Connolly Station Enhancement Options Study

National Transport Authority

Options Selection Report

32110100-GEN-RP-003 | 0

26 March 2019

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Project No:	32110100
Document Title:	Options Selection Report
Document No.:	32110100-GEN-RP-003
Revision:	0
Date:	26 March 2019
Client Name:	National Transport Authority
Client No:	
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File Name:	\\europe.jacobs.com\dc4\MFS\Projects\Rail\32110100 - Connolly Station Enhancement Options\400 Project Output\WP6 - Preferred Option\32110100-GEN-RP-003.docx

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Document history and status

Revision	Date	Description	By	Review	Approved
0	26/03/19	Issue to Client	AB	ST	JM

Contents

Executive Summary

This report describes the option selection process and supporting work completed which informed the outcome of an Option Appraisal Workshop held on 1st March 2019 by Jacobs from which an Emerging Preferred Option was developed from five short-listed options using multi-criteria analysis. The short-listed options were extracted from a long-list of over twenty feasible options that we had previously selected because of their potential to satisfy the requirements of the Connolly Station Enhancement Study brief.

To support the multi-criteria analysis our engineering leads presented the requirements, issues and constraints for their discipline with reference to the outline permanent way design layouts for each option. Train operational modelling and high-level comparative costing were also available for the five options.

The key features of the short-listed Options 3, 6B, 6D, 8B, and 8D can be summarised as:

Option 3 extends and realigns the existing platforms and includes a remodelling throat to reduce conflicts, it provides an improved Newcomen single line chord with a new canal drop-lock. The Enterprise Maintenance Shed needs to be removed.

Option 6B reconstructs all platforms, widened to suit passenger growth and all connected by a new footbridge and lifts. The Newcomen Chord is twin tracked and a new canal drop-lock is required along with a reconstructed North Strand Road bridge. The ticket gate-line is relocated in the train shed to the north to provide an enlarged concourse and retail area. The Enterprise Maintenance Shed is removed to enable the remodelled station throat to remove conflicting movements.

Option 6D is a variant of Option 6B. The main difference is the Newcomen Chord is only single tracked and there is no requirement to replace the North Strand Road bridge. However, the option does require the construction of a significant intervention at Glasnevin, which is outside the scope of this study but is briefly discussed below for completeness. This option will also require the construction of a new canal drop-lock.

Option 8B requires remodelling of the throat and an additional platform with associated replacement of an existing bridge deck on the western side of the station. The possibility of retaining the existing platforms and in particular Platforms 6 and 7 at their current width was examined but it was found that that the existing platforms are likely to require widening and lengthening to safely handle the potential number of passengers, services and access routes. Option 8B focused on the impact of these safety driven alterations rather than leaving the existing platforms untouched and this has had an impact across the entire northern throat. This results in necessary alterations to most of the station. Option 8B also requires a twin tracked Newcomen Chord with associated replacement of the North Strand Road bridge and new canal drop-lock. Third-party land is required for the new platform to the west of the station, including the adjacent car park and properties in Amiens Street and Preston Street.

Option 8D is a variant of Option 8B. The main difference is the Newcomen Chord is only single tracked and there is no requirement to replace the North Strand Road bridge. However, the option does require the construction of a significant intervention at Glasnevin, which is outside the scope of this study but is briefly discussed below for completeness. This option will also require the construction of a new canal drop-lock.

A service pattern whereby 16tphpd Maynooth and 12tphpd Phoenix Park Tunnel trains split equally so that 14tphpd go to both Connolly and Docklands stations might be possible should a major intervention take place at Glasnevin, while taking account of design requirements for MetroLink. Service levels are such that full grade separation is likely to be needed to achieve a reliable service. It is understood that Irish Rail's original proposal was developed on a smaller number of services operating through Glasnevin. Operational modelling is necessary to assess the performance impact of this intervention, but the capital cost is likely to be considerably higher than the installation of a dual-track along the Newcomen Chord, even with the reconstruction of the North Strand Road bridge.

The Multi-Criteria Analysis performed by the study team identified Option 6B as the Emerging Preferred Option. It is considered that although this Option will inevitably cause disruption to train operations during construction, the final scheme will provide the greatest operational flexibility achievable within the study area. The option

provides the better performance and passenger service outcomes for the ‘B’ options and delivers the maximum capacity and operational flexibility at Connolly Station to deal with changing demands in the future.

The results of this appraisal were presented to the National Transport Authority (NTA) and Iarnród Éireann (IÉ) on 6th March 2019.

Upon NTA acceptance of the appraisal findings, Jacobs will develop a Concept Design for the Preferred Option.

1. Introduction

1.1 Project Background

The National Transport Authority (NTA) along with Iarnród Éireann (IÉ) wishes to evaluate the options at Connolly Station to optimise its capacity to handle through-running or terminating trains from the four connecting radial routes served by the Northern Line, the Maynooth Line, Phoenix Park Tunnel Line and the Southeast Line. This is likely to involve platform changes and operational enhancements at the station together with changes to the approaching track layout and junctions.

Jacobs was awarded the Connolly Station Enhancement Options Study, which has the key objectives of:

- Identifying all options for enhancing capacity at Connolly Station to deliver the target capacities while taking the Connolly Master Plan into account;
- Minimising crossovers in the station and maintaining separation of the Northern Line from the western radial lines;
- Assessing various service patterns that maximise the capacity and flexibility of the station operations for each of the infrastructure layout options;
- Completing a sifting exercise to identify a shortlist of options, including those developed by IÉ prior to this scheme, that meet the project objectives;
- Producing outline designs for each of the shortlisted options, including the preparation of high-level cost estimates for each option and the identification of high level benefits; and
- Simulating train services to demonstrate that shortlisted outline designs and their service patterns can handle the specified target capacities.

The National Development Plan (2018 to 2027) has the aim of creating a full metropolitan area DART network for Dublin with all the lines linked and connected. Connolly Station sits at the heart of the Dublin railway system and the Connolly Station Enhancement Options Study is intended to increase capacity and operational flexibility.

NTA has set a station target capacity of 30 trains per hour per direction (tphpd) from the combined three radial routes: Northern Line (16 trains per hour per direction (tphpd)), Maynooth Line (16 tphpd) and the Phoenix Park Tunnel Line (12 tphpd) and with through running of 18 tphpd on the Southeast Line. The balance of 14tphpd is expected to be directed towards an expanded Docklands station.

The Connolly Station Enhancement Options Study shall take account of the following design requirements when developing options:

- The Schedule of Standards covering IÉ and Other Standards;
- Connolly Station designed to accommodate 8-car trainsets, including Diesel Multiple Unit (DMU) and DART Electric Multiple Units (EMUs) operating at 1500V DC. The design shall also accommodate the existing Belfast Enterprise service;
- Passive provision clearance for transition to 25KV AC electrification in the future;
- Station platforms to be minimum of 174m long for 8-car trainsets and 215m for Belfast Enterprise;
- Maximum track gradient at platform of 0.2%;
- Signalling design capacity for the station and radial routes on all lines of 20 trains per hour per direction;
- Turnback capacity per platform to be taken as 6 trains per hour for 1 driver or 9 trains per hour with 2 drivers utilising a ‘stepping-up of drivers’ operating procedure;
- Extent of Connolly Station enhancements to take cognisance of the wider Connolly Masterplan development;

- The relevant Study Area for this brief shall extend around Connolly Station and all track layout bounded by Loop Line Bridge on south and up to and including Newcomen, North Strand and East Wall Junctions in north.

1.2 Study Area

The diagram below indicates the study area to which this scheme is confined, and it is noted that Glasnevin Junction is outside the geographical boundary of the study.

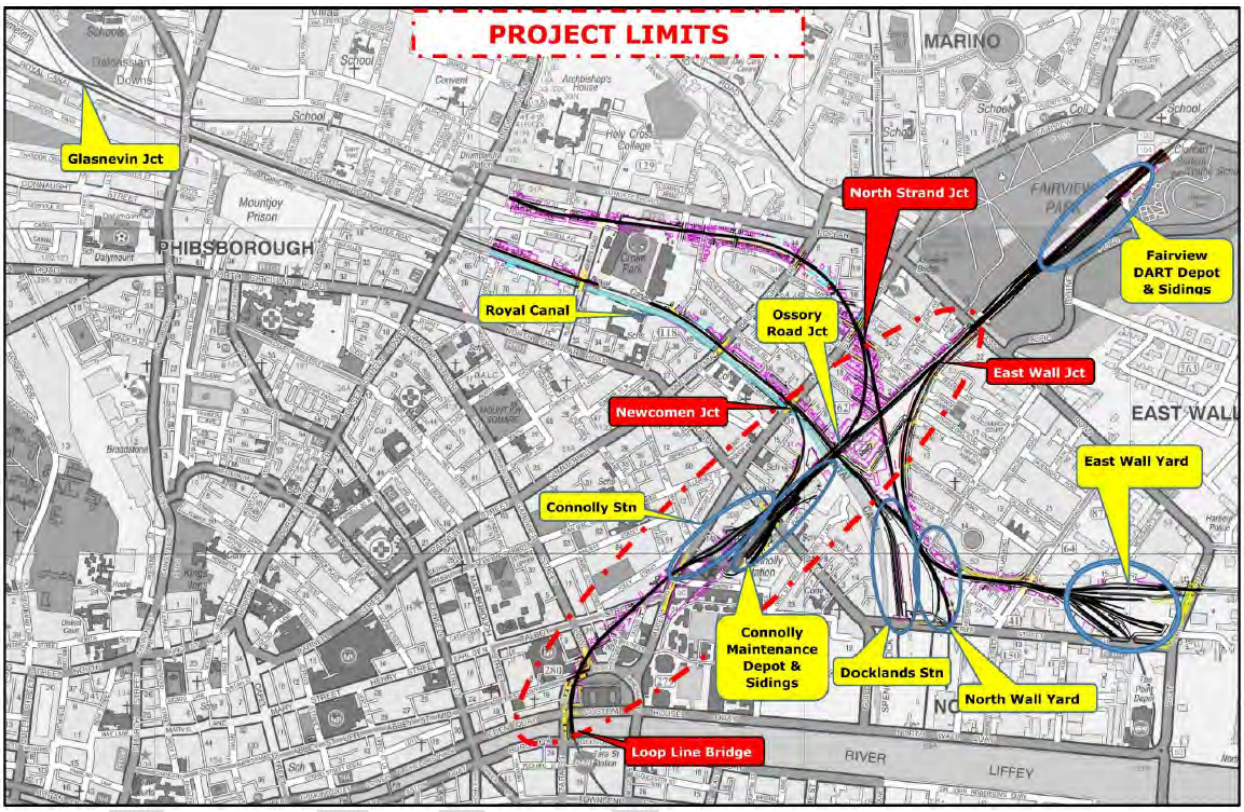


Image 1-1 Study Area for the Connolly Station Enhancement Options Study

1.3 Identification and Appraisal of Feasible Options

In November 2018, the Jacobs project team, led by the operations discipline lead, were tasked with identifying potential enhancement options to be developed for initial appraisal. This activity resulted in a list of 13No. options to be assessed. Each of these options was reviewed and appraised by the Project Discipline Leads prior to an Option Appraisal Workshop held on 13th December 2018.

A further 6No. options were identified during the workshop, which were added to the initial list to make 19No.for assessment.

The Option Appraisal Workshop was successful in further developing and assessing the 19No. identified options. A total of 5No. were removed from the list because they did not satisfy the project objectives, leaving a long list of 14No. options that had the potential of achieving the 30tphpd target. An additional 3No. options were added to this list after discussion at a Client Steering meeting on 18th December 2018 making a total of 17No. options forming the “Long List” that has since been assessed as part of the appraisal process. For detailed findings of this process including descriptions of the initial ‘Long List’ of options, reference should be made to the Options Appraisal Report, reference 32110100-GEN-RP-002.

The long list of options was assessed by workshop delegates from the disciplines of project management, train operations, permanent way, civil/structural, cost consulting, and environment. Acknowledging the project brief requirements, including the train service and station capacity, capital cost, constructability, and environmental impact, it was agreed to take a shortlist of 5No. options on to more detailed assessment.

The long list of options is listed below for information:

Table 1-1: Long List of Options

Option	Title	Description
1.	Do Nothing	Leave the station layout as it currently exists with no changes to platform arrangements, no changes to any operational approaches and a station throat layout with no changes to operational flexibility or routing.
2.	Alternative Approach to Platforming	Operational 'split' of the station to re-route trains between their respective points of origin and destination within the existing station layout with no changes to platforms or station throat.
3.	Platforms Unchanged with Remodelled Station Throat	Operational 'split' of the station and re-routing of trains between their respective points of origin and destination within the existing station layout. Minor modifications to terminal platform lengths and no changes to through-platform layout but with changes to station throat and routing.
3A.	Option 3, with dual-tracking of Newcomen Line	Operational 'split' of the station and re-routing of trains between their respective points of origin and destination within the existing station layout. Minor modifications to terminal platforms and no changes to platform layout but with changes to station throat and routing and a double track around the Newcomen Chord line.
4.	Remodelled Platform with Throat Retained	Operational 'split' of the station and re-routing of trains between their respective points of origin and destination. Reduction in the number of terminal platforms to 3 No and re-construction of through platforms eastwards to allow construction of a new Platform 7 with very minor changes to platform tracks and no change to station throat.
5.	Elevated Approach from West Lines	Operational 'split' of the station and re-routing of trains by diversion of the GSW lines over a dedicated twin track flyover (elevated) from North Strand Road Junction to serve an increased number of terminal platforms, shared in part by northern approaching services. Modifications to the station but only re-numbering of the through platforms to include a Platform 8 and a double track around the Newcomen Chord line.
6.	Remodelled Platforms and Station Throat – Platforms 6 and 7 Terminate	Operational 'split' of the station and a reduced number of terminating platforms in the train shed. Retention of only 2 No through tracks and re-construction of all platforms with a new terminal Platform 7 and the severing of Platform 6 track to also become a terminal platform. Total re-modelling of the station throat and introduction of a double track around the Newcomen Chord line.
6A.	Remodelled Platforms and Station Throat – Platforms 6 and 7 through line	Operational 'split' of the station and a reduced number of terminating platforms in the train shed. Creation of 4 No through tracks and re-construction of all platforms with a new Platform 7. Total re-modelling of the station throat and introduction of a double track around the Newcomen Chord line.
6B.	Remodelled Platforms and Station Throat in Combination with Additional Crossings	Operational 'split' of the station and a reduced number of terminating platforms in the train shed. Creation of 4 No through tracks and re-construction of all platforms with a new Platform 7. Total re-modelling of the station throat to include new scissor crossovers between Platforms 4&5, 6&7 and introduction of a double track around the Newcomen Chord line.

Option	Title	Description
6C.	Option 6 with scissors at end of platform	Operational 'split' of the station and a reduced number of terminating platforms in the train shed. Retention of 3 No through platform tracks and re-construction of all platforms with a new terminal Platform 7. Total re-modelling of the station throat to include new scissors crossovers between Platforms 4&5, 6&7, and introduction of a double track around the Newcomen Chord line.
6D.	Option 6b without dual-tracking of Newcomen	Operational 'split' of the station and a reduced number of terminating platforms in the train shed. Creation of 4 No through tracks and re-construction of all platforms with a new Platform 7. Total re-modelling of the station throat to include new scissor crossovers between Platforms 4&5, 6&7.
7.	Option 6b with variant on Crossings	Operational 'split' of the station and a reduced number of terminating platforms in the train shed. Creation of 4 No through platforms and re-construction of all platforms with a new Platform 7. Total re-modelling of the station throat to include new scissors crossovers between Platforms 4&5 and 6&7 but with reduced operational flexibility to service the double track Newcomen Chord lines by the positioning the 6&7 scissor crossover further northwards.
8	Modified Existing Layout with New Platform 8 and Revised Throat	Operational 'split' of the station with minor modifications to terminal platform lengths in the train shed. Retention of 3No through platforms and construction of a new terminal Platform 8. Total remodelling of the station throat utilising some double slip junctions for operational crossover flexibility and retention of single track Newcomen Chord line.
8A.	Option 8 with dual-tracking of Newcomen Line	Operational 'split' of the station with minor modifications to terminal platform lengths in the train shed. Retention of 3No through platforms and construction of a new terminal Platform 8. Total remodelling of the station throat utilising some double slip junctions for operational crossover flexibility and introduction of a double track around the Newcomen Chord line.
8B.	Combination of elements of 6a (Throat) and 8a (Platforms)	Operational 'split' of the station with the introduction of additional new platform 8 on west side as a terminus platform served by a double track on the Newcomen Chord line with double slip junctions into the Suburban Lines. A total re-modelling of the station throat and retention of existing platform arrangements and through tracks with only minor modifications to terminal track platforms.
8C.	Option 8B with Platform 8 Through Line	Operational 'split' of the station with the introduction of additional new through Platform 8 on west side served by a double track on the Newcomen Chord line. A total re-modelling of the station throat with total crossover flexibility and retention of existing platform arrangements and through tracks with only minor modifications to terminal track platforms.
8D.	Option 8B without dual-tracking of Newcomen	Operational 'split' of the station with the introduction of additional new Platform 8 on west side as a terminus platform. A total re-modelling of the station throat and retention of existing platform arrangements and through tracks with only minor modifications to terminal track platforms.
9.	Under Arches from Newcomen line	Operational 'split' of the station with the introduction of additional new Platform 8 & 9 island platform with scissor crossover, constructed beneath the existing train shed on a dedicated new connection from Newcomen Junction – replacing the Newcomen Chord Lines Remainder of existing station unaltered.
10.	Double-decking of the Loop Line	Operational 'split' of the station with the introduction of additional new double track overhead structure and grade separated high-level lines constructed over the top of the existing Suburban Lines and station throat from a location north of Ossory Rd Junction through new high level Platforms 9 & 10 over the existing Platforms 7 & 8, and southwards towards Tara Street station. Remainder of existing station unaltered.

Option	Title	Description
11.	Dual-tracking of Newcomen line only	Operational 'split' of the station and introduction of a double track over the Newcomen Chord lines only. No platform changes or alterations to existing station throat apart from new chord connection into suburban lines.
12.	Connect Container Depot lines to Terminal Platforms using Grade Separated Approach	Operational 'split' of the station with the introduction of a new double track connection into the low level North Wall Container Depot lines (east of the northern lines overbridge) and new double track chord connection climbing to station level over non-railway land, over the Docklands station lines and Royal Canal into the terminal tracks within the train shed. Station throat area of terminal tracks remodelled utilising single slip junctions to improve operational flexibility. Remainder of existing station unaltered.
13.	Platform 4 and 5 Suburban Island Platform	This layout creates a new island platform within the existing footprint of the station. It would enable the segregation of South-West and North Line through services to the Loop Line.

The Shortlisted Options were as follows:

- Option 3: Platforms Unchanged with Remodelled Station Throat
- Option 6B: Remodelled Platforms and Station Throat in Combination with Additional Crossings
- Option 6D: Option 6B, without dual-tracking of Newcomen
- Option 8B: Combination of elements of 6A (Throat) and 8A (Platforms)
- Option 8D: Option 8B, without dual-tracking of Newcomen

These options have now been developed further by the operational, engineering, environmental and cost consulting disciplines. The outputs and appraisal from each discipline is outlined within this report.

A further option has been briefly considered in Section 15 - Glasnevin in the event that Glasnevin Junction is remodelled so that Maynooth and Phoenix Park Tunnel services can access both Connolly Station and Docklands.

2. Methodology for Option Selection

2.1 Objective

The five shortlisted options, as listed in Section 1.3, were appraised using a Multi-Criteria Analysis (MCA) to establish an Emerging Preferred Option (EPR). The appraisal was carried out based on the criteria identified in the Common Appraisal Framework for Transport Projects and Programmes (DTTAS, 2016), as described in Jacobs' document entitled: Multi-Criteria Analysis – Methodology, dated 24 January 2019 (Ref: 32110100-GEN-RP-001).

A workshop was attended by the Jacobs' engineering team on 1st March 2019, chaired by the Jacobs Project Manager. Prior to the workshop outline designs were developed for each of the five shortlisted options. This included the preparation of cost estimates and the identification of high-level benefits. Train service simulation modelling was carried out to demonstrate that the shortlisted options and associated service patterns could provide the target capacities specified in the project brief. For further details refer to Section 3 below.

2.2 Criteria for Multi Criteria Analysis

The Common Appraisal Framework (CAF) recommends that the following topics are considered in a qualitative appraisal of options:

- Economy (including non-quantifiable economic impacts);
- Safety;
- Physical Activity;
- Environment;
- Accessibility and Social Inclusion; and
- Integration.

2.2.1 Aspects of Environmental Criterion

Under the environmental criterion the options had the potential to differ in terms of land use, water quality, landscape and visual, archaeological/ architectural heritage and biodiversity impacts.

However, they did not differ significantly at this stage in terms of socio-economic, air and climate including adaptation to climatic factors and human health/population, as all options ultimately support an increase in rail traffic through Connolly Station. Potential impacts on radiation, stray current and agronomy are not anticipated. These environmental sub-criteria were therefore not considered at this stage of the assessment.

The production of waste, impacts on soils/geology and impacts of vibration were not considered, however these impacts will be considered during the Concept Design of the Emerging Preferred Option, to be undertaken following the MCA appraisal process.

2.2.2 Criteria Not Included within Appraisal

The criterion of Physical Activity is considered neutral in the context of this appraisal as all rail infrastructure options use the same transport mode and will deliver similar health benefits for users.

Accessibility and social inclusion were not assessed as the study area is within a relatively small geographical area, and the operational similarities of the options under consideration would likely result in the options being neutral.

2.3 Option Appraisal

2.3.1 Stage 1 Appraisal

The long list of options was assessed by delegates from the disciplines of project management, train operations, permanent way, civil/structural, cost consulting, and environment at the workshop and in the days that followed.

A pass / fail criteria method of appraisal was used to undertake the Stage 1 assessment.

Acknowledging the project brief requirements, including the train service and station capacity, capital cost, constructability, and environmental impact, it was agreed to take a shortlist of 5No. options on to more detailed assessment.

2.3.2 Criteria for Stage 2 Appraisal

The criteria for the MCA appraisal are detailed in Table 2-1 as shown below:

Table 2-1 MCA Stage 2 Appraisal Criteria

Criteria	Sub-criteria	Description	Metric
Economy	Capital Cost	Estimates to be prepared and assessed in line with NTA guidelines	Comparison of options with regards to comparative capital cost
	Efficiency and Effectiveness	Maximise the value for money	Comparative analysis of options in relation to station capacity
	Construction and Maintenance Impacts	Minimise the potential disruption to rail and other transport users	Comparative assessment of potential impacts of delays to station and other transport network users arising from staging of works
Environment	Ecology and water resources (impacts on habitats/species and surface/groundwater arising from landtake)	Avoid and mitigate adverse effects on biodiversity arising from proposed scheme, and minimise impacts on water resources arising from implementation of proposed scheme	Qualitative appraisal of potential effects of proposed option on internationally and nationally important designated sites and associated flora and fauna, and existing surface water bodies and aquifers
	Built environment, land use and visual	Avoid and minimise impact on land take requirements	Comparative qualitative assessment of land use requirements for each option
	Archaeological architectural and cultural heritage	Avoid and minimise impact on the archaeological, architectural and cultural heritage environment	Qualitative appraisal of potential impacts of proposed options on legally protected sites
Integration	Integration	Maximise the integration of all connecting lines through and terminating at Connolly Station	Comparison of each option in relation to conflict reduction and connectivity
	Flexibility	Ensure option complies with City and Regional transport, economic and planning policies and strategies	Qualitative appraisal of compliance with appropriate policies
	Geographical Integration (Connolly Masterplan)	Maximise the integration of all operational and infrastructure implications with the proposed Connolly Masterplan	Qualitative appraisal of each option in relation to flexibility of design, specifically relating to proposed developments
Safety	Operational Safety	Reduction associated maintenance risk within the scheme area	Comparison of each option in relation to appraisal of asset maintenance requirements

2.4 MCA Scoring System

A comparative appraisal was undertaken using a five-point scale, ranging from significant advantages over other options to significant disadvantages over other options. This five-point scale is colour coded as presented in Table 2-2, shown below.

Table 2-2 Options Appraisal Colour Coding System

Score / Colour	Description
	Significant advantages over other options
	Some advantages over other options
	Comparable to other options
	Some disadvantages over other options
	Significant disadvantages over other options

2.4.1 Scoring Process

Each of the sub-criteria listed in Table 2-2 was considered in turn. A Discipline Lead was chosen for each of the sub-criteria to lead discussion and comparison of options, based on the development of the designs undertaken by the relevant Discipline Lead.

The results of each sub-criteria appraisal were challenged by the project team, and consensus was reached on each before moving onto the next sub-criteria.

The results of the appraisal are outlined in Sections 10 – 13 of this report.

2.5 Non-Scored Options

Following further development of the outline designs it was determined that two of the options did not meet the criteria as set out in the project brief.

- **Option 3** – the single suitable terminating platform means that a maximum of 26 tphpd (with 4 terminating) can be delivered in this Option. Furthermore, the minimal works undertaken to the platforms, and no extra provision for passenger movements, mean that this Option is not capable of achieving the required capacity.
- **Option 8B** - operational modelling of this Option was completed as part of this scheme. However, the modelling was undertaken with the assumption that a scissors crossover or similar arrangement could be provided at the end of Platforms 7 and 8. Subsequently it was confirmed that due to the curvature of the Newcomen Chord it would not be possible to install a scissors crossover at this location. Following confirmation of this it was decided that this Option would not be scored against the other options.

3. Outline Design Development

Prior to the workshop on the 1st March 2019, Jacobs developed outline permanent way and civils design drawings for each of the five shortlisted options. The input from each discipline and relevant appraisal sub-criteria is described below.

3.1.1 Permanent Way

Permanent way drawings were developed for each of the five shortlisted options and can be found in Appendix A of this report. The permanent way designs were developed in conjunction with other key disciplines, specifically the operations and civil engineering disciplines.

These drawings were provided to the engineering team to allow other key disciplines to develop their outline designs, and to facilitate comparative appraisal of each option during the workshop on 1st March 2019.

The permanent way designs were used to compare each option with regards to *operational safety*, specifically relating to the appraisal of asset maintenance requirements for each option.

3.1.2 Civil and Structural Engineering

Platform layout drawings were developed for each of the five shortlisted options, taking into account the findings of the pedestrian flow analysis. Furthermore, outline design drawings were developed for the construction of the drop-lock which will be required to allow for increased service over the Newcomen Chord. These drawings can be found in Appendix B of this report.

These drawings were provided to the engineering team to allow other key disciplines to develop their outline designs, and to facilitate comparative appraisal of each option during the workshop on 1st March 2019.

The outline civil engineering designs were used to compare each option against the *construction and maintenance impacts* and *geographical integration* sub criteria associated with **economy**.

Each option requires the construction of a drop-lock at the Newcomen Chord location. This drop-lock will allow navigation of the canal without the need to interfere with railway operations. Its form will be similar to that recently installed at Dalmuir, West Dunbartonshire, Scotland. This will allow the existing railway lifting bridge to be replaced with a fixed bridge. The required size and location of the drop-lock differs between option ‘B’ and ‘D’ variants as the ‘B’ variants require dual-tracking of the chord.

3.1.3 Train Operations

A summary was produced outlining the operational modelling undertaken on Options 6B, 6D, 8B and 8D for the remodelling of Connolly Station. This summary can be found in Section 9 of this report. Within the overall summary each option is scored from 1 (poor) to 5 (good) against four key operational areas:

1. Accommodate Specification
2. Passenger Outcomes
3. Performance
4. Future proofing

The operational modelling analysis was used to compare each option with regards to the following sub-criteria:

- *Efficiency and effectiveness*: the effectiveness of each option with regards to (1) accommodating the specification and (2) passenger outcomes was used to appraise each option with regards to *efficiency and effectiveness*.

- *Integration*: each option was ranked with regards to (3) performance.

- *Flexibility*: each option was ranked with regards to (4) future proofing.

3.1.4 Pedestrian Flow and Fire Safety

A Passenger Demand Assessment report was produced by the Jacobs' passenger flow team in order to complete a full comparative appraisal of each option. This report can be found in Appendix C of this report.

The passenger demand assessment was used to compare each option with regards to the *efficiency & effectiveness* sub criteria associated with **economy**.

The implications of station design were also reviewed with regards to fire safety. This review formed part of this overall appraisal.

3.1.5 Cost Consulting

Capital cost estimates have been produced for each option in accordance with the project brief. A breakdown of this cost build-up can be found in Appendix D of this report.

These estimates were used to assign a comparable rating for each option.

3.1.6 Environmental and Heritage

An Environmental Assessment of Options Report was written by Jacobs' environmental team in order to complete a full comparative appraisal of each option. This report can be found in Appendix E of this report.

This report was used to compare each option with regards to all **environment** main criteria.

3.1.7 Overhead Line Electrification (OLE)

Overhead Line Electrification drawings were developed for each of the five options and can be found in Appendix XX. These designs were developed in conjunction with other key disciplines, specifically the permanent way discipline.

These drawings were used to verify the feasibility of each option and feed into the overall costing for each option.

3.1.8 Telecommunications / Signalling / Electrical and Plant

The telecommunications / signalling / electrical and plant disciplines reviewed the outline designs for each option and provided commentary with regards to their feasibility.

4. Option 3 (Do-Minimum)

4.1 Overview

Option 3 is the 'Do Minimum' option requiring the lowest level of infrastructure changes. The proposals require the following interventions to be made to the rail infrastructure;

- The station throat to be remodelled to reduce conflicts and improve movements to provide a timetable allowing an increase in tphpd using the station to be increased towards the project target of 30 tphpd (this Option cannot achieve this target).
- Minor revision to the alignment and length of the north end of all platforms to accommodate the revised throat layout is required, platform widths and lengths will be improved.
- Installation of an improved Newcomen single line chord with new canal drop-lock and replacement single line rail bridge over the canal as well as a replacement cycle route bridge to allow revenue services to be timetabled on the chord.

There is no requirement to purchase land outside the railway boundary within this Option.

4.2 Track Works

This Option requires the replacement of the core of the north end track at Connolly Station which includes the east side approaches to the bay platforms and a completely new bay platform arrangement on new track centres. The number of bay platforms is retained at 4 and through tracks can be accommodated on very similar alignments to the existing arrangement and tracks tied-in approximately half way along the platform, well in advance of the south end of the station and junctions over Amiens Street.

Geographically, all new track work installation and changes are undertaken without affect to Ossory Road and Suburban Junctions. This Option preserves the void between the viaduct structures which contains the car repair centre.

The Newcomen Junction line remains as a single line and a revised positioning of the Newcomen cord connecting turnout provides for the drop-lock without the need to demolish the North Strand Road bridge but the new cycle bridge that is proposed to be connected to this bridge will require replacement.

4.3 Civil and Structural Works

This Option will not require any third-party land take and require the least infrastructure works, these can be summarised as;

- Platform 1-2 lengthened and realigned.
- Platform 3 lengthened and realigned.
- A very slight slue of the north end of Platform 5.
- A very slight slue of the north end of Platform 6.
- A significant slue of the north end of Platform 7.
- No structural works are required to the arches.
- The existing concourse and platform accesses are unaffected.
- The existing platform canopies are unaffected.
- The existing OLE masts in the station are unaffected but those in the station northern approaches will need to be reconstructed.
- Drop-lock installed at Newcomen Junction.
- New steel single line rail bridge installed to Newcomen Junction.

- New cycle bridge over canal at Newcomen Junction to be replaced.
- Demolition of the Enterprise Maintenance Shed.

4.4 Appraisal

Following further inter-disciplinary reviews with all members of the project team, it was determined that the Do Minimum option was not a feasible option as it does not provide the capacity required by the project brief. This Option was therefore ruled out prior to the Short List Option Appraisal Workshop and has not been scored as part of the overall appraisal.

5. Option 6B – Remodelled Platforms and Station Throat in Combination with Additional Crossings

5.1 Overview

Option 6B requires a significant level of infrastructure works, particularly within the station area. The proposals require the following interventions to be made to the rail infrastructure;

- The station throat is to be remodelled to reduce conflicts and improve movements to provide a timetable allowing an increase in tphpd using the station to be increased to achieve the project target of 30 tphpd
- Demolition of the Enterprise Maintenance Shed to accommodate the revised throat.
- Reconstruction of all platforms to provide the minimum width required to achieve the target passenger capacity, while accommodating the proposed track layout. This includes platform seven being relocated from the east to the west side of road seven, the current island Platform 6/7 to be rebuilt to take roads 5 & 6 and the terminating Platform 4 being relocated outside the train shed and being remodelled as new through line.
- Closure and infill of the existing subway serving Platforms 6 & 7.
- Provision of a new footbridge with lifts and stairs serving Platforms 3/4, 5/6 & 7.
- Relocation of the ticket gate-line to the north within the train shed to provide an enlarged concourse and retail area.
- Installation of an improved Newcomen twin line chord with new canal drop-lock and reconstructed twin line rail bridge over the canal as well as a replacement cycle route bridge to allow revenue services to be timetabled on the chord.
- The North Strand Road bridge over the railway and canal will need to be replaced to facilitate the dual-track Newcomen Chord.

This Option does not require the purchase of land outside the railway boundary.

This Option will cause significant disruption to transport infrastructure during construction as the station platforms are all remodelled and the North Strand Road bridge will require replacement. However, the final scheme is believed to offer the greatest operational capacity and flexibility and the initial Jacobs constructability review found that Connolly Station could remain operational using two through tracks open at all times, with the exception of a limited number of possessions for replacing key turnouts and signalling commissioning.

5.2 Track Works

This Option comprises a large amount of track alteration and installation with re-aligned through platforms and a new arrangement of bay platforms. The number of bay platforms is reduced from 4 down to 3 and the introduction of a new Platform 7 on the western edge of the railway structure introduces an additional through line connecting into a revised junction arrangement over Amiens Street. Tracks immediately to the north are effectively straightened out to accommodate back to back running double junction between the Dundalk and Suburban lines and a double junction from the Dundalk lines to serve the bay platform approaches. Additionally, there is a new scissors crossover within the Dundalk lines which can be positioned to avoid clash with the existing Suburban Junction.

Geographically, all new track work installation and changes are undertaken without affecting Ossory Road and Suburban Junctions. This Option preserves the void between the viaduct structures which contains the car repair centre.

The Newcomen Junction Chord becomes a twin track line and a drop-lock is provided.

5.3 Civil and Structural Works

This Option will not require any third-party land take but will require the most infrastructure works, these can be summarised as;

- All platforms require to be reconstructed.
- The corridor between arches requires to be bridged to allow for rail loading
- The Enterprise Maintenance Shed requires demolition.
- The redundant existing platform wells in the concourse are to be infilled and paved.
- The existing underpass to Platform 5-6 is to be infilled and a new footbridge structure connecting Platforms 3 to 7 to replace it.
- The existing Platform 5, 6 & 7 canopies require to be reconstructed.
- The existing OLE masts require to be fully reconstructed.
- No land purchase is required.
- Drop-lock to be installed at Newcomen Junction.
- New steel double line rail bridge installed to Newcomen junction.
- New cycle bridge over canal at Newcomen Junction to be replaced.
- North Strand Road bridge to be replaced.

5.4 North Strand Road Bridge

The replacement of the North Strand Road bridge is a significant requirement of this Option. North Strand Road is a major arterial road into and out of Dublin city centre and this intervention will cause delays during the construction period.

The Jacobs design team have undertaken high-level considerations of this and have identified methods by which this interruption can be minimised. Existing archive information and records will be sought at the next stage of the project to determine construction type of the bridge which will have implications for any time savings that can be made.

5.5 Reconstruction of Platforms within Station

The reconstruction of the platforms within the station is a significant intervention but will allow the flexibility required for this scheme. The construction has been considered by the Jacobs project team at a high-level and have concluded that two through lines can remain operational at all times, with the exception of a limited number of possessions for replacing key turnouts and signalling commissioning.

Furthermore, in order to minimise disruption to the network a phased approach would be required which would see the platforms reconfigured in two stages. This would require temporary alignments of the permanent way. This will be considered in detail at the next stage of design.

5.6 Enterprise Maintenance Shed

At the next stage of design, all endeavours will be made to attempt to refrain from impacting on the Enterprise Maintenance Shed. However, to prepare for the event that retaining the maintenance shed is not achievable Jacobs have undertaken high-level considerations of potential depot relocations.

6. Option 6D – As Option 6B but without dual-tracking of Newcomen

6.1 Overview

Option 6D is a variant of Option 6B and is identical for the core of the station and approach works. The exception is the Newcomen Junction line which in this Option, is a single line.

The revised alignment of the Newcomen Chord connecting turnout provides for the drop-lock and the elimination of the need for demolition of the North Strand Road bridge.

The differences between this Option and Option 6B are summarised below;

- Newcomen Junction realigned single track.
- New steel single line rail bridge installed to Newcomen Junction.
- Existing North Strand Road bridge is retained.

This Option reduces the impact on transport links during construction by not requiring the reconstruction of the North Strand bridge However, this Option can only achieve the 30 tphpd target if there is an intervention at Glasnevin to provide an improved junction.

7. Option 8B – Combination of Elements of 6a (at Throat) and 8a (at Platforms)

7.1 Overview

Option 8B requires infrastructure works, both within the station and new structures outside the existing railway boundary. The proposals will require the purchase and demolition of third-party property. The proposals require the following interventions to be made to the rail infrastructure;

- The station throat to be remodelled to reduce conflicts and improve movements to provide a timetable allowing an increase in tphpd using the station to be increased towards the project target of 30 tphpd. (this Option cannot achieve this target).
- An additional platform (Platform 8) will be constructed to the Western side of the station, this platform will extend out over third-party land. This will require the purchase of the third-party land, comprising of the adjacent car park, No. 102-106 Amiens Street, part of Preston Street and No.4 Preston Street.
- All existing platforms will require revision to their alignment and length at the north end to accommodate the revised throat layout. The lengths of Platforms 3, 4/5 & 6/7 will be increased, Platform 1/2 will be shortened.
- An existing bridge deck to the Western side of the station (part of the face of the station retaining wall) will require replacement with a new retaining wall and infill to allow the proposed Platform 8 to be constructed.
- This Option requires the modification of the void between the viaduct structures which contains the car repair centre.
- Provision of a new footbridge with lifts and stairs serving Platforms 1/2, 3, 4/5, 6/7 & 8. The existing subway serving Platform 6/7 will be retained.
- Installation of an improved Newcomen twin track chord with new canal drop-lock and reconstructed twin track rail bridge over the canal as well as a replacement cycle route bridge to allow revenue services to be timetabled on the chord.
- The North Strand Road bridge over the railway and canal will need to be replaced to facilitate the installation of the drop-lock.

This Option will cause disruption to transport infrastructure during construction as the North Strand Road bridge will require replacement. There will also be disruption to train operations at Connolly Station to facilitate the required improvements to the platforms. If this option were to be taken forward to concept design the Jacobs project team would develop methods of minimising the effects of this.

The Enterprise Maintenance Shed and sidings are not affected by this Option

7.2 Track Works

This Option requires the replacement of all the north end track at Connolly Station with some minor changes to the east side bay platforms and service roads. The train shed and bay platforms are unaffected and the alignments remain in their current position for Platforms 1 to 4.

The through tracks can be accommodated on very similar alignments to the existing arrangement and tracks tied-in approximately half way along the platform length, well in advance of the south end of the station and junctions over Amiens Street.

Geographically, all new track work installation and changes are undertaken without affect to Ossory Road and Suburban Junctions. This Option requires the modification of the void between the viaduct structures which contains the car repair centre.

In order to provide the target capacity as required by the project brief, a scissors crossover would be required at the north end of Platforms 7 and 8. Due to the curvature of the Newcomen Chord it was not possible to provide this crossover without realignment of the tracks, leading to further land purchase and demolition.

7.3 Civil and Structural Works

This Option will require significant works to be completed outside the current station land boundary, the proposed works are summarised below;

- Platform 1-2 shortened and realigned redundant track trough to be infilled and paved.
- Platform 3 lengthened and realigned.
- Platform 4-5 lengthened and realigned.
- Platform 6-7 lengthened and realigned.
- Platform 8 constructed overhanging the edge of the existing arches. Blockwork/concrete piers will support concrete beams to form the platform.
- Platform 8 line constructed overhanging the edge of the existing metallic underbridge. Bridge to be removed and infilled, with a new retaining wall constructed.
- Emergency access stairs to be provided from both ends of Platform 8 to street level.
- The corridor between arches requires to be bridged to allow rail loading.
- The Enterprise Maintenance Shed is retained.
- The existing concourse and platform accesses are unaffected.
- A new footbridge structure spanning all platforms is required.
- The existing Platform 5 canopy requires reconstruction.
- The existing Platform 6-7 canopy requires reconstruction at the north end.
- The existing OLE masts throughout the station and approaches will require to be fully reconstructed.
- Land purchase is required along the western fringe of the station, comprising of the adjacent car park, No. 102-106 Amiens Street, part of Preston Street and No.4 Preston Street.
- The open area between arches requires to be bridged. A ventilation system will likely need to be installed as part of these works
- Drop Lock installed at Newcomen Junction.
- New steel double line rail bridge installed to Newcomen junction.
- New cycle bridge over canal at Newcomen Junction to be replaced.
- North Strand Road bridge to be replaced.

7.4 Platform Widening within Station

During the development of this design it was determined that the target number of trains per hours will require a greater capacity to the existing platforms, as well as the construction of Platform 8. The Passenger Demand Assessment Report (included in Appendix C) concludes that the existing station layout is unlikely to cope with long term (foreseeable) peak passenger flows with growth derived from the NTA Dublin Regional Model for 2040. Platform congestion and ramp access congestion is forecast.

The island Platform 6 and 7 in particular would require a significant increase in width and length to accommodate the proposed train and passenger numbers. The Passenger Demand Assessment Report also indicates that the footbridge is a requirement of this design as it provides the necessary connection and capacity between platforms. The footbridge and the required width of the stairs impacted on the final design width of Platform 6 and 7.

The assessment undertaken by the Jacobs Passenger Flow team states that this Option matches the passenger forecast 2040 flows, with the designs as shown in the drawings provided. For example, the required width of island Platform 6 and 7 is 9.8m, and the design size of the platform is currently 10m.

8. Option 8D – Option 8B, without dual-tracking of Newcomen

8.1 Overview

Option 8D is a variant of Option 8B and is identical for the core of the station and approach works. The exception is the Newcomen Junction line which in this Option, is a single line.

The revised alignment of the Newcomen Chord connecting turnout provides for the drop-lock and the elimination of the need for demolition of the North Strand Road bridge.

The differences between this Option and Option 8B are summarised below;

- Newcomen junction realigned single track.
- New steel single line rail bridge installed to Newcomen junction.
- Existing North Strand Road bridge is retained.

This Option reduces the impact on transport links during construction by not requiring the reconstruction of the North Strand Road Bridge.

The 30 tphpd target can only be achieved with this Option if there is an intervention at Glasnevin to provide an improved junction.

9. Operational Modelling

9.1 Overview

This section summarises the operational modelling undertaken on Options 6B, 6D, 8B and 8D for the remodelling of Connolly Station. The objective is to determine which option delivers the target 30 tphpd into Connolly with the best possible performance and passenger outcomes.

9.2 Train Service Summary

The specified train service comprises 44 trains per hour per direction (tphpd) running in and out of central Dublin from the Phoenix Park, Maynooth and Northern Lines. 30 tphpd run to Connolly Station, with the balance running to Docklands station. Of these 30 tphpd, 18 tphpd run across Connolly Station towards Pearse, Grand Canal Dock or Bray.

- **Northern Line**: 16 tphpd are specified on this route (including a 1 tphpd 'Enterprise' service). All of these services must run to Connolly Station as no connection between the Northern Line and Docklands has been assumed. A significant number of Northern Line services currently run across Connolly towards Bray in today's timetable
- **Phoenix Park Line**: 12 tphpd are specified on this route; this route has the option to run to either Connolly or Docklands. There is an existing flow from the Phoenix Park line to Pearse and towards Bray. Therefore, it is assumed that it would be beneficial for this service linkage to continue in the future.
- **Maynooth services**: 16 tphpd are specified on this route; this route can run to either Connolly or Docklands. There are only a few existing services that run across Connolly Station on this route.

As the Northern Line can only run to Connolly, the remaining 14 tphpd (to make 30 tphpd) total must come from the Phoenix Park and/or Maynooth lines. The simplest solution in terms of timetabling and providing a choice of destinations for passengers is for half of the service on each route (8 tphpd Maynooth and 6 tphpd Phoenix Park) to operate to Connolly and the remainder to Docklands. In theory, this provides a clockface, alternating destination service on both lines.

A maximum of 15 out of the 18 tphpd running across Connolly towards Bray can come from the Northern Line (with the Enterprise service terminating). The remainder must run through from either Phoenix Park or Maynooth. When considering which route to run trains across Connolly Station from, the following points are taken into account:

- It would be beneficial to provide more than 3 tphpd from either route in order to provide a consistent, useable clockface service; the proportion of Northern line services running through can therefore be reduced
- It is operationally simpler (and likely to deliver significantly more robust performance) to have the additional services operate solely from one route (rather than a mix of both Phoenix Park and Maynooth lines)
- It would be operationally simpler and provide a better timetable for all of the services from the chosen route to run towards Bray (rather than a proportion terminating at Connolly)

In this study, the services chosen to run through are the Phoenix Park trains. This is because:

- There is an existing linkage on this route today
- It is easier for Maynooth services (compared with Phoenix Park trains) to terminate at Connolly Station without impact on other service groups
- An 18 tphpd timetable towards Bray could notionally be based on a repeating 3/3/4-minute service interval (i.e. departures at xx.00, xx.03, xx.06, xx.10 etc.). This would be easier to integrate with half (6 tphpd) of Phoenix Park line services running to Connolly operating on a 10-minute interval than 8 tphpd from Maynooth on a 7.5-minute interval
- It is easier to integrate 12 tphpd Northern Line with 6 tphpd Phoenix Park line rather than 10 tphpd Northern Line with 8 tphpd Maynooth line

Therefore, the service specification has been implemented as follows:

Table 9-1: Service Specification Required

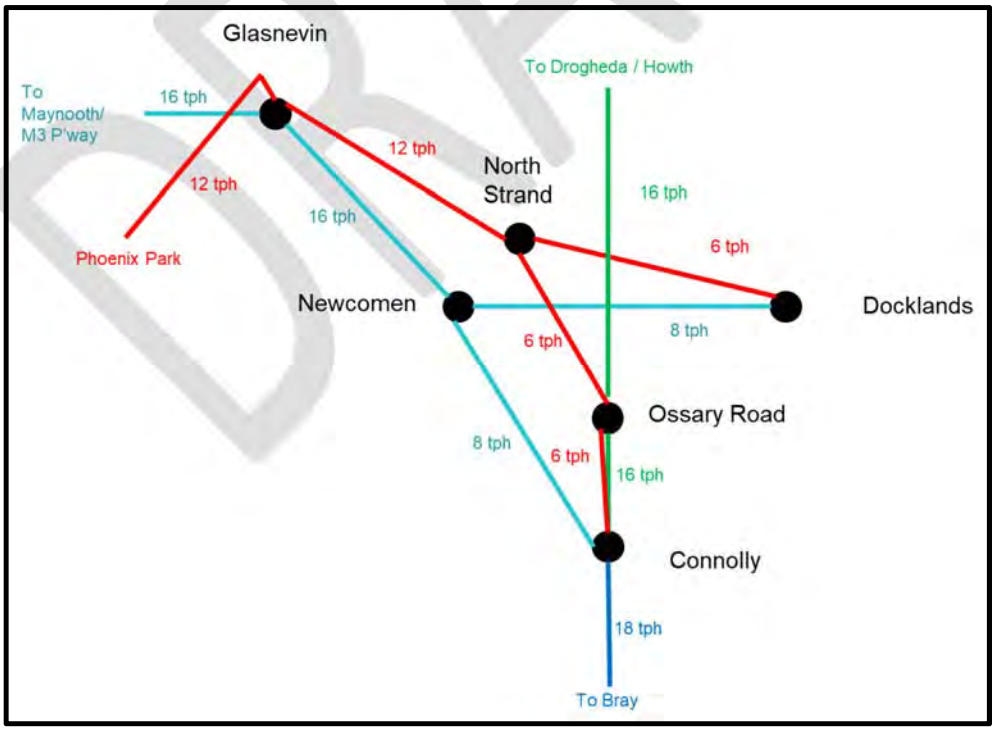
Service	Total tphpd	To Docklands	To Connolly	Of which, running through Connolly
Northern Line	16	0	16	12
Maynooth	16	8	8	0
Phoenix Park	12	6	6	6
TOTAL	**44**	**14**	**30**	**18**

9.3 'B' Routeing Options (Option 6B and 8B)

N.B. This analysis assumes a scissor crossover or similar arrangement is provided in Option 8B at the end of Platforms 7 and 8. Without this crossover, it is likely this option is not feasible

Options 6B and 8B have the Newcomen Chord double-tracked leading into two separate platforms at Connolly. This fits well with the train service described previously, as all Maynooth trains are routed via Newcomen Junction with half proceeding to Docklands and half to Connolly via the Newcomen Chord. This provides complete segregation between the Maynooth and Phoenix Park routes, which will provide a significant performance benefit as delay will not be transferred between routes. It also allows each route's timetable to be optimized to provide the best possible journey times and service spacing, as integration with the other route is not required.

Figure 9-1: Operational Layout of 'B' Options



8 tphpd from Maynooth therefore terminate in the two platforms at the west side of the station (4 trains per hour in each platform). This is possible with robust turnrounds (typically around 10 minutes) for each service.

The Phoenix Park trains cross the layout at the parallel ladder at the end of the central platforms. The timetable has been planned around parallel moves across this junction to provide maximum robustness.

The remaining Northern Line services terminate in the bay platforms; three platforms are more than sufficient for this, even providing a dedicated platform for the Enterprise service.

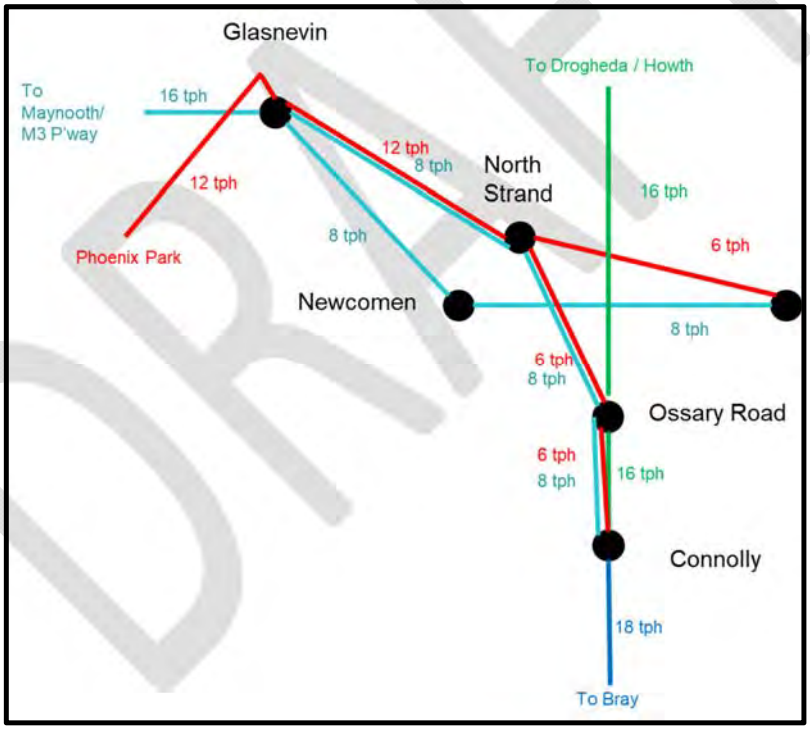
Overall, these options therefore accommodate all of the 30 tphpd requirement and provide a good passenger output and are likely to give the best performance possible.

9.4 'D' Routeing Options (Option 6D and 8D)

In Options 6D and 8D, Newcomen Chord is not doubled but an intervention is assumed at Glasnevin Junction. It is assumed that this intervention will allow the integration of the Maynooth and Phoenix Park routes at Glasnevin as required.

In these Options, the Maynooth – Docklands services can continue to operate via Newcomen Junction, but the Maynooth – Connolly services must merge with the Phoenix Park line services at Glasnevin Junction. This places 20 tphpd between Glasnevin Junction and North Strand Junction, where the service splits between 6 tphpd to Docklands and 14 tphpd to Connolly.

Figure 9-2: Potential Operational Layout of 'D' Options



This number of services can be accommodated, but significant constraints are imposed:

- The even intervals on each route cannot be maintained, as a 5-minute interval from Phoenix Park does not fit well with a 7.5-minute interval from Maynooth.
- With 20 tphpd operating over North Strand Junction, the junction must be planned to operate using parallel moves to/from Docklands and Connolly. This therefore involves aligning both directions which imposes an additional timetable constraint.

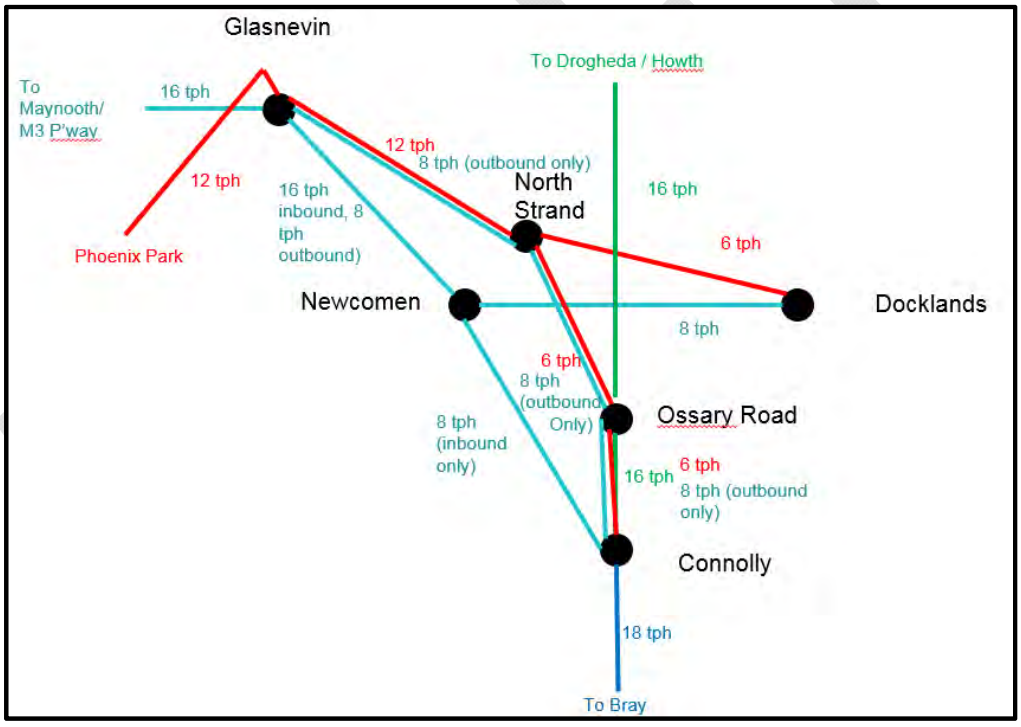
- The Phoenix Park line services are fixed by the timings at Connolly to integrate with the Northern line. Therefore, the Maynooth line services are adjusted to fit

The impact of this is that the intervals on each route are lost (for example, a train every 7.5 minutes on the Maynooth line into Connolly can become a 4/11-minute service interval). Pathing time is added in some trains to get them to present at key locations on time, meaning junction times are extended compared to the minimum possible.

The line between Glasnevin Junction and North Strand Junction (and North Strand Junction itself) is likely to be operating at near-maximum capacity, even if a signalling enhancement is also provided. This, combined with the inter-mixing of different service groups and potential knock-on impact to Northern Line and Bray services, means that a significant performance impact is likely to be seen compared to the 'B' Options.

Therefore the 'D' options are designed to route inbound services from Maynooth via Newcomen Junction and outbound services via North Strand Junction. This means that, 20 tph is required between North Strand Junction and Glasnevin Junction in only one direction, and the number of conflicting moves at North Strand Junction is reduced. Although this eases the timetable issues and performance risks slightly, it will require reconstruction of the Newcomen Chord whilst providing little of the benefit of the equivalent 'B' Option. This is shown in the operational diagram below:

Figure 9-3: Operational Layout of 'D' Options



9.5 Option 6 and 8 Comparison

This section of the report compares Options 6B and 6D with Options 8B and 8D, as the significant differentiator between the 'B' and 'D' variants is the construction of the Newcomen Chord, i.e. dual-track in the 'B' variants and single-track in the 'D' variants.

In terms of the ability to operate the train service specified and as implemented here, Options 6 and 8 are functionally identical. They are differentiated only on a few points, as described below.

The benefits of Option 6 are:

- Significantly more flexibility if Maynooth services are to operate across Connolly Station. The additional through platforms allow these trains to operate in either 'B' or 'D' scenarios and provides full routeing flexibility. This is likely to occur should Northern Line services be diverted away from Connolly Station in the future.

- Ability to divide station in two parts for maintenance purposes and keep operating a through service.

- Flexibility to route around any issues occurring at Connolly Station itself. Operating 18 tphpd or more through a busy station with only two operational through platforms is a challenge similar to Crossrail or Thameslink.

The benefit of Option 8 is:

- An additional terminating bay platform on the west side of the station. This may provide limited additional flexibility to terminate more trains from the Northern line, but as described previously this is a less likely scenario.

Therefore, Option 6 provides more future-proofing than Option 8 as more trains can use the platforms at the station providing maximum flexibility.

The Option 6 routeing flexibility is also likely to be beneficial in terms of maintenance and recovery from more significant delays.

For example, in a scenario where a train fails in one of the through platforms:

- In Option 6, one of the three other through platforms is used for Bray services, allowing the target of 18 tphpd to/from Bray to still operate. The Maynooth service to Connolly is thinned from 8tph to 4 tph or diverted to Docklands.

- In Option 8, only one of the two other through platform is available for westbound through services. Given the increased platform reoccupations when alternating direction through a single platform, the Bray service must be thinned to 7 – 8 tphpd. Services from the Northern Line or Phoenix Park can terminate at Connolly Station, but services from Bray must be held elsewhere on the route, or turned back, until the full service restarts (which will be operationally challenging due to lack of suitable holding locations).

In essence, with Option 8 there is one fewer through platform that would be available under degraded working caused by failures either at Connolly or elsewhere on the network. There is capability to terminate some services (including those from the Northern Line) in the lower numbered bay platforms in times of disruption, but some services may need to be terminated elsewhere in the station. Option 6 offers full flexibility to work around any such operational requirements, but Option 8 is more restricted due to the reduction in through platforms. Therefore, in some perturbed scenarios there may be a requirement to intervene and reduce the service further in Option 8 compared to Option 6.

9.6 Overall Summary of Operations

The four options considered have been ranked from 1 (poor) to 5 (good) for four key operational areas:

Accommodate Specification: defined by the capacity of an option to accommodate the required timetable as specified in the project brief.

Passenger Outcomes: defined as the performance of an option with regards to movement of passengers across the network, and interconnectivity with routes within the system and other transport networks.

Performance: scored using the operational modelling undertaken using Railsys by evaluating the performance of each option with regards to consistency of service, potential of perturbation, and risk of delay.

Future Proofing: defined as the suitability of an option to integrate with proposed future schemes and developments, for example, DART Underground.

Table 9-2: Operational Scoring of Options

Criteria	Option 6B	Option 6D	Option 8B	Option 8D
Accommodate Specification	5	4	5	4
Passenger Outcomes	5	2	5	2
Performance	5	1	3	1
Future Proofing	5	5	3	3
Total	**20**	**12**	**16**	**10**

Option 6B is scored best, as it provides the better performance and passenger service outcomes of the 'B' Options combined with the maximum flexibility at Connolly Station and suitability for the future. Furthermore, this Option is not dependent on a scheme being built at Glasnevin Junction. Option 8B is scored marginally worse due to the restriction on future flexibility and impact under perturbation.

9.7 Option 3

Option 3 has not been considered in detail here as it does not deliver the specified service outputs. The single Newcomen Chord means that the disbenefits of the 'D' Options also apply to this Option, and the single suitable terminating platform (for services from the west), means that a maximum of 26 tph (with 4 terminating) could be delivered. However, this Option could be an intermediate step between today and either of the Option 6 or Option 8 designs.

10. Economy

10.1 Capital Cost

Indicative comparative costs were prepared for five options in relation to the adaptation of Connolly station and the associated rail infrastructure out to Newcomen Junction. The indicative costs were prepared from outline design information provided by the Jacobs design team, augmented where necessary by assumptions as to differentiator costs between the options. The cost estimates prepared are intended only to provide a comparison of the likely costs associated with each option. Due to the limited amount of design information available, the total costs stated are indicative of the likely total cost only.

The report included in Appendix D is intended to provide details of the indicative costs used at the workshop to identify the Emerging Preferred Option.

A summary of the Costs associated with each option, subject to the contents of the CDAL (Cost Data Assumptions List) and Exclusions listed elsewhere in this report, are as follows:

Table 10-1: Connolly Station Options Cost Summaries

Connolly Station Detailed Options - Cost Summary (€ M's)	
	Cost
Option 3	**€135.00**
Option 6b	**€198.00**
Option 6d	**€187.00**
Option 8b	**€198.00**
Option 8d	**€184.00**

Where possible, the major elements of construction have been quantified. These quantities have been costed at rates derived from projects of a similar nature and where these have not been available, from pricing books or using the estimator's judgement.

An allowance of 30% has been applied to all cost estimates in relation to preliminaries costs. Without an outline construction programme, it has not been possible to differentiate between the options for this cost element. However, discussions during design team conference calls indicated that where one programme may take longer in comparison to another, the effects of each would be neutralised against each other as a comparison. Consequently, the same percentage has been used for all options. It is not considered likely that any fluctuation in this percentage allowance would differentiate between the options.

The overall costs were used to appraise each option against the sub-criteria of Capital Cost. The results of the appraisal are as follows:

Sub-Criteria	Description	Metric	6B	6D	8D
Capital Cost	Estimates to be prepared and assessed in line with NTA guidelines	Comparison of options with regards to comparative capital cost			

As the capital cost difference between options is not considered to be significant, Options 6D and 8D are considered as “comparable to other options” while Option 6B is considered to have “some disadvantages over other options”.

10.2 Efficiency and Effectiveness

Operational modelling was used to compare each of the options, and a summary is provided in Section 9. The key operational areas of “Accommodate Specification” and “Passenger Outcomes” were used to appraise each option against the sub-criteria of Efficiency and Effectiveness.

Furthermore, a Passenger Demand Assessment report was produced by the Jacobs’ passenger flow team in order to complete a full comparative appraisal of each option. This report can be found in Appendix C of this report.

The results of the appraisal are as follows:

Sub-Criteria	Description	Metric	6B	6D	8D
Efficiency and Effectiveness	Maximise the value for money	Comparative analysis of options in relation to station capacity			

Option 6B scores higher than Options 6D and 8D for the reasons set out in the operational modelling analysis.

With regards to pedestrian flow, it is accepted that at current design maturity the passenger flow capability of Option 8B is superior to Options 6B and 6D. However it is considered that, if taken forward to Concept Design Stage, amendments can be made to the Option 6B design which make the passenger flow capability as good as Option 8B.

10.3 Construction and Maintenance Impacts

A qualitative comparison of the construction and maintenance impacts was undertaken, to appraise each option with regards to impact on the station and on transport network users. The permanent way and civil engineering drawings were used to outline the key items with regards to construction requirements for each option.

Key differentiators between options have been discussed in previous sections of this report and these were used as part of the comparative appraisal. The results of the appraisal are as follows:

Sub-Criteria	Description	Metric	6B	6D	8D
Construction and Maintenance Impacts	Minimise the potential disruption to rail and other transport users	Comparative assessment of potential impacts of delays to station and other transport network users arising from staging of works			

There were several key considerations when determining these scores.

Option 6B requires significant work within Connolly Station, as well as the dual-tracking of the Newcomen Chord. Furthermore, the North Strand Road bridge must be reconstructed in order to provide room for the dual-tracked chord.

11. Environment

A report titled Environmental Assessment of Potential Options has been prepared and is included as Appendix E. The following sections summarise the potential impacts associated with ecology & water resources, the built environment, land use & visual, and cultural heritage.

11.1 Ecology and Water Resources

11.1.1 Ecology

All of the options propose works to the Royal Canal. Given the canal's status as a proposed Natural Heritage Area (pNHA) and the records of protected flora and fauna associated with the canal it is recommended that aquatic ecology surveys be undertaken as the Emerging Preferred Option is progressed through the design phases, to identify any specific aquatic constraints. In the comparison for the three options, it is considered that the options present similar potential impacts to aquatic ecology. Similarly, at this stage it is considered that all three options present similar impacts in relation the potential to encounter invasive species, particularly Japanese Knotweed (*Fallopia japonica*).

During a site walkover a number of properties with the potential to support roosting bats were recorded, including houses on Preston Street and Seville Place, 102-106 Amiens Street and Irish Rail offices. In addition, bridges within the Study Area are also considered to have potential to support roosting bats while the underground vaults/arches may have the potential to support hibernating bats.

Option 6D is considered to have some advantages as there are fewer potential impacts associated when compared to the other two Options.

Option 6B is considered to have disadvantages when compared to Option 6D as the double tracking of the Newcomen Chord will require the demolition and reconstruction of the North Strand Road bridge. The linear nature of the canal means that the bridge has bat roost potential. Further surveys and assessments will be required if this Option is progressed.

Option 8B is considered to have significant disadvantages of the three Options as it will require the demolition of all or part of 102-106 Amiens Street, No.4 Preston Street and disturbance to properties adjacent to Preston Street. These properties were all identified as having bat roost potential during an initial site walkover, and further surveys of these buildings are recommended in advance of any construction or demolition works.

11.1.2 Water Quality

Option 6B comprises a large amount of infrastructure works to construct. From a water quality perspective, the activities with the greatest potential for water impacts would include the development of the twin tracking of the Newcomen Junction Line which involves construction on the banks of the canal and over it, the demolition and reconstruction of the North Strand Road bridge which spans the canal and the development of a drop lock in the Royal Canal. The twin tracking of the Newcomen Junction Line associated with this option will require a much larger drop lock construction than the single-track options and necessitates the demolition and reconstruction of the North Stand Road bridge. The level of construction works required in, over and around the Royal Canal means that Option 6B presents the most potential for negative water quality impacts between the options.

Option 6D and Option 8D will involve an upgrade of the single-track on the Newcomen Junction Line and the development of a drop lock. The upgrade to the single track does not require the demolition and reconstruction of the North Strand Road bridge and the drop lock required will be smaller than that associated with Option 6B. The potential water quality impacts of Options 6D and 8D are anticipated to be similar at this stage.

Sub-Criteria	Description	Metric	6B	6D	8D
Ecology and water resources	Avoid and mitigate adverse effects on biodiversity arising from proposed scheme	Qualitative appraisal of potential effects of proposed option			

11.2 Built Environment, Land Use and Visual

It is anticipated at this stage that all three options will have a significant short-term visual impact at the station and in the surrounding areas. However, it is also acknowledged that Dublin City is constantly evolving and the presence of construction including cranes and hoarded off sites are common place.

Option 6B will require the demolition and reconstruction of the North Strand Road bridge. At this stage a detailed design for the reconstruction has not been prepared but it is anticipated that the detailed design will take into consideration the historic nature of the Royal Canal and the existing bridge design and will develop a design which is appropriate to the area. Option 6B will include the introduction of a passenger footbridge from Platforms 3 to 7. This will alter the existing view of the station from the north. Again, it is anticipated that the design of the footbridge will take into account the visual impact. Option 6B does not require any third-party land take.

As with Option 6B, Option 6D is anticipated to result in a local visual impact associated with the realignment of platforms and the introduction of the footbridge from Platforms 3 to 7. Option 6D does not require any third-party land take.

Option 8D presents the greatest potential for negative landscape and visual impacts. 102-106 Amiens Street may require demolition as part of the option, or at least part of the building to the rear. If the building is demolished in it's entirely this will have an impact on the existing landscape of Amiens Street. The building is on the National Inventory of Architectural Heritage as a property with features of architectural, artistic, historical and social interest. If only part of the building is demolished (the rear closest to the existing Platform 7) consideration will need to be given to how the rear of the building is reconstructed – the oculus (round window) to the rear of the building is noted in descriptions of the buildings and has formed part of the existing landscape of the station as the buildings rear wall borders the existing station footprint. Option 8D also includes for the introduction of a large footbridge, spanning from Platform 1 to the Proposed Platform 8. It is considered that Option 8D presents the most significant potential for negative impacts in terms of the built environment, land use and visual and therefore it has been identified as being the least preferred among the three Options.

Sub-Criteria	Description	Metric	6B	6D	8D
Built environment, land use and visual	Avoid and minimise impact on land take requirements	Comparative qualitative assessment of land use requirements for each option			

11.3 Cultural Heritage

There are more than 40 other Protected Structures in the vicinity of Connolly Station including houses and other premises along Amiens Street, Preston Street, Seville Place, Talbot Street and North Strand Road. These include 102–106 Amiens Street (former postal sorting office, RPS Ref. No. 126), 100 Seville Place (RPS Ref. No. 7496; reputedly used as a safe house by Michael Collins during the War of Independence), 4 Preston Street (RPS Ref. No. 6850), the lock-keeper's cottage at the 1st Lock, Royal Canal (RPS Ref. No. 5824) and Newcomen Bridge/North Strand Road bridge (RPS Ref. No. 911), North Strand, which is a granite canal bridge built c.1790 to carry North Strand Road over the Royal Canal. The canal was built in the late eighteenth century to provide freight and passenger transport between Dublin and the River Shannon. George's Dock, to the south of Connolly Station, was built in 1821 to the designs of John Rennie, and is also a Protected Structure (RPS Ref. No. 3173) comprising limestone ashlar dock walls with granite copings, granite and cast-iron bollards, steps, lock gates,

cast-iron mooring rings, ladders and winches. All nineteenth-century portions of main railway station complex are a Protected Structure (RPS Ref. No. 130, NIAH 50011009 – Regional significance) listed in the current Record of Protected Structures (RPS) for Dublin City (Volume 3 of the 2016–2022 Dublin City Development Plan).

All three Options will involve reconstruction of the roof canopies and would result in potential impacts on the arches below the station, both of which are a component part of the Connolly Station Protected Structure (RPS Ref. No. 130).

Option 8D would involve the greatest levels of impact to Cultural Heritage, including the potential demolition of part or all of the former postal sorting office at 102–106 Amiens Street (Protected Structure) and demolition of No. 4 Preston Street (Protected Structure), while the footbridge would require removal of the turntable and would also potentially impact on the water tower. Option 8D has been identified as being the least preferred among the three Options from the perspective of Cultural Heritage.

Option 6B and Option 6D would also have a potential impact on the turntable as result of the proposed footbridge. In addition, Option 6B would require demolition and reconstruction of Newcomen Bridge/North Strand Road Bridge (Protected Structure) and demolition of stone-built sections of the Royal Canal at the proposed drop lock and is assessed as not preferable from the perspective of Cultural Heritage.

Sub-Criteria	Description	Metric	6B	6D	8D
Archaeological architectural and cultural heritage	Avoid and minimise impact on the archaeological, architectural and cultural heritage environment	Qualitative appraisal of potential impacts of proposed options on legally protected sites			

12. Integration

12.1 Integration

Operational modelling was used to compare each of the options, and a summary is provided in Section 9.

The key operational areas of “Performance” was used to appraise each option against the sub-criteria of Integration. The results of the appraisal are as follows:

Sub-Criteria	Description	Metric	6B	6D	8D
Integration	Maximise the integration of all connecting lines through and terminating at Connolly Station	Comparison of each option in relation to conflict reduction and connectivity			

12.2 Flexibility

Operational modelling was used to compare each of the options, and a summary is provided in Section 9.

The key operational areas of “Future Proofing” was used to appraise each option against the sub-criteria of flexibility. The results of the appraisal are as follows:

Sub-Criteria	Description	Metric	6B	6D	8D
Flexibility	Ensure option complies with City and Regional transport, economic and planning policies and strategies	Qualitative appraisal of compliance with appropriate policies			

12.3 Geographical Integration (Connolly Masterplan)

Civil engineering drawings were used to assess the impacts of each option on the Connolly MasterPlan. The outline designs for the Connolly MasterPlan were provided by Iarnród Éireann.

During development of the outline designs it was determined that none of the options had any impact on the requirements of the Connolly MasterPlan, and therefore each option was scored identically. The results have been included in this report in order to record that this was taken into consideration:

Sub-Criteria	Description	Metric	6B	6D	8D
Geographical Integration (Connolly Masterplan)	Maximise the integration of all operational and infrastructure implications with the proposed Connolly Masterplan	Qualitative appraisal of each option in relation to flexibility of design, specifically relating to proposed developments			

13. Safety

All designs have been developed to ensure maximum safety of train operations and network users. However the Common Appraisal Framework does include Safety as one of the main criteria to include in the optioneering process. Therefore each option was assessed with regards to operational safety, specifically with regards to the associated maintenance risk of each option.

The Jacobs permanent way team undertook a review of each design to determine which option required the most switches and crossings to be installed. A comparison was made, with the premise being that the more switches and crossings in place the more maintenance would be required. This is an example of considering safety in design at the very early stages.

The results of the appraisal are as follows:

Sub-Criteria	Description	Metric	6B	6D	8D
Operational Safety	Reduction associated maintenance risk within the scheme area	Comparison of each option in relation to appraisal of asset maintenance requirements			

Each of the options are considered equal with regards to operational safety as all options have been designed with safety at the forefront of considerations.

14. Overall Scoring

The overall scores are shown in the table below:

Table 14-1 Summary of Scoring

Criteria	Sub-Criteria	Description	Metric	6B	6D	8D
Economy	Capital Cost	Estimates to be prepared and assessed in line with NTA guidelines	Comparison of options with regards to comparative capital cost			
	Efficiency and Effectiveness	Maximise the value for money	Comparative analysis of options in relation to station capacity			
	Construction and Maintenance Impacts	Minimise the potential disruption to rail and other transport users	Comparative assessment of potential impacts of delays to station and other transport network users arising from staging of works			
Environment	Ecology and water resources	Avoid and mitigate adverse effects on biodiversity arising from proposed scheme	Qualitative appraisal of potential effects of proposed option			
	Built environment, land use and visual	Avoid and minimise impact on land take requirements	Comparative qualitative assessment of land use requirements for each option			
	Cultural heritage	Avoid and minimise impact on the archaeological, architectural and cultural heritage environment	Qualitative appraisal of potential impacts of proposed options on legally protected sites			
Integration	Integration	Maximise the integration of all connecting lines through and terminating at Connolly Station	Comparison of each option in relation to conflict reduction and connectivity			
	Flexibility	Ensure option complies with City and Regional transport, economic and planning policies and strategies	Qualitative appraisal of compliance with appropriate policies			
	Geographical Integration (Connolly Masterplan)	Maximise the integration of all operational and infrastructure implications with the proposed Connolly Masterplan	Qualitative appraisal of each option in relation to flexibility of design, specifically relating to proposed developments			
Safety	Operational Safety	Reduction associated maintenance risk within the scheme area	Comparison of each option in relation to appraisal of asset maintenance requirements			

15. Glasnevin

The project brief indicates that it may be beneficial to “look at combining the Western trains onto the existing North Strand line – but any required development at Glasnevin is outside the scope of this study”.

Train operations at Connolly Station, specifically regarding direction of movement to/from the west of Dublin, would be impacted significantly if an intervention at Glasnevin were to be introduced. The precise details of any intervention at Glasnevin are outside this study brief. However, for a robust appraisal of all options affecting Connolly Station, we have included a high-level assessment.

Jacobs are advised by IÉ that they are considering a rail infrastructure scheme at Glasnevin Junction that enables an equal split of trains going to Connolly and Docklands Stations. This service pattern is illustrated in the operational diagram shown in Figure 15-1 below:

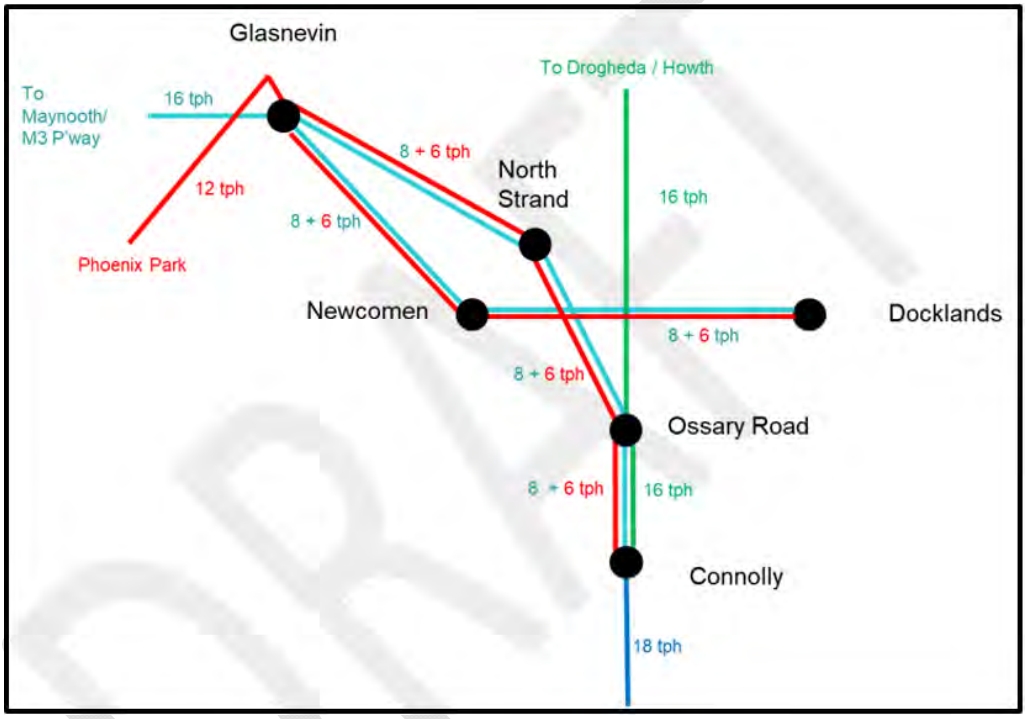


Figure 15-1 - Operational Layout including Intervention at Glasnevin

The above diagram illustrates a method for routeing trains that requires the complete remodelling of Glasnevin Junction to enable the crossover of services in each direction between the MGWR and GSWR lines. This is currently only possible in one direction from the MGWR to the GWSR as can be seen form the “Quail Map” copied below in Figure 15-2 below.

A further consideration is the heavy rail work necessary to align with the proposals being developed for the proposed MetroLink station at Glasnevin.

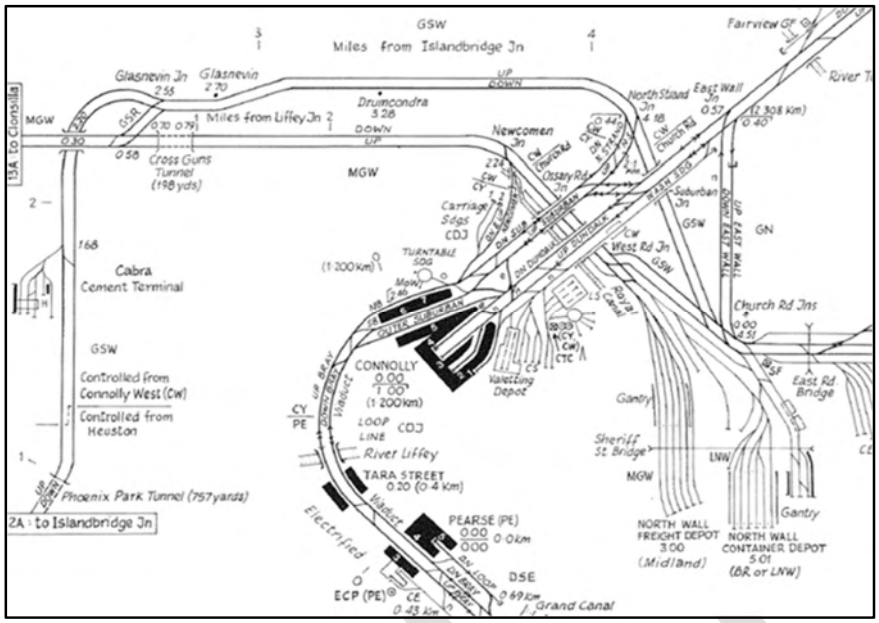


Figure 15-2 – Track Layout at Connolly Station and Glasnevin Junction

Should it be possible in the future to route trains as shown it would address some of the capacity constraints described for the Glasnevin Junction routeings for Options 3, 6D and 8D, namely:

- All services to Docklands would be routed via Newcomen Junction (from both Phoenix Park and the Maynooth line)
- All services to Connolly would be routed via North Strand Junction (from both Phoenix Park and the Maynooth line)

This reduces the service levels between Glasnevin Junction and Connolly Station to 14 tphpd, and eliminates the conflicting junction moves at North Strand Junction. This is an improvement over the previously described option of routeing trains via North Strand Junction but, compared to Option 6B and the use of Newcomen Chord, the following should be considered:

- Integrating trains from both lines at Glasnevin Junction (as opposed to keeping them segregated as in Option 6B) means that service intervals are likely to be more uneven because the service spacing on both lines (16tphpd to Maynooth and 12 tphpd to Phoenix Park) are not equal.
- There are a higher number of trains between Ossory Road Junction and Connolly Station than proposed in Option 6B; integrating a proportion of these trains with the Northern Line service is likely to be more difficult and lead to a higher performance risk. This is because there must be an available path on the Suburban Lines that aligns with a crossing move into the through platforms at Connolly Station, which is more difficult to achieve when the traffic on the Suburban lines has increased.
- Services from both Phoenix Park and Maynooth can serve Drumcondra, unlike in Option 6B. However, Drumcondra can only be served by trains to Connolly, not Docklands
- The infrastructure that must be provided at Glasnevin Junction is significant. Ideally, full grade separation would be provided due to the service levels involved (28 tph in each direction, half of which are swapping lines). Should only an upgraded flat junction or partially grade separated junction be provided, the required timetable is likely to be constructed around all moves being parallel moves which, as well as imposing additional timetable constraints, is likely to significantly increase performance risk when trains are running out of course.

Therefore, we conclude that while the separation of service flows at Glasnevin Junction is likely to accommodate the required 30 tph service level at Connolly Station, this would provide a less optimal passenger timetable (in terms of service intervals on each individual line) and with a higher performance risk than Option 6B.

Operational modelling could be performed to determine the scale of the performance impact of this intervention.

The remainder of the commentary comparing Option 6 and Option 8 still applies to this method of routeing trains.

As any scheme at Glasnevin is outside the scope of this report the capital cost of a grade-separated or other junction at Glasnevin has not been considered. However, following a high-level review of the requirements of any scheme of this nature, the capital cost is likely to be considerably higher than the installation of a dual-track along the Newcomen Chord, even with the reconstruction of the North Strand Road bridge.

16. Conclusion

Following the appraisal the results were aggregated to determine which option achieved the highest score in each main criteria. The overall are shown in Table 16-1 below:

Table 16-1: Aggregate of Scores from MCA Appraisal

	6B	6D	8D
Economy			
Environment			
Integration			
Safety			

Option 6B scores highest in terms of flexibility and provides the greatest capacity at Connolly Station. The capital cost and construction impacts of Option 6B is concluded to be marginally higher than the other options, but this is offset against the benefits.

Options 6B and 6D score similarly with regards to impacts on the environment, with the significant difference being the demolition and reconstruction of the North Strand Road Bridge. The differentiating factor with regards to Option 8D is principally that, environmentally, it will have the biggest visual impact and requires the greatest land purchase.

With regards to Integration Option 8D offers the least flexibility from an operational viewpoint.

Each option has been designed with safety at the forefront of considerations and therefore each option scores neutral on a comparative basis.

Appendix A. Permanent Way Drawings

Legend/Notes

1. THIS DESIGN IS BASED UPON THE SURVEY MAPPING SUPPLIED BY IRISH RAIL SUPPLEMENTED BY THE ORDNANCE SURVEY IRELAND DATA. OS IRELAND MAP DATA REPRODUCED BY PERMISSION OF CEO, ORDNANCE SURVEY IRELAND (ACTING ON BEHALF OF THE GOVERNMENT) DATED FEBRUARY 09, 2016 © ORDNANCE SURVEY IRELAND / GOVERNMENT OF IRELAND. ORDNANCE SURVEY IRELAND LICENCE No. EN 0082115

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Rev	Date	Description of Revisions	Drawn	Chkd	Appr
P02	20/03/19	OPTION SELECTION - IDC COMMENTS INCORPORATED	SP	CB	AB
P01	22/02/19	OPTION SELECTION	SP	CB	AB

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CONNOLLY STATION ENHANCEMENT OPTIONS STUDY

Drawing Title

CONNOLLY STATION REMODELLING AND NEWCOMEN JUNCTION PERMANENT WAY LAYOUT OPTION 3

Designed	Suresh Pillai	Signed		Date	20/03/19
Drawn	Suresh Pillai	Signed		Date	20/03/19
Checked	Chris Belton	Signed		Date	20/03/19
Approved	Alex Bradley	Signed		Date	20/03/19

Scale(s): 1:500
ELR & Mileage:
Alternative Reference:
Sheet: 01 of 01
Drawing Number: 32110100-03-ETR-DG-001
Revision: P02

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P01	22/02/19	OPTION SELECTION	SP	CB	AB

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CONNOLLY STATION ENHANCEMENT OPTIONS STUDY

Drawing Title

CONNOLLY STATION REMODELLING AND NEWCOMEN JUNCTION PERMANENT WAY LAYOUT OPTION 6B

Designed: Suresh Pillai	Signed	Date: 20/03/19
Drawn: Suresh Pillai	Signed	Date: 20/03/19
Checked: Chris Belton	Signed	Date: 20/03/19
Approved: Alex Bradley	Signed	Date: 20/03/19
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CONNOLLY STATION ENHANCEMENT OPTIONS STUDY

Drawing Title

CONNOLLY STATION REMODELLING AND NEWCOMEN JUNCTION PERMANENT WAY LAYOUT OPTION 6D

Designed	Suresh Pillai	Signed		Date	20/03/19
Drawn	Suresh Pillai	Signed		Date	20/03/19
Checked	Chris Belton	Signed		Date	20/03/19
Approved	Alex Bradley	Signed		Date	20/03/19
Scale(s)	1:500	ELR & Mileage			
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Project
CONNOLLY STATION ENHANCEMENT OPTIONS STUDY

Drawing Title
CONNOLLY STATION REMODELLING AND NEWCOMEN JUNCTION P WAY LAYOUT - OPTION 8B

Designed	Suresh Pillai	Signed		Date	20/03/19
Drawn	Suresh Pillai	Signed		Date	20/03/19
Checked	Chris Belton	Signed		Date	20/03/19
Approved	Alex Bradley	Signed		Date	20/03/19

Scale(s): 1:500
ELR & Mileage:
Alternative Reference:
Sheet: 01 of 01
Drawing Number: 32110100-08-ETR-DG-008
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3. ALL DIMENSION IN METRES UNLESS OTHERWISE STATED.

4. THE PROPOSED SPEED SHOWN IN THIS DIAGRAM IS THE MAXIMUM PERMISSIBLE SPEED IN KILOMETRES PER HOUR (KM/H) BASED ON THE DESIGN. A LINE SPEED ASSESSMENT WILL BE CARRIED OUT AT NEXT DESIGN STAGE.

5. THE PROPOSED TRACK ALIGNMENT WILL BE SUBJECT TO ASSESSMENT OF STRUCTURAL AND ELECTRIFICATION CLEARANCES. THE CLEARANCE ASSESSMENT TO BE UNDERTAKEN AT SUBSEQUENT DESIGN STAGES.

6. THE LENGTH OF PLATFORM SHOWN IN THIS DRAWING IS THE OPERATIONAL PLATFORM LENGTH, BASED ON THE ASSUMED POSITON OF EXISTING BUFFER STOP AND SIGNAL.

7. PLATFORMS SHOWN IN THIS DRAWING EXCLUDE ANY RAMPS OR EXTENTS

8. THE DESIGN CONSIDER NO MAJOR LAYOUT CHANGE AT SOUTHERN END OF PLATFORMS. THE LENGTH OF PLATFORMS 5, 6 & 7 SHOWN IN THIS LAYOUT ARE BASED ON THE ASSUMED POSITION OF EXISTING SIGNALS. HENCE THE SOUTHERN EXTENT OF PLATFORMS ARE EXCLUDED FROM WORKING LENGTH

KEY:-

- PROPOSED ALIGNMENT
- EXISTING TO BE REMOVED
- IRISH RAIL SIDING DESIGN
- PROPOSED PLATFORM
- EXISTING PLATFORM

Rev	Date	Description of Revisions	Drawn	Chkd	Appr
P02	20/03/19	OPTION SELECTION - IDC COMMENTS INCORPORATED	SP	CB	AB
P01	22/02/19	LH CROSSOVER INTRODUCED BETWEEN PLT. 7 & 8	SP	CB	AB

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Project
CONNOLLY STATION ENHANCEMENT OPTIONS STUDY

Drawing Title
CONNOLLY STATION REMODELLING AND NEWCOMEN JUNCTION
P WAY LAYOUT - OPTION 8D

Designed	Suresh Pillai	Signed	Date 20/03/19
Drawn	Suresh Pillai	Signed	Date 20/03/19
Checked	Chris Belton	Signed	Date 20/03/19
Approved	Alex Bradley	Signed	Date 20/03/19
Scale(s)	1:500	ELR & Mileage	

Alternative Reference

Sheet 01 of 01

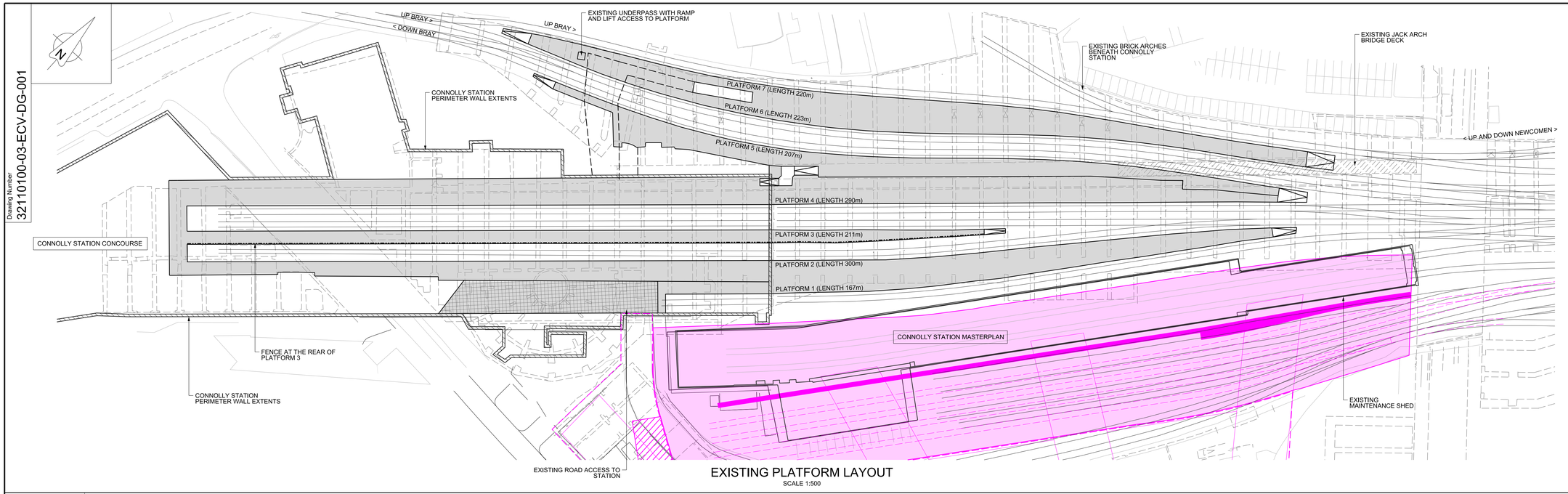
Drawing Number: 32110100-08-ETR-DG-009

Revision: P02

Sheet Size A1+6 594 x 2101

Appendix B. Civil Engineering Drawings

Drawing Number
32110100-03-ECV-DG-001



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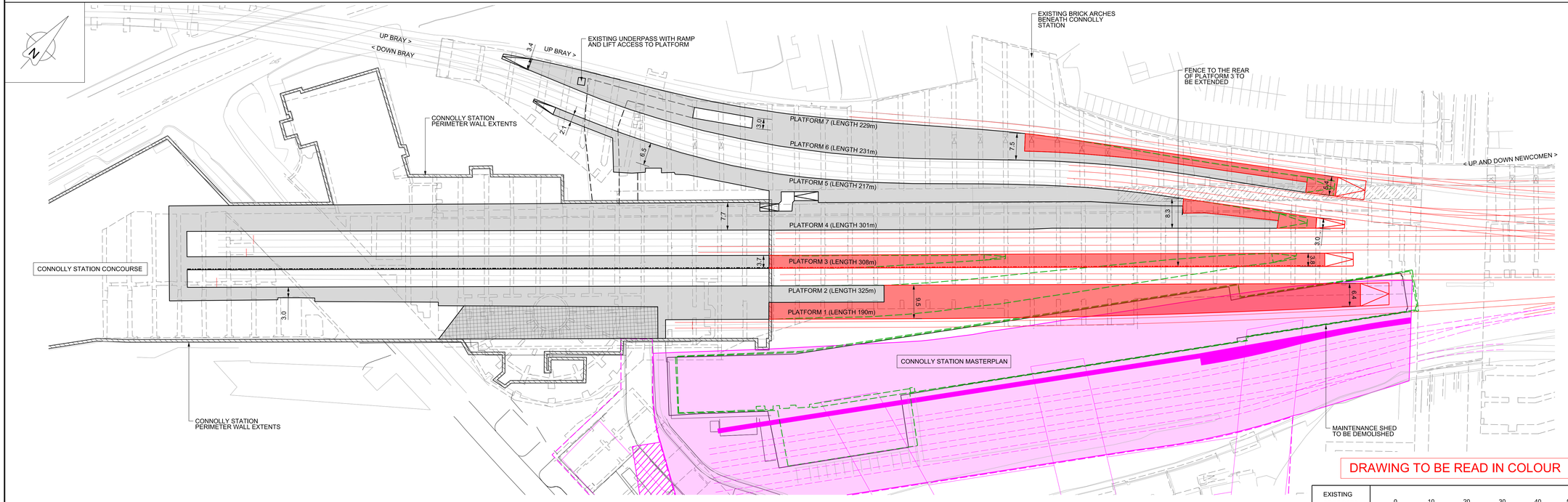

PROPOSED PLATFORM LAYOUT
SCALE 1:500

DRAWING TO BE READ IN COLOUR

EXISTING
PROPOSED
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REMOVED

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SCALE 1 : 500

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- EXISTING ROAD INSIDE STATION
- STATION PERIMETER WALL EXTENTS
- EXISTING JACK ARCH BRIDGE DECK
- EXISTING TO BE REMOVED
- PROPOSED ALIGNMENT
- PROPOSED PLATFORM ALTERATIONS

CONNOLLY STATION MASTERPLAN:

- IRISH RAIL SIDING DESIGN
- SITE A EXTENTS
- BUFFER OVER-RUN RESTRICTED DEVELOPMENT ZONE
- RAIL LEVEL DEVELOPMENT EXCLUSION ZONE
- PERMITTED GROUND LEVEL DEVELOPMENT ZONE

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P01	01/03/19	FOR DISCUSSION	DWW	DAS	AB

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Project
CONNOLLY STATION ENHANCEMENT OPTIONS STUDY

Drawing Title
CONNOLLY STATION REMODELLING
PLATFORM LAYOUT
OPTION 3

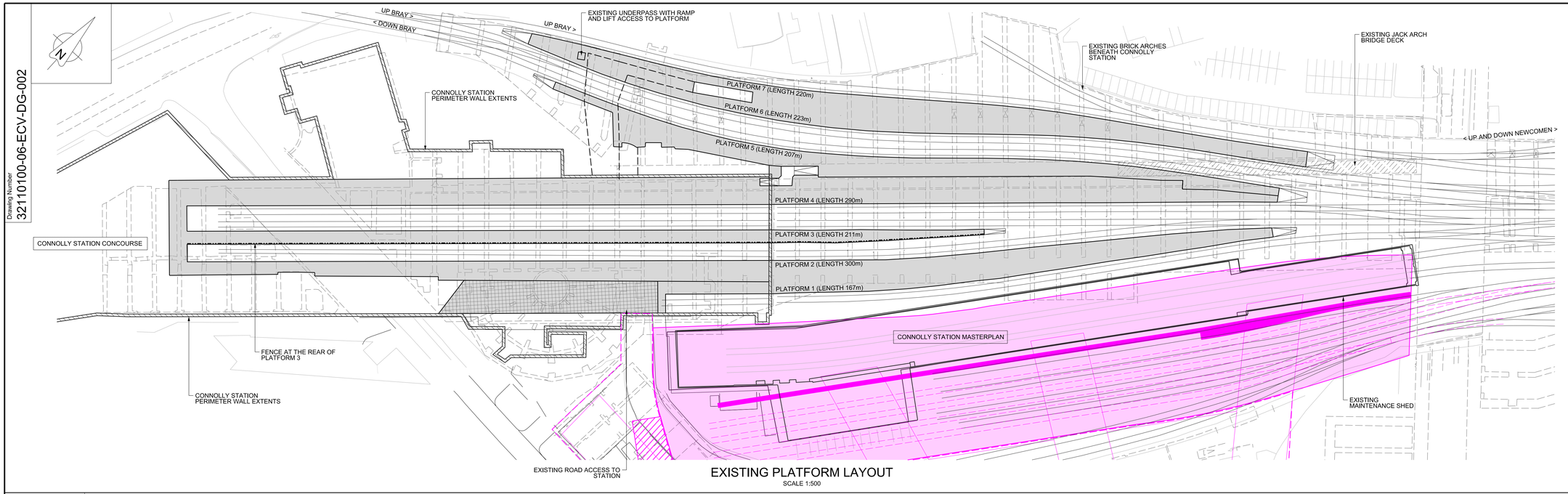
Designed	D.SINCLAIR	Signed	Date 01/03/19
Drawn	D.WELSH	Signed	Date 01/03/19
Checked	D.SINCLAIR	Signed	Date 01/03/19
Approved	A.BRADLEY	Signed	Date 01/03/19
Scale(s)	1:500	ELR & Mileage	

Alternative Reference
Sheet 01 of 01

Drawing Number
32110100-3-ECV-DG-001
Revision P01

Sheet Size A1+1 594 x 1051

Drawing Number
32110100-06-ECV-DG-002



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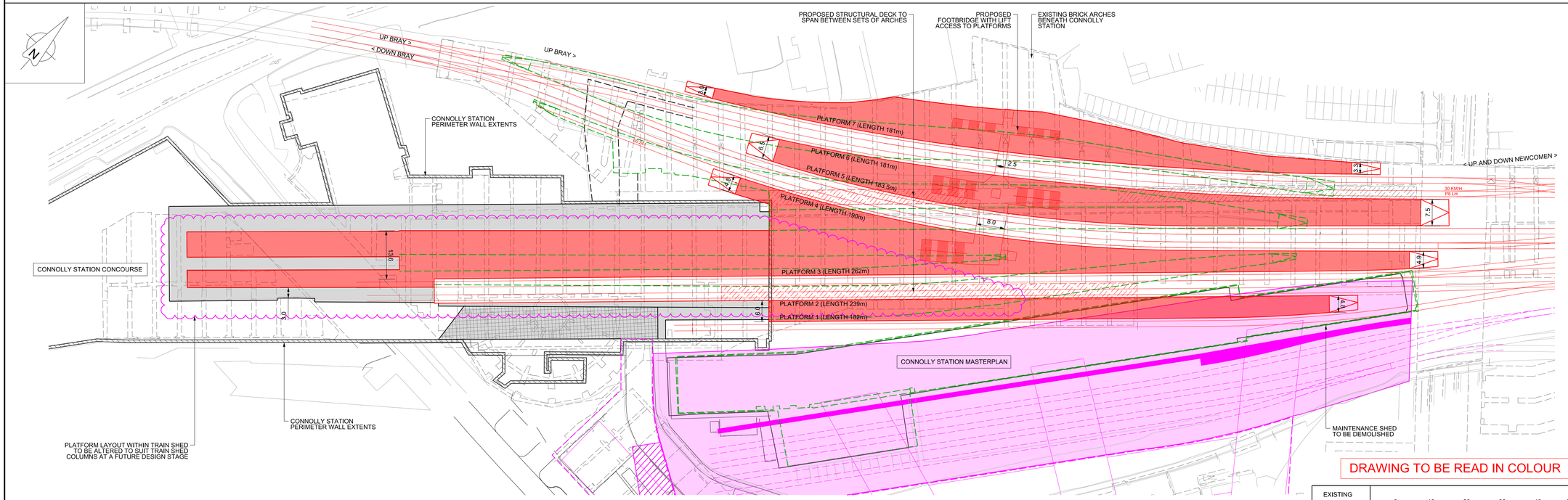

PROPOSED PLATFORM LAYOUT
SCALE 1:500

DRAWING TO BE READ IN COLOUR

EXISTING
PROPOSED
MODIFIED
REMOVED

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SCALE 1 : 500

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- EXISTING ROAD INSIDE STATION
- STATION PERIMETER WALL EXTENTS
- EXISTING JACK ARCH BRIDGE DECK
- EXISTING TO BE REMOVED
- PROPOSED ALIGNMENT
- PROPOSED PLATFORM ALTERATIONS
- PROPOSED BRIDGE DECK

CONNOLLY STATION MASTERPLAN:

- IRISH RAIL SIDING DESIGN
- SITE A EXTENTS
- BUFFER OVER-RUN RESTRICTED DEVELOPMENT ZONE
- RAIL LEVEL DEVELOPMENT EXCLUSION ZONE
- PERMITTED GROUND LEVEL DEVELOPMENT ZONE

Rev	Date	Description of Revisions	Drawn	Chkd	Appr
P01	01/03/19	FOR DISCUSSION	DWW	DAS	AB

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Project
CONNOLLY STATION ENHANCEMENT OPTIONS STUDY

Drawing Title
CONNOLLY STATION REMODELLING PLATFORM LAYOUT OPTION 6

Designed	D.SINCLAR	Signed	Date 01/03/19
Drawn	D.WELSH	Signed	Date 01/03/19
Checked	D.SINCLAIR	Signed	Date 01/03/19
Approved	A.BRADLEY	Signed	Date 01/03/19
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Alternative Reference
Sheet 01 of 01

Drawing Number
32110100-6-ECV-DG-002
Revision P01

Sheet Size A1+1 594 x 1051

Drawing Number
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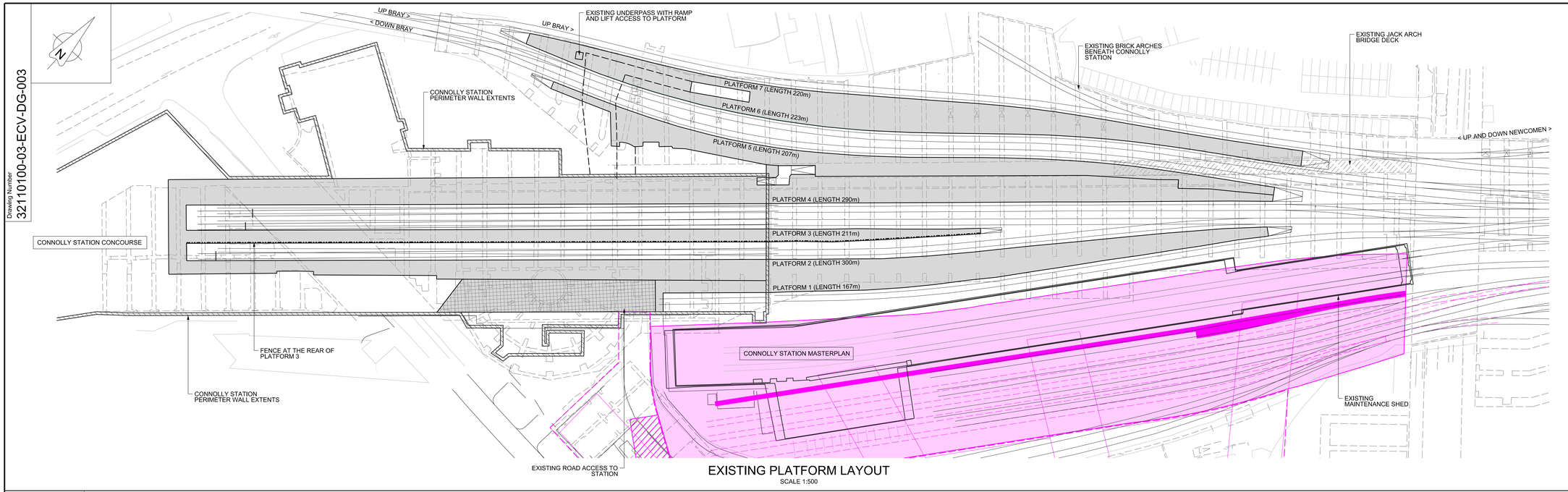

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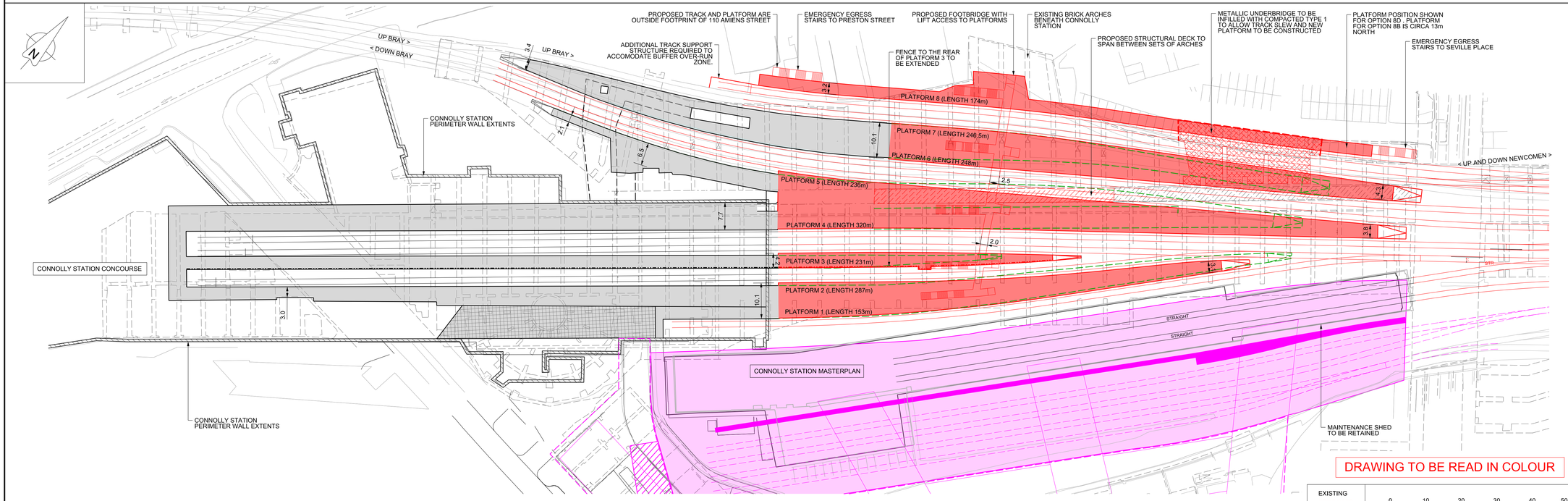

PROPOSED PLATFORM LAYOUT
SCALE 1:500

DRAWING TO BE READ IN COLOUR

EXISTING
PROPOSED
MODIFIED
REMOVED

0 10 20 30 40 50 m
SCALE 1 : 500

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- EXISTING ROAD INSIDE STATION
- STATION PERIMETER WALL EXTENTS
- EXISTING JACK ARCH BRIDGE DECK
- EXISTING TO BE REMOVED
- PROPOSED ALIGNMENT
- PROPOSED RETAINING WALL
- PROPOSED PLATFORM ALTERATIONS
- PROPOSED BRIDGE DECK
- PROPOSED BRIDGE INFILL

CONNOLLY STATION MASTERPLAN:

- IRISH RAIL SIDING DESIGN
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- RAIL LEVEL DEVELOPMENT EXCLUSION ZONE
- PERMITTED GROUND LEVEL DEVELOPMENT ZONE

Rev	Date	Description of Revisions	Drawn	Chkd	Appr
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Project
CONNOLLY STATION ENHANCEMENT OPTIONS STUDY

Drawing Title
CONNOLLY STATION REMODELLING
PLATFORM LAYOUT
OPTION 8

Designed	D.SINCLAIR	Signed	Date 01/03/19
Drawn	D.WELSH	Signed	Date 01/03/19
Checked	D.SINCLAIR	Signed	Date 01/03/19
Approved	A.BRADLEY	Signed	Date 01/03/19
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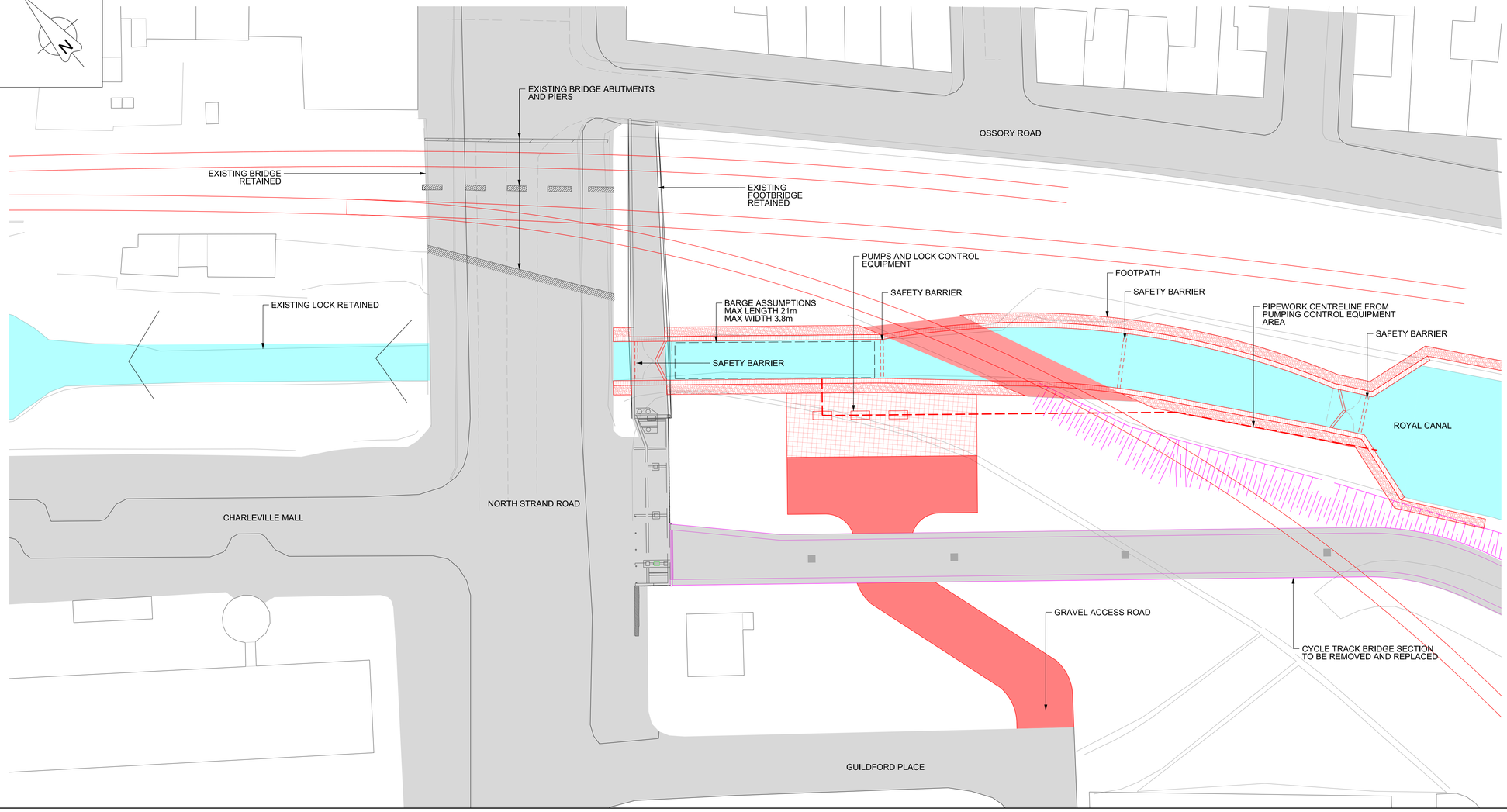
Alternative Reference		Sheet	01 of 01
Drawing Number	32110100-8-ECV-DG-003	Revision	P01

Sheet Size A1+1 594 x 1051

Drawing Number



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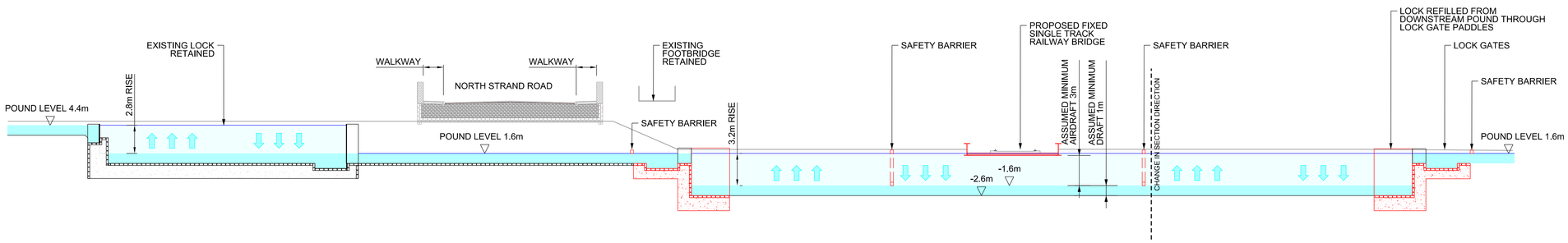

PROPOSED SECTION THROUGH LOCKS

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Project: CONNOLLY STATION ENHANCEMENT OPTIONS STUDY

Drawing Title: NEWCOMON JUNCTION DROP LOCK SINGLE TRACK OPTION

Designed	D SINCLAIR	Signed	Date 01/03/19
Drawn	G MACINTOSH	Signed	Date 01/03/19
Checked	D SINCLAIR	Signed	Date 01/03/19
Approved	A BRADLEY	Signed	Date 01/03/19
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Alternative Reference		Sheet	of
Drawing Number	32110100-3-ECV-DG-004	Revision	P01

Sheet Size A1+1 594 x 1051

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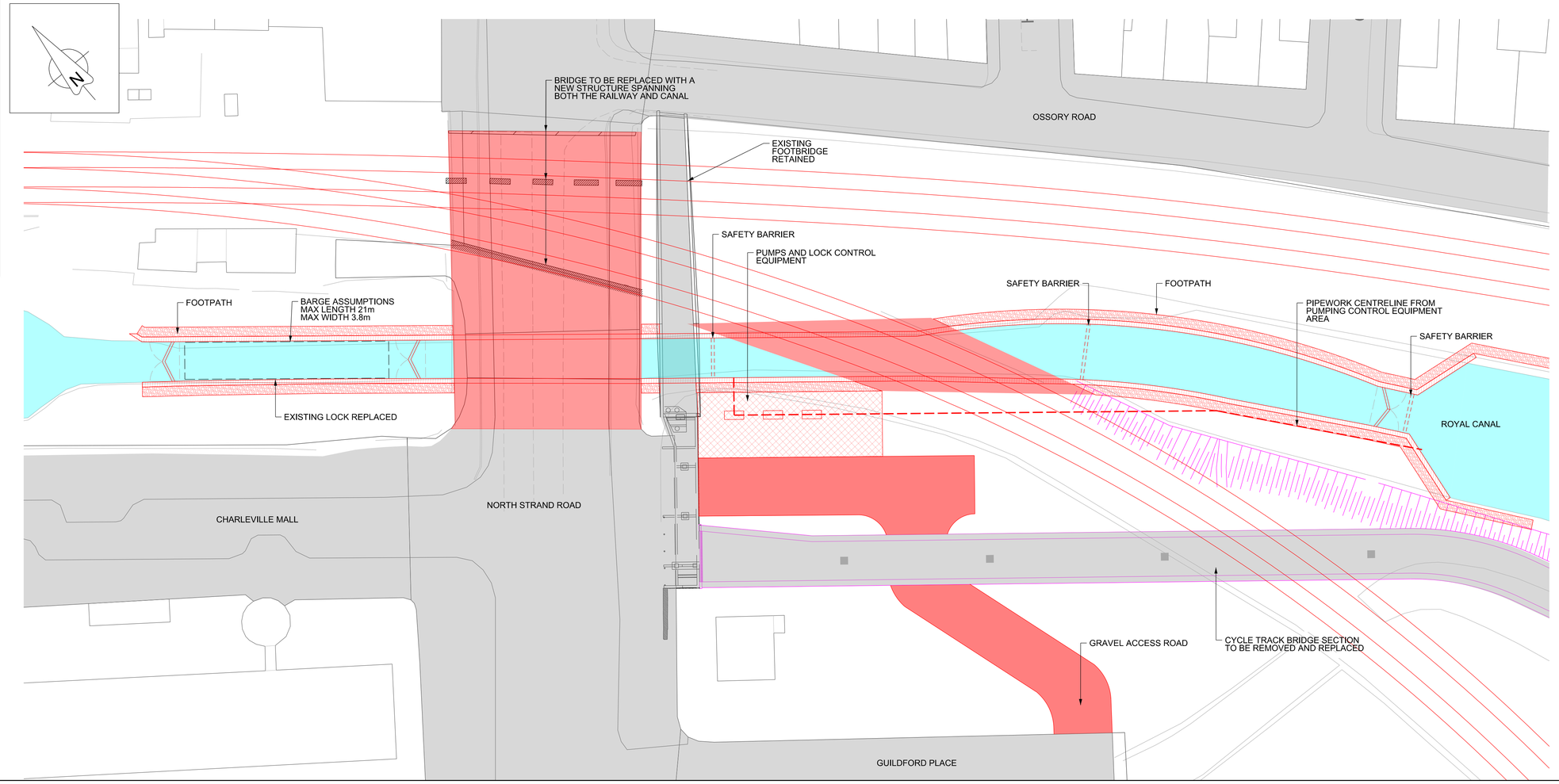

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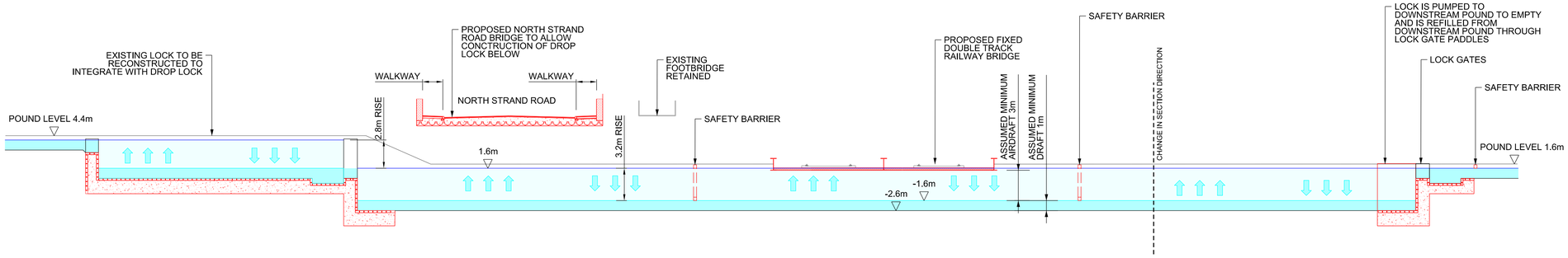

PROPOSED SECTION THROUGH LOCKS

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Project: CONNOLLY STATION ENHANCEMENT OPTIONS STUDY

Drawing Title: NEWCOMON JUNCTION DROP LOCK DOUBLE TRACK OPTION

Designed	D SINCLAIR	Signed	Date 01/03/19
Drawn	G MACINTOSH	Signed	Date 01/03/19
Checked	D SINCLAIR	Signed	Date 01/03/19
Approved	A BRADLEY	Signed	Date 01/03/19
Scale(s)	1:250	ELR & Mileage	
Alternative Reference		Sheet	of
Drawing Number	32110100-3-ECV-DG-005	Revision	P01

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Appendix C. Passenger Demand Assessment Report

Connolly Station Enhancement Options Study

National Transport Authority

Passenger Demand Assessment

32110100-GEN-RP-002|0 | 1

27 February 2019

TBC

Connolly Station Enhancement Options Study

Project No:	32110100
Document Title:	Passenger Demand Assessment
Document No.:	32110100-GEN-RP-002|0
Revision:	1
Date:	27 February 2019
Client Name:	National Transport Authority
Client No:	TBC
Project Manager:	Project Manager
Author:	Geoff Smith
File Name:	C:\Users\gsmith01\Documents\Connolly Station Study\Connolly Station Dublin Passenger Capacity Assessment revised 27feb19.docx

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Document history and status

Revision	Date	Description	By	Review	Approved
0	19 Feb 2019	Draft Passenger Demand Assessment	G Smith		
1	27 Feb 2019	Passenger Demand Assessment Revised	G Smith		

Contents

Executive Summary

This passenger capacity assessment of the main options for improving capacity at Connolly Station have employed a desktop assessment based on observed rail flows (annual one day census) and broadly factored to service group operational assumptions for each option. The calculations use standard rail industry approaches to assessing platform width requirements, stairs width and passageway width requirements.

The existing station layout is unlikely to cope with long term (foreseeable) peak passenger flows with growth derived from the NTA Dublin Regional Model for 2040. Platform congestion and ramp access congestion is forecast. The Option 3 design lengthens and widens the platform which will provide more capacity for the with management of passengers to utilise the whole length to reduce delays. However, there is limited ability to widen the ramp to the underpass so passive provision for a second access to be provided in the long term should be considered. For example; a footbridge between platform 5 and platform 6/7 further north than the current access.

The option 6 design removes the current underpass access to the island platform for through services. This results in the need for a very large new footbridge / transfer deck. That may be difficult to position with sufficient access around each side to the lift for wheelchair passengers. Platform 5/6 is also expected to be heavily used which brings a risk of congestion at the bottom of the footbridge impeding access and egress. Assuming that Platform 7 will not be used as the main through service platform standard bridge and stairway can be provided and the platform narrowed to standard to enable Platform 5/6 to be widened.

Option 8 design retains the existing underpass access to the island platform reducing the scale of footbridge / transfer deck required, if it is extended to platform 5. The designed platform widths and lengths match the forecast 2040 flows and overall this solution provides the best option for the passenger capacity requirements.

Given the potential congestion problems forecast and reliance on an assumption regarding option 8, it is strongly recommended that at the next stage of development pedestrian simulation modelling (eg Legion) is undertaken to check the designs taking account of passenger behaviour.

1. Introduction

This passenger demand assessment was undertaken to assess the pedestrian capacity implications of the options for improving train capacity at Connolly Station in Dublin.

1.1 Study Methodology

Station capacity planning guidelines in Ireland[1] provide for the safety of passengers and staff in line with the Railway Safety Act 2005. The general guidance specifies planning for the free movement of passengers in passageways and stairs, etc, for the foreseeable peak passenger use. Stairways, steps and ramps should have adequate width to avoid overcrowding and provide for access by people with disabilities. Platform widths should be adequate for the greatest number of passengers as any time. Some specific minimum standards are provided:

- Stairs at least 1.2m wide between handrails and not more than 2.4m between handrails.
- Ramps at least 2m wide.
- Lift run-off at least 2m.
- Stairs run-off to platform edge 5m, or barrier required.
- Single face platform not less than 2.5m wide.
- High speed platform not less than 3.0m wide.
- Island platform not less than 4.0m wide.
- High speed island platform not less than 6.0m wide.

However, in the absence of detailed guidance on the methodology for assessing free movement of passengers we have adopted the approach based on Fruin Levels which are the basis of assessment using detailed pedestrian simulation models used across the world. At this stage a desktop assessment of the three options - Option 3, Option 6 and Option 8 was undertaken. The sub-options relate to track capacity and train performance rather than passenger capacity.

1.2 Existing Passenger Demand and Trends

The National Transport Authority (NTA) publishes annual rail census information and has provided a detailed spreadsheet of Connolly station boarding and alighting data for 2017 for use in this study. Connolly Station is the busiest station in Ireland with 18,062 boardings and 18,927 alightings on the Census day in 2017. Flows at Connolly are 19% higher than the second ranked station (Pearse) and 66% higher than Heuston serving traffic from the west and southwest.

Figure 1.1 shows that Connolly Station flows declined between 2012 and 2014, during the recession, and demand has grown strongly since 2014 in line with the growth in the economy – shown in Figure 1.2.

There has been a 48% increase in passenger demand at Connolly between 2014 and 2017 aided by the introduction of services to Heuston in 2017 leading to a 19% increase in that year. Without Heuston flows the growth was 16% in 2017.

[1] CRR Guidelines – RSC-G-001-B, 2008 and CCE Departmental and Multi-disciplinary Standards I-DEP-0121

Figure 1.1: Connolly Station Flows 2012 – 2017 (Census Day). Source: NTA National Heavy Rail Census Report 2017.

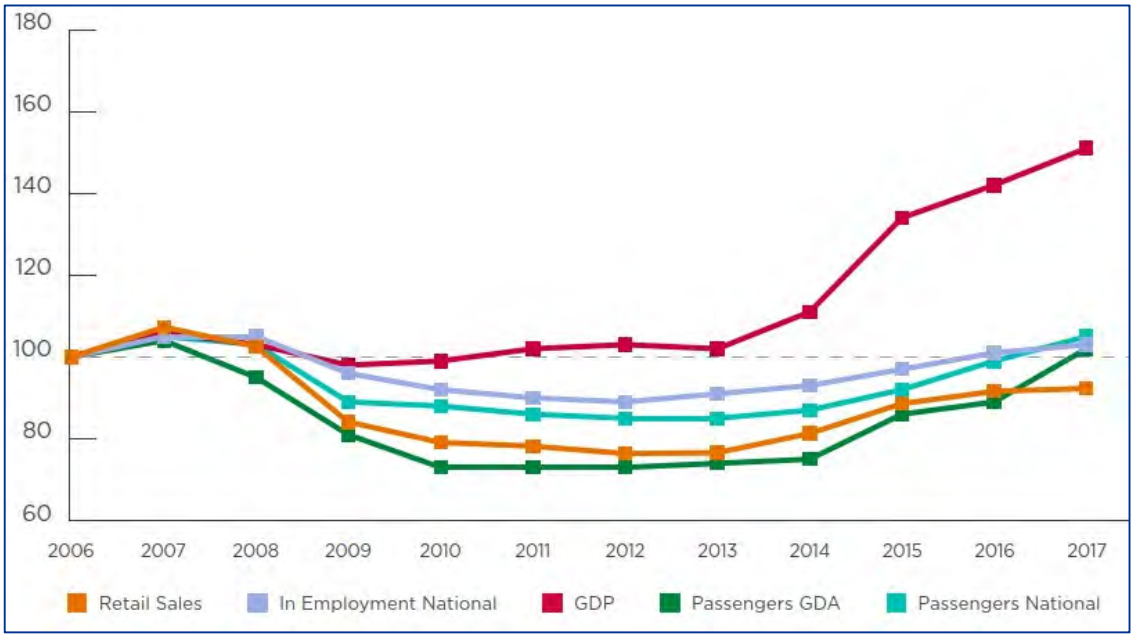

Figure 1.2: Rail Journeys in the GDA and Key Economic Indicators Indexed to 2006. Source, NTA Rail Census 2017

1.3 Future Passenger Demand at Connolly

To assess the "foreseeable peak passenger use" of the station, data for Connolly Station flows was extracted from the NTA Dublin Regional Transport Model which produced outputs from the 2012 base and the 2040 PLUTO tests. Figure 1.3 shows the AM and PM peak forecasts which produce a growth of 95% and 84% for the AM and PM peaks respectively. These forecasts represent annual compound growth factors of 2.4% AM peak and 2.2% PM peak. Whilst the growth forecasts appear low compared to recent trends the model contains committed schemes which may alter travel patterns in the city so are taken as the best evidence.

Passenger growth from 2017 to 2040 is estimated as 73% AM peak and 65% PM peak.

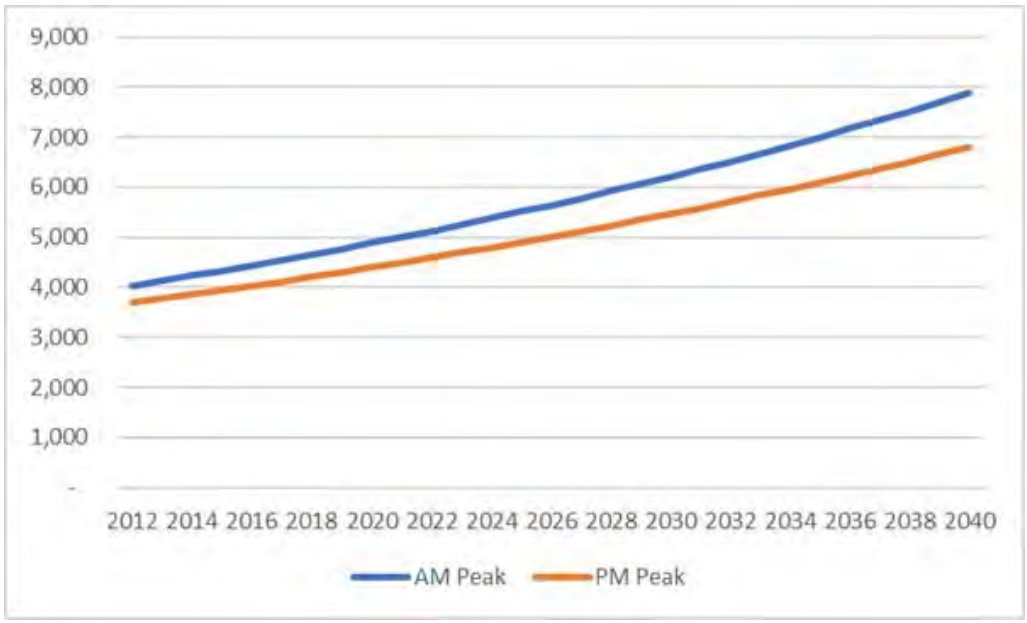

Figure 1.3: Forecast Connolly Station Flows 2012 – 2040 Source: NTA Regional Traffic (PLUTO) Model

The detailed spreadsheet of 2017 flows were used to estimate the peak hour flow (17% of all day flows) and that the highest peak hour flow is between 0800 and 0900.

2. Assessment of Options

2.1 Forecast Platform and Access Flows

The flows for each service group were allocated to each platform according to the assumptions in the operational effectiveness section of the detailed appraisal of options in the Connolly Station Enhancement Options Study, Option Appraisal report (sections 6.2.1, 6.2.5 and 6.2.11).

Option 3 retains the existing platform and access layout at the station. The platform flows were estimated from the normal service pattern and is summarised in Table 2.1. The assessment concentrates on the highest flows which relate to the through platforms and DART services. The underpass flow is also shown.

Platform	Daily Journeys 2017	Peak Hour Journeys 2017	Peak Hour Journeys 2040
Platform 6/7	15,441	2,625	4,541
Underpass flow		2,625	4,541
Platform 4/5	15,862	2,696	4,665
Platforms 1 to 3	5,686	967	1,672
Total	36,989		

Table 2 1: Option 3 Future Platform Flows and Underpass Flow

Option 6 provides a new platform (Platform 7) with an additional platform capable of through movements. Table 2.2 shows the forecast platform and connector flows. This option replaces the underpass with a new footbridge / transfer deck facility with two sections - connecting Platform 5/6 and Platform 7. This assumes that everyone using Platform 7 would transfer over the full bridge, rather than transferring to through services in platform 5/6.

Platform	Daily Journeys 2017	Peak Hour Journeys 2017	Peak Hour Journeys 2040
Platform 7	1,940	330	570
Footbridge Flow		330	570
Platform 5/6	13,502	2,295	3,971
Footbridge Flow		2,625	4,541
Platform 1 to 4	15,862	2,696	4,665
Total	36,989		

Table 2 2: Option 6 Future Platform Flows and Footbridge Flows

Option 8 retains Platforms 1 to 7 and provides a new north facing turnback platform (Platform 8). Table 2.3 shows the forecast flows including platform connections. A footbridge will connect to Platform 8 and also to Platforms 5 and 6/7. The design also retains the existing underpass between the concourse and Platform 6/7. It has been assumed that two thirds of Platform 6/7 users would use the underpass as it is closer to the main entrance.

Platform	Daily Journeys 2017	Peak Hour Journeys 2017	Peak Hour Journeys 2040
Platform 8	1,376	234	405
Footbridge Flow		234	405
Platform 6/7	14,065	2,391	4,137
Underpass Flow		1,578	2,730
Footbridge Flow		1,023	1,770
Platform 5	15,862	2,696	4,665
Platform 1 to 4	5,686	967	1,672
Total	36,989		

Table 2 3: Option 8 Future Platform Flows and Footbridge Flows

2.2 Capacity Assessment Option 3

The dimensions of the existing station were measured from the topographical survey CAD file;

- Platform 6/7 width at the end of the run off of the ramp access = 9.5m.
- Platform 6/7 Length = 230m.
- Platform 5 width at the middle of the platform = 13m.
- Platform 5 length = 217m.
- Ramp width = 2.4m.
- Ramp length = 34m
- Stairs width = 2 * 1.6m
- Escalator width = 1.2m

The stairs have 2*10 steps with midpoint landing.

There are three doorways between the concourse and access to the stairs each 1.6m wide.

The passenger capacity assessment (see calculation approach in Appendix A) concentrates on the stairs and platform dimensions using the 2040 design year flows and is summarised in Table 2.4. The measurements take account of the Option 3 design with platform extensions but shows that the platforms are forecast to be crowded, especially Platform 6/7. As the platform is narrower than required more of the platform length is likely to be used at this density, which could lead to congestion at the top of the ramp.

Element	Size Requirement	Size in Design
Platform 6/7	10.3m wide	9.5m
Platform 5	11.2m wide	13m (inc Platform 4)
Underpass / Ramp	3.6m wide	2.4m
Stairs	4.2m wide (2-way)	3.2m + escalator

Table 2 4: Option 3 Passenger Capacity Assessment

The ramp width leading to the underpass is currently 2.4m wide and unlikely to cope with peak flows in 2040. This is likely to lead to passenger congestion on the platform. The underpass itself is wider than the ramp as shown in Figure 2.1.

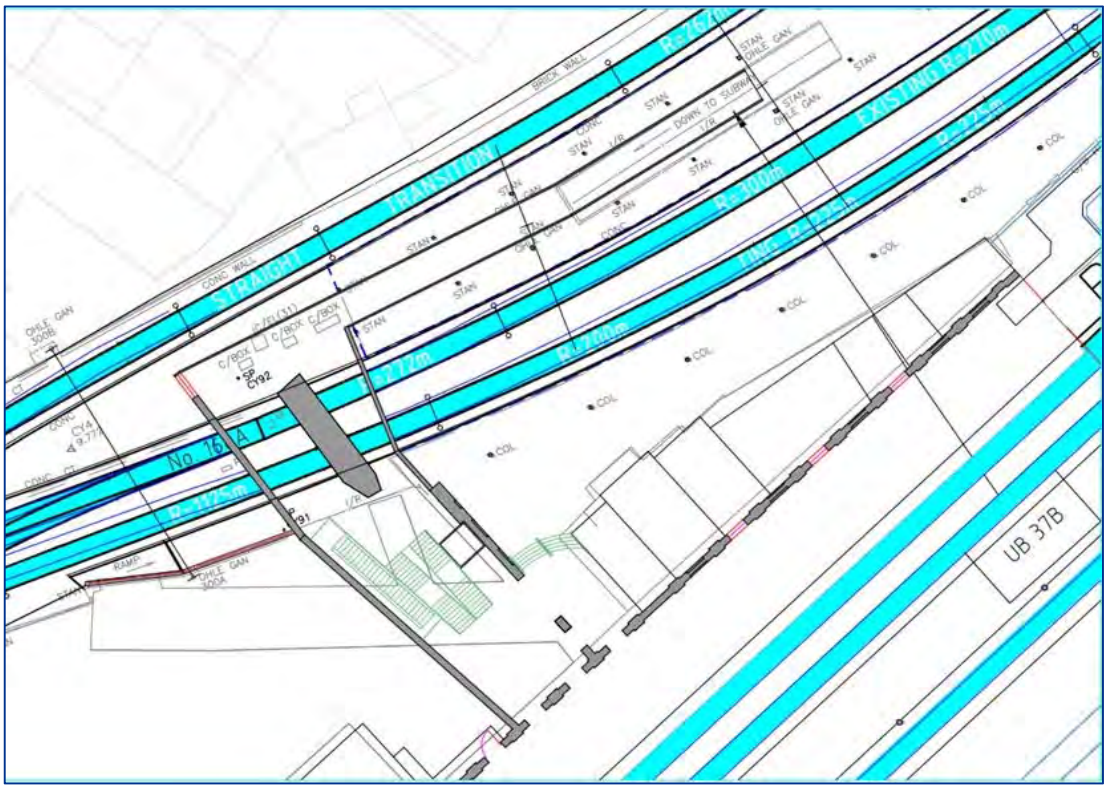

Figure 2.1: Current Access between Concourse and Platform 6/7.

The stairs requirement of 1 metre wider than the current staircase (2-way width) explains why an escalator has been provided to cope with peak direction flows. The escalator is likely to have a capacity of 100 passengers per minute which would cope with 85% of the forecast flows if all in one direction. Overall there is sufficient capacity in the underpass access stairs / escalator for the future year flows.

2.2.1 Conclusion

The existing station layout is unlikely to cope with long term (foreseeable) peak passenger flows with platform congestion and ramp access congestion forecast. The Option 3 design lengthens the platform which will provide more capacity enabling management of passengers to utilise the whole length. However, there is limited ability to widen the ramp to the underpass so passive provision for a second access to be provided in the long term should be considered. For example; a footbridge between platform 5 and platform 6/7 further north than the current access.

2.3 Capacity Assessment Option 6

Key dimensions taken from the engineering drawings are;

- Platform 5/6 width = 10.5m
- Platform 5/6 length = 182m
- Platform 7 width = 11.5m
- Platform 7 Length = 180m.

The passenger capacity assessment is shown in Table 2.5. Platform 7 is expected to have less trains per hour than the other through-platforms so the design shows plenty of capacity and could be reduced (assuming that it will not become the main through platform in future). Platform 5/6 is forecast to be heavily used and in 2040 will require a slightly wider platform than shown in the design. This assessment assumes 50% of the flow within 30% of the platform so it is likely that a longer length of the platform would have this level of density at the peak and, depending on the location of the stairs to the footbridge, could cause congestion for people accessing the platform which may need management.

The stairs to Platform 7 and the bridge to that platform can be standard width but the stairs to platforms 4 and 5/6 need to be much wider than standard and the bridge between also wider than standard. This will need careful design to ensure that there is sufficient width either side of the stairs to reach the lift without wheelchair passengers being too close to the platform edge.

Element	Size Requirement	Size in Design
Platform 7 width	1.6m	11.5m
Platform 5/6 width	11.3m	10.5m
Stairs width Platform 7	0.5m	Standard 1.2m
Stairs width Platform 5/6	3.7m	Suggest 4.0m with central handrail
Stairs width Platform 4	4.2m	Suggest 4.2 with central handrail
Bridge width Platform 7 to Platform 5/6	1.0m	Standard 1.2m
Bridge width Platform 5/6 to Platform 4	3.6m	Recommended 3.6m

Table 2 5: Option 6 Passenger Capacity Assessment

An alternate access arrangement with a new underpass and escalators to platforms 3 / 4, 5 / 6 and 7 has been proposed for this option. Table 2.6 shows the results highlighting that the escalators and underpass will provide for the 2040 flows. This assessment does not take account of the additional underpass and stairs to platforms 5 / 6 and 7, but the escalators to those platforms are forecast to cope with the flows. The heaviest used escalator will be to / from Platform 4 which has to handle the combined flows from the through platforms. It would be advisable to widen that access to provide a 2.0m staircase between the escalators for contingency planning and longer-term capacity.

Element	Size Requirement	Size in Design
Platform 7 width	1.6m	11.5m
Platform 5/6 width	11.3m	10.5m
Escalators Platform 7 up/ down	0.12 / 0.03	1 / 1
Escalators Platform 5/6 up/down	0.78 / 0.26	1 / 1
Underpass Width	1.1m	3m
Escalators Platform 4 up/down	0.28 / 0.90	1 / 1

Table 2 6: Option 6 Passenger Capacity Assessment – assuming new Underpass and Escalators

2.3.1 Conclusions

The option 6 design removes the current underpass access to the island platform for through services. This results in the need for a very large new footbridge / transfer deck. That may be difficult to position with sufficient access around each side to the lift for wheelchair passengers. Platform 5/6 is also expected to be heavily used which brings a risk of congestion at the bottom of the footbridge impeding access and egress. Assuming that Platform 7 will not be used as the main through service platform standard bridge and stairway can be provided and the platform narrowed to standard to enable Platform 5/6 to be widened. However, for operational flexibility it would be advisable to provide a higher capacity access to Platform 7.

An alternative design with a new underpass and escalators to platforms 4, 5 / 6 and 7 will provided sufficient capacity, if it can be achieved.

2.4 Capacity Assessment Option 8

Key dimensions taken from the engineering drawings are;

- Platform 4/5 width = 13m +
- Platform 5 length = 220m
- Platform 6/7 width = 10m
- Platform 6/7 length = 220m
- Platform 8 width = 3m
- Platform 8 Length = 174m

The passenger capacity assessment results are shown in Table 2.7. Platform 8 is expected to have less trains per hour than others and the space required is within the standard design. Platform 6/7 and Platform 5 will have substantial flows but the platform width requirements are within the design (in the case of Platform 5 assuming light use of Platform 4 at the northern end).

The relatively low use of Platform 8 means that a standard width footbridge and stairway will provide sufficient capacity. The provision of that footbridge also from Platform 6/7 to Platform 5 will provide a second means of access between the busy platforms and reduce use of the underpass to within capacity (assuming one third of passengers use the new footbridge). In addition, the footbridge and stairways width requirements are much lower than for option 6 and more realistic to provide within the width of the platforms.

Element	Size Requirement	Size in Design
Platform 8 width	1.2m	3m
Platform 6/7 width	9.8m	10m
Platform 5 width	10.1m	10.5m
Platform 8 footbridge stairs width	0.4m	Standard 1.2m
Platform 6/7 ramp width	2.4m	2.4m
Platform 6/7 underpass stairs width	2.5m	3.2m
Platform 6/7 footbridge stairs width	1.3m	Recommended standard 2.0m
Platform 5 footbridge stairs width	1.6m	Recommended standard 2.0m
Bridge Platform 8 to Platform 6/7 width	0.9m	Recommended standard 2.0m
Bridge Platform 6/7 to Platform 5 width	1.8m	Recommended standard 2.0m

Table 2 7: Option 8 Passenger Capacity Assessment

2.4.1 Conclusion

Option 8 design retains the existing underpass access to the island platform reducing the scale of footbridge / transfer deck required, if it is extended to platform 5. The designed platform widths and lengths match the forecast 2040 flows and overall this solution provides the best option for the passenger capacity requirements.

3. Conclusions and Recommendations

This capacity assessment has indicated potential congestion problems with option 3 – requiring a second access in the longer-term.

Option 6 removes the existing underpass and the footbridge requirements would be difficult to achieve within the platform widths whilst maintaining standards for passenger movement. An alternative option providing a new underpass and escalators to the through platforms will provide sufficient capacity if it is practical.

Option 8 retains the existing underpass and provided a second access to the main platforms and passenger flows fit with the capacity provided based on an assumption regarding the number of people who would choose the main and second accesses.

It is therefore recommended that any options taken forward are subjected to pedestrian simulation modelling (eg Legion) to ensure that passenger behaviour is taken into account in the detailed design.

Appendix A. Capacity Assessment Methodologies.

Platform Width

Capacity assessment using a space standard (i.e Fruin Level of Service C), of 0.8sqm per person applied to the busiest 30% of platform with 50% of boarding and alighting demand in the peak 15 minutes for the peak.

Stairs Width

Source: London Underground Station Planning Standards and Guidelines - Good Practice Guide (G-371A)

Observed flow and additional / reduced flow. Peak 15 mins flow converted to average minute and divided by 28 for the stairway width required.

Passageways

Source: London Underground Limited, Standard 2-03001-024, Station Planning.

Two-way passageway width = (Average peak minute flow / 40) + (2*0.3) m

Appendix D. Preferred Option Selection - Indicative Costs

CONNOLLY STATION INFRASTRUCTURE UPGRADE

Preferred Option Selection - Indicative Costs

Document No. | v1

1st March 2019

CONNOLLY STATION INFRASTRUCTURE UPGRADE

Project no:	Project Number
Document title:	Preferred Option Selection - Indicative Costs
Document No.:	Document No.
Revision:	v1
Date:	1st March 2019
Client name:	
Client no:	Client Reference
Project manager:	Alex Bradley
Author:	Alastair Mackenzie
File name:	X:\Buildings\PMCM\1 PROJECTS\Connelly Station\02 Detailed Options Stage\Sifting Workshop Report v01.docx

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Document history and status

Revision	Date	Description	By
01	1st March 2019	First version issued	

Contents

Executive Summary

Indicative costs were prepared for five options in relation to the adaptation of Connolly station and the associated rail infrastructure out to Newcomen Junction. These options were identified as potentially meeting the Client's requirements to achieve 30 trains per hour through Connolly station.

The indicative costs were prepared from outline design information provided by the design team, augmented where necessary by assumptions as to differentiator costs between the options. A detailed cost estimate will be developed for the preferred option.

This report is intended to provide details of the indicative costs used at the workshop to identify the preferred option.

A summary of the Costs associated with each option, subject to the contents of the CDAL (Cost Data Assumptions List) and Exclusions listed elsewhere in this report, are as follows:-

Connolly Station Detailed Options - Cost Summary (£ / € M's)		
	Cost GBP	***Cost***
Option 3	**£116.86**	**€134.39**
Option 6b	**£171.79**	**€197.56**
Option 6d	**£158.80**	**€186.62**
Option 8b	**£172.10**	**€197.91**
Option 8d	**£159.43**	**€183.34**

1. Introduction

Cost Estimates for five options were prepared based on outline design information provided by the Design Team. Each of the five options were considered independently to arrive at a total estimated construction cost.

The cost estimates prepared are intended only to provide a comparison of the likely costs associated with each option. Due to the limited amount of design information available, the total costs stated are indicative of the likely total cost only.

Where little or no information was available, reasonable allowances have been included as to the likely cost of some of the major cost components, based on the estimator's judgement.

For development of the cost estimate for the preferred option, additional design information will require to be developed.

2. Information Used

The Cost Estimate has been prepared using the following Information:-

Pway Drawings

Drawing Reference	OPTION 3 32110100-03-ETR-DG-001
	OPTION 6B -32110100-06-ETR-DG-002
	OPTION 6D 32110100-06-ETR-DG-003
	OPTION 8 B 32110100-08-ETR-DG-008
	OPTION 8 D 32110100-08-ETR-DG-009

Engineering Drawings

Drawing Reference	DROP LOCK SINGLE TRACK 2110100-3-ECV-DG-004-P01
	DROP LOCK DOUBLE TRACK 2110100-3-ECV-DG-005-P01
	PLATFORM LAYOUT OPTION 3 32110100-3-ECV-DG-001
	PLATFORM LAYOUT OPTION 6 32110100-6-ECV-DG-002
	PLATFORM LAYOUT OPTION 8 32110100-8-ECV-DG-003

Overhead Line Electrification Drawings

Drawing Reference	OLE LAYOUT OPTION 3 32110100-03-EOH-DG-001 P01
	OLE LAYOUT OPTION 6B 32110100-06B-EOH-DG-001 P01
	OLE LAYOUT OPTION 6D 32110100-06D-EOH-DG-001 P01
	OLE LAYOUT OPTION 8B 32110100-08B-EOH-DG-001 P01
	OLE LAYOUT OPTION 8D 32110100-08D-EOH-M2-001 P01

Signalling

A commentary on the likely parameters for the future design of signalling to be installed has been provided. It has not been possible to quantify and cost the likely future installation from this information. An allowance has been included in the cost plan estimates for each of the options based on the likely requirements determined from the line diagrams and using estimator's judgement.

Telecommunications

A commentary on the likely parameters for the future design of telecoms to be installed has been provided. It has not been possible to quantify and cost the likely future installation from this information. Again, allowance have been included in the cost plan estimates for each of the options based on the likely requirements determined from previous experience and using estimator's judgement.

Programme

No detailed programme information was available at this stage of the programme. Preliminaries costs have been based on likely percentage additions for work of this nature, established from similar previous projects.

3. Cost Estimate Summary

3.1 Basis of Costs

Where possible, the major elements of construction have been quantified. These quantities have been costed at rates derived from projects of a similar nature and where these have not been available, from pricing books or using the estimator's judgement.

Where known elements have no information upon which to base calculated costs, a reasonable allowance has been included based on the estimator's judgement. Where there is a clear difference in the cost between the options, this has been reflected in the allowances included.

Due to the lack of cost information available in relation to major rail infrastructure projects in the Republic of Ireland (ROI), the estimates have been based on rates applicable within the UK. Some general market research has been carried out in relation to the cost differences between the UK and ROI and it has been determined that major cost elements are generally 10% cheaper in the ROI than in the UK at present. This topic will require to be explored further for the preparation of the detailed cost estimate.

An allowance of 30% has been applied to all cost estimates in relation to preliminaries costs. Due to the absence of an outline programme, it has not been possible to differentiate between the options for this cost element. However, discussions during design team conference calls indicated that where one programme may take longer in comparison to another, the cost of Possessions vs closing the station may effectively neutralise or minimise any major difference in cost for this element. Consequently, the same percentage has been used for all options. It is not considered likely that any fluctuation in this percentage allowance would differentiate between the options.

Overheads and Profit (O&P)have been considered and some soft market research has indicated that the current levels of O&P in ROI and the UK are broadly similar. An allowance of 10% has been included as being a reasonable allowance for this cost element based on recent projects in the UK. It is not considered likely that any fluctuation in this percentage allowance would differentiate between the options.

An allowance of 10% has been applied to all options in respect of the cost of professional fees. Dependant on the requirements for the different options, it is considered that there may be some minor fluctuation in the level of professional fees required, however it is not considered likely that any such fluctuation would be a cost differentiator between the options. This cost element will require to be developed further for the detailed cost estimate.

Land Purchase Costs have been included for Option 8. In the absence of any specific expert local knowledge, a review of recent local land and building purchases has been carried out. From this information, an allowance has been included in respect of the likely costs associated with purchasing the additional land necessary to achieve the proposed scheme. Included within these figures is an allowance for the fact that the land will require to be the subject of Compulsory Purchase Orders.

3.2 Option Costs – Main Summary

The outputs from the options cost estimates, prepared on the basis of the above information, is summarised on the following table:-

Connolly Station - MASTER SUMMARY		Option 3		Option 6b		Option 6d		Option 8b		Option 8d
		Cost		*Cost*		*Cost*		*Cost*		*Cost*
1	*Track*									
1.1	Plain Line	£4,462,000		£6,672,000		£6,260,000		£6,952,000		£6,171,000
1.2	S&C	£6,760,000		£11,253,000		£10,670,000		£12,342,000		£11,198,000
1.3	Signalling	£28,335,000		£34,635,000		£33,435,000		£33,435,000		£32,535,000
1.4	OLE	£1,278,000		£1,593,000		£1,852,000		£1,371,000		£1,213,000
1.6	Telecoms	£379,000		£618,000		£618,000		£650,000		£650,000
1.5	Power Supply	£500,000		£500,000		£500,000		£500,000		£500,000
2	*Civils*									
2.1	Demolitions	£480,000		£1,389,000		£585,000		£991,000		£741,000
2.2	Bridges	£1,000,000		£5,566,000		£1,150,000		£5,566,000		£4,450,000
2.3	Retaining Structures	£752,000		£1,682,000		£986,000		£1,682,000		£986,000
2.4	Platforms	£5,473,000		£13,434,000		£13,434,000		£10,109,000		£10,109,000
2.5	Civils ad-hocs	£6,567,000		£5,105,000		£8,316,000		£6,084,000		£6,084,000
3	*Buildings*									
3.1	Demolitions	£342,000		£367,000		£367,000		£316,000		£316,000
3.2	Station Works	£11,375,000		£13,291,000		£12,801,000		£3,113,000		£3,113,000
	Sub Total	**£67,703,000**		**£96,105,000**		**£90,974,000**		**£83,111,000**		**£78,066,000**
4	Adjustment for ROI construction c	-10.0% -£3,937,000.00		-£6,147,000.00		-£5,754,000.00		-£4,968,000.00		-£4,554,000.00
	Sub Total	**£63,766,000**		**£89,958,000**		**£85,220,000**		**£78,143,000**		**£73,512,000**
5	General Preliminaries	30.0% £19,130,000.00		£26,988,000.00		£25,566,000.00		£23,443,000.00		£22,054,000.00
6	Overheads & Profit	10.0% £6,377,000.00		£8,996,000.00		£8,522,000.00		£7,815,000.00		£7,352,000.00
	Sub Total	**£89,273,000**		**£125,942,000**		**£119,308,000**		**£109,401,000**		**£102,918,000**
7	Professional Fees	10.0% £8,928,000.00		£12,595,000.00		£11,931,000.00		£10,941,000.00		£10,292,000.00
	Sub Total	**£98,201,000**		**£138,537,000**		**£131,239,000**		**£120,342,000**		**£113,210,000**
	Contingency & Construction Risk	19% £18,659,000.00	24%	£33,249,000.00	21%	£27,561,000.00	30%	£36,103,000.00	27%	£30,567,000.00
	Land Purchase Costs	£0		£0		£0		£15,646,000.00		£15,646,000.00
	Total Construction Costs GBP	**£116,860,000**		**£171,786,000**		**£158,800,000**		**£172,091,000**		**£159,423,000**

The above information has been summarised in the following table.

As stated above, the costs have been prepared in GBP (£'s).and the current exchange rate between the Euro and GBP has been used to provide the indicative costs in the Euro equivalent values.

Connolly Station Detailed Options - Cost Summary (£ / € M's)		
	Cost GBP	***Cost***
Option 3	**£116.86**	**€134.39**
Option 6b	**£171.79**	**€197.56**
Option 6d	**£158.80**	**€186.62**
Option 8b	**£172.10**	**€197.91**
Option 8d	**£159.43**	**€183.34**

3.3 Risk

Allowances in respect of construction risks have been made for each of the options in the above costs.

A draft Risk Register was circulated to the Design Team for comment. This document identified some of the risks associated with the construction activities. Any comments received were considered and included in the Risk Register.

A risk scoring matrix was developed and each of the risks were considered and allocated a risk cost which was used to determine the differentiating risks between the options. This exercise was intended only to demonstrate the differing level of risks between the various options and does not represent the overall risks to the project to be considered as part of the detailed cost estimate. This cost element will require significant further development for the detailed cost estimate.

The risk scoring matrix used is as follows:-

Project: Connolly Station Infrastructure Adaptation- Scoring Matrix

Scoring matrix to be set according to size of the project, and agreed with Senior Construction Manager
Below is an example of scoring matrix for a project of c. £1 mill cost and 1-year timescale.

THREAT

	LIKELIHOOD of adverse impact			COST IMPACT *Increase in total project cost*		*Increase in whole project schedule*	
5. Very High	Almost Certain	91%	100%	£ 3,000k	or more	4 weeks	or more
4. High	Probable	61%	90%	£ 1,500k	£ 3,000k	3 weeks	4 weeks
3. Medium	Possible	31%	60%	£ 1,000k	£ 1,500k	2 weeks	3 weeks
2. Low	Unlikely	11%	30%	£ 800k	£ 1,000k	1 weeks	2 weeks
1. Very Low	Remote	0%	10%	£ 500k	£ 800k	1 day	1 weeks

HEAT MAP

Almost Certain	8	15	22	24	25
Probable	7	14	19	20	23
Possible	5	9	16	18	21
Unlikely	3	4	10	13	17
Remote	1	2	6	11	12
	Very Low	Low	Medium	High	Very High

The risks considered for each of the options and the risk costs attached to each are detailed on the following pages. Note that this information will require to be significantly augmented and developed for the preferred option cost estimate : -

Option 3

General Mandatory Risk Data							Current Risk Ranking							Mitigation Plan Details (Only to be populated where Risks for Red or Y	
Unique Identifier	Risk, Opportunity	Description			Risk / Opportunity Owner	Movement	Assessment (Qualitative)				Highest Initial Risk Rating	Risk Score	Responce Strategy	Action Planned To Reduce Risk Or Enhance An Opportunity	Agreed Mitigation Plan Cost
							Probability		Schedule Impact	Cost Impact			Risk / Opportunity	Scope Details	
		As a result of (Definite Cause)	,(uncertain event) may occur	Which may lead to (effect on objectives)			%age	In Words	In Words	In Words					
1	Risk	Failure to obtain permission to re-locate Maintenance Shed	Delay to commencement of the work	Cost escalation/completion delayed	NTA	No Change	50%	Possible	High	Medium	Medium	16	Accept	Early IR Involvement and discussion on re-location measures	800
2	Risk	Existing platforms in poorer condition than anticipated resulting in additional demolition and replacement	Additional time on site	Cost escalation/completion delayed	NTA	No Change	60%	Possible	High	High	Medium	18	Accept	Extensive survey work required to identify any issues with existing platforms	1000
3	Risk	Existing structure requires more strengthening than anticipated to suit new platform configuratrion	Following additional survey work, existing structure requires more strengthening than anticipated	Additional costs and additional time to design	NTA	No Change	75%	Possible	High	Very High	Medium	21	Accept	Extensive survey work required to identify any issues with existing platforms	1000
4	Risk	Innovative design for drop lock	Delay to design and construction process due to unforseen design matters	Delay and additional costs	NTA	No Change	50%	Unlikely	Medium	Medium	Medium	10	Accept	Extensive research and design work prior to procurement required	800
5	Risk	Construction of new bridge at Ossory Road	Existing canal construction being found to be unsuitable for construction of new dual track bridge	Substantial additional canal strengthening works required prior to cvonstruction of new bridge	NTA	No Change	50%	Possible	Medium	Medium	Medium	16	Accept	Early condition surveys to be carried out	1000
6							0%					-		Total	4600

Option 6b

OPTION 6b

General Mandatory Risk Data							Current Risk Ranking							Mitigation Plan Details (Only to be populated where Risks for Red or Y	
Unique Identifier	Risk, Opportunity	Description			Risk / Opportunity Owner	Movement	Assessment (Qualitative)				Highest Initial Risk Rating	Risk Score	Responce Strategy	Action Planned To Reduce Risk Or Enhance An Opportunity	Agreed Mitigation Plan Cost
							Probability		Schedule Impact	Cost Impact			Risk / Opportunity	Scope Details	
		As a result of (Definite Cause)	,(uncertain event) may occur	Which may lead to (effect on objectives)			%age	In Words	In Words	In Words					
1	Risk	Failure to obtain permission to re-locate Maintenance Shed	Delay to commencment of the work	Cost escalation/completion delayed	NTA	No Change	50%	Possible	High	Medium	Medium	16	Accept	Early consultation with highways authorities	1500
2	Risk	Existing platforms in poorer condition than anticipated resulting in additional demolition and replacement	Additional time on site	Cost escalation/completion delayed	NTA	No Change	60%	Possible	High	High	Medium	18	Accept	Early condition surveys to be carried out	3000
3	Risk	Existing structure requires more strengthening than anticipated to suit new platform configuratrion	Following additional survey work, existing structure requires more strengthening than anticipated	Additional costs and additional time to design	NTA	No Change	75%	Possible	High	Very High	Medium	21	Accept	Early ground investigation works to be carried out	3000
4	Risk	Innovative design for drop lock	Delay to design and construction process due to unforseen design matters	Delay and additional costs	NTA	No Change	50%	Unlikely	Medium	Medium	Medium	10	Accept	Early condition surveys to be carried out	800
5	Risk	Demolition and re-construction of North Strand Bridge	Failure to obtain approval to re-route traffic during construction period	Constraints on demolition and construction being partial and phased	NTA	No Change	50%	Possible	High	High	High	18	Accept	Early condition surveys to be carried out	3000
6	Risk	Construction of new bridge at Ossory Road	Existing canal construction being found to be unsuitable for construction of new dual track bridge	Substantial additional canal strengthening works required prior to cvonstruction of new bridge	NTA	No Change	50%	Possible	Medium	Medium	Medium	16	Accept	Early ground investigation works to be carried out	1500
7	Risk	Dualling of track from Newcomen - ground conditions not as expected / suitable for rail track	Existing ground conditions found to be unsuitalbe for new track layout	Additional ground stabilistation works prior to laying of new track	NTA	No Change	75%	Possible	Medium	Medium	Medium	16	Accept	Early ground investigation works to be carried out	1500
8	Risk	Additional strengthening works required to existing Bridge structures to cater for new works	Unexpected additional strengthening works required to existing structures to support new deck infills	Additional design time and construction costs	NTA	No Change	75%	Possible	High	High	High	18	Accept	Early ground investigation works to be carried out	1500
9	Risk	Suitability of existing structure to incorporate additional overbridges and lift pits	Unexpected additional strengthening works required to existing structures to support new deck infills	Additional design time and construction costs	NTA	No Change	75%	Probable	Medium	Medium	Medium	19	Accept	Early condition surveys to be carried out	3000
												-		Total	18800

Option 8b

OPTION 8b

General Mandatory Risk Data							Current Risk Ranking							Mitigation Plan Details (Only to be populated where Risks for Red or Y	
Unique Identifier	Risk, Opportunity	Description			Risk / Opportunity Owner	Movement	Assessment (Qualitative)				Highest Initial Risk Rating	Risk Score	Responce Strategy	Action Planned To Reduce Risk Or Enhance An Opportunity	Agreed Mitigation Plan Cost (£K)
							Probability		Schedule Impact	Cost Impact			Risk / Opportunity		
		As a result of (Definite Cause)	,(uncertain event) may occur	,Which may lead to (effect on objectives)			%age	In Words	In Words	In Words				Scope Details	
1	Risk	Failure to obtain permission to re-locate Maintenance Shed	Delay to commencment of the work	Cost escalation/completion delayed	NTA	No Change	50%	Possible	High	Medium	Medium	16	Accept	Early consultation with highways authorities	1500
2	Risk	Existing platforms in poorer condition than anticipated resulting in additional demolition and replacement	Additional time on site	Cost escalation/completion delayed	NTA	No Change	60%	Possible	High	High	Medium	18	Accept	Early condition surveys to be carried out	3000
3	Risk	Existing structure requires more strengthening than anticipated to suit new platform configurartion	Following additional survey work, existing structure requires more strengthening than anticipated	Additional costs and additional time to design	NTA	No Change	75%	Possible	High	Very High	Medium	21	Accept	Early ground investigation works to be carried out	3000
4	Risk	Innovative design for drop lock	Delay to design and construction process due to unforseen design matters	Delay and additional costs	NTA	No Change	50%	Unlikely	Medium	Medium	Medium	10	Accept	Early condition surveys to be carried out	800
5	Risk	Demolition and re-construction of North Strand Bridge	Failure to obtain approval to re-route traffic during construction period	Constraints on demolition and construction being partial and phased	NTA	No Change	50%	Possible	High	High	High	18	Accept	Early condition surveys to be carried out	3000
6	Risk	Construction of new bridge at Ossory Road	Existing canal construction being found to be unsuitable for construction of new dual track bridge	Substantial additional canal strengthening works required prior to cvonstruction of new bridge	NTA	No Change	50%	Possible	Medium	Medium	Medium	16	Accept	Early ground investigation works to be carried out	1500
7	Risk	Dualling of track from Newcomen - ground conditions not as expected / suitable for rail track	Existing ground conditions found to be unsuitalbe for new track layout	Additional ground stabilistation works prior to laying of new track	NTA	No Change	75%	Possible	Medium	Medium	Medium	16	Accept	Early ground investigation works to be carried out	1500
8	Risk	Additional strengthening works required to existing Bridge structures to cater for new works	Unexpected additional strengthening works required to existing structures to support new deck infills	Additional design time and construction costs	NTA	No Change	75%	Possible	High	High	High	18	Accept	Early ground investigation works to be carried out	1500
9	Risk	Suitability of existing structure to incorporate additional overbridges and lift pits	Unexpected additional strengthening works required to existing structures to support new deck infills	Additional design time and construction costs	NTA	No Change	75%	Probable	Medium	Medium	Medium	19	Accept	Early condition surveys to be carried out	3000
10	Risk	Failure to CPO derelict house requiring demolition; Failure to CPO Car park area required for platform extension; Failure to obtain approval to demolish section of IR building	Currently unknown if it will be possible to CPO required land and if IR will agree to demolition of portion of building	Significant delays to progress and substantial additional land acquisition costs	NTA	No Change	80%	Probable	High	Medium	High	20	Accept	Early consultation and negotiation	3000
11	Risk	Unknown condition of existing arches leading to higher design and construction costs	Extenson of existing arches into car park to support platform extension may require excessive additional structural works	Additional design time and construction costs	NTA	No Change	75%	Possible	Medium	Medium	Medium	16	Accept	Early condition surveys to be carried out	1000
12	Risk	Work at heights over public areas for platform 8 extension works	Danger to public outwith the curtiledge of the site	Additional protective measures required	NTA	No Change	100%	Almost Certain	Low	Low	Medium	15	Accept	Ensure additional protective measures are in place	1000
14	Risk	Infilling void on bridge at throat	Major engineering activities over public highway	Danger to public and possibility of damage to structure of bridge	NTA	No Change	50%	Possible	Medium	Medium	Medium	16	Accept	Possibility of introducing temporary supporting structure and/or crash deck	1250
15												-		Total	23550

Option 8d

OPTION 8d

General Mandatory Risk Data							Current Risk Ranking							Mitigation Plan Details (Only to be populated where Risks for Red or Y	
Unique Identifier	Risk, Opportunity	Description			Risk / Opportunity Owner	Movement	Assessment (Qualitative)				Highest Initial Risk Rating	Risk Score	Responce Strategy	Action Planned To Reduce Risk Or Enhance An Opportunity	Agreed Mitigation
							Probability		Schedule Impact	Cost Impact			Risk / Opportunity		
		As a result of (Definite Cause)	,(uncertain event) may occur	,Which may lead to (effect on objectives)			%age	In Words	In Words	In Words				Scope Details	
1	Risk	Failure to obtain permission to re-locate Maintenance Shed	Delay to commencment of the work	Cost escalation/completion delayed	NTA	No Change	50%	Possible	High	Medium	Medium	16	Accept	Early consultation with highways authorities	1500
2	Risk	Existing platforms in poorer condition than anticipated resulting in additional demolition and replacement	Additional time on site	Cost escalation/completion delayed	NTA	No Change	60%	Possible	High	High	Medium	18	Accept	Early condition surveys to be carried out	3000
3	Risk	Existing structure requires more strengthening than anticipated to suit new platform configuratrion	Following additional survey work, existing structure requires more strengthening than anticipated	Additional costs and additional time to design	NTA	No Change	75%	Possible	High	Very High	Medium	21	Accept	Early ground investigation works to be carried out	3000
4	Risk	Innovative design for drop lock	Delay to design and construction process due to unforseen design matters	Delay and additional costs	NTA	No Change	50%	Unlikely	Medium	Medium	Medium	10	Accept	Early condition surveys to be carried out	800
5	Risk	Construction of new bridge at Ossory Road	Existing canal construction being found to be unsuitable for construction of new dual track bridge	Substantial additional canal strengthening works required prior to cvonstruction of new bridge	NTA	No Change	50%	Possible	Medium	Medium	Medium	16	Accept	Early ground investigation works to be carried out	1500
6	Risk	Additional strengthening works required to existing Bridge structures to cater for new works	Unexpected additional strengthening works required to existing structures to support new deck infills	Additional design time and construction costs	NTA	No Change	75%	Possible	High	Very High	Medium	21	Accept	Early ground investigation works to be carried out	1500
7	Risk	Suitability of existing structure to incorporate additional overbridges and lift pits	Unexpected additional strengthening works required to existing structures to support new deck infills	Additional design time and construction costs	NTA	No Change	75%	Probable	Medium	Medium	Medium	19	Accept	Early condition surveys to be carried out	3000
8	Risk	Failure to CPO derelict house requiring demolition; Failure to CPO Car park area required for platform extension; Failure to obtain approval to demolish section of IR building	Currently unknown if it will be possible to CPO required land and if IR will agree to demolition of portion of building	Significant delays to progress and substantial additional land acquisition costs	NTA	No Change	80%	Probable	Very High	High	High	23	Accept	Early consultation and negotiation	2000
9	Risk	Unknown condition of existing arches leading to higher design and construction costs	Extension of existing arches into car park to support platform extension may require excessive additional structural works	Additional design time and construction costs	NTA	No Change	75%	Possible	Medium	Medium	Medium	16	Accept	Early condition surveys to be carried out	1000
10	Risk	Work at heights over public areas for platform 8 extension works	Danger to public outwith the curtiledge of the site	Additional protective measures required	NTA	No Change	100%	Almost Certain	Low	Low	Medium	15	Accept	Ensure additional protective measures are in place	1000
11	Risk	Infilling void on bridge at throat	Major engineering activities over public highway	Danger to public and possibility of damage to structure of bridge	NTA	No Change	50%	Possible	Medium	Medium	Medium	16	Accept	Possibility of introducing temporary supporting structure and/or crash deck	1250
12												-		Total	18050

3.4 Assumptions

The assumptions that have been made when compiling the option cost estimates are detailed in the following table:-

COST DATA ASSUMPTIONS LIST - OPTION 3			
The following assumptions have been made in the preparation of the costs contained in this report			
	Item	**Description**	**Assumption**
TRACK			
1	Scope of work	Extent of existing and new track is not clear from drawings provided	Assumed that all track shown red on Pway drawings is new
2	Scope of work	Extent of track to be lifted is not clear	Assumed that track to be lifted as shown on the detailed information provided for Option 6b is common to all options
3	Scope of work	Maintenance lines at South East	Assumed that all of these lines will be completed prior to station upgrade works commencing. Arbitrary line struck between completion of maintenance lines and commencement of station track upgrade - no information available
4	Signalling	No quantification possible	Assumed that there are no abnormal costs associated with the signalling for this project. In the absence of detailed information, a general allowance based on similar projects has been included
TELECOMS			
1	Scope of Work	No definition provided	Assumed that LLPA will link back to existing system. One extension to system per platform has been assumed
2	CIS Scope of Work	No definition provided	costs are based on rate per m2 from similar projects. Assumed there are no abnormal costs associated with this item
3	CCTV installation Scope of Work	No definition provided	Assumed that the existing CCTV system will be suitable for extension to suit the new platform layouts. No allowance made for upgrading existing system.
POWER SUPPLY			
1	Scope of Work	No definition provided	General allowance made for extending and upgrading current provision
2	Scope of Work	No definition provided	It has been assumed that outwith the general allowance included, there will be no requirement for major power infrastructure upgrading works to be carried out i.e. no new sub-station or extensive HV cabling to be provided

CIVILS			
1	Scope of Work	Existing platforms	Assumed all existing platforms are to be demolished and removed offsite
2	Scope of Work	Excavation	Assumed no existing materials are being reused
3	Scope of Work	Demolition	Assumes the railway bridge - over canal is to be demolished
4	Scope of Work	Demolition	Assumes the lift bridge over canal is to be demolished
5	Scope of Work	Bridges	We have made an allowance for structural alterations and strengthening to existing arches
6	Scope of Work	Bridges	We have made an allowance for building the new railway bridge - over canal
7	Scope of Work	Bridges	We have made an allowance for a temporary bridge to accommodate existing services
8	Scope of Work	Newcomen Junction	Assumed vehicles diverted elsewhere during bridge replacement works
9	Scope of Work	Newcomen Junction	Assumed canal closed during construction works
10	Scope of Work	Newcomen Junction	Assumed crash deck/catch nets or similar to prevent debris falling into the canal
11	Scope of Work	Newcomen Junction	No details on the pumping units - all aspects have been assumed
12	Scope of Work	Newcomen Junction	Assumed no existing materials are being reused
13	Scope of Work	Newcomen Junction	Assumed dredging will be required to lower water level
14	Scope of Work	Newcomen Junction	Temporary bridge required to maintain existing services over the canal during road bridge replacement works
15	Scope of Work	Existing utilities	In the absence of any information we have included an allowance of £750,000 for dealing with existing utilities
16	Scope of Work	New platforms	The platforms are assumed to be of a typical front wall construction. • 665 x 1100mm solid concrete blockwork walls with cope. • Concrete strip foundations 1100 x 470mm. • Concrete support. • Between walls it is assumed that that it will be filled with 6N material. • Typical platform make up; 50mm dense bitumen base and 25mm bitumen wearing. course.

			• 400mm wide concrete tactile slabs to run the length of the platform.
17	Scope of Work	New platforms	Where the new platforms are to constructed between gap in the existing arched, we have assumed there will a new concrete slab supported on concrete beams on either side.
18	Scope of Work	New platforms	Lighting poles are assumed to be 15m centres.
19	Scope of Work	New platforms	Passenger information screens are assumed to be at 15m centres.
20	Scope of Work	New platforms	We have assumed any existing platforms will be re-surfaced.
BUILDINGS			
1	Scope of Work	Existing maintenance shed	Assumed existing maintenance shed has to be demolished and rebuilt
STATION WORKS			
1	Demolitions	Maintenance shed	Assumed that maintenance shed has to be demolished and re-located for this option
2	New Work	Platform Infrastructure	Assumed that no alterations are being made to existing infrastructure beyond platform adaptations. No allowance is made for new ticket barriers, ticket machines, escalators, lifts, stairs etc.
3	Scope of Work	New platforms	It is assumed new canopy's to platform 4/5 & 6/7
METHODOLGY			
1	Method of work	Sequence of construction	It is assumed that this work can be carried out as a phased construction utilising Possessions as required

COST DATA ASSUMPTIONS LIST - OPTION 6b			
The following assumptions have been made in the preparation of the costs contained in this report			
	Item	**Description**	**Assumption**
TRACK			
1	Scope of work	Extent of existing and new track is not clear from drawings provided	Assumed that all track shown red on Pway drawings is new
2	Scope of work	Extent of track to be lifted is not clear	Assumed that track to be lifted as shown on the detailed information provided for Option 6b is common to all options
3	Scope of work	Maintenance lines at South East	Assumed that all of these lines will be completed prior to station upgrade works commencing. Arbitrary line struck between completion of maintenance lines and commencement of station track upgrade - no information available

4	Scope of work	Maintenance shed	Assumed Maintenance shed has to be demolished and re-built
5	Signalling	No quantification possible	Assumed that there are no abnormal costs associated with the signalling for this project. In the absence of detailed information, a general allowance based on similar projects has been included
TELECOMS			
1	Scope of Work	No definition provided	Assumed that LLPA will link back to existing system. One extension to system per platform has been assumed
2	CIS Scope of Work	No definition provided	costs are based on rate per m2 from similar projects. Assumed there are no abnormal costs associated with this item
3	CCTV installation Scope of Work	No definition provided	Assumed that the existing CCTV system will be suitable for extension to suit the new platform layouts. No allowance made for upgrading existing system.
POWER SUPPLY			
1	Scope of Work	No definition provided	General allowance made for extending and upgrading current provision
2	Scope of Work	No definition provided	It has been assumed that outwith the general allowance included, there will be no requirement for major power infrastructure upgrading works to be carried out i.e. no new sub-station or extensive HV cabling to be provided
CIVILS			
1	Scope of Work	Existing platforms	Assumed all existing platforms are to be demolished and removed offsite
2	Scope of Work	Excavation	Assumed no existing materials are being reused
4	Scope of Work	Demolition	Assumes the lift bridge over canal is to be demolished
5	Scope of Work	Bridges	We have made an allowance for structural alterations and strengthening to existing arches
6	Scope of Work	Bridges	We have made an allowance for building the new railway bridge - over canal
7	Scope of Work	Bridges	We have made an allowance for a temporary bridge to accommodate existing services
8	Scope of Work	Newcomen Junction	Vehicles diverted elsewhere during bridge replacement works
9	Scope of Work	Newcomen Junction	Canal closed during construction works
10	Scope of Work	Newcomen Junction	Assumed crash deck/catch nets or similar to prevent debris falling into the canal

11	Scope of Work	Newcomen Junction	No details on the pumping units - all aspects have been assumed
12	Scope of Work	Newcomen Junction	Assumed no existing materials are being reused
13	Scope of Work	Newcomen Junction	Assumed dredging will be required to lower water level
14	Scope of Work	Newcomen Junction	Temporary bridge required to maintain existing services over the canal during road bridge replacement works
15	Scope of Work	Existing utilities	In the absence of any information we have included an allowance of £750,000 for dealing with existing utilities
16	Scope of Work	New platforms	The platforms are assumed to be of a typical front wall construction. • 665 x 1100mm solid concrete blockwork walls with cope. • Concrete strip foundations 1100 x 470mm. • Concrete support. • Between walls it is assumed that that it will be filled with 6N material. • Typical platform make up; 50mm dense bitumen base and 25mm bitumen wearing. course. • 400mm wide concrete tactile slabs to run the length of the platform.
17	Scope of Work	New platforms	Where the new platforms are to constructed between gap in the existing arched, we have assumed there will a new concrete slab supported on concrete beams on either side.
18	Scope of Work	New platforms	Lighting poles are assumed to be 15m centres.
19	Scope of Work	New platforms	Passenger information screens are assumed to be at 15m centres.
20	Scope of Work	New platforms	We have assumed any existing platforms will be re-surfaced.
BUILDINGS			
1	Scope of Work	Existing maintenance shed	Assumes existing maintenance shed is to remain
2	Scope of Work	Existing Offices on platform 4	Assumes a section of the station offices will be demolished and a new structural external wall built.
STATION WORKS			
1	Scope of Work	Footbridges	Assumes there will be no requirement for escalators, ticket barriers or ticket machines.
2	Scope of Work	Existing maintenance shed	Assumes existing maintenance shed is to be demolished and re-built

3	Scope of Work	New canopy's platforms	It is assumed new canopy's to platform 4/5 & 6/7
METHODOLGY			
1	Method of work	Sequence of construction	It is assumed that this Option will require the entire closure of Connolly station for a period of time

COST DATA ASSUMPTIONS LIST - OPTION 6d			
The following assumptions have been made in the preparation of the costs contained in this report			
	Item	**Description**	**Assumption**
TRACK			
1	Scope of work	Extent of existing and new track is not clear from drawings provided	Assumed that all track shown red on Pway drawings is new
2	Scope of work	Extent of track to be lifted is not clear	Assumed that track to be lifted as shown on the detailed information provided for Option 6b is common to all options
3	Scope of work	Maintenance lines at South East	Assumed that all of these lines will be completed prior to station upgrade works commencing. Arbitrary line struck between completion of maintenance lines and commencement of station track upgrade - no information available
4	Scope of work	Maintenance shed	Assumed Maintenance shed has to be demolished and re-built
5	Signalling	No quantification possible	Assumed that there are no abnormal costs associated with the signalling for this project. In the absence of detailed information, a general allowance based on similar projects has been included
TELECOMS			
1	Scope of Work	No definition provided	Assumed that LLPA will link back to existing system. One extension to system per platform has been assumed
2	CIS Scope of Work	No definition provided	costs are based on rate per m2 from similar projects. Assumed there are no abnormal costs associated with this item
3	CCTV installation Scope of Work	No definition provided	Assumed that the existing CCTV system will be suitable for extension to suit the new platform layouts. No allowance made for upgrading existing system.
POWER SUPPLY			
1	Scope of Work	No definition provided	General allowance made for extending and upgrading current provision
2	Scope of Work	No definition provided	It has been assumed that outwith the general allowance included, there will be no requirement for major power infrastructure upgrading works to be

			carried out i.e. no new sub-station or extensive HV cabling to be provided
CIVILS			
1	Scope of Work	Existing platforms	Assumed all existing platforms are to be demolished and removed offsite
2	Scope of Work	Excavation	Assumed no existing materials are being reused
3	Scope of Work	Bridges	We have made an allowance for structural alterations and strengthening to existing arches
4	Scope of Work	Newcomen Junction	Assumed the canal will be closed during construction works
5	Scope of Work	Newcomen Junction	Assumed crash deck/catch nets or similar to prevent debris falling into the canal
6	Scope of Work	Newcomen Junction	No details on the pumping units - all aspects have been assumed
7	Scope of Work	Newcomen Junction	Assumed no existing materials are being reused
8	Scope of Work	Newcomen Junction	Assumed dredging will be required to lower water level
9	Scope of Work	Existing utilities	In the absence of any information we have included an allowance of £750,000 for dealing with existing utilities
10	Scope of Work	New platforms	The platforms are assumed to be of a typical front wall construction. • 665 x 1100mm solid concrete blockwork walls with cope. • Concrete strip foundations 1100 x 470mm. • Concrete support. • Between walls it is assumed that that it will be filled with 6N material. • Typical platform make up; 50mm dense bitumen base and 25mm bitumen wearing. course. • 400mm wide concrete tactile slabs to run the length of the platform.
11	Scope of Work	New platforms	Where the new platforms are to constructed between gap in the existing arched, we have assumed there will a new concrete slab supported on concrete beams on either side.
12	Scope of Work	New platforms	Lighting poles are assumed to be 15m centres.
13	Scope of Work	New platforms	Passenger information screens are assumed to be at 15m centres.

14	Scope of Work	New platforms	We have assumed any existing platforms will be re-surfaced.
BUILDINGS			
1	Scope of Work	Existing maintenance shed	Assumed existing maintenance shed is to be demolished and re-built
2	Scope of Work	Existing Offices on platform 4	Assumed a section of the station offices will be demolished and a new structural external wall built.
STATION WORKS			
1	Scope of Work	Footbridges	Assumes there will be no requirement for escalators, ticket barriers or ticket machines.
2	Scope of Work	Existing maintenance shed	Assumes existing maintenance shed is to remain
3	Scope of Work	New canopy's platforms	It is assumed new canopy's to platform 4/5 & 6/7
METHODOLGY			
1	Method of work	Sequence of construction	It is assumed that this Option will require the entire closure of Connolly station for a period of time

COST DATA ASSUMPTIONS LIST - OPTION 8b			
The following assumptions have been made in the preparation of the costs contained in this report			
	Item	**Description**	**Assumption**
TRACK			
1	Scope of work	Extent of existing and new track is not clear from drawings provided	Assumed that all track shown red on Pway drawings is new
2	Scope of work	Extent of track to be lifted is not clear	Assumed that track to be lifted as shown on the detailed information provided for Option 6b is common to all options
3	Scope of work	Maintenance lines at South East	Assumed that all of these lines will be completed prior to station upgrade works commencing. Arbitrary line struck between completion of maintenance lines and commencement of station track upgrade - no information available
4	Signalling	No quantification possible	Assumed that there are no abnormal costs associated with the signalling for this project. In the absence of detailed information, a general allowance based on similar projects has been included
TELECOMS			
1	Scope of Work	No definition provided	Assumed that LLPA will link back to existing system. One extension to system per platform has been assumed
2	CIS Scope of Work	No definition provided	costs are based on rate per m2 from similar projects. Assumed there are no abnormal costs associated with this item

3	CCTV installation Scope of Work	No definition provided	Assumed that the existing CCTV system will be suitable for extension to suit the new platform layouts. No allowance made for upgrading existing system.
POWER SUPPLY			
1	Scope of Work	No definition provided	General allowance made for extending and upgrading current provision
2	Scope of Work	No definition provided	It has been assumed that outwith the general allowance included, there will be no requirement for major power infrastructure upgrading works to be carried out i.e. no new sub-station or extensive HV cabling to be provided
CIVILS			
1	Scope of Work	Existing platforms	Assumed all existing platforms are to be demolished and removed offsite
2	Scope of Work	Excavation	Assumed no existing materials are being reused
3	Scope of Work	Demolition	Assumed the railway bridge - over canal is to be demolished
4	Scope of Work	Demolition	Assumed the lift bridge over canal is to be demolished
5	Scope of Work	Bridges	We have made an allowance for structural alterations and strengthening to existing arches
6	Scope of Work	Bridges	We have made an allowance for building the new railway bridge - over canal
7	Scope of Work	Bridges	We have made an allowance for a temporary bridge to accommodate existing services
8	Scope of Work	Newcomen Junction	Assumed vehicles diverted elsewhere during bridge replacement works
9	Scope of Work	Newcomen Junction	Assumed canal closed during construction works
10	Scope of Work	Newcomen Junction	Assumed crash deck/catch nets or similar to prevent debris falling into the canal
11	Scope of Work	Newcomen Junction	No details on the pumping units - all aspects have been assumed
12	Scope of Work	Newcomen Junction	Assumed no existing materials are being reused
13	Scope of Work	Newcomen Junction	Assumed dredging will be required to lower water level
14	Scope of Work	Newcomen Junction	Temporary bridge required to maintain existing services over the canal during road bridge replacement works
15	Scope of Work	Existing utilities	In the absence of any information we have included an allowance of £750,000 for dealing with existing utilities

16	Scope of Work	New platforms	The platforms are assumed to be of a typical front wall construction. • 665 x 1100mm solid concrete blockwork walls with cope. • Concrete strip foundations 1100 x 470mm. • Concrete support. • Between walls it is assumed that that it will be filled with 6N material. • Typical platform make up; 50mm dense bitumen base and 25mm bitumen wearing. course. • 400mm wide concrete tactile slabs to run the length of the platform.
17	Scope of Work	New platforms	Where the new platforms are to constructed between gap in the existing arched, we have assumed there will a new concrete slab supported on concrete beams on either side.
18	Scope of Work	New platforms	Lighting poles are assumed to be 15m centres.
19	Scope of Work	New platforms	Passenger information screens are assumed to be at 15m centres.
20	Scope of Work	New platforms	Where the new platforms are to constructed between gap in the existing arched, we have assumed there will a new concrete slab supported on concrete beams on either side.
21	Scope of Work	New platforms	footbridge to extend from Platform 1 -8; 4no lifts and 5no stair cases.
22	Scope of Work	New platforms	It is assumed new canopy's to platform 4/5, 6/7 & 8
23	Scope of Work	New platforms	Construction of platform 8. • To enable the construction of platform 8 we have assumed that new brickwork columns will be constructed at 5 meter centres. • We have assumed that existing plate girder underbridge will be demolished and new retaining wall will be built. The arches and behind the retaining wall will be backfilled. • We assumed that the • We have made an allowance for piling for the brickwork arches.
24	Scope of Work	New platforms	We have allowed for the courtyard to the garages to be bridged with a concrete deck; allowance of 100m2.

25	Scope of Work	New platforms	We have allowed for new ventilation to the courtyard/ garages; allowance of 100m2.
BUILDINGS			
1	Scope of Work	Existing maintenance shed	Assumes existing maintenance shed demolished and rebuilt
2	Scope of Work	"Post Office" building	Assumes the back on Irish rail offices is to be demolished and new structural wall built
3	Scope of Work	Burnt out House	Assumes the house is to be demolished
STATION WORKS			
1	Scope of Work	Station works	Assumes there will be no requirement for escalators, ticket barriers or ticket machines.
2	Scope of Work	Existing maintenance shed	Assumes existing maintenance shed is to remain
3	Scope of Work	New canopy's platforms	It is assumed new canopy's to platform 4/5 & 6/7
LAND PURCHASE			
1	Purchase of Derelict House at Throat	Derelict house at the location of the throat will require to be demolished to allow the throat to be extended	Assumed that this will be the subject of a Compulsory Purchase Order
2	Purchase of Car Park adjacent to the arches	The car park spaces at the arches will require to be purchased to facilitate the construction of the structural supports for the bridge extension	Assumed that this will be the subject of a Compulsory Purchase Order
3	Purchase of "Post Office" building	The building known as the "Post Office" building will require to be purchased in order that the gable nearest the railway can be demolished and re-built further from the railway to facilitate the extension of the throat	Assumed that this will be the subject of a Compulsory Purchase Order
4	Purchase of "garages" building	Garages located in the arched below the tracks	Assumed that this land is owned by the client. No allowances have been made for decanting tenants or providing tenants with new accommodation.
METHODOLGY			
1	Method of work	Sequence of construction	It is assumed that this work can be carried out as a phased construction utilising Possessions as required

COST DATA ASSUMPTIONS LIST - OPTION 8d

The following assumptions have been made in the preparation of the costs contained in this report			
	Item	**Description**	**Assumption**
TRACK			
1	Scope of work	Extent of existing and new track is not clear from drawings provided	Assumed that all track shown red on Pway drawings is new
2	Scope of work	Extent of track to be lifted is not clear	Assumed that track to be lifted as shown on the detailed information provided for Option 6b is common to all options
3	Scope of work	Maintenance lines at South East	Assumed that all of these lines will be completed prior to station upgrade works commencing. Arbitrary line struck between completion of maintenance lines and commencement of station track upgrade - no information available
4	Signalling	No quantification possible	Assumed that there are no abnormal costs associated with the signalling for this project. In the absence of detailed information, a general allowance based on similar projects has been included
TELECOMS			
1	Scope of Work	No definition provided	Assumed that LLPA will link back to existing system. One extension to system per platform has been assumed
2	CIS Scope of Work	No definition provided	costs are based on rate per m2 from similar projects. Assumed there are no abnormal costs associated with this item
3	CCTV installation Scope of Work	No definition provided	Assumed that the existing CCTV system will be suitable for extension to suit the new platform layouts. No allowance made for upgrading existing system.
POWER SUPPLY			
1	Scope of Work	No definition provided	General allowance made for extending and upgrading current provision
2	Scope of Work	No definition provided	It has been assumed that outwith the general allowance included, there will be no requirement for major power infrastructure upgrading works to be carried out i.e. no new sub-station or extensive HV cabling to be provided
CIVILS			
1	Scope of Work	Existing platforms	Assumed all existing platforms are to be demolished and removed offsite
2	Scope of Work	Excavation	Assumed no existing materials are being reused
3	Scope of Work	Bridges	We have made an allowance for structural alterations and strengthening to existing arches

4	Scope of Work	Newcomen Junction	Assumed vehicles diverted elsewhere during bridge replacement works
5	Scope of Work	Newcomen Junction	Assumed canal closed during construction works
6	Scope of Work	Newcomen Junction	Assumed crash deck/catch nets or similar to prevent debris falling into the canal
7	Scope of Work	Newcomen Junction	No details on the pumping units - all aspects have been assumed
8	Scope of Work	Newcomen Junction	Assumed no existing materials are being reused
9	Scope of Work	Newcomen Junction	Assumed dredging will be required to lower water level
10	Scope of Work	Newcomen Junction	Temporary bridge required to maintain existing services over the canal during road bridge replacement works
11	Scope of Work	Existing utilities	In the absence of any information we have included an allowance of £750,000 for dealing with existing utilities
12	Scope of Work	New platforms	The platforms are assumed to be of a typical front wall construction. • 665 x 1100mm solid concrete blockwork walls with cope. • Concrete strip foundations 1100 x 470mm. • Concrete support. • Between walls it is assumed that that it will be filled with 6N material. • Typical platform make up; 50mm dense bitumen base and 25mm bitumen wearing. course. • 400mm wide concrete tactile slabs to run the length of the platform.
13	Scope of Work	New platforms	Where the new platforms are to constructed between gap in the existing arched, we have assumed there will a new concrete slab supported on concrete beams on either side.
14	Scope of Work	New platforms	Lighting poles are assumed to be 15m centres.
15	Scope of Work	New platforms	Passenger information screens are assumed to be at 15m centres.
16	Scope of Work	New platforms	Where the new platforms are to constructed between gap in the existing arched, we have assumed there will a new concrete slab supported on concrete beams on either side.
17	Scope of Work	New platforms	footbridge to extend from Platform 1 -8; 4no lifts and 5no stair cases.

18	Scope of Work	New platforms	It is assumed new canopy's to platform 4/5, 6/7 & 8
19	Scope of Work	New platforms	Construction of platform 8. • To enable the construction of platform 8 we have assumed that new brickwork columns will be constructed at 5 meter centres. • We have assumed that existing plate girder underbridge will be demolished and new retaining wall will be built. The arches and behind the retaining wall will be backfilled. • We assumed that the • We have made an allowance for piling for the brickwork arches.
20	Scope of Work	New platforms	We have allowed for the courtyard to the garages to be bridged with a concrete deck; allowance of 100m2.
21	Scope of Work	New platforms	We have allowed for new ventilation to the courtyard/ garages; allowance of 100m2.
BUILDINGS			
1	Scope of Work	Existing maintenance shed	Assumes existing maintenance shed demolished and rebuilt
2	Scope of Work	"Post Office" building	Assumes the back on Irish rail offices is to be demolished and new structural wall built
3	Scope of Work	Burnt out House	Assumes the house is to be demolished
STATION WORKS			
1	Scope of Work	Station works	Assumes there will be no requirement for escalators, ticket barriers or ticket machines.
2	Scope of Work	Existing maintenance shed	Assumes existing maintenance shed is to remain
3	Scope of Work	New canopy's platforms	It is assumed new canopy's to platform 4/5 & 6/7
LAND PURCHASE			
1	Purchase of Derelict House at Throat	Derelict house at the location of the throat will require to be demolished to allow the throat to be extended	Assumed that this will be the subject of a Compulsory Purchase Order
2	Purchase of Car Park adjacent to the arches	The car park spaces at the arches will require to be purchased to facilitate the construction of the structural supports for the bridge extension	Assumed that this will be the subject of a Compulsory Purchase Order

3	Purchase of "Post Office" building	The building known as the "Post Office" building will require to be purchased in order that the gable nearest the railway can be demolished and re-built further from the railway to facilitate the extension of the throat	Assumed that this will be the subject of a Compulsory Purchase Order
4	Purchase of "garages" building	Garages located in the arched below the tracks	Assumed that this land is owned by the client. No allowances have been made for decanting tenants or providing tenants with new accommodation.
METHODOLGY			
1	Method of work	Sequence of construction	It is assumed that this work can be carried out as a phased construction utilising Possessions as required

3.5 Exclusions

The following table lists the specific exclusions from the option cost estimates

EXCLUSIONS

The following Items are EXCLUDED from the reported costs

Item	Element	Description
1	VAT	No allowance is made in the costs for VAT
2	Power Infrastructure	No allowance is made for any local electrical power infrastructure upgrades by Statutory Authorities required as a result of the station infrastructure upgrade works
3	Inflation	Costs are based on a commencement in 1Q 2019 no allowance has been made for inflationary effects beyond these allowances
4	Re-location costs	No allowance has been made for any costs associated with relocating staff/equipment from existing premises either to new premises or to alternative existing premises
5	Re-location costs	Where an option includes for the construction of a new facility, no costs are included in respect of either the transfer of or purchase of new loose furniture, fittings or equipment
6	Re-location costs	The cost of re-locating any plant machinery or equipment from any of the existing facilities to be vacated to a new location is excluded
7	Rates, Taxes and Insurance	The costs associated with any additional rates, taxes or insurance as a result of relocating to alternative premises is specifically excluded
8	Traffic Management	The cost of any traffic management measures required in relation to the closure of roads, footpaths or car parks is excluded
9	Legal Costs	No allowance has been made for any costs associated with legal fees, conveyancing etc.
10	Land Acquisition	With the exception of the requirements specific to Option 8b and 8d, No allowance has been made for any costs associated with Land Acquisition
11	Archaeological works	No allowance has been included in respect of any work associated with Archaeological findings or dealing with uncovered munitions
12	Contaminated land	No allowance has been included for constructing on or remediating any contaminated land which may be uncovered.
13	Ordinance	No allowance has been included in respect of dealing with any unexploded ordinance which may be uncovered
14	Finance costs	No allowance has been made in respect of financing costs

EXCLUSIONS

The following Items are EXCLUDED from the reported costs

Item	Element	Description
15	Planning / Building / Local Authority Approvals	No allowance has been made in respect of any costs associated with obtaining construction approval e.g. Planning Charges, Building Control fees Planning Consultation costs, Road Closure requests etc.
16	Ecological mitigation measures	No allowance has been made in respect of any costs in respect of any ecological mitigation measures which may prove necessary
17	Rail infrastructure outwith the scope of the project	No allowance has been included in respect of any enabling work which may be required to other sections of the rail infrastructure to facilitate the proposals at Connolly Station / Newcomen Junction (e.g. Glasnevin)
18	Existing Station Facilities	The cost of any upgrading required to the existing station facilities beyond that necessary for the platform and trail re-alignments is specifically excluded
19	Landowner Interface issues	No allowance has been made for any costs associated with interfaces with adjacent landowners
20	Third Party costs	No allowance has been included for costs in respect of payments to third parties e.g. access consents etc.

3.6 Class of Estimate

The classification of the above estimate in relation to the Jacobs SOP 211 is a Class 4 estimate with confidence levels of **-30%** and **+40%**. The classification table is shown below:-

	Primary Characteristics	*Secondary Characteristics*			
ESTIMATE CLASS	**LEVEL OF PROJECT DEFINITION** Expressed as % of complete definition	**END USAGE** Typical purpose of estimate	**METHODOLOGY** Typical estimating method	**AACE EXPECTED ACCURACY RANGE** Typical variation in low and high ranges (a)	**JACOBS EXPECTED OVERALL ACCURACY RANGE**
Class 5 (Order of Magnitude)	**0% to 2%**	Concept Screening	Capacity Factored, Parametric Models, Judgement or Analogy	**L: -20% to -50% H: +30% to +100%**	**- 50% to + 50%**
Class 4 (Preliminary)	**1% to 15%**	Study or Feasibility	Equipment Factored or Parametric Models	**L: -15% to -30% H: +20% to +50%**	**- 30% to + 40%**
Class 3 (Early Budget)	**10% to 40%**	Budget, Authorisation or Control	Semi-detailed Unit Costs with Assembly Level Line Items	**L: -10% to -20% H: +10% to +30%**	**- 20% to + 30%**
Class 2 (Budget/Control)	**30% to 70%**	Control or Bid/Tender	Detailed Unit Cost with Forced Detailed Takeoff	**L: -5% to -15% H: +5% to +20%**	**- 10% to + 15%**
Class 1 (Definitive/ Construction)	**50% to 100%**	Check Estimate or Bid/Tender	Detailed Unit Cost with Detailed Takeoff	**L: -3% to -10% H: +3% to +15%**	**- 5% to + 5%**

Appendix E. Environmental Assessment of Potential Options

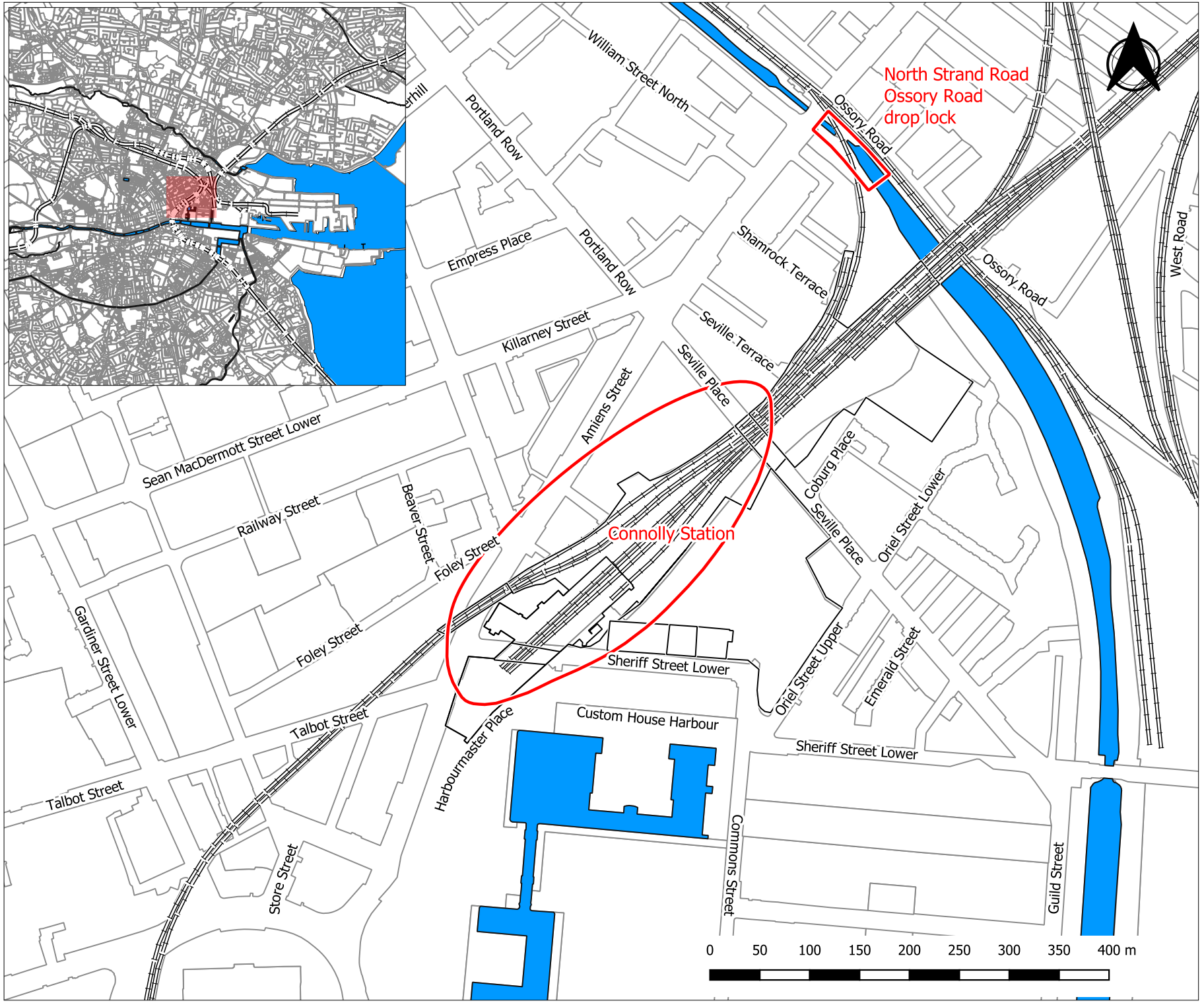


FIGURE 1

CONNOLLY STATION
ENHANCEMENT OPTIONS STUDY
ASSESSMENT AREAS

AMS Ref. Number: J2014
Jacobs Ref. Number: 32110100

Legend

- Rail Line
- Assessment Area
- Water
- Connolly Station

NOTES

Background mapping: Open Street Maps & DCC Development Plan
: https://data.smartdublin.ie/dataset/development-plans-

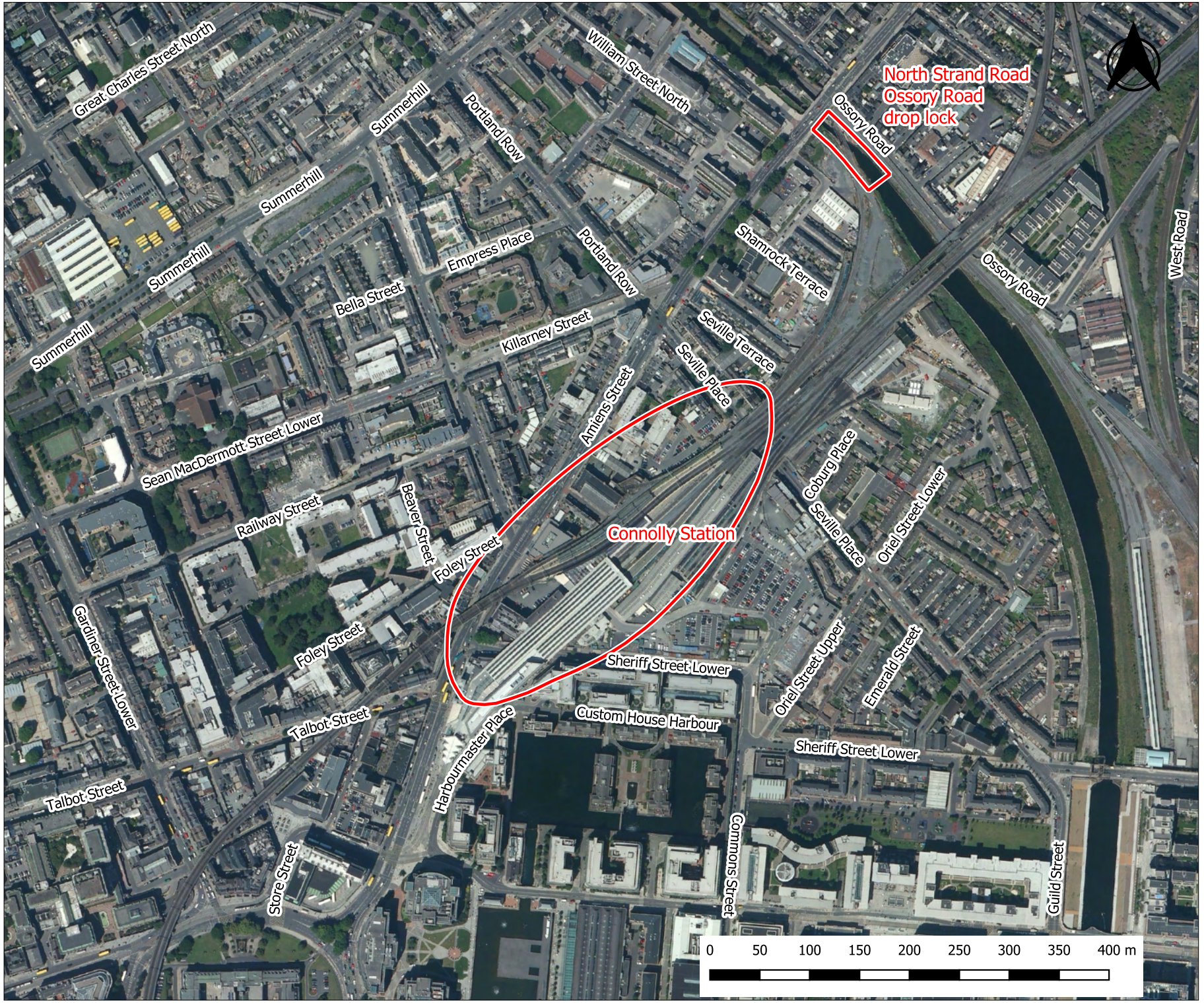


FIGURE 2

CONNOLLY STATION
ENHANCEMENT OPTIONS STUDY
ASSESSMENT AREAS
BING IMAGES

AMS Ref. Number: J2014
Jacobs Ref. Number: 32110100

Legend

Assessment Area

NOTES

Background mapping: Open Street Maps & BING satellite Images

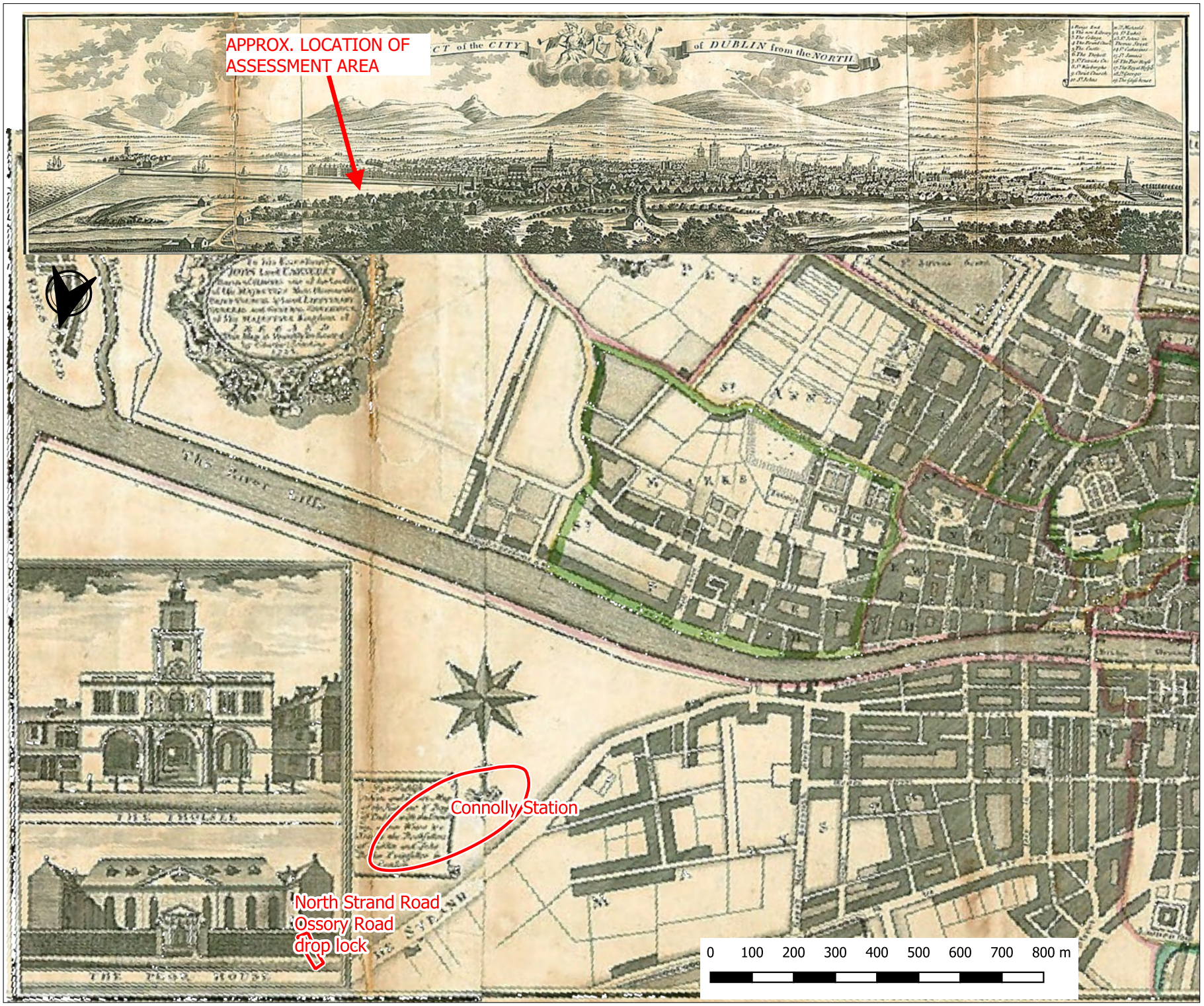


FIGURE 3

CONNOLLY STATION
ENHANCEMENT OPTIONS STUDY
EXTRACT OF BROOKING'S A MAP OF DUBLIN 1728

AMS Ref. Number: J2014
Jacobs Ref. Number: 32110100

Legend

Works Areas

Assessment Area

NOTES

Background mapping: Extract of Charles Brooking's 'A map of the city and suburbs of Dublin', 1728, available at https://www.iberlibro.com/servlet/

FIGURE 4

CONNOLLY STATION
ENHANCEMENT OPTIONS STUDY
ASSESSMENT AREAS
ROCQUE'S MAP OF DUBLIN 1756

AMS Ref. Number: J2014
Jacobs Ref. Number: 32110100

Legend

Assessment Area

NOTES

Background mapping: Rocque, J. 1756. An Exact Survey of the City and Suburbs of Dublin. [Online]. Available at: https://iiif.lib.harvard.edu/manifests/view/ids:10135315

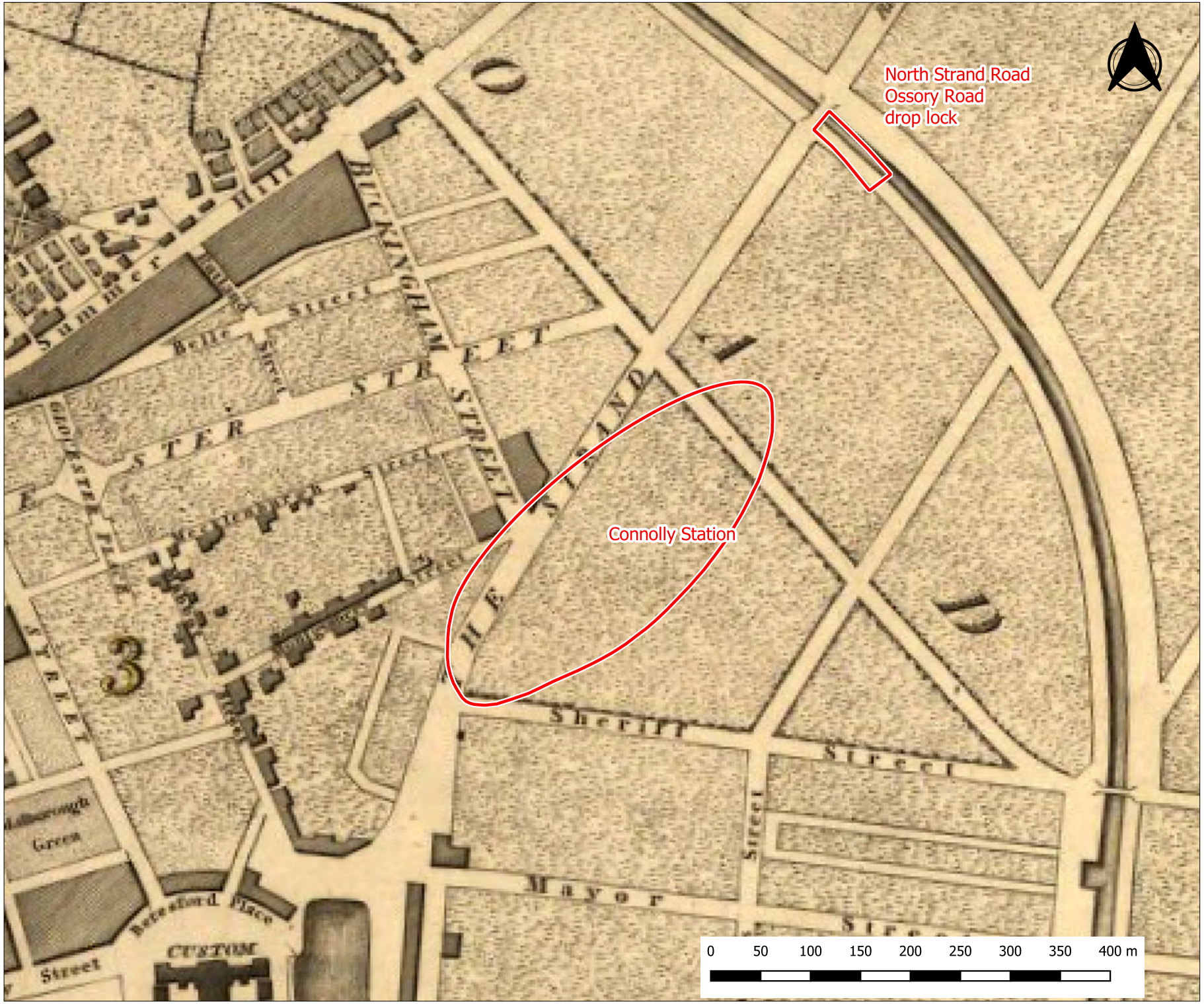


FIGURE 5

CONNOLLY STATION
ENHANCEMENT OPTIONS STUDY
ASSESSMENT AREAS
FADEN'S MAP OF DUBLIN 1797

AMS Ref. Number: J2014
Jacobs Ref. Number: 32110100

Legend

Assessment Area

NOTES

Background mapping: Faden, W. et al. 1797. A plan of the city of Dublin : as surveyed for the use of the division[a]l justices ... 1797. image, London : Sold by W. Allen & J. Archer. [Online]. Available at: https://www.loc.gov/item/2004626017/ [Accessed 5 March 2019].

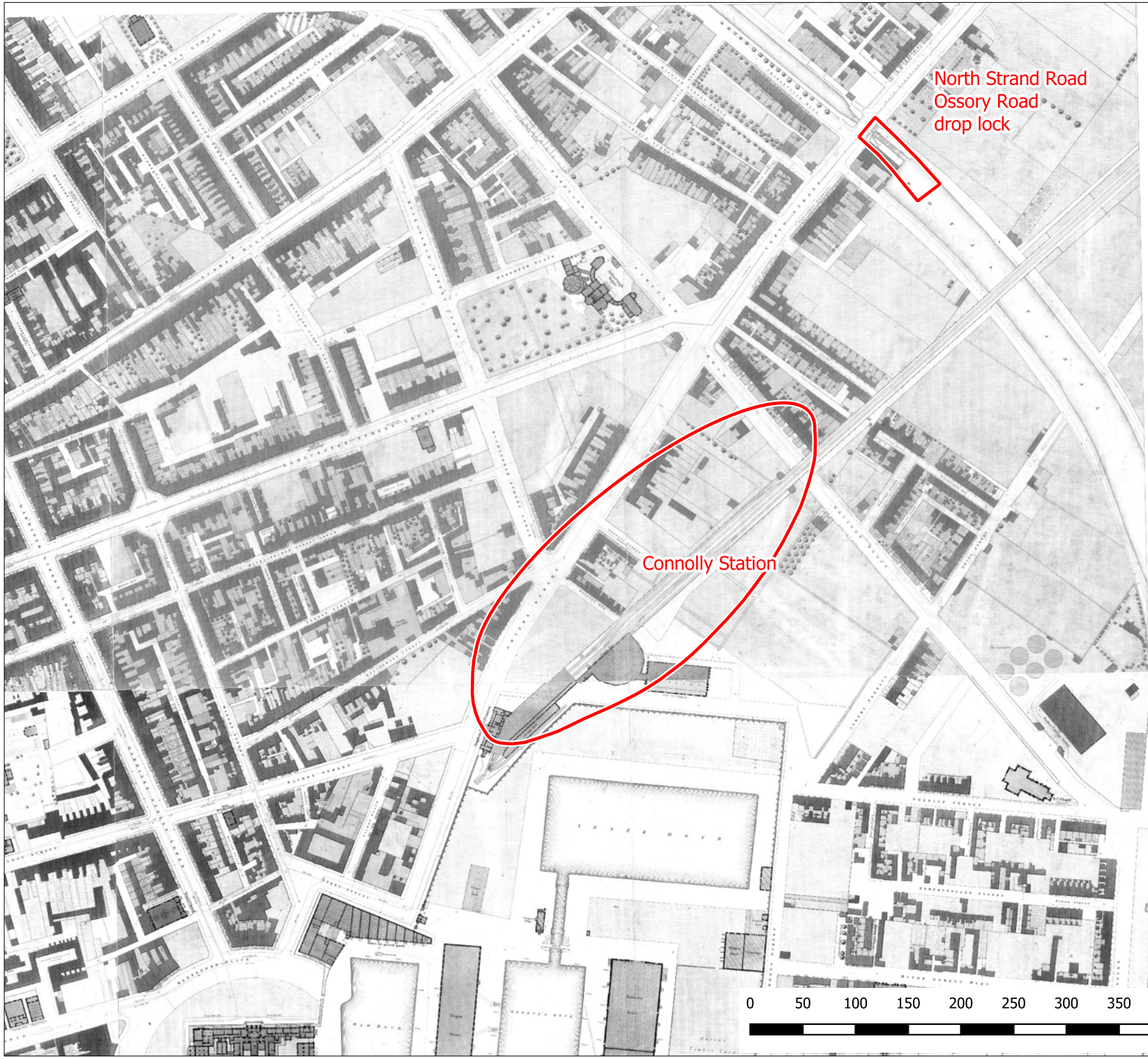


FIGURE 6

CONNOLLY STATION
ENHANCEMENT OPTIONS STUDY
ASSESSMENT AREAS
ORDNANCE SURVEY OF IRELAND
TOWN PLAN (1:1056)
SURVEYED 1838,
PUBLISHED 1847

AMS Ref. Number: J2014
Jacobs Ref. Number: 32110100

Legend

Assessment Area

NOTES

Background mapping: Ordnance Survey of Ireland. 1847. Town Plan 1:1056, City of Dublin: sheets 8, 9, 14, 15 (surveyed 1838). Dublin, Ireland : Ordnance Survey of Ireland.

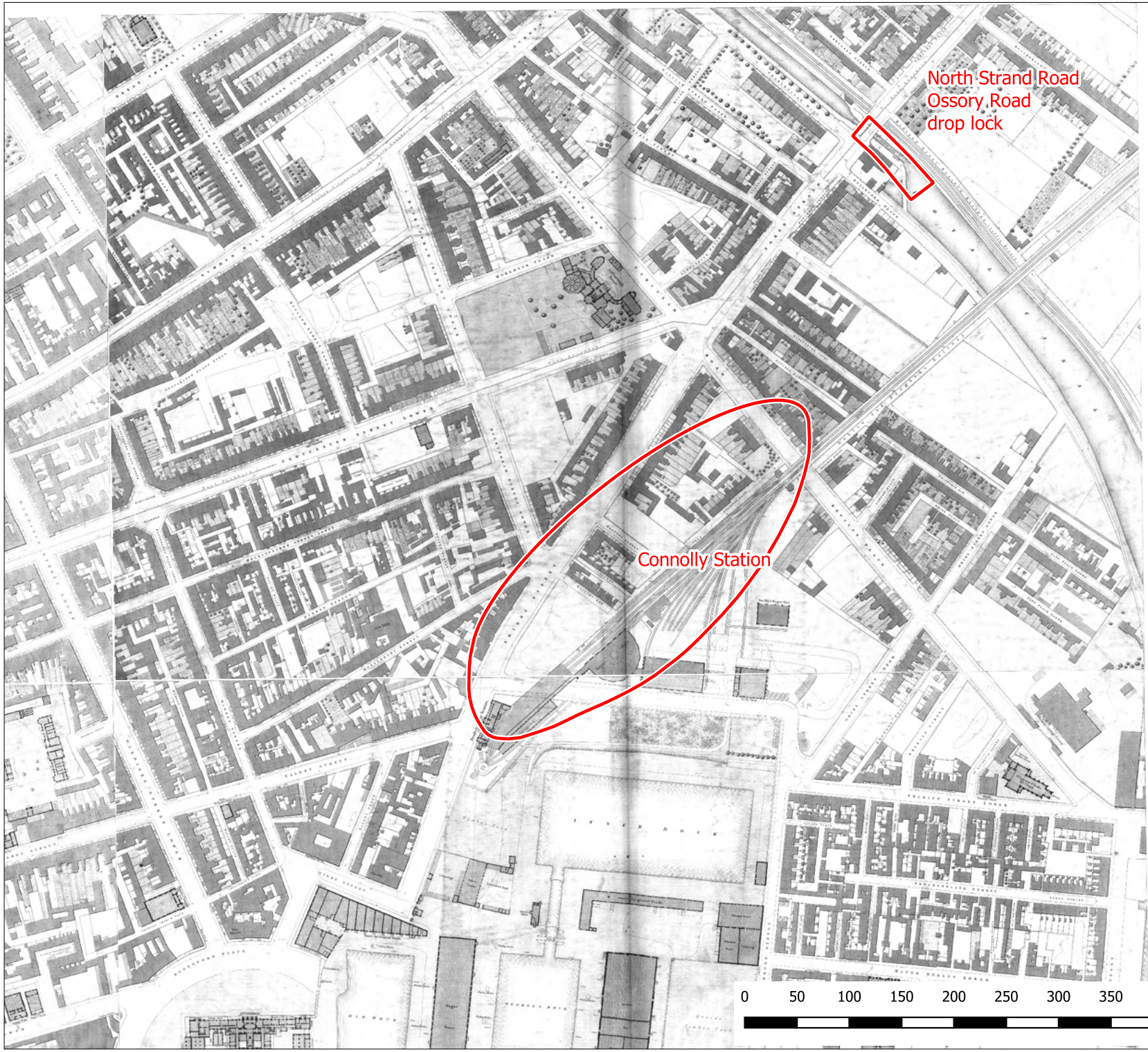


FIGURE 7

CONNOLLY STATION
ENHANCEMENT OPTIONS STUDY
ASSESSMENT AREAS
ORDNANCE SURVEY OF IRELAND
TOWN PLAN (1:1056)
ENGRAVED 1864

AMS Ref. Number: J2014
Jacobs Ref. Number: 32110100

Legend

Assessment Area

NOTES

Background mapping: Ordnance Survey of Ireland. 1864. Town Plan 1:1056, City of Dublin: sheet 8, 9, 14, 15. 2nd ed. Dublin, Ireland : Ordnance Survey of Ireland.

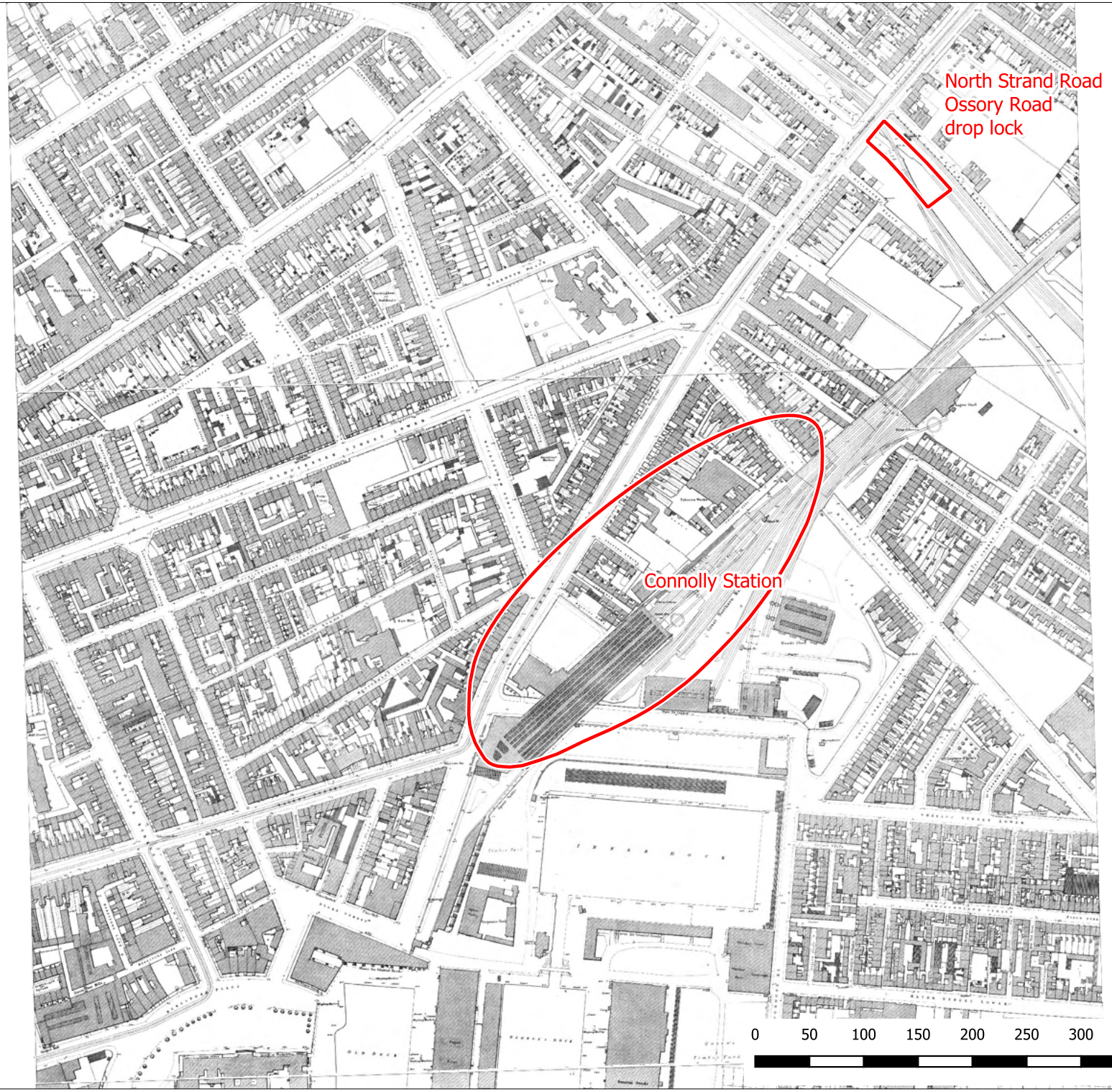


FIGURE 8

CONNOLLY STATION
ENHANCEMENT OPTIONS STUDY
ASSESSMENT AREAS
ORDNANCE SURVEY OF IRELAND
TOWN PLAN (1:1056)
ENGRAVED 1888

AMS Ref. Number: J2014
Jacobs Ref. Number: 32110100

Legend

Assessment Area

NOTES

Background mapping: Ordnance Survey of Ireland. 1888. Town Plan 1:1056, City of Dublin: sheet 38, 48, 58. 3rd ed. Dublin, Ireland : Ordnance Survey of Ireland.

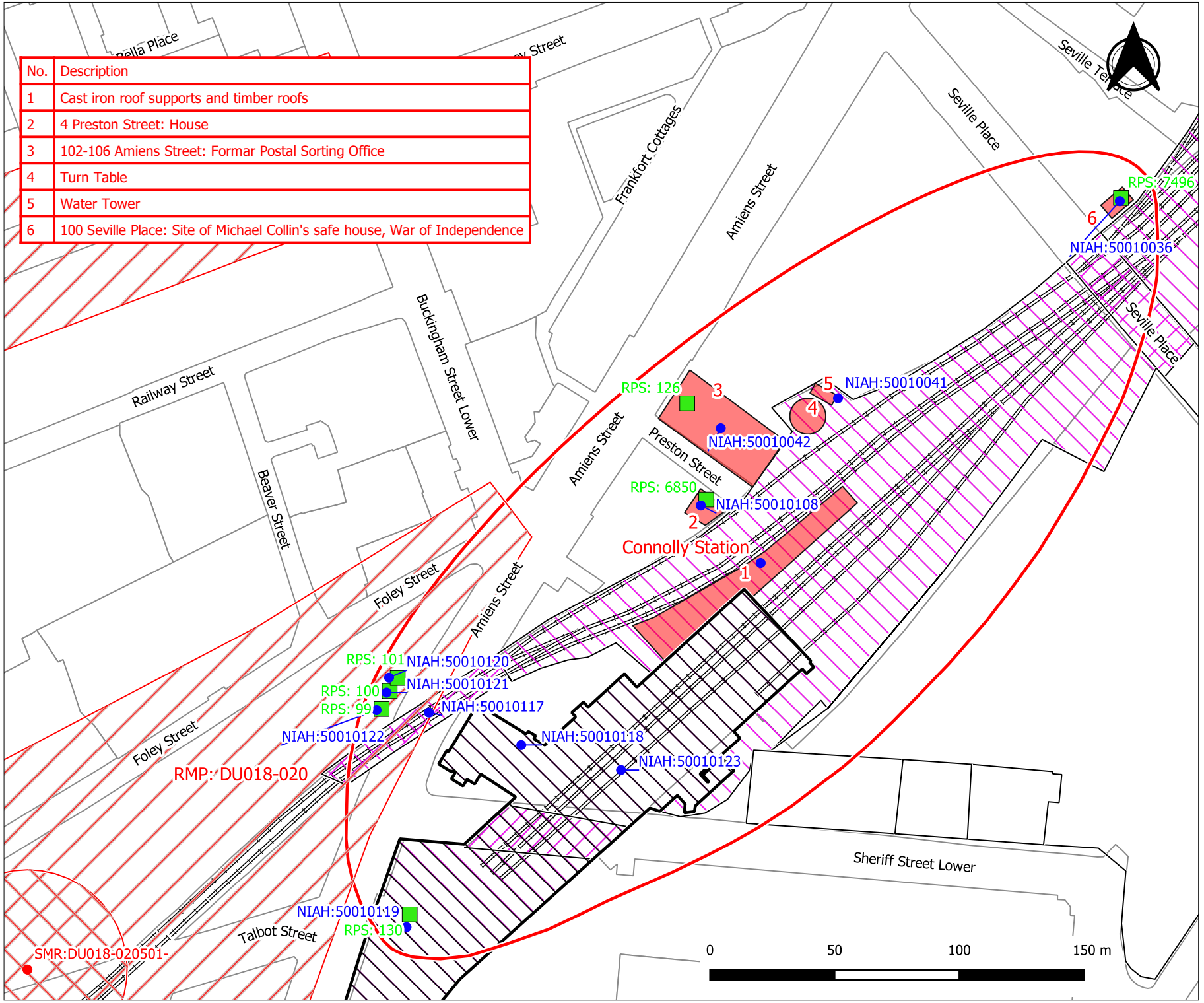


FIGURE 9

CONNOLLY STATION
ENHANCEMENT OPTIONS STUDY
ASSESSMENT AREAS
CONNOLLY STATION AREA
RECORDED ARCHAEOLOGY
AND ARCHITECTURE

AMS Ref. Number: J2014
Jacobs Ref. Number: 32110100

Legend

- Assessment Area
- Features
- Brick Arches
- Bridge
- Connolly Station
- NIAH
- RPS
- SMR Zone
- SMR
- RMP DU018-20

NOTES

Background mapping: Street names from Open Street Maps; RMP, RPS and street outline from Dublin City Council: https://data.smartdublin.ie/dataset/development-plans-dublin-city. SMR and NIAH from www.archaeology.ie.

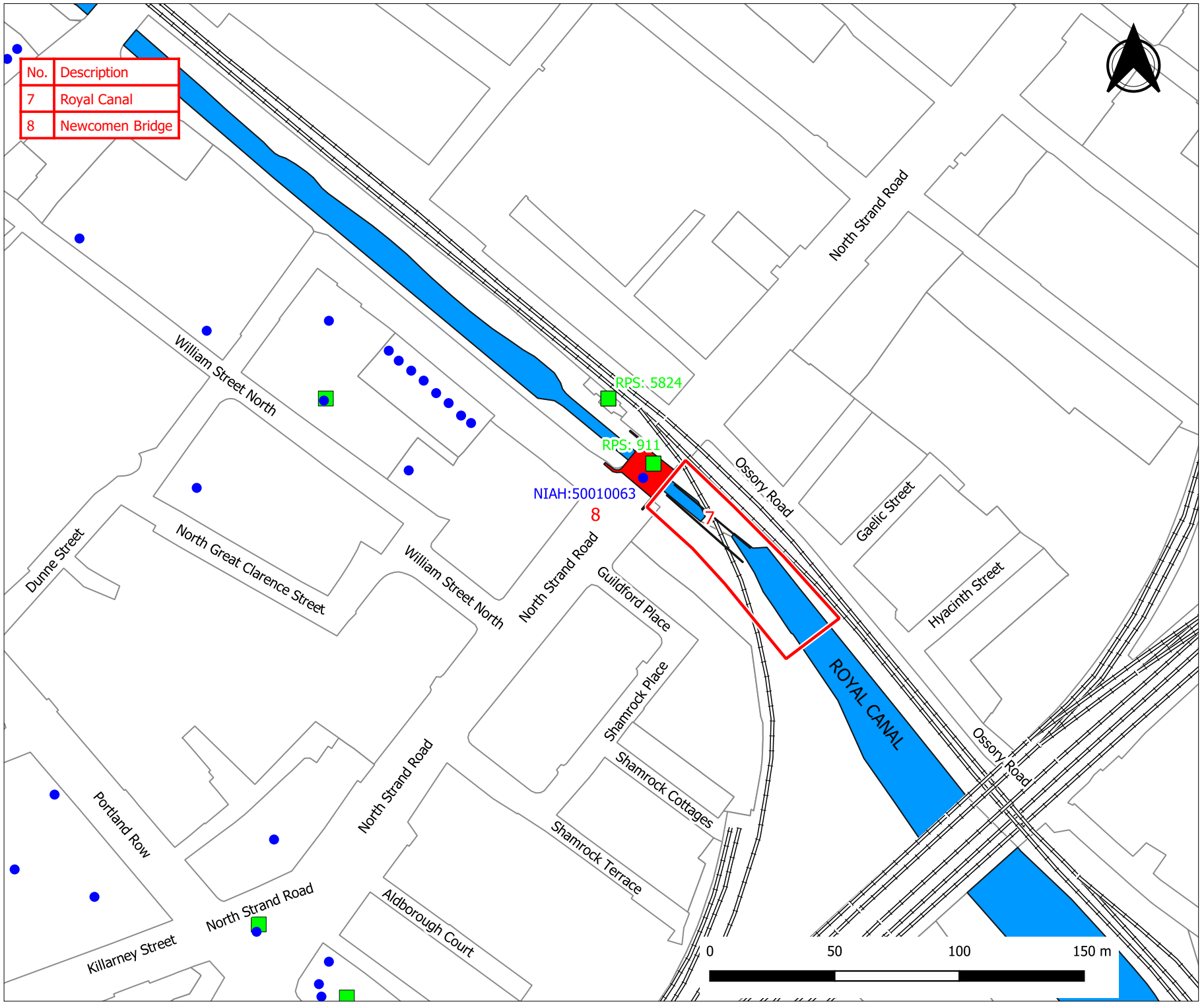


FIGURE 10

CONNOLLY STATION
ENHANCEMENT OPTIONS STUDY
ASSESSMENT AREAS
NEWCOMEN BRIDGE/ OSSORY ROAD DROP LOCK AREA
RECORDED ARCHAEOLOGY AND ARCHITECTURE

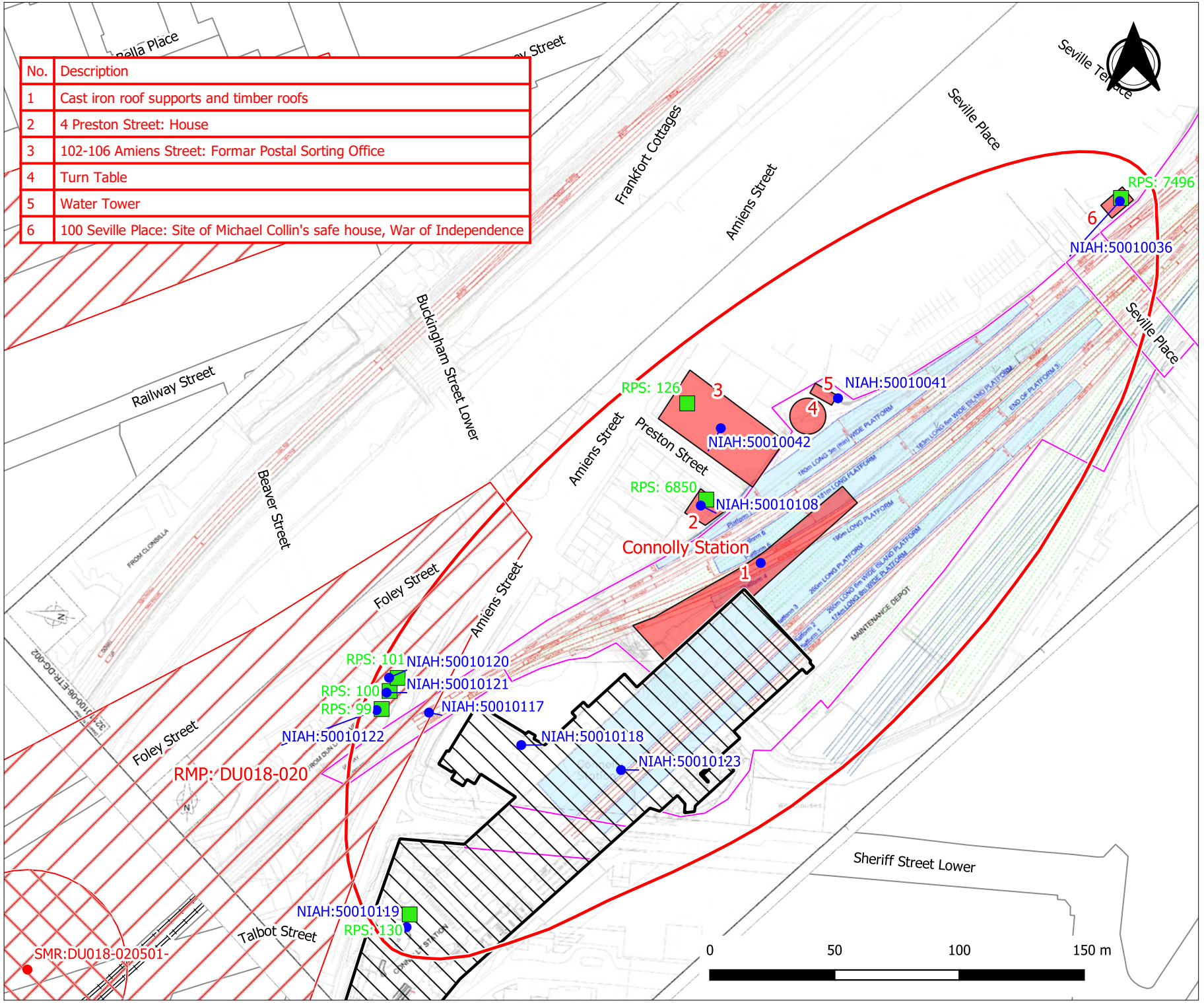
AMS Ref. Number: J2014
Jacobs Ref. Number: 32110100

Legend

- Assessment Area
- Features
- Brick Arches
- Bridge
- NIAH
- RPS

NOTES

Background mapping: Street names from Open Street Maps; RMP, RPS and street outline from Dublin City Council: https://data.smartdublin.ie/dataset/development-plans-dublin-city. NIAH from www.archaeology.ie.



No.	Description
1	Cast iron roof supports and timber roofs
2	4 Preston Street: House
3	102-106 Amiens Street: Formar Postal Sorting Office
4	Turn Table
5	Water Tower
6	100 Seville Place: Site of Michael Collin's safe house, War of Independence

FIGURE 11

CONNOLLY STATION
ENHANCEMENT OPTIONS STUDY
ASSESSMENT AREAS
CONNOLLY STATION AREA
OPTION 6B

AMS Ref. Number: J2014
Jacobs Ref. Number: 32110100

Legend

- Assessment Area
- Features
- Brick Arches
- Connolly Station
- NIAH
- RPS
- SMR Zone
- SMR
- RMP DU018-20

NOTES

Background mapping: Street names from Open Street Maps; RMP, RPS and street outline from Dublin City Council: https://data.smartdublin.ie/dataset/development-plans-dublin-city. SMR and NIAH from www.archaeology.ie.

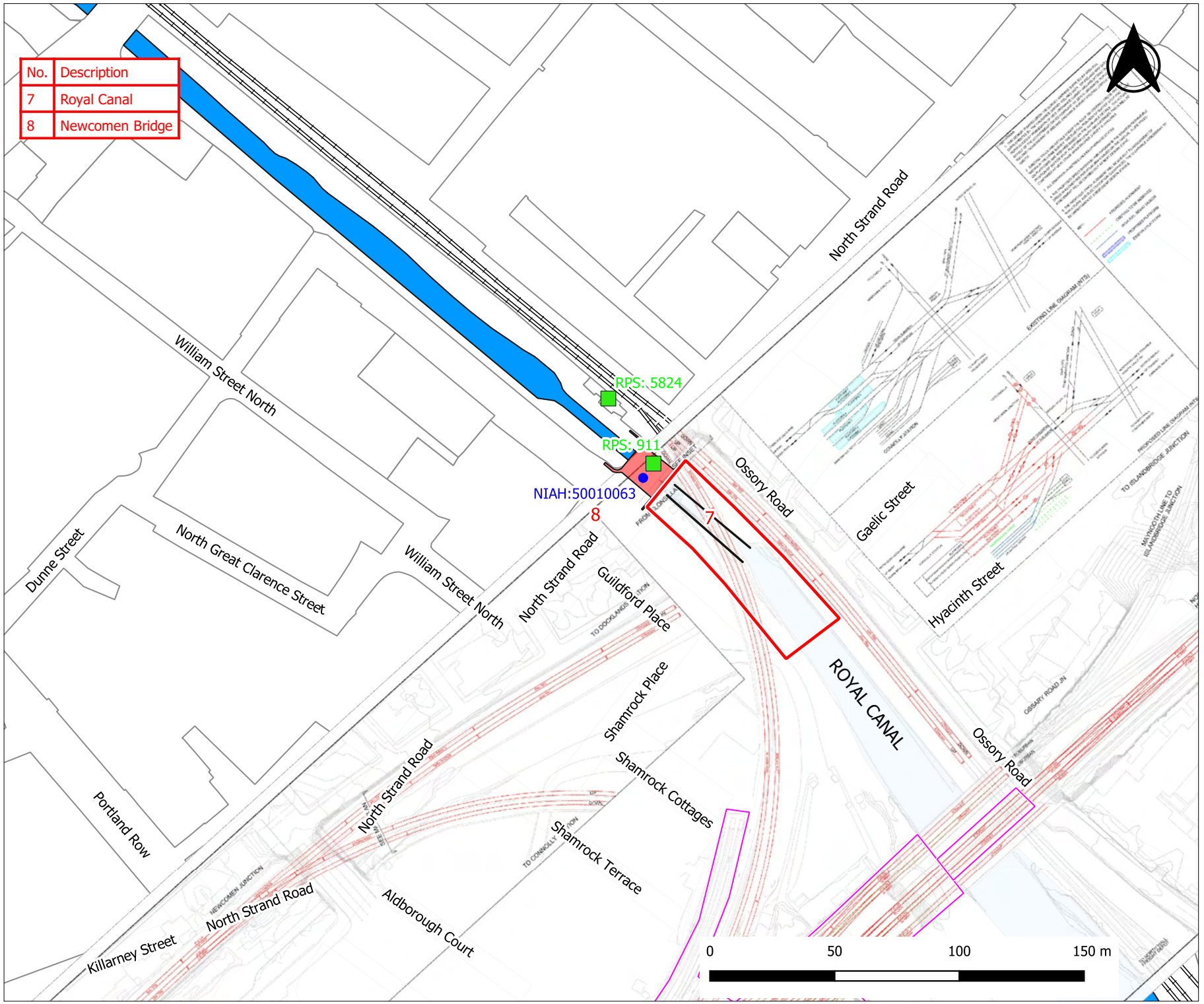


FIGURE 12

CONNOLLY STATION
ENHANCEMENT OPTIONS STUDY
ASSESSMENT AREAS
NEWCOMEN BRIDGE/ OSSORY ROAD DROP LOCK AREA
OPTION 6B

AMS Ref. Number: J2014
Jacobs Ref. Number: 32110100

Legend

- Assessment Area
- Features
- Brick Arches
- NIAH
- RPS

NOTES

Background mapping: Street names from Open Street Maps; RMP, RPS and street outline from Dublin City Council: https://data.smartdublin.ie/dataset/development-plans-dublin-city. NIAH from www.archaeology.ie.

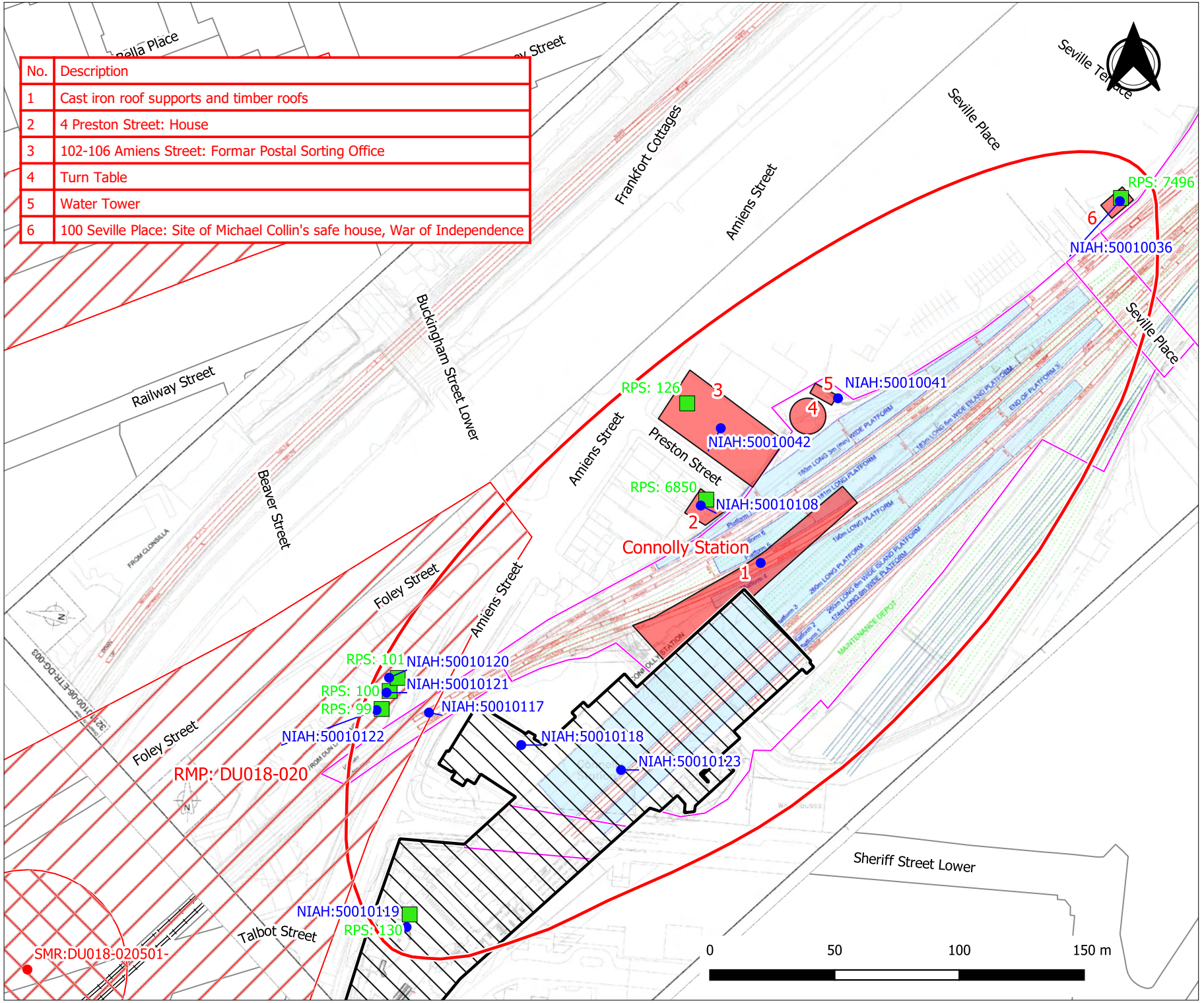


FIGURE 13

CONNOLLY STATION
ENHANCEMENT OPTIONS STUDY
ASSESSMENT AREAS
CONNOLLY STATION AREA
OPTION 6D

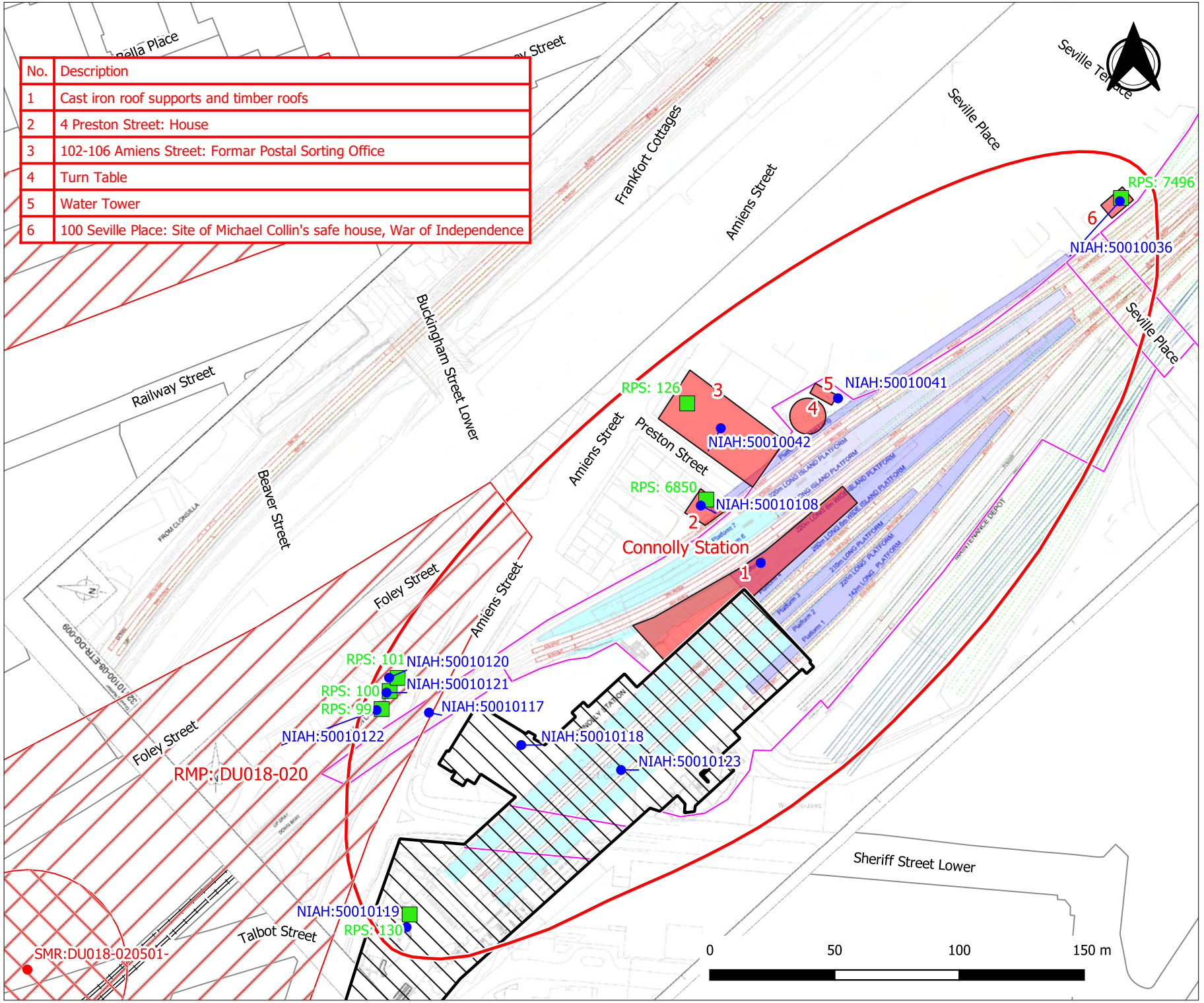
AMS Ref. Number: J2014
Jacobs Ref. Number: 32110100

Legend

- Assessment Area
- Features
- Brick Arches
- Connolly Station
- NIAH
- RPS
- SMR Zone
- SMR
- RMP DU018-20

NOTES

Background mapping: Street names from Open Street Maps; RMP, RPS and street outline from Dublin City Council: https://data.smartdublin.ie/dataset/development-plans-dublin-city. SMR and NIAH from www.archaeology.ie.



No.	Description
1	Cast iron roof supports and timber roofs
2	4 Preston Street: House
3	102-104 Amiens Street: Formar Postal Sorting Office
4	Turn Table
5	Water Tower
6	100 Seville Place: Site of Michael Collin's safe house, War of Independence

FIGURE 14

CONNOLLY STATION
ENHANCEMENT OPTIONS STUDY
ASSESSMENT AREAS
CONNOLLY STATION AREA
OPTION 8D

AMS Ref. Number: J2014
Jacobs Ref. Number: 32110100

Legend

- Assessment Area
- Features
- Brick Arches
- Connolly Station
- NIAH
- RPS
- SMR Zone
- SMR
- RMP DU018-20

NOTES

Background mapping: Street names from Open Street Maps; RMP, RPS and street outline from Dublin City Council: https://data.smartdublin.ie/dataset/development-plans-dublin-city. SMR and NIAH from www.archaeology.ie.