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Iarnród Éireann
Irish Rail

30th August 2023

Cllr David Healy

Email: david.healy@cllrs.fingal.ie

Re: AIE Request response [IE_AIE_031]

Dear Cllr David Healy,

I refer to your request dated 28th July 2023, which was received by this office on that date, which you have made under the EC (Access to Information on the Environment) Regulations 2007 to 2014. Your request sought:

Request & response:

- Any analyses of potential operational patterns involving a shuttle service between Howth Junction and Howth, requiring passengers to change at Howth Junction to access Bayside, Sutton and Howth.

Attached below.

- Any analyses of the time delays or reduced capacity of the network at Howth Junction caused by the current arrangement where northbound trains to Howth cross the southbound track from Malahide.

No specific analyses undertaken over and above the attached reports.

- Any analyses of the time savings or increased capacity of the network should one or more Howth bound trains be replaced by a shuttle service.

No specific analyses undertaken over and above the attached reports.

- A copy of the terms of reference for "studies which will examine the doubling of track capacity between Dublin's Connolly and Malahide train stations, where DART and intercity traffic currently share the same tracks", for which funding was awarded on 22nd June.

Attached below.

Response:

I, Colm Reynolds, have now made a final decision to part grant your request on 23rd August 2023 see response below and the relevant documents attached along with schedule of records.

In the event that you are not happy with this decision you can make an appeal in relation to this matter, you can do so by writing to the FOI Unit, Corporate Communications, Iarnród Éireann Irish Rail, Connolly Station, Amiens St, Dublin 1 or by e-mail to foi@irishrail.ie.

Should you wish to discuss the above, please contact me by telephone at 087-6043902

Yours sincerely,

Mr. **Eoin Kennedy, Freedom of Information / Data Protection Office, Corporate Communications Iarnród Eireann Irish Rail, Connolly Station, Amiens Street, Dublin 1**

Access to information on the Enviroment Request:
Schedule of Records for IE_AIE_031 : Summary for Decision Making

Record No.	Date of Record	Brief Description	No. of Pages	Decision: Grant/Part Grant/Refuse	Section of Act if applicable	Record Edited/Identify Deletions
1	.2018.	Jacobs - AppB timetable report - Greater Dublin Area Timetable Modeling , please note: *(Section 3.2.5 states 'The Howth branch therefore operates as a shuttle between Howth and Howth Junction')*	37	Part Grant	S8(a)(i)	personal information (names of staff not apart of IE)
2	.2018.	addendum report - Dart Expansion programme options assesment , please be advised *(Page 27 includes the tph for all sections and states 'Howth to Howth Jn (Shuttle)' at 6tph.)*	28	Part Grant	S8(a)(i)	personal information (names of staff not apart of IE)
2	.2018.	addendum report - Dart Expansion programme options assesment	28	Part Grant	S9(a)(c)	S9(1)(c) - commercial or industrial confidentiality, where such confidentiality is provided for in national or Community law to protect a legitimate economic interest,

Signed
Freedom of Information / Data Protection Office

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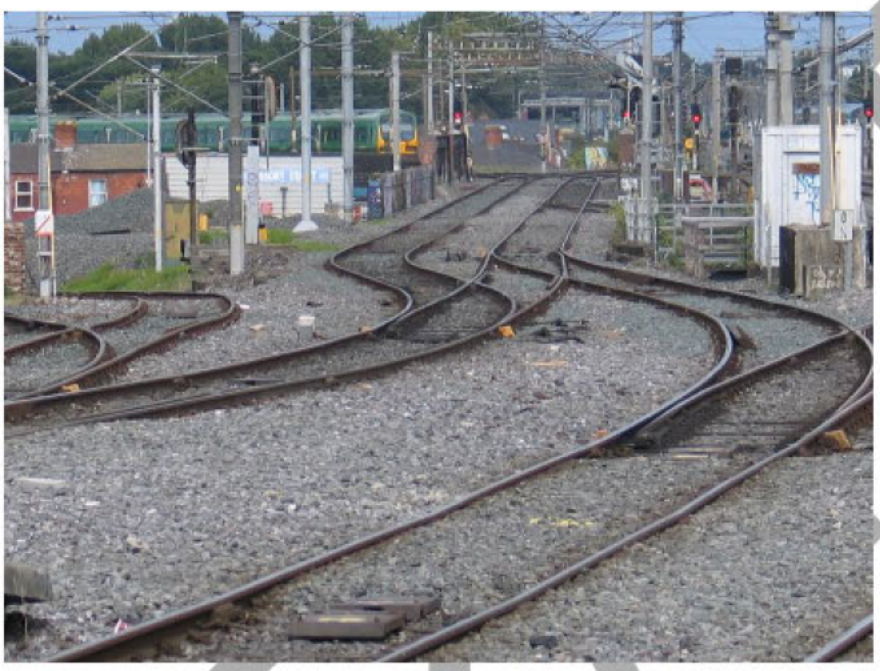
Greater Dublin Area Timetable Modelling



NTA

Review Paper

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TP-062.0

Document history and status

Revision	Date	Description	By	Review	Approved
01	24/03/18	First draft for review	[redacted]	[redacted]	[redacted]
02	25/03/18	After Initial Comments	[redacted]	[redacted]	[redacted]
03	16/04/18	After Timetable Review	[redacted]	[redacted]	[redacted]

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Greater Dublin Area Timetable Modelling

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Contents

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1. Executive Summary

The National Transport Authority's Transport Strategy for the Greater Dublin Area 2016-2035 includes a number of heavy rail infrastructure and service improvement interventions which will underpin the wider development of the heavy rail network across the GDA and nationally. This report considers how a set of proposed infrastructure interventions (including a remodeled Connolly station, Spencer Dock station and Dun Laoghaire turnback) would support the proposed Train Service Specification (TSS).

Two iterations of timetable modelling have taken place, the second following feedback from the NTA on the preliminary findings. The timetable which has been developed delivers the TSS, with the following exceptions:

- Only 15 tph (rather than 16 tph) operate to Maynooth due to signalling headway and plain line capacity constraints. Stopping patterns on this line are also sub-optimal as a result.
- 3 tph terminate at Clongriffin and 3 tph at Malahide (leaving 7 tph operating to Drogheda) due to plain line capacity constraints. This requires infrastructure to turn back trains north of Howth Jn (e.g. at Malahide)
- 3 tph terminating at Dun Laoghaire (leaving 9 tph operating to Bray) due to signalling constraints and turnback facilities at Bray

All of these factors are in areas which are not affected by the enhanced infrastructure provided. Therefore, it is recommended that these constraints are considered further should the service levels in the TSS be required.

The enhanced infrastructure as modelled supports the service levels in the TSS. Specifically:

- **Connolly / Newcomen Jn**. The layout has been developed in conjunction with the timetable modelling. The final layout is therefore the optimal way of delivering the TSS. Key features include the Platform 6 & 7 scissors crossover which enables parallel moves at Newcomen Junction (note this maintains the current 8-car length rather than enabling 10-car services) and the parallel crossovers from Platforms 4 & 5 to the Suburban lines which provide flexibility and will have a performance benefit
- **Spencer Dock**. The proposed layout is highly flexible and supports the service levels in the TSS and provides a significant amount of room for further growth in services if required
- **Dun Laoghaire.** The centre turnback arrangement allows trains to terminate from Dublin and provides a performance benefit. The developed timetable could be delivered on the existing layout, but at an increased performance risk
- **Malahide**. Providing a 6 tph DART-style service on the line to Howth Jn (alongside an increase in services to Drogheda) requires turnback facilities to be provided (for example at Malahide)

A qualitative performance assessment has taken place during timetable development and has been fed into the engineering workstream. This uses a number of factors including static RailSys conflict modelling to consider the robustness of the timetable. Whilst performance in some areas will be expected to decline due to the significant number of extra trains operating without additional infrastructure (e.g. Maynooth line), the central Dublin area and supporting enhancements has been developed to support a high level of performance (provided a suitable signalling solution is also developed).

The developed timetable will provide a service level, journey time and service interval enhancement for most of the key stations into Central Dublin. Where this is not possible, proposals have been made to amend the timetable for future iterations. The timetable outputs here are one example of how the TSS can be delivered and what the enhanced infrastructure can also provide. Further development of the TSS is also recommended to consider the trade-offs between journey times, connectivity and stopping patterns which will allow further development of the timetable and supporting infrastructure.

2. Introduction

2.1 Background and purpose

The National Transport Authority's (NTA) Transport Strategy for the Greater Dublin Area (GDA) 2016-2035 includes a number of heavy rail infrastructure and service improvement interventions which will underpin the wider development of the heavy rail network across the GDA and nationally. In the exploration of opportunities related to Dart expansion, a number of partially integrated opportunities have been identified that, if confirmed as potentially viable, could be developed in parallel with various Dart expansion options.

The NTA have supplied a peak-hour Train Service Specification (TSS) which represents a significant uplift on most of the routes in the GDA. A number of infrastructure schemes have been developed by Jacobs which are intended to support these increased service levels.

The purpose of this Timetable Modelling exercise is to determine whether the proposed TSS can be delivered on the upgraded track layout, with acceptable performance. This will be assessed by developing a peak-hour timetable based on the TSS using RailSys combined with a qualitative performance assessment of the output timetable. Full dynamic performance modelling using RailSys can be undertaken at a later stage if required.

The results here are following two iterations of modelling, with the final results based upon feedback from the NTA on the preliminary findings.

2.2 Assumptions

2.2.1 Timetable Specification

A new timetable has been developed based on the TSS supplied by the NTA (NTA Bundle 6E). One amendment to this TSS was made before work commenced; this was an additional four trains per hour on the line between Heuston and Hazelhatch. This is shown diagrammatically in Figure 1.

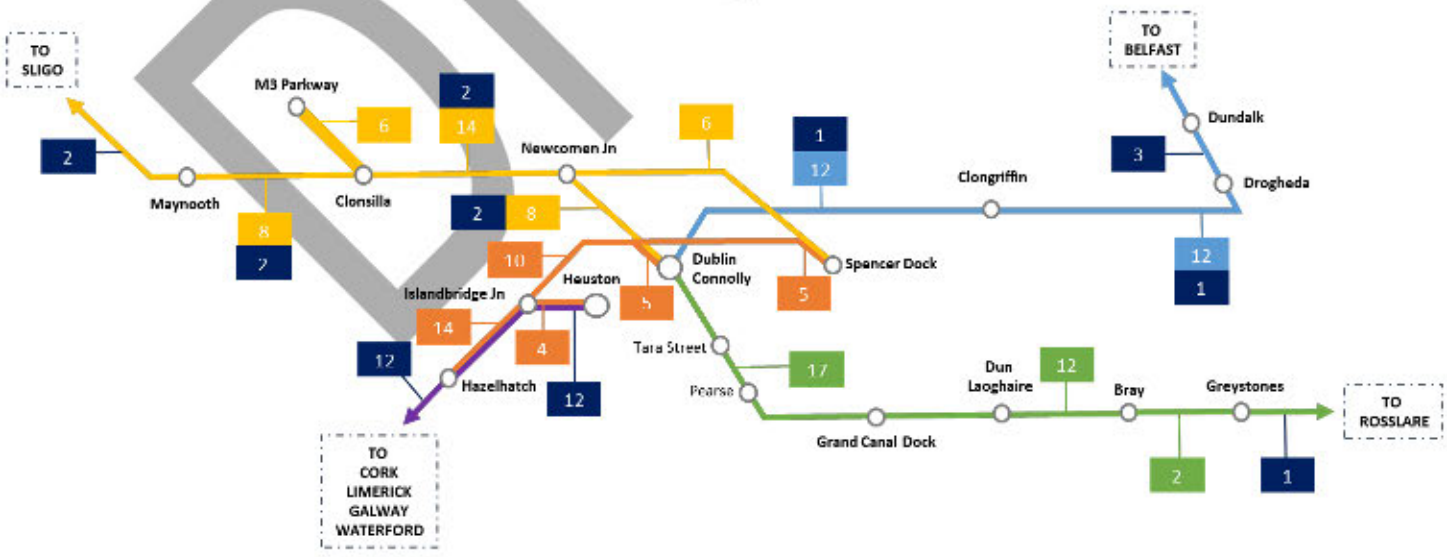

Figure 1: NTA Train Service Specification

The timetable developed here is based on a peak standard hour pattern which could be repeated to give a three-hour peak. It is assumed that the same service structure and service level operates in both the peak and contra-peak directions.

2.2.2 Infrastructure

The current RailSys model of the GDA was updated to include the post-Dublin City Centre Resignalling infrastructure. A number of proposed enhancement schemes were then overlaid on top of this base infrastructure (Table 1).

Infrastructure	Source	Document Reference
Connolly Station Remodelling and Newcomen Junction	Jacobs	32106211-IRM-PW-GAD-20000 Version P04
Spencer Dock Station	Jacobs	32106211-IRM-PW-GAD-30000 Version P01
Heuston West New Station	Jacobs	32106211-IRM-CIV-GA-70000 Version P01
Dun Laoghaire Station Turnback Platform	Jacobs	32106211-IRM-PW-GAD-80000 Version P01
Whitworth New Station	Jacobs	Whitworth Concept Sketch
Malahide Turnback Facility	Jacobs	Malahide Station Turnback
Park West – Heuston 4-tracking	IE	18_1.1 K05_1020 - 1026
Clongriffin Up Loop	IE	Proposed Up Loop at Clongriffin Station

Table 1: Additional Infrastructure Included in timetable modelling

The sketches provided do not include signalling detail. Therefore, for new infrastructure, signalling has been provided in the RailSys model which reflects the existing railway (e.g. in terms of signal spacing and number of aspects).

This is a reasonable assumption given the level of scheme development here, but the RailSys model will need to be refined during the scheme development process to reflect the actual infrastructure (if different from the assumptions).

2.2.3 Timetable Planning Values

The timetable created as part of this workstream has used the timetable planning values currently in use and as shown in the December 2017 Irish Rail Working Timetable. Where infrastructure has been modified or additional detail is required, RailSys has been used to calculate new or amended values as described below.

Sectional Running Times (SRTs)

The running times from the December 2017 Working Timetable have been applied for this work. The main exceptions to this are:

- Connolly Station: the increased linespeed through the station area has enabled a reduction in some of the running times in this area
- Proposed New Stations. SRT values have been calculated using RailSys based on the proposed locations of the new stations
- Park West – Heuston 4-tracking. It is assumed that the running times for the new 4-tracked section will be the same as for the existing railway

Due to the significant increase in the number of services, additional rolling stock would be required to operate the timetable. This would require new rolling stock with unknown performance characteristics. In order to provide a worst-case scenario in terms of rolling stock performance, services were timed using the current running times for DART, ICR or Enterprise sets depending on the service being considered.

Headways

Example headway values have been calculated using RailSys and used as a guideline for the timetable modelling. More detail is given in section 3.1

2.2.4 RailSys Modelling

All modelling using RailSys has been undertaken in Version 10.3.296.

The 2018 RailSys Standards issued by Network Rail (for use in the UK) have been applied to this modelling as an example of good practice.

The base RailSys model for the GDA was provided by IE.

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3. Findings

3.1 Capacity Analysis

Most of the routes in the GDA see a significant increase in service levels in the proposed TSS. This is summarised by route in Table 2.

Route	December 2017	NTA Bundle 6E
Connolly – Drogheda	10 Commuter / DART 1 InterCity **TOTAL: 11**	12 Commuter / DART 1 Intercity 6 Howth branch shuttles **TOTAL: 13 + 6**
Connolly – Greystones	3 Greystones / InterCity 3 Bray 1 Grand Canal Dock 2 Pearse 2 Empty Coaching Stock **TOTAL: 11**	2 Greystones / InterCity 10 Bray 5 Grand Canal Dock **TOTAL: 17**
Connolly – Maynooth	3 Commuter (Connolly) 2 Commuter (Docklands) 1 InterCity (Connolly) **TOTAL: 6**	8 Commuter (Connolly) 6 Commuter (Docklands) 2 InterCity (Connolly) **TOTAL: 16**
Heuston - Hazelhatch	2 Inner Commuter (Phoenix Park line) 2 Inner Commuter (Heuston) 8 Outer Commuter / InterCity **TOTAL: 12**	10 Inner Commuter (Phoenix Park line) 4 Inner Commuter (Heuston) 12 Outer Commuter / InterCity **TOTAL: 26**

Table 2: Number of services by route section arriving into Dublin between 0800-0859 for current (December 2017) timetable compared to the NTA TSS

However, the enhanced TSS is assumed to operate in both peak and contra-peak directions and across the whole of the three-hour peak. Currently, the contra-peak service is typically lower and there are fewer services in other hours compared to the high peak hour. Therefore, the total increase in trains across the three-hour peak is significantly higher than highlighted in Table 2.

To consider the feasibility of operating this service where additional infrastructure is not provided above today, approximate headways and capacity usage has been calculated using RailSys and analysed using the number of trains in the TSS (**Error! Reference source not found.**). A range of headways is required to accommodate

both stopping and non-stop services. For stopping trains, it has been assumed that the trains may not arrive on a green signal at some locations where this would significantly increase the headway (for example, where a train arriving at a station on a green signal would require the previous train to have left the next station).

The range of capacity use values also reflect possible mixes of stopping and non-stopping trains. It is assumed that below 75%-line capacity use would be achievable without issue, 75-90% is achievable but may cause a performance impact and above 90% is unlikely to be achievable in practice.

Route	Section	Calculated Headways (min)	Trains Per Hour	Approximate Capacity Use
Heuston – Kildare	Heuston – Adamstown (SL)	3.0	14	80-85%
	Heuston – Adamstown (FL)	3.5 – 4.0	12	70%
	Adamstown - Kildare	3.0 – 4.5	12	60-90%
Islandbridge – Spencer Dock	Islandbridge Jn – North Strand Jn	5.0 – 5.5	10	90-100%
	North Strand Jn – Spencer Dock	3.0	5	25%
	North Strand Jn - Connolly	3.0	5	25%
Maynooth Line	Maynooth – Clonsilla	4.0 - 5.0	10	80-90%
	M3 Parkway – Clonsilla	4.5	6	50%
	Clonsilla – Broombridge	3.0 – 3.5	16	90-110%
	Broombridge – Newcomen Jn	3.0 – 4.0	16	100-120%
Connolly - Bray	Bray – Killiney	3.0	12	60-70%
	Killiney – Dun Laoghaire	3.0 – 4.0	12	80-90%
	Dun Laoghaire – Grand Canal Dock	3.0 – 3.5	12	60-70%
	Grand Canal Dock - Connolly	2.0	17	60-75%
Connolly - Drogheda	Connolly – Howth Jn	3.0 – 4.0	13	75–85%
	Howth Jn – Drogheda	3.5 – 4.5	13	90-110%
	Howth Jn - Howth	4.5	6	50%

Table 3: RailSys Calculated Headways and Approximate Capacity Use based on TSS (headway values not inclusive of dwell time)

The key sections of concern are therefore:

- **Islandbridge Jn – Glasnevin Jn (Phoenix Park line):** IE have indicated that this section would be resignalled to support the service levels
- **Newcomen Jn – Clonsilla:** The level of service cannot be supported on this section. A lower service level than the ITSS will need to be timetabled, however this will still represent a performance risk without further infrastructure and will impact journey times.
- **Dun Laoghaire – Killiney:** Although not above 90%, the service levels on this section would impact journey times and cause a performance risk as it feeds in to the critical section between Grand Canal Dock and Connolly. This could be mitigated by using the proposed Dun Laoghaire turnback or resignalling

- **Howth Jn – Drogheda:** Operating all 13 trains per hour as far as Drogheda would not be achievable, would extend journey times (including for Enterprise) and represent a performance risk. Therefore, terminating some services short of Drogheda is likely to be required.

3.2 Timetable Development and Outputs

3.2.1 Timetable Development Principles

The NTA TSS does not provide details of the stopping patterns for the services in the TSS. Therefore, there is a trade-off between providing faster limited-stop services from outlying areas and providing an increase in stopping services from stations closer to Dublin. As a general guide, the following timetable development principles were adopted:

- Journey times to be no longer than today, with an improvement if possible
- Service intervals to be as even as possible
- The number of calls at intermediate stations to be equivalent (or better) than today

3.2.2 Dublin to Hazelhatch (Slow Lines)

In the TSS, this route has a significant increase to 14 trains per hour; this is enabled by the additional four-tracking between Park West and Islandbridge Junction. New stations have been assumed near Inchicore (Kylemore Road), Heuston West and Whitworth (Glasnevin Junction).

Of the 14 trains per hour, four terminate at Heuston, five terminate at Spencer Dock and five terminate at Connolly. As noted in section 3.1, the 10 trains per hour on the Phoenix Park line will require a headway reduction to operate reliably.

Due to the high number of trains, it is assumed that all trains call at all stations. Stops could be removed from certain services if required, but this is unlikely to provide a significant journey time improvement due to the number of trains operating. It is assumed there is no interaction between the Slow Lines and Fast Lines, and outer commuter services (towards Kildare) will be served from the Fast Lines into Heuston.

The output TSS is shown in Table 4.

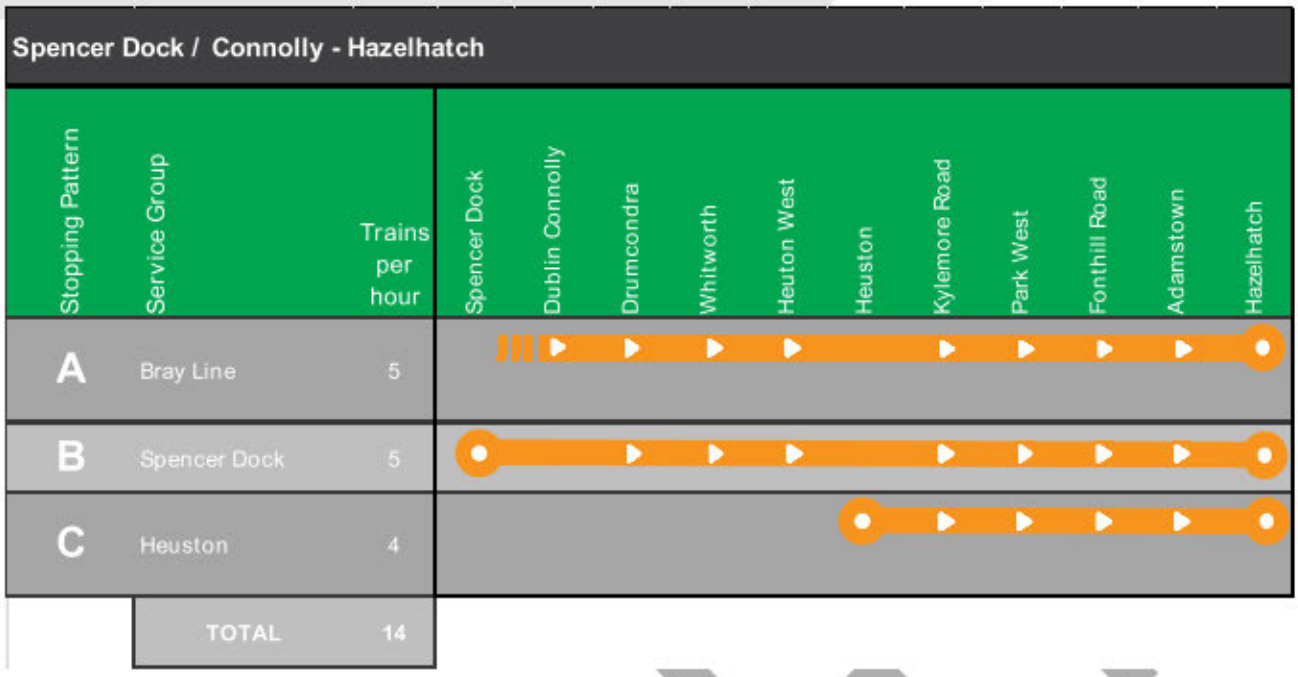

Table 4: Output TSS for Dublin - Hazelhatch (Slow Lines)

An even 6-minute service interval is provided between Heuston West and Drumcondra, with trains alternating between Connolly and Spencer Dock. The trains to Connolly are extended towards Bray as described in section 3.2.6. Some trains have pathing time between Drumcondra and Connolly. This is because a train arrives from the Phoenix Park Line (at Connolly) every 12 minutes and must fit into the 15-minute repeating service pattern arriving from Howth Junction. This could be avoided by operating a service with 6 trains to Spencer Dock and 4 trains to Connolly; however, this would mean uneven service intervals and loss of the alternating pattern on the rest of the line.

The 14 trains between Islandbridge Junction and Hazelhatch would require a train approximate every 4 ¼ minutes to give an even service interval on this section. This would not fit well with the 6-minute service interval on the Phoenix Park line, and either journey times would be extended (to get back to a 6-minute interval) or an irregular service provided to/from Connolly and Spencer Dock.

Instead, the trains from the Phoenix Park line are flexed slightly to give a 5-7 minute service interval between Hazelhatch and Heuston West. The four trains to Heuston run in the larger gaps; this does mean that the trains to and from Heuston operate at a 12/18 minute service interval rather than a standard 15-minute interval. However, it would not be possible to provide an even interval even if the 4 ¼ interval alternative were used instead.

Turnround times for these trains are:

- 6 – 9 minutes at Hazelhatch
- 8 – 14 minutes at Heuston
- 15 minutes at Spencer Dock

3.2.3 Dublin to Kildare (Fast Lines)

In the TSS, this route has an increase from 8 to 12 trains per hour. This can be accommodated on the infrastructure provided that stopping patterns are 'flighted'. The destinations are not specified in the TSS, however it is assumed that the service would be similar to:

- 2 fast trains Dublin – Cork (non-stop on this section)
- 2 semi-fast trains to Waterford, aligning to the current times on the single line at Athy
- 6 semi-fast or stopping trains to Portarlington or Portlaoise, providing the outer commuter service
- 2 trains to Newbridge (in order to reduce capacity use between Newbridge and Cherryville Junction and alleviate potential headway issues).

This service is based on a 30-minute repeating pattern and is shown (with example calling patterns) in Table 5).

Heuston - Kildare (Fast Lines)

Stopping Pattern	Service Group	Trains per hour	Heuston	Inchicore	Park West	Fonthill Road	Kishogue	Adamstown	Hazelhatch	Sallins	Newbridge	Kildare
A	Heuston - Newbridge	2	●							▶	●	
B	Heuston - Portlaoise	2	●							▶	▶	▶
C	Heuston - Portarlington	2	●						▶			▶
D	Heuston - Portlaoise	2	●							▶		
E	Heuston - Waterford	2	●								▶	▶
F	Heuston - Cork	2	●									
	TOTAL	12										

Table 5: Output TSS for Dublin - Kildare (Fast Lines)

It is assumed that Fast Line trains do not need to call between Heuston and Sallins & Naas. However, two calls are provided at Hazelhatch to connect into the Slow Line services and provide connectivity to the intermediate stations. The calling patterns shown in Table 5 are suggested examples only and can be amended once further details are known (for example, which outer-commuter stations need the connectivity to the Slow Line stations).

3.2.4 Maynooth Line

The TSS for the Maynooth Line shows an increase to 16 trains per hour. As discussed in section 3.1, this is not achievable due to signalling headways and line capacity. 15 trains per hour is the most that is achievable, which is demonstrated here.

The stations from Broombridge to Clonsilla currently receive five trains per hour in the high peak hour into Dublin. It is not possible to provide five trains calling at all stations from Broombridge to Clonsilla without having a significant detrimental impact on the journey time of the remaining services. As a result, a skip-stopping pattern must be used. Due to the number of trains and restrictive headways, it is not possible for a train to call at more than two stations in a row before it is caught by the following train. Therefore, ten trains provide the skip-stop patterns on this section. This therefore leads to a repeating timetable pattern with five groups of 3 trains:

- A train from M3 Parkway calling at Clonsilla, Coolmine, Navan Road and Ashtown
- A train from Maynooth calling at Coolmine, Castleknock, Ashtown and Broombridge
- A train from Maynooth running fast or picking up selected intermediate calls

For the last train path in the group, it is used twice an hour to provide a fast service which is suitable for extending as an InterCity path to Sligo or another destination as required. In addition, it is used three times per hour to call at selected intermediate stations to provide connectivity between stations (e.g. every station can travel to every other) and to provide all stations with a service to Connolly.

This is shown in Table 6.

Connolly / Spencer Dock - Maynooth & M3 Parkway																
Stopping Pattern	Service Group	Trains per hour	Connolly	Spencer Dock	Whitworth	Broombridge	Ashtown	Navan Road	Castleknock	Coolmine	Clonsilla	Hansfield	Dunboyne	M3 Parkway	Leixlip Confey	Leixlip Louisa	Maynooth
A	Connolly - Maynooth	5	●		▶	▶	▶		▶	▶					▶	▶	●
B	Spencer Dock - M3 Parkway	5		●	▶		▶	▶		▶	▶	▶	▶	●			
C	Connolly - Maynooth	1	●		▶	▶					▶						●
D	Connolly - Maynooth	1	●		▶	▶		▶	▶								●
E	Connolly - Maynooth	1	●		▶				▶		▶						●
F	Connolly - InterCity	2	●		▶												●
	TOTAL	15															

Table 6: Output TSS for Dublin - Maynooth & M3 Parkway

It is assumed that all trains will call at Whitworth for interchange purposes. The two InterCity paths per hour provide a journey time which is the same as the current fastest Dublin – Maynooth journey time. Providing any other intermediate calls on other services (for example to improve connectivity) would extend this journey time. When the other three Maynooth paths (C, D and E in Table 6) operate, additional stops could be added at Leixlip Confey and Leixlip Louisa without impact (to provide connectivity to the other intermediate stations if required).

The timetable is structured around parallel moves at Newcomen Junction as otherwise this would represent a significant capacity constraint. These parallel moves require the updated design at Connolly, with a scissors

crossover at the end of Platforms 6 and 7; this enables the parallel move to occur at Newcomen Junction as otherwise trains arriving at Connolly Platform 7 would conflict with departures from Platform 6 at Newcome Junction.

Turnrounds for all services are 8 minutes at Connolly and 7 minutes at Docklands.

It is acknowledged that the service patterns shown here are a compromise to retain current intermediate station calls and current journey times despite the significant increase in the number of trains operating. It may be possible to provide minor tweaks to the intermediate stopping patterns between Broombridge and Clonsilla to optimize connectivity between stations taking into account travel patterns and demands, but no significant changes are possible. Whilst resignalling would provide a performance benefit, it is likely a section of four-tracking somewhere between Broombridge and Clonsilla would be required to enable the higher service levels to operate and maintain an all-stations 'inner' service.

3.2.5 Dublin – Drogheda

Although the increase in service levels on this route is relatively small, the current timetable structure cannot be carried over due to the increase in contra-peak service levels. This causes a constraint at Howth Junction (crossing moves towards Howth) and at Malahide, where it is not possible to turnround enough trains whilst maintaining contra-peak service levels towards Drogheda.

To deliver a 6 tph all-stations service between Connolly and Howth Junction additional infrastructure is required to turnback trains. The locations chosen are at Clongriffin (using the assumed loop) and Malahide (using a new turnback facility due to the enhanced contra-peak service). The Howth branch therefore operates as a shuttle between Howth and Howth Junction.

If three trains per hour terminate at Clongriffin and three at Malahide, the remaining 7 trains per hour (including Enterprise) must therefore run as far as Drogheda, whereas only 5 trains per hour operate that far today. Running this many trains calling at all stations would impact on the journey time for Enterprise. As most stations beyond Malahide only receive around four calls today, it is possible to implement a mixture of skip-stopping and stopping services.

As a starting point, half of the trains call at all stations between Portmarnock and Drogheda and half have a skip-stopping pattern calling at the larger stations (by passenger usage). This pattern is slightly amended (stops are removed) when the Enterprise operates to avoid having a journey time impact; the journey times for Enterprise are similar to today. If the Enterprise does not operate every hour, it is possible to adopt a more uniform stopping pattern.

To fit in between the 6 tph service beween Howth Jn and Connolly, most of the 'outer' commuter services have additional time inserted into the timetable. This can be used to add station calls at selected 'inner' stations to maintain current connectivity and service levels.

The calling patterns shown in Table 7 are a representative example only; fine-tuning can occur when the station usage and intermediate journey requirements are better understood.

Table 7: Output TSS for Dublin – Dundalk

3.2.6 Dublin – Bray & Greystones

This route has 17 trains per hour in the TSS, with 12 trains running from the Dundalk line and 5 trains from Hazelhatch. Integrating these two service groups together is difficult as the Dundalk line is based on a 15-minute repeating pattern and Hazelhatch on a 12-minute pattern. Therefore, the approach taken here is to run 6 groups of 2 trains, with four trains added on to the end of some of the groups. This delivers 16 tph; it is not possible to operate 17 tph in this structure due to the constraint of suitable locations to turnback trains.

To provide a mix of intermediate calls and journey time improvements, three different calling patterns are used with the trains 'flighted' together:

- 4 trains per hour all stations to Grand Canal Dock (from Hazelhatch or Drogheda)
- 6 trains per hour all stations to Dun Laoghaire (from Dundalk or Drogheda). Three trains continue to Bray as it is not possible to terminate all 6 trains at Dun Laoghaire. These trains call at some of the intermediate stations between Dun Laoghaire and Bray in order to provide extra calls and provide 6 tph at these stations
- 6 trains per hour semi-fast to Dun Laoghaire (calling at central Dublin stations then Lansdowne Road, Sydney Parade, and Blackrock). Five of these trains then call at all stations between Dun Laoghaire and Bray with the sixth path running non-stop (to provide a suitable intercity path if required)

This option uses Dun Laoghaire turnback as an alternative to resignalling and remodeling at Bray. The bigger stations (Dun Laoghaire and Blackrock) are also likely to realise a journey time improvement. All stations receive a minimum of 6 tph with up to 12 tph at the larger stations.

Due to the integration of the trains from Drogheda and Hazelhatch, there is some swapping of origin and destinations (across Connolly) for the Dun Laoghaire and Bray stopping trains. However, to resolve this would

involve changing the number of trains from each route running across Dublin and would have a knock-on impact on service intervals on the other routes.

As an example, in the timetable described here, one of the semi-fast paths suitable for an intercity train beyond Greystones links to the stopping service from Malahide. Should this not be desirable, there is an opportunity to split the service at Connolly using the bay platforms.

Connolly - Dun Laoghaire - Bray - Greystones

Stopping Pattern	Service Group	Trains per hour
A	Hazelhatch / Drogheda - Grand Canal Dock	4
B	Drogheda / Dundalk - Dun Laoghaire	3
C	Drogheda - Bray	1
D	Drogheda - Bray	1
E	Drogheda - Greystones	1
F	Malahide / Clongriffin - Bray	5
G	Malahide - Greystones	1
	TOTAL	16

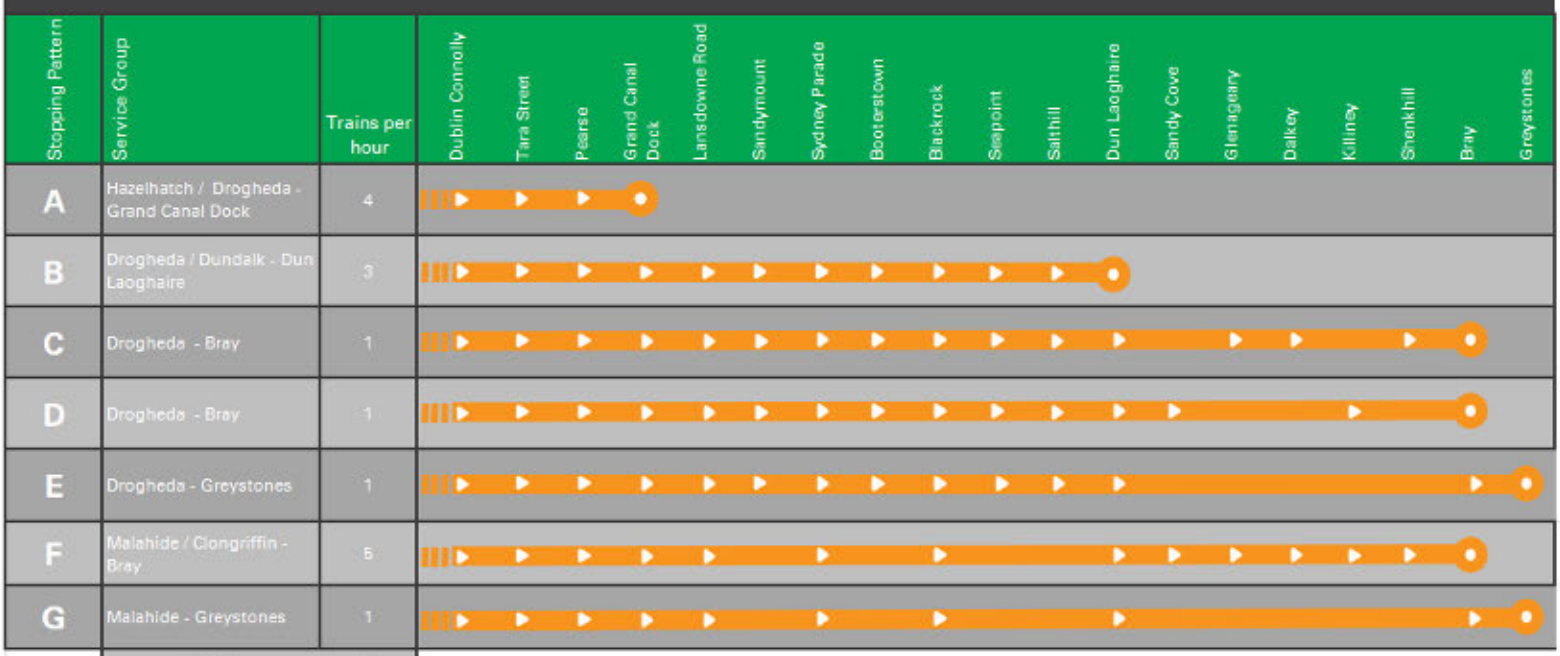

Table 8: Output TSS for Dublin – Greystones

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3.3 Sample Outputs

As described in section 3.2, as stopping patterns are not described in the TSS the example outputs are only one way to express what the infrastructure can deliver. The aim of the exercise is to provide a journey time and service increase where possible.

To demonstrate what this may mean in practice, the NTA National Heavy Rail Census report (published September 2017) has been used to examine what the outputs are for the twelve stations with the biggest daily passenger numbers in the study area (excluding the central Dublin stations).

	December 2017 Timetable				Future Timetable based on TSS			
Station	Trains Per Hour	Quickest Journey Time (min)	Average Journey Time (min)	Service Interval (min)	Trains Per Hour	Quickest Journey Time (min)	Average Journey Time (min)	Service Interval (min)
Dun Laoghaire	6	24.0	24.7	8 - 15	12	22.0	23.5	3 - 7
Lansdowne Rd	6	9.5	10.3	5 - 15	12	9.0	9.5	3 - 7
Bray	6	42.0	43.0	6 - 15	9	36.5	40.6	5 - 10
Blackrock	6	18.0	18.9	6 - 15	12	16.5	17.0	4 - 6
Maynooth	4	33.0	42.4	10 -19	10	33.0	34.5	5 - 7
Malahide	6	15.0	22.0	4 - 18	8	19.0	23.5	8 - 9
Raheny	7	11.0	11.4	5 - 17	9	10.0	10.7	4 - 10
Greystones	3	53.0	53.8	8 - 22	2	47.0	50.0	30
Sydney Parade	5	13.5	14.0	5 - 15	12	12.5	12.8	5 - 10
Howth Junction	9	12.0	14.3	5 - 12	9	12.5	14.9	5 - 10
Balbriggan	4	39.5	41.9	10 - 21	5	38.0	40.8	6 - 19
Clonsilla	5	22.0	25.8	7 - 15	7	20.5	21.6	4 - 12

Table 9: Comparison of outputs for the December 2017 and future timetable. Based on arrivals into Connolly between 0800-0900. For future timetable, Green = better than 2017, white = the same as 2017, red = worse than 2017.

As Table 9 shows, most stations show an improvement in number of station calls, headline quickest journey times and average journey times.

For those issues highlighted in red, the following suggestions are made for the next iteration of the timetable:

- **Malahide**. The increase in stopping services to 6 tph has constrained the ability to provide fast non-stop trains to Dublin. Therefore, the average and lowest journey times have both increased.
- **Greystones**. It is not possible to operate a third path with two paths operating in the contra-peak direction. One contra-peak path would need to be removed.

- **Howth Junction**. As seen for Malahide, the increase in stopping services has caused a journey time increase.

The output TSS is shown in Figure 2.

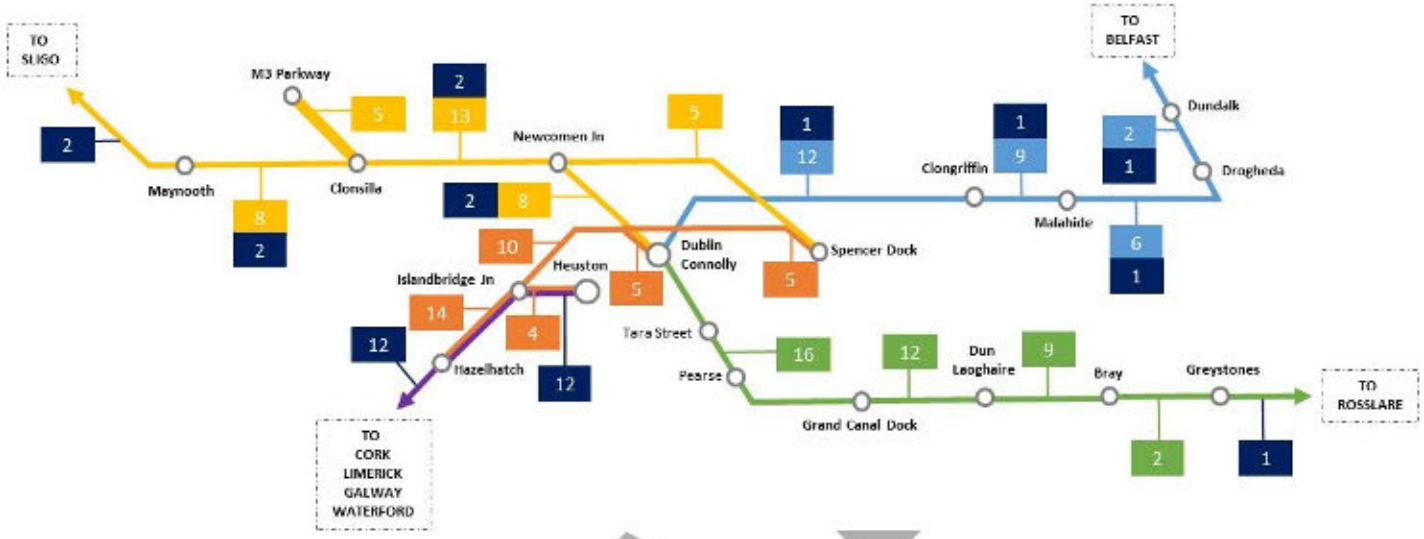

Figure 2: Output TSS (including results of the timetable modelling)

3.4 Performance

Dynamic performance modelling using RailSys has not been undertaken as part of this exercise. Instead, a qualitative assessment has been undertaken during the timetable development.

This has taken place in four different ways:

- Calculation of technical headway values using RailSys to ensure that the fundamental building blocks of the timetable are robust
- Feedback of the performance findings to the engineering disciplines, allowing development of designs based on the findings (e.g. Connolly station / Newcomen Junction layout)
- Assessment of the static conflicts highlighted in the timetable (i.e. to ensure that there are no significant conflicts in the timetable as developed)
- A single unperturbed dynamic simulation of the RailSys timetable. The maximum delay noted during the simulation was 25 seconds, which is significantly better than achieved in most timetables (the RailSys standards allow a value of 300 seconds as satisfactory for performance modelling). This value will never be zero due to the inherent issues in planning the timetable, such as the rounding of SRTs and junction margins to the nearest 30 seconds.

It is to be expected that dynamic performance modelling will show a performance decrease in some geographical areas. This is because on some routes there is a very significant increase in service levels (e.g. Maynooth line) without supporting infrastructure; this will always cause performance degradation. Further performance modelling would demonstrate what these issues area.

However, the enhanced infrastructure is supportive of performance and provides sufficient capacity (providing a suitable signalling solution is developed) to operate the TSS. The layout in the Connolly area segregates the traffic flows as much as is possible and provides redundancy where this cannot be achieved (e.g. the parallel crossovers on Platforms 4 and 5). The layout at Dun Laoghaire supports the number of terminating trains and, as a through platform, would allow overtaking of slower services during perturbation. The layout at Spencer Dock provides sufficient capacity for future growth and will therefore support the service levels in the TSS.

4. Conclusions

A timetable has been developed which delivers the TSS, with the following exceptions:

- Only 15 tph (rather than 16 tph) operate to Maynooth due to signalling headway and plain line capacity constraints
- 3 tph terminate at Clongriffin and 3 tph at Malahide (leaving 7 tph operating to Dundalk) due to plain line capacity constraints. This requires a turnback facility to be provided at Malahide.
- 3 tph terminating at Dun Laoghaire (leaving 9 tph operating to Bray) due to signalling constraints and turnback facilities at Bray
- Only 16 tph (rather than 17 tph) operate between Connolly and Grand Canal Dock due to the combination of the calling patterns on the Drogheda and Hazelhatch lines

The developed timetable will provide a service level, journey time and service interval enhancement for most of the key stations into Central Dublin. Where this is not possible, proposals have been made to amend the timetable for future iterations.

The purpose of the modelling exercise is to determine whether the proposed enhanced infrastructure supports the TSS. Each of the infrastructure enhancements will now be discussed in turn.

4.1.1 Connolly Station & Newcomen Jn

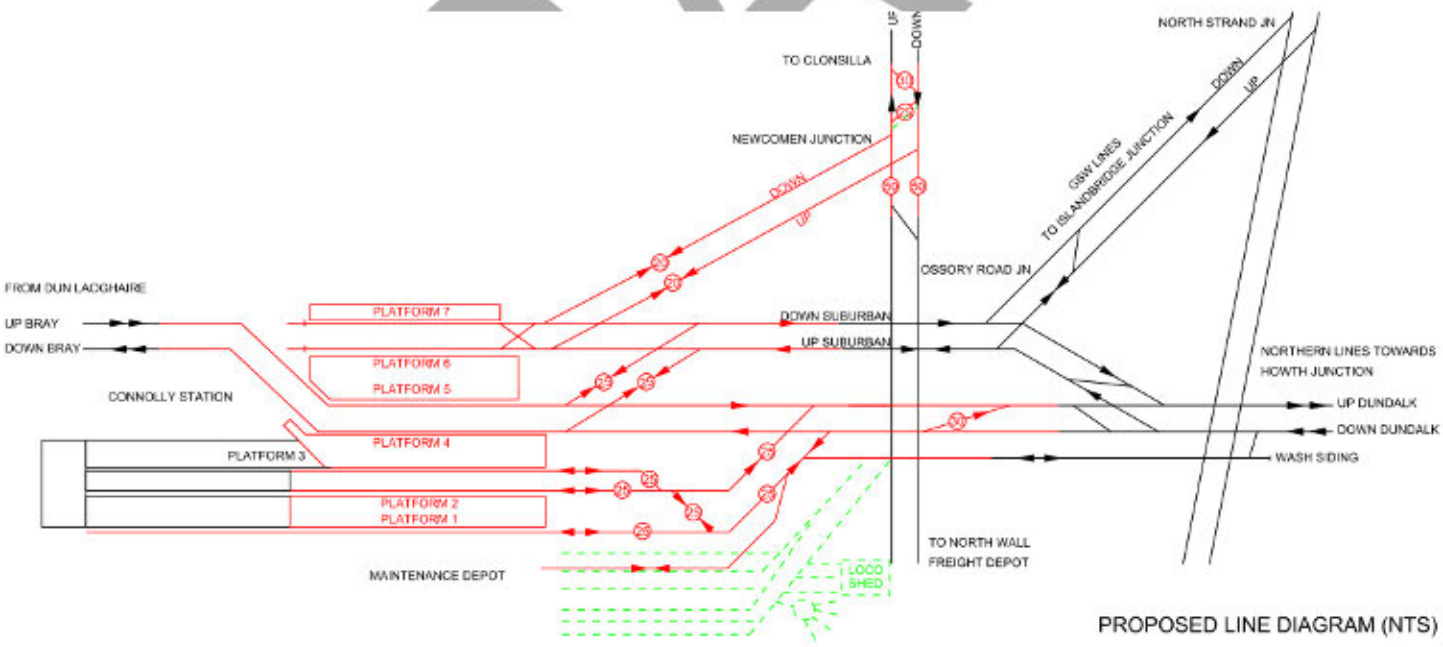

Figure 3: Connolly Layout as modelled

The Connolly and Newcomen Junction layout as modelled has been developed iteratively with the feedback from the modelling. As such, it represents the optimal way of delivering the TSS. The Platform 6 and 7 arrangements (as terminating platforms with a scissors crossover) combined with the doubling of the chord from Newcomen Junction is required to deliver the 10 trains per hour from the Maynooth line. Without the scissors crossover, it is

not possible to plan parallel moves at Newcomen Junction which would significantly increase performance risk and impact on the deliverability of the timetable.

The two additional crossovers at Newcomen Junction (and the bi-directional signalling on the chord) are not required for timetabling purposes as long as the scissors crossover is retained but could provide extra flexibility during perturbation.

Services cannot run towards Bray from Platforms 6 and 7. This is not required in the TSS, and it would be difficult to deliver in any case due to the number of conflicting moves this would introduce at the Bray end of Connolly station. Access (for example during engineering works) can be maintained by running *via* North Strand Junction if required.

The parallel crossovers between Platforms 4 and 5 and the Suburban lines are not strictly required to deliver the timetable but are necessary to mitigate the performance risk of through running from the Phoenix Park line.

The iterative process for platform 6 and 7 has resulted in a limitation of 8 cars (as now), on services using these platforms, whereas all other platforms are designed for a minimum of 10 cars. However, when the Dart Underground is commissioned and Northern Line services are diverted away from Connolly, it will be possible to remove the scissors, extend platforms 6 and 7 to 10 car and connect the platform 6 and 7 lines to the through tracks operating over the Loop Line bridge.

4.1.2 Spencer Dock Station

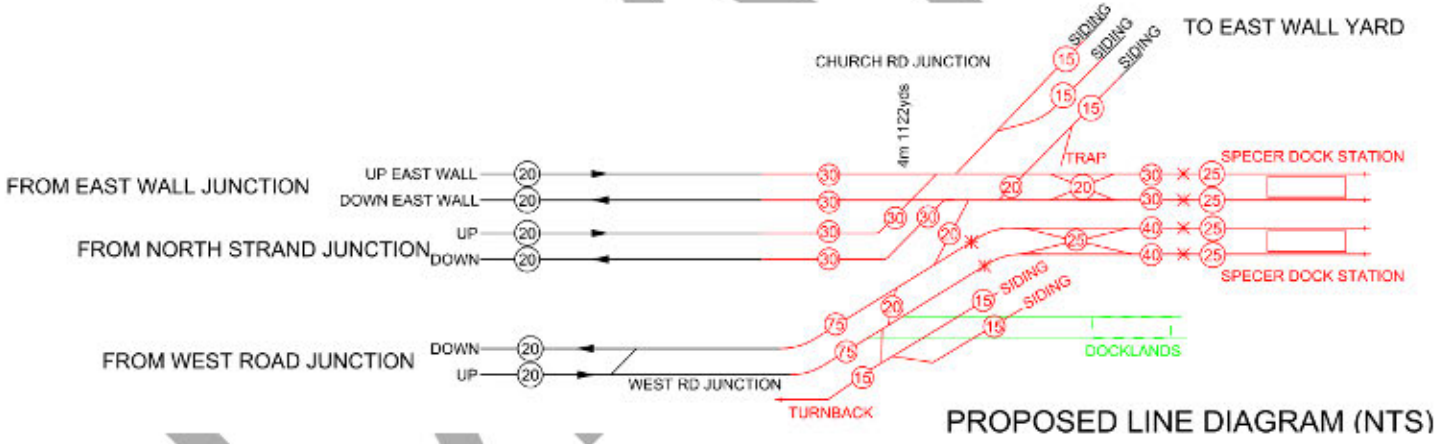

Figure 4: Spencer Dock station as modelled

The layout as modelled at Spencer Dock is more than sufficient to operate the level of service in the TSS (6 tph from the Maynooth Line and 5 tph from Hazelhatch). There is sufficient capability remaining to absorb future growth, including that using the connection from the Drogheda line.

4.1.3 Dun Laoghaire station

Dun Laoghaire station has been used to terminate three trains per hour in the timetable. This is an alternative to operating to Bray, which would likely require signalling enhancements and an improvement to turnback facilities at Bray. The centre turnback arrangement is likely to have a significant performance impact compared to a side turnback, although the side turnback could be made to work with the timetable.

In the modelled timetable, no through services use the new Platform 2 and as such it could be made into a terminal platform. However, this would remove the ability to overtake trains which may provide a performance improvement.

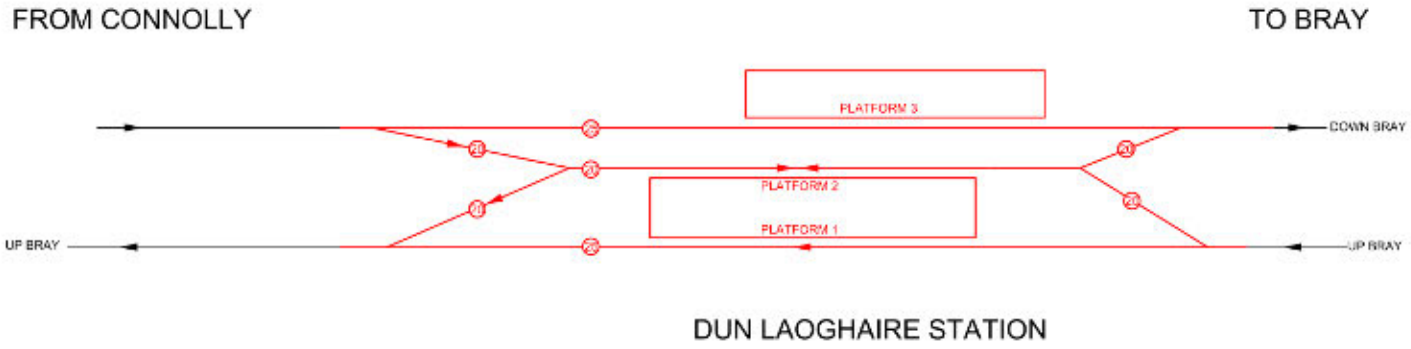

Figure 5: Dun Laoghaire station as modelled

4.1.4 Malahide Turnback

It is not possible to run all thirteen paths from Connolly as far as Drogheda. Three paths per hour terminate at Clongriffin on the assumed enhanced infrastructure (using the loop platform for through services). The additional three 'inner' suburban services also need to terminate somewhere on this section.

Currently, a number of peak services start at Malahide and turn back either in the station or by shunting out to the north end and into the opposite platform. This is not possible to achieve in the modelled timetable due to the increase in the number of services north of Malahide and an increase in the number of contra-peak trains compared to today.

A potential location for a turnback just north of Malahide station has been identified. Whilst there are environmental considerations to be taken into account, initial analysis suggests a centre turnback facility could be installed adjacent to the sewage works (Figure 6). A copy of the proposed sketch is provided in Section 6 (Appendix A).

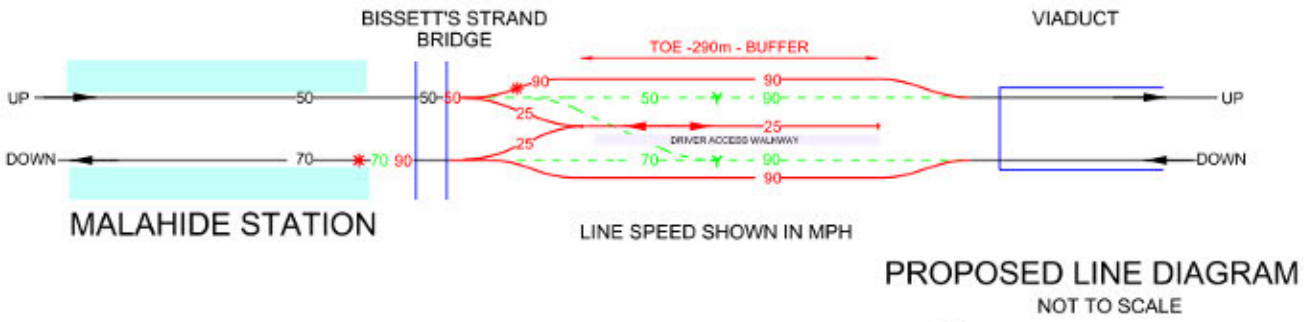

Figure 6: Malahide station proposal

4.1.5 New Stations

New stations have been included at Whitworth, Heuston West and Kylemore Road. These stations have been included in the timetable and the proposed infrastructure for each is sufficient to deliver the TSS. Omission of any of these stations would not have a significant impact on the findings in this report.

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5. Recommendations

This report has examined how the proposed enhanced infrastructure can deliver an enhanced train service in the GDA. The timetable outputs should be read as one way of expressing the outputs and are not a definitive output but are intended to demonstrate how the infrastructure could be used. Differing outputs could be achieved depending on the required outcomes in terms of calling patterns and journey times.

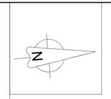
The infrastructure has been found to support the proposed TSS. Alongside the development of the infrastructure, the following activities are also recommended:

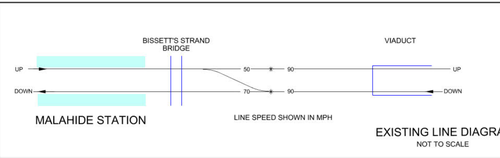
- Undertake the infrastructure development and timetable modelling together to ensure that the overall system output is optimized
- Produce a more definitive TSS which uses the findings of this report to consider stopping patterns, journey times and service intervals. This will provide a base on which further timetable modelling and engineering development can take place.
- Performance modelling of the infrastructure and timetable to highlight any areas where infrastructure may be required for robustness rather than capacity
- Consider the capacity constraints away from Central Dublin (e.g. the Maynooth line) and how the highlighted issues could be overcome

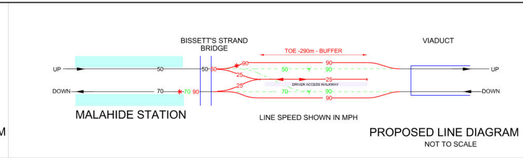
6. Appendix A

Proposed Malahide Turnback Sketch

Drawing Number
32106211-XXXXXXXXXX





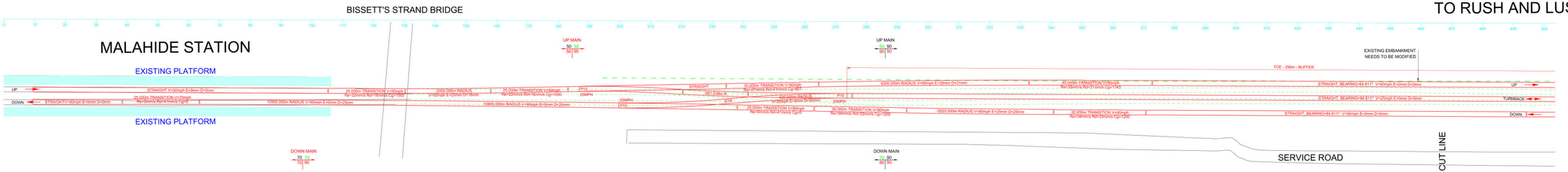


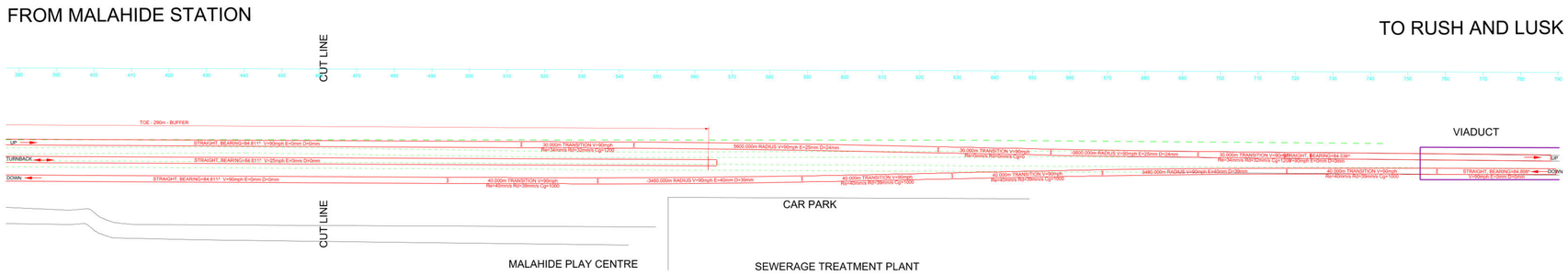
Legend/Notes

1. THIS DESIGN IS BASED UPON THE GOOGLE MAPPING TO UNDERSTAND THE FEASIBILITY OF THE ALIGNMENT. HENCE THE ACTUAL DISTANCE IN RELATION TO THE EXISTING POSITION OF TRACK AND STRUCTURE MAY VARY.
2. ALL DIMENSION IN METRES UNLESS OTHERWISE STATED.
3. THE PROPOSED SPEED SHOWN IN THIS DIAGRAM IS THE MAXIMUM PERMISSIBLE SPEED BASED ON THE DESIGN. A LINE SPEED ASSESSMENT MAY BE REQUIRED AT SUBSEQUENT DESIGN STAGE BASED ON THE SIGNALING REQUIREMENT AND EXISTING TRACK GEOMETRY.
4. THIS SKETCH IS BEING PREPARED WITHOUT ACCESS TO IRISH RAIL DESIGN STANDARDS. HENCE, THE LINE SPEED IS CALCULATED BASED ON FIRST ENGINEERING PRINCIPLES.
5. THE PROPOSED TRACK ALIGNMENT WILL BE SUBJECT TO ASSESSMENT OF STRUCTURAL AND ELECTRIFICATION (IF APPLICABLE) CLEARANCES. THE CLEARANCE ASSESSMENT TO BE UNDERTAKEN AT SUBSEQUENT DESIGN STAGES.
6. THE EXISTING AND PROPOSED SPEED SHOWN IN THIS DIAGRAM IS MPH.

KEY:-

- PROPOSED ALIGNMENT
- EXISTING EMBANKMENT NEED MODIFICATION
- EXISTING PLATFORM





DRAFT FOR INFORMATION ONLY

Rev	Date	Description of Revisions	Drawn	Chkd	Appr

Status: FOR INFORMATION ONLY

Údarás Náisiúnta Iompair
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Project

DART EXPANSION
TECHNICAL OPTIONS STUDY

Drawing Title

MALAHIDE STATION NORTH
PROPOSED TURNBAK FACILITY
PERMANENT WAY LAYOUT

Designed	S. PILLAI	Signed	Date -
Drawn	S. PILLAI	Signed	Date -
Checked	P. RANSOM	Signed	Date -
Approved	R. EASTMAN	Signed	Date -
Scale(s)	1:500	ELR & Mileage	-

Alternative Reference

Sheet 1 of 1

Drawing Number 32106211-XXXXXXXXXX

Revision P01

0 10 20 30 40 50m
SCALE 1:500

Sheet Size A1+2 594 x 1261

malahide station turnback.dgn 12/04/2018 18:06:58

7. Appendix B

Example Working Timetables

Hazelhatch - Dublin (Slow Lines only)

ID		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Previous	Arr	07:17	07:22	07:27	07:31	07:35	07:40	07:43	07:47	07:52	07:57	08:01	08:05	08:09	08:13
From	From	Greystones	Spencer Dk	Bray	Heuston	Spencer Dk	Dun Laog.	Heuston	Spencer Dk	Dun Laog.	Spencer Dk	Heuston	Pearse	Spencer Dk	Heuston
Hazelhatch	dep	**07:25**	**07:30**	**07:33**	**07:37**	**07:43**	**07:48**	**07:51**	**07:55**	**08:00**	**08:03**	**08:07**	**08:13**	**08:18**	**08:21**
Adamstown	dep	**07:29 ½**	**07:34 ½**	**07a38**	**07:41 ½**	**07:47 ½**	**07:52 ½**	**07a56**	**07:59 ½**	**08:04 ½**	**08a08**	**08:11 ½**	**08:17 ½**	**08:22 ½**	**08a26**
Kishogue	dep	*07/32*	*07/37*	*07/40 ½*	*07/44*	*07/50*	*07/55*	*07/58 ½*	*08/02*	*08/07*	*08/10 ½*	*08/14*	*08/20*	*08/25*	*08/28 ½*
Fonthill Road	dep	**07a34 ½**	**07a39 ½**	**07a43**	**07a46 ½**	**07a52 ½**	**07a57 ½**	**08a01**	**08a04 ½**	**08a09 ½**	**08a13**	**08a16 ½**	**08a22 ½**	**08a27 ½**	**08a31**
Park West	dep	**07:38**	**07:43**	**07:46 ½**	**07:50**	**07:56**	**08:01**	**08:04 ½**	**08:08**	**08:13**	**08:16 ½**	**08:20**	**08:26**	**08:31**	**08:34 ½**
HK 106	dep	*07/38 ½*	*07/43 ½*	*07/47*	*07/50 ½*	*07/56 ½*	*08/01 ½*	*08/05*	*08/08 ½*	*08/13 ½*	*08/17*	*08/20 ½*	*08/26 ½*	*08/31 ½*	*08/35*
Kylemore Road	dep	**07a41**	**07a46**	**07a49 ½**	**07a53**	**07a59**	**08a04**	**08a07 ½**	**08a11**	**08a16**	**08a19 ½**	**08a23**	**08a29**	**08a34**	**08a37 ½**
Inchicore	dep	*07/42*	*07/47*	*07/50 ½*	*07/54*	*08/00*	*08/05*	*08/08 ½*	*08/12*	*08/17*	*08/20 ½*	*08/24*	*08/30*	*08/35*	*08/38 ½*
Islandbridge Jn	dep	*07/44 ½*	*07/49 ½*	*07/53*	*07/56 ½*	*08/02 ½*	*08/07 ½*	*08/11*	*08/14 ½*	*08/19 ½*	*08/23*	*08/26 ½*	*08/32 ½*	*08/37 ½*	*08/41*
Heuston	Arr			**07:56**				**08:14**			**08:26**				**08:44**
Heuston West	Arr	**07:45 ½**	**07:50 ½**		**07:57 ½**	**08:03 ½**	**08:08 ½**		**08:15 ½**	**08:20 ½**		**08:27 ½**	**08:33 ½**	**08:38 ½**	
	dep	**07:46 ½**	**07:52 ½**		**07:58 ½**	**08:04 ½**	**08:10 ½**		**08:16 ½**	**08:22 ½**		**08:28 ½**	**08:34 ½**	**08:40 ½**	
Cabra	dep	*07/50 ½*	*07/56 ½*		*08/02 ½*	*08/08 ½*	*08/14 ½*		*08/20 ½*	*08/26 ½*		*08/32 ½*	*08/38 ½*	*08/44 ½*	
Glasnevin Jn	dep	*07/52 ½*	*07/58 ½*		*08/04 ½*	*08/10 ½*	*08/16 ½*		*08/22 ½*	*08/28 ½*		*08/34 ½*	*08/40 ½*	*08/46 ½*	
Whitworth	dep	**07:54**	**08:00**		**08:06**	**08:12**	**08:18**		**08:24**	**08:30**		**08:36**	**08:42**	**08:48**	
Drumcondra	dep	**07a56 ½**	**08a02 ½**		**08a08 ½**	**08a14 ½**	**08a20 ½**		**08a26 ½**	**08a32 ½**		**08a38 ½**	**08a44 ½**	**08a50 ½**	
North Strand Jn	dep	*07/58*	*08/04*		*08/10*	*08/16*	*08/22*		*08/28*	*08/34*		*08/40*	*08/46*	*08/52*	
Connolly	Arr	**08:00**			**08:14**		**08:26**			**08:41**			**08:48**		
Church Road Jn	dep		*08/05 ½*			*08/17 ½*			*08/29 ½*			*08/41 ½*		*08/53 ½*	
Spencer Dock	Arr		**08:07**			**08:19**			**08:31**			**08:43**		**08:55**	
To		Dun Laog.			Dun Laog.		Bray			Bray			Pearse		
Next	To		H'hatch	H'hatch		H'hatch		H'hatch	H'hatch		H'hatch	H'hatch		H'hatch	H'hatch
	Dep		08:22	09:10		08:34		08:22	08:46		08:40	08:58		09:10	08:52

Dublin - Hazelhatch (Slow Lines only)

ID		1	2	3	4	5	6	7	8	9	10	11	12	13	14
From	From	Dun Laog.			Dun Laog.			Pearse			Greystones		Bray		
Previous	Arr		08:14	07:55		08:07	08:26		08:19	08:44		08:31		08:56	08:43
	From		H'hatch	H'hatch		H'hatch	H'hatch		H'hatch	H'hatch		H'hatch		H'hatch	H'hatch
Spencer Dock	dep			**08:10**		**08:22**			**08:34**			**08:46**			**08:58**
Church Road Jn	dep			*08/11 ½*		*08/23 ½*			*08/35 ½*			*08/47 ½*			*08/59 ½*
Connolly	dep	**08:02**			**08:17**			**08:29**			**08:38**		**08:50**		
North Strand Jn	dep	08/07		*08/13*	*08/19*	*08/25*		*08/31*	*08/37*		*08/43*	*08/49*	*08/55*		*09/01*
Drumcondra	dep	**08a10**		**08a16**	**08a22**	**08a28**		**08a34**	**08a40**		**08a46**	**08a52**	**08a58**		**09a04**
Whitworth	dep	**08:12**		**08:18**	**08:24**	**08:30**		**08:36**	**08:42**		**08:48**	**08:54**	**09:00**		**09:06**
Glasnevin Jn	dep	*08/12 ½*		*08/18 ½*	*08/24 ½*	*08/30 ½*		*08/36 ½*	*08/42 ½*		*08/48 ½*	*08/54 ½*	*09/00 ½*		*09/06 ½*
Cabra	dep	*08/14 ½*		*08/20 ½*	*08/26 ½*	*08/32 ½*		*08/38 ½*	*08/44 ½*		*08/50 ½*	*08/56 ½*	*09/02 ½*		*09/08 ½*
Heuston West	Arr	**08:18 ½**		**08:24 ½**	**08:30 ½**	**08:36 ½**		**08:42 ½**	**08:48 ½**		**08:54 ½**	**09:00 ½**	**09:06 ½**		**09:12 ½**
	dep	**08:19 ½**		**08:26 ½**	**08:31 ½**	**08:37 ½**		**08:44 ½**	**08:49 ½**		**08:56 ½**	**09:01 ½**	**09:07 ½**		**09:14 ½**
Heuston	dep		**08:22**				**08:40**			**08:52**				**09:10**	
Islandbridge Jn	dep	*08/20 ½*	*08/24*	*08/27 ½*	*08/32 ½*	*08/38 ½*	*08/42*	*08/45 ½*	*08/50 ½*	*08/54*	*08/57 ½*	*09/02 ½*	*09/08 ½*	*09/12*	*09/15 ½*
Inchicore	dep	*08/23*	*08/26 ½*	*08/30*	*08/35*	*08/41*	*08/44 ½*	*08/48*	*08/53*	*08/56 ½*	*09/00*	*09/05*	*09/11*	*09/14 ½*	*09/18*
Kylemore Road	dep	**08:24 ½**	**08:28**	**08:31 ½**	**08:36 ½**	**08:42 ½**	**08:46**	**08:49 ½**	**08:54 ½**	**08:58**	**09:01 ½**	**09:06 ½**	**09:12 ½**	**09:16**	**09:19 ½**
Park West	dep	**08:27 ½**	**08a31 ½**	**08a35**	**08a40**	**08:45 ½**	**08:49**	**08a53**	**08:57 ½**	**09:01**	**09a05**	**09a10**	**09:15 ½**	**09:19**	**09a23**
Fonthill Road	dep	**08:30 ½**	**08:34 ½**	**08:38**	**08:43**	**08:48 ½**	**08:52**	**08:56**	**09:00 ½**	**09:04**	**09:08**	**09:13**	**09:18 ½**	**09:22**	**09:26**
Kishogue	dep	*08/32*	*08/36*	*08/39 ½*	*08/44 ½*	*08/50*	*08/53 ½*	*08/57 ½*	*09/02*	*09/05 ½*	*09/09 ½*	*09/14 ½*	*09/20*	*09/23 ½*	*09/27 ½*
Adamstown	dep	**08a36**	**08:39**	**08a43**	**08a48**	**08:53**	**08a57**	**09a01**	**09:05**	**09a09**	**09a13**	**09a18**	**09:23**	**09a27**	**09a31**
Hazelhatch	dep	**08:40**	**08:43**	**08:47**	**08:52**	**08:57**	**09:01**	**09:05**	**09:09**	**09:13**	**09:17**	**09:22**	**09:27**	**09:31**	**09:35**
Next	To	Bray	Heuston	Spencer Dk	Bray	Heuston	Spencer Dk	Pearse	Spencer Dk	Heuston	Dun Laog.	Spencer Dk	Heuston	Dun Laog.	Spencer Dk
	Dep	08:48	08:51	08:55	09:00	09:03	09:07	09:13	09:18	09:21	09:25	09:30	09:33	09:37	09:43

Portarlington - Dublin (Fast Lines only)

ID		1	2	3	4	5	6	7	8	9	10	11	12
Previous	Arr	07:18						07:48					
	Fm	N'bridge					Cork	N'bridge					Cork
Portarlington	dep		**07:28**	**07:33**	**07:39**		*07/54*		**07:58**	**08:03**	**08:09**		*08/24*
Monasterevin	dep		*07/32*	**07:38**	*07/43*		*07/57 ½*		*08/02*	**08:08**	*08/13*		*08/27 ½*
Athy	dep					**07:40**						**08:10**	
Cherryville Jn	dep		*07/35 ½*	*07/41 ½*	*07/46*	*07/50*	*08/00*		*08/05 ½*	*08/11 ½*	*08/16*	*08/20*	*08/30*
Kildare	dep		**07:39**	**07:45**	*07/50*	**07:54 ½**	*08/01 ½*		**08:09**	**08:15**	*08/20*	**08:24 ½**	*08/31 ½*
Curragh	dep		*07/41 ½*	*07/47 ½*	*07/52*	*07/57*	*08/03 ½*		*08/11 ½*	*08/17 ½*	*08/22*	*08/27*	*08/33 ½*
Newbridge	dep	**07:38**	**07a45**	*07/49*	*07/53 ½*	**08a00 ½**	*08/05*	**08:08**	**08a15**	*08/19*	*08/23 ½*	**08a30 ½**	*08/35*
HK177	dep	*07/42*	*07/48*	*07/51 ½*	*07/56 ½*	*08/04*	*08/08*	*08/12*	*08/18*	*08/21 ½*	*08/26 ½*	*08/34*	*08/38*
Sallins	dep	**07:45 ½**	*07/50 ½*	*07/54*	**08:00**	*08/06 ½*	*08/10*	**08:15 ½**	*08/20 ½*	*08/24*	**08:30**	*08/36 ½*	*08/40*
HK157	dep	*07/49 ½*	*07/53 ½*	*07/57*	*08/04*	*08/09*	*08/13*	*08/19 ½*	*08/23 ½*	*08/27*	*08/34*	*08/39*	*08/43*
HK151	dep	*07/51*	*07/56*	*07/59 ½*	*08/06 ½*	*08/10 ½*	*08/14 ½*	*08/21*	*08/26*	*08/29 ½*	*08/36 ½*	*08/40 ½*	*08/44 ½*
Hazelhatch	dep	*07/52*	*07/57*	**08:02**	*08/07*	*08/11*	*08/15*	*08/22*	*08/27*	**08:32**	*08/37*	*08/41*	*08/45*
Adamstown	dep	*07/54*	*07/59*	*08/04 ½*	*08/08 ½*	*08/12 ½*	*08/16 ½*	*08/24*	*08/29*	*08/34 ½*	*08/38 ½*	*08/42 ½*	*08/46 ½*
Kishogue	dep	*07/55*	*08/00*	*08/05 ½*	*08/09 ½*	*08/13 ½*	*08/17 ½*	*08/25*	*08/30*	*08/35 ½*	*08/39 ½*	*08/43 ½*	*08/47 ½*
Fonthill Road	dep	*07/56*	*08/01*	*08/06 ½*	*08/10 ½*	*08/14 ½*	*08/18 ½*	*08/26*	*08/31*	*08/36 ½*	*08/40 ½*	*08/44 ½*	*08/48 ½*
Park West	dep	*07/57*	*08/02*	*08/07 ½*	*08/11 ½*	*08/15 ½*	*08/19 ½*	*08/27*	*08/32*	*08/37 ½*	*08/41 ½*	*08/45 ½*	*08/49 ½*
HK101	dep	*07/57 ½*	*08/02 ½*	*08/08*	*08/12*	*08/16*	*08/20*	*08/27 ½*	*08/32 ½*	*08/38*	*08/42*	*08/46*	*08/50*
Inchicore	dep	*07/59*	*08/04*	*08/09 ½*	*08/13 ½*	*08/17 ½*	*08/21 ½*	*08/29*	*08/34*	*08/39 ½*	*08/43 ½*	*08/47 ½*	*08/51 ½*
Islandbridge Jn	dep	*08/01 ½*	*08/06 ½*	*08/12*	*08/16*	*08/20*	*08/24*	*08/31 ½*	*08/36 ½*	*08/42*	*08/46*	*08/50*	*08/54*
Heuston	dep	**08:06**	**08:11**	**08:16**	**08:20**	**08:24**	**08:28**	**08:36**	**08:41**	**08:46**	**08:50**	**08:54**	**08:58**
Next	To	N'bridge	Port.	Port.	Port.	W'ford	Cork	N'bridge	Port.	Port.	Port.	W'ford	Cork
	Dep	08:23	08:34	08:39	08:43	08:49	09:00	08:53	09:04	09:09	09:13	09:19	09:30

Dublin - Portarlington (Fast Lines only)

ID		1	2	3	4	5	6	7	8	9	10	11	12
Previous	Arr	07:28	07:41	07:46	07:50	07:54	08:06	07:58	08:11	08:16	08:20	08:24	08:36
	Fm	Cork	Port.	Port.	Port.	W'ford	N'bridge	Cork	Port.	Port.	Port.	W'ford	N'bridge
Heuston	dep	**08:00**	**08:04**	**08:09**	**08:13**	**08:19**	**08:23**	**08:30**	**08:34**	**08:39**	**08:43**	**08:49**	**08:53**
Islandbridge Jn	dep	*08/01 ½*	*08/05 ½*	*08/10 ½*	*08/14 ½*	*08/20 ½*	*08/24 ½*	*08/31 ½*	*08/35 ½*	*08/40 ½*	*08/44 ½*	*08/50 ½*	*08/54 ½*
Inchicore	dep	*08/04 ½*	*08/08*	*08/13*	*08/17*	*08/23*	*08/27*	*08/34 ½*	*08/38*	*08/43*	*08/47*	*08/53*	*08/57*
HK101	dep	*08/05 ½*	*08/09*	*08/14*	*08/18*	*08/24*	*08/28*	*08/35 ½*	*08/39*	*08/44*	*08/48*	*08/54*	*08/58*
Park West	dep	*08/06 ½*	*08/10*	*08/15*	*08/19*	*08/25*	*08/29*	*08/36 ½*	*08/40*	*08/45*	*08/49*	*08/55*	*08/59*
Fonthill Road	dep	*08/07 ½*	*08/11*	*08/16*	*08/20*	*08/26*	*08/30*	*08/37 ½*	*08/41*	*08/46*	*08/50*	*08/56*	*09/00*
Kishogue	dep	*08/08 ½*	*08/12*	*08/17*	*08/21*	*08/27*	*08/31*	*08/38 ½*	*08/42*	*08/47*	*08/51*	*08/57*	*09/01*
Adamstown	dep	*08/09 ½*	*08/13*	*08/18*	*08/22*	*08/28*	*08/32*	*08/39 ½*	*08/43*	*08/48*	*08/52*	*08/58*	*09/02*
Hazelhatch	dep	*08/11 ½*	*08/14 ½*	*08/19 ½*	**08:26**	*08/29 ½*	*08/33 ½*	*08/41 ½*	*08/44 ½*	*08/49 ½*	**08:56**	*08/59 ½*	*09/03 ½*
HK151	dep	*08/12*	*08/15*	*08/20*	*08/27*	*08/30*	*08/34*	*08/42*	*08/45*	*08/50*	*08/57*	*09/00*	*09/04*
HK157	dep	*08/14 ½*	*08/17 ½*	*08/22 ½*	*08/29 ½*	*08/32 ½*	*08/36 ½*	*08/44 ½*	*08/47 ½*	*08/52 ½*	*08/59 ½*	*09/02 ½*	*09/06 ½*
Sallins	dep	*08/16 ½*	**08:21**	*08/25*	*08/32*	*08/35*	**08:40**	*08/46 ½*	**08:51**	*08/55*	*09/02*	*09/05*	**09:10**
HK177	dep	*08/19*	*08/24 ½*	*08/27 ½*	*08/34 ½*	*08/37 ½*	*08/43 ½*	*08/49*	*08/54 ½*	*08/57 ½*	*09/04 ½*	*09/07 ½*	*09/43 ½*
Newbridge	dep	*08/21 ½*	*08/27*	**08:31**	*08/37*	**08b42**	**08:48**	*08/51 ½*	*08/57*	**09:01**	*09/07*	**09b12**	**09:18**
Curragh	dep	*08/23*	*08/28 ½*	*08/33 ½*	*08/38 ½*	*08/44 ½*		*08/53*	*08/58 ½*	*09/03 ½*	*09/08 ½*	*09/14 ½*	
Kildare	dep	*08/24 ½*	*08/30 ½*	**08:36 ½**	**08:41 ½**	**08b48 ½**		*08/54 ½*	*09/00 ½*	**09:06 ½**	**09:11 ½**	**09b18 ½**	
Cherryville Jn	dep	*08/27*	*08/32 ½*	*08/39*	*08/44*	*08/53*		*08/57*	*09/02 ½*	*09/09*	*09/14*	*09/23*	
Athy	arr					**09:04**						**09:34**	
Monasterevin	dep	*08/30*	*08/36*	*08/42*	**08:47 ½**			*09/00*	*09/06*	*09/12*	**09:17 ½**		
Portarlington	arr	*08/34*	**08:40**	**08:46**	**08:52 ½**			*09/04*	**09:10**	**09:16**	**09:22 ½**		
Next	To						Heuston						Heuston
	Dep						09:08						09:38

Maynooth - Dublin

ID		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
From	Arr	Can	07:27	07:26	Can	07:39	07:38	Can	07:51	07:50	Can	08:03	08:02	Can	08:12	08:14
	Fm	extend	Spencer Dk	Maynooth	extend	Spencer Dk	Maynooth	extend	Spencer Dk	Maynooth	extend	Spencer Dk	Maynooth	extend	Spencer Dk	Maynooth
Maynooth	dep	**07:33**		**07:38**	**07:45**		**07:50**	**07:57**		**08:02**	**08:09**		**08:14**	**08:12**		**08:26**
Leixlip Louisa	dep	*07/38 ½*		**07:45**	*07/50 ½*		**07:57**	*08/02 ½*		**08:09**	*08/14 ½*		**08:21**	*08/26 ½*		**08:33**
Leixlip Confey	dep	*07/41*		**07a48 ½**	*07/53*		**08a00 ½**	*08/05*		**08a12 ½**	*08/17*		**08a24 ½**	*08/29*		**08a36 ½**
M3 Parkway	arr		**07:35**			**07:47**			**07:59**			**08:11**			**08:23**	
Dunboyne	dep		**07a39 ½**			**07a51 ½**			**08a03 ½**			**08a15 ½**			**08a27 ½**	
Hansfield	dep		**07a46**			**07a58**			**08a10**			**08a22**			**08a34**	
Clonsilla Jn	dep	*07/44 ½*	*07/47 ½*	*07/52 ½*	*07/56 ½*	*07/59 ½*	*08/04 ½*	*08/08 ½*	*08/01 ½*	*08/16 ½*	*08/20 ½*	*08/23 ½*	*08/28 ½*	*08/32 ½*	*08/35 ½*	*08/40 ½*
Clonsilla	dep		**07:49**			**08:01**			**08:13**			**08:25**			**08:37**	
Coolmine	dep	*07/47 ½*		**07:55 ½**	*07/59 ½*		**08:07 ½**	*08/11 ½*		**08:19 ½**	*08/23 ½*		**08:31 ½**	*08/35 ½*		**08:43 ½**
Castleknock	dep	*07/48 ½*	**07:52 ½**		*08/00 ½*	**08:04 ½**		*08/12 ½*	**08:16 ½**		*08/24 ½*	**08:28 ½**		*08/36 ½*	**08:40 ½**	
Navan Road	dep	*07/50 ½*		**07:59**	*08/02 ½*		**08:11**	*08/14 ½*		**08:23**	*08/26 ½*		**08:35**	*08/38 ½*		**08:47**
Ashtown	dep	*07/51 ½*	**07:56 ½**		*08/03 ½*	**08:08 ½**		*08/15 ½*	**08:20 ½**		*08/27 ½*	**08:32 ½**		*08/39 ½*	**08:44 ½**	
Broombridge	dep	*07/54 ½*		**08:03**	*08/06 ½*		**08:15**	*08/18 ½*		**08:27**	*08/30 ½*		**08:39**	*08/42 ½*		**08:51**
Glasnevin Jn	dep	*07/56 ½*	*08/01 ½*	*08/05*	*08/08 ½*	*08/13 ½*	*08/17*	*08/20 ½*	*08/25 ½*	*08/29*	*08/32 ½*	*08/37 ½*	*08/41*	*08/44 ½*	*08/49 ½*	*08/53*
Whitworth	dep	**07:58**	*08/03 ½*	*08/07 ½*	**08:10**	*08/15 ½*	*08/19 ½*	**08:22**	*08/27 ½*	*08/31 ½*	**08:34**	*08/39 ½*	*08/43 ½*	**08:46**	*08/51 ½*	*08/55 ½*
Church Road	dep		*08/04 ½*			*08/16 ½*			*08/28 ½*			*08/40 ½*			*08/52 ½*	
Spencer Dock	dep		**08:06**			**08:18**			**08:30**			**08:42**			**08:54**	
Connolly	dep	**08:03**		**08:10**	**08:15**		**08:22**	**08:27**		**08:34**	**08:39**		**08:46**	**08:51**		**08:58**
Next	To	Maynooth	M3 Pway	Maynooth	Maynooth	M3 Pway	Maynooth	Maynooth	M3 Pway	Maynooth	Maynooth	M3 Pway	Maynooth	Maynooth	M3 Pway	Maynooth
	Dep	08:12	08:19	08:16	08:24	08:31	08:28	08:36	08:43	08:40	08:48	08:55	08:52	09:00	09:07	09:04

Dublin - Maynooth

ID		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Previous	Arr	08:51	07:58	07:54	08:03	08:10	08:06	08:15	08:22	08:18	08:27	08:34	08:30	08:39	08:46	08:42
	Fm	Maynooth	Maynooth	M3 Pway	Maynooth	Maynooth	M3 Pway	Maynooth	Maynooth	M3 Pway	Maynooth	Maynooth	M3 Pway	Maynooth	Maynooth	M3 Pway
Connolly	dep	**08:00**	**08:04**		**08:12**	**08:16**		**08:24**	**08:28**		**08:36**	**08:40**		**08:48**	**08:52**	
Spencer Dock	dep			**08:07**			**08:19**			**08:31**			**08:43**			**08:55**
Church Road	dep			*08/09 ½*			*08/21 ½*			*08/33*			*08/45 ½*			*08/57 ½*
Newcomen Jn	dep	*08/01*	*08/05*	*08/10*	*08/13*	*08/17*	*08/22*	*08/25*	*08/29*	*08/34*	*08/37*	*08/41*	*08/46*	*08/49*	*08/53*	*08/58*
Whitworth	dep	**08:04 ½**	*08/07 ½*	*08/12 ½*	**08:16 ½**	*08/19 ½*	*08/24 ½*	**08:28 ½**	*08/31 ½*	*08/36 ½*	**08:40 ½**	*08/43 ½*	*08/48 ½*	**08:52 ½**	*08/55 ½*	*09/01*
Glasnevin Jn	dep	*08/05*	*08/08 ½*	*08/13*	*08/17*	*08/20 ½*	*08/25*	*08/29*	*08/32 ½*	*08/37*	*08/41*	*08/44 ½*	*08/49*	*08/53*	*08/56 ½*	*09/03*
Broombridge	dep	*08/07*	**08:11 ½**		*08/19*	**08:23 ½**		*08/31*	**08:35 ½**	*08/39*	*08/43*	**08:47 ½**		*08/55*	**08:59 ½**	
Ashtown	dep	*08/09 ½*		**08:17 ½**	*08/21 ½*		**08:29 ½**	*08/33 ½*		**08:41 ½**	*08/45 ½*		**08:53 ½**	*08/57 ½*		**09:05 ½**
Navan Road	dep	*08/10 ½*	**08:15**		*08/22 ½*	**08:27**		*08/34 ½*	**08:39**		*08/46 ½*	**08:51**		*08/58 ½*	**09:03**	
Castleknock	dep	*08/13 ½*		**08:21**	*08/25 ½*		**08:33**	*08/37 ½*		**08:45**	*08/49 ½*		**08:57**	*09/01 ½*		**09:09**
Coolmine	dep	*08/14 ½*	**08:18 ½**		*08/26 ½*	**08:30 ½**		*08/38 ½*	**08:42 ½**		*08/50 ½*	**08:54 ½**		*09/02 ½*	**09:06 ½**	
Clonsilla	arr			**08:25**			**08:37**			**08:49**			**09:01**			**09:13**
Clonsilla Jn	dep	*08/16 ½*	*08/20*	*08/25 ½*	*08/28 ½*	*08/32*	*08/37 ½*	*08/40 ½*	*08/44*	*08/49 ½*	*08/52 ½*	*08/56*	*09/01 ½*	*09/04 ½*	*09/08*	*09/13 ½*
Hansfield	dep			**08a28 ½**			**08a40 ½**			**08a52 ½**			**09a04 ½**			**09a16 ½**
Dunboyne	dep			**08a34 ½**			**08a46 ½**			**08a58 ½**			**09a10 ½**			**09a22 ½**
M3 Parkway	arr			**08:39**			**08:51**			**09:03**			**09:15**			**09:27**
Leixlip Confey	dep	*08/20*	**08a25 ½**		*08/32*	**08a37 ½**		*08/44*	**08a49 ½**		*08/56*	**09a01 ½**		*09/08*	**09a13 ½**	
Leixlip Louisa	dep	*08/22*	**08:28 ½**		*08/34*	**08:40 ½**		*08/46*	**08:52 ½**		*08/58*	**09:04 ½**		*09/10*	**09:16 ½**	
Maynooth	arr	**08:32**	**08:38**		**08:44**	**08:50**		**08:56**	**09:02**		**09:08**	**09:14**		**09:20**	**09:26**	
Next	To	Can	08:50	08:47	Can	09:02	08:59	Can	09:14	09:12	Can	09:26	09:24	Can	09:38	09:36
	Dep	extend	Connolly	Spencer Dk	extend	Connolly	Spencer Dk	extend	Connolly	Spencer Dk	extend	Connolly	Spencer Dk	extend	Connolly	Spencer Dk

Dundalk/Drogheda - Dublin

ID		1a	2	3	4	5	6	7	8	9	10	11	12	1b	13
Dundalk	dep								**07:24**				**07:40**		**08:01 ½**
Drogheda	arr								**07:44**				**08:00**		**08:21**
	dep				**07:25**		**07:37**		**07:45**		**07:57**		**08:01**	**08:06**	**08:22**
Laytown	dep				**07:31 ½**		*07/43 ½*		**07:51 ½**		*08/03 ½*		*08/07 ½*	**08:12 ½**	
Mosney	dep				*07/33 ½*		*07/45*		*07/53 ½*		*08/05*		*08/09*	*08/14 ½*	*08/28 ½*
Gormanstown	dep				**07:36 ½**		*07/46 ½*		**07:56 ½**		*08/06 ½*		*08/11 ½*	**08:17 ½**	
Balbriggan	dep				**07:40**		**07:49 ½**		**08:00**		**08:09 ½**		**08:16**	**08:21**	*08/31 ½*
Skerries	dep				**07:45**		**07:54 ½**		**08:05**		**08:14 ½**		**08:21**	**08:26**	*08/34*
Rush & Lusk	dep				**07:50 ½**		*07/59*		**08:10 ½**		*08/19*		**08:26 ½**	*08/30 ½*	
Donabate	dep				**07:54 ½**		**08:02 ½**		**08:14 ½**		**08:22 ½**		**08:30 ½**	**08:34**	
Malahide	arr				**07:58**		**08:06**		**08:18**		**08:26**			**08:37 ½**	
	dep			**07:51**	**07:59**		**08:07**	**08:11**	**08:19**		**08:27**	**08:30**	*08/34*	**08:38 ½**	*08/43*
Portmarnock	dep			**07:55**	**08:03 ½**		*08/10*	**08:15**	**08:23 ½**		*08/30*	**08:34**	**08:38 ½**	*08/41 ½*	*08/45*
Clongriffin	arr	<----		**07:57 ½**				**08:17 ½**				**08:36 ½**		**08:43 ½**	
	dep	**07:48**	**07:53**	**07:58**	*08/05*	**08:08**	*08/12*	**08:18**	*08/25*	**08:28**	*08/32*	**08:37 ½**	*08/40 ½*	--->	
Howth Junction	dep	**07:50 ½**	**07:55½**	**08:00 ½**	*08/05 ½*	**08:10 ½**	**08:15**	**08:20 ½**	*08/25 ½*	**08:30 ½**	**08:35**	**08:40 ½**	*08/43 ½*		*08/47*
Kilbarrack	dep	**07:52**	*07/56 ½*	**08:02**	*08/06*	**08:12**	*08/16*	**08:22**	08/26	**08:32**	*08/36*	**08:42**	*08/45*		*08/48*
Raheny	dep	**07:54**	*07/57 ½*	**08:04**	**08:08**	**08:14**	*08/17*	**08:24**	**08:28**	**08:34**	*08/37*	**08:44**	**08:47 ½**		*08/50 ½*
Harmonstown	dep	**07:56**	*07/59 ½*	**08:06**	*08/09*	**08:16**	*08/19*	**08:26**	*08/29*	**08:36**	*08/39*	**08:46**	*08/49*		*08/52 ½*
Killester	dep	**07:58 ½**	**08:02**	**08:08 ½**	*08/11 ½*	**08:18 ½**	*08/22 ½*	**08:28 ½**	*08/31 ½*	**08:38 ½**	*08/42*	**08:48 ½**	*08/51 ½*		*08/54 ½*
Clontarf Road	dep	**08:01 ½**	*08/04 ½*	**08:11 ½**	*08/14 ½*	**08:21 ½**	*08/25 ½*	**08:31 ½**	*08/34 ½*	**08:41 ½**	*08/45 ½*	**08:51 ½**	*08/54 ½*		*08/57 ½*
Connolly	arr	**08:05**	**08:08**	**08:15**	**08:18**	**08:28**	**08:31**	**08:35**	**08:41**	**08:45**	**08:51**	**08:55**	**08:58**		**09:00**
	dep	**08:06**	**08:09**	**08:16**	**08:19**	**08:29**		**08:36**	**08:42**	**08:46**	**08:52**	**08:56**	**08:59**		
	To	Bray	Dun L.	Greys.	Bray	Dun L.		Bray	GCD	Bray	GCD	Bray	Bray		

Dublin - Drogheda / Dundalk

ID		1	2	3	4	5	6	7	8	9	10	11	12	13
From		Bray	Greystones	Bray	Dun L.	Bray		Bray	Greystones	Dun L.	Bray	Bray		Dun L.
Connolly	arr	**08:01**	**08:07**	**08:11**	**08:17**	**08:21**		**08:27**	**08:31**	**08:37**	**08:41**	**08:47**		**08:57**
	dep	**08:02**	**08:08**	**08:12**	**08:18**	**08:22**	**08:25**	**08:28**	**08:32**	**08:38**	**08:42**	**08:48**	**08:52**	**08:58**
Ossary Road Jn	dep	*08/03*	*08/09*	*08/13*	*08/19*	08/23	*08/26*	*08/29*	*08/33*	*08/39*	*08/43*	*08/49*	*08/53*	*08/59*
Clontarf Road	dep	**08:05 ½**	*08/11 ½*	**08:15 ½**	*08/20 ½*	**08:25 ½**	*08/28 ½*	*08/31 ½*	**08:35 ½**	*08/40 ½*	**08:45 ½**	*08/51 ½*	**08:55 ½**	*09/00 ½*
Killester	dep	**08:08**	*08/14*	**08:18**	*08/22*	**08:28**	*08/31*	*08/34*	**08:38**	*08/42*	**08:48**	*08/54*	**08:58**	*09/02*
Harmonstown	dep	**08:10 ½**	*08/16 ½*	**08:20 ½**	*08/23 ½*	**08:30 ½**	*08/33 ½*	*08/36 ½*	**08:40 ½**	*08/43 ½*	**08:50 ½**	*08/56 ½*	**09:00 ½**	*09/03 ½*
Raheny	dep	**08:12 ½**	**08:19**	**08:22 ½**	*08/25 ½*	**08:32 ½**	*08/35 ½*	**08:39**	**08:42 ½**	*08/45 ½*	**08:52 ½**	**08:59**	**09:02 ½**	*09/05 ½*
Kilbarrack	dep	**08:14 ½**	*08/21*	**08:24 ½**	*08/27 ½*	**08:34 ½**	*08/37 ½*	*08/41*	**08:44 ½**	*08/47 ½*	**08:54 ½**	*09/01*	**09:04 ½**	*09/07 ½*
Howth Junction	dep	**08:16**	*08/22*	**08:26**	**08:30**	**08:36**	*08/39*	*08/42*	**08:46**	**08:50**	**08:56**	*09/02*	**09:06**	**09:10**
Clongriffin	arr	**08:18**		**08:28**		**08:38**			**08:48**		**08:58**		**09:08**	
	dep		*08/24*	**08:29**	*08/32*		*08/41*	*08/44*	**08:49**	*08/52*		*09/04*	**09:09**	*09/12*
Portmarnock	dep		**08:26 ½**	**08:32**	*08/35*		*08/42*	**08:46 ½**	**08:52**	*08/55*		**09:06 ½**	**09:12**	*09/15*
Malahide	arr		**08:30 ½**	**08:36**	**08:40**			**08:50 ½**	**08:56**	**09:00**		**09:10 ½**	**09:16**	**09:20**
	dep		**08:31 ½**	(0838)	**08:41**		*08/46*	**08:51 ½**	(0858)	**09:01**		**09:11 ½**	(0918)	**09:21**
Donabate	dep		**08:35 ½**		**08:45**			**08:55 ½**		**09:05**		**09:15 ½**		**09:25**
Rush & Lusk	dep		**08:39**		*08/47 ½*			**08:59**		*09/07 ½*		**09:19**		*09/27 ½*
Skerries	dep		**08:43 ½**		**08:51**		*08/55 ½*	**09:03 ½**		**09:11**		**09:23 ½**		**09:31**
Balbriggan	dep		**08:48**		**08:55 ½**		*08/59 ½*	**09:08**		**09:15 ½**		**09:28**		**09:35 ½**
Gormanstown	dep		**08:51 ½**		*08/58*			**09:11 ½**		*09/18*		**09:31 ½**		*09/38*
Mosney	dep		*08/53*		*08/59*		*09/02 ½*	*09/13*		*09/19*		*09/33*		*09/39*
Laytown	dep		**08:55 ½**		*09/00 ½*			**09:15 ½**		*09/20 ½*		**09:35 ½**		*09/40 ½*
Drogheda	arr		**09:01**		**09:06**		**09:09**	**09:21**		**09:26**		**09:41**		**09:46**
	dep						**09:10 ½**			**09:27**				**09:47**
Dundalk	arr						**09:29 ½**			**09:49**				**10:09**
	To													

Greystones / Bray - Dublin

ID		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
From	From										ICR						
Greystones	dep			**07:14**							**07:44**						
Bray	Arr			**07:23**							**07:53**						
	dep	**07:20**		**07:27**	**07:30**			**07:40**		**07:45**	**07:54 ½**			**08:00**	**08:05**	**08:10**	
Shankill	dep	**07:24**		*07/30*	**07:34**			**07:44**		**07:49**	*07/57 ½*			**08:04**	*08/08 ½*	**08:14**	
Killiney	dep	**07:26 ½**		*07/32*	**07:36 ½**			**07:46 ½**		*07/51*	*07/59*			**08:06 ½**	**08:11**	**08:16 ½**	
Dalkey	dep	**07:30 ½**		*07/35 ½*	**07:40 ½**			**07:50 ½**		**07:54 ½**	*08/02 ½*			**08:10 ½**	*08/14 ½*	**08:20 ½**	
Glenageary	dep	**07:33**		*07/37 ½*	**07:43**			**07:53**		**07:57**	*08/04 ½*			**08:13**	*08/16 ½*	**08:23**	
Sandycove	dep	**07:35 ½**		*07/39*	**07:45 ½**			**07:55 ½**		*07/59*	*08/06*			**08:15 ½**	**08:18 ½**	**08:25 ½**	
Dun Laoghaire	Arr	**07:38**		**07:41**	**07:48**			**07:58**		**08:01**	**08:08**			**08:18**	**08:21**	**08:28**	
	plat																
	dep	**07:39**		**07:42**	**07:49**		**07:52**	**07:59**		**08:02**	**08:09**		**08:12**	**08:19**	**08:22**	**08:29**	**08:32**
Salthill	dep			**07a45**			**07a55**			**08a05**			**08a15**		**08a25**		**08a35**
Seapoint	dep			**07:47**			**07:57**			**08:07**			**08:17**		**08:27**		**08:37**
Blackrock	dep	**07:44 ½**		**07a49 ½**	**07:54 ½**		**07a59 ½**	**08:04 ½**		**08a09 ½**	**08:14 ½**		**08a19½**	**08:24 ½**	**08a29 ½**	**08:32 ½**	**08a39 ½**
Booterstown	dep			**07:51 ½**			**08:01 ½**			**08:11 ½**			**08:21 ½**		**08:31 ½**		**08:41 ½**
Sydney Parade	dep	**07:48 ½**		**07:54**	**07:58 ½**		**08:04**	**08:08 ½**		**08:14**	**08:18 ½**		**08:24**	**08:28 ½**	**08:34**	**08:38 ½**	**08:44**
Sandymount	dep			**07:56**			**08:06**			**08:16**			**08:26**		**08:36**		**08:46**
Lansdowne Road	dep	**07:51**		**07:58**	**08:01**		**08:08**	**08:11**		**08:18**	**08:21**		**08:28**	**08:31**	**08:38**	**08:41**	**08:48**
Grand Canal Dock	Arr	**07:52 ½**		**07:59 ½**	**08:02 ½**		**08:09 ½**	**08:12 ½**		**08:19 ½**	**08:22 ½**		**08:29 ½**	**08:32 ½**	**08:39 ½**	**08:42 ½**	**08:49 ½**
	dep	**07:53 ½**	**07:56**	**08:00 ½**	**08:03 ½**	**08:06**	**08:10 ½**	**08:13 ½**	**08:16**	**08:20 ½**	**08:23 ½**	**08:26**	**08:30 ½**	**08:33 ½**	**08:40 ½**	**08:43 ½**	**08:50 ½**
Pearse	Arr	**07:55**	**07:58**	**08:02**	**08:05**	**08:08**	**08:12**	**08:15**	**08:18**	**08:22**	**08:25**	**08:28**	**08:32**	**08:35**	**08:42**	**08:45**	**08:52**
	dep	**07:56**	**07:59**	**08:03**	**08:06**	**08:09**	**08:13**	**08:16**	**08:19**	**08:23**	**08:26**	**08:29**	**08:33**	**08:36**	**08:43**	**08:46**	**08:53**
Tara Street	Arr	**07:57**	**08:00**	**08:04**	**08:07**	**08:10**	**08:14**	**08:17**	**08:20**	**08:24**	**08:27**	**08:30**	**08:34**	**08:37**	**08:44**	**08:47**	**08:54**
	dep	**07:58**	**08:01**	**08:05**	**08:08**	**08:11**	**08:15**	**08:18**	**08:21**	**08:25**	**08:28**	**08:31**	**08:35**	**08:38**	**08:45**	**08:48**	**08:55**
Connolly	arr	**08:01**	**08:04**	**08:07**	**08:11**	**08:14**	**08:17**	**08:21**	**08:24**	**08:27**	**08:31**	**08:34**	**08:37**	**08:41**	**08:47**	**08:51**	**08:57**
	dep	**08:02**	**08:05**	**08:08**	**08:12**	**08:15**	**08:18**	**08:22**	**08:25**	**08:28**	**08:32**	**08:35**	**08:38**	**08:42**	**08:48**	**08:52**	**08:58**
To		Clongriffin	Hazelhatch	Drogheda	Malahide	Hazelhatch	Drogheda	Clongriffin	Hazelhatch	Drogheda	Malahide	Hazelhatch	Dundalk	Clongriffin	Drogheda	Hazelhatch	Dundalk

Dublin - Greystones / Bray

ID		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
From		Hazelhatch	Drogheda	Clongriffin	Hazelhatch	Malahide	Drogheda	Hazelhatch	Clongriffin	Malahide	Hazelhatch	Dundalk	Clongriffin	Hazelhatch	Drogheda	Malahide	Dundalk
Connolly	arr	**08:01**	**08:05**	**08:08**	**08:12**	**08:15**	**08:18**	**08:25**	**08:28**	**08:35**	**08:38**	**08:41**	**08:45**	**08:48**	**08:51**	**08:55**	**08:58**
	dep	**08:02**	**08:06**	**08:09**	**08:13**	**08:16**	**08:19**	**08:26**	**08:29**	**08:36**	**08:39**	**08:42**	**08:46**	**08:49**	**08:52**	**08:56**	**08:59**
Tara Street	arr	**08:03 ½**	**08:07 ½**	**08:10 ½**	**08:14 ½**	**08:17 ½**	**08:20 ½**	**08:27 ½**	**08:30 ½**	**08:37 ½**	**08:40 ½**	**08:43 ½**	**08:47 ½**	**08:50 ½**	**08:53 ½**	**08:57 ½**	**09:00 ½**
	dep	**08:04 ½**	**08:08 ½**	**08:11 ½**	**08:15 ½**	**08:18 ½**	**08:21 ½**	**08:28 ½**	**08:31 ½**	**08:38 ½**	**08:41 ½**	**08:44 ½**	**08:48 ½**	**08:51 ½**	**08:54 ½**	**08:58 ½**	**09:01 ½**
Pearse	arr	**08:06**	**08:10**	**08:13**	**08:17**	**08:20**	**08:23**	**08:30**	**08:33**	**08:40**	**08:43**	**08:46**	**08:50**	**08:53**	**08:56**	**09:00**	**09:03**
	dep	**08:07**	**08:11**	**08:14**	**08:18**	**08:21**	**08:24**	**08:31**	**08:34**	**08:41**	**08:44**	**08:47**	**08:51**	**08:54**	**08:57**	**09:01**	**09:04**
	line	ML			ML							ML			ML		
Grand Canal Dock	arr	**08:09**	**08:12 ½**	**08:15 ½**	**08:20**	**08:22 ½**	**08:25 ½**	**08:32 ½**	**08:35 ½**	**08:42 ½**	**08:45 ½**	**08:49**	**08:52 ½**	**08:55 ½**	**08:59**	**09:02 ½**	**09:05 ½**
	plat																
	dep		**08:13 ½**	**08:16 ½**		**08:23 ½**	**08:26 ½**	**08:33 ½**	**08:36 ½**	**08:43 ½**	**08:46 ½**		**08:53 ½**	**08:56 ½**		**09:03 ½**	**09:06 ½**
Lansdowne Road	dep		**08:16**	**08:19**		**08:26**	**08:29**	**08:36**	**08:39**	**08:46**	**08:49**		**08:56**	**08:59**		**09:06**	**09:09**
Sandymount	dep			**08:21**			**08:31**		**08:41**		**08:51**			**09:01**			**09:11**
Sydney Parade	dep		**08:19 ½**	**08a23 ½**		**08:29 ½**	**08a33 ½**	**08:39 ½**	**08a43 ½**	**08:49 ½**	**08a53 ½**		**08:59 ½**	**09a03 ½**		**09:09 ½**	**09a13 ½**
Booterstown	dep			**08:26**			**08:36**		**08:46**		**08:56**			**09:06**			**09:16**
Blackrock	dep		**08:23**	**08:28**		**08:33**	**08:38**	**08:43**	**08:48**	**08:53**	**08:58**		**09:03**	**09:08**		**09:13**	**09:18**
Seapoint	dep			**08a30 ½**			**08a40 ½**		**08a50 ½**		**09a00 ½**			**09a10 ½**			**09a20 ½**
Salthill	dep			**08a33**			**08:42 ½**		**08a53**		**09:02 ½**			**09a13**			**09:22 ½**
Dun Laoghaire	arr		**08:28**	**08:35**		**08:38**	**08:44 ½**	**08:48**	**08:55**	**08:58**	**09:04 ½**		**09:08**	**09:15**		**09:18**	**09:24 ½**
	plat																
	dep		**08:29**			**08:39**	**08:45 ½**	**08:49**		**08:59**	**09:05 ½**		**09:09**			**09:19**	**09:25 ½**
Sandycove			**08:32**			*08/41*	*08/48*	**08:52**		**09:02**	*09/07 ½*		**09:12**			**09:22**	**09:29**
Glenageary			**08:34 ½**			*08/42*	**08:50**	**08a54 ½**		**09:04** ½	*09/08 ½*		**09a14 ½**			**09:24 ½**	*09/30 ½*
Dalkey			**08:37**			*08/44*	**08:52 ½**	**08:57**		**09:07**	*09/10 ½*		**09:17**			**09:27**	*09/32 ½*
Killiney			**08:41**			*08/47*	*08/55 ½*	**09:01**		**09:11**	*09/13 ½*		**09:21**			**09:31**	**09:36**
Shankill			**08:43 ½**			*08/49*	**08:58**	**09:03 ½**		**09:13 ½**	*09/17 ½*		**09:23 ½**			**09:33 ½**	*09/38 ½*
Bray	arr		**08:48**			**08:52 H**	**09:03**	**09:08**		**09:18**	**09:22 ½**		**09:28**			**09:38**	**09:43**
	dep					**08:56**					**09:26**						
Greystones	arr					**09:05**					**09:35**						
Next	To					ICR											
	Dep																

DART Expansion Programme

Reference number TP 077-0

21/08/2018

DART EXPANSION PROGRAMME OPTIONS ASSESSMENT – ADDENDUM REPORT

SYSTRA JACOBS Údarás Náisiúnta Iompair National Transport Authority Iarnród Éireann Irish Rail

DART EXPANSION PROGRAMME

DART EXPANSION PROGRAMME OPTIONS ASSESSMENT

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Project	DART Expansion Programme
Study	DART Expansion Programme Options Assessment
Type of document	Addendum Report
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Confidentiality	Confidential
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APPROVAL					
Version	**Name**		**Position**	**Date**	**Modifications**
1	Author	[redacted]	Principal Consultant	14/08/2018	V1 Draft for client review
	Checked by	[redacted]	Director	17/08/2018	
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	Checked by			DD/MM/YY	
	Approved by			DD/MM/YY	

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDICES

1. INTRODUCTION

1.1 Overview

1.1.1 This is an Addendum to the **DART Expansion Programme Options Assessment Report** (hereinafter referred to as the *"Main Report"*).

1.1.2 The NTA commissioned SYSTRA to undertake additional strategic modelling, following the publication of the Main Report, to reflect the outcome of an independent Timetable Modelling Assessment of the preferred option (Scheme Bundle 6), that was undertaken by Jacobs Engineers, within a separate DART Expansion work-stream.

1.1.3 This Addendum Report details the outputs of the strategic modelling of the revised service levels arising from that assessment.

1.2 Background

1.2.1 The NTA commissioned SYSTRA and Jacobs to undertake an extensive transport modelling and appraisal of the DART Expansion Programme, which is a key infrastructure measure which forms part of the Government's Project Ireland 2040[1] - National Planning Framework (NPF) and National Development Plan (NDP) 2018-2027 and the National Transport Authority's (NTA) Greater Dublin Area (GDA) Transport Strategy[2].

1.2.2 The project sought to identify a lower cost alternative to the proposed DART underground tunnel component of the DART Expansion Programme. It did this in the context of the importance of the DART Expansion Programme as identified in the GDA Transport Strategy and following on from the NTA recommendations on the deferral of the DART Underground Project in 2015. It also sought to maintain similar transport user benefits as the original DART Underground scheme and to maintain all other elements of the DART Expansion Programme.

1.3 Options Assessment Report

1.3.1 The Main Report recommended that the DART Expansion programme be delivered by enhancing the existing rail network in the short to medium term (Scheme Bundle 6). It further recommended that the DART Underground Project (Scheme Bundle 2) is not required in the short to medium term and that the underground tunnel component of the DART Expansion Programme should be re-designed for implementation in the longer term - subsequent to the implementation of the exiting network improvements (Scheme Bundle 6).

1.3.2 Further details on the DART Expansion Options Assessment and recommendations can be found in the Main Report which should be read alongside this Addendum Report.

[1] Project Ireland 2040 is the Government's overarching planning policy initiative for development up to 2040. It was published along with its associated documents the National Planning Framework to 2040 and the National Development Plan 2018-2027 in February 2018.

[2] The Transport Strategy for the Greater Dublin Area, 2016-2035 was prepared and published by the National Transport Authority in 2016

1.4 Independent Service Plan Review

1.4.1 As outlined above, an independent Timetable Modelling Assessment of the preferred option (Scheme Bundle 6) was undertaken by Jacobs Engineers to understand the feasibility and operational requirements of delivering the proposed service patterns.

1.4.2 Jacobs produced a summary report - ***'Greater Dublin Area Timetable Modelling – Review Paper'*** (included within Appendix B), which provides a capacity analysis and a proposed Train Service Specification (TSS) for the wider rail network across the Greater Dublin Area (GDA), for the Bundle 6 option. Example headway values were calculated by Jacobs using RailSys[3] software and used as a guideline for the timetable modelling.

1.5 Purpose of this Addendum Report

1.5.1 This Addendum Report summarises the outcomes of a strategic modelling assessment of the DART Expansion scheme bundle options based on a set of revised service plans – following the independent capacity analysis review of the rail network in the GDA.

1.5.2 The revised service levels were tested in the NTA East Regional Model (ERM) to understand the impacts on patronage levels, performance and value for money and are in line with the modelling outputs presented in the Main Report.

[3] RailSys is a software package used in the technical and operational planning of railway transport networks.

2. TIMETABLE MODELLING OUTCOMES

2.1 Introduction

2.1.1 The following chapter provides a summary of the key outcomes from the Jacobs Timetable Modelling review described above.

2.2 Revised Train Service Specification

2.2.1 The Train Service Specification (TSS) (for Bundle 6) from the Main Report along with the Jacobs TSS as output from the timetable modelling exercise are shown in Figure 1 and Figure 2 overleaf with the key outcomes of the review detailed below:

- Reduced service levels at the extremities of GDA rail network i.e. to/from Maynooth, Drogheda and Hazelhatch;
  - Kildare line services reduced by 2 TPDPH from Hazelhatch;
  - Services from the Maynooth line are reduced by 7 Trains Per hour per Direction (TPDPH);
    - Replaced mostly from Clonsilla with M3-Parkway services (5-TPDPH) through running onto the Maynooth line;
    - Previously assumed that services from M3-Parkway to Clonsilla would be a 'shuttle' service;
    - all Maynooth Line services terminate at Connolly station.
  - Reduction of 5 TPDPH between Malahide and Drogheda on the Northern line;
    - 4 TPDPH fewer on the Clongriffin to Malahide section;
  - 6 TPDPH fewer to Dun Laoghaire on the South-East line;
    - 3 TPDPH fewer to Bray;

2.2.2 To accommodate the level of services proposed, it was found that trains could not stop at all stations and as such a 'Skip-stopping' pattern is required.

2.2.3 In addition to the above, it was assumed that there will be a balanced distribution of services within the city centre area to/from the Maynooth and Kildare lines, with services allocated equally between Connolly, Docklands and south over the Loop-line Bridge.

Figure 1. Bundle 6 - Main Report - TSS

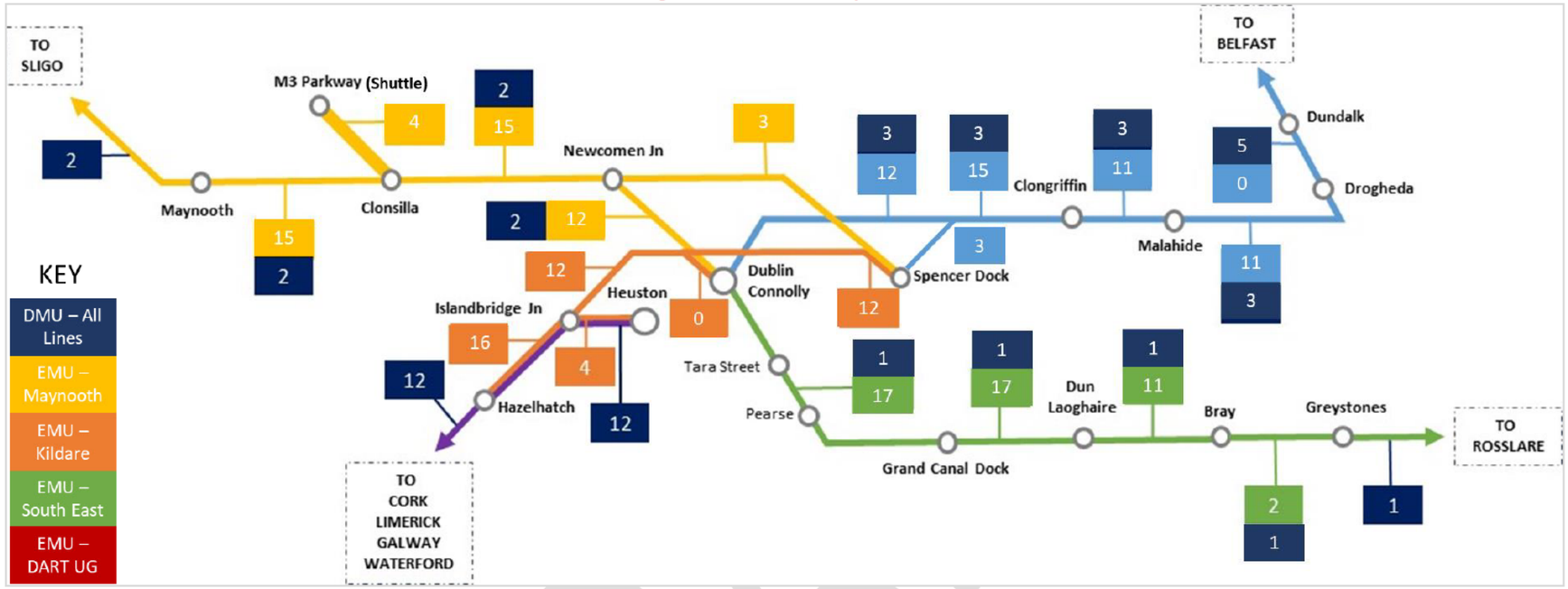
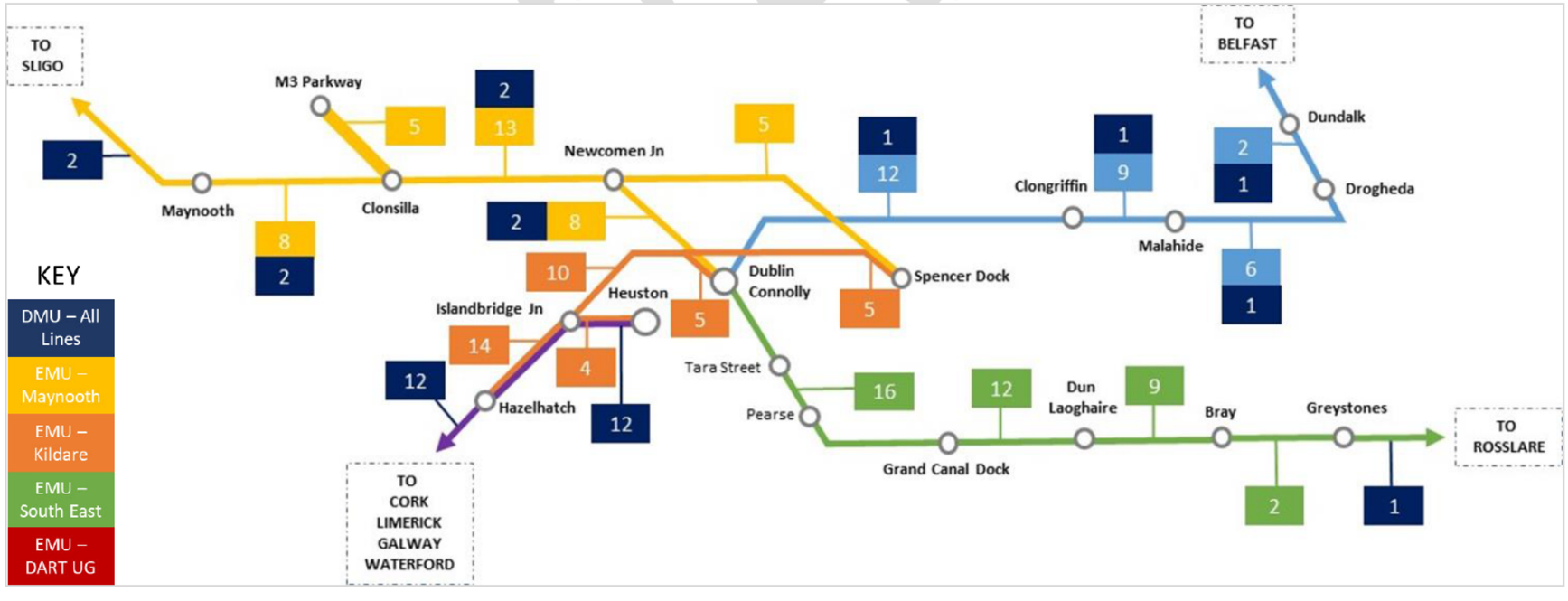


Figure 2. Bundle 6 - Jacobs Timetable Modelling - Output TSS



3. TRAIN SERVICE SPECIFICATION ENHANCEMENTS

3.1 Introduction

3.1.1 The initial train path service plans for each scheme bundle, used in the Main Report modelling assessment were based on service plans provided by Iarnród Éireann (IÉ).

3.1.2 Throughput the project, the service plans were further enhanced and optimised along each corridor using demand outputs from the NTA East Regional Model (ERM) and through consultation with IÉ and NTA – to maximise rail patronage across the DART Expansion options to the greatest extent.

3.1.3 The service plans were also optimised to provide the greatest level of integration with the proposed MetroLink[4] scheme.

3.2 Passenger Demand Sensitivities

3.2.1 As part of the modelling assessment within the Main Report, it was found that overall rail patronage levels were quite sensitive to the terminating location and the distribution of services within the city centre i.e. to what extent services were distributed to terminate at either Connolly or Docklands stations or at stations further south of the Loop-line bridge.

3.2.2 Patronage levels were also found to be quite sensitive to the overall service levels crossing the Loop-line bridge i.e. increased services resulted in higher overall network wide rail patronage levels.

3.2.3 For the above reasons, two alternative options have been developed to deliver the Jacobs Output TSS, that build on the analysis of passenger demand requirements from the Main Report, whilst still working within the upper limit constraints for each line, identified from the Jacobs review i.e. lower service levels.

3.3 Jacobs Output TSS with Enhancements

3.3.1 Further details on the alternative options are provided below, with the TSS for both options displayed in Figure 3 and Figure 4, respectively below.

[4] The MetroLink project is the development of a north-south urban railway service that will run between Swords and Sandyford, connecting key destinations including Dublin Airport and the City Centre along the 26km route.

Bundle 6 - Revised TSS Option 1 – Balanced City Centre Distribution

3.3.2 Option 1 is very similar to the Jacobs Output TSS and retains the balanced city centre service distribution. This option includes the following elements:

- Line capacities limited to Jacobs Output TSS levels outside of city centre;
- Loop-line Bridge capacity increased from 16 to 18 as per service levels in the Main Report;
  - 2 additional TPDPH on Loop-line Bridge to turn-back at Grand Canal Dock;
- No restriction on Maynooth line services proceeding further south beyond Connolly Station;
- 2 TPDPH from Northern Line diverted to Docklands station to provide full movements from each rail corridor (Kildare, Maynooth and Northern lines); and
- It is assumed that all DART services stop at all stations.

Bundle 6 - Revised TSS Option 2 – Optimised City Centre Distribution

3.3.3 Option 2 is similar to Option 1, however the distribution of services within the city centre has been optimised in line with the preferred service plan for Bundle 6 identified within the Main Report.

3.3.4 The service plans proposed provide the highest level of integration with the MetroLink scheme providing for higher levels of interchange at Glasnevin between the two high capacity lines. MetroLink provides the alternative North / South capacity for passengers from the Kildare line rather than the Loop-line bridge.

3.3.5 In summary, the following elements are included in Option 2:

- Kildare / Phoenix Park Tunnel services directed entirely to Docklands station (10 TPDPH);
- No Kildare / Phoenix Park Tunnel services directed to Connolly station;
- No Maynooth or Northern line services to Docklands station; and
- Both Maynooth and Northern line services can access Connolly station **and** can also proceed further south across the Loop-line bridge.

3.3.6 The service plans for each options can be found in Appendix A.

Figure 3. Bundle 6 - Revised TSS Option 1 – Balanced City Centre Distribution

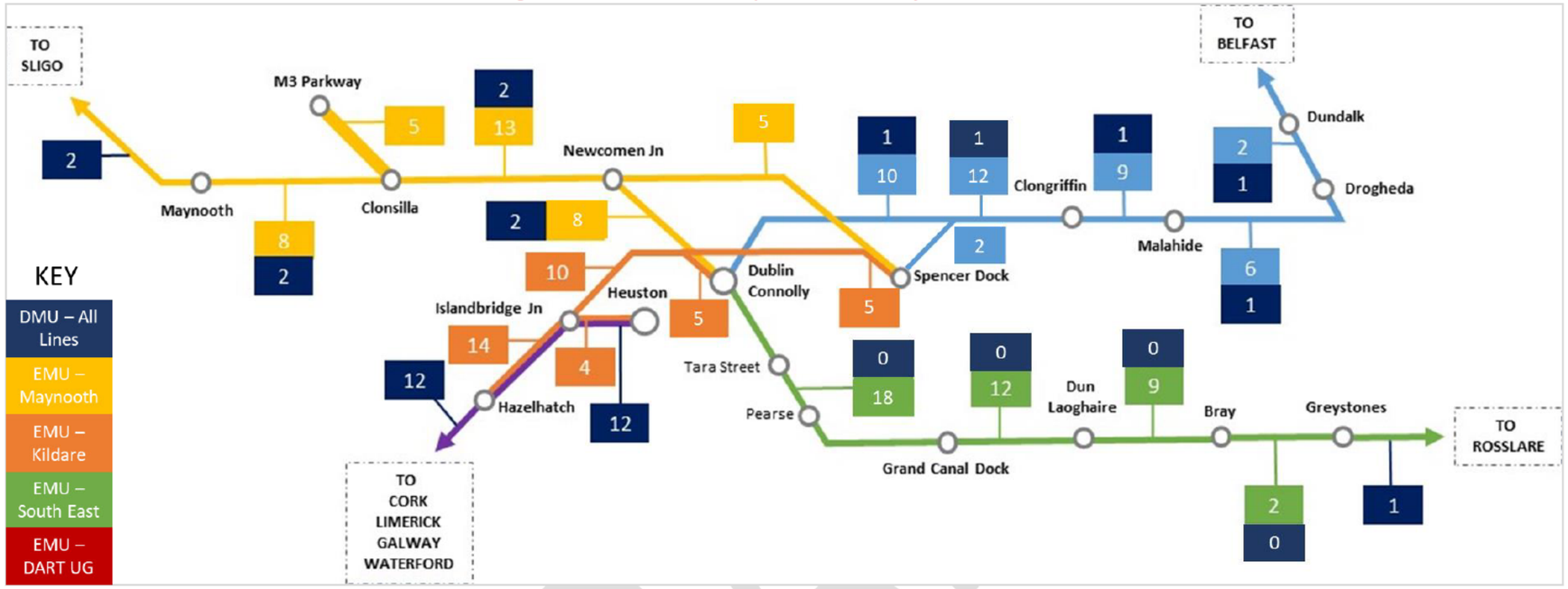
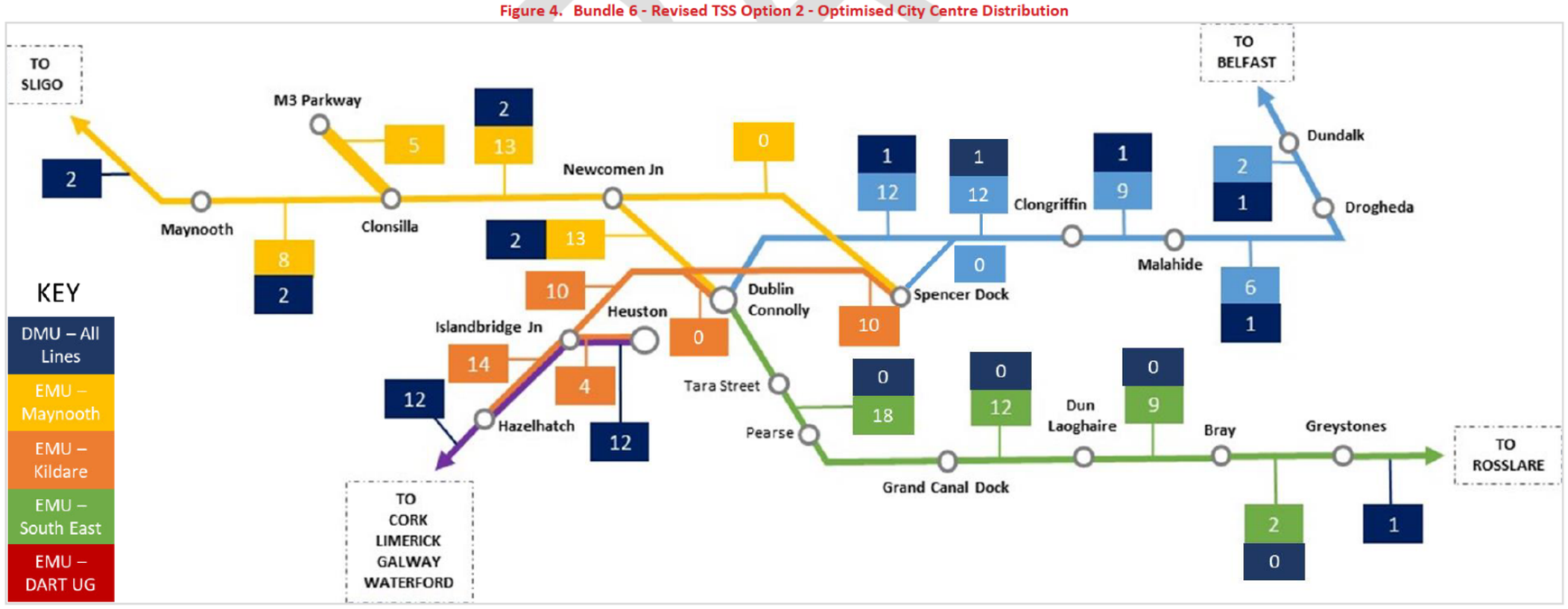


Figure 4. Bundle 6 - Revised TSS Option 2 - Optimised City Centre Distribution



3.4 Scheme Bundle 2 – DART Underground Option

3.4.1 Scheme Bundle 2 includes for the DART Underground tunnel as well as all other DART Expansion Programme elements. This scheme bundle was identified as one of the emerging preferred scheme bundles within the Main Report.

3.4.2 To provide a 'Like-for-Like' comparison with the Bundle 6 options, the Train Service Specification (TSS) for Bundle 2 has also been revised and constrained to the upper limit service levels as per the Jacobs Output TSS levels for Bundle 6.

3.4.3 Figure 5 below shows the Bundle 2 TSS from the Main Report whilst Figure 6 shows the revised Bundle 2 TSS following the adjustments as per the Jacobs Output TSS.

3.4.4 Further detail on the differences between the service plans is provided below:

- Line capacities limited to Jacobs Output TSS;
  - Kildare line services reduced by 2 TPDPH from Hazelhatch;
    - Some Kildare line DART services running to Heuston over-ground station;
    - DART Underground tunnel services limited to 12 TPDPD due to constraints on the Northern Line;
    - 2 additional TPDPD on the Kildare line directed to Heuston over-ground station to maintain 14 TPDPD service level on this line as per the Bundle 6 options.
  - Services from the Maynooth line are reduced by 8 Trains Per hour per Direction (TPDPH);
    - replaced mostly from Clonsilla with M3-Parkway services (5-TPDPH) through running onto the Maynooth line;
    - Previously assumed that services from M3-Parkway to Clonsilla would be a 'shuttle' service;
  - Reduction of 4 TPDPH between Malahide and Drogheda on the Northern line;
    - 1 TPDPH fewer on the Clongriffin to Malahide section;
  - 5 TPDPH fewer to Dun Laoghaire on the South-East line;
    - 5 TPDPH fewer to Bray;

3.4.5 There is no change to the overall pattern of services facilitated by the DART Underground i.e. X (Cross) network configuration retained:

- Maynooth line services connecting to South-east Line via the Loop-line bridge; and
- Kildare line connecting to the Northern Line via the underground tunnel;

Figure 5. Bundle 2 – Main Report Service Plans

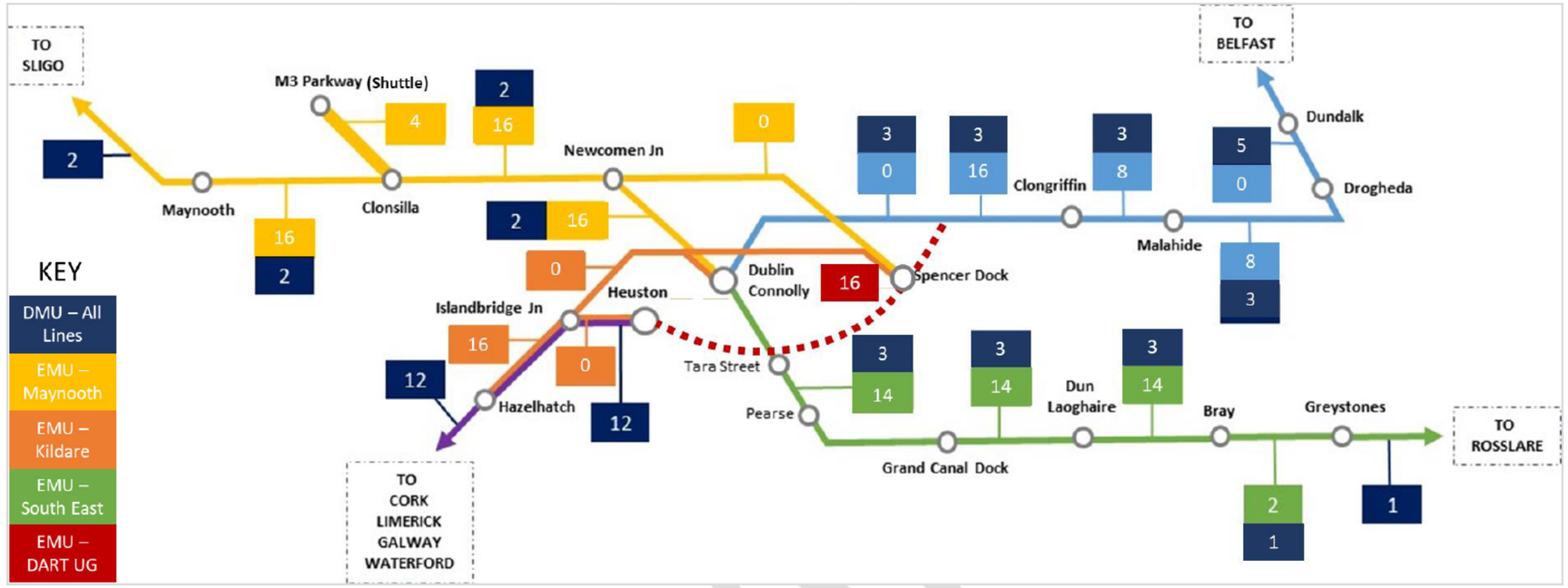
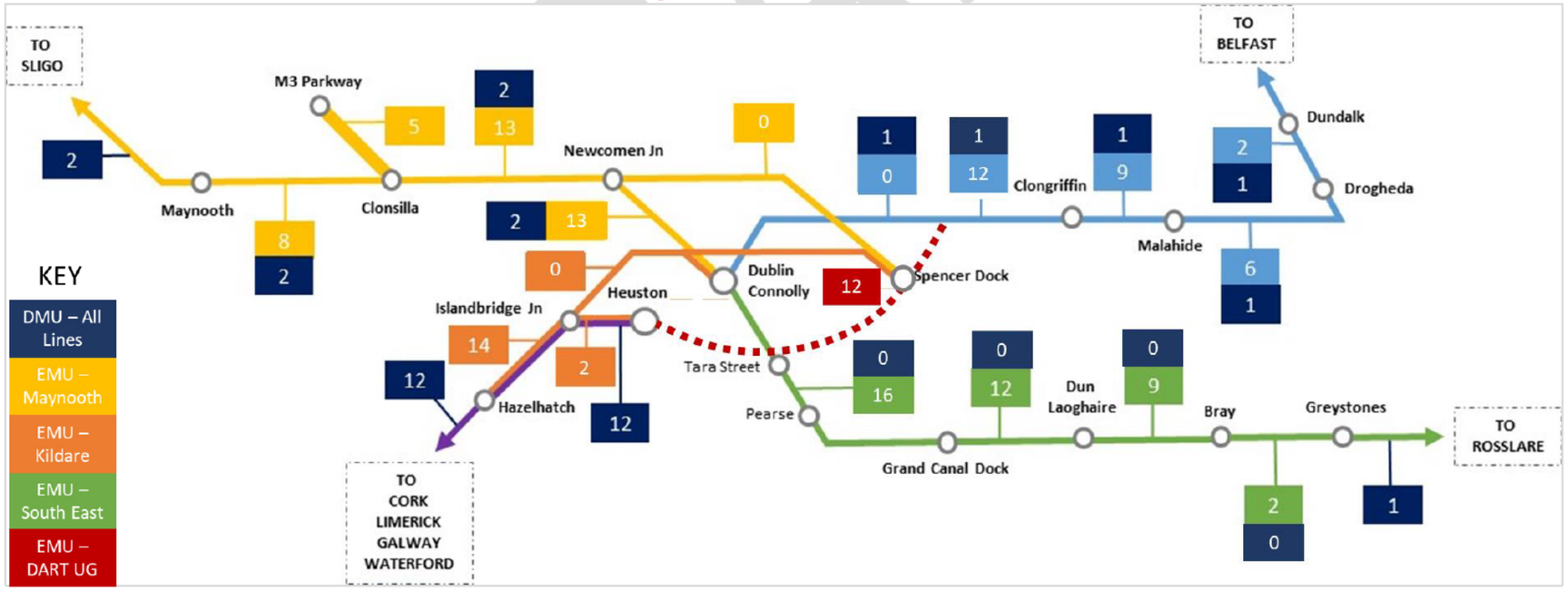


Figure 6. Bundle 2 – Revised TSS



3.5 Modelling Assumptions

3.5.1 The following outlines the key modelling assumptions included in the ERM for this assessment. The assumptions are in line with the modelling assumptions within the Main Report:

- A common appraisal design year of 2035 (representing the GDA Transport Strategy horizon year);
- 5 minute interchange penalty assumed between all public transport sub-modes;
- MetroLink[5] included in all options; and
- No change in station to station journey times for each option from the Main Report assumptions.

3.5.2 Further details on the NTA ERM input assumptions can be found in Chapter 4 of the Main Report. The end-to-end service plans for each option can be found in Appendix A.

3.6 Scheme Bundle Costs

Capital Expenditure (CapEx) Costs

3.6.1 Table 2 below provides a detailed breakdown of the cost estimates for both Scheme Bundles 2 and 6. The table also outlines a breakdown of the costs of the common elements to both scheme bundles. These common elements are essentially the extra infrastructure included in the DART Expansion Programme such as 4-Tracking, electrification and fleet upgrade costs etc.

3.6.2 As can be seen from the table below there is a significant variation in the costs between both scheme bundles with the main cost differential being the underground tunnel element included within Scheme Bundle 2. Scheme Bundle 6 is approximately €1.75 Billion less expensive than Scheme Bundle 2.

3.6.3 For this assessment, it has been assumed that there will be no change to the CapEx costs for each of the Bundle 2 and 6 options.

3.6.4 It is assumed that all infrastructure measures identified within the Main Report will be implemented fully to allow flexibility in service operation as required i.e. Newcomen link to Connolly station, East-wall link from Northern Line to Docklands station etc.

Operational and Maintenance (O&M) Costs

3.6.5 There have, however, been changes applied to the O&M costs to reflect the reduced traction and routine vehicle maintenance costs associated with the operation of lower service levels than previously proposed.

3.6.6 As outlined in Table 1 below, the reduced service levels, particularly at the extremities of the network, results in a 21% and 41% reduction in Bundle 2 and 6 annual O&M costs. The lower

[5] It should be noted that the alignment of MetroLink used within the assessment was the Emerging Preferred Route from the New Metro North Alignment Options Study at the time of modelling (July 2018). This also includes a tie-in with the Luas Green Line and upgrading of Luas Green Line to Metro Standard. This includes a direct interchange with the heavy rail lines at Whitworth Road (proposed new station) and Tara Street.

percentage reduction for Bundle 2 is due to the fact that traction and routine vehicle maintenance costs make up a smaller proportion of overall operational costs, with tunnel maintenance costs remaining unchanged.

3.6.7 It has been assumed that all Bundle 6 options will have the same O&M costs, although it is acknowledged that there would be slight differences between each option due to the minor differences in stopping pattern and distribution within the city centre area.

3.6.8 No account has been taken of any potential cost reductions associated with the 'skip-stopping' pattern inherent within the Jacobs Output TSS Bundle 6 option.

3.6.9 For the purpose of appraisal, the O&M costs detailed in Table 1 are only the costs above the Do Minimum baseline cost levels. The costs shown reflect the lower unit costs associated with electric trains compared to diesel equivalents.

Table 1. O&M Costs – Revised TSS.

SCHEME BUNDLE	O&M COSTS (MAIN REPORT) (€M PER ANNUM)	O&M COSTS (REVISED TSS) (€M PER ANNUM)	% CHANGE
2	[redacted]	[redacted]	[redacted]
6	[redacted]	[redacted]	[redacted]

Table 2. Cost Breakdown of Scheme Bundles 2 and 6

Scheme Bundle 2 - DART Expansion including DART Underground			Scheme Bundle 6 - DART Expansion with PPT upgrade		
	Scheme Description	Scheme Costs (,000)		Scheme Costs (,000)	Source
Common Infrastructure	Electrification / Signalling Heuston	[redacted]			
	4-Track Parkwest to Inchicore				
	Electrification / Signalling Maynooth				
	Electrification / Signalling Northern Line				
	Level Crossings - Maynooth Line				
	Improved Depot facilities				
	Fleet - 296 Electric Multiple Units (EMUs)				
	Total Costs - Common Infrastructure				
Scheme Specific Infrastructure			Scheme Specific Infrastructure		
Work Package	Scheme Costs (,000)	Source	Work Element	Scheme Costs (,000)	Source
• DU - Watling St to East Wall	[redacted]	Irish Rail	• Newcomen Junction link to Connolly	[redacted]	Irish Rail / Jacobs Engineering
• WTI Option from Sarsfield Bridge			• Connolly Station Platform Remodelling		
• 4-Track Inchicore to Sarsfield			• Docklands Station (Spencer Dock)		
• Dún Laoghaire Station - Turnback			• Tara Street upgrade		
• Inchicore works for B4T			• Dún Laoghaire Station - Turnback		
• FFSS Adjustment			• Glasnevin Station		
• Parkwest Turnback			• Cabra Station		
• Kylemore Station			• 4-Track Inchicore to OB1		
Total Scheme Specific Elements			• Inchicore works for B4T		
Bundle 2 - Total Scheme Cost			• FFSS Adjustment		
			• OB1 Bridge Adjustments		
			• Kylemore Station		
			• PPT upgrade / Electrification / Signal		
			• Electrification OB1 - Heuston		
			Total Scheme Specific Elements	[redacted]	
			Bundle 6 - Total Scheme Cost		

4. OUTPUT MODELLING RESULTS FOR REVISED SERVICE LEVELS

4.1 Introduction

4.1.1 This chapter provides a summary of the outputs of the modelling assessment of each of the scheme bundle options described above.

4.1.2 To comparatively assess each scheme bundle option a set of Key Performance Indicators (KPIs) have been extracted from the ERM for each of the options tested and include the following:

- Mode Share (AM peak hour and 24hr);
- Total Boardings (AM peak hour and 24hr);
- Total Boardings by PT Sub-mode (AM peak hour and 24hr);
- Public Transport Transfers (AM);
- Cap Ex Costs (€ millions);
- O&M Costs (€ millions);
- Transport User Benefits (€ millions);
- Present Value of Costs (€ millions); and
- Benefit to Cost Ratio (BCR).

4.2 Bundle 6 Options – Revised TSS Results

4.2.1 Table 3 below provides a summary of the performance of each of the Scheme Bundle 6 options tested.

4.2.2 As can be seen from the results below, there is a reduction in performance for the Bundle 6 – Jacobs Output TSS option. Rail Boardings in the AM peak hour, reduce by approximately [redacted] – reflecting the reduced service offering and 'skip-stopping pattern'. Overall AM PT Boardings reduce by approximately [redacted] reflecting the transfer to bus and Metro. Transport User Benefits are still relatively high at almost [redacted], however this is approximately [redacted] lower than the Bundle 6 option from the Main Report. The BCR for this option is still very high at 2.33, which reflects the reduced O&M costs associated with this option.

4.2.3 As expected the Bundle 6 – Revised TSS – Option 1 performs better than the Jacobs Output TSS option due to services stopping at all stations. This results in [redacted] in additional Transport User Benefits with a slight increase in the outcome BCR to 2.41.

4.2.4 The best performing option following the revised TSS – is Option 2. Option 2 provides for direct services from the Kildare line to Docklands Station resulting in higher levels of transfer and integration with MetroLink at Glasnevin. Transport User benefits are approximately [redacted] higher than the Jacobs Output TSS option with Rail Boardings in the AM peak hour only [redacted] less than the Bundle 6 options from the Main Report. The BCR for this option is [redacted] which represents a very high return on investment.

4.3 Bundle 2 – Revised TSS Results

4.3.1 Table 4 below provides a summary of the performance of Scheme Bundle 2 with the revised service levels constrained to the Jacobs Output TSS levels.

4.3.2 The results demonstrate lower overall Rail Boardings [redacted] in AM, [redacted] over 24hrs) and a corresponding reduction in Transport User Benefits of approximately [redacted] resulting in a marginal reduction in the BCR from [redacted].

4.3.3 The reduction in services in the DART Underground tunnel from 16 to 12 TPDPH is not shown to have a substantial negative impact on the overall performance of the scheme bundle, as this level of service is shown to meet the demand reequipments on the line.

4.4 Impact of MetroLink on DART Expansion Options

4.4.1 The modelling assessment contained within the Main Report included MetroLink along with the various DART Expansion measures in all modelling tests. Bundle 6, was accordingly developed based on the potential to maximise the level of interchange with MetroLink at its intersection points with the heavy rail network at Glasnevin and Tara Street stations.

4.4.2 As part of this Addendum report and in addition to the testing of revised service levels for each option, it was also important to understand the performance of each option without the inclusion of MetroLink. This was done to understand if the DART Expansion options would stand on their own merits, without the wider integration benefits from this scheme.

4.4.3 For this reason, Scheme Bundles 2 and 6 have been tested without[6] MetroLink in place. Table 5 below provides a summary of the model results for Bundle 2 and 6 – with and without Metro Link. For this assessment the best performing Scheme Bundle 6 option (Option 2) has been used.

4.4.4 As can be seen in Table 5, the overall performance of the options without MetroLink reduces. The Transport User Benefits for Bundle 2 reduce by [redacted] whilst the Bundle 6 option reduces by [redacted] This highlights that Bundle 6 integrates slightly better with MetroLink releasing approximately [redacted] more in Transport User Benefits. The exclusion of MetroLink has less of an impact on Bundle 2 due to the higher level of penetration that this scheme provides within the city centre.

4.4.5 The BCR for Scheme Bundle 2 reduces from [redacted] to [redacted] without MetroLink while the equivalent BCR change for Scheme Bundle 6 is [redacted], reducing to [redacted]

4.4.6 The results show that while the inclusion of MetroLink provides benefits for both options, the DART Expansion scheme bundle options provide substantial user benefits in their own right and will provide a very strong return on investment, even without MetroLink.

[6] Note that MetroLink is also removed from the Do Minimum for these tests when calculating Transport User benefits for the 'No MetroLink' options using TUBA software.

Table 3. Bundle 6 - Revised KPI Summary

KPI	BUNDLE 6 – MAIN REPORT	BUNDLE 6 – JACOBS OUTPUT TSS	BUNDLE 6 – REVISED TSS – OPTION 1	BUNDLE 6 – REVISED TSS – OPTION 2
AM Mode Share (PT)	22.1%	21.9%	21.9%	22.2%
24 Hr Mode Share (PT)	12.7%	12.6%	12.6%	12.7%
AM PT Boardings	192,800	190,462	189,800	191,800
Rail	65,800	61,432	63,200	63,900
Bus	68,500	69,861	68,600	69,100
LRT	11,900	11,747	11,500	11,700
Metro	46,600	47,422	46,500	47,400
24 Hr Boardings	1,207,100	1,194,415	1,188,000	1,199,600
Rail	403,500	380,595	384,500	390,000
Bus	416,400	423,593	418,800	420,500
LRT	86,000	84,381	83,500	84,400
Metro	301,200	305,846	301,100	304,800
PT Transfers	43,800	42,700	41,200	43,200
Cap Ex Costs (€ millions)	[redacted]			
O&M Costs (€ millions)				
Transport User Benefits (€ millions)				
Present Value of Costs (€ millions)				
BCR	3.14	2.33	2.41	2.68

Table 4. Bundle 2 - Revised KPI Summary

KPI	BUNDLE 2 – MAIN REPORT	BUNDLE 2 – REVISED TSS
AM Mode Share (PT)	22.3%	23.4%
24 Hr Mode Share (PT)	13.0%	13.2%
AM PT Boardings	192,600	196,815
Rail	72,800	70,220
Bus	64,500	68,857
LRT	10,600	11,348
Metro	44,700	46,390
24 Hr Boardings	1,212,100	1,222,548
Rail	452,400	427,405
Bus	392,700	413,866
LRT	76,200	79,808
Metro	290,900	301,468
PT Transfers	44,300	45,700
Cap Ex Costs (€ millions)	[redacted]	[redacted]
O&M Costs (€ millions)	[redacted]	[redacted]
Transport User Benefits (€ millions)	[redacted]	[redacted]
Present Value of Costs (€ millions)	[redacted]	[redacted]
BCR	2.49	2.35

Table 5. KPI Summary – With and Without MetroLink

KPI	BUNDLE 2 – REVISED TSS	BUNDLE 2 – REVISED TSS – WITHOUT METRO	BUNDLE 6 – REVISED TSS – OPTION 2	BUNDLE 6 – REVISED TSS – OPTION 2 – WITHOUT METRO
AM Mode Share (PT)	23.4%	21.4%	22.2%	20.8%
24 Hr Mode Share (PT)	13.2%	12.1%	12.7%	11.8%
AM PT Boardings	196,815	171,200	191,800	167,700
Rail	70,220	70,700	63,900	64,100
Bus	68,857	74,500	69,100	77,400
LRT	11,348	26,100	11,700	26,200
Metro	46,390	-	47,400	-
24 Hr Boardings	1,222,548	1,064,400	1,199,600	1,042,300
Rail	427,405	432,400	390,000	387,600
Bus	413,866	458,100	420,500	477,500
LRT	79,808	173,900	84,400	177,200
Metro	301,468	-	304,800	-
PT Transfers	45,700	35,000	43,200	31,500
Cap Ex Costs (€ millions)	[redacted]			
O&M Costs (€ millions)				
Transport User Benefits (€ millions)				
Present Value of Costs (€ millions)				
BCR	2.35	2.20	2.68	2.32

5. CONCLUSIONS AND NEXT STEPS

5.1 Assessment Conclusions

5.1.1 This Addendum Report summarises the outcomes of a strategic modelling assessment of the preferred DART Expansion scheme bundle options based on a set of revised service plans – following an independent capacity analysis review of the rail network in the Greater Dublin Area (GDA) .

5.1.2 The revised service levels were tested in the NTA ERM to understand the impacts on passenger demand levels, performance and value for money in comparison to the results from the Main Report.

5.1.3 In summary the modelling assessment has found that:

- There remains a very strong return on investment and a positive business case for the implementation of both Scheme Bundles 2 and 6 with revised (lower) service levels;
- BCRs have reduced as a result of the revised service levels, although remain highly positive.
  - **Bundle 6** - Range of 2.32 to 2.68 with lower service levels (Previously 3.14)
  - **Bundle 2** - Range of 2.20 to 2.35 with lower service levels (Previously 2.49)
- There is a very strong and positive BCR for both scheme bundles, even without MetroLink being in place;
- Direct services from the Phoenix Park Tunnel line to Docklands provides for the greatest transfer levels and best integration with MetroLink; and
- The through running of M3 Parkway services on the Maynooth line performs well, in place of the previously proposed 'shuttle' service from M3 Parkway to Clonsilla.

5.2 Recommendation

Based on the modelling assessment and KPI evaluation, it is recommended that as per the Main Report, Scheme Bundle 6 is the preferred scheme bundle option to deliver DART Expansion. Scheme Bundle 6 still maintains a higher BCR than Scheme Bundle 2 and is [redacted] cheaper.

5.3 Potential Next Steps

5.3.1 In line with the Public Spending Code and the DTTAS "Common Appraisal Framework for Transport Projects and Programmes 2016" (CAF), government departments are required to submit a Business Case for capital projects greater than [redacted] in value.

5.3.2 The Main Report including this Addendum report is considered a Stage 1 - Preliminary Appraisal (as defined in CAF), in that it includes the background, initial specification of the needs and objectives, identification of potential options and a preliminary assessment of the costs and benefits of the options.

5.3.3 The next steps in the project will be to move to the Stage 2 – Detailed Appraisal stage, which will include:

- A full Economic Appraisal;
- Financial Appraisal; and
- Risk Analysis.

5.3.4 This should culminate in the submission of a full Business Case to secure project approvals and funding. In parallel to this, it is recommended that an Implementation and Phasing Strategy is undertaken to understand the incremental benefit of delivering the scheme bundle elements and sequencing of delivery to give the best return on investment.

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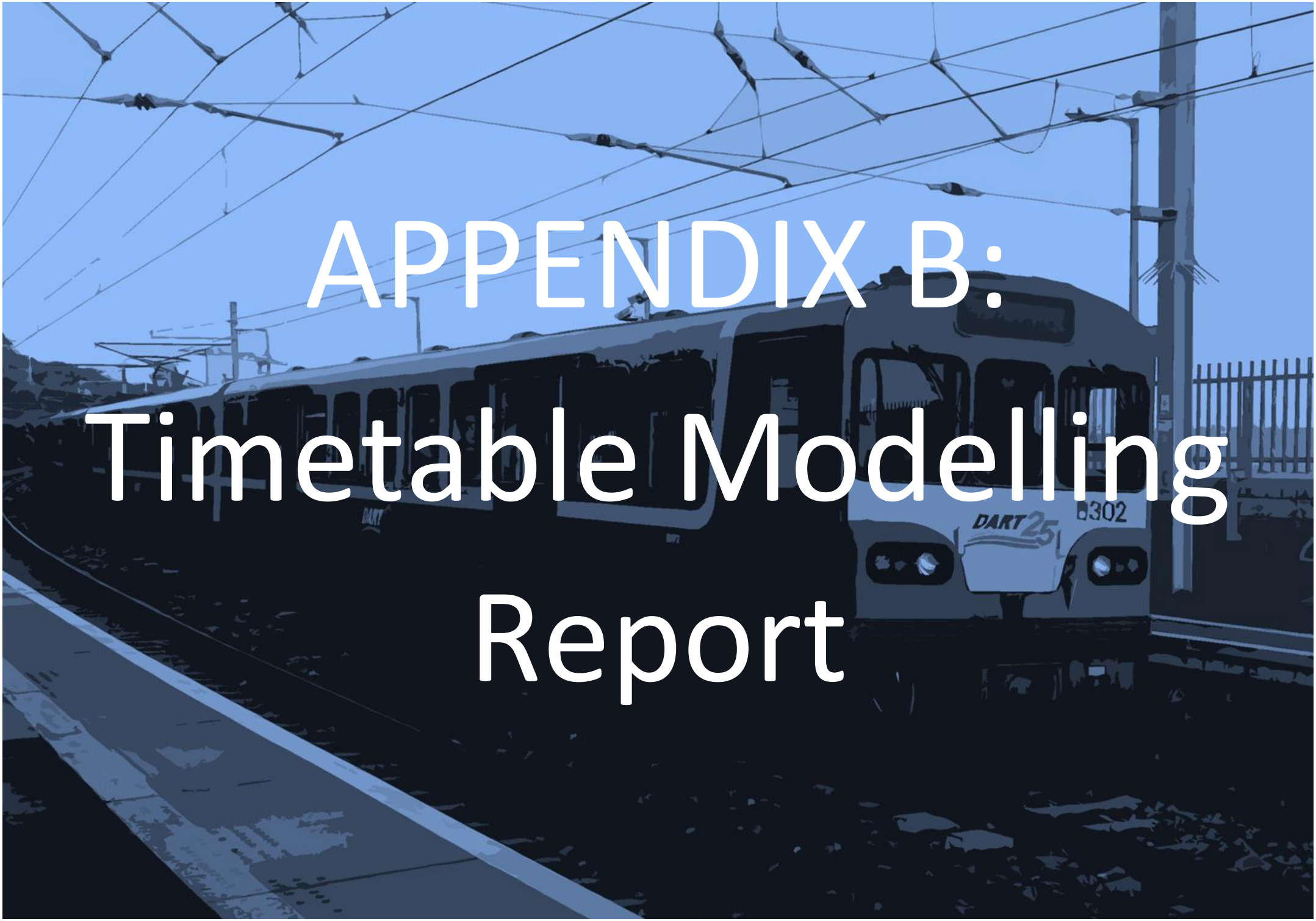
SYSTRA

APPENDIX A: Service Patterns

Note: The table below contains a breakdown of the Services modeled as part of the Adddendum Report.

	Bundle 2		Bundle 6			
Route	**Main Report**	**Revised TSS**	**Main Report**	**Jacobs Output - TSS**	**Enhanced TSS - Option 1**	**Enhanced TSS - Option 2**
Northern Line						
Belfast to Connolly (Enterprise)	1	1	1	1	1	1
Connolly to Rosslare Europort (Diesel)	1	1	1			
Greystones to Rosslare Europort (Diesel)				1	1	1
Dundalk to Drogheda [Shuttle]	2		2			
Dundalk to Connolly (Diesel)	2		2			
Dundalk to Bray				2	2	2
Drogheda to Docklands			3		2	
Drogheda to GCD				2	2	4
Drogheda to Connolly			2			
Drogheda to Dún Laoghaire			6			
Drogheda to Bray				2		
Malahide to Greystones				2		
Malahide to Bray				1	3	3
Clongriffin to Dún Laoghaire				1	3	3
Howth to Howth Jn [Shuttle]	6	6	6	6	6	6
Connolly to Bray	3					
Clongriffin to Bray			4	2		
Kildare / Northern Lines						
Drogheda to Hazelhatch	8	4				
Dundalk to Hazelhatch		2				
Clongriffin to Hazelhatch	8	3				
Malahide to Hazelhatch		3				
Maynooth & M3 Parkway						
Sligo to Connolly (Diesel)	2	2	2	2	2	2
Maynooth to Connolly			5	8		2
Maynooth to Docklands			3			
Maynooth to GCD					4	2
Maynooth to Dún Laoghaire		3				
Maynooth to Bray	12	3	5		2	2
Maynooth to Greystones	2	2	2		2	2
M3 Parkway to Clonsilla [Shuttle]	4	4	4			
M3 Parkway to Connolly						5
M3 Parkway to Docklands				5	5	
M3 Parkway to GCD		2				
M3 Parkway to Bray		3				
Kildare Line						
Mainline to Heuston (DMU)	12	12	12	12	12	12
Hazelhatch to Heuston		2	4	4	4	4
Hazelhatch to Docklands			12	5	5	10
Hazelhatch to Connolly				1	5	
Hazelhatch to GCD				2		
Hazelhatch to Dún Laoghaire				2		



APPENDIX B:
Timetable Modelling Report