Ref:	**139797**
Version:	1.1
Date:	June 2015

Appendix B

CH2MHILL REPORT – BRISTOL NEW STATIONS – HIGH LEVEL ASSESSMENT STUDY

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Technical Report

Bristol New Stations High Level Assessment Study – locations on Filton Bank

Prepared for

Bristol City Council

November 2014

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Contents

Section **Page**

Section **Page**

Tables

Figures

Section **Page**

Appendices

Document History

Report:

Bristol New Stations, High Level Assessment Study – locations on Filton Bank

Client:

Bristol City Council

Project Number: 203742.BD.00.29

Report Number: 203742.BD.00.29_001

This document has been issued and amended as follows:

Version	Date	Description	Created by	Verified by	Approved by
v1	3rd March 2014	First Draft (excluding Horfield)	GW/KP	PB	PB
v2	29th April 2014	Second Draft (including Horfield)	GW/KP	PB	PB
v3	8th May 2014	Third Draft (revised cost assumptions & re-calibrate demand at Ashley Down/Hill)	GW/KP	PB	PB
v4	20th May 2014	Fourth Draft (revised & additional contingency assumptions)	GW/KP	PB	PB
v5	23rd May 2014	Fifth Draft (minor alterations)	GW/KP	PB	PB
v6	14th November 2014	Final Report issued	GW/KP	PB	PB

SECTION 1

1. Introduction

1.1 Background

A number of initiatives are on-going that will see major rail developments around Bristol, in particular electrification of the Great Western Main line and upgrades of Temple Meads Station. Also, renewal of the Great Western passenger rail franchise was due to be completed in 2013. While the process began in 2012, the recently announced revisions to the franchise programme means that the current operator (First Great Western) will remain in place until at least 2016. The longer-term future of this franchise and how it operates is to be determined. In conjunction with these initiatives, the West of England Area Rail Studies packaged proposed a series of local rail enhancement schemes. This was initially known as the 'Greater Bristol Metro', subsequently renamed MetroWest.

The four West of England authorities (North Somerset, Bristol City, Bath & North East Somerset and South Gloucestershire Councils) are jointly promoting MetroWest, which includes:

- MetroWest Phase 1 – half hourly train services for the Severn Beach line, local stations between Bristol Temple Meads, Bath Spa and Weston-super-Mare (Bedminster and Parson Street) and the reopened Portishead line, including stations at Portishead & Pill;
- MetroWest Phase 2 – half hourly train services to Yate and hourly services on a reopened Henbury line (capacity for two new stations) with (at the time of writing) potential additional stations at Horfield and Ashley Down; and
- A range of smaller projects including additional potential station (re)openings.

Bristol City Council has appointed CH2M HILL to progress work on future development of potential new stations in the city that are identified as part of MetroWest Phase 2 and the New Stations Package. A key area is on the Filton Bank between Stapleton Road and Filton Abbey Wood stations. The potential locations of the stations on the Filton Bank are shown in Figure 1-1.

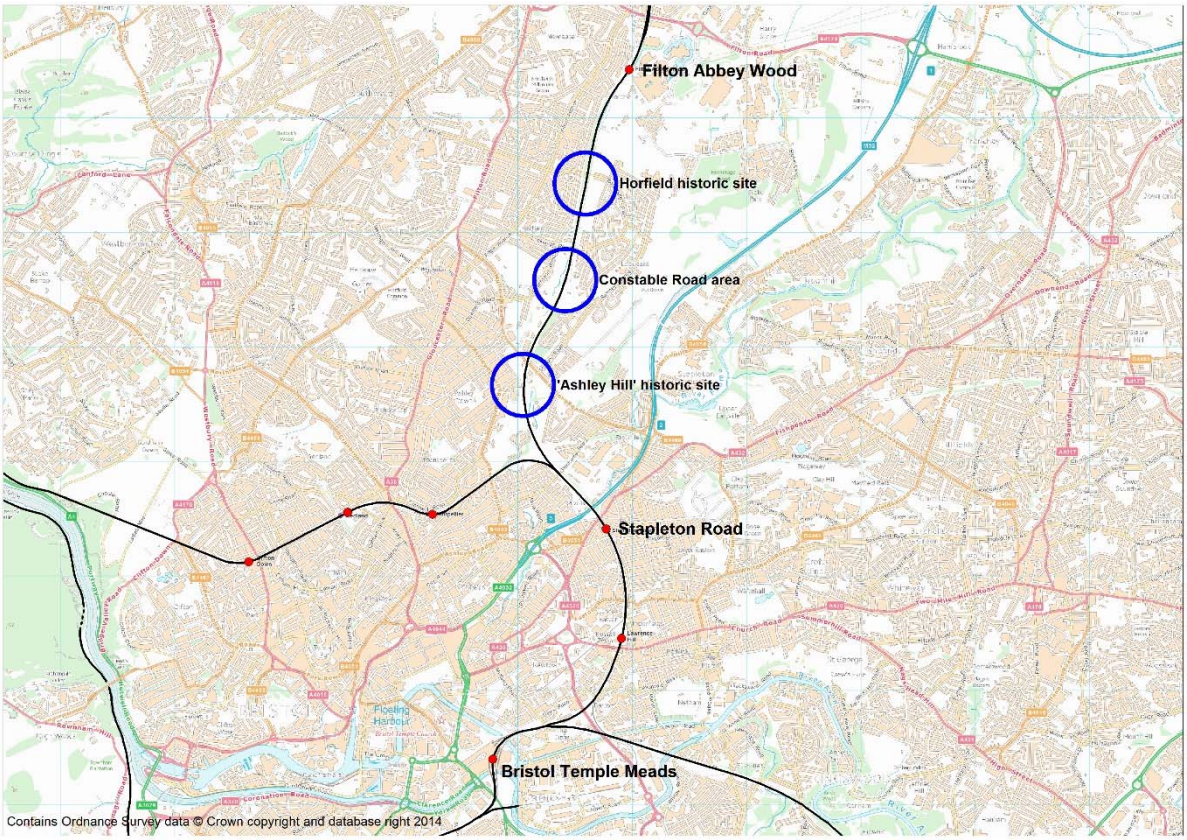

Figure 1-1: Locations of potential new station sites

1.2 The Study

A High Level Assessment has been carried out, to understand the station locations and potential designs, and potential demand for the stations. There are two key elements to the study, including:

- Station location and design – outline design concepts for the stations, including key elements such as platform locations, access to the station from the highway network (for pedestrians – it is understood that no car parking is to be provided at either station location) and access to platforms, with initial cost estimates based on benchmarking with other new stations. The Filton Bank is a potentially challenging area to develop new stations, so this includes more detailed consideration of other engineering issues such as track alignment and levels, signalling, and interaction with future electrification facilities; [1]and

- Demand analysis – this section builds on demand forecasting work undertaken as part of the West of England Rail Studies, improving the rigour of the forecasts.

This report

After this introduction there are four further chapters in the report:

- Chapter 2 considers the engineering issues for potential station locations on Filton Bank (between Stapleton Road and Filton Abbey Wood stations), including potential sites at Ashley Down (the Ashley Hill historic location), near Constable Road and the historic Horfield station location;

- Chapter 3 sets out demand forecasts that have been developed for the potential new stations, including reference to the potential differential demand that could result from different station locations on Filton Bank; and

- Chapter 4 draws together the study's findings in the form of a summary and conclusions.

Appendices include:

- A – Drawings
- B – Permanent way costings

[1] Note that consideration of engineering issues in this report is at a high level and does not specifically deal with issues such as ground conditions and drainage, as well as requirements for retaining structures. The requirements for possessions and/or disruption to the railway during station construction has similarly no been considered, though an allowance for possession management has been included in non-construction costs for each station, likewise potential TOC compensation has not been assessed. Other elements not considered at this stage are that any land acquisition costs that may be required are not included, neither have costs associated with changes to the existing public highway, and any subsequent traffic management requirements, been considered or costed at this stage. No specific assessment has been made of the need for or cost of contaminated waste disposal.

SECTION 2

2. Station outline designs & engineering

2.1 Introduction

2.1.1 Background

This section of the report briefly describes the engineering issues and outline designs for potential station locations on Filton Bank (between Stapleton Road and Filton Abbey Wood stations). There are three sites, as shown in Figure 1-1. These include potential station sites:

- Ashley Down (the site of the historic Ashley Hill station);
- Near Constable Road; and
- The historic Horfield station.

Outline design work undertaken in this study has considered the station locations, with respect to permanent way constraints, design of station platforms and other supporting station infrastructure, changes to alignments as a result of horizontal and vertical track positioning, relationship with overhead electrification equipment (OLE) and signalling and telecommunications (S&T) equipment. The level of detail is broadly that of a GRIP2 study.

2.1.2 Station requirements

All the station design options considered in this study are based on the same basic assumptions and inclusions in terms of station facilities, as follows:

- Two single faced station platforms, each 136m long[2];
- Sheltered waiting areas (using a basic bus shelter type);
- Platform seating;
- Provision for long line public address (LLPA) system, customer information system (CIS), closed circuit television cameras (CCTV) for security and operations and customer 'Help Points';
- Fully lighted platform;
- Automatic ticketing machines;
- Storage space for platform maintenance and small office with single male female toilet;
- Cycle spaces;
- Basic vehicle access – drop-off/pick-up area for taxis and cars including turning area if appropriate and possible (no station car parking);
- Station to be fully compliant with PRM-TSI regulations (Passengers with Reduced Mobility – Technical Specifications for Interoperability);
- Station to be designed to general guidelines contained in SRA document 'New Stations A guide for Promoters'; and
- Fencing.

2.1.3 Permanent way baseline

The starting point for all assessments is post 4-tracking of Filton Bank, as set out in 'Track Form A (I2)' provided by Network Rail (document issued 23rd August 2013), because by the time any new station schemes is implemented, the Filton Bank 4-track project will have been completed. This scheme comprises 4-tracking of the current double track line between Filton Abbey Wood Station and Dr Days Junction (ELR BWS ch.0M55ch to 4M35ch).

For this reason the Permanent Way design is based on the Filton Bank Track Form A which is referred to as the 'existing alignment'. For a GRIP2 study, the horizontal and vertical alignments of the

[2] It is considered likely that the initial platform length built for a new station on the Filton Bank will be less than 136m (6-car), with 101m (4-car) or 125m (5-car) platforms designed in the first instance, though passive provision would be made for 6-car platforms to follow in due course.

aforementioned design was analysed and amended to allow for acceptable alignment and station parameters at the station locations. Only the 'Relief' lines were analysed as it is assumed that trains won't stop on the 'Main' lines.

The existing gradient for all three station locations on the Filton Bank is very steep (1 in 76 or 1.33%). Group standard GI/RT/7016 states that: "*Wherever possible, platforms shall be located on track with an average gradient not steeper than 1 in 500. It is permissible for platforms to be located on track with average gradients steeper than 1 in 500 provided trains are not planned to terminate or reverse at the platform"*. This is guidance rather than a definitive requirement, but 1:75 is still is considered too steep for a new station to be developed on. Guidance note GI/GN7616 provides further information for consideration of risks associated with proposing platforms relating to horizontal curvature and longitudinal gradients.

Vertical track positioning can be adjusted through track lifts and earthworks to re-profile gradients. However, as the provision of a 1:500 platform gradient would lead to excessive gradients on either side of the station, it was decided to target a station gradient of 1:220 (0.45%). This is consistent with a station gradient deviation granted for (the reopened) Corby station (Certificate number 07/182/DGN). Designs using this 1:220 gradient are much more likely to be accepted by Network Rail (NR) even though still requiring some deviation from guidance in the group standards. They do however lead to significant works in terms of Permanent Way and track drainage, signalling, earthworks and electrification.

It would be possible to seek deviations from standards for the existing (much steeper) gradient through the station, which would reduce the requirement for Permanent Way works and their associated costs, but this is considered unlikely to be practical that such a deviation would be granted. Costs have therefore only been developed for designs producing a 1:220 gradient through the station sites.

It should be considered that failing to achieve a derogation that the 1:220 gradient through a station is acceptable could significantly change the requirements at each station, and thus would require re-assessment of the assumptions in this report.

2.2 Ashley Down (Ashley Hill historic location)

2.2.1 Overview

The station formerly called Ashley Hill was opened in 1864 by the Bristol & South Wales Union Railway and later absorbed by Great Western Railway in 1868. The station was closed after the Nationalisation of Britain's railways, in 1964, by the British Railway Board. The station was located as shown in Figure 2-1, with more details of the identified in the aerial photograph in Figure 2-2.

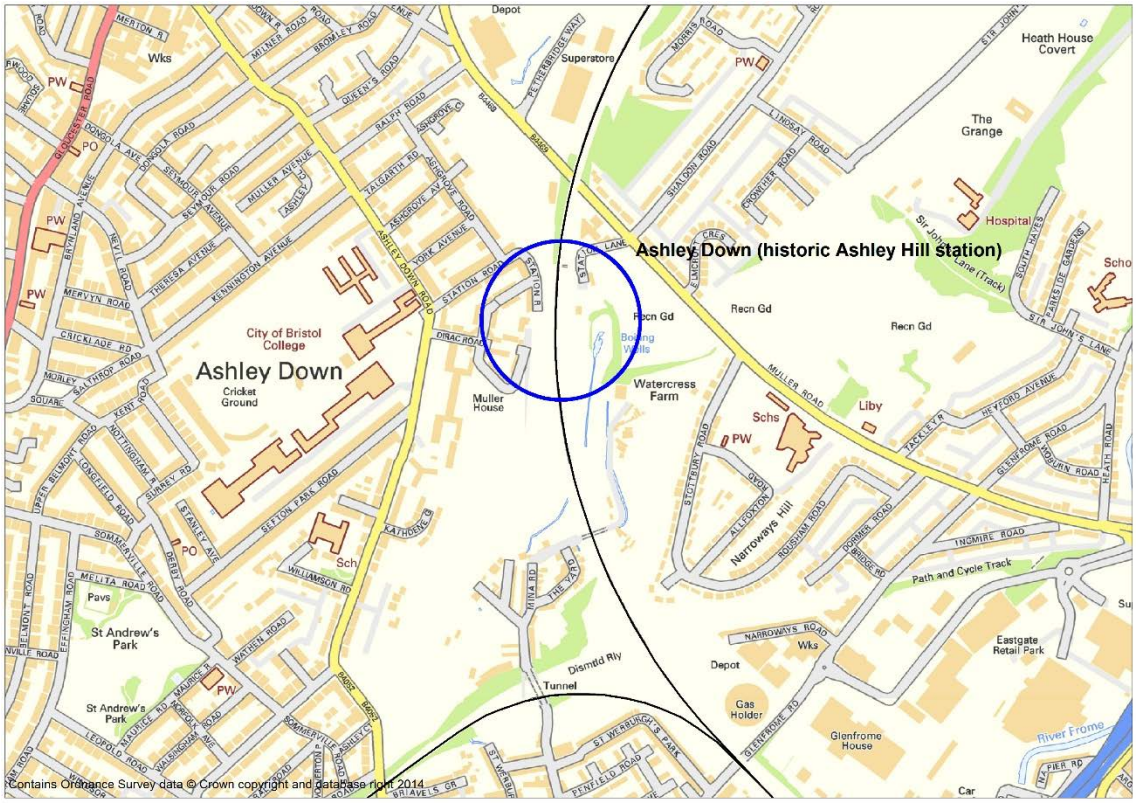

Figure 2-1: Location of Ashley Down station (historic Ashley Hill station site)

Figure 2-2: Location of Ashley Down station (historic Ashley Hill station site)

2.2.2 Initial site selection

The proposed Ashley Down station location (historic Ashley Hill station) is a natural choice for a station as a former station site, and the Filton Bank Permanent Way horizontal alignment allows for a station to be built in this area. Note that Filton Bank 4-tracking of the existing 2-track layout is assumed as the 'existing layout' for a station in this location, as any new station in this area would only be built after 4-tracking is completed. In addition to reference to the 4-tracking plans, a desktop study was undertaken using Google Earth, OS mapping, the Network Rail Sectional Appendix, 5 Mile diagrams and Quail maps. Additionally, a site visit was undertaken to get a general impression of the proposed station location. For further information on the station design and location see drawing HGL/GS2/DRG/001 (Appendix A). [3]

Initial site selection was based on five major criteria:

- Land availability;
- Size of station, including construction footprint;
- Accessibility;
- Permanent Way factors, such as alignments, switches and crossings (S&C), etc; and
- Environmental factors.

The proposed site can accommodate 136m long platforms[4]. Station Road is proposed as the access for the station and the associated drop off/ pickup area. In general there are no major earthworks for the erection of the station footprint including its operational facilities. Though the adjacent access road will incur minor earthworks due to the level difference between the proposed access road and station platforms. Consequently requirements for track lifts on the embankment will incur some earthworks which are included in permanent way works discussed later in the report.

The final criterion was to ensure environmental factors are considered in the station development. Figure 2-3 shows the location of potential environmental issues to be considered in any future detailed station designs.

Figure 2-3: Potential environmental issues

[3] Passive provision for a station at Ashley Down is included in designs for the Filton Bank 4-track scheme.

[4] It is considered likely that the initial platform length built for a new station on the Filton Bank will be less than 136m (6-car), with 101m (4-car) or 125m (5-car) platforms designed in the first instance, though passive provision would be made for 6-car platforms to follow in due course.

Initial potential issues highlighted from the desk study are as follows:

- The area in the red box (on Figure 2-3) indicates an area of woodland/trees that would be fully or partially cleared to allow construction works and to form the permanent footprint for the development. Removal of natural woodland will be unfavourable to the local community and will require approval. Seasonal restrictions on tree removal during nesting period may also apply. Organisation of mitigation measures may include, responsible disposable/recycling of material, where possible considering use of community involvement projects with artists, schools or local project groups to use waste material for local benefit. This method is likely to improve local relations and local acceptance of the project. Previous projects such as the Broadland Flood Alleviation Project passed waste products to artists to create furniture for community projects. Note that research into the existence of invasive plant species or protected wildlife in this location is not accounted for at this stage.

- The area in the yellow box (Figure 2-3) includes continuation of a public footpath (Concorde Way, a long distance walk and cycle path that also passes through the red box in the figure). There is potential that the station footprint would encroach on this footpath that could require diversion or relocation to accommodate the station development, partial closure or even full closure. Any changes could cause inconvenience to local residents, as well as require external approval, so community engagement through information and events are likely to lessen adverse local reaction. At this stage however, the effect on Concorde Way is unclear, and it is recommended that further design work, should the station be developed, should specifically consider linkages to, from and through the station area in detail, in particular Concorde Way.

- Some additional traffic usage will be incurred from the use of the station on the surrounding road network. This influence on local services may merit further consideration if deemed significant. Community benefits for improved transport networks and favourable localised economy are likely to offset local community concerns.

The following areas should be assessed, and appropriate mitigation developed, in any subsequent more detailed design work:

- Ecology & Nature Conservation;
- Historic Environment;
- Townscape & Visual Amenity;
- Water Resources;
- Noise & Vibration;
- Air Quality;
- Geology, Soils & Land Contamination;
- Resources Use & Waste Management;
- Traffic & Transport;
- Socio-Economic Impacts;
- Cumulative impacts with other developments; and
- Third party land and access issues/requirements.

2.2.3 Station design

Figure 2-4 shows the station footprint, with Figure 2-5 showing the station location in its current state. Figure 2-6 sets out a proposed station layout with operational facilities (based on the assumptions outlined earlier). The basic construction cost of the station layout as shown in Figure 2-6 is £2,629,200 (excluding contingency). [5] [6] [7]

2.2.4 Permanent Way

The proposed station location is identical to the historical one. The Filton Bank design (Form A) allowed for a future station in this location from a horizontal alignment point of view. For more information please refer to drawing HGL/GS2/DRG/001.

The existing horizontal alignments (as per Filton Bank design) of both the Filton Up and Down Relief lines contain radii smaller than 1000m alongside the proposed station which are non-compliant with standard NR/L2/TRK/2049. For this reason the alignments have been adjusted to stay above this limit (min. design radius = 1016m). This has led to slues of approx. 200mm on both the Up and the Down Filton Relief lines. At the same time it has been checked that the Down Relief existing cant of 150mm can be reduced to 110mm alongside the proposed platform. The horizontal design of the Filton Main lines is unchanged. The Filton Bank design allowed for 3 No. platforms, i.e. two single face platforms (Up Relief and Down Main) and an island platform (Down Relief and Up Main) however, only two single face platforms are considered for the Up Relief and the Down Relief lines.

Vertically there are (notionally) two options for the Relief Lines. It would theoretically be possible to maintain the existing gradient through the station, but as this is not considered practical, the design considered is to adapt a station gradient of 0.45% (1:220). This is the maximum gradient found in the Group Standard Deviations Register for similar conditions (Corby Station). A similar deviation from Group Standard GI/RT/7016 will have to be sought for this project. To achieve this gradient over a distance of approx. 180m the gradients to either side of the station need to be steepened. To the south of the station this means that the existing gradient of 1.32% has been increased to be 1.52% over approx. 535m. This has led to lifts of up to 940mm (ch.3900m). This again will lead to a significant amount of earthworks as the existing track bed will have to be reconstructed between ch.3560m and ch.4250m to accommodate lifts and lowers.

To the north the station gradient of 0.45% has led to track lowerings of up to 190mm (ch.4130m) and a steepened gradient of 1.50% (existing 1.20% = 1 in 83) to tie-into the existing vertical alignment. Train retarders at the low end of the platforms will be required to avoid ‘runaway’ trains. [8]

The overall Permanent Way cost to achieve the gradient and curvature as discussed above for Ashley Down station is £944,860 (excluding contingency). See Appendix B for further details of the derivation of Permanent Way costings. [9]

[5] Contingency (of 20% or 40%) is added to total costings later in this chapter. Likewise, non-construction costs (including contractor preliminaries, GRIP stages 4 development costs, GRIP stage 5 detailed design, project management & sponsorship, testing & commissioning, and possession management) are similarly added.

[6] All prices exclude VAT. Rules of the route possessions are assumed. NR asset protection costs included within Project Management, GRIP 4 development, GRIP 5 detailed design and testing and commissioning.

[7] Note that TOC compensation and land acquisition costs are not included. There is also no provision for contaminated waste disposal.

[8] Further, more detailed, assessments may indicate that retarders or catch points are not required at the station, though the costs of potentially providing these facilities have been retained in the overall totals in this report.

[9] Contingency (of 20% or 40%) is added to total costings later in this chapter. Likewise, non-construction costs are similarly added.

Figure 2-4: Ashley Down proposed station footprint

Figure 2-5: E*xisting 2-track layout showing Ashley Down future station location*

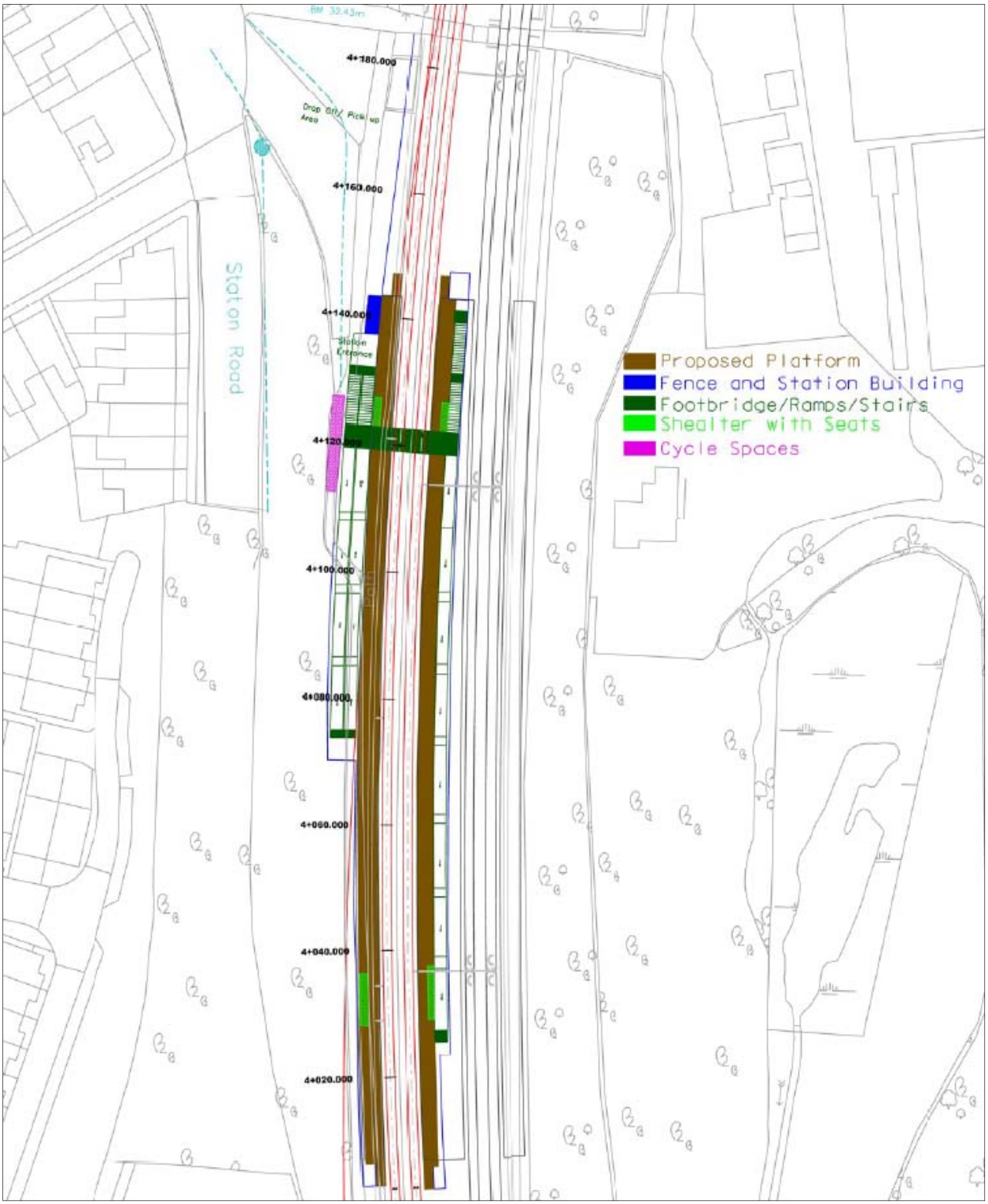

Figure 2-6: Proposed Ashley Down station layout with operational facilities

2.2.5 Electrification

As Filton Bank is assumed to be electrified prior to any Ashley Down station being implemented, changes to the electrification equipment will be required. A number of assumptions have been made to determine the costs of doing this.

Where track lowering or raising occurs, existing OLE (overhead line equipment) structures and support equipment (cantilever frames) will need to be adjusted to suit the new track levels. Where track lifts are <200mm, the existing tolerance in the mast length should negate the need for structure replacement. However loads, in particular overturning should be checked to confirm adequacy of the retained mast and foundation. Where track lifts at the OLE structure position occur (between chainages 3+600 and 4+110), new structures will need to be installed. It may be possible to reuse some of the existing masts and cantilever frames. Based on a track radius of curvature of between 870m and 1200m, OLE structures have been positioned at 50m spans.

It is proposed to free run the overhead line equipment through new station footbridge. It is assumed that the soffit height of the bridge can take account any proposed track lift. At the proposed bridge centre line at chainage 4+124, the track lift is negligible. However confirmation would be required to establish the minimum clearance between rail and soffit to be considered. Information is available in the NR Track Design Handbook; NR/L2/TRK/2049.

No allowance has been made for trough routes which may impact on the location of OLE foundations. An interdisciplinary assessment would have to be made at the detail design phase of the project which in turn would dictate foundation locations. Location of OLE structures may be impacted by signal locations. Interdisciplinary assessments will have to be made to verify locations of other track side furniture which could have an impact on the earthing and bonding strategy. Concrete foundations have been considered, however there may be scope, following ground surveys that piles/bored foundations could be an improved option. No allowance has been made for overlaps or mid-point anchors (MPAs). Contact/Catenary wire splices should be avoided if possible. This may introduce the need for half tension lengths. It is assumed that all relocated OLE structures will be installed within railway land. Confirmation to be ascertained prior to 4 tracking of route.

Table 2-1 shows estimated costs of electrification changes associated with track lifts at Ashley Down.

TABLE 2-1
Ashley Down – electrification costs (as a result of track lifts)
ELECTRIFICATION EQUIPMENT ONLY

Element	Cost per element	Cost
Overhead Line (OLE) Materials based on 13 support structures on each of the Filton Relief Lines (26 total)	Unit breakdown of Foundations, Steelwork, Cantilevers, Insulators and Conductors	£107,872
Labour & Plant required for Installation of OLE equipment provided above	Labour to include experienced operatives for the above activities and adequate plant to support	£150,100
White period possessions		£31,200
Transport, Small Tools (Generators, Drills, Dropper Table), Office and Messing		£70,598
Work Package Plans (WPP) and Railway Safety Case		£58,500
Design of OLE, including provision of layout plans and cross sections and providing "As Fitted" documents	Design to include for site survey and provision of protection	£9,500
TOTAL		**£427,770**

Notes:

- All prices exclude VAT
- Overheads and profit have not been included in the cost estimate
- Contingency (of 40%) is added to total costings later in this chapter
- Non-construction costs (including contractor preliminaries, GRIP stages 4 development costs, GRIP stage 5 detailed design, project management & sponsorship, testing & commissioning, and possession management) are similarly added later.

2.2.6 Signalling & telecommunications (S&T)

Ashley Down station relative is located East of Stapleton Road Station and West of Filton Abbey Wood and Filton South Junction. The location of the proposed station is between chainages 4007m and 4143m (see Permanent Way drawings HGL/GS2/DRG/001).

From the Sectional Appendix the existing lines speeds are 60 mph on the Up Filton and 75mph on the Down Filton line. The proposed line speeds once the Filton Bank 4-track scheme is completed are 60mph on the Up Filton Relief, 75mph on the Down Filton Relief and the Up Filton Main, and 85mph on the Down Filton Main lines. The Work in Progress stamped Signalling Scheme Plan supplied as reference (see Figure 2-7) covers the area between Stapleton Road and Filton Abbey Wood.

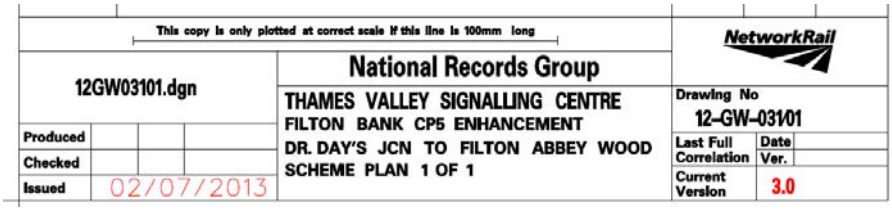

Figure 2-7: Work in Progress stamped Signalling Scheme Plan – Filton Bank

The area becomes four track with the Up and Down Relief lines passing through the passive provision platforms covering Ashley Down Platform 1 (Up Relief) and Platform 2 (Down Relief). The Signalling Scheme plan indicates Ashley Down Station at approx. 2½ (4032m) with a passive Platform (Up Relief) located between New BL1800 4 Aspect Colour Light and an adapted two to three 3 aspect signal BL1594. The latter would, if visible from end of Platform 1, be regarded as a Platform 1 Up Relief Ashley Down Start Signal. Ashley Down Platform 2 (DN Relief) is located between new BL 1589 4 Aspect Colour Light and an existing 4 aspect signal BL1599. The latter would, if visible from end of Platform 2, be regarded as a Platform 2 DN Relief Ashley Down Start Signal.

Signalling Scheme Plan

The Signalling Scheme plan does not appear to be signalled for full accommodation of the Ashley Down proposed Station and the passive provision of platforms has not been named Ashley Down. The assumption would therefore be that the signalling scheme plan would need to be modified under an instruction to accommodate the proposed Ashley Down station. In which case Signalling and Telecoms cost would need to cover adapting the Signalling Scheme plan to provide:

- Platform berth train detection in the Ashley Down Platform areas.
- Signal Sighting appraisal of visibility of adapted 2 to 3 aspect signal BL1594. The latter would, if visible from end of Platform 1, be regarded as a Platform 1 Up Relief Ashley Down Start Signal.
- Signal Sighting appraisal of visibility of existing 4 aspect signal BL1599. This would, if visible from end of Platform 2, be regarded as a Platform 2 DN Relief Ashley Down Start Signal; and
- Platform 1 and Platform 2 train stopping positions to be confirmed in platforms.

Assuming the signals (adapted 2 to 3 aspect signal BL1594 and existing 4 aspect signal BL1599) remain as indicated on scheme plan then detailed design, installation, testing and commissioning costs including platform train detection and stopping point arrangements would be approximately £45,000.

To this should be added approximately £5,000 for Signal Sighting (SS) costs using a Signal Sighting Chairman and Committee to produce Prelim Signal Sighting Forms, SS Report, carry out a SS Committee walk through and the final Signal Sighting. Signal Sighting would need to take into account the notable gradient in the Ashley Down Station Area (even after this is adjusted to 1:220).

The total cost of signalling & telecommunications design & build changes related to the Signalling Scheme Plan would be some £50,000.

Screen layout & ergonomic train describer modifications

Around £5,000 should be allowed for signalling screen layout changes and ergonomic and train describer mods/considerations at the signalling control centre, so that passenger/operational trains may be observed stopping, entering and exiting the proposed new Ashley Down Up and Down Relief platforms.

Note though that if other stations were located on a shared line of route and designed for (Ashley Down being just one) cost efficiencies could be achieved by doing all signalling control screen layout changes and train describer based on the all stations final scheme plan and control tables in one go.

CCTV & Help Points

Provision of Customer Information System (CIS), Help Points and Closed Circuit television (CCTV) would require an additional £30,000. This assumes that works included in the Platform Technology are for equipment to cover 136m long platforms on both Up and Down Relief lines, including sufficient public address (PA) system and CCTV coverage.

Total S&T cost

The total S&T cost estimated to incorporate Ashley Down station would be some £85,000 (excluding contingency). Note though that these costs are very preliminary as they are suggested in isolation from any other proposed new stations (such as those included in MetroWest Phase 1 or 2). The separate station signalling design and construction costs for all stations, when added up to form one total, would be reduced if intelligently packaged and programmed as one project (potentially by around 20%). [10]

2.2.7 Total cost of Ashley Down station

Table 2-2 shows total costs of developing Ashley Down station. Note that this table assumes that the MetroWest Phase 2 Project would cover scheme preparation work, so does not include the full array of non-construction costs (including GRIP stages 4 development, GRIP stage 5 detailed design and project management & sponsorship), and also has a 20% allowance for contingency. This is considered a realistic assessment.

Table 2-4 shows a worst case assessment of costs, incorporating the full non-construction costs (including GRIP stages 4 development, GRIP stage 5 detailed design and project management & sponsorship) and furthermore with an increase contingency allowance of 40%.

[10] Contingency (of 20% or 40%) is added to total costings later in this chapter. Likewise, non-construction costs are similarly added.

TABLE 2-2
Ashley Down – station costs
February 2014 figures

Element	%	Cost
Construction cost		
Station		£2,629,200
Platforms (incl lighting, signage, furniture)		£1,335,200
Footbridge, ramps, steps (as appropriate)		£800,000
Other station costs (fencing, buildings)		£45,500
Access road, bus turning and cycle stands		£232,000
Technology (ticket machines, CCTV, PA)		£121,250
Site preparation, drainage & utilities		£95,250
Infrastructure & permanent way		£1,457,630
Permanent Way		£944,860
Electrification		£427,770
Signalling & Telecommunications		£85,000
Sub-total (construction cost)		£4,086,830
Non-construction cost		
Contractor preliminaries	20%	£817,366
Testing and commissioning	2.5%	£102,171
Possession management	2.5%	£102,171
Sub-total (non-construction cost)	25%	£1,021,708
Total cost (initial)l		£5,108,538
Contingency	20%	£1,021,708
TOTAL		£6,130,245

Notes:

- Includes 20% contingency
- All prices exclude VAT
- Cost of land acquisition not included
- No provision for contaminated waste disposal
- Overheads and profit have not been included in the cost estimate
- No provision for TOC compensation
- Rules of the route possessions assumed
- MetroWest Phase 2 project covers Project Management, GRIP 4 development and GRIP 5 detailed design

TABLE 2-3
Ashley Down – station costs
February 2014 figures

Element	%	Cost
Construction cost		
Station		£2,629,200
Platforms (incl lighting, signage, furniture)		£1,335,200
Footbridge, ramps, steps (as appropriate)		£800,000
Other station costs (fencing, buildings)		£45,500
Access road, bus turning and cycle stands		£232,000
Technology (ticket machines, CCTV, PA)		£121,250
Site preparation, drainage & utilities		£95,250
Infrastructure & permanent way		£1,457,630
Permanent Way		£944,860
Electrification		£427,770
Signalling & Telecommunications		£85,000
Sub-total (construction cost)		£4,086,830
Non-construction cost		
Contractor preliminaries	20%	£817,366
GRIP stages 4 development	1%	£40,868
GRIP stage 5 detailed design	6%	£245,210
Project Management & Sponsorship	10%	£408,683
Testing and commissioning	2.5%	£102,171
Possession management	2.5%	£102,171
Sub-total (non-construction cost)	42%	£1,716,469
Total cost (initial)l		£5,803,299
Contingency	40%	£2,321,319
TOTAL		£8,124,618

Notes:

- Includes 40% contingency
- All prices exclude VAT
- Cost of land acquisition not included
- No provision for contaminated waste disposal
- Overheads and profit have not been included in the cost estimate
- No provision for TOC compensation
- Rules of the route possessions assumed
- NR asset protection costs included within Project Management, GRIP 4 development, GRIP 5 detailed design and testing and commissioning

2.3 Near Constable Road

2.3.1 Initial site selection

Initial site selection was based on five major criteria:

- Land availability;
- Size of station, including construction footprint;
- Accessibility;
- Permanent Way factors, such as alignments, switches and crossings (S&C), etc; and
- Environmental factors.

The principal purpose of assessing a station site near to Constable Road is to identify if there is a viable alternative site on the Filton Bank to either of the historic station locations (at Ashley Down or Horfield). The specific location chosen was driven initially by a desire to avoid the gradient issues at Ashley Down. However, as the Filton Bank has a reasonably uniform gradient throughout its length, this particular aim is not possible. Hence, the secondary desire is to avoid interference with any of the proposed switch and crossing (S&C) layouts associated with Filton Bank 4-tracking, which subtends this particular site near Constable Road. This site therefore has a major advantage over the historic Horfield station site, as there is no S&C in the area that will be installed in this area prior to this scheme as part of the Filton Bank project.[11]

The potential station site is located approximately 475m south of Constable Road over-bridge between Bristol Temple Meads to Filton Abbey Wood. The location of the potential station is shown Figure 2-8, with the potential station footprint shown in in proposed station is shown in Figure 2-9, which highlights its location surrounded by a strip of woodland/green areas. A number of industrial businesses/areas are nearby with a number of residential properties also noted. This section seeks to assess the suitability and cost of establishing a station development in the location shown.

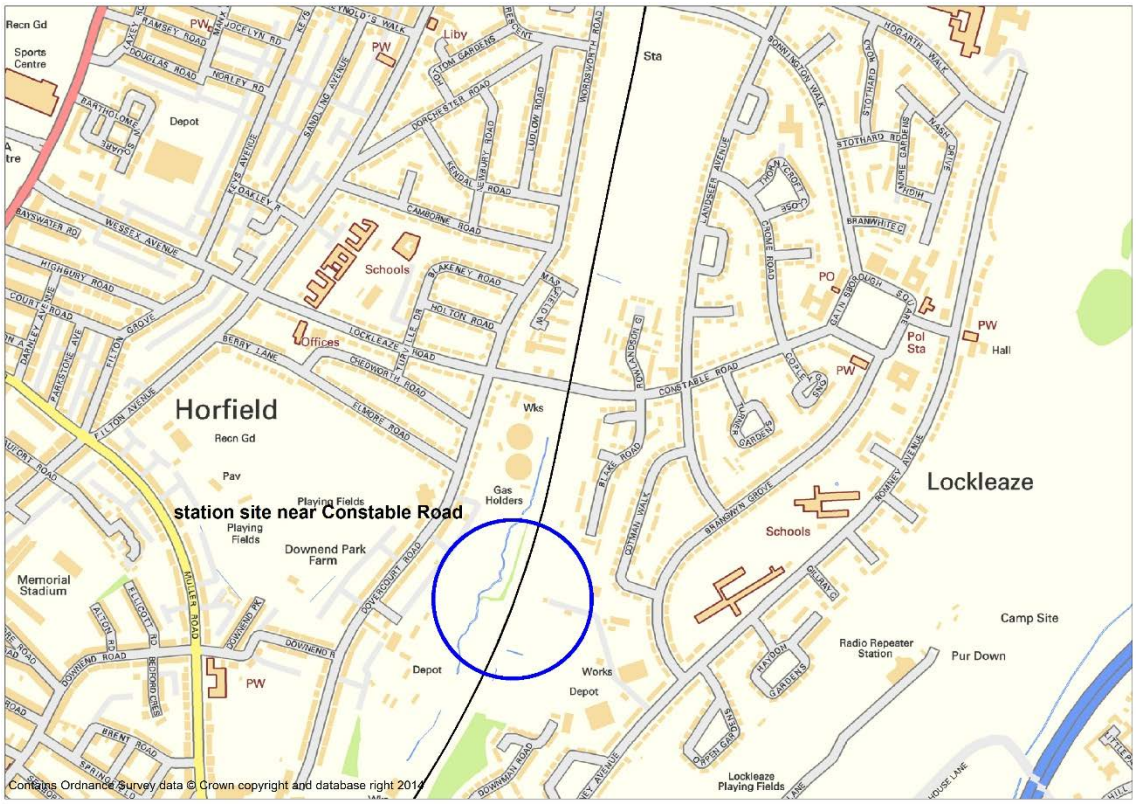

Figure 2-8: Location of possible station site near Constable Road

[11] It should be noted that there is currently no passive provision for a station at Constable Road in designs for the Filton Bank 4-track scheme.

Figure 2-9: Constable Road station footprint

Note that, as with Ashley Down, Filton Bank 4-tracking of the existing 2-track layout is assumed as the 'existing layout' for a station in this location, as any new station in this area would only be built after 4-tracking is completed. In addition to reference to the 4-tracking plans, a desktop study was undertaken using Google Earth, OS mapping, the Network Rail Sectional Appendix, 5 Mile diagrams and Quail maps. Additionally, a site visit was undertaken to get a general impression of the proposed station location. For further information on the station design and location see drawing HGL/GS2/DRG/002 (Appendix A). No earthworks are anticipated for the erection of the station including its operational facilities.

The proposed site satisfies the requirement for 136m long platforms[12]. For the purposes of this study, Romney Avenue is proposed as the notional access for the station and route for access to the associated vehicle drop off/pickup area. It should be noted that no specific allowance has been made, at this stage, for land requirements for this access, in terms of considering land ownership and potential purchase, access restrictions or associated costs.

The final criterion noted above was to ensure environmental factors are considered in the station development. Initial potential issues are highlighted from desk study, including:

- The area station development may require some limited clearance of woodland/ trees adjacent to the current road alignment to allow construction works and form part of the construction footprint for the development. Removal of natural woodland will be unfavourable to the local community and is likely to require local council approval. Seasonal restrictions on tree removal during nesting period may also apply. The close proximity of woodland to the track alignment and lack of direct public visibility of the area means the local community will be largely unaffected by this clearance. Resolution through necessary council permission and planning for the practical measures of tree removal in close proximity to the track are likely to mitigate this issue successfully. Note that research into the existence of invasive plant species or protected wildlife in this location is not accounted for at this stage/ desktop study.

[12] It is considered likely that the initial platform length built for a new station on the Filton Bank will be less than 136m (6-car), with 101m (4-car) or 125m (5-car) platforms designed in the first instance, though passive provision would be made for 6-car platforms to follow in due course.

- Additional traffic usage will be incurred from the use of the station on the surrounding road network. This influence on local services may merit further consideration if deemed significant. Community benefits for improved transport networks and favourable localised economy are likely to offset local community concerns.

If the project is developed further, the following areas should be discussed and mitigated:

- Ecology & Nature Conservation;
- Historic Environment;
- Townscape & Visual Amenity;
- Water Resources;
- Noise & Vibration;
- Air Quality;
- Geology, Soils & Land Contamination;
- Resources Use & Waste Management;
- Traffic & Transport;
- Socio-Economic Impacts;
- Cumulative impacts with other developments; and
- Third party land and access issues/requirements.

Station design

Figure 2-10 showing the station location in its current state, with Figure 2-11 setting out a proposed station layout with operational facilities (based on the assumptions outlined earlier). The basic construction cost of the station layout as shown in £2,514,350 (excluding contingency). [13] [14] [15]

Figure 2-10: Existing 2-track layout showing Constable Road future station location

[13] Contingency (of 20% or 40%) is added to total costings later in this chapter. Likewise, non-construction costs (including contractor preliminaries, GRIP stages 4 development costs, GRIP stage 5 detailed design, project management & sponsorship, testing & commissioning, and possession management) are similarly added.

[14] All prices exclude VAT. Rules of the route possessions are assumed. NR asset protection costs included within Project Management, GRIP 4 development, GRIP 5 detailed design and testing and commissioning.

[15] Note that TOC compensation and land acquisition costs are not included. There is also no provision for contaminated waste disposal.

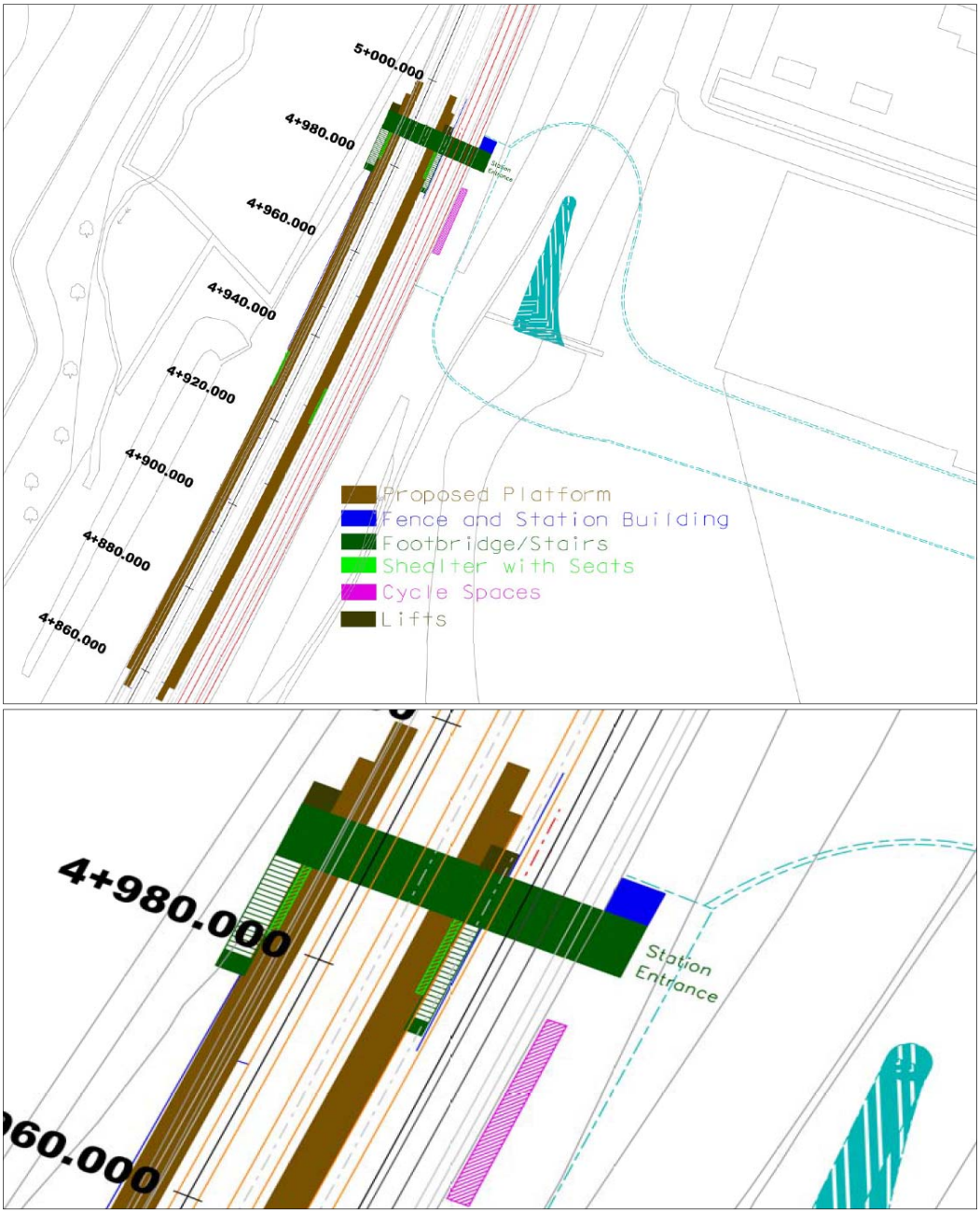

Figure 2-11: Proposed Station layout Constable Road with operational facilities

2.3.2 Permanent Way

The proposed station location is between chainage 4860m and 4996m which is approximately 475m south of Constable Road over-bridge.

NR preferred a station in this location over the historical Horfield site as after the 4-tracking there is a number of turnouts and crossovers within the Horfield site area which NR don't want to be disturbed. For more information concerning Constable Road Station location please refer to drawing HGL/GS2/DRG/002.

The existing horizontal alignments (as per Filton Bank design) of both the Filton Up and Down Relief lines have not been changed. However, to allow for a new platform between the Relief and Main lines, both Main lines had to be slued away from the Relief lines by a maximum of 2.29m (ch. 4920m). This way room has been made for a single face platform alongside the Filton Down Relief line.

Vertically there are (notionally) two options for the Relief Lines. It would theoretically be possible to maintain the existing gradient through the station, but as this is not considered practical, the design considered is to adapt a station gradient of 0.45% (1:220). This is the maximum gradient found in the

Group Standard Deviations Register for similar conditions (Corby Station). A similar deviation from Group Standard GI/RT/7016 will have to be sought for this project. To achieve this gradient over a distance of approx. 180m the gradients to either side of the station need to be steepened.

To the south of the station this means that the existing gradient of 1.20% has been increased to be 1.44% over approx. 340m. This has led to lifts of up to 810mm (ch.4830m). This again will lead to a significant amount of earthworks as the existing track bed will have to be reconstructed between ch.4535m and ch.5220m to accommodate lifts and lowers.

North of the station the gradient of 0.45% has led to track lowerings of up to 470mm (ch.5020m) and a steepened gradient of 1.58% (existing 1.34%) to tie-into the existing vertical alignment. Train retarders at the low end of the platforms will be required to avoid 'runaway' trains [16]. The Up and Down Main lines remain unchanged from a vertical point of view.

The overall Permanent Way cost to achieve the gradient and curvature as discussed above for Ashley Down station is £1,430,713 (excluding contingency). See Appendix B for further details of the derivation of Permanent Way costings. [17]

2.3.3 Electrification

As Filton Bank is assumed to be electrified prior to any Constable Road station being implemented, changes to the electrification equipment will be required. A number of assumptions have been made to determine the costs of doing this.

Where track lowering occurs (between chainages 4+960 and 5.220), existing OLE structures and support equipment (cantilever frames) will have to be lowered to suit the new track levels. Where track lifts are <200mm, the existing tolerance in the mast length should negate the need for structure replacement. However loads, in particular overturning should be checked to confirm adequacy of the retained mast. Where track lifts at the OLE structure position occur (between chainages 4+570 and 4+930), new structures will need to be installed. It may be possible to reuse some of the existing masts and cantilever frames.

Based on a track radius of curvature of 1600m, OLE structures have been positioned at 55m spans. Where the radius of curvature decreases to 1100m spans of 50m have been considered. It is proposed to free run the overhead line equipment through the new station footbridge. It is essential therefore that the soffit height of the bridge takes account of any proposed track lift. At the proposed bridge centre line of chainage 4+988, the track lift is approximately 400mm.

When considering track slews of approximately 2.30m on the Up and Down Filton main lines, consideration could be given at the initial design stage to installing two track cantilevers with a longer boom to compensate for the slews. This may assist with any signalling sighting issues introduced with the design and installation of the OLE. A desk top study based on virtual reality modelling would ascertain whether any clash was evident.

If the existing footbridge at approximately chainage 5+047 is retained, the proposed track lower of 420mm should allow sufficient soffit clearance for the bridge to be free run with the OLE.

No allowance has been made for trough routes which may impact on the location of the OLE foundations. An interdisciplinary assessment would have to be made at the detail design phase of the project. Location of OLE structures may be impacted by signal locations. Interdisciplinary assessments will have to be made to verify locations of other track side furniture which could have an impact on the earthing and bonding strategy. Concrete foundations have been considered, however there may be scope, following ground surveys that piles/bored foundations could be an improved option. No

[16] Further, more detailed, assessments may indicate that retarders or catch points are not required at the station, though the costs of potentially providing these facilities have been retained in the overall totals in this report.

[17] Contingency (of 20% or 40%) is added to total costings later in this chapter. Likewise, non-construction costs are similarly added.

allowance has been made for overlaps or mid-point anchors (MPAs). Contact/Catenary wire anchors should be avoided if possible. This may introduce the need for half tension lengths. It has been assumed that all relocated OLE structures will fall within the existing railway land.

Table 2-4 shows estimated costs of electrification changes associated with track lifts at the Constable Road station site.

TABLE 2-4
Constable Road – electrification costs (as a result of track lifts)
ELECTRIFICATION EQUIPMENT ONLY

Element	Cost per element	Cost
Overhead Line (OLE) Materials based on 10 support structures on each of the Filton Relief Lines (20 total)	Unit breakdown of Foundations, Steelwork, Cantilevers, Insulators and Conductors	£82,978
OLE supports associated with track slews of Filton Main Lines. 8 supports for each line (total 16)	Unit breakdown of Foundations, Steelwork, Cantilevers, Insulators and Conductors	£66,383
Labour & Plant required for Installation of OLE equipment provided above	Labour to include experienced operatives for the above activities and adequate plant to support	£207,830
White period possessions		£43,200
Transport, Small Tools (Generators, Drills, Dropper Table), Office and Messing		£77,752
Work Package Plans (WPP) and Railway Safety Case		£58,500
Design of OLE, including provision of layout plans and cross sections and providing "As Fitted" documents	Design to include for site survey and provision of protection	£13,154
TOTAL		**£549,797**

Notes:

- All prices exclude VAT
- Overheads and profit have not been included in the cost estimate
- Contingency (of 40%) is added to total costings later in this chapter
- Non-construction costs (including contractor preliminaries, GRIP stages 4 development costs, GRIP stage 5 detailed design, project management & sponsorship, testing & commissioning, and possession management) are similarly added later.

2.3.4 Signalling & telecommunications (S&T)

Constable Road Station (see permanent way Constable Road vertical and horizontal alignment design drawing HGL/GS2/ DRG/002) is located at approx. 4860m to 5000m between Stapleton Road and Filton Abbey Wood. The 5 mile diagram currently shows two lines (Up Filton and Down Filton) however, this scheme will be implemented once the Filton Bank scheme will have been completed.

The layout comprises four Tracks, two new Up and Down Main lines with two existing tracks (Up and Down Relief lines) used for stopping trains at the station. The proposed line speeds are 60mph on the Up Filton Relief , 75mph on the Down Filton Relief and the Up Filton Main, and 85mph on the Down Filton Main lines. The Work in Progress stamped Signalling Scheme Plan supplied as reference (see Figure 2-7) covers the area between Stapleton Road and Filton Abbey Wood. The area becomes four track with the Up and Down Relief lines passing through the proposed Constable Road station.

In the vicinity of Constable Road Station there is a 4 Aspect Signal BL1590 at 4889m (Up Filton Relief). If this was used as a Platform Start at Constable Road it would be located at approx. 5000 in which case the Up Platform Relief requires a Platform Start signal. It would be advised to check if BL1590 could be relocated 111m east relative to the scheme plan, line-speeds, signal spacing and braking distance requirements. The signalling cost for Constable Road will however assume a new 4 Aspect Platform Start for the Up Relief platform along with the associated train detection system.

Relative to Down Filton Relief there is a new 4 Aspect signal signal BL1589 on the Scheme plan at 5116m. Ideally this would be at approx. 4860m at the end of the platform. The signalling cost will therefore

assume a new Platform Start signal for the Down Relief platform along with the associated train detection system.

Signalling and Telecoms cost would need to cover adapting the Signalling Scheme plan to provide

- Platform Starts and berth train detection in the Filton Relief Up and Down platform areas;
- Berth train detection in the Filton Relief Up and Down Platform 1 and 2 areas;
- Platform 1 and 2 S&T Cable Route management systems and locations cases with local signalling and train detection PSUs;
- Preliminary Signal Sighting and final signal sighting of Platform Starts; and
- Identification of platform stopping positions for the required Rolling Stock.

Signalling Scheme Plan

The development of a scheme plan, the detailed design Location Area Plan, Wiring diagrams, installation, testing and commissioning costs including platform train detection and stopping point arrangements would be approx. £100,000 as two new 4 Aspect Platform Start signals would be supplied along with Cable Route management systems.

An additional £5,000 would be required for Signal Sighting Costs, using a Signal Sighting (SS) Chairman and Committee to produce Prelim Signal Sighting Forms, an SS Report, carry out a SS Committee walk through and do the final Signal Sighting.

This adds up to approximately £105,000. This figure assumes efficiencies including passive provision when constructing the platform for Platform Start Signals and cable route management systems. Likewise sharing of possessions and access during the construction phases.

Screen layout & ergonomic train describer modifications

Around £5,000 should be allowed for signalling screen layout changes and ergonomic and train describer mods/considerations at the signalling control centre, so that passenger/operational trains may be observed stopping, entering and exiting the proposed new Constable Road Up and Down Relief platforms.

Note though that if other stations were located on a shared line of route and designed for (Constable Road being just one) cost efficiencies could be achieved by doing all signalling control screen layout changes and train describer based on the all stations final scheme plan and control tables in one go.

CCTV & Help Points

Provision of Customer Information System (CIS), Help Points and Closed Circuit television (CCTV) would require an additional £30,000. This assumes that works included in the Platform Technology are for equipment to cover 136m long platforms on both Up and Down Relief lines, including sufficient public address (PA) system and CCTV coverage.

Total S&T cost

The total S&T cost estimated to incorporate Ashley Down station would be some £140,000 (excluding contingency). [18]

Note though that these costs are very preliminary as they are suggested in isolation from any other proposed new stations (such as those included in MetroWest Phase 1 or 2). The separate station signalling design and construction costs for all stations, when added up to form one total, would be reduced if intelligently packaged and programmed as one project (potentially by around 20%).

[18] Contingency (of 20% or 40%) is added to total costings later in this chapter. Likewise, non-construction costs are similarly added.

2.3.5 Total cost of Constable Road station

Table 2-5 shows the total costs of developing a station near Constable Road. Note that this table assumes that the MetroWest Phase 2 Project would cover scheme preparation work, so does not include the full array of non-construction costs (including GRIP stages 4 development, GRIP stage 5 detailed design and project management & sponsorship), and also has a 20% allowance for contingency. This is considered a realistic assessment.

Table 2-8 shows a worst case assessment of costs, incorporating the full non-construction costs (including GRIP stages 4 development, GRIP stage 5 detailed design and project management & sponsorship) and furthermore with an increase contingency allowance of 40%.

TABLE 2-5
Constable Road – station costs
February 2014 figures

Element	%	Cost
Construction cost		
Station		£2,514,350
Platforms (incl lighting, signage, furniture)		£1,238,200
Footbridge, ramps, steps (as appropriate)		£780,000
Other station costs (fencing, buildings)		£29,000
Access road, bus turning and cycle stands		£173,000
Technology (ticket machines, CCTV, PA)		£78,750
Site preparation, drainage & utilities		£215,400
Infrastructure & permanent way		£2,120,510
Permanent Way		£1,430,713
Electrification		£549,797
Signalling & Telecommunications		£140,000
Sub-total (construction cost)		£4,634,860
Non-construction cost		
Contractor preliminaries	20%	£926,972
Testing and commissioning	2.5%	£115,872
Possession management	2.5%	£115,872
Sub-total (non-construction cost)	25%	£1,158,715
Total cost (initial)l		£5,793,575
Contingency	20%	£1,158,715
TOTAL		£6,952,290

Notes:

- Includes 20% contingency
- All prices exclude VAT
- Cost of land acquisition not included
- No provision for contaminated waste disposal
- Overheads and profit have not been included in the cost estimate
- No provision for TOC compensation
- Rules of the route possessions assumed
- MetroWest Phase 2 project covers Project Management, GRIP 4 development and GRIP 5 detailed design

TABLE 2-6
Constable Road – station costs
February 2014 figures

Element	%	Cost
Construction cost		
Station		£2,514,350
Platforms (incl lighting, signage, furniture)		£1,238,200
Footbridge, ramps, steps (as appropriate)		£780,000
Other station costs (fencing, buildings)		£29,000
Access road, bus turning and cycle stands		£173,000
Technology (ticket machines, CCTV, PA)		£78,750
Site preparation, drainage & utilities		£215,400
Infrastructure & permanent way		£2,120,510
Permanent Way		£1,430,713
Electrification		£549,797
Signalling & Telecommunications		£140,000
Sub-total (construction cost)		£4,634,860
Non-construction cost		
Contractor preliminaries	20%	£926,972
GRIP stages 4 development	1%	£46,349
GRIP stage 5 detailed design	6%	£278,092
Project Management & Sponsorship	10%	£463,486
Testing and commissioning	2.5%	£115,872
Possession management	2.5%	£115,872
Sub-total (non-construction cost)	42%	£1,946,641
Total cost (initial)l		£6,581,501
Contingency	40%	£2,632,600
TOTAL		£9,214,102

Notes:

- Includes 40% contingency
- All prices exclude VAT
- Cost of land acquisition not included
- No provision for contaminated waste disposal
- Overheads and profit have not been included in the cost estimate
- No provision for TOC compensation
- Rules of the route possessions assumed
- NR asset protection costs included within Project Management, GRIP 4 development, GRIP 5 detailed design and testing and commissioning

2.4 Horfield (historic location)

2.4.1 Overview

The historic Horfield station site is located almost 5km from Bristol Temple Meads railway station, and just over 1km south of Filton Abbey Wood station. The station site is located adjacent to the Bonnington Walk over-bridge and parallel to Wordsworth Road. It can be accessed from Bonnington Walk. Figure 2-12 shows the location, with an aerial photo of the vicinity in Figure 2-13.

The site is in a deep cutting, and some elements of the former platform can be seen at the foot of the embankment on the western edge of the foundation. The current tracks are located on the eastern side of the cutting, which would ultimately become the location of the 'Main' lines when Filton Bank 4-tracking is completed. Two new 'Relief' lines would be located on the western side of the foundation, and any new station platforms at Horfield are assumed to be located alongside these tracks only.

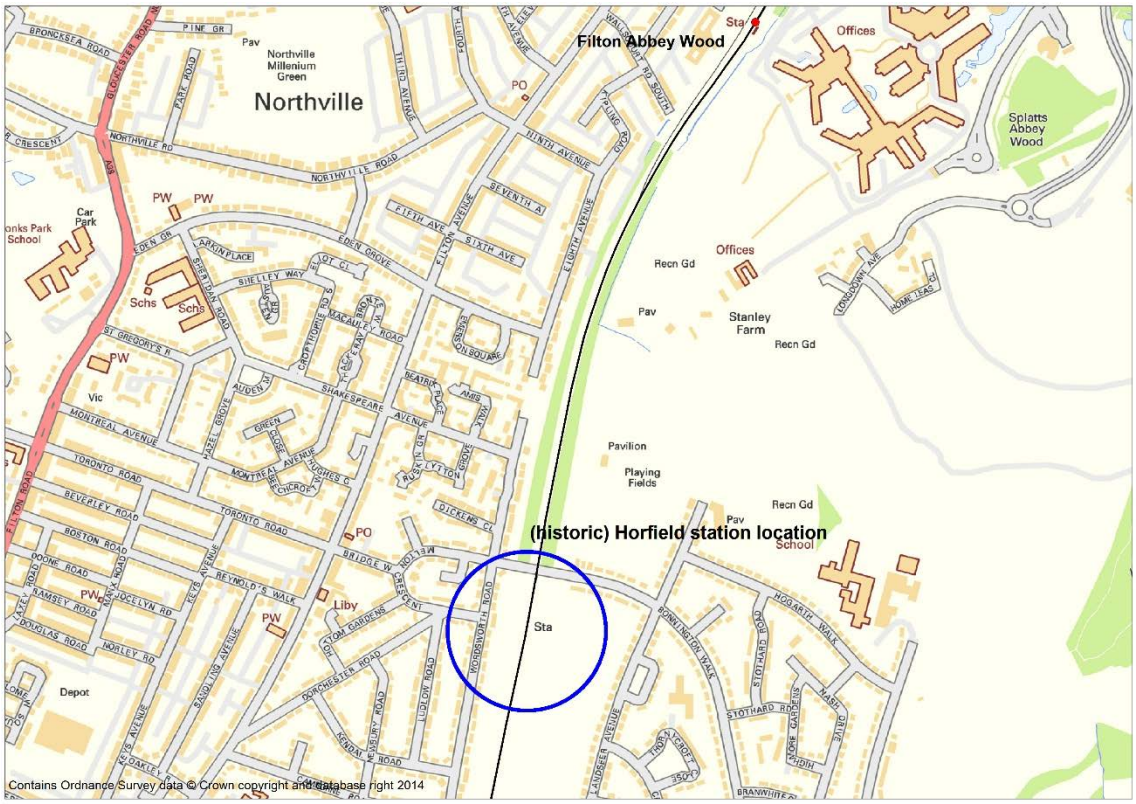

Figure 2-12: Location of historic Horfield station site

Initial desk study

An initial desktop study has thus far been undertaken for a potential Horfield station. In summary:

- Horizontally there appears to be enough room to build a platform between the Down Relief and the Up Main. This is due to the fact that the Relief and the Main lines have to split because of the existing abutment of the over-bridge (Bonnington Walk), and the prior existence of a station in this location.[19]
- However, to build the station just south of the bridge a crossover which will be installed during the Filton Bank 4-tracking scheme will have to be re-located. It is a valid option to move the crossover to the south without causing operational disadvantages.[20]
- From a vertical point of view the Relief line gradients at the station location are similarly steep to Ashley Down or Constable Road and would need to be addressed in a similar fashion, i.e. the

[19] It should be noted that there is currently no passive provision for a station at Horfield in the designs for the Filton Bank 4-track scheme.

[20] Note though that for the purposes of this study that no specific request to move the crossover has been made to Network Rail. It is understood, however, that this is highly unlikely to be acceptable, as it could be detrimental to the overall operation of Filton Bank.

Relief lines would require significant lifts and a steepening of gradients to achieve a 0.45% (1:220) platform gradient.

- The overall Permanent Way cost for Horfield station should be similar to Ashley Down however, there will be additional costs for moving the cross-over mentioned above.

Figure 2-13: Location of historic Horfield station site

2.4.2 Initial Site Selection

A desktop study was undertaken using Google Earth, OS mapping, the NR Sectional Appendix, 5 Mile diagrams and Quail maps. Additionally, a site visit was undertaken to get a general impression of the proposed station location. The initial site selection was based on five major criteria:

- Land availability;
- Size of station, including construction footprint;
- Accessibility;
- Permanent Way factors, such as alignments, S&C etc; and
- Environmental factors.

Although the station site itself is essentially fixed, two options were identified for station access, both of which have been considered in this study. These are:

- Station access via a new footbridge and link from Bonnington Walk; and
- Station access directly from the Bonnington Walk bridge.

The potential site has the same essential requirements as the other sites considered on the Filton Bank. However, it differs from the Ashley Down and Constable Road sites in that the track (and hence platform) level is located at a much lower height than the surrounding ground, and furthermore between steep slopes. This limits the options for the location of the station, in particular with respect to accesses, drop/pick up areas. Figure 2-14 shows the potential Horfield station location, as viewed from the Bonnington Walk over-bridge. Figure 2-15 illustrates the cutting slope in the vicinity of the

Bonnington Walk bridge. For further information on the station design and location see drawing HGL/GS2/DRG/003 (Appendix A).

Figure 2-14: Existing 2-track layout showing Horfield future station location (looking south from Bonnington Walk)

Figure 2-15: Cutting slope to the north of Bonnington Walk bridge

Due to the limitations of space in the cutting, and the proximity of houses on Wordsworth Road, a possible station access area is between the station site and Landseer Avenue, where a drop/pick up roundabout and station building would be located. Access to this area would need to be constructed from Bonnington Walk.

The area in the yellow box in Figure 2-16 indicates an area of woodland/trees that would need to be fully or partially cleared to allow construction works and to form the permanent footprint for the station access development. Removal of natural woodland may be unfavourable to the local community and will require approval. Seasonal restrictions on tree removal during nesting period may also apply. Organisation of mitigation measures may include, responsible disposable/recycling of material, where

possible considering use of community involvement projects with artists, schools or local project groups to use waste material for local benefit. This method is likely to improve local relations and local acceptance of the project. Note that research into the existence of invasive plant species or protected wildlife in this location is not accounted for at this stage. Whilst this is highlighted as a potential risk, the area is largely surrounded by industrial buildings, which may reduce the realisation of this risk item. However, there is potential direct impact on residential housing and the local community. Some additional traffic would be generated by users of a station.

Figure 2-16: Possible Horfield station access site

2.4.3 Station design

As noted earlier, two options for station access have been considered:

- Option 1 – access to the platform by a footbridge starting from high ground to the east of the proposed station, with stairs and lifts to reach the platforms. The footbridge would connect to the north end of the platform, due to space limitation next to it (Up and Down Mail lines). The layout of this option can be seen in Figure 2-17.
- Option 2 – uses Bonnington Walk bridge to provide access to the platforms using ramps (at compliant gradients). No lifts or stairs are needed, though the Bonnington Walk overbridge would have to be widened. A key disadvantage of this approach would be no immediately adjacent space for a drop-off/pick up area, meaning that this would have to be located in the same area as the previous option. The layout of this option can be seen in Figure 2-18.

The basic construction cost of the station layout for Option 1 access arrangements is £2,278,410, and £2,350,710 for Option 2 access (excluding contingency). [21] [22] [23]

[21] Contingency (of 20% or 40%) is added to total costings later in this chapter. Likewise, non-construction costs (including contractor preliminaries, GRIP stages 4 development costs, GRIP stage 5 detailed design, project management & sponsorship, testing & commissioning, and possession management) are similarly added.

[22] All prices exclude VAT. Rules of the route possessions are assumed. NR asset protection costs included within Project Management, GRIP 4 development, GRIP 5 detailed design and testing and commissioning.

[23] Note that TOC compensation and land acquisition costs are not included. There is also no provision for contaminated waste disposal.

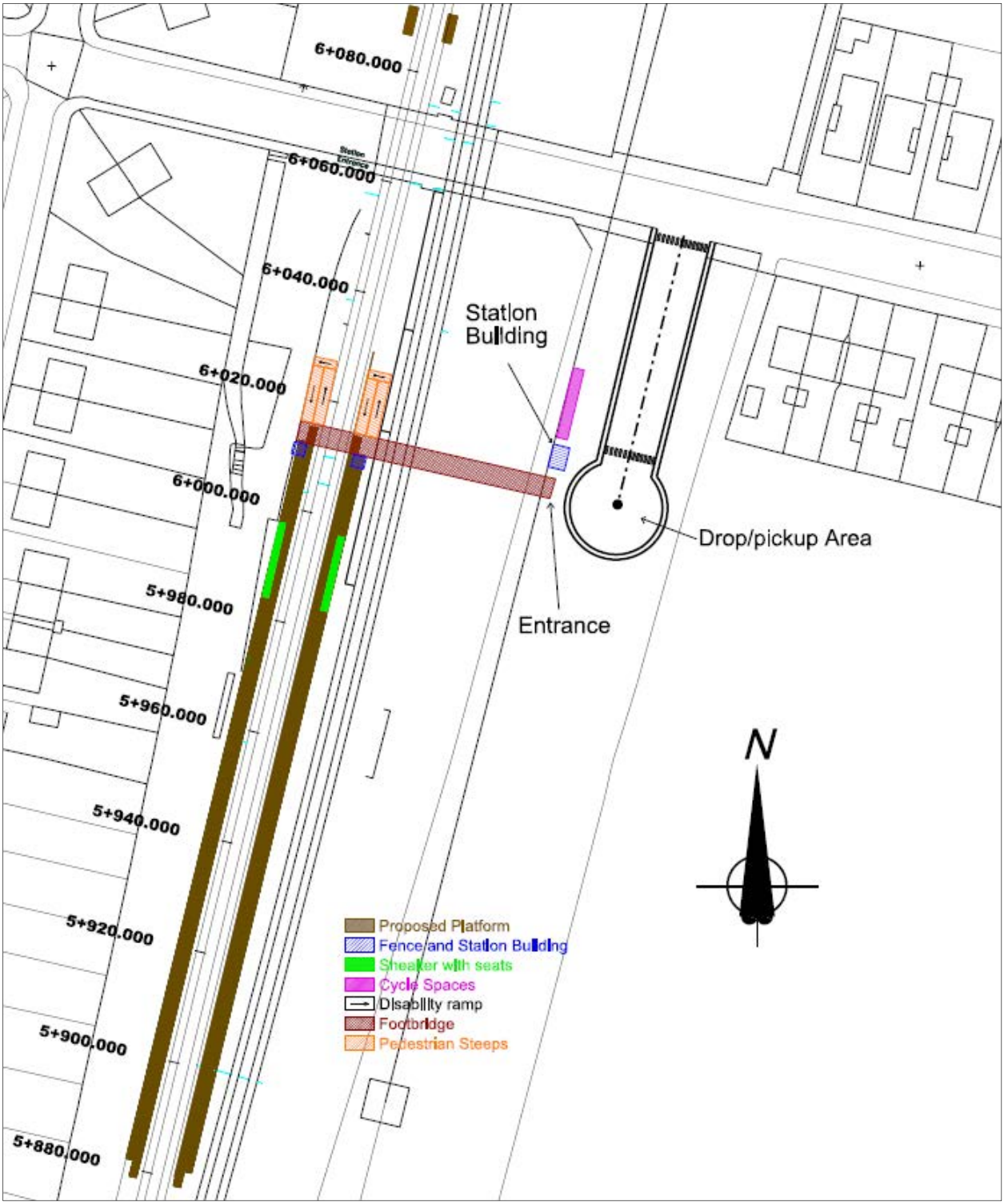

Figure 2-17: Horfield station – access option 1 – new footbridge

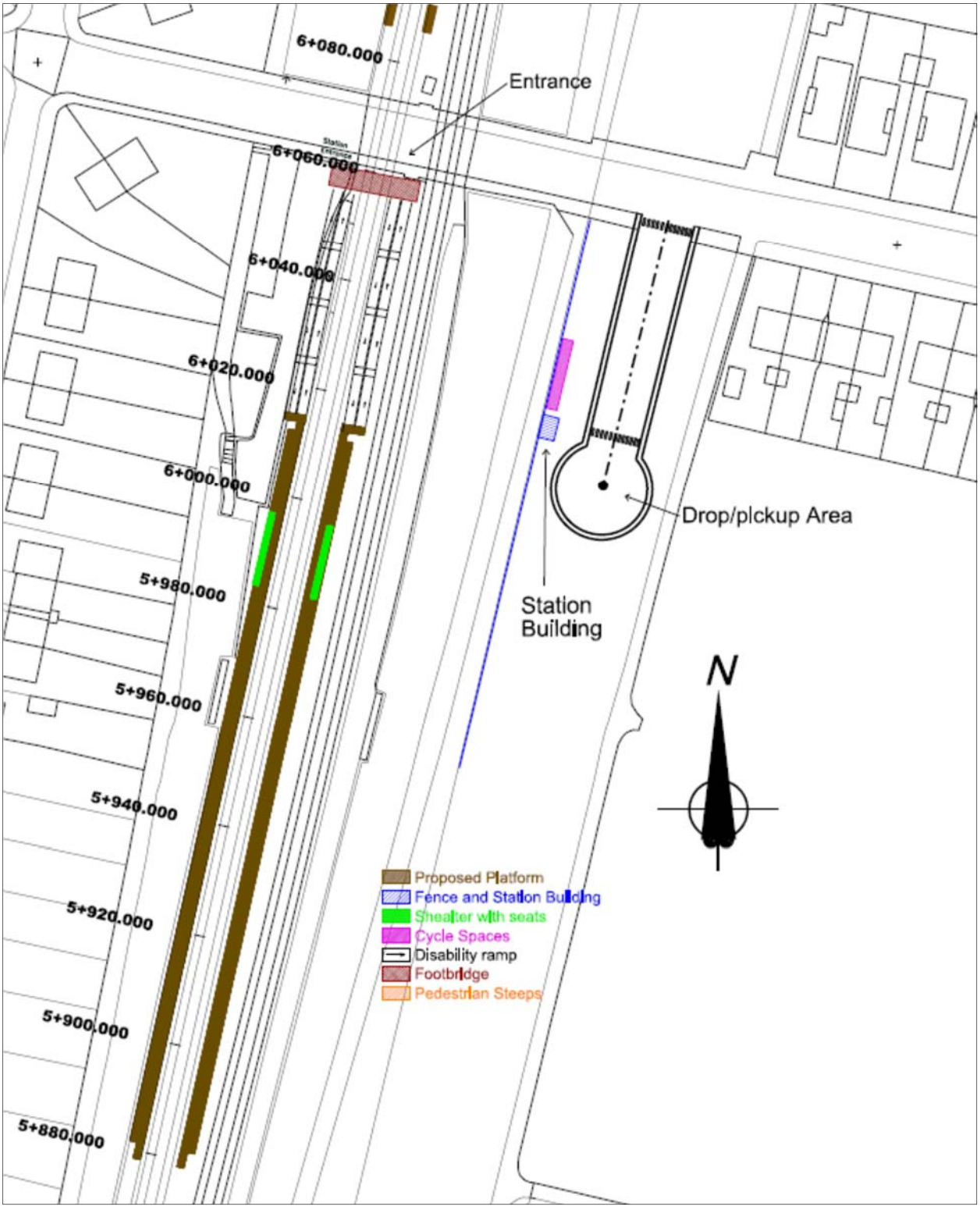

Figure 2-18: Horfield station – access option 2 –direct link from Bonnington Walk bridge

2.4.4 Permanent Way

The potential new station location at Horfield is very close to the historic site. As a result, the Filton Bank 4-track design (Form A) allows for a future station in this location from a horizontal alignment point of view. This is due to the Relief and the Main lines having to split to pass either side of the existing abutment of the Bonnington Walk overbridge. Therefore to fit in a Horfield station, the horizontal alignment of all of the (future) 4 lines is unchanged (and as per Filton Bank design). Two single face platforms are considered for the Up Relief and the Down Relief lines.

Vertically there are (notionally) two options for the Relief Lines. It would theoretically be possible to maintain the existing gradient through the station, but as this is not considered practical, the design considered is to adapt a station gradient of 0.45% (1:220). This is the maximum gradient found in the Group Standard Deviations Register for similar conditions (Corby Station). A similar deviation from Group Standard GI/RT/7016 will have to be sought for this project. To achieve this gradient over a distance of approx. 180m the gradients to either side of the station need to be steepened.

To the south of the station this means that the existing gradient of 1.45% has been increased to be 1.84% over approx. 390m. This has led to lifts of up to 1.53m (ch.5860m). This again will lead to a significant amount of earthworks as the existing track bed will have to be reconstructed between ch.5480m and ch.6050m to accommodate lifts and lowers. To the north the station the gradient of 0.45% has led to track lowerings of up to 100mm (ch.6040m) and a steepened gradient of 1.30% (existing 1.20%) to tie-into the existing vertical alignment. A maximum track lowering of 100mm at the adjacent overbridge has been applied to not potentially compromise the bridge foundations Train retarders at the low end of the platforms will be required to avoid 'runaway' trains[24]. The Up and Down Main lines remain unchanged from a vertical point of view.

To build the station just south of the bridge, a crossover (NR60G), which will be installed during the Filton Bank 4-tracking scheme, will have to be re-located. Moving the crossover to the south will not cause any operational disadvantages.

The overall Permanent Way cost to achieve the gradient and curvature as discussed above for a Horfield station is £1,701,500 (excluding contingency). Compared with the Ashley Down station the cost is much higher due to higher lifts required and the moving of the NR60G crossover. See Appendix B for further details of the derivation of Permanent Way costings. [25]

2.4.5 Electrification

As Filton Bank is assumed to be electrified prior to any Horfield station being implemented, changes to the electrification equipment will be required. A number of assumptions have been made to determine the costs of doing this, as discussed briefly below.

- Where track lifts are <200mm, between chainages 5+500 and 5+910, existing tolerance in the mast lengths should negate the need for structure replacement. However loads, in particular overturning should be checked to confirm adequacy of the retained masts and foundations.
- Where track lifts at the OLE structure positions occur; between 5+510 and 6+000, new structures will need to be installed. It may be possible to reuse some of the existing masts and cantilever frames. This would be subject to a design assessment.
- Based on a track radius of curvature of 2000m, on the Up and Down Filton Relief, where the track lifts occur, OLE structures have been positioned at 65m spans.
- It is proposed to free run the overhead line equipment through the existing Bonnington Walk overbridge. The soffit height of the bridge will need to be confirmed prior to any detailed OLE design being undertaken. At the proposed bridge centre line of 6+066, the track lift is

[24] Further, more detailed, assessments may indicate that retarders or catch points are not required at the station, though the costs of potentially providing these facilities have been retained in the overall totals in this report.

[25] Contingency (of 20% or 40%) is added to total costings later in this chapter. Likewise, non-construction costs are similarly added.

negligible. However confirmation would be required to establish the minimum clearance between rail and soffit. Information is available in the NR Track Design Handbook; NR/L2/TRK/2049, where clearances are specified for the various route types.

- No allowance has been made for trough routes which may impact on the across track location of the OLE foundations. An interdisciplinary assessment would have to be made at the detail design phase of the project.
- Because of the reduced 10' (10 foot), typically 2.88 rail to rail, between the Filton Down Relief and the Filton Up Main for the initial OLE design, portal structures across all lines with independent registration should be considered. This would then only require the replacement of shorter stove pipes/drop tubes for the Relief lines. To maintain the minimum static electrical clearance it might be necessary to reduce the system height in the areas of greatest track lift.
- Location of OLE structures may be impacted by signal locations, and in particular with respect to signal sighting. Desk top studies will need to be carried out prior to any OLE detailed design. Interdisciplinary assessments will also have to be made to verify locations of other track side furniture which could have an impact on the earthing and bonding strategy.
- As there is a cross over between the Filton Up and Down Relief, it will be necessary to install OLE structures at the 200mm opening from the switch toe positions to register the cross over and Up & Down Filton Relief equipment. These are located at 5+689 and 5+803 with a further registration point at 5+746 to support a section insulator. However, exact locations will be subject to a detail study once the cross over location has been confirmed.
- Concrete foundations have been considered, however there may be scope, following ground surveys, for piles/bored foundations to be an alternative option.
- No allowance has been made for overlaps or mid-point anchors (MPAs), and their respective anchors. These will be subject to detailed design.
- Contact/Catenary wire splices should be avoided if possible. This may introduce the need for half tension lengths, which may also be determined by the location of the cross over.
- It is assumed that all relocated OLE structures will be installed within the LOD. Confirmation to be ascertained prior to 4 tracking of route.

Table 2-7 shows estimated costs of electrification changes associated with track lifts at the Horfield station site, taking into account the assumptions noted above.

TABLE 2-7
Horfield – electrification costs (as a result of track lifts)
ELECTRIFICATION EQUIPMENT ONLY

Element	Cost per element	Cost
Overhead Line (OLE) Materials based on 10 support structures on each of the Filton Relief Lines (20 total)	Unit breakdown of Foundations, Steelwork, Cantilevers, Insulators and Conductors	£8,650
Labour & Plant required for Installation of OLE equipment provided above	Labour to include experienced operatives for the above activities and adequate plant to support	£24,000
White period possessions		£19,200
Transport, Small Tools (Generators, Drills, Dropper Table), Office and Messing		£39,270
Work Package Plans (WPP) and Railway Safety Case		£22,000
Design of OLE, including provision of layout plans and cross sections and providing "As Fitted" documents	Design to include for site survey and provision of protection	£10,200
TOTAL		**£123,320**

Notes:

- All prices exclude VAT
- Overheads and profit have not been included in the cost estimate
- Contingency (of 20% or 40%) is added to total costings later in this chapter
- Non-construction costs (including contractor preliminaries, GRIP stages 4 development costs, GRIP stage 5 detailed design, project management & sponsorship, testing & commissioning, and possession management) are similarly added later.

2.4.6 Signalling & telecommunications (S&T)

The new Horfield station site is approximately where the historic Horfield station was located. The Carillion Lawrence Hill Filton 5 mile diagram gives the chainage of Horfield (Closed) station as 03M 1210y. Originally a two track area it will become 4-track with two Up/Down Filton Relief tracks running between Horfield Station Platforms 1 and 2 as indicated on the PWay diagram in Figure 2-19. The PWay diagram gives the station position as approx. 5+880 and 6+0160. As the PWay diagram indicates there is an overbridge just east of the platforms.

The Thames Valley Signalling Centre Signalling Scheme Plan provided for estimating purposes (Title Block Figure 2-7) indicates the disused Horfield station and proposed 4 track Signalling through the area. With reference to the extract from the Signalling Scheme plan the two new platform on the Up/Down Filton Relief lines would straddle the crossover 7012A/B Points and lie approximately between Signals BL1584 and Bl1583. The crossover 7012A/B Points will be moved just west of the proposed station (Figure 2-20).

Figure 2-19: PWay Diagram; Horfield Station proposed platform location and relocated crossover position.

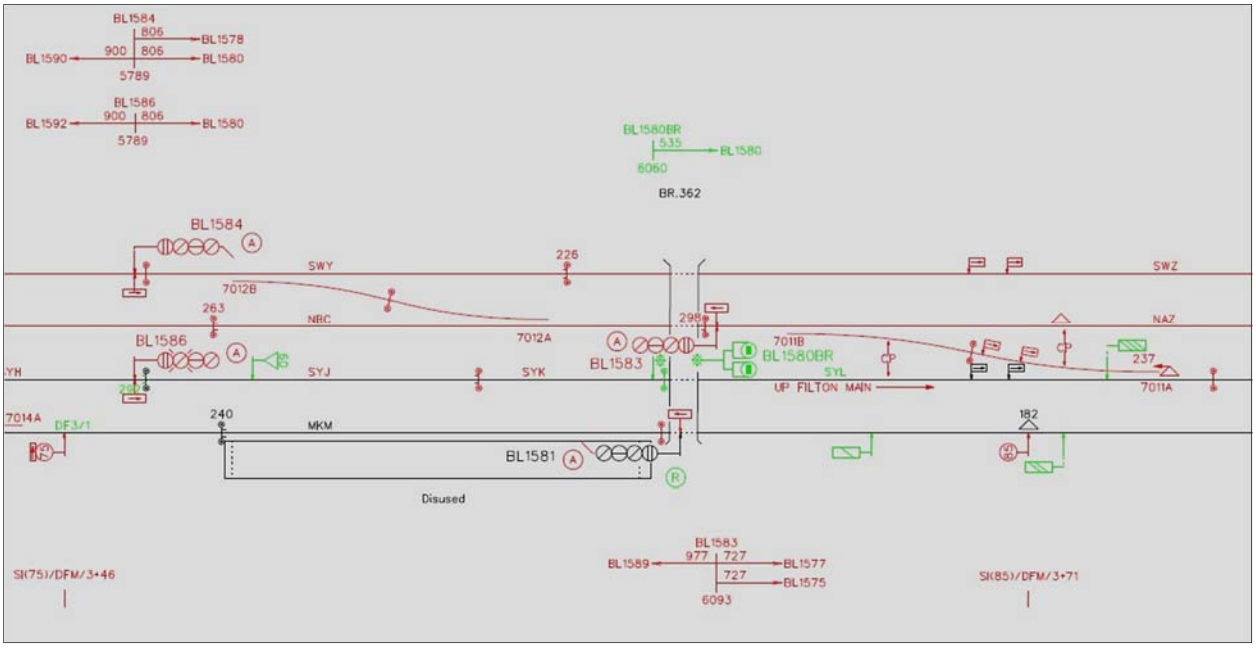

Figure 2-20: Extract Signalling Scheme Plan (estimating purposes)

For the potential station, the existing signalling system arrangement including exact signal positions will need to be assessed during the GRIP design process. The same applies to the track circuit arrangements. The Up and Down Filton Relief lines through the platforms will need to be provided with the associated

colour light signalling. The existing signalling will require modifications relative to Signal Spacing lengths of Track circuits etc. Ideally Signals BL1584 and Bl1583 as shown on the above Signalling Scheme Plan extract would be relocated approx. 150m East and West respectively to become Platform start signals.

With the crossover 7012A/B Points moved west of the station this would permit a route set from the Up Filton Relief into the Down Filton Relief Platform. Possibly existing Up Filton Relief BL1590 could set this route through the Down Horfield Platform via relocated west crossover 7012A/B Points and then on to the Up Filton Main with 7011A/B Crossover points remaining in their existing scheme plan position.

For the Horfield Up and Down Filton Relief platform end new start signals with associated berth track circuits and location cases with PSUs will be required. The signalling scheme plan indicates there is not bi-directional running through the station. There is however a move through the Down Horfield Platform via relocated west crossover 7012A/B Points and then on to the UP Filton Main via 7011A/B Crossover points that remain in the their existing scheme plan position. It should be noted that due to the incline through the proposed Horfield station area trapping will be required with associated track circuit interrupter installed.

A red-green signalling scheme plan should be produced for the station signalling area at GRIP 3 stage. In order to take account of the repositioning of the existing crossover, the red-green signalling scheme plan should indicate track circuit alterations, IBJs etc. A final option will eventually be developed at GRIP 4 stage (outline design/ single option development). Signal positions and train stopping point locations will be subject to a signal sighting chairman's recommendation prior to GRIP 5 design.

Preliminary signalling scope

Signalling and Telecoms cost would need to cover adapting the Existing Signalling Scheme plan and master records to provide:

- Platform Starts and berth train detection UP and Down Filton Relief Horfield Platform areas;
- Berth train detection in UP and Down Filton Relief Horfield Platform 1 and 2 areas;
- Platform 1 and 2 S&T Cable Route management systems and locations cases with local signalling and train detection PSUs;
- Preliminary Signal Sighting and Final signal sighting of Platform Starts;
- Identification of platform stopping positions for the required Rolling Stock;
- Re track circuiting of relocated west crossover 7012A/B Points and fitment of track circuit interrupters required for trapping of these points; and
- Modification of signal in rear of relocated crossover 7012A/B Points.

Both Platform start signals will require TPWS (TSS-OSS) and overlaps. It could be assumed Signals BL 1584 and BL1583 as shown on the above Signalling Scheme Plan would be relocated approx. 150 m (TBC) East and West respectively to become Platform start signals. It could be assumed the existing Up Filton Relief signal BL1590 (TBC) could set this route 'wrong direction' through the Down Horfield Platform via relocated west crossover 7012A/B points and then on to the UP Filton Main signal BL1560 with 7011A/B Crossover points remaining in the their existing above scheme plan position.

Signalling Scheme Plan

The development of a scheme plan, the detailed design Location Area Plan, Wiring diagrams, installation, testing and commissioning costs including platform train detection and stopping point arrangements would be approx. £80,000 as two new 4 Aspect Platform Start signals would be supplied along with Cable Route management systems.

Re-track circuiting of relocated west crossover 7012A/B Points and fitment of track circuit interrupters would be required for trapping of these points, at a cost of £30,000. Modification required to the signal in rear of relocated crossover 7012A/B Points would also be required, at a cost of £10,000. An additional £5,000 would be required for Signal Sighting Costs, using a Signal Sighting (SS) Chairman and Committee to produce Prelim Signal Sighting Forms, an SS Report, carry out a SS Committee walk through and do the final Signal Sighting.

This adds up to approximately £125,000. This figure assumes efficiencies including passive provision when constructing the platform for Platform Start Signals and cable route management systems. Likewise sharing of possessions and access during the construction phases.

Screen layout & ergonomic train describer modifications

Around £7,000 should be allowed for signalling screen layout changes and ergonomic and train describer mods/considerations at the signalling control centre, so that passenger/operational trains may be observed stopping, entering and exiting the proposed new Horfield Up and Down Filton Relief platforms. The move via relocated west and re-track circuited crossover 7012A/B Points and fitment of track circuit interrupters would also require monitoring from the signalling control centre. Likewise the route setting move from modified signal in rear possibly BL 1590 Up Filton Relief to UP Filton Main BL1560 would need to be accommodated.

Note though that if other stations were located on a shared line of route and designed for (Horfield being just one) cost efficiencies could be achieved by doing all signalling control screen layout changes and train describer based on the all stations final scheme plan and control tables in one go.

CCTV & Help Points

Provision of Customer Information System (CIS), Help Points and Closed Circuit television (CCTV) would require an additional £30,000. This assumes that works included in the Platform Technology are for equipment to cover 136m long platforms on both Up and Down Relief lines, including sufficient public address (PA) system and CCTV coverage.

Total S&T cost

The total S&T cost estimated to incorporate a Horfield station would be some £162,000 (excluding contingency). [26]

Note though that these costs are very preliminary as they are suggested in isolation from any other proposed new stations (such as those included in MetroWest Phase 1 or 2). The separate station signalling design and construction costs for all stations, when added up to form one total, would be reduced if intelligently packaged and programmed as one project (potentially by around 20%).

2.4.7 Total cost of Horfield station

Table 2-8 shows the total costs of developing a station at the historic Horfield site, for both station access options 1 and 2. Overall, option 1 (new footbridge) is slightly cheaper than option 2 (access from Bonnington Walk overbridge). Note that this table assumes that the MetroWest Phase 2 Project would cover scheme preparation work, so does not include the full array of non-construction costs (including GRIP stages 4 development, GRIP stage 5 detailed design and project management & sponsorship), and also has a 20% allowance for contingency. This is considered a realistic assessment.

Table 2-9 shows a worst case assessment of costs, incorporating the full non-construction costs (including GRIP stages 4 development, GRIP stage 5 detailed design and project management & sponsorship) and furthermore with an increase contingency allowance of 40%.

[26] Contingency (of 20% or 40%) is added to total costings later in this chapter. Likewise, non-construction costs are similarly added.

TABLE 2-8
Historic Horfield site – station costs
February 2014 figures

Element	%	Access Option 1	Access Option 2
Construction cost			
Station		£2,278,410	£2,350,710
Platforms (incl lighting, signage, furniture)		£1,215,200	£1,222,000
Footbridge, ramps, steps (as appropriate)		£730,000	£800,000
Other station costs (fencing, buildings)		£66,500	£66,500
Access road, bus turning and cycle stands		£85,210	£87,710
Technology (ticket machines, CCTV, PA)		£151,000	£144,000
Site preparation, drainage & utilities		£30,500	£30,500
Infrastructure & permanent way		£1,986,816	£1,986,816
Permanent Way		£1,701,496	£1,701,496
Electrification		£123,320	£123,320
Signalling & Telecommunications		£162,000	£162,000
Sub-total (construction cost)		£4,265,226	£4,337,526
Non-construction cost			
Contractor preliminaries	20%	£853,045	£867,505
Testing and commissioning	2.5%	£106,631	£108,438
Possession management	2.5%	£106,631	£108,438
Sub-total (non-construction cost)	25%	£1,066,307	£1,084,382
Total cost (initial)l		£5,331,533	£5,421,908
Contingency	20%	£1,066,307	£1,084,382
TOTAL		£6,397,839	£6,506,289

Notes:

- Includes 20% contingency
- All prices exclude VAT
- Cost of land acquisition not included
- No provision for contaminated waste disposal
- Overheads and profit have not been included in the cost estimate
- No provision for TOC compensation
- Rules of the route possessions assumed
- MetroWest Phase 2 project covers Project Management, GRIP 4 development and GRIP 5 detailed design

TABLE 2-9
Historic Horfield site – station costs
February 2014 figures

Element	%	Access Option 1	Access Option 2
Construction cost			
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Platforms (incl lighting, signage, furniture)		£1,215,200	£1,222,000
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Access road, bus turning and cycle stands		£85,210	£87,710
Technology (ticket machines, CCTV, PA)		£151,000	£144,000
Site preparation, drainage & utilities		£30,500	£30,500
Infrastructure & permanent way		£1,986,816	£1,986,816
Permanent Way		£1,701,496	£1,701,496
Electrification		£123,320	£123,320
Signalling & Telecommunications		£162,000	£162,000
Sub-total (construction cost)		£4,265,226	£4,337,526
Non-construction cost			
Contractor preliminaries	20%	£853,045	£867,505
GRIP stages 4 development	1%	£42,652	£43,375
GRIP stage 5 detailed design	6%	£255,914	£260,252
Project Management & Sponsorship	10%	£426,523	£433,753
Testing and commissioning	2.5%	£106,631	£108,438
Possession management	2.5%	£106,631	£108,438
Sub-total (non-construction cost)	42%	£1,791,395	£1,821,761
Total cost (initial)l		£6,056,621	£6,159,287
Contingency	40%	£2,422,648	£2,463,715
TOTAL		£8,479,269	£8,623,002

Notes:

- Includes 40% contingency
- All prices exclude VAT
- Cost of land acquisition not included
- No provision for contaminated waste disposal
- Overheads and profit have not been included in the cost estimate
- No provision for TOC compensation
- Rules of the route possessions assumed
- NR asset protection costs included within Project Management, GRIP 4 development, GRIP 5 detailed design and testing and commissioning

SECTION 3

3. Demand forecasting

3.1 Methodology

Demand forecasts of the potential new stations in Bristol have been carried out using a similar methodology to that used for other recent studies associated with the development of MetroWest Phase 2 and the new stations package. In outline, the methodology makes use of rail industry data and derived techniques to forecast demand at new stations broadly based on relationships at existing stations elsewhere.

Forecasts have employed existing data sources, as well as made use of previous forecasts carried out for the West of England Rail Studies during earlier development of the 'Greater Bristol Metro'.

3.1.1 Key data sources

National Rail Travel Survey (NRTS)

The National Rail Travel Survey (NRTS) provides estimates of the number of rail trips at stations on a notional and typical day and includes origins and destinations of trips using the rail network, both in terms of rail journeys themselves (the first, intermediate and last stations used) and the 'true' origin and destination of trips (including the locations where the overall journey started and finished, such as home, work or other location and the mode of station access/egress). Other journey characteristics derived from NRTS data includes ticket types, journey purposes and journey frequency. NRTS data is key to developing the bespoke gravity type model for new stations, as well as assessing potential demand changes at existing stations using PDFH derived calculations.

Office of Rail Regulation (ORR) statistics

Passenger counts at stations. The latest ORR station statistics were published in February 2013 covering the annual period 2011-12. ORR station totals are used in conjunction with NRTS and MOIRA2 data to update figures as required.

West of England annual station survey

Passenger counts at stations. The latest West of England station survey was carried out in November 2013. The survey results are used in conjunction with ORR station statistics.

MOIRA2

MOIRA2 is used by the rail industry to forecast the impact of timetables on passenger revenue, including analysing the effect of changes such as stopping patterns, infrastructure and rolling stock on the passenger numbers carried and the revenue impact. MOIRA2 was previously provided to the study team by the DfT for use in the Metro West studies. Information from these previous analyses has been utilised in this study in generalised cost and fare/revenue calculations, though no specific assessments have been possible for this study. MetroWest was modelled using MOIRA2 as Phase 1, Phase 2 and a 'new stations package'. This sought to forecast changes in demand at existing stations as a result of changes to the rail service. As such, Henbury and Filton North have not been modelled using MOIRA2.

Passenger Demand Forecasting Handbook (PDFH)

The PDFH summarises knowledge of the effects of changes to services, fares and other factors on rail passenger demand, and provides guidance on applying this to forecasts. Values in the PDFH can be used to assess demand responses to timetabling and operating decisions.

3.1.2 New station demand forecasts

A series of approaches are required to assess different aspects of new stations. These consider three main elements that together enable the net total benefit to the railway to be established, and include:

- Total trips generated by the new station;
- Existing rail trips diverted from existing trips to the new station; and
- Suppression of demand at existing stations by an extra station call.

Total station demand

This has employed a simple gravity model technique, which takes into account the relationship between journeys and catchments at a number of similar stations. Regression has been used to identify a series of demand/catchment relationships for several types of movements, including journeys made using full price tickets, reduced price tickets and season tickets, and between 'independent' stations (such as Keynsham), 'regional' stations (such as Bristol Parkway), 'urban' stations (such as Stapleton Road) and London stations, as the characteristics of such trips can differ. Stations used in the regressions are drawn from the local West of England area locations as much as possible. The specific models used to forecast demand at the Bristol stations has been calibrated using demand quantum and access modes at either Clifton Down or Stapleton Road stations, the former being considered the best demographic fit as a similar 'urban' characteristic station catchment for the Ashley Down site, and the latter being applied to the Constable Road and Horfield sites.

Diversions of existing trips to new station

An estimate of how many trips are new to the railway or transferring from other stations is assessed using a station choice logit model, using generalised costs calculated for whole journeys from origin (home in many cases) to destination (for example, work) via the existing station used, which NRTS data identifies, compared with a similar trip using the new station.

Suppression of demand

Overlaying the direct demand impact of the station is an appraisal of lost demand to existing rail passengers on the stopping train. Where a new station is implemented on an existing line, there is potential to affect demand on services passing through (and stopping) at the new station, as a result of lengthening journey times. This can have a significant effect on revenue if the services to be stopped at a new station are fast and/or long distance, where the journey time penalty is greater and/or fares paid are higher than more local journeys. The new stations at Henbury and Filton North are not located on an existing passenger rail line, and no existing services would be delayed to stop at them. As such, suppression of demand at existing stations does not apply to these new stations.

3.1.3 Future demand

Demand for rail travel has grown significantly in recent years, with, for example, an almost 70% increase in passenger numbers being recorded through stations in the West of England area between 2004/05 and 2011/12 (based on ORR figures). This includes even larger increases on specific routes, such as more than doubling of patronage on the Severn Beach line. Historic growth rates at groups of West of England stations are shown in Table 3-1 and Figure 3-1. Apart from a slight levelling in 2007/08, growth has continued in spite of the economic recession, and seems likely to continue, albeit it is debatable whether the rates will be as high as seen in recent times.

Looking into the future, the Great Western RUS (published in March 2010) forecasted that demand in the Bristol area would rise by 41% at peak times between 2008 and 2019 (a rate of 3.2% per annum), and 37% off peak (2.9% per annum), with an average growth rate of 3.0% per annum.

The LTPP Regional Urban Markets study (published October 2013) uses a series of wider economic scenarios to frame changes in rail use, and forecasts are presented for rail use in/around key urban centres. The resulting growth rates for the Bristol area vary from 0.6% per annum to 3.9% per annum. More details of the LTPP growth rates are shown in Table 3-2.

TABLE 3-1
ORR historic patronage growth in West of England area
2004-2012 figures

Station groupings	2010/11 to 2011/12	2009/10 to 2010/11	2004/05 to 2011/12	2004/05 to 2011/12
	per annum	per annum	TOTAL	per annum
Bristol main (Temple Meads & Parkway)	5.7%	6.1%	57%	6.6%
Severn Beach Line	9.8%	18.9%	163%	14.8%
Other Bristol urban	8.7%	13.3%	142%	13.5%
B&NES (incl. Keynsham)	8.7%	9.3%	54%	6.4%
South Gloucestershire (excl. Parkway)	11.8%	13.2%	115%	11.5%
North Somerset	6.0%	10.9%	56%	6.5%
OVERALL	8.7%	10.9%	69%	7.8% [27]

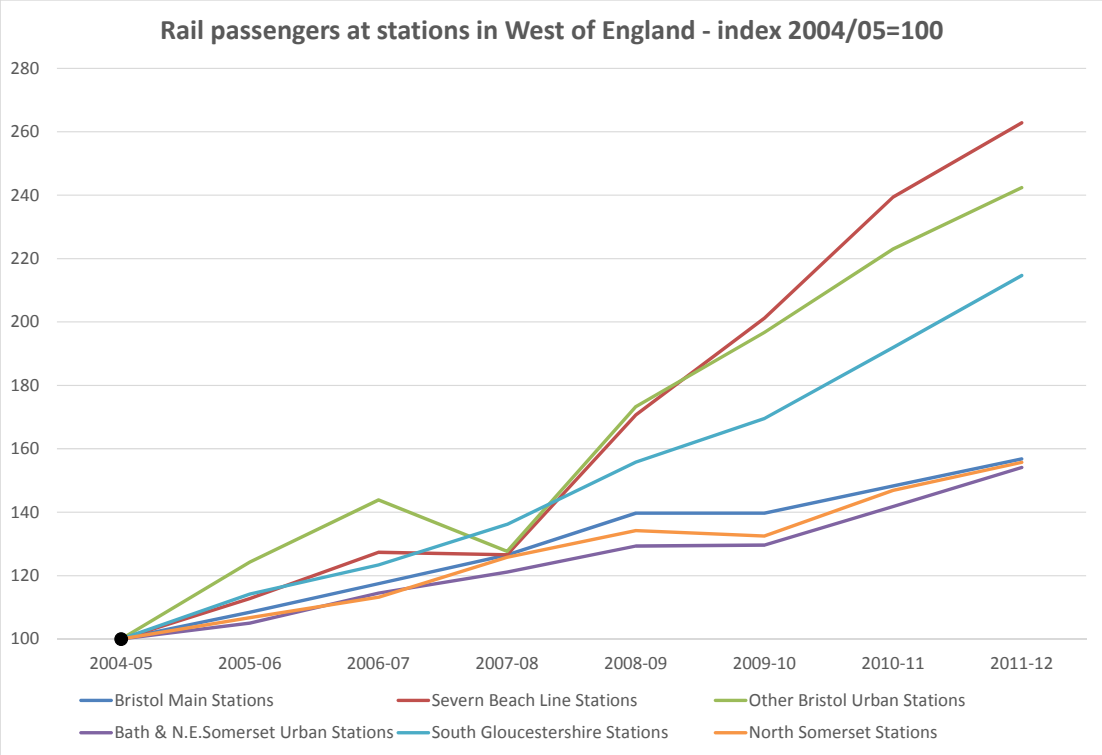


Figure 3-1: ORR historic growth in West of England area

TABLE 3-2
Network Rail LTPP: Regional Urban Markets Study – Bristol area forecast growth
(October 2013)

Economic scenario	2013-23	2013-23	2023-2043	2023-2043
	total	per annum	total	per annum
'Prosperity in isolation'	14%	1.3%	33%	1.4%
'Global stability'	47%	3.9%	44%	1.8%
'Struggling in isolation'	6%	0.6%	15%	0.7%
'Global turmoil'	35%	3.0%	21%	1.0%
AVERAGE	26%	2.3%	29%	1.3%

[27] As a comparison, the West of England station survey showed a 6.5% per annum increase from 2005 to 2012

In spite of recorded growth in recent years, it is possible that these rates would not continue unabated. As such, future year forecasts for North Fringe stations have been produced using a combination of decrementing historic rates, RUS and LTPP figures, as follows: [28]

- 2013 to 2017 – taper from recent historic growth rates at West of England stations (7.8% per annum) to RUS average of peak and off peak (3.0% per annum);
- 2018 & 2019 – RUS average rate (3.0% per annum);
- 2020 to 2023 – taper from RUS average rate (3.0% per annum) to an LTPP average rate derived from the four economic scenarios (2.3% per annum); and
- 2023 to 2043 – taper from 2023 LTPP average rate (2.3% per annum) to 2043 LTPP average rate (1.3% per annum).

3.2 Results of forecasts

3.2.1 Demand and revenue

Headline results of demand forecasts for potential Filton Bank stations, including sites at Ashley Down (the Ashley Hill historic location) and near Constable Road and at the historic Horfield station site are shown in Table 3-3. Forecasts are based on 2 trains per hour (notionally including stops by the new Henbury line service and another passing service), with each site considered as operating in isolation.

Forecasts are shown for 2022, as this represents the first full year after commencement of MetroWest Phase 2, assuming that the new stations were opened with MetroWest Phase 2 in 2021. It should be noted that the daily forecasts represent an 'average day', based on a new stations annualisation factor of 315 (in turn based on analysis of data extracted from MOIRA2) and do not take into account daily or weekly fluctuations in demand from, for example, seasonal variation, and incorporate future growth assumptions described earlier.

TABLE 3-3
Demand forecasts – potential Filton Bank stations sites
2022 figures (2 trains per hour)

Demand/revenue	Ashley Down	Near Constable Rd	(historic) Horfield
Annual demand	175,000	94,000	95,000
Daily demand (average)	555	299	301
Annual revenue (£)	£362,000	£195,000	£196,000

Demand forecasts suggest that the Ashley Down location (historic Ashley Hill station) is the most attractive location, with almost 175,000 trips per annum in 2022 (555 trips per day by 279 individuals and annual revenue of £362,000), compared to only just over 94,000 trips per annum (299 trips per day by 150 individuals and revenue of £195,000 per annum) for a station located near Constable Road. This is essentially as a result of the catchment around the Ashley Down site being more uniform around the station and more densely populated, as well as a potentially higher propensity to travel by train of a more affluent catchment polulace. The site near Constable Road is also relatively remote from the local road network. The historic Horfield site has demand forecast figures similar to those for the site near Constable Road, with just under 95,000 annual trips (301 trips per day by 151 individuals and annual revenue of £196,000).

Of the demand forecast at Ashley Down, only around 6% of trips are likely to be as a result of existing rail trips that have transferred from other stations. Transfers from existing stations are considered to be around 3% at Constable Road; this is lower than the at Ashley Down because the nearest station, Filton Abbey Wood, has a much better service than the Constable Road station would, and thus attracts more

[28] Given recent historic rates of growth of rail patronage, the forecast growth rates assumed can be considered comparatively conservative.

of the potential demand. Transfers to a Horfield station are considered to be very limited. The station site is even closer to Filton Abbey Wood, and as such the catchment has been restricted in demand forecasting to that which would realistically choose a Horfield station over Filton Abbey Wood, with the latter having a far superior train service.

Figure 3-2 shows summary future year forecasts of demand at the potential new stations from opening in 2021 to 2043, including annual and daily (average day) demand and revenue. Both main and sensitivity train service scenarios are included for the Filton Bank sites. Note that growth assumptions are conservative when compared with recent actual growth in rail use, but still indicate that demand could increase substantially as time passes, in effect increasing by over 50% between opening in 2021 and 2043.

3.2.2 Sensitivity tests

A series of sensitivity tests have also been carried out, to illustrate the potential effects that changes to underlying assumptions about development and train services could have on demand. Sensitivity tests include:

- 1 train per hour at all three sites (Ashley Down, near Constable road and historic Horfield), reflecting the situation that only an hourly Henbury line service could call at the stations;
- Full build-out of the Temple Quarter Enterprise Zone – applied to all three sites. This has the effect of adding more jobs to the area surrounding Bristol Temple Meads Station (this sensitivity test assumes one train per hour at all the stations); and
- Developments in the vicinity of Ashley Down station site – this sensitivity test only applied to the Ashley Down site, and includes two sub-tests of development near the cricket ground and development of the City of Bristol College (this sensitivity test assumes one train per hour at the Ashley Down station).

Table 3-4 shows results of sensitivity tests at the Ashley Down station site, with Table 3-5 and Table 3-6 showing the results for Constable Road and historic Horfield respectively.

TABLE 3-4
Demand forecasts – sensitivity tests at Ashley Down
2022 figures (2 trains per hour, unless indicated)

Demand/revenue	MAIN TEST	Reduced train service	Enterprise Zone	Local development	College development
	2 trains/hr	1 train/hr	2 trains/hr	2 trains/hr	2 trains/hr
Annual demand	175,000	151,000	178,000£	179,000	180,000
Daily demand (average)	555	479	566	569	573
Annual revenue (£)	£362,000	£312,000	£369,000	£371,000	£373,000

TABLE 3-5
Demand forecasts – sensitivity tests at Constable Road
2022 figures (2 trains per hour, unless indicated)

Demand/revenue	MAIN TEST	Reduced train service	Enterprise Zone
	2 trains/hr	1 train/hr	2 trains/hr
Annual demand	94,000	80,000	97,000
Daily demand (average)	299	254	307
Annual revenue (£)	£195,000	£165,000	£200,000

TABLE 3-6
Demand forecasts – sensitivity tests at historic Horfield
2022 figures (1 train per hour, unless indicated)

Demand/revenue	MAIN TEST	Reduced train service	Enterprise Zone
	2 trains/hr	1 train/hr	2 trains/hr
Annual demand	95,000	79,000	98,000
Daily demand (average)	301	252	310
Annual revenue (£)	£196,000	£164,000	£202,000

For all the potential station sites at Ashley Down and Constable Road, demand decreases by around 15% with only one train per hour. This is slightly higher (16%) at the historic Horfield site, because of a more direct relationship to the catchment with Filton Abbey Wood. The Enterprise Zone sensitivity test adds around 2% to demand at Ashley Down and 2.5% at Constable Road, rising to an increase of 3% at Horfield (again as a result of better serving the overlapping catchment). Local developments at Ashley Down could also add around 4% to demand for the station at this location.

3.2.3 Catchment and access modes

The total demand forecasts have been further analysed to identify the locations that potential users of the potential new stations would come from, as well as the likely modes of transport they would use to reach the stations. This is based primarily on analysis of users at Stapleton Road, Bedminster and Parson Street stations. NRTS data is used, as this provides the true origin of trips, as well as the mode of transport used to access the station.

Table 3-7 shows catchment distance and mode of access for Ashley Down station, for 2022 demand forecasts. Almost half of all one-way trips are likely to be outward and return portions of day returns, thus suggesting some 279 individuals arrive at the station (555 trips). Table 3-8 and Table 3-9 show similar figures for Constable Road and Horfield respectively.

Catchments of all stations are considered to be local in nature, and the rail services essentially also a local link, and while this will provide opportunities for people to make longer journeys on the wider rail network, neither station is anticipated to be a major railhead.

None of the stations are planned to provide car parking, and as such no ‘car parked’ access trips are forecast. This is consistent with NRTS data for stations in Bristol that do not have parking provided at the station (such as Stapleton Road and Bedminster), in that respondents in the NRTS at these stations did not indicate ‘car parked’ as their access mode.

Hence, the majority of station users at all the stations are anticipated to come from within 2km of the stations (around 85% of demand). This is based on the likely use of the stations, as noted, and comparison with similar locations elsewhere in the Bristol area.

On the Filton Bank, the catchment of the Ashley Down (historic Ashley Hill) station site potentially overlaps with both Montpelier and Stapleton Road stations, though as Ashton Gate is to Parson Street, both existing stations are around 1.5km from Ashley Down. However, Stapleton Road is on the opposite side of the M32 to Ashley Down, which, with limited crossing opportunities, effectively splits the catchments. Montpelier sits on the Severn Beach line, thus offering different journey opportunities to Ashley Down, and has typically very crowded peak time services (at present). Like Ashton Gate, these overlaps have been taken into account in the catchment areas, but as they are at the outer ranges are judged to have limited effect.

The Constable Road location is more remote from Montpelier and Stapleton Road stations than Ashley Down, but, as mentioned earlier, is closer to Filton Abbey Wood (1.6km). While this is in the outer catchment of the station, it has an effect on demand because Filton Abbey Wood has a significantly

superior train service to that proposed for the Filton Bank stations, or indeed to that at any of the urban stations in the Bristol area apart from the main stations of Bristol Temple Meads and Bristol Parkway.

The historic Horfield station site is located even closer to Filton Abbey Wood (little more than 1km away). This has a significant effect on potential demand at a 'Horfield' station.

TABLE 3-7
Rail users accessing Ashley Down – by origin catchment and access mode
2022 figures, 2 trains per hour

Catchment	Walk	Bus	Car parked	Car drop off	Bicycle	Taxi	ALL
Less than 1 km	80	-	-	2	-	-	90
from 1 to 2 km	115	23	-	2	-	12	152
from 2 to 3 km	35	1	-	-	-	-	36
from 3 to 4 km	-	-	-	-	-	-	-
from 4 to 5 km	-	-	-	-	-	-	-
from 5 to 10 km	-	-	-	-	-	-	-
More than 10 km	-	-	-	-	-	-	-
TOTAL	230	24	-	4	-	12	279

numbers may not add up exactly to totals due to rounding

TABLE 3-8
Rail users accessing site near Constable Road – by origin catchment and access mode
2022 figures, 2 trains per hour

Catchment	Walk	Bus	Car parked	Car drop off	Bicycle	Taxi	ALL
Less than 1 km	43	-	-	1	-	-	49
from 1 to 2 km	62	12	-	1	-	6	82
from 2 to 3 km	19	1	-	-	-	-	20
from 3 to 4 km	-	-	-	-	-	-	-
from 4 to 5 km	-	-	-	-	-	-	-
from 5 to 10 km	-	-	-	-	-	-	-
More than 10 km	-	-	-	-	-	-	-
TOTAL	124	13	-	2	-	6	150

numbers may not add up exactly to totals due to rounding

TABLE 3-9
Rail users accessing (historic) Horfield – by origin catchment and access mode
2022 figures, 2 trains per hour

Catchment	Walk	Bus	Car parked	Car drop off	Bicycle	Taxi	ALL
Less than 1 km	43	-	-	1	-	-	49
from 1 to 2 km	62	12	-	1	-	6	82
from 2 to 3 km	19	1	-	-	-	-	20
from 3 to 4 km	-	-	-	-	-	-	-
from 4 to 5 km	-	-	-	-	-	-	-
from 5 to 10 km	-	-	-	-	-	-	-
More than 10 km	-	-	-	-	-	-	-
TOTAL	125	13	-	2	-	6	151

numbers may not add up exactly to totals due to rounding

Year	Filton Bank - ASHLEY DOWN 2 trains per hour			Filton Bank - CONSTABLE RD 2 train per hour			Filton Bank - HORFIELD 2 train per hour			
	Demand		Revenue	Demand		Revenue	Demand		Revenue	
	annual	daily	annual	annual	daily	annual	annual	daily	annual	
2013	-	-	-	-	-	-	-	-	-	
2014	-	-	-	-	-	-	-	-	-	
2015	-	-	-	-	-	-	-	-	-	
2016	-	-	-	-	-	-	-	-	-	<< electrification PARTIAL
2017	-	-	-	-	-	-	-	-	-	<< electrification COMPLETE
2018	-	-	-	-	-	-	-	-	-	
2019	-	-	-	-	-	-	-	-	-	<< Metro PHASE 1 (assumed)
2020	-	-	-	-	-	-	-	-	-	
2021	170,281	541	£352,293	91,841	292	£190,010	92,350	293	£191,062	<< Metro PHASE 2 (assumed)
2022	174,824	555	£361,692	94,292	299	£195,079	94,814	301	£196,160	
2023	179,165	569	£370,672	96,633	307	£199,923	97,168	308	£201,030	
2024	183,281	582	£379,188	98,853	314	£204,515	99,400	316	£205,648	
2025	187,399	595	£387,708	101,074	321	£209,111	101,634	323	£210,269	
2026	191,516	608	£396,226	103,295	328	£213,705	103,867	330	£214,889	
2027	195,627	621	£404,731	105,512	335	£218,292	106,096	337	£219,502	
2028	199,728	634	£413,216	107,724	342	£222,869	108,320	344	£224,103	
2029	203,815	647	£421,671	109,928	349	£227,429	110,537	351	£228,689	
2030	207,883	660	£430,087	112,122	356	£231,968	112,743	358	£233,253	
2031	211,927	673	£438,455	114,303	363	£236,481	114,937	365	£237,791	
2032	215,944	686	£446,765	116,470	370	£240,963	117,115	372	£242,298	
2033	219,929	698	£455,009	118,619	377	£245,410	119,276	379	£246,769	
2034	223,876	711	£463,176	120,748	383	£249,814	121,417	385	£251,198	
2035	227,782	723	£471,256	122,855	390	£254,173	123,535	392	£255,581	
2036	231,642	735	£479,241	124,936	397	£258,480	125,628	399	£259,911	
2037	235,450	747	£487,121	126,990	403	£262,729	127,694	405	£264,185	
2038	239,203	759	£494,885	129,015	410	£266,917	129,729	412	£268,395	
2039	242,896	771	£502,524	131,006	416	£271,037	131,732	418	£272,539	
2040	246,523	783	£510,029	132,963	422	£275,085	133,699	424	£276,609	
2041	250,081	794	£517,390	134,882	428	£279,055	135,629	431	£280,601	
2042	253,564	805	£524,597	136,760	434	£282,942	137,518	437	£284,509	
2043	256,969	816	£531,641	138,597	440	£286,741	139,364	442	£288,329	

Figure 3-2: New station forecasts – demand and revenue over time

SECTION 4

4. Summary

This report briefly describes the engineering issues and outline designs for potential station locations on Filton Bank (between Stapleton Road and Filton Abbey Wood stations), as well as providing demand forecast.

There are three sites, as shown in Figure 1-1. These include potential station sites:

- Ashley Down (the site of the historic Ashley Hill station);
- Near Constable Road; and
- The historic Horfield station site.

Rail engineering

Outline design work undertaken in this study has considered the station locations, with respect to permanent way constraints, design of station platforms and other supporting station infrastructure, changes to alignments as a result of horizontal and vertical track positioning, relationship with overhead electrification equipment (OLE) and signalling and telecommunications (S&T) equipment. The level of detail is broadly that of a GRIP2 study.

This study has indicated that, while it is possible to develop stations in several locations on the Filton Bank, none are particularly straightforward in terms of railway engineering.

Not least this is because of the prevailing gradient on the Filton Bank between the existing stations at Stapleton Road and Filton Abbey Wood is 1:75, which is considered very steep to locate a new station. This can be overcome by selective track lifting and lowering to engineer a track gradient through the station platforms of 1:220 (considered an appropriate target gradient), but with attendant civils costs associated with this. In addition, as a result of the electrification of the Great Western Main Line (including Filton Bank) taking place prior to any potential station construction, there will be a need to adjust OLE (electrification equipment) to match the raised and lowered track.

The vertical alignment issues apply to all station options, albeit with detail differences related to the specific locations.

Additionally at the Constable Road site, there are horizontal alignment issues that would need to be overcome. By virtue of never being a station before, the alignment is narrower than at either Ashley Down or Horfield. Hence, the Main and Relief lines are located closer together than at the other sites, which would additionally require the Main lines to be slewed to accommodate a platform between the Main and Relief lines.

While the historic Horfield site has no width issues, it is located in a deep cutting with steep sides. This affects and restricts access to platforms, necessitating either extensive ramps or a footbridge with lifts and steps. However, more significantly at Horfield, a crossover (which will be installed during the Filton Bank 4-tracking scheme), will have to be re-located. Although moving the crossover to the south will not cause any operational disadvantages, this increases the costs of required engineering works to facilitate a Horfield station.

Costs

Table 4-1 shows the total costs of developing stations at the three Filton Bank sites. The requirement for significant civil engineering, electrification and other permanent way works is reflected in the costs for all three of the sites considered. This table assumes that the MetroWest Phase 2 Project would cover scheme preparation work, so does not include the full array of non-construction costs (including GRIP stages 4 development, GRIP stage 5 detailed design and project management & sponsorship), and also has a 20% allowance for contingency. This is considered a realistic assessment.

Table 4-2 shows a worst case assessment of costs, incorporating the full non-construction costs (including GRIP stages 4 development, GRIP stage 5 detailed design and project management & sponsorship) and furthermore with an increase contingency allowance of 40%

TABLE 4-1
Filton Bank site – station costs
February 2014 figures

Element	%	Station		
		Ashley Down	**Constable Rd**	**Horfield** [29#]
Construction cost				
Station		£2,629,200	£2,514,350	£2,278,410
Platforms (incl lighting, signage, furniture)		£1,335,200	£1,238,200	£1,215,200
Footbridge, ramps, steps (as appropriate)		£800,000	£780,000	£730,000
Other station costs (fencing, buildings)		£45,500	£29,000	£66,500
Access road, bus turning and cycle stands		£232,000	£173,000	£85,210
Technology (ticket machines, CCTV, PA)		£121,250	£78,750	£151,000
Site preparation, drainage & utilities		£95,250	£215,400	£30,500
Infrastructure & permanent way		£1,457,630	£2,120,510	£1,986,816
Permanent Way		£944,860	£1,430,713	£1,701,496
Electrification		£427,770	£549,797	£123,320
Signalling & Telecommunications		£85,000	£140,000	£162,000
Sub-total		£4,086,830	£4,634,860	£4,265,226
Non-construction cost				
Contractor preliminaries	20%	£817,366	£926,972	£853,045
Testing and commissioning	2.5%	£102,171	£115,872	£106,631
Possession management	2.5%	£102,171	£115,872	£106,631
Sub-total	25%	£1,021,708	£1,158,715	£1,066,307
Total cost (excluding contingency)l		£5,108,538	£5,793,575	£5,331,533
Contingency	20%	£1,021,708	£1,158,715	£1,066,307
TOTAL		£6,130,245	£6,952,290	£6,397,839

Notes:

- Includes 20% contingency
- All prices exclude VAT
- Cost of land acquisition not included
- No provision for contaminated waste disposal
- Overheads and profit have not been included in the cost estimate
- No provision for TOC compensation
- Rules of the route possessions assumed MetroWest Phase 2 project covers Project Management, GRIP 4 development and GRIP 5 detailed design

[29] Horfield station access option1 shown

TABLE 4-2
Ashley Down – station costs
February 2014 figures

Element	%	Station		
		Ashley Down	Constable Rd	Horfield [30#]
Construction cost				
Station		£2,629,200	£2,514,350	£2,278,410
Platforms (incl lighting, signage, furniture)		£1,335,200	£1,238,200	£1,215,200
Footbridge, ramps, steps (as appropriate)		£800,000	£780,000	£730,000
Other station costs (fencing, buildings)		£45,500	£29,000	£66,500
Access road, bus turning and cycle stands		£232,000	£173,000	£85,210
Technology (ticket machines, CCTV, PA)		£121,250	£78,750	£151,000
Site preparation, drainage & utilities		£95,250	£215,400	£30,500
Infrastructure & permanent way		£1,457,630	£2,120,510	£1,986,816
Permanent Way		£944,860	£1,430,713	£1,701,496
Electrification		£427,770	£549,797	£123,320
Signalling & Telecommunications		£85,000	£140,000	£162,000
Sub-total (construction cost)		£4,086,830	£4,634,860	£4,265,226
Non-construction cost				
Contractor preliminaries	20%	£817,366	£926,972	£853,045
GRIP stages 4 development	1%	£40,868	£46,349	£42,652
GRIP stage 5 detailed design	6%	£245,210	£278,092	£255,914
Project Management & Sponsorship	10%	£408,683	£463,486	£426,523
Testing and commissioning	2.5%	£102,171	£115,872	£106,631
Possession management	2.5%	£102,171	£115,872	£106,631
Sub-total (non-construction cost)	42%	£1,716,469	£1,946,641	£1,791,395
Total cost (initial)l		£5,803,299	£6,581,501	£6,056,621
Contingency	40%	£2,321,319	£2,632,600	£2,422,648
TOTAL		£8,124,618	£9,214,102	£8,479,269

Notes:

- Includes 40% contingency
- All prices exclude VAT
- Cost of land acquisition not included
- No provision for contaminated waste disposal
- Overheads and profit have not been included in the cost estimate
- No provision for TOC compensation
- Rules of the route possessions assumed
- NR asset protection costs included within Project Management, GRIP 4 development, GRIP 5 detailed design and testing and commissioning

[30] Horfield station access option1 shown

Demand forecasts

Forecasts at the three station sites on Filton Bank indicate that the Ashley Down site has the potential for the greatest demand. This is because the station is better sited with respect to the potential catchment, and furthermore does not encroach as much on the catchment area of a significantly better served station. Both Constable Road and Horfield are relatively close to Filton Abbey Wood, which has an adverse effect on the demand at these stations, and particularly Horfield. This is perversely mitigated in comparison with Constable Road because the Constable Road site is located remote from even its immediate residential catchment. Subsequent redevelopment in the Lockleaze area could make this station site more attractive, but this is not currently included in any future anticipated development.

Table 4-3 shows demand forecasts at the three station sites assessed (2022 figures, assuming 2 trains per hour serving the stations).

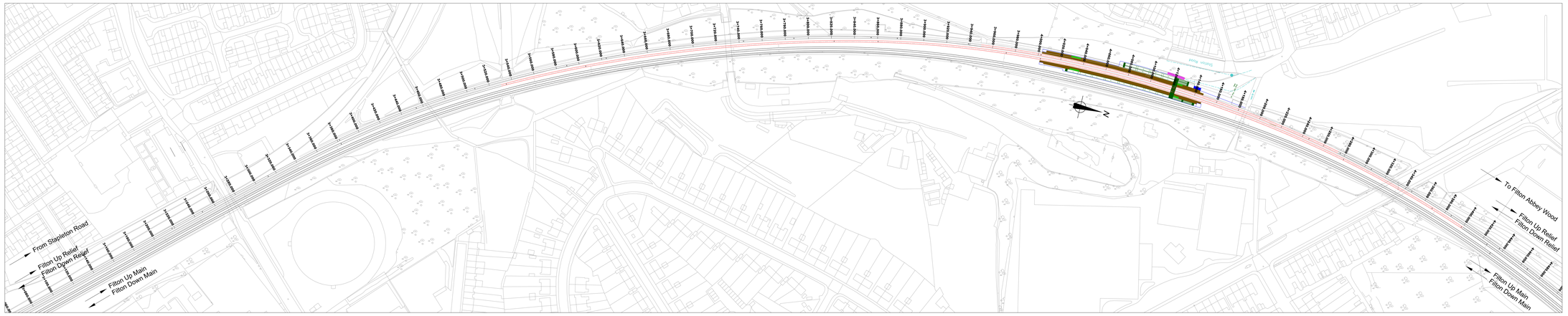
TABLE 4-3
Demand forecasts – potential Filton Bank stations sites
2022 figures (2 trains per hour)

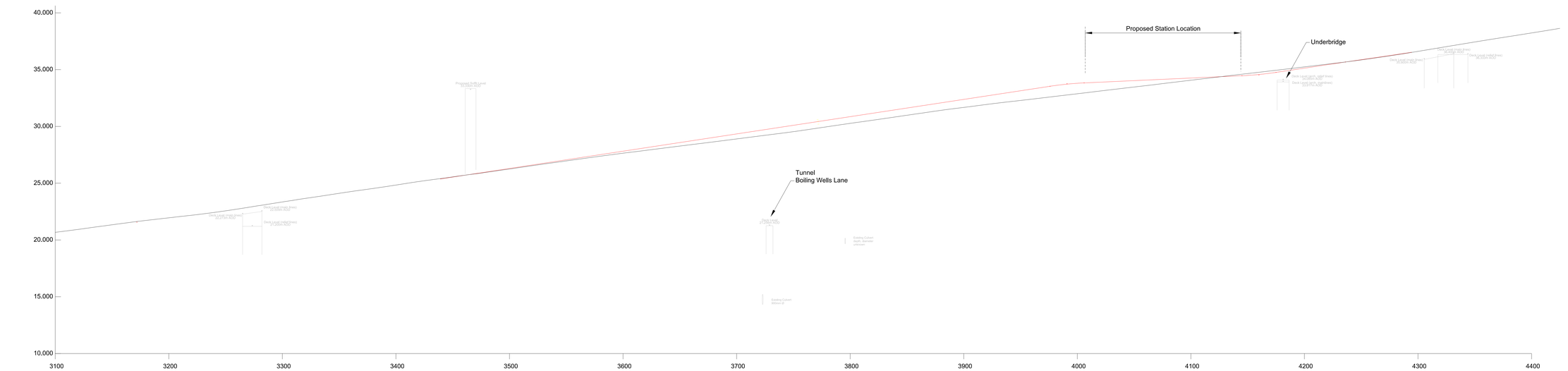
Demand/revenue	Ashley Down	Near Constable Rd	(historic) Horfield
Annual demand	175,000	94,000	95,000
Daily demand (average)	555	299	301
Annual revenue (£)	£362,000	£195,000	£196,000

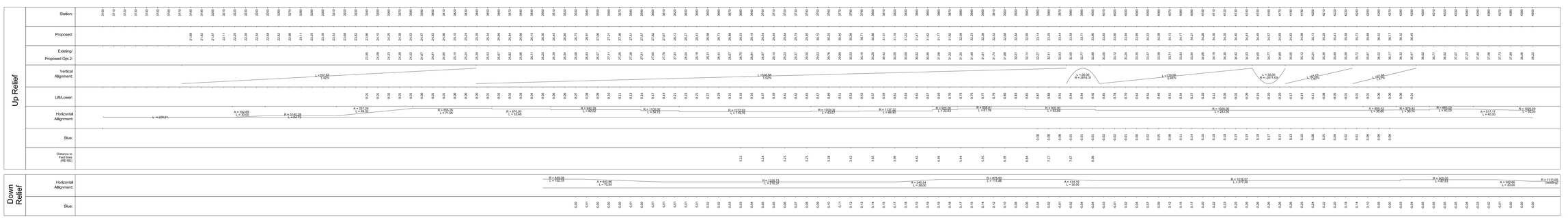
Appendix A

Appendix A: Drawings

- HGL/GS2/DRG/001: Permanent Way – Ashley Down Horizontal and Vertical Alignment Design
- HGL/GS2/DRG/002: Permanent Way – Constable Road Horizontal and Vertical Alignment Design
- HGL/GS2/DRG/003: Permanent Way – historic Horfield Horizontal and Vertical Alignment Design







Key Plan:

Notes:
01. All dimensions shown in metres unless stated otherwise.
02. Existing vertical alignment (= Proposed Option 2) as per Filton Bank Track Form A.
03. Up Relief line used as reference for vertical design

Horizontal Key:

Proposed alignment showing existing centreline (grey)

Existing alignment (as per Filton Bank Track Form A)

Vertical Key:

Proposed Option 1 alignment

Existing alignment
= Proposed Option 2 alignment

Station Key:

Platform and Platform
Proposed Station Building
Footbridge/Ramps/Stairs
Shelter with Seats
Cycle Spaces

Rev	By	Chkd	Apprvd	Date	Description

Client
Bristol City Council
City Transport
City Hall
College Green
Bristol
BS1 5TA
Tel 01117 922 2000

Consultant
Elms House, 43 Brook Green, Hammersmith, London W6 7BY
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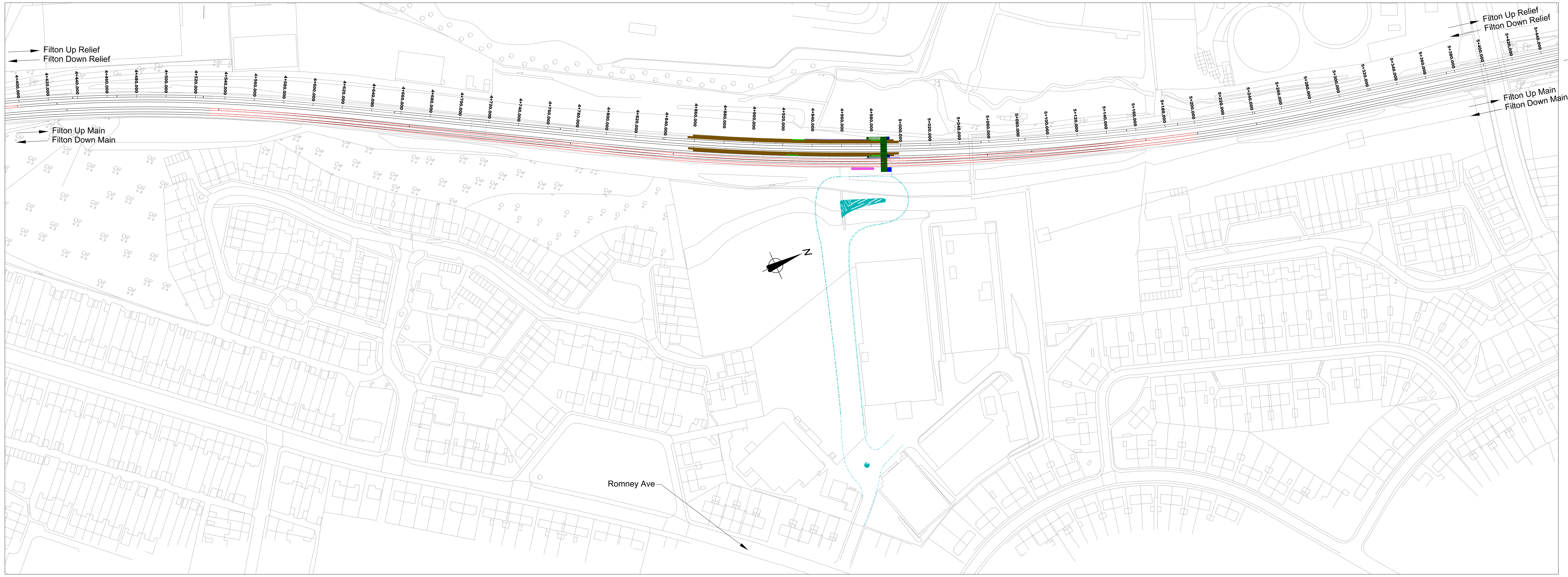
CH2MHILL

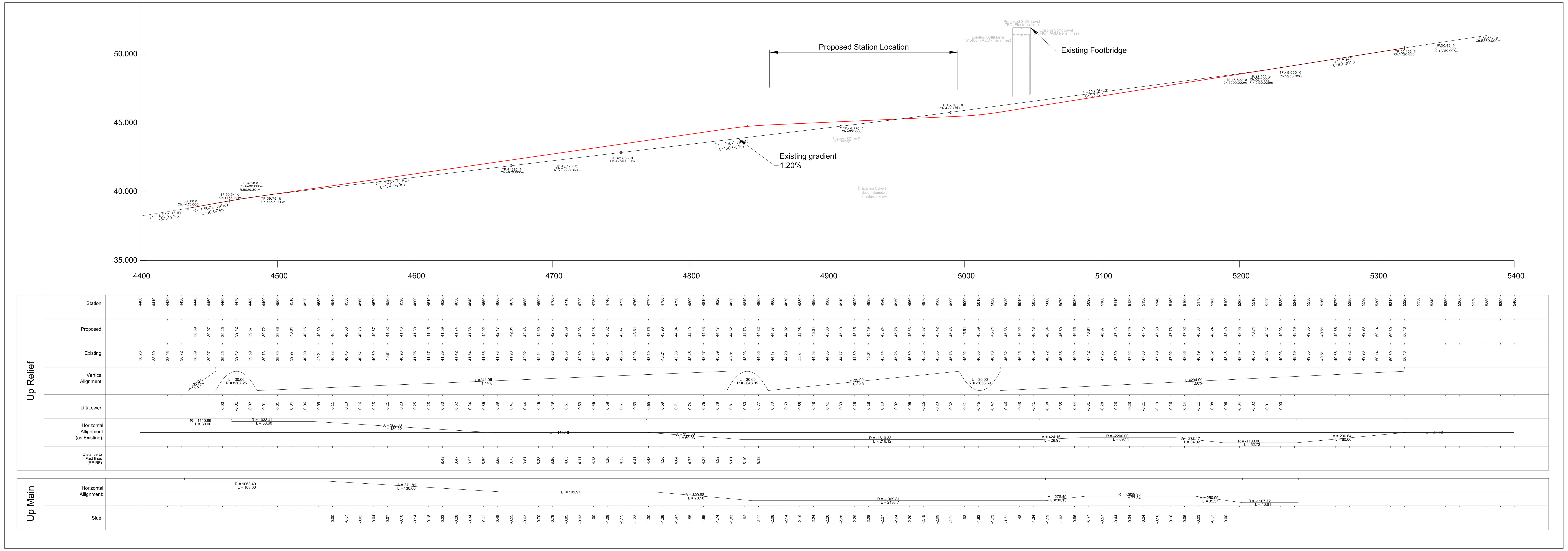
Project
Bristol New Stations
High Level Assessment Study-
GRIP STAGE 2

Drawing
PERMANENT WAY
ASHLEY DOWN STATION
HORIZONTAL AND VERTICAL ALIGNMENT DESIGN

Drawn by: Klaus Pajung	Date:	28/02/2014
Checked by: Belinda Cerqueira	Date:	28/02/2014
Approved by: Paul Bufton	Date:	28/02/2014
Drawing No. HGL/GS2/DRG/001	Revision	A01

Drawing Scale: H/V 1:1000/ 1:100 @ A0





Key Plan:

Notes:

01. All dimensions shown in metres unless stated otherwise.
02. Existing vertical alignment as per Filton Bank Track Form A.
03. Up Relief line used as reference for vertical design.
04. Relief Lines horizontal alignments as per Filton Bank Track Form A (unchanged).

Horizontal Key:

- Proposed alignment
- Existing alignment (as per Filton Bank Track Form A).

Vertical Key:

- Proposed Option 1 alignment
- Existing alignment = Proposed Option 2 alignment

Station Key:

- Proposed Platform
- Fence and Station Building
- Footbridge/Ramps/Stairs
- Shealter with Seats
- Cycle Spaces

Rev	By	Chkd	Apprvd	Date	Description

Client
Bristol City Council
City Transport
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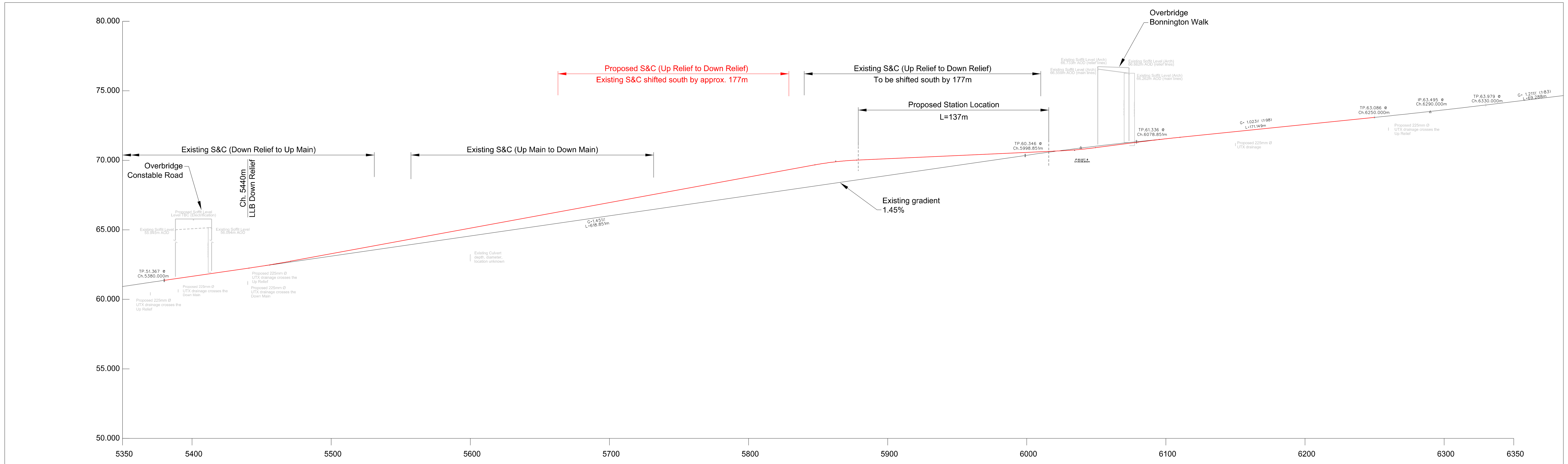
Project
Bristol New Stations
High Level Assessment Study-
GRIP STAGE 2

Drawing
PERMANENT WAY
CONSTABLE ROAD STATION
HORIZONTAL AND VERTICAL
ALIGNMENT DESIGN

Drawn by: Klaus Pajung Date: 28/02/2014
Checked by: Belmiro Cerqueira Date: 28/02/2014
Approved by: Paul Bufton Date: 28/02/2014

Drawing No. HGL/GS2/DRG/002
Revision A01

Drawing Scale: H/V 1:1000/ 1:100 @ A0



Station	Proposed	Existing	Lift/Lower
5350			
5360			
5370			
5380			
5390	61.51	61.51	
5400	61.66	61.66	
5410	61.80	61.80	
5420	61.95	61.95	
5430	62.09	62.09	
5440	62.24	62.24	0.00
5450	62.39	62.38	0.01
5460	62.55	62.53	0.02
5470	62.73	62.67	0.06
5480	62.91	62.82	0.09
5490	63.10	62.96	0.14
5500	63.28	63.11	0.17
5510	63.46	63.25	0.21
5520	63.65	63.40	0.25
5530	63.83	63.54	0.29
5540	64.01	63.69	0.32
5550	64.20	63.83	0.37
5560	64.38	63.98	0.40
5570	64.57	64.12	0.45
5580	64.75	64.27	0.48
5590	64.93	64.41	0.52
5600	65.12	64.56	0.56
5610	65.30	64.70	0.60
5620	65.49	64.85	0.64
5630	65.67	64.99	0.68
5640	65.85	65.14	0.71
5650	66.04	65.28	0.76
5660	66.22	65.43	0.79
5670	66.40	65.57	0.83
5680	66.59	65.72	0.87
5690	66.77	65.86	0.91
5700	66.96	66.01	0.95
5710	67.14	66.15	0.99
5720	67.32	66.30	1.02
5730	67.51	66.45	1.06
5740	67.69	66.59	1.10
5750	67.88	66.74	1.14
5760	68.06	66.88	1.18
5770	68.24	67.03	1.21
5780	68.43	67.17	1.26
5790	68.61	67.32	1.29
5800	68.79	67.46	1.33
5810	68.98	67.61	1.37
5820	69.16	67.75	1.41
5830	69.35	67.90	1.45
5840	69.53	68.04	1.49
5850	69.71	68.19	1.52
5860	69.86	68.33	1.53
5870	69.97	68.48	1.49
5880	70.03	68.62	1.41
5890	70.07	68.77	1.30
5900	70.12	68.91	1.21
5910	70.16	69.06	1.10
5920	70.21	69.20	1.01
5930	70.25	69.35	0.90
5940	70.30	69.49	0.81
5950	70.34	69.64	0.70
5960	70.39	69.78	0.61
5970	70.43	69.93	0.50
5980	70.48	70.07	0.41
5990	70.53	70.22	0.31
6000	70.57	70.36	0.21
6010	70.62	70.50	0.12
6020	70.66	70.64	0.02
6030	70.71	70.77	-0.06
6040	70.80	70.90	-0.10
6050	70.92	71.02	-0.10
6060	71.05	71.13	-0.08
6070	71.18	71.24	-0.06
6080	71.31	71.35	-0.04
6090	71.43	71.45	-0.02
6100	71.55	71.55	0.00
6110	71.65	71.65	
6120	71.76	71.76	
6130	71.86	71.86	
6140	71.96	71.96	
6150	72.06	72.06	
6160	72.17	72.17	
6170	72.27	72.27	
6180	72.37	72.37	
6190	72.47	72.47	
6200	72.57	72.57	
6210	72.68	72.68	
6220	72.78	72.78	
6230	72.88	72.88	
6240	72.98	72.98	
6250		73.09	
6260		73.19	
6270		73.30	
6280		73.40	
6290		73.51	
6300		73.63	
6310		73.74	
6320		73.86	
6330		73.98	
6340		74.10	
6350		74.22	

Vertical Alignment: L =60.86 1.45%; L = 30.00; L =376.82 1.84%; L = 30.00; L =141.76 0.45%; L = 30.00; L =30.71 1.30%; L = 30.00; L =139.85 1.02%

Horizontal Allignment: L = 1013.53; L = 1013.53; A = 266.09 L = 65.35

Distance to Fast lines (RE-RE): 2.87, 2.88, 2.88, 2.88, 2.88, 2.88, 2.88, 2.88, 2.88, 2.88, 2.88, 3.01, 3.27, 3.68, 4.21, 4.85

Key Plan:

Notes:
01. All dimensions shown in metres unless stated otherwise.
02. Existing vertical alignment (= Proposed Option 2) as per Filton Bank Track Form A.
03. Up Relief line used as reference for vertical design.
04. Horizontal alignments as per Filton Bank Track Form A (unchanged).

Horizontal Key:
- Proposed alignment as per Filton Bank Track Form A (unchanged).
- Proposed crossover location
- Existing crossover location
- LLB — Last long bearer

Vertical Key:
- Proposed Option 1 alignment
- Proposed Option 2 alignment = Existing alignment

Station Key:
- Proposed Platform
- Fence and Station Building
- Footbridge/Ramps/Stairs
- Shealter with Seats
- Cycle Spaces
- Pedestrian Steps
- Lift

Rev	By	Chkd	Apprvd	Date	Description

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Project
Bristol New Stations
High Level Assessment Study-
GRIP STAGE 2

Drawing
PERMANENT WAY
HORFIELD STATION
HORIZONTAL AND VERTICAL
ALIGNMENT DESIGN

Drawn by: Klaus Pajung Date: 23/04/2014
Checked by: Belmiro Cerqueira Date: 23/04/2014
Approved by: Paul Bufton Date: 23/04/2014

Drawing No. HGL/GS2/DRG/003
Revision A01

Drawing Scale: H/V 1:1000/ 1:100 @ A0

Appendix B

Appendix B: Permanent Way costings

- Ashley Down
- Constable Road
- Horfield (historic site)

Ashley Down Permanent Way costs

Item		from ch. (m)	to ch. (m)	Length (m) No. (-)	Unit	Unit rate 2003	Unit rate 2014	Cost (£)
A	**Relief Lines (lift/lower and slue)**							
1	Tamp to lift 100mm:	3420	3560	280	£/m	31.77	42.89	12,009
2	Ballast for lifts up to 100mm:	3420	3560	140	£/m^3	123.87	167.22	7,721
3	Dismantle track for lift >100mm and lower:	3560	4230	1340	£/m	20.50	27.68	37,085
4	Remove ballast (250mm):	3560	4230	670	£/m^2	10.50	14.18	78,827
5	Excavate for lowering:	4130	4230	100	£/m^3	27.48	37.10	3,443
6	Bring in material, compact:	3560	4120	560	£/m^3	95.67	129.15	311,840
7	Bring in ballst (new, 250mm) and Lay Track (CWR):	3560	4230	670	£/m^3	123.87	167.22	283,686
8	Lay track (CWR):	3560	4230	1340	£/m	75.56	102.01	136,688
9	Catch points (material and lay):			2	£	2979.06	25000.00	50,000
	Drainage:							
10	Pipes:			100	£/m	91.36	123.34	12,334
11	Man holes			5	£	1663.38	2245.56	11,228
							Sum:	**£944,860**

Notes/ Assumptions:

1) Costs developed using Spon's Railways Construction Price book from 2003. Rates adjusted to allow for inflation
2) Price excludes VAT, overhead costs and profits
3) Price includes design and project management
4) Lift up to 100mm acceptable by tamping
5) Rails and sleepers to be reused
6) Estimate of costs within +/- 30%

Constable Road Permanent Way costs (4 tracks)

Item		from ch. (m)	to ch. (m)	Length (m) No. (-)	Unit	Unit rate 2003	Unit rate 2014	Cost (£)
A	**Relief Lines (lift and lower)**							
1	Tamp to lift 100mm:	4495	4535	80	£/m	31.77	42.89	3,431
2	Ballast for lifts up to 100mm:	4495	4535	40	£/m^3	123.87	167.22	2,276
3	Dismantle track for lift >100mm and lower:	4535	5220	1370	£/m	20.50	27.68	37,915
4	Remove ballast (250mm):	4535	5220	685	£/m^2	9.00	12.15	69,079
5	Excavate for lowering:	4950	5220	270	£/m^3	27.48	37.10	20,230
6	Geotextile (Terram 4000):	4535	5220	685	£/m^2	4.18	5.64	32,083
7	100mm sand blanket:	4535	5220	685	£/m^2	7.84	10.58	60,175
8	Bring in material, compact:	4535	4950	415	£/m^3	95.67	129.15	204,316
9	Bring in ballst (new, 250mm):	4535	5220	685	£/m^3	123.87	167.22	290,038
10	Lay track (CWR):	4535	5220	1370	£/m	69.72	94.12	128,947
11	Retarders (material and lay):			2	£	-	25000.00	50,000
	Drainage:							
12	Pipes:			200	£/m	91.36	123.34	24,667
13	Man holes			7	£	1663.38	2245.56	15,719
							Sum Relief Lines:	**£938,876**

Item		from ch. (m)	to ch. (m)	Length (m) No. (-)	Unit	Unit rate 2003	Unit rate 2014	Cost (£)
B	**Main Lines (slue)**							
1	Temp for slue up to 380mm:	4540	4690	300	£/m	25.60	34.56	10,368
		5090	5200	220	£/m	25.60	34.56	7,603
2	Temp for slue between 380mm to 760mm:	4640	4690	100	£/m	25.60	34.56	3,456
		5090	5120	60	£/m	25.60	34.56	2,074
3	Dismantle track for slue >760mm :	4690	5090	800	£/m	20.50	27.68	22,140
4	Remove ballast (250mm):	4690	5090	400	£/m^2	10.50	14.18	47,061
5	Excavate for new track bed:	4690	5090	400	£/m^3	27.48	37.10	39,634
6	Geotextile (Terram 4000):	4690	5090	400	£/m^2	4.18	5.64	10,866
7	100mm sand blanket:	4690	5090	400	£/m^2	7.84	10.58	35,139
8	Bring in ballst (new, 250mm):	4690	5090	400	£/m^3	123.87	167.22	169,365
9	Lay track (CWR):	4690	5090	800	£/m	75.56	102.01	81,605
	Drainage:							
12	Pipes:			200	£/m	91.36	123.34	24,667
13	Man holes			7	£	1663.38	2245.56	15,719
							Sum Main Lines:	**£491,837**
							Sum Constable Road:	**£1,430,713**

Notes/ Assumptions:

1) Costs developed using Spon's Railways Construction Price book from 2003. Rates adjusted to allow for inflation
2) Price excludes VAT, overhead costs and profits
3) Price includes design and project management
4) Estimate of costs within +/- 30%
5) Standard Solution No.3 (NR/SP/TRK/9039) as on Main Lines as per Filton Bank Track From A (p.14f)
   Relief Lines: 100%, Main Lines: 58%
6) Lift up to 100mm acceptable by tamping
7) Slues up to 760mm acceptable by tamping
8) Rails and sleepers to be reused (Main Line slues)

Horfield Permanent Way costs

Item		from ch. (m)	to ch. (m)	Length (m) No. (-)	Unit	Unit rate 2003	Unit rate 2014	Cost (£)
	Relief Lines (lift and lower)							
1	Tamp to lift 100mm:	5440	5480	80	£/m	31.77	42.89	3,431
2	Ballast for lifts up to 100mm:	5440	5480	40	£/m^3	123.87	167.22	2,048
3	Dismantle track for lift >100mm and lower:	5480	6100	1240	£/m	20.50	27.68	34,317
4	Remove ballast (250mm):	5480	6100	620	£/m^2	10.50	14.18	72,945
5	Excavate for lowering:	6020	6100	80	£/m^3	27.48	37.10	1,619
6	Bring in material, compact:	5480	6025	545	£/m^3	95.67	129.15	479,934
7	Bring in ballst (new, 250mm) :	5480	6100	620	£/m^3	123.87	167.22	262,516
8	Lay track (CWR):	5480	6100	1240	£/m	75.56	102.01	126,487
9	Catch points (material and lay):			2	£		25000.00	50,000
10	100mm sand blanket (Up Relief):			650	£/m^2	7.84	10.58	28,550
11	100mm sand blanket (Down Relief):			570	£/m^2	7.84	10.58	25,036
12	Geotextile (Terram 4000, Up Relief):			650	£/m^2	4.18	5.64	15,222
13	Geotextile (Terram 4000, Up Relief):			570	£/m^2	4.18	5.64	13,349
14	Impermeable Geocomposite (Down Relief):			50	£/m^2		20.00	4,150
	Crossover (NR60G):							
10	Remove Crossover:			1	£			55,000
11	Plain line where crossover removed (lay):			90	£/m	69.72	94.12	16,942
12	Dismantle plain line in new crossover position:			90	£/m	20.50	27.68	4,982
13	Lay turnouts (concrete bearers, incl. dig and reballasting):			2			465000	930,000
14	Deduct material crossover (re-use):			1	£	346140	467289	-467,289
15	Deduct ballast removal from 4) above:			128	£/m^2	10.50	14.18	-15,060
16	Deduct new ballast from 7) above:			128	£/m^3	123.87	167.22	-54,197
	Drainage:							
17	Pipes:			540	£/m	91.36	123.34	66,601
18	Man holes:			20	£	1663.38	2245.56	44,911
							Sum:	**£1,701,496**

Notes/ Assumptions:

1) Costs mainly developed using Spon's Railways Construction Price book from 2003. Rates adjusted to allow for inflation.
2) Price excludes VAT, overhead costs and profits
3) Price includes design and project management
4) Lift up to 100mm acceptable by tamping
5) Rails and sleepers to be reused
6) Standard Solutions No.3-5 (NR/SP/TRK/9039) as per Filton Bank Track From A (p.14f)
7) Crossover to be re-used approx. 177m south of original psition
8) Estimate of costs within +/- 30%