StARLink

St Andrews Rail Link

High Level Report

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TATA STEEL

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Executive Summary

This report has been commissioned by StARLink (St Andrews Rail Link Campaign) to define the case for a railway service to St Andrews. The study has looked at an optimised route alignment for a new railway and the journey time and business case that could support it.

The study has reviewed the Scott Wilson study of 1999 and considered a new alignment proposed by StARLink.

The original route has been built over at the old station site in St Andrews and at Guardbridge. The railway cutting southwards to Anstruther through the town has been in-filled, with part of the station site used as a car-park. Re-use of the original route would also cause disruption to the golf links and buildings. Essentially a new route for the railway needs to be defined, preferably a shorter one and avoiding the golf course and adjoining hotel.

StARLink has proposed an alternative route 7.7 km long, also following the A91 to the Eden Valley, but making a triangular junction with the East Coast Main Line (ECML) at Seggie.

Tata Steel Projects has proposed an innovative method of designing new railways using Route Optimisation Algorithms. This has been used on this project and the results assessed.

The study has considered an initial business case from a timetable analysis of the new infrastructure and a demand assessment.

The main outcome of this study is that an optimum route has been identified for the railway from St Andrews to the East Coast Main Line (ECML).

The length of the new railway will be 7855 metres, or 4 miles 70 chains which will take a Class 170 train 5 minutes to traverse at up to 90mph.

An indicative timetable has been prepared that shows it is possible to achieve an hourly service from St Andrews to both Edinburgh and Dundee.

The proposed service takes 1 hour and 19 minutes from St Andrews to Edinburgh and 1 hour and 14 minutes from Edinburgh to St Andrews. It will serve Cupar, Dunfermline Town, Edinburgh Gateway (shown as South Gyle in the timetable until the new station opens) and Haymarket.

From St Andrews to Dundee via Leuchars, the service takes 22 minutes and from Dundee to St Andrews the service takes 19 minutes.

A bill of quantity has been prepared together with cost estimate for the construction of the whole railway and supporting structures. The construction cost at third quarter 2011 prices is £50,508,080.

With indirect costs added this rises to £54,558,080 and with 30% risk this rises to £70,925,504. Escalation will increase this further.

The proposed St Andrews service shows a strong demand. The low and high demand revenue estimates for the service are £653,305 and £1,637,252 per annum. There is however an abstraction of revenue from Leuchars Station.

External benefits also accrue to the scheme: -

- Travel time reduction benefits are in the range of £214,000 to £269,000 per annum at 2011 prices.
- Modal transfer from car to rail benefits, are in the range of £69,000 to £166,000 per annum at 2011 prices.

The wider economic benefits and employment multipliers have not been considered in this initial analysis.

The operating costs are likely to be positive, i.e. less than the revenue and benefits, but the initial capital costs may need to be supported by grant funding.

The business case for the scheme needs to be refined. Considerable revenue and external benefits accrue to the scheme. The capital costs have been outlined.

Further analysis needs to be undertaken on the running costs to ensure that the service level accurately reflects the demand profile and costs are split with other existing services in the peak hours. This should be done as part of the Scottish Transport Appraisal Guidance (STAG) process.

Similarly the environmental assessment should be undertaken, linked to the STAG process.

The next stage of development would be to seek funding from SESTRANS, Fife Council and Transport Scotland to conduct the STAG appraisal to define the business and environmental case.

The business case will need to be accepted by the Scottish Government and funding for the construction agreed.

At that point an outline design can be produced to support an application for a Transport and Works (Scotland) Order (TAWS).

A strategy for presenting the case to the public and local bodies needs to be developed in parallel with the application for the TAWS order. This should include the scheme being adopted into the strategic and local plans to safeguard the route.

1.0 Introduction

1.1 Overview of the Route Optimisation Process

Tata Steel Projects has teamed up with ATRC, a leading developer of Route Optimisation Software in the USA to produce software for new railway developments in the U.K. This work is a pilot project to demonstrate how new railways could be built, using modern computer algorithms for automated and cost effective design methods.

The actual model integrates Genetic Algorithms (GAs) with Geographic Information System (GIS) data for optimising railway alignments, and processes very large amounts of relevant data associated with railway design. This has enabled a wide list of constraints and other factors to be built into the design that cannot be sensibly considered using manual methods.

Typically a route designed using Route Optimisation Software will reduce construction costs by 25% over a manually chosen route. Moreover the ability to run a series of options in a short period of time can shorten drastically the decision making, design time and costs.

Advantages of Route Optimisation for the St Andrews Project: -

- Reduced timescale and costs for design;
- Visual presentation to support public consultations;
- Typically construction costs reduced by 25%;
- Operating costs assessed.

The route optimisation is performed based on user specified criteria, such as minimisation of: -

- Track related construction cost,
- Structures and Bridges along the route;
- Land cost including compensation;
- Earthwork cost;
- Environmental and socio-economic costs.

Further from available data we have analysed passenger journey times and timetable solutions and their effect on passenger demand and propensity to travel.

1.2 The Design Process

This study is the first stage in the design process – the Concept Design.

The design process incorporates the Concept Design, the Outline Design, the Detailed Design and the Final Design.

The Concept Design is primarily a desktop assessment using available data, such as Ordnance Survey Digital Mapping, Digital Terrain Mapping, Geographic Information System (GIS) data, British Geological Society (BGS) geology mapping and a site visit. This allows us to produce an initial cost estimate with a risk log.

The Outline Design stage is the selection of a single option and its progression for approval. In Scotland, this is the appropriate design stage for a Transport and Works Order to obtain statutory powers to purchase land and alter rights of way etc. This process requires a topographical survey and appropriate ground investigations. At this stage a thorough qualitative risk assessment is undertaken and the cost estimate can be assessed for risk.

The Detailed Design is when the project has the appropriate consents and is fully funded. The design is taken to the “For Construction” point.

The Final Design is the record of the actual “As Built” infrastructure.

2.0 Client’s Remit

The client’s remit is to consider three identified options for railway link from St Andrews to the East Coast Main Line (ECML)

These were: -

- Option 1 – Scott Wilson Route, South of A91 via Eden Valley to Dairsie;
- Option 2 – StARLink Proposal, North of A91 via Eden Valley to Seggie;
- Option 3 – North of A91 via Eden Valley to Dairsie.

In essence, all these various options have some benefits and shortcomings. Other solutions can be developed as a combination of the above. The purpose of the Route Optimisation Process is to model the terrain and the new railway (including new bridges) and produce a minimum cost, maximum benefit solution.

New timetables and possible passenger services will be proposed, based on the route length and travel times.

A concept design is to be produced for a preferred option. This is to be modelled and costs and benefits analysed.

3.0 Scope of Works

The main objective is finding an optimal, feasible and cost-effective route between the site of the old station in St Andrews (where the station shall be re-opened) and the ECML near Guardbridge.

The geographical and environmental constraints need to be mapped and understood. Of particular importance to St Andrews and its cultural associations, is the effect of any railway on the golf courses and the historic landscape associated with the development of golf.

In addition the area has several environmental designations of national and international importance, principally in the River Eden estuary. This will influence the location of a bridge over the River Eden and its length.

A number of transport optimisation factors need to be considered, modelled and priced via the optimisation software – length of the route, necessary land take, maximum permissible gradient, minimum radius of the track, length (cost) of the under-bridges, over-bridges and viaducts. All these factors will be elaborated in Section 3.2 below.

3.1 Background information

The railway line from Leuchars to St Andrews opened in 1852 and closed in 1969. The original station was North of the town. In 1887 the line was extended to Anstruther and a new station built in the town centre. The old station became a goods station and latterly has been converted into the Old Course Hotel. The cutting for the Anstruther line has been in-filled and the second station site converted into a car park. The bus station and town centre are close by.

The original railway was built by Sir Thomas Bouch. His railways were noticeable for the low construction costs by avoiding heavy railway engineering. This matched the available funds of the St Andrews Railway.

The railway had sharp curves, especially in the Guardbridge area and low speeds.

A short portion of the original route extension into St Andrews centre may still be re-usable and the station site could be excavated where necessary.

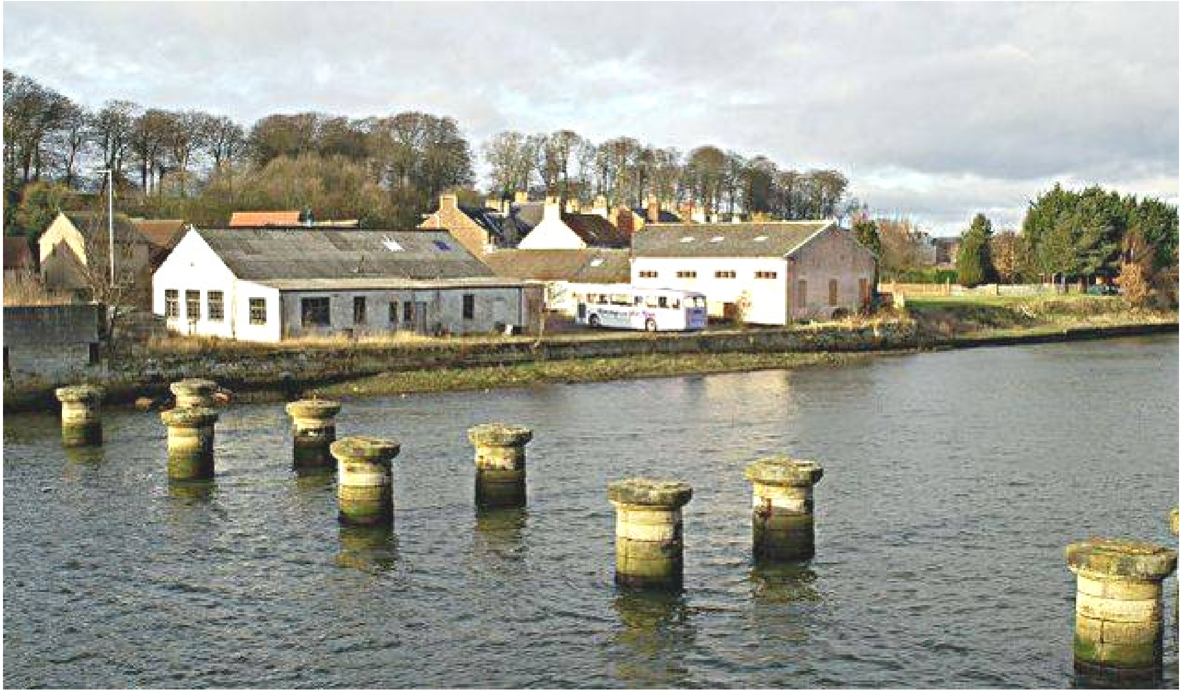
The railway route bisected the golf links at St Andrews and then followed the coast westwards to Guardbridge with the disadvantage that railway itself formed the sea-wall in places. The River Eden was crossed by a multi-span curved viaduct, the piers of which still remain.

At Guardbridge there was an intermediate station with a level crossing. The route then proceeded northwards, with sidings for the paper mill, to Leuchars, making a north-facing junction only with the East Coast Main Line. Passengers travelling between St Andrews and Edinburgh changed trains at Leuchars. The slow speeds and the change of train or reversal at Leuchars would make the journey times today uncompetitive with road transport.

The service only ran six days per week owing to a covenant to observe the Sabbath from the Cheape family, owners of the Golf Course

Since its closure in 1969, there has been continuous pressure to re-instate a railway service to St Andrews.

An earlier study by Scott Wilson in 1999 proposed a route adjacent to the A91 and then following the Eden valley to a new triangular junction at Dairsie with the East Coast Main Line. This route is approximately 9.5 km long and might not be practicable, due to housing development in the area and tight curves enforcing low speed and high maintenance regime.



Picture 1. The remains of Guardbridge Viaduct, courtesy of www.geolocation.ws

4.0 Initial Option Selection

Three options for railway connection from St Andrews to ECML had initially been proposed by the client: -

- Option 1 – Scott Wilson Route, South of A91 via Eden Valley to Dairsie;
- Option 2 – StARLink Proposal, North of A91 via Eden Valley to Seggie;
- Option 3 – North of A91 via Eden Valley to Dairsie.

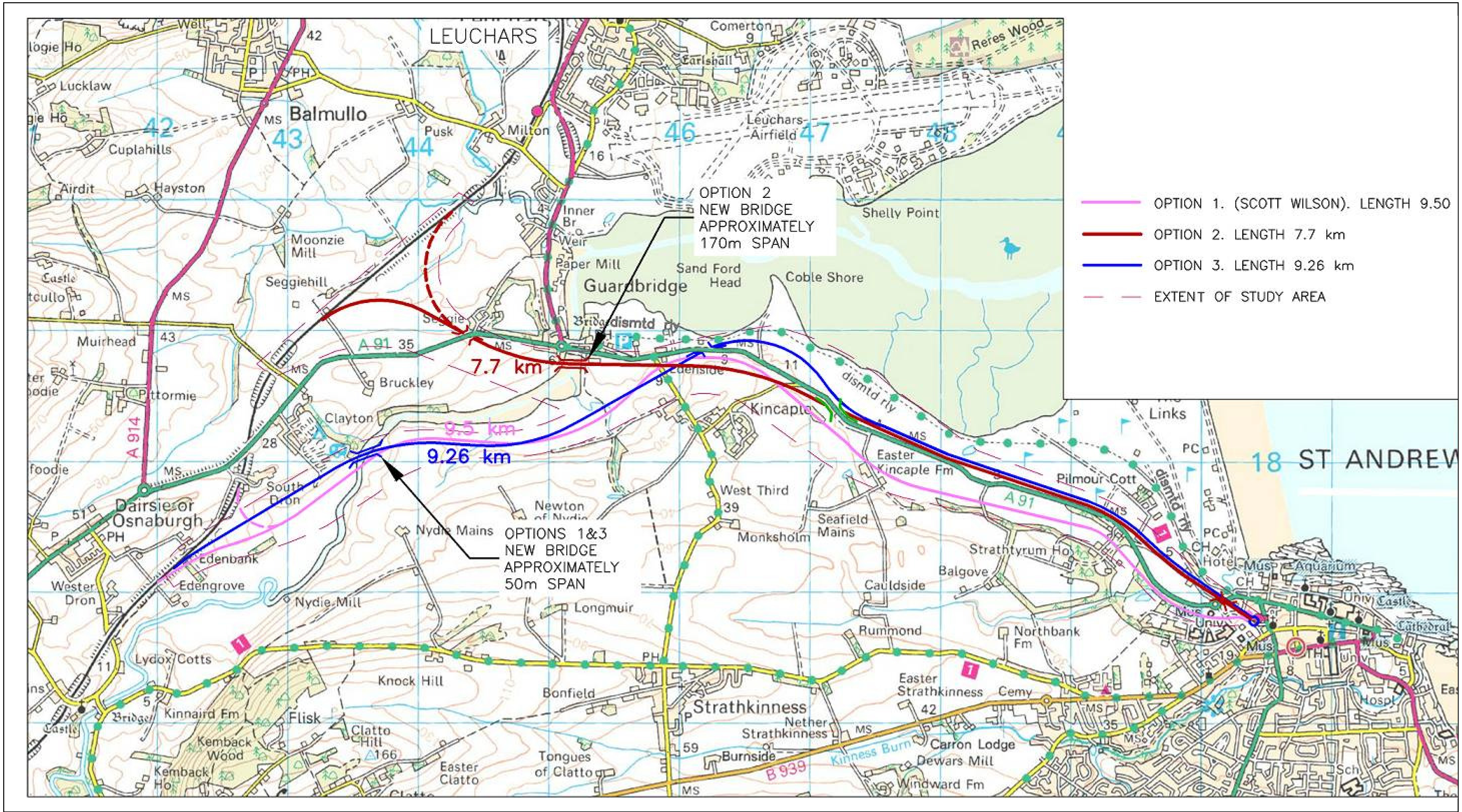


Figure 1. Options Considered

We examined these route options and commented on their practicality. The route of the original railway was not considered to be practical nor did it meet the remit to provide direct services to Edinburgh.

4.1 Option 1

The following extract of the 1999 alignment has been provided by the client.

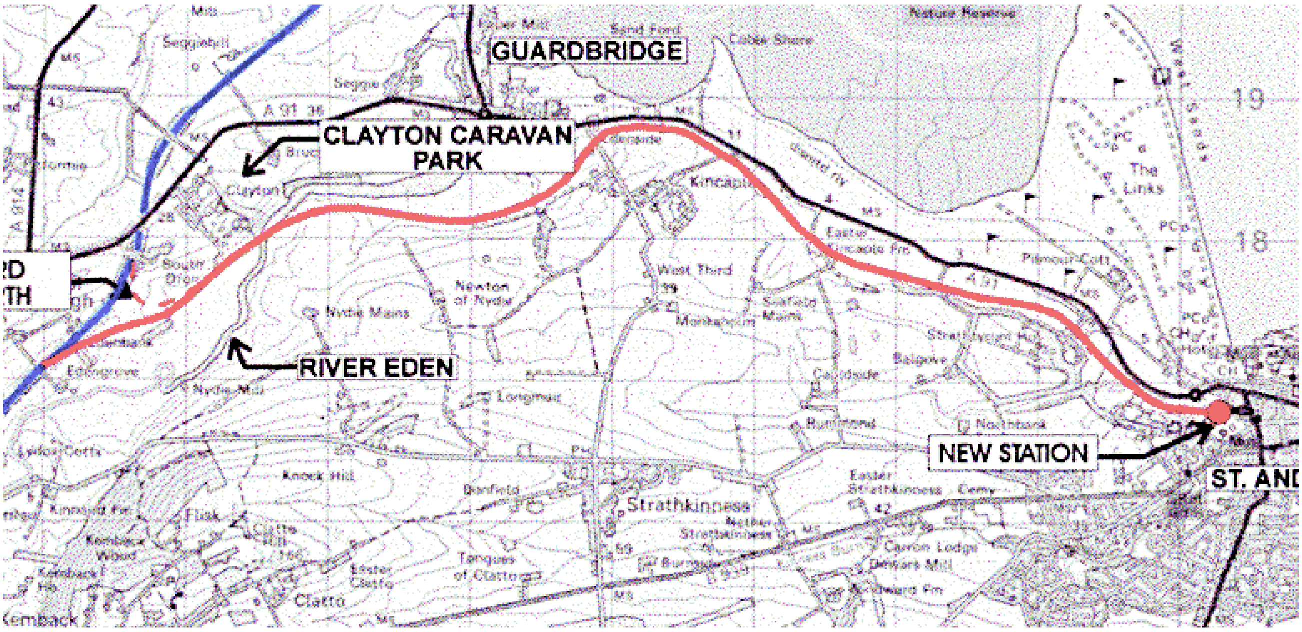


Figure 2. Scott Wilson Alignment 1999

This route (shown in Red) leaves the East Coast Main Line (ECML) (shown in Blue) at Dairsie.

This particular section of the ECML is curved and the junction appears to be on the transition between reverse curves. This will restrict the speed at the junction and increase the journey time. A second North facing junction is postulated, though the junction could be similarly constrained by curvature of the ECML and that of the chord line. The railway then descends to cross the River Eden, presumably staying above the flood plain on the escarpment at Clayton.

The route then curves sharply at Kincaple to follow the South side of the A91 Trunk Road to St Andrews.

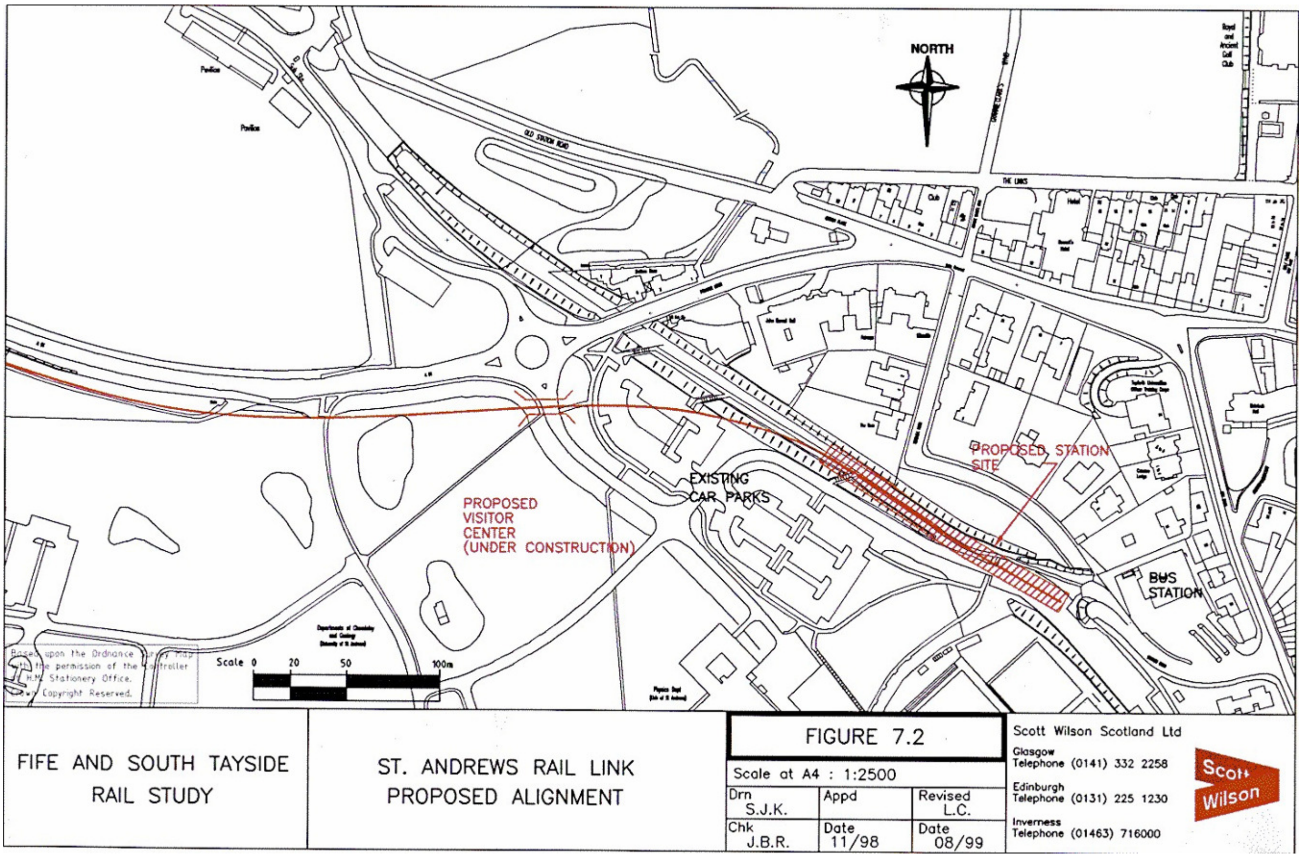


Figure 3. Scott Wilson alignment from 1999 at St Andrews

At St Andrews, the railway traverses the University grounds and must rise to climb and bridge the adjacent slip road to the Visitor Centre (now the Gateway Building). It then turns South-east towards the former station site across the car park area. The length of the station platform is not given, but appears to be suitable for two or three carriages only.

This route has many difficulties, in particular its length for construction cost, sharp curvature for slow speeds and difficult to construct terminal station site. Our opinion is that it is less practical than the other options. However to consider the benefits more thoroughly we have produced an Option 3 that also runs from a junction at Dairsie to St Andrews, but on a better alignment, North of the A91.

Option 1 – Scott Wilson Route		
Issue	Risk	Opportunity
Direct route from Dairsie to St Andrews	Distance (9.5 km) compared to a shorter route adds considerably to construction costs and reduces benefit to cost ratio. Capacity is reduced to two trains per hour by long single line section.	Junction at this location and route following River Eden reduces overall distance to Edinburgh, potentially reducing journey times.
South Junction with ECML	Junction on reverse curves is	

	geometrically difficult and may reduce line speeds. This may not be acceptable to other parties.	
North Junction with ECML	Chord Line on sharp curve and possibly steep gradient and junction on a curve. Extended distance and consequent longer journey times for the St Andrews to Dundee services reduces their competitiveness and the overall benefit to cost ratio.	
Encroaches on the escarpment at Clayton before crossing the River Eden.	Substantial earthworks may be required on each side of the River Eden. Affect on adjacent SAC and SSSI site in River Eden to be assessed.	
Sharp curve at Kincaple round headland.	Line speed will be limited, which may nullify advantage of shorter overall distance to Edinburgh by increasing journey times.	
Access to property and amenities South of A91 Trunk Road between Kincaple and St Andrews severed.	Accommodation works required. Scheme may be opposed.	
New housing at Strathtyrum South of A91 Trunk Road will be adversely affected	Property may have to be acquired and demolished. Scheme may be opposed.	

Table 1. Option 1 risk analysis

The conclusion reached is that Option 1 should be discarded.

4.2 Option 2

This option is based on a junction with the ECML at Seggiehill and the construction of the shortest practicable new route to St Andrews. A North facing chord is provided from Seggie to Moonzie for Dundee services.

The junction locations at Seggiehill and Moonzie were fixed due to the need to provide junctions on straight sections of the ECML wherever practicable. This was achieved. The junction at Seggie was fixed by the need to pass under the A91 Trunk Road at this location.

At St Andrews the route was fixed to provide a straight and level track in the terminal platform. Passive provision has been made for a run round and a possible second platform for golf excursion trains. The station requirements necessitated the use of the existing railway earthworks and the existing bridge abutments on the A91 Trunk Road (Links Crescent).

Between Seggie and St Andrews, the route drops towards Guardbridge, running across open country to the west of the village to cross the River Eden at height. Ideally this would be with a single span bridge, but the design of this would need to be confirmed. The geological data shows fault lines in this area. A three span bridge would require piers in the river bed, this could affect the SAC and SSSI site on the River Eden. The route then crosses under the A91 Trunk Road near Kincaple. The minor road network would be affected by a closure and a diversion. The route then crosses open land to run close to the A91 Trunk Road at Strathtyrum. Various accommodation works will be required to provide access to fields and golf course land. Any encroachment onto Strathtyrum golf course is mainly limited to ancillary land and one fairway.

From Strathtyrum the route runs to the north of the old Guardbridge road and cycleway, avoiding the Madras Rugby Ground. The route then rises on an embankment and then a viaduct over the cycleway and car park entrances adjacent to the Madras Rugby Ground, without impinging on the recreational land. It does however reduce the car park size. This would have to be resolved in negotiations with the Old Course Hotel, noting the benefits that the coming of railway would bring to the Hotel. The viaduct then joins the existing former railway embankment to enter St Andrews.

Option 2 – Seggiehill to St Andrews (North of A91 Trunk Road) Route		
Issue	Risk	Opportunity
Shortest route to the ECML	Longer route to Edinburgh requires high speed alignment to reduce running times	Distance (7.5 Kms) reduces construction costs and increases benefit to cost ratio. Shorter single line section to St Andrews allows 3 trains per hour on the route without double track.
South Junction with ECML	Adequate length of straight track for crossover and turnout is available.	Junction is on straight alignment reducing maintenance costs.
North Junction with ECML	Adequate length of straight track for crossover and turnout is available.	Junction is on straight alignment reducing maintenance costs.
Crosses River Eden at high level.	Substantial bridge is required over the River Eden. Affect on adjacent SAC and SSSI site in River Eden to be assessed.	Single span bridge would avoid environmental issues.
Proximity of route to Old Course Hotel	Careful design needed to mitigate risk.	Early consultation to win acceptance on the basis of overall benefit to the community.

Table 2. Option 2 risk analysis

The conclusion is that Option 2 should be developed further.

4.3 Option 3

This option is a development of Options 1 & 2 designed to produce a more acceptable alignment from Dairsie to St Andrews. The rationale is that this could produce a faster route from Edinburgh to St Andrews.

The route leaves the ECML at a similar location; however it follows the contours producing a straighter, better graded alignment to Clayton than Option 1. It encroaches on the Southern edge of the caravan park and crosses the River Eden. On this alignment it is not practical to have a North facing chord for Dundee traffic. However the additional distance the train would have to travel compared with Option 2, makes this Dundee chord less viable.

At Kincaple, the curve is eased slightly as the railway bows out to the North. It still remains a speed restriction however at the midpoint of the route.

After Kincaple the line rejoins the Option 2 alignment North of the A91 Trunk Road.

Option 3 – Dairsie to St Andrews (North of A91 Trunk Road) Route		
Issue	Risk	Opportunity
Direct route from Dairsie to St Andrews	Distance (9.5 km) compared to a shorter route adds considerably to construction costs and reduces benefit to cost ratio.	Junction at this location and route following River Eden reduces overall distance to Edinburgh, potentially reducing journey times.
South Junction with ECML	Junction on reverse curves geometrically difficult, may reduce line speeds on the ECML for through trains. This may not be acceptable to other parties.	
North Junction with ECML	Not possible	
Encroaches on the escarpment at Clayton before crossing the River Eden.	Substantial earthworks may be required on each side of the River Eden. Affect on adjacent SAC and SSSI site in River Eden to be assessed.	
Sharp curve at Kincaple round headland.	Line speed will be limited, which may nullify the advantage of shorter overall distance to Edinburgh by increasing journey times.	

Table 3. Option 3 risk analysis

The conclusion reached is that Option 3 offers little additional benefit over Option 1 and should be discarded.

4.4 Initial Option Selection - Conclusions

The original Sir Thomas Bouch route does not meet the requirements to deliver a direct service to Edinburgh. It has multiple disadvantages, such as passing between the golf links, acting as a sea wall and passing through Guardbridge with a level crossing. It is a circuitous and tortuous route that would be difficult and expensive to bring up to the standards required today.

Option 1 has been discarded due to long construction length, curvature and gradients, land issues and poor approach to the terminal station.

Option 3 sought to improve Option 1 by raising the speed, through easing curves and gradients and reducing contentious land issues by running to the North of the A91 Trunk Road. However it is 20% longer than Option 2, increasing construction costs and has the disadvantage of not providing a direct service to Dundee. In consequence Option 3 has also been discarded.

Option 2 has been taken forward for development. It provides good connectivity to both Edinburgh and Dundee with fast journey times. The route North of the A91 Trunk Road should produce fewer contentious land issues than a route South of the A91 Trunk Road. However the bridge span over the River Eden is greater than Option 3.

5.0 Route Optimisation

The next stage in the process is to optimise the route for Option 2 within a limit of deviation 100 metres each side of an initial centre line. This is done through a GIS model.

5.1 Data requirements

Various data is necessary to create a realistic landscape model between St Andrews and the ECML. Wherever possible we sourced the information from official maps and records: -

- Fife Council provided drawings of the council and publicly owned land;
- The golf course and its auxiliary land from Ordnance Survey digital mapping;
- Digital Terrain Model, using photogrammetric data from Centremaps;
- Flood Risk datum was sourced from the Scottish Environment Protection Agency (SEPA);
- List of monuments from Historic Scotland;
- Local nature Reserve, SPA, SSSI and RAMSAR from Scottish Natural Heritage;
- Land Capability for Agriculture (LCA map) from the Macaulay Land Use Research Institute;
- Recreational Route and a Cycleway from Ordnance Survey digital mapping;
- Protected Open Areas from Fife Council;
- Special Landscape Area from Fife Council;
- Geology, bedrock and superficial formation from the British Geological Survey.

5.2 Design Parameters

The following standards were used for the design parameters for the model: -

- BS EN 13803-1 2010 “Railway Applications. Track. Track alignment design parameters. Track gauges 1435 mm and wider. Plain Line”;
- BS 13803-2 2006+A1 2009 “Railway Applications. Track. Track alignment design parameters. Switches and crossings and comparative alignment design situations with abrupt changes of curvature”;
- UIC Code Leaflet 719 R “ Earthworks and track bed for railway lines” 3rd Edition 2008.

5.3 Constraints Used in the Optimisation

A number of mathematical constraints are utilised, which the optimisation software must satisfy in order to arrive at the optimal route. These constraints are: -

- Minimum Horizontal Curve radius – 1500 metres, except where a junction will be installed;
- Default spiral transition curve length – 70 metres;
- Maximum gradient – 1 in 75 (1.333%);
- Fill slopes for bedrock types – 25 degrees;
- Cut slopes for bedrock types – 30 degrees
- Fill slopes superficial formation – 25 degrees;
- Cut slopes superficial formation – 30 degrees;
- Cut cost – £18/m^3 Fill cost – £11/m^3

Ideally the model would use the standard soil classifications as per the UIC Code 719 R to produce slopes for cut and fill. However the complexity of the geology in the U.K. means that a manual analysis has to be undertaken to associate various soil and bedrock types with slopes. The slope requirements vary slightly with different soils and bedrock. See Appendix C for details. However to reduce the complexity of the model we have adopted mean values. The manual analysis of the geology has also revealed that little of the cut material is suitable for re-use as fill. The model is adjusted to reduce the cut volumes. The fill material in consequence is brought in.

The geological data used in the model comprised British Geological Society (BGS) digital maps of surface and bedrock geology with known fault lines.

From the BGS Label tables, we used the descriptions to assess cut and fill slopes for particular rock types and the general suitability of the soil and rock types for embankment fill

The purpose of the route optimisation algorithms is to determine the most cost effective route. The system works over a wide area with thousands of iterations.

At the concept design stage this level of information is adequate. More detailed information, for example borehole data, is not of use at this stage, as it concerns the viability of the route when chosen, not the process of route selection.

At the later outline design stage when the business case is proven, we can then use further historical borehole data and undertake ground investigations and a topographical survey. This will then refine the cost estimates.

The route is primarily determined by topology and the topography and is unlikely to vary greatly because of geological conditions.

A 1 in 200 year flood level requirement imposes a minimum 5 metre height AOD for the proposed railway line (including ballast and sleepers depth).

When an over-bridge (road-over-rail) is analysed, a nominal clearance of 5.0 metres from rail surface to the soffit of the over-bridge has been allowed for. With a normal construction depth, this equates to about 6.0 metres from the rail-head to the carriageway surface. These values will alter slightly at the next stage of work as the specification is agreed with Network Rail.

The optimisation model is estimating the cost of the bridges according to their length, employing semi-exponential cost increase to cater for construction depth increase.

Earthworks are calculated using the height of the railway over or under the ground surface to determine the cross-section of the cut or the fill, and therefore to calculate the volume of works.

Costs of land disposal, under-track culverts, de-forestation and other small items are not calculated, as that would bring a degree of sophistication that was thought to be inappropriate at this stage.

Land Values were derived from the LCA map, imposing high cost for Grade 1 Agricultural Land and using the current equivalent market prices for the rest of the land.

The land price for the actual golf links was set to a very high level, to minimise any land take or split of the land. The auxiliary land, not forming part of the actual course is priced at lower level.

The terminal station location and the alignment of the route into the new station area were fixed prior to modelling. Similarly the junction locations were fixed taking into account possible Switch and Crossing geometry on the East Coast Main Line.

6.0 Methodology

The purpose of the Route Optimisation Process is to model the landscape and calculate the costs of building of railway on it. To do this the model uses the absolute height of the surface, design height of the new railway, lengths, cut and fill volumes, landtake, golf links area, protected open zones, agricultural land, necessary bridges (obstacles that need bridging), etc.

Then the possible routes and sub-routes will be calculated at separate iterations (steps). As a result the algorithm will analyse the enormous multitude of sub-options, convert this information to money-equivalent and produce a minimal cost solution. The optimal solution will have the lowest overall outlay.

One main consideration in the trade-off analysis of the model is the right-of-way costs. The model uses the unit cost of land for optimising land purchases. Land costs for the golf-course are given high value to discourage the model from choosing alignments there. Technically, land cost for bridging a river is zero because it is normally public property. However, we use double the average cost of regular land for rivers and streams. This forces the model to choose shorter bridges instead of longer bridges. Land prices in SSSI areas are increased by 10% so that the model minimises any alignments passing through these areas. Table 1 shows some details of how we calculate the unit-cost of land.

Land Type	LCA Code	SSSI Code	Stream?	Unit Cost	
				(£ /ft^2)	(£ /m^2)
Grade 1	2.0	No	No	0.25	2.72
		Yes	No	0.23	2.47
		No	Yes	0.46	4.94
		Yes	Yes	0.48	5.18
Grade 2	3.1, 3.2	No	No	0.18	1.98
		Yes	No	0.20	2.16
		No	Yes	0.37	3.95
		Yes	Yes	0.39	4.15
Grade 3	6.1	No	No	0.14	1.48
		Yes	No	0.15	1.63
		No	Yes	0.28	2.96
		Yes	Yes	0.29	3.11
Residential	888	No	No	1.00	10.75
		Yes	No	1.10	11.83
		No	Yes	2.00	21.51
		Yes	Yes	2.10	22.58

Table 4: Costs for Land Calculations

An important consideration in the Route Optimisation Model is minimising earth work costs by balancing the cost of cut and fill. Abiding by the other alignment constraints, the proposed alignment is the best feasible in terms of earthwork and bridge costs.

The basis of the study is Geographical Information System (GIS) data.

7.0 Results

The results of our model are shown in detail in Appendix A as all-encompassing drawing and in Appendix B as two large-scale general arrangement drawings. The total length of the new railway is 7855 metres. A short summary and small illustration follow: -

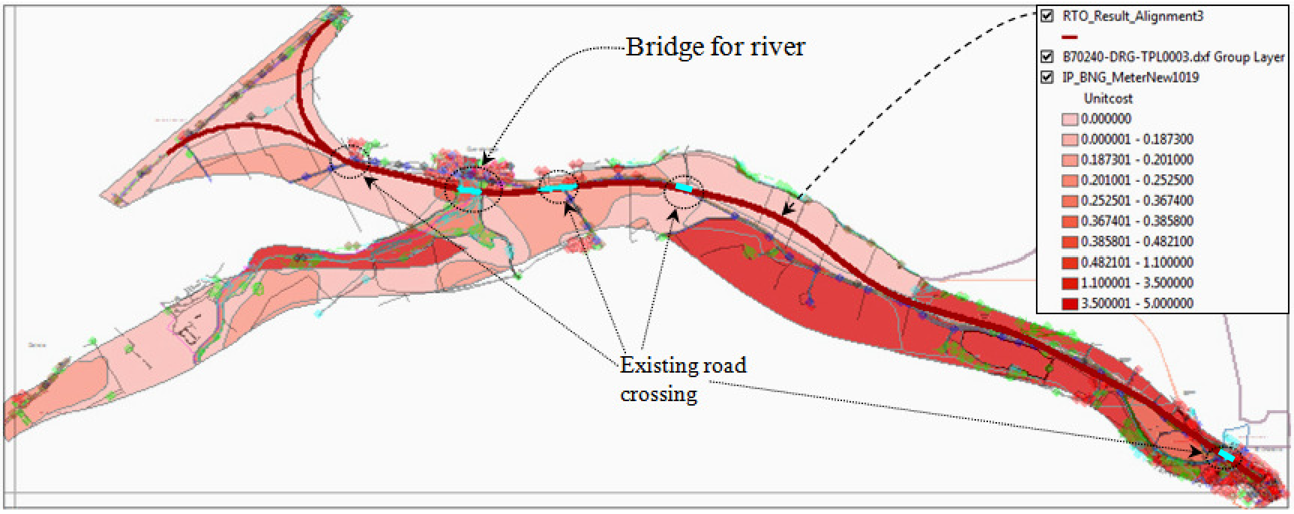


Figure 4: Proposed Horizontal Alignment plotted on a Map of Land Prices

The model is run for 300 iterations. During this process, the model generated and evaluated 8191 alignments. The computation time was just under 2½ hours. Figure 1 shows the result of proposed alignment by the model superimposed on the map of land prices. As can be seen, the proposed alignment avoids the areas with high land costs.

The short blue spots on the proposed alignment indicate the need for bridge construction. There are five locations where some form of bridge is necessary, and is further explained in Section 8.1.

On Figure 1, going from west to east, the first, third and fourth locations are overbridges (road-over-rail bridges). The second location for a bridge is over the River Eden. The fifth one near St Andrews indicates an under-bridge (road under rail). There is also a need for a viaduct near the Madras Rugby Football Club (in order to retain the road network in this area).

At other locations where the railway alignment crosses a public or private right of way, we have shown a diversion or closure as appropriate.

8.0 Discussion

The route optimisation has produced a practical alignment. Where necessary we have made adjustments to cater for known constraints e.g. roads

At St Andrews Station, we have shown a platform with a maximum practical length of 257 metres. The requirement here is to provide both for a three-car 170 passenger service and for additional charter trains during golf tournaments. Passive provision is made for a run round loop and possible second platform for charter trains.

The platform length is constrained by the rail-over-road bridge over the A91 Links Crescent to the West and by Station Road to the East. In addition modern standards recommend that platforms are not placed on curves of less than 1000m radius to ensure that gaps between the train and the platform are minimised, particularly for mobility impaired people.

The station location is only shown in outline, the detailed provision of facilities have still to be determined. Access to the station would be in two directions, from Station Way to the North, leading to the town centre and the car-park to the South leading to the Gateway Centre and the University of St Andrews.

The station site is centrally located to maximise footfall. The adjacent car-park also provides for commuters. The bus station is also on Station Road, thereby providing an integrated transport interchange.

Picture 2. Station location, looking south-east

The route utilises the existing abutments for the railway bridge at the A91 Links Crescent., subject to assessment.

Picture 3. Abutments of the former railway bridge

It then descends; initially on the existing embankment and then on a viaduct adjacent to Madras Rugby Football Club. This viaduct, though of low headroom, allows a restricted traffic circulation of bicycles on the cycleway and light vehicles.

The viaduct is followed by an embankment across the car-park for the Old Course Hotel. The alignment stays as close as possible to the existing road network to minimise land-take. Though disadvantaged by loss of car-parking spaces, the Hotel should benefit also from visitors being able to arrive by train using the new station.

Picture 4. Entrance of Old Course Hotel

The railway reaches ground level adjacent to the A91, north-west of the hotel..

Two occupation roads giving access to the Balgove, Strathtyrum and Eden Courses, the St Andrews Links Offices, Eden Clubhouse and Golf Academy, will need to be considered, either for closure or diversion.'

Picture 5. Eden Clubhouse access road

Picture 6. The west access road

The golf driving range will also be affected by the route, as will ancillary golf buildings. These include the R & A Equipment Test Building and the new Links Storage Building near to the junction of the private occupation road and the A91. It may be possible to re-erect or replace these buildings clear of the railway alignment.

The cycleway on the A91 Guardbridge Road at Strathtyrum will need to be re-aligned and the carriageway may also need a minor alteration.

West of Strathtyrum the railway swings away from the road across a field to follow the A91 Guardbridge Road as closely as possible alongside Strathtyrum golf course. Some resiting of the junior range may be necessary, with additional land purchased.

In this area the railway is embanked at the 5 metres A.O.D. to comply with the 1 in 200 year flood levels.

West of Strathtyrum Golf Course, the railway swings away from the road across a golf driving range to cross the A91 Guardbridge Road The A91 would be raised at this point to cross the railway with a road over rail bridge.

The railway then climbs at a constant gradient to the River Eden bridge, following the alignment of the A91 to Edenside. The Hungry Horse Diner will need to be acquired and re-located. The direct road to Kincaple would be closed with a footbridge provided over the railway. The Kincaple access road from the A91 to the North-East may need its junction with the A91 improving to allow movements to and from Guardbridge.

After Edenside the railway swings inland to the rear of Avalon Business Park to cross the River Eden with a single-span bridge of approximately 175 metres length.

Picture 7. River Eden, east bank

This avoids any interference with the SPA, SSSI and LNR designated area of the river itself. The bridge construction has not been evaluated, however a design based on a Composite Truss Bridge similar to the Nantanbach bridge over the River Main in Germany may be suitable. To the immediate west of the River Eden, there is a geological fault line that may influence the design.

Provision is made for the main span to cross also an occupation road on the right bank of the river and for an accommodation road to give access to farmland on the left bank of the river.

The railway then crosses brown-field land and Grade 3 farmland to climb to Seggie and pass under the A91 Cupar Road. The main route then curves on the level to Seggiehill where a junction is made with the East Coast Main Line on a straight section. This would probably require a 60 mph NR60 SG turnout and crossover. The existing occupation road level crossing at the junction site may need to be diverted.

A branch towards Leuchars and Dundee is provided for from a 50 mph junction at Seggie falling towards Moonzie. An intermediate bridge is required over Seggie Burn and an accommodation road. The junction at Moonzie is made on a straight. This would probably require a 50 mph CEN56 FV turnout and crossover.

Additional signalling will be required on the East Coast Main Line for the new junctions; this will have the added advantage of improving the headways on the main line.

8.1 Description of Works

The General Arrangement drawings in Appendix A and B show the new railway with chainage in kilometres and metres.

Overall length of the railway is 7855 metres from Seggiehill Jn to the re-opened station. The north chord is additionally 1108 metres long.

The volume of necessary earthworks is calculated as: -

- Cut – 125,000 m^3;
- Fill – 170,000 m^3;

These volumes and the necessary works are described in Appendix D.

As much of the excavated material is unsuitable for embankment fill, the cutting depths have been reduced wherever possible. Excavated material could be deposited locally on the worksite adjacent to the A91 bridge over the railway on land acquired from the golf driving range. This would be subject to an environmental assessment when the project is developed further.

The connection with East Coast Main Line can be accomplished with a 50 mph single turnout and crossover at the North end (to Dundee) and 60 mph turnout and crossover at the South end (to Edinburgh). These speeds will need to be confirmed in a detailed design following a full topographical survey.

Position and estimated length of the necessary bridges: -

- Overbridge for A91 road at 1+295 metres – length 19.0 m;
- River Bridge at 2+120 metres – length 175.0 m. Initial design and costing are for a 4-span continuous steel-concrete composite bridge, supported on piled reinforced concrete piers and bank-seats. A more desirable single-span bridge would have a similar cost.
- Footbridge to replace a small road at 2+766 metres – length 14.5 m;
- Skew Overbridge for A91 road at 3+547 metres – length 54.0 m;
- Viaduct near the Madras Rugby Football Club at 7+355 metres – approximate length 145.0 m;
- Underbridge to be reinstated for A91 road at 7+586 metres – length 13.2 m;

If the North Chord to Moonzie Junction is built, an additional underbridge must be constructed for the Seggie Burn and an accommodation way next to it. Location 0+530 metres – span 8.0 metres.

In addition to the permanent works there will be temporary works for the construction of the railway.

8.2 Estimates, Bills Of Quantity

Using the results from the optimisation process, which are based on Ordnance Survey and Photogrammetric Digital Terrain Model data, we can calculate the approximate volume of necessary earthworks and size of the bridges.

Note that a full-scale topographical survey will be needed to determine the exact terrain geometry.

The volume of all necessary works is described in Appendix D.

8.3 Speed Profile and Speed Assessment

We used “Dynamis” train performance simulation software to determine the journey time for a Class 170 DMU over the new railway. With a maximum speed of 90 mph the journey time from the ECML junctions to St Andrews will be just under 5 minutes. We used the following permissible speeds: -

St Andrews to Seggie Jn	Line Speed 90 mph
Seggie Junction to Seggiehill Jn	Line Speed 60 mph
Seggie Jn to Moonzie Jn	Line Speed 50 mph

More simulation diagrams, plotted against time are shown in Appendix E.

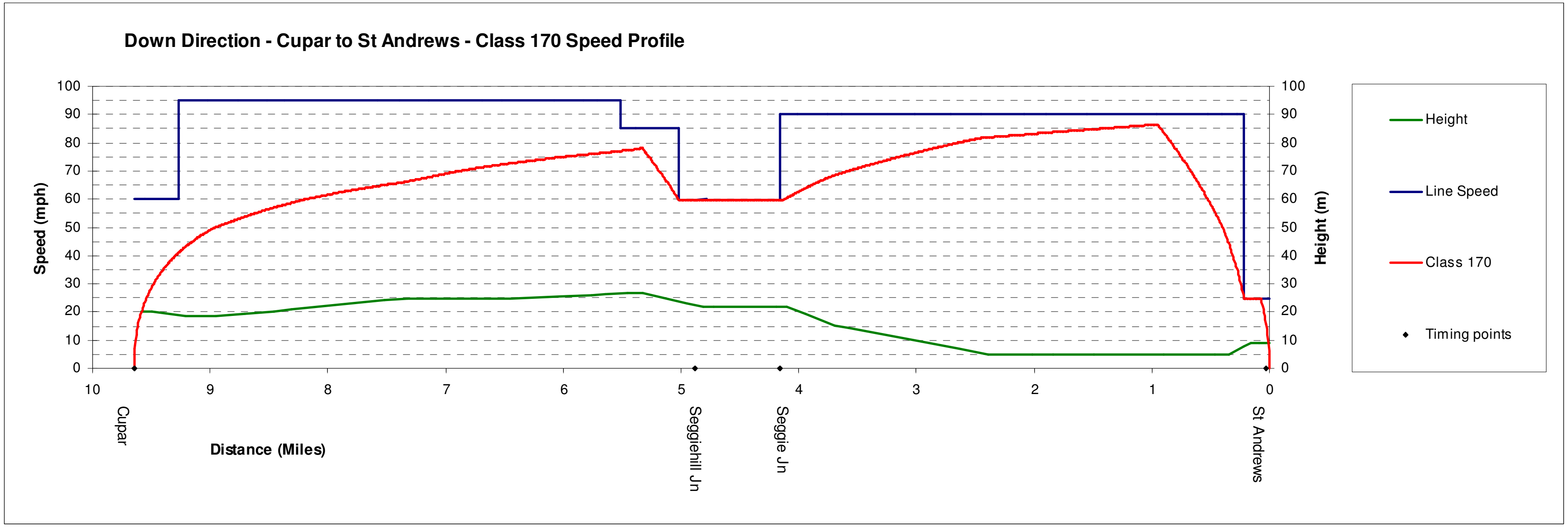
The result of the Class 170 modelling for trains to and from St Andrews are: -

St Andrews Railway Minimum Running Times (shown in hours, minutes and seconds)

South Chord (St Andrews to Cupar)				
From	To	Activity	Class 170	
St Andrews	Seggie Hill Jn	start-pass	00:05:06	
Seggie Hill Jn	Cupar	pass-stop	00:04:26	
Cupar	Seggie Hill Jn	start-pass	00:05:04	
Seggie Hill Jn	St Andrews	pass-stop	00:04:42	
North Chord (St Andrews to Leuchars)				
From	To	Activity	Class 170	Class 150
St Andrews	Moonzie Jn	start-pass	00:05:11	00:05:20
Moonzie Jn	Leuchars	pass-stop	00:01:12	00:01:11
Leuchars	Moonzie Jn	start-pass	00:01:25	00:01:24
Moonzie Jn	St Andrews	pass-stop	00:04:59	00:05:12

Table 5: The results of Dynamis simulation

In addition a 3 minute timing allowance will be required approaching St Andrews. This is needed for future engineering works both on the current railway from Edinburgh and the proposed new line.



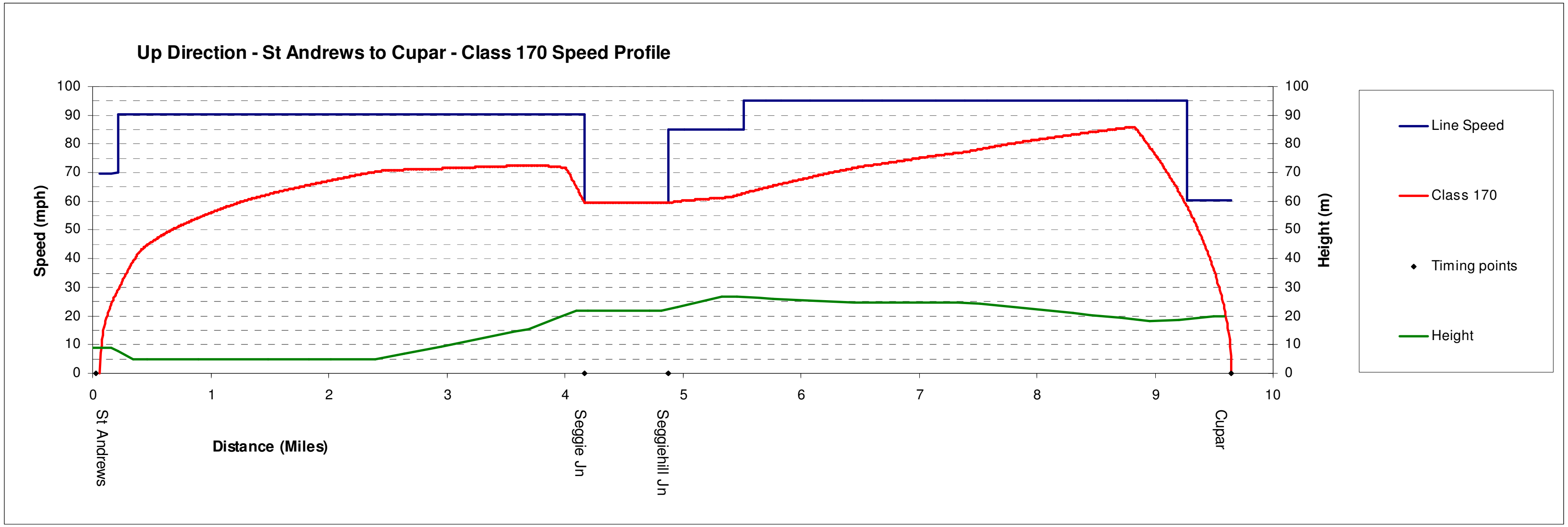


Figure 5: Snapshot from the Dynamis analyses for a Class 170 DMU

8.4 Indicative Timetable

To commence the passenger demand analysis we produced an indicative hourly timetable.

In the area of interest, between Cupar and Dundee there are 2 to 3 trains per hour and between Dundee and Carnoustie there are again 2-3 trains per hour. The difference comes from a HST running between Aberdeen and Kings Cross every 2 hours. Overall, they are spaced at a roughly 20 minute interval, which allows one additional train-path to be woven between each two. This is an indicative timetable, details for passing the trains around Edinburgh are not worked out.

There are several possible options to provide a passenger service to St Andrews. These evolved through a detailed examination of the 2011 Scottish timetable.

- Option 1 – Divert Existing Services

  The existing hourly semi-fast service from Edinburgh to Dundee (and vice versa) is diverted to run directly from Cupar to St Andrews, reverse and thence via Leuchars to Dundee. One train per hour can call at St Andrews in each direction. The throughout journey time will be extended by 15 ½ minutes, calling at St Andrews and reversing there, en-route to Dundee.

- Option 2 – Divert and Extend Existing Services

  The existing hourly semi-fast service from Edinburgh to Dundee (and vice versa) is diverted to run directly from Cupar to St Andrews, reverse and thence via Leuchars to Dundee. One train per hour can call at St Andrews in each direction. The throughout journey time will be extended by 15 ½ minutes, calling at St Andrews and reversing there, en-route to Dundee. As this service would have a turnaround time of approximately 50 minutes at Dundee, the opportunity was taken to see if a cross Tay service could be provided linking St Andrews with Carnoustie.

- Option 3 – New Services

  Provide a new direct service from Edinburgh to St Andrews with a separate new St Andrews to Dundee service. Examine possible calling patterns en-route to maximise revenue.

  Options 1 & 2 were initially developed. However it proved impossible to co-ordinate the paths north of St Andrews to Dundee with the paths south of St Andrews to Edinburgh. The constraints were the occupation of the single line to St Andrews, the restrictions on trains passing one another on the Tay Bridge and the existing timetable. The paths from Dundee to Carnoustie were also unattractive, being timed very close to existing services.

  Option 3 was then developed with two separate services. It was not possible to insert additional trains via the Burntisland route; however paths were possible via Dunfermline. Some adjustment of existing services was necessary to provide the standard hourly paths to St Andrews. We calculate that three Class 170 Diesel Multiple Units will be required for the Edinburgh to St Andrews service and one Class 170 Diesel Multiple Unit will be required for the Dundee to Edinburgh service

Proposed timetables for the Option 3 are shown in Appendix F.

8.5 Passenger Demand Assessment

Introduction

The purpose of this Section 8.5 sub-report (prepared by others) is to provide an outline assessment of potential passenger demand impact of a proposed new rail station and services at St Andrews.

The rail line to St Andrews was closed in 1969, since when the nearest rail access has been at Leuchars eight kilometres away. There has been a long standing campaign for re-instatement of the line to St Andrews. The proposal under consideration is to reinstate the line with a station at the original site. The former station site has good road access and is within easy reach of the centre for pedestrians. The timetable, developed as part of the proposal, provides hourly services between Edinburgh and St Andrews and Dundee and St Andrews.

Station Catchment Profile

St Andrews is a Fife coastal town with a population of 16,680[1]. The town is located 80 kilometres from Edinburgh and 20 km from Dundee and is world renowned for its 15th century university and world class golf course.

The population profile[2] is younger and more affluent than the average in the Fife region and Scotland as a whole. The university is a significant influence on both of these measures, which are important in terms of propensity to travel.

The university has over 7,000 students and more than 2,000 staff. It is a major contributor to the local economy, the other main sector being tourism. Visitors are attracted to St Andrews by the coastal location, historic townscape and golfing facilities. In 2009 St Andrews was reported to have generated 1.3 million visitor days. Both the university and the tourist industry attract inbound travel and rely on good transport links.

Passenger Demand Forecast Methodology

The nature of St Andrews as generator of travel from trips originating from the resident population and destinating trips from tourists, students and staff at the university means that a simple forecast methodology is not appropriate. The situation has further complexity due to the existing use of Leuchars station as a rail-head for St Andrews. A reinstated service would, inevitably, have an abstraction effect on demand at Leuchars which must be reflected in the forecast. Additional rail services may also impact on other stations depending on calling patterns and timetable adjustments.

The trip rate method is recognised as a suitable approach for projects in the early stages of planning and deals suitably with originating trips. However, trip rate estimates based solely on

[1] General Register Office for Scotland Mid-2008 Population Estimates for Settlements and Localities in Scotland
[2] Scottish Neighbourhood Statistics

station catchment do not adequately address circumstances where a significant proportion of destinating trips are expected. To address this element of the forecast, the trip rate method was enhanced through analysis of data on comparable stations and consideration of survey data. A further enhancement was made to forecast the abstraction effect at Leuchars. Separate calculations were made to assess the impact on other stations of additional services and timetable adjustments.

Trip rate methodology uses the direct relationship between passenger demand at a railway station and the population of the surrounding area. A trip rate measures the number of rail journeys per head of population. The rate is highest in the population resident in the immediate vicinity of the station and decays as the distance increases.

Rail industry guidance on demand forecasting[3] uses three distance bands: -

- 0 to 0.8km:
- 0.8km to 2km; &
- 2km to 5km.

The majority of trips will come from those living in the 0 – 0.8km band, the rate reduces in the following bands and, in general, a very small proportion will be from beyond 5 kilometres.

PDFH[3] includes evidence of typical trip rates within distance bands for stations in various different circumstances. These typical rates do not provide a strong match with the proposed station at St Andrews. Therefore, it was decided to calculate rates using population and rail journey data specific to the study area. This approach enabled us to customise the forecasts to reflect local conditions. It provided also a basis for comparison with other stations and allowed for abstraction effects to be included in a consistent forecasting framework.

Demand forecasts for St Andrews and Leuchars were calculated based on a series of linear regression analyses comparing the relationship between journeys and population for a range of comparable stations along the line of route and within Fife Council and neighbouring Local Authority areas.

Population and Journey Data

It was not possible, within the scope of this exercise, to derive specific station catchment population estimates matching PDFH distance bands. Rather we have used data published by the General Register for Scotland. Population estimates (mid-year 2008) for settlements and localities matching the stations chosen for the study were used. This means there may be some risks in the accuracy of the forecasting model as the populations are based on different area sizes. These risks are somewhat offset by the use of a consistent data source and a reduced risk of overlapping station catchments.

Journey data was also collected from a published source, the latest station usage data from the Office of Rail Regulation. This data is based on ticket sales in the financial year 2009-10 and covers all National Rail stations throughout England, Scotland and Wales. Station usage data are an

[3] Passenger Demand Forecasting Handbook 5 (PDFH5) 2011 Revision ATOC

estimate of the number of passengers travelling to and from each station. The ticket sales data are taken from LENNON, the national rail ticketing database, added to which are estimates of journeys taken using zonal/multi-modal tickets such as those in use within Strathclyde Partnership for Transport.

Two sets of stations were included in the analysis. Firstly stations along the proposed line of route for the new St Andrews services which we have named “Group A”, secondly “Group B” local stations between Inverkeithing Junction and Kirkcaldy which complete the Fife circle line. The base population and journey data for both groups of stations are provided in the following table (a line separates the two groups): -

	Population	**Journeys**
Dundee	152,320	1,664,210
Leuchars	3,730	423,144
Cupar	8,980	227,656
Springfield	940	860
Ladybank	1,560	59,942
Markinch	2,420	251,744
Glenrothes with Thornton	47,280	52,648
Cardenden	5,270	56,968
Lochgelly	6,490	59,810
Cowdenbeath	18,140	151,892
Dunfermline Stations*	78,550	806,450
Rosyth	12,790	239,196
Inverkeithing	5,180	943,400
North Queensferry	9,010	135,748
South Gyle	4,932	475,824
Kirkcaldy	48,630	1,074,524
Kinghorn	2,930	91,894
Burntisland	5,940	192,694

Aberdour	1,700	131,874
Dalgety Bay	10,090	247,778

* Dunfermline stations include DunfermlineTown and Dunfermline Queen Margaret

Regression Analyses

The first series of linear regression analyses tested the relationship between journeys per annum and population. This analysis was done using comparison stations along the proposed line of route Group A stations.

The resulting R^2 value, which measures the strength of the relationship between the two variables, demonstrated a fairly strong relationship, R^2 of 0.6169 (R^2 value of 1 indicates a perfect relationship and 0 indicates no relationship). The chart below shows the results of the analysis.

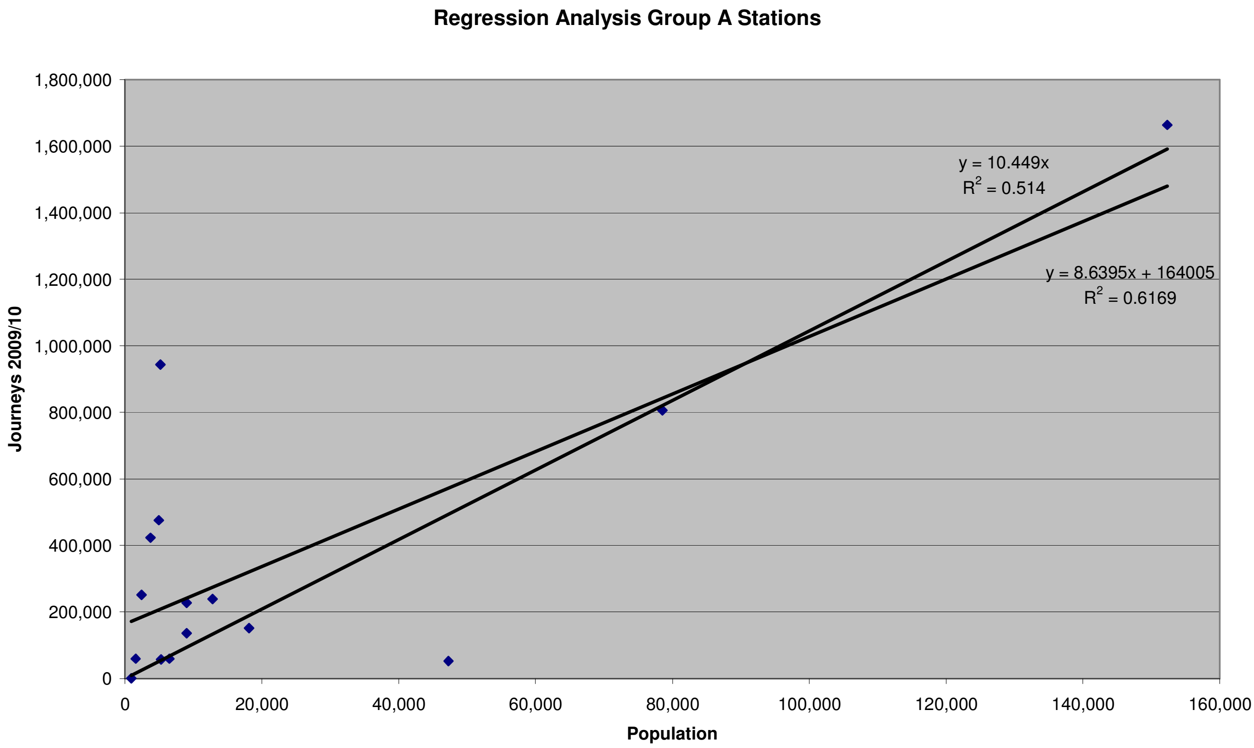


Figure 6: Regression Analyses for Group A stations

Examination of the chart highlights some locations where the relationship between population and journeys are outside the general trend. The following table includes the information used in the analysis to which we have added the calculated value for average daily trip rate[4] per thousand head of population. This helps to identify the outlying data points, some of which can be readily explained. For example, Markinch and Glenrothes with Thornton have, respectively, high and low trip rates.

[4] Daily trip rates are calculated assuming lower volumes on weekend days to an equivalent of 6.5 days per week equated to 338 days per annum.

However, these neighbouring stations lie on the edge of Glenrothes and serve both localities. Combining the data gives an average daily trip rate of 18 per thousand, closer to the normal range. Stations served by main line trains and used by a larger catchment for rail-heading, Leuchars and Inverkeithing, for example also have high comparative trip rates. South Gyle has a high trip rate, but this can be explained because it serves the Gyle shopping centre and a business park both of which generate destinating trips unrelated to the station catchment population.

	Population	**Journeys**	**Average daily rate / 000**
Dundee	152,320	1,664,210	32
Leuchars	3,730	423,144	336
Cupar	8,980	227,656	75
Springfield	940	860	3
Ladybank	1,560	59,942	114
Markinch	2,420	251,744	308
Glenrothes with Thornton	47,280	52,648	3
Cardenden	5,270	56,968	32
Lochgelly	6,490	59,810	27
Cowdenbeath	18,140	151,892	25
Dunfermline Stations	78,550	806,450	30
Rosyth	12,790	239,196	55
Inverkeithing	5,180	943,400	539
North Queensferry	9,010	135,748	45
South Gyle	4,932	475,824	285

A second analysis was then completed on Group B stations. The results of the regression analysis show a very strong relationship between the two variables and gave an R^2 value of 0.9959. The variables used in the analysis and calculated average daily trip rates are included in the table below followed by a chart showing the regression analysis. The outlying result from this station group is Aberdour which may be due to it being a stronger tourism draw than other stations along the coast.

	Population	Journeys	Average daily rate / 000
Kirkcaldy	48,630	1,074,524	65
Kinghorn	2,930	91,894	93
Burntisland	5,940	192,694	96
Aberdour	1,700	131,874	230
Dalgety Bay	10,090	247,778	73

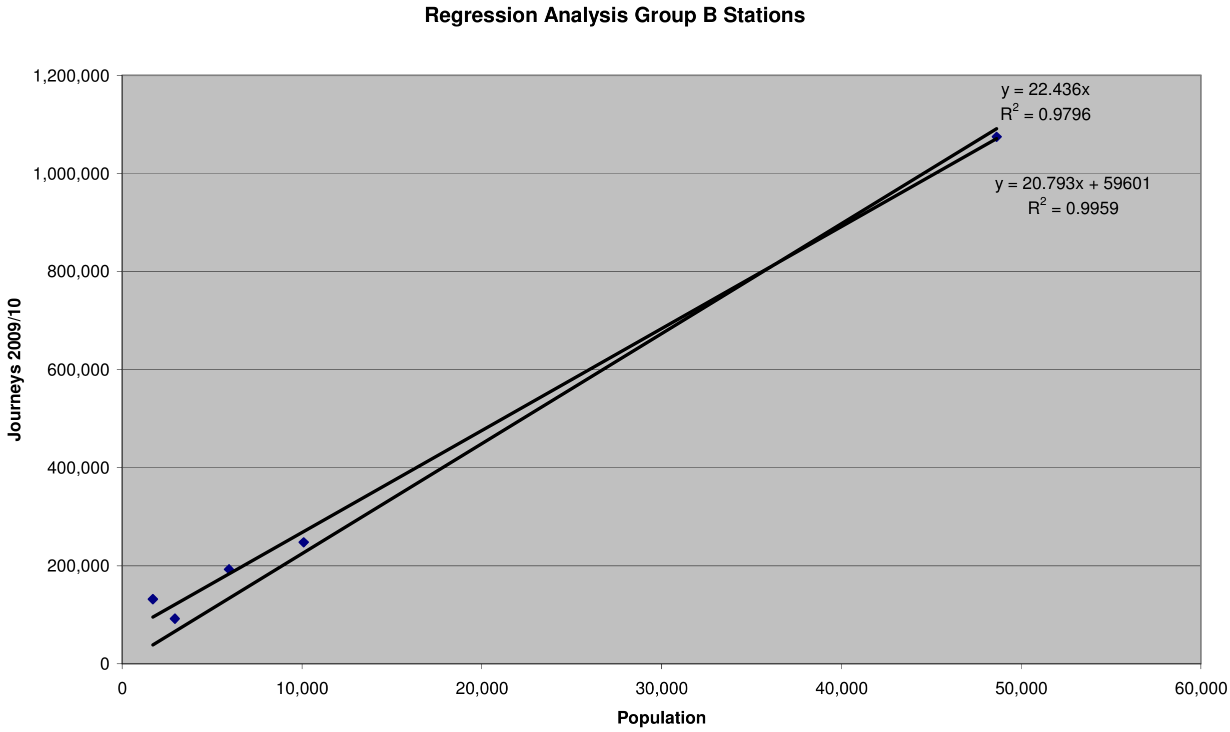


Figure 7: Regression Analyses for Group B stations

Demand Forecasts

Two forecasts were calculated for St Andrews using the regression analysis for the two groups of stations:-

	Population	Forecast Annual Journeys – Base Group A	Forecast Annual Journeys – Base Group B
St Andrews	16,680	308,112	406,431

The forecasts would give average daily trip rates of 55 and 72 respectively; these are relatively high rates for originating travel compared to benchmark research provided in PDFH. There studies in the 1980s and '90s found typical trip rates ranging from 18 to 40 a day depending on circumstances (free standing town to suburban areas). Growth in rail demand since then could have doubled these rates. We have therefore assumed the two forecasts provide a reasonable estimate of the likely range of originating (and some destinating) travel at the proposed St Andrews station.

The mix of stations used to calculate these forecasts would reflect some of the destinating travel we would expect to see at St Andrews, but we have considered other sources to test whether the rates should be adjusted upwards. PDFH includes research findings which suggest demand at seaside resorts is likely to be as much as 30% higher than it otherwise would be and for tourist centres, York, Lincoln and Chester for example, up to 96% higher. Survey results specific to St Andrews have also been made available to this study; "University of St Andrews Travel Survey 2009 Staff and Students" and "St Andrews Visitor Survey 2010".

The University travel surveys provided evidence of suppressed rail demand. We can use the survey results to estimate possible transfer to rail. In the case of staff, 40% live 10 or more miles from St Andrews, this is the group with potential to transfer to rail but not all will transfer. Of the sample surveyed almost 45% said no changes could be made to persuade them to travel by public transport (although a new station was not specifically tested). Car is the main mode of travel for those living 10 miles or more from St Andrews, about a third of the sample travelling by car share with others so are less likely to transfer. Based on these figures, we estimate between 10% and 20% of the 10 miles or more group might transfer to rail. Assuming a total of about 2,000 staff travelling on a daily basis, weekday term time would equate to about 30,000 journeys per annum.

Similar calculations were done using the student survey. In this case the main market for rail travel is between home and University at the start of term or for occasional term-time visits. Quite a high proportion of students already use the train to Leuchars and a growing number fly, if the proposed St Andrews service includes a link to Edinburgh Airport (for example South Gyle tram interchange) then this provides potential for further rail use. We have calculated approximately 7,000 additional journeys per annum from the University students.

The visitor survey also suggested some suppressed rail demand, although the results indicate as many as 10% of visitors already use the rail service to Leuchars (1% responded that they had travelled by rail a further 9% that they had travelled by bus from Leuchars). Using the reported number of visitor days along with evidence from the visitor survey on length of stay we were able to estimate the number of visitors and the likely use of rail for travel to St Andrews. We have estimated a potential additional 70,000 journeys per annum.

Using the survey based calculations we have assumed a 25% uplift to the trip rate forecasts to give the following range:

Passenger Demand Proposed St Andrews Station	Forecast Journeys per Annum Low	 High
Base originating forecast	308,112	406,431
Uplift for destinating journeys + 25%	77,028	101,608
Base originating + destinating	385,140	508,039

The regression analysis has been used to calculate the abstraction effect on Leuchars of introducing direct services to St Andrews. The analysis gives an average picture of demand for a station catchment population. When applied to the population of Leuchars, this provides an estimate more typical than the existing usage, which includes passengers whose final destination is St Andrews. The difference between actual station usage and estimated “typical” usage provides a means to estimate the abstraction effect and is calculated in the table below:

	Forecast Annual Journeys – Base Group A	Forecast Annual Journeys – Base Group B
Leuchars population based forecast	196,230	137,160
Actual usage Leuchars station	423,144	423,144
Difference / estimated abstraction effect	226,914	285,984

Using the estimated abstraction effect as calculated above we can give a forecast range of the net effect on demand of the new station and services at St Andrews.

Passenger Demand Proposed St Andrews Station	Forecast Journeys per Annum Low	 High
Base originating + destinating	385,140	508,039

Less estimated abstraction effect	285,984	226,914
Net increase in demand	99,156	281,125

Impact on Other Stations

The proposed rail service for St Andrews provides additional calls at existing stations presently assumed to have an hourly service at South Gyle, Dunfermline Town and Cupar in the Edinburgh service and Leuchars in the Dundee service. These additional calls have the effect of reducing generalised journey time (GJT) on flows to and from the affected stations. PDFH guidance was used to derive a simplified GJT calculation to estimate the impact. To avoid risk of double counting we have applied the calculation only to a proportion of total demand at the station to approximate to the major flow. The result is an increase in demand of about 31,000 journeys per annum broken down as follows:

South Gyle	6,700
Dunfermline Town	19,100
Cupar	2,400
Leuchars	2,800

The proposed timetable also requires adjustment to certain existing services; however, the changes do not significantly affect generalised journey time and are thought unlikely to result in measurable changes in demand.

Benefits Assessment

In order to evaluate the priced passenger benefits, we needed to ascribe a value to the forecast journeys. In the absence of revenue yield data specific to the study area we have considered published data sources. The Office of Rail Regulation publishes National Rail Trends (NRT) and the Scottish Government publishes Transport Statistics (TS) both of which include journey and revenue information enabling calculation of revenue per journey. The following table includes relevant revenue per journey figures:

Source	**Revenue per Journey (£)**		
	2008/ 09	**2009/ 10**	**2010/ 11**

NRT - All Services	4.71	4.91	4.89
NRT - Long distance	19.88	19.86	20.06
NRT - Regional services	2.81	3.01	3.11
TS - Scotland Internal & Originating Cross Boundary	3.64	n/a	n/a

Based on the visitor and student survey evidence on home residence, we have assumed that it would be reasonable to split the St Andrews originating journey forecast 90% “Scotland Internal & Originating Cross Boundary” and 10% “Long Distance” and the forecast change in journeys for other stations 100% “Scotland Internal & Originating Cross Boundary”. Evaluation of the forecasts based on the 2010/11 revenue yield gives the following results: -

	Forecast Revenue per Annum (£)	
Evaluation	**Low**	**High**
St Andrews Assumed Journey Split 90/10	536,153	1,520,099
Other Stations	117,152	117,152
Total Forecast Revenue Benefit	**653,305**	**1,637,252**

Travel time savings are frequently a significant element of a transport scheme business case, but assessment requires more sophisticated modelling than we have used in this exercise. However, we have estimated the number of journeys likely to switch from Leuchars station to a new St Andrews station. There will be a time savings attached to these journeys through removal of interchange and the onward road journey. Assuming a ten minute saving on each journey and using DfT guidance on values of travel time we have estimated an annual benefit in the range of **£214k - £269k** per annum at 2011 prices.

In order to make an estimate of the benefit from reductions in the external costs of cars derived from people switching from road to rail, we firstly estimated rail passenger kilometres related to the proposal. To do this, we used average passenger kilometres per journey from National Rail Trends information for Scotrail services. Then, assuming a 30% transfer from car to rail, and using DfT guidance on car occupancy and external costs we calculated benefits in the range of **£69k - £166k** per annum at 2011 prices.

External costs of cars includes congestion reduction, infrastructure cost savings, reductions in accidents, air pollution, noise and greenhouse gas emissions, offset by lower indirect taxation.

8.6 Further Analysis

The demand study indicates several different markets for rail travel to St Andrews. However the initial timetable we have tested has been a straightforward all day standard hourly service to both Edinburgh and Dundee.

This service plan requires three Class 170 Diesel Multiple Units for the Edinburgh to St Andrews service and one Class 170 Diesel Multiple Unit for the Dundee to Edinburgh service.

The journey time, with limited stops at Cupar, Dunfermline and South Gyle (Edinburgh Gateway) is particularly attractive to long distance travellers such as tourists. However the tourist traffic may be more concentrated in off-peak hours.

This offers the possibility that the service plan could be varied with a fast off-peak service to Edinburgh and a slower peak hour service extending an existing Edinburgh to Cowdenbeath service to and from St Andrews. The main competition in peak hours will be the private car. However private car journey times in the peak hours will be extended by traffic congestion around the Forth Bridge.

The main advantage of this scenario would be to reduce the operating cost (OPEX) of the new service to Edinburgh and maximise passenger loadings per train over the Forth Bridge. In peak hours, the requirement for new rolling stock on the Edinburgh Line would be reduced from three trains to one train. In off-peak hours, the available rolling stock idle between peaks could be utilised for a direct fast Edinburgh to St Andrews service.

There may also be an advantage in evaluating a half hourly interval service between Dundee and St Andrews calling at Leuchars, rather than an hourly service. The hourly interval could be a disincentive to travel. The provision of a half hourly service would increase the rolling stock requirement by a further train-set. This could be linked to an examination of the case for a new station at Wormit, though the catchment area here may be too small.

9.0 Development of the St Andrews Scheme

As a concept design and initial business case, this study can provide the scope for more detailed transport and environmental studies.

These studies would be undertaken to the Scottish Transport Appraisal Guidance (STAG) Stages 1 & 2 and would need to be funded by public bodies such as SESTRANS (South East of Scotland Transport Partnership), Fife Council or Transport Scotland.

The STAG study would form the basis of public consultation for the subsequent statutory order.

A statutory order will be required to build operate and maintain the railway, to obtain land by compulsory purchase, to divert or stop up rights of way and to divert services (electricity, gas, telephones, water, etc) run by statutory undertakings. The Scottish Minister issuing the order also provides deemed planning permission and other consents such as alterations to listed buildings. The Order is obtained under the Transport and Works (Scotland) Act 2007.

The next stage of the design process would be to undertake topographical surveys and ground investigations along the route to produce an outline design. This would be used as the basis for the Transport and Works (Scotland) Order (TAWS). A centre line of the route with a long section and cross sections is required and limits of deviation (horizontal and vertical) need to be defined.

At the outline design stage an environmental assessment would be needed. At STAG stage 1 this would be scoped in accordance with national planning guidelines. At STAG stage 2 the full environmental assessment would be undertaken.

A Book of Reference on land ownership and rights in land will also be required to support the application for a TAWS Order.

The full requirements for a TAWS Order are: -

- A draft order;
- An explanatory memorandum of the draft order;
- A memorandum setting out the aims of the proposal;
- A statement that the proposed order is within the legislative competence of the Scottish Parliament;
- A report summarising the consultations carried out by the applicant;
- Plans showing the location and route, if applicable, of the proposed project;
- An environmental statement;
- A book of reference, including names of owners and occupiers of land to be bought compulsorily/acquired;
- The estimated expenses of the proposed works;
- The funding arrangements; and
- The appropriate fee.

10.0 Conclusions

The main outcome of this study is that an optimum route has been identified for the railway from St Andrews to the East Cost Main Line (ECML). All details can be found in Appendices A and B. The cost estimates are in Appendix D.

Length of the new railway will be 7855 metres, or 4 miles 70 chains. Travel times from the ECML to the re-opened station will be around 5:00 minutes.

An indicative timetable has been prepared that shows it is possible to achieve an hourly service from St Andrews to both Edinburgh and Dundee.

The proposed service takes 1 hour and 19 minutes from St Andrews to Edinburgh and 1 hour and 14 minutes from Edinburgh to St Andrews.

From St Andrews to Dundee via Leuchars, the service takes 22 minutes and 19 minutes from Dundee to St Andrews.

A bill of quantity has been prepared together with cost estimate for the construction of the whole railway and supporting structures. The construction cost at third quarter 2011 prices is £50,508,080.

With indirect costs added this rises to £54,558,080 and with 30% risk this rises to £70,925,504. Escalation will increase this further.

The proposed St Andrews service shows a strong demand. There is however an abstraction of revenue from Leuchars Station. The low and high demand estimates are £653,305 and £1,637,252 per annum.

External benefits also accrue to the scheme. Travel time reduction benefits are in the range of £214,000 to £269,000 per annum at 2011 prices. Modal transfer from car to rail benefits are in the range of £69,000 to- £166,000 per annum at 2011 prices.

The wider economic benefits and employment multipliers have not been considered in this initial analysis.

Bearing in mind that the operating costs are likely to be positive, i.e. less than the revenue and benefits, the initial capital costs may need to be supported by grant funding.

11.0 Recommendations

The business case for the scheme needs to be refined. Considerable revenue and external benefits accrue to the scheme. The capital costs have been outlined. Further analysis needs to be undertaken on the running costs to ensure that the service level accurately reflects the demand profile and costs are split with other existing services in the peak hours. This should be done as part of the STAG process.

Similarly the environmental assessment should be undertaken, linked to the STAG process.

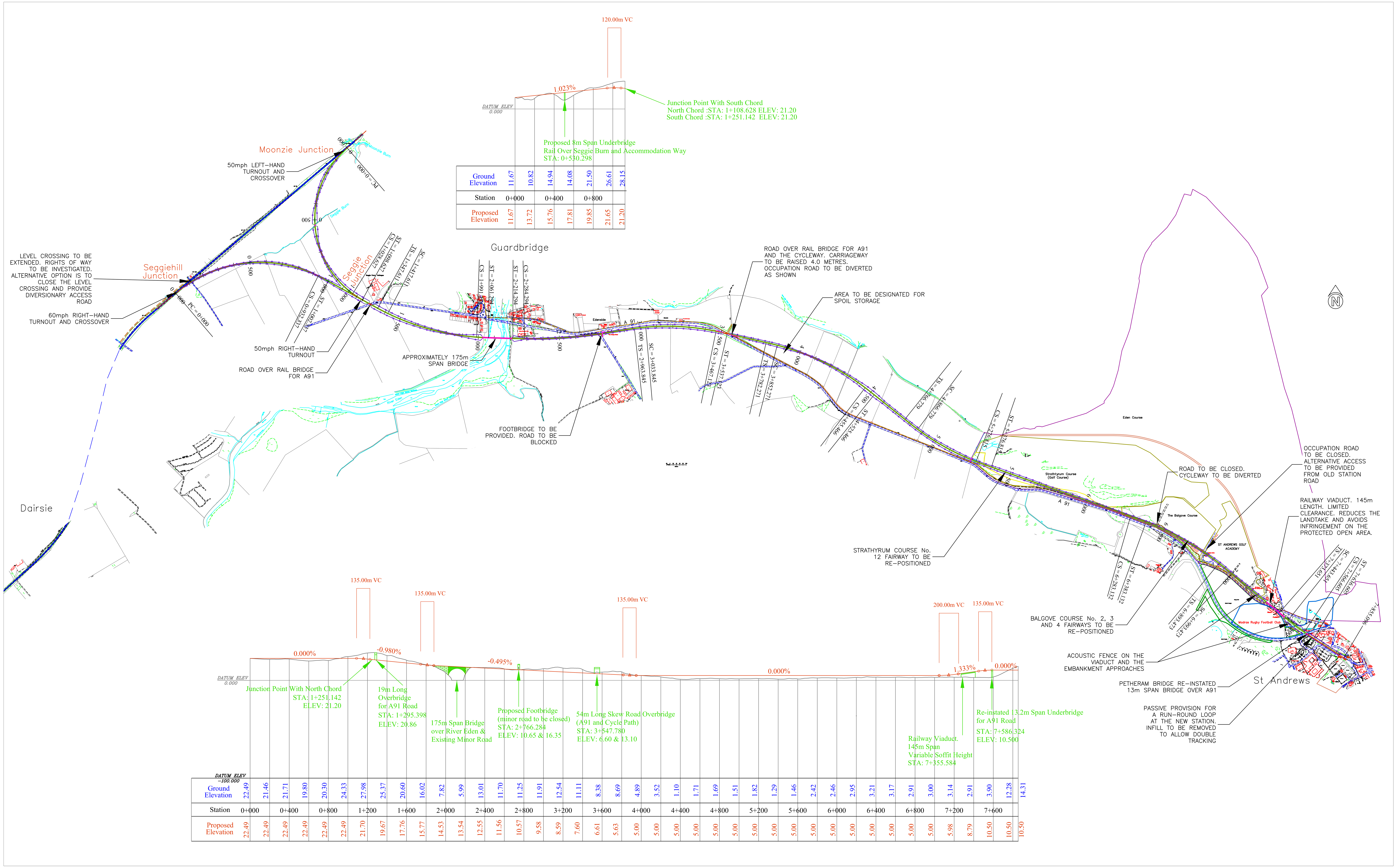
The next stage of development once the business case is accepted is to produce an outline design and an application for a TAWS order.

A strategy for presenting the case to the public and local bodies needs to be developed in parallel with the application for the TAWS order. This should include the scheme being adopted into the strategic and local plans to safeguard the route.

Appendix A: Optimised Alignment – Map of the Whole Route

1 drawing @ 1:10000 scale

B70240-DRG-TPL0008 rev.P02



Ground Elevation	11.67	10.82	14.94	14.08	21.50	26.61	28.15
Station	0+000		0+400		0+800		
Proposed Elevation	11.67	13.72	15.76	17.81	19.85	21.65	21.20

Station	Ground Elevation	Proposed Elevation
0+000	22.49	22.49
	21.46	22.49
0+400	21.71	22.49
	19.80	22.49
0+800	20.30	22.49
	24.33	22.49
1+200	27.98	21.70
	25.37	19.67
1+600	20.60	17.76
	16.02	15.77
2+000	7.82	14.53
	5.99	13.54
2+400	13.01	12.55
	11.70	11.56
2+800	11.25	10.57
	11.91	9.58
3+200	12.54	8.59
	11.11	7.60
3+600	8.38	6.61
	8.69	5.63
4+000	4.89	5.00
	3.52	5.00
4+400	1.10	5.00
	1.71	5.00
4+800	1.69	5.00
	1.51	5.00
5+200	1.82	5.00
	1.29	5.00
5+600	1.46	5.00
	2.42	5.00
6+000	2.46	5.00
	2.95	5.00
6+400	3.21	5.00
	3.17	5.00
6+800	2.91	5.00
	3.00	5.00
7+200	3.14	5.98
	2.91	8.79
7+600	3.90	10.50
	12.28	10.50
	14.31	10.50

DO NOT SCALE

NOTES

1. ST ANDREWS AREA
2. CENTRED AT ORDNANCE SURVEY GRID REFERENCE NO466187
3. THE PROPOSED RAILWAY ALIGNMENT IS INDICATIVE ONLY. SURVEY HAS NOT BEEN CONDUCTED

KEY

- 4 + 500 — Chainage (km + metres) of the optimised route
- Golf Links
- Golf Course Auxiliary Land
- Special Landscape Area
- Protected Open Areas
- Publicly Owned Land
- Alignment of the new Railway
- Footprint of the new Railway and Earthworks
- New Land Boundary
- Existing Cycleway
- Existing Recreational Route
- Proposed Diverted Recreational Route/Cycleway
- Flood Risk Zone (Fluvial)

NB: Estuary Flooding Area; 1 in 200 years occurance equates to land lying below the 4.07 metres AOD contour

Rev	Date	Description of Revision			
P03	27/04/12	NOTES ADDED	VR	HP	HP
P02	17/02/12	VERTICAL ALIGNMENT IMPROVED	VR	HP	--
P01	27/06/11	ORIGINAL DRAWING	VR	HP	HP

StARLink

TATA STEEL PROJECTS
Meridian House
The Crescent
York
YO24 1AW

FOR INFORMATION

Designed: V.RANGELOV — Checked: H.PACK
Approved: H.PACK — Date: 27/06/11

ST ANDREWS RAIL LINK

OPTIMISED ALIGNMENT OF THE NEW RAILWAY

Scale: 1:10000 — CAD: VR
Status: Issued
Drawing Number: B70240-DRG-TPL0008 — Revision: P03

Appendix B: General Arrangements at 1:1250 scale

2 drawings @ 1:1250 scale

B70240-DRG-TPL0009 rev.P02

B70240-DRG-TPL0010 rev.P02

NOTES

1. ST ANDREWS AREA
2. CENTRED AT ORDNANCE SURVEY GRID REFERENCE NO483177
3. THE PROPOSED RAILWAY ALIGNMENT IS INDICATIVE ONLY. SURVEY HAS NOT BEEN CONDUCTED
4. OPTIMISATION OF THE ROUTE HAS BEEN PERFORMED USING DEDICATED SOFTWARE. FULL DETAILS OF THE ALIGNMENT CAN BE SEEN ON DRAWING B70240-DRG-TPL0008 IN SMALLER SCALE

KEY

4 + 500 Chainage (km + metres) of the optimised route
Golf Links
Golf Course Auxiliary Land
Special Landscape Area
Protected Open Areas
Publicly Owned Land
Alignment of the new Railway
Top And Bottom of New Railway Cutting and Embankment
New Land Boundary
Existing Cycleway
Existing Recreational Route
Proposed Diverted Recreational Route/Cycleway
Flood Risk Zone (Fluvial)

NB: Estuary Flooding Area; 1 in 200 years occurance equates to land lying below the 4.07 metres AOD contour

Rev.	Date	Descriptions of Revision	Des.	Chkd.	Appr.
P03	27/04/12	NOTES AND PICTURES ADDED	VR	HP	HP
P02	17/02/12	VERTICAL ALIGNMENT IMPROVED	VR	HP	--
P01	27/06/11	ORIGINAL DRAWING	VR	HP	HP

Client

StARLink

TATA STEEL PROJECTS
Meridian House
The Crescent
York
YO24 1AW

Status
FOR INFORMATION

Designed	Checked
V.RANGELOV	H.PACK
Approved	**Date**
H.PACK	27/06/11

ST ANDREWS RAIL LINK

OPTIMISED RAILWAY ALIGNMENT
GENERAL ARANGEMENT
SHEET 2 OF 2

Scales 1:1250 | CAD VR
PW Workflow State: Issued
Drawing Number: B70240-DRG-TPL0009 | Revision: P03

DO NOT SCALE

Plot Date: 10/05/2012 12:11

NOTES

1. ST ANDREWS AREA
2. CENTRED AT ORDNANCE SURVEY GRID REFERENCE NO483177
3. THE PROPOSED RAILWAY ALIGNMENT IS INDICATIVE ONLY. SURVEY HAS NOT BEEN CONDUCTED
4. OPTIMISATION OF THE ROUTE HAS BEEN PERFORMED USING DEDICATED SOFTWARE. FULL DETAILS OF THE ALIGNMENT CAN BE SEEN ON DRAWING B70240–DRG–TPL0008 IN SMALLER SCALE

KEY

- 4 + 500 Chainage (km + metres) of the optimised route
- Golf Links
- Golf Course Auxiliary Land
- Special Landscape Area
- Protected Open Areas
- Publicly Owned Land
- Alignment of the new Railway
- Top And Bottom of New Railway Cutting and Embankment
- New Land Boundary
- Existing Cycleway
- Existing Recreational Route
- Proposed Diverted Recreational Route/Cycleway
- Flood Risk Zone (Fluvial)

NB: Estuary Flooding Area; 1 in 200 years occurance equates to land lying below the 4.07 metres AOD contour

B70240–DRG–TPL0009

DO NOT SCALE

Rev.	Date	Descriptions of Revision	Des.	Chkd.	Appr.
P03	27/04/12	NOTES AND PICTURES ADDED	VR	HP	HP
P02	17/02/12	VERTICAL ALIGNMENT IMPROVED	VR	HP	--
P01	27/06/11	ORIGINAL DRAWING	VR	HP	HP

Client

StARLink

TATA STEEL PROJECTS
Meridian House
The Crescent
York
YO24 1AW

Status
FOR INFORMATION

Designed: V.RANGELOV	Checked: H.PACK
Approved: H.PACK	Date: 27/06/11

ST ANDREWS RAIL LINK

OPTIMISED RAILWAY ALIGNMENT
GENERAL ARANGEMENT
SHEET 1 OF 2

Scales: 1:1250	CAD: VR
PW Workflow State: Issued	
Drawing Number: B70240-DRG-TPL0010	Revision: P03

Plot Date: 10/05/2012 12:14

Tata Steel UK Rail Consultancy Ltd.

Appendix C: Geology Data

A two-part label, referred to as a 'LEX-RCS' seed, such as 'MMG-MDST', identifies every polygon on each theme. Here, the first part, MMG, is the BGS Lexicon code abbreviation for the name of the unit: 'MERCIA MUDSTONE GROUP'. This is defined in the BGS Lexicon of Named Rock Units (see http://www.bgs.ac.uk/lexicon/lexicon.cfm?pub=MMG),

BEDROCK labels

LEX_RCS-Index	LEX_RCS	LEX_D formation	RCS_D material type	Fill suitable Y/N	Embankment (Fill) Angle Natural	Embankment (Fill) Angle Supported	Cutting Angle Natural	Cutting Angle Supported	Design excavation Difficulty Multiplier
1322129	ARBS-CYCS	ANSTRUTHER FORMATION -	SEDIMENTARY ROCK CYCLES, STRATHCLYDE GROUP TYPE	N	30	45	30	90	2
1330199	GEF-SDST	GLENVALE SANDSTONE FORMATION	SANDSTONE	Y	32	45	32	90	2
1322129	PMB-CYCS	PITTENWEEM FORMATION	SEDIMENTARY ROCK CYCLES, STRATHCLYDE GROUP TYPE	N	30	45	30	90	2
1322129	SCB-CYCS	SANDY CRAIG FORMATION	SEDIMENTARY ROCK CYCLES, STRATHCLYDE GROUP TYPE	Y	32	45	32	90	2
1330399	SCN-SDST	SCONE SANDSTONE FORMATION	SANDSTONE	Y	32	45	32	90	2
1321999	SCPPV-TUAG	SCOTTISH LATE CARBONIFEROUS TO EARLY PERMIAN PLUGS AND VENTS SUITE	TUFF AND AGGLOMERATE	N	30	45	30	90	3

SUPERFICIAL labels

LEX_RCS-Index	LEX_RCS	LEX_D formation	RCS_D material	Fill suitable Y/N	Embankment (Fill) Angle Natural	Embankment (Fill) Angle Supported	Cutting Angle Natural	Cutting Angle Supported	Design excavation Difficulty Multiplier
1110119	ALV-XCZSV	ALLUVIUM	CLAY, SILT, SAND AND GRAVEL	N	20	30	20	45	1
1119999	BSA-S	BLOWN SAND	SAND	Y	25	30	25	35	1
1119999	MBD-XVSZ	MARINE BEACH DEPOSITS	GRAVEL, SAND AND SILT	Y	25	30	25	35	1
1110119	RMDF-XCZSV	RAISED MARINE DEPOSITS OF FLANDRIAN AGE	CLAY, SILT, SAND AND GRAVEL	N	23	30	23	35	1
1110119	RMDF-XSV	RAISED MARINE DEPOSITS OF FLANDRIAN AGE	SAND AND GRAVEL	Y	27	30	27	30	1.5
1110201	RMDV-XCZSV	RAISED MARINE DEPOSITS, DEVENSIAN	CLAY, SILT, SAND AND GRAVEL	N	23	30	23	35	1
1110201	TILLD-DMTN	TILL, DEVENSIAN	DIAMICTON	Y	24	30	24	45	1

LINEAR features labels

Backfeature_Former_coast	Backfeature marking former coastline, arrowheads denote uphill side
Normal_Inf (black)	Normal fault, inferred

Appendix D: Bill of Quantity / Cost Estimates

Starlink

St Andrews Rail Link

Outline Budget Estimate

B70240-EST-COM0001

Version P02

For Approval

19 August 2011

Document History					
Version No	issued date	Description	Prepared By	Reviewed By	Approved By
P01	12/08/2011	Initial issue	Helen Morgan	Mark Davison	Steve Bunter
P02	19/08/2011	Changes to S&C types and changes to chainages listed for bridges	Helen Morgan	Mark Davison	Steve Bunter

TATA STEEL

Project Title / Location St Andrews Rail Link
Corus Estimate No. B70240-COM-EST0001 **Revision** P02 **Estimate Stage** GRIP 2
Estimate Date 19-Aug-11 **Price 'Base date'** 3Q2011 **Confidence** +/-40%
Anticipated Start Date 01-Jan-13 **Anticipated Finish Date** 01-Jan-14 **Mid point** 2Q2013

Estimate Breakdown	Option 1	Option 2	Option 3	Option 4	Option 5
Contractor's direct costs -					
Signalling	2,340,000				
AV/DC Electrification	-				
Permanent Way	9,175,200				
Telecoms	418,000				
Operational Property	884,960				
Structures	15,150,000				
General Civils	9,738,457				
Utilities	100,000				
Level Crossings	10,000				
Other	-				
Contractor's Base Construction Cost inc OH&P: Sub-Total A	37,816,617	-	-	-	-
Network Rail's "direct costs"					
NDS - Materials	incl. in rates	incl. in rates	incl. in rates	incl. in rates	incl. in rates
NDS - Fleet	incl. in rates	incl. in rates	incl. in rates	incl. in rates	incl. in rates
- Engineering trains	incl. in rates	incl. in rates	incl. in rates	incl. in rates	incl. in rates
- Tampers	incl. in rates	incl. in rates	incl. in rates	incl. in rates	incl. in rates
NDS - Possession / Isolation Management	incl. in rates	incl. in rates	incl. in rates	incl. in rates	incl. in rates
Sub - Total B	-	-	-	-	-
Total Base Construction Cost inc OH&P: Sub-Total C (A+B)	37,816,617	-	-	-	-
Contractor's indirect costs					
Preliminaries (Note 1)	7,896,475	-	-	-	-
Design (Note 1)	4,075,932	-	-	-	-
Testing & Commissioning (Note 1)	669,056	-	-	-	-
Training excluded at this stage					
Spares excluded at this stage					
Road closures / traffic management	50,000				
Sub - Total D	12,691,463	-	-	-	-
Total Construction Cost E (C+D)	**50,508,080**	**-**	**-**	**-**	**-**
Indirect & other costs					
Starlink Costs Client to enter as required					
Network Rail	640,000	-	-	-	-
Compensation charges (TOC & FOC)	10,000	-	-	-	-
TWA Charges	-	-	-	-	-
Land / Property Costs & compensation	3,400,000	-	-	-	-
Sponsor (Finance costs etc)	-	-	-	-	-
Sub - Total F	4,050,000	-	-	-	-
Point Estimate - Sub - Total G (E+F)	**54,558,080**	**-**	**-**	**-**	**-**
Uplift for Risk and Contingency					
To Mean £					
Project Budget (Point Estimate + Uplift to Mean)	54,558,080	-	-	-	-
QRA Value - at P50 £					
QRA Value - at P80 - incremental on P50 v £					
Adjustment for residual factors % 0%					
or Contingency allowance 30%	16,367,424	-	-	-	-
Project Anticipated Final Cost (AFC)	70,925,504	-	-	-	-
Other Costs to the Customer					
Allowance for Escalation 2Q2013 7.74%	5,492,327	-	-	-	-
Allowance for Network Rail Fee Fund					
Allowance for Industry Risk Fund					
Allowance for Insurance Top-up					
Cost to Customer	**76,417,831**	**-**	**-**	**-**	**-**

ASSUMPTIONS AND COMMENTS

Project Title / Location **St Andrews Rail Link**
Corus Estimate No. B70240-COM-EST0001 **Revision** P02
Price 'Base date' 3Q2011

CALCULATION OF INDIRECT COSTS

The following values have been used for calculation of Contractors and Network Rail's Indirect Costs:

Asset	Preliminaries	Design	Test & Commission	Network Rail Management	Sponsor
Signalling	35%	15%	15%	N/A	N/A
AV/DC Electrification	20%	10%	15%		
Permanent Way	20%	10%	3%		
Telecoms	25%	10%	10%		
Operational Property	15%	8%	0%		
Structures	20%	10%	0%		
General Civils	20%	12%	0%		
Utilities	25%	10%	0%		
Level Crossings	25%	12%	10%		
Other	25%	10%	10%		

User note: Any values entered above will be carried to the estimate summary.

GENERAL

The estimates are based on information contained in:

Drawing / report ref.	Version	Title
B70240-DRG-TPL0008	P02	Optimised Alignment of the New Railway
B70240-DRG-TPL0009	P01	Optimised Alignment General Arrangement Sheet 1 of 2
B70240-DRG-TPL0010	P01	Optimised Alignment General Arrangement Sheet 2 of 2

ASSUMPTIONS

Escalation based on RPI

Bridges have been described in accordance with normal rail terminology, e.g. the Bridge at 1+295 where the bridge is on top of the railway has been identified as an overbridge, this has a 6m span between abutments and has a length of 19m long (running under the road).

Road / Rail Bridges included for piled foundations, it has been assumed that the Footbridge will not require piling.

Reinstatement of deck on UB deck at 7+586. It has been assumed that the existing abutments are in good condition and suitable for re-use.

It has been assumed that no lighting will be required for the new road bridge at 3+547

Assumes 40m of plain line to be replaced each side of new S&C.

Proposed road bridge at 3+347 (A91 and cycle path). In order to reduce the costs involved with the structure it has been assumed that the road will be diverted slightly to reduce the extent of slew on the bridge, this also has the benefit to allow the bridge to be built off line so reducing the impact on the road. As new approach ramps will be required anyway the additional cost of realigning the road will be minor compared to building it on its existing alignment.

EXCLUSIONS

Public enquiry / cost of obtaining planning permissions

OPTION SUMMARY

Project Title / Location	**St Andrews Rail Link**			Special factor	1.00
Option	Optimised Alignment			Indices factor	1.07
Corus Estimate No.	B70240-COM-EST0001	**Revision**	P02	Overall factor	1.07
Estimate Date	19-Aug-11	**Price 'Base date'**	3Q2011		

section	item			quant	unit	rate	total	Comments
Signalling								
Priced on SEU								
	Signalling Equivalent Units			9.00	nr	260,000.00	2,340,000	inc T&C & design
	others..please state				x		-	**2,340,000 Signalling**
Electrification	(Line not electrified)							**- Electrification**
P-way								
Removals	Removal of plain line			1,000.00	m	37	37,000	
	others..please state				x		-	
New	Plain line (CEN56; 250mm)			8,993.00	m	610	5,485,730	rate for laying outside possessions
	Plain line (CEN56; 250mm) - mains			480.00	m	812	389,760	rate for laying in possessions
	E/O for Geotech & Sand blanket			3,763.00	m	60	225,780	rate for laying outside possessions
	Track drainage (cuttings only)			3,763.00	m	110	413,930	inc catch pits at 25m centres
	S&C	turnouts	EV21	1.00	nr	285,000	285,000	rate for laying outside possessions
	S&C	turnouts	EV21	1.00	nr	379,000	379,000	rate for laying in possessions
	S&C	crossover	EV21	1.00	nr	646,000	646,000	rate for laying in possessions
	S&C	turnouts	GV28	1.00	nr	486,000	486,000	rate for laying in possessions
	S&C	crossover	GV28	1.00	nr	827,000	827,000	rate for laying in possessions
	others..please state				x		-	**9,175,200 P-way**
Telecoms								
	CIS	4	screens	1.00	sum	75,000	75,000	includes control equipment
	PA	4	speakers	1.00	sum	24,000	24,000	includes control equipment
	CCTV	4	cameras	1.00	sum	59,000	59,000	includes control equipment
	Lumpsum for telecoms along route			1.00	sum	260,000	260,000	**418,000 Telecoms**
Operational Property								
	New platform			1,028.00	m2	770.00	791,560	
	Basic shelter			1.00	nr	30,000.00	30,000	
	Lighting columns			20.00	nr	2,670.00	53,400	
	Canopies			-	m	1,600.00	-	
	Station building			-	nr	600,000.00	-	
	Car park			-	spaces	1,600.00	-	
	Signage			1.00	sum	10,000	10,000	**884,960 Station**
Bridges	0+530	Underbridge (stream)		1.00	nr	510,000	510,000	8m span x 6m width
	1+295	Overbridge (Road)		1.00	nr	1,240,000	1,240,000	6m span x 19m long
	2+120	Underbridge (River Eden)		1.00	nr	5,990,000	5,990,000	175m span x 6m wide (inc 4 piers)
	2+766	Footbridge		1.00	nr	160,000	160,000	20m span, 2m wide, LM type
	2+766	E/O FB for DDA Ramps		200.00	m	2,700	540,000	Steel ramps 2m wide
	3+547	Overbridge (Road)		1.00	nr	2,080,000	2,080,000	6m span x 40m long (exc ramps)
	7+355	Viaduct		1.00	nr	4,240,000	4,240,000	145m span x 6m wide (inc 3 piers)
	7+586	Re-instate UB deck		1.00	nr	330,000	330,000	13m span x 6m wide
	culverts	various locations		4.00	nr	15,000	60,000	**15,150,000 Bridges**
Civils								
General Civils								
	Site clearance			240,000	m2	0.25	60,000	General site clearance
Embankments / cutting								
	Remove top soil,			22,690.15	m3	2.08	47,196	store on site for re-use
	Cut - assumes 33% rock			124,906.43	m3	18.48	2,308,271	
	Cut - prep for re-use			41,717.87	m3	12.10	504,786	
	disposal of unusable material			83,188.56	m3	7.35	611,436	Spread and level on site
	Fill - material obtained on site			41,717.87	m3	5.11	212,970	
	Fill - material brought in			128,996.39	m3	27.50	3,547,401	
	Replace topsoil			22,690.15	m3	9.72	220,548	obtained on site
Additional items if sub-base layer required under ballast								
	Additional excavation			13,989	m3	18.48	258,510	
	Sub-base layer (300mm thick)			13,989	m3	27.50	384,687	
	disposal of unusable material			9,317	m3	7.35	68,476	Spread and level on site
	Saving for re-useable fill			4,672	m3	(10.30)	(48,099.25)	
Roadworks								
	Occupation road (Seggiehill Jct)			600	m	92.50	55,500	Compacted granular fill road
	minor realignment of A61 (6+000)			400.00	m	500	200,000	
	Diversion of cycle route (3+547)			50.00	m	114	5,700	new cycle route 3m wide
	Diversion of cycle route (6+000)			750.00	m	114	85,500	new cycle route 3m wide
	Closure of roads (6+545,6+845)			2.00	nr	2,500	5,000	allowance for fencing / signs
	Remodel of road layout (7+285)			1.00	Sum	150,000	150,000	under Viaduct
	Remodel of roads / paths (station)			1.00	Sum	30,000	30,000	Around platform areas

OPTION SUMMARY

Project Title / Location	**St Andrews Rail Link**	Special factor	1.00
Option	Optimised Alignment	Indices factor	1.07
Corus Estimate No.	B70240-COM-EST0001 **Revision** P02	Overall factor	1.07
Estimate Date	19-Aug-11 **Price 'Base date'** 3Q2011		

section	item	quant	unit	rate	total		Comments
Approach ramps road bridge @ 3+547							
	Remove existing road surfacing	4,200.00	m2	12.00	50,400		
	Disposal of road surface	840.00	m3	80.00	67,200		off site, inc tipping charges
	Removal of topsoil, stack for reuse	675.00	m3	2.08	1,404		
	Filling	8,100.00	m3	27.50	222,750		
	Replace topsoil	675.00	m3	9.72	6,561		
	New carriageway, inc cycle path	300.00	m	941.00	282,300		
Fencing							
	Fencing - post & wire	17,400.00	m	18.47	321,291		Lineside
	Fencing - crash barrier	420.00	m	175.00	73,500		road bridge @ 3+547
	Fencing - post & wire	280.00	m	18.47	5,170		road bridge @ 3+547
						9,738,457	**Civils**
Utilities	Service diversions etc	1.00	Sum	100,000	100,000		
	others..please state		x		-	**100,000**	**Utilities**
Level Crossings							
	Relocation of Occupation crossing (Seggiehill Jct - ballast crossing)	1.00	Sum	10,000	10,000	**10,000**	**Level Crossings**
Other	others..please state		x		-	**-**	**Other**

Summary

Signalling	**2,340,000**
AV/DC Electrification	**-**
Permanent Way	**9,175,200**
Telecoms	**418,000**
Operational Property	**884,960**
Structures	**15,150,000**
General Civils	**9,738,457**
Utilities	**100,000**
Level Crossings	**10,000**
Other	**-**
Carried to estimate Summary	**37,816,617**

Project Title / Location **St Andrews Rail Link**

Item			Agricultural	Business	St Andrews	golf course	Other		
embankment / cutting footprint area	123,794	m2	99,419.00	375	9000	15000			
extra area cut off by Railway	12,000	m2				12000			
Road diversions	4,000	m2	4,000.00						
Spoil area	15,200	m2	15,200.00						
Temporary land take for compounds	15,000	m2					£25,000		
The Hungry Horse (2+750)							£150,000	fast food Restaurant	
		m2	118,619.00	375.00	9,000.00	27,000.00	175,000.00		
	cost per m2		£10	£200	£100	£20			
Land take cost	**cost**		**£1,186,190**	**£75,000**	**£900,000**	**£540,000**	**£175,000**		**2,876,190.00**
			5%	30%	30%	15%	50%		
Additional for compensation			**59,309.50**	**22,500.00**	**270,000.00**	**81,000.00**	**87,500.00**		**520,309.50**
									3,400,000.00

Appendix E: Results from the Dynamis simulation

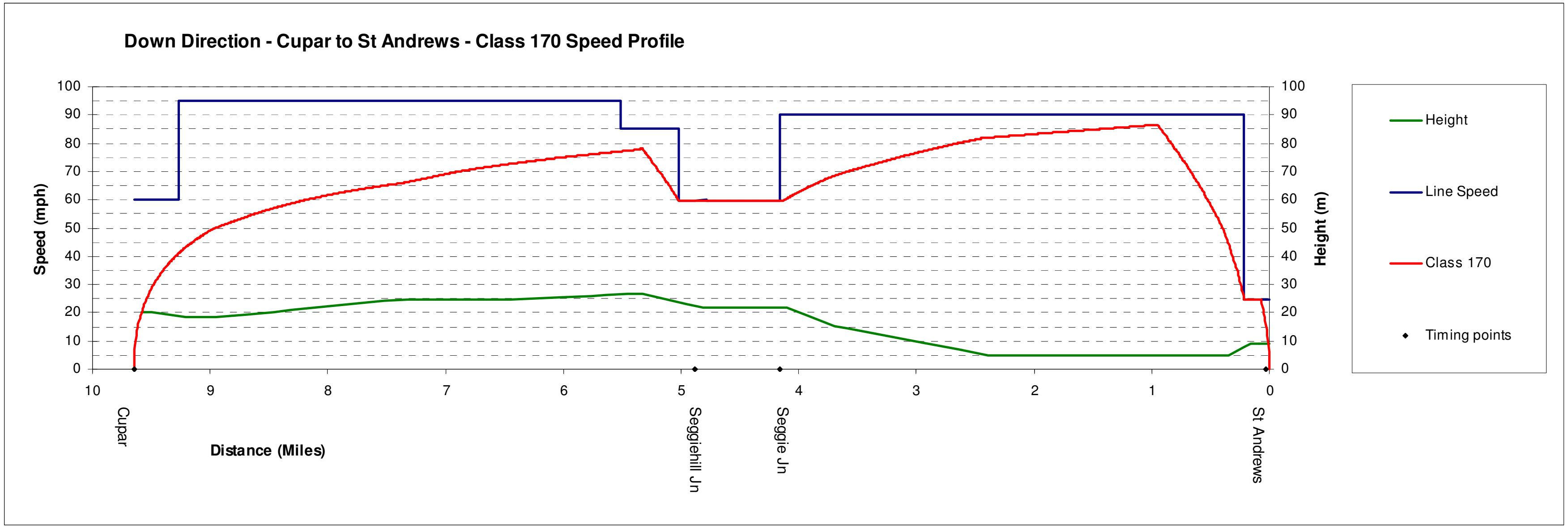
St Andrews Minimum Running Times

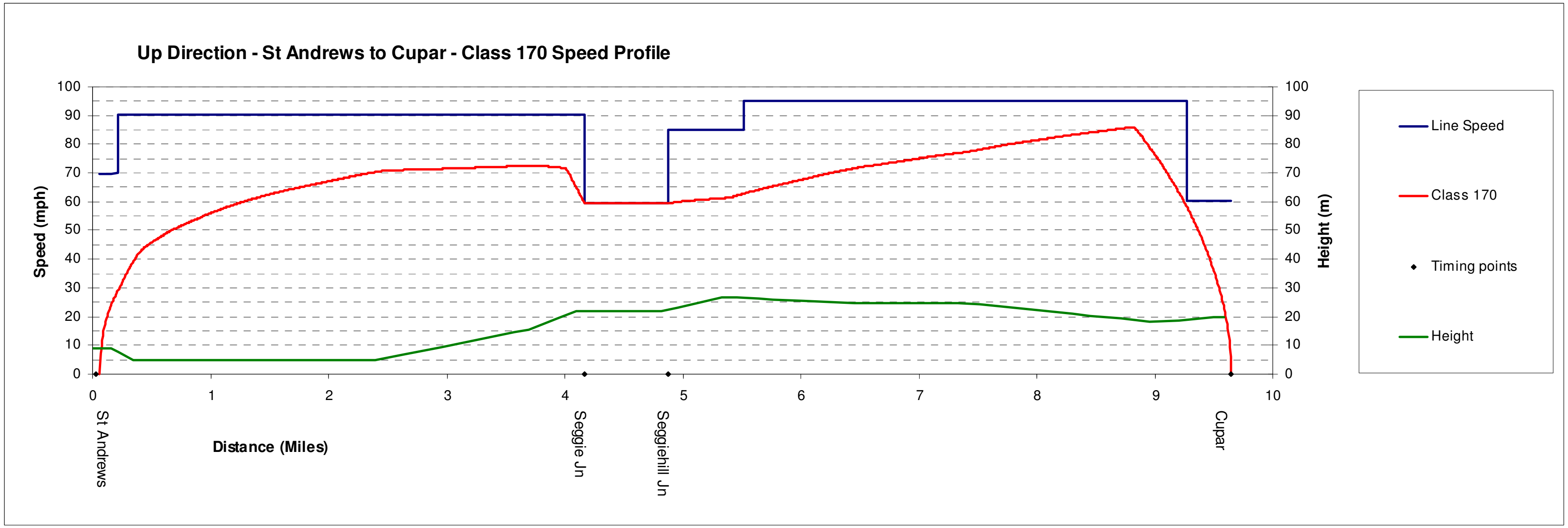
South

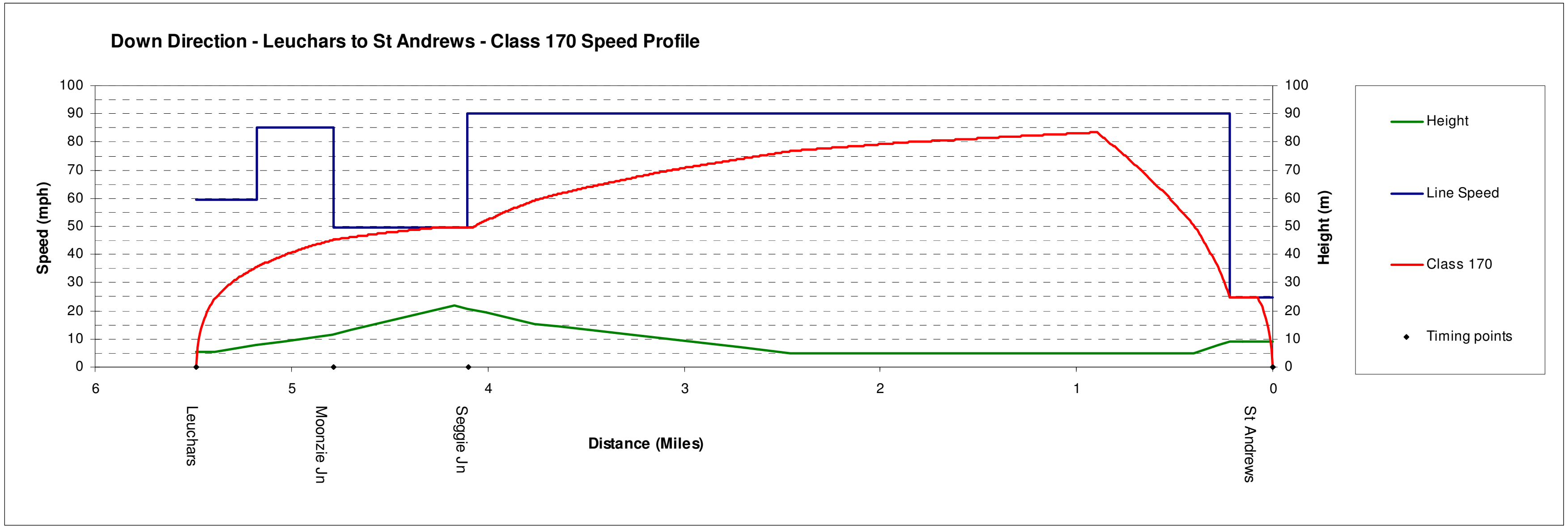
From	To	Stop/Pass	Class 170 60mph connection
St Andrews	Seggie Hill Jn	stop-pass	00:05:06
Seggie Hill Jn	Cupar	pass-stop	00:04:26
Cupar	Seggie Hill Jn	stop-pass	00:05:04
Seggie Hill Jn	St Andrews	pass-stop	00:04:42

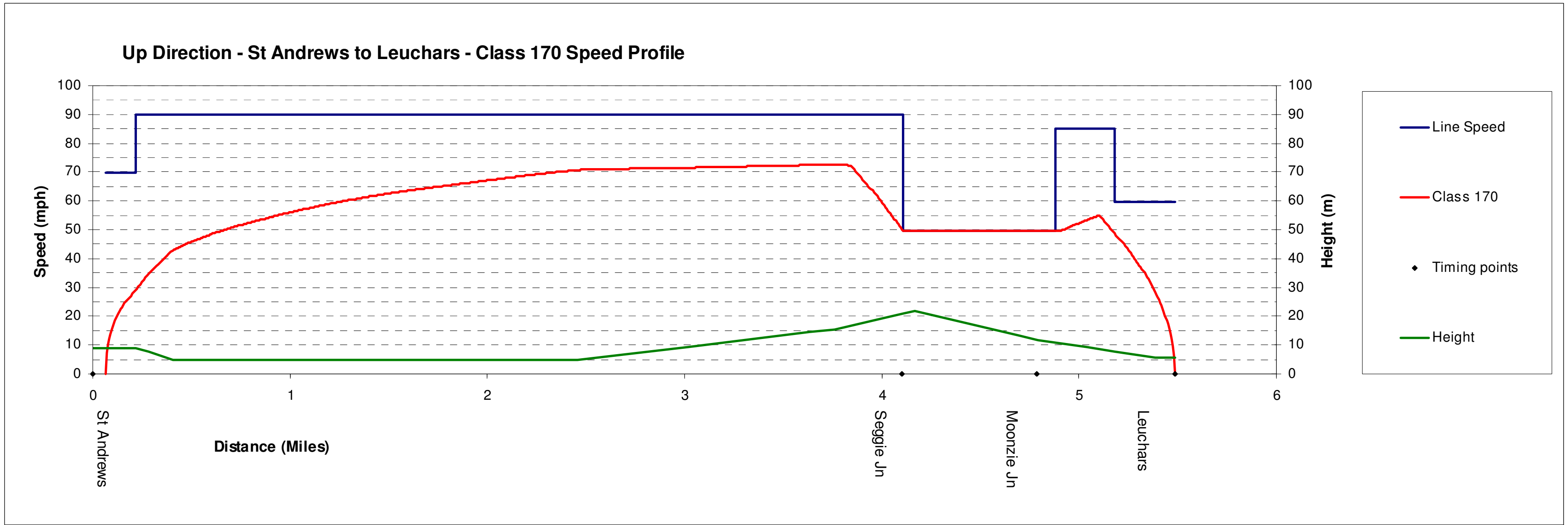
North

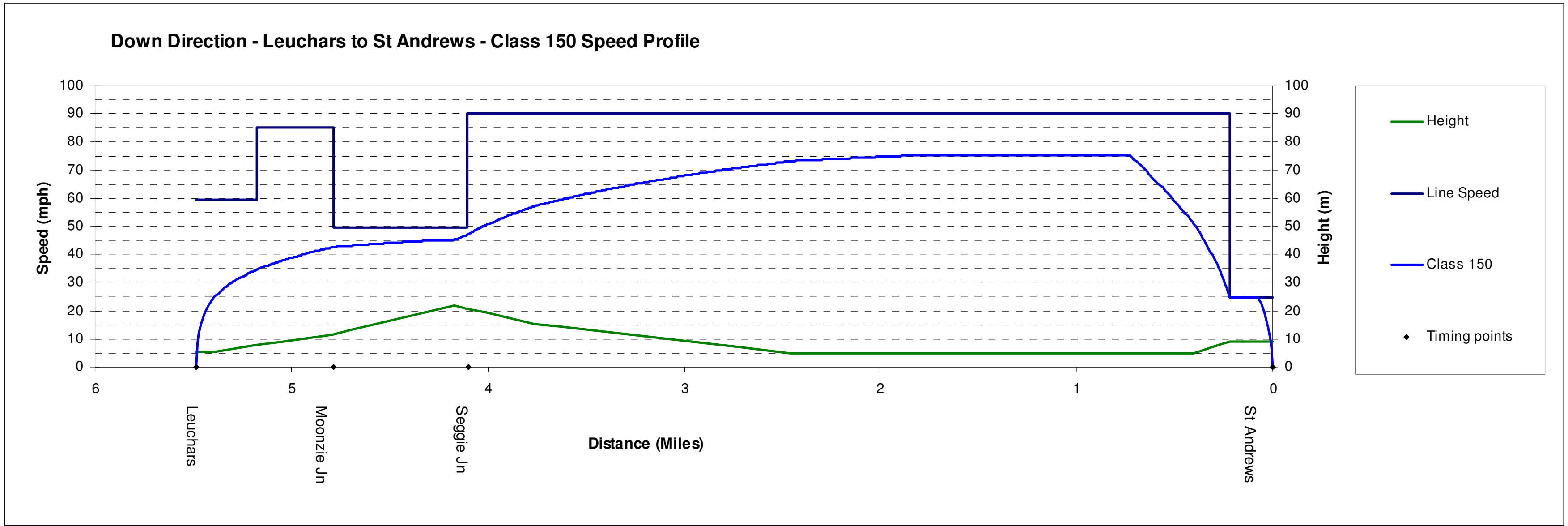
From	To	Stop/Pass	Class 150 50mph connection	Class 170 50mph connection
St Andrews	Moonzie Jn	stop-pass	00:05:20	00:05:11
Moonzie Jn	Leuchers	pass-stop	00:01:11	00:01:12
Leuchers	Moonzie Jn	stop-pass	00:01:24	00:01:25
Moonzie Jn	St Andrews	pass-stop	00:05:12	00:04:59

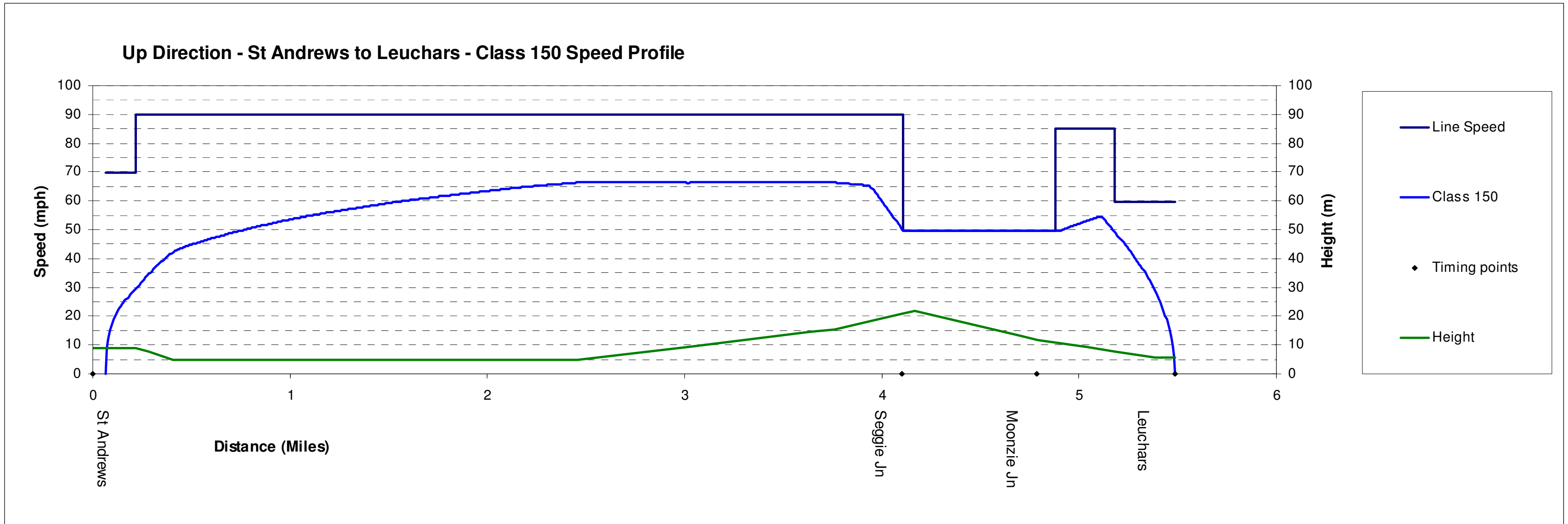

Down Direction - Cupar to St Andrews - Class 170 Speed Profile
Speed (mph)
Height (m)
Distance (Miles)
Cupar
Seggiehill Jn
Seggie Jn
St Andrews
Height
Line Speed
Class 170
Timing points


Up Direction - St Andrews to Cupar - Class 170 Speed Profile
Speed (mph)
Height (m)
Distance (Miles)
St Andrews
Seggie Jn
Seggiehill Jn
Cupar
Line Speed
Class 170
Timing points
Height


Down Direction - Leuchars to St Andrews - Class 170 Speed Profile
Speed (mph)
Height (m)
Distance (Miles)
Leuchars
Moonzie Jn
Seggie Jn
St Andrews
Height
Line Speed
Class 170
Timing points


Up Direction - St Andrews to Leuchars - Class 170 Speed Profile
Speed (mph)
Height (m)
Distance (Miles)
St Andrews
Seggie Jn
Moonzie Jn
Leuchars
Line Speed
Class 170
Timing points
Height


Down Direction - Leuchars to St Andrews - Class 150 Speed Profile
Speed (mph)
Height (m)
Distance (Miles)
Leuchars
Moonzie Jn
Seggie Jn
St Andrews
Height
Line Speed
Class 150
Timing points
100
90
80
70
60
50
40
30
20
10
0
6
5
4
3
2
1
0


Up Direction - St Andrews to Leuchars - Class 150 Speed Profile
Speed (mph)
Height (m)
Distance (Miles)
St Andrews
Seggie Jn
Moonzie Jn
Leuchars
Line Speed
Class 150
Timing points
Height
100
90
80
70
60
50
40
30
20
10
0
0
1
2
3
4
5
6

Appendix F: Outline Timetables

Mondays to Fridays

EDINBURGH TO DUNDEE

Signal ID			1L59		1X01	2K67	2G23	1S03	1L09	2K09	2G65	1A59	1L61			2K69	2G25	1A71	IHII	2K11	2G69
Drig. Dep. Time						9.47		07.10		10.17		10.41				10.47				11.17	
Drig. Loc. Name						Newcraighall		Leeds		Newcraighall		Giasgow Queen Street				Newcraighall				Newcraighall	
Dest. Loc. Name						GlenrothesWith Thornton		Aberdeen	Perth	Edinburgh	Newcraighall	Aberdeen				GienrothesWith Thornton		Aberdeen	Inverness	Edinburgh	Newcraighall
Timing Load			170		170	158	158	HST9-125	158	158	158	170	170	170	170	158	158	170	170	158	158
Operating Characteristics																					
DatesOf Operation			SX		SX	SX	SX	SX	SX	SX	SX	SX	SX		SX	SX	SX	SX	SX	SX	SX
Edinburgh	arr	1	...		...	9.57	...	10.20	...	10.27½	...	...	...	...	...	10.57	...	...	...	11.29	...
	plt	2	15F		?	1	16	19	17F	1	18	...	17	...	?	1	15F	15	17	1	15F
	dep	3	10:00		10:04	10.09½	10.19	10p28	10.35	10.38	10.48	...	11.00	...	11:04	11.09½	11.20	11.27	11.35	11.39	11.48
	dep-line	4	Y		Y	Z	Y	Z	Y	Z	Z	...	Y	...	Y	Z	Y	Y	Y	Z	Y
	mgn	5	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Princes St Gardens	dep	6	10/01		10/05	10/10½	10/20	10/29	10/36	10/39	10/49	...	11/01	...	11/05	11/10½	11/21	11/28	11/36	11/40	11/49
	dep-line	7	DN		DN	DN	DN	DN	DN	DN	DN	...	DN	...	DN	DN	DN	DN	DN	DN	DN
	mgn	8	...		...	...	...	...	(½)	(1)	(½)	...	...	...	...	...	...	(1)	(½)	...	...
Haymarket	arr	9	10#03½		10:07½	10:13	10.22½	10.31	10.39	10#42½	10.52	...	11.03½	...	11:07½	11.13	11.23½	11.31½	11.39	11.42½	11.51½
	plt	10	2		2	2	2	2	2	2	2	...	2	...	2	2	2	2	2	2	2
	dep	11	10p04½		10:08½	10.14	10.23½	10p33	10.40	10p43½	10.53	...	11.04½	...	11:08½	11.14	11.24½	11.32½	11U40	11.43½	11.52½
	dep-line	12	DN		DN	DN	DN	DN	DN	DN	DN	...	DN	...	DN	DN	DN	DN	DN	DN	DN
	mgn	13	(1½)		(½)	...	...	...	...	...	...	...	...	...	(1½)	...	...	...	...	...	...
Haymarket Depot	dep	14	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Haymarket Central Jn	dep	15	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	dep-line	16	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	mgn	17	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
HaymarketWestJn	dep	18	10/07½		10/10½	10/15½	10/25	10/35	10/41½	10/45	10/54½	...	11/06	...	11/10½	11/15½	11/26	11/34	11/41½	11/45	11/54
	mgn	19	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
South Gyle	dep	20			10a14	10.18½	10.28	...	...	10.48	10.57½	...	...	...	11a14	11.18½	11.29		11/46½	11.48	11.57
	mgn	21	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...	(1½)	...	(1)
Dalmeny Jn	dep	22	10/12½		10/18½	10/23	10/32½	10/40	10/47	10/52½	11/02	...	11/11	...	11/18½	11/23	11/33½	11/39	...	11/52½	12/02½
	mgn	23	...		...	...	...	(½)	...	...	...	...	...	...	...	...	...	(2½)	11/53½	...	...
Dalmeny	dep	24	...		...	10a25	10a34½	...	...	10a54½	11a04	...	...	...	...	11a25	11a35½	...	...	11a54½	12ap04½
North Queensferry	dep	25	...		...	10.28½	10.38	...	...	10.58	11.07½	...	...	...	...	11.28½	11.39	...	...	11.58	12p08
	mgn	26	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Inverkeithing	arr	27	10.18		...	10.31½	10.41	10.46½	10.52½	11.01	11.10½	...	11.16½	...	...	11.31½	11.42	...	...	12.01	12.11
	dep	28	10.19		10/24	10.32½	10.42	10p48½	10.53½	11.02	11.11½	...	11.17½	...	11/24	11.32½	11.43	11/47	...	12.02	12p12
	mgn	29	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Inverkeithing Central Jn	arr	30	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	dep	31	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Rosyth	dep	32	...		...	...	10.45½	...	...	...	11.15	...	...	...	...	...	11.46½	...	...	...	12.15½
DunfermlineTown	dep	33	...		10a30½	...	10a50½	...	...	...	11a20	...	...	...	11a30½	...	11a51½	...	...	...	12ap20½
Dunfermline Queen Margaret	dep	34	...		...	...	10.54	...	...	...	11.23½	...	...	...	...	...	11.55	...	...	...	12p24
	mgn	35	...		...	...	[3](½)	...	...	...		...	...	...	...	...	[3](½)	...	...	...	...
Cowdenbeath	arr	36	...		10/38	...	11.03	...	...	...	11.29	...	...	...	11/38	...	12.04	...	...	...	12#29½
	dep	37	...		...	...	...	...	...	...	11.30	...	...	...	...	...	...	...	...	...	12p30½
	mgn	38	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Lochgelly	dep	39	...		...	...	...	...	...	...	11.35½	...	...	...	...	...	...	...	...	...	12p36
Cardenden	dep	40	...		...	...	...	...	...	...	11a39½	...	...	...	...	...	...	...	...	...	12ap40
	mgn	41	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Glenrothes With Thornton	arr	42	...		...	...	...	...	...	...	11.45½	...	...	...	...	...	...	...	...	...	12.46
	plt	43	...		...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	1
	dep	44	...		10/49	...	...	...	...	...	11.48	...	...	...	11/49	...	...	...	...	...	12.47
	mgn	45	...		...	...	...	...	...	...	[3]	...	...	...	...	...	...	...	...	...	[3]
Glenrothes Sig ET556	arr	46	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	dep	47	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Dalgety Bay	dep	48			...	10.35½	...	...	...	11.05	...	...	...	...	...	11.35½	...	...	...	12.05	...
Burntisland	dep	49	10/27		...	10.44½	...	10/56½	11/01½	11.14	...	...	11/25½	...	...	11.44½	...	11/55	12/01½	12.14	...
	mgn	50	...		...	...	...	...	(1)	...	...	...	...	...	...	...	...	...	...	...	...
Kinghorn	dep	51	...		...	10a49½	...	...	...	11a19	...	...	...	...	...	11a49½	...	...		12a19	
	mgn	52			...	...						...	...	...	...	...	...	...			
Kirkcaldy	arr	53	10.34		...	10.53½		11.03½	11.09½	11.23	...	...	11.32½	...		11.53½	...	...	12.08½	12.23	...
	dep	54	10.35		...	10.54½	...	11.05½	11.10½	11.24	...	...	11.33½	...	...	11.54½	...	12/01	12U09½	12.24	...
	mgn	55	...		...	[3]	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Kirkcaldy Sig Ek838	arr	56	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	12/52½
	dep	57	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	mgn	58			...	...	...	...	...	...	...	...	(1½)	...	...	...	...	...	...	...	...
Thornton South Jn	dep	59	10/39½		...	11/03	...	11/10½	11/15½	11/29	11/53½	...	11/39½	...	...	12/00	...	12/05	12/14	12/29½	...
Thornton North Jn	dep	60	10/40		10/51	...	...	11/11	11/16	...	...	...	11/40	...	11/51	...	...	12/05½	12/14½	...	...
	mgn	61	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Markinch	arr	62	10.43		...	...	...	...	11.19	...	...	...	11.43	...	...	...	...		12.17½	...	...
	dep	63	10.44		...	...	...	...	11.20	...	...	...	11.44	...	...	...	...	...	12.18½	...	...
	mgn	64			...	...	...	...	...	...	...	...	...	...	...	...	...	...	(2)	...	...
Ladybank	arr	65	10.50½		...	...	...	...	11.26½	...	...	...	11.50½	...	...	...	...	...	...	...	...
	dep	66	10.51½		10/58½	...	...	11/17½	11.27½	...	...	...	11.51½	...	11/58½	...	...	12/13	12/27	...	...
	mgn	67			...	...			...				...		...				...		
Newburgh	dep	68			...	...			11/37	...	...	...	...	...	...	...		...	12/37	...	...
Springfield	dep	69	...		...	...	...		...	...	...	...	...	...	...					...	...
	mgn	70			...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Cupar	dep	71	10a58		11d06	...	...	11/22½	...	...	...	...	11a58	...	12a06	...	...	12/17½	...	...	...
	mgn	72	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Seggiehill Junction	dep				11/11	...	...	...	...	...	...	...	...	...	12/11	...	...	...	...	...	...
	mgn				[3]							...		...	[3]						
St Andrews	arr				11.18½	...	...	...	...	...	...	...	...	...	12.18½	...	...	...	...	...	...
	dep			11.07		...	...	...	...	...	...	...	...	12.07		...	...	...	...	...	...
	mgn					...	...	...	...	...	...	...	...			...	...	...	...	...	...
Moonzie Junction	dep			11/12½	...	...	...	...	...	...	...	...	...	12/12½	...	...	...	...	...	...	...
Leuchars	arr	73	11.04	11.13½	...	...	...	11.28	...	...	...	...	12.04	12.13½	...	...	...	12.23	...	...	...
	dep	74	11.05	11.14½	...	...	...	11p30	...	...	...	...	12.05	12.14½	...	...	...	12p24	...	...	...
	mgn	75	[3]	[3]	...	...	...	...	...	...	...	...	[3]	[3]	...	...	...	...	...	...	...
Tay Bridge South	dep	76	11/14	11/23½	...	...	...	11/36	...	...	...	...	12/14	12/23½	...	...	...	12/30	...	...	...
	mgn	77	...		...	...	...	...	...	...	...	...	...		...	...	...	...	...	...	...
Dundee Central Jn	arr	78	...		...	...	...	...	...	...	...	...	...		...	...	...	...	...	...	...
	dep	79	11/18½	11/28	...	...	...	11/41	...	...	...	11/58	12/18½	12/28	...	...	...	12/34½	...	...	...
Dundee	arr	80	11.20	11.29	...	...	...	11.42½	...	...	...	11.59	12.20	12.29	...	...	...	12.35½	...	...	...
	plt	81	3		...	...	...	4	...	...	...	4	3		...	...	...	4	...	...	...
	dep	82	...		...	...	...	11p44½	...	...	...	12p01	...		...	...	...	12.37	...	...	...
	mgn	83	...		...	...	...		...	...	...	...	...		...	...	...	...	...	...	...
Camperdown Jn	arr	84	...		...	...	...		...	...	...	...	...		...	...	...	...	...	...	...
	dep	85			...	...		11/47½				12/03½			...			12/39½			

Mondays to Fridays

DUNDEE TO EDINBURGH

Signal ID			1L10	1B18	2K07	2G49		1L60		1T14	2G53	2K23	1L12	1E15	2K09		2G65		1L62		1T18
Orig. Dep. Time			09.51	09.07	09.17	09.50				09.08		11.18	11.00	09.52	10.17		10.48				10.38
Orig. Loc. Name			Perth	Aberdeen	Newcraighall	Edinburgh				Dyce		GienrotbesWith Thornton	Perth	Aberdeen	Newcraighall		Edinburgh				Aberdeen
Dest. Loc. Name					Newcraighall					Glasgow Queen Street		Newcraighall		London Kings Cross			Newcraighall				Glasgow Queen Street
Timing Load			158	170	158	158	170	170	170	170	158	158	158	HST9-125	158		158	170	170	170	170
Operating Characteristics																					
DatesOf Operation			SX	SX	SX	SX		SX		SX	SX	SX	SX	SX	SX		SX		SX		SX
Camperdown Jn	dep	1	...	10/12½	...	...	...	...	...	10/50½	...	...	...	11/03	...	...	...	...	...	...	11/46½
	mgn	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Dundee	arr	3	...	10.15	...	...	...	...	...	10#53	...	...	...	11.05½	...	...	...	...	...	...	11.49
	plt	4	...	1	...	...	...	3	...	1	...	...	...	1	...	...	...	...	3	...	1
	dep	5	...	10.17	...	...	...	10.35	10.43	10q54½	...	...	...	11p07½	...	...	...	...	11.30	11.43	11p50½
Dundee Central Jn	dep	6	...	10/18	...	...	...	10/36	10/44	10/55½	...	...	...	11/08½	...	...	...	...	11/31	11/44	11/51½
	mgn	7	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Tay Bridge South	dep	8	...	10/22½	...	...	...	10/40½	10/48½	...	...	...	...	11/13½	...	...	...	...	11/35½	11/48½	...
	mgn	9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Leuchars	arr	10	...	10.28	...	...	...	10.46	10.54	...	...	...	...	11.19½	...	...	...	...	11.41	11.54	...
	dep	11	...	10.29	...	...	...	10.47	10.55	...	...	...	...	11p21½	...	...	...	...	11.45½	11.55	...
	mgn	12	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Moonzie Junction	dep		...	...	...	...	...	...	10/56½	...	...	...	...	...	...	...	...	...	...	11/56½	...
	mgn		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
St Andrews	arr		...	...	...	...	...	...	11.01½	...	...	...	...	...	...	...	...	...	...	12.01½	...
	dep		...	...	...	...	10.33	...	...	...	...	...	...	...	...	...	...	11.33	...	...	...
	mgn		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Seggiehill Junction	dep		...	...	...	...	10/38	...	...	...	...	...	...	...	...	...	...	11/38	...	...	...
Cupar	arr	13	...	...	...	...	10.43	10.53½	...	...	...	...	...	...	...	...	...	11.43	11.52	...	...
	dep	14	...	10/35½	...	...	10.44	10.54½	...	...	...	...	...	11/27½	...	...	...	11.44	11.53	...	...
	mgn	15	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Springfield	dep	16	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	mgn	17					...											...			
Newburgh	dep	18	10/04½	...	...	...	...	...	...	...	...	...	11/13½	...	...	...	...	...	...		...
	mgn	19	(2½)	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		...
Ladybank	arr	20	10#16½	...	...	...	...	11.01	...	...	...	...	11.23	...	...	...	...	...	11.59½		...
	dep	21	10r17½	10/40½	...	...	10/49	11.02	...	...	...	...	11.23½	11/32	...	...	...	11/49	12.00½		...
Markinch	arr	22	10.24½	...	...	...	...	11.08½	...	...	...	...	11.30½	...	...	...	...	...	12.07		...
	dep	23	10.33	...	...	...	...	11.09½	...	...	...	...	11.31½		...	...	...	...	12.08		...
	mgn	24	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		...
Thornton North Jn	dep	25	10/36	10/48	...	...	10/56½	11/12½	...	...	...	...	11/34½	11/38½	...	...	...	11/56½	12/11		...
Thornton North U.P.L.	arr	26	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		...
	dep	27	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		...
Thornton South Jn	dep	28	10/36½	10/48½	10/31½	10/53½	...	11/13	...	...	...	11/20½	11/35	11/39	11/29	...	11/53½	...	12/11½		...
	mgn	29	...	...	...	...	...	...	...	...	...	(½)	...	...	...	...	...	...	...		...
Kirkcaldy Sig EK838	arr	30	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		...
	dep	31	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		...
Kirkcaldy	arr	32	10.41½	...	...	10.59	...	11.18	...	...	...	11.26	11.40	11.43½	...	...	11.59	...	12.16½		...
	dep	33	10.42½	10/52½	...	11.00	...	11.19	...	...	...	11.27	11.41	11.45½	...	...	12.00	...	12.17½		...
	mgn	34	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		...
Kinghorn	dep	35		...	...	11.04½	...	...	...	...	...	11.31½	...	...	...	...	12.04½	...	...		...
Burntisland	dep	36	10/49½	10/59	...	11a09	...	11/26	...	...	...	11a36½	11/48	11/52½	...	...	12a09	...	12/24½		...
	mgn	37	(1)	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		...
Aberdour	dep	38	...	...	...	11.13½	...	...	...	...	...	11.41	...	...	...	...	12.13½	...	...		...
Dalgety Bay	dep	39	...	...	...	11a18½	...	...	...	...	...	11a46	...	...	...	...	12a18½	...	...		...
	mgn	40					...											...			
Glenrothes Sig ET556	arr	41	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		...
	dep	42	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		...
Glenrothes With Thornton	arr	43	...	...	10#34	...	...	...	...	...	...	...	...	...	11.31½	...	...	...	...		...
	plt	44	...	...	1	...	...	...	...	...	...	...	...	...	1	...	...	...	...		...
	dep	45	...	...	10q34½	...	10/58½	...	...	...	...	...	...	...	11.34	...	...	11/58½	...		...
	mgn	46	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		...
Cardenden	dep	47	...	...	10aq42	...	...	...	...	...	...	...	...	...	11a41½	...	...	...	...		...
Lochgelly	dep	48	...	...	10q46	...	...	...	...	...	...	...	...	...	11.45½	...	...	...	...		...
	mgn	49	...	...	[3]	...	[3]	...	...	...	...	...	...	...	[3]	...	...	[3]	...		...
Cowdenbeath	arr	50	...	...	10#54	...	...	...	...	...	...	...	...	...	11.53½	...	...	...	...		...
	dep	51	...	...	10q55	...	11/13½	...	...	...	11.23	...	...	...	11.54½	...	...	12/13½	...		...
	mgn	52	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		...
Dunfermline Queen Margaret	dep	53			11q00½		...				11.28½	...	...	...	12.00	...	...	...	...		...
DuntermlineTown	dep	54	...	...	11aq04	...	11a21½	...	...	...	11a32	...	...	...	12a03½	...	...	12a21½	...		...
Rosyth	dep	55	...	...	11q07½	...	...	...	...	...	11.35½	...	...	...	12.07	...	...	...	...		...
	mgn	56			...	...	...	...	...	...	(½)	...	...	...	...	...	...	...	...		...
Inverkeithing Central Jn	arr	57	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		...
	dep	58	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		...
Inverkeithing	arr	59	10.58½		11#10½	11.20½	...	11.34	...	...	11.39	11.48½	11.56	12.00	12.10	...	12.20½	...	12.32½		...
	dep	60	10.59½	11/06½	11p11½	11.21½	11/26½	11.35	...	...	11.40	11.49½	11.57	12p02	12.11	...	12.21½	12/26½	12.35		...
	mgn	61	(3)	(1½)	...	...	(3½)	...	...	...	...	...	...	...	...	...	...	(3½)	...		...
North Queensferry	dep	62	...	...	11.15½	11.25½	...	...	...	...	11.44	...	...	...	12.15	...	12.25½	...	...		...
Dalmeny	dep	63	...	...	11ap19½	11a29½	...	...	...	...	11a48	...	...	...	12a19	...	12a29½	...	...		...
	mgn	64	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		...
Dalmeny Jn	arr	65	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		...
	dep	66	11/08½	11/13½	11/20½	11/30½	11/35½	11/40½	...	...	11/49	11/55½	12i03	12/08½	12/20	...	12/30½	12/35½	12/40½		...
	mgn	67	[3](½)	[3]	...	...	(½)	[3](3½)	...	...	...	...	[3]	[3]	...	...	...	(½)	[3](3½)		...
South Gyle	dep	68		...	11p25½	11.35½	11a41½	...	...	...	11.54	12.00½	...	...	12.25	...	12.35½	12a41½	...		...
	mgn	69		...	[3]	[3]	[3]	...	...	...	[3]	[3]	...	...	[1½]	...	[3]	[3]	...		...
Haymarket West Jn	dep	70	11/17	11/21½	11/31½	11/41½	11/47½	11/50½	...	...	12i00	12/06½	12/11	12/16½	12/29½	...	12/41½	12/47½	12/50½		...
	dep-line	71	US	UN	UN	UN	UN	UN	...	...	UN	UN	UN	UN	UN	...	UN	UN	UN		...
	mgn	72		...	...	...	...	(1)	...	...	(½)	...	...	...	...	...	...	...	(1)		...
Haymarket Central Jn	dep	73					...					...	...					...			
Haymarket Depot	arr	74	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		...
	dep	75	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		...
Haymarket	arr	76	11.18½	11.23	11v33	11.43	11.49	11.53	...	...	12.02	12.08	12.12½	12.18½	12#31	...	12#43	12.49	12.53		...
	plt	77	3	1	1	1	1	1	...	...	1	1	1	1	1	...	1	1	1		...
	dep	78	11.19½	11.24	11.34	11.44	11.50	11.54	...	...	12p03	12p09	12.13½	12.20½	12p32	...	12p44	12.50	12.54		...
	dep-line	79	US	UN	UN	UN	UN	UN	...	...	UN	UN	UN	UN	UN	...	UN	UN	UN		...
	mgn	80	(½)	(1)	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		...
Princes St Gardens	dep	81	11/22	11/27	11/36	11/46	11/52	11/56	...	...	12/05	12/11	12/15½	12/22½	12/34	...	12/46	12/52	12/56		...
	dep-line	82	X	Z	Z	Z	Z	Z	...	...	Y	Z	Z	Z	Z	...	Z	Z	Z		...
	mgn	83	...	...	...	...	...	...	...	...	...	...	(½)	...	...	...	...	...	...		...
Edinburgh	arr	84	11.24	11w29	11.38	11.48	11.54	11.58	...	...	12.07	12.13	12.18	12W24½	12.36	...	12.48	12.54	12.58		...
	plt	85	12	16	20	18F	...	17	...	...	17F	20	16F	19	19	...	20	...	17		...
	dep	86		...	11.51	...	...					12p21		12.30		...	12.51	...			

Mondays to Fridays

EDINBURGH TO DUNDEE

Signal ID			1X01	1X01	1X01	1X01	1X01	1X01	1X01	1X01	1X01	1X01	1X01	1X01	1X01	1X01	1X01	1X01	1X01	1X01	1X01
Drig. Dep. Time																					
Drig. Loc. Name																					
Dest. Loc. Name																					
Timing Load			170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170
Operating Characteristics																					
DatesOf Operation			SX	SX	SX	SX	SX	SX	SX	SX	SX	SX	SX	SX	SX	SX	SX	SX	SX	SX	SX
Edinburgh	arr	1	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	plt	2	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
	dep	3	05:00	06:04	07:04	08:04	09:04	10:04	11:04	12:04	13:04	14:04	15:04	16:04	17:04	18:04	19:04	20:04	21:01	22:04	23:04
	dep-line	4	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	mgn	5	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Princes St Gardens	dep	6	05/01	06/05	07/05	08/05	09/05	10/05	11/05	12/05	13/05	14/05	15/05	16/05	17/05	18/05	19/05	20/05	21/02	22/05	23/05
	dep-line	7	DN	DN	DN	DN	DN	DN	DN	DN	DN	DN	DN	DN	DN	DN	DN	DN	DN	DN	DN
	mgn	8	(½)	…	…	…	…	…	…	…	…	…	(1)	…	…	…	…	…	…	…	…
Haymarket	arr	9	05:04	06:07½	07:07½	08:07½	09:07½	10:07½	11:07½	12:07½	13:07½	14:07½	15:08½	16:07½	17:07½	18:07½	19:07½	20:07½	21:04½	22:07½	23:07½
	plt	10	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	dep	11	05:05	06:08½	07:08½	08:08½	09:08½	10:08½	11:08½	12:08½	13:08½	14:08½	15:09½	16:08½	17:08½	18:08½	19:08½	20:08½	21:05½	22:08½	23:08½
	dep-line	12	DN	DN	DN	DN	DN	DN	DN	DN	DN	DN	DN	DN	DN	DN	DN	DN	DN	DN	DN
	mgn	13	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Haymarket Depot	dep	14	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Haymarket Central Jn	dep	15	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	dep-line	16	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	mgn	17	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
HaymarketWestJn	dep	18	05/07	06/10½	07/10½	08/10½	09/10½	10/10½	11/10½	12/10½	13/10½	14/10½	15/11½	16/10½	17/10½	18/10½	19/10½	20/10½	21/07½	22/10½	23/10½
	mgn	19	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
South Gyle	dep	20	05a10½	06a14	07a14	08a14	09a14	10a14	11a14	12a14	13a14	14a14	15a15	16a14	17a14	18a14	19a14	20a14	21a11	22a14	23a14
	mgn	21	…	…	…	…	…	…	…	…	…	…	…	…	(1)	…	…	…	…	…	…
Dalmeny Jn	dep	22	05/15	06/18½	07/18½	08/18½	09/18½	10/18½	11/18½	12/18½	13/18½	14/18½	15/19½	16/18½	17/19½	18/18½	19/18½	20/18½	21/15½	22/18½	23/18½
	mgn	23	…	…	(1½)	…	…	…	…	…	…	…	…	…	(1)	(3)	…	…	…	…	…
Dalmeny	dep	24	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
North Queensferry	dep	25	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	mgn	26	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Inverkeithing	arr	27	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	dep	28	05/20½	06/24	07/25½	08/24	09/24	10/24	11/24	12/24	13/24	14/24	15/25	16/24	17/26	18/27	19/24	20/24	21/21	22/24	23/24
	mgn	29	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	(1)	…	…
Inverkeithing Central Jn	arr	30	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	dep	31	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Rosyth	dep	32																			
DunfermlineTown	dep	33	05a27	06a30½	07a32	08a30½	09a30½	10a30½	11a30½	12a30½	13a30½	14a30½	15a31½	16a30½	17a32½	18a33½	19a30½	20a30½	21a28½	22a30½	23a30½
Dunfermline Queen Margaret	dep	34	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	mgn	35	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	(1½)	…	…
Cowdenbeath	arr	36	05/34½	06/38	07/39½	08/38	09/38	10/38	11/38	12/38	13/38	14/38	15/39	16/38	17/40	18/41	19/38	20/38	21/37½	22/38	23/38
	dep	37	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	mgn	38	…	…	…	…	…	(3)	(½)	(1)	(1)	(2)	…	…	(3)	(4)	(5)	(5)	(6½)	(1)	…
Lochgelly	dep	39	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Cardenden	dep	40	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	mgn	41	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Glenrothes With Thornton	arr	42	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	plt	43	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	dep	44	05/45½	06/49	07/50½	08/49	09/49	10/52	11/49½	12/50	13/50	14/51	15/50	16/49	17/54	18/56	19/54	20/54	21/56	22/50	23/49
	mgn	45	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	(4½)	…
Glenrothes Sig ET556	arr	46	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	dep	47	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Dalgety Bay	dep	48	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Burntisland	dep	49	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	mgn	50	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Kinghorn	dep	51	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	mgn	52	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Kirkcaldy	arr	53	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	dep	54	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	mgn	55	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Kirkcaldy Sig Ek838	arr	56	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	dep	57	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	mgn	58	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Thornton South Jn	dep	59	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Thornton North Jn	dep	60	05/47½	06/51	07/52½	08/51	09/51	10/54	11/51½	12/52	13/52	14/53	15/52	16/51	17/56	18/58	19/56	20/56	21/58	22/56½	23/51
	mgn	61	…	…	…	…	…	…	…	…	…	…	…	…	…	(4)	…	…	…	(8)	…
Markinch	arr	62	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	dep	63	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	mgn	64	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Ladybank	arr	65	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	dep	66	05/55	06/58½	08/00	08/58½	09/58½	11/01½	11/59	12/59½	13/59½	15/00½	15/59½	16/58½	18/03½	19/09½	20/03½	21/03½	22/05½	23/12	23/58½
	mgn	67	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Newburgh	dep	68	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Springfield	dep	69	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	mgn	70	…	…	…	…	…	…	…	…	…	…	…	…	…	(6½)	…	…	…	…	…
Cupar	dep	71	06d02½	07d06	08d07½	09i08½	10c05½	11a07½	12b05½	13a05½	14a05½	15a06½	16a05½	17c05½	18a09½	19a22	20a09½	21a09½	22a11½	23a18	00a04½
	mgn	72	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Seggiehill Junction	dep		06/07½	07/11	08/12½	09/13½	10/10½	11/12½	12/10½	13/10½	14/10½	15/11½	16/10½	17/10½	18/14½	19/27	20/14½	21/14½	22/16½	23/23	00/09½
	mgn		[3](3½)	[3]	[3]	[3]	[3](½)	[3]	[3](½)	[3](½)	[3](½)	[3]	[3](½)	[3](½)	[3]	[3]	[3]	[3]	[3]	[3]	[3]
St Andrews	arr		06.18½	07.18½	08.20	09.21	10.18½	11.20	12.18½	13.18½	14.18½	15.19	16.18½	17.18½	18.22	19.34½	20.22	21.22	22.24	23.30½	00.17
	dep		…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	mgn		…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Moonzie Junction	dep		…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Leuchars	arr	73	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	dep	74	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	mgn	75	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Tay Bridge South	dep	76	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	mgn	77	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Dundee Central Jn	arr	78	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	dep	79	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Dundee	arr	80	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	plt	81	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	dep	82	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	mgn	83	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Camperdown Jn	arr	84	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	dep	85	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…

Notes

Would require 2K33 08:08 Edinburgh to Newcraighall service retiming 2 minutes later from Dalmeny Junction
Would require 2K65 09:06 Edinburgh to Glenrothes service retiming 2 minutes later from Edinburgh
Would require 2K67 09:47 Edinburgh to Glenrothes service retiming 2 minutes later from Edinburgh
Would require 2K69 10:47 Edinburgh to Glenrothes service retiming 1 minute later approaching South Gyle
Would require 2K71 11:47 Edinburgh to Glenrothes service retiming 1 minute later approaching South Gyle
Would require 2K73 12:47 Edinburgh to Glenrothes service retiming 1 minute later approaching South Gyle
Would require 2K75 13:47 Edinburgh to Glenrothes service retiming 1 minute later approaching South Gyle
Would require 2K63 14:47 Edinburgh to Glenrothes service retiming 1 minute later approaching South Gyle
Would require 2K31 15:47 Edinburgh to Glenrothes service retiming 1 minute later approaching South Gyle
Would require 2G13 17:08 Edinburgh to Edinburgh service retiming by 2 minutes later from South Gyle. Also requires 5G21 17:39 Cowdenbeath to Edinburgh to be retimed 4 minutes earlier from Cowdenbeath.

Would require 3½ minutes pathing time moving in 1S45 09:25 Plymouth to Aberdeen to approaching Dalmeny Junction. Arrives St Andrews after standard departure back to Edinburgh. Follows 2G09 17:37 Newcraighall to Edinburgh via Dunfermline. 2G09 is running 6 mins later than standard hour path, although only has 2 mins dwell in Edinburgh so therefore would require retiming earlier from Newcraighall. St Andrews service drops in behind 1S45 from Thornton. If St An drews could run earlier then 1S45 would have to follow with pathing time moved from approaching Leuchars to appraoching Thornton.

Could run via Kirkcaldy as follows stopper to Glenrothes, this results in another train following requiring retiming later to Dundee by 3½ minutes.
Could run via Kirkcaldy as follows stopper (2G25 21:33 Newcraighall to Perth) via Glenrothes to Ladybank, or stopper would have to be retimed.
5S49 22:00 Dundee to Craigentinny will need rtiming to avoid conflict at Seggiehill Junction

Mondays to Fridays

DUNDEE TO EDINBURGH

Signal ID																				
Orig. Dep. Time																				
Orig. Loc. Name																				
Dest. Loc. Name																				
Timing Load			170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170
Operating Characteristics																				
DatesOf Operation																				
Camperdown Jn	dep	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	mgn	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Dundee	arr	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	plt	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	dep	5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Dundee Central Jn	dep	6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	mgn	7	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Tay Bridge South	dep	8	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	mgn	9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Leuchars	arr	10	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	dep	11	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	mgn	12	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Moonzie Junction	dep		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	mgn		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
St Andrews	arr		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	dep		06.33	07.23	08.33	09.33	10.33	11.33	12.33	13.33	14.33	15.33	16.25	17.33	18.33	19.33	20.33	21.33	22.33	23.33
	mgn		...	...	...	...	...	...	...	...	...	...	...	...	(2)	...	(2)	...	...	...
Seggiehill Junction	dep		06/38	07/28	08/38	09/38	10/38	11/38	12/38	13/38	14/38	15/38	16/30	17/38	18/40	19/38	20/40	21/38	22/38	23/38
Cupar	arr	13	06.43	07.33	08.43	09.43	10.43	11.43	12.43	13.43	14.43	15.43	16.35	17.43	18.45	19.43	20.45	21.43	22.43	23.43
	dep	14	06.44	07.34	08.44	09.44	10.44	11.44	12.44	13.44	14.44	15.44	16.36	17.44	18.46	19.44	20.46	21.44	22.44	23.44
	mgn	15	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Springfield	dep	16	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	mgn	17	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Newburgh	dep	18	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	mgn	19	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ladybank	arr	20																		
	dep	21	06/49	07/39	08/49	09/49	10/49	11/49	12/49	13/49	14/49	15/49	16/41	17/49	18/51	19/49	20/51	21/49	22/49	23/49
Markinch	arr	22	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	dep	23	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	mgn	24	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	(2½)	(2½)	...
Thornton North Jn	dep	25	06/56½	07/46½	08/56½	09/56½	10/56½	11/56½	12/56½	13/56½	14/56½	15/56½	16/48½	17/56½	18/58½	19/56½	20/58½	21/59	22/59	23/56½
Thornton North U.P.L.	arr	26	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	dep	27	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Thornton South Jn	dep	28	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	mgn	29	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Kirkcaldy Sig EK838	arr	30	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	dep	31	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Kirkcaldy	arr	32	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	dep	33	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	mgn	34	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Kinghorn	dep	35	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Burntisland	dep	36	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	mgn	37	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Aberdour	dep	38	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Dalgety Bay	dep	39	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	mgn	40	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Glenrothes Sig ET556	arr	41	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	dep	42	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Glenrothes With Thornton	arr	43	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	plt	44	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	dep	45	06/58½	07/48½	08/58½	09/58½	10/58½	11/58½	12/58½	13/58½	14/58½	15/58½	16/50½	17/58½	19/00½	19/58½	21/00½	22/01	23/01	23/58½
	mgn	46	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Cardenden	dep	47	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Lochgelly	dep	48	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	mgn	49	[3](2)	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]
Cowdenbeath	arr	50	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	dep	51	07/15½	08/03½	09/13½	10/13½	11/13½	12/13½	13/13½	14/13½	15/13½	16/13½	17/05½	18/13½	19/15½	20/13½	21/15½	22/16	23/16	00/13½
	mgn	52	(3)	(2)	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Dunfermline Queen Margaret	dep	53	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
DuntermlineTown	dep	54	07a24½	08a13½	09a21½	10a21½	11a21½	12a21½	13a21½	14a21½	15a21½	16a21½	17a13½	18a21½	19a23½	20a21½	21a23½	22a24	23a24	00a21½
Rosyth	dep	55	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	mgn	56	(7)	...	...	(2)	...	...	...	...	...	...	...	...	(3½)	(3½)	...	...	...	...
Inverkeithing Central Jn	arr	57	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	dep	58	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Inverkeithing	arr	59	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	dep	60	07/36½	08/16½	09/26½	10/28½	11/26½	12/26½	13/26½	14/26½	15/26½	16/26½	17/18½	18/26½	19/32	20/30	21/28½	22/29	23/29	00/26½
	mgn	61	(2)	(3½)	...	...	(3½)	(3½)	(3½)	(3½)	(3½)	(3½)	(1)	(1)	(3½)	(1½)	...	(2½)	(2½)	...
North Queensferry	dep	62	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Dalmeny	dep	**63**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	mgn	64	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Dalmeny Jn	arr	65	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	dep	66	07/44	08/35½	09/32	10/34	11/35½	12/35½	13/35½	14/35½	15/35½	16/35½	17/25	18/33	19/41	20/37	21/34	22/37	23/37	00/32
	mgn	67	...	(½)	...	...	(½)	(½)	...	...	...	...	...	...	...	...	...	...	...	...
South Gyle	dep	68	07a49½	08a41½	09a37½	10a39½	11a41½	12a41½	13a41	14a41	15a41	16a41	17a30½	18a38½	19a46½	20a42½	21a39½	22a42½	23a42½	00a37½
	mgn	69	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]
Haymarket West Jn	dep	70	07/55½	08/47½	09/43½	10/45½	11/47½	12/47½	13/47	14/47	15/47	16/47	17/36½	18/44½	19/52½	20/48½	21/45½	22/48½	23/48½	00/43½
	dep-line	71	UN	UN	UN	UN	UN	UN	UN	UN	UN	UN	UN	UN	UN	UN	UN	UN	UN	UN
	mgn	72	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Haymarket Central Jn	dep	73	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Haymarket Depot	arr	74	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	dep	75	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Haymarket	arr	76	07.57	08.49	09.45	10.47	11.49	12.49	13.48½	14.48½	15.48½	16.48½	17.38	18.46	19.54	20.50	21.47	22.50	23.50	00.45
	plt	77	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	dep	78	07.58	08.50	09.46	10.48	11.50	12.50	13.49½	14.49½	15.49½	16.49½	17.39	18.47	19.55	20.51	21.48	22.51	23.51	00.46
	dep-line	79	UN	UN	UN	UN	UN	UN	UN	UN	UN	UN	UN	UN	UN	UN	UN	UN	UN	UN
	mgn	80	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Princes St Gardens	dep	81	08/00	08/52	09/48	10/50	11/52	12/52	13/51½	14/51½	15/51½	16/51½	17/41	18/49	19/57	20/53	21/52	22/53	23/53	00/48
	dep-line	82	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
	mgn	83	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Edinburgh	arr	84	08.02	08.54	09.50	10.52	11.54	12.54	13.53½	14.53½	15.53½	16.53½	17.43	18.51	19.59	20.55	21.54	22.55	23.55	00.50
	plt	85	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	dep	86	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

Notes

Path would require retiming of 1N80 07.13 Kirkcaldy to Glasgow QS and 1V54 06.32 Dundee to Plymouth to Edinburgh. Alternatively a path exists via Kirkcaldyand 2K16 would require retiming 1 minute late Inverkeithing to Edinburgh.

No path from Inverkeithing. Path very tight between 1B07 and 1B09 between Seggiehill Junction and Ladybank

Runs in same path as 1H91/1H93/1H84 08.07 Dundee to Edinburgh between Inverkeithing and Edinburgh

Requires 2G49 Edinburgh to Edinburgh to be retimed 3 minutes earlier

Requires 1L62 11.30 Dundee to Edinburgh to be retimed 2 minutes later from South Gyle and Edinburgh

Requires 1L52 12.34 Dundee to Edinburgh to be retimed 1 minutes later from South Gyle and Edinburgh

Requires 1L54 13.34 Dundee to Edinburgh to be retimed 3½ minutes later from South Gyle and Edinburgh

Requires 2G73 13.48 Edinburgh to Newcraighall to be retimed 1½ minutes earlier

Requires 1L26 17.26 Dundee to Edinburgh to be retimed 4 minutes later from Cupar to Dalmeny jn, 6 minutes later from Haymarket West to Edinburgh.

2K26 21.02 Glenrothes to Newcraighall to b e retimed 2 minutes later from Glenrothes to Edinburgh

2K28 22.02 Glenrothes to Newcraighall to be retimed 3 minutes later from Glenrothes to Edinburgh

Insufficient turnaround after arrival of Down train at St Andrews. Down train to be retimed earlier and existing train to be retimed?

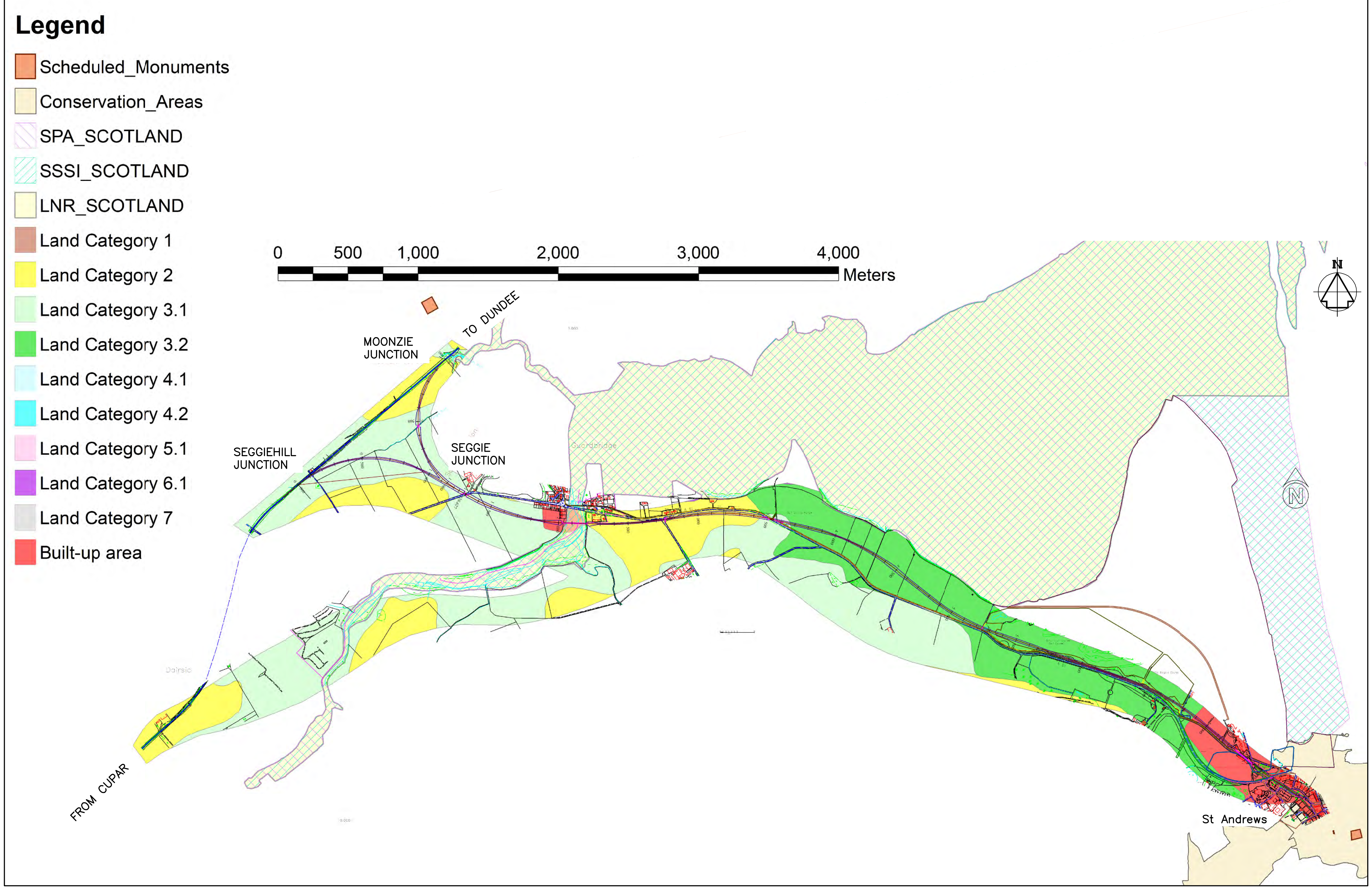
Requires retiming of 2L81 21.07 Edinburgh to Dundee to run 4½ minutes later from Thornton North Junction

Requires the retimng of 2L83 22.09 Edinburgh to Dundee to run 3 minutes later at Thornton North Junction, 1 minutes later to Dundee. Re

Requires the retimng of 2L85 23.09 Edinburgh to Dundee to run 1 minute later at Thornton North Junction to Dundee. Re

Appendix G: Geological and Environmental Maps

Land Capability for Agriculture and Environmental Features



DO NOT SCALE

Rev.	Date	Descriptions of Revision	Des.	Chkd.	Appr.
P01	17/02/12	ORIGINAL DRAWING	VR	HP	--

Client

StARLink

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The Crescent
York
YO24 1AW

Status

FOR INFORMATION

Designed: V.RANGELOV	Checked: H.PACK
Approved:	Date: 17/02/12

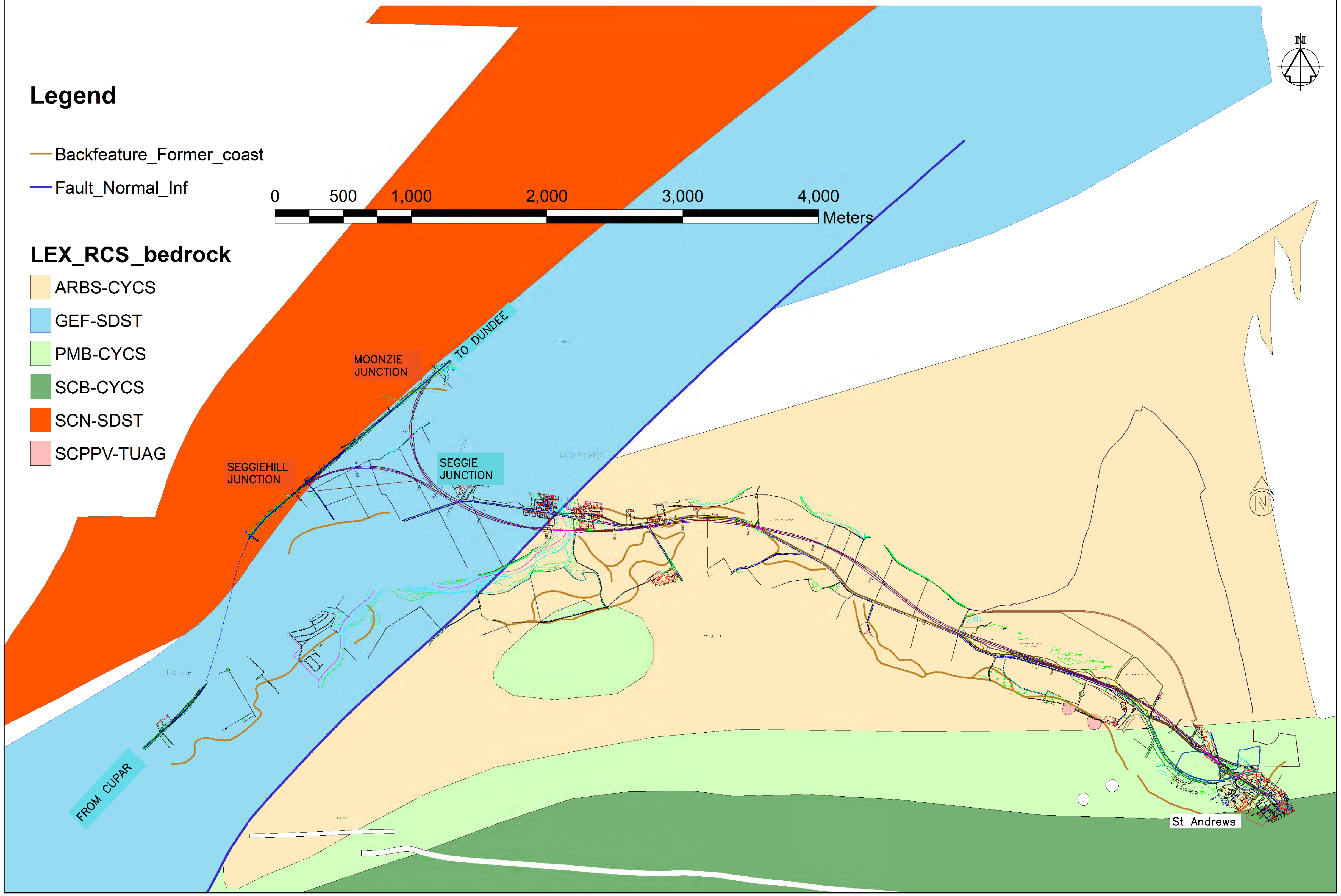
ST ANDREWS RAIL LINK

LAND CAPABILITY FOR AGRICULTURE (LCA) AND ENVIRONMENTAL FEATURES

Scales: AS SHOWN	CAD: VR
PW Workflow State: Initially Checked	
Drawing Number: B70240-DRG-TPL0011	Revision: P01

Plot Date: 23/02/2012 15:49

Bedrock Geological Map



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P01	17/02/12	ORIGINAL DRAWING	VR	HP	--

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Designed	Checked
V.RANGELOV	H.PACK
Approved	Date 17/02/12

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GEOLOGICAL MAP
BEDROCK

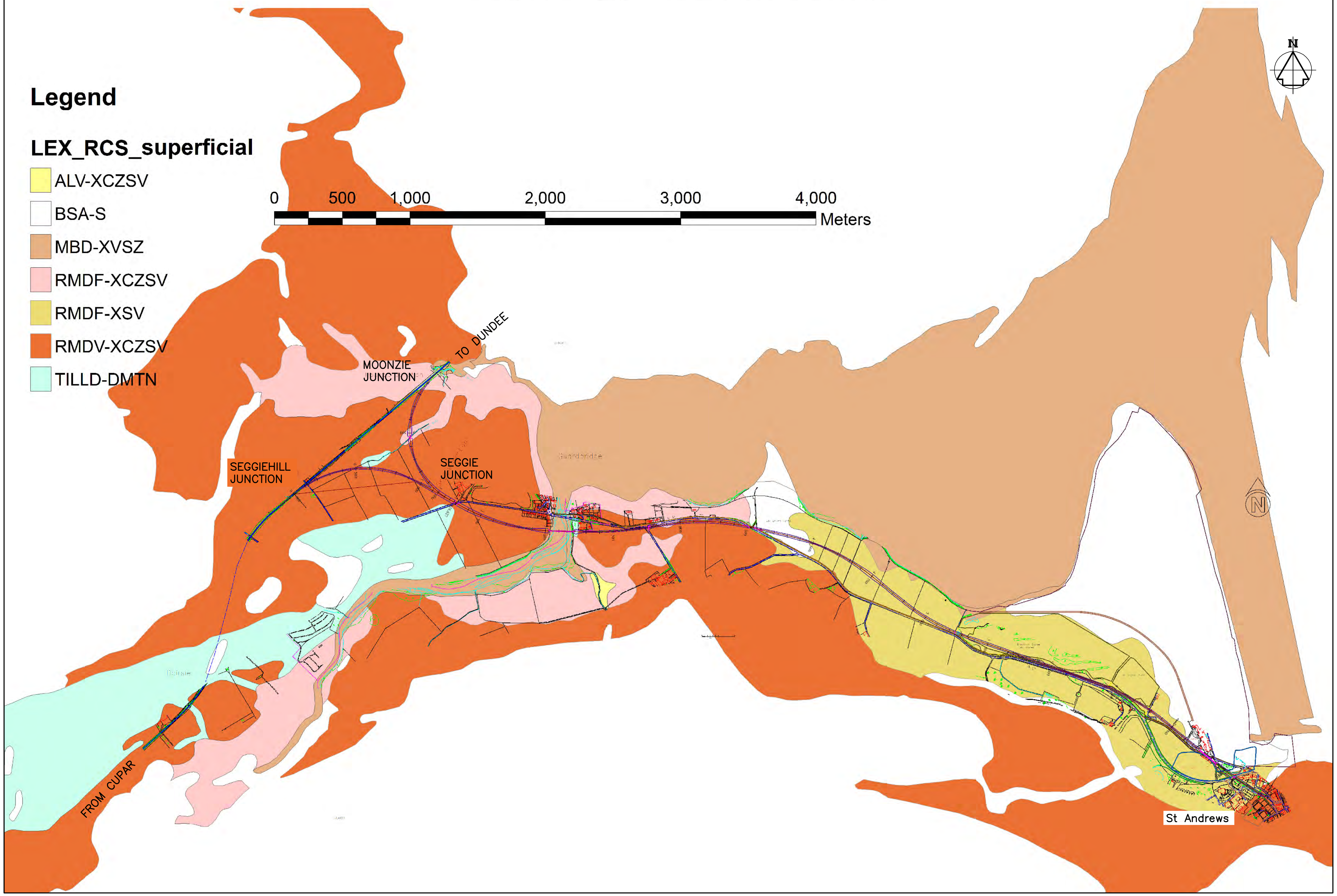
Scales AS SHOWN | CAD VR

PW Workflow State: Initially Checked

Drawing Number: B70240-DRG-TPL0012 | Revision: P01

Plot Date: 23/02/2012 15:50

Superficial Geological Map



DO NOT SCALE

Rev.	Date	Descriptions of Revision	Des.	Chkd.	Appr.
P01	17/02/12	ORIGINAL DRAWING	VR	HP	--

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FOR INFORMATION

Designed V.RANGELOV	Checked H.PACK
Approved	Date 17/02/12

SAINT ANDREWS RAIL LINK

GEOLOGICAL MAP
SUPERFICIAL

Scales AS SHOWN	CAD VR
PW Workflow State Initially Checked	
Drawing Number B70240-DRG-TPL0013	Revision P01

Plot Date: 23/02/2012 15:50

Appendix H: Land Capability for Agriculture Classification (LCA) Explanation

THE MACAULAY INSTITUTE
research today for land use tomorrow

The Land Capability for Agriculture METADATA Sheet

Release Date
28/09/2010

Copyright

Format
Arc View shapefile.

Scale
1:50,000 scale

System of Land Capability for Agriculture Classification

THE CLASSES

Land suited to arable cropping

Class 1 Land capable of producing a very wide range of crops
Cropping is highly flexible and includes the more exacting crops such as winter harvested vegetables (cauliflowers, brussels sprouts, leeks), The level of yield is consistently high. Soils are usually well-drained deep loams, sandy loams, silty loams, or their related humic variants, with good reserves of moisture. Sites are level or gently sloping and the climate is favourable. There are no or only very minor physical limitations affecting agricultural use.

Class 2 Land capable of producing a wide range of crops
Cropping is very flexible and a wide range of crops can be grown though some root and winter harvested crops may not be ideal choices because of difficulties in harvesting. The level of yield is high but less consistently obtained than on Class I land due to the effects of minor limitations affecting cultivation, crop growth or harvesting. The limitations include, either singly or in combination, slight workability or wetness problems, slightly unfavourable soil structure or texture, moderate slopes or slightly unfavourable climate. The limitations are always minor in their effect however and land in the class is highly productive.

Class 3 Land capable of producing a moderate range of crops.
Land in this class is capable of producing good yields of a narrow range of crops, principally cereals and grass, and/or moderate yields of a wider range including potatoes, some vegetable crops (e.g. field beans and summer harvested brassicae) and oil-seed rape. The degree of variability between years will be greater than is the case for Classes I and 2, mainly due to interactions between climate, soil and management factors affecting the timing and type of cultivations, sowing and harvesting. The moderate limitations require careful

management and include wetness, restrictions to rooting depth, unfavourable structure or texture, strongly sloping ground, slight erosion or a variable climate. The range of soil types within the class is greater than for previous classes.

Class 4 Land capable of producing a narrow range of crops
The land is suitable for enterprises based primarily on grassland with short arable breaks (e.g. barley, oats, forage crops). Yields of arable crops are variable due to soil, wetness or climatic factors. Yields of grass are often high but difficulties of production or utilisation may be encountered. The moderately severe levels of limitation restrict the choice of crops and demand careful management. The limitations may include moderately severe wetness, occasional damaging floods, shallow or very stony soils, moderately steep gradients, erosion, moderately severe climate or interactions of these which increase the level of farming risk.

Class 5 Land suited only to improved grassland and rough grazing
Land capable of use as improved grassland. The agricultural use of land in Class 5 is restricted to grass production but such land frequently plays an important role in the economy of British hill lands. Mechanised surface treatments to improve the grassland, ranging from ploughing through rotation to surface seeding and improvement by non-disruptive techniques are all possible. Although an occasional pioneer forage crop may be grown, one or more severe limitations render the land unsuited to arable cropping. These include adverse climate, wetness, frequent damaging floods, steep slopes, soil defects or erosion risk. Grass yields within the class can be variable and difficulties in production, and particularly utilisation, are common.

Class 6 Land capable only of use as rough grazing
The land has very severe site, soil or wetness limitations which generally prevent the use of tractor-operated machinery for improvement. Some reclamation of small patches to encourage stock to range is often possible. Climate is often a very significant limiting factor. A range of widely different qualities of grazing is included, from very steep land with significant grazing value in the lowland situation to moorland with a low but sustained production in the uplands. Grazing is usually insignificant in the arctic zones of the mountain lands but below this level grazings which can be utilised for five months or longer in any year are included in the class. Land affected by severe industrial pollution or dereliction may be included if the effects of the pollution are non-toxic.

Class 7 Land of very limited agricultural value
Land with extremely severe limitations that cannot be rectified. The limitations may result from one or more of the following defects: extremely severe wetness, extremely stony, rocky land, bare soils, scree or beach sand and gravels, toxic waste tips and dereliction, very steep gradients, severe erosion including intensively hagged peat lands and extremely severe climates (exposed situations, protracted snow-cover and short growing season). Agricultural use is restricted to very poor rough grazing.

Other codes
Code **888** represents land covered by built up areas, quarries, gravel workings, collieries and bings.

Code **999** represents areas covered by lochs and inland water
Code **9500** represents areas of land not classified for reasons other than those represented by codes **888** and **999**.

THE DIVISIONS

A division is a ranking within a class; the approach to it however needs to be selective. Because the requirements of the crops suited to Classes 1 and 2 are fairly stringent, land in these classes has inherently low degrees of internal variability. The requirements of crops grown in the remaining classes are less rigorous, consequently land included is more variable in character and covers larger areas. For purposes of strategic and regional planning, it is quite clear that some further guidance is necessary in these areas, although for detailed planning the variability of the class dictates that on-site inspections must always be made. Classes 3 and 4 each have two divisions based on increasing restrictions to arable cropping. These are principally climate, in particular the reliability of suitable weather conditions and interactions between soil properties and climatic features. Qualities of land such as workability and droughtiness are particularly affected. Relatively small amounts of rain upon clayey topsoils may equal or exceed in their effect upon farming, that of large amounts upon coarser topsoil textures for example. Site criteria and erosion play relatively small parts. Class 5 land has three divisions based on potential for successful reclamation and Class 6 three based upon the value of the existing vegetation for grazing purposes.

The divisions of Class 3

The definition of Class 3 incorporates land which has a good capability for the production of a moderate range of crops, that part of the British farmscape which is usually regarded as 'average arable land'. For economic reasons it is devoted principally to cereal and grass farming, but the land is often capable of producing in addition, potatoes, oilseed rape, field beans or some vegetables. The picture throughout the class is one of variability so that it is possible that, in anyone year, the situation may differ drastically from the mean. It is against this background that the farmer has to plan the long-term investment on his farm and decide the kinds of enterprise he wishes to practise and thus the actual farming patterns found reflect social as much as physical conditions.In dividing any class, the choice of limits is difficult and their significance to agricultural operations more tenuous. This is particularly so in Class 3 and for this reason only two divisions are proposed.

Division 1

Land in this division is capable of producing consistently high yields of a narrow range of crops (principally cereals and grass) and/or moderate yields of a wider range (including potatoes, field beans and other vegetables, and root crops). Short grass leys are common.

Division 2

This land is capable of average production but high yields of grass, barley and oats are often obtained. Other crops are limited to potatoes and forage crops. Grass leys are common and reflect the increasing growth limitations for arable crops and degree of risk involved in their production.

The divisions of Class 4

The class comprises land marginal for the economic production of crops and usually confined to types suitable for winter feeding to livestock. Farming enterprises on this land are based primarily on livestock production, as with Class 3, year to year variability in crop yield is large, but the risks of crop failure or poor weather interfering with harvests are higher. Class 4 land is principally found where the deleterious effects of many types of limitation combine. Foremost among these are high rainfall causing wetness limitations, particularly in central and western Scotland. In southern and eastern Scotland, however, shallow or sandy soils and low rainfall are responsible for some areas being included in the class because of drought limitations. As with Class 3, the critical parameters are climate, wetness and droughtiness.

Division 1
Land in this division is suited to rotations which, although primarily based on long ley grassland, include forage crops and cereals for stock feed. Yields of grass are high but difficulties of utilisation or conservation may be encountered. Other crop yields are very variable and usually below the national average.

Division 2
The land is primarily grassland with some limited potential for other crops. Grass yields can be high but the difficulties of conservation or utilisation may be severe, especially in areas of poor climate or on very wet soils. Some forage cropping is possible and, when the extra risks involved can be accepted, an occasional cereal crop.

The divisions of Class 5
By definition, land included in Class 5 is suited to use as grassland and to improvement by mechanised means. Improvement may take the form of regeneration (reseeding of previously sown swards which have deteriorated in quality through time) or reclamation (the production of new grasslands from previously uncultivated natural or semi-natural vegetation). By 'mechanised means' is understood all techniques for the production of grassland from full ploughing to surface seeding without the disruption of soil. Class 5 land is broadly constrained by climate limitations to hill areas where risks are too great for arable cropping. Other limitations are usually subsidiary in determining the overall pattern of class distribution but become important in intra-class ranking and in determining the boundary between Classes 5 and 6. The assumption regarding level of management is significant in determining what land is to be considered improvable, since it involves a favourable balance in input output relationships. This latter criterion should not be carried too far however, for it is the physical qualities of the land which are diagnostic. Many other characters, such as the pattern of land ownership, farm structure, availability of roads and the farmer's preference may determine the actual areas selected for improvement within the class. The allocation of land to Class 5 only indicates a potential for some improvement, which is attainable within a very short time scale compared with the slower improvements which result from careful grazing management within Class 6. It is useful, therefore, to know whether the improvement results in valuable grassland with long term potential or grassland with only short term potential and requiring constant maintenance. Sward quality of improved grasslands and their levels of production are always high compared with the semi-natural grasslands found in hill areas. The important factors to be considered in improvement are (a) the ease or otherwise of establishment of the sward, (b) the persistence of the sown species, (c) the costs of maintenance and (d) whether the resultant sward can be used for grass conservation or whether it must be grazed.

Division 1
Land well suited to reclamation and to use as improved grassland Establishment of a grass sward and its maintenance present few problems and potential yields are high with ample growth throughout the season. Patterns of soil, slope or wetness may be slightly restricting but the land has few poaching problems. High stocking rates are possible.

Division 2
Land moderately suited to reclamation and use as improved grassland Sward establishment presents no difficulties but moderate or low trafficability, patterned land and/or strong slopes cause maintenance problems. Growth rates are high and despite some problems of poaching, satisfactory stocking rates are achievable. Division 3 Land marginally suited to reclamation and use as improved grassland Land in this division has properties which lead to serious trafficability and poaching difficulties and although sward establishment may be easy, deterioration in quality is often rapid. Patterns of soil, slope or wetness may seriously interfere with establishment and maintenance. The land cannot support high stock densities without damage and this may be serious after heavy rain, even in summer.

The divisions of Class 6
Land included in Class 6 is unsuited to improvement by mechanised means but has some sustained grazing value. The grazings must be available for five months or more in any year. Improvements to sward quality and quantity have been practised in these areas for many years and include stock control by fencing, encouragement to the grazing animal to range (mosaic improvements of small areas « 40%) by limited mechanical means) and by burning. In general, such improvement techniques are slow compared with those available on Class 5 land and often achieve their more striking successes only on the best land of the class. With such a wide range of sward quality included, attention has been given to developing a technique of assessing relative grazing values of different swards. In this, the use of adequately described and defined plant communities (e.g. Birse and Robertson 1976) was invaluable. The number and type of plant communities in any area can be determined and the value of each to the grazing animal assessed. Communities dominated by grasses are usually of high relative value; those by dwarf shrubs and mosses of low value. Management of hill and mountain areas has often resulted in the modification of the original plant communities, sometimes fairly substantially. The resultant replacement communities have a relationship with the original communities and, if the particular form of management ceases, will revert to them within a short period. In the broad sense there is a relationship between the semi-natural and replacement communities and the underlying soil types, and both are related to climatic zones in mountainous areas which allow useful suitability groups to be identified. It must be stressed that rarely does one plant community cover a large enough area to map individually, but mosaics of plant communities are found which are averaged to give values for the area.

Division 1 High grazing value
The dominant plant communities contain high proportions of palatable herbage, principally the better grasses, e.g. bent-fescue or meadowgrass-bent pasture.

Division 2 Moderate grazing value
Moderate quality herbage such as white and flying bent grasslands, rush pastures and herb-rich moorlands, or a mosaic of high and low grazing values characterises land in the division.

Division 3 Low grazing value
The vegetation is dominated by plant communities with low grazing values, particularly heather moor, bog heather moor and blanket bog.

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