DART+ Coastal North

ANNEX 3.7

Technical Optioneering Report: Howth Branch Level Crossings

ARUP

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Abbreviations

Abbreviation	Definition
CAF	Common assessment framework
CCTV	Closed-circuit television
DART	Dublin Area Rapid Transport
EMU	Electric multiple units
IÉ	Iarnród Éireann
MCA	Multi-Criteria Analysis
MMQ	Mean maximum queue
OSI	Ordinance Survey Ireland
PCU	Passenger Car Units
TPH	Trains per hour
TPHPD	Trains per hour per direction
TSS	Train service specification
WTT	Working timetable

1 Introduction

The purpose of this report is to provide the technical input to the Preliminary Option Selection Report. This report details the assessment undertaken for impacts to the existing level crossings on the Howth Branch due to alterations to service frequency. As this aspect of works is solely assessing impact, it is not subject to the same optioneering process of longlist creation, sifting to shortlist and multi-criteria analysis (MCA), in line with the Option Selection Process section of the Preliminary Option Selection Report.

The report contains:

- An explanation of the impacts of the Train Service Specification to services on the Howth Branch line;
- The inputs, methodology and results for barrier opening times from a train operations perspective;
- Assessment of impacts of changed barrier opening times on vehicles;
- Assessment of impacts of changed barrier opening times on pedestrians and cyclists;
- Conclusion of the overall impact of changes to services on the Howth Branch.

1.1 Packages of work

The scope of work for DART+ Coastal North covers a wide range of interventions on the Northern Line needed in order to meet the Train Service Specification (TSS) requirements. To appropriately assess options against each other, the scope of work has been split into separate work packages, as contained within the various Annexes. Where appropriate, the works have then been further split down into 'Sections' which define the system which has been subject to the optioneering and design process.

1.2 References

This report should be read in conjunction with the following related optioneering reports:

Table 1-1: List of key documents associated with this report

Annex	Title	Description
N/A	DART+ Coastal North Preliminary Option Selection Report	This is the main report which summarises the optioneering process and the different packages of proposed works on the DART+ Coastal North project.
N/A	DART+ Coastal North Preliminary Option Selection Report – Executive Summary	This report summarises the main Preliminary Option Selection Report.
1	Emerging Preferred Option Maps	Includes drawings for each Emerging Preferred Option, to support the Preliminary Option Selection Report.
2.1	Policy Context	This presents a detailed review of the European, National, Regional and Local policy context for the DART+ Programme and the DART+ Coastal North Project
2.2	Useful Links	Useful links to documents/websites relating to the DART+ Coastal North project.
3.1	Constraints Report	This report reviews the DART+ Coastal North constraints.
3.2	Technical Optioneering Report: Electrification of the Northern Line between Malahide and Drogheda.	The Technical Optioneering Report for the Electrification of the Northern Line between Malahide and Drogheda. The report is divided into a series of sections, as described in Table 1.
3.3	Technical Optioneering Report: Works around Drogheda MacBride Station	The Technical Optioneering Report for Works around Drogheda MacBride Station. The report addresses track and station modifications to allow for the increased number of DART services.
3.4	Technical Optioneering Report: Works around Malahide Station	The Technical Optioneering Report for Works around Malahide Station. The report addresses track modifications required to allow trains to be turned back clear of through running services.

Annex	Title	Description
3.5	Technical Optioneering Report: Works around Clongriffin Station	The Technical Optioneering Report for Works around Clongriffin Station. The report addresses track modifications required to allow trains to be turned back clear of through running services.
3.6	Technical Optioneering Report: Works around Howth Junction & Donaghmede Station	The Technical Optioneering Report for Works around Howth Junction & Donaghmede Station. The report addresses the addition of tracks to allow a higher frequency shuttle service.
3.7	Technical Optioneering Report: Howth Branch Level Crossings	The Technical Optioneering Report for the Howth Branch Level Crossings. The report addresses the impacts of all proposed increases in train frequency on existing level crossings on the Howth Branch.

2 Existing Situation

2.1 Train operations

IÉ currently operates trains on the Howth Branch as an extension of DART services from Bray or Greystones, integrated with trains going to Malahide. Howth and Malahide-bound services split at Howth Junction & Donaghmede Station, where Howth trains operate a stopping service at Sutton, Bayside, and Howth. Services average around 3 trains per hour (TPH) per direction, though on occasion IÉ schedules up to 4 TPH per direction during peak periods. Due to the interlined nature of Howth services, they are vulnerable to the import of delays from other parts of the network.

2.2 Level crossings

The Howth Branch has four level crossings:

- Baldoyle Road Level Crossing (XQ001) – hereby referred to as Kilbarrack to match signal diagrams provided by IÉ, numbered 917 on signal diagrams
- Sutton Level Crossing (XQ002) – numbered 916 on signal diagrams
- Cosh Level Crossing (XQ003) – number 915 on signal diagrams
- Claremont Level Crossing (XQ004) – numbered 913 on signal diagrams

Kilbarrack Crossing (917) carries R809/Baldoyle Road over the Howth Branch, which is a critical corridor for road traffic. Sutton Crossing (916) is adjacent to Sutton Station and carries the heavily used R106/Station Road, a principal means of access for the Howth peninsula. Cosh Crossing (915) carries Lauder's Lane over the railway line, connecting one side of the Sutton Golf Club to the other. Claremont Crossing (913) allows for access to a small residential development on a private road and providing exclusive access to the area for motor vehicles. An informal path leads off to the west - connecting to Claremont Road and an overbridge over the railway to Howth Road - but is unusable other than for foot and cycle traffic. An overview of their locations on the Howth Branch is provided in Figure 2-1. Aerial views of the individual crossings are provided in the subsequent figures.

Figure 2-1: Overview of level crossing locations on the Howth Branch (Source: OSI aerial imagery)

Figure 2-2: Baldoyle Road Level Crossing (XQ001, 917) (Kilbarrack) plan view (Source: OSI aerial mapping)

Figure 2-3: Sutton Level Crossing (XQ002, 916) plan view (Source: OSI aerial mapping)

Figure 2-4: Cosh Level Crossing (XQ003, 915) plan view (Source: OSI aerial mapping)

Figure 2-5: Claremont Level Crossing (XQ004, 913) plan view (Source: OSI aerial mapping)

During normal operations the level crossings operate as part of the signalling system and are automatically lowered when a train passes a trigger point (referred to as a 'strike in point'). The branch level crossings can be operated under other procedures; however, IÉ has stated these are uncommon occurrences. Sutton crossing (916) is unique in that, according to IÉ, it alone has a 10-15 second delay built in between a train passing its strike in point and the level crossing barriers

beginning to close. This is to improve the operational efficiency of the crossing (which is triggered at the same time as Kilbarrack), limiting extraneous downtime while still maintaining a safe warning period. No other crossing on the Howth Branch has a similar variation in operation.

The level crossing boom gates are raised shortly after a train clears sensors adjacent to the level crossing. If a train in the opposing direction is scheduled to pass the level crossing shortly after a train clears it, the level crossing will stay closed until that train passes and clears the crossing as well.

All crossings are equipped with full four-quadrant boom gates, completely cutting off access to the railway when closed. All crossings are remotely observed with CCTV to ensure that the crossing is clear of traffic when the boom gates are closed. Spotlights are co-mounted with the cameras to allow all day operation.

3 Train Service Specification

As part of the DART+ Coastal North project, IÉ intends to increase the number of services on the Howth Branch while also improving reliability by separating operations from the rest of the DART network. This forms part of the Train Service Specification (TSS), which is the 'desired' number of train services to have on each branch of the DART network (i.e. trains per hour per direction [TPHPD]). This report adopts version TSS1C.

Whilst final operational decisions will be made subject to demand requirements and assessment, TSS 1C assumes all Howth trains will operate as a shuttle service between Howth and Howth Junction & Donaghmede stations (Some through trains off-peak may be timetabled). Services in TSS 1C are assumed to change from being 3-4TPH per direction and dictated by scheduling needs in other parts of the network to being a regular service of 6 full-length trains per hour per direction, (i.e. trains departing every 10 minutes).

The changes represent a substantial increase in capacity, both in frequency and size of individual services. Additionally, as a shuttle service, Howth Branch trains will be almost fully insulated from delays on other parts of the DART and IÉ network.

Changes to the service and operating condition of the line creates the need to assess any impact on the barrier opening times and its associated effects on vehicles, pedestrians and cyclists.

The proposed services as part of DART+ Coastal North are shown in Figure 3-1. Of note is the regularity and shuttle nature of the Howth Branch services which forms the basis of the assessment as described in this report.

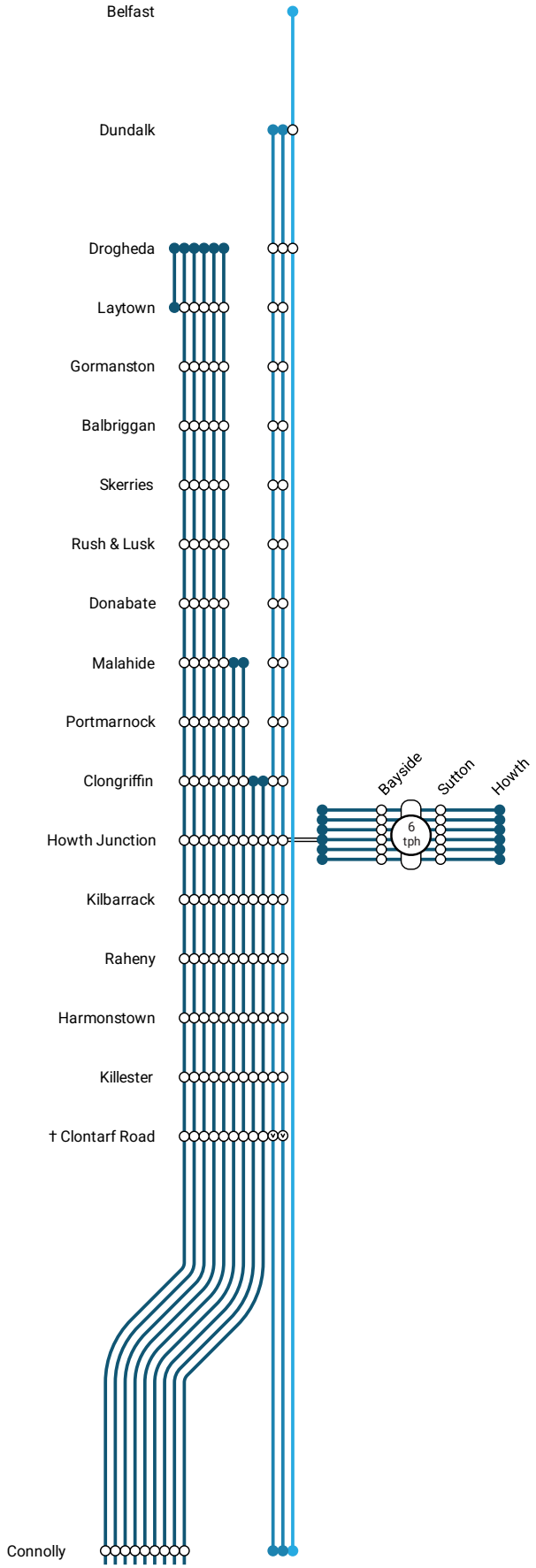

Figure 3-1: DART+ Coastal Services

4 Modelling Parameters

Arup modelled the four Howth Branch level crossings in RailSys software, using the program's integrated level crossing function. Arup, in agreement with IÉ, chose to exclusively model level crossing operations in their normally operated method, not including modelling non-standard scenarios such as non-stop trains or during perturbed operations. As such, all trains are assumed to be DART EMU (Electric Multiple Unit) trainsets, with 30 second station dwells, stopping at all stations. Arup confirmed the strike in points to be at the following locations, as shown in Appendix A.

The modelling assumes that all level crossings are automatic and require safe closure before the signals can be set for the approaching train. Between barrier closures the road will need to be open for a minimum of 90 seconds, otherwise the barriers will remain down and the crossing closed. The crossing is assumed to begin to open once the train passes a clearance point, assumed to be 10m off of the level crossing, and the barriers are assumed to take 8 seconds to open. The modelling assumes a 10 second delay for Sutton Crossing (916) between a train passing the strike in point and the barriers beginning to lower. Assumptions were agreed with IE to be a reasonable reflection of reality and will be validated upon receipt of further survey data.

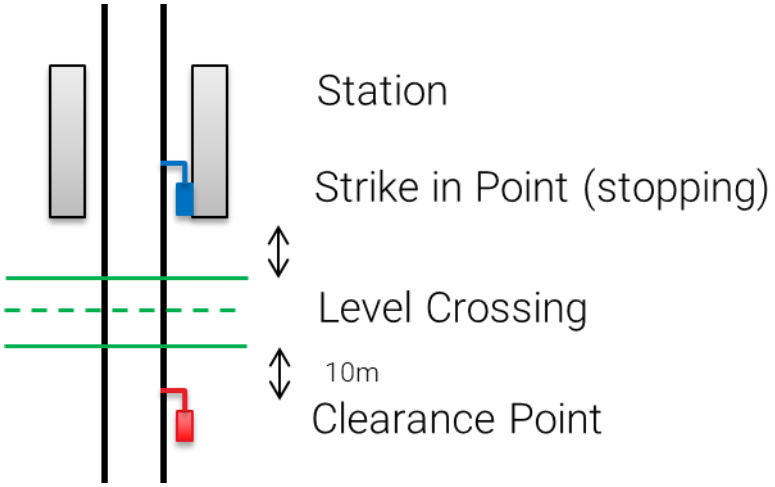

Figure 4-1: Example schematic for strike in and clearance points

Modelling covers the following 14 service variations per direction:

- 3 TPH (Reflects Working Timetable – i.e. the baseline scenario)
- 4 TPH (regular intervals)
- 5 TPH (regular intervals)
- 6 TPH (regular intervals, reflects TSS 1C)
- 6 TPH with 1-minute offset
- 6TPH with 2-minute offset
- 6TPH with 3-minute offset

- 6TPH with 4-minute offset
- 6TPH with 5-minute offset
- 6TPH with 6-minute offset
- 6TPH with 7-minute offset
- 6TPH with 8-minute offset
- 6TPH with 9-minute offset
- 6TPH with 10-minute offset

All offset scenarios are based on the 6 TPH TSS1C, with all Down direction trains offset by a period of time. Since TSS1C is not necessarily the timetable to which trains will operate following implementation of the DART+ Programme, this serves as a sensitivity check to evaluate how differently the level crossings will behave if services are more or less synchronized.

5 Barrier Results

Arup modelled the level crossing closure behaviours for the entire Howth Branch for 14 different service variations. Summary results from the five most important scenarios are listed below in Table 5-1.

TSS1C is the main service scenario, assuming trains will leave every 10 minutes, with services departing from Howth Junction & Donaghmede Station and services departing Howth Station separated by eight minutes. This scenario results in barriers being open between 29 minutes out of an hour to 49 minutes out of an hour, depending on the specific crossing.

The level crossing closures are highly sensitive to the exact meeting point of trains in any given scenario; having trains cross simultaneously is the best case, as it allows two trains to pass for one closure. By contrast, the worst scenario would be two trains separated by just less than 90 seconds, meaning that the level crossing will be held down for the maximum amount of time.

To test the effect of differing meeting points - stemming from different service patterns - scenarios offsetting the departure time of Down trains by 1 to 10 minutes were run. Since the level crossing closure times depend on the relative meeting point between Down and Up services, it is only necessary to offset trains in one direction. Offsets were continued up to + 10min, at which point a regular 6 TPH per direction service like the Howth Branch will bring the timetable back to its starting point.

Scenario “Modified TSS1C (Down + 5 min)” below was chosen as it is a proxy to a timetable running out of path, in this case running ahead or behind schedule by half the headway. While the opening times of most level crossings actually increases (an improvement for road traffic), this is not a uniform effect. Sutton Crossing (916) - itself the worst performing in the base TSS1C scenario - sees open times drop by approximately 20 seconds per hour. This scenario and the other offset scenarios demonstrate two facts:

- Firstly, that TSS1C is neither the most optimistic nor most pessimistic modelling scenario;
- Secondly, that changes in service timetabling on the Howth Branch will have varying benefits and detriments to each level crossing.

The results in the table below show that opening numbers increase and decrease but are not detrimentally impacted by a changing timetable or timetable performance. Intuitively, the fewer trains are run per hour, the longer the barriers will be open.

Table 5-1: Level Crossing Open Time Results – range of open time and total open time in any given hour

	Claremont (913)	**Cosh (915)**	**Sutton (916)**	**Kilbarrack (917) (Baldoyle Road)**
TSS1c	6 Openings (05:16 to 05:50) Sum: 33:18	12 Openings (01:55 to 03:59) Sum: 35:12	6 Openings (04:34 to 05:08) Sum: 29:06	6 Openings (08:02 to 08:21) Sum: 49:09
Modified TSS1c (Down + 5 min)	6 Openings (06:16 to 06:16) Sum: 37:36	6 Openings (06:55 to 07:25) Sum: 43:00	6 Openings (04:32 to 05:02) Sum: 28:42	12 Openings (03:02 to 04:28) Sum: 44:48
5 TPH per direction	5 Openings (07:16 to 07:51) Sum: 38:03	10 Openings (03:25 to 04:26) Sum: 39:18	10 Openings (01:32 to 05:08) Sum: 33:08	5 Openings (08:02 to 08:32) Sum: 41:09
4 TPH per direction	4 Openings (11:16 to 11:16) Sum: 45:04	4 Openings (11:55 to 12:25) Sum: 48:40	4 Openings (09:32 to 10:02) Sum: 39:08	8 Openings (03:02 to 09:28) Sum: 50:00
3 TPH per direction (WTT – *'Existing', see section 6.1.2*)	5 Openings (02:40 to 13:20) Sum: 43:23	3 Openings (14:52 to 17:36) Sum: 49:16	3 Openings (15:58 to 16:41) Sum: 48:39	5 Openings (01:41 to 16:42) Sum: 51:28

6 Assessment of Proposal on Vehicles on the Road Network

In this section of the report the effect of the Howth Branch of the DART line and the level crossings on the surrounding road network has been investigated, looking specifically at the queueing at level crossings and nearby junctions during barrier closure times. A baseline DART service of 3 trains per hour per direction (3TPH), based on the modelled 3TPH per direction barrier timings and level crossing closures during the AM peak has been modelled using junction modelling software, LinSig[1]. This has been compared to the proposed worst-case scenario of 6 trains per hour per direction scenario. A sensitivity analysis has also been carried out to understand the reliance of queueing on the road network on train departure times for the 6TPH per direction scenario.

6.1 Background Information

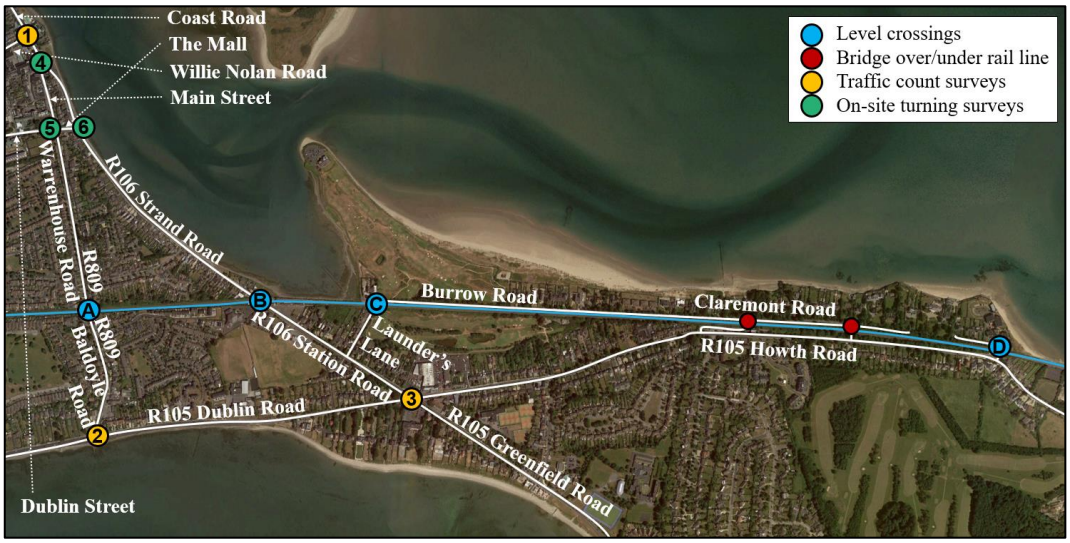

Figure 6-1: Overview of the area of interest along the Howth Branch

6.1.1 Level Crossings

There are four level crossings situated along the Howth Branch, shown in blue in Figure 6-1. They are as follows:

A. 917: Kilbarrack Level Crossing (XQ001) (Baldoyle Road) – Rail line across the Baldoyle Road/ Warrenhouse Road;

B. 916: Sutton Level Crossing (XQ002) – Rail line across Station Road, adjacent to Sutton Station;

C. 915: Cosh Level Crossing (XQ003) – Rail line across Lauder's Lane;

[1] LinSig is an industry standard software tool which allows traffic engineers to model traffic signals and their effect on traffic capacities and queuing

D. 913: Claremont Level Crossing (XQ004) - Rail line across a Private Access Road.

Each level crossing has a different amount of demand for vehicle traffic crossing it.

Kilbarrack (917) and Sutton (916) Level Crossings are the two that have the highest volumes of vehicles crossing them and have the greatest potential to cause delays on the wider network if queues form at the level crossings. As a result, these have been analysed using modelling software and quantitative methods.

Cosh (915) and Claremont (913) Level Crossings have a much lower level of vehicle traffic crossing them as they are mainly only used for local access, and they don't run the risk of causing long queues. For these, qualitative analysis methods have been applied.

6.1.2 Existing Barrier Closure Timings

Howth branch operates as a through service, with alternating train serving Howth and Malahide. Three to four trains per hour travel in each direction travel along this line equalling a maximum of eight trains in total, per hour.

Iarnród Éireann (IE) has provided some data on working timetable (WTT). With this data a RailSys model for 3TPH per hour per direction, based on the WTT, was modelled. This is detailed in Section 5. The output of the RailSys model has been used and represents the Baseline scenario for the comparison. This will be detailed further in section 6.2.1.

6.1.3 Traffic Data

Traffic data is required to undertake the assessment and understand the impact on vehicles and queueing in the surrounding area. Unfortunately, due to Covid-19, it was not possible to commission a traffic count survey for the Sutton area as the volumes of traffic would not have been representative of pre Covid-19 times. However, historical data which was collected in 2018 and 2019 at three junctions was available and applied for a robust assessment. The three junctions at which historical traffic data is available are shown in Figure 6-1 in yellow and are as follows:

1. R139 Willie Nolan Road/R106 Coast Road/R106 Main Street Junction
    - Collected: 31st January 2018
2. R105 Dublin Road/R809 Baldoyle Road Junction
    - Collected: 23rd May 2019
3. R105 Howth Road/R105 Greenfield Road/R105 Dublin Road/R106 Station Road Junction (Sutton Cross)
    - Collected: 7th March 2019

In addition to using these traffic counts, a turning survey was done to understand the percentage of vehicles turning at three junctions, shown in green in Figure 6-1:

This survey complemented the historical traffic data, enabling the volumes in the historical data to be distributed though the network in proportions that would be representative of observed traffic patterns. The turning counts were collected over a 30-minute period between 07:45-09:45 to coincide with the AM peak. The three junctions at which the turning count surveys were done are:

1. R106 Strand Road/Main Street Junction
2. The Mall/Dublin Street/R809 Warrenhouse Road Junction
3. The Mall/ R106 Strand Road Junction

The traffic data showed that the AM peak hour is the critical peak from a vehicle traffic point of view. This has therefore formed the focus for the rest of this assessment, which was considered the most appropriate, as it represents the impact on the busiest period from a traffic point-of-view. This assumption will be validated with the future traffic data collected.

6.2 Assessment Methodology

Two methodologies of analysis have been used as part of this assessment. Kilbarrack (917) and Sutton (916) Level Crossings have been analysed through quantitative methods, using traffic data and LinSig modelling. The need for quantitative analysis and modelling is driven by the high volume of vehicles using the crossings and their ability to, during barrier closure times, cause queuing and delays on the regional road network. Queuing could also be impacted at the Dublin Road/ Baldoyle Road Junction and Sutton Cross Junction (labelled as 2 and 3 in Figure 6-1). The level crossing closure times were simulated in the LinSig network model as signalised junctions which, in effect, represents the barriers being closed and allows for an understanding of the mean maximum queue (MMQ) that builds up at both the level crossings and the junctions in the surrounding network.

Cosh (915) and Claremont (913) Level Crossings have been assessed using qualitative analysis methods. These two level crossings have a much lower volume of traffic crossing them as they are mostly used for local access and therefore do not run a high risk of causing queuing that will affect the regional road network.

As mentioned in section 6.1.3, the focus of the study was on analysing observed AM peak hour volumes as it represents the impact on the busiest time from a traffic point-of-view. Even though queues will be in different places in the PM peak and interpeak, the study shows an overall improvement in queues in the AM peak. It is reasonable that improvements will also occur in the PM and interpeak queueing.

No strategic assignment / route choice / mode choice modelling was carried out. The use of LinSig is considered sufficient as any redistribution and reassignment of trips because of the changes are not envisaged at the level crossings.

6.2.1 Baseline 3TPH Per Direction – Kilbarrack (917) and Sutton (916) Level Crossings

The baseline scenario of 3TPH per direction travel in each direction has been modelled during the AM peak using the level crossing closure time data for the RailSys model, as shown in Table 6-1.

During the AM peak hour Kilbarrack (917) Level Crossing closes five times per hour and Sutton (916) Level Crossing closes three times per hour with three trains per hour per direction passing through each one. Figure 6-2: and Figure 6-3: show the closure times across the full one hour period.

Table 6-1: Baseline Level Crossing Closure Times for 3TPH Per Direction

Baseline 3TPH per direction	Number of closures per hour	Total baseline closure time per hour	Maximum baseline single closure time
Kilbarrack (917) Level Crossing	5	00:09:32	00:03:18
Sutton (916) Level Crossing	3	00:12:21	00:05:00

In Figure 6-2 and Figure 6-3 phases A and B represent when the barriers are open and vehicles have a green light, A is Warrenhouse Road in the southbound direction and B is Baldoyle Road in the northbound direction. Phases C and D represent when the barriers are closed and the trains have a “green light” to pass through the LC, C is the westbound train and D is the eastbound train. The closure times represent the AM peak hour 08:00-09:00.

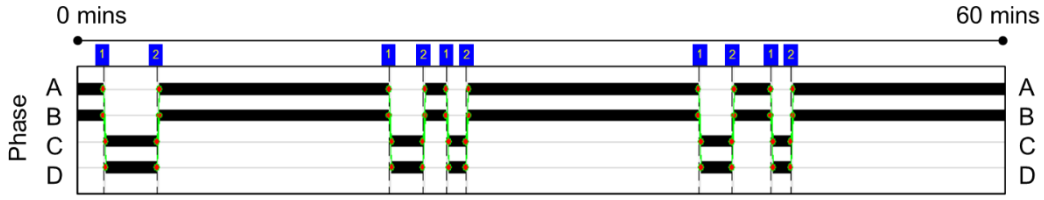

Figure 6-2: Kilbarrack (917) Level Crossing, Baseline Barrier Closure Times

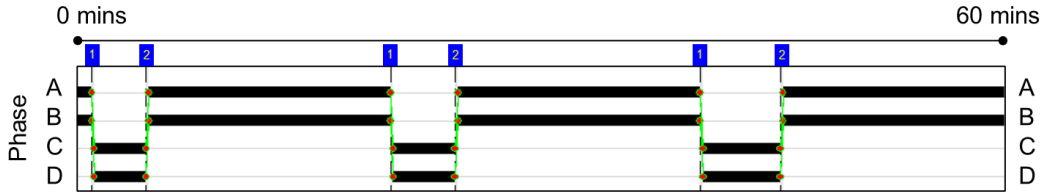

Figure 6-3: Sutton (916) Level Crossing, Baseline Barrier Closure Times

The signal timings for the two junctions south of the level crossings, Sutton Cross Junction and Dublin Road/Baldoyle Road Junction, were set to be optimised in the LinSig simulation in the baseline and proposed scenarios, to allow them to sync up with the opening and closing times of the level crossings.

6.2.2 Proposed 6TPH Per Direction– Kilbarrack (917) and Sutton (916) Level Crossings

The proposed current scheme is described in detail in Section 3. The scenario for six trains per hour per direction (6TPH) has been modelled as this represents the largest increase in the number of trains when compared to the Baseline scenario and is therefore the worst-case scenario.

Under the 6TPH TSS1C scenario, the Howth Branch will run as a shuttle service. Six trains per hour per direction will pass through each of the level crossings, equating to a total of 12 trains passing per hour.

The proposed opening and closure times of the level crossings barriers are extracted outputs from the RailSys model, as provided in Section 5. With six trains per direction, this in effect means a train departs each end station every 10 minutes. This is presented in Table 6-2, and the opening and closure times are shown in the figures below.

Table 6-2: Proposed Level Crossing Closure Times for 6TPH per direction model

Proposed 6TPH TSS1C	Number of Closures per hour	Total proposed closure time per hour	Maximum proposed single closure time
Kilbarrack (917) Level Crossing	6	00:10:51	00:01:58
Sutton (916) Level Crossing	6	00:30:54	00:05:26

In Figure 6-4 and Figure 6-5 phases A and B represent when the barriers are open and vehicles have a green light, A is Station Road in the southbound direction and B is Station Road in the northbound direction. Phases C and D represent when the barriers are closed and the trains have a “green light” to pass through the LC, C is the westbound train and D is the eastbound train. The closure times represent the AM peak hour 08:00-09:00.

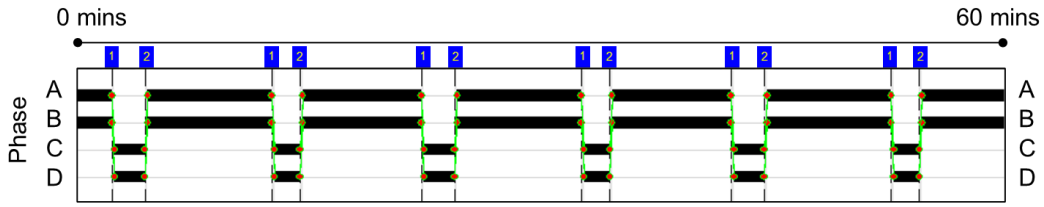

Figure 6-4: Kilbarrack (917) Level Crossing, Proposed Barrier Closure Times

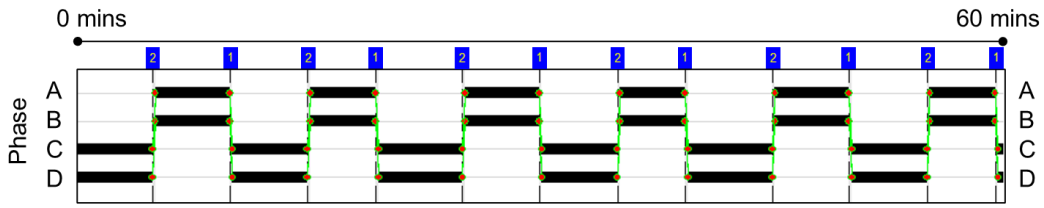

Figure 6-5: Sutton (916) Level Crossing, Proposed Barrier Closure Times

The signal timings for the two junctions south of the level crossings, Sutton Cross Junction and Dublin Road/Baldoyle Road Junction, were set to be optimised in the LinSig simulation, to allow them to sync up with the opening and closing times of the level crossings.

6.3 Modelling Results - Kilbarrack (917) Level Crossing and Dublin Road/Baldoyle Road Junction (XQ001)

6.3.1 Baseline 3TPH Per Direction

In the Baseline scenario of 3TPH, Kilbarrack (917) Level Crossing produces a MMQ of 323 meters at the level crossing in the southbound direction, equating to 62% of the possible capacity of the link.

The northbound MMQ at the level crossing is 124 meters and takes up 35% of the available space.

The southbound arm of the Dublin Road/Baldoyle Road Junction also has a MMQ that exceeds the length of the link, of 373 meters (107% of the available space).

These results show that in the baseline scenario the southbound arm of the Dublin Road/Baldoyle Road Junction is over capacity, this will cause delays and increased queuing at Kilbarrack (917) Level Crossing in the southbound direction and in the wider network.

The results are shown in Figure 6-6 and Table 6-3.

Figure 6-6: Baseline 3TPH Per Direction MMQ Results

Table 6-3: Baseline 3TPH Per Direction MMQ Results

Baseline 3TPH	Link Length	MMQ (PCUs)	MMQ	% Capacity
Kilbarrack (917) Level Crossing SB	520m	54	323m	62%
Kilbarrack (917) Level Crossing NB	350m	21	124m	35%
Dublin Road/ Baldoyle Road Junction SB Arm	350m	62	373m	107%

6.3.2 Proposed 6TPH Per Direction

Under the proposed 6TPH TSS1C proposed scenario Kilbarrack (917) Level Crossing produces a MMQ of 205 meters at the level crossing in the southbound direction, equating to 39% of the possible capacity of the link.

The northbound MMQ at the level crossing is 112 meters and only take up 32% of the available space on this link.

The southbound arm of the Dublin Road/Baldoyle Road Junction has a MMQ of 197 meters (56% of capacity).

These results show that road network around Kilbarrack (917) Level Crossing operates under capacity and should not cause more delays in the wider network.

The results are shown in Figure 6-7 and Table 6-4.

Figure 6-7: Proposed 6TPH Per Direction MMQ Results

Table 6-4: Proposed 6TPH Per Direction MMQ Results

Proposed 6TPH TSS1C	Link Length	MMQ (PCUs)	MMQ	% Capacity
Kilbarrack (917) Level Crossing SB	520m	34	205m	39%
Kilbarrack (917) Level Crossing NB	350m	19	112m	32%
Dublin Road/ Baldoyle Road Junction SB Arm	350m	33	197m	56%

6.3.3 Comparison

Kilbarrack (917) Level Crossing closes one additional time, with 6 closures, in the proposed 6TPH TSS1C scenario compared to 5 times per hour in the Baseline 3TPH per direction scenario. The total closure time per hour is 1 minute and 19 seconds more in the proposed scenario and the longest single closure time is 1 minutes and 20 seconds less than the baseline. . These results are summarised in Table 6-5, and shown in Figure 6-8 and Figure 6-9.

Table 6-5: Comparison of Level Crossing Closure Times – Kilbarrack (917)

	Number of Closures per hour	Total closure time per hour	Maximum single closure time
Baseline Kilbarrack (917) Level Crossing	5	00:09:32	00:03:18
Proposed Kilbarrack (917) Level Crossing	6	00:10:51	00:01:58

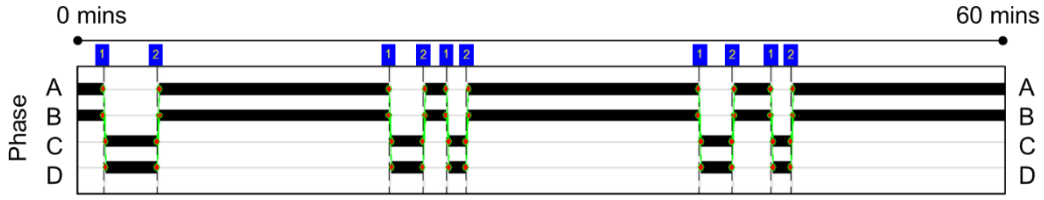

Figure 6-8: Kilbarrack (917) Level Crossing, Baseline Barrier Closure Times

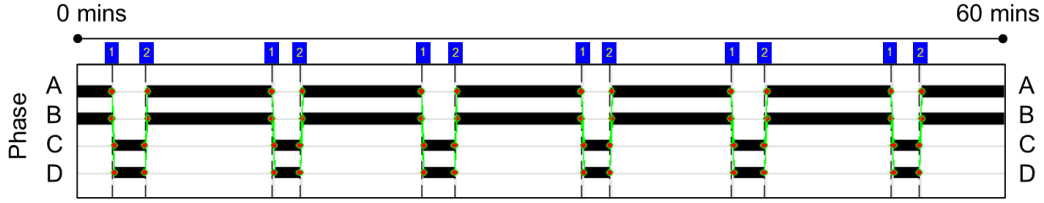

Figure 6-9: Kilbarrack (917) Level Crossing, Proposed Barrier Closure Times

Comparing the mean maximum queue lengths at Kilbarrack (917) Level Crossing and at the Dublin Road/Baldoyle Road Junction, the proposed scenario of 6TPH per direction has less queues on all arms, with a reduction of between 10% to 47%. These results are shown in Figure 6-10 and Table 6-6.

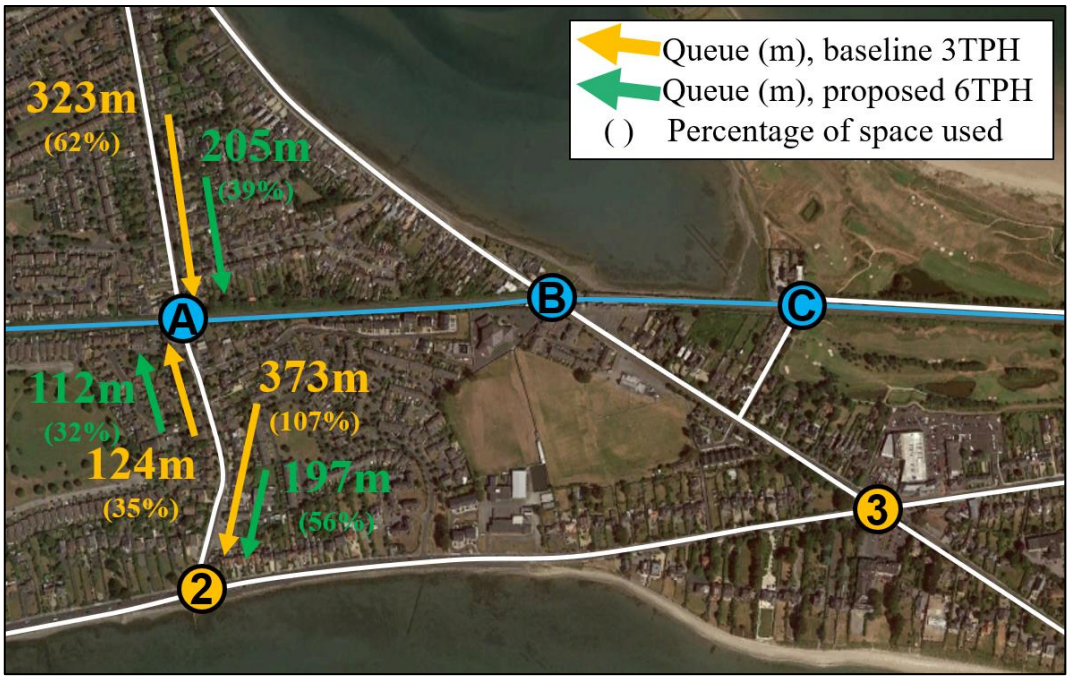

Figure 6-10: Comparison – Kilbarrack (917) Level Crossing and Dublin Road/Baldoyle Road Junction SB Arm Queue Length Modelling Results

In the baseline scenario queues build up when the barrier is closed, then once the barrier opens the queue dissipates. There is then a period of time, before the next closure, when there is no longer a queue and the link is free flowing.

In the proposed scenario this free flow condition (after the dissipation of the queue) does not occur to the same extent. Instead, the free flow condition is much shorter in the proposed scenario than in the baseline scenario because the barrier closes more frequently.

Queuing therefore depends on two factors – the frequency of barrier closure and the total closure times. In the proposed scenario the increased closure frequency allows the queuing to be shorter, even though the total closure times are approximately the same as in the baseline scenario.

Table 6-6: Comparison – Kilbarrack (917) Level Crossing and Dublin Road/Baldoyle Road Junction SB Arm Queue Length Modelling Results

Location	Baseline MMQ	Proposed MMQ	% Change in Queue Length
Kilbarrack (917) Level Crossing SB	323m	205m	**-37%**
Kilbarrack (917) Level Crossing NB	124m	112m	**-10%**
Dublin Road/ Baldoyle Road Junction SB Arm	373m	197m	**-47%**

6.4 Modelling Results - Sutton (916) Level Crossing and Sutton Cross Junction (XQ002)

6.4.1 Baseline 3TPH Per Direction

In the Baseline scenario of 3TPH per direction, Sutton (916) Level Crossing produces a MMQ of 428 meters at the level crossing in the southbound direction, equating to 57% of the possible capacity of the link.

The northbound MMQ at the level crossing is 287 meters and takes up 57% of the available space.

The southbound arm of Sutton Cross Junction also has a MMQ of 288 metres, taking up 58% of the capacity of the link.

These results show that the road network around Sutton (916) Level Crossing operates within capacity.

The results are shown in Figure 6-11 and Table 6-7.

Figure 6-11: Baseline 3TPH Per Direction MMQ Results

Table 6-7: Baseline 3TPH Per Direction MMQ Results

Baseline 3TPH Per Direction	Link Length	MMQ (PCUs)	MMQ	% Capacity
Sutton (916) Level Crossing SB	750m	71	428m	57%
Sutton (916) Level Crossing NB	500m	48	287m	57%
Sutton Cross Junction SB Arm	500m	48	288m	58%

6.4.2 Proposed 6TPH Per Direction

Under the proposed 6TPH TSS1C scenario, Sutton (916) Level Crossing produces a MMQ of 466 meters at the level crossing in the southbound direction, equating to 62% of the possible capacity of the link.

The northbound MMQ at the level crossing is 282 meters and only take up 56% of the available space on this link.

The southbound arm of Sutton Cross Junction also has a MMQ of 280 meters, taking up 56% of the capacity of the link.

These results show that road network around Sutton (916) Level Crossing operates under capacity and should not cause more delays in the wider network.

The results are shown in Figure 6-12 and Table 6-8.

Figure 6-12: Proposed 6TPH Per Direction MMQ Results

Table 6-8: Proposed 6TPH Per Direction MMQ Results

Proposed 6TPH TSS1C	Link Length	MMQ (PCUs)	MMQ	% Capacity
Sutton (916) Level Crossing SB	750m	78	466	62%
Sutton (916) Level Crossing NB	500m	47	282	56%
Sutton Cross Junction SB Arm	500m	47	280	56%

6.4.3 Comparison

Sutton (916) Level Crossing closes 100% more often with 6 closures in the proposed 6TPH TSS1C scenario compared to 3 times per hour in the Baseline 3TPH

per direction scenario. The total closure time increases in the proposed scenario by 18 minutes 33 seconds, and the longest closure time is 26 seconds longer. These results are summarised in Table 6-9, and shown in Figure 6-13 and Figure 6-14.

Table 6-9: Comparison of Level Crossing Closure Times – Sutton (916)

Location	Number of Closures per hour	Total closure time per hour	Maximum single closure time
Baseline Sutton (916) Level Crossing	3	00:12:21	00:05:00
Proposed Sutton (916) Level Crossing	6	00:30:54	00:05:26

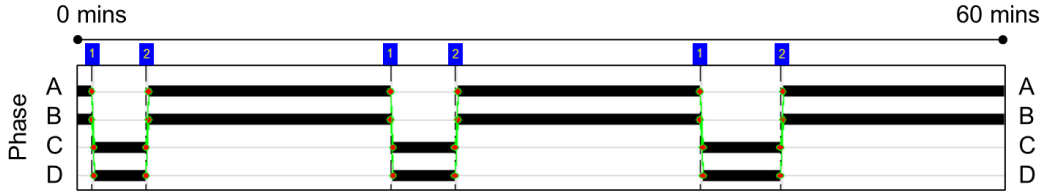

Figure 6-13: Sutton (916) Level Crossing, Baseline Barrier Closure Times

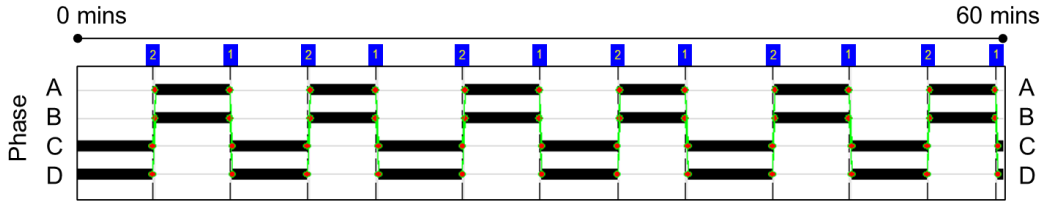

Figure 6-14: Sutton (916) Level Crossing, Proposed Barrier Closure Times

Comparing the mean maximum queue lengths at Sutton (916) Level Crossing and at Sutton Cross Junction, the proposed scenario of 6TPH per direction has less queues on all arms, with a reduction of between 2% to 3%, on two of the arms and increase of 9% on one arm. These results are shown in Figure 6-15 and Table 6-10.

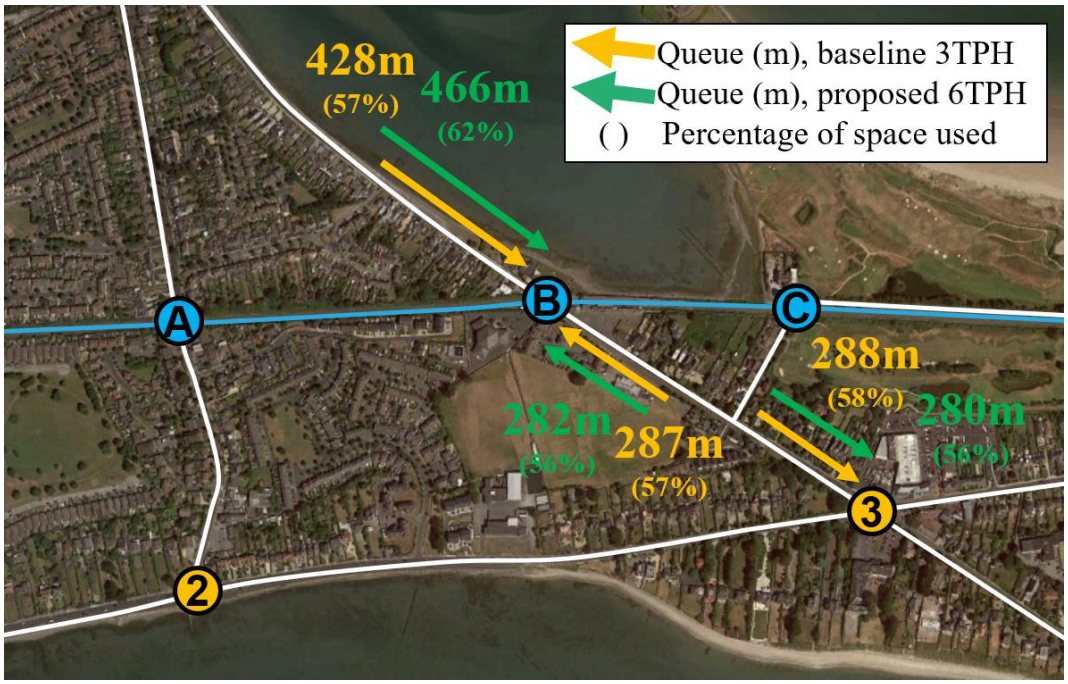

Figure 6-15: Comparison – Sutton (916) Level Crossing and Sutton Cross Junction SB Arm Queue Length Modelling Results

The situation at Sutton (916) Level Crossing is similar to that at Kilbarrack (917). In the baseline scenario queues build up when the barrier is closed, then once the barrier opens the queue dissipates. There is then a period of time, before the next closure, when there is no longer a queue and the link is free flowing.

In the proposed scenario this situation, when the queue has dissipated, does not happen to the same extent. What happens is that the queue builds up when the barrier is closed, then the barrier opens, the queue dissipates and there is a period of free flow. However, this period of free flow is much shorter in the proposed scenario than in the baseline scenario because the barrier closes more frequently.

Queueing is therefore, not drastically longer and is slight shorter on two of the arms, even though the total closure time has increased by a lot.

Table 6-10: Comparison – Sutton (916) Level Crossing and Sutton Cross Junction SB Arm Queue Length Modelling Results

Location	Baseline MMQ	Proposed MMQ	% Change in Queue Length
Sutton (916) Level Crossing SB	428m	466m	**+9%**
Sutton (916) Level Crossing NB	287m	282m	**-2%**
Sutton Cross Junction SB Arm	288m	280m	**-3%**

6.5 Qualitative Assessment of Cosh (915) (XQ003) and Claremont (913) (XQ004) Level Crossings

For Cosh (915) and Claremont (913) level crossings, the assessment was carried out by comparing both the frequency and length of barrier closures in the baseline 3TPH per direction scenario to the proposed 6TPH TSS1C scenario.

The baseline and proposed opening and closure times of the level crossing barriers at Cosh (915) and Claremont (913) are the outputs from the RailSys model, described in section 5.

6.5.1 Cosh (915) Level Crossing

From the Railsys model it is determined that Cosh (915) Level Crossing has an increase in the number of closures from 3 to 12 and the total closure time per hour has increased by 14 minute and 4 seconds. The maximum single closure time though has reduced by 2 minutes and 27 seconds. These results are shown in Table 6-11 and in Figure 6-16 and Figure 6-17.

The volume of vehicles crossing Cosh (915) Level Crossing is relatively small, as it only used for local access. This would mean that queuing at the level crossing will likely not to be an issue. The number of barrier closures and the total closure time has increase but the maximum length of time a vehicle would have to wait has decreased. Based on the findings of the other two junctions it is suspected that this level crossing will operate slightly worse for vehicles, but it is not expected to have a significant impact due to the low volumes of vehicles that cross the level crossing.

Table 6-11: Comparison of Level Crossing Closure Times – Cosh (915)

Location	Number of Closures per hour	Total closure time per hour	Maximum single closure time
Baseline Cosh (915) Level Crossing	3	00:10:44	00:04:39
Proposed Cosh (915) Level Crossing	12	00:24:48	00:02:12

Figure 6-16 and Figure 6-17 phases A and B represent when the barriers are open and vehicles have a green light, A is Burrow Road in the southbound direction and B is Lauder's Lane in the northbound direction. Phases C and D represent when the barriers are closed and the trains have a "green light" to pass through the LC, C is the westbound train and D is the eastbound train. The closure times represent the AM peak hour 08:00-09:00.

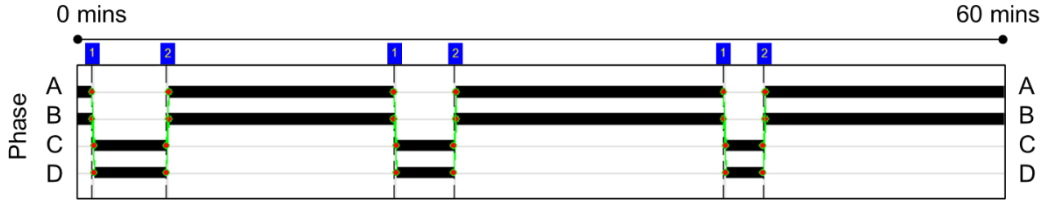

Figure 6-16: Cosh (915) Level Crossing, Baseline Closure Times

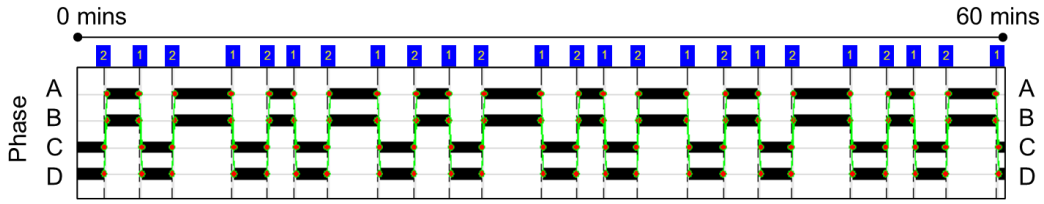

Figure 6-17: Cosh (915) Level Crossing, Proposed Barrier Closure Times

6.5.2 Claremont (913) Level Crossing

From the Railsys model it is determined that Claremont (913) Level Crossing has an increase in the number of closures from 5 to 6 and the total closure time per hour has increased by 10 minute and 5 seconds. The maximum single closure time though has reduced by 1 minutes and 56 seconds. These results are shown in Table 6-12 and in Figure 6-18 and Figure 6-19.

Similarly, to Cosh (915) Level Crossing, the volume of vehicles crossing Claremont (913) Level Crossing is relatively small, as it only used for local access. This would mean that queuing at the level crossing will likely not to be an issue. The number of barrier closures and the total closure time has increase but the maximum length of time a vehicle would have to wait has decreased. Based on the findings of the two junctions that were modelled it is suspected that this level crossing will operate slightly worse for vehicles, but it is not expected to have a significant impact due to the low volumes of vehicles that cross the level crossing.

Table 6-12: Comparison of Level Crossing Closure Times – Claremont (913)

Location	Number of Closures per hour	Total closure time per hour	Maximum single closure time
Baseline Claremont (913) Level Crossing	5	00:16:37	00:06:40
Proposed Claremont (913) Level Crossing	6	00:26:42	00:04:44

Figure 6-18 and Figure 6-19 phases A and B represent when the barriers are open and vehicles have a green light, A is the local road in the southbound direction and B is the local road in the northbound direction. Phases C and D represent when the barriers are closed and the trains have a "green light" to pass through the LC, C is the westbound train and D is the eastbound train. The closure times represent the AM peak hour 08:00-09:00.

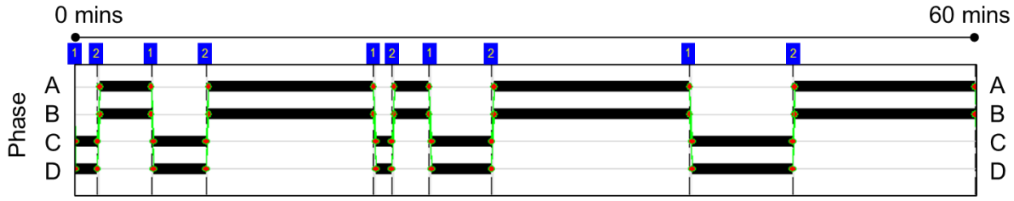

Figure 6-18: Claremont (913) Level Crossing, Baseline Barrier Closure Times

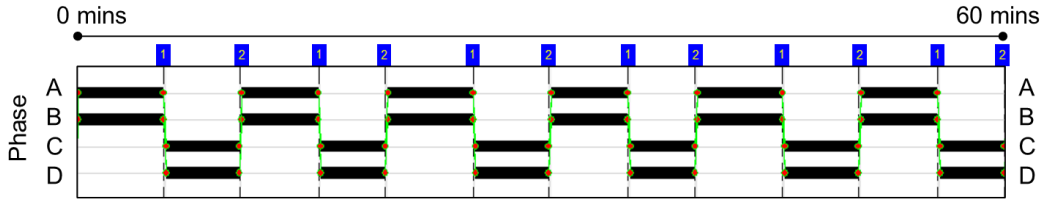

Figure 6-19: Claremont (913) Level Crossing, Proposed Barrier Closure Times

6.6 Sensitivity Analysis – Kilbarrack (917) (XQ001) and Sutton (916) (XQ002) Level Crossings

The previous vehicle analysis is based upon the TSS1C regular service model and hence assumes that trains depart at each end of the shuttle service at the same time every 10 minutes (assuming 6 trains per direction). To better understand how any changes to the departure times of the trains effect queueing along the surrounding road network a sensitivity analysis was undertaken. This sensitivity analysis was done by inputting the barrier results from the 6TPH per direction 1 to 9 minute offset outlined in Section 4. A 10 minute offset is the same as a regular timetable.

6.6.1 Level Crossings Closure Timings

6.6.1.1 Kilbarrack (917) Level Crossing (Baldoyle Road)

At Kilbarrack (917) Level Crossing an offset of 3-6 minutes requires the level crossing barriers to close 12 times per hour, meaning that only one train passes through the level crossing during each closure. The rest of the offsets have six closures per hour with two trains passing through each time.

The lengths of time the barrier is closed for change for the different offsets, with the 8-minute offset having the longest total closure time of 16 minutes 42 seconds. 7-minute offset has the longest single closure time with 3 minutes and 32 seconds.

Table 6-13: Kilbarrack (917) Level Crossing Closure Times for 6TPH per direction for Clock Face and 1–9 minute offset

Kilbarrack (917) Level Crossing	Number of Closures per hour	Total forecast closure time per hour	Maximum forecast single closure time
Regular	6	00:10:51	00:01:58
Offset +1min	6	00:16:18	00:02:58
Offset +2min	6	00:22:18	00:03:58
Offset +3min	12	00:15:12	00:01:39
Offset +4min	12	00:15:12	00:01:39
Offset +5min	12	00:15:12	00:01:39
Offset +6min	12	00:15:12	00:01:39
Offset +7min	9	00:16:18	00:03:32
Offset +8min	6	00:16:42	00:03:02
Offset +9min	6	00:11:03	00:02:02

6.6.1.2 Sutton (916) Level Crossing

At Sutton (916) Level Crossing an offset of 2-3 minutes requires the level crossing barriers to close 9 times per hour, meaning that three of the closures have two trains passing through and the other six closures have one train passing through each time. The rest of the offsets have six closures per hour with two trains passing through each time.

The lengths of time the barrier is closed for change for the different offsets, with the 4-minute offset having the longest total closure time of 37 minutes 18 seconds.

Table 6-14: Sutton (916) Level Crossing Closure Times for 6TPH per direction for Clock Face and 1-9 minute offset

Sutton (916) Level Crossing	Number of Closures per hour	Total forecast closure time per hour	Maximum forecast single closure time
Clock Face	6	00:30:54	00:05:26
Offset +1min	6	00:36:54	00:06:26
Offset +2min	9	00:36:57	00:06:52
Offset +3min	9	00:37:03	00:06:58
Offset +4min	6	00:37:18	00:06:28
Offset +5min	6	00:31:18	00:05:28
Offset +6min	6	00:25:18	00:04:28
Offset +7min	6	00:20:30	00:03:28
Offset +8min	6	00:20:12	00:03:26
Offset +9min	6	00:24:54	00:04:26

6.6.2 Modelling Results

The result of this sensitivity analysis modelling is shown in Table 6-15 and Table 6-16. The Mean Max Queue length in meters over the peak hour is shown for the regular service scenario and each subsequent offset time. In brackets beside each of the queue lengths is the percentage of queue space taken up. The length of each link is also shown at the top of each table.

The results of the modelling show that, for both Kilbarrack (917) and Sutton (916) level crossings and at the two junctions south of the level crossings, the mean maximum queue is always shorter than the length of the link for every offset scenario.

The 2-minute offset has the highest percentage of a single link taken up by the queue at Dublin Road/ Baldoyle Road Junction southbound arm, taking up 89% of the capacity of the link.

The 6-minute offset produces the least amount of queuing of any of the scenarios, with the largest percentage of spaces taken up in this scenario being 57% on the Dublin Road/Baldoyle Road Junction southbound arm.

Figure 6-20: Locations of Each Queue for Kilbarrack (917) Level Crossing

Table 6-15: Results of Sensitivity Analysis Modelling – Kilbarrack (917)

Kilbarrack (917)	Kilbarrack (917) Level Crossing SB Queue	Kilbarrack (917) Level Crossing NB Queue	Dublin Road/ Baldoyle Road Junction SB Arm Queue
Link Length	***520m***	***350m***	***350m***
Regular service	**205m (39%)**	**112m (32%)**	**197m (56%)**
Offset +1min	295m (57%)	122m (35%)	238m (68%)
Offset +2min	385m (74%)	177m (51%)	311m (89%)
Offset +3min	178m (34%)	103m (29%)	231m (66%)
Offset +4min	178m (34%)	74m (21%)	174m (50%)
Offset +5min	178m (34%)	67m (19%)	271m (77%)
Offset +6min	178m (34%)	80m (23%)	201m (57%)
Offset +7min	346m (66%)	131m (38%)	247m (70%)
Offset +8min	300m (58%)	140m (40%)	210m (60%)
Offset +9min	211m (41%)	120m (34%)	241m (69%)

Figure 6-21: Locations of Each Queue for Sutton (916) Level Crossing

Table 6-16: Results of Sensitivity Analysis Modelling – Sutton (916)

Sutton (916)	Sutton (916) Level Crossing SB Queue	Sutton (916) Level Crossing NB Queue	Sutton Cross Junction SB Arm Queue
Link Length	***750m***	***500m***	***500m***
Clockface	**466m (62%)**	**282m (56%)**	**280m (56%)**
Offset +1min	556m (74%)	382m (76%)	379m (76%)
Offset +2min	551m (74%)	418m (84%)	232m (46%)
Offset +3min	584m (78%)	395m (79%)	292m (58%)
Offset +4min	560m (75%)	370m (74%)	312m (62%)
Offset +5min	469m (62%)	308m (62%)	278m (56%)
Offset +6min	386m (52%)	230m (46%)	274m (55%)
Offset +7min	305m (41%)	182m (36%)	241m (48%)
Offset +8min	302m (40%)	171m (34%)	248m (50%)
Offset +9min	383m (51%)	220m (44%)	242m (48%)

6.7 Summary of Vehicle Assessment

In conclusion, the assessment of the proposed upgrades to the Howth Branch on vehicles and queueing at level crossing is a positive one.

In the baseline scenario queues build up when the barrier is closed, then once the barrier opens the queue dissipates. There is then a period of time, before the next closure, when there is no longer a queue and the link is free flowing.

In the proposed scenario this free flow condition (after the dissipation of the queue) does not occur to the same extent. Instead, the free flow condition is much shorter in the proposed scenario than in the baseline scenario because the barrier closes more frequently.

It can be seen that the queueing therefore depends on two factors – the frequency of barrier closure and the total closure times. In the proposed scenario the increased closure frequency allows the queuing to be shorter, even though the total closure times are approximately the same as in the baseline scenario.

Cosh (915) and Claremont (913) Level Crossing the total closure time will increase but the impact will be minimal, due to the low volume of vehicles that will be crossing the level crossings.

Overall, this upgrade will have no significant negative impact on vehicles and queuing. The sensitivity analysis shows that there is resilience in the road network and that it can operate without causing delays and queuing in situations where trains are not running according to the regular service timetable.

7 Assessment of Proposal on Pedestrians and Cyclists at Level Crossings

In this section of the report, the effect of changes to the operating conditions of the Howth Branch and associated level crossings on pedestrians and cyclists has been investigated. The baseline service of 3 trains per hour per direction (3TPH) and level crossing closures has been compared to the proposed worst-case scenario of 6 train per hour per direction (6TPH TSS1C). All four level crossings were assessed using qualitative analysis methods, similar to the ones used in Section 6.

The assessment looked at the changes to the quality of service for pedestrians and cyclists using the level crossings. The operation and barrier closure times of the level crossings for the baseline 3TPH per direction and proposed 6TPH TSS1C scenarios are described in Section 6.2

Figure 7-1: Overview of the area of interest for Pedestrian Assessment

7.1 Kilbarrack (917) Level Crossing (XQ001) (Baldoyle Road) Pedestrian Assessment

There are pedestrian footpaths on both sides of the road on Warrenhouse Road and Baldoyle Road, running the full length of both roads. These footpaths also cross the Kilbarrack (917) Level Crossing.

Kilbarrack (917) Level Crossing closes one additional time, with 6 closures, in the proposed 6TPH TSS1C scenario compared to 5 times per hour in the baseline 3TPH per direction scenario.

The total closure time per hour is 1 minute and 19 seconds more in the proposed scenario and the maximum single closure time is 1 minutes and 20 seconds less that the baseline. This increase in closure times reduces the total time for pedestrians and cyclists to cross, although only by a very small amount. The maximum amount of time a pedestrian would have to wait is approximately 2 minutes, compared with 3 minutes and 18 seconds in the baseline scenario. The results are summarised in Table 7-1.

It is anticipated that the operation of Kilbarrack (917) Level Crossing will be slightly improved for pedestrians and cyclists with the maximum single closure time reduced by 1 minute and 20 seconds. However, the likelihood of having to wait will increase, due to the increase in the number of closures per hour.

Table 7-1: Comparison of Level Crossing Closure Times – Kilbarrack (917)

Scenario	Number of Closures per hour	Total closure time per hour	Maximum single closure time
Baseline Kilbarrack (917) Level Crossing	4	00:11:13	00:04:48
Proposed Kilbarrack (917) Level Crossing	6	00:10:51	00:01:58

7.2 Sutton (916) Level Crossing (XQ002) Pedestrian Assessment

There are pedestrian footpaths running the full length on both sides of Station Road. These footpaths also cross the Sutton (916) Level Crossing. Sutton Train Station is located adjacent to the level crossing, which would attract pedestrians and cyclists.

Sutton (916) Level Crossing closes twice as often with 6 closures in the proposed scenario 6TPH TSS1C, compared to 3 times per hour in the baseline 3TPH per direction scenario. The maximum closure time is slightly increased from 5 min to 5min 26 seconds. The operation of this level crossing is likely to have a slight negative impact on pedestrians and cyclists as the likelihood of having to wait will double, due to the increase in the number of closures per hour from 3 to 6. The results are summarised in Table 7-2.

Table 7-2: Comparison of Level Crossing Closure Times – Sutton (916)

Scenario	Number of Closures per hour	Total closure time per hour	Maximum single closure time
Baseline Sutton (916) Level Crossing	3	00:12:21	00:05:00
Proposed Sutton (916) Level Crossing	6	00:30:54	00:05:26

7.3 Cosh (915) Level Crossing (XQ003) Pedestrian Assessment

There is only a pedestrian footpath on the west side of the Lauder's Lane running the full length of the road. There is also a footpath on the southern side of Burrow Road, just north of the level crossing. Sutton Golf Course is split in two by the railway tracks, with the crossing providing the only way to get between the two sections of the course. As a result, golfers use this crossing regularly throughout the day. There is a footpath on both sides of Cosh (915) Level Crossing.

Cosh (915) Level Crossing has an increase in the number of closures from 3 to 12 and the total closure time per hour has increased by 14 minute and 4 seconds. The

maximum single closure time though has reduced by 2 minutes and 27 seconds. The results are summarised in Table 7-3.

It is anticipated that the operation of Cosh (915) Level Crossing will be improved in the proposed 6TPH TSS1C scenario as the maximum time pedestrians and cyclists have to wait at the level crossing will reduce from nearly 5 minutes to just over 2 minutes. The likelihood of having to wait will increase, due to the increase in the number of closures per hour. However, due to the low number of pedestrians and cyclists likely to use this crossing, the effect of the increase is not significant.

Table 7-3: Comparison of Level Crossing Closure Times – Cosh (915)

Scenario	Number of Closures per hour	Total closure time per hour	Maximum single closure time
Baseline Cosh (915) Level Crossing	3	00:10:44	00:04:39
Proposed Cosh (915) Level Crossing	12	00:24:48	00:02:12

7.4 Claremont (913) Level Crossing (XQ004) Pedestrian Assessment

The Howth Road has a pedestrian footpath on both sides of the road running the full length of the road. These footpaths also cross the Claremont (913) Level Crossing on both sides. The private access road to the north of Claremont (913) Level Crossing has no pedestrian facilities along it. Out of all four of the level crossings this is the least used by pedestrian as it provides access to a small number of residential units.

Claremont (913) Level Crossing has an increase in the number of closures from 5 to 6 and the total closure time per hour has increased by 10 minute and 5 seconds. The maximum single closure time though has reduced by 1 minutes and 56 seconds. The results are summarised in Table 7-4.

It is anticipated that the operation of Claremont (913) Level Crossing will be improved in the proposed 6TPH TSS1C scenario as the maximum time pedestrians and cyclists have to wait at the level crossing will reduce from 6 to almost 5 minutes. The likelihood of having to wait will increase, due to the increase in the closures per hour. However, due to the low number of pedestrians and cyclists likely to use this crossing, the effect of the increase is not significant.

Table 7-4: Comparison of Level Crossing Closure Times – Claremont (913)

Scenario	Number of Closures per hour	Total closure time per hour	Maximum single closure time
Baseline Claremont (913) Level Crossing	5	00:16:37	00:06:40
Proposed Claremont (913) Level Crossing	6	00:26:42	00:04:44

7.5 Summary of Pedestrian Assessment

In conclusion, the assessment of the impact of proposed upgrades to the Howth Branch on pedestrians and cyclists at level crossings has shown the change to be slightly positive. At three of the four level crossings, the maximum single closure time for pedestrians and cyclists will decrease. However, at Sutton (916) (XQ002) level crossing the maximum time has increased slightly by 26 seconds. At all level crossing the chance of having to wait has increased but the maximum wait time has decreased except for Sutton.

8 Conclusion

Proposed changes to the Howth Branch, as defined in the Train Service Specification TSS1C, will see both the service frequency and capacity increase, along with improvement to the reliability of timetabling.

The level crossing closures are highly sensitive to the exact meeting point of trains in any given scenario; having trains cross simultaneously is the best case, as it allows two trains to pass for one closure. By contrast, the worst scenario would be two trains separated by just less than 90 seconds, meaning that the level crossing will be held down for the maximum amount of time.

The effect of these changes on the barrier opening times of level crossings has been assessed for a variety of timetable scenarios, which serves as a sensitivity check to evaluate how differently the level crossings will behave if services are more or less synchronized.

The modelled barrier results have been used to inform vehicular and pedestrian assessments which have shown some overall improvement to the surrounding vehicular flows and pedestrian experience. It was found that queuing depends on two factors, namely the frequency of barrier closure and the total closure times.

The analysis indicates that more frequent, shorter openings perform better than less frequent, longer openings, even if the sum of open time has decreased. This is further secured by the reliability of the Howth Branch operating a regular service as trains will no longer be susceptible to delays caused by the main line. Additionally, the improvement has been shown as resilient to timetable changes by sensitivity analysis.

Similarly, the assessment of the impact of proposed upgrades to the Howth Branch on pedestrians and cyclists at level crossings has shown the change to be slightly positive. This is on the basis that although, the chance of pedestrians and cyclists having to wait has increased, the maximum wait time has decreased except for Sutton. At Sutton (916) (XQ002) level crossing the maximum time has marginally increased by 26 seconds.

9 Next Steps

Further survey data will be collected to validate the model and assumptions, including additional traffic count surveys and observed level crossing operational data. This information will be used to establish if the proposal to keep the level crossings in operation is feasible, or if more significant interventions are required at the crossing.