0
56%	2.0
50%	1.7
47%	1.5

Table 5-N Analysis of importance of Terminus Factor for Dowlais Station

6 Conclusions and Recommendations

6.1 Conclusions

This study has shown that it would be practical to extend the proposed passenger rail service along the rail line and beyond to a new terminus to serve a development site at Dowlais (Ffos-y-Fran). The infrastructure to provide an hourly service would be much less than for a half hourly service including protecting the freight paths on the line.

The new station at Dowlais (Ffos-y-Fran) could provide direct access to businesses at the development site created following completion of the open cast mining and restoration of the land. It could also be provided with a large car park and provide for park and ride demand – which is limited at the existing Merthyr Tydfil Station. The new station could therefore provide a complementary role.

The area beyond the immediate catchment of the new station at Dowlais (Ffos-y-Fran) contains significant more people and businesses than the wider catchment of the potential new station at Bedlinog. That factor justifies the inclusion of the Terminus Station (Heads of the Valleys) factor in the new station trip rate model in forecasting demand for the station at Dowlais (Ffos-y-Fran) and suggests that it would not be justified for the station at Bedlinog.

The new rail service would open up a greater range of destinations served by rail including between Merthyr Tydfil and Caerphilly and other stations on the Rhymney Line. However, the vast majority of trips are forecast to be between the new station at Dowlais and Cardiff. The new station and service provides an alternative to the use of Merthyr Tydfil station and may be more convenient to some passengers.

The economic appraisal suggests that the business case for a Diesel service is better than further electrification of this section of the network.

The option of an hourly service to Dowlais (Ffos-y-Fran) provides best value for money and with a reasonable share of the Heads of the Valley demand has a reasonable business case. There is also a reasonably good business case for a half hourly service to Dowlais (Ffos-y-Fran).

6.2 Recommendations

It is recommended that Sewta, and in particular the authorities of Merthyr Tydfil and Caerphilly Councils, seek restoration of the rail alignment in the remediation of the open cast site at Ffos-y-Fran. As levels and gradients are a key issue in that location further work should be undertaken to create an alignment that minimises the gradient for the railway and the need for further works at the Bogey Road Bridge.

It is recommended that the revised Sewta Rail Strategy refers to the network extension option as to Dowlais (Ffos-y-Fran) rather than to Bedlinog.

It is recommended that further investigation of the business case for this scheme should be undertaken when the Post-CASR timetable is produced. The capacity provided by CASR will result in a timetable recast and could create the opportunity to extend otherwise local stopping trains to Caerphilly.

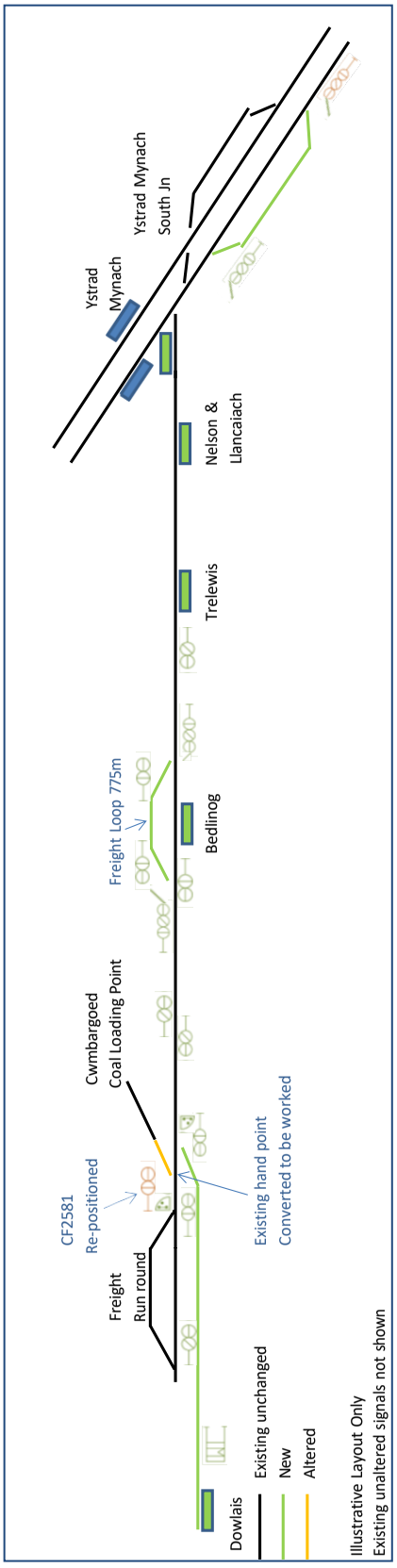
However, there is a known shortage of Diesel rolling stock in the UK and the opportunity may therefore be delayed until electrification of the Valley Lines and release of existing diesel trains from other services. This should be taken into account in the rolling stock plans.

It is recommended that further analysis of the demand for a new station at Dowlais (Ffos-y-Fran) should be undertaken, through stated preference surveys with residents and / or a redevelopment of the trip rate model based on Census 2011 data and increased attention to the breakdown / explanation of the heads of the valleys station factor.

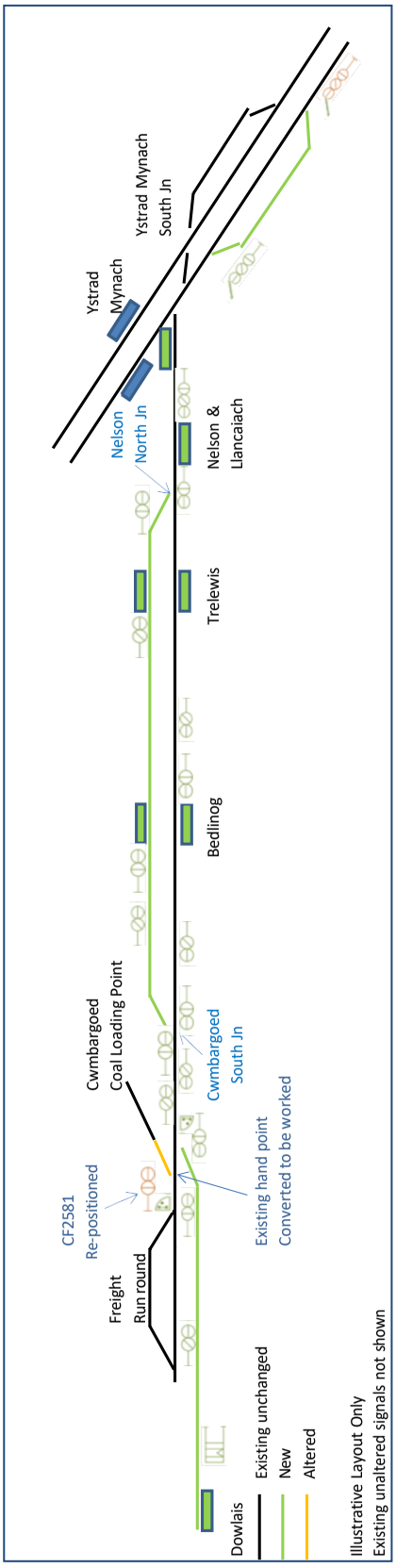
Given the strategic overview of the passenger demand and practicality assessment it can be concluded that there is reasonable evidence for a business case for extension of rail services to Dowlais (Ffos-y-Fran). It is therefore recommended to protect the land to preserve the opportunity for this scheme.

Appendix A Infrastructure Diagrams

1 Train / Hour



2 Trains / Hour



Appendix B Sewta New Station Trip Rate Model

Introduction

The SEWTA Rail Strategy Study Trip Rate Model was calibrated based on existing rail station patronage (MOIRA model flows, Q3 2005) compared with 2001 Census data for the catchment area of each stations, taking account of overlapping catchments of adjacent stations and against a range of other data including rail network statistics for each station and alternative mode data. SPSS multi-linear regression analysis was used to establish best fit models for the two main station flows in the South East Wales area (Cardiff and Newport) and factors derived to factor up to total flows. This Appendix describes the resultant models;

Variables

A: Demographic Data

2001 Census data was analysed using GIS to provide the demographic data for each station catchment in the region in 3 bands, within 400m of the station, within 800m of the station and within 2,000m of the station, taking account of overlapping catchments between adjacent stations. The following data was input to the model both logged and in a natural state.

- Population;
- Households; and
- Car ownership.

Car ownership was included as a proxy measure of income, which was not available in sufficient detail. However, all forms of the household car ownership data failed to provide a significant variable in the model calibration process.

B: Service Data

Data was collated for both rail and bus journeys to Cardiff and Newport from the stations on the region.

C: Rail Data

The following data was developed into variables and then tested during the creation of the model:

- Fare data for journeys to Cardiff/Newport;
- Rail vehicles per hour to Cardiff/Newport in the AM Peak;
- Rail vehicles per hour to Cardiff/Newport in the Off Peak;
- Rail headway to Cardiff/Newport in the AM Peak;
- Rail headway to Cardiff/Newport in the Off Peak;
- In vehicle time to Cardiff/Newport in the AM Peak; and
- In vehicle time to Cardiff/Newport in the Off Peak.

D: Bus Data

The following data was developed into variables and then tested during the creation of the model:

- Fare data for journeys to Cardiff/Newport;
- Bus vehicles per hour to Cardiff/Newport in the AM Peak;
- Bus vehicles per hour to Cardiff/Newport in the Off Peak;
- Bus headway to Cardiff/Newport in the AM Peak;
- Bus headway to Cardiff/Newport in the Off Peak;
- In vehicle time to Cardiff/Newport in the AM Peak; and
- In vehicle time to Cardiff/Newport in the Off Peak.

E: Generalised Cost Data

Both bus and rail variables were developed into generalised cost variables (with varying values of time) for each time period, mode and destination using the following equations:

GC = (fare + 2(IVT+Headway))
GC = (fare + 3(IVT+Headway))
GC = (fare + 4(IVT+Headway))

These variables were tested both in their natural state and logged. The difference between bus and rail generalised cost was also tested in each time period.

F: Other Variables

Dummy variables were tested to reflect a range of other factors including differences between individual lines:

- Stations on the Treherbert line;
- Stations on the Aberdare line;
- Stations on the Merthr Tydfil line;
- Stations on the Pontypridd line;
- Stations on the Coryton line;
- Stations on the Rhymney line;
- Stations on the Newport line;
- Stations on the Maesteg line;
- Stations on the Barry Island line;
- Stations on the Cardiff Bay line;
- Stations on the Penarth line, and;
- Stations on the City Line.

Other variables were:

- Is the station a terminus (Head of the Valley);
- Does the station have parking;
- Does the station have a direct service to Newport;
- Distance to Newport/Cardiff;
- Is there a bus link to the station; and
- Does the station have a direct service to London.

Calibrated Models

A: Cardiff Model

Using SPSS, the variables were tested against both demand and logged demand in order to see which would offer the best fit. Various model forms were tested and appraised on the basis of;

- The direction of the sign of the coefficient;
- The overall model fit (adjusted r squared factor);
- The significance of each variable (t-test), and;
- Application back to the base data to assess any regional or other bias.

The recommended model is shown in Table 1. This model predicts logged demand to central Cardiff. The adjusted r squared is 0.641.

This model excluded flows between Cardiff (Queen Street and Central) and the flowing stations (mainly due to very low or high flow to the city):

- Cathays;
- Pyle;
- Maesteg Eweny Road;
- Ynyswen;
- Gilfach Fargoed;
- Pentre Bach; and
- Cwmbach.

NB Stations excluded from the Cardiff Model were excluded from the combined model.

Table 1 Cardiff Model Variables

Variable	Co-efficient	T-Test
Constant	14.232	7.990
City Route	-0.949	-1.959
Penarth / Barry Route	-0.821	-2.418
Maesteg Route	-0.783	-2.266
Bus Vehicles per hour	-0.205	-4.571
Parking Provided	0.569	2.656
Terminus Station	2.128	6.896
Log Population within 800m	0.695	4.571
Log Rail Generalised Cost AM Peak (ln_Rail_4GC_AM)	-1.666	-6.761

B: Newport Model

The same process was undertaken for the development of the model to predict Newport flows. The recommended model is shown in Table 2 and again forecasts logged demand based on logged population and generalised cost variable with other factors. The adjusted r squared for this model is 0.613.

This model excluded flows between Newport and the following stations (mainly due to very low or high flow to the city):

- Cardiff Central Stations;
- Cardiff Bay:
- Barry Island;
- Pencoed;
- Maesteg Eweny Road;
- Birthdir;
- Cwmbach;
- Fernhill;
- Garth;
- Gilfach Fargoed;
- Pontlottyn;
- Pyle;
- Sarn;
- Tir Phil;
- Tondu;
- Whitchurch;
- Wildmill; and
- Ynyswen.

Table E2 Newport Model Variables

Variable	Co-efficient	T-Test
Constant	9.66475	2.57651
Terminus Station	1.25303	3.53331
Parking Provided	0.78401	2.84168
Direct Service to Newport	2.09124	4.39591
Log Rail Generalised Cost AM Peak (ln_rail_4gc_am)	-1.68171	-3.72779
Log Population within 2000m	0.63288	2.74782

Uplift of Flows

Application of the trip rate models forecasts trips to/from Cardiff and Newport. Factors are applied to estimate all station flows to all destinations. There are two approaches that can be used;

- *Network Average: A factor of 2.46 was derived from comparison of the average model fit for the existing stations in the Sewta Area.*

- *Shadow Station(s): Some proposed new stations have similar features to existing stations so alternative factors are derived using an individual uplift from a nearby 'shadow' station or group of stations along a section of the existing network. This takes account of the ability of the trip rate model to predict demand for the shadow station(s).*

Revenues for each station were developed by applying a revenue/trip factor to each new station based on that of a station with similar attributes.

Model Application

It is noticeable that the Cardiff element of the model has a relatively high factor applied for Terminus (Heads of the Valleys) stations. Application of the model took account of this through sensitivity testing and care is taken in 'sense checking' forecasts against shadow / comparator stations.

Appendix C Appraisal Summary Tables – Main Options

Cardiff Dowlais Top Hourly (Diesel)

Table 1: Economic Efficiency of Transport System (revenues are scored as positives, costs as negatives)

	All Modes	Road	Bus & Coach	Rail Total		Rail	Rail
	Total	Cars, LGVs and goods vehicles	Passengers	Passengers	Walk and Cycle	Company A e.g. NR	Other e.g. TOC/FOC
Consumers - Commuting							
User benefits							
- travel time saving	39,280,655	6,804,959		32,475,696			32,475,696
- Vehicle opcost	-			-			
- user charges	-			-			
- during construction & maintenance	-			-			
Net Consumer Benefits (1a)	**39,280,655**	6,804,959		32,475,696			32,475,696
				-			
Consumers - Other							
User Benefits							
- travel time saving	30,325,869	5,253,637		25,072,233			25,072,233
- Vehicle opcost	-			-			
- user charges	-			-			
- during construction & maintenance	-			-			
Net Consumer Benefits (1b)	**30,325,869**	5,253,637	-	25,072,233		-	25,072,233
Business							
User benefits							
- Travel time	5,719,023	990,760		4,728,262			4,728,262
- Vehicle opcost	-			-			
- Reduced absenteeism	-						
- user charges	-			-			
- during construction & maintenance	-			-			
Net Business User Benefits (2)	**5,719,023**	990,760	-	4,728,262	-	-	4,728,262
Private sector provider impact							
- revenue	66,431,107			66,431,107			66,431,107
- opcost	- 76,214,993			- 76,214,993			-76,214,993
- investment cost	-			-			
- grant/subsidy	9,783,886	0	0	9,783,886	0	0	9,783,886
- revenue transfer	-			-			
Sub total (3)	**-**	-	-	-		-	-
Other impacts							
- Developer contribution (4)		-	-	-			
Net business impact (5 = 2+3+4)	**5,719,023**	990,760	-	4,728,262	-		
Total, PV of transport econ eff. Benefits (6 = 1a + 1b + 5)	**75,325,547**						

Note that subtotals (1a + 1b) and (5) flow into the AMCB table. Subtotal (6) does not.

Cardiff Dowlais Top Hourly (Diesel)

Table 2 Public Accounts (costs should be recorded as a positive number, surpluses as a negative one)

	All Modes Total	Road Infrastructure	Bus & Coach	Rail	Walk and Cycle		
Local Government funding							
- Direct Revenue	-						
- Operating costs	-						
- Investment costs	- 268,980	-268,980					
- Developer and other contributions	-						
- Grant/Subsidy (k)*	-						
- Revenue transfer	-						
Net (7)	**- 268,980**	- 268,980	-	-			
Central Government funding: Transport							
- Direct Revenue	-						
- Operating costs	-						
- Investment costs*	15,247,217			15,247,217			
- Developer and other contributions	-						
- Grant/Subsidy (k)*	9,783,886	0	0	9,783,886	0		
- Indirect Tax Revenues							
- Revenue transfer	-						
Net (8)	**25,031,103**	-	-	25,031,103			
Central Government Funding: Non-Transport							
Indirect tax Revenues (9)	**16,800,339**	16,800,339					
Totals							
Broad Transport Budget (10 = 7 + 8)	**24,762,123**						
Wider Public Finances (11 = 9)	**16,800,339**						

*The public sector costs in these boxes should exclude developer contribution e.g. developer contribution is subtracted from these figures to give Net (8)

Cardiff Dowlais Top Hourly (Diesel)

Table 3: Analysis of Monetised Costs and Benefits (AMCB)

	Total	Road	Bus & Coach	Rail	Walk and Cycle		
Noise	175,422			175,422			
Local air quality	-	0					
Greenhouse gases	1,882,861	1,882,861					
Journey ambience (incl. rolling stock quality, and in vehicle crowding)	-						
Accidents (incl. safety)	7,863,510	4,116,565		3,746,945			
Physical Fitness	8,640,788			8,640,788			
Economic Efficiency: Consumers Users (Commuting) (1a)	39,280,655	6,804,959		32,475,696			
Economic Efficiency: Consumers Users (Other) (1b)	30,325,869	5,253,637	0	25,072,233			
Economic Efficiency: Business users and providers (5)	5,719,023	990,760	0	4,728,262			
Wider Public Finances (indirect Taxation Revenues (-11)	- 16,800,339						
Reliability (incl. performance & reliability)	-						
Option values	-						
Interchange (station quality and crowding)	-						
Present Value of Benefits (PVB) (sum all benefits - 11)	**77,087,789**						
Broad Transport Budget (10)	24,762,123						
Present Value of Costs (PVC) (10)	**24,762,123**						
Overall Impacts							
Net Present Value (NPV)	**52,325,666**						
Benefit to Cost Ratio (BCR)	**3.11**						

Cardiff Dowlais Top Half Hourly (Diesel)

Table 1: Economic Efficiency of Transport System (revenues are scored as positives, costs as negatives)

	All Modes	Road	Bus & Coach	Rail Total		Rail	Rail
	Total	Cars, LGVs and goods vehicles	Passengers	Passengers	Walk and Cycle	Company A e.g. NR	Other e.g. TOC/FOC
Consumers - Commuting							
User benefits							
- travel time saving	66,067,366	11,360,525		54,706,841			54,706,841
- Vehicle opcost	-			-			
- user charges	-			-			
- during construction & maintenance	-			-			
Net Consumer Benefits (1a)	**66,067,366**	11,360,525		54,706,841			54,706,841
				-			
Consumers - Other							
User Benefits							
- travel time saving	51,006,031	8,770,673		42,235,358			42,235,358
- Vehicle opcost	-			-			
- user charges	-			-			
- during construction & maintenance	-			-			
Net Consumer Benefits (1b)	**51,006,031**	8,770,673	-	42,235,358		-	42,235,358
Business							
User benefits							
- Travel time	9,619,003	1,654,023		7,964,981			7,964,981
- Vehicle opcost	-			-			
- Reduced absenteeism	-						
- user charges	-			-			
- during construction & maintenance	-			-			
Net Business User Benefits (2)	**9,619,003**	1,654,023	-	7,964,981	-	-	7,964,981
Private sector provider impact							
- revenue	110,081,057			110,081,057			110,081,057
- opcost	- 140,697,050			- 140,697,050			-140,697,050
- investment cost	-			-			
- grant/subsidy	30,615,994	0	0	30,615,994	0	0	30,615,994
- revenue transfer	-			-			
Sub total (3)	**-**	-	-	-		-	-
Other impacts							
- Developer contribution (4)		-	-	-			
Net business impact (5 = 2+3+4)	**9,619,003**	1,654,023	-	7,964,981	-		
Total, PV of transport econ eff. Benefits (6 = 1a + 1b + 5)	**126,692,401**						

Note that subtotals (1a + 1b) and (5) flow into the AMCB table. Subtotal (6) does not.

Cardiff Dowlais Top Half Hourly (Diesel)

Table 2 Public Accounts (costs should be recorded as a positive number, surpluses as a negative one)

	All Modes Total	Road Infrastructure	Bus & Coach	Rail	Walk and Cycle		
Local Government funding							
- Direct Revenue	-						
- Operating costs	-						
- Investment costs	- 449,048	-449,048					
- Developer and other contributions	-						
- Grant/Subsidy (k)*	-						
- Revenue transfer	-						
Net (7)	**- 449,048**	- 449,048	-	-			
Central Government funding: Transport							
- Direct Revenue	-						
- Operating costs	-						
- Investment costs*	37,504,361			37,504,361			
- Developer and other contributions	-						
- Grant/Subsidy (k)*	30,615,994	0	0	30,615,994	0		
- Indirect Tax Revenues							
- Revenue transfer	-						
Net (8)	**68,120,355**	-	-	68,120,355			
Central Government Funding: Non-Transport							
Indirect tax Revenues (9)	**28,047,292**	28,047,292					
Totals							
Broad Transport Budget (10 = 7 + 8)	**67,671,306**						
Wider Public Finances (11 = 9)	**28,047,292**						

*The public sector costs in these boxes should exclude developer contribution e.g. developer contribution is subtracted from these figures to give Net (8)

Cardiff Dowlais Top Half Hourly (Diesel)

Table 3: Analysis of Monetised Costs and Benefits (AMCB)

	Total	Road	Bus & Coach	Rail	Walk and Cycle		
Noise	292,858			292,858			
Local air quality	-	0					
Greenhouse gases	3,143,338	3,143,338					
Journey ambience (incl. rolling stock quality, and in vehicle crowding)	-						
Accidents (incl. safety)	13,127,721	6,872,391		6,255,330			
Physical Fitness	14,565,327			14,565,327			
Economic Efficiency: Consumers Users (Commuting) (1a)	66,067,366	11,360,525		54,706,841			
Economic Efficiency: Consumers Users (Other) (1b)	51,006,031	8,770,673	0	42,235,358			
Economic Efficiency: Business users and providers (5)	9,619,003	1,654,023	0	7,964,981			
Wider Public Finances (indirect Taxation Revenues (-11)	- 28,047,292						
Reliability (incl. performance & reliability)	-						
Option values	-						
Interchange (station quality and crowding)	-						
Present Value of Benefits (PVB) (sum all benefits - 11)	**129,774,352**						
Broad Transport Budget (10)	67,671,306						
Present Value of Costs (PVC) (10)	**67,671,306**						
Overall Impacts							
Net Present Value (NPV)	**62,103,046**						
Benefit to Cost Ratio (BCR)	**1.92**						