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TRANSPORT SCOTLAND

Edinburgh Glasgow Improvement Programme Strategic Review

egip
Edinburgh Glasgow
Improvement Programme

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1 Executive Summary

1.1 Transport Scotland Requirements

In its start up briefing, Transport Scotland, (TS) requested that Jacobs conduct a short sharp review of the current EGIP programme to confirm the current scope and to investigate any alternative solutions that provide similar benefits.

In undertaking this review we understood that the key EGIP objectives can be summarised as;

- Increase capacity on the Edinburgh – Glasgow Route
- Deliver a reduction in journey time
- Reduce the Carbon footprint

TS asked Jacobs to appraise certain EGIP elements in more detail, in particular:

1. Whether all the infrastructure schemes on the Edinburgh and Glasgow route are required?
2. Whether it is possible to defer some of the infrastructure elements and thus defer cost?

Jacobs were also asked to consider alternative options to the existing Programme that could be considered attractive and viable to TS. For any alternative option, Jacobs had to provide sufficient evidence to justify further investigation and possible deviation from the existing Programme

1.2 Existing Programme

In considering the existing programme, available documentation dating back to 2007 has been reviewed. Although a number of options for capacity improvements were identified in early reports, the preferred solution was quickly identified as increasing capacity by increasing the number of services, rather than increasing the length of existing services. No detailed evidence was found that specifically indicated why the longer train options were not investigated in more detail. We believe that the issues related to increasing the length of trains at Queen Street station were considered irresolvable at the time.

Accepting that the increase in frequency to 6 trains per hour was considered the only sensible option at the time of the scheme development, then the infrastructure works identified to deliver this increase in service are considered necessary. Previous work has confirmed that most of the infrastructure works packages were only required for the increase in service frequency. There is no evidence or reason to believe that this position was not the most sensible, given the information available at the time.

Analysis of the works packages indicate that with the possible exception of the electrification extension to Stirling, Alloa and Dunblane, all the major infrastructure improvements would be required in order to deliver the benefits from the 6tph timetable. We have supported this opinion with our own modelling of the 6tph scenario. Although we have spent less time in detailed analysis, we also concur that a regular 5tph service would be difficult to introduce, whilst maintaining and improving performance, without the additional infrastructure that the current EGIP programme requires. We are therefore satisfied that the works packages identified for current Scheme are necessary for a 6tph service.

In considering whether the CAPEX figures can be reduced in individual years by extending the programme, we have concluded that there would be no difficulty from a construction perspective of reprogramming the works sequentially. However, we see little benefit from this as apart from increasing the overall price due to the extended requirement for fixed overheads, we do not believe that the majority of the programme benefits can be realised until all the packages have been completed. If electrification is completed first, it is likely that overcrowding would increase in the short term as the service frequency could not be increased until the infrastructure improvements were completed. If the infrastructure works were undertaken first, passengers would be inconvenienced by years of disruption, at the end of which they would be unlikely to perceive any benefits as a shortage of rolling stock would limit capacity improvements and the diesel fleet would be unable to improve journey time. If a new High Speed line were to be constructed between Edinburgh and Glasgow, there is also the possibility the infrastructure improvements could be rendered redundant by the diversion of fast services to the new line.

We therefore conclude that the current scheme is correctly specified for the proposed service and that it is unlikely that substantial savings could be made without adversely affecting the delivery of the programme objectives

1.3 Alternative Proposal Delivering Savings and Functionality

As identified above, the existing scheme was developed, on the information available at the time. This appeared to preclude serious consideration of extending the length of existing services.

On the 26th September 2011, Network Rail announced proposals to redevelop Queen Street station indicating that all the existing structures between the Concourse and West George Street would be removed.

Given this opportunity, we have reviewed the potential to remodel Queen Street station to accept 8 car trains. Having explored a number of alternative approaches, a possible solution has been developed for this study. As this proposal has been developed in isolation, it is not a defined solution but rather a concept from which we believe a successful design can be achieved. Our proposal offers three 8 car platforms, three 6 car platforms and a 4 car platform. As the service frequency to Edinburgh is not increased to 6tph, we have not developed platform 7a. The permanent way design, is not fully compliant to current standards but we believe is equivalent to the current Arup Grip 3 design. Our signalling proposal will again require consideration and derogations but is based on installations safely and successfully operating elsewhere on Network Rail.

We have developed a concept for the revised concourse, identifying critical pedestrian routes and including a new footbridge spanning the width of the entire site from the proposed Buchanan Galleries extension to Dundas Street, thus relieving pressure on the existing Dundas Street entrance. Although only an initial concept, we believe we have demonstrated that an alternative remodelling of Queen Street station could deliver 8 car services for the Edinburgh route.

Although the existing Scheme is at GRIP 4, we believe that given suitable support, our alternative proposal should not necessarily delay the introduction of benefits to passengers, although issues like planning might defer the full completion of the Scheme.

In addition to Queen Street, in order to operate 8 car services, four intermediate stations would require platform extensions or approved for Selective Door Operation. Edinburgh Waverley would also require the station working to be recast but we believe possess sufficient platforms for an 8 car service to be accommodated.

An increase in the length of the current 4 trains per hour from 6 to 8 cars would increase capacity on the route without the need for the major infrastructure works identified for the existing EGIP scheme. The electrification of the core route would see journey time improvements on all services between Edinburgh and Glasgow with an aspiration of 42 minutes. In order to relieve specific overcrowding as well as setting a headline journey time, we believe that it would be possible to incorporate one fast service each way per day.

1.4 Conclusion

If the six trains per hour scheme of the existing programme is accepted as the way to proceed, then the current infrastructure schemes are correctly specified. Whilst it might be technically possible to defer some of the infrastructure elements, we do not believe that the majority of the programme benefits identified in the existing programme can be realised until all the packages have been completed. Therefore, any cost deferral will have to be balanced against the delay in the delivery of benefits to passengers.

There is however a new opportunity to align with the requirement to identify alternative options. If accepted, we believe that our alternative proposal would enable Transport Scotland to substantially reduce the CAPEX and OPEX budgets for the EGIP scheme.

Although changing the design at this stage risks some delay to the final completion date, we believe that our alternative proposal meets all the objectives of EGIP;

- Increase capacity on the Edinburgh – Glasgow Route
- Deliver a reduction in journey time
- Reduce the Carbon footprint

Whilst substantially reducing both the CAPEX and OPEX budgets.

Contents

2 Introduction

2.1 Background

Transport Scotland, (TS) indicated that internal discussions had taken place about the ability to fund the full Scottish rail programme through CP5 and the government wanted to take the opportunity to conduct a governance review of the scheme. This review would be independent and consider whether this is the "right scheme" to progress especially given the backdrop of the cost of rail in Scotland.

The Edinburgh – Glasgow Improvement Programme, (EGIP), was initiated in 2007. A primary driver for EGIP was the forecast that capacity on the Edinburgh – Glasgow via Falkirk High corridor would become an issue by 2019/20. The key objectives of EGIP were therefore to;

- Increase capacity on the Edinburgh – Glasgow Route
- Deliver a reduction in journey time
- Reduce the Carbon footprint

2.2 Client Requirements

In setting their challenge, Transport Scotland has asked Jacobs to appraise certain elements of the current EGIP in more detail. These include:

- Are all the infrastructure schemes on the E and G route required?
- Is it possible to defer some of the infrastructure elements by extending the construction programme 5, 10 or 15 years and thus deferring cost?
- What is the optimum journey time?
- When is the right time to electrify?

Jacobs were also asked to consider alternative solutions that could be considered attractive and viable to Transport Scotland. During initial discussions, a variety of options were discussed and identified for addressing. These included;

- Is there a demonstrably viable alternative to the 6 trains per hour of 6 cars as currently proposed for EGIP?
- Would a 6 trains per hour standard calling pattern work?
- Would a total recast of the Scottish timetable deliver benefits?
- How long would 4 trains per hour capacity last at 6 car and 7 car under both diesel and electric traction options?
- If a 4 train per hour 8 car train solution were viable, when would capacity be reached
- If a High Speed line were to be constructed between Glasgow and Edinburgh, what impact would it have on EGIP infrastructure?

2.3 Deliverables

Transport Scotland has requested that the deliverables from this study are provided in two formats;

1. A written report, documenting the Study, the options considered, outline proposals supporting evidence or opinion and recommendations

2. A power point presentation summarising the Study that would be suitable for briefing senior staff in Transport Scotland and in the Scottish Government

Given the short time frame for the Study and the directions from Transport Scotland that Jacobs were to work independently from the EGIP delivery team, the typical stakeholder engagement activities for a study of this were not undertaken. The only documentary evidence that Jacobs has been able to utilise is that held by Transport Scotland or in the public domain. Detailed site information, historical records and internal development proposals, particularly relating to the Buchanan Galleries Queen St scheme have therefore not been available to Jacobs. No externally managed model runs have been undertaken due to the limited timescales and confidentiality. However, Jacobs has constructed some models within the team to test certain assumptions.

2.4 Our Approach

Having carefully considered the Transport Scotland requirements, and with particular consideration to the limited time and confidentially, the team decided to concentrate on those elements of the current EGIP Programme that had the potential to deliver the best output benefits. Therefore, smaller elements, like the Bellgrove Remodelling and Finnieston Turnback have not been examined.

The team has divided its work activities into two discrete segments;

1. The first focuses on the existing 6tph Programme, whether all elements are required, whether the construction programme can be modified and whether there are any opportunities for substantial savings

2. the objectives of the programme, i.e. increase in capacity, the reduction in journey time and the reduction in the Carbon footprint and looked afresh at possible solutions

Transport Scotland requested that we provide sufficient information for an informed decision to be made on whether there was reasonable grounds for diverting from the existing programme in order to more fully develop any alternative proposal. Any alternative proposal put forward by Jacobs, should be capable of being implemented in similar timescales to the existing programme, whilst still delivering the identified savings. As the existing EGIP scheme is currently in GRIP 4, it is well advanced on any proposals put forward by Jacobs which could only be considered GRIP 1 at best. We have therefore tried to utilise existing work wherever possible.

Wherever possible, we have tried to identify whether they have been considered before and any reasons for their not being progressed. Where evidence was found that justified the abandonment of ideas, we have not progressed them. Our proposals are therefore based on concepts that we can find no evidence for previous abandonment.

It should be recorded that as these proposals were developed by a team working independently, there could be reasons preventing their development of which the team was not aware. It must also be recognised that for a number of challenges we have proposed adopting non standard solutions albeit similar to those adopted elsewhere on Network Rail infrastructure.

3 Current EGIP Proposal

Fundamental to the Base EGIP proposal is the requirement to deliver increased capacity on the main E&G corridor. Throughout the development of EGIP this has been interpreted as increasing the frequency of train services from 4 TPH (trains Per Hour) to 6 TPH. The base proposal would not only increase capacity by some 50% but would also provide the additional benefit of offering passengers more trains to choose from when planning their journeys. Whilst this proposal delivers increased capacity it also drives the requirement for the overwhelming majority of EGIP infrastructure and journey time improvements.

3.1 6 Trains per Hour Proposal

Exhaustive reviews of various timetabling permutations confirmed that only by enhancing the current infrastructure could the 6tph E&G train plan be delivered without adversely affecting other services. Our review concurs with that conclusion.

In short, if service frequency (rather than capacity enhancement) is viewed as the prime objective then all of the infrastructure enhancements currently proposed will need to be undertaken. Such are the capacity constraints and operational conflicts along the E&G that the requirement for the infrastructure programme as currently proposed would also be required to facilitate the introduction of a 5tph service or 6tph service with a 3+3 or standard calling pattern.

3.2 Route Electrification

In order to ascertain whether it is possible to reduce costs on the core electrification scheme, a high level review of the Atkins Grip 3 Report was undertaken. The key objectives of the review were to identify whether it would be possible to reduce the number of feeder stations if the electrification to Stirling / Dunblane / Alloa was deferred and whether the current design was considered “over engineered” and capable of simplification.

3.2.1 Traction Power

Regrettably, the traction power distribution and system modelling was unavailable at the time of review. However, as the proposed electrification of the Glasgow Queen Street to Edinburgh Waverly route appears to be an extension to existing electrification assets, the approximation for existing traction feeder stations can be reasonably assumed.

Consequently, it is assumed that there exist substantial bulk power feeder stations in the Glasgow and Edinburgh areas that are adequate for existing routes and for expansion of the proposed electrification route. However, when supplies from these existing feeder stations are applied to the proposed electrification route it is likely that a voltage drop from these assumed feeder stations will probably affect the minimal pantograph voltage that may affect to the operational performance of the rolling stock and consequently a threat to performance. To provide resilience and security of supply into the traction system it is favourable to provide a twin fed power supply to an appropriate mid-point location. This will ensure that under full availability of power supply connections the voltage at the pantograph can be maintained at the required nominal voltage of 25kV. In the event that a power supply is lost under fault or planned outage, the system should be robust enough to maintain pantograph voltage to minimum levels. The traction power voltage diagram included as figure 2 refers. Furthermore, this mid-point feeder will also be able to provide robust traction power to the Stirling and Alloa branches (should this be progressed) with the provision of further enhancement and back-up from an alternative future source.

The proposals examined thus far indicate that these principles have been diligently and economically applied.

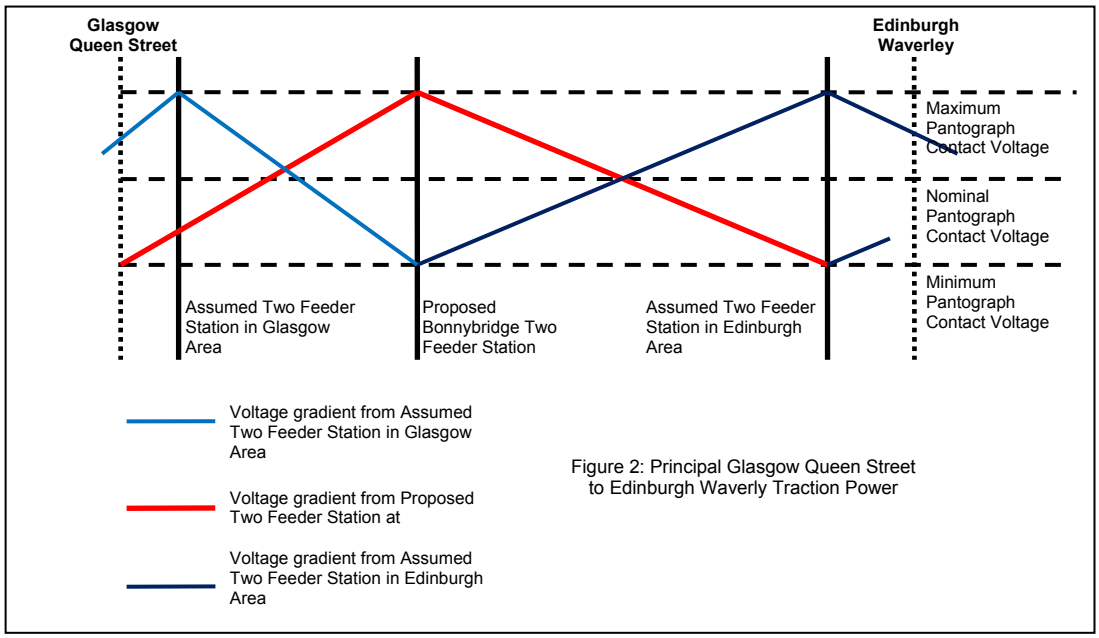


Figure 2: Principal Glasgow Queen Street to Edinburgh Waverly Traction Power

Figure 2: Principal Glasgow Queen Street to Edinburgh Waverley Traction Power

3.2.2 OHLE

It is assumed that the proposed electrification of the Glasgow Queen Street to Edinburgh Waverley route is an extension to the adjoining existing traction systems. It is therefore assumed that traction power is based on the existing 25KV AC 50Hz single phase overhead line system.

3.2.3 Electrification Conclusion

In principle, the recommendation of the GRIP3 study for traction power for EGIP is regarded to be compliant and economic to meeting the requirements for each of the priority routes, diversionary routes, linked opportunities and extensions either individually or collectively. It is regarded to be a robust system wide solution. However, there may be opportunity subject to review of the presently unavailable traction system report to examine the feeding arrangements at the extremities of the EGIP route and the possibilities of alternative feeding configuration.

It would seem that there is no practical value to steer away from a booster transformer arrangement for the OHLE as this arrangement matches the existing adjoining electrification and a change to either a simplified AC system or an autotransformer system would provide no benefit and may possibly be adverse.

The provision of a twin feed at Bonnybridge would provide secure and reliable traction power for the principal route between Glasgow Queen Street and Edinburgh Waverley and also accommodate without major disruption or increase in capacity/availability the subsequent development to this main route. It is not considered that the deferral of electrification to Stirling / Dunblane / Alloa would result in a reduction in the requirement for new feeder stations and that therefore the only saving from the deferral of this element is in the OHLE costs

3.3 Delivery Programme

3.3.1 Existing Programme Review

This EGIP review is based on the request from Transport Scotland to look at the existing programme and consider whether it offers an efficient delivery of works. We have also been asked to consider the potential to extend the construction period by between 5 and 15 years by deferring certain elements of the scope. The effect of this deferment would be to reduce the CAPEX expenditure in the years 2016 to 2019.

A high level review of the current programme would indicate that delivery of the scope as defined in the existing EGIP proposal would be achievable. We are comfortable that the evidence we have reviewed indicates that the programme being developed does represent an efficient approach to the delivery of the works specified.

3.3.2 Programme Slippage or Deferral

It is critical that whilst we consider that the overall scope is scalable in terms of work packages as it stands, a number of issues arise if the programme were to be extended and certain elements of works deferred. The central issue is that the majority of the work packages are required to be delivered in order to achieve the benefits of the Programme. This is perhaps best illustrated by considering the sequential delivery of electrification and the key infrastructure improvements at Greenhill Junction and the Winchburgh – Dalmeny Chord.

Electrification on its own would enable electric services to operate between Glasgow and Edinburgh but only as the existing 4 trains per hour of 6 cars. The lack of the infrastructure improvements would preclude the increase in service to 6 trains per hour. Whilst the electric service would reduce journey time, one of the main drivers of the Programme is the forecast that the route will be at capacity by 2019. Electrification on its own will not deliver increased capacity and the reduced journey time might even increase existing forecast loadings.

3.3.3 Alternative to Initial Electrification

An alternative to initial electrification would be the construction of the major infrastructure works on the route. It would be perfectly feasible to construct Greenhill Junction and the Winchburgh – Dalmeny Chord, which the current programme indicates falls within the period 2013 to 2015, as a first stage of an extended programme. The difficulty with this proposal is that the works are expensive and would cause disruption to passengers, who would see very little direct benefit upon their commissioning. Deferment of the overall scheme may result in these works being in place for a significant period of time until the whole scheme benefits are realised and in terms of public opinion they may not necessarily be seen to deliver any perceived benefit for the investment in the short term.

3.3.4 High Speed 2

If on completion of the packages a decision is taken to construct a new High Speed Line between Edinburgh and Glasgow, this could render the improvements redundant were the additional services removed from the E&G route and transferred to the new High Speed Line.

3.3.5 Deferral Implication

There might be potential to defer certain individual packages, for example the electrification to Stirling, Dunblane and Alloa. Should this or any other package deferral be pursued, consideration would need to be given to the following:

It is fundamental that the overall design is based upon the correct agreed scope, whilst elements may be deferred or deleted in their entirety it is important that the design does not limit or preclude future considerations, amendments or alterations. Consideration must be given to the design as a whole and potential staging of works to allow future incorporation of work packages if required. Key to achieving this is a robust procurement strategy which builds in this flexibility. For example, it might be necessary to order a reduced number of electric vehicles in the initial procurement exercise but with an option for a second batch.

It may be sensible in terms of future proofing to commit to doing the design of the complete proposal as a minimum, ensuring that the various elements are considered and fully integrated.

Key elements

- Signalling
- OLE in terms of isolation and load distribution
- Alignment – Grade separated Junction and the Dalmeny Chord
- Parallel projects

3.3.6 Delivery

The current EGIP proposal to increase services to 6 trains per hour hinges on the delivery of significant infrastructure enhancements, Greenhill grade separated junction and the Dalmeny Chord amongst others.

The current programme has a number of disruptive / critical possessions identified. It is reasonable and practicable to assume that key (EGIP) outputs can be achieved using these, however extending the programme will have a significant impact. It is reasonable to assume these will require adjustment or in some cases cancellation if in detailed planning it is determined that they no longer facilitate the delivery. This is likely to result in the need for more disruptive possessions spread over an extended programme period of say an additional 5 to 10 years. There is an obvious cost impact in increasing the number of disruptive possessions and in managing the process. Again this would need to be factored into the procurement of the management and delivery of the project.

It is perhaps important to stress that an extension of a construction programme also extends the time and cost of the Project Management team and that assumed savings might not be deliverable.

3.3.7 Programme Conclusion

Whilst it is technically possible to defer the overall project programme by between 5 to 15 years, it would require careful consideration of all aspects. In particular, it must be recognised that the majority of benefits identified in the current scheme will only be realised upon completion of most work packages. The only potential exception to this, which we have not proved, is to defer the electrification to Stirling, Dunblane and Alloa.

An extension to the construction programme will require a more detailed integration plan to ensure success, it is however likely to outturn at a significantly higher total project cost. We believe that it is likely that a proposal to extend the existing programme by between an additional 5 to 15 years would mean that the project would be subject to challenge on a number of fronts.

3.4 E & G Route Performance

Increasing capacity and reducing journey times whilst improving punctuality and reliability are at the heart of the EGIP programme. It is essential that any improvement in journey time or increase in capacity does not adversely affect the punctuality and reliability of services.

3.4.1 Current E&G Punctuality and Performance

Information provided by the client shows that train performance on the E&G in 2005 was poor with less than 90% of trains arriving within 10 minutes of their scheduled arrival time. Clearly, the journey time review undertaken in 2006 and subsequent performance improvement initiatives have paid dividends as E&G punctuality on both the 0-5 and 0-10 measure has improved dramatically.

The latest performance information produced by First Scotrail shows that in Period 13 (to March 31st 2012):

- 94.7% of all E&G services arrived within 5 minutes of their scheduled arrival time.
- 97.7% of all E&G services arrived within 10 minutes of their scheduled arrival time.
- 0.6% of services were cancelled in part or full.

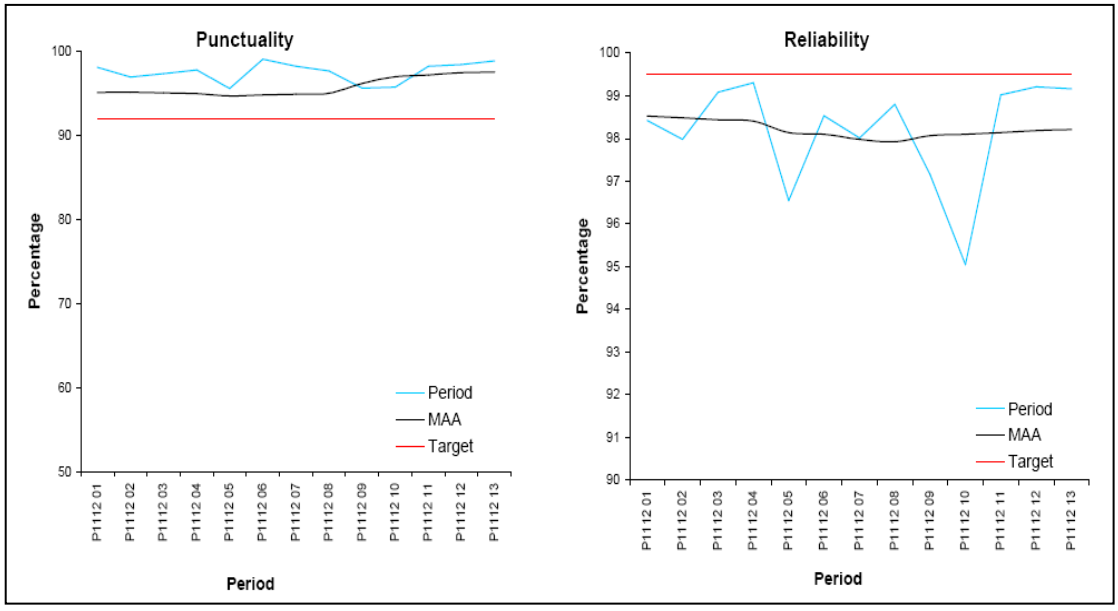


Figure 3: E&G Period 13 Punctuality & Reliability Statistics

Although current performance offers scope for further improvement it should be acknowledged that current E&G punctuality and reliability compares favourably with other, similarly intensive “inter-city” operations.

3.4.2 Route Cause Delay on E&G

In so far as delay minutes are concerned 55% of all delay minutes incurred on the E&G were attributed to Network Rail whilst 45% of delays were attributed to FSR and 10% to other Train Operating Companies (TOCs).

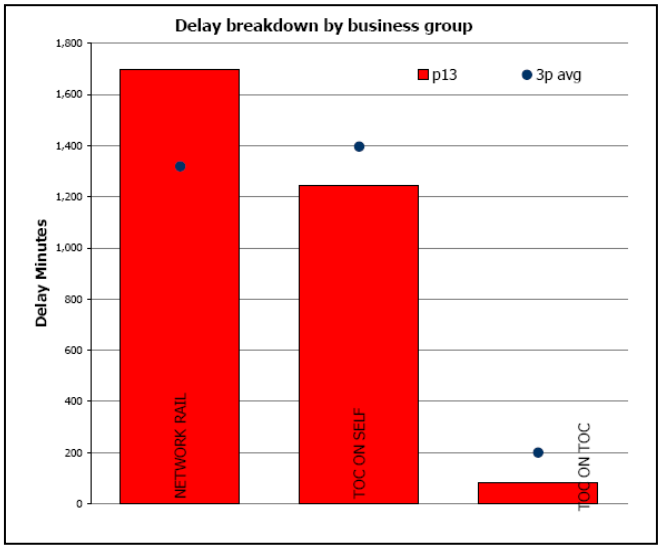


Figure 4: Period 13 E&G Delay Minutes

Whilst most of the Network Rail delays are attributable to the effects of planned or emergency speed restrictions, as the graph below illustrates by far and away the most significant cause of FSR delay on the E&G is fleet related (701D & 701A)

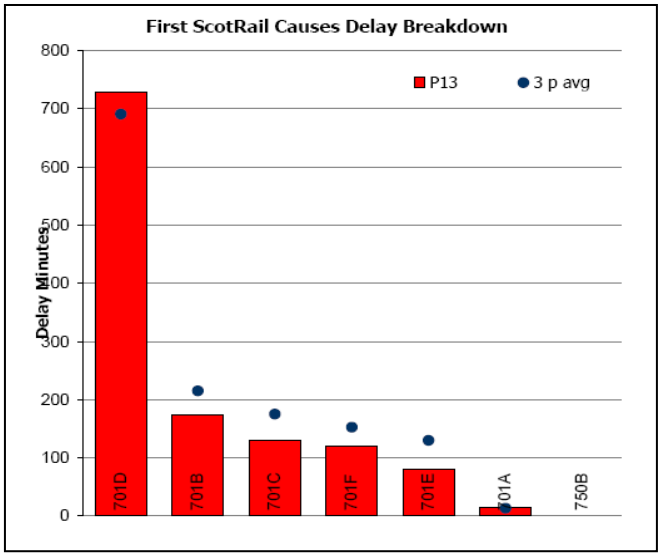


Figure 5: Period 13 Scotrail Causes Delay Breakdown

3.4.3 Route Performance Moving Forward

The step-change in train performance on the E&G since 2006 provides an excellent platform for yet further improvement and care must be taken to ensure that improvements in journey time and capacity also enhance train performance. Analysis of current delay trends suggests that improving the reliability and availability of rolling stock as well as taking forward measures designed to improve the robustness of the infrastructure will be key in ensuring that train services remain punctual and reliable. With this in mind, it should be acknowledged that the proposed introduction of new AC EMU's will not only contribute to an improvement in journey time but *should* also result in an improvement in the availability and reliability of the E&G fleet, thereby reducing the most significant cause of FSR delays currently experienced on the E&G.

4 Alternative EGIP Proposal

It is understood that historically, the primary reason that train lengthening on the Edinburgh and Glasgow route has not been pursued is that it was not previously considered possible to accommodate longer trains at Queen Street Station. Whilst a small number of 7 car trains might be accommodated in the present station, it was accepted that a standard increase to 8 car trains was not practicable. The main reason for this was that the extension to the Millennium Hotel, formerly the North British Hotel, prevented any extension of tracks across the existing concourse. However, we believe that a small window of opportunity has opened that could allow the operation of 8 car services on the Edinburgh to Glasgow via Falkirk High Route.

On the 26th September 2011, Network Rail announced plans for a multi million pound redevelopment of Queen Street station. The supporting illustration, below, showed that the Millennium Hotel Extension had been removed as trains could be clearly seen from the vantage point in George Square.

4.1 Glasgow Queen Street HL Station

This proposal is not presented as a definitive design for Queen Street but rather as a proof of a concept that an acceptable design, meeting revised requirements should be possible. Neither the track nor signalling solutions fully comply with Network Rail standards without the need for derogations and will require careful consideration by the relevant engineers and committees before an acceptable solution is agreed upon. We do however believe that our track proposal is no worse than that proposed by Arup in their Grip 3 design and that the signalling solutions proposed have been based on similar installations elsewhere on Network Rail.

4.1.1 Operational Concept of Alternative Proposal

In developing our alternative design for Queen Street Station, we have endeavoured, as a minimum, to retain the existing routing capability whilst delivering sufficient platforms for an 8 car Edinburgh – Glasgow service. We have endeavoured to extend the other core platforms to 6 cars, whilst allowing the use of Platform 1 by 4 car services. This initial concept was developed by an operator before the design was completed by relevant engineers.

We have accepted the current Grip 3 Arup design for the crossovers in the Queen Street High Level tunnel. The distance of these crossovers from the portal increases the occupation of critical routes by most movements in the station. Without the opportunity to discuss this design with Network Rail, we do not know the reasons behind the current design, although we have noted the opposition to the Scissors proposal. From an operational perspective, the closer the crossover or scissors can be positioned to the portal, the less time routes will be locked out for individual movements.

Our design proposal is therefore focused on the Queen Street throat from the tunnel portal to the buffer stops. The design provides for speeds throughout the layout to be 20mph and for the critical Edinburgh services to be focused either side of an island on Platforms 5 and 6. This platform concept for dedicated services has been successfully adopted by London amongst others, Heathrow Express at Paddington and Gatwick Express at Victoria. The focus of a service on specific platforms allows the potential of branding and targeted advertising to be focused on these platforms.

i. Alternatives to 6 Trains per Hour

The idea of running longer train sets as an alternative means of delivering enhanced passenger capacity along the E&G route was briefly considered during the early days of EGIP. For reasons we have been unable to ascertain the proposal was not examined in detail but our review has clearly identified that running longer trains is a realistic alternative to running *additional* trains. Running longer trains will present some challenges in so far as the platforming of services is concerned but we believe that those challenges are surmountable and the option of running 8 car trains would not only deliver increased capacity but would also significantly reduce both CAPEX and OPEX.

ii. Timetable Implications of 6tph

Operations along the E&G are both complex and intensive, whilst the capacity and operational challenges posed by both Glasgow Queen Street and Edinburgh Waverley present an additional level of complexity that must be consistently monitored and managed if standards of punctuality and reliability are to be maintained and improved. This has been recognised throughout the development of EGIP with several reports recommending that EGIP should be used as a platform for a full review of the Scotrail timetable. Although our core proposal does not increase the number of services using the E&G we would concur that the opportunity should be taken to review and recast the Scotrail timetable. This will not only allow E&G flagship services to be planned as a priority but would also allow the inefficiencies and complexities which generally accompany the piecemeal development of separate timetables to be addressed in one hit.

iii. Station Approach

Trains approaching Queen Street in the Jacobs alternative proposal on the Down Line can directly access platforms 7, 6 and 5. Trains approaching on the Up Line can directly access Platforms 5, 4, 3, 2 and 1.This differs from the existing station layout which allows trains from the Down Line to directly access Platform 4. The one platform that has direct access to both lines has been changed from Platform 4 to 5. This is because the focus has been switched from shorter services able to use Platform 4 to the 8 car Edinburgh service which can gain maximum benefit from this flexibility.

iv. Platform 7

The length of Platform 7 from buffer stop to signal is approximately 200.9m,. The signal for Platform 7 is located where the 6 foot between tracks 6 and 7 is 1800mm. Whilst this is below the normal standard, it is sufficient to give clearance to trains on both tracks. It should be noted that at this location, the maximum speed is 20mph, whereas the drawings we have for the lines in the tunnel appears to indicate that the 6 ft is 1810mm where the speed in the Up direction is 50mph. The design currently indicates that the signal on Platform 7 offers approximately 6m sighting distance to an uncoupled 94.28m 4 car unit, (8m to an 8 car train). We recognise that this is below the 25m standard, but we believe that there are some options that can be can be explored to deliver a satisfactory solution for driver sighting. The next stage of design should review the detailed survey of the tunnel mouth to identify whether the point work can be moved further into the throat and in conjunction with Scotrail, the use of co-acting signals should be explored as well as the prohibition on splitting 8 car units in the platform. We have deliberately not extended Platform 7 into the concourse as by altering the buffer stop, the platform will lose its “Grandfather Rights” not to have an additional track well beyond the buffer stop. The addition of a well on this platform would adversely affect passenger flows due to the proximity of the corner of the Millennium Hotel. As part of the mitigation for reducing risk in this platform, we propose to direct the majority of Class 3xx 8 car services to platforms 5 and 6.

v. Platform 6

The initial proposed length of Platform 6 from buffer stop to signal is approximately 200.3m. The signal for platform 6 is located where the 6 foot between tracks 6 and 7 is 1800mm. As described above, whilst this is below the normal standard, it is sufficient to give clearance to trains on both tracks. Signal sighting should offer at least 6m and as the signal will be on the drivers side of the cab, improved sighting over the signal on platform 7. In order to ensure improved signal sighting distance, the buffer stops on platform 6 have been extended 2m into the concourse. This alteration has automatically triggered the requirement for an extended track well beyond the buffer stops. Our calculations, shown in Appendix D indicate that we must provide at least 10m from the face of the buffer stops. In the next stage of design, in conjunction with the modelling of pedestrian movements, it might be possible to move the buffer stop further into the concourse, thereby increasing the distance available for signal sighting.

vi. Platform 5

The length of Platform 5 from buffer stop to signal is approximately 200.1m. Platform 5 is probably the most problematic platform in the design. The 200m has been created by siting the signal on the toes of the points and extending the track 16m into the concourse, with the additional 10m well. We recognise the issues on positioning a signal so close to the turnout. We believe that we have sufficient clearance between the tracks to locate the signal away from the platform, improving sighting for the driver and could, if necessary provide co-acting signals in addition to the main signal. In the next stage of design, in conjunction with the modelling of pedestrian movements, it might be possible to move the buffer stop further into the concourse, thereby increasing the distance available for signal sighting. We therefore believe that, as elsewhere, a safe solution can be developed.

vii. Platform 4

The length of Platform 4 from buffer stop to signal is approximately 157.1m, sufficient for a 6 car class 170. The signal for Platform 4 is located on the ramp of the platform. It offers approximately 9.5m sighting to a driver which should be sufficient. Platform 4 is also extended 16m into the concourse, primarily to balance the track well on Platform 5.

viii. Platform 3

The length of Platform 3 from buffer stop to signal is approximately 155.6m, sufficient for a 6 car class 170. The signal for Platform 3 is located on the ramp of the platform. It offers approximately 8m sighting to a driver. It is recognised that this might be insufficient for adequate sighting. The signal is placed where the 6 ft is 1970mm and some additional length could be obtained by moving the signal to the location where the 6ft is 1800mm. Whilst it might also be possible to gain a short distance into the concourse, we would prefer to seek alternative ways of reaching satisfactory sighting, if necessary through the use of co-acting signals. Platform 3 is extended 14m into the concourse. It is currently shown shorter than Platforms 4 and 5 as we are trying to maximise available space to the corner of the existing Boots retail unit.

ix. Platform 2

The length of Platform 2 from buffer stop to signal is approximately 157.4m, sufficient for a 6 car class 170. The signal for Platform 2 is located on the platform. It offers approximately 9.8m sighting to a driver and is situated on the driver's side of the cab. It has been identified that Platform 2 offers potential for accommodating longer trains, although they would block access to Platforms 3 and 4, This would require an additional signal on the ramp of the platform, in a similar manner to the second signal on platform 5 today. For ease of clarity, we have not illustrated this option but note it as a possibility.

x. Platform 1

The length of Platform 1 from buffer stop to signal is approximately 107.6m, sufficient for a 4 car class 170. The signal for Platform 1 is located on the cess side of the track. As drawn, it offers approximately 7m sighting to a driver of a class 170 and is situated on the driver's side of the cab. We believe that should the design be taken forward, this signal could be moved some metres further away from the buffer stops. In order to achieve this length, Platform 1 has been extended back into the train shed extension and would require the removal of the existing train crew accommodation and operations centre. As part of our proposal, we have therefore relocated these facilities into the Buchanan Galleries development alongside Platform 7.

Platform	Length (m)	Number of 23m Cars
1	75	3
2	162	6
3	125	5
4	125	5
5	168	7
6	173	7
7	192	8

Table 4: Current GQS Platform Standages*

**Source – Arup EGIP Grip 3 Engineering & Technical Report and NR Rules of the Plan*

1 - The third column in the table assumes that 2 m is provided at the buffer stop and 4m is provided for splitting / joining of trains for 6 cars or greater.
2 - Platform 2 is shown as providing 162m but our measurements indicate that this is the distance from Buffer stop to signal and not usable platform length.
3 - Platform 6 is shown as accommodating 7 car trains but this is based on 23m length. It is likely that Class 170's at 23.6m coach length overhang the top of the ramp and reduce signal sighting

Train of 23m vehicles	6 Car	7 Car	8 Car
23m Vehicle	138m	161m	184m

Joining / Splitting Allowance	4m	4m	4m
Buffer Stop Allowance	2m	2m	2m
Standage Required	**144m**	**167m**	**190m**
Signal Sighting Allowance	8m	8m	8m
Track Length required	**152m**	**175m**	**198m**

Table 5: Class 380 Standage Requirements at Queen Street HL Station

Class 380 and 170	**6 Car**	**7 Car**	**8 Car**
23.6m Vehicle	141.6m	165.2m	188.6m
Joining / Splitting Allowance	4m	4m	4m
Buffer Stop Allowance	2m	2m	2m
Standage Required	**147.6m**	**171.2m**	**194.6m**
Signal Sighting Allowance	8m	8m	8m
Track Length required (without co-acting signals or special instructions)	**155.6m**	**179.2m**	**202.6m**

Table 6: Class 380 and 170 Standage Requirements at Queen Street HL Station

Platform	**4 Car 170**	**4 Car 23m**	**6 Car 380/170**	**6 Car 23m**	**7 car 380/170**	**7 Car 23m**	**8 Car 380/170**	**8 Car 23m**
1	25.4m	23m	N/A	N/A	N/A	N/A	N/A	N/A
2	0	0	0	0	9.2m	5m	32.6m	28m
3	0	0	22.6m	19m	46.2m	42m	69.6m	65m
4	0	0	22.6m	19m	46.2m	42m	69.6m	65m
5	0	0	0	0	3.2m	0	26.6m	22m
6	0	0	0	0	0	0	21.6m	17m
7	0	0	0	0	0	0	4.6m	0

Table 7: Additional Platform Standage Required per Train Configuration

From the information available, 7 car 23m trains could be accommodated in platforms 5, 6 and 7 without modification. Whilst this would be suitable for those classes of train consisting of 23m vehicles, the Class 380 and 170 vehicles are 23.6m. Platform 5 would either require some extension or a resolution to reducing the signal sighting distance.

It is noted that a 7 car option would only be suitable for Edinburgh services if the timetable will sustain the Edinburgh services all operating via the single lead from these platforms into the tunnel.

If it were possible to lengthen Platforms 5 and 6 into the concourse, extended to George Square, it could be assumed that 8 car trains might be accommodated without modifications to the throat. Initial investigations into the impact of extending the platforms into an extended concourse, taking into account modern standards for terminal platforms, has identified issues, in particularly with Platform 6 and clearance with the old North British Hotel.

The simplest solution from a construction perspective would be to extend Platform 5 only, offering two 8 car platforms at Queen Street Station. In achieving this, most of the potential concourse to the George Square frontage would be sacrificed for the extension of this single platform. Given the operational risk from only providing two 8 car platforms, alternative solutions were considered to ensure the availability of three platforms. With Platforms 2 and 6 providing the only realistic locations for the third 8 car platform, a conflict with either the North British Hotel or the SPT building seems inevitable.

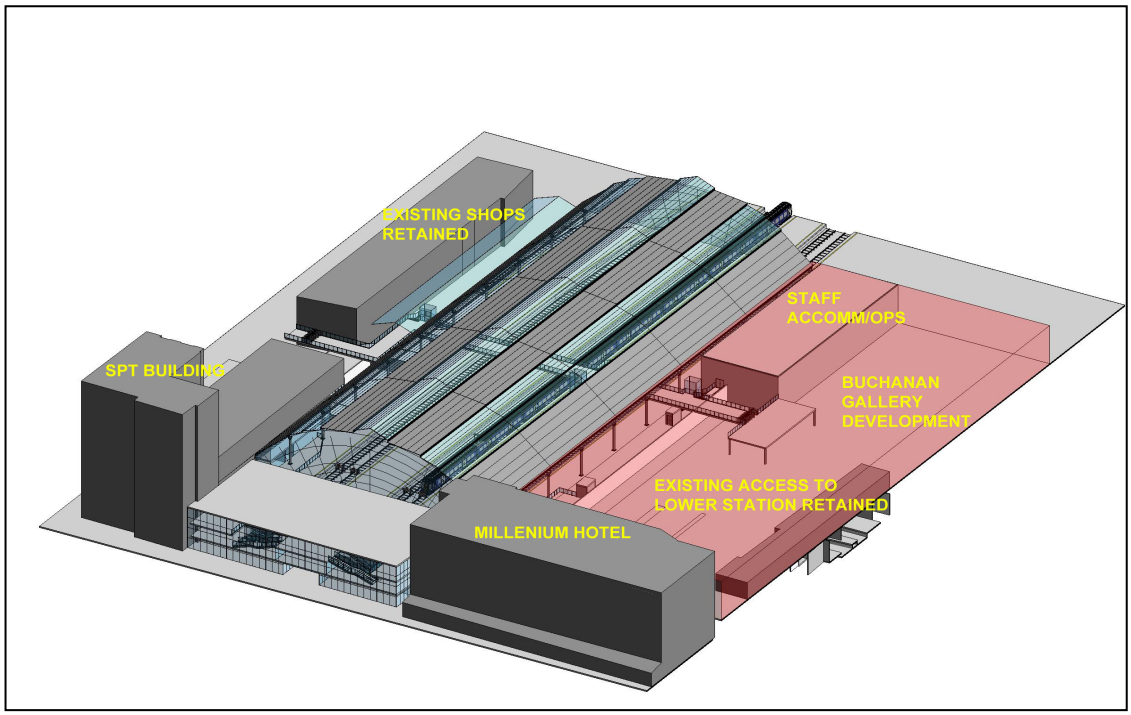
Research has identified that it might be possible to reduce the sighting distance on the signal, consequently reducing the space required in the concourse.

Although not advocating any compromise on safety and being conscious of how critical suitable signal sighting is for a driver we believe that an alternative solution could be reached. Further diligent exploration would be required but given the potential savings to the industry, we believe that the use of the co-actor signals could enable the design to succeed. We recommend this on the strength and understanding that the Co-actor has been operating successfully at Penzance for some years where the cab of HSTs was level with the signal and that another was installed during the recent resignalling at Lincoln.

PZ 70 is shown below.

The conclusions that we have drawn from this analysis is that whilst individual changes could be made to the platforms at the concourse or the track layout in the station throat, the only way that maximum benefit can be obtained is for an integrated design to exploit changes at both ends of the station.

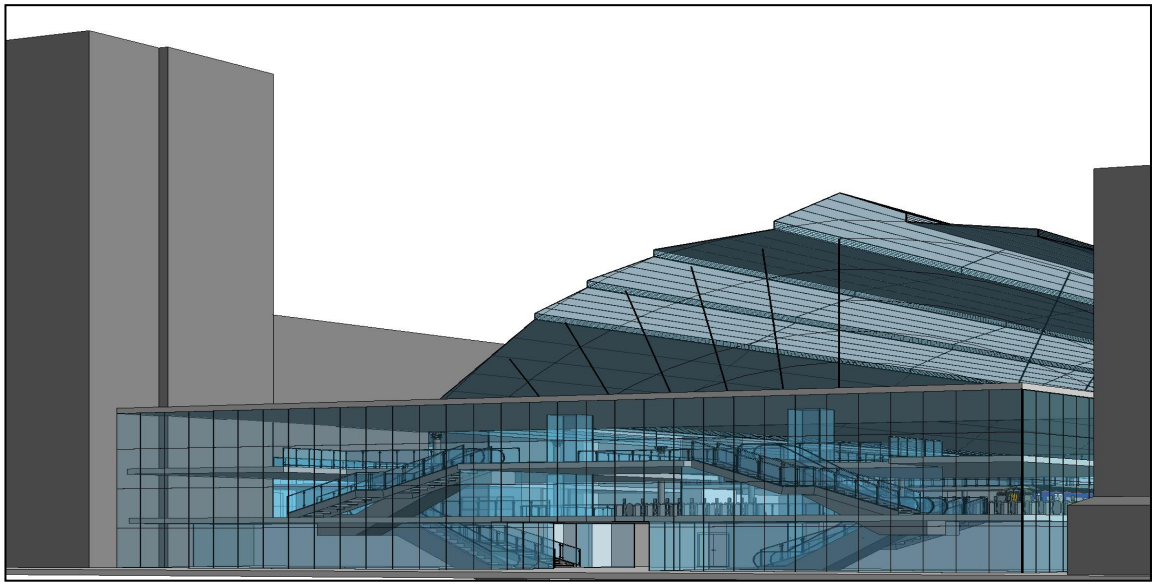
4.1.2 Core Queen Street Station Design



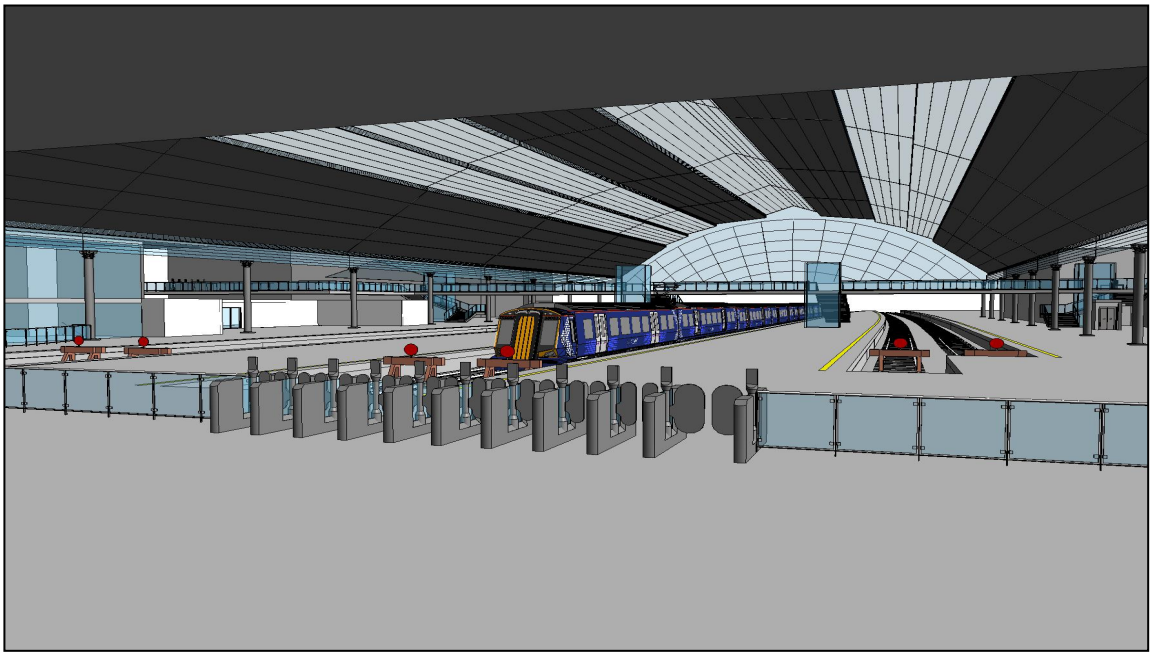
i. Architectural Considerations

Any redevelopment of Queen Street Station to accommodate 8 car services will need to accommodate the impact of permanent way and signalling changes in the throat and corresponding platform extensions southwards, encompassing buffer stops, wells and concourse structure exclusion zones. Replanning the station in terms of pedestrian flows, staff accommodation, retail, etc must respect the Schedule A wrought iron arched roof and supporting structure whilst delivering a World Class architectural solution.

The intention of this proposal is to expose all the original 1880 Corinthian, cast-iron, columns supporting the wrought iron arched roof, to realise the true spaciousness of the span. Any new architecture, to the east and west, will be set outside of the existing roof structure.



Spacial Considerations



Platforms, 5, 6 and 7 are identified as required for an 8 car train service with the majority of Edinburgh services focussed on Platforms 5 and 6, which could be branded, specific to the route.

It is intended that the proposed 8 car 4 tph design of Queen Street Station will integrate with the current proposals sponsored by Network Rail/Buchanan Galleries. This can be achieved by relocating the existing staff accommodation, Train Crew, Lockers, CTM, DTM, etc; to the east side, combining with BTP, Lost Property, etc in a new integrated station accommodation block within the east side development. The new station facilities provision will, at the very least, match the existing floor areas.

New public facilities, male, female and disabled toilets, Left Luggage and Lost Property, will be located on the east side of the station.

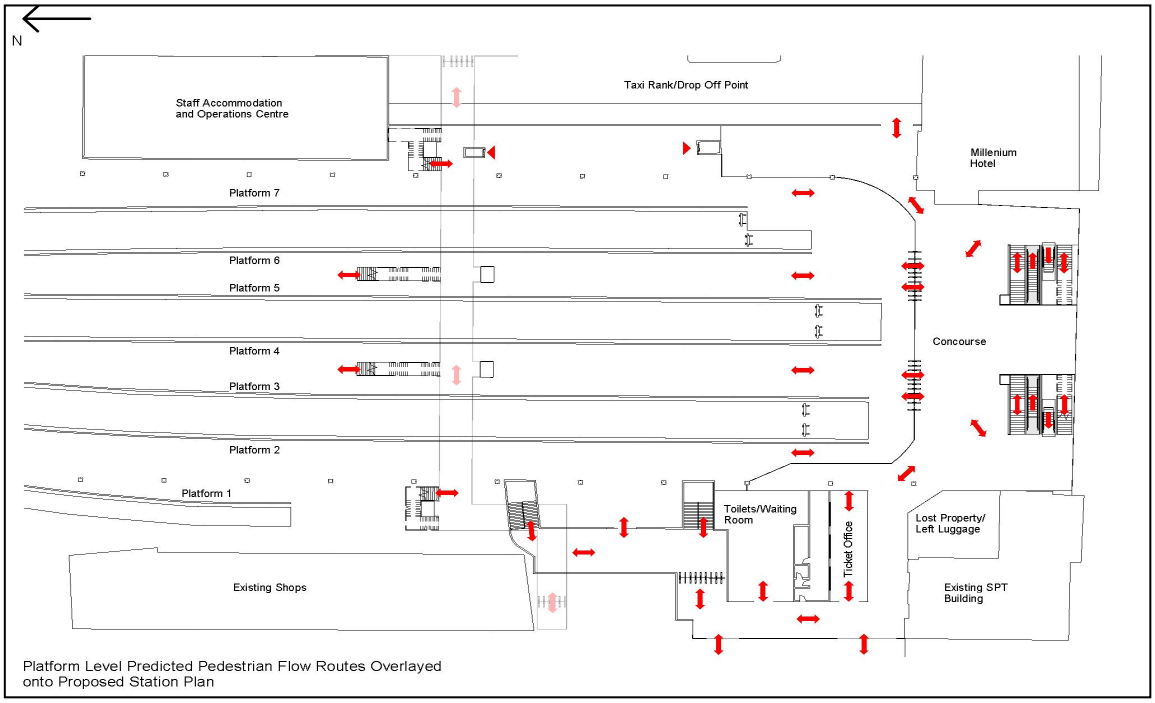
The proposed east side development will also retain the Taxi Rank, drop-off and Bus facilities.

The current lift and stair access locations to the Lower Station, Platforms 8 and 9, will be retained.

Currently there is approximately a 3.0m difference in levels between George Street, back of pavement, and the platform concourse which massively influences the station planning and elevational treatment to the south. The new proposal will provide stairs with step free access, comprising escalators and lifts, linking both levels.

The design will need to take account of predicted future station pedestrian levels.

4.1.2.1 Pedestrian Flow Study



Pedestrian flows are based on *Arup Scotland High Level Static Pedestrian Study*, conducted on Thursday 19th June 2009 during AM, 07.00 – 10.00, and PM, 16.00 – 19.00, peak periods, as part of the Edinburgh to Glasgow Improvement Programme (EGIP).

The visual study clearly shows the following pedestrian movements:

AM Peak

- The primary access/egress point to the station is on Dundas Street to the West Elevation for the morning peak. Egress is the dominant direction of travel to the city centre/subway from the High Level station platforms 1 to 7.

- The secondary access/egress point to the station is again on Dundas Street to the West Elevation for morning peak. Egress is the dominant direction of travel to the city centre /subway from the Low Level station platforms 8 and 9.

- A lesser used access/egress point is George Square, to the South elevation, with egress being the dominant direction of travel.

- The least used access/egress point to the station is the North Hanover Street Taxi Rank/Drop-off Area to the East elevation. Egress is also the dominant direction of travel at this location.

PM Peak

- The primary access/egress point to the station for the evening peak is on Dundas Street to the West Elevation. Access is the dominant direction of travel from the city centre to the High Level station platforms 1 to 7.

- The secondary access/egress point to the station for the evening peak is on George Square, South Elevation. Access is the dominant direction of travel from the Square to the High Level station, platforms 1 to 7.

- A lesser used access/egress point is Dundas Street to the West Elevation with access being the dominant direction of travel from the city centre/subway to the Low Level station platforms 8 and 9.

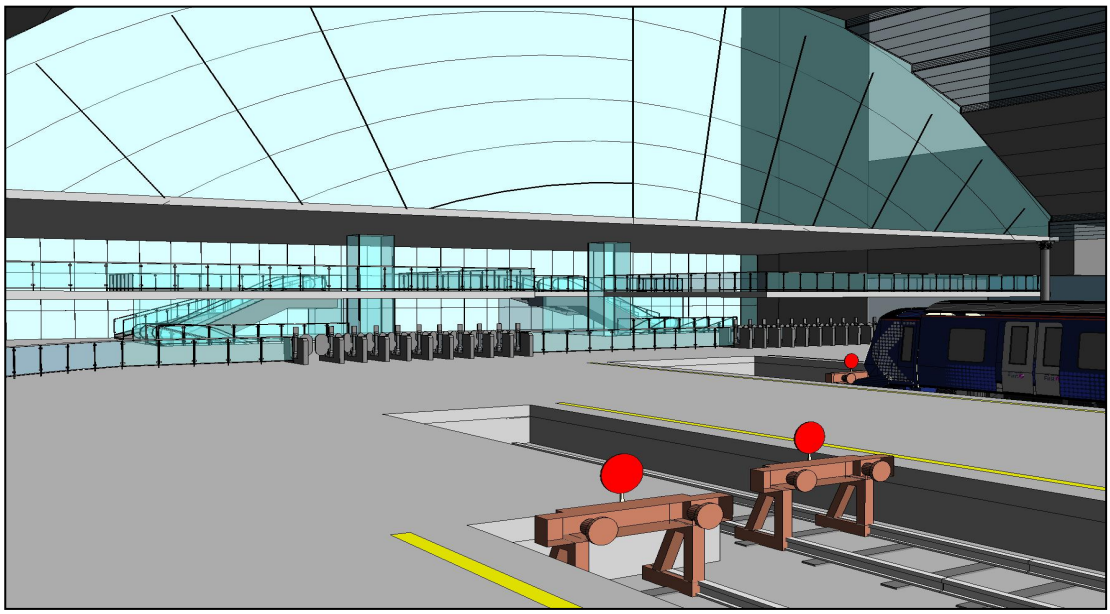
- The least used access/egress point to the station is the North Hanover Street Taxi Rank/Drop-off Area to the East elevation with access being the dominant direction of travel.

iii. Unpaid Concourse

The Unpaid Concourse currently has an adequate floor area of 1300sqm, to accommodate pedestrian flows. The new proposal aims to provide, as a minimum, the same area and preferably an increased space.

The current gateline provision is 21no. automatic ticket gates and 2no. wide aisle gates, set in a double array and is considered adequate for pedestrian flows. However, the survey identified a pedestrian preference to use the Western array rather than spread across both. This leads to queuing at peak periods. The new proposal aims to increase the gateline provision and look at the arrangement to encourage even use at peak periods.

iv. Paid Concourse



The Paid Concourse area is currently adequate. However, the survey identified a pedestrian preference to wait for train announcements here and then transfer across to the relevant platform. The new proposal aims to address this through provision of adequate train display boards, supported by timely announcements by the Station Announcer. The proposed design concept allows access to both High level and Low Level platforms from any gateline.

A review of the street level entrance point widths was undertaken for two-way pedestrian flows, which showed the current entrances were wider than required. The new proposal would aim to at least replicate this, preferably increasing the widths, in main flows, where possible.

v. Street Level Access/Egress

The street levels to the east and west elevation access/egress points currently match the platform concourse level and provide step free access. The new proposal will respect and maintain this.

vi. Pedestrian Footbridge

A raised pedestrian footbridge will run east to west, below the wrought iron arched roof structure, with a lift and stair linking each island platform. The height of the footbridge, the finished floor of which is 4.5m above platform level, will allow for OHLE to be installed below.

The footbridge will provide a link from the station staff accommodation, on the east side, to each platform and it is proposed to interface with the new Buchanan Galleries retail proposals on the east side and directly to Dundas Street on the west side. Gatelines will be required at these locations comprising a mix of normal and wide aisle gates.

The footbridge will be supported directly off the platforms and independent from the roof structure. The location of the footbridge enables stairs and lifts down to the platforms to be set back from the nosings in order to give adequate clearance and not require any collision loading considerations.

vii. Low Level Station Interface

The Low Level station paid corridor will be opened up to platforms 1 and 2 to allow direct access to the footbridge. This will provide an alternative route for travellers in possession of tickets, giving relief, especially at peak times, at the High Level Station gateline.

4.1.2.2 Alternative Design Variations

The current access/egress point Woodside Way/Dundas Street, most heavily used in both AM and PM peaks is not a significant entrance, in terms of location, architecture and signage. To miss this opportunity, in a new proposal, because 'it's there already' and works for today's peak flows, will be restrictive in allowing the station planning to reflect requirements for the future, say 2030. Given the limited time in which to develop these proposals and the requirement for early implementation, this access/egress point has been retained in the design but a number of alternative options that could improve on this entrance have been identified for future consideration

i. Design Option A

Option A looks to open up the lower two floors of the SPT Building, by removing Sainsburys and Boots, to allow an access/egress point at the south west corner, junction of Woodside Way/Dundas Street and West George Street, giving a more direct route for the largest flow of pedestrians in both AM and PM peaks into the station. This will require a step free solution.

If this is retained as the main entrance the inherent problem, due to the platform ends and gateline moving south, is restricted and compromised pedestrian movement adjacent to the north west corner of the SPT building, throughout the day but certainly during AM and PM peak periods.

ii. Design Option B

Option B considers bringing the main pedestrian entrance to the south elevation on West George Street/George Square, therefore combining the pedestrian flows from Woodside Way/Dundas Street and West George Street. While this redirects the main flow of pedestrians, it reinforces the south elevation as the primary entrance, in terms of functionality and architectural treatment, especially with regards to George Square. Experience elsewhere indicates that the public will quickly get used to the redirection, allowing cohesive signage and placement of main display boards. This proposal will not affect the access/egress requirements for the Lower Station which will be maintained.

This option with stair, escalator and lift provision, as shown for the south elevation, on the south west corner will benefit pedestrian flow from street level, through the Unpaid Concourse and approach to the gateline. This option is more robust in terms of future proofing where a predicted increase in passenger figures is expected.

iii. Design Option C

Option C is considered the most future proof. It considers replacing the SPT building, allowing the redevelopment of the entire south west corner. This would enable a dedicated entrance at the point of greatest demand as well as providing new retail opportunities on West George Street and an integrated architectural solution. Research indicates that this option has been identified in previous proposals but we do not have any details.

This would seem to be the approach for both the chosen scheme and the published runner up in regards to a primary entrance on the south elevation.

Option C can be achieved as a masterplanning exercise giving a fully cohesive design solution for total south west corner redevelopment. Phasing implementation, if required for station improvements, would need to be factored into the master plan at design stage. Whilst this is not ideal it can be implemented.

4.1.3 Accommodating Longer Trains

As part of the exercise to establish if the introduction of longer train sets could play a part in addressing capacity issues on the E&G it was necessary to establish if Glasgow Queen Street could theoretically accommodate the operation of longer train sets with or without alterations to the track layout.

Platforms 5, 6 & 7 can already accommodate 7 car train sets but the operation of 8 car sets would require significant alterations to station infrastructure as discussed elsewhere in this document.

Having established that both 7 and 8 car train sets can be physically accommodated in platforms 5 to 7, it was then necessary to establish if the timetable could be operated without changes to the track layout. Currently, E&G services use a variety of platforms at Queen Street and reference to the proposed track layout will show that access to platforms 5, 6 & 7 can only be gained via a single set of points. This means that, today, the simultaneous parallel working of trains into and out of these platforms is not possible. This would represent a significant impediment to the successful introduction of 7 or 8 car working.

Time constraints have dictated that it has not been possible to model the arrival and departure of all train services into and out of Queen Street however we have considered, in isolation, the feasibility of operating 7 & 8 car E&G services using platforms 5 to 7.

i. 7 Car Working

Seven car working would, in theory, be possible using the current track layout and the tables below consider, simplistically, the feasibility of operating 7 car E&G services without any alterations to the infrastructure using Platforms 5 to 7 alone. The exercise does not consider the wider requirements of the GQS platforming plan.

The following tables illustrate 4tph journey time and turn around scenarios;

Table 8: With just two minutes between the arrival and departure of services using the same single lead connection this option would NOT work.

Service	0000 ex EW	0015 ex EW	0030 Ex EW	0045 Ex EW	0100 Ex EW	0115 Ex EW
Arr. GQS	0047	0102	0117	0132	0147	0202
Platform	5	6	5	6	5	6
Dep. GQS	0100	0115	0130	0145	0200	0215

Table 8: 4tph 47 minute journey time clock-face departures allowing 13 minutes turn around at both GQS & EDB

Table 9: This option allows five minutes between the arrival and departure of E&G services at GQS and, provided there is no perturbation, this option could work.

Service	0000 ex EW	0015 ex EW	0030 Ex EW	0045 Ex EW	0100 Ex EW	0115 Ex EW
Arr. GQS	0047	0102	0117	0132	0147	0202
Platform	5	6	5	6	5	6
Dep. GQS	0057	0112	0127	0142	0157	0212

Table 9: 4tph 47 minute journey time clock-face departures allowing 10 minutes turn around at GQS &16 minutes at EDB

Table 10: With just three minutes between the arrival and departure of services using the same single lead connection this option could work but would not allow for even the slightest operational perturbation.

Service	0000 ex EW	0015 ex EW	0030 Ex EW	0045 Ex EW	0100 Ex EW	0115 Ex EW
Arr. GQS	0042	0057	0112	0127	0142	0157
Platform	5	6	5	6	5	6
Dep. GQS	0100	0115	0130	0145	0200	0215

Table 10: 4tph 42 minute journey time clock-face departures allowing 18 minutes turn around at both GQS & EDB

Table 11: This option allows five minutes between the arrival and departure of E&G services and provided there is no operational perturbation the option could work.

Service	0000 ex EW	0015 ex EW	0030 Ex EW	0045 Ex EW	0100 Ex EW	0115 Ex EW
Arr. GQS	0042	0057	0112	0127	0142	0157
Platform	5	6	5	6	5	6
Dep. GQS	0102	0117	0132	0147	0202	0217

Table 11: 4tph 42 minute journey time clock-face departures allowing 20 minutes turn around at GQS & 16 minutes at EDB

Table 12: An additional peak service departure from both Edinburgh and Glasgow could be accommodated (even as a 7 car working) however all three 7 car platforms would be required and the service would need to be timed at 42 minutes to avoid a conflict with other E&G movements at Queen Street.

Service	0000 ex EW	ECS Ex Eastfield	0015 ex EW	0030 Ex EW	0045 Ex EW	0100 Ex EW	0110 Ex EW	0115 Ex EW
Arr. GQS	0042	0050	0057	0112	0127	0142	0152	0157
Platform	5	7	6	5	6	5	7	6
Dep. GQS	0102	0110	0117	0132	0147	0202	0212	0217
		Express to EW					ECS to Eastfield	

Table 12: 4tph (including additional high peak departure) 42 minute journey time clock-face departures allowing 20 minutes turn around at GQS & 16 minutes at EDB

In summary, the above tables demonstrate that with both current and accelerated timings, 7 car working (including the running of an additional peak service departure) *could* be accommodated at Glasgow Queen Street using just platforms 5 to 7. However it must be emphasised that the model takes no account of the platforming requirements for other services. More importantly the use of a single lead to access all three 7 car platforms provides little scope for dealing with perturbation.

ii. 8 Car Working

Currently, only Platform 7 is capable of holding an 8 car train. As a result significant changes to both the station and track layout would be needed to facilitate 8 car operations. The revised track layouts considered as part of this review would provide for the operation of 8 car train sets and Jacobs' preferred option would also allow for some simultaneous parallel movements into and out of Platforms 5 to 7. This would provide a degree of robustness and operational flexibility not offered by the current track design and allow for the operation of 8 car E&G services utilising Platforms 5 to 7. However, as with our assessment of the 7 car option we have assumed that the platforming of E&G services would take priority and we have not undertaken a complete re-platforming exercise. A definitive answer regarding the operability of this proposal can only be given upon completion of a complete review of the platforming arrangements at Glasgow Queen Street.

iii. GQS Longer Train Summary

- 7 car operation is possible using the current track layout. Platforms 5 to 7 provide sufficient length but the use of a single lead means that this is a high risk option offering little in the way of flexibility at times of operational perturbation.
- 8 car operation is also possible, again using Platforms 5, 6 & 7, but this would require the remodelling of both the station and track layout. Only platform 7 is currently long enough to accommodate an 8 car train set.
- On the face of it restricting platform options for longer E&G services to just three platforms might seem unacceptably restrictive bearing in mind that, today, 6 car E&G services can use all but Platform 1, however, the operation of a 4tph service would only require the use of two platforms.
- The revised layout required for 8 car operation would allow the simultaneous arrival and departure of 8 car E&G services. This would provide significant flexibility to both train planners and signallers in managing the planning and operation of longer trains into and out of Glasgow Queen Street.
- In conclusion, whilst 7 and 8 car E&G operation can be accommodated at Queen Street a complete review of the platforming arrangements would be necessary to validate our proposals.

4.1.4 Station Track Works

The remodelling of Glasgow Queen Street Station throat was carried out using the design geometries as listed in *NR/L2/TRK/2049 Track Design Handbook*.

The designs were carried out using MX Rail design software and focused on the horizontal alignments to demonstrate a spatial fit with in the site boundaries to maximise platform extensions towards the north side of the site and reduce the need for extending to the south end. Vertical alignments and clearance assessments were not undertaken at this time and should the works be further developed then it is recommended that they should be done at that time.

In order that the throat could be designed to fan out as quickly as possible without affecting the existing tunnel and retaining walls, the use of uncommon switch geometries such as tandem switches and slips were investigated. All of the design geometry used was CEN 56E1 Vertical S&C as listed in *NR/L2/TRK/2049 Track Design Handbook* and most of the S&C geometries are listed as Non-Preferred, or withdrawn, in *Section J.1.1: Preferred Geometries and Standard Configurations of S&C*. Derogation from the Network Rail Head of Track would be required prior to carrying out detailed design.

The minimum design line speed throughout the station area was 20mph with zero cant applied to achieve this speed within maximum design values. Where practicable the design radius has been kept as flat as possible to allow for compliant stepping distances and kinematic clearances to all useable lengths of platforms.

Further investigations would have to be carried out at a future design stage to confirm that the layouts used could be supplied on concrete bearers and with cast crossings that would allow for the layout to be stressed. This would reduce future maintenance as the number of joints could be reduced.

On platforms where the existing buffers require to be moved or replaced new friction buffers would be required in accordance with current standards. Initial calculations show that a free track length of approximately 10m beyond the front face of the new buffer would be required to safely arrest trains travelling at 10kph.

4.2 Platforming 8 car trains at Edinburgh Waverley Station

Edinburgh Waverley currently accommodates approximately 1600 weekday train movements servicing passenger and freight routes throughout Scotland and the busy East Coast Main Line (ECML).

Bearing this in mind it has been our intention to consider the potential impact of nominating preferred platforms for the 8 car EGIP services.

4.2.1 Waverley Station Operation

Currently, loaded services running between Edinburgh Waverley & GQS HL are accommodated in a variety of platforms. The current “docker plan” provided by the client suggests that the most frequently used platforms are platforms 12, 13 & 14. Other platforms are used less frequently and the summary of departures, shown below, illustrates the extent to which each platform is used to facilitate the delivery of E&G services.

Ancillary moves such as ECS departures are not shown in this summary and it should be further noted that platform 20 is also used on a single occasion to facilitate an ECS move to Haymarket depot.

i. Waverley Departures to Queen Street

The following table illustrates the majority of platforms currently used for E&G services are capable of holding an 8 car EMU (191m). However, of the three most frequently used platforms (12, 13 &14) two of those platforms (12 & 13) cannot currently hold an 8 car EMU

Platform	No. of GQS Departures	Network Rail RotP Usable Length
7	1	222
8	1	293
10	1	224
11	1	262
12	10	119
13	22	151
14	17	212
15	6	201
16	1	197
17	1	196
18	1	109
20	1* ECS to HA	156

Table 13: Waverley Platforming Arrangements

ii. Potential for Platform Lengthening

Of the platforms currently used for E&G services, Platforms 12, 13, 18 & 20 are of insufficient length to cater for the operation of 8 car trains. A site visit was undertaken to establish if any of those platforms could be readily extended to cater for longer trains.

In so far as platforms 12, 13 & 18 are concerned, extensions to both the west or “buffer-stop” end of the platforms is not a practicable proposition. Any lengthening to the west would require significant remodelling of the approaches whilst any extension at the other end is precluded by the station access ramps which run in towards platform level over the buffer stops.

In so far as platform 20 is concerned, lengthening appears possible (towards the tunnel portal) but it is unclear whether the required length would be achieved and its limited use for E&G services would suggest that this would not be a cost effective option.

iii. Nominated Platforms for E&G Services

A superficial assessment of the platform layout suggests that platforms 14 & 15 would be ideal candidates for the focus of E&G operations with other suitable platforms being brought into use as and when operational circumstances dictate.

It should be noted, however, that although 8 car EMU’s could be physically accommodated in a number of platforms, this takes no account of the extent to which more than one service occupies the platform at any one time (i.e. permissive working) or the scale of operational conflict which may arise through the dedication of specific platforms for the operation of E&G services.

A further more detailed review (using the appropriate software) needs to be undertaken to confirm that 8 car E&G services can be operated using 2 or 3 “dedicated” platforms of sufficient length or through a greater use of “non core” platforms of sufficient length.

4.3 Intermediate Stations Infrastructure Requirements

Currently E&G services are operated by either 3 car or 6 car DMU's, each vehicle measuring approximately 23m in length. Eight car EMU operation, as proposed by the Jacobs project team, will require a usable platform length of at least 191m. The following sections illustrate the current usable platform lengths and consider the potential for extending platforms to facilitate 8 car EMU operations.

The purpose of these works is to provide an 8-car platform length on both platforms where the existing platforms are only suitable for up to 6-car.

For each of the intermediate stations we have investigated the following;

1. Can the platforms be lengthened?
2. Is Selective Door Opening (SDO) an option?
3. What is the estimated CAPEX for each to provide 8 car platform capability?

A more detailed Optioneering report and associated drawing references for each of the stations is provided as Appendix A.

4.3.1 Croy Station

During our investigation 3 potential options were identified and are described below.

i. Option 1: Extend Platforms towards Lenzie

The first option under consideration for Croy Station is to extend both platforms towards Lenzie Station by approximately 50m and leave the existing station infrastructure in place.

ii. Option 2: Extend Platforms at both ends

Another option to consider is the removal of the existing footbridge which is located at the North end of the site, and a replacement with a new fully DDA compliant footbridge and lifts or ramps. Removal of the footbridge would allow the existing platforms to be extended towards Falkirk High Station by approximately 10m, although 40m extension towards Lenzie Station would still be required.

iii. Option 3: Selective Door Opening

The final option for consideration is to introduce a Selective Door Opening (SDO) system to all trains. SDO could provide an alternative (either in the short or long term) to the CAPEX spend which would be required to extend short platforms at intermediate stations. There are, however, some practical advantages to extending platforms rather than relying on ASDO. Principal amongst these considerations is the fact that allowing passengers to access and egress trains using all available doors, dwell times will be kept to a minimum as people make best use of the available platform with the objective of securing a seat upon the train's arrival. This is especially true during busy periods.

It seems a sensible proposition that platform extensions could be considered only for those stations where traffic projections suggest that failure to extend platform lengths to accommodate 8 car trains could result in an increase in dwell time.

4.3.1.1 Croy Recommendation

It is recommended that both platforms are extended towards Lenzie by approximately 50m in order to achieve the required 8-car platform length (Option 1).

4.3.2 Falkirk High Station

i. Option 1: Extend Platforms towards Croy

It is proposed to utilise a flat area of land which exists beyond Platform 1 and Platform 2, towards Croy, allowing extensions of approximately 60m and 35m respectively,

In order to extend Platform 1 towards Croy, it will be necessary to demolish the existing timber boundary fence which separates the railway from the station car park. Additionally, the existing lighting columns and car parking bays which are located in close vicinity to the timber fence will also be affected. It is proposed to erect a new timber fence, similar to existing, set back into existing car park which will tie into the existing fenceline towards Croy. It is assumed that the existing lighting columns and car parking bays can be set further into the car park similar to the existing arrangement.

Consultation with First Scotrail will be required to discuss and agree a revised layout for the existing car park in order to accommodate the proposed works at Platform 1. It would be beneficial to re-model the existing car park arrangement in order to maintain the number of spaces currently provided.

It is also recommended that the existing station footbridge is demolished and replaced with a new DDA compliant structure to improve accessibility between platforms.

Additionally, it is recommended that the existing brickwork wall located along the rear of Platform 2 is partially demolished and re-aligned. The section of wall which steps out towards the platform edge shall be demolished and a constant wall profile that is aligned with the wall section set further back into the cutting slope shall be constructed. This alteration would improve lateral clearance along the length of the platform.

ii. Option 2: Selective Door Opening

As with Croy the final option for consideration is to introduce SDO to all trains, and leave both platforms as the current 6 car length.

4.3.2.1 Falkirk High Recommendation

It is recommended that Platform 1 and Platform 2 are extended towards Croy by approximately 60m and 35m respectively.

4.3.3 Polmont Station

During our investigation 3 potential options were identified and are described below.

i. Option 1: Extend Platforms towards Linlithgow

The first option under consideration for Polmont Station is to extend both platforms towards Linlithgow (east) by approximately 45m. There may a requirement for a dwarf retaining wall to retain a small slope to the rear of Platform 2. It is also noted that the radius of the existing track at the east end of Platform 1 may not be within current standards, and further investigation will be required.

ii. Option 2: Extend Platform 1 to the east & Platform 2 to the west

The second option is to extend Platform 1 to the west by 45m, and Platform 2 to the east by 45m. One issue identified with this option is the presence of an existing signal within the proposed extension area on Platform 1.

Extending Platform 2 to the west has been discounted as evidence of a historic slope failure was observed, raising concerns of the slope stability in this area. Additionally extending to the west on Platform 2 would require the removal of a large volume of material and may cause the existing retaining wall to be become unstable.

iii. Option 3: Selective Door Opening

As with Croy and Falkirk High the final option for consideration is to introduce SDO to all trains, and leave both platforms as the current 6 car length.

4.3.3.1 Polmont Station Recommendation

It is recommended that both platforms are extended towards Linlithgow by approximately 45m in order to achieve the required 8-car platform length (Option 1).

4.3.4 Linlithgow Station

i. Option 1: Extend Platforms towards Polmont

An existing flat area exists beyond Platform 1 and Platform 2, towards Polmont, which would provide a potential extension area to accommodate both platform extensions by 35m and 65m respectively.

In order to extend Platform 1 towards Polmont, it will be necessary to construct a cantilevered section of platform which will overhang Station Road. A section of the extension at this end would be cantilevered out and supported by the existing superstructure at UB 107/039. This proposal will also result in modifications being carried out to the existing stonework boundary wall to accommodate the proposed platform extension. Additionally, a section of the existing platform could be widened to improve the existing lateral clearance, where it is proposed to extend the platform.

In order to construct the extension towards Polmont at Platform 2, it may be possible to demolish the existing stonework wall and replace with a new earth retaining structure which would be set back from its current alignment and provide support to the rear of the platform. This option would eliminate any potential issues with regards to affecting headroom at the rear of the platform by removing the overhanging section.

Consultation with the local authority/land owner will be required to establish if an area of land at Station Road is required to be purchased in order to enable the platform extension at the Polmont end of Platform 2 to be carried out.

ii. Option 2: Extend Platforms towards Edinburgh

This option considers extending both platforms towards Edinburgh. The proposed platform construction would have to be supported by the existing superstructure at Underbridge (UB) 107/037 and would cantilever out over Back Station Road. It is likely that the existing stonework boundary wall which runs parallel with the tracks beyond UB 107/037 will require modifications in order to accommodate the proposed platform extension in this direction.

Additionally, the existing platform ramps would be demolished and a replacement stair access would be constructed at the Polmont end of both platforms to assist with achieving the required platform length.

Extending both platforms towards Edinburgh is likely to impact upon the existing track crossover located to the east of the station and may require extensive track re-modelling works in this area to accommodate the platform extension.

In general, the local authority will need to be consulted to establish if a planning consent submission is required to satisfy the planning department.

A detailed structural analysis would be required to confirm that the existing superstructures at UB 107/037 and UB 107/039 have sufficient capacity to provide support to the new platform construction. Also, the existing stonework boundary walls located beyond the underbridges would have to be assessed to ensure that the proposed modification do not undermine their structural integrity.

Should it be found that Option 2 existing stonework boundary wall and superstructure at UB 107/037 & UB 107/039 do not have sufficient capacity to cope with the additional loads being applied from the platform extension works, then an alternative option would be to operate selective door opening on the 8-car trains using this station and without the need to extend the existing platforms.

iii. Option 3: Selective Door Opening

As with the other intermediate stations the final option for consideration is to introduce SDO to all trains, and leave both platforms as the current 6 car length.

4.3.4.1 Linlithgow Station Recommendation

It is recommended that Platform 1 is extended by approximately 35m and Platform 2 by approximately 60m towards Polmont in order to achieve the required 8-car platform length (Option 1).

As part of the proposed platform extension works, it is also recommended that the existing section of platform at the Polmont end is widened, if possible, to provide an increased platform width for passengers using the extension.

Should it be found that the existing stonework boundary wall and superstructure at UB 107/037 & UB 107/039 do not have sufficient capacity to cope with the additional loads being applied from the platform extension works, then an alternative option would be to operate selective door opening on the 8-car trains using this station and without the need to extend the existing platforms.

4.4 Journey Time Assessment for 4 x 8 car EMU Trains per Hour

In calculating the optimum journey time a mix of calling patterns, reflecting the current timetable, were used. For comparison, journey times for the current 6 car class 170 DMU and the proposed 8 car EMU were created allowing easy identification of where the Sectional Running Times (SRT's) differed. The journey times are presented in timetable format and included in Appendix E