Highland and Islands Enterprise

Highland Rail
Room for Growth Study
Final Report

24 March 2006

Highland Rail – Room for Growth Study
Final Report

for

Highlands and Islands Enterprise
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Report Verification

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Revision Schedule

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EXECUTIVE SUMMARY

The 'Room for Growth' Study for all of the rail routes in the Highlands of Scotland has been commissioned by Highlands and Islands Enterprise to address key rail development issues. These key rail issues are dealt with in the Rail Utilisation Strategies (RUS) in other parts of the country, the responsibility of Network Rail. In order for the Highland routes to reach comparable status in terms of an overall transport framework for Scotland within a reasonable timescale, Scott Wilson Railways Group has prepared this report which equates to RUS for other routes in Central and Southern Scotland. It is the intention that each route is considered in turn with a view to highlighting potential areas of development that can be considered for support or rejection in the political arena. Decisions can then be reached within the context of best value for the monies allocated by the Scottish Executive for rail transport throughout Scotland.

KEY AREAS OF STUDY

The study splits the Highland Rail Network in to specific lines of route. These routes each have special characteristics, geographical and social, as well as unique characteristics of railway operation. The routes are:

- Highland Main Line: Perth to Inverness;
- Far North Line: Inverness to Thurso and Wick;
- Kyle Line: Dingwall to Kyle of Lochalsh;
- Glasgow to Fort William;
- Glasgow to Oban;
- Fort William to Mallaig; and
- Inverness to Aberdeen (but considering only between Inverness and Elgin).

The key areas of study for each of the above routes have been split in to two distinct railway disciplines: operations and engineering. Operational issues consider line capacity, timetables and trains whilst engineering issues consider permanent way, signalling and structures and the implications of any enhancements to each of these individual areas. Cost estimates are summarised where appropriate in order to provide the authorities with ballpark figures based on our knowledge as railway consulting engineers.

STUDY AIMS

The aim of the study (for each line of route) is to:

- Analyse present timetables which operate over the routes, recommending where improvements could be made and how more efficient use of existing resources might be managed;
- Discuss the possible enhancements to train services, as laid down by the clients and consulted bodies, and what solutions may be required from a line capacity point of view;
- As a result of desired increase to train services to discuss the essential engineering requirements that will need to be considered to attain the desired line capacity to make timetables robust; and
- To provide an estimate*e* of the associated costs of both provision of additional resources to operate the enhanced services and provision of certain engineering solutions that have been brought forward for consideration.

The study does not attempt to supply:

- Timetables that are detailed to the degree that they are compliant with Rules of the Route/Plan and have been modelled through computer simulation in accordance with present day standards of Network Rail and Train Operators;
- Methods of working which a particular Train Operator should employ;
- Final solutions;
- Detailed costs of operating or engineering solutions; and
- Detailed engineering surveys.

The study does not attempt to advise partners in the rail industry how to conduct their businesses.

KEY OPTIONS FOR APPRAISAL FOR EACH LINE OF ROUTE

- Highland Main Line (including Ladybank to Hilton):

  Linespeed improvements, reinstatement of double track between Daviot and Culloden and reinstatement of lifted loops.

- Far North Line (existing mileage):

  Linespeed improvements, level crossing upgrades, points renewals at loops for higher speeds.

  Construction of link from Tain to Golspie via Dornoch.

- Kyle Line:

  Upgrading of line for freight and reinstatement of passing loop at Stromeferry.

- Fort William, Mallaig & Oban lines:

  Timetable improvements

- Oban line infrastructure enhancements:

  Upgrading of line for freight

- Inverness to Elgin:

  Introduction of a variation to Invernet 2 timetable

SUMMARY

The various highlighted recommendations for each line of route can be considered amongst any package of measures if it is decided, at some future date, to proceed with improvements to Highland Rail Routes as part of an overall upgrade strategy.

Part 1

1. INTRODUCTION

1.1 BACKGROUND

Scott Wilson Railways were commissioned by a Client Group led by Highlands and Islands Enterprise in August 2005 to undertake a study of the Highland Rail network. Set against the background of the devolution of rail powers to the Scottish Executive the aim of the study is to identify the main constraints on the capacity of the network's infrastructure, which are limiting potential development opportunities. The study is also required to identify, on the basis of growth predictions and aspirations, the work that is required to remove the constraint and in so doing provide an estimate of the cost of such works.

The lines covered by the study are illustrated in Figure 1-1 below.

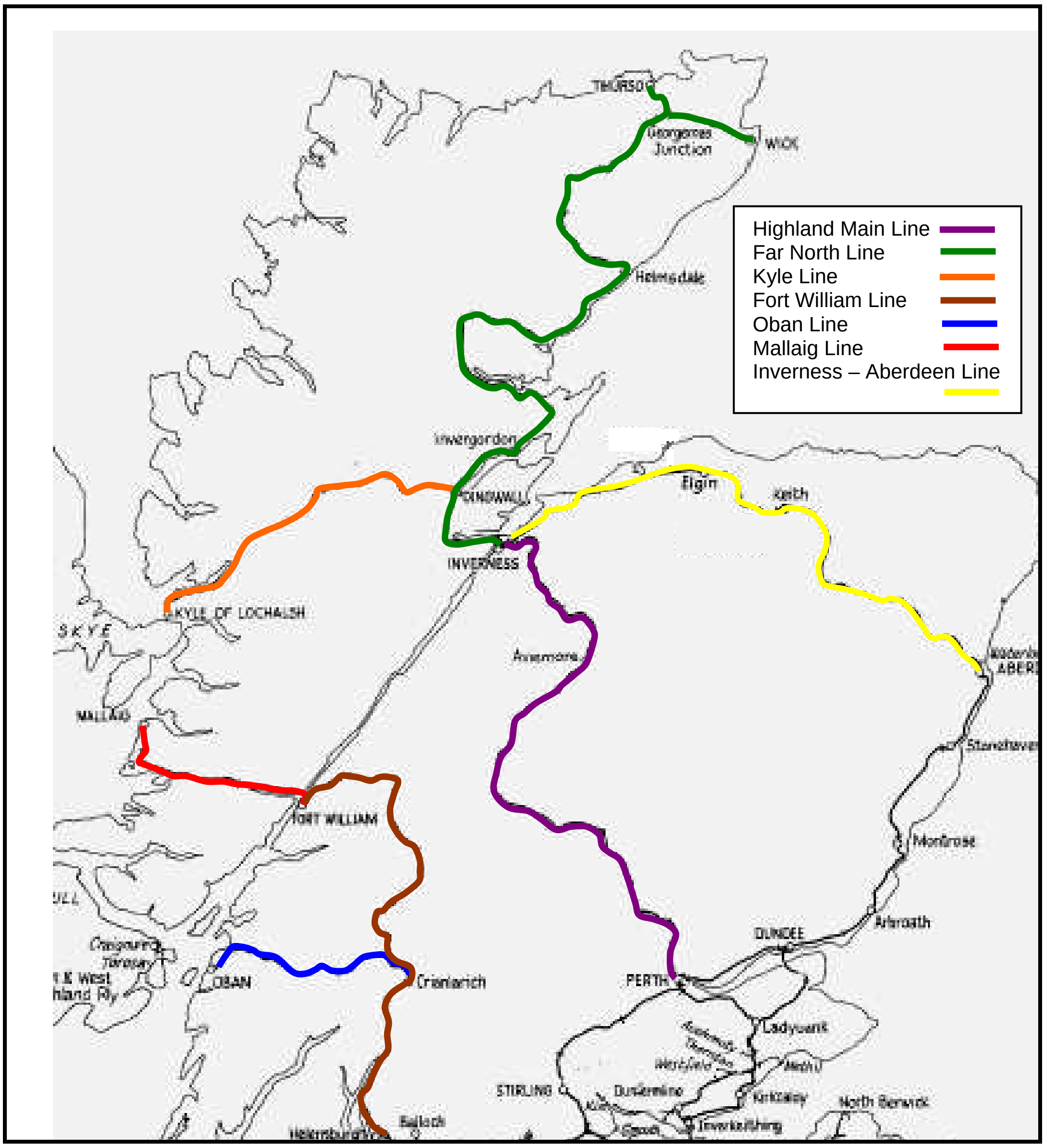

Figure 1-1: Overview of Study Network

The lines covered by the study are defined as shown in Table 1-1.

Line	Definition
Highland Main Line	Perth to Inverness
Far North Line	Inverness to Wick and Thurso
Kyle Line	Dingwall Junction to Kyle of Lochalsh
Fort William Line	Craigendoran to Fort William
Oban Line	Crianlarich Junction to Oban
Mallaig Line	Fort William Junction to Mallaig

Table 1-1: Definition of Lines in Study Area

The Inverness to Aberdeen line is included in the foregoing diagram although it is excluded from the study by virtue of it being part of the Network Rail RUS. There is however a link into the study area brought about through the second phase of Invernet.

Whilst the foregoing describes the area of the study it should be recognised that consideration will be given to the links from the study area to both Edinburgh and Glasgow.

1.2 PURPOSE OF REPORT

The study is divided into two parts. The first gathers data from a number of sources to present a view of the current rail network. This is considered from both the engineering and operational standpoints. The output from this work is reported here in Part 1 of the study.

The second part of the study provides analysis, taking account of the growth forecasts and aspirations for the Highland rail network, and based on the Part 1 outcome determines the actions required to deliver the growth options. This is reported in Part 2 of this document.

1.3 REPORT STRUCTURE

Following this brief introduction the report provides an overview of the methodology used in the gathering of the data required to deliver this report. Section 3 is the first of two sections considering the operational aspects of the network; it deals with the traffic on the routes. The second operations section provides a link into the engineering by setting out the operational limitations imposed by the infrastructure; this is Section 4.

Section 5 sees the start of the technical assessment of the network. This part provides an overview of the existing infrastructure available on the network. This is followed by consideration of the individual engineering elements of the railway through the identification of the issues associated with each.

A final Section considers external factors that may impact on the rail network and any enhancements to be considered in the study.

The report is supported by two appendices, which provide a route-based summary of the operational and engineering characteristics of the lines.

2. METHODOLOGY

2.1 INTRODUCTION

This Section of the report provides a brief summary of the methodology employed to deliver this Issues Report. It provides a view on the sources of the data used in the report and their assimilation into the tables and appendices.

2.2 DATA GATHERING

The data that has been assembled for this report has been obtained from a number of sources. Consideration of the operational capabilities of the individual lines has come from Network Rail documentation namely, Sectional Appendix, Rules of the Plan, Working Timetables and Rules of the Route. This has been supplemented by first hand knowledge of the network and contact with relevant parties in the train operating companies.

The infrastructure elements of the network have been derived from Network Rail records, the Network Rail web site, and known issues derived from experience both within and outwith the study team. Information relating to the structure clearance along the route has been obtained through the running of the ‘Clear Route 5’ software to analyse information held in the National Gauging Database for the various lines. This analysis has been carried out in conformance with Network Rail’s Group Standard GC/RT/5212, which is the accepted industry standard.

2.3 REPORTING

The format of the report is described in Section 1.3. The approach adopted has been to provide a commentary covering both the operational and technical features of the lines. This is then summarised in a series of line diagrams, which provide a feature-by-feature walk-through for each line highlighting the capabilities and capacity of the route and drawing special attention to any constraints as they emerge.

3. OPERATIONS – TRAFFIC

3.1 INTRODUCTION

This Section of the report provides an account of the traffic that operates on the Highland rail network. This begins with a historical summary of traffic levels and types, considers the train operators on the routes, and finally provides a review of current traffic patterns for both passenger and freight.

3.2 BACKGROUND

The railways of the Highlands of Scotland have undergone a radical transformation in the last forty years although it could be argued that the infrastructure is now inadequate to cope with future aspirations. Although many miles of track were closed prior to 1965 the remainder has been saved due largely to the inadequate state of the road network and the social consequences faced by the local population.

The Highland railways of the early part of the 20th century saw tourist traffic for only two or three months of the year, during which trains carried vast numbers of people, who had emigrated from the Islands, home from the Central Belt on holiday. These people were generally from the lower income brackets and for whom car transport was not possible. In the winter trains carried few passengers. Freight was mainly fish from Kyle, Mallaig and Oban and it was not until the late 1920s when the new aluminium industry brought other traffic (and a working population) to Fort William. The opening of the Corpach Pulp Mill in 1966 contributed to the saving of the West Highland Railway.

The prospect of oil helped the cause of the Far North and Kyle lines although the threat of closure of the Kyle line was not lifted until 1974. This promised oil traffic also led to the reinstatement of the double line between Blair Atholl and Dalwhinnie. At the same time the whisky traffic from Speyside remained a stable commodity until the late 1980s. Fish traffic on rail had largely ceased by the late 1960s.

Now with the growth of Inverness, the outdoor centres of Fort William and Aviemore (and the re-introduction of steam trains) and the greater mobility of the population, the tourist industry has blossomed in to an all year round activity. Along with this business traffic has increased on the network in reaction to improvements in the quality of the service. At the same time forests are maturing and timber is being transported to railheads such as Kinbrace, Crianlarich and Arrochar for onward shipment. Inverness is also growing as a commercial and industrial centre leading to a requirement for more freight traffic.

The railways, able to cope with the demands of a generation ago, are now being called upon to cater for traffic they were not necessarily built for. It is an understanding of the future demands on the rail network that is the driver for this study.

3.3 PASSENGER OPERATING COMPANIES

First ScotRail operates around 95% of the passenger train services in Scotland. In the Highland area the only other trains are the daily Inverness / Kings Cross service operated by GNER and the summer Jacobite steam service between Fort William and Mallaig operated by West Coast Railways who also now operate the Royal Scotsman Luxury Train.

The development of the lightweight 'sprinter' unit operation has revolutionized passenger traffic and increased the number of service per day to some locations. First ScotRail now run a fleet of Class 170 units on the Highland Main Line, Class 158s on the Far North and Kyle lines and Class 156s on the Fort William Lines. The use of these units on other routes in the Central Belt has meant that services are more integrated and more economic use can be made of all units.

There are also smaller companies that run charter traffic but only on an ad hoc basis. First ScotRail operates all overnight sleeper services. Virgin Trains do not run any services in the area being considered in this report.

3.4 FREIGHT OPERATING COMPANIES

English, Welsh and Scottish Railway (EWS) operates the greater percentage of freight traffic in the Highland area. This traffic comprises of timber, oil and petroleum, bulk alumina and finished products on the Fort William Line, pipe traffic to the Far North and express parcels traffic between the Midlands and Inverness.

Freightliner Ltd runs a daily cement train between the Lafarge terminal at Oxwellmains (Dunbar) to the Lafarge terminal at Inverness.

Other freight companies such as Direct Rail Services (DRS) and GB Railfreight presently do not run services in the Highland area. DRS has a major base at Grangemouth from which it runs container based perishable foods on a daily basis to Aberdeen. At the time of writing this report it is known that DRS is actively recruiting drivers in Inverness.

3.5 PASSENGER TRAFFIC

3.5.1 Highland Main Line

All of the train services on this section of line either start or terminate outwith the area of study. Most of the journeys therefore start or finish in another region. The following are factors that contribute to the increase in passenger journeys, particularly on First ScotRail services:

- Tourism;
- Social; and
- Commuter, particularly with growth of commercial centres i.e. Inverness.

The social journeys by local residents are also a factor of population increase around Inverness and Perth. The increase in commuter journeys will be greater in 2005 with the introduction of the Invernet services, which adds a commuter train from Kingussie to Inverness and return in the evening.

A study carried out by Steer Davies Gleave in 2004 (Valuing the Rail Network) showed that most people travelled all the way between Perth and Inverness and that Edinburgh and Glasgow were the most common origin / destination. Of the intermediate stations Pitlochry and Aviemore have the highest patronage, which bears out the relevance of commuter type travel as these places are nearest to the centres of commerce.

First ScotRail run a two hourly frequency and GNER run a daily train on the route. Business travellers between Edinburgh and Inverness, according to GNER, favour the inter-city style service as it provides a restaurant service and runs to / from Edinburgh at convenient times for such a market. However, the larger percentage of travellers on this train is travelling longer distances to avoid having to change trains en route. This is the only daytime Anglo-Scottish commercial service specified by the Department for Transport on the line.

The overnight sleeper service is popular with both tourist and business travellers and provides good connections at Inverness with Wick, Kyle and Aberdeen trains. There is limited seating accommodation on the sleeper service aimed mainly at backpackers.

The Royal Scotsman Luxury train runs on average twice per week (summer only) on various parts of the route. As part of the routing, this train accesses the Strathspey Private Railway and Boat of Garten.

The following tabulation contains the SRA recorded footfall at the stations on the line in 2004.

Station	Annual Station Entries	Annual Station Exits
Inverness	376,305	345,053
Perth	271,389	279,504
Aviemore	34,892	35,380
Pitlochry	33,429	33,461
Kingussie	11,672	12,143
Dunkeld	7,297	8,109
Blair Atholl	4,146	4,467
Newtonmore	1,977	2,207
Dalwhinnie	929	1,137
Carrbridge	722	809

Table 3-1: Highland Main Line Station Usage

3.5.2 Far North Line

Most trains start / terminate at Inverness with connections with other services. All are operated by First ScotRail and are formed by Class 158 units. Where trains do run through, and there is only one train out of six that does so, this is done purely for operational reasons. Passenger traffic between Inverness and Thurso caters for the highest percentage (Steer Davies Gleave study) this reflects the fact that Thurso has the largest population north of Inverness. The journey time from Wick is not as attractive and the mileage by rail is longer due to services running to Thurso before going south to Inverness.

The following tabulation lists the footfall at stations on the route from SRA data for 2004.

Station	Annual Station Entries	Annual Station Exits
Thurso	19,100	19,012
Dingwall	18,853	12,996
Wick	8,367	11,199
Muir of Ord	8,210	13,845
Beauly	5,808	15,529
Golspie	5,248	1,784
Tain	4,499	6,384
Invergordon	2,580	4,489
Brora	2,021	2,003
Lairg	1,969	2,357
Helmsdale	1,851	2,121
Ardgay	1,349	1,154
Alness	1,284	2,433
Culrain	865	891
Rogart	805	698
Forsinard	716	716
Fearn	653	1,256
Georgemas	583	546
Kinbrace	394	360
Invershin	136	151
Scotscalder	105	103
Dunrobin Castle	84	107
Kildonan	44	45
Altnabreac	38	55

Table 3-2: Far North Line Station Usage

With the new Invernet service proposal the early morning train to Inverness will start from Lairg, which has always been viewed as the railhead for the far northwest of Scotland and services are being increased to and from Tain and Invergordon. Communities within easy reach of Inverness will benefit greatly and it is expected that the patronage at most stations will increase.

Three trains per day will run beyond Lairg to Thurso and Wick, four southbound from Wick from December 2006.

The Royal Scotsman will continue to use the line to Dingwall, on average twice per week between April and October, to gain access to the Kyle Line.

3.5.3 Kyle Line

Three trains operate each way daily on the route with a fourth service operating in the summer peak. These are operated by First ScotRail and are formed by Class 158 units. The SDG Survey showed that more than 50% of the patronage on the line travel the entire route with Plockton being the most used intermediate station.

Tourist traffic caters for the bulk of travellers due to the high scenic qualities of the route and worldwide publicity, particularly over the closure threats of recent years. The line is not being provided with any additional services as a result of the Invernet proposals.

The Royal Scotsman runs on average twice per week, stabling overnight at Kyle of Lochalsh. The route is used often by charter trains due to the high scenic quality of the journey.

The following tabulation lists the footfall at stations on the route from SRA data for 2004.

Station	Annual Station Entries	Annual Station Exits
Kyle of Lochalsh	16,001	25,242
Garve	4,645	2,483
Strathcarron	3,932	3,910
Plockton	3,859	4,101
Achnasheen	1,088	1,059
Stromeferry	558	608
Achnashellach	282	382
Duirinish	243	276
Lochluichart	154	148
Duncraig	143	145
Attadale	106	110
Achanalt	98	88

Table 3-3: Kyle Line Station Usage

3.5.4 Fort William Line

All services are operated by First ScotRail and formed by Class 156 units. There is a daily overnight sleeper service between Fort William and London, which has a passenger coach for day travel between Fort William and Edinburgh. The services to and from Glasgow run attached to an Oban portion between Glasgow and Crianlarich. There are presently three trains per day on the line. The present Garelochhead to Glasgow morning commuter service is being extended to start at Arrochar and Tarbet from 12 December 2005.

The SDG study highlighted Bridge of Orchy and Corrour as the best used intermediate stations, as there are a considerable number of passengers that will leave their cars at Bridge of Orchy to travel by train to Corrour to go walking on Rannoch Moor where there is no public road access.

The following tabulation lists the footfall at stations on the route from SRA data for 2004.

Station	Annual Station Entries	Annual Station Exits
Fort William	59,266	47,018
Rannoch	6,455	6,007
Crianlarich	4,824	4,988
Arrochar & Tarbet	4,426	3,236
Corrour	4,286	5,601
Spean Bridge	2,444	2,636
Bridge of Orchy	2,367	2,549
Garelochhead	1,778	2,090
Roy Bridge	1,742	1,849
Tulloch	1,326	1,513
Ardlui	758	811
Helensburgh Upper	54	94
Upper Tyndrum	30	23

Table 3-4: Fort William Line Station Usage

Rannoch and Crianlarich are busy intermediate stations with the latter acting as an interchange facility for tourists travelling between Fort William and Oban. Train timetables are planned to cater for this flow as a service requirement.

The Royal Scotsman runs on average once every two weeks, stabling overnight at Spean Bridge.

The route is used often by charter trains due to the high scenic quality of the journey.

3.5.5 Oban Line

All services are operated by First ScotRail and formed by Class 156 units. The services to and from Glasgow run attached to a Mallaig portion between Glasgow and Crianlarich. There are three trains per day with an additional train on Saturdays between March and October.

The SDG study showed that 71% of passenger journeys were between Glasgow and Oban, that is, did not involve the use of intermediate stations. There are a very high number of journeys connecting with Inner Isles ferries. The journey time between Glasgow and Oban compares favourably with the scheduled bus services.

The following tabulation lists the footfall at stations on the route from SRA data for 2004.

Station	Annual Station Entries	Annual Station Exits
Oban	51,430	50,123
Tyndrum Lower	3,390	3,547
Taynuilt	3,288	4,249
Connel Ferry	1,270	1,416
Dalmally	1,119	1,211
Loch Awe	987	1,072
Falls of Cruachan	32	36

Table 3-5: Oban Line Station Usage

The Royal Scotsman runs on average once every two weeks, stabling overnight at Taynuilt.

3.5.6 Mallaig Line

Four services each way are operated by First ScotRail and formed by Class 156 units, three of which run to / from Glasgow. Connections are made with the sleeper service at Fort William. Arisaig is the most used intermediate station (a larger than average population for a Highland village) although Glenfinnan station is now a museum, which attracts large numbers.

The Jacobite steam service runs six days per week between May and October with this increased to seven days in August. These services attract many hundreds of people to the line. This is mainly because of the connection with the 'Harry Potter' films and Glenfinnan and the unique scenic quality of the line, which is world-renowned. There are many charter trains during the summer months.

The Royal Scotsman runs on average once every two weeks between April and October.

The following tabulation lists the footfall at stations on the route from SRA data for 2004.

Station	Annual Station Entries	Annual Station Exits
Mallaig	29,111	35,189
Arisaig	3,551	4,127
Glenfinnan	1,671	1,996
Morar	1,614	1,934
Banavie	1,196	1,722
Corpach	970	994
Lochailort	818	889
Loch Eil Outward Bound	277	334
Beasdale	242	247
Locheilside	167	157

Table 3-6: Mallaig Line Station Usage

3.5.7 Service Frequency

The following tabulation provides a summary of the current service frequencies on the various routes.

Route	Service	Trains per Weekday
Highland Main Line	Perth to Inverness	9
Far North Line	Inverness to Thurso and Wick	3
Kyle Line	Inverness to Kyle of Lochalsh	3 (July – September)
Fort William Line	Glasgow to Fort William	4
Oban Line	Glasgow to Oban	3 (4 on Saturdays)
Mallaig Line	Fort William to Mallaig	5 (includes Jacobite)

Table 3-7:Summary of Passenger Service Frequencies

3.6 FREIGHT TRAFFIC

3.6.1 Highland Main Line

Commodities carried:

Cement, container based perishable goods, oil, pipes, parcels, and timber.

Paths per day in timetable: 3

Freight terminals: Inverness Millburn

3.6.2 Far North Line

Commodities carried:

Container based perishable goods, oil, pipes, and timber.

Paths per day in timetable: 4

Freight terminals: Lairg, Kinbrace and Georgemas

3.6.3 Kyle Line

Commodities carried: Nil

Potential commodities: Fish, Oil, Timber, and Parcels

Paths in timetable: Nil

Freight terminals: none

3.6.4 Fort William Line

Commodities carried: Oil, bulk alumina, timber, aluminium ingots, MOD Explosives

Paths in timetable: 5

Freight Terminals: Glen Douglas, Arrochar, Crianlarich Upper, Fort William British Alcan, Fort William Junction

3.6.5 Oban Line

Commodities carried: Nil

Potential commodities: Oil, Fish, Timber, and Parcels

Paths in timetable: Nil

Freight Terminals: none in use

3.6.6 Mallaig Line

Commodities carried: Nil (formerly china clay to Corpach Pulp Mill)

Potential Commodities: Oil, Fish, and Timber

Paths in timetable: 1 per day

Freight Terminals: none in use

4. OPERATIONS - INFRASTRUCTURE LIMITATIONS

4.1 INTRODUCTION

This Section considers the operational limitations imposed by the infrastructure on the routes.

4.2 BACKGROUND

The growth in traffic over recent years, coupled with known aspirations has led to this review of the network and to examine in detail each route and where there are constraints to growth. The Highland routes are characterised by long sections of single line track. The problems of operating a single line railway are well known and have been well documented over times past. Trains are now capable of higher speeds and require to be of a longer length in order to be more economical.

Signalling renewals due to the assets becoming life expired has driven many alterations to infrastructure. In the 1970s and 1980s there was much work done on the Highland Main Line to improve signalling, with the commissioning of the Aviemore panel and closure of some signal boxes as a result. In the past, the rationalisation of the Highland Main Line saw the closure of a number of loops notably at Murthly and Ballinluig. In more recent times a number of these rationalisations are being reversed in the light of additional traffic requirements.

Radio Electronic Token Block (RETB) signalling transformed the Far North, Kyle and Fort William Lines in the late 1980s. However the RETB system does not facilitate the overtaking of trains by faster services.

In order to achieve the aspiration of quicker journeys and more train paths a detailed review of train service patterns may be required (perhaps with the aid of computer modelling) to ascertain where areas of single line require to be doubled or loops inserted.

There is a real concern amongst some stakeholders that the Highland routes have become a victim of their own success. There is now very little opportunity for additional trains e.g. charters to find 'white space' to run ad hoc services. The emphasis on safe working and new rules and regulations has meant that some practices, commonplace at one time, are now 'illegal' but still perfectly safe if managed properly. These include propelling of passenger trains and stabling overnight in a passenger loop although this applies to the Royal Scotsman service only. On routes where there is a considerable under-utilisation of capacity, the customer cannot understand why the same restrictions placed on busy routes (and understandably) must apply.

4.3 LINE SPEEDS

Whilst it is recognized that the ideal railway would have maximum line speeds everywhere it is recognized that geographical constraints in the Highlands make this difficult to achieve. The following are the main features on each route which increase these constraints even more and which are paramount issues to address:

4.3.1 Highland Main Line

The general running speeds on the Highland Main Line are 75 / 80mph. At specific locations this reduces to 55 / 60mph and for a short length increases to 100mph. The following are notable low line speed restrictions that affect increase in point to point timings:

Location	Restriction
Killiecrankie Tunnel	30 mph as a result of restricted gauge clearance

Table 4-1: Highland Main Line Speed Constraints

4.3.2 Far North Line

The general line speed on this route is 60 / 65mph. North of Helmsdale this reduces to 50mph. The following lower line speeds apply which affect increase in point to point timings:

4.3.3 Kyle Line

The line speeds are relatively low at 40mph due to geographical nature of the area and curvature of the track. There are a lot of further restrictions as a result of the numerous level crossings.

4.3.4 Fort William Line

The line speeds are a relatively low 40mph due to geographical nature of the area and curvature of the track.

4.3.5 Oban Line

The line speeds range between 45-50mph due to geographical nature of the area and curvature of the track.

4.3.6 Mallaig Line

The line speeds range between 30-40mph due to geographical nature of the area and curvature of the track.

4.4 JOURNEY TIMES

The following tables provide a summary of journey times for both passenger and freight traffic on the lines.

4.4.1 Highland Main Line

Route Section	Distance	Average Speed	Fastest Journey Times	Slowest Journey Times
Perth – Inverness	118 miles	52 - 58mph	121 minutes (First ScotRail Class 170 with three station calls) 126 minutes for GNER HST	137 minutes (First ScotRail Class 170 calling all stations)
Inverness – Perth *	118 miles	54 - 59mph	119 minutes (First ScotRail Class 170 with four station calls) 119 minutes for GNER HST	131 minutes (First ScotRail Class 170 calling at all stations)

*** Gradients in southbound (Up) direction not as long or as severe.**

Table 4-2: Highland Main Line Passenger Journey Times

Considering the links to Edinburgh and Glasgow train times from Perth to these cities are:

- Edinburgh to Perth: 73 to 90 minutes giving an average speed range of between 47 and 57mph for the 70 miles
- Glasgow to Perth: 57 to 67 minutes giving an average speed range of between 55 and 65mph for the 62 miles

Freight train running times between Perth and Inverness range between 128 minutes and 294 minutes depending on service type and time of day.

4.4.2 Far North Line

Route Section	Distance	Average Speed	Fastest Journey Times	Slowest Journey Times
Inverness – Tain	44 miles	40mph	65.5 minutes	67 minutes
Inverness – Thurso	147 miles	39mph	222 minutes	227 minutes
Inverness – Wick via Thurso	175 miles	41mph	255 minutes	257 minutes
Wick – Inverness (via Thurso)	175 miles	42mph	251 minutes	254 minutes
Thurso - Inverness	147 miles	39mph	222 minutes	227 minutes
Tain - Inverness	44 miles	40mph	65 minutes	67 minutes

Note: All times quoted are for First ScotRail Class 158 units.

Table 4-3: Far North Line Passenger Journey Times

Freight train running times between Inverness and Georgemas range between 205 minutes and 250 minutes depending on service type and time of day.

4.4.3 Kyle Line

Route Section	Distance	Average Speed	Fastest Journey Times	Slowest Journey Times
Inverness – Kyle	82 miles	31-35mph	147 minutes	157 minutes *
Kyle – Inverness	82 miles	33mph	149 minutes	152 minutes

*** Starts Inverness Platform 4 and reverses at Welsh's Bridge to run via Rose Street**

Table 4-4: Kyle Line Passenger Journey Times

There are no timetabled freight services on this line.

4.4.4 West Highland Line

Route Section	Distance	Average Speed	Fastest Journey time	Slowest Journey time
Glasgow Queen Street – Fort William	122 miles	33 mph	221 minutes	225 minutes 226 minutes +
Glasgow Queen Street – Mallaig	161 miles	31mph	308 minutes	310 minutes
Glasgow Queen Street - Oban	101 miles	34mph	175 minutes	179 minutes
Fort William – Glasgow Queen Street	122 miles	33mph	221 minutes	223 minutes 235 minutes +
Mallaig – Glasgow Queen Street	161 miles	31mph	310 minutes	320 minutes
Oban – Glasgow Queen Street	101 miles	33mph	174 minutes	189 minutes

+ Locomotive hauled sleeper service between Westerton and Fort William

Table 4-5: West Highland Line Passenger Journey Times

Freight train running times between Mossend and Fort William range between 353 minutes and 364 minutes depending on service type and time of day.

There are no freight services timetabled on the Oban and Mallaig lines.

4.5 ROUTE CAPABILITY

The capability of the lines on the Highland Rail Network, as defined in this Issues Report, cover two parameters, route availability and gauge clearance. The base data for this summary has been sourced from the Network Rail web site.

Gauge clearance defines the limiting cross-section of trains that will fit through bridges on the route. The 'W' relates to specific profiles for freight wagons however, these profiles also accommodate passenger coaches. The number associated with the profile represents, on an ascending scale, a route capable of handling larger trains.

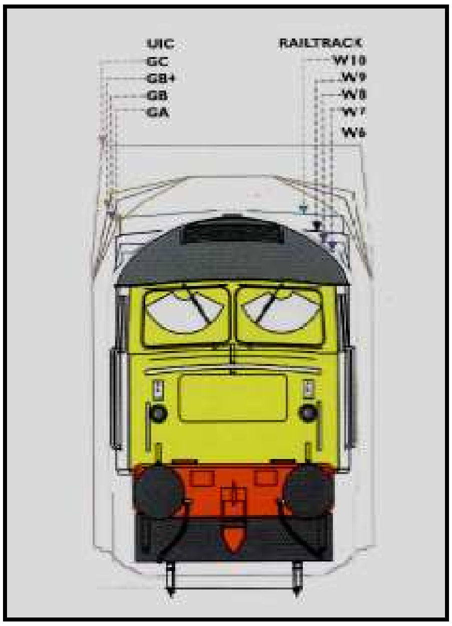

Figure 4-1: Diagram of Structure Clearances

Route Availability is a measure of the weight of train that can be carried safely over the route. The numbers relate to specific permissible axle weight limits. The two ranges identified on the Highland Network are:

- RA10 – the maximum capability on any UK route with a permissible axle loading of 25.4tonnes.
- RA5 – a permissible axle loading of 19.05tonnes.

Line of Route	Section	Gauge Clearance	Route Availability
Highland Main Line	Perth to Inverness	W8	RA10
Far North Line	Inverness to Invergordon	W8	RA10
	Invergordon to Wick	W8	RA5
	Georgemas to Thurso	W7	RA5
Kyle Line	Dingwall Junction to Kyle of Lochalsh	W7	RA5
Fort William Line	Craigendoran Junction to Fort William	W8	RA5
Oban Line	Crianlarich Junction to Oban	W7	RA5
Mallaig Line	Fort William Junction to Corpach	W8	RA5
	Corpach to Mallaig	W7	RA5

Table 4-6: Summary of Route Capabilities

4.6 ROUTE CAPACITY

This Section considers the capacity of the route to handle trains. A table is presented for each line. The data provided considers

Headways – the time difference between services based on the signalling system. This represents how close trains can follow each other through a section.

Pinch Points – a location on a route that constrains capacity either as a result of low speeds or long signal sections.

Theoretical Capacity per Hour – based on the headway with an allowance for performance reasons.

4.6.1 Highland Main Line

Route Section	Headways	Single / Double Line	Pinch Points	Theoretical Capacity per Hour	Remarks
Perth – Stanley (7 miles)	5 minutes	Double		10 per hour in each direction	Actual usage governed by sections further north
Stanley – BlairAtholl (28 miles)	15 minutes	Single	Pitlochry – Blair Atholl (maximum of 30 mph at Killiecrankie)	4 per hour	Longest section is Dunkeld to Pitlochry
BlairAtholl – Dalwhinnie (23 miles)	10 minutes	Double		5 per hour in each direction	Actual usage governed by sections further north and south
Dalwhinnie – Kingussie (13 miles)	15 minutes	Single	Whole section	4 per hour	No intermediate signals
Kingussie – Culloden (40 miles)	10 minutes	Single		5 per hour	Colour light signalling / track circuit block
Culloden – Inverness (7 miles)	10 minutes	Double		5 per hour in each direction	Actual usage governed by sections further south

Table 4-7: Operational Characteristics on Highland Main Line

4.6.2 Far North Line

Route Section	Headways	Single / Double Line	Pinch Points	Theoretical Capacity per Hour	Remarks
Inverness - Muir of Ord (13 miles)	22 minutes	Single	Clachnaharry (10mph)	2 trains	Trains following in the same direction are able to follow at fourteen minute intervals using token exchange point at Clunes
Muir of Ord - Dingwall (6 miles)	12 minutes	Single		4 trains	
Dingwall - Tain (25 miles)	19 minutes	Single		3 trains	
Tain - Helmsdale (57 miles)	15 minutes	Single		4 trains	
Helmsdale - Georgemas (46 miles)	35 minutes	Single	Yes	1 train	Helmsdale to Forsinard is long RETB section
Georgemas - Wick (14 miles) Georgemas – Thurso (7 miles)	23 minutes	Single		2 trains	One train working

Table 4-8: Operational Characteristics on the Far North Line

4.6.3 Kyle Line

Route Section	Headways	Single / Double Line	Pinch Points	Theoretical Capacity per Hour	Remarks
Dingwall - Garve (12 miles)	20 minutes	Single		2 trains	
Garve – Achnasheen (16 miles)	25 minutes	Single		2 trains	
Achnasheen- Strathcarron (18 miles)	26 minutes	Single		2 trains	
Strathcarron – Kyle (18 miles)	42 minutes	Single	Yes	1 train	Single line with one block section

Table 4-9: Operational Characteristics on Kyle Line

4.6.4 Fort William Line

Route Section	Headways	Single / Double Line	Pinch Points	Theoretical Capacity per Hour	Remarks
Craigendoran-Garelochhead (9 miles)	20 minutes	Single		3 trains	Trains following in the same direction are able to follow at ten minute intervals using token exchange point at Helensburgh Upper
Garelochhead-Ardlui (19 miles)	14 minutes	Single		4 trains	
Ardlui – Crianlarich (8 miles)	18 minutes	Single	Yes	3 trains	Heavy Gradient
Crianlarich-Bridge of Orchy (13 miles)	16 minutes	Single		3 trains	
Bridge of Orchy - Tulloch (33 miles)	30 minutes	Single	Yes	2 trains	Trains following in the same direction are able to follow at fifteen minute intervals using token exchange points at Gorton or Corrour
Tulloch- Fort William (17 miles)	18 minutes	Single		3 trains	Trains following in the same direction are able to follow at ten minute intervals using token exchange point at Roy Bridge

Table 4-10: Operational Characteristics on Fort William Line

4.6.5 Oban Line

Route Section	Headways	Single / Double Line	Pinch Points	Theoretical Capacity per Hour	Remarks
Crianlarich – Dalmally (17 miles)	26 minutes	Single	Yes	2 trains	Trains following in the same direction are able to follow at ten minute intervals using token exchange point at Tyndrum Lower
Dalmally – Taynuilt (12 miles)	21 minutes	Single		2 trains	
Taynuilt – Oban (12 miles)	23 minutes	Single		2 trains	Trains following in the same direction are able to follow at twelve minute intervals using token exchange point at Connel Ferry.

Table 4-11: Operational Characteristics on the Oban Line

4.6.6 Mallaig Line

Route Section	Headways	Single / Double Line	Pinch Points	Theoretical Capacity per Hour	Remarks
Fort William - Glenfinnan (15 miles)	35 minutes	Single	Yes	1 train	Trains following in the same direction are able to follow at twenty minute intervals using token exchange point at Loch Eil Outward Bound
Glenfinnan – Arisaig (17 miles)	35 minutes	Single	Yes	1 train	Single block section
Arisaig – Mallaig (7 miles)	17 minutes	Single		3 trains	

Table 4-12: Operational Characteristics on the Mallaig Line

4.7 ROUTE UTILISATION

The following tables provide a measure of the individual lines' abilities to handle more traffic. This is calculated through the determination of the current utilisation. This figure is based on the Theoretical Capacity calculated earlier and reflects the capacity being taken up by the current train patterns.

4.7.1 Highland Main Line

Route Section	Number of Booked Paths per Day (05:30 – 23:30)		Percentage Capacity Utilised	Remarks
	Passenger	Freight		
Perth – Stanley (7 miles)	22	13*	10%	Double Line: track circuit block
Stanley – Blair Atholl (28 miles)	22	13	49%	
BlairAtholl – Dalwhinnie (23 miles)	22	13	17%	Double Line: Intermediate Block signal sections
Dalwhinnie – Kingussie (13 miles)	22	13	49%	
Kingussie – Culloden (40 miles)	22	13	32%	
Culloden – Inverness (7 miles)	22	13	17%	Double Line

*** Additional northbound freight path between 03:00 and 05:00 makes total of 14 freight trains**

Table 4-13: Highland Main Line Utilisation

Pathing conflictions can occur where areas of double track merge in to a single-track section, which raises track occupation time and therefore percentages.

4.7.2 Far North Line

Route Section	Number of Booked Paths per Day (05:30 – 23:30)		Percentage Capacity Utilised	Remarks
	Passenger	Freight		
Inverness – Muir of Ord (13 miles)	24	8	44%	Post Invernet Takes account of Clunes IB
Muir of Ord – Dingwall (6 miles)	24	8	44%	
Dingwall – Tain (25 miles)	24	8	59%	Longer signal sections
Tain – Helmsdale (57 miles)	8	8	22%	
Helmsdale – Georgemas (46 miles)	6	6	67%	
Georgemas- Wick (14 miles) Georgemas – Thurso (7 miles)	6	0	17%	

Table 4-14: Far North Line Utilisation

4.7.3 Kyle Line

Route Section	Number of Booked Paths per Day (05:30 – 23:30) $		Percentage Capacity Utilised	Remarks
	Passenger	Freight		
Dingwall - Garve (12 miles)	9	0	25%	Includes Royal Scotsman (one direction only) and summer ScotRail service
Garve – Achnasheen (16 miles)	9	0	25%	
Achnasheen- Strathcarron (18 miles)	9	0	25%	
Strathcarron – Kyle (18 miles)	9	0	50%	

$ By reducing number of hours of day operation the percentage usage will rise

Table 4-15: Kyle Line Utilisation

4.7.4 Fort William Line

Route Section	Number of Booked Paths per Day (05:30 – 23:30)		Percentage Capacity Utilised	Remarks
	Passenger	Freight		
Craigendoran- Garelochhead (9 miles)	10	8	33%	
Garelochhead-Ardlui (19 miles)	8	8	22%	
Ardlui – Crianlarich (8 miles)	8	6	25%	
Crianlarich - Bridge of Orchy (13 miles)	8	6	25%	
Bridge of Orchy- Tulloch (33 miles)	8	4	33%	
Tulloch- Fort William (17 miles)	8	4	22%	

Table 4-16: Fort William Line Utilisation

4.7.5 Oban Line

Route Section	Number of Booked Paths per Day (05:30 – 23:30)		Percentage Capacity Utilised	Remarks
	Passenger	Freight		
Crianlarich – Dalmally (17 miles)	7 *	0	20%	
Dalmally – Taynuilt (12 miles)	7 *	0	20%	
Taynuilt – Oban (12 miles)	6	0	17%	

*** Includes Royal Scotsman in one direction per day**

Table 4-17: Oban Line Utilisation

4.7.6 Mallaig Line

Route Section	Number of Booked Paths per Day (05:30 – 23:30)		Percentage Capacity Utilised	Remarks
	Passenger	Freight		
Fort William- Glenfinnan (15 miles)	10 ^	0	55%	
Glenfinnan – Arisaig (17 miles)	10 ^	0	55%	
Arisaig – Mallaig (7 miles)	10 ^	0	18%	

^ Includes Jacobite summer steam service

Table 4-18: Mallaig Line Utilisation

4.8 SIGNAL BOX OPENING HOURS

This section provides a view on the opening hours of signal boxes along the various lines. This provides an indication of when the routes are available for traffic. It should however be noted that signal boxes can be opened if traffic justifies the related additional costs.

4.8.1 Highland Main Line

Signal Box	Hours of Opening	Comments
Perth	Continuous	
Stanley Junction	Continuous	
Dunkeld	Continuous*	
Pitlochry	Continuous*	
Blair Atholl	Continuous*	
Dalwhinnie	Continuous*	
Kingussie	Continuous*	
Aviemore	Continuous	Controls Kincraig to Culloden
Inverness SC	Continuous	Controls Culloden northwards

*** These boxes were previously closed on the night shift but were open continuously for the EWS supermarket traffic, which has now ceased.**

Table 4-19: Highland Main Line Signal Box Opening Hours

4.8.2 Far North Line

Signal Box	Hours of Opening	Comments
Inverness RETB	Continuous	Night shift signaller works both the RETB and conventional signalling control systems

Table 4-20: Far North Line Signal Box Opening Hours

4.8.3 Fort William Line

Signal Box	Hours of Opening	Comments
Yoker IECC	Continuous	
Banavie RETB	Continuous	North & South Panels operated by one signaller on night shift.

Table 4-21: Fort William Line Signal Box Opening Hours

4.8.4 Kyle Line

Signal Box	Hours of Opening	Comments
Inverness RETB	Continuous	Night shift signaller works both the RETB and conventional signalling control systems

Table 4-22: Kyle Line Signal Box Opening Hours

4.8.5 Oban Line

Signal Box	Hours of Opening	Comments
Banavie RETB	Continuous	North & South Panels operated by one signaller on night shift.

Table 4-23: Oban Line Signal Box Opening Hours

4.8.6 Mallaig Line

Signal Box	Hours of Opening	Comments
Banavie RETB	Continuous	North & South Panels operated by one signaller on night shift.

Table 4-24: Mallaig Line Signal Box Opening Hours

5. INFRASTRUCTURE BASE INFORMATION

5.1 INTRODUCTION

This Section of the report provides an overview of the existing infrastructure available on the Highland rail network at this time. This is presented in a series of tables produced for each of the lines being considered.

5.2 MAINTENANCE

All railway lines require maintenance. This can be undertaken between traffic or at night when no services are timetables to run – the white period. The no-train periods on the Highland Network routes are tabulated below

SECTION	MIDWEEK	SAT - SUNDAY	REMARKS
Craigendoran - Ardlui	00:45 – 04:00	20:45 – 10:30	Times can vary according to time of year with additional Sunday services or charters during the summer Times of blockage will be imposed on passage of last booked service.
Ardlui – Crianlarich	04:10 – 07:15	20:15 – 10:30	
Crianlarich – Fort William	02:55 – 07:35	20:45 – 12:45	
Crianlarich – Oban	21:20 – 07:30	21:20 – 12:45	
Fort William – Mallaig	23:35 – 05:45	23:35 – 10:15	
Perth – Inverness	23:20 – 05:45	22:25 – 09:30	
Inverness – Ardgay	23:00 – 04:30	23:00 – 10:40	
Ardgay – Helmsdale	20:15 – 03:00	20:15 – 11:30	
Helmsdale – Wick	22:00 – 05:45	22:00 – 11:00	
Dingwall - Kyle	23:00 – 07:00	23:00 – 07:00	

Table 5-1: No-Train Periods on the Highland Network

5.3 RENEWALS

Infrastructure renewals are generally planned on an annual basis based on condition. In the past, major renewals were undertaken over a period of time, generally in the no-train periods, to minimise disruption to traffic. This protracted methodology resulted in higher costs and inefficiencies in the method of working. Recently, there has been a move to undertake major works in 'big bangs'. This shortens the period of work, improves efficiency but results in disruption to traffic.

5.4 EXISTING SIGNALLING AND OPERATIONAL INFRASTRUCTURE

All railway infrastructure represented or implied by these tables (track, civil, signal, operational, and electrical works etc.) is provided to permit the railway to operate as desired. To perform as designed, this infrastructure needs to be monitored, maintained, renewed, and enhanced as appropriate. By increasing traffic levels or line speeds, maintenance and renewal levels will alter; provision of operational alterations may lead to increasing the equipment count along the railway. Each of these factors adjust the whole-life cost of the infrastructure necessary for running the railway layout chosen for commercial operation.

5.4.1 Highland Main Line

Location	Stations	Crossing Loops	Mile Post	Number of Tracks	Signalling Control
Perth to Stanley	(No station)	Not applicable	0	Double Track	Colour Light, Track Circuit Block, from Perth SC
Stanley SB	(No station)	Not applicable	7	Double Track	Semaphore signals, Track Circuit Block, from Stanley SB
Dunkeld	Dunkeld & Birnam	Yes	15½	Single	Semaphore signals, from Dunkeld SB
Pitlochry	Pitlochry	Yes	28½	Single	Semaphore signals, from Pitlochry SB
Blair Atholl to Dalwhinnie	Blair Atholl	Not applicable	35¼	Double Track	Semaphore signals, Absolute Block with IBs, from Blair Atholl SB
	Dalwhinnie	Not applicable	59½	Double Track	Semaphore signals, Track Circuit Block, from Dalwhinnie SB
Dalwhinnie to Kingussie	Newtonmore	(No crossing loop)	69¾	Single	Situated in block section
	Kingussie	Yes	72½		Semaphore signals, from Kingussie SB
Kincraig	(No station)	Yes	78¼	Single	Colour Light, Track Circuit Block, from Aviemore SB
Aviemore	Aviemore	Yes	84¼	Single	Semaphore signals, Track Circuit Block, from Aviemore SB
Carrbridge	Carrbridge	Yes	91¼	Single	Colour Light, Track Circuit Block, from Aviemore SB
Slochd	(No station)	Yes	96½		
Tomatin	(No station)	Yes	100		
Moy	(No station)	Yes	104¼		
Culloden	(No station)	Not applicable	111½	Changes Single to Double	Colour Light, Track Circuit Block, from Inverness SC
Culloden to Inverness	Inverness	Not applicable	118	Double Track	

Table 5-2: Highland Main Line Infrastructure Base Line

5.4.2 Far North Line

Location	**Stations**	**Crossing Loops**	**Mile Post**	**Number of Tracks**	**Signalling Control**
Inverness	Inverness	Not applicable	0	Multiple	Colour Light, Track Circuit Block, from Inverness SC
Inverness to Clachnaharry	(No station)	(No crossing loop)	1½	Single	RETB, from Inverness SC
Clachnaharry BB	(No station)	(No crossing loop)	1½	Single, Swing bridge over canal	RETB, from Inverness SC, with colour light signal overlay to protect bridge
Clachnaharry to Wick	Beauly	(No crossing loop)	10	Single	RETB, from Inverness SC
	Muir of Ord	Yes	13		
	Dingwall	Yes	18¾	Crossing Loop and Junction	RETB, from Inverness SC; plus Driver-operated Junction Signals
	Alness	(No crossing loop)	20½	Single	RETB, from Inverness SC
	Invergordon	Yes	31½		
	Fearn	(No crossing loop)	40¾		
	Tain	Yes	44¼		
	Ardgay	Yes	57¾		
	Culrain	(No crossing loop)	61		
	Invershin	(No crossing loop)	61½		
	Lairg	Yes	67		
	Rogart	Yes	77		
	Golspie	(No crossing loop)	84½		
	Dunrobin Castle	(No crossing loop)	87		
	Brora	Yes	90½		
	Helmsdale	Yes	101½		
	Kildonan	(No crossing loop)	111		
	Kinbrace	(No crossing loop)	118¼		
	Forsinard	Yes	125¾		
	Altnabreac	(No crossing loop)	134		
	Scotscalder	(No crossing loop)	143		
	Georgemas Junction	Yes	147¼	Crossing Loop and Junction	RETB, from Inverness SC; plus Driver-operated Junction Signals
	Wick	Rounding facility in station	161½	Single	RETB, from Inverness SC
Georgemas Junction to Thurso	Georgemas Junction	At Station	0	Single	RETB, from Inverness SC
	Thurso	Rounding facility in station	6¾		

Table 5-3: Far North Line Infrastructure Base Line

5.4.3 Kyle Line

Location	Stations	Crossing Loops	Mile Post	Number of Tracks	Signalling Control
Dingwall to Kyle of Lochalsh	Dingwall	At the station	0	Crossing Loop and Junction	RETB, from Inverness SC; plus Driver-operated Junction Signals
	Garve	Yes	11¾	Single	RETB, from Inverness SC
	Lochluichart	(No crossing loop)	17¼		
	Achanalt	(No crossing loop)	21½		
	Achnascheen	Yes	27¾		
	Achnashellach	(No crossing loop)	40½		
	Strathcarron	Yes	45¾		
	Attadale	(No crossing loop)	48¼		
	Stromeferry	(No crossing loop)	53¼		
	Duncraig	(No crossing loop)	57		
	Plockton	(No crossing loop)	58¼		
	Duirinish	(No crossing loop)	59¾		
	Kyle of Lochalsh	Rounding facility in station	63½		

Table 5-4: Kyle Line Infrastructure Base Line

5.4.4 Fort William Line

Location	Stations	Crossing Loops	Mile Post	Number of Tracks	Signalling Control
Craigendoran	(No station)	Yes	0	Single	Colour light, Track Circuit Block, from Yoker IECC
Craigendoran to Crianlarich (both exclusive)	Helensburgh Upper	(No crossing loop)	2	Single	RETB, from Banavie SC
	Garelochhead	Yes	9		
	(No station)	Glen Douglas	15¼		
	Arrochar & Tarbet	Yes	19½		
	Ardlui	Yes	27½		
Crianlarich	Crianlarich	At Station	36¼	Crossing Loop and Junction	RETB, from Banavie SC; plus Driver-operated Junction Signals
Crianlarich to Fort William Junction (exclusive)	Upper Tyndrum	Yes	41¼	Single	RETB, from Banavie SC
	Bridge of Orchy	Yes	48¾		
	Rannoch	Yes	64½		
	Corrour	Engineers siding	71¾		
	Tulloch	Yes	81¾		
	Roy Bridge	(No crossing loop)	87½		
	Spean Bridge	Yes	90¾		
Fort William Junction	(No station)	(No crossing loop)	98¾	Single	Semaphore, Track Circuit Block, from Fort William Junction SB
Fort William Junction to Station	Fort William	Rounding facility in station	99½	Single, sidings at station	Colour light, Track Circuit Block, from Fort William Junction SB

Table 5-5: Fort William Line Infrastructure Base Line

5.4.5 Oban Line

Location	Stations	Crossing Loops	Mile Post	Number of Tracks	Signalling Control
Crianlarich	Crianlarich	At Station	0	Crossing Loop and Junction	RETB, from Banavie SC; plus Driver-operated Junction Signals
Crianlarich to Oban	Tyndrum Lower	(No crossing loop)	5	Single	RETB, from Banavie SC
	Dalmally	Yes	17		
	Loch Awe	(No crossing loop)	19½		
	Falls of Cruachan	(No crossing loop)	23		
	Taynuilt	Yes	28¾		
	Connel Ferry	(No crossing loop)	35½		
	Oban	Rounding facility in station	41¾		

Table 5-6: Oban Line Infrastructure Base Line

5.4.6 Mallaig Line

Location	Stations	Crossing Loops	Mile Post	Number of Tracks	Signalling Control
Fort William Station to Junction	Fort William	Rounding facility in station	0	Single, sidings at station	Colour light, Track Circuit Block, from Fort William Junction SB
Fort William Junction Signal Box	(No station)	Yes, on Mallaig Branch only	½	Crossing Loop and Junction	Semaphore, Track Circuit Block, from Fort William Junction SB
Banavie	Banavie	(No crossing loop)	2¼	Single	RETB, from Banavie SC
Banavie	(No station)	(No crossing loop)	2¼	Single, Swing bridge over canal	RETB, from Banavie SC, with colour light signal overlay to protect bridge
Corpach	Corpach	(No crossing loop)	3¼	Single	RETB, from Banavie SC
Annat Gate Box	(No station)	(No crossing loop)	4¼	Single, Gate box protects 2 crossings	RETB, from Banavie SC, with semaphore signal overlay controlled from Annat to protect level crossings
Annat to Mallaig	Loch Eil Outward Bound	(No crossing loop)	6¼	Single	RETB, from Banavie SC
	Locheilside	(No crossing loop)	10		
	Glenfinnan	Yes	16½		
	Lochailort	(No crossing loop)	25¾		
	Beasdale	(No crossing loop)	30¼		
	Arisaig	Yes	34		
	Morar	(No crossing loop)	38½		
	Mallaig	Rounding facility	41½		

Table 5-7: Mallaig Line Infrastructure Base Line

5.5 TECHNICAL SPECIFICATIONS

The following paragraphs provide an indication of the technical and legislative requirements that are currently in force. These largely dictate the design requirements applicable on the Network today.

5.5.1 Technical Standards

Any new works proposed to modify or add to the existing railway infrastructure must comply with the requirements of the following suite of standards applicable to the railway industry:

- HMRI Railway Principles and Guidance;
- Railway Group Standards; and
- Network Rail Company Standards.

It should be noted that much signalling and operational infrastructure might not comply with current Railway Standards, owing to the age of such installations and the historical period in which they were installed. This does not imply a safety risk however, when new Standards come into force these apply to new installations and it is generally not necessary to retro-upgrade existing equipment.

5.5.2 Legislative Requirements

Proposals for new infrastructure on or outwith the railway boundary, and affecting the public, will in addition to complying with the necessary Technical Standards, require to comply and seek the following:

- Local Authority Planning Regulations, and appropriate Planning Permission;
- Relevant Utility providers' regulations, and Approval;
- HMRI Guide to the Approval of Railway Works, Plant and Equipment to ensure compliance with the Railway and Other Transport Systems (Approval of Works etc.) Regulations 1994;
- HMRI Requirements, and Approval; and
- Network Rail Approval of connection arrangements or modification to:
    - Their infrastructure;
    - Drawings etc; and
    - Construction methods.

In addition there will be a requirement to enter into an "Agreement" with Network Rail (as the railway infrastructure owner) to enable them to input their requirements to the project and approve the final proposals. This "Agreement" entails the payment of all reasonable Network Rail costs on a time and line basis.

6. INFRASTRUCTURE CONSIDERATIONS – NON SIGNALLING

6.1 INTRODUCTION

The Section of the report provides a review of the infrastructure in the area of the study by considering the various components, namely:

- Track;
- Civil Engineering;
- Stations; and
- Electrical and Plant.

Because of its critical importance to the study a separate chapter, Section 7, provides a review of the signalling on the Highland Network.

6.2 TRACK

In the Highland area, the railway predominantly consists of a single-track line with crossing loops (passing places) to permit two-way traffic working; there are stretches of double track but these are confined to areas of the Highland Main Line between Perth and Inverness. Line speeds are generally low, being less than 80mph, with only the Perth to Inverness line having speeds in excess of this.

The following tabulation provides a summary of the speeds on the Scottish Rail Network (excluding East and West Coast Main Lines) as a comparison:

Speed Range	Highland Network		Scottish Network	
	Track kms.	% of Total	Track kms.	% of Total
Less than 35mph	162	17%	522	15%
40mph to 80 mph	773	81.2%	2427	68%
80mph to 105mph	17	1.8%	636	17%
Over 110mph	0	0%	0	0%

Table 6-1: Summary of Scottish Rail Network Speeds

Owing to the magnitude of forces being exerted on railway infrastructure by certain types of trains travelling at certain speeds, differential speed restrictions are applied as required in order to limit these forces to an acceptable level. Predominantly applied to RETB-controlled lines, there is usually an overall maximum permitted speed for lightweight multiple-unit rolling stock and a lower maximum permitted speed for all other types of train. In addition, there are certain localised speed restrictions applicable to either multiple unit stock and / or other types of rolling stock, depending upon the infrastructure limitations necessary at the location concerned – see Section 4.2. These speed restrictions may apply to trains in either or both directions, and they may be imposed due to a variety of reasons such as:

- Track condition or curvature;
- Bridge condition or capacity;
- Presence of point operation apparatus (as in the case of hydro-pneumatic type points machine);
- Presence of certain types of power operated level crossings (to allow train drivers to observe a Proceed Authority at the level crossing before being allowed to pass over the road); and

- To limit train speed approaching user-operated level crossings where no rail infrastructure exists (and the onus is on the public to ascertain whether or not it is safe to cross the railway; e.g. footpaths, farm roads).

Localised speed restrictions exist where either track alignment or track condition - infrastructure style or deterioration of equipment – determines it is necessary. In certain geographical areas these restrictions are many and can be extensive owing to the geological conditions through which the railway passes, e.g. the Mallaig branch, between Craigendoran and Crianlarich, Corrour and Spean Bridge, and from Strathcarron to Kyle of Lochalsh.

The track infrastructure in the Highland area employs a variety of different types, having probably the greatest age range of such infrastructure in the UK rail network, and consists of modern-day components through to those that are long obsolescent. A quick summary of the infrastructure is as follows, with the individual components assembled in a variety of different fashions.

- Track;
    - Jointed; and
    - Welded (CWR).
- Rails;
    - Bullhead (not common); and
    - Flat-bottomed (certain styles obsolete).
- Sleepers;
    - Timber;
    - Steel; and
    - Concrete (certain styles obsolete).
- Points;
    - Bespoke (many styles obsolete); and
    - Standard pattern.
- Point Operating Equipment;
    - Mechanical, from signal box;
        - Acceptable and maintainable
        - Not preferred for new works
        - Limited to Semaphore signalling areas
    - Mechanical, from local ground frame;
        - Acceptable in appropriate circumstances
        - Used throughout Highland area, all lines
    - Electrical machines; power operated from signal box;
        - Older styles now obsolete
        - Used in certain Semaphore and in Colour Light signalling areas
    - Hydraulic machines; power operated from signal centre or local control position;
        - Used in Inverness area, and at specific locations on Far North and Fort William Lines
    - Hydro-pneumatic machines;
        - Actuated by train movement alone
        - Not controlled by signaller
        - Used exclusively on RETB-fitted lines
            - Far North
            - West Highland
            - Kyle of Lochalsh

- Oban
- Mallaig

- Limits train movements across points to 15mph

Given the length of route in the Highland area, the geographical extent of specific track styles has been defined by the individual renewal requirements carried out on the railway over the last 100+ years; e.g. a section of relatively new track may be immediately adjacent that of extreme vintage. Points infrastructure will generally have a similar history but points operating equipment is directly related to the requirements of the signalling system in operation currently.

It is the signalling requirement in the extensive RETB areas – there being no centralised and direct control of local infrastructure - that led to the mass introduction of hydro-pneumatic points on the main running lines and locally manually-operated ground frames on associated sidings. The 15mph restriction over hydro-pneumatic points is necessary to ensure that they function correctly and no derailment of the train occurs, however this clearly lengthens journey times. The point mechanism is entirely self-contained and requires no power for operation, which as a result limits the force available for point blade movement and consequently reduces the attainable safety level for the system; an acceptable safety level is achieved by restricting the wheel (train) speed through the mechanism.

Track is designed to allow trains to travel at a certain speed by ensuring it meets certain level, gradient, curvature, and cant parameters appropriate to the speed required; these conditions being affected by the geographical placement of the railway and the terrain through which it passes. There will therefore be those areas on the railway where an increase in line speed is only possible through major reconstruction of the railway environment and alignment, and others where there is leeway within the characteristics of the track infrastructure to permit speed increases. Primarily, the limitations for such increases will be where the line is heavily curved or where there is poor supporting substructure. Another or complementary method of achieving line speed increases involving a reduced level of track redesign works is available, namely the use of tilting trains, but there is still the requirement to make or prove the track infrastructure capable of handling such traffic at the speeds desired.

If using existing line speeds but increasing the traffic levels over those lines, the impact on the track infrastructure will tend to be an increase in the maintenance requirement necessary to keep the track within the appropriate quality tolerances, and an expected reduction in the life span of such infrastructure.

Proposed developments such as placing an additional track adjacent to an existing single line in order to increase route capacity - by creating double track or providing a crossing loop – can be problematic in ensuring sufficient land or an appropriate track support zone is available for example. Depending upon what is required and at which location, there may be an opportunity to make use of previous track provisions throughout the history of the railways in the Highland area. On certain stretches of line where single track now exists, previously double track was constructed or the track bed or structures were made good for the possible introduction of a double line of track. Additionally, there was historically more crossing loops provided on the railway than is now the case. Without further investigation, it will not be certain whether advantage can be taken of these historical provisions as current track alignment and required clearances through earthworks or structures may preclude their use unless additional works are carried out; they may however provide a suitable location and basis for development.

In addition to the main running lines, there are also many sidings leading off from the main tracks. Although nominally operational, recent railway history – traffic patterns, commercial expediency, and rail gauge corner cracking (post-Hatfield) – has seen many of these facilities fall out of use. The level of dilapidation in or onto these sidings may vary between a requirement to commit to vegetation clearance, up to having to reinstall sections of track or point-work, possibly with associated signalling or operational issues.

6.3 CIVILS

To create the envelope containing the track in the area through which the railway passes, a variety and sometimes a multitude of earthworks and civil engineering has to be carried out in order to produce the necessary, workable, and satisfactory alignment of the operational railway. These works are in addition to all the operational building requirements such as stations, depots, control, and equipment buildings etc and are constructed as bespoke units, adequate for their location and purpose. They may generally be considered under the following headings:

- The track bed in general, including support works that may not be visible;
- Drains, drainage, and culverts;
- Walls, fencing, etc;
- Support structures, retaining walls, protective barricades;
- Embankments or cuttings;
- Bridges (under or over the railway, single or multi-span) and viaducts;
- Tunnels; and
- The crossing zone where roads cross over the railway.

The civil engineering requirement will encounter all types of ground conditions throughout the length of the railway, where the local need will be met by the appropriate use of a variety of materials arranged as per the specific design for the location concerned. For example, the bridges and viaducts may be masonry, brick, or concrete arched, and constructed solely from those materials, or they could be steel or concrete decked and appropriately constructed from a composite of all these materials.

The lines in the Study area are well over one hundred years old and as such the majority of the structures on the routes will date from that time. Individual structures will have been renewed since the original construction dependent on condition although it should be noted that the bulk of the structures are approaching or past their original design life.

Due to the nature of the terrain in the Highland geographical area, the railways in general have been quite heavily engineered, employing some significant structures in order to achieve a workable line of route. However, even for a line considered to be 'lightly engineered' (compared to some others), the Far North line contains significant structures in the form of Inverness, Conon Bridge, and Culrain Viaducts.

The presence of such structures significant or otherwise, has an impact on what may be achieved - using defined resources - in terms of increasing traffic levels or line speed. Volume and speed of traffic has a direct effect on the life and maintenance requirement of all supporting structures; additionally, most such structures will not take an additional track placed on them. The exception to this is where structures have been purposely built to accommodate two lines of railway, although the current alignment of the track or condition or capability of the structure may preclude immediate reinstatement or provision of two tracks.

The following tabulations provide a summary of the major structures on the individual routes annotated with comments where applicable. Where comments are made these have been drawn from information held by the study team and are not obtained from Network Rail records.

Line	Structure	Comments
Highland Main Line	Schochie Viaduct	Masonry structure with spandrel problems
	Kingswood Tunnel	
	Inver Tunnel	Tight clearances although better than Killiecrankie Tunnel
	Tay Viaduct	ok
	Killiecrankie Viaduct	Tight clearances on a curve has had some work done to it recently
	Killiecrankie Tunnel	The clearance limiter on the line
	Spey Viaduct	ok
	Dulnain Viaduct	Two span continuous lattice – ok
	Slochd Viaduct	Considered to be in good condition
	Findhorn Viaduct	Located on a curve; in good condition
	Aultnaslanach Viaduct	Recently renewed
	Culloden Viaduct	Masonry arch generally ok

Table 6-2: Highland Main Line Major Structures

The Highland Main Line structures are generally well engineered and could be capable of allowing an increase in Route Availability although clearance is constrained by tunnels.

Line	Structure	Comments
Far North Line	Ness Viaduct	Renewed in the 1980's
	Clachnaharry Swing Bridge	The abutments and bearings have recently been renewed – speed restriction over structure
	Beauly Viaduct	No issues
	Conon Viaduct	ok
	Shin Viaduct	Has recently had steelwork repairs to work done to pier heads
	Sea Defence Walls	
	Brora Viaduct	Large single span structure – will not perform well when assessed for increased traffic loads

Table 6-3: Far North Line Major Structures

Line	Structure	Comments
Kyle Line	Achanalt Viaduct	Long standing problems but subject to recent repairs
	Carron Viaduct	
	Rockfall Tunnel	

Table 6-4: Kyle Line Major Structures

Line	Structure	Comments
Fort William Line	Garlochhead Viaduct	Ok for current traffic levels
	Finnart Viaduct	
	Manse Viaduct	
	Inveruglas Viaduct	ok
	Creag an Ardain Viaduct	
	Creag an Ardain Tunnel	Clearance problems
	Glen Falloch Viaduct	Likely to throw up assessment issues when considered for heavier loading – ok for current traffic levels
	Crianlarich Viaduct	Likely to throw up assessment issues when considered for heavier loading – ok for current traffic levels
	Fillan Viaduct	Likely to throw up assessment issues when considered for heavier loading – ok for current traffic levels
	Auchentyre Viaduct	Has had a history of problems
	Gleann Viaduct	Has had a history of problems
	Horseshoe Viaduct	Has had problems but has recently been re-decked – speed restriction due to curvature on structure
	Garbh Ghaoir Viaduct	
	Rannoch Viaduct	Has some specific defects which may require attention for heavier traffic
	Cruach Snowshed	
	Fersit Tunnel	
	Tulloch Viaduct	Has some specific defects which may require attention for heavier traffic
	Spean Viaduct	

Table 6-5: Fort William Line Major Structures

The major structures on this route are characterised by being lofty and curving. This limits speed and requires consideration of the lateral forces on structures.

Line	Structure	Comments
Oban Line	Succoth Viaduct	Generally acceptable for current traffic levels – speed restricted
	Orchy Viaduct	Generally acceptable for current traffic levels
	Falls of Cruachan Viaduct	Generally acceptable for current traffic levels
	Awe Viaduct	Generally acceptable for current traffic levels

Table 6-6: Oban Line Major Structures

Line	Structure	Comments
Mallaig Line	Lochy Viaduct	
	Banavie Swing Bridge	Constraint to speed due to the design of the structure would require to be renewed or removed to increase speed
	Glenfinnan Viaduct	High structure on a curve – speed restricted
	Leachabhuidh Tunnels	Tight clearances
	Lochailort Tunnel	Tight clearances
	Polnish Tunnel	Tight clearances
	Arnabol Viaduct	
	Loch nan Uamh Tunnels	Tight clearances
	Beasdale Tunnels	Tight clearances
	Borrodale Tunnels	Tight clearances
	Borrodale Viaduct	
	Larich Mor Viaduct	
	Morar Viaduct	

Table 6-7: Mallaig Line Major Structures

Consideration is being given to the restrictions on gauge clearance along the lines. This analysis is using ‘Clear Route 5’ software to review the restrictions to clearance along the routes for specific traffic types.

6.4 STATIONS

By its very nature the stations served by the Highland Main Line network are mostly rural stations with limited facilities. The exception to this are the main terminal stations at Inverness, Perth, Wick, Thurso, Kyle of Lochalsh, Fort William, Oban and Mallaig where there are a greater range of facilities for passengers. The following series of tables highlight the stations on each line and list their category and the facilities at each. The information presented has been sourced from Network Rail documentation and the First ScotRail web site.

6.4.1 Highland Main Line

Station	Number of Platforms	Ticket Office?	Car Park?	Customer Information System?	Public Address?	Comments
Perth	7	✓	✓	✓	✓	Grade B listed
Dunkeld & Birnam	2	✗	✓	✗	✓	Grade A Listed
Pitlochry	2	✓	✓	✗	✓	Grade B Listed
Blair Atholl	2	✗	✓	✗	✓	
Dalwhinnie	2	✗	✓	✗	✓	
Newtonmore	1	✗	✓	✗	✓	
Kingussie	2	✓	✓	✗	✓	Grade B Listed
Aviemore	2	✓	✓	✗	✓	
Carrbridge	2	✗	✓	✗	✓	Grade B Listed
Inverness	7	✓	✓	✓	✓	In Conservation area

Table 6-8: Highland Main Line Stations

6.4.2 Far North Line

Station	Number of Platforms	Ticket Office?	Car Park?	Customer Information System?	Public Address?	Comments
Beauly	1	✗	✓	✗	✓	Short platform
Muir of Ord	2	✗	✓	✗	✓	
Dingwall	2	✓	✓	✗	✓	Grade B Listed
Alness	1	✗	✓	✗	✓	
Invergordon	2	✗	✓	✗	✓	In conservation area
Fearn	1	✗	✓	✗	✓	
Tain	2	✗	✓	✗	✓	Grade B Listed
Ardgay	2	✗	✓	✗	✓	
Culrain	1	✗	✗	✗	✓	
Invershin	1	✗	✗	✗	✓	
Lairg	2	✗	✓	✗	✓	
Rogart	2	✗	✓	✗	✓	
Golspie	1	✗	✓	✗	✓	
Dunrobin Castle (private station)	1	✗	✗	✗	✗	
Brora	2	✗	✓	✗	✓	
Helmsdale	2	✗	✓	✗	✓	Grade B Listed
Kildonan	1	✗	✓	✗	✓	
Kinbrace	1	✗	✓	✗	✓	
Forsinard	2	✗	✓	✗	✓	
Altnabreac	1	✗	✗	✗	✓	
Scotscalder	1	✗	✓	✗	✓	
Georgemas	2	✗	✓	✗	✓	
Wick	1	✓	✓	✗	✓	
Thurso	2	✓	✓	✗	✓	

Table 6-9: Far North Line Stations

6.4.3 Kyle Line

Station	Number of Platforms	Ticket Office?	Car Park?	Customer Information System?	Public Address?	Comments
Garve	2	✗	✓	✗	✓	
Lochluichart	1	✗	✗	✗	✓	
Achanalt	1	✗	✓	✗	✓	
Achnasheen	2	✗	✓	✗	✓	
Achnashellach	1	✗	✓	✗	✓	
Strathcarron	2	✗	✓	✗	✓	
Attadale	1	✗	✗	✗	✗	
Stromeferry	1	✗	✗	✗	✓	
Duncraig	1	✗	✗	✗	✓	
Plockton	1	✗	✓	✗	✓	
Duirinish	1	✗	✗	✗	✓	
Kyle of Lochalsh	2	✓	✓	✗	✓	

Table 6-10: Kyle Line Stations

6.4.4 Fort William Line

Station	Number of Platforms	Ticket Office?	Car Park?	Customer Information System?	Public Address?	Comments
Helensburgh Upper	2	✗	✗	✗	✓	In conservation area
Garelochhead	2	✗	✓	✓	✓	
Arrochar & Tarbet	2	✗	✓	✗	✓	Grade B Listed
Ardlui	2	✗	✗	✗	✓	
Crianlarich	2	✗	✓	✗	✓	
Upper Tyndrum	2		✓			Grade B Listed
Bridge of Orchy	2	✗	✓	✗	✓	Grade B Listed
Rannoch	2	✗	✓	✗	✓	Grade B Listed
Corrour	2	✗	✗	✗	✓	
Tulloch	2	✗	✓	✗	✓	
Roy Bridge	1	✗	✗	✗	✓	
Spean Bridge	2	✗	✓	✗	✓	
Fort William	2	✓	✓	✗	✓	

Table 6-11: Fort William Line Stations

6.4.5 Oban Line

Station	Number of Platforms	Ticket Office?	Car Park?	Customer Information System?	Public Address?	Comments
Tyndrum Lower	1	✗	✓	✗	✓	
Dalmally	2	✗	✓	✗	✓	Grade B Listed
Loch Awe	1	✗	✓	✗	✓	
Falls of Cruachan	1	✗	✗	✗	✓	
Taynuilt	2	✗	✓	✗	✓	
Connel Ferry	1	✗	✓	✗	✓	
Oban	2	✓	✓	✗	✓	

Table 6-12: Oban Line Stations

6.4.6 Mallaig Line

Station	Number of Platforms	Station Category	Ticket Office?	Car Park?	Customer Information System?	Public Address?	Comments
Banavie	1	NME	✗	✓	✗	✓	
Corpach	1	NME	✗	✓	✗	✓	
Loch Eil (OB)	1	F(R)	✗	✗	✗	✓	
Locheilside	1	NME	✗	✓	✗	✓	
Glenfinnan	2	F(R)	✗	✓	✗	✓	Grade B Listed
Lochailort	1	NME	✗	✓	✗	✓	
Beasdale	1	NME	✗	✗	✗	✓	
Arisaig	2	F(R)	✗	✓	✗	✓	Grade B Listed
Morar	1	F(R)	✗	✓	✗	✓	
Mallaig	2	E(R)	✓	✗	✗	✓	

Table 6-13: Mallaig Line Stations

6.5 ELECTRICAL & PLANT

On the lines under consideration, the provision of electrical and plant infrastructure is fairly limited in comparison with other parts of the railway, but is numerous in terms of local areas served and in the number of connections to the Regional Electricity Company (REC) supplier. Electrical power is usually provided to the following infrastructure:

- Stations, depots, and yards;
- Signal boxes, centres, and control points;
- Equipment rooms;
- Power worked level crossings; and
- Discrete line side or on track components, such as signals, signalling equipment, points operating equipment, and point heaters.

Generally, on main trafficked lines for signalling and control purposes, the REC primary supply is taken at one location and distributed along the line to where it is needed; the geographical limit of this single point of distribution is defined by a combination of circuit length (along the line) and equipment load placed upon it. This single point of source connection readily allows the supply to be 'backed-up' by the railway infrastructure controller in times of supply disruption caused by failure or poor quality. This is usually carried out by means of providing a 'standby diesel generator' and more recently, with the addition of an Uninterruptible Power Supply (UPS) facility.

Given the paucity of power-operated equipment along the line and the large geographical areas to be covered, this form of power distribution has been deemed uneconomical for the Highland Main Lines in general and is only employed in the following areas:

- At Craigendoran;
- In the Fort William and Banavie area;
- Between Perth and Stanley;
- Between Blair Atholl and Dalwhinnie; and
- Between Kingussie and Clachnaharry.

Basically all other areas have their signalling power needs supplied directly from the REC to the local point of use, thereby leading to a multiplicity of individual REC connections scattered throughout the Highland rail network. These supplies usually do not have the benefit of a 'back-up' and so are susceptible to all power disruptions; only recently are new 'major' installations such as level crossings being given certain 'back-up' facilities. Other than the main line side power distribution networks, REC supplies in the Highland area will tend to be provided as follows:

- Individually to stations, depots, and yards – locally distributed as required;
- To each signal box – distributed locally to signalling equipment etc. thereafter;
- To individual 'Distant' signals – where sufficiently remote from the appropriate signal box;
- To locally grouped sets of points for point heating purposes;
- To each power operated level crossing;

- To each crossing loop, for local signal indication purposes only;
    - With the exception of Crianlarich, Dingwall, and Georgemas Junction, where locally operated sets of power operated points are provided
- To RETB transmission equipment.
    - As RETB is a radio-based system, certain transmission equipment is located remotely from the railway in order to achieve optimum propagation performance; some of these locations are shared radio transmission sites serving multiple users

Any proposals to increase rail traffic or line speed will only have an effect on power supply requirements through the need to supply additional or relocated electrical equipment, such as signals, points, level crossings etc. If however improved network (railway) resilience is sought, there could be significant implications in how the electrical supply to the railway in the Highland area is both distributed and managed, through the provision of remote monitoring of supplies, 'back-up', and 'standby' arrangements.

With the exception of standby diesel generators provided at present, the other plant equipment of note in this area is the two swing bridges carrying the railway over the Caledonian Canal at Banavie and Clachnaharry. Although they are both structures and the responsibility of the civil engineer, they are power worked in operation in order to clear the canal for boat traffic, with the complete drive mechanism being the responsibility of the electrical and plant engineer. The bridges are additionally interlocked with the signalling system in order to control trains approaching the bridges accordingly. Due to their track and mechanical arrangements, there is a 5mph speed limit over both bridges.

Proposals to increase rail traffic or line speed over these bridges will have significant implications as their design, condition, and age probably precludes any speed increase, while an increase in traffic will increase the maintenance requirement on both installations as well as shortening their life span. Given the line speed over these bridges currently, there may however be relatively significant benefits in seeking to raise the line speeds through these areas.

7. INFRASTRUCTURE CONSIDERATIONS – SIGNALLING

7.1 RETB SIGNALLING SYSTEM

Most lines in the Highland geographical area are presently signalled on the Radio Electronic Token Block (RETB) principle, with control exercised via a central Control Point located at Inverness (for the Kyle and Far North lines) or at Banavie (for the West Highland, Oban, and Mallaig lines). This method of working employs a single, common radio communication channel for all rail traffic requirements in a given geographical area, with no line-side signalling infrastructure worked from the RETB control point. The following map shows the coverage of lines controlled by RETB.

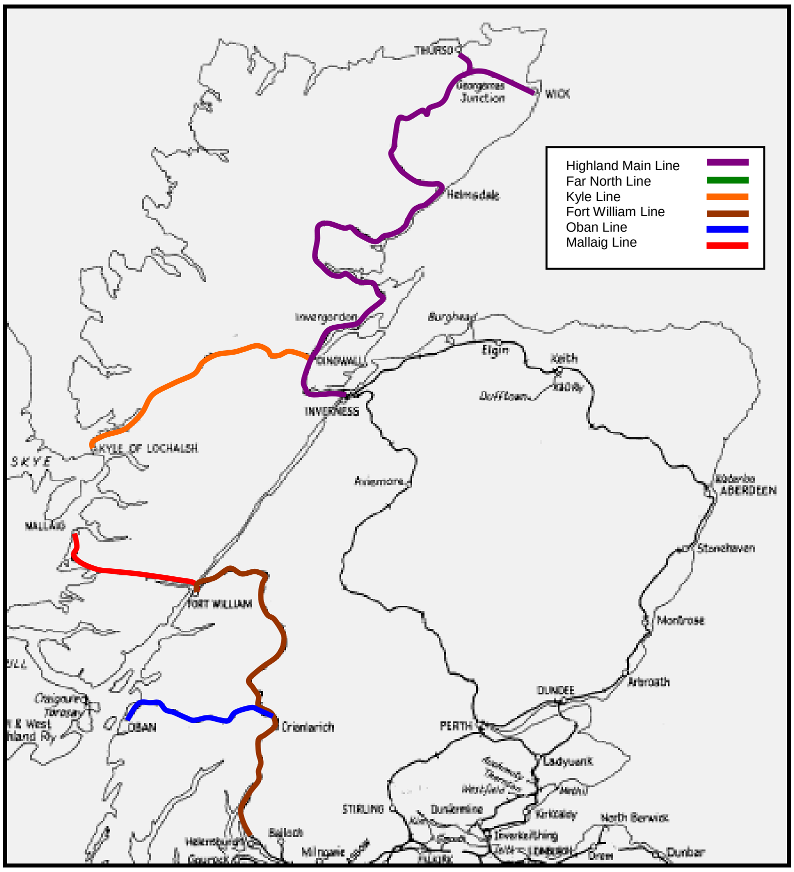

Figure 7-1: Extent of RETB Signal Control

Train drivers in communication with the Control Point operator request Authority for all train movements over the common radio channel. The Controller uniquely gives such Authority (called a 'token') to the appropriate driver via an electronic authority code that appears on the driver's RETB unit in his cab; this permits only a single train to operate at any one time between discrete control sections that are geographically based. Once the movement has been completed satisfactorily, the driver returns the Authority he has received, which is then cancelled by the Controller. These requests for a Movement Authority apply to any movement that is to be carried out on the main running line, or to any line connected to it. This means that the operation of any ground frame or siding connected to the main line is covered by the rules governing the issue of such Authorities.

The present RETB signalling systems based at both Banavie and Inverness do not readily lend themselves to alteration, and due cognisance of this should be reflected in any track, signalling, or operational alterations or additions proposed. Whilst being an operationally sound system for its area of application, and having served the north of Scotland well since its first introduction in 1985, the hardware employed to actuate and transmit the RETB signalling processes is now obsolete, while the operational protocols employed can now considered to be antiquated.

There are three separate RETB Controllers working the lines in the Highland area:

- Based at Inverness SC; and
    - Far North Line (Inverness to Wick / Thurso) and the Kyle of Lochalsh Line
- Based at Banavie SC.
    - Craigendoran (exclusive) to Tyndrum Upper, and the Oban line
    - Tyndrum Upper to Fort William, and the Mallaig line

With only a single communication channel available, individual Controllers can cover a significant geographical area and its consequent railway operation. The running of additional trains and / or the creation of additional RETB token (Authority) sections would be an additional workload for the Controller to undertake, adding radio traffic to a control system already operating near capacity. Any modification to the existing RETB token sections would require alteration to the electronic interlocking arrangements that control and support RETB operations. For a variety of reasons - system obsolescence, availability of technical staff, and system design - this may prove impracticable, problematic, or expensive.

Network Rail have recognised that the present RETB systems are approaching life-expiry, and whilst retaining the existing operational processes has initiated moves to have its supporting constituent components overhauled or replaced to sustain RETB operation until 2012. Following the introduction of the Invernet services the RETB system on the Far North will be at capacity. One of the reasons for this is the need to exchange tokens when a train is stationary another is the limited radio capacity.

The expected replacement technology - a version of the European Rail Traffic Management System (ERTMS) - is proposed to be available for UK implementation in a timescale not too dissimilar to this, however Network Rail's 2005 Route Plan only anticipates ERTMS implementation to have an affect on signalling implementation plans from 2013 / 2014 onwards.

In this Route Plan and elsewhere, Network Rail states that no renewal strategy for RETB has yet been decided. Given the potential, proposed, or aspired modifications, alterations, or additions to the rail system covered by the present RETB control system in the Highland area, it would be prudent of interested parties to become involved or at least informed of the development process associated with the RETB replacement. In this way, it may be seen whether the system proposed to supersede RETB will deliver or can cater for the functionality desired by those operators and communities to be served in the Highland area.

Beyond the basic system development phase, there will be an opportunity to tailor this new control system during the early stages of application design development, in order to deliver the local operational requirements necessary for running the train services or pattern required. Whilst concerned or interested parties should be invited to input to such a process by the project developer, it would be prudent for such parties to ensure that they are involved at this stage.

Given the wide geographical coverage of the RETB network it is considered as a significant issue in the development of additional capacity for service improvements on these routes and a potential high-cost item when renewal is required.

7.2 SEMAPHORE SIGNALLING

This is the original style of signalling trains represented by the coloured movable arms mounted on signal posts, and operated by a signaller working a mechanical lever that is mounted on a lever frame situated in a signal box. The interlocking arrangements to permit safe operation of the system are supplied via mechanical arrangements built into the lever frame, or via ancillary electrical equipment connected to it. By the nature of its mechanical operation, the extent of workable control is limited, usually to a visual sight line from the signal box.

Semaphore signalling arrangements can lend themselves to modification more easily than some systems, however issues with such systems currently are non-availability of the necessary components and expertise for such alterations. As such, and in seeking to provide improved safety levels, it is more usual to replace such semaphore and mechanical systems with present-day power operated systems. This has however the effect of dramatically increasing both the scope and cost of such alterations, when compared to 'simple' alterations to the existing semaphore and mechanical systems.

The semaphore signalling systems employed in the Highland area are distributed and based on signal boxes as follows:

- Highland Main Line;
    - Stanley
    - Dunkeld
    - Pitlochry
    - Blair Atholl
    - Dalwhinnie
    - Kingussie
    - Aviemore Station
- Fort William Line.
    - Fort William Junction
    - Annat

The semaphore signalling coverage is highlighted in the map shown in Figure 7-2.

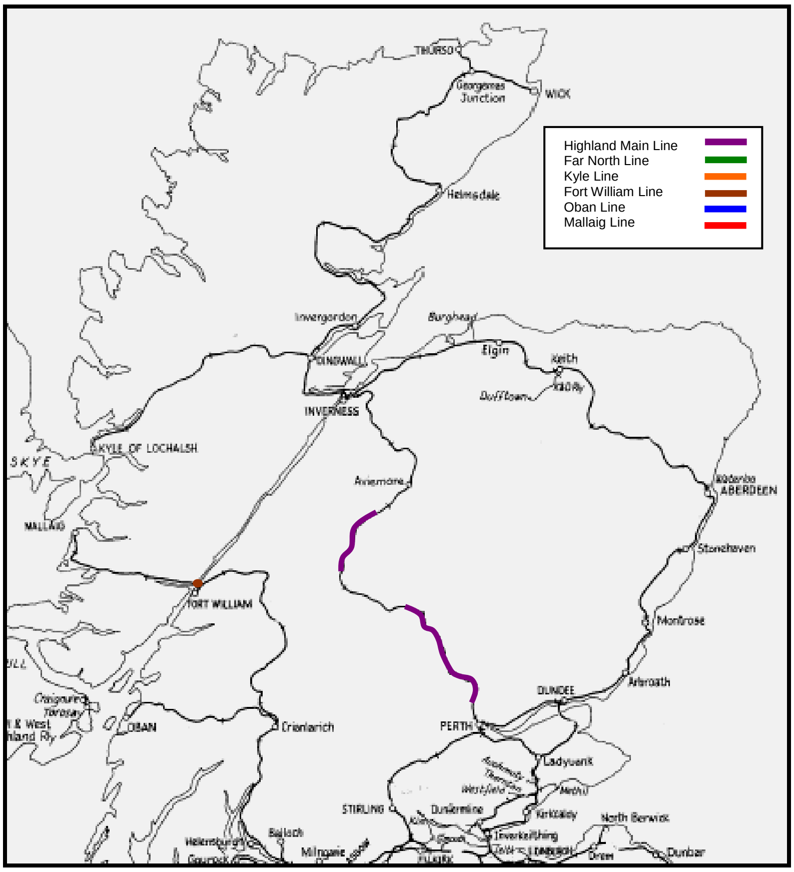

Figure 7-2: Extent of Semaphore Signal Control

7.3 COLOUR LIGHT SIGNALLING

This is the present day and more usual method of signalling trains, represented by colour light signals mounted on signal posts and worked from local or remote signal boxes, or centralised signal centres. The interlocking arrangements to permit safe operation of the system are supplied via a variety of electrical or electronic systems, dependant upon which engineering preference prevailed at the time of construction.

The colour light signalling systems employed in the Highland area are distributed and based on signal boxes or signal centres as follows:

- Highland Main Line;
  - Perth to Stanley (Perth SC)
  - Blair Atholl to Dalwhinnie exclusive (Blair Atholl & Dalwhinnie SB's)
  - Kingussie to Aviemore exclusive (Aviemore SB)
  - Aviemore to Culloden exclusive (Aviemore SB)
  - Culloden to Inverness (Inverness SC)
- Far North Line;
  - Clachnaharry (Clachnaharry SB)
- Fort William Line; and
  - Fort William Junction to Fort William Station
- Mallaig Branch.
  - Banavie

Figure 7-3 shows the extent of colour light signal control.

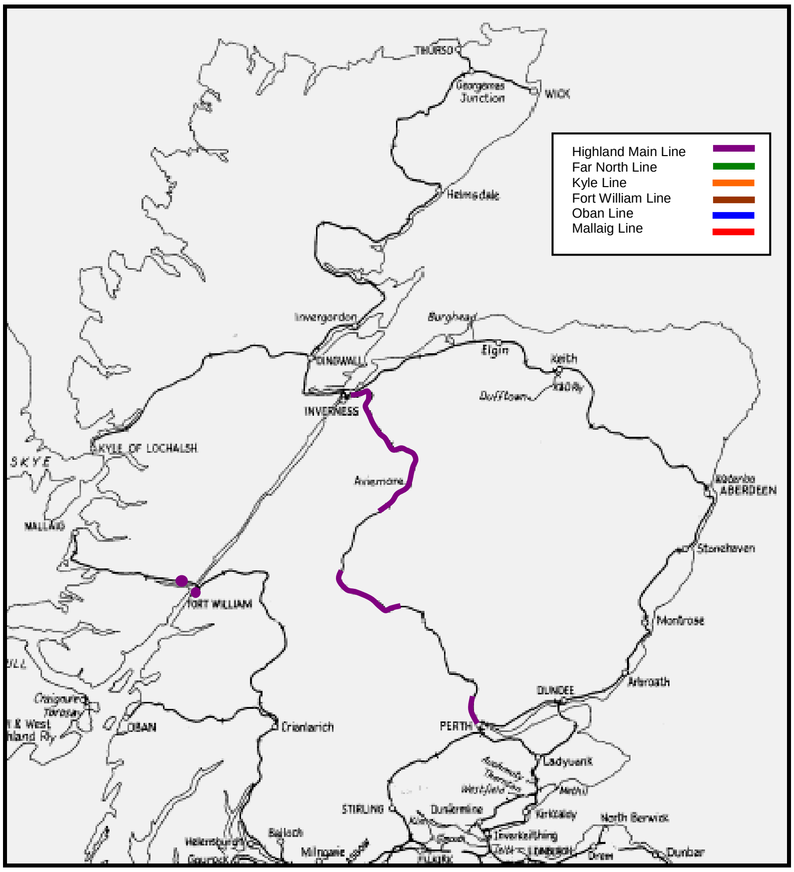

Figure 7-3: Extent of Colour Light Signal Control

Modification or addition to such arrangements can range from being reasonably straightforward to being extremely complex, given the sometimes intricate and extensive arrangements necessary to control and drive such systems. There is however, the advantage that most such systems are in extensive use and are supplied and supported by industry currently. Some interlocking arrangements are now obsolete, with consequent issues for maintenance or proposed alterations. Currently there are no known systems employed in the Highland area in this capacity that are so considered, although certain discrete components of the colour light systems and their supporting interlocking arrangements are considered to be obsolete.

7.4 LEVEL CROSSINGS

All at grade road / rail interfaces, level crossings, are laid out and provided with signs and equipment for both the road and rail user, as stipulated in the statutory regulations applicable for the type of level crossing and the location in which it is employed. In addition for all sites, a risk assessment is carried out pertaining to the local conditions, the results of which determine which type of level crossing may be employed in a specific location. By comparison with other geographical areas in Scotland, the Highland area has a comparatively large number of level crossings, forming a variety of generic and sub types:

- Controlled by signaller;
    - Signaller local to level crossing
    - Signaller remote to level crossing
- Automatically controlled by trains; and
    - Fitted with road barriers, train does not regulate speed on approach (AHB)
    - Fitted with road barriers, train regulates speed on approach (ABCL)
    - Not fitted with road barriers, train regulates speed on approach (AOCL)

- Road-user operated.
    - Gates, provided with telephone
    - Gates, not provided with telephone

Level crossings controlled by signaller are fully monitored and operated by a signaller located at the level crossing for that purpose alone or in conjunction with other operational signalling requirements; or he is located remotely from the level crossing that is then monitored by CCTV and other electrical supervisory systems.

Automatic level crossings are worked by the approach and passing of trains, and stand as autonomous individual systems remote from the RETB control of train operations; to operate the level crossing, specific controls are located at an appropriate distance on the railway to initiate the operational sequence. With the exception of the AHB's, the control point does not monitor operation of these level crossings, all monitoring being carried out locally by the train driver. The operation of these level crossings is directly linked to the train speed approaching the crossing, their design incorporating calculation of train position to commence or curtail the sequencing of certain equipment operations where appropriate (road light sequences, barrier lowering / raising, train signal sequence).

In the road-user operated situation, the opening / closing of the gates and monitoring of the railway to ensure safe passage is carried out by the road-user. A telephone link to the control point is provided in certain situations where the road-user is unable to adequately determine whether it is safe to cross - the caller being given permission to cross by the control point when it is deemed safe to do so. A risk assessment is carried out for each of these level crossings to determine the safe approach speed of trains - in order to give the road user adequate time of sighting - or the necessary provision of other equipment or arrangements in order to enable the road user to cross safely (such as telephones).

When considering possible line (train) speed increases, the following need to be taken into account:
.

- At level crossings controlled by the signaller, their operation tends to be independent of the train speeds on the approach, thus usually permitting a line speed increase with minimal consequential works to the level crossing operation (although works will be required to the signalling arrangements themselves).
- For automatic level crossings, any alteration of train speeds requires a minimum of repositioning the train-sensing equipment in order to maintain the appropriate timing and sequence of operation of the crossing. Additionally, a recalculation of the risk assessment at those level crossings so affected is required, in order to determine the adequacy or otherwise of the level crossing type at that location. With the change in line speed and using the latest road traffic figures, there is the possibility that the new risk assessment would show that a level crossing at a particular location requires to be upgraded in order to meet the necessary statutory requirements.
- At road-user worked level crossings generally their safe operation is already arranged considering the maximum line speed achievable currently. A potential line speed increase may only be possible by providing additional infrastructure. This may be as 'simple' as providing a telephone link to the Control Point, or as complex as providing a fully automatic-worked level crossing installation.

The level crossing style employed at each specific location is that deemed appropriate to the level of road and rail usage at the time of construction. Consequently as road traffic levels have and do rise, and as public or user perception of an increasing operational risk becomes more apparent, a need to upgrade certain level crossings emerges irrespective of any requirement or desire to raise line speed; the ability to raise line speeds may however be a by-product of such level crossing improvements. The order of preference for level crossing styles is as follows, commencing with the least preferred type.

- Road-user operated gates, not provided with telephone;
- Road-user operated gates, provided with telephone;
- Automatically controlled by trains and not fitted with road barriers; train regulates speed on approach (AOCL);
- Automatically controlled by trains and fitted with road barriers; train regulates speed on approach (ABCL);
- Miniature Red Green Warning Lights;
- Automatically controlled by trains and fitted with road barriers; train does not regulate speed on approach (AHB) – note that this style of crossing may only be used in certain circumstances; and
- Controlled by signaller who is located either local or remote to level crossing; level crossing is fully monitored and controlled, and is directly incorporated into the signalling system.

Where increases in rail traffic are proposed (as opposed to train speeds), all level crossing styles would have to be subject to a suitable risk assessment to determine their adequacy for continued operation in their current style. Unlike any proposal to raise line speeds where all level crossings except those operated directly by a signaller would require alteration, this risk assessment may well show that most level crossings still comply with their statutory requirements under the new conditions.

7.5 SIGNALLING AND OPERATIONAL MODIFICATIONS

Proposals to either increase rail traffic or raise the line speed impact directly on the signalling system, as does any modification to the current method of working or operational function of the railway. The issues and consequences of each proposal are summarised in the table below.

Considering one possible proposal, the table addresses the issue of providing "Additional 'mid-section blocks', through use of IB Signals or Token Exchange Points (TEPs) (RETB)". This is a method of increasing the throughput of trains along a railway line by shortening the distance the first train has to go before a second train is permitted to follow it; this distance being referred to as the 'block'. The provision of this signalling arrangement is useful where the 'blocks' are geographically long, and / or train occupancy of the 'block' is significant due to the line speeds within it. Two examples are as follows:

- (Conventional signalled area) One single 'Block' length is between Dalwhinnie and Kingussie, 13 miles; predominant speeds are 2¾miles at 90mph, 4miles at 80mph, 4miles at 70mph, remainder at 75mph or 65mph; and
- (RETB signalled area) One single 'Block' length is between Glenfinnan and Arisaig, 17¼ miles; maximum speed is 40mph, including 6¾miles at 35mph.

On a double line of track, Intermediate Block (IB) Signals may be provided that can effectively bisect the 'block' length for consecutive trains; these IB signals work and are obeyed by the driver in exactly the same way as ordinary signals. On a single line of track where Intermediate Block (IB) Signals may be provided, the 'block' length for consecutive trains proceeding in one direction at a time may be halved; again, these IB signals work and are obeyed by the driver in exactly the same way as ordinary signals. To make the IB signals work in either situation, the line has to be converted to what is known as Track Circuit Block (TCB). This requires the line to be fitted with train detection equipment for the complete length of the 'block' in order to conclusively prove the correct passage of trains to the signalling equipment controlling the line.

In RETB areas, the signals are replaced by TEPs that perform the same purpose as signals, but are identifiable positions at which the driver must seek and obtain the appropriate Authority to proceed from the Control Point operator. In the Highland area, RETB only applies to single lines of railway. No train detection equipment is fed back to the RETB system, the logic of permitting train moves is governed by the computer system driving the RETB through its knowledge of what it has previously authorised against its known infrastructure layout 'matrix'. Any alterations to the arrangement of this matrix require the RETB system to be redesigned.

It may be possible to provide additional operational features on existing track layouts, such as bi-directional running in crossing loops on the single lines. This would allow trains to overtake one another, or to use a preferred side of a crossing loop for higher running speed, or to access certain station facilities if there was not a requirement to cross trains at that location. For example, if the crossing loop at Pitlochry were made bi-directional, northbound trains not required to cross with a southbound train could access the southbound platform with its station facilities and immediate access to buses, taxi rank, and car park, alleviating the need for passengers to use the footbridge on that occasion.

The following table identify, for a given enhancement, what the likely impact on the signalling infrastructure is likely to be. In some cases there are significant issues to be addressed.

Issue	Signalling System Affected	Impact
Raise Line Speed	RETB	• No effect on operational signalling arrangements • Appropriate Distant Boards to be relocated to cater for higher approach speeds • All appropriate line side signs, boards, and indicators to be assessed to ensure adequate time allowed for sighting at higher approach speed
	Semaphore Signalling	• Possible effect on operational signalling arrangements • Appropriate Distant Signals may need to be relocated to cater for higher approach speeds • All appropriate signals, line side signs, and boards to be assessed to ensure adequate time allowed for sighting at higher approach speed
	Colour Light Signalling	• Possible effect on operational signalling arrangements • Signals affected may need to be relocated to cater for higher approach speeds • All appropriate signals, line side signs, and boards to be assessed to ensure adequate time allowed for sighting at higher approach speed
	Level Crossings (power operated)	• Affected level crossings to be risk assessed to ensure continued compliance with statutory requirements • Train detection equipment to be relocated as necessary to maintain agreed timing sequences
	Level Crossings (user operated)	• Affected level crossings to be risk assessed to ensure continued adequate sighting of trains at higher approach speeds • Possible fitment of telephone at crossing, or • Possible fitment of additional infrastructure at crossing, or • Possible conversion of crossing to power worked type, or • Possible closure of crossing
Increased Rail Traffic	RETB	• No impact on system infrastructure • Increases occupation of radio communications network • Traffic limited by track arrangements and capacity of Control Point operator
	Semaphore Signalling	• No impact on system infrastructure • Traffic limited by track arrangements and signalling provision
	Colour Light Signalling	• No impact on system infrastructure • Traffic limited by track arrangements and signalling provision
	Level Crossings (power operated)	• No impact on system infrastructure
	Level Crossings (user operated)	• No impact on system infrastructure
Provide additional crossing loop, or additional track	RETB	• Current system cannot accommodate without redesign
Provide additional crossing loop, or Provide additional track	Semaphore Signalling	• Too costly new colour light signalling would be used instead
	Colour Light Signalling	• Existing system to be modified accordingly, or • To be provided as new work
	Level Crossings	• If affected, to be reassessed and modified accordingly
Provide additional 'mid-section blocks', through use of IB Signals or TEP's (RETB)	RETB	• Current system cannot accommodate without redesign
	Semaphore Signalling	• Not acceptable for proposed new work • Convert existing block sections to TCB and provide IB's as Colour Light Signals
	Colour Light Signalling	• Existing system to be modified accordingly • Provide new infrastructure as necessary
	Level Crossings	• If affected, to be reassessed and modified accordingly
Provide additional operational features, such as bi-directional running in crossing loops	RETB	• Not possible with current system
	Semaphore Signalling	• Considered as acceptable given the limited application proposed • Modify existing and provide new infrastructure as necessary • Issues of equipment and skills availability exist
	Colour Light Signalling	• Existing system to be modified accordingly • Provide new infrastructure as necessary
	Level Crossings	• Existing system to be modified accordingly • Provide new infrastructure as necessary

Table 7-1: Impact on Signalling of Enhancement Proposals

8. EXTERNAL ISSUES

8.1 INTRODUCTION

This Section of the report briefly considers external factors that will have an influence on the rail network. These have been identified based on experience elsewhere and represent issues that may require consideration in any proposed enhancement of the rail network.

8.2 LAND ISSUES

Some landowners will be more sympathetic to a proposal than others, and this may well impact on which option is taken forward for development. The status of third party land adjacent the railway (i.e. other than that owned by Network Rail) is not known at present, and this may lead to complications regarding any proposed land purchases or property deals.

During project development, the impact of proposed railway infrastructure alterations on adjacent domestic, commercial, and industrial properties, farm buildings and fields, through both the construction phase and after completion, should be considered. Particular issues may be where temporary accesses are required for the construction of the proposed development, especially where these accesses are used during 'unsocial' hours – a typical situation for railway construction – or where the proposed development unfavourably impacts on the perceived life-quality of a neighbour, for example placing a signal outside a domestic property where trains may come regularly to a stand.

8.3 STATUTORY PERMISSIONS

In developing new railway infrastructure it may be necessary to obtain permissions from various external bodies depending on the scale of the works. For activities confined to the limits of deviation granted under the original parliamentary powers for the construction of the railway line then it is generally the case that this can be done under 'permitted developments'. That is, the works are covered by the original statutory powers.

For works beyond these limits then, depending on the scale of operations, they may be covered by either planning permission or a new parliamentary bill. This latter course of action would cover items line new lines or the creation of deviations from the existing alignment of the railway. Works that could be covered by planning permission include new buildings or structures.

8.4 USER SAFETY

User safety for both rail operations and the public is critical to the acceptability of any proposals to the statutory authorities, the rail industry and the public.

Given their population in the Highland area compared to the rest of Scotland, the operation of road-rail level crossings is (rightly) perceived as a key safety issue. Ideally the number of level crossings should be minimised however the practicality of doing so would require considerable investment and political will. A rise in road traffic and public demands for an increasing level of safety drives a requirement to provide an increasing number of 'automatically worked' level crossings, thereby introducing infrastructure with significant start-up and running costs.

User safety from the rail passengers' point of view drives an increasing equipment count and sophistication from the signalling and operational systems necessary to control and run the rail network.

Part 2

9. INTRODUCTION AND BACKGROUND

The first part of this study has been concerned with the identification of the characteristics of the Highland rail network as it exists today. The results of this review were contained in Part 1 of the report, the Issues Report produced in November 2005.

This second part of the study report uses the understanding of the current network previously gained along with the series of aspirations identified during the stakeholder consultation to consider how the network could develop in the future. The lines covered by the study are illustrated in Figure 9-1 below.

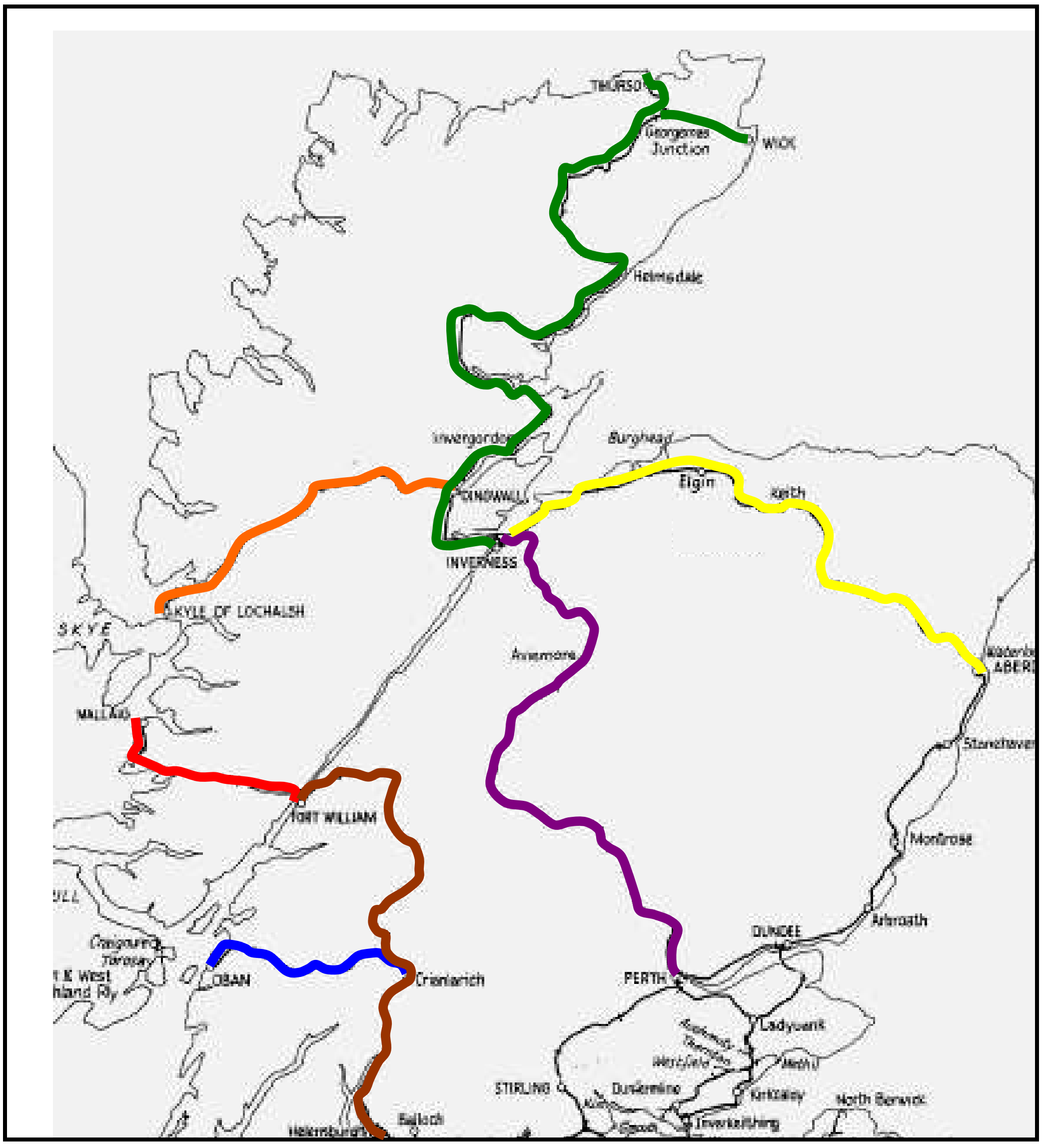

Figure 9-1: Overview of Study Network

9.1 ASPIRATIONS

As reported in the Issues Report, the opportunity was taken during the data-gathering phase of the study to consult with various stakeholders to identify their aspirations for the Highland Rail Network. Consultation was undertaken with the following parties:

- Argyll and Bute Council;
- EWS;
- First ScotRail;
- Freightliner;
- GB Railfreight;
- GNER;
- Highland Council;
- Highlands and Islands Enterprise*;
- Highland Rail Partnership*;
- HITRANS*;
- Moray Council;
- Network Rail*;
- Perth and Kinross Council;
- Royal Scotsman;
- Scottish Executive*; and
- West Coast Railway Company

*** organisations that are part of the Client Group**

Meetings were held as part of the study with all the foregoing parties. The notes of all these discussions are attached in Appendix C. One key aspect of this dialogue was the determination of the aspirations for the network of the various members of the Group. These would form the basis of the schemes that would be considered in taking the study forward. The list of aspirations was then reviewed by the Client Group. Appendix D contains a spreadsheet listing of the aspirations that it was agreed would be developed during the course of the study. It was agreed that the identified aspirations would be developed and recorded in the final study report.

Section 10 of this report considers the methodology adopted in the development of the individual aspirations from an operational and / or technical perspective appropriate for each.

10. CONSIDERATION OF THE ASPIRATIONS

10.1 INTRODUCTION

As stated previously Appendix D contains a summary listing of the aspirations that have been identified during the course of the study. The spreadsheet shows the provenance of the items and provides a brief explanation of the issues to be addressed in each case. Where appropriate, aspirations have been amalgamated where there is a clear overlap of content. It is clear that combining aspirations in this way provides a more rounded solution that takes a wider view of the aims of the proposal.

The following table provides a summary of the aspirations considered during the course of the study.

Route	Reference	Description
Highland Main Line	HML1	To use non-tilting high speed diesel units on the route
	HML2	To review the timetable on the line and consider passenger service enhancements in terms of frequency and to reduce journey time to close to target of two hours thirty minutes between Edinburgh/Glasgow and Inverness
	HML3	To provide four freight train paths in each direction
	HML7	To ensure the route is capable of handling train of 12 parcel vehicles
	HML8	To enhance gauge clearance on the route
	HML9	To create an inter-modal terminal at Inverness
	HML10	To create a new station at Culloden
Far North Line	FNL1	To enhance the frequency of passenger services on the route
	FNL3	To open a new station at Conon
	FNL4	To reduce journey times on the line
	FNL6	To create a new chord line at Georgemas providing a link from the south to Thurso
	FNL7	To reinstate the Dornoch branch and construct link from Tain to Dornoch
Kyle Line	KL1	To provide a service into Inverness suitable for commuters, i.e. before 09:00
	KL2	To permit heavier locomotive to access the route
	KL3	To increase the capacity of the route particularly in the area around Strathcarron
	KL4	To consider the development of line-side loading for freight
Fort William Line	FWL1	To improve line speeds on the route
	FWL2	To consider a fourth passenger path between Glasgow and Fort William
Oban Line	OL1	To determine the limiting capacity of the infrastructure in terms of train paths
	OL2	To improve capacity on passenger services
	OL3	To reduce journey times for passenger services between Oban and Glasgow
	OL4	To allow Class 66 locomotives to operate on the route
	OL5	To improve the maximum train length permitted on the line
	OL6	To create a new timber loading facility at Dalmally
Mallaig Line	ML1	To recast the service on the line
	ML2	To provide improved facilities at Mallaig station
Inverness to Aberdeen Line	IAL1	To enhance services into Inverness from this line particularly for commuters
	IAL2	To provide a new station at Dalcross

Table 10-1: Summary of Aspirations Considered in the Study

The paragraphs in Sections 11 to 19 of this report summarise the development work that has been undertaken along with the outcome and recommendations going forward.

10.2 METHODOLOGY

The approach taken in considering the identified aspirations varied according to their specific requirements and theme. The listing was grouped into those that required primarily operational analysis and those that were largely technical in nature. For the majority, elements from both disciplines were required and in such circumstances a degree of iteration between functions took place.

In developing the aspiration from an operational perspective consideration was taken of the existing Working Timetables. Use was also made of the Scott Wilson Infrastructure for Future Train Timetables (SWIFTT) software. This in-house operational modelling tool provides a means of deriving running times for given rolling stock and route characteristics. Whilst this tool is not as sophisticated as the more generally accepted industry software it does provide a good 'first cut' indication of what is possible. The model can be calibrated with timings from actual runs.

Where engineering development was required site visits were arranged to allow basic information to be captured. It should be noted that at all times the appropriate railway safety rules were rigorously applied. Where multi-disciplinary input was needed this was found from within the Scott Wilson technical resources. In all cases it was possible to work-up engineering solutions based on known railway methodologies, local knowledge and experience. In general, a range of options was developed to satisfy the aims of the aspiration, however in many cases there were limited technical options available due to the nature of the problem.

In all cases where there was an overlap between operations and engineering discussion took place between the respective champions to ensure a co-ordinated output.

10.3 REPORT STRUCTURE

The following Sections of the report consider, on a line-by-line basis, the aspirations and their possible solutions.

- Section 11: Highland Main Line;
- Section 12: Far North Line;
- Section 13: Kyle Line;
- Section 14: Fort William Line;
- Section 15: Oban Line;
- Section 16: Mallaig Line; and
- Section 17: Inverness to Aberdeen Line.

A final Section considers the recommendations going forward for the Highland Rail Network.

11. HIGHLAND MAIN LINE

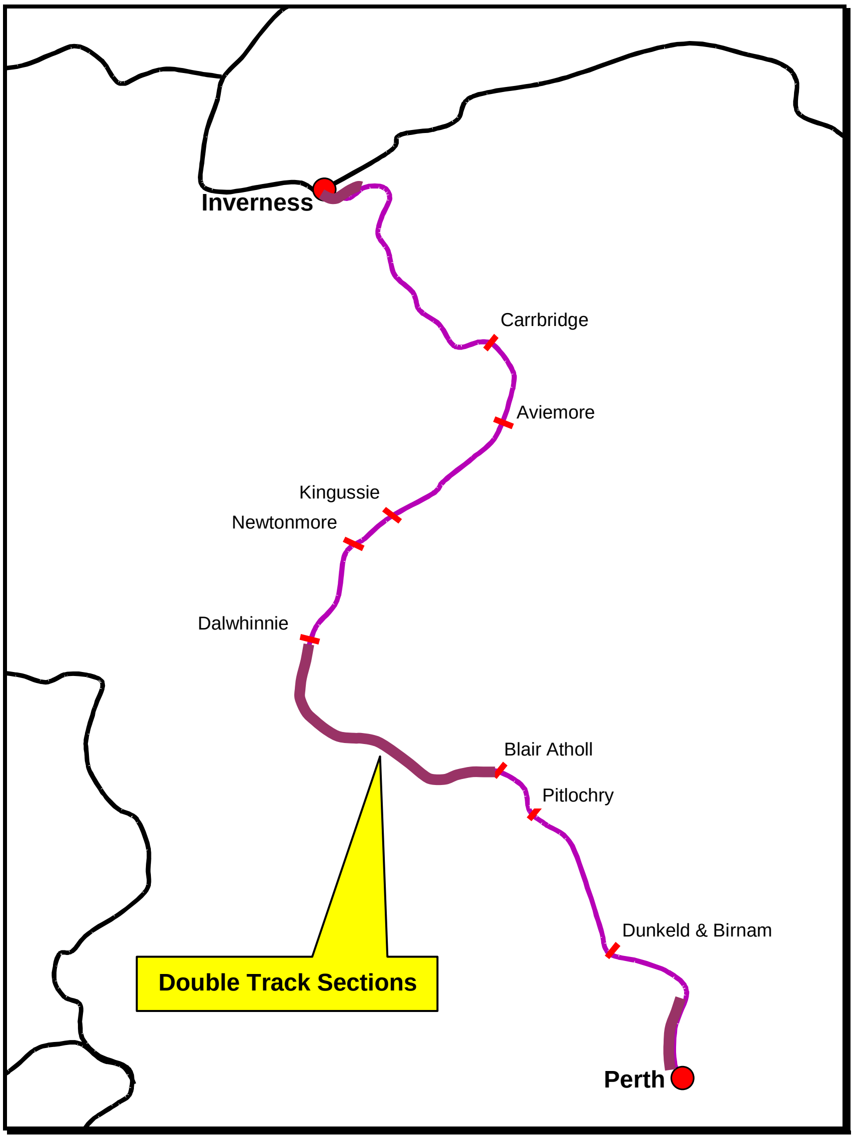

Figure 11-1: Schematic Layout of Highland Main Line

The Highland Main Line extends for 118 miles from Perth to Inverness. It is mainly a single-track railway with stretches of double track and passing loops. These are between Perth and Stanley, Blair Atholl to Dalwhinnie and from Culloden to Inverness (see diagram). A key feature of the route is the predominance of gradients.

The line is controlled from nine signalboxes at Perth, Stanley, Dunkeld, Pitlochry, Blair Atholl, Dalwhinnie, Kingussie, Aviemore and Inverness. There are stretches of mechanical signalling with some colour lights. These are dominant at either end of the route.

The gradients and curves result in a route limit speeds and as a result journey times are relatively slow with the fastest journey time a little over two hours. This struggles to be competitive to the adjacent A9 trunk road. The passenger service is comprised mainly of Class 170 diesel units, operated by First ScotRail.

11.1 HML1: TO UTILISE HIGHER SPEED DIESEL UNITS (SIMILAR TO VOYAGERS)

11.1.1 The Issue

There is a perception that the distance and travel time from the Central Belt to Inverness is such that it acts as a barrier to economic and social interaction. Train speeds on the line from Perth to Inverness are generally lower than those on the other ScotRail Express Network routes. This aspiration has therefore emerged to overcome this perception of Inverness, and therefore the Highlands generally, as being disconnected from the lowlands. The aim is to improve train speeds and reduce journey time to Inverness.

There are a number of initiatives and enhancement proposals currently being considered for the rail network in the Central Belt of Scotland. One of these, the Edinburgh Airport Rail Link, has considered as part of the package of new services providing links from the airport to the north. It is likely that these new services will feature high-speed diesel multiple units similar to those operated on Virgin Cross Country services marketed as 'Voyagers' or Voyager type units (i.e. Class 220 or 221 diesel multiple units). As a result of this initiative there is therefore an aspiration in the Highlands to extend these services to Inverness with the twin aims of significantly reducing the journey times on the Highland Main Line and providing access from the Highlands to Edinburgh Airport. This aspiration considers the potential benefits that such traction could bring to the route.

11.1.2 Operational Analysis

The use of Voyager type units will provide improved acceleration over the current Class 170 trains, and coupled with greater seating capacity would go some way to fulfilling the aims of HML2, to improve end to end journey times bringing it closer to the target time of two and a half hours for a journey between Edinburgh/Glasgow and Inverness. In order to undertake the analysis the characteristics of the route along with the acceleration and braking capabilities of the rolling stock were determined and used in the Scott Wilson Infrastructure for Future Train Timetables calculator (SWIFTT). The following table shows the output from this modelling. It provided a comparison in Sectional Running Times (SRT) between Class 170 and Voyager Units.

Section	**Class 170 Units (Using SWIFTT): Minutes / Seconds ***			**Voyager Units (SRT Calculated by SWIFTT): Minutes / Seconds ***		
NON-STOP TO INVERNESS	**SRT**	**SRT+10%**	**Total**	**SRT**	**SRT+10%**	**Total**
Perth – Pitlochry	00:28:12	00:31:01	00:31:01	00:24:59	00:27:29	00:27:29
Pitlochry – Kingussie	00:43:10	00:47:29	01:18:30	00:39:27	00:43:24	01:10:53
Kingussie – Aviemore	00:10:08	00:11:09	01:29:39	00:08:52	00:09:45	01:20:38
Aviemore – Inverness	00:33:17	00:36:37	02:06:16	00:29:47	00:32:46	01:53:24
	* - These journey times do not include engineering recovery allowances					

Table 11-1: Comparison of Journey Times (Northbound)

Section	Class 170 Units (Using SWIFTT): Minutes / Seconds *			Voyager Units (SRT Calculated by SWIFTT): Minutes / Seconds *		
NON-STOP TO PERTH	**SRT**	**SRT+10%**	**Total**	**SRT**	**SRT+10%**	**Total**
Inverness – Aviemore	00:36:57	00:40:39	00:40:39	00:29:51	00:32:50	00:32:50
Aviemore – Kingussie	00:10:11	00:11:12	00:51:51	00:08:51	00:09:44	00:42:34
Kingussie – Pitlochry	00:44:43	00:49:11	01:41:02	00:39:28	00:43:25	01:25:59
Pitlochry - Perth	00:26:09	00:28:46	02:09:48	00:24:52	00:27:21	01:53:20
	*** These journey times do not include engineering recovery allowances**					

Table 11-2: Comparison of Journey Times (Southbound)

The addition of 10% to each sectional running time produced by the software is to allow for performance factors such as defensive driving and the rolling stock perhaps being less than 100% mechanically efficient on any day. However, the original SRT values for Class 170s, using SWIFTT, compare favourably with actual operational measurements and so therefore it is reasonable to expect that the same degree of accuracy will apply to the base figure for Voyager Units.

In each direction a Voyager unit running unconstrained (by infrastructure or signals) can achieve over 100mph (if the line speed were available) on a non-stop run between:

- Dunkeld and Pitlochry – current maximum linespeed is 80mph at certain locations;
- Dalwhinnie and Kingussie – current maximum linespeed is 90mph at certain locations;
- Kingussie and Aviemore – current maximum linespeed is 100mph at certain locations; and
- Daviot and Millburn (down direction only) – current maximum linespeed is 75mph

To achieve the optimum journey times, if it is desirable to significantly lower end to end journey times between Edinburgh and Inverness, consideration could be given to raising line speeds for Voyagers at the locations listed above.

11.1.3 Engineering Review

It is clear from the foregoing that the Voyager type units could deliver improved journey times without the need to enhance the infrastructure with the exception of line speed improvements. Running in excess of the current line speeds would require further engineering surveys and assessments of the infrastructure. In particular, the evaluation of the works required to deliver speeds of in excess of 100mph on the Highland Main Line would necessitate a detailed assessment of the route. In all cases this would consider the line curvature and the impact of the higher speeds on structures. It is however clear from the analysis that has been undertaken that the acceleration characteristics of the diesel units mean that they could take advantage of improvements in the infrastructure.

11.1.4 Summary

The consideration of the use of Voyager type units on the Highland Main Line is intrinsically linked to the overall enhancement of services in terms of journey times and frequency. There are clear benefits to be obtained from the introduction of such units, which would further improve the travelling environment for passengers and reduce journey times, even based on current infrastructure capabilities. It is estimated that a saving of up to seventeen minutes could be achieved by the introduction of this rolling stock with enhanced acceleration characteristics. This journey time saving is also capable of being achieved with station stops. To reap further benefits a more detailed engineering survey to increase line speeds would be necessary.

11.2 HML2: TIMETABLE IMPROVEMENTS

11.2.1 The Issue

Whilst journey time will improve connectivity a further influencing factor is the train frequency. As related in the previous section there is a drive to improve links on the Highland Main Line. Delivery of the twin enhancements of reduced journey time and greater frequency will make the railway more competitive when compared to the road alternative. This aspiration therefore considers the potential to improve service frequency whilst reducing journey times through changes in the stopping pattern of services. It further takes advantage, where appropriate, of the benefits to be obtained from improved rolling stock as outlined above in HML1.

11.2.2 Background

The Perth to Inverness timetables have been historically designed to fit in with the requirements of services in Central Scotland and how long distance trains between Edinburgh or Glasgow and Inverness can serve various markets. These historically would have been:

- Local traffic between Glasgow and Edinburgh and 'suburban' stations;
- Longer distance traffic between the cities and Stirling or Perth; and
- Traffic covering the entire route (traditionally leisure traffic).

Passenger markets are developing and the pattern of train services must change to maximise its relevance to these shifts. Inverness is becoming a new city with new demands on year round business links with other Scottish cities. Perth is also attracting commuters from more outlying areas such as Dunkeld and Pitlochry. The Scottish Parliament calls for more business travel to and from Edinburgh at convenient times of the day. As a result the train service on the Highland Main Line is being called upon to serve a greater variety of requirements.

With the demands on rail infrastructure becoming far greater there is not so much scope for re-writing timetables in order to satisfy one corner of the country without re-writing the timetable for almost the whole country. The desire for an hourly passenger timetable between Inverness and beyond Perth will consequently have to take cognisance of what is required in the Central Belt. Also, the routing, start points and destinations may need to change. This is because the distance and time taken between Perth and Glasgow is not the same as between Perth and Edinburgh and the railways around Glasgow have different services to cater for from those around Edinburgh.

It is recognized that the desire of newly formed Transport Scotland is to eventually examine, and possibly recast, some of the Scotland timetables to take into account all recent developments both in infrastructure, rolling stock and new trends in passenger movement.

From an operational perspective the journey time between Edinburgh and Inverness could be much reduced by line speed improvements between Ladybank and Hilton Junction. Line capacity can be increased by re-doubling the track between Newburgh and Hilton and by raising the line speed from 55mph to 90 mph. The journey time can be further cut by eliminating station stops in Fife and if the journey time between Edinburgh and Perth can be reduced to a maximum of one hour using voyager type units, calling at Haymarket only, then an end to end journey time of two hours and forty-five minutes between Edinburgh and Inverness can be achieved. The 1998 Scott Wilson report 'Edinburgh to Perth: Desk Top Study for Line Speed Improvement' highlighted a possible line speed increase to 75mph between Ladybank and Hilton, saving three minutes at a cost of £4.17 million. This would allow voyager type units a journey time of sixty-one minutes from Edinburgh to Perth calling at Haymarket only. [In order to gain the most from Voyager Units' performance capabilities a further upgrade to 90mph should be considered in order to achieve as close to the optimum end to end journey time of two and a half hours as possible and allow for possible additional station calls. Further linespeed increases to 90 mph would save a further three minutes.] This increase to 75mph would avoid consideration of major infrastructure enhancements in Fife. Cost estimates for increasing the linespeed to 75 mph between Ladybank and Hilton are £12 million (+/- 50%), at today's prices. A possible timing schedule is outlined in Table 11-5 below.

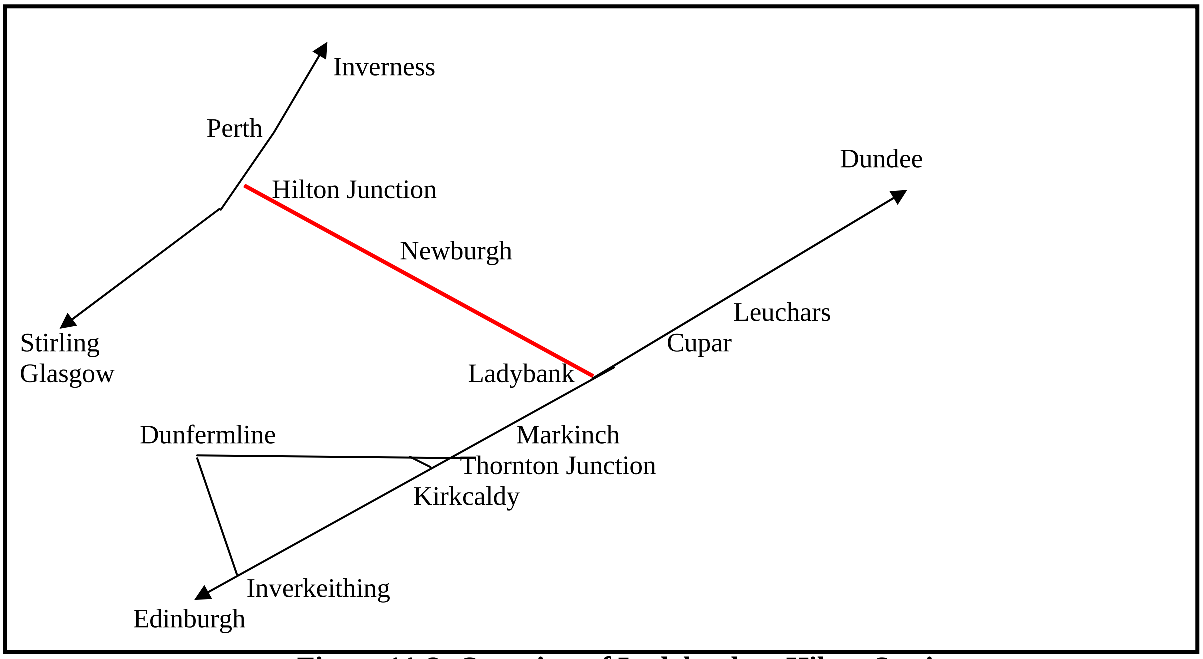

Figure 11-2: Overview of Ladybank to Hilton Section

11.2.3 Operational Analysis

If a starting point for a revised timetable is taken at Perth with northbound trains departing on the hour, departures can be moved round the clockface to suit interaction with other services south of Perth as well as through services. Obviously services in the opposite direction will need to move the same amount of minutes either forwards or backwards in order to meet crossing points on the single line.

The Sectional Running Times (SRTs) for Voyagers employed in the study are based on the times shown in Tables 11-1 and 11-2 with some adjustments made to cater for anticipated line speed improvements mentioned in the May 1998 Scott Wilson Report to Railtrack Scotland, 'Perth to Inverness: Desk Top Study for Route Speed Improvement'. The service pattern remains similar to that operated today of a four hour cycle, in order to provide

- Pitlochry and Aviemore an hourly service;
- Dunkeld and Kingussie a two-hourly service; and
- Blair Atholl, Dalwhinnie, Newtonmore and Carr Bridge a service every four hours

This pattern would hold except early and late in the day. Marketing analysis would deem whether any station call be omitted from this pattern to quicken journeys.

The following tables show this pattern (assuming a starting point of 10:00 from Perth and no additional infrastructure was to be provided):

Station				
Perth	10:00	11:00	12:00	13:00
Stanley	10/07	11/07	12/07	13/07
Dunkeld	10/x14h	11ax16	12/x16h	13ax17
Pitlochry	10a25h	11a28	12a28h	13a29
Blair Atholl	10/35	11/37h	12a39h	13/38h
Dalwhinnie	10a54h	11/55h	12/58h	13/56h
Newtonmore				14a07
Kingussie	11a06h	12/07h	13a09h	14/10h
Kincraig	11/11	12/11h	13/x14	14/x14h
Aviemore	11ax16h	12a16h	13a19h	14a20
Carrbridge	11/22	12a23h	13/25	14/25h
Slochd	11/28	12/30h	13/31	14/31h
Tomatin	11/31h	12/34	13/34h	14/35
Moy	11/34h	12/37	13/37h	14/38
Culloden	11/39h	12/42	13/42h	14/43
	[3]	[3]	[3]	[3]
Millburn	11/47h	12/50	13/50h	14/51
Inverness	11:50	12:52	13:53	14:53

/ - trains do not call; times are passing times
a - stops for station call
[3] - minutes allowed for temporary speed restrictions as a result of engineering works en route
x - indicates where a train will cross another in the opposite direction at a passing loop
h - indicates the half minute

Table 11-3: Northbound Hourly Voyager Timetable

This pattern could start at any hour or minute of the day but would have to repeat itself in a four hourly cycle as illustrated. The reverse direction would fit thus:

Station				
Inverness	09:38	10:41	11:36	12:36
Millburn	09/39h	10/42h	11/37h	12/37h
Culloden	09/45	10/48	11/43	12/43
Moy	09/52h	10/55h	11/50h	12/50h
Tomatin	09/55h	10/58h	11/53h	12/53h
Slochd	09/59	11/02	11/57	12/57
Carr Bridge	10/02h	11a08	12/01	13/01
Aviemore	10a09h	11ax16	12a08	13a08
Kincraig	10/x14h	11/21	12/x15	13/x15
Kingussie	10a22	11/25	12a24h	13/21
Newtonmore				13a35
Dalwhinnie	10a36	11/37	12/36	13/36
Blair Atholl	10/56	11/55	12a56h	13/54
Pitlochry	11a04h	12a03h	13a06	14a02h
Dunkeld	11/x15h	12ax17	13/x16	14ax15
Stanley	11/23	12/24h	13/23h	14/22h
	[3]	[3]	[3]	[3]
Perth	11:31	12:32h	13:31h	14:30h

/ - trains do not call; times are passing times
a - stops for station call
[3] - minutes allowed for temporary speed restrictions as a result of engineering works en route
x - indicates where a train will cross another in the opposite direction at a passing loop
h - indicates the half minute

Table 11-4: Southbound Hourly Voyager Timetable

This pattern must start twenty-two minutes earlier than the northbound direction cycle starts at Perth in order to take advantage of trains being able to pass each hour on double line sections between Culloden and Millburn and between Blair Atholl and Dalwhinnie. However, timings would remain very tight at Culloden and the slightest perturbation to trains from the south will accumulate delay from that moment on. It is recommended that the double line should be extended from Culloden to Daviot and this is discussed further, under engineering options. It should also be noted that most passenger services use Dunkeld as a crossing place on the single line. Performance risk during perturbation would be limited with the reinstatement of Ballinluig as a passing loop. Examination of freight services strengthens the argument and is expounded under the section on freight services; this location is also mentioned under engineering options.

In order for a non-stop service to operate the following time pattern is suggested outwith the four-hour cycle of services (which could depart Perth between 09:00 and 16:00) to suit the business market:

Station	Timing	Timing	Notes
Edinburgh	07:00	16:00	
Haymarket	07a04	16a04	
Haymarket West Jn	07/06	16/06	
Dalmeny Jn	07/11	16/11	**Local Services to be Adjusted**
Inverkeithing	07/16	16/16	
Burntisland	07/22	16/22	
Kirkcaldy	07/28	16/28	
Thornton S	07/32	16/32	
Thornton N	07/32h	16/32h	
Ladybank	07/38h	16/38h	**Assumes Linespeed Increase**
Newburgh	07/47h	16/47h	
	[3]	[3]	
Hilton Jn	07/57h	16/57h	
Perth arr	08:01	17:01	
Perth dep	08:02	17:02	
Stanley	08/09	17/09	
Dunkeld	08/ 16h	17x/16h	
Pitlochry	08/26	17/26	
Blair Atholl	08/35	17/x35	
Dalwhinnie	08/53	17/53	
Kingussie	09/03	18/03	
Kincraig	09/07	18/07	
Aviemore	09/12	18/12	
Carrbridge	09/18	18/18	
Slochd	09/23	18/23	
Tomatin	09/26h	18/26h	
Moy	09/29h	18/29h	
Culloden	09/34h	18/34h	
	[3]	[3]	
Millburn	09/42h	18/42h	
Inverness	09:45	18:45	

Table 11-5: Northbound Express Voyager Timetable

The 18:00 departure from Perth would be formed by GNER's 12:00 service from Kings Cross. It is anticipated that after this hour, services might adopt a similar pattern to today's timetable unless the hourly service should continue until later during the evening.

In the southbound direction express departures would again be able to suit the business market and not affect the four-hour cycle (see Table 11-4), which could operate between 08:30 and 15:30.

Station	Timing	Notes	Timing
Inverness	06:27		16:27
Millburn	06/28h		16/28h
Culloden	06/34		16/34
Moy	06/41h		16/41h
Tomatin	06/44h		16/44h
Slochd	06/48		16/48
Carr Bridge	06/52		16/52
Aviemore	06/57h		16/57h
Kincraig	07/02		17/02
Kingussie	07/06		17/06
Newtonmore			
Dalwhinnie	07/18		17/18
Blair Atholl	07/36		17/36
Pitlochry	07/43		17/43
Dunkeld	07/52h		17/52h
Stanley	08/00		18/00
	[3]		[3]
Perth arr	08:08		18:08
Perth dep	08:10		18:10
Hilton Jn	08/13		18/13
Newburgh	08/23		18/23
Ladybank	08/32	**<<<Retime 08:00 ex Dundee to 08:10 and 07:20 Fife Circle via Dalmeny Loop**	18/32
Thornton N	08/38		18/38
Thornton S	08/38h		18/38h
Kirkcaldy	08/42h		18/42h
Burntisland	08/48h		18/48h
Inverkeithing	08/54h		18/54h
Dalmeny Jn	08/59h		18/59h
	[3]		[3]
Haymarket West Jn	09/06h		19/06h
Haymarket	09a09		19a09
Edinburgh	09:12		19:12

Table 11-6: Southbound Express Timetable

Consequential minor retimings to the four hour cycle trains will be required if expresses are introduced. It would be essential for double track to extend south of Culloden to allow the 16:27 express to pass the last of the northbound four-hour pattern services on this section.

It should be noted that these are only ***possible timings*** and services would require some adjustment to existing Fife services if they were to run in these time slots. However, movement round the clock-face to gain a better fit with other services will be the subject of further timetable studies once specifications have been agreed and demand studies completed.

Although Tables 11-4 and 11-5 highlight Edinburgh to Inverness options, a similar journey time would be available between Glasgow and Inverness as the current journey time between Glasgow and Perth is 56.5 minutes with one station stop of two minutes and three minutes engineering recovery time. (The journey time between Perth and Glasgow averages 62 minutes due to congestion south of Larbert and therefore slower running speeds.)

Any reduction in journey times will be beneficial so that more economic use of train sets can be attained, as well as more efficient use of train crews' time which could reduce actual hours worked and therefore some associated costs.

11.2.4 Engineering Requirements

A number of the consultees approached during the course of the study raised the issue of journey times and numbers of passenger services on the Highland Main Line. There are a number of potential methods of achieving these aims. From an engineering perspective, and based on the operational analysis, the following specific schemes have been identified as contributing to these goals, at the same time providing greater timetable robustness:

- Re-double line between Culloden and Daviot; and
- Provide a loop at Ballinluig.

Additionally a number of proposals were raised in the Scott Wilson Railways report produced for Railtrack in 1998. These included:

- Plain line realignment and recanting along the route;
- Works to underbridges where restrictions existed, namely bridges 90,91 and 346;
- Works to Kingswood tunnel;
- Formation widening north of Stanley Junction; and
- Enhancement work to the S&C at Dunkeld.

The report divided proposals into lower and higher costs. The report concluded that for "around £3m (1998 cost) a saving of around three minutes could be realised", and for a further £8m a saving of around ten minutes could be made. Some of the works, such as the replacement of Moy Viaduct, have been carried out. Whilst it requires to be confirmed which of these works have been carried out since the report was written the following paragraphs consider the main proposals. The revised total cost at 2006 prices is £14 million. This work is viewed as essential to be able to achieve an hourly service without major enhancements.

11.2.5 Re-Double Line between Culloden and Daviot

This option would entail the re-doubling of the entire four-mile length between Culloden and Daviot. Whilst this would be the optimum solution it would also be possible to re-double a shorter length.

To verify whether this option is viable it will be necessary to carry out a more detailed investigation, including a walk out over the entire length. Since the route was singled it is likely that sections of double track bed on the line will require significant works to bring them up to an acceptable standard for a second track. There may have been structures and level crossings that have been altered or replaced in a form suitable only for single track. For example, major embankment stabilisation has taken place adjacent to Culloden Viaduct.

Figure 11-3: Culloden Looking South

Signalling alterations would be required for this option. The new track would be controlled from either Inverness Signalling Centre or Aviemore Panel and would comprise of colour light signalling. The cost of this signalling alteration is estimated at £5m. On the assumption that there are no major structural or civil engineering alterations required, the shot estimate for track replacement, renewal and civil engineering work would be £12m including an allowance for replacement of four number single span underbridges. This makes a total cost of £17m for the works.

11.2.6 Provide a Loop at Ballinluig

This option would require a loop to be provided at Ballinluig close to the location of the previous junction with the line to Aberfeldy. It would allow trains to pass travelling in the same or opposite directions.

The length of loop requires to be considered further, but as a minimum would be required to cater for a 265m freight train. (The shortest current loop length is 265m at Pitlochry – see 11.7.2.)

The shot estimate for this option would be £0.9m for a 270m long loop without any major civil engineering works and excluding signalling costs.

Figure 11-4: Ballinluig Looking South

The signalling infrastructure would have to be upgraded. It is likely that the new loop would be controlled from Pitlochry signal box and controlled by colour light signals. The estimated cost of providing the signalling for such a facility is £4m. This makes the total cost for such a facility in the region of £5m.

11.2.7 Summary

It is recommended that further investigation be made into providing a loop at Ballinluig (as proved by the requirement to operate freight trains during the period of an hourly passenger service discussed below), doubling the Culloden to Daviot section and carrying out line improvements as highlighted in the 1998 report. This will enable potential timetable specifications to be met without compromising performance and fit with business plans of both passenger and freight operators.

Infrastructure Enhancement in order of priority for new services	Cost	Benefit	Minutes Saved
1.Line speed improvements as per 1998 Scott Wilson Report	£14 m	Achieve national aspiration for hourly service	12
2. Double line from Daviot to Culloden	£17m	Lower performance risk on introduction of hourly service: essential for non stop services catering for business market – see Tables 11-5 and 11-6.	Not applicable
3. Reinstate Ballinluig Loop	£5m	Ability to run freight service at times of hourly passenger service	Not applicable

Table 11-7: Cost Benefit Summary: Highland Line Enhancements

11.3 HML3: PROVISION OF FOUR FREIGHT PATHS IN EACH DIRECTION

11.3.1 The Issue

It is clear from the nature of the route as described earlier with stretches of single line interspersed with passing loops and double track that capacity is a key issue. The case for expanding the passenger train services has been highlighted in the previous paragraphs. The growth in passenger services potentially constricts spare capacity on the route, which could be utilised by freight services. This is important given the desire for a parallel growth to take place in rail freight along with the passenger operations. This aspiration is aimed at protecting the interests of the freight operator and to provide them with their required number of paths. The issue is to identify what additional infrastructure would be required to accommodate the growth in both passenger and freight sectors.

11.3.2 The Background

The provision of additional, faster passenger services will mean that it is likely that freight services will not only require to be by-passed at loops but also that they may be required to run at higher speeds. Assuming that an hourly passenger service operates between 08:00 and 18:00 then it is estimated that, in the Down (northbound) direction, each freight service will require to be overtaken by at least one, and sometimes two, passenger services if they remain running at the present 60mph (Class 6). The result of this is that a freight service will take three and a half hours between Perth and Inverness, an average speed of under 40 mph. This will not be acceptable to freight operators both from a resource utilisation and customer delivery time perspective.

Assuming the passenger service pattern is based on times shown above then, as Dunkeld is the point at which passenger services cross, a freight service must depart Perth immediately behind a northbound passenger service and be able to run to Pitlochry to pass a southbound train (at xx:00). An ample time margin is required for the service to reach Dalwhinnie before the next hourly passenger train requires to overtake it. A lack of signalling infrastructure north of Dalwhinnie means that a freight train cannot leave Dalwhinnie until the passenger train has passed Kingussie.

To run as illustrated between the hours of 08:00 and 18:00 at 60mph the *outline* timings of Down trains would be as follows:

Station	Passenger Service	Freight at 60mph	Passenger Service	Freight at 60mph	Passenger Service
Perth	10:00	10:10	11:00		12:00
Stanley	10/07	10/30	11/07		12/07
Dunkeld	10/x14h	10/40	11ax16		12/x16h
Pitlochry	10a25h	11x05	11a28		12a28h
Blair Atholl	10/35	11/15	11/37h	←	12a39h
Dalwhinnie	10a54h	11:45/12:08	11/55h	12:08	12/58h
Kingussie	11a06h	→	12/07h	12x25	13a09h
Kincraig	11/11		12/x11h	12/35	13/x14
Aviemore	11ax16h		12a16h	12/42	13a19h
Carrbridge	11/22		12a23h	12/52	13/25
Slochd	11/28		12/30h	13x02	13/31
Tomatin	11/31h		12/34	13/07	13/34h
Moy	11/34h		12/37	13/12	13/37h
Culloden	11/39h		12/42	13/20	13/42h
	[3]		[3]	[4]	[3]
Millburn	11/47h		12/50	13/30	13/50h
Inverness	11:50		12:52	13:35	13:53

x - cross southbound train at loop on single line
→/← - indicates a train has to stop for some time in a loop to allow faster service to overtake

Table 11-8: Sample Freight Path Imposed on Table 11-3 (Northbound)

Whilst there would be several paths of this nature before 18:00, more freight paths and better timing schedules are available outwith the period of an hourly service and the start of any engineering period when it is presumed that an hourly passenger service would not be required.

If trains were able to run at 75mph (Class 4) then, by departing Perth immediately behind a passenger service, Inverness would be reached without as much regulation for other services. A 90mph train (e.g. parcels) train can run behind a passenger train without being overtaken, in which case a path would be available most hours.

In the Up (southbound) direction a similar scenario applies. Paths are more readily available outside the hourly service period. Unless some new facility is made available south of Kingussie to allow Up freight services to be overtaken, then the paths in the present Working Timetable (2005), with the exception of the 90mph parcels train, would have to be moved until after 18:00. Also, the times illustrated in Tables 11-7 and 11-8 show that even with a facility between Kingussie and Dalwhinnie freight trains could not pass in the same hour without excessive delay and require to be timed on alternate hours over this section. Similarly, there needs to be a facility for freight services to be overtaken south of Pitlochry given the demands of the passenger service. The *outline* timings are shown below:

Station	Passenger Service	Freight at 60mph	Passenger Service	Freight at 60mph	Passenger Service
Inverness	09:38	09:45	10:41		11:36
Millburn	09/39h	09/47	10/42h		11/37h
Culloden	09/45	10/04	10/48		11/43
Moy	09/52h	10/22	10/55h		11/50h
Tomatin	09/55h	10x32	10/58h		11/53h
Slochd	09/59	10/38	11/02		11/57
Carr Bridge	10/02h	10/50	11a08		12/01
Aviemore	10a09h	10/56	11ax16		12a08
Kincraig	10/x14h	11x04	11/21		12/x15
Kingussie	10a22	11/14	11/25	←	12a24h
Newtonmore		11***20		11:38	
Dalwhinnie	10a36	→	11/37	11/x54	12/36
Blair Atholl	10/56		11/55	12x39	12a56h
Pitlochry	11a04h		12a03h	12/47	13a06
Dunkeld	11/x15h		12ax17	13/%03	13/x16
Stanley	11/23		12/24h	13/%16	13/23h
	[3]		[3]	[4]	[3]
Perth	11:31		12:32h	13%30	13:31h

***** - train needs to pass northbound freight and be overtaken by following passenger service**
x - cross southbound train at loop on single line
% - cannot run to Stanley without delaying northbound passenger (13:00 ex Perth): requires to be overtaken before Dunkeld where passenger trains must cross to maintain hourly pattern
(sectional running times based on current running times in Freight Working Timetable)

Table 11-9: Sample Freight Path Imposed on Table 11-4 (Southbound)

11.3.3 Reinstate the Loop at Newtonmore Station

To provide the necessary freight train paths the operational analysis has demonstrated that the re-instatement of the loop at Newtonmore would be necessary. This option would require the loop to be provided at Newtonmore Station on the former solum. It would allow trains to pass travelling in the same or opposite directions. The current redundant Up platform may require to be re-commissioned depending on the passenger timetable requirements.

The length of loop requires to be considered further, but as a minimum would be required to cater for a 240m freight train (EWS specification). There may be a requirement to partially demolish the redundant platform wall to obtain satisfactory clearances. It is noted that although the redundant platform could be reinstated the associated costs may prove prohibitive to ensure compliant footbridge access. The signalling infrastructure would also have to be upgraded. The new loop would be controlled from Kingussie box by colour light signals.

The shot estimate for this option would be £0.75m for a 300m loop without any major civil engineering works. Signalling costs are estimated at £5m and £0.8m for the platform reinstatement. This brings a total cost of £6.5m.

11.3.4 Summary

Reinstatement of Newtonmore loop will enhance capacity and improve performance in times of perturbation. Freight trains cannot run during periods of an hourly passenger services without the additional infrastructure.

Infrastructure Enhancement	Cost	Benefit	Minutes Saved
Reinstate Newtonmore Loop	£6.5m	Breaks long section Kingussie – Dalwhinnie: allows the necessary capacity for freight traffic	N/A

Table 11-10: Cost Benefit Summary; Freight Paths

11.4 HML4: SHORTEN THE LONG SIGNAL SECTIONS

11.4.1 The Issue

Capacity levels on a route are determined by the spacing of signals. The further apart the signals are then the lower the capacity since each section (the distance between signals) of the line can only accommodate one train with safety. There is concern that long signal sections on the Highland Main Line are impeding improvements to train services. The issue is therefore to identify which 'long sections' are critical to the development of the aspirational train services on the route.

11.4.2 The Analysis

It has been demonstrated in HML2 that various timetable scenarios highlighted the need for additional crossing loops. These loops create shorter signal sections where trains could be 'flighted' more closely together. An example of this is the loops north of Kingussie where they require controlled stop signals which not only allow trains to be crossed, but also permit trains to follow at relatively short time intervals. The best locations, demonstrated by the requirements of a notional timetable, are between Dunkeld and Pitlochry and between Dalwhinnie and Kingussie. Prior to signalling rationalization in the 1980s there were loops at Ballinluig and Newtonmore and prior to 1960 there was a loop at Etteridge, between Dalwhinnie and Newtonmore. Even today, with quicker rolling stock, the long sections prove a hindrance to performance during times of perturbation. As has been shown, timetable improvements could not be introduced without some capacity enhancement.

11.4.3 Summary

Reinstatement of Ballinluig will enhance capacity, allowing more freight services to operate between 09:00 and 17:00 and improve performance in times of perturbation.

A facility is necessary to regulate freight trains between Dalwhinnie and Kingussie and should be considered at Newtonmore or Ettridge, particularly if Option HML5 is adopted.

Infrastructure Enhancement	Cost	Benefit	Minutes Saved
Reinstate Ballinluig Loop	£5m	Breaks long signal section Dunkeld - Pitlochry: allows more capacity for daytime freight traffic	Non quantifiable
Reinstate Newtonmore Loop	£6.5m	Breaks long signal section Kingussie – Dalwhinnie: allows more capacity for daytime freight	Non quantifiable

Table 11-11: Cost Benefit Summary; Shorter Signal Sections

11.5 HML5: CLOSE NEWTONMORE STATION

11.5.1 The Issue

The aim of reducing journey time could be achieved by a reduction in the number of station stops. Whilst 'skip-stopping' is one solution the closure of stations provides a more permanent means of raising average speeds. The stations at Newtonmore and Kingussie are only three miles apart. Whilst it is recognised that the stations serve two distinct communities the potential remains to close one facility and provide links to the other. This aspiration considers the practicalities of closing the lesser used station at Newtonmore.

11.5.2 The Operational Analysis

The close proximity of the two stations at Newtonmore and Kingussie plays a significant part in slowing services on what is elsewhere well spaced out stations. The resulting double stop means that the train cannot reach line speed before requiring to apply the brakes for the second stop thus the effect of the additional stop is magnified in operational terms. The anticipated time saving from eliminating the station stop at Newtonmore is some four minutes.

The lesser used of the two stations is Newtonmore. It also serves a smaller community and is some distance from the village centre. Whilst station closure is a highly emotive subject it may be possible to substitute the station with a bus link to Kingussie. If Newtonmore station was closed then a loop could be re-instated at Etteridge, half way between Dalwhinnie and Kingussie. This was a passing loop until rationalization in the mid 1960s. This would be a more sensible location for a passing loop in terms of distance rather than at Newtonmore, which is far closer to Kingussie than Dalwhinnie.

If the decision was made to close Newtonmore to save time, re-instating the former loop does not make sense. It is our view that Etteridge should be examined as an alternative. Detailed computer modelling of timetables would be able to determine the best location for an additional passing loop, a remit for possible further study.

11.5.3 Summary

Closure of the station at Newtonmore would save a small amount in operational and maintenance costs (as the station is not staffed there is no staff saving but cost of a replacement bus would be essential to be included in any comparison). There would also be a saving in journey time, estimated at four minutes for stopping services. A dedicated shuttle bus is likely to cost in the region of £50k per annum. The closure of the station would also require agreement between parties and the formal Station Closure process would require to be enacted. Closure of the station at Newtonmore would save an estimated £0.1m per annum.

11.6 HML6: REINSTATE SECTIONS OF FORMER DOUBLE TRACK (NOW SINGLED)

11.6.1 The Issue

There is concern that the Highland Main Line could fulfil more of its potential if it were possible to enhance the capacity and line speed along the route. Certain portions of the line were singled in the past to reduce costs. This was also a reflection of the decline in traffic on the route at the time. Recently, there has been an upsurge in traffic with further growth forecast and hence it is appropriate that a review be undertaken of areas where previously double track had existed. This links in with the general timetable reviews being undertaken as part of the evaluation of other aspirations.

11.6.2 The Operational Review

The case for re-instatement of as much former infrastructure as possible has been documented above. This is particularly the case for the former double line between Daviot and Culloden, which is required to maintain performance levels with a robust enhanced timetable. The signalling required would also provide a useful capacity enhancement. A train travelling in the same direction would be able to follow from Culloden once the previous train has passed signals at Daviot instead of Moy, a saving of between seven and ten minutes. The same is true in the reverse direction. Because the distance between Daviot and Culloden is greater than four miles, intermediate signals could be positioned at roughly half way to increase operational flexibility even further.

11.6.3 The Engineering Considerations

This option would entail the re-doubling of the entire four-mile length between Culloden and Daviot. It would also be possible to re-double a shorter length.

To verify whether this option is viable it will be necessary to carry out a more detailed investigation, including a walk out over the entire length. Since the route was singled it is likely that sections of double track bed on the line will require significant works to bring them up to an acceptable standard for a second track. There may have been structures and level crossings that have been altered or replaced in a form suitable only for single track. For example, major embankment stabilisation has taken place adjacent to Culloden Viaduct.

Signalling alterations would be required for this option. The new track would be controlled from either Inverness Signalling Centre or Aviemore Panel and would comprise of colour light signalling. The cost of this work is estimated at £5m based on previous experience of a similar job.

On the assumption that there are no major structural or civil engineering alterations required, the shot estimate for this option would be £17m. An allowance for replacement of four number single span under-bridges has been included.

11.6.4 Summary

The option considered above in Section 11.2, for the cost of providing double track between Daviot and Culloden, was estimated at £17m.

Infrastructure Enhancement	Cost	Benefit	Minutes Saved
Double line from Daviot to Culloden	£17m	Lower performance risk on introduction of hourly service	Not quantifiable

Table 11-12: Cost Benefit Summary: Double Tracking

11.7 HML7: TO PERMIT FREIGHT TRAINS OF UP TO 240 METRES TO OPERATE

11.7.1 The Issue

EWS, during the course of discussions as part of the study, expressed the desire to operate freight services of up to twelve parcel vehicles over the Highland Main Line. Thus, as part of the review, consideration has been given to determining the suitability of the route to handle such trains.

11.7.2 The Operational Analysis

The principal factor affecting a routes ability to handle lengthy trains, particularly on a predominantly single line route, is the length of the loops. Trains that are longer than the loops restrict the ability of trains to pass them either in the same or opposite direction without significant delay. From the base line information gathered in the earlier part of the study it is known that shortest loop lengths on the route are:

- Dunkeld: 301 metres
- Pitlochry: 265 metres
- Kingussie: 280 metres

11.7.3 Summary

Whilst the requirement for Freight Operators for trains is understood to be trains of the maximum length possible to fit the longest loop, the aspiration for a parcels train length of up to 265m (or 41.5 standard rail length units) is satisfied by all the loops on the route including the shortest ones mentioned above. Train lengths will be restricted by other parts of the network over which a through service runs.

11.8 HML8: IMPROVED GAUGE CLEARANCE

11.8.1 The Issue

The current capability of the Highland Main Line to handle freight services conveying inter-modal units is restricted as a result of the gauge clearances on the route. The aspiration is to provide sufficient clearance to allow 'W9' gauge vehicles to pass on the line. However this aspiration can only be worthwhile if fulfilled in conjunction with similar enhancements on other sections of the network e.g. Mossend to Perth.

11.8.2 Technical Analysis

Data regarding the structural clearances of Network Rail overbridges and tunnels is available on a database with access available to licence holders. Scott Wilson, as holders of such a licence, has undertaken a simulation of the route to identify the extent of the structures that are foul to the desired clearance. The results of this exercise are contained in Appendix F. An explanation of the methodology and the results in provided at the start of the Appendix.

A model run was made for both 'W9' and 'W10' gauge. 'W9' is the structure gauge for demountable loads. 'W10' provides clearance for 9' 6" high containers on specific wagons.

The results provide a colour-coded key to the degree to which the vehicles either pass or strike the structures. The following tables summarise the structures that 'foul' the clearance necessary for the passage of the individual wagons. It is clear from the significant number of bridges and other lineside equipment involved that there would be considerable cost involved in 'clearing' the route for this traffic. This is particularly true when consideration is given to the conflict with the tunnels on the route.

Structure	Description	Measure	Degree of Conflict
OB 99	St Leonards	Above 1100mm	foul
OB 101	Hydraulic Hoist Bridge	Above 1100mm	60
OB 106	Glasgow Road Bridge	Above 1100mm	foul
OB 107	Dovecotland Bridge	Above 1100mm	-14
OB 108	Crieff Road Bridge	Above 1100mm	-71
OB 119	Belvedere Bridge	Above 1100mm	-116
OB 121	Waulkmill Ferry Bridge	Above 1100mm	-54
OB 122	Dunkeld Road A9 Bridge	Above 1100mm	foul
OB 133	Caputh - Perth Road Bridge	Above 1100mm	foul
OB 134	Station Road Bridge	Above 1100mm	77
OB 135	Access Road Bridge	Above 1100mm	39
Tunnel	Murthly Kingswood Bridge No. 9	Above 1100mm	-1
OB 18	Strath Ban Road Bridge	Above 1100mm	-55
Tunnel	Inver Tunnel	Above 1100mm	foul
Platform	Dalguise Station Single Platform (disused)	Above 1100mm	foul
Tunnel	Killiecrankie Tunnel	Above 1100mm	-75
OB 86	Tilt Bridge (Viaduct)	Above 1100mm	-52
OB 88	Dukes Bridge	Above 1100mm	43
OB 155	A9 Trunk Road Bridge	Above 1100mm	14
OB 173	Etteridge - A9 Trunk Road Bridge	Above 1100mm	14
OB 175	Glentruim Bridge	Above 1100mm	5
OB 180	A9 Trunk Road Bridge	Above 1100mm	32
OB 205	Arched Overbridge	Above 1100mm	-16
OB 209	Kinara No. 3 Bridge	Above 1100mm	56
OB 223	Avielochan Road Bridge	Above 1100mm	71
OB 317	Clava Bridge	Above 1100mm	42
OB 322	Milton Bridge	Above 1100mm	-3
OB 325	Feabuie Bridge	Above 1100mm	33
OB 333	Presidents Bridge	Above 1100mm	4
OB 335	Woodside Bridge	Above 1100mm	3
OB 336	Resaurie Bridge	Above 1100mm	foul
OB 342	Drumrosach Bridge	Above 1100mm	12
UB 348	Longman Bridge	Above 1100mm	foul

Positive numbers indicate the clearance in millimetres
Negative numbers indicate the overlap distance
Foul indicates that structure is under 200mm overlaping the wagon

Table 11-13: Summary of Clearance Results for 'W9'

Structure	Description	Measure	Degree of Conflict
OB 99	St Leonards	Above 1100mm	foul
OB 101	Hydraulic Hoist Bridge	Above 1100mm	-8
OB 106	Glasgow Road Bridge	Above 1100mm	foul
OB 107	Dovecotland Bridge	Above 1100mm	foul
OB 108	Crieff Road Bridge	Above 1100mm	foul
OB 119	Belvedere Bridge	Above 1100mm	foul
OB 121	Waulkmill Ferry Bridge	Above 1100mm	foul
OB 122	Dunkeld Road A9 Bridge	Above 1100mm	foul
OB 133	Caputh - Perth Road Bridge	Above 1100mm	foul
OB 134	Station Road Bridge	Above 1100mm	foul
OB 135	Access Road Bridge	Above 1100mm	foul
Tunnel	Murthly Kingswood Bridge No. 9	Above 1100mm	foul
OB 18	Strath Ban Road Bridge	Above 1100mm	foul
Tunnel	Inver Tunnel	Above 1100mm	foul
Tunnel	Killiecrankie Tunnel	Above 1100mm	foul
OB 86	Tilt Bridge (Viaduct)	Above 1100mm	foul
OB 155	A9 Trunk Road Bridge	Above 1100mm	foul
OB 173	Etteridge - A9 Trunk Road Bridge	Above 1100mm	foul
OB 175	Glentruim Bridge	Above 1100mm	foul
OB 180	A9 Trunk Road Bridge	Above 1100mm	foul
OB 181	Spey Bridge (Viaduct)	Above 1100mm	-15
OB 205	Arched Overbridge	Above 1100mm	foul
OB 209	Kinara No. 3 Bridge	Above 1100mm	foul
OB 218	Granish Bridge	Above 1100mm	foul
OB 223	Avielochan Road Bridge	Above 1100mm	-18
OB 312	Castletown Bridge	Above 1100mm	-12
OB 317	Clava Bridge	Above 1100mm	foul
OB 322	Milton Bridge	Above 1100mm	foul
OB 325	Feabuie Bridge	Above 1100mm	foul
OB 333	Presidents Bridge	Above 1100mm	foul
OB 335	Woodside Bridge	Above 1100mm	foul
OB 336	Resaurie Bridge	Above 1100mm	foul
OB 342	Drumrosach Bridge	Above 1100mm	foul

Positive numbers indicate the clearance in millimetres
Negative numbers indicate the overlap distance
Foul indicates that structure is under 200mm overlaping the wagon

Table 11-14: Summary of Clearance Results for 'W10'

11.8.3 Summary

From the foregoing tabulations it is clear that considerable work would be required to provide the necessary clearances on the route. By concentrating on the 'W9' results it is possible to establish a work programme to deliver the necessary clearances. Whilst the reconstruction of over-bridges is relatively straight forward, work in tunnels can be significantly more problematic in terms of the potential risks and the level of disruption to services. It is also more difficult to cost such work.

There are, however eight bridge structures that are 'foul'. Assuming that these will require to be reconstructed at an average cost of £0.75m then this accounts for some £6m. The volume of work required in Inver Tunnel is uncertain but a sum of £10m has been assumed to address this. Of the remaining twenty-five structures an average figure of £0.2m has been assumed. Thus a total package to deliver 'W9' could be in the region of £21m.

11.9 HML9: PROVISION OF INTERMODAL FREIGHT TERMINAL AT INVERNESS

11.9.1 The Issue

In order to secure a larger share of the inter-modal market on the A9 trunk route EWS has an aspiration to develop a new fast container handling facility in Inverness such that train arriving at the terminal can be off-loaded and the containers trans-shipped as part of a time sensitive delivery package. The proposal would reduce road traffic on the A9 road south of Inverness.

11.9.2 Background

This proposal had previously been put forward by J.G. Russell. At that time the scheme incorporated two sidings and a run-round loop with associated road and storage areas to allow for the loading, unloading and storage of containers. A similar specification has been assumed as part of the examination of this aspiration.

11.9.3 The Operational Impact

There are a number of parties that currently utilise parts of Millburn Yard. A new freight facility would potentially impact on these other operations. These activities including:

- Access to the First ScotRail depot and sidings;
- Access to the carriage wash facilities;
- Network Rail and First Engineering maintenance facilities;
- Snowplough storage; and
- Other existing freight operations.

11.9.4 Summary

In order to produce detailed proposals for a new terminal it would be necessary to carry out detailed discussions with all affected parties to understand their requirements and concerns. In order to accommodate all parties it may be an option to extend the yard east into land owned by Highland Council. It is assumed that a suitable agreement can be brokered with these parties to allow the development to take place. On this basis, and excluding any compensation issues associated with neighbouring parties a shot cost for the development of the terminal is estimated at £2.0m. It should be noted that a Freight Facility Grant may be made available from the Scottish Executive for part of this sum.

11.10 HML10: NEW STATION AT CULLODEN

11.10.1 The Issue

There is a perception that a new station at Culloden would benefit both commuters from the outlying part of Inverness travelling into the city as well as passengers wishing to travel to the south without driving into Inverness or south to Carrbridge or Aviemore.

11.10.2 Technical Analysis

Through an examination of the site two possible locations have been identified for a new Culloden Station. There was a station at Culloden in the past and the first potential site is to reconstruct the new facility in the former station's location. The second potential site is located near the recent residential development that has taken place in the area. This would potentially provide convenient access to the railway from the houses.

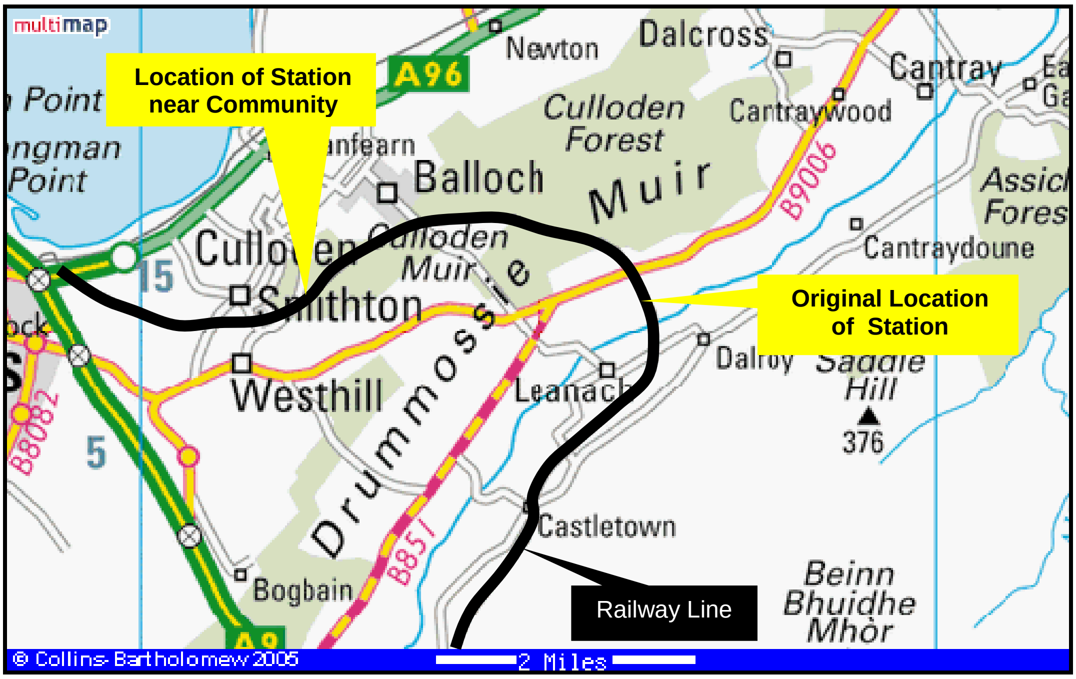

Figure 11-5: Map Showing Locations of Culloden Station

11.10.3 Option 1: Former Station Site

The former station site is adjacent to the B9006 road overbridge. The site, as seen from the figure below is relatively remote and not well placed to serve the community. The station would require to be served with bus services in order to allow decent access for public transport.

This site is therefore rejected on the grounds that it is too remote

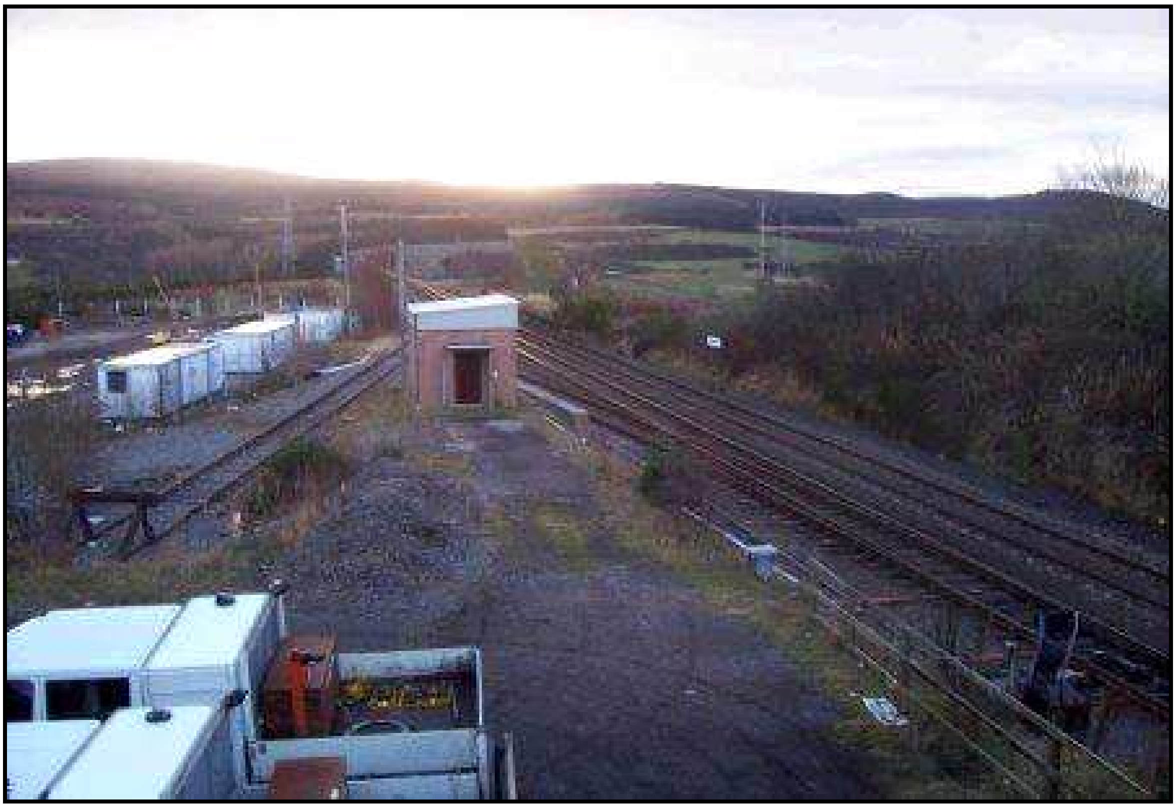

Figure 11-6: Location of Former Culloden Station

11.10.4 Option 2: Adjacent to Residential Properties

A more acceptable site, from an access perspective is to locate the station on the railway line as it passes past the edge of the community. However, the railway at this point is on a heavy gradient of 1 in 70. This is far in excess of the HMRI acceptable gradient of 1:500 for station platform areas. It is not possible to flatten out the gradient locally to a more acceptable level, which could be subject to a special dispensation from HMRI. This is due to the extreme nature of the gradient and the local topography.

11.10.5 Summary

On the basis of the foregoing it is concluded that a station at any site nearer to Inverness would be technically unacceptable or prohibitively expensive because of the substantial gradient; the re-opening at the location of the former station is not seen as economically viable.

11.11 CONCLUSION

The following key areas should be studied further in order to achieve aspirations for the route:

- Detailed timetable study and computer simulation of an hourly passenger service derived from more detailed specification to prove timetable and obtain information regarding pinch points and possible performance risks on present infrastructure;
- Carry out similar timetable study and computer simulation on new infrastructure e.g. double line Daviot – Culloden with reinstated loops at Newtonmore and Ballinluig; and
- Re-visit gauging clearances to W9 and W10 gauge for new freight opportunities.

As a summary of options discussed, the table below sets out the proposals and options discussed in this section highlighting costs and benefits of each for the purposes of possible prioritisation:

Infrastructure Enhancement	Cost (+/- 50%)	Benefit	Minutes Saved
Line speed improvements as per 1998 Scott Wilson Report Upgrade Ladybank to Hilton Junction as per 1998 Scott Wilson Report	£14 m £12m	Hourly passenger service and a journey time of 2 hours 45 minutes for express Edinburgh to Inverness service Contributes to reducing overall journey time to 2 hours 45 minutes	12 – for express services over current fastest journey time
Double line from Daviot to Culloden	£17m	Lower performance risk on introduction of hourly service: tight margins between trains passing Culloden on and off single line	Not quantifiable unless current delay minutes can be assessed for this section of route
Reinstate Ballinluig Loop	£5m	Capacity Enhancement: splits long signal section Dunkeld - Pitlochry: allows capacity for daytime freight traffic and will reduce performance delays to all service groups in times of service perturbation	Not quantifiable unless current delay minutes can be assessed for this section of route
Reinstate Newtonmore Loop	£6.5m	Capacity Enhancement: breaks long signal section Kingussie – Dalwhinnie: essential for capacity to run freight traffic at times of hourly passenger service	Not quantifiable
TOTAL	**£54.5m**		

Table 11-15: Key Options for route enhancement

It is recognised that the target fastest journey time between Edinburgh and Inverness is two hours and thirty minutes. The above table highlights the estimated expenditure required to achieve some way towards that target. Further major works to save the other fifteen minutes will include:

- Major realignment of Inverkeithing to Thornton via Kirkcaldy and/or Dunfermline, further upgrade of Ladybank to Hilton section to 90mph and remodelling of Hilton Junction to raise speed through junction to above 20mph;
- Structures work e.g. increase linespeed over Forth Bridge from 50mph, widening of Inver and Killiecrankie Tunnels and raise speeds over major viaducts at Killiecrankie and Findhorn;
- Raising linespeeds throughout but especially through loops and over Switches & Crossings; and
- Major recanting of track and elimination of the tightest curves.

As a result there would be an incremental increase in costs from £54.5m quoted in Table 11-15.

12. FAR NORTH LINES

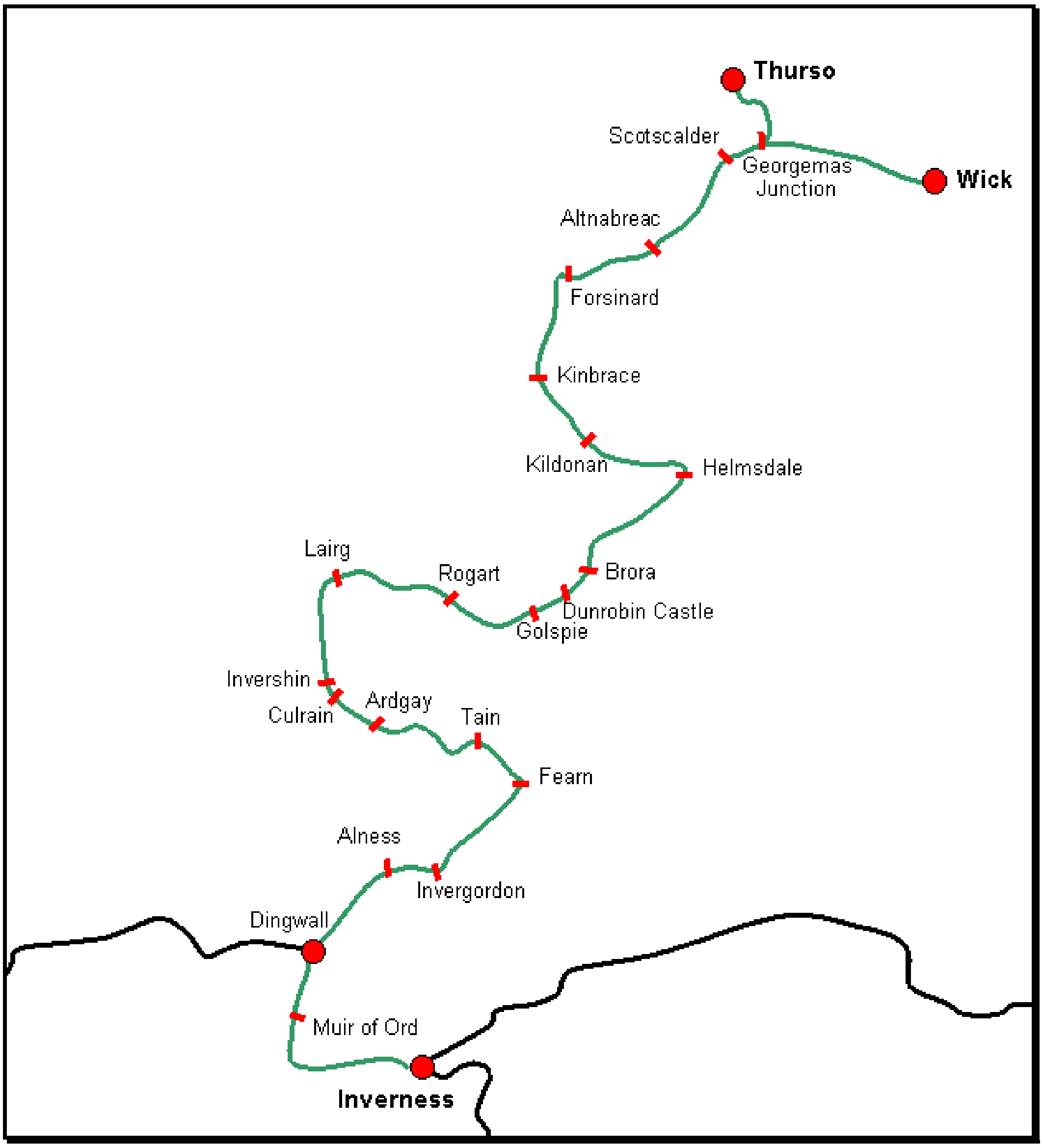

Figure 12-1: Schematic of Far North Lines

The Far North Lines extend from Inverness to Wick and Thurso and are entirely single line with passing loops. Excluding Inverness there are twenty-three stations on the route. The line is controlled from Inverness Signalling Centre. The Radio Electronic Block System (RETB) was introduced in 1985. All passing loops have train-controlled points and speeds are limited to 15mph through loops. Journey time on the line is an issue with an end-to-end trip taking four hours twenty minutes. The basic service north of Lairg is three passenger trains in each direction that start and terminate at Wick, reversing at Thurso. Additional Invernet (local) services operate between Lairg and Inverness, introduced in December 2005. The line between Inverness and Dingwall is shared with Kyle of Lochalsh trains.

12.1 FNL1: ENHANCE PASSENGER SERVICES TO PROVIDE FOUR WICK TRAINS

12.1.1 The Issue

The current train pattern is sparse however with the aim of increasing patronage and the viability of services on the Far North Line there is an aspiration to increase the number of passenger services on the route. In particular, there is a desire to provide a connection with the morning GNER departure from Inverness to Edinburgh and London.

12.1.2 The Operational Analysis

The introduction of Invernet services on 12 December 2005 has gone some way to providing enhanced services at the south end of the route. This aspiration sees the number of through trains serving Wick and Thurso rising from three to four. The announcement has also been made of the intention to introduce a fourth Up (southbound train) from December 2006 with the balancing set working being two sets on the last Down (northbound) train, splitting on arrival at Wick. The present signalling allows for this to happen whereas the infrastructure at Wick does not allow for permissive working in the platform (the first train would have to be shunted to the rounding loop).

A balanced working would be for the new 08:13 Wick to Inverness (the fourth train) to return from Inverness at around midday. On arrival at Wick in the early evening the set would have to be shunted clear of the platform line: no new additional infrastructure is required. Additional train crews are being recruited at Wick for the new 0813 service. A train departing from Wick at 08:13 would pass the current 07:14 Inverness – Wick at Helmsdale at 09:45. Provided that two passenger trains could occupy Georgemas platform simultaneously, the midday train from Inverness would run via Thurso to Wick after crossing the 15:50 from Wick to Inverness. Journey times can be reduced on new services if several station calls are omitted, particularly where there are no token exchange facilities at that station e.g. Kildonan, Kinbrace, Invershin and Culrain. These stations have been identified as having low use and by missing these stops a journey time saving of some eight minutes could be realised.

In order to provide an arrival into Inverness by 07:45 the empty stock working to Lairg (04:45 ex Inverness) could be formed of two sets and crews and run to Ardgay where the train would split. The rear set would form the first train to Inverness at 06:20, arriving at 07:44. This would provide a service of three trains arriving at Inverness before 09:00 (if the first train from Kyle departs one hour earlier - see KL1). Three corresponding trains currently leave Inverness in the evening peak, at 17:03, 17:47 and 18:00.

12.1.3 Summary

The operational analysis has shown that it is possible to provide the desired for workings with the present infrastructure. It should be noted that this could be achieved without requiring an increase in the number of sets deployed. The number of train crews based at Inverness does not need to be increased but an increase at Wick is required.

12.2 FNL2: PROVIDE PATHS FOR A DAILY FREIGHT SERVICE

12.2.1 The Issue

Providing enhanced passenger services can jeopardise the ability of freight services to operate on a route. This is particularly true where significant speed differentials exist. This aspiration seeks to protect the ability of rail freight to serve markets in the far north.

12.2.2 The Operational Analysis

There are paths allocated for freight trains in the present Working Timetables and any timetable recasts are obliged to include the bid paths of freight operators as far as practicable. It is appreciated that freight business changes more quickly and there may be the need for new paths at fairly short notice. The present timetable allows for an early morning path to Georgemas (formerly used by the Safeway Container traffic), a midday path to Lairg for oil traffic one day per week (this could be extended to Georgemas on other days for other traffic) and an evening path to Kinbrace for timber traffic. There are corresponding paths in the opposite direction. There is an evening southbound path catering for oil pipe traffic.

Any extension of freight paths would be included in future timetable studies commissioned by the Transport Scotland as part of railway development in Scotland.

12.3 FNL3: OPEN NEW STATION AT CONON BRIDGE

12.3.1 The Issue

There is a desire to create a new station at Conon. This aspiration has been fuelled by the proposed development of new housing in the immediate area and the likelihood that there will be a forecast increase in demand for commuter services.

12.3.2 Technical Assessment

A pre-feasibility study carried out in 2005 by Scott Wilson Railways examined the options for constructing a new railway station in Conon Bridge on the existing rail line between Inverness and Dingwall.

Five locations were looked at in the report along with potential different platform lengths. The locations examined were:

- The site of the original station at the end of Station Road;
- At the south end of Conon Bridge, beyond the last house;
- On the rail embankment at or close to the end of Bank Street;
- Adjacent to the bridge over the Conon River; and
- Adjacent to Riverford Farm.

Platform lengths examined were for a 15 metre (as per Beauly Station), 2 and 4 coaches.

The preferred location was at the site of the original station, due to its significantly better access.

	Former Station Location		**Embankment Location**	**Bridge Location**	**Southern Location**	**Riverford Location**
Platform Length	15m	2 car	15m	15m	15m	15m
Total	£0.25m	£0.35m	£0.45m	£0.5m	£0.5m	£0.45m

Table 12-1: Conon Bridge Station Costs (+/-50%; 4Q2005 prices)

12.3.3 Operational Issues

The creation of the new station stop at Conon will increase journey time. Based on the location of the new station it is estimated that the additional stop will impose a time penalty of three minutes in each direction. There is a capacity issue on the line with the introduction of new Invernet service and each service would have to be examined to see if extra time for a station call is affordable and has no effect on other services.

12.3.4 Summary

The key recommendations were that rail industry organisations such as Her Majesty's Railway Inspectorate, Network Rail, the Train Operating Company and the Scottish Executive be further consulted to determine the preferred solution. If a short platform is proposed then dispensations will be required from these organisations. Network Rail and First ScotRail are not currently supportive of a short platform option. Demand and operations modelling will be required at this stage, and will assist in determining whether a good business case exists. The pre-feasibility studies are now with the client, Highland Council, for further action.

12.4 FNL4: REDUCE JOURNEY TIME BY IMPROVING LINE SPEEDS

12.4.1 The Issue

The present tortuous route of the railway combined with low average speeds makes the train uncompetitive when compared to road-based journeys. In order to reduce this disadvantage there is an aspiration to improve speeds on the route by tackling the restrictions that currently exist. This section gives consideration to the causes of any restrictions on the route and attempts to identify mitigation measures that could be put in place to improve timings.

12.4.2 Technical Analysis

The main constraint to reducing journey time is the speeds imposed through loops controlled by the RETB signalling system. Historically, the length of loops built by the Highland railway companies were such that they had to be controlled by two signal boxes, one at each end. With the introduction of RETB these signal boxes were closed and the sites de-manned. Points are now train-operated, however as a consequence of this, speeds at the entrance and exits to loops have been reduced to 15mph.

It is the signalling requirement in the extensive RETB areas – there being no centralised and direct control of local infrastructure - that led to the mass introduction of hydro-pneumatic points on the main running lines and locally manually-operated ground frames on associated sidings. The 15mph restriction over hydro-pneumatic points is necessary to ensure that they function correctly and no derailment of the train occurs. The point mechanism is entirely self-contained and requires no power for operation, which as a result limits the force available for point blade movement and consequently reduces the attainable safety level for the system; an acceptable safety level is achieved by restricting the wheel (train) speed through the mechanism.

Further safety measures led to the introduction of the Train Protection Warning System (TPWS), which detects if a train is travelling at excessive speed in areas of signalling restraint and applies the braking system automatically. Therefore, trains travelling through loops are now restricted to 15mph from one end to the other. Relaxation of this rule is a matter for Network Rail Safety and Standards to address. Representation has been made at local level, with examination of the RETB systems in rural Wales to identify if a similar practice could be adopted here. Future signalling systems may allow higher speeds over points and through loops due to new designs of track circuit operated points.

An increase in speed over points and through loops will not bring necessarily bring much benefit as trains will be slowing down to stop at stations. At long loops where the points are some distance from the platform, a train may be able to reach 25mph instead of being limited to 15mph thus saving up to half a minute. Trains omitting a station call may be able to save up to two minutes per loop. The following table provides a summary of the saving that could be achieved if the Standards were relaxed. Actual savings would require to be calculated using a recognised computer simulation tool.

Station or Loop	**Possible time saving if speeds over points raised**
Muir of Ord	30 secs
Dingwall	30 secs
Invergordon	30 secs
Tain	30 secs
Ardgay	30 secs
Lairg	30 secs
Rogart	30 secs
Brora	30 secs
Helmsdale	30 secs
Forsinard	30 secs
TOTAL	**5 minutes**

Table 12-2: Summary of Possible Time Savings at Loops

Much work has been done to improve line speeds away from loops although the number of level crossings does mean that, because of sighting distances, these speeds have to reduce on approach to such crossings. Safety at level crossings is high on the political agenda after numerous accidents at rural level crossings across the country.

When considering possible line (train) speed increases, the following should be taken into account.

- At level crossings controlled by the signalman, their operation tends to be independent of the train speeds on the approach, thus usually permitting a line speed increase with minimal consequential works to the level crossing operation (although works will be required to the signalling arrangements themselves).
- For automatic level crossings, any alteration of train speeds requires a minimum of repositioning the train-sensing equipment in order to maintain the appropriate timing and sequence of operation of the crossing. Additionally, a recalculation of the risk assessment at those level crossings so affected is required, in order to determine the adequacy or otherwise of the level crossing type at that location. With the change in line speed and using the latest road traffic figures, there is the

possibility that the new risk assessment would show that a level crossing at a particular location requires to be upgraded in order to meet the necessary statutory requirements.

- At road-user worked level crossings generally their safe operation is already arranged considering the maximum line speed achievable currently. A potential line speed increase may only be possible by providing additional infrastructure. This may be as 'simple' as providing a telephone link to the Control Point, or as complex as providing a fully automatic-worked level crossing installation.

The level crossing style employed at each specific location is that deemed appropriate to the level of road and rail usage at the time of construction. Consequently as road traffic levels have risen, and as public or user perception of an increasing operational risk becomes more apparent, a need to upgrade certain level crossings emerges irrespective of any requirement or desire to raise line speed. The ability to raise line speeds may however be a by-product of such level crossing improvements. The order of preference for level crossing styles is as follows, commencing with the least preferred type:

- Road-user operated gates, not provided with telephone;
- Road-user operated gates, provided with telephone;
- Automatically controlled by trains and not fitted with road barriers; train regulates speed on approach (AOCL): [no new AOCL can now be installed but existing ones can continue];
- Automatically controlled by trains and fitted with road barriers; train regulates speed on approach (ABCL);
- Automatically controlled by trains and fitted with road barriers; train does not regulate speed on approach (AHB) – note that this style of crossing may only be used in certain circumstances; and
- Controlled by signalman who is located either local or remote to level crossing; level crossing is fully monitored and controlled, and is directly incorporated into the signalling system

The time saved at each crossing will be dependent on the current line speed and that achievable. An example would be if the desired (and achievable) line speed was 90mph but a crossing reduced the speed to 60mph then the journey time for that section could increase by up to half a minute to allow for braking and acceleration.
The following table illustrates what changes could be made in order to save some running time. An estimate of £0.25m for each is assumed based on today's costs across the network:

Crossing	Action	Estimated Cost	Estimated Time Saving
Delny AOCL	Convert to AHB (if conditions allow)	£0.25m	30 seconds
Nigg AHB	Raise line speed (if conditions allow)	£0.25m	30 seconds
Acheilidh LC	Supply telephone to Inverness Signalling Centre	£50k	2 minutes (northbound direction only)
Rovie AOCL	Convert to AHB	£0.75m	30 seconds
Morvich No 5	Supply telephone to Inverness Signalling Centre	£50k	1 minute
Kirkton AOCL	Convert to AHB (if conditions allow)	£0.75m	30 seconds
Kildonan LC	Convert to AHB	£0.75m	30 seconds
Kinbrace AOCL	Convert to AHB (if conditions allow)	£0.75m	1 minute
TOTAL		**£3.6m**	**6.5 minutes**

Table 12-3: Summary of Possible Time Savings at Level Crossings

In 1996, Scott Wilson Kirkpatrick produced a report for Railtrack on route speed and loading improvements for the Far North Line. This highlighted the potential speed improvements available for the route based on works at Georgemas, loop turnout speeds and speed improvements on particular curves.

Theoretical speed increases can be obtained through re-canting of the track and increasing speeds to the maximum values allowable under current standards. The work could be carried out under a specific renewals programme, or as and when particular sections of track are subject to routine maintenance.

The 1996 report identified a maximum theoretical potential time saving of 18.5 minutes through re-canting works on the 158 curves on the route. This was subject to site survey to confirm specific details including transition length, condition of track, clearances to structures, differential freight and passenger speeds, vertical alignment and requirements for braking / acceleration. Therefore, the actual obtainable speeds will generally be less than the theoretical value. It has not been determined whether any of the works highlighted in the report have been implemented.

Costs for this option have not been identified as this will be dependent on the number of curves that are identified as suitable for improvements and the method of implementing the works. If this option is to be pursued then it is recommended that confirmation is obtained from Network Rail as to whether any works have been carried out from the 1996 report and thereafter surveys are carried out to provide an estimate for the costs.

12.4.3 Summary

Time savings will largely depend on an assessment of all the track and level crossings to see if raising the line speed is possible at certain locations. It is envisaged that many crossings will require upgrading from their present classification to Automatic Half Barrier status. Costs for this work are unknown until an initial study has been done to assess numbers but without this work savings in running time may be miniscule. Raising speeds through loop points may be practical if the system of operation is altered to track circuit operation, likely when the RETB signalling system is eventually replaced.

The following key areas should be studied further in order to achieve lower journey times for the route:

- Examine each level crossing to see if line speeds can be increased, how much time could be saved and if the crossing would require upgrading; and
- Assess line speeds at loops (if necessary by computer modelling) to calculate time- savings.

12.5 FNL5: INCREASE CAPACITY ON THE ROUTE

12.5.1 The Issue

Whilst there is a perception that the Far North Line is lightly used and therefore has plenty of spare capacity the reality is that south of Dingwall particularly the line is at capacity. This aspiration considers the options to increase capacity on the line.

There are currently issues regarding capacity of the existing Radio Electronic Token Block (RETB) system and it is likely to prove extremely difficult to carry out alterations to the system to increase capacity. The present RETB signalling systems based at Inverness does not readily lend itself to alteration, and due cognisance of this should be reflected in any track, signalling, or operational alterations or additions proposed. Whilst being an operationally sound system for its area of application, and having served the north of Scotland well since its first introduction in 1985, the hardware employed to actuate and transmit the RETB signalling processes is now obsolete, while the operational protocols employed can now considered to be antiquated. In the proposals discussed below it may be worth to consider extending Inverness colour light signalling north to Dingwall to release signalling capacity.

There is one RETB Controller working the Far North Line. With only a single communication channel available, individual Controllers can cover a significant geographical area and its consequent railway operation. The running of additional trains and / or the creation of additional RETB token (Authority) sections would be an additional workload for the Controller to undertake, adding radio traffic to a control system already operating near capacity. Any modification to the existing RETB token sections requires alterations to the electronic interlocking arrangements that control and support RETB operations. For a variety of reasons – system obsolescence, availability of technical staff, and system design - this may prove impracticable, problematic, or expensive.

Network Rail has recognised that the present RETB systems are life-expired, and whilst retaining the existing operational processes has initiated moves to have its supporting constituent components overhauled or replaced to sustain RETB operation until 2012. The expected replacement technology – a version of the European Rail Traffic Management System (ERTMS) – is proposed to be available for UK implementation in a timescale not too dissimilar to this, however Network Rail's 2005 Route Plan only anticipates ERTMS implementation to have an affect on signalling implementation plans from 2013 / 2014 onwards.

In this route plan and elsewhere, Network Rail states that no renewal strategy for RETB has yet been decided. Given the potential, proposed, or aspired modifications, alterations, or additions to the rail system covered by the present RETB control system in the Highland area, it would be prudent of interested parties to become involved or at least informed of the development process associated with the RETB replacement. In this way, it may be seen whether the system proposed to supersede RETB will deliver or can cater for the functionality desired by those operators and communities to be served in the Highland area.

12.5.2 Operational Analysis

Whilst it is unlikely that the number of passenger trains will increase after introduction of Invernet, it is acknowledged that capacity between Inverness and Dingwall is at its limits. The timetable is very tight and any late running has a subsequent knock-on effect. Connections with other services at Inverness are considered too neat and often services are delayed waiting connections.

The main capacity constraint south of Dingwall is the long section of single line between Inverness and Muir of Ord, a distance of 13 miles. There is an intermediate block post at Clunes (7.6 miles), which allows 'flighting' of trains; the new station at Beauly puts additional time in to each train. In order to improve timetable planning and performance (particularly if trains are running out of course) it is recommended that consideration be given to re-instating the section of double line from approximately the two milepost (west of Clachnaharry) to Clunes at 7.6 miles. This section was singled during rationalization in the 1960s. This would mean installation of colour light signalling and track circuit block to Clunes or a suitable point further north, controlled from Inverness panel, from where RETB signalling would apply. The following structures would have to be altered:

Structure	Mileage	Work Required
Bunchrew AOCL	3m 58ch	Convert to double line crossing of higher specification than AOCL
Underbridge (A862) – new construction	5m 00ch	Convert from single to double
Lentran Old Station	5m 69ch	Possible demolition of old platforms to conform to new gauging clearances
Overbridges / Underbridges	Various	Built to double line width: examination required to restore/replace to original use

Table 12-4: Work Required to Reinstate Double Track

The line cannot be doubled between Inverness Rose Street and Clachnaharry due to the major structures over the River Ness and Caledonian Canal and the high cost of converting them.

12.5.3 Technical Analysis

Clachnaharry to Clunes Re-Doubling

The aspiration to increase capacity of the Far North Line was raised by both the Steering Group and the Royal Scotsman. The option of re-doubling the six miles of line between Clachnaharry to the west of Inverness and Clunes to the east of Beauly, would assist in this and would potentially increase capacity for both the Far North and Kyle lines.

There are currently issues regarding capacity of the existing Radio Electronic Token Block (RETB) system and it is likely to prove extremely difficult to carry out the proposed alterations to the system. Two options have been examined, the re-doubling of the route between Clachnaharry and Clunes and the provision of a passing loop at the site of the former Lentran Station.

Option 1: Doubling of Entire Route Between Clachnaharry and Clunes

This option would entail the re-doubling of the entire 6-mile length between Clachnaharry and Clunes. It would also be possible to re-double a shorter length.

To verify whether this option is viable it will be necessary to carry out a more detailed investigation, including a walk out over the entire length. Since the route was singled it is likely that sections of double track bed on the line will require significant works to bring them up to an acceptable standard for a second track. There may have been structures and level crossings that have been altered or replaced in a form suitable only for single track. For example, a new road underbridge has been constructed to the east of Lentran. On the assumption that there are no major structural or civil engineering alterations required, the shot estimate for this option would be £9m.

Signalling alterations would be required for this option. This stretch is on the edge of the RETB system. The capacity constraints of the system are covered elsewhere in this report however the fact that this does line at the interface between the 'conventional' signalling and the RETB allow the potential to extend the colour light signalling in the area to cover this additional section of route. This would extend the control of the Inverness signalling centre out to Clunes where RETB would commence. There would be a requirement to reconfigure the RETB system to exclude this section. The estimated cost of the total signalling package is £6m.

Thus the total cost for the option is some £15m.

Option 2: Provision of Loop at Lentran

After the route was singled between Clachnaharry and Clunes, a passing loop was retained at the site of the former Lentran Station. This was lifted at the time of the introduction of the RETB system during the 1980's.
This option would allow trains to pass travelling in the same or opposite directions.

The length of loop requires to be considered further, but as a minimum would be required to cater for a 4 car diesel multiple unit (158 or Sprinter) of approximately 100 metres length. The shot estimate for track works only for this option would be £0.7m for a 200m loop.

In a similar vein to the argument put forward above it would be a practical proposition to extend the colour light signalling from Inverness to cover the new facility. Installing the kit including the cabling and the need to modify the RETB means that there would be little saving in term of the cost of the signalling over Option 1. This signalling cost of this option is estimated at £6m.

The total cost of the option is some £7m.

12.5.4 Summary

By extending Inverness Signalling Centre's colour light signalling area to Clunes or point further north, doubling of the line from Clachnaharry would ease timetabling constraints on the busiest section of the route.

Infrastructure Enhancement	Cost	Benefit	Minutes Saved
Double line from Clachnaharry to Clunes	£15m	Increases capacity for higher numbers of passenger trains now operating	Not quantifiable
Reinstate passing loop at Lentran	£7m	Increases capacity for higher numbers of passenger trains now operating	Not quantifiable

Table 12-5: Summary of Costs: Increasing Capacity

12.6 FNL6: CREATION OF CHORD LINE AT GEORGEMAS

12.6.1 The Issue

Associated with the aspiration to reduce the overall journey time along the route consideration is to be given to the development of a new chord line at Georgemas. This would provide a direct link between the line from the south and the branch to Thurso. Trains from Inverness would not require to travel via the existing Georgemas station in order to serve Thurso and then Wick.

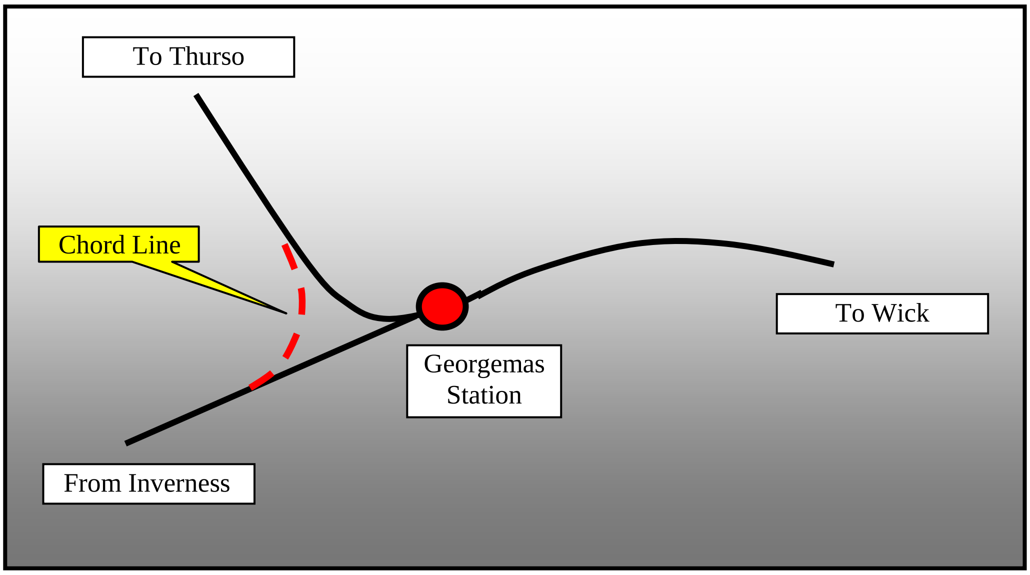

Figure 12-3: Schematic Plan of Rail Layout at Georgemas

Figure 12-4: View From Georgemas Station Looking West

12.6.2 Operational Review

Whilst this may be operationally beneficial to reducing journey times and shunting moves at Georgemas (FNL4) a more detailed business case may be required. Trains presently reverse at Georgemas in three minutes and all trains run to Thurso before terminating at Wick and vice versa. A new junction (with ground frame provision to allow freight trains direct access to Georgemas itself) would have to be constructed at Halkirk for any new chord line. . The present platform at Georgemas would continue to serve trains between Thurso and Wick. A junction plunger would also have to be provided at a new junction at Hoy for southbound trains or trains running from Thurso to Wick. Time saving on each journey is estimated at three minutes.

12.6.3 Engineering Review

The aspiration to introduce a new chord line at Georgemas Junction was raised by Highland Council. This would allow trains to travel directly from Thurso to and from the south without the driver changing ends of the train at Georgemas or the train travelling via Wick. This option was investigated by Scott Wilson Kirkpatrick (SWK) on behalf of Railtrack in 1996, and it is understood that Railtrack have further investigated this proposal, although their findings are unknown. The SWK report investigated various proposals for route speed and load increases. It was estimated that a chord would allow one to two minutes savings over the (then proposed, now current) plunger system.

There would be land purchase required for this proposal for the chord and possibly the station, and a legal process such as a Light Rail Order would be required.

A chord of radius three to four hundred metres would enable speeds of approximately 50mph although this may be limited by the switch and crossing design. The chord would tie in with existing straights to the north and south of Georgemas Junction.

Fairly significant earthworks would be required to form an embankment. There are field access under-bridges at or close to both tie in points, which may require to be widened or replaced.

The shot estimate for construction of the chord, excluding signalling costs is £4m.

Halkirk is currently an intermediate block point in the northbound (down) direction and this could be altered to a ground frame operated junction with the main route set towards Thurso. However this will add a time penalty for direct trains to/from Georgemas and Wick, for manual operation of the ground frame.

Beyond the basic system development phase, there will be an opportunity to tailor this new control system during the early stages of application design development, in order to deliver the local operational requirements necessary for running the train services or pattern required. Whilst concerned or interested parties should be invited to input to such a process by the project developer, it would be prudent for such parties to ensure that they are involved at this stage.

12.6.4 Summary

A saving of three minutes between Thurso and Inverness for passenger trains can be made if the chord line is built at an estimated cost of £4 million.

12.7 FNL7: INSTALL DIRECT LINE VIA DORNOCH

12.7.1 Introduction

There has been a common theme of journey time reduction running through the aspirations that have been identified during the course of the study. In the 1980's when the upgrading of the A9 trunk road was being planned the design of a new road bridge across the Dornoch Firth was proposed. The opportunity was taken at the time to also consider the costs and benefits from constructing the crossing such that road and rail vehicles could share the bridge. For a variety of reason the shared structure concept was dropped and a road only bridge was constructed. However, the journey time benefit potential of such a crossing in terms of the railway line were exposed. It is therefore appropriate that the study consider the merits of creating such a crossing for the railway line.

12.7.2 Engineering issues

The work on this aspiration is largely based on a report carried out by Scott Wilson Kirkpatrick for British Rail in 1985. This has been supplemented by a review of current Ordnance Survey maps and a short visit to the proposed route in January 2006.

The 1985 report was written prior to the construction of the Dornoch Firth Road Crossing, which now acts as a physical constraint to the rail route. Costs for the proposal were included in the 1985 report, and have been reviewed in line with current rail construction costs.

It is understood that British Rail carried an operational report out around 1985, however this has not been sourced.

12.7.3 The Route Options

The existing rail line runs between Tain and Golspie via Lairg, a distance of approximately forty miles. This line serves various communities including Ardgay / Bonar Bridge, Lairg and Rogart. A branch line connected this line to Dornoch from north of Loch Fleet on the Mound, but this was closed in June 1960. Two route options were examined between the Dornoch Firth and Dornoch, and four routes to cross Loch Fleet. The route can be divided into four sections:

- Tain to Dornoch Firth;
- Dornoch Town;
- Dornoch to Loch Fleet; and
- Loch Fleet to Golspie.

12.7.4 Tain – Dornoch Firth

The route would diverge from the existing line approximately 3.5 kilometres north of Tain at Ardjachie Farm, before running parallel to the Dornoch Firth shore and meeting the existing road crossing causeway. The Dornoch Firth would be crossed by a combination of causeway and bridge. It would probably utilise a widened road causeway for 550m at the south end of the crossing and an independent 780m bridge over the central section. Navigational clearance is required for recreational and existing commercial craft. Cost savings identified for a combined road / rail crossing will be significantly reduced now that the road has been built.

The design of the crossing was examined with a through girder solution being recommended. Interface issues require to be addressed between road and rail crossings to avoid vehicle incursion onto the railway and the hazard of car and train headlights.

12.7.5 Dornoch Town

Two main options were given for this section; one running close to the shore and the other inland. The inland route offers less visual intrusion, but is 0.5km longer. Both routes cross areas with important environmental designations.

Two station locations were identified for Dornoch within 1,400m and 700m of the town square. Since 1985 land has been zoned for housing development to the south of the town. This coupled with the secondary school location may make the site to the west of the school more attractive.

12.7.6 Dornoch – Loch Fleet

This section of the route was proposed to broadly follow the line of the former branch line, although modern track design standards will preclude this in certain areas. The village of Embo may have to be bypassed as the former branch line solum has been built over to provide the main village access road.

12.7.7 Loch Fleet – Golspie

North of Embo, the 1985 study identified four options for the crossing of Loch Fleet. Each option impacts upon environmentally sensitive areas. The furthest east route crossing at the mouth of the Loch was recommended, subject to further environmental review. Conceptual layouts were provided for the options.

12.7.8 Minor Crossings

The report was based on the provision of bridge crossings of existing roads, an assumption that would still be reasonable today. A schedule of structure was provided, with typical layouts.

12.7.9 Environmental Issues

The 1985 report highlighted the proposed route crossed a number of important environmentally designated areas including;

- Sites of Special Scientific Interest (SSSI) at the Dornoch Firth and the Mound;
- Ramsar wetland sites at the Dornoch Firth and Loch Fleet;
- Special Protected Areas (SPA) at the Dornoch Firth and Loch Fleet;
- Special Area of Conservation (SAC) at the Dornoch Firth and the Mound; and
- A National Nature Reserve at Loch Fleet.

Agricultural land will be affected both by severance and by land take. Accommodation crossings have been allowed for to address the land severance. Some forestry land is also affected.

There will be significant visual intrusion caused by the proposal, in particular the two major crossing at the Dornoch Firth and Loch Fleet. The effect of the rail crossing at the Dornoch Firth will be reduced since 1985 as the road has now been constructed.

12.7.10 Geotechnical Aspects

The 1985 report gave an analysis of the geo-technical aspects of the proposal, and concluded that the route would in broad terms be suitable for the construction of a railway.

12.7.11 Signalling

Signalling issues were not included in the 1985 report. The Far North Line is currently signalled using the Radio Electronic Token Block (RETB) system. This is currently at capacity, and it is understood that it will only be possible to alter the system to introduce this proposed new line by replacing some of the existing RETB capability with conventional signalling e.g. the resulting branch line from Tain to Lairg and transferring the current software for Tain to Lairg to the new section of route. However this has not been proven. It is understood that a new signalling system (i.e. ERTMS) is being considered for introduction on the Far North Line in 10 – 15 years time.

12.7.12 Costs

Costs were produced in the 1985 report. These have been reviewed and updated to bring them in line with current industry costs. Signalling costs are EXCLUDED for reasons given above:

Item	Shot Estimate (£m)
Permanent Way	13
Signalling	**EXCLUDED see paragraph 12.7.11**
Bridges	35
Station	1
Retaining Walls	1
Earthworks & fencing	7
Land Costs	3
Industry Costs	13
Total (£m)	**73**

Table 12-6: Total Costs (1Q 2006 Prices)

Therefore total estimated costs for the Dornoch link are £73 million (+/-50%) but this cost EXCLUDES signalling costs. The total time saving would be thirty-seven minutes (see below).

12.7.13 Operational Analysis

The seven and three-quarter mile branch line from the Mound to Dornoch was operational only between 1902 and 1960. Part of the track bed has now been converted to a cycleway. The road bridge across the Dornoch Firth was constructed in the 1990s although an original scheme had been to construct a joint road and rail crossing. This opportunity was not taken up.

The total length of a new link would be thirteen miles from a junction two miles west of Tain station to a Golspie station via the shortest crossing of Loch Fleet. A rail bridge would have to be constructed across the Dornoch Firth beside the road bridge and a new rail line constructed between the north bank and Dornoch. At Dornoch a new two platform station with passing loop would be constructed to the north of the town and the line would connect with the former solum to the northeast of Dornoch.

The following table shows estimates of distance, time taken and amount of time saved over the present rail line:

Existing Section	Actual Time Taken	Proposed Section	Estimated Distance (miles)	Activity	Estimated Time Taken	Remarks
Tain - Ardgay	14.5 minutes	Tain to South Bridge Junction	2.2		3 minutes	
Ardgay - Lairg	17.5 minutes	Dornoch Bridge	1.2		3 minutes	
Lairg - Rogart	13.5 minutes	North of Bridge to Dornoch	4		5 minutes	
Rogart - Golspie	10.5 minutes	Dornoch station call			3 minutes	As per standard Rules of the Plan for other stations
Station dwell times	3 minutes	Dornoch to Golspie	6		8 minutes	
Total Minutes	**59**			**Total Minutes**	**22**	

Table 12-7: Estimate of Distances and Sectional Running Times

It is assumed that, should the line to Lairg be retained, the main route at the junction south of the Dornoch Bridge would be set for Dornoch with trains for Lairg having to stop to allow the traincrew to operate the junction manually for access to the Lairg 'branch'.

The total projected running time of twenty-two minutes for the new link is a saving of thirty-seven minutes over the present booked running time between Tain and Golspie for a class 158 diesel two-car unit. If the Lairg loop is closed and there is no need to provide junction plungers at Tain and the Mound, this time saving would increase to thirty-seven minutes in each direction as no stop at either end of the link would be necessary to select the required route.

The estimated time for a journey from Inverness to Thurso would fall to a minimum of three hours and three hours and thirty-five minutes for Inverness to Wick via Thurso plus any required allowances for crossing other trains at passing loops. By super-imposing today's timetable on this new infrastructure, the new service might appear thus:

Location					**Location**				
Inverness	**depart**	07:14	10:39	17:47	**Wick**	**depart**	06:20	11:50	15:50
Dingwall	**depart**	07:45	11:13	18:20	**Thurso**	**depart**	06:49	12:19	16:19
Tain	**depart**	08:20	11:47	18:55	**Golspie**	**depart**	08:26	13:56	17:56
Golspie	**depart**	08:43	12:10	19:18	**Tain**	**arrive**	08:49	14:19	18:19
Thurso	**arrive**	10:19	13:46	20:54	**Dingwall**	**arrive**	09:25	14:55	18:55
Wick	**arrive**	10:49	14:16	21:24	**Inverness**	**arrive**	09:55	15:25	19:35
		A	B	C			A	B	C

A - first trains of the day departing at these times would require to pass at Dornoch, requiring a two platform station: this would add to capital cost of link. Also requires first departure from Kyle of Lochalsh to run earlier (see KL1).
B – middle trains of the day would require to cross at Forsinard requiring an adjustment to one of the departure times from either Inverness (10:39) or Wick (12:37).
C – anticipated crossing point would be Invergordon.

Table 12-8: Basic 2005-06 Timetable Projected Over New Link

The above timetable would require other Invernet services to be recast and these are tabled below. For example, the present arrival at Inverness from Kyle of Lochalsh at 09:57 would have to be altered (there are options for this service to run one hour earlier – see KL1). The level of Invernet service would also require to be reviewed depending on retention or closure of the line to Lairg.

Under the options for the Far North Line (FNL1), a fourth train is to be introduced in December 2006 adding the requirement for an additional train set. This new service level, diverted, might appear thus:

Location					Location				
Inverness depart	07:34	10:39	13:10	17:33	**Wick depart**	06:20	08:13	11:50	15:30
Dingwall depart	08:05	11:13	13:41	18:04	**Thurso depart**	06:49	08:42	12:19	15:59
Tain depart	08:40	11:48	14:19	18:39	**Golspie depart**	08:26	10:19	13:56	17:36
Golspie depart	09:03	12:10	14:42	19:02	**Tain arrive**	08:49	10:43	14:19	17:59
Thurso arrive	10:39	13:46	16:18	20:38	**Dingwall arrive**	09:25	11:19	14:55	18:35
Wick arrive	11:09	14:16	16:48	21:08	**Inverness arrive**	09:55	11:49	15:25	19:05
			D E F				D		F

D – this would allow the additional Wick traincrew to work to Inverness with suitable time at Inverness for a break.
E - on arrival at Wick at 1648 set would require to shunt clear of main line and stable in loop until next working
F - two trains would require to pass at Georgemas

Table 12-9: Basic Service with Fourth Train Added

A fifth service in each direction could be made with the unit arriving at Wick at 16:48 forming an evening departure to Inverness and the unit arriving at Inverness at 19:05 returning to Wick on the path of the present 2037 Inverness to Tain: additional traincrew provision would need to be considered for these trains at an estimated cost of £140k per annum. A total of three units would be required to work this basic service of four or five trains daily.

12.7.14 Retention of Lairg rail link

One option would be to retain the existing line from the new junction at the southern end of the Dornoch Bridge to Lairg and close the line from Lairg to Golspie. Rogart station would be closed. Existing Invernet services would have to be recast to continue a service to Lairg, which could make use of existing resources. A junction at the south end of the Dornoch Bridge could be formed of a ground frame connection where trains to and from Lairg would have to stop to operate this ground frame, the main route being set for Dornoch. Oil traffic would continue to operate from Grangemouth. A possible timetable between Inverness and Lairg might be:

Location	Empty stock				Location				
Inverness depart	04+45	09:20	14:33	17:03	**Lairg depart**	06:35	11:05	16*15	18:50
Dingwall depart		09:51	15:04	17:34	**Ardgay depart**	06:50	11:20	16*30	19:05
Tain depart		10:25	15:38	18:08	**Tain depart**	07:10	11:40	16:50	19:25
Ardgay depart		10:40	15*53	18;23	**Dingwall depart**	07:45	12:15	17:25	20:00
Lairg arrive	06+25	10:55	16*08	18:38	**Inverness arrive**	08:16	12:46	17:56	20:31
								F	

*** - two additional train sets would be required unless the 14:33 ex Inverness only operated as far as Tain, returning at 15:55 to form the 17:33 Inverness to Wick, in which case these Invernet services could be operated by only one unit, interacting with the one unit resourcing the Wick services shown in Table 12-6**
F – the 17:47 Inverness to Wick would require to depart from Inverness at approximately 17:33 and cross this service at Muir of Ord or on a new stretch of double line between Clachnaharry and Clunes.

Table 12-10: Options for Serving Lairg as a Terminal Station

12.7.15 Closure of Lairg Loop

The same level of Invernet services could operate between Inverness and Tain along side an envisaged faster Wick service. The present 14:33 Inverness to Invergordon could extend to Tain (or Dornoch) to avoid conflicting with the new path of the 12:37 from Wick.

There would be no requirement for junction plungers at each end of the diversionary route if the line was closed between the Mound and Tain via Lairg.

A summary of a possible timetable would be as follows:

Location					C					A
Inverness depart	05:20	07:34	09:20	10:42	12:10	13:10	14:33	17:03	17:33	20:37
Dingwall depart		08:05	09:51	11:13	12:41	13:41	15:04	17:34	18:04	21:08
Tain depart	06:26	08:50	10:44	11:48		14:19	15:39	18:08	18:39	21:43
Dornoch depart	06:41	09:04	10:58	12:02		14:33		18:21	18:53	21:56
Golspie depart		09:13		12:10		14:42			19:02	***22:05***
Thurso arrive		10:49		13:46		16:18			20:38	***23:41***
Wick arrive		11:19		14:16		16:48			21:08	***00:11***
Location					C					B
Wick depart		06:20	08:13			11:50		15:30		***19:45***
Thurso depart		06:49	08:42			12:19		15:59		***20:16***
Golspie depart		08:26	10:19			13:56		17:36		***21:53***
Dornoch depart	06:55	08:34	10:27	11:33		14:04		17:44	19:00	22:01
Tain depart	07:10	08:49	10:43	11:48		14:19	15:55	18:09	19:15	22:16
Dingwall arrive	07:46	09:25	11:19	12:24	13:20	14:55	16:31	18:45	19:51	22:52
Inverness arrive	08:16	09:55	11:49	12:54	13:45	15:25	17:01	19:15	20:21	23:22

A – a fifth daily service could depart Inverness at 20:37 and extend beyond Dornoch
B – a fifth daily service could depart Wick at 19:45 and take up the path of the last Invernet service from Dornoch
C – service would require to be operated by a fifth unit if required to run beyond Dingwall

Table 12-11: Summary of Invernet and Dornoch Link Services

12.7.16 Resources

A summary of the workings of the four (existing) units required to operate is shown in Table 12-8:

UNIT 1	**UNIT 2**	**UNIT 3**	**UNIT 4**
			(*from siding*)
Inverness 05:20	Inverness 07:34	Wick 06:20	Wick 08:13
Dornoch 06:41 06:55	Wick 11:19 11:50	Inverness 09:55 10:42	Inverness 11:49 12:10
Inverness 08:16 09:20	Inverness 15:25 17:03	Wick 14:16 15:30	Dingwall 12:41 13:20
Dornoch 10:58 11:33	Dornoch 18:21 19:00	Inverness 19:15	Inverness 13:50 14:33
Inverness 12:54 13:10	Inverness 20:21 20:37		Tain 15:39 15:55
Wick 16:48	Dornoch 21:56 22:01		Inverness 17:01 17:33
(*stable in siding*) **OR**	Inverness 23:22 **OR**		Wick 21:08
Wick 19:45	Wick 00:11		
Inverness 23:22			
Works Unit 4 next day	Works Unit 1 next day	Works Unit 2 next day	Works Unit 3 next day

Table 12-12: Summary of Resource Diagrams

12.8 CONCLUSION

The following key areas should be studied further in order to achieve aspirations for the route:

- Linespeed improvements and level crossing upgrades should be the subject of further engineering surveys; and
- The Dornoch link should be the subject of a separate study in order to examine the optimum journey time savings;

As a summary the table below sets out the proposals and options discussed in this section, highlighting costs and benefits of each for the purposes of possible prioritisation:

Infrastructure Enhancement	Estimated cost (+/- 50%)	Benefit	Minutes Saved
Raising linespeed throughout (based on Highland Main Line costs)	£14m	Reduce end to end journey time	18
Upgrade level crossings	£1.6m	Reduce end to end journey time and increase safety	6.5
Upgrade loop speeds	£2m	Reduce end to end journey time	5
Construct Georgemas Chord	£4m	Reduce Thurso to Inverness journey time	3
Construct Dornoch Link	£73m	Reduce end to end journey time	37
Double line from Clachnaharry to Clunes	£15m	Increases capacity for higher numbers of passenger trains now operating	Not quantifiable
Reinstate passing loop at Lentran	£7m	Increases capacity for higher numbers of passenger trains now operating	Not quantifiable

Table 12-13: Options for upgrade of Far North Line

It should be emphasised that the total number of minutes saved will depend on which options, or combination of options are decided upon. For example the amount of 18 minutes for line improvements, 6.5 minutes for level crossings and 5 minutes for loop speeds would be a lesser value if the Dornoch link were to be constructed. Therefore it is not possible to quote a total estimated cost for the various works because many variations will exist.

13. DINGWALL – KYLE OF LOCHALSH

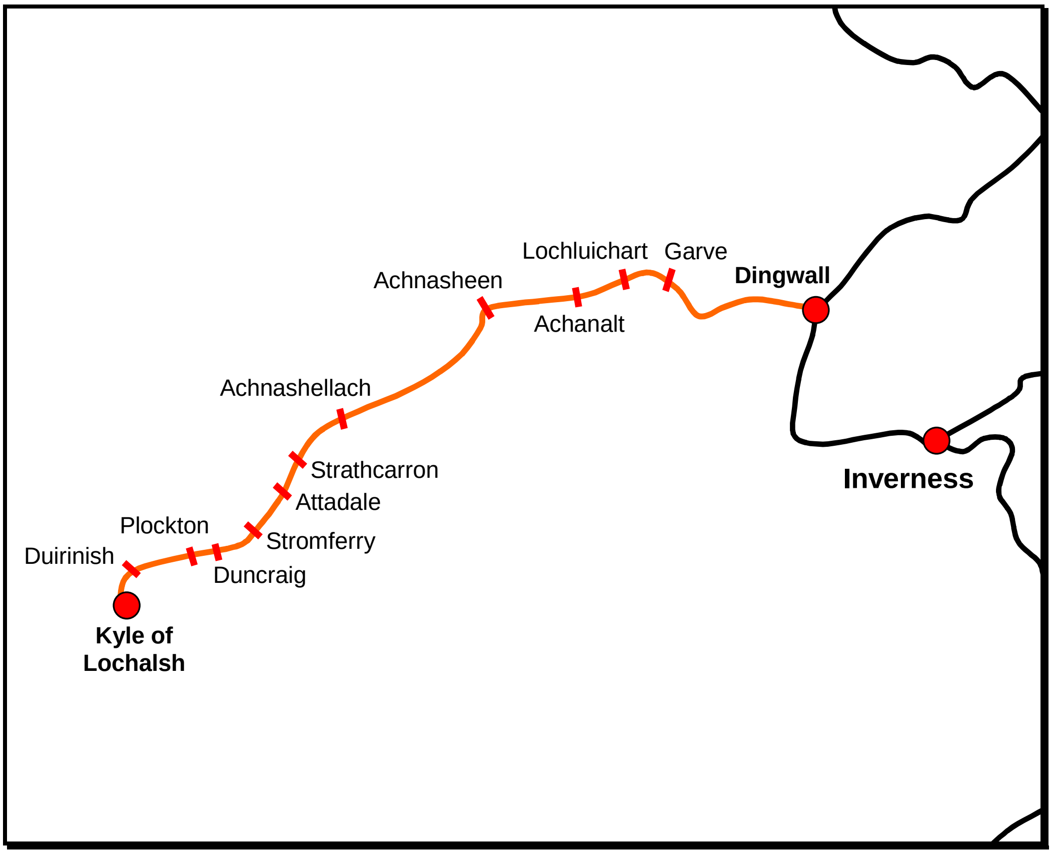

Figure 13-1: Schematic Layout of Kyle of Lochalsh Line

The line from Dingwall to Kyle of Lochalsh is a single-track railway with passing places. It runs through an area of particularly sparse population density but one of great beauty. As a result the majority of the traffic on the line is driven by the leisure and tourism industries. The sixty-three mile stretch is controlled by the RETB signalling system based in Inverness Signalling Centre. The basic passenger service is three trains in each direction with a fourth service introduced in the summer months. There is no booked freight traffic on the line currently.

13.1 KL1: PROVIDE A SERVICE TO INVERNESS SUITABLE FOR COMMUTERS

13.1.1 The Issue

The aspiration is aimed at providing an early morning service into Inverness from Kyle of Lochalsh such that it would be attractive to potential commuters. An evening service would also be required to return commuters.

13.1.2 The Operational Analysis

The current early morning service from Kyle of Lochalsh to Inverness departs Kyle at 07:25 and arrives at 09:57. This makes it unattractive to potential commuters. Consideration has therefore been given to starting the service at 06:25 and running the service one hour earlier. The units used for this service are stabled overnight in Kyle and therefore there is no impact on any outward empty coaching stock movement. The service would arrive into Inverness marginally before 09:00 making commuting to city centre locations viable. This would also provide an additional commuter service into Inverness from Dingwall after the present 07:43 departure.

The present 10:53 Inverness to Kyle runs only two hours after the first train, after which there is a seven-hour period before the 18:00 service. In order to lessen the gap there is an option of running the 10:53 in the path of the summer 12:41 service thus giving an opportunity for spending nearly four hours in Inverness either in the morning or afternoon or a whole day for business purposes. The 10:53 Inverness to Kyle of Lochalsh would become the summer additional train.

In the evening there is presently an 18:00 service from Inverness. It is recognised that 18:00 is not ideal in terms of the return working and that a departure around 17:15 to 17:30 would be preferable. This train is formed by a set working through from Aberdeen and it is therefore difficult to re-time this service without impacting on the Aberdeen to Inverness service pattern in the late afternoon. There will be an opportunity to review this should the service pattern on the Aberdeen line be enhanced.

13.2 KL2: ALLOW HEAVIER LOCOMOTIVE ACCESS (TYPICALLY CLASS 66)

13.2.1 The Issue

The freight operating companies have invested heavily in new locomotives and wagons over the course of the past ten years. This has allowed the displacement of older locomotives from the fleet. The line to Kyle of Lochalsh is cleared for vehicles of route availability RA5. This precludes the use by the FOC of the latest locomotives, which exceed the limiting weight restriction on the line. The ability to operate Class 66 locomotives (RA7) would allow freight companies to extend the workings of trains from south of Inverness thus saving costs and could encourage more freight movements by rail. Present locomotives allowed to traverse the route are now life expired and without the weight restrictions lifted, freight proposals would fail to appear attractive and financially viable. This aspiration considers the work required to be undertaken to the infrastructure to permit Class 66 locomotives to operate to Kyle of Lochalsh.

13.2.2 Technical Assessment

Network Rail have provided information on the status of the bridges on these lines to enable an evaluation of the feasibility of operating the proposed rolling stock over these routes. It should be noted that although all of the bridges on both routes have been assessed many of these assessments are to standards, which have now been superseded and in these cases the bridges are in Network Rail's assessment programme for future reassessment.

The tables below list the bridges on each of the lines that the review of Network Rail's records indicate would be a constraint to the use of the Class 66. In some cases it may be possible for the locomotive to run at reduced speed and it is therefore recommended that a review of the assessments be carried out, in the first instance, to evaluate the effects of the specific locomotive loading and also consider the level of speed restriction that would be required. In some cases the speed restriction may need to be 20mph or less and it would be necessary to for FOCs to decide if this would be acceptable.

A number of the bridges on both lines are of short span and stone slab or reinforced concrete construction. These bridges have been subject to qualitative assessment only and are not considered likely to present a problem to the operation of the Class 66. However, it may be necessary in some instances to institute a monitoring regime after the commencement of operation of the locomotives to review the effects of the revised loading.

The philosophy of this report has been to consider the most economical method of obtaining clearance for the Class 66. It has therefore been considered that the first action in most instances is to carry out a review of the available assessment information to consider the specific loadings from the locomotive and to look at the effects of speed to see if a reduction in the speed over the bridge would permit operation. It is appreciated that this may be abortive work in some instances. Should it not be possible to allow operation of the locomotive in this way it will be necessary to consider the extent of strengthening works that will be required for which a review of the assessment will be necessary in any case. In some cases it is considered that there is little scope for obtaining clearance by more refined analysis methods in which case strengthening will be recommended.

It should be noted that if the routes are cleared for the operation of the Class 66 locomotive specifically, it will not necessarily permit the operation of RA7 traffic generally. Certain types of RA7 rolling stock may have certain characteristics, which will not permit access to this route without further works being carried out. It should also be noted that this report considers the effects on the bridges only and there may be other constraints on the route such as gauging or permanent way alignment and this report should not be considered in isolation.

A number of structures on this line present constraints to the use of the Class 66 locomotives, although in general the majority of the route could be cleared with only relatively minor works being required. The bridges providing the main constraints are listed below along with proposed mitigating actions:

Bridge	Speed	Limiting Member	Comment	Action
15	20	Timber waybeams	Steelwork OK	Review assessment of waybeams
18	40	Not specified	Main members appear to be OK	Review assessment. Speed restriction may give the required RA
23	30/40	Timber waybeams	Main girder also limits Class 66 use	Strengthening required. Review assessment for likely extent
32	40	Not specified	No details	Review assessment
35	45	Cross girder bending	Possible cross girder strengthening although scope for speed restriction	Review assessment in the first instance although it is unlikely that a speed restriction alone will give the required RA
40	45	Not specified	No details	Review assessment
43	40/45	Not specified	No details	Review assessment
46	45	Timber waybeams	Steelwork OK	Review assessment of waybeams
70	45	Not specified	No details	Review assessment
81	40/45	Not specified	No details	Review assessment
96	45	Up side main girder	Based on damaged section (bridge strike)	Repair / strengthening to damaged girder. Otherwise OK
103	40/45	Not specified	No details	Review assessment
104	40	Not specified		Review assessment
111	40	Not specified	No details	Review assessment
146	30	Not specified	No details	Review assessment

Table 13-1: Summary of Structural Work Required to Raise Route to RA7

It will be noted that a number of the structures on the route may require upgrading but insufficient information is currently available to determine if this is the case. However, based on the foregoing information an estimate of the associated works are:

- Bridge Re-assessments: twelve structures at £9k each
- Bridge Strengthening: three structures at £30k each

Thus, the total cost of works is £0.2m. However, if the reassessments all show a need for repairs this will potentially add a further £0.36m. This does not allow for any bridge reconstructions but current indications are that none are required. Thus the upper limit of works is £0.56m.

13.3 KL3: INCREASE LINE CAPACITY

13.3.1 The Issue

The forty-five minute section between Strathcarron and Kyle of Lochalsh restricts the line capacity to one train per hour between those points. This effectively drives the capacity on the whole route unless trains are terminated / started at intermediate locations. This aspiration considers what could be done to enhance capacity on the route.

13.3.2 Operational Analysis

In a similar vein to the Far North Lines there is a perception that the Kyle Line, because of its infrequent service, must have significant spare capacity to accommodate increased services. In reality as a result of the long sections, particularly between Strathcarron and Kyle of Lochalsh, the route can be operating at capacity. When the Royal Scotsman is added to the base number of trains (six) and also the additional summer ScotRail service, it becomes very difficult to find paths for charter trains. Whilst this may seem a luxury it should be considered that the line is mainly in existence for tourism and charter trains earn more money per mile than the service trains. The following analysis shows the occupancy of the Strathcarron to Kyle of Lochalsh section throughout the day.

Hour	Train Service	Remarks
07:25 – 08:25	07:25 Kyle - Inverness	
08:25 – 09:25	Nil	
09:25 – 10:25	Royal Scotsman (RUNS ON CERTAIN DATES ONLY)	Departs from Kyle after overnight stabling
10:25 – 11:25	08:53 Inverness - Kyle	On arrival at Kyle only 39 minutes turn around before returning to Inverness at 11:59
11:25 – 12:25	11:59 Kyle - Inverness	
12:25 – 13:25	10:53 Inverness - Kyle	
13:25 – 14:25	Nil	
14:25 – 15:25	12:41 Inverness - Kyle	Runs July to September only
15:25 – 16:25	15:13 Kyle – Inverness and Royal Scotsman (Certain days only)	Runs July to September only
16:25 – 17:25	Royal Scotsman (Certain days only) and 16:38 Kyle – Inverness	
17:25 – 18:25	Nil	
18:25 – 19:25	Nil	
19:25 – 20:25	18:00 Inverness – Kyle	
20:25 – 21:25	18:00 Inverness – Kyle	Arrives Kyle 20:37

Table 13-2: Utilisation of Strathcarron – Kyle Section During Passenger Services

As can be seen from the tabulation there is currently little scope for additional trains particularly on days when the Royal Scotsman runs, and during the peak summer months when the additional ScotRail services run. Whilst there is the option to arrive in Kyle around 14:15, during the peak summer, departure from Kyle would not be possible until 17:30. This makes day trips from south of Inverness very long and less attractive, at the time when it is most likely that demand is at the highest.

Potential freight services are also limited in this way, possibly restricting them to before 07:25 and after 20:37. This may encroach on engineering periods. The proposal for the first train to leave Kyle one hour earlier in the morning (KL1 – see above) would restrict these available times even more.

The benefits of an intermediate block post at Stromeferry are:

- Charter trains can depart as early as 07:50 once the first ScotRail train has cleared the section;
- A charter or freight train to arrive in Kyle before 10:30 and perform shunting operations at Kyle whilst 08:53 ex Inverness is in section between Strathcarron and Stromeferry; and
- At Kyle where a train can depart immediately after one has arrived, the time before the arriving train can commence shunting operations will be almost halved from forty-five minutes to twenty-five minutes.

A crossing loop at Stromeferry would allow the above plus:

- An early freight or charter path to arrive in Kyle before 08:30;
- Charter trains could vary their itineraries and depart Kyle as late as 10:20 to cross the first train from Inverness;
- A charter or freight train could follow the 08:53 from Inverness and arrive in Kyle at 11:50;
- The additional summer passenger train from Kyle could depart at 14:00 giving a more even space of departure times;
- Charter trains could arrive in Kyle at 17:30 after crossing the 16:38 ex Kyle; and
- A late freight or charter train could leave Kyle as late as 19:45, reaching Inverness before 22:30.

13.3.3 Engineering Review

The limited capacity on the Kyle of Lochalsh line can be addressed through the provision of additional infrastructure at Stromeferry and the provision of an additional section between Kyle of Lochalsh and Strathcarron.

This would allow trains to operate both between Kyle of Lochalsh and Stromeferry, and Stromeferry and Strathcarron, as opposed to the single train at present, thus increasing the capacity of this section of line. Currently a train has to wait for approximately forty-five minutes in Kyle of Lochalsh for a train that has left Kyle of Lochalsh in front of it to clear Strathcarron before it can carry out shunting movements or proceed towards Stromeferry.

Two options have been examined, the introduction of an Intermediate Block Point and the provision of a passing loop, both at Stromeferry Station.

13.3.4 Option 1 Provision of Intermediate Block Point

This option would maintain the same track arrangement as present whilst introducing additional signalling infrastructure. The difficulties associated with modifications to the RETB system were outlined in Section 4.6.3. These equally apply to this option that, in effect, prevents its development and subsequent delivery at this time.

13.3.5 Option 2: Provision of Loop at Stromeferry

This option would require a loop to be provided at Stromeferry Station along the line of the previously removed loop. It would provide the same benefits as Option 1 whilst also allowing trains to pass travelling in the same or opposite directions.
The length of loop requires to be considered further, but as a minimum would be required to cater for a four-car diesel multiple unit (Class 158 or Sprinter) of approximately 100 metres length. Constraints exist at either end of the station with the track going onto a curve at either end restricting the positioning of turn outs, and an under-bridge (Number 124) having been previously reduced from double track to single track width. It would therefore be most straightforward to provide a loop within the length of the original platforms.

13.3.6 Summary

The long signal sections could be divided by reinstatement of former loops and Stromeferry would be the most beneficial. Charter traffic and freight traffic would be the beneficiaries as the level of regular passenger service merits only the current infrastructure.
The shot estimate for Stromeferry would be £0.7m for a 200m loop without bridge works and excluding signalling costs. However, this would again require work to be undertaken to the RETB system, which is not likely to be sanctioned at this time.

13.4 KL4: LINESIDE LOADING FOR FREIGHT

13.4.1 The Issue

The creation of dedicated infrastructure to support freight movements can make them uneconomic in terms of the likely returns. Equally, the locations of existing freight facilities do not necessarily lend themselves to their use for potential traffic opportunities given the need to tranship cargo between road and rail to complete the journey. Consideration is therefore necessary of the potential to load traffic on the main line at suitable locations thereby avoiding additional infrastructure costs and the need to haul to local railheads.

13.4.2 Operational Review

From an operational perspective the halting of a train in mid-section to load goods is acceptable providing certain conditions are satisfied. Clearly the blockage of the line resulting from the loading operation must be containable within the timetable. This will normally require the operation to be undertaken at night unless a sufficiently long no-train period can be established during the day. Care must be taken if loading is taking place during the day to ensure there is sufficient contingency in place should problems occur such that other planned services are not disrupted.

In terms of safety there will be a requirement to ensure good site communication and full understanding of the methodology before work starts. Good lighting is also essential to safe working.

The precedent has been set for this on the Far North Line where timber loading at Kinbrace is carried out during the existing 'no-train' period i.e. after the last passenger train passes around 22:00. A similar method of operation could exist on the Kyle line, between the last train arriving in Kyle at 20:37 and the first morning departure. However, it will be necessary to gain acceptance from Network Rail to this method of operation early on.

13.4.3 Technical Review

The technical issues surround the operation include:

- The need to identify level and straight track with suitable access close to the production location;
- Potential contamination of the ballast at the loading point leading to poor drainage and potential track alignment deterioration;
- The need to find suitable access to the track for loading purposes and the dangers associated with unsecured access routes; and
- The potential effect on maintenance periods on the track should night loading be planned on a regular basis.

13.4.4 Summary

As stated above the principle of line-side loading is accepted for other lines. With suitable access points it is considered that it will be possible to utilise this low cost means of loading freight trains.

14. FORT WILLIAM LINE (CRAIGENDORAN TO FORT WILLIAM)

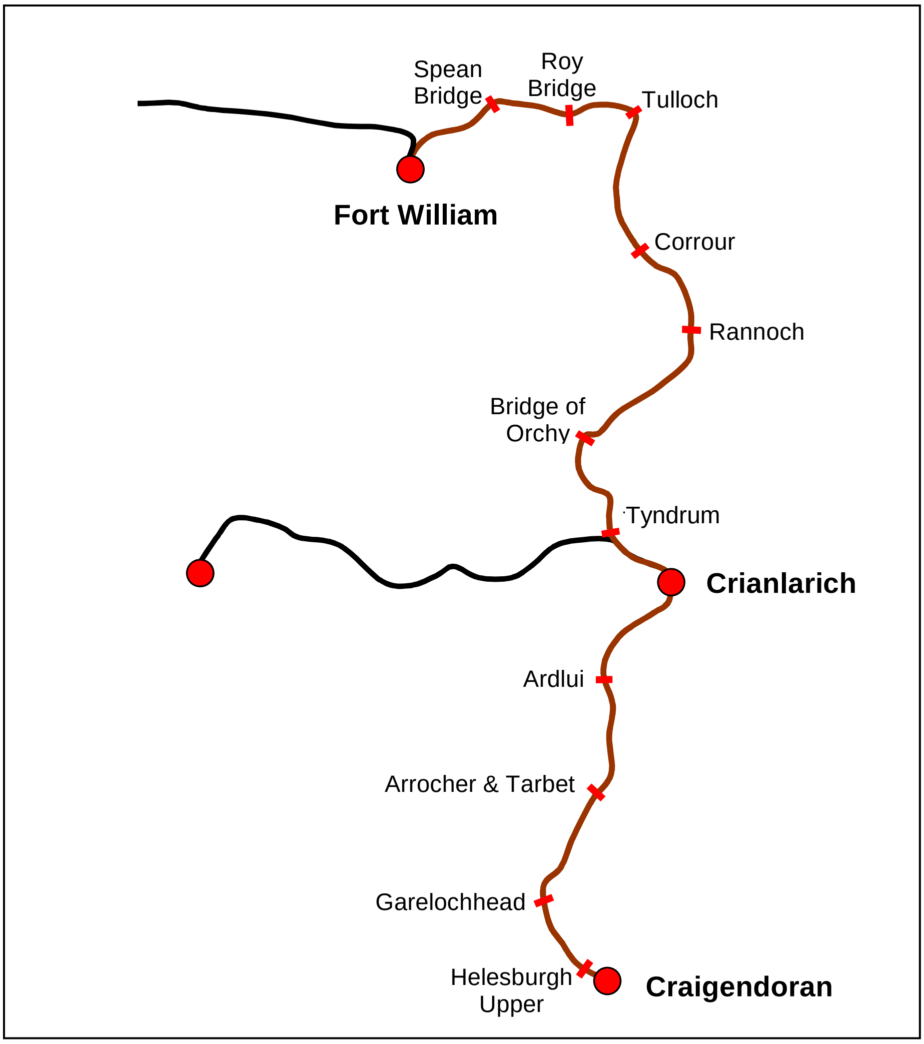

Figure 14-1: Schematic Layout of Fort William Line

The West Highland Lines run from Craigendoran (on the Glasgow North Electric network) to Fort William with branches to Oban and Mallaig. They are single-track railways with passing places generally at stations. The lines are controlled from Banavie, outside Fort William, by the RETB signalling system. The route is particularly scenic and the traffic is predominantly leisure and tourist driven. The train service is more intensive than on the Far North lines with regular freight traffic.

14.1 FWL1: IMPROVE LINE SPEEDS ON THE ROUTE

14.1.1 The Issue

Whilst the West Highland Line is recognised as being one of the most scenic in the UK the line provides a more mundane service to locals who require a swift and efficient link to the major economic centres along the route. The aspiration involves the identification of means to reduce journey times on the route.

14.1.2 Operational Analysis

In order to reduce journey times, examination of the timetable needs to be carried out. Trains are limited by geographical constraints and single line operation. One way to reduce times would be to run separate trains to Oban and Fort William in order to save a further three minutes on Oban services and a further nine minutes on Fort William services. In addition, not having to switch train crews at an intermediate location would save a further few minutes. Aspects of timetable development are considered in FWL2.

14.2 FWL2: TO CONSIDER AN ADDITIONAL DAYTIME SERVICE

14.2.1 The Issue

The consultation process identified a requirement to consider a fourth path between Glasgow and Fort William to enhance the current service level. This aspiration has been developed in terms of the operational and resulting technical analysis.

14.2.2 Operational Analysis

Resource requirements are a critical issue on the West Highland Line and it is the availability of rolling stock and crew that drives the service provision. The view of any train operator would be that there is a need to run additional services with existing resources and to run the additional services at times convenient to the public. Currently, the overnight services between Fort William and London incur large amounts of non-productive train crew mileage i.e. staff having to travel long distances to work trains. The current workings are:

04:50 Edinburgh to Fort William: Queen Street crew work train to Rannoch (arrive 08:35) and then travel back per 06:05 Mallaig to Queen Street arriving 11:25. Fort William crew travel to Rannoch per 06:05 from Mallaig to work service north; and

19:55 Fort William to Edinburgh: Fort William crew work train to Rannoch then travel back to Fort William with 18:20 ex Queen Street; Queen Street crew travel to Rannoch per 18:20 from Queen Street to work service south.

By adding an additional service in each direction, more productive use would be made of train crew hours at little additional staffing cost to the company. Another train set would however, be required. The altered workings would be:

Queen Street crew work 04:50 Edinburgh to Fort William through to Fort William and return with a new service at 10:40 from Fort William to Queen Street; and

Queen Street crew work a new service from Queen Street to Fort William at 15:50 arriving Fort William at 19:25 and then work 20:05 Fort William to Edinburgh

This would leave an additional unit stabled at Fort William overnight. The Fort William crew, who presently work the Euston from Rannoch to Fort William in the morning, could work this unit as an additional 'peak' hour train from Roy Bridge to Fort William [this unit could operate as a through service to Mallaig], departing at 08:00, and afterwards perform the shunting duties required by the sleeper after arrival at 09:43. A summary of the timetable would be:

Station			Ex Euston			New Service	
Edinburgh			04:45				
Queen Street				08:20	13:10	15:50	18:20
Crianlarich			07:42	10:10	15:00	17:40	20:15
Roy Bridge		0800					
Fort William		08:20	09:43	11:55	16:45	19:25	22:00
		08:35		12:10	16:55		22:10
Glenfinnan		09:05		12:40	17:25		22:40
Mallaig		09:55		13:30	18:15		23:30
Station	**Empty to Roy Bridge**	**0605 Service Retimed**	**New Service**				**To Euston**
Mallaig		07:05		10:35	15:40	18:30	
Glenfinnan		07:55		11:25	16:30	19:20	
Fort William		08:25		12:00	17:05	19:50	
	07+35	08:40	10:40	12:40	17:40		20:05
Crianlarich		10:30	12:25	14:30	19:33		22:05
Queen Street		12:26	14:26	16:18	21:25		
Edinburgh							01:10

Table 14-1: Summary of Option for Additional Fort William Service

Some services would operate separately from Oban trains. The 08:40 from Fort William would be staffed by a Fort William crew right through to Queen Street, returning at 13:10, and a Queen Street crew would work the 08:20 through to Fort William and return at 12:35 (after a break). This would give more services between Glasgow and Crianlarich (see OL1) and avoid the present unproductive turn for the Queen Street crew in the summer who must wait at Crianlarich from 10:10 until 13:55. The early Mallaig crew would perform a double run to Fort William and back, finishing at 13:30.

14.2.3 Technical Analysis

The timetables that have been developed to satisfy the aspiration have no implications in terms of requiring enhancement to the infrastructure.

14.2.4 Summary

The additional service to Fort William could be provided with no additional train crew resources but would require an additional set. The costs associated with these requirements total some £0.25m per annum.

The Fort William services could operate separately from services serving Oban as will be shown in the section below. The only exceptions are the first and last services from Oban, which attach to Fort William trains. A full summary timetable for Oban and Fort William is shown at the end of the section on Oban services in order to provide an overall picture of how the services would interact.

15. OBAN LINE (CRAIGENDORAN TO OBAN)

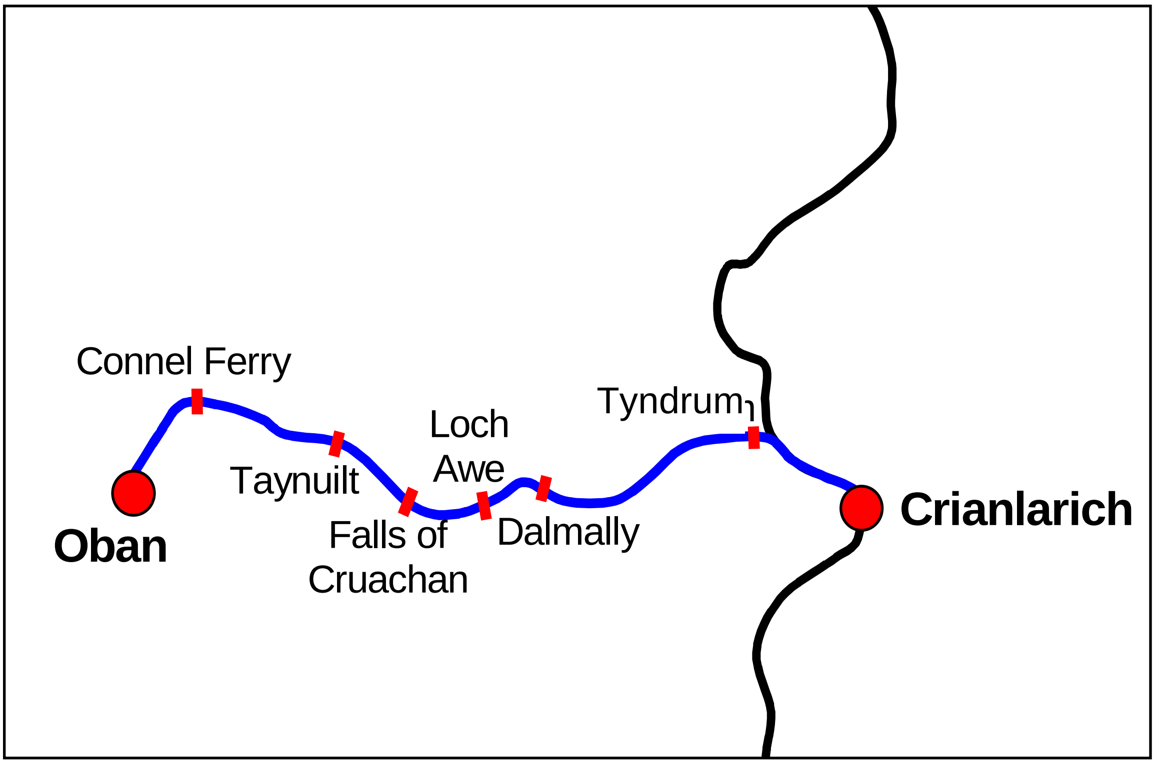

Figure 15-1: Schematic Layout of Oban Line

The Oban Branch of the West Highland Lines runs from Crianlarich to Oban. It is controlled from Banavie, outside Fort William, by the RETB signalling system. The train pattern is a basic service of three passenger trains per day with extra trains during the summer months. There is no booked freight traffic currently. The line is single throughout with passing loops at Dalmally and Taynuilt and train operated points.

15.1 OL1: DETERMINATION OF LIMITING CAPACITY OF INFRASTRCTURE

15.1.1 The Issue

There is concern that the Oban Line could better be utilised if the current constraints to growth in terms of the present infrastructure were established. This item also considers the development of a commuter service on the route.

15.1.2 Operational Analysis

The following review of the timetable on the West Highland Lines takes account of the desires to have increased commuter services and reduced journey times. This has been developed against a background of an understanding over the limited resources and the constraints of the infrastructure. The following table is largely based on the timetable introduced in 1989 when Sprinters were commissioned and which was operational until economies were made in 1993. This timetable had four trains in each direction two return trips for Glasgow train crews and two return trips for Oban crews.

Station		Empty Stock					
Queen Street	05:25			08:50	12:40	16:50	20:20
Westerton	05:43	05+44					
Crianlarich		07+20		10:34	14:29	18:34	22:05
Crianlarich			07:39	10:37	14:34	18:37	22:10
Oban			08:45	11:43	15:40	19:43	23:16
Station	**07:09 Arrochar extended**	**08:20 retimed: attach to 07:05 from Mallaig**		**Present summer Saturday to run all weekdays**		**Attach to 15:40 from Mallaig**	
Oban	05:30	09:20	12:45	16:30		18:20	20:25
Crianlarich	06:36	10:26	13:54	17:36		19:26	21:31
	06:38	10:38	13:57	17:39		19:33	21:33
Queen Street	08:26	12:26	15:44	19:26		21:26	23:20

Table 15-1: Summary of Option for Additional Oban Services

Most of these services can run separately from Fort William services except where shown in the column. The additional service between Crianlarich only and Oban is a connection with the Euston service and the last train from Oban to Glasgow forms a connection in to the Fort William to Euston. There would be no requirement to run an additional service on Saturdays. Most services would be formed of two sets for capacity seating. The 12:40 from Queen Street would split on arrival at Oban to form the 16:30 and 18:20 trains. These trains from Oban currently run as two car workings so it would be a matter for the train operator to assess if there was overcrowding issues to be addressed.

The first Oban crew would work a double run to and from changeover points, travelling as passengers on the 10:37 from Crianlarich. The second Oban crew would work the 16:30 to Glasgow and return with the 20:20. Queen Street crews would staff all other services.

The full West Highland service would therefore operate as under:

Station		Empty Stock		08:00 ex Roy Bridge	Ex Euston	New service	
Edinburgh					04:45		
Queen Street	05:25						08:20
Westerton	05:43	05+44			05:52		
Crianlarich arr		07+20			07:34		10:10
Crianlarich dep					07:42	07:39	10:13
Oban						08:45	
Fort William arr				08:20	09:43		11:55
Fort William dep				08:35			12:10
Glenfinnan				09:05			12:40
Mallaig				09:55			13:30

Station			New service	New service	New service		New service
Queen Street	08:50	12:40	13:10	15:50	16:50	18:20	20:20
Westerton							
Crianlarich arr	10:34	14:29	15:00	17:39	18:34	20:05	22:05
Crianlarich dep	10:37	14:34	15:03	17:42	18:37	20:15	22:10
Oban	11:43	15:40			19:43		23:16
Fort William arr			16:45	19:25		22:00	
Fort William dep			16:55			22:10	
Glenfinnan			17:25			22:40	
Mallaig			18:15			23:30	

Station	07:09 Arrochar extended	ECS to Roy Bridge	New service	New service	New Service		
Mallaig				07:05			10:35
Glenfinnan				07:55			11:25
Fort William arr				08:25			12:00
Fort William dep		07:35		08:40	10:40		12:40
Oban	05:30		09:20			12:45	
Crianlarich arr	06:36		10:26	10:32		13:54	
Crianlarich dep	06:38		→	10:38	12:38	13:57	14:30
Westerton							
Queen Street	08:26			12:26	14:26	15:44	16:18

Station						To Euston	
Mallaig		15:40		18:30			
Glenfinnan		16:30		19:20			
Fort William arr		17:05		19:50			
Fort William dep		17:40				20:05	
Oban	16:30		18:20		20:25		
Crianlarich arr	17:36		19:26		21:31	22:06	
Crianlarich dep	17:38	19:33	19:33		21:33	22:08	
Westerton			←			23:57	
Queen Street	19:26	21:26			23:20		
Edinburgh						00:50	

Table 15-2: Summary of all Improved West Highland Services

It is estimated that a total of two additional sets and two additional Glasgow Queen Street train crew turns would be required (therefore an additional four staff). Unfortunately the morning and midday northbound departures from Queen Street cannot be greater than thirty minutes apart due to having to make boat connections at Oban and Mallaig and also because of train crew hours of duty. The morning connection from stations on the Oban line to Fort William and Mallaig would be broken although the afternoon and evening opportunities remain. The additional resource requirements in terms of rolling stock would amount to some £0.45m per annum and traincrew costs of £0.15m per annum.

15.1.3 Summary

The increase in number of services between Glasgow and Crianlarich would enhance the opportunity for day trips by rail to the Loch Lomond National Park and beyond and also allow for a potential increase in commuting by rail between Arrochar and Glasgow, given the increase in population in these areas.

15.2 OL2: IMPROVEMENTS TO PASSENGER SERVICE CAPACITY

15.2.1 The Issue

The current arrangement whereby services from Glasgow split at Crianlarich to go forward to both Fort William and Oban can result in overcrowding on the Oban portion of the service. This review considers ways of alleviating this problem.

15.2.2 Operational Analysis

Services on the West Highland Line are generally made up of Class 156 two-car diesel multiple units. The normal method of working is for trains of two, two-car sets to depart from Glasgow. These are split at Crianlarich with one portion running forward to Fort William and the other on the Oban. In the off-peak season this arrangement is generally satisfactory however in the height of the summer season when the originating service is strengthened to six-car the Oban branch remains with a two-car set with the remaining four coaches running to Fort William. This is largely due to the greater demand on that line. It does however mean that there is frequently overcrowding on the Oban portion of the service.
In the past consideration has been given to splitting a two-car set such that two three-car trains would result, however in trials in England this option have proved unsuccessful in terms of the control circuits in the trains.
A further possible solution would be to operate the Fort William and Oban portions of the service as separate trains. This is considered in OL3 and OL7 where enhancements to the service are proposed.

15.3 OL3: REDUCTION IN JOURNEY TIMES

15.3.1 The Issue

Analyse the current speeds on the route to establish what could be done to reduce journey time between Crianlarich and Oban.

15.3.2 The Operational Analysis

The current speed along the majority of the line for Class 15x units is as shown in the following tabulation. The majority of the line operates, in both directions, in the range between 45 and 55mph. Where there are departures from this the explanation can be traced to either the safety requirements associated with an unmanned crossing or a point of severe line curvature.

In order to reduce journey times, examination of the timetable needs to be carried out. Trains are limited by geographical constraints and single line operation. One way to reduce times would be to run separate trains to Oban and Fort William in order to save a further three minutes on Oban services and a further nine minutes on Fort William services. In addition, not having to switch train crews at an intermediate location would save a further few minutes. Separate services would also allow two sets to operate coupled together on most services. It would also allow introduction of Class 170 units at some time in the future. Aspects of potential timetable alterations are considered above.

From	To	Line Speed	Comment
0m 00y	0m 970y / 30m 510y	50	Change of mileage
30m 510y	31m 880y	50	
31m 880y	31m 1080y	45	
31m 1080y	40m 310y	50	
40m 310y	43m 440y	45	
43m 440y	44m 00y	35	Line curvature
44m 00y	44m 440y	45	
44m 440y	45m 1200y	55	
45m 1200y	50m 00y	45	
Dalmally Loop		15	Hydro-pneumatic points
50m 00y	51m 660y	50	
51m 660y	56m 1650y	45	
56m 1650y	58m 1570y	50	
Taynuilt Loop		15	Hydro-pneumatic points
58m 1570y	58m 1710y	20	Crossing sighting
58m 1710y	59m 1490y	50	
59m 1490y	60m 240y	45	
60m 240y	61m 1080y	50	
61m 1080y	62m 20y	40	
62m 20y	64m 1010y	55	
64m 1010y	65m 1570y	45	
65m 1570y	68m 970y	55	
68m 970y	69m 850y	35	Line curvature
69m 850y	69m 940y	20	Crossing sighting
69m 940y	71m 970m	35	

Table 15-3: Current Down Line Speeds on Oban Line

From	To	Line Speed	Comment
71m 970y	69m 1060y	35	
69m 1060y	69m 960y	20	Crossing sighting
69m 960y	68m 970y	35	Line curvature
68m 970y	65m 1570y	55	
65m 1570y	64m 1010y	45	
64m 1010y	62m 20y	55	
62m 20y	61m 1080y	40	
61m 1080y	60m 240y	50	
60m 240y	59m 1490y	45	
59m 1490y	59m 170y	50	
59m 170y	58m 1730y	15	Crossing sighting
58m 1730y	58m 1210y	50	
Taynuit Loop		15	Hydro-pneumatic points
58m 1210y	56m 1650y	50	
56m 1650y	51m 660y	45	
51m 660y	50m 00y	50	
50m 00y	46m 1670y	45	
Dalmally Loop		15	Hydro-pneumatic points
46m 1670y	45m 1200y	45	
45m 1200y	44m 440y	55	
44m 440y	44m 00y	45	
44m 00y	43m 440y	35	Line curvature
43m 440y	40m 310y	45	
40m 310y	31m 1080y	50	
31m 1080y	31m 880y	45	
31m 880y	30m 510y / 0m 970y	50	Change of mileage
30m 510y / 0m 970y	0m 00y	50	

Table 15-4: Current Up Line Speeds on the Oban Line

15.3.3 Technical Analysis

The opportunity to raise line speeds would require either the closure of a crossing or significant works associated with the re-alignment of specific curves. In general the line has been engineered to only a moderate standard as befits the traffic requirements. Raising the line speed throughout to something significantly higher than 50 /55 would potentially require the upgrading of significant parts of the route. It is not possible, in this exercise, to quantify the volume of work associated with this aspiration however, it is judged that this could amount to some £10m - £15m worth of work.

15.4 OL4: IMPROVE ROUTE AVAILABILITY ON THE LINE

15.4.1 The Issue

The freight operating companies have invested heavily in new locomotives and wagons over the course of the past ten years. This has allowed the displacement of older locomotives from the fleet. The line to Oban is cleared for vehicles of route availability RA5. This precludes the use by the FOC of the latest locomotives, which exceed the limiting weight restriction on the line. The ability to operate Class 66 locomotives (RA7) would allow freight companies to extend the workings of trains and could encourage more freight movements by rail. Present locomotives allowed to traverse the route are now life expired and without the weight restrictions lifted, freight proposals would fail to appear attractive and financially viable. This aspiration considers the work required to be undertaken to the infrastructure to permit Class 66 locomotives to operate to Oban.

15.4.2 Technical Analysis

EWS have an aspiration to enhance their freight capability on various lines in the Highlands. Included in this is the operation of Class 66 locomotives (RA7) over the Oban Branch, which is currently classified as RA5.

Network Rail have provided information on the status of the bridges on these lines to enable an evaluation of the feasibility of operating the proposed rolling stock over these routes. It should be noted that although all of the bridges on both routes have been assessed many of these assessments are to standards, which have now been superseded and in these cases the bridges are in Network Rail's assessment programme for future reassessment.

The table below lists the bridges on the line that the review of Network Rail's records indicate would be a constraint to the use of the Class 66. In some cases it may be possible for the locomotive to run at reduced speed and it is therefore recommended that a review of the assessments be carried out, in the first instance, to evaluate the effects of the specific locomotive loading and also consider the level of speed restriction that would be required. In some cases the speed restriction may need to be 20mph or less and it would be necessary to for EWS to decide if this would be acceptable.

A number of the bridges on the line are of short span and stone slab or reinforced concrete construction. These bridges have been subject to qualitative assessment only and are not considered likely to present a problem to the operation of the Class 66. However, it may be necessary in some instances to institute a monitoring regime after the commencement of operation of the locomotives to review the effects of the revised loading.

The philosophy of this report has been to consider the most economical method of obtaining clearance for the Class 66. It has therefore been considered that the first action in most instances is to carry out a review of the available assessment information to consider the specific loadings from the locomotive and to look at the effects of speed to see if a reduction in the speed over the bridge would permit operation. It is appreciated that this may be abortive work in some instances. Should it not be possible to allow operation of the locomotive in this way it will be necessary to consider the extent of strengthening works that will be required for which a review of the assessment will be necessary in any case. In some cases it is considered that there is little scope for obtaining clearance by more refined analysis methods in which case strengthening will be recommended.

It should be noted that if the routes were cleared for the operation of the Class 66 locomotive specifically, it would not necessarily permit the operation of RA7 traffic generally. Certain types of RA7 rolling stock may have certain characteristics, which will not permit access to this route without further works being carried out. It should also be noted that this report considers the effects on the bridges only and there may be other constraints on the route such as gauging or permanent way alignment and this report should not be considered in isolation.

There are two major structures on this route that would require to be upgraded to allow the operation of the Class 66 locomotives. In addition there are a number of smaller span bridges, which, whilst adequate for the lighter axle loadings of the existing stock, would require some strengthening work for the heavier traffic. These bridges are listed below with proposed mitigating actions.

Bridge	Speed	Limiting Member	Comment	Action
3	50	Main girder	Based on corroded section	Strengthening work may be required, although speed restriction may achieve the desired RA. Review assessment
158	50	Timber deck	Main girder also limits Class 66 use	Review assessment. Possible speed restriction to achieve desired RA
173N	LS	Buckle plate floor	Very short span	Replace
190	LS	Masonry arch / concrete	5 span viaduct. Assessment based on condition	Repairs required
206	45	Unknown	7 span viaduct. Strengthening works potentially extensive	Review assessment in the first instance to determine the extent of strengthening works
221	50	Railbearer	Based on corroded section	Repairs to rail bearer web and strengthening to flange
224	LS	Unknown	More detail required	Review assessment
232	45	Timber deck	Metallic members OK	Review assessment in the first instance to determine the extent of strengthening works. Possible deck replacement
233	45	Timber deck	Cross girders also limit Class 66 use	Review assessment in the first instance to determine the extent of strengthening works. Possible deck replacement and cross girder strengthening
237	70	Railbearer	Based on corroded section	Strengthening works required
238	50	Unknown	More detail required	Review assessment
242	50	Cross girders		Strengthening works to cross girders
244	50	Railbearer		Strengthening works required
247	50	Railbearer		Strengthening works required
259	55	Railbearer	Based on corroded section	Repair to rail bearer webs
267	45	Railbearer	Based on corroded section	Strengthening works to rail bearers. Review assessment to determine if speed restriction would achieve the required RA in the first instance
268	55	Railbearer		Repairs to rail bearer web and strengthening to flange
271	55	Railbearer		Strengthening works to rail bearers. Review assessment to determine if speed restriction would achieve the required RA in the first instance

Table 15-5: Summary of Survey Work Required to Raise Route Availability on the Route

It should be noted that Network Rail have experienced problems on other routes of a similar nature following the introduction of Class 66 locomotives due to lateral loading effects. This is particularly evident on retaining walls in close proximity to the track. Also, increased track wear has been experienced on tight curves due to the length and rigidity of the locomotive bogies. Neither case can be identified with an increased capital cost but will result in an increased maintenance liability.

The section of line between Crianlarich and Oban has passing loops at Dalmally and Taynuilt. Dalmally loop is 197 metres long (30 SLU) and there is a siding that could be developed for timber loading. Taynuilt loop is 229 metres (35SLU) and has sidings that were used for timber loading until a few years ago; these could be reinstated should such traffic return to the area although local residents complained of noise levels: this contributed to the cessation of operations. There are ample sidings at Oban for potential traffic.

15.4.3 Summary

Should freight traffic return to this route (a commercial decision for traders and freight operators) then there are the loop lengths and timetable capacity available to cater for this although most trains are now hauled by more modern but heavier locomotives and gauging enhancements may be required to accommodate these locomotives. The Royal Scotsman luxury train now stables regularly in the loop at Taynuilt (two locomotives and nine coaches) with trains passing on the opposite line. Lengthening of loops would only be required if two trains of a greater length were to pass at Dalmally and Taynuilt. As the regular passenger service is comprised of short length trains, lengthening of loops may only be necessary for sporadic charter trains passing long freight trains and unlikely to satisfy the necessary business case.

15.5 OL5: IMPROVE MAXIMUM TRAIN LENGTH ON THE LINE

15.5.1 The Issue

There is a perception that the length of trains on the line is constrained by the current infrastructure. This item seeks to identify the work required to enhance the line.

15.5.2 Operational Analysis

The determining factor in terms of train length on the line is the length of the loops through which the train would require to pass. This is important since the ability of trains to pass on the line or, in the event of a train failure, the ability to get an assisting locomotive onto a train.
There are two loops on the Oban Line and, as identified in the Issues Report, these are:

- Dalmally Loop at length 197m; and
- Taynuilt Loop at length 229m.

No specific train length has been requested on the line, however EWS did specify a train length of up to 240m for the Highland Main Line. Given the greater potential of the Highland Main Line to require such traffic capability a similar specification has been adopted as 'worst case' for the Oban Line.

From the loop dimensions it is clear that these locations will not be able to fully stable the proposed train. It is noted that in both cases the loops are located at stations at which passenger services must call. Operationally it is possible for a shorter passenger train to pass a freight train, which cannot be fully accommodated into a passing loop. It is proposed that this stepped arrangement therefore be adopted for such planned services on this line. In the methodology the freight train would arrive at the loop first and draw into the loop. The passenger service would then approach from the other direction and call at the station. The passenger service would therefore clear the section behind it thereby allowing the freight train to pull away thus clearing the path for the passenger service to continue after undertaking its station duties. Minor retimings to passenger services will be required.

15.5.3 Summary

It is noted that the current service arrangement requires no passenger services to cross on the line, except on Saturdays and thus the opportunity would be open to adopt this methodology. It is however recognised that this method of working may impose a nominal time penalty on the passenger train.

15.6 OL6: TIMBER LOADING FACILITY AT DALMALLY

15.6.1 The Issue

There is considerable timber moved form the area surrounding Dalmally and thus the creation of a low-cost terminal in this area would be beneficial to securing a portion of the traffic to rail.

15.6.2 Operational Analysis

The track layout at Dalmally is as shown in the following diagram.

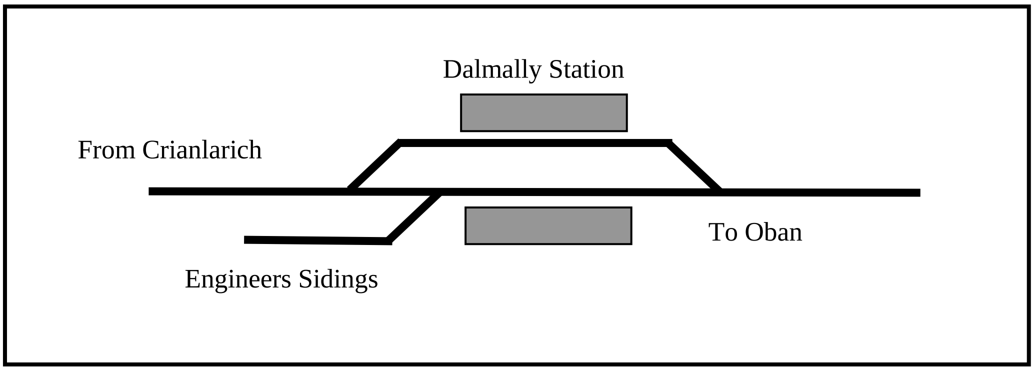

Figure 15-2: Schematic Diagram of the Track Layout at Dalmally

It is intended that a timber loading facility be created at Dalmally close to the point of production of the timber. Discussions have been ongoing for some time regarding the location and the ability of the railway to handle this traffic.

From an operational perspective the use of the Engineering siding for loading purposes would allow wagons to be stabled and the customer to load without the associated time pressures associated with line-side loading. Access to the sidings is ground frame controlled. Trains from Crianlarich would pass into the loop and then set back into the Engineering Sidings. There is limited space in the yard for the storage of timber prior to loading however it is anticipated that lorries would be off-loaded directly onto trains using on-board lifting equipment. Trains exiting the site would enter the loop and then round before departing to the south. It is considered that the rail operational aspects of the process are relatively straightforward, however road access to the site may be an issue.

15.6.3 Summary

There are no freight paths currently in the timetable on the line however it is not considered problematic to develop such paths within the current passenger train services. As an alternative line-side loading could be developed providing suitable access to the track could be provided with all the attendant safety arrangements in place.

16. MALLAIG LINE (FORT WILLIAM TO MALLAIG)

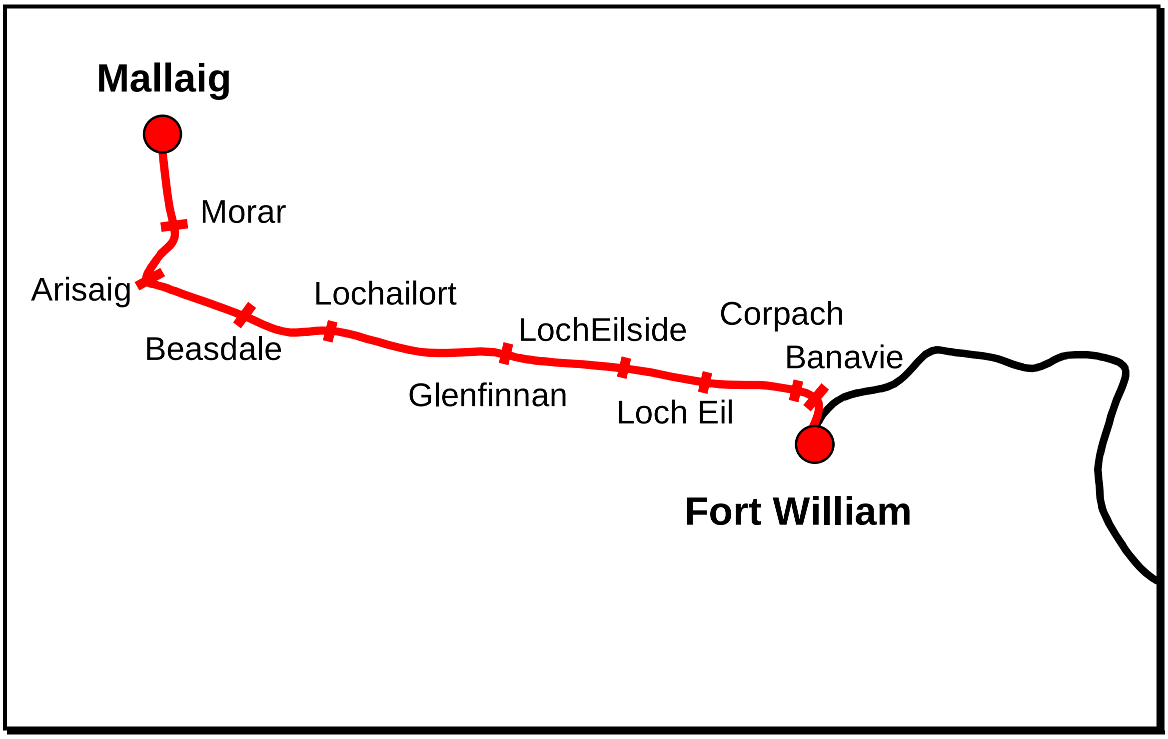

Figure 16-1: Schematic Layout of Mallaig Line

The Mallaig Extension of the West Highland Line runs from Fort William to Mallaig. It is a single- track railway with passing loops at Glenfinnan and Arisaig. Signalling on the line is provided by the RETB system controlled from Banavie, outside Fort William. The train service is a basic service of four passenger trains per day with extra trains during the summer months. There is no booked freight traffic currently. The line is a particular attraction to tourist and leisure market travellers with steam operation in the summer months.

16.1 ML1: RECAST SERVICES

16.1.1 The Issue

There is a view that a wholesale recasting of the timetable between Fort William and Mallaig would provide benefits in terms of the attractiveness of the service and its potential to increase patronage. This aspiration considers the practicalities and opportunities surrounding this.

16.1.2 The Operational Analysis

The present arrangements mean that services are wholly driven by the requirements of the Glasgow – Fort William route. That is, trains tend to be through services to Mallaig from Glasgow. Thus, resources and timings are driven by the requirements south of Fort William. This effectively constrains any alterations to the timetable pattern.

However, if is deemed commercially acceptable to separate the two lines and have connecting services only (similar to the Inverness – Kyle of Lochalsh line) then timings could change. Potential housing development on the northern outskirts of Fort William may lead to demand for a peak hour service on the Mallaig Line. During consideration of the Fort William line the operational analysis took a view on the timings along the entire West Highland Line. As such Tables 14-1 and 14-2 demonstrated a number of potential changes to the pattern of services on the Mallaig Line. These are reproduced in Table 16-1 below.

Station	08:00 ex Roy Bridge		Present 12:40 Retimed	
Edinburgh				
Queen Street		08:20	13:10	18:20
Crianlarich		10:10	15:00	20:15
Fort William	08:20	11:55	16:45	22:00
	08:35	12:10	16:55	22:10
Glenfinnan	09:05	12:40	17:25	22:40
Mallaig	09:55	13:30	18:15	23:30
Station	**Present 06:05 Retimed**			**Present 18:15 Retimed**
Mallaig	07:05	10:35	15:40	1830
Glenfinnan	07:55	11:25	16:30	1950
Fort William	08:25	12:00	17:05	
	08:40	12:40	17:40	
Crianlarich	10:30	14:30	19:33	
Queen Street	12:26	16:18	21:25	

Table 16-1: Summary of Recast Mallaig Services

This shows the path available for a 07:05 Mallaig to Fort William. This would satisfy any demand for a commuter service into Fort William. In the opposite direction the present 16:27 Fort William to Mallaig could be put back some thirty minutes to accommodate peak journeys in the opposite direction. Due to the requirement for a connection from Mallaig into the Euston sleeping car service from Fort William this train cannot run to Mallaig and return to Fort William any later. Services have also to provide good boat connections at Mallaig. It is noted that services require to be strengthened to four-car sets in the summer to accommodate demand.

16.2 ML2: INFRASTRUCTURE IMPROVEMENTS

16.2.1 The Issue

The station platforms at Mallaig and intermediate stations are too short for today's trains. The structures are listed, being the first mass concrete structures to be used in the building of Britain's railways and cannot easily be lengthened because of loop lengths and disused signal boxes which are also listed buildings.

16.2.2 Operational Analysis

The station platform lengths at Mallaig are short by modern day standards but present methods of working by train operators have been devised to overcome this deficiency. There is the potential to alter the station layout at Mallaig by relaying the bay platform line across the solum of the former oil siding and increasing the length of the platform. However, the length of the present rounding loop is constrained by an under-bridge at the station throat and can only cater for trains of seven vehicles.

16.2.3 Technical Analysis

The opportunities to lengthen the present rounding facilities are limited given the lack of potential lengthening at the buffer stop end and the presence of an under-bridge at the station throat. As with many proposals to alter the layout in RETB areas such proposals may require alterations to the signalling system. However it is considered that these would be of a relatively minor nature such that they could be undertaken without need to incur massive expenditure. Taking the track laying and other factors in to consideration, it is estimated that this could be delivered at Mallaig for £0.75m.

16.2.4 Summary

The Mallaig line services cannot be radically recast unless they run separately from services between Glasgow and Fort William. The platform lengths are short (do not cater for more than four car units) but are listed structures. The platform at Mallaig could be lengthened if minor track alterations were made. Each train operator has a safe method of working currently in place for over-length trains.

17. INVERNESS TO ABERDEEN LINE

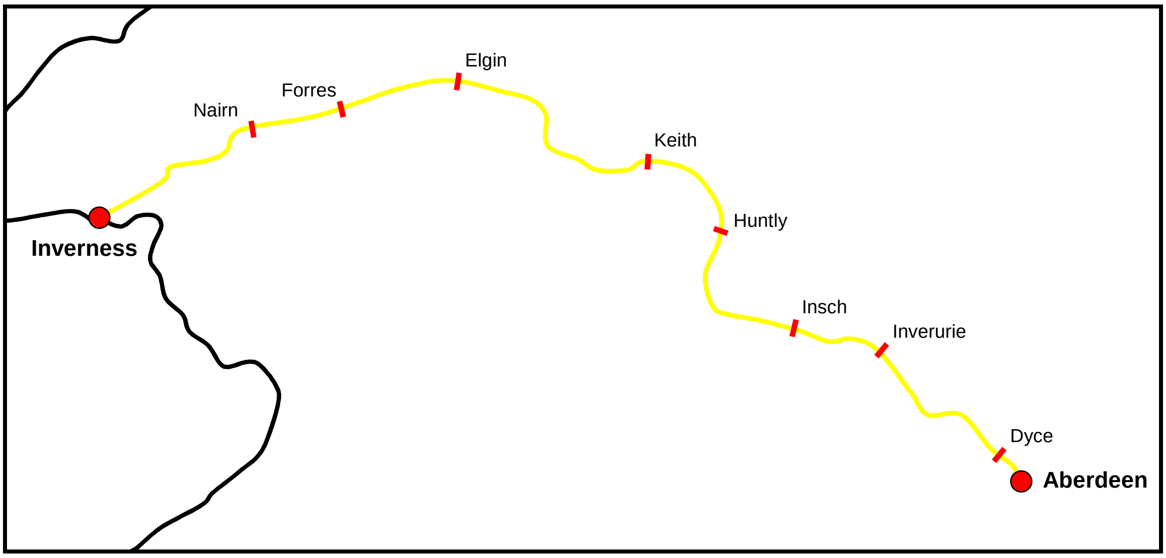

Figure 17-1: Schematic Layout of Inverness to Aberdeen Line

The line between Inverness and Aberdeen is single track throughout except for a section of double line between Huntly and Insch. There are nine intermediate signal boxes, at Dyce, Inverurie, Insch, Kennethmont, Huntly, Keith, Elgin, Forres and Nairn and a variety of signalling systems from track circuit block to electric key token block. The signalling systems mean longer journey times as trains have to stop at some places to hand over physical tokens. There is a long single line section between Keith and Elgin, which equates to a twenty-minute section and this is a pinch-point in capacity terms.

17.1 IAL1: PROVIDE COMMUTER SERVICES BETWEEN INVERNESS AND ELGIN

17.1.1 The Issue

The current services into Inverness from the east are not considered to be ideal to meet the requirements of the commuter market. The aspiration is therefore to recast the service to provide the necessary timings into and out of Inverness to satisfy this market.

17.1.2 Operational Analysis

By creating a new train crew depot at Elgin and deploying train sets to stable overnight at Elgin, (and avoid unnecessary empty stock movements to and from Inverness) a new commuter service can be introduced which would operate along with the existing Inverness / Aberdeen timetable. There would be an additional seven trains per day in each direction between Elgin to Inverness and one between Nairn to Inverness. Two current empty stock workings between Inverness and Elgin would be eliminated. A summary of the timetable is shown thus (new services highlighted in red):

Remarks		NEW		NEW		NEW		NEW		NEW
Aberdeen			06:25		07:28		09:25		11:40	
Elgin arr			07:54		08:56		10:55		13:03	
Elgin dep	06:58	07:29	07:56	08:30	08:58		10:57	12:09	13:05	14:15
Forres	07:12	07:44	08:10	08:45	09:16		11:17	12:23	13:19	14:30
Nairn	07:23	07:55	08:21	09:00	09:27	10:18	11:28	12:37	13:30	14:41
Inverness	07:41	08:13	08:39	09:18	09:45	10:36	11:46	12:55	13:48	14:59
Remarks			NEW			NEW		NEW		
Aberdeen	13:12	15:23		17:14	18:19		20:06		21:55	
Elgin arr	14:38	16:55		18:45	19:44		21:35		23:20	
Elgin dep	14:41	16:57	17:57	18:51	19:46	20:32	21:37	22:20	Terminate	
Forres	14:55	17:11	18:11	19:05	20:00	20:46	21:56	22:34		
Nairn	15:06	17:30	18:26	19:16	20:11	21:00	22:07	22:45		
Inverness	15:23	17:48	18:44	19:34	20:29	21:17	22:25	23:02		

Table 17-1: Summary of Combined Westbound Services

Remarks	Previous 0500 ex Inverness		NEW		NEW		NEW		NEW	
Inverness		05:55	07:05	08:42	09:48	10:44	11:05	12:19	13:10	13:57
Nairn		06:12	07:25	08:59	10:05	11:01	11:28	12:36	13:27	14:14
Forres		06:23	07:36	09:10		11:12	11:39	12:47	13:41	14:25
Elgin arrive		06:37	07:50	09:26		11:30	11:55	13:02	13:57	14:39
Elgin depart	05:44	06D41				11:32		13:06		14:42
Aberdeen	07:14	08:14		10:53		12:59		14:32		16:11
Remarks				NEW			NEW	1953 retimed		NEW
Inverness			15:25	16:37	17:12	18:07	18:56	20:42	21:22	2228
Nairn			15:42	16:54	17:29	18:24	19:13	20:59	21:39	2245
Forres			15:53	17:05	17:40	18:35	19:24	21:11	21:50	2256
Elgin arrive			16:07	17:26	17:54	18:49	19:40	21:27	22:06	2312
Elgin depart			16:09		17:56	18:54			22:08	
Aberdeen			17:36		19:28	20:29			23:38	

D – empty unit detached from rear of train to work 06:58 Elgin to Inverness

Table 17-2: Summary of Combined Eastbound Services

The timetable provides roughly one train each hour between Inverness and Elgin, a significant improvement over today's service. According to calculations the service would be covered by four shifts of train crew at Elgin (two of which would be transferred from Inverness) and two units would be stabled at Elgin overnight. All empty stock working would be dispensed with, saving an annual mileage of 44,000 miles. Starting the first train, and terminating the last train from Aberdeen at Elgin, a further 22,000 miles per annum, in train mileage, would be saved.

The first train from Elgin to Inverness at 06:58 would be formed of a set on the rear of the 05:57 Inverness to Aberdeen, the second train from Elgin at 07:29 to Inverness formed by one unit stabled overnight in Elgin Yard. There may need to be empty workings on a Saturday night and Monday morning to compensate, if no Sunday Elgin / Inverness service operates, to allow units weekend maintenance at Inverness depot.

Reduction of journey times will be made possible by raising line speeds, relocating Forres station and altering the present signalling system (electric token block) between Forres and Elgin which currently requires trains to stop at signal boxes to hand over tokens. This work is all part of a wider policy initiative to reduce journey times between Inverness and Aberdeen.

17.2 IAL1: NEW STATION AT DALCROSS

17.2.1 The Issue

There is an aspiration to provide a new station at Dalcross, which will serve the local area and Inverness Airport.

17.2.2 Operational Analysis

Based on the development of the local services as outlined in IAL1 it is possible that some of the new local services could call at a proposed new station at Dalcross, adjacent to Inverness Airport, in addition to three of the through Aberdeen trains in each direction which are deemed to have time to call at the station.

The resulting pattern of services would be as shown in the following tables.

Station											
Aberdeen			06:25		07:28		09:25		11:40		13:12
Elgin arrive			07:54		08:56		10:55		13:03		14:38
Elgin depart	06:58	07:29	07:56	08:30	08:58		10:57	12:09	13:05	14:15	14:40
Forres	07:12	07:44	08:10	08:45	09:16		11:17	12:23	13:19	14:30	14:55
Nairn	07:23	07:55	08:21	09:00	09:27	10:18	11:28	12:37	13:30	14:41	15:06
Dalcross	**07:33**	**08:05**	**08:31**	**09:10**	**09:37**	**10:28**		**12:47**		**14:51**	
Inverness	07:44	08:15	08:41	09:20	09:47	10:38	11:46	12:57	13:48	15:01	15:23
Station											
Aberdeen	15:23		17:14	18:19		20:06		21:55			
Elgin arrive	16:55		18:45	19:44		21:35		23:20			
Elgin depart	16:57	17:57	18:51	19:46	20:32	21:37	22:20				
Forres	17:11	18:11	19:05	20:00	20:46	21:56	22:34				
Nairn	17:30	18:26	19:16	20:11	21:00	22:07	22:45				
Dalcross		**18:36**		**20:21**	**21:10**		**22:55**				
Inverness	17:48	18:46	19:34	20:31	21:20	22:25	23:05				

Table 17-2: Services with Dalcross Station

Only the 06:25, 07:28 and 18:19 from Aberdeen to Inverness can call additionally at Dalcross. End to end journey time is a sensitive political issue and there are tightly timed crossings at loops (and at the end of the single line sections before Inverness and Aberdeen) that can badly affect performance. It is essential that connections are maintained at either end of the route in order to maximise through journeys and increase revenue potential. As highlighted above the long stretches of single line and the different signalling systems are not conducive to minor alterations to timetables. The effect of the new station would be that journeys would be lengthened by two minutes and it is felt that these trains mentioned are those which can most afford a minor retiming.

Station									
Inverness		05:54	07:05	08:42	09:48	10:44	1105	12:19	13:10
Dalcross		**06:04**	**07:15**	**08:52**	**09:58**		**11:15**		**13:20**
Nairn		06:14	07:25	09:02	10:08	11:01	11:25	12:36	13:30
Forres		06:25	07:36	09:13		11:12	11:38	12:47	13:43
Elgin arrive	05:42	06:39	07:54	09:26		11:30	11:53	13:02	13:58
Elgin depart	05:44	06:41		09:28		11:32		13:06	
Aberdeen	07:14	08:14		10:53		12:59		14:32	
Station									
Inverness	13:57	15:25	16:37	17:12	18:05	18:56	20:40	21:22	22:28
Dalcross			**16:47**		**18:15**	**19:06**	**20:50**		**22:38**
Nairn	14:14	15:42	16:57	17:29	18:25	19:16	21:00	21:39	22:48
Forres	14:25	15:53	17:12	17:40	18:36	19:27	21:11	21:50	22:59
Elgin arrive	14:39	16:07	17:26	17:54	18:50	19:41	21:25	22:06	23:13
Elgin depart	14:42	16:09		17:56	18:54			22:08	
Aberdeen	16:11	17:36		19:28	20:29			23:38	

Table 17-3: Summary of Eastbound Services with Dalcross Station

Only the 05:55, 08:42 and 18:05 trains from Inverness to Aberdeen can call additionally at Dalcross due to constraints of the timetable and geography along the entire route (see above).

As a result of this pattern of services the new station at Dalcross would be served by a total of twenty-three trains per day, eleven westbound and twelve eastbound.

The station at Dalcross would have one platform face on the north side of the line. However land acquisition should allow for a future aspiration to re-double the line from Millburn and therefore an additional platform to be added on the south side of the line(s).

18. RECOMMENDATIONS

18.1 INTRODUCTION

This final section of the report seeks to pull together the findings of the study to present a series of recommendations in taking the development of the Highland Rail Network forward. Whilst the report has focussed on consideration of the individual aspirations on each of the lines it is clear that there are some common themes developing and a need to take a broad overview of the Highland Network as a whole as well as its relationship with the rest of Scotland's railways.

The remit of this study has, by necessity, meant that a limited amount of analysis and development work could be undertaken given the broad range of issues and geographical area. It is clear that should further consideration be required of specific matters identified in this study then it will be necessary conduct a more detailed examination of the operational and engineering issues. This may well involve operational modelling and site surveys.

18.2 HIGHLAND MAIN LINE

Two clear inter-related themes emerged from the aspirations and the analysis that was undertaken on this line. The first was the need to reduce journey times to the Central Belt of Scotland and the second to improve the frequency of passenger services. Both of these are squarely aimed at improving the connectivity of the region and of Inverness in particular.

The introduction of improved rolling stock with enhanced braking and acceleration characteristics is an easy-win in terms of the infrastructure since a noticeable improvement in journey times can be achieved without work on the ground. Refocusing the service pattern to target services where the market demand is strongest is a further means of speeding services up. This latter solution will need to be linked to the greater frequency of services to reduce potential criticism driven by fear of severance through a reduction in calls at particular stations.

It is not within the remit of this study to identify the benefits derived from the enhancements to the train services on the route however it is possible from the available information to derive a list of potential actions that will maximise the potential of the route. These are:

Action	Justification	Benefit
If Voyager units are utilised by ScotRail then there introduction should be pressed for on the Highland Main Line.	Longer distances and improved acceleration and braking characteristics will allow the benefits of the unit characteristics to be fully achieved on this route	With no enhancement to the infrastructure journey time saving of 17 minutes can be achieved on the current pattern of station calls.
Services on the route should be enhanced to an hourly frequency with a four-hourly pattern of station stops	When combined with the introduction of Voyagers the reduction in station stops will maximise benefits and remain focused on demand	With enhancement to the infrastructure to accommodate the line capacity requirements Perth to Inverness could be achieved in 1 hour and 45 minutes.
Freight trains should be provided with suitable paths	The impact on freight of the enhanced passenger services would make freight unattractive both to the freight operator and customer unless services could be timed outwith the 08:00 to 18:00 enhanced passenger period.	Potentially retains the viability of freight on the route. It is a key aim to achieve balanced growth between the sectors.

Table 18-1: Summary of Actions on Highland Main Line

Based on the foregoing and the need to provide a greater level of development to allow decisions to be taken the following work is recommended:

- Detailed timetable study and computer simulation derived from more detailed specification to prove timetable and obtain performance delay minutes and actions for rectification;
- Detail costs for required new infrastructure e.g. double line Daviot – Culloden, reinstated loops at Newtonmore and Ballinluig;
- Re-examine 1998 report to further assess sections of line where speeds could be raised to take maximum advantage of new rolling stock; and
- Re-commission gauging clearance surveys in order to achieve W9/10 gauge for freight traffic.

18.3 FAR NORTH LINES

The case for developing the services and the Far North Lines route is driven by growth in passenger demand and the need to reduce journey times in order to compete with road transport. Significant enhancements to the infrastructure are likely to trigger signalling alterations, which are currently difficult to execute given the capacity constraints and age of the existing Radio Token Block signalling system. Network Rail has provided an indicative programme date for the renewal of the present system driven by European Rail Traffic Management System (ERTMS) considerations. Ahead of this upgrade it is not recommended that consideration be given to any significant enhancements of the type likely to trigger signalling works.

There is however the opportunity to consider minor works to enhance line speeds throughout the route however these are likely to yield only minor benefits in terms of the savings. The conversion of loop points to some form of train detection operation has been considered however raising line speeds from 15mph to 25 mph only achieves a saving of five minutes along the route. The following recommendation is made:

Action	Justification	Benefit
Undertake examination of the potential to increase line speeds through a series of minor works or the relaxation of curving rules and braking assumptions	Major works are unlikely to be justifiable however a series of smaller improvements may yield noticeable benefits	To be determined.
Carry out tests on loop points to see if speed increase is practicable	Would increase speeds through stations where no station call was being made	Decrease in end to end journey times: amount yet to be determined
Examine each level crossing where train running speeds need to be reduced substantially to ascertain if improvements can be made	Decrease wear and tear on track and rolling stock; increase safety to road and rail users at crossings	Decrease in end to end journey times: amount yet to be determined

Table 18-2: Summary of Actions on Far North Lines

Based on the foregoing and the need to provide a greater level of development to allow decisions to be taken the following work is recommended.

- Examine sections of line where line speeds could be increased; and
- Assess level crossings to determine costs of line speed improvements at these locations.

Major alterations to the route are possible with the construction of the Dornoch link that is estimated at saving thirty-seven minutes in running time alone. This figure combined with more minor alterations on other sections of the route will increase savings proportionately.

18.4 DINGWALL TO KYLE OF LOCHALSH

Based on the cost and difficulties associated with upgrades to the signalling system it is recommended that no capacity enhancements be undertaken on this line. Upgrading of the line to cater for heavier rolling stock is possible and should be the subject of more detailed engineering surveys.

18.5 GLASGOW TO FORT WILLIAM

The study considered the potential to alter the current pattern of services to provide a better timetable. To achieve this it is necessary to deploy additional rolling stock. It is known that First ScotRail operate this service to tightly controlled resource levels however if the additional costs associated with the development of the timetable were matched with additional funding then it is clear that they would improve the service. It will be for the demand study to determine the likely benefits from such a change. If it is commercially beneficial to operate these trains it is likely that First ScotRail will go some way to introducing improvements to the timetable.

18.6 GLASGOW TO OBAN

See comments for Fort William line regarding passenger timetable aspirations.

The consideration of the potential to upgrade the line for Class 66 operation could cost in the region of £10m to £15m to achieve. It is known that potential freight operators must rely on older (and lighter) traction to serve the branch if required to do so. The investment of £15m would appear to represent poor value for money, given the present freight potential, and it may therefore be preferred to maintain the specialist equipment necessary to serve the branch on an 'ad hoc' basis.

18.7 FORT WILLIAM TO MALLAIG

The study determined that it may be possible to undertake minor adjustments to the timetable on this line and these are recommended as being taken forward within the limitations of the available resources. It is recognised that any alterations to improve station facilities will be subject to regulations covering listed structures given the historical significance of the line.

18.8 INVERNESS TO ELGIN

Work associated with the line from Inverness to Aberdeen is connected with present developments in particular at the eastern end, i.e. Aberdeen Crossrail and freight developments at Raith's Farm. Network Rail's Rail Utilisation Strategy (RUS) studies are also being employed for the route. It is considered likely that the outcome of those deliberations will drive any major timetable recasts at the Inverness end as a result of infrastructure improvements.

However, the introduction of Phase 2 of Invernet services will enhance the local service between Inverness and Elgin within the near future and without any alterations to track or signalling but this may be the temporary limit of enhancements to the route until any major expenditure for the line is authorised.

Appendix A
Operational Review

Appendix B
Engineering Review

Appendix C
Consultation Meeting Notes

Appendix D
Aspiration Summary Spreadsheet

Appendix E
Clear Route 5 Results

Appendix F
Rail Terminology Glossary