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ETIHAD STADIUM NORTH STAND EXPANSION

**Stage 3 Part 2 Construction Hoarding – crowd
movement assessment (DRAFT)**

12 April 2023

DRAFT

METADATA



Title	Etihad Stadium, North Stand Expansion – Stage 3 Part 2 Construction Hoarding – crowd movement assessment (DRAFT)
Abstract	Crowd movement study to assess the impact of the proposed construction hoarding on pedestrian circulation during event days at the Etihad Stadium.
Client	City Football Group Limited
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Reviewer	Samuel Moutet
Date	12 April 2023

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CONTENTS



Section	page
01 Executive summary	04
02 Scope	09
03 Assumptions	12
04 SENSE modelling of pedestrian circulation routes	18
05 Metrolink westbound service (post event)	47
06 Future stages of construction	57

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01 EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

Scope of works

Movement Strategies (MS) has been commissioned by City Football Group Limited (CFGL) to provide crowd movement consultancy services to inform the development of the North Stand Expansion of the Etihad Stadium.

This document assess the impact of the construction hoarding layout proposed by Laing O'Rourke (LOR) for the duration of the construction phase of the North Stand Expansion. The study aims to determine the ability of pedestrians accessing the Etihad Stadium to circulate through the routes available to the west, north and east of the construction hoarding.

The MS scope of assessment extends from the points of arrival/departure (available to the public) in the wider area up to the stadium building line (turnstile and exit doors). Circulation within the building has been assessed by CFGL.

This document should be read in conjunction with:

- NS Hording Impact – Ingress and Egress Alterations.pptx *[received on 24/03/23]*
- 230320 12588700 – MCFC North Stand Expansion Stage 3 Part 2 Databook_DRAFT-0.5.pdf
- 12588700-MCFC North Stand Expansion Stage 3 Part 2 Crowd Modelling_DRAFT.pdf

Main Findings

1. The route between the Squash Centre and the construction hoarding has a minimum width of 11.73 metres at this location. Following discussions with LOR and CFGL we understand the minimum width at this location is due to existing infrastructure that cannot be moved.
2. Mitigation measures along this route may be required for a Etihad Stadium and Co-Op Live Arena simultaneous egress, based on current planning assumptions. These may include:
 - Encouraging Arena spectators via the City Link route to the City Centre
 - Directing southbound spectators to make use of the ramp route available by the Squash Centre, providing an alternative southbound route.
 - Etihad Stadium spectators could be encouraged to use alternative routes to the City Centre to reduce demand on the City Link.
 - Etihad Stadium spectators could be advised on the long waiting times at the Metrolink westbound service and encouraged to use alternative routes to the City Centre.
3. The existing queue space available for the Metrolink westbound service cannot accommodate the level of queueing expected for scenarios where the Stadium and the Arena are in operation, based on existing planning assumptions. Additional overflow queue space has been identified. In general terms, an additional 1,060 m² will need to be provided as a minimum.

EXECUTIVE SUMMARY

Scenario 1: Stadium Ingress (pre-event arrivals)

- Provision and location of Food & Beverage (F&B) and entertainment opportunities pre-event should be considered in order to avoid peak circulation periods across the construction hoarding prior to kick off.

Scenario 3: Stadium Hard Egress (post event departures)

- The route to the south west of the construction compound (by the stairs leading to the Squash Centre) will experienced higher flow rates. This is due to the reduced width of 11.73 metres at this location.

Scenario 4: Stadium Hard Egress + Arena Egress (30 minute offset)

- Peak spectator flows around the construction hoarding are on the north side of the compound (by the Metrolink eastbound service), with a two way demand (eastbound and westbound) of 17,510 spectators.
- Maximum flow rates on the route by the Squash Centre will be similar to those in Scenario 3: Stadium Hard Egress (post event departures).
- Overflow queue space is required for the Metrolink westbound service, based on existing planning assumptions. This overflow queue space can be provided at locations identified.

Scenario 5: Stadium Hard Egress + Arena Egress (simultaneous)

- Peak spectator flows around the construction hoarding are on the north side of the compound (by the Metrolink eastbound service), with a projected two-way demand (eastbound and westbound) of 16,450 spectators.
- Most of the routes around the construction hoarding will likely be at or close to the target capacity.
- Mitigation measures along the route between the Squash Centre and construction compound may be required, based on current planning assumptions. These may include:
 - Encouraging Arena spectators via the City Link route to the City Centre.
 - Directing southbound spectators to make use of the ramp route available by the Squash Centre, providing an alternative southbound route.
 - Etihad Stadium spectators could be encouraged to use alternative routes to the City Centre to reduce demand on the City Link.
 - Etihad Stadium spectators could be advised on the long waiting times at the Metrolink westbound service and encouraged to use alternative routes to the City Centre.
- Overflow queue space is required for the Metrolink westbound service, based on existing planning assumptions. This overflow queue space can be provided at locations identified.
- It should be noted that following meetings with the Etihad Stadium and the Co-Op Live Arena it is assumed that the NW Gate leading from the Arena onto Alan Turing Way is closed.

EXECUTIVE SUMMARY

Scenario 6: Arena Egress (post event departures)

- Most of the pedestrian circulation routes around the construction hoarding will experience flow rates of up to 49 persons/minute/metre width.

Scenario 7: Stadium Evacuation

- Peak spectator flows around the construction hoarding are on the east side of the compound, with 9,110 spectators travelling northbound.
- The pedestrian circulation route to the north of the construction compound (by the Metrolink westbound service) will experience flow rates up to 70 persons / minute / metre width.
- Whilst this is below the maximum threshold permitted, the possibility of making alternative routes available for spectators departing via this route should be explored.
- The maximum flow rates by Exit X and Exit C are a result of the level of demand assumed to use these routes when exiting the building.

Metrolink westbound service

Match Day pedestrian surveys

Match day pedestrian surveys indicate that approximately 14% of spectators arrive at the Etihad Stadium via the Metrolink eastbound service stopping at Etihad Campus (from the City Centre). These surveys also show that 9% of spectators choose to depart the Etihad Stadium via the Metrolink westbound service stopping at Etihad Campus (to the City Centre).

Whilst it is accepted that a variety of factors may influence the decision on transport choice, based on current planning assumptions:

- If 14% of stadium demand used the Metrolink westbound service during the post event departure period, they would experience a maximum individual delay of 115 minutes.
- With 9% of stadium demand using the Metrolink westbound service during the post event departure period, this equates to a maximum individual delay of 65 minutes.

Based on the available survey information, it is estimated that spectators are currently willing to wait for up to one hour to access the Metrolink westbound service after an event.

EXECUTIVE SUMMARY

Additional Metrolink westbound service queue area requirements

It should be noted that this document assumes that queue spaces available include the new queue area between the Metrolink westbound service and Forge Lane Bridge. This increases the total queue area from 820 m² to 1,242 m².

For scenarios where the Stadium and the Arena are in operation, additional queue space will need to be provided (based on current planning assumptions). In general terms, **an additional 1,060 m² will need to be provided as a minimum.**

The need for this additional queue space is based on the current planning assumption that during a Stadium and Arena simultaneous egress scenario, there will be a peak queue of approximately 6,900 persons, with a maximum individual delay in excess of 2 hours and a queue clearance time of 3 hours. Based on the available survey information, it is estimated that spectators are currently willing to wait for up to one hour to access the Metrolink westbound service after an event.

Potential overflow queue areas

A number of potential overflow queue areas have been identified:

- The pedestrian route on the east side of the construction hoarding.
- Existing pedestrian circulation space to the south east of the construction hoarding (by Turnstile C).
- Joe Mercer Way. We understand Joe Mercer Way has been used in previous events as a holding area for the Metrolink westbound service.

It is also important to note that the Arena will have its own queue management operations in place for spectators accessing Forge Lane Bridge. This space has not been considered as part of the queue area available.

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02 SCOPE

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SCOPE



Movement Strategies (MS) has been commissioned by City Football Group Limited (CFGL) to provide crowd movement consultancy services to inform the development of the North Stand Expansion of the Etihad Stadium.

This document assess the impact of the construction hoarding layout proposed by Laing O'Rourke (LOR) for the duration of the construction phase of the North Stand Expansion. The study aims to determine the ability of pedestrians accessing the Etihad Stadium to circulate through the routes available to the west, north and east of the construction hoarding.

The MS scope of assessment extends from the points of arrival/departure (available to the public) in the wider area up to the stadium building line (turnstile and exit doors). Circulation within the building has been assessed by CFGL. **For the purpose of this assessment it is assumed that adequate security screening on arrivals has been provided to match the turnstile capacity.**

The key analysis from a crowd flow perspective is to provide evidence that supports the capacity calculations. The methods of analysis in this phase are static/spreadsheet modelling (which is the methodology needed for compliance with *The Guide to Safety at Sports Grounds*), and *SENSE* network modelling.

The analysis undertaken looks to assess the pedestrian circulation for ingress, normal egress and emergency evacuation whilst the construction is in place.

This document does not include:

- Detailed operational / staffing plans
- Contingency planning



Figure 01: Existing Etihad Stadium with project area highlighted (Source: Google Earth)



Figure 02: Proposed North Stand construction hoarding (Source: LOR)

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SCOPE

The adjacent figure shows the proposed construction compound for the North Stand and the pedestrian circulation space available around the compound.

This structure will stay in place for the duration of the construction period, with the Stadium remaining in operation.

Minimum pedestrian circulation widths available are presented in the assumptions chapter of this document.

On an event day at the Etihad Campus and/or the Co-Op Live Arena it is assumed that no construction works will take place and that all doors into the construction compound will be closed.

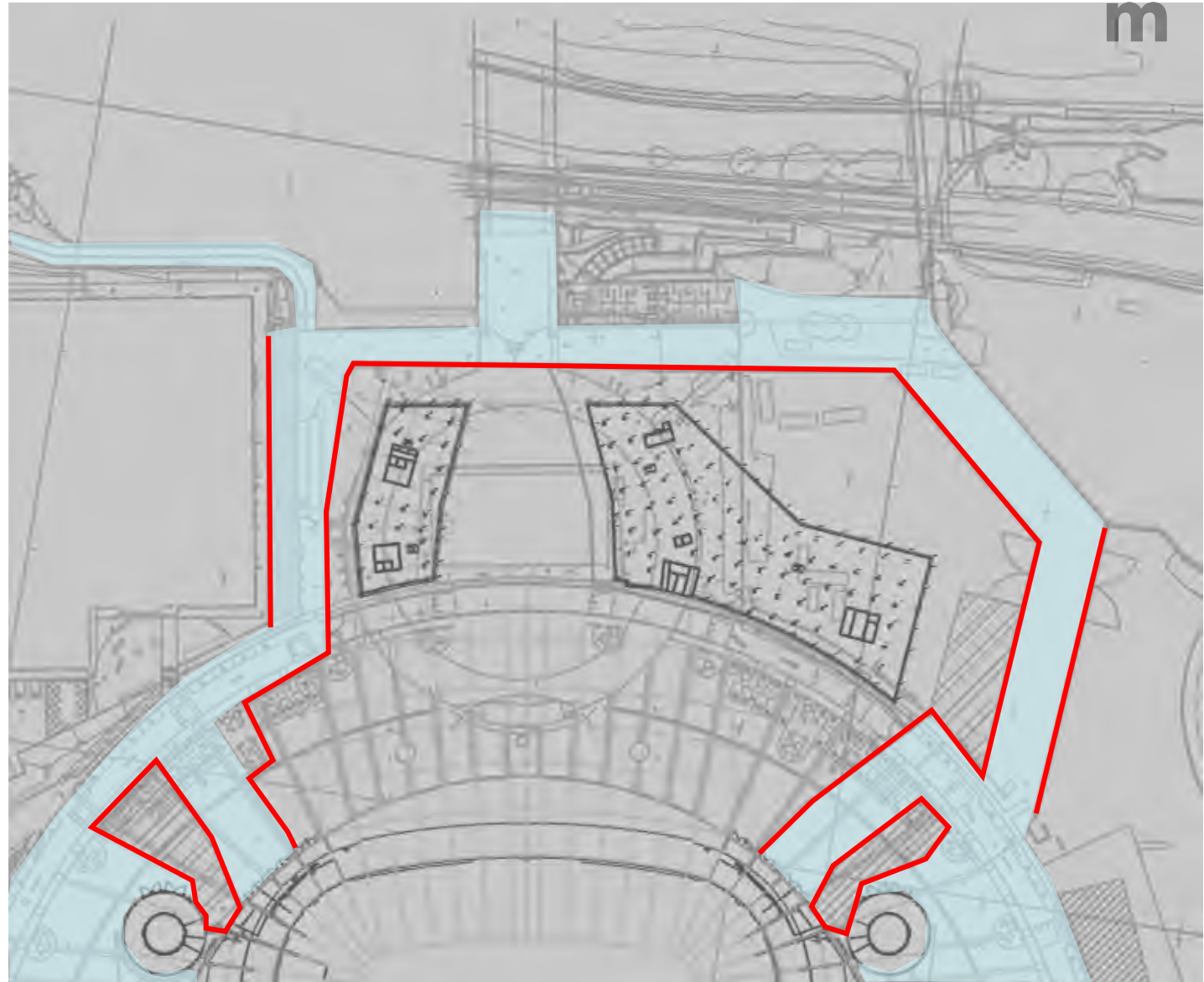
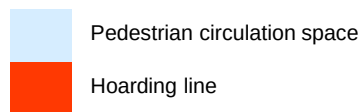


Figure 03: Pedestrian circulation space around the construction hoarding (source: LOR)

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03 ASSUMPTIONS

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DESIGN INPUTS



DOCUMENTS REFERENCED

- NS Hording Impact – Ingress and Egress Alterations.pptx [*received on 24/03/23*]
- 230320 12588700 – MCFC North Stand Expansion Stage 3 Part 2 Databook_DRAFT-0.5.pdf
- 12588700-MCFC North Stand Expansion Stage 3 Part 2 Crowd Modelling_DRAFT.pdf

DRAWINGS REFERENCED

Hoarding compound layout

- MCFC Logistics Layout Rev 15-2.dwg
- MCFC Logistics Layout Rev15.1.pdf

Metrolink westbound queue area

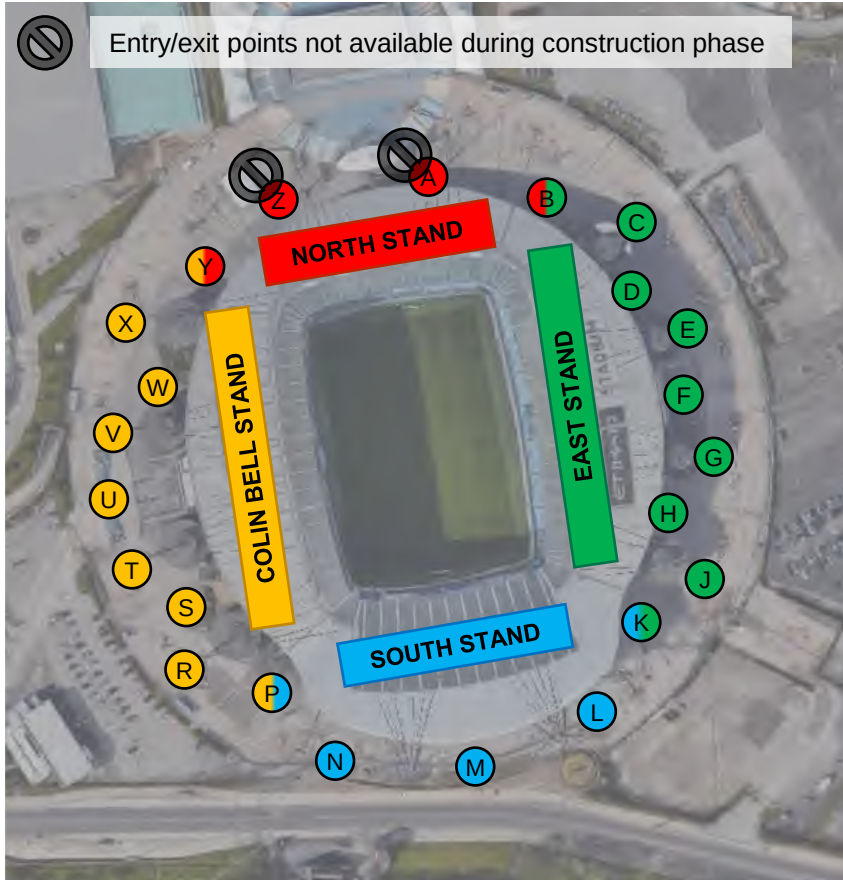
- NSE-BHE-XX-XX-SK-C-002600_Ver1(1).pdf

RELEVANT GUIDANCE DOCUMENTS

- Guide to Safety at Sports Grounds (“Green Guide”), 6th Edition, 2018 (Sports Grounds Safety Authority, UK), which provides guidance for the safe design of sports grounds;
- BS EN 13200 -1:2012, Spectator facilities, Part 1: General characteristics for spectator viewing areas;
- BS EN 13200 -7:2014, Spectator facilities, Part 7: Entry and exit elements and routes;
- Pedestrian Planning and Design (J.J. Fruin, 1971), defining a quantified scale of ‘Levels of Service’ related to crowd movement on walkways, stairs and in queuing areas.

EXISTING SPECTATOR AND STAFF POPULATION IN EACH STAND

Figure 04: Existing Stadium stands



Source: Google Earth

Table 01: Existing Stadium spectator and staff population

Ingress		
Spectators	Staff	TOTAL
54,042	0	54,042

Egress		
Spectators	Staff	TOTAL
54,042	0	54,042

Evacuation	
Spectators + Staff	TOTAL
58,856	58,856

- Staff is not included in our ingress or egress calculations.
- Evacuation numbers provided do not separate staff and spectator demand.
- Entrance/exit points A and Z will not be available during the construction phase. The re-routing of these spectators is based on 'NS Hording Impact – Ingress and Egress Alterations.pptx' provided by CFGL.

EXISTING SPECTATOR AND STAFF POPULATION

		Ingress			Egress			Evacuation	
Exit		Spectators	Staff	TOTAL	Spectators	Staff	TOTAL	Spectators + Staff*	TOTAL
North Stand	A	0	0	0	0	0	0	0	0
	B	5,108	0	5,108	5,108	0	5,108	4,855	4,855
	C	4,275	0	4,275	3,341	0	3,341	4,257	4,257
	D	704	0	704	393	0	393	2,217	2,217
	E	1,500	0	1,500	2,855	0	2,855	3,920	3,920
East Stand	F	1,159	0	1,159	1,049	0	1,049	0	0
	G	2,088	0	2,088	2,088	0	2,088	3,290	3,290
	H	536	0	536	536	0	536	1,478	1,478
	J	1,842	0	1,842	1,842	0	1,842	4,295	4,295
South Stand	K	3,618	0	3,618	3,618	0	3,618	2,040	2,040
	L	2,021	0	2,021	2,021	0	2,021	2,428	2,428
	M	5,034	0	5,034	5,034	0	5,034	3,057	3,057
	N	4,344	0	4,344	4,344	0	4,344	3,378	3,378

* Assuming numbers provided in evacuation drawings include both spectators and staff

Continued on next page

EXISTING SPECTATOR AND STAFF POPULATION

		Ingress			Egress			Evacuation	
Exit		Spectators	Staff	TOTAL	Spectators	Staff	TOTAL	Spectators + Staff*	TOTAL
West Stand	P	5,282	0	5,282	5,282	0	5,282	2,369	2,369
	R	1,599	0	1,599	1,599	0	1,599	4,105	4,105
	S	571	0	571	571	0	571	1,478	1,478
	T	2,296	0	2,296	2,296	0	2,296	2,907	2,907
	U	1,592	0	1,592	708	0	708	0	0
	V	1,089	0	1,089	2,693	0	2,693	3,259	3,259
North Stand	W	664	0	664	357	0	357	2,217	2,217
	X	3,796	0	3,796	3,382	0	3,382	4,250	4,250
	Y	4,925	0	4,925	4,925	0	4,925	3,056	3,056
	Z	0	0	0	0	0	0	0	0
	Total	54,042	0	54,042	54,042	0	54,042	58,856	58,856

Table 02: Proposed Stadium spectator and staff population

* Assuming numbers provided in evacuation drawings include both spectators and staff

North Stand and Arena Network Widths

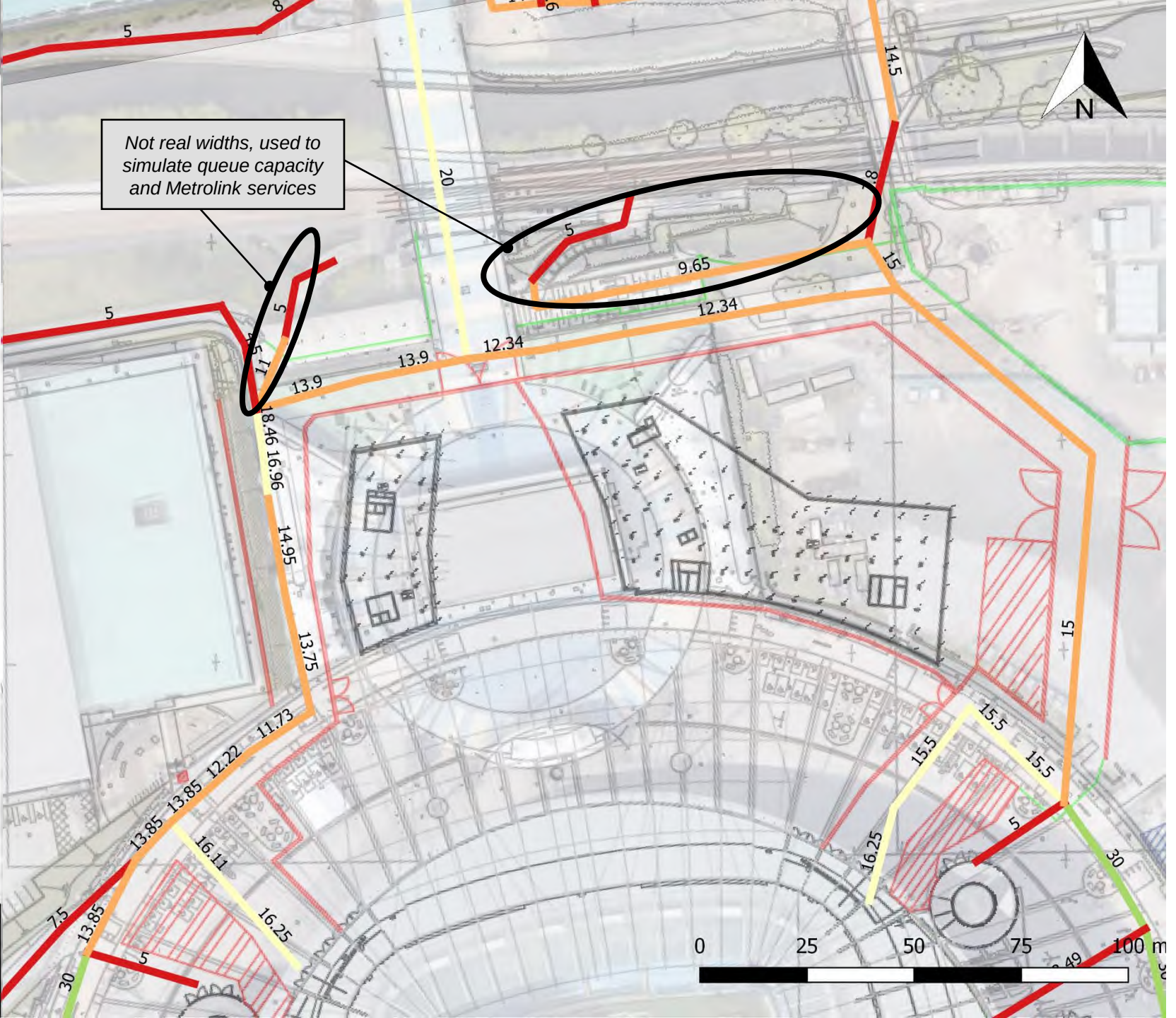
The assumed widths for this model have been measured in CAD provided, or directly on Google Maps when CAD was not available.

Flows out of the Stadium
are constrained by the
width of the exit doors.

Note that for special operations, it is assumed that 7.5m width will be provided along Alan Turing Way (from OVG Manchester, Details of the Special Measures Operating Plan, Buro Happold, 10 November 2022)

Legend

- 1 - 8 m
■ 8 - 15
■ 15 - 25
■ 25 - 30
■ 30 - 100



04 SENSE MODELLING OF PEDESTRIAN CIRCULATION ROUTES

SCENARIOS MODELLED IN SENSE

Scenario 1: Stadium Ingress (pre-event arrivals)

- Spectator arrivals to the local area and then accessing the Etihad Stadium building line.

Scenario 3: Stadium Hard Egress (post event departures)

- Spectator departures from Etihad Stadium and then accessing destinations in the local area.

Scenario 4: Stadium Hard Egress + Arena Egress (30 minute offset)

- Spectator departures from Etihad Stadium followed by spectator departures from the Co-Op Live Arena 30 minutes later. Both sets of spectators accessing destinations in the local area.

Scenario 5: Stadium Hard Egress + Arena Egress (simultaneous)

- Spectator departures from Etihad Stadium and spectator departures from the Co-Op Live Arena simultaneously. Both sets of spectators accessing destinations in the local area.

Scenario 6: Arena Egress (post event departures)

- Spectator departures from Co-Op Live Arena and then accessing destinations in the local area.

Scenario 7: Stadium Evacuation

- Spectator evacuation from the Etihad Stadium building line over an 11 minute period. Spectators accessing routes away from the building line, not attempting to access a local destination.

Metrolink westbound service

- All Metrolink services (westbound or eastbound) are assumed to have a capacity of 300 passengers every 6 minutes. This is assumed to equate to a capacity of 50 passengers every 1 minute (*OVG Manchester, Details of the Special Measures Operating Plan, 10 November 2022*).

SCENARIO 1: STADIUM INGRESS (PRE EVENT ARRIVALS)

Scenario 1

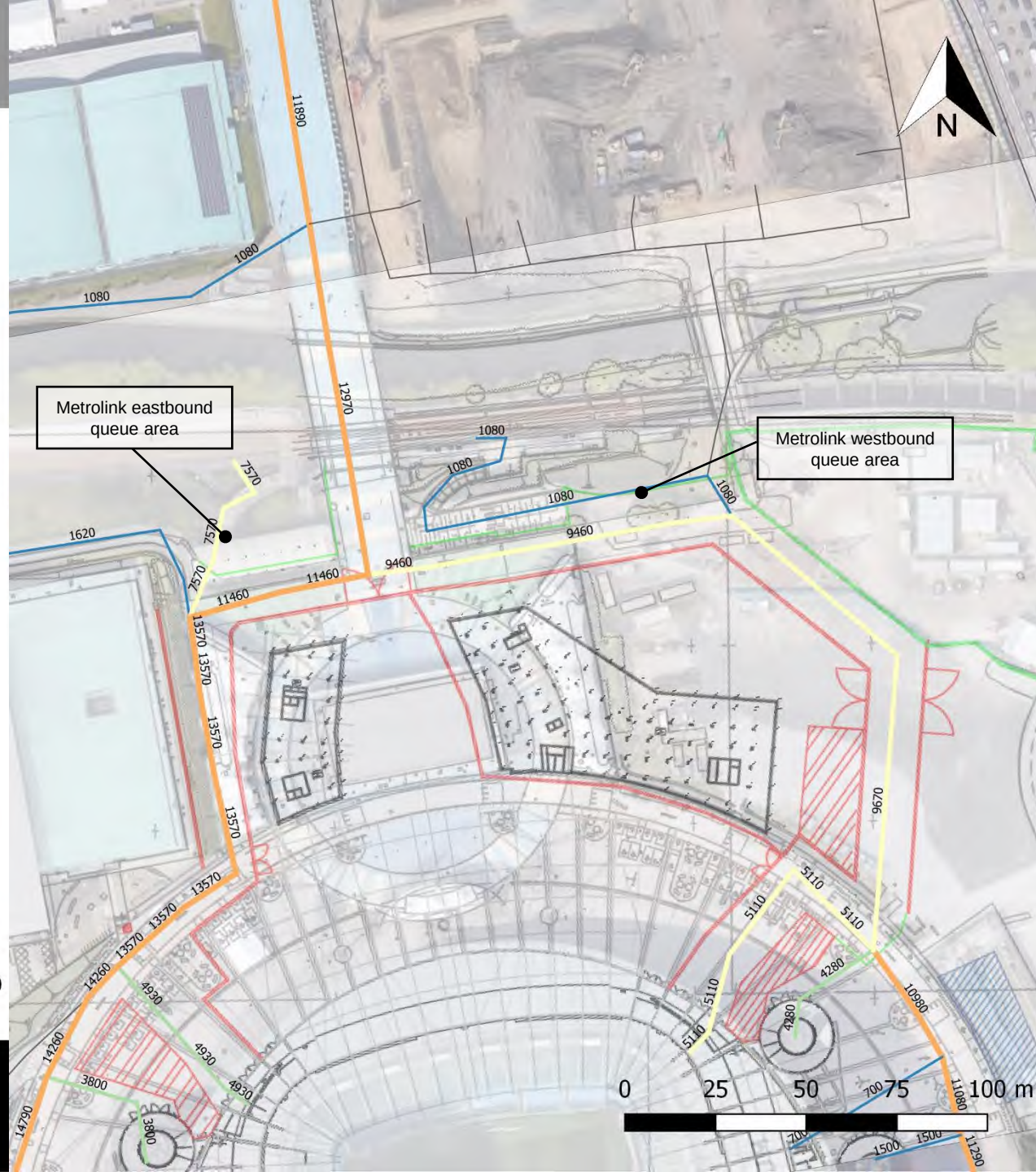
Construction - Stadium Ingress

North Stand and Arena Static Assignment by Link

- Peak spectator flows around the construction hoarding are on the west side of the compound, with 13,570 spectators accessing Etihad Stadium.
- This model assumes spectators arrive in the local area and walk directly to their turnstiles
- Provision and location of Food & Beverage (F&B) and entertainment opportunities pre-event should be considered in order to avoid peak circulation periods across the construction hoarding prior to kick off.
- Pedestrian density on circulation routes near F&B provision should be monitored.

Legend

- No people
- < 2,500 ppl
- 2,500 - 5,000
- 5,000 - 10,000
- 10,000 - 20,000
- > 20,000 ppl



Scenario 1

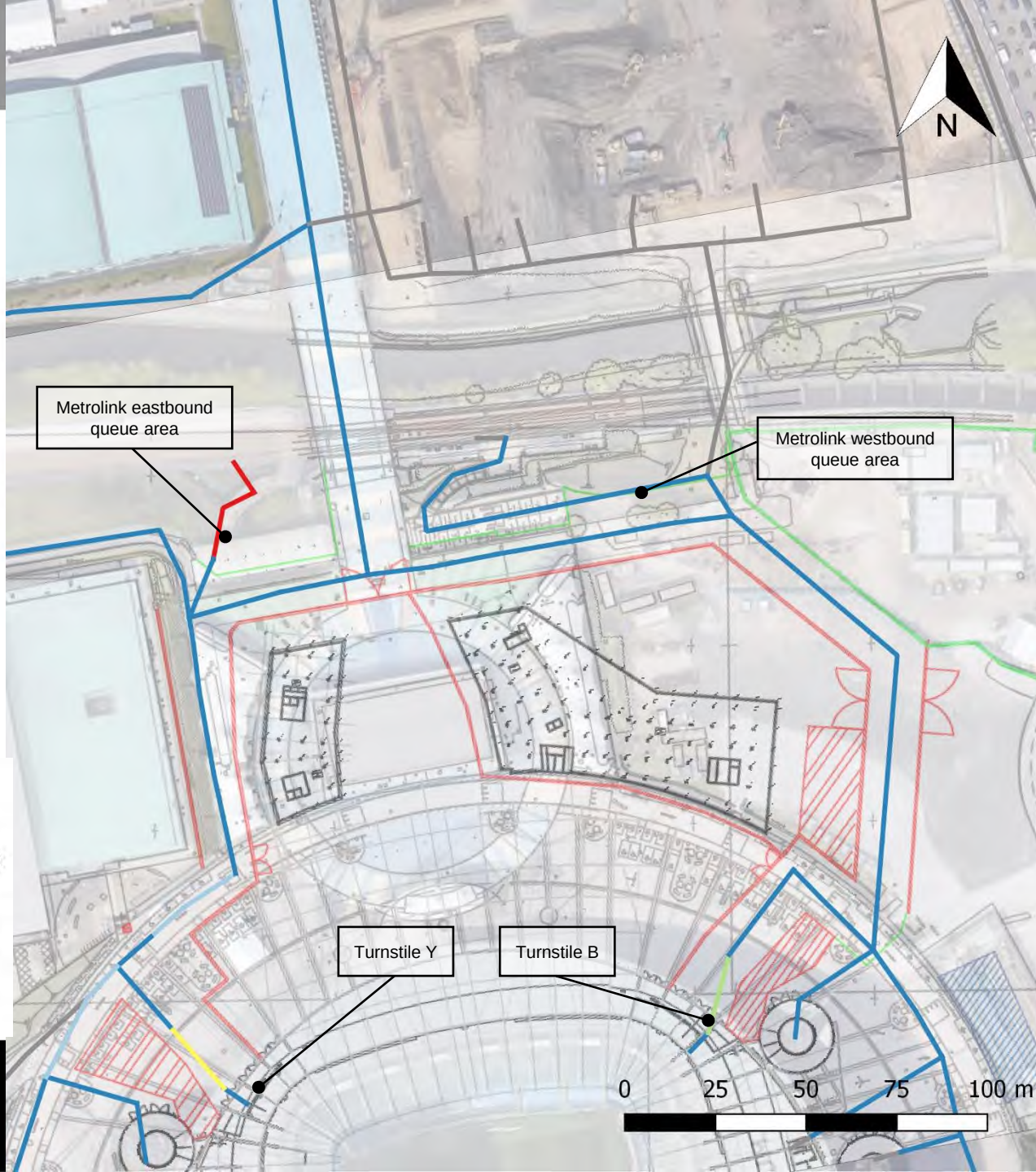
Construction - Stadium Ingress

North Stand and Arena Max Density by Link

- The circulation routes around the construction compound experience densities of up to 0.5 persons per m².
- On approach to turnstiles Y and B, spectators may experience an increase in density as their tickets are checked.

Legend

- No ppl
- LoS A - < 0.31 ppl/ m²
- LoS B - 0.31 - 0.43
- LoS C - 0.43 - 0.72
- LoS D - 0.72 - 1.08
- LoS E - 1.08 - 2.17
- LoS F - 2.17 - 4



Scenario 1

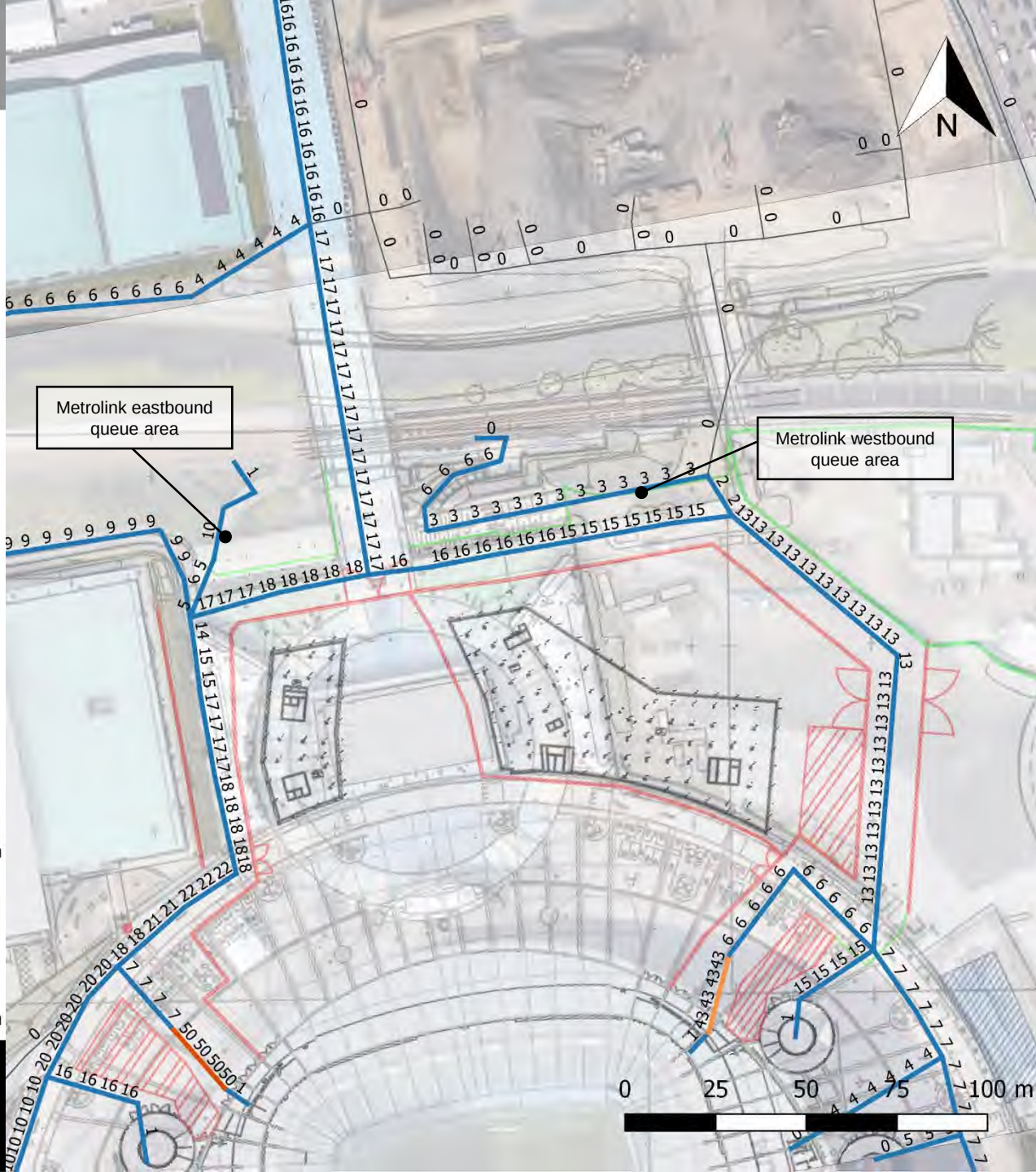
Construction - Stadium Ingress

North Stand and Arena Max Flowrate by Link

- Most of the pedestrian circulation routes around the construction hoarding will experience flow rates of up to 23 persons/minute/metre width.
- It should be noted that spectators accessing the site via the Metrolink service **are limited by the capacity of the tram service frequency**.
- If the route with the highest pedestrian demand of 13,570 persons were to arrive using the peak arrival profile assumed (40% of people over a 15 minute period) **a peak flow rate of 35 persons / minute / metre width would be achieved at the narrowest point.**

Legend

- No people
- < 23 ppl/m/min
- 23 - 33
- 33 - 49
- 49 - 66
- 66 - 82
- > 82 ppl/m/min



SCENARIO 3: STADIUM HARD EGRESS (POST EVENT DEPARTURES)

Scenario 3

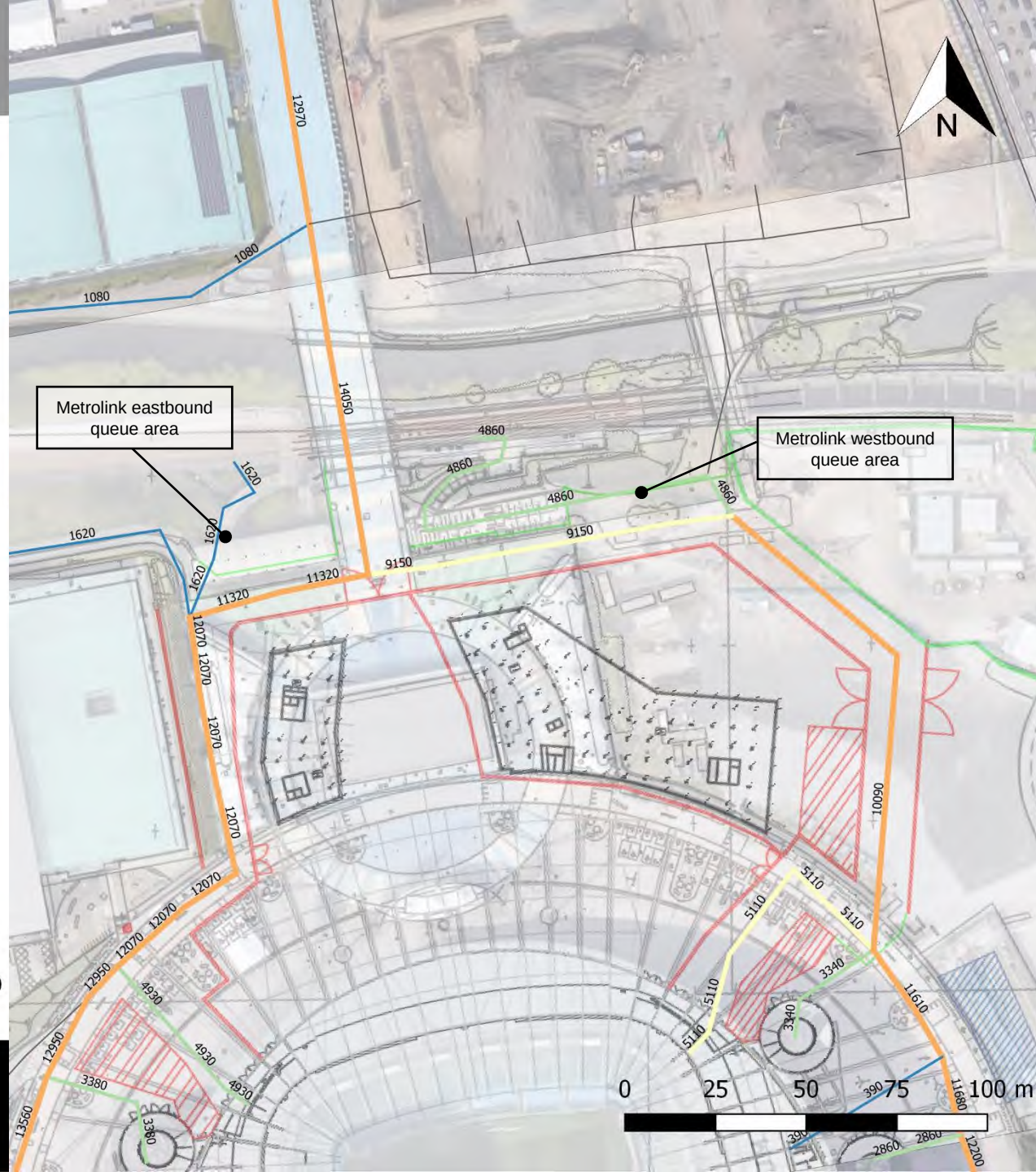
Construction - Stadium Hard Egress

North Stand and Arena Static Assignment by Link

- Peak spectator flows around the construction hoarding are on the west side of the compound, with 12,070 spectators travelling northbound.
- This model assumes spectators depart the Etihad Stadium and look at access local destinations.
- No F&B or entertainment opportunities are considered.

Legend

- No people
- < 2,500 ppl
- 2,500 - 5,000
- 5,000 - 10,000
- 10,000 - 20,000
- > 20,000 ppl



Scenario 3

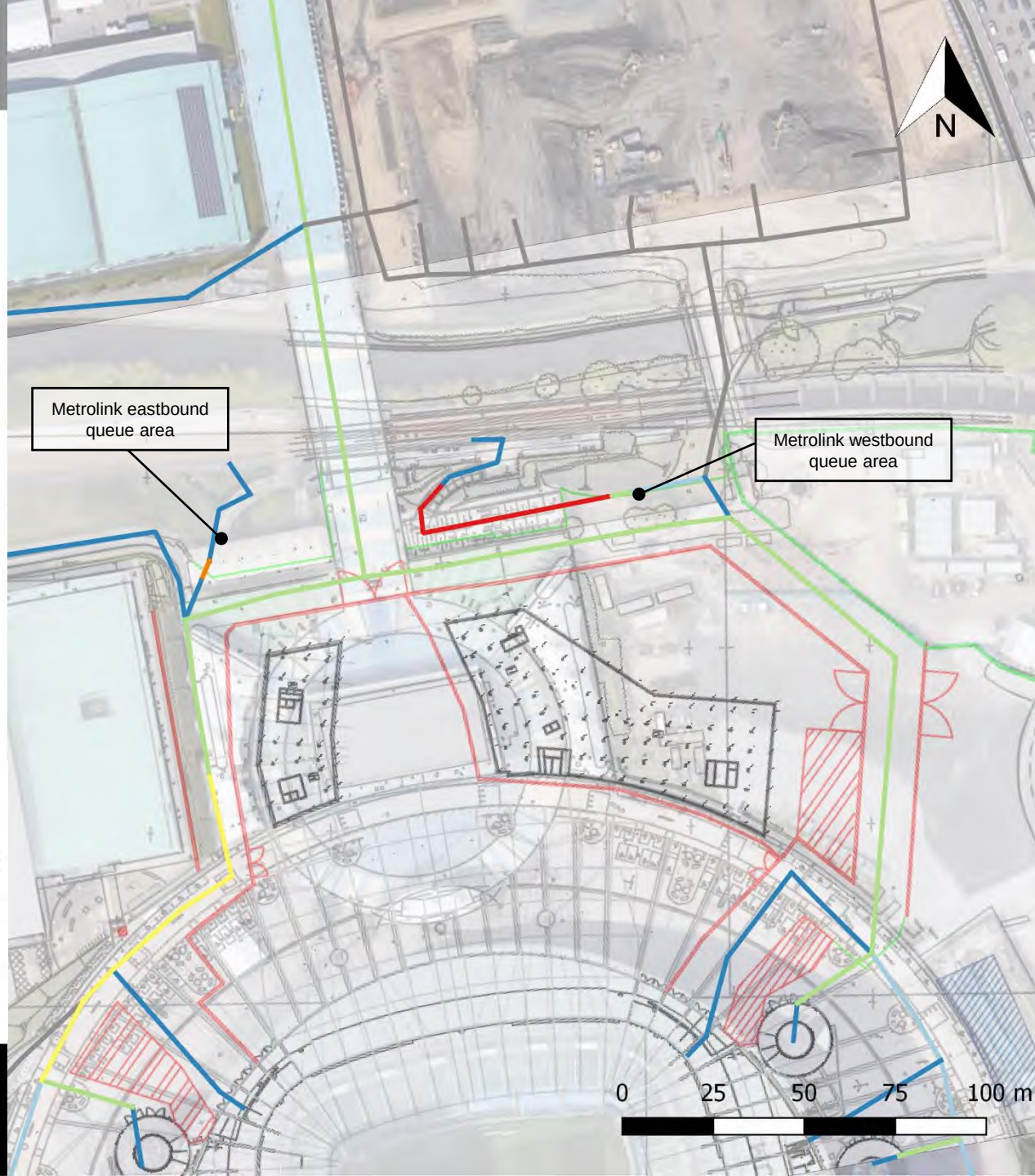
Construction - Stadium Hard Egress

North Stand and Arena Max Density by Link

- The circulation routes around the construction compound experience densities of up to 1.1 persons per m².

Legend

- No ppl
- LoS A - < 0.31 ppl/ m²
- LoS B - 0.31 - 0.43
- LoS C - 0.43 - 0.72
- LoS D - 0.72 - 1.08
- LoS E - 1.08 - 2.17
- LoS F - 2.17 - 4



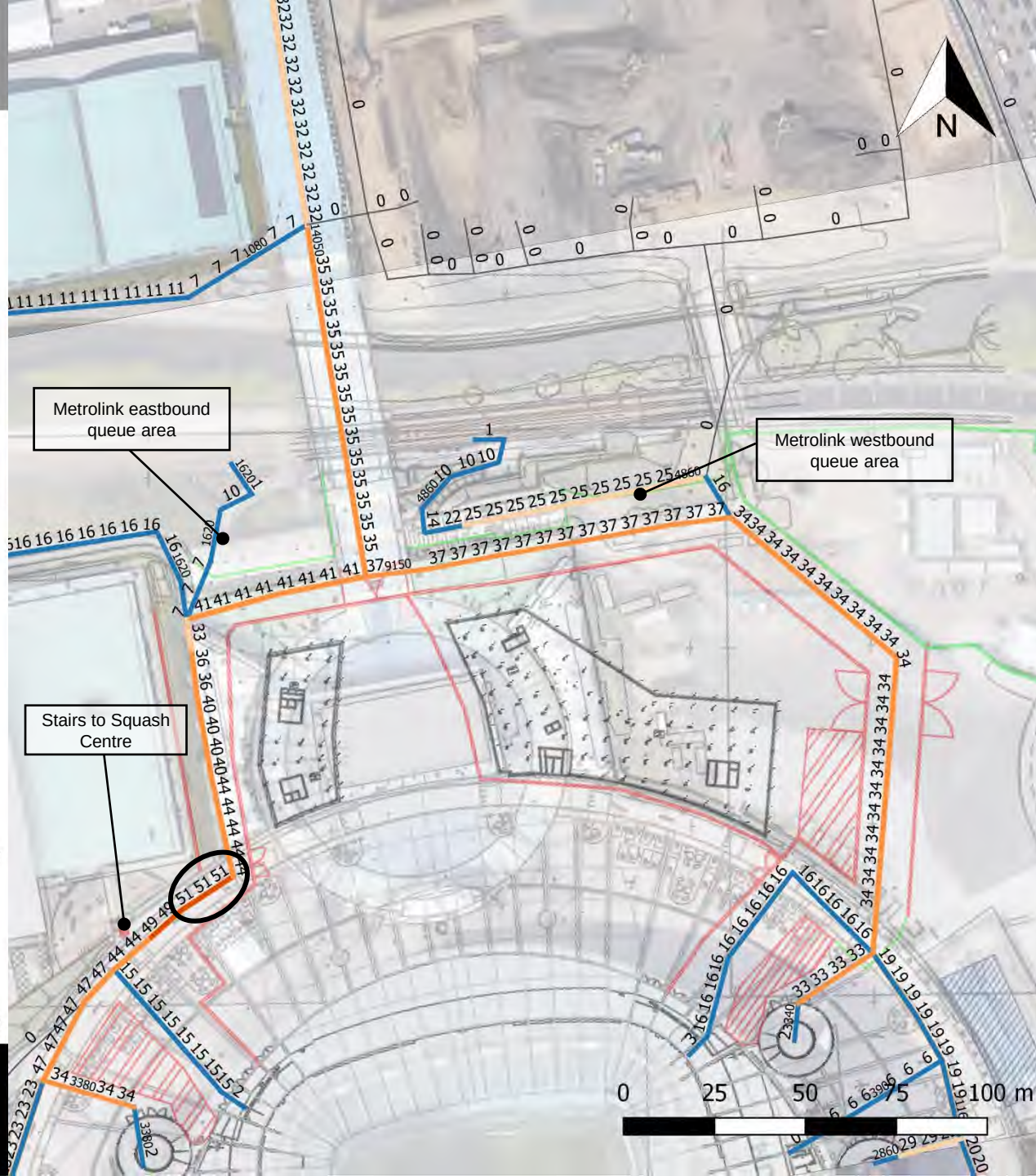
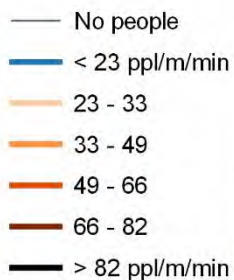
Scenario 3

Construction - Stadium Hard Egress

North Stand and Arena Max Flowrate by Link

- Most of the pedestrian circulation routes around the construction hoarding will experience flow rates of up to 49 persons/minute/metre width.
- The route to the south west of the compound (by the stairs leading to the Squash Centre) will experience slightly higher flow rates (highlighted in the adjacent image). This is due to the reduced width of 11.73 metres at this location. Following discussions with LOR and CFGL we understand the minimum width at this location is due to existing infrastructure that cannot be moved.

Legend



SCENARIO 4: STADIUM HARD EGRESS + ARENA EGRESS (30 MINUTE OFFSET)

Scenario 4b

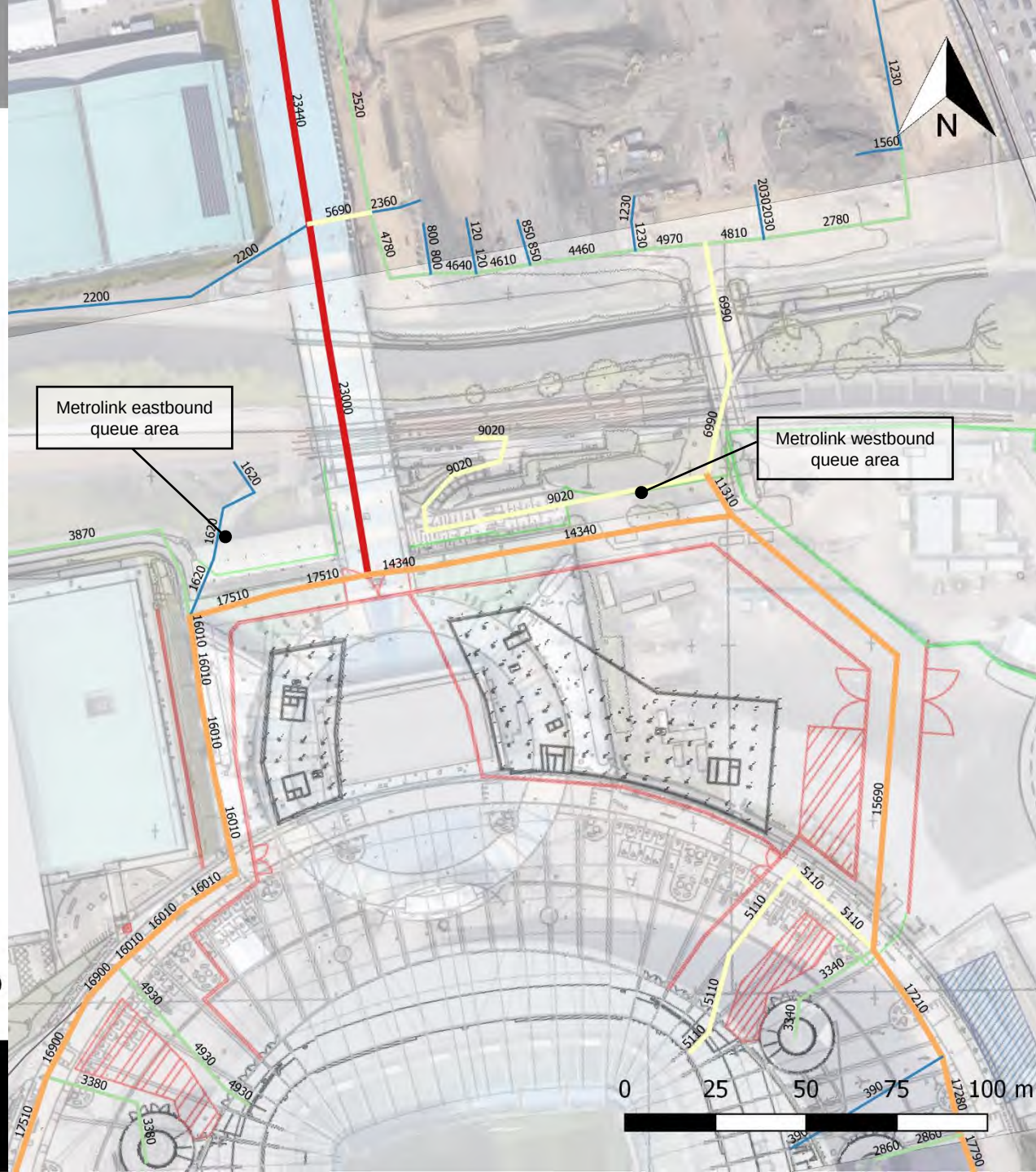
Construction - Stadium Hard Egress + Arena 30 min offset

North Stand and Arena Static Assignment by Link

- Peak spectator flows around the construction hoarding are on the north side of the compound (by the Metrolink eastbound service), with a two way demand (eastbound and westbound) of 17,510 spectators.

Legend

- No people
- < 2,500 ppl
- 2,500 - 5,000
- 5,000 - 10,000
- 10,000 - 20,000
- > 20,000 ppl



Scenario 4b

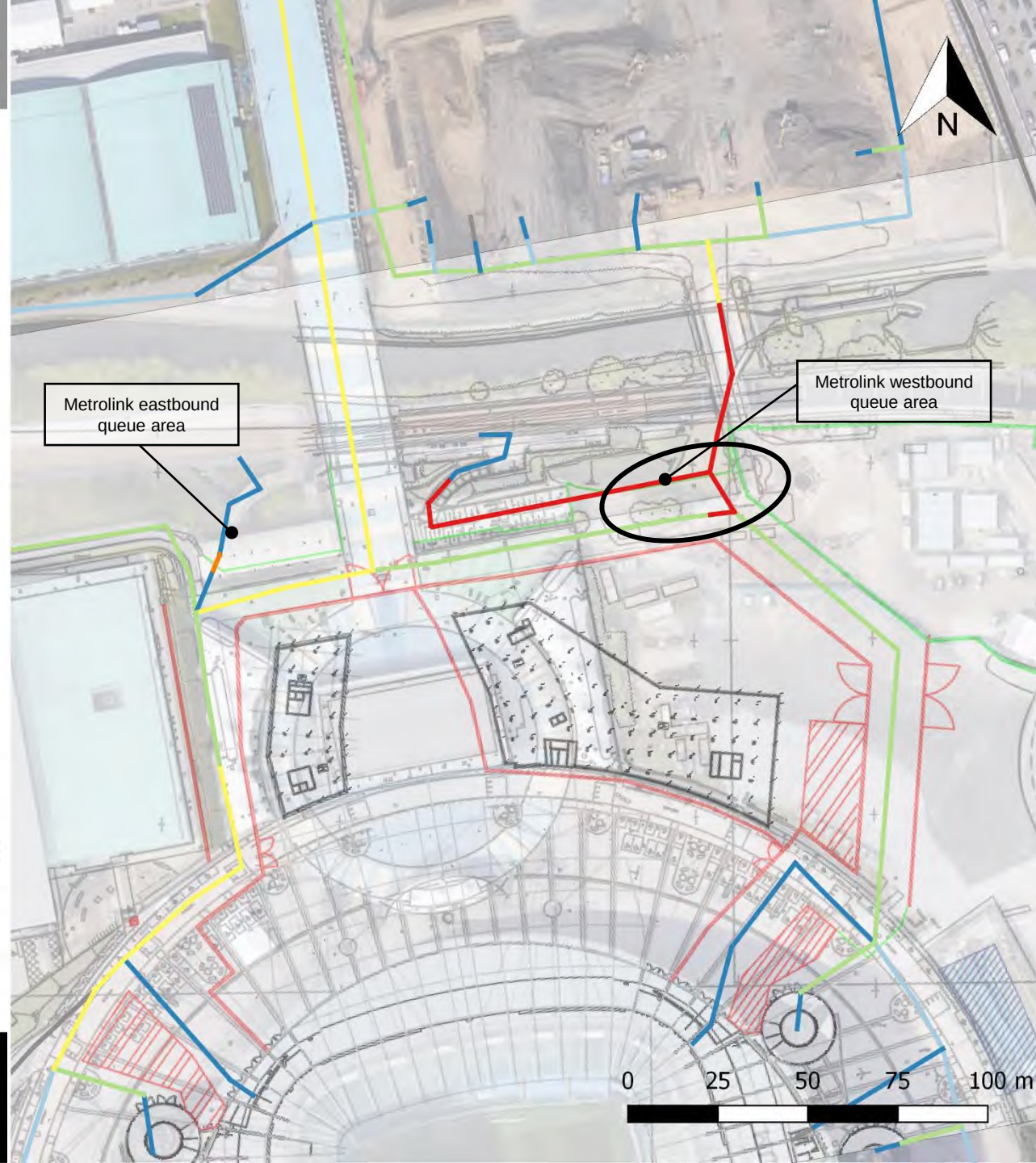
Construction - Stadium Hard Egress + Arena 30 min offset

North Stand and Arena Max Density by Link

- The circulation routes around the construction compound experience densities of up to 1.1 persons per m².
- The queue space available for the Metrolink westbound service cannot accommodate the level of queueing expected, based on existing planning assumptions. If left unmanaged, this could lead to the blockage of pedestrian circulation routes. Potential mitigation measures for this location are set out in the 'Metrolink westbound service (post event)' chapter in this document.
- High spectator densities that may require management are expected on Forge Lane Bridge as spectators depart the arena. We understand the Arena are aware of this and are looking to have a queue management operation in place at this location.

Legend

- No ppl
- LoS A - < 0.31 ppl/ m²
- LoS B - 0.31 - 0.43
- LoS C - 0.43 - 0.72
- LoS D - 0.72 - 1.08
- LoS E - 1.08 - 2.17
- LoS F - 2.17 - 4



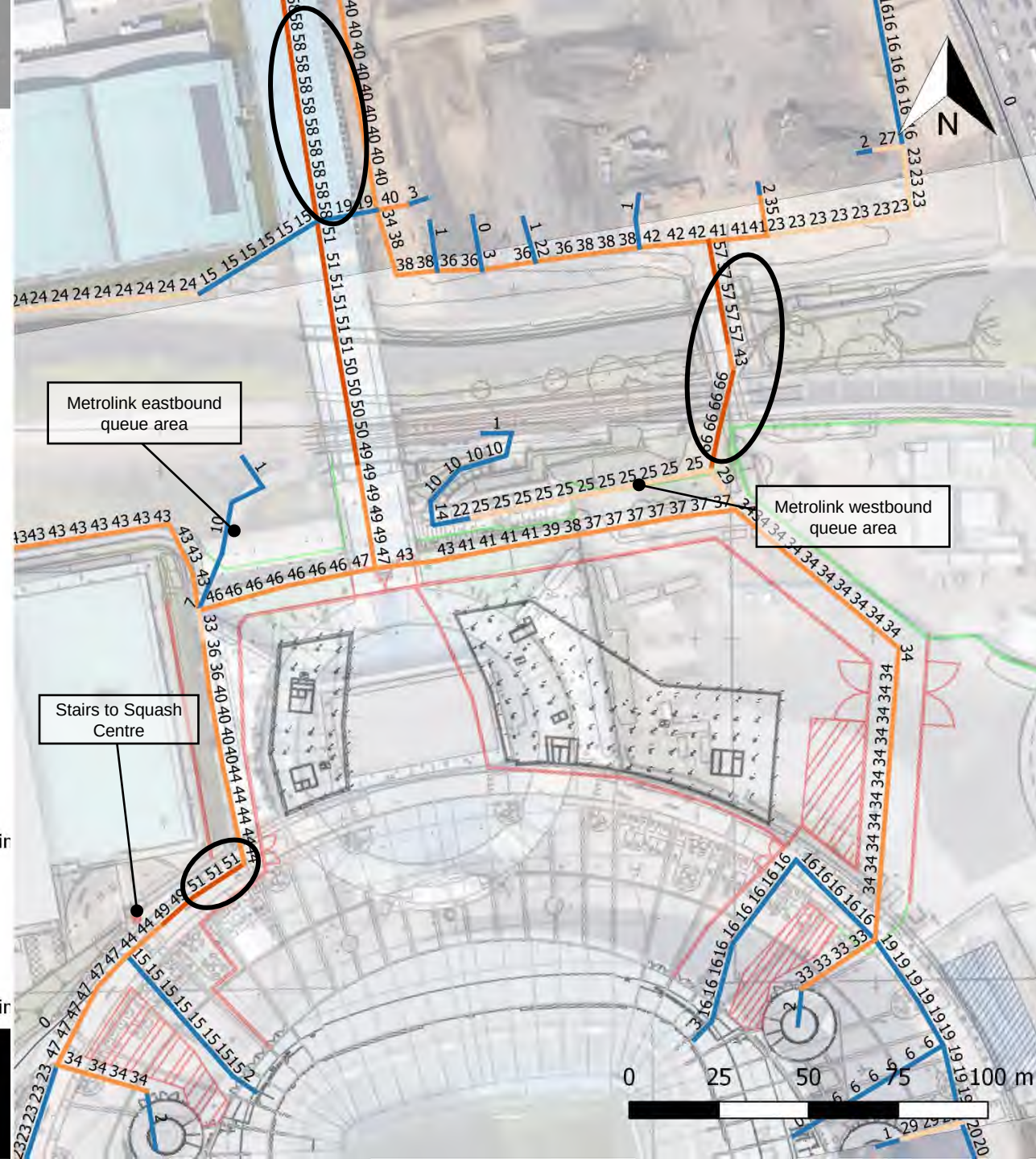
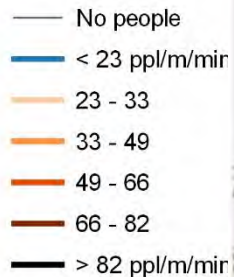
Scenario 4b

Construction - Stadium Hard Egress + Arena 30 min offset

North Stand and Arena Max Flowrate by Link

- The route to the south west of the compound (by the stairs leading to the Squash Centre) will experience slightly higher flow rates (highlighted in the adjacent image). This is due to the reduced width of 11.73 metres at this location. Following discussions with LOR and CFGF we understand the minimum width at this location is due to existing infrastructure that cannot be moved.
- Spectators on Forge Lane Bridge and Joe Mercer Way may need to be managed.

Legend



SCENARIO 5: STADIUM HARD EGRESS + ARENA EGRESS (SIMULTANEOUS)

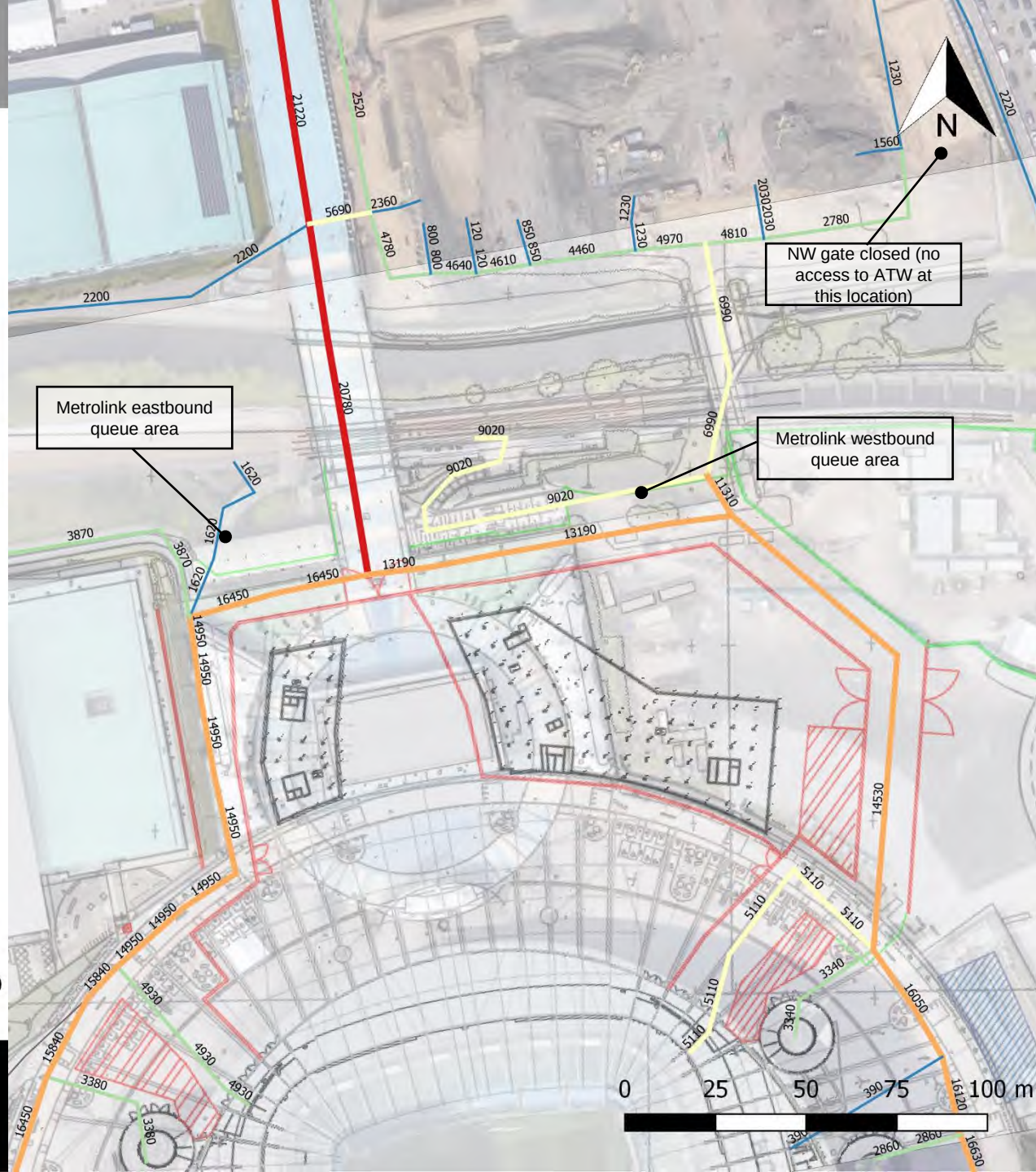
Scenario 5b

Construction - Stadium Hard Egress + Arena Simultaneous Egress

North Stand and Arena Static Assignment by Link

- The Special Measures Operating Plan for the Arena re-directs spectator demand onto Alan Turing Way, resulting in a reduction in spectator demand across the construction compound, when compared to the previous scenario.
- Peak spectator flows around the construction hoarding are on the north side of the compound, with a two way demand (eastbound and westbound) of 16,450 spectators.
- It should be noted that following meetings with the CFGL and the Co-Op Live Arena it is assumed that the NW Gate leading from the Arena onto Alan Turing Way is closed.

Legend



Scenario 5b

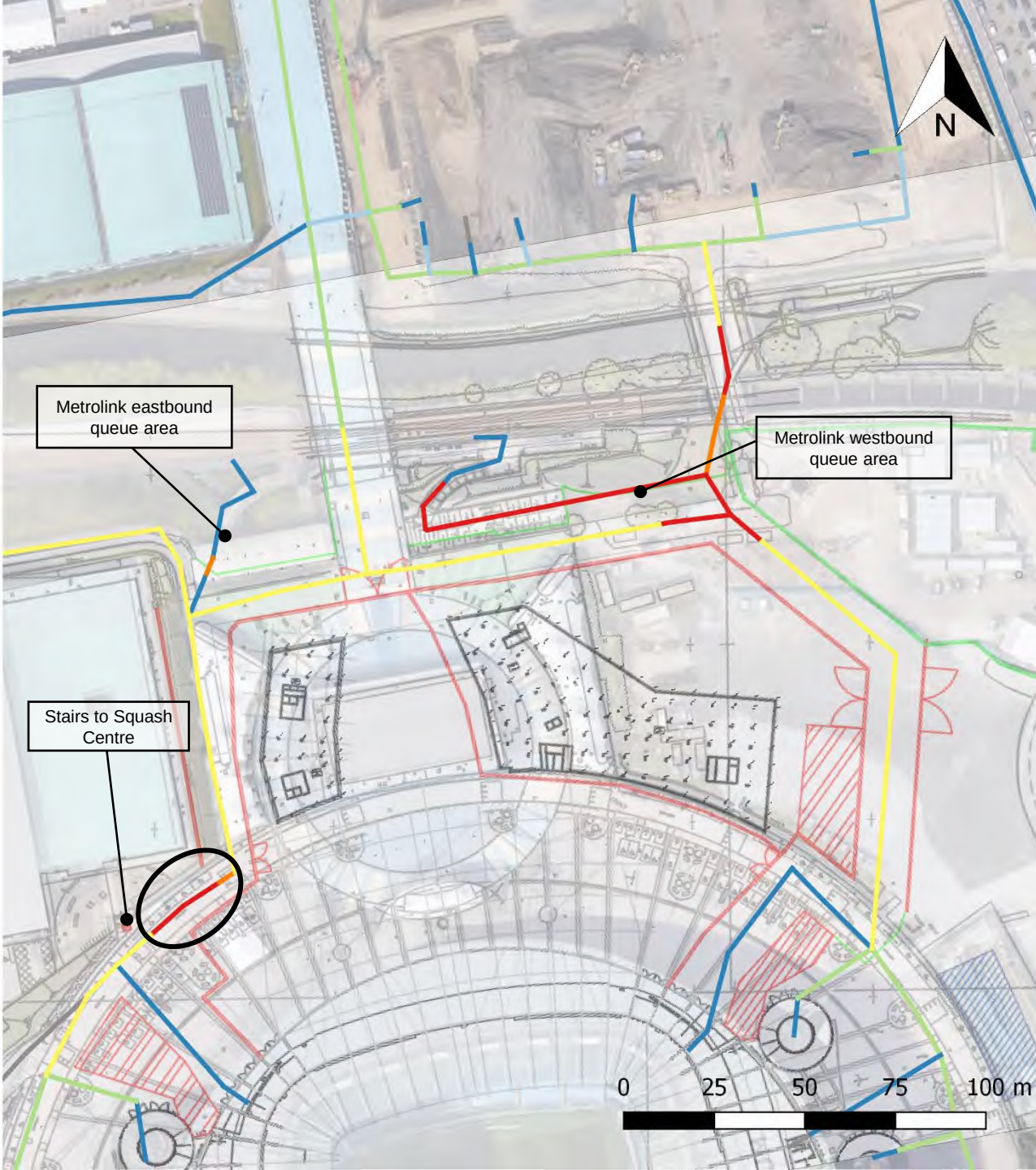
Construction - Stadium Hard Egress + Arena Simultaneous Egress

North Stand and Arena Max Density by Link

- Densities of up to 1.08 persons per m² (LoS D/E) are experienced around most of the construction compound.
- As for previous egress scenarios, the route by the stairs leading to the Squash Centre shows higher densities due to the reduction in width to 11.73 metres (highlighted in the figure adjacent).
- The queue space available for the Metrolink westbound service cannot accommodate the level of queueing expected, based on existing planning assumptions. If left unmanaged, this could lead to the blockage of pedestrian circulation routes. Potential mitigation measures for this location are set out in the 'Metrolink westbound service (post event)' chapter in this document.
- High spectator densities that may require management are expected on Forge Lane Bridge as spectators depart the arena. We understand the Arena are aware of this and are looking to have a queue management operation in place at this location.

Legend

- No ppl
- LoS A - < 0.31 ppl/ m²
- LoS B - 0.31 - 0.43
- LoS C - 0.43 - 0.72
- LoS D - 0.72 - 1.08
- LoS E - 1.08 - 2.17
- LoS F - 2.17 - 4



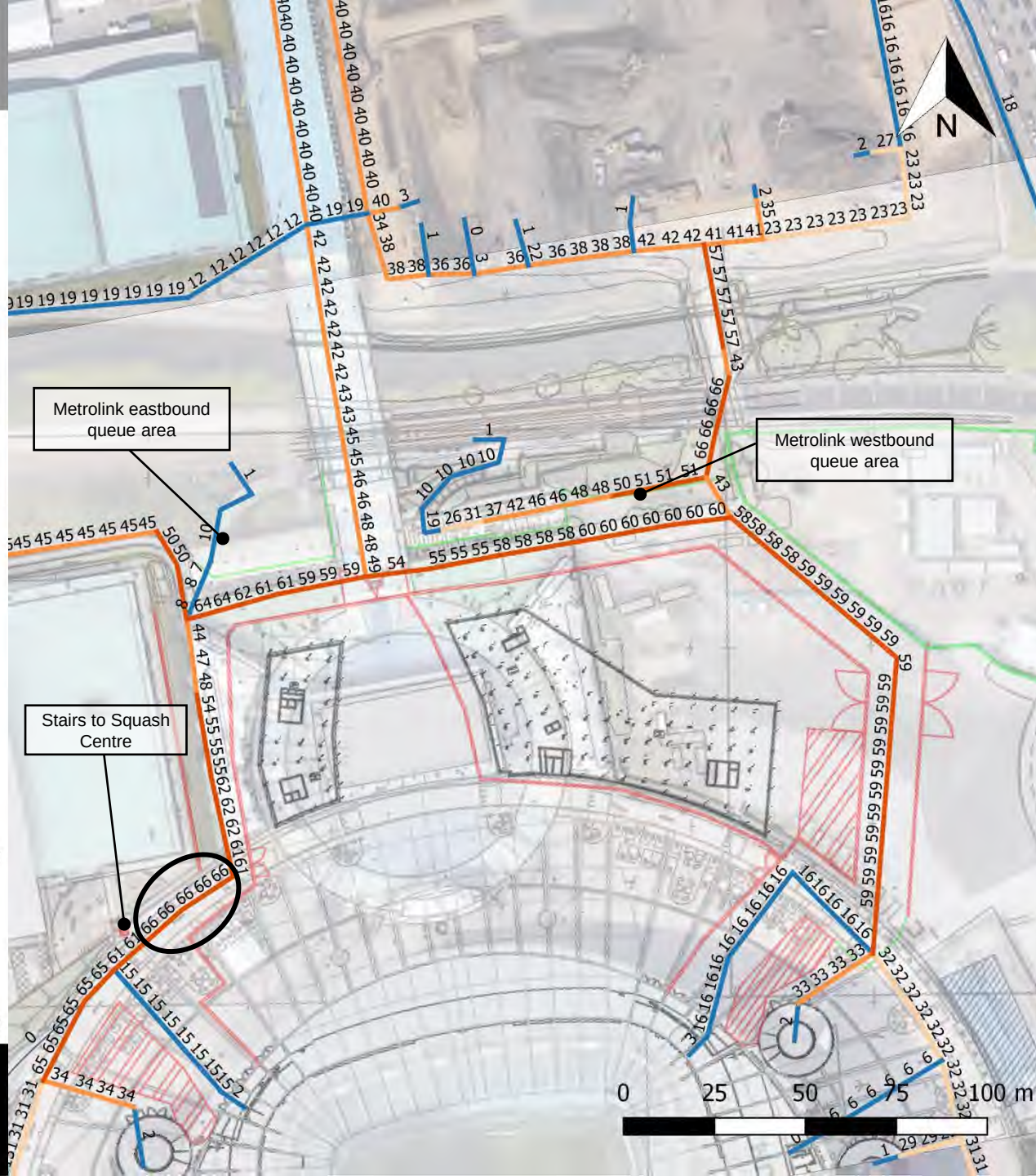
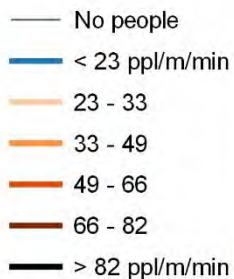
Scenario 5b

Construction - Stadium Hard Egress + Arena Simultaneous Egress

North Stand and Arena Max Flowrate by Link

- Most of the routes around the construction hoarding will be close to the target capacity.
- The route to the south west of the compound (by the stairs leading to the Squash Centre) will experience slightly higher flow rates (highlighted in the adjacent image). This is due to the reduced width of 11.73 metres at this location. Following discussions with LOR and CFGL we understand the minimum width at this location is due to existing infrastructure that cannot be moved.
- The SENSE model shows this will result in queueing along this route (see next slide).

Legend

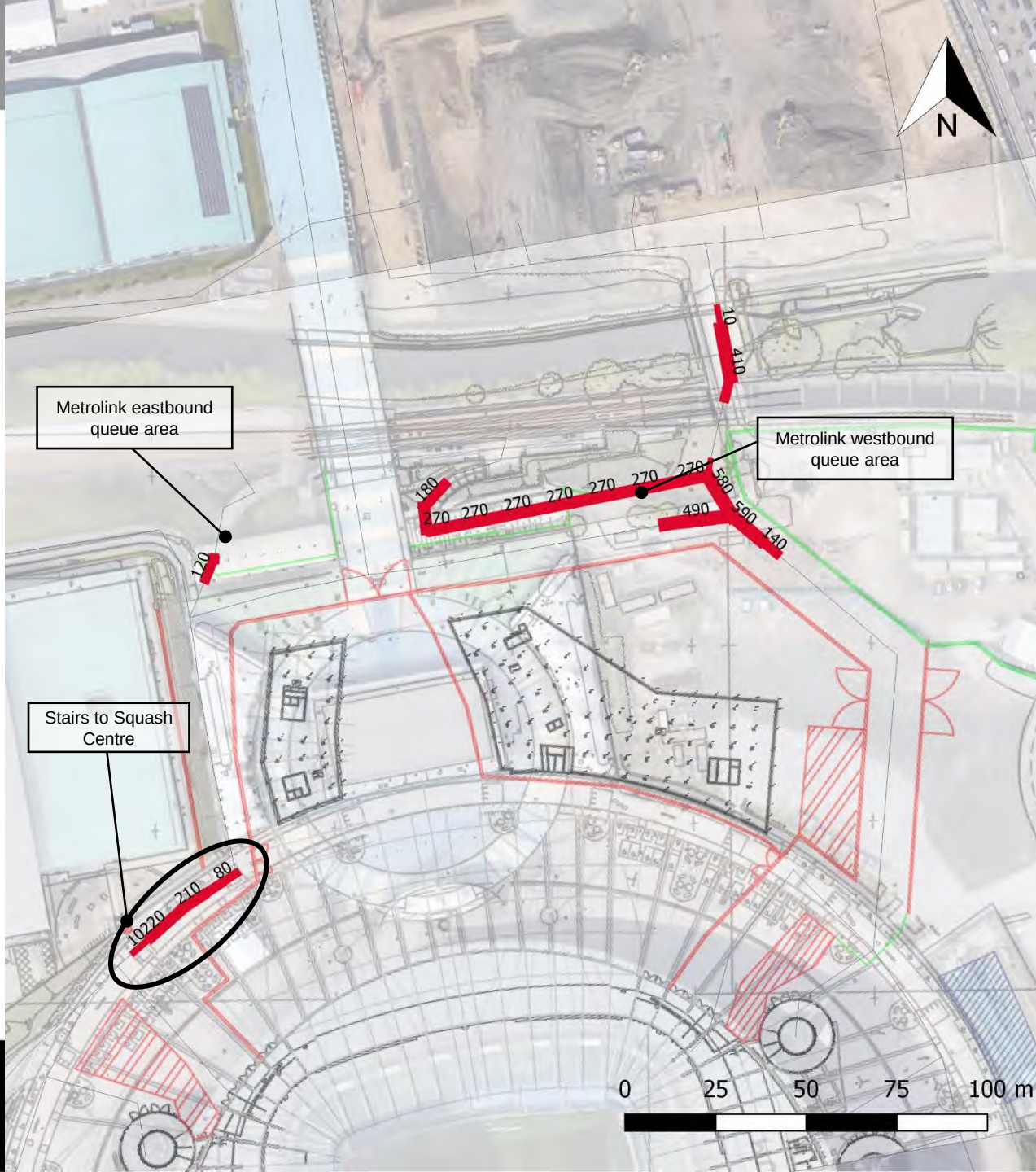


Scenario 5b

Construction - Stadium Hard Egress + Arena Simultaneous Egress

North Stand and Arena Max Queue by Link

- The route to the north of the stairs leading to the Squash Centre is likely to experience queues for up to 10 minutes, with maximum queues of between 750-800 persons. This is due to the reduction in width available to 11.73 metres at this location. Proposed mitigation measures are discussed in the next slide.
- The queue space available for the Metrolink westbound service cannot accommodate the level of queueing expected, based on existing planning assumptions. If left unmanaged, this could lead to the blockage of pedestrian circulation routes. Potential mitigation measures for this location are set out in the 'Metrolink westbound service (post event)' chapter in this document.



SPECTATOR QUEUES BY THE SQUASH CENTRE

Spectator circulation by the Squash Centre and the construction hoarding may need to be managed during a simultaneous Etihad Stadium and Co-Op Live Arena, based on current planning assumptions.

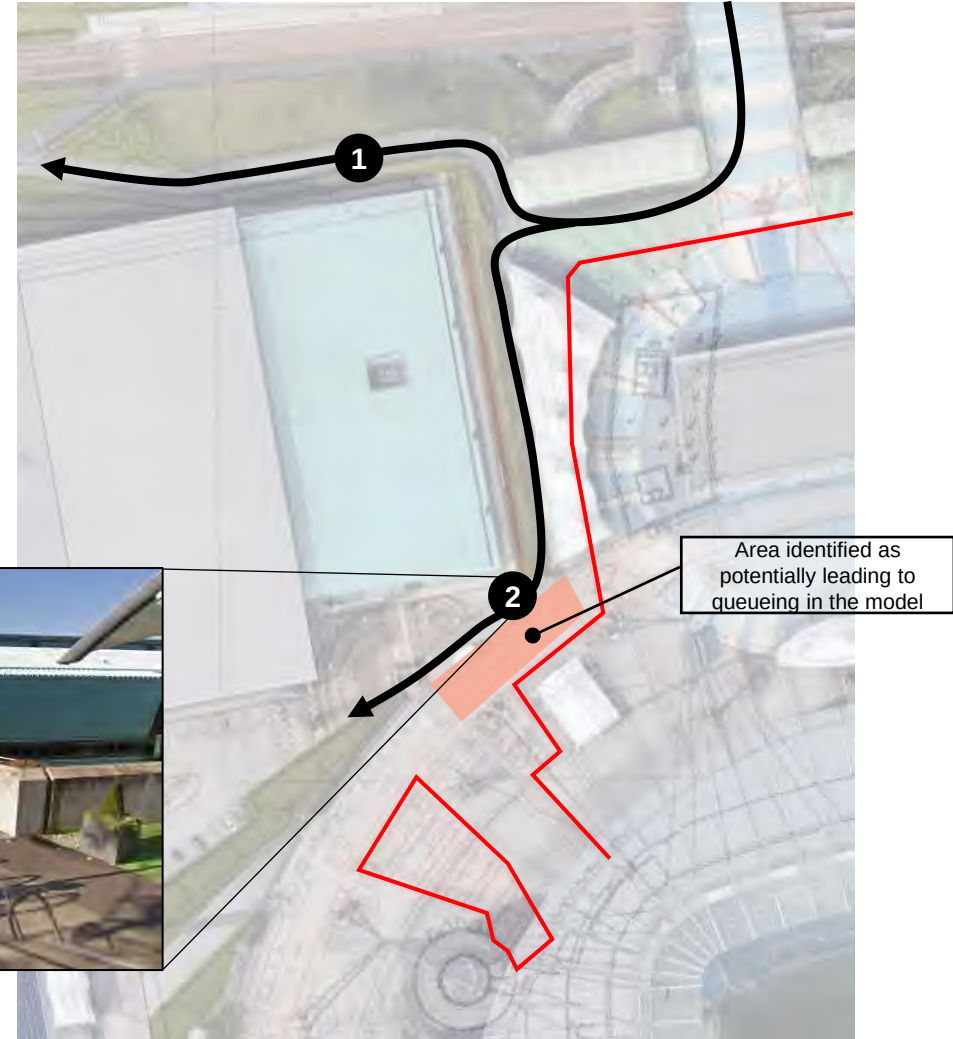
Proposed mitigation measures include:

- Re-directing Arena spectators via the City Link route to the City Centre ('1' in the adjacent image)
- Directing southbound spectators to make use of the ramp route available, providing an alternative southbound route ('2' in the adjacent image).
- Etihad Stadium spectators could be encouraged to use alternative routes to the City Centre to reduce demand in the City Link.
- Etihad Stadium spectators could be advised on the long waiting times at the Metrolink westbound service and encouraged to use alternative routes to the City Centre.



Figure 05: Alternative circulation routes

Source: Google Earth



SCENARIO 6: ARENA EGRESS (POST EVENT DEPARTURES)

Scenario 6

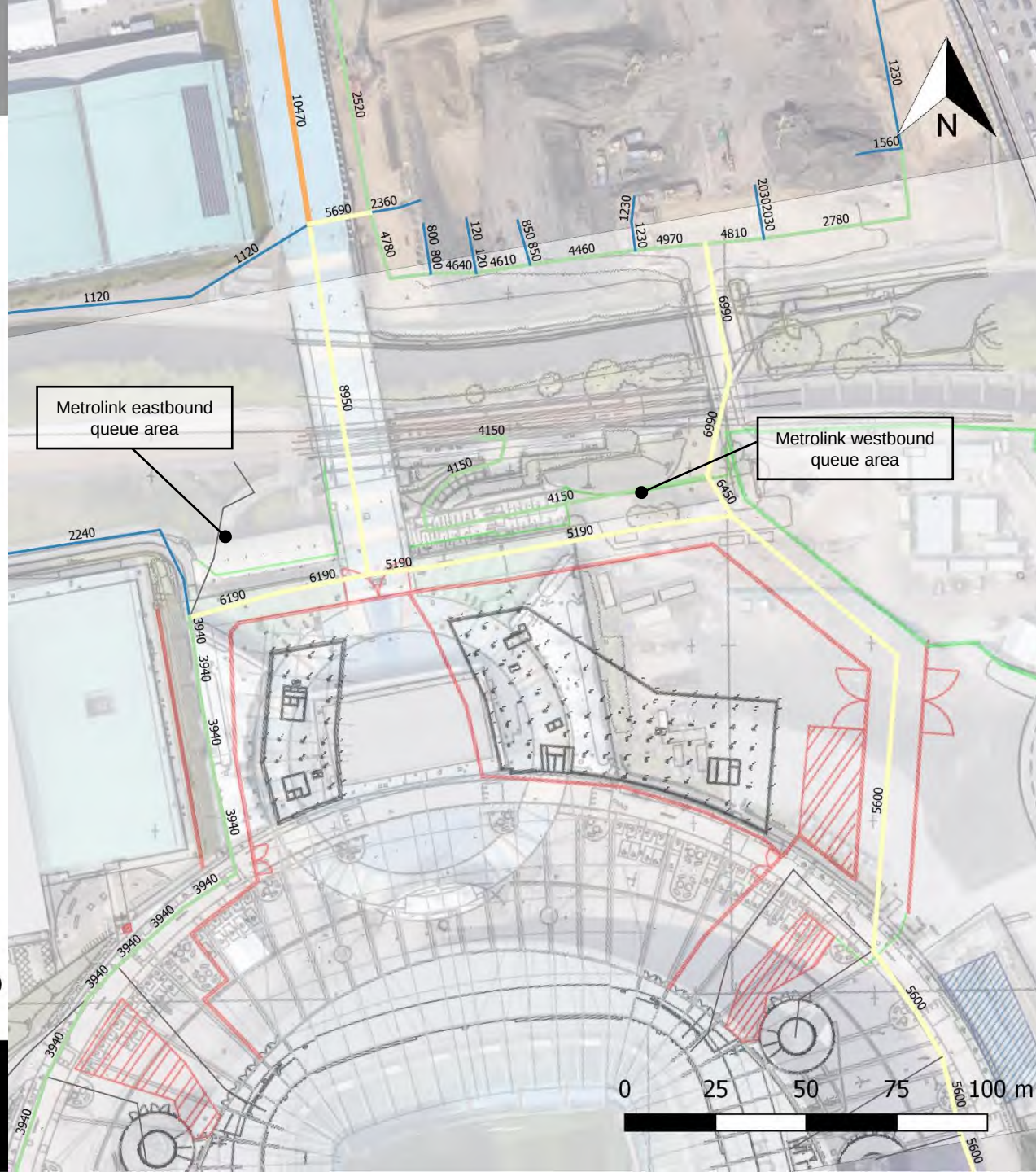
Construction - Arena Egress

North Stand and Arena Static Assignment by Link

- Peak spectator flows around the construction hoarding are on the north side of the compound (by the Metrolink eastbound service), with a demand of 6,190 spectators.

Legend

- No people
- < 2,500 ppl
- 2,500 - 5,000
- 5,000 - 10,000
- 10,000 - 20,000
- > 20,000 ppl



Scenario 6

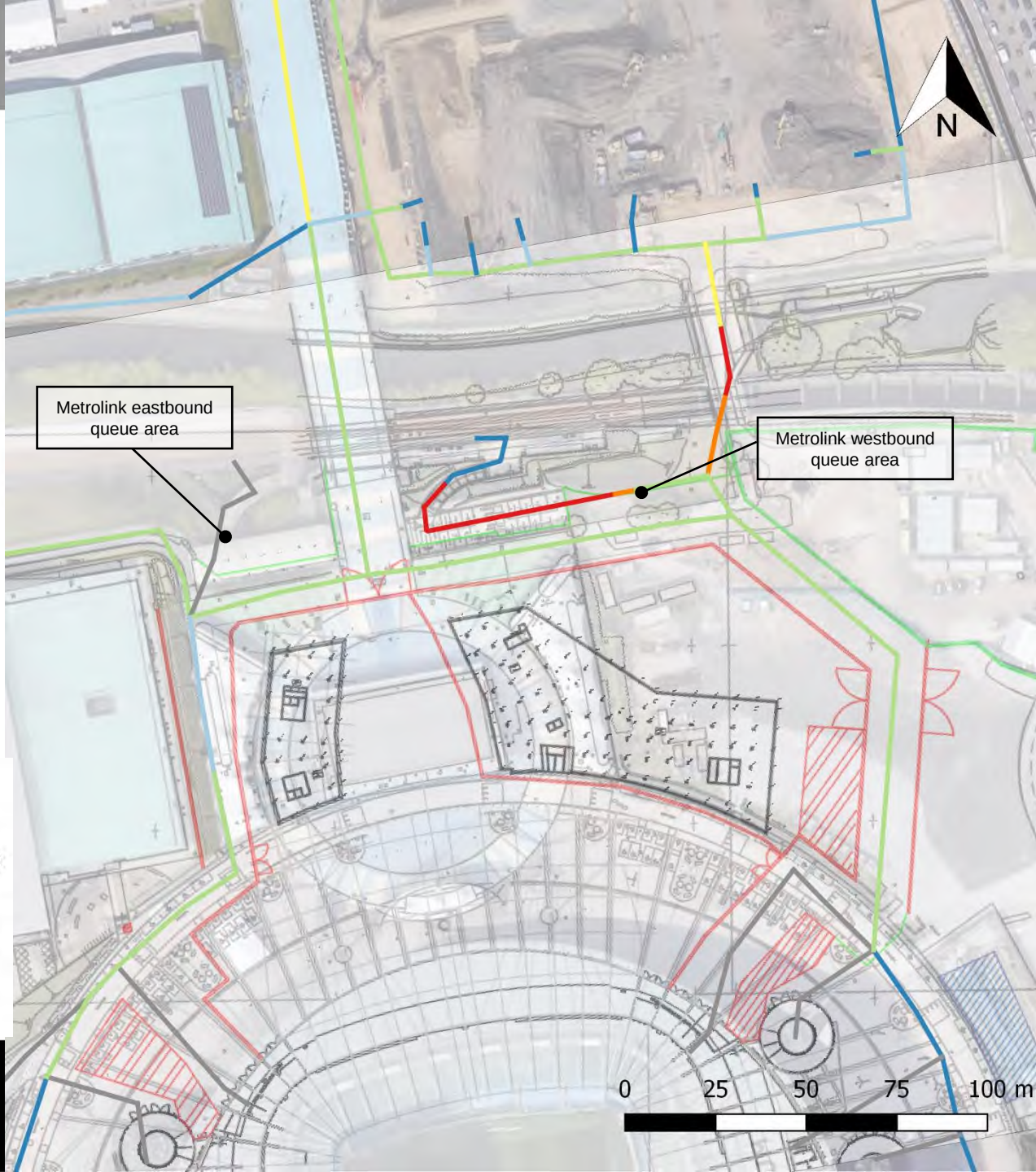
Construction - Arena Egress

North Stand and Arena Max Density by Link

- The circulation routes around the construction compound experience densities of up to 0.72 persons per m².
- JMW will experience densities of up to 1.08 persons per m².

Legend

- No ppl
- LoS A - < 0.31 ppl/ m²
- LoS B - 0.31 - 0.43
- LoS C - 0.43 - 0.72
- LoS D - 0.72 - 1.08
- LoS E - 1.08 - 2.17
- LoS F - 2.17 - 4

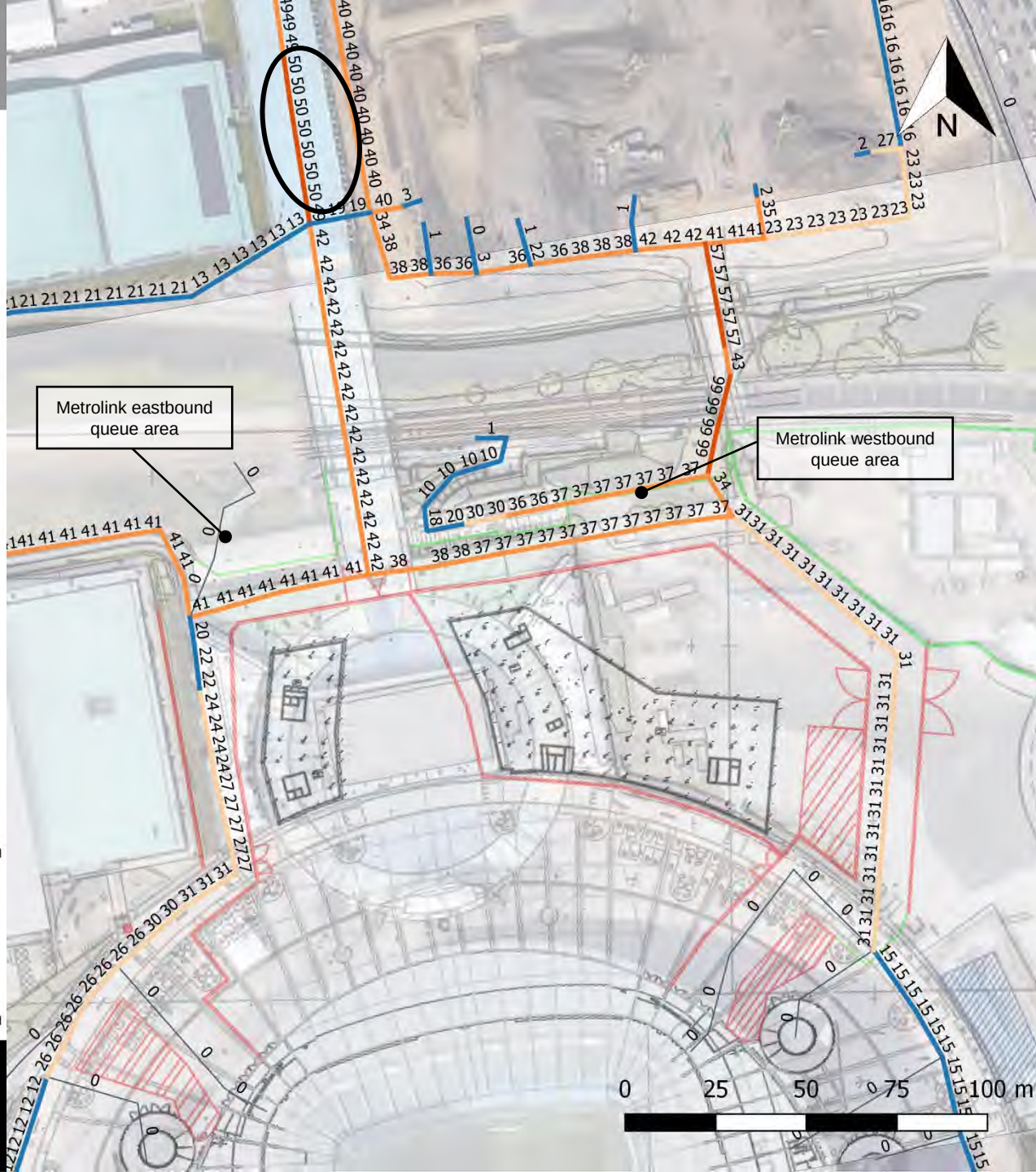
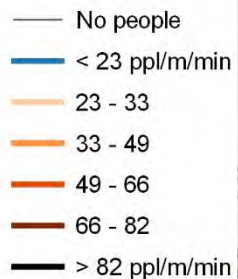


Construction - Arena Egress

North Stand and Arena Max Flowrate by Link

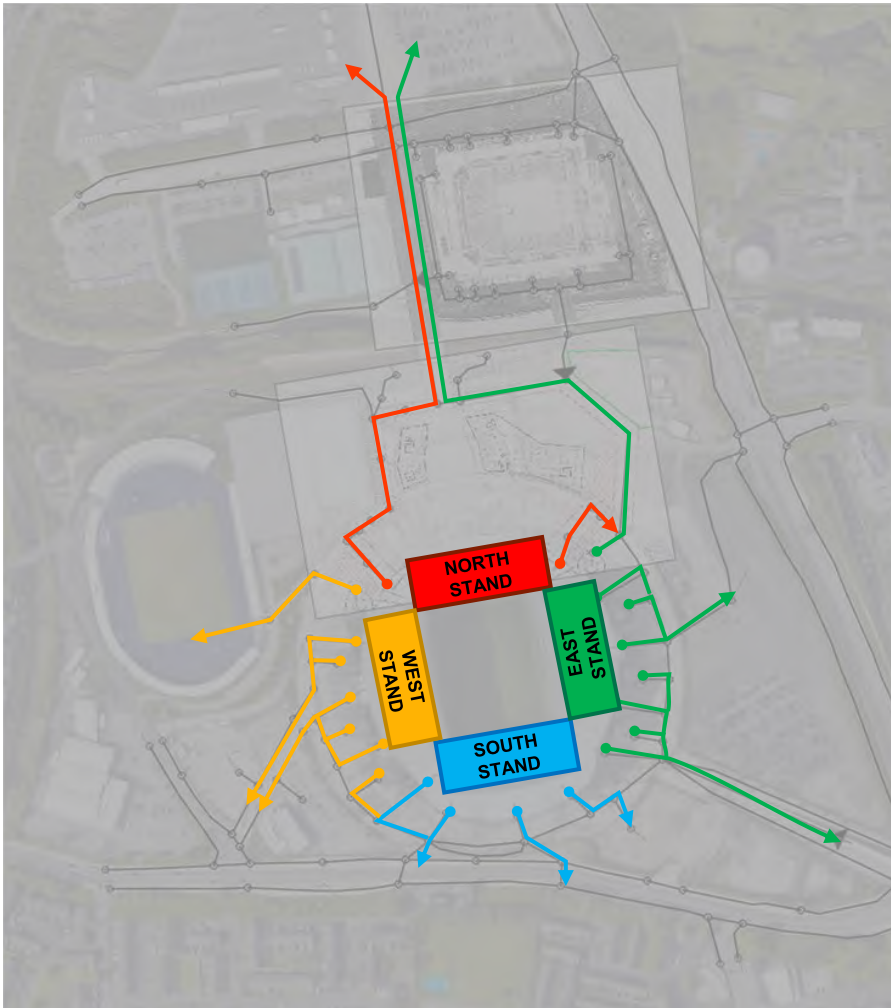
- Most of the pedestrian circulation routes around the construction hoarding will experience flow rates of up to 49 persons/minute/metre width.

Legend



SCENARIO 7: **STADIUM EVACUATION**

STADIUM SPECTATOR AND STAFF EVACUATION ROUTES



General Routing Assumptions

The existing Stadium will have a considered emergency evacuation strategy, the most onerous of which would be a full Stadium capacity evacuation and dispersal.

For the purpose of this assessment a **simultaneous full evacuation** (rather than a phased evacuation) over an 11 minute period will be assessed.

Spectators will be assigned to their closest exit route using the following routing assumptions:

- Exit Y will use the pedestrian circulation route on the west side of the construction compound. Other exits on the west side of the stadium will make use of alternative routes available
- Exit B and Exit C will use the pedestrian circulation route on the east side of the construction compound. Other exits on the east side of the stadium will make use of alternative routes available

Whilst this assessment does not look to analyse the evacuation of the East Stand, South Stand and West Stand, the impact of persons emerging from other stands using evacuation routes designated to the North Stand Expansion can be considered.

Figure 06: Spectators and staff evacuation routes outside the Stadium

Source: Google Earth

Scenario 7

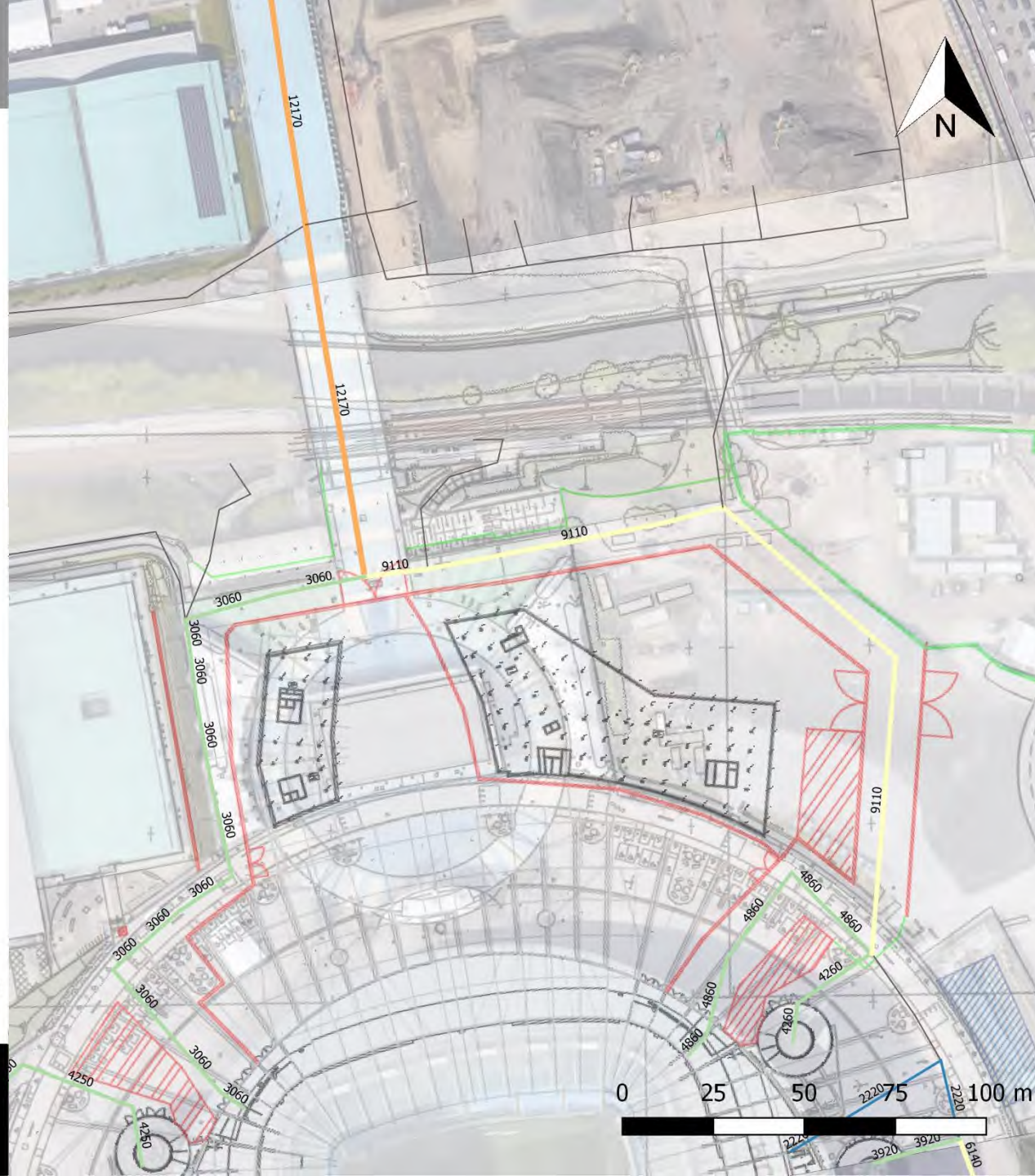
Construction - Stadium Evacuation

North Stand and Arena Static Assignment by Link

- Peak spectator flows around the construction hoarding are on the east side of the compound, with 9,110 persons travelling northbound.

Legend

- No people
- < 2,500 ppl
- 2,500 - 5,000
- 5,000 - 10,000
- 10,000 - 20,000
- > 20,000 ppl



Scenario 7

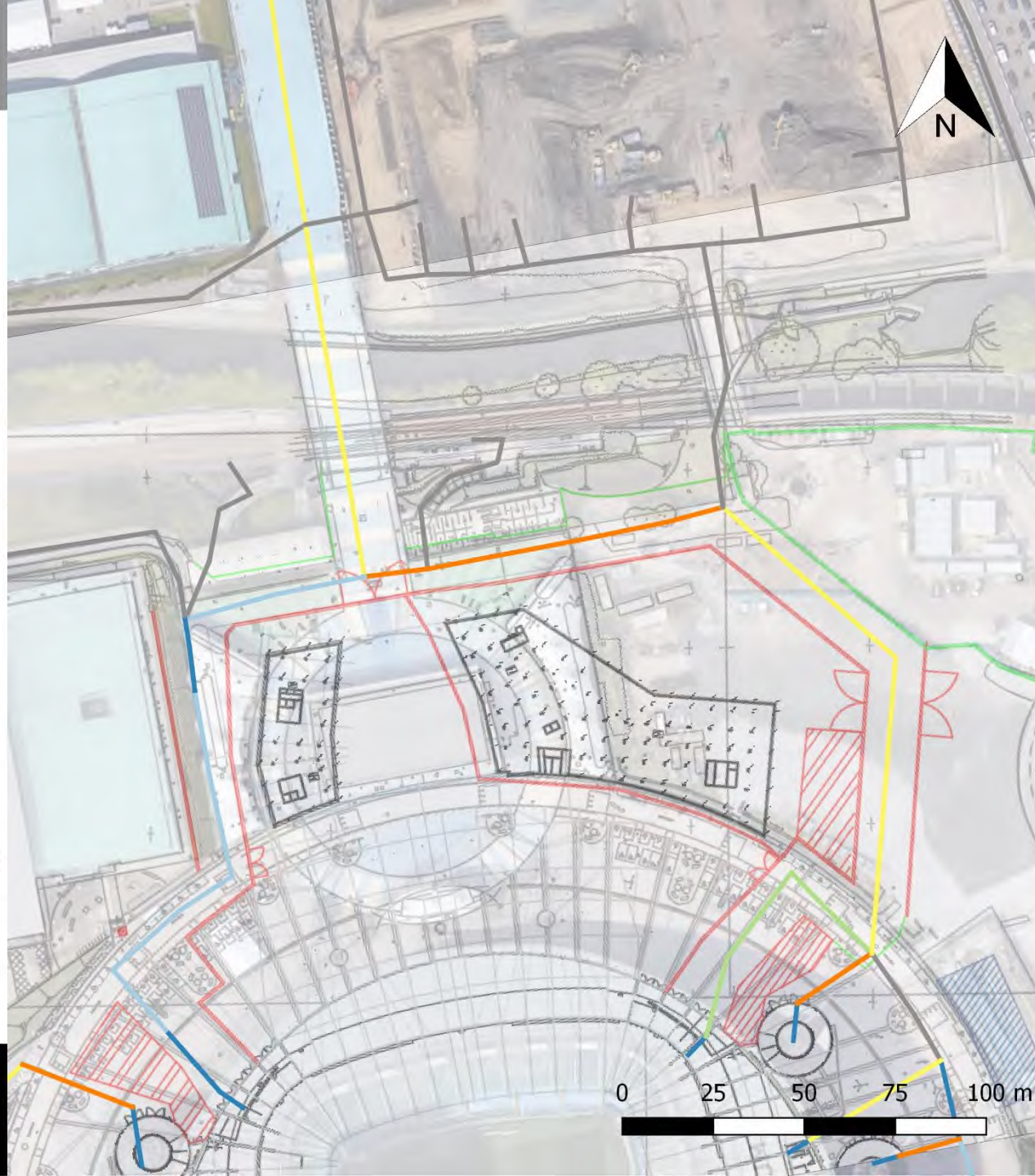
Construction - Stadium Evacuation

North Stand and Arena Max Density by Link

- Peak densities of 1.08 to 2.17 persons per m² are experienced on the pedestrian circulation routes to the north east of the construction compound (by the Metrolink westbound service).
- The possibility of making alternative routes available for spectators departing via this route should be explored.

Legend

- No ppl
- LoS A - < 0.31 ppl/ m²
- LoS B - 0.31 - 0.43
- LoS C - 0.43 - 0.72
- LoS D - 0.72 - 1.08
- LoS E - 1.08 - 2.17
- LoS F - 2.17 - 4



Scenario 7

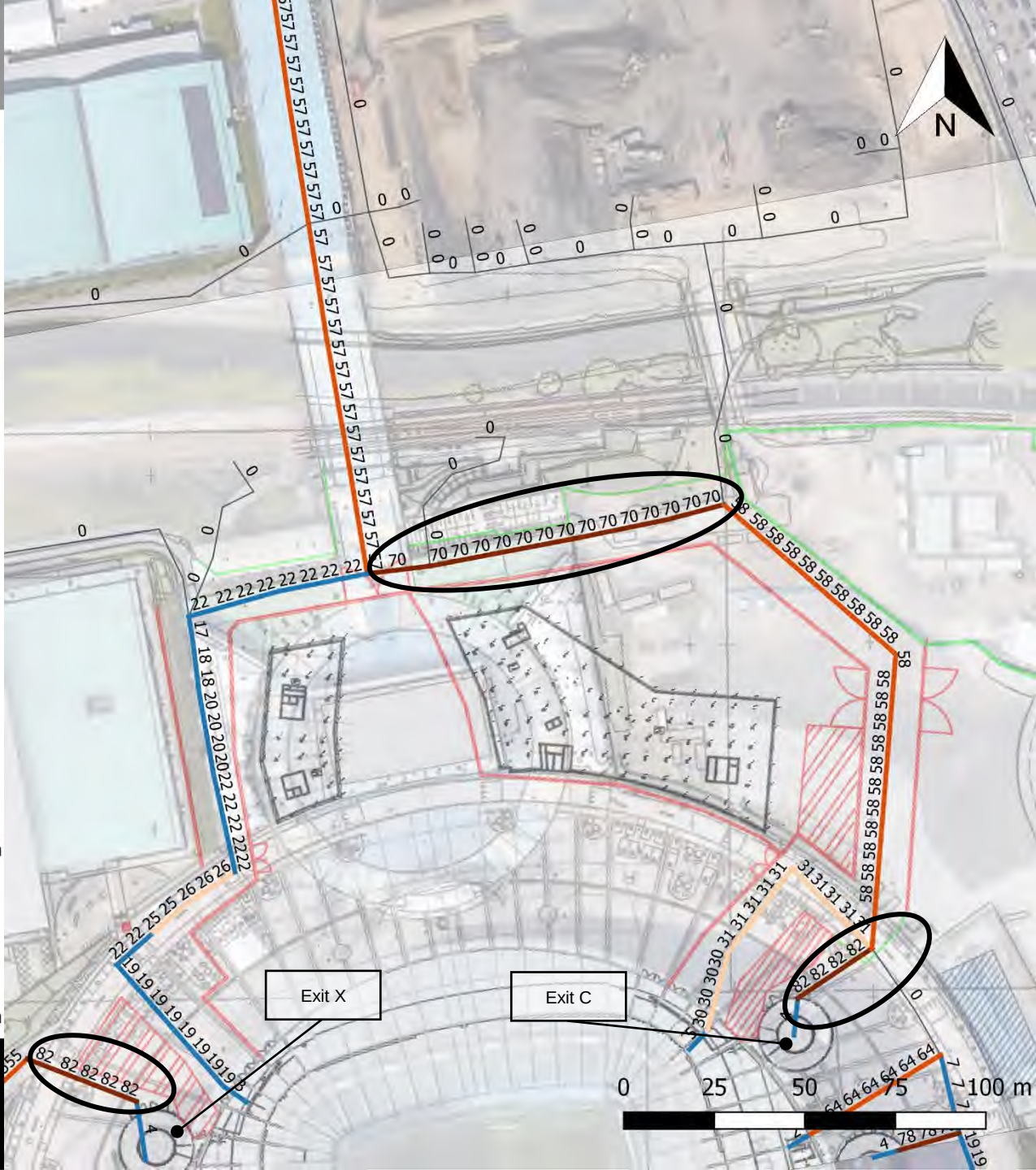
Construction - Stadium Evacuation

North Stand and Arena Max Flowrate by Link

- The pedestrian circulation route to the north of the construction compound (by the Metrolink westbound service) will experience flow rates up to 70 persons / minute / metre width.
- Whilst this is below the maximum threshold permitted, the possibility of making alternative routes available for spectators departing via this route will be explored.
- The maximum flow rates by Exit X and Exit C are a result of the level of demand assumed to use these routes when exiting the building.

Legend

- No people
- < 23 ppl/m/min
- 23 - 33
- 33 - 49
- 49 - 66
- 66 - 82
- > 82 ppl/m/min



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05 METROLINK WESTBOUND SERVICE (POST EVENT)

METROLINK WESTBOUND SERVICE

Service description

The Metrolink westbound tram service is located on the east side of Joe Mercer Way (north of the Etihad Stadium and south of the Co-Op Live Arena).

The current planning assumption for the westbound service is that the tram can accommodate 300 passengers from the Etihad Campus tram stop every 6 minutes.

Travel time from the Etihad Campus tram stop to the Piccadilly tram stop (City Centre) is quoted at approximately 7 minutes. By comparison, walking between the two tram stops is estimated at 36 minutes.

Match Day pedestrian surveys

Match day pedestrian surveys indicate that approximately 14% of spectators arrive at Etihad Stadium via the Metrolink eastbound service stopping at Etihad Campus. These surveys also show that 9% of spectators choose to depart the Etihad Stadium via the Metrolink westbound service stopping at Etihad Campus.

Whilst it is accepted that a variety of factors may influence the decision on transport choice, based on current planning assumptions:

- If 14% of stadium demand used the Metrolink westbound service during the post event departure period, they would experience a maximum individual delay of 115 minutes.
- With 9% of stadium demand using the Metrolink westbound service during the post event departure period, this equates to a maximum individual delay of 65 minutes.

Based on the survey information, it is estimated that spectators are willing to wait for up to one hour to access this service after an event.

Maximum queue size by scenario

The existing Metrolink westbound service has an estimated queue area of approximately 820 m² (permanent infrastructure on site). A new queue area has been identified between the tram stop and Forge Lane Bridge, providing an estimated 422 m² of additional queue space.

The table below presents the maximum queue sizes expected at the Metrolink westbound tram service, based on current planning assumptions.

Scenario	Spectator Demand (persons)	Maximum Queue (persons)	Maximum Delay (minutes)	Last Departure (hh:mm)
Stadium	4,865	3,125	62	01:40
Arena	4,155	3,545	71	01:23
Stadium + Arena (30 minute offset)	9,020	6,625	135	03:00
Stadium + Arena (simultaneous)	9,020	7,275	145	03:00

Table 02: Maximum queues at the Metrolink westbound service post event.

The following pages show the worst-case scenario queue builds up (Stadium and Arena simultaneous egress) considering walking times and how many passengers waiting to access the Metrolink westbound service will require additional queuing space.

METROLINK WESTBOUND SERVICE | PEAK PASSENGER QUEUES

Queue sizes have been extracted from the SENSE model (assuming free flowing conditions and considering walking times). The graph below shows the peak queue sizes for the Stadium and Arena Simultaneous Hard Egress (Scenario 5b). It should be noted that the queue space capacity available assumes that the new area between the Metrolink westbound service and Forge Lane Bridge is available for use.

For scenarios where the Stadium and the Arena are in operation, additional queue space will need to be provided to accommodate up to 6,910 people (based on current planning assumptions). In general terms, **an additional 1,060 m² will need to be provided, at minimum.**

Queue Size over Time vs Queue Capacity

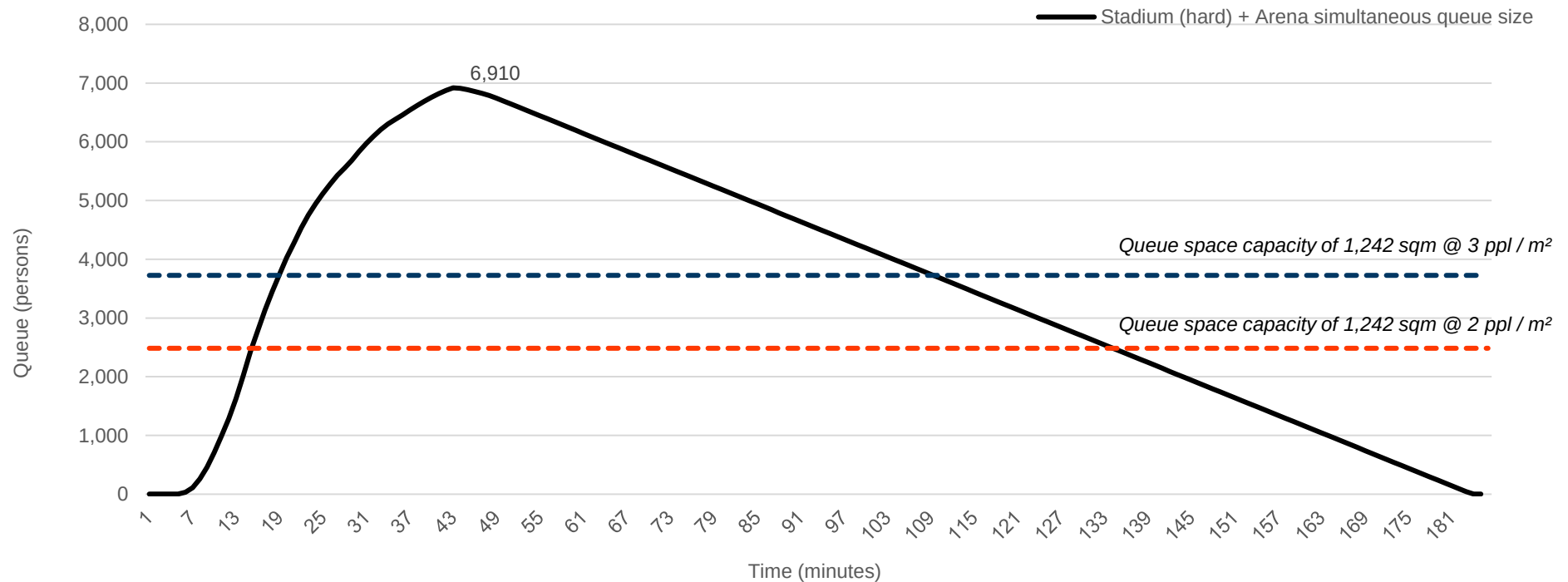


Figure 07: Queue size over time versus queue capacity

METROLINK WESTBOUND | AVAILABLE QUEUING AREAS

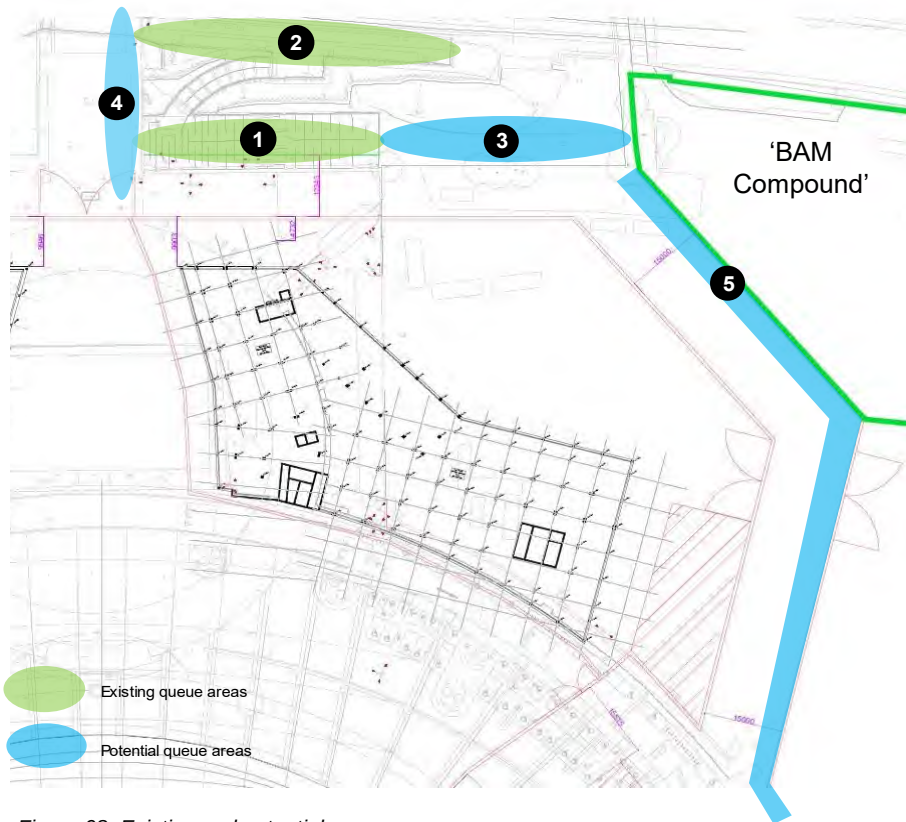


Figure 08: Existing and potential queue areas

Potential locations for overflow queue areas on the approach to the Metrolink westbound service have been explored based on the existing infrastructure, proposed construction hoarding and forecast spectator flows post event (detailed on the following page).

Existing queue areas are as follows:

1. **Existing westbound queue area (~500m²)**
2. **Existing westbound platform (~320m²)**

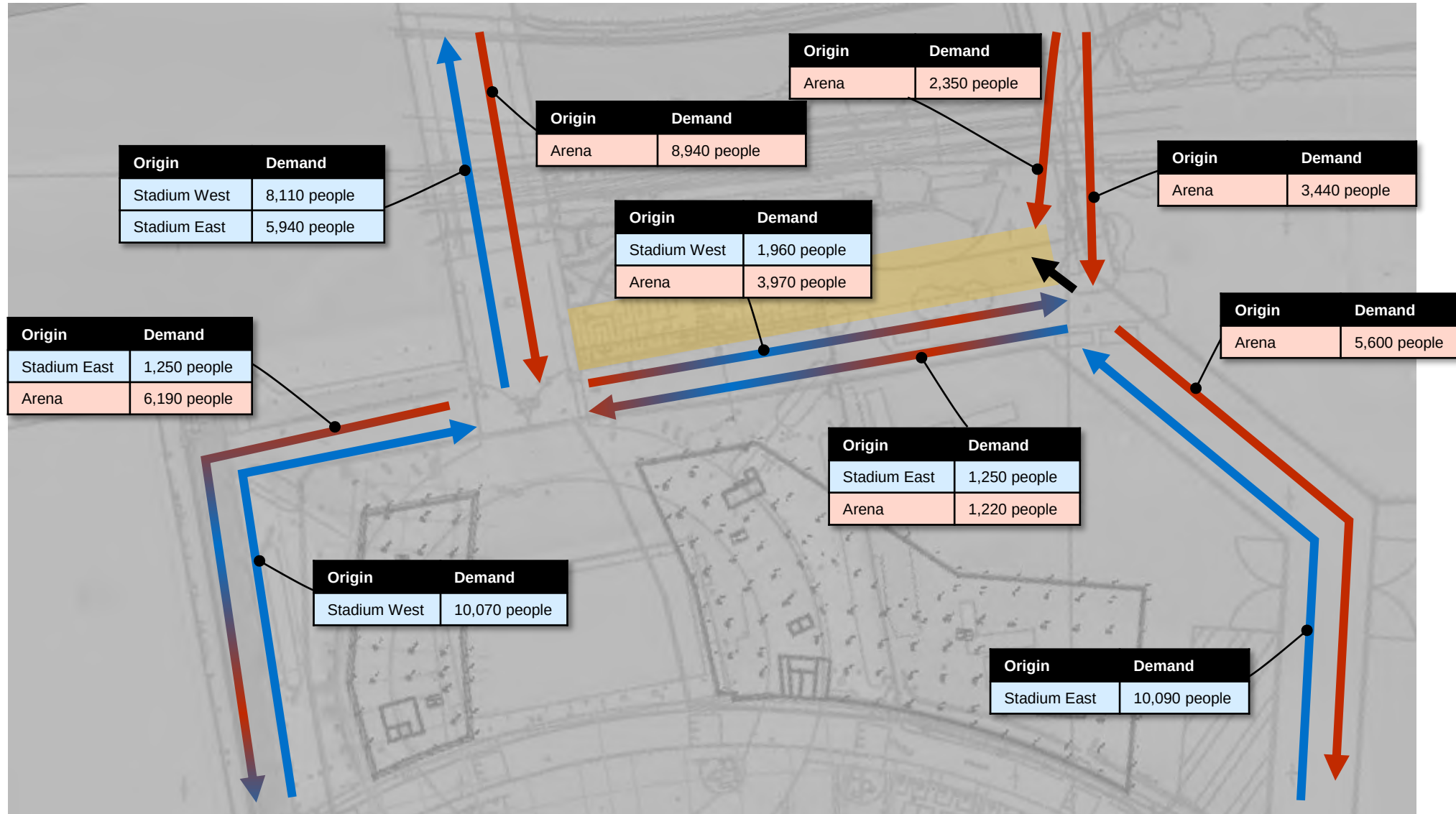
Other possible queue management opportunities are:

3. **New westbound queue area (~422m²)**. This area is assumed to be available as part of the departure operation.
4. **Potential overflow queue space along Joe Mercer Way**. CFGL have advised that queuing on approach to the Metrolink along JMW has been successfully deployed at previous events.
5. **Potential overflow queue space in the eastern corridor**. Any spare capacity along this route (and closer to Exit C) could be used as queueing space.

Queue areas that have not been considered include:

- **'BAM compound'**. This area may be re-purposed at different stages of the construction phase. For planning purposes, it has been assumed that it is not available.
- **Arena podium**. Spectators will be managed on departure from the Arena across Forge Lane Bridge. Any holding area available has not been considered as part of this study.

SPECTATOR DEMAND | STADIUM + ARENA (30 MINUTE OFFSET)



METROLINK WESTBOUND | FLOWS EASTERN ROUTES

The SENSE model was interrogated to obtain maximum flows at each of the proposed queue locations when the Stadium and Arena are in operation

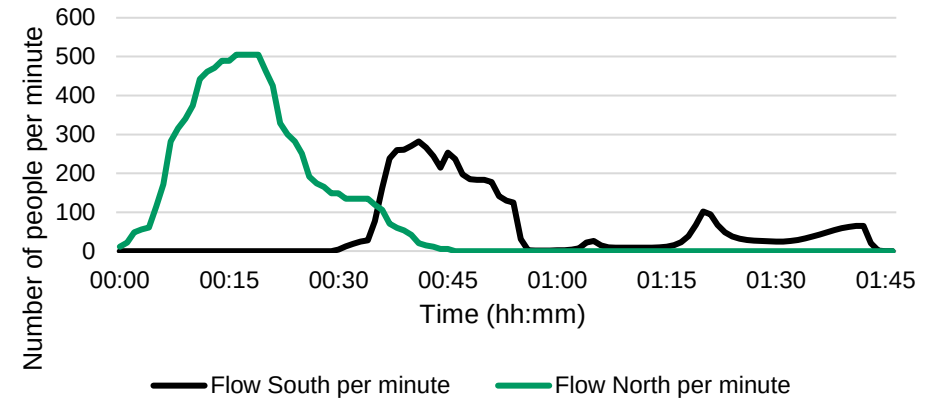
When there is a 30 minute offset, the peaks flows do not coincide. This results in a maximum flow of 504 people per minute. This requires a minimum width of 7.8 metres, leaving 7.2 metres available for queuing.

For simultaneous egress, the maximum flow of 869 people per minute requires a minimum width of 13.2 metres, leaving 1.8 metres available for queuing.

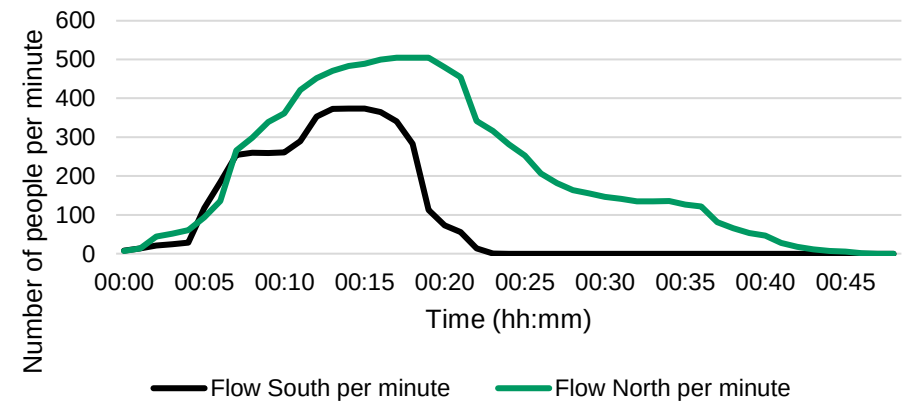


Figure 10: SENSE model pedestrian flow, east of compound

30 min offset egress



Simultaneous egress



METROLINK WESTBOUND | FLOWS JOE MERCER WAY

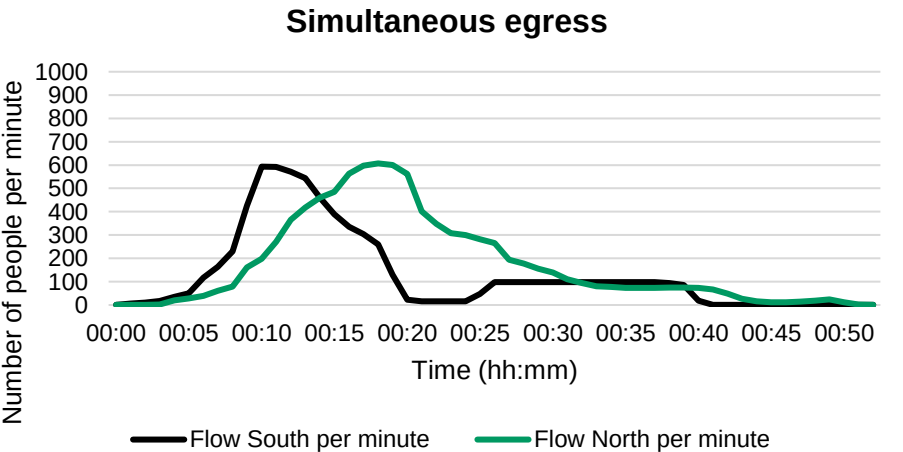
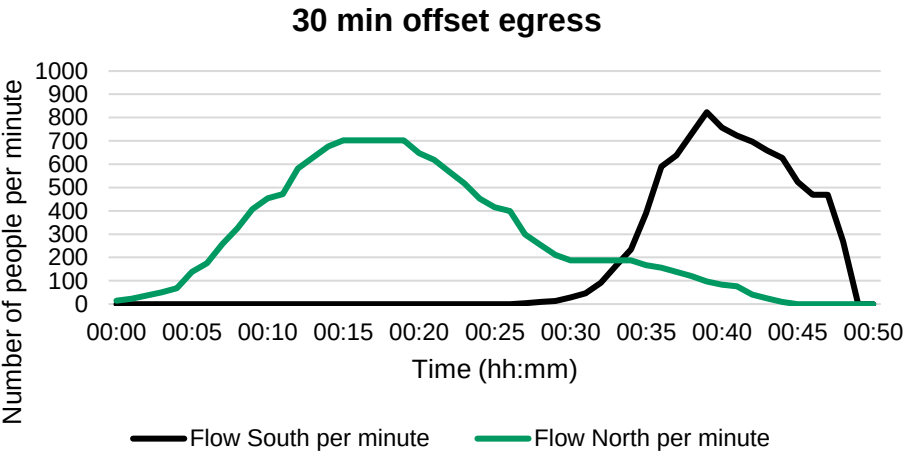
The SENSE model was interrogated to obtain maximum flows at each of the proposed queue locations when the Stadium and Arena are in operation

When there is a 30 minute offset, the peaks flows do not coincide. This results in a maximum flow of 912 people per minute. This requires a minimum width of 14.2 metres, leaving 5.8 metres available for queuing.

For simultaneous egress, the maximum flow of 963 people per minute requires a minimum width of 14.6 metres, leaving 5.4 metres available for queuing.



Figure 11: SENSE model pedestrian flow, Joe Mercer Way



METROLINK WESTBOUND | FLOWS NORTH EAST

The SENSE model was interrogated to obtain maximum flows at each of the proposed queue locations when the Stadium and Arena are in operation

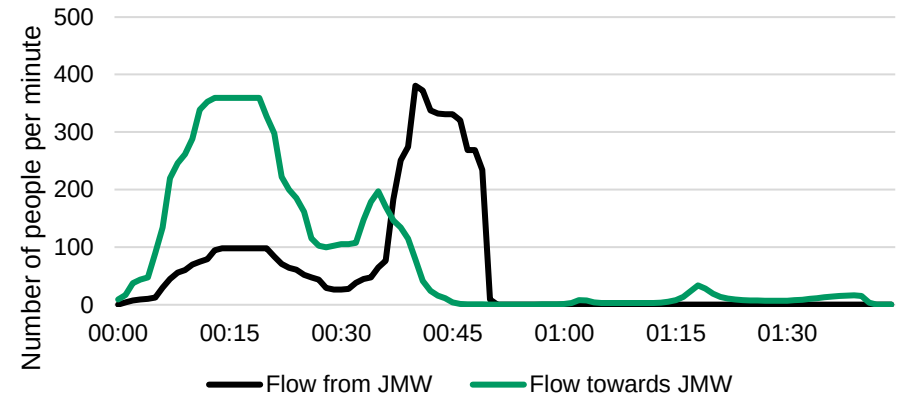
When there is a 30 minute offset, the peaks flows do not coincide. This results in a maximum flow of 458 people per minute. This requires a minimum width of 7.0 metres, leaving 5.3 metres available for queuing.

For simultaneous egress, the maximum flow of 713 people per minute requires a minimum width of 10.8 metres, leaving 1.5 metres available for queuing.

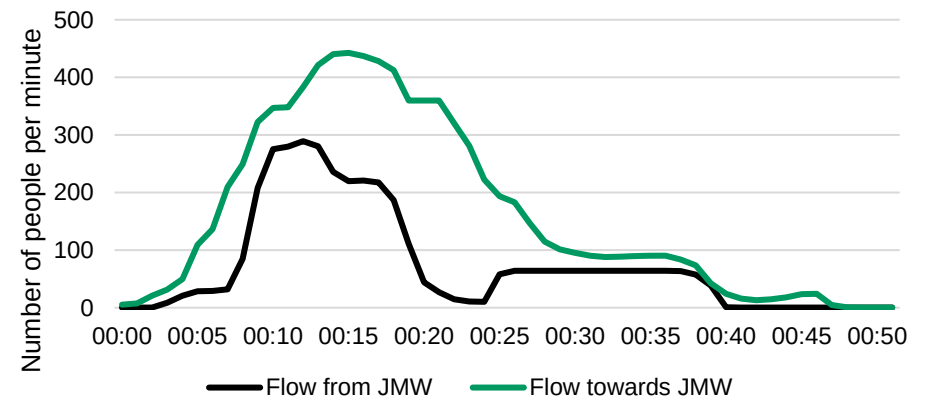


Figure 12: SENSE model pedestrian flow, north of compound

30 min offset egress (Normal Operations)



Simultaneous Egress (Special Operations)



METROLINK WESTBOUND | POTENTIAL QUEUE AREAS

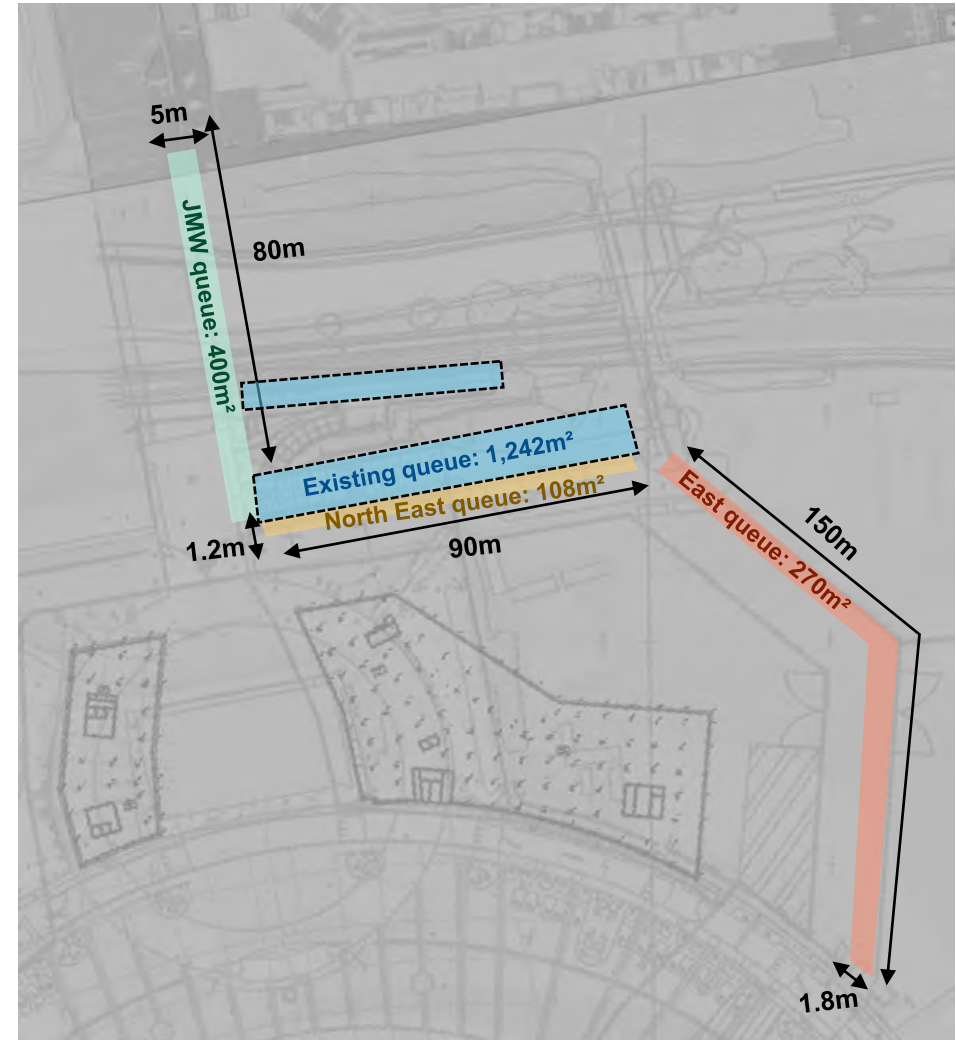
Figure 13: Potential queue areas

The adjacent figure presents potential queuing areas, based on the SENSE modelling outputs:

- Provision of a 1.8 metre **queue area** on the eastern side of the construction compound may provide at least 270 m² of queue area. Additional queue area could also be provided to the south of the corridor (by Turnstile C).
- Provision of a 5 metre **queue area** on Joe Mercer way may provide approximately 400 m² of queue area.
- Provision of a 1.2 metre **queue area** to the south of the Metrolink westbound service may provide approximately 108 m² of queue area. Whilst there may be capacity available along this route, this may not be a desirable location for a queue due to the high level of demand along it.

The above areas total 778 m² of queue area. If required, the remaining 223 m² of queue area could be provided to the south of the East queue without affecting crowd circulation at that location.

It is also important to note that the Arena will have their own queue management operations in place for spectators accessing Forge Lane Bridge. That space has not considered as part of the queue area available.



METROLINK WESTBOUND | CONCEPT OF OPERATION

The adjacent figure presents a high level concept of operation for the Metrolink westbound queue areas.

Stadium spectators arriving from the west and Arena spectators emerging onto Joe Mercer Way, looking to access the Metrolink westbound service, could be directed to the queue area on Joe Mercer Way.

Stadium spectators arriving from the south, looking to access the Metrolink westbound service, could be directed to a queue area on the east side of the construction compound. An overflow queue area would also be available to the south of construction compound, if required.

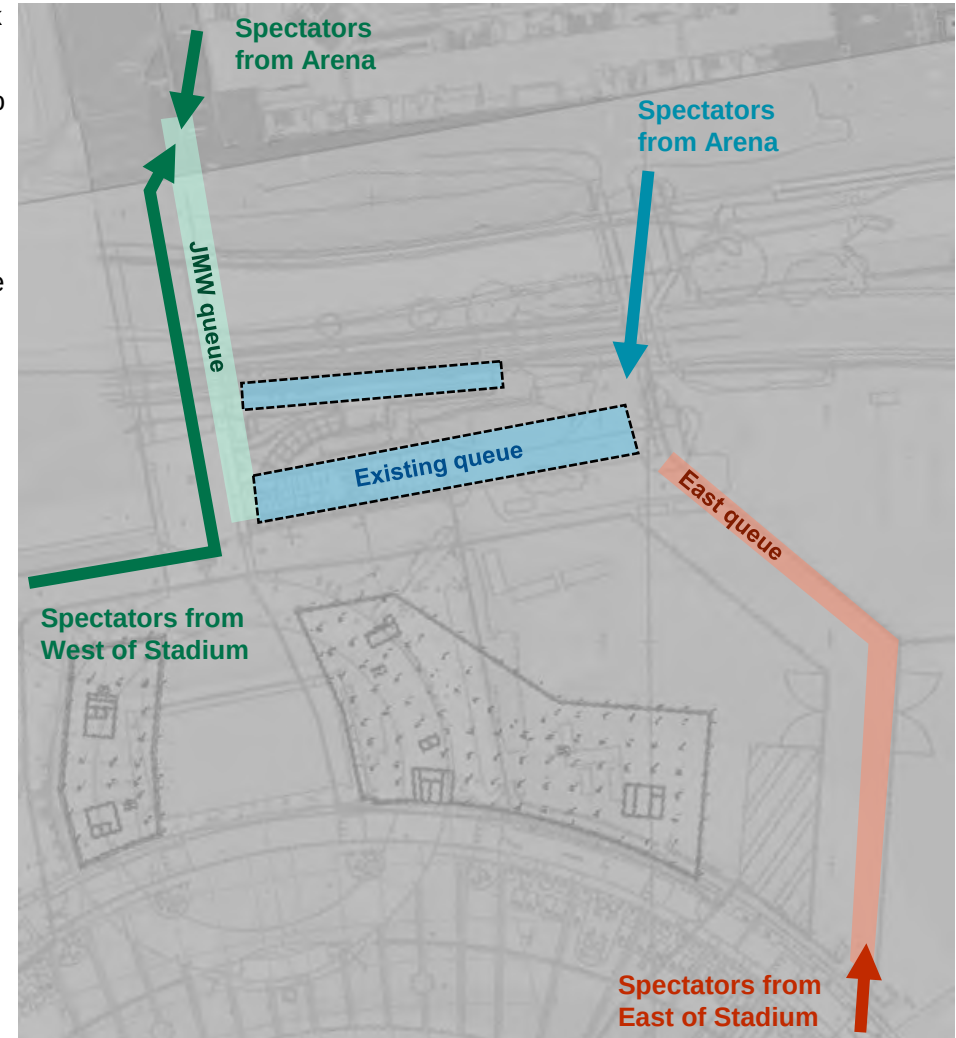
Arena spectators arriving via Forge Lane Bridge would be need to be managed on as they leave the Arena, on Forge Lane Bridge and/or on access to the Metrolink westbound queue area.

Stop & Hold operations would likely be required to manage access to the Metrolink westbound service and Arena spectator demand travelling southbound from Forge Lane Bridge.

It should be noted that this concept of operation **does not** consider in detail the impact the above changes would have on spectator circulation patterns and/or how the queue areas would interface with the Stadium, Arena or Metrolink operations.

This operation would require the Stadium, the Arena and the Metrolink operations to work together.

Figure 14: Proposed concept of operation



06 FUTURE STAGES OF CONSTRUCTION

FUTURE DESIGN CHANGES

Completion of the Commercial Building (west side of construction compound)

During the construction phase, there is potentially a period when the Commercial Building will be completed but City Square (between the Commercial Building and the Hotel Building) will not be available as a pedestrian route (as it will be when the North Stand has been constructed). At that stage, the outer ring road (connecting the west side to the east side of the Etihad Stadium) will be available.

Based on current planning assumptions, the minimum widths presented in this document are to be maintained throughout the construction phase.

Changes to the pedestrian route on the east side of the Hotel Building (east side of construction compound)

During the construction phase, there is potentially a period when the pedestrian route on the east side of the Hotel Building (by the Metrolink westbound service) will change in shape. Based on current planning assumptions, the minimum widths presented in this document are to be maintained throughout the construction phase.

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