

REPORT

Castlefield Viaduct, Manchester

Initial Flood Risk Appraisal

Client: National Trust

Reference: PC2387-RHD-ZZ-XX-RP-Z-003

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Date: 26 April 2021

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Table of Contents

Contents

1	Introduction	1
2	Site Description and Location	2
2.1	Site Location	2
2.2	Existing Site Description	3
2.3	Proposed Site Description	3
2.4	Site Topography	3
3	Environment Agency Flood Zones and Development Suitability	6
3.1	Environment Agency Flood Map for Planning	6
3.2	Vulnerability Classification	7
3.3	Consideration of the Sequential Test	7
4	Flood Risk Appraisal	9
4.1	Phase 1 Pilot 'Micro Park' Scheme	9
4.1.1	Fluvial Risk	9
4.1.2	Surface Water (Pluvial) Risk	10
4.1.3	Groundwater Risk	11
4.1.4	Flood Risk from Sewers	12
4.1.5	Residual Risk	12
4.1.6	Off-site Impacts	13
4.1.7	Flood Risk Management Measures	13
4.1.8	Safe Access and Egress	13
4.1.9	Summary of Flooding to Phase 1 Pilot 'Micro Park' Scheme	14
4.2	Phase 2 Permanent Urban Park and Travel Hub Scheme	15
4.2.1	Fluvial Risk	15
4.2.2	Surface Water (Pluvial) Risk	16
4.2.3	Groundwater Flooding Risk	18
4.2.4	Flood Risk from Sewers	18
4.2.5	Residual Risk	18
4.2.6	Off-site Impacts	19
4.2.7	Flood Risk Management Measures	19
4.2.8	Safe Access and Egress	20
4.2.9	Summary of Flooding to Phase 2 Permanent Scheme	22
5	Conclusions	24

Table of Tables

Table 3-1: Flood Risk Vulnerability and Flood Zone ‘Compatibility’ (NPPF, Table 3)	8
Table 4-1: Maximum Undefended Modelled Flood Levels (Source: Environment Agency)	10
Table 4-2: Summary of Flood Risk to the Pilot Scheme	14
Table 4-3: Maximum Undefended Modelled Flood Levels (Source: Environment Agency)	15
Table 4-4: Maximum Undefended Flood Depths (Calculation: Depths = Modelled Flood Levels – Average Topographic Level)	15
Table 4-5: Estimated Hazard Rating	21
Table 4-6: Summary of Flood Risk to the Permanent Scheme	22

Table of Figures

Figure 2-1: Location of Castlefield Viaduct in Manchester (Source: Historic England)	2
Figure 2-2: Satellite Imagery of Castlefield Viaduct (Source: Twelve Architects Masterplanners)	2
Figure 2-3: Proposed Site Layout (Source: Twelve Architects Masterplanners)	3
Figure 2-4: 25cm Resolution Digital Surface Model (Source: Environment Agency)	4
Figure 2-5: 25cm Resolution Digital Surface Model (Source: Environment Agency)	5
Figure 3-1: Flood Map for Planning (Source: Environment Agency)	7
Figure 4-1: In-Channel 1D Model Node Locations (Source: Environment Agency)	9
Figure 4-2: Risk of Surface Water Flooding Map (Source: Environment Agency)	11
Figure 4-3: Susceptibility to Groundwater Flooding (Source: BGS)	12
Figure 4-4: Flood Risk from Reservoir Failure Map (Source: Environment Agency)	13
Figure 4-5: Recorded Historic Flood Outline Mapping (Source: Environment Agency)	16
Figure 4-6: EA 1 in 30 Year RoFSW Flood Depth and Flood Extent Map (Source: Environment Agency)	16
Figure 4-7: EA 1 in 100 Year RoFSW Flood Depth and Flood Extent Map (Source: Environment Agency)	17
Figure 4-8: EA 1 in 1,000 Year RoFSW Flood Depth and Flood Extent Map (Source: Environment Agency)	17
Figure 4-9: Flood Risk from Reservoir Failure Map (Source: Environment Agency)	19
Figure 4-10: FD2320 Flood Hazard Matrix (Calculation: Hazard Rating = Depth x (Velocity + 0.5) x Debris Factor)	20
Figure 4-11: Flood Hazard Data from Surface Water Sources for the 1 in 1,000 Year Rainfall Event (Source: Environment Agency)	22

Appendices

Appendix A – Site Plans

Appendix B – Environment Agency Product 4 Data Package

1 Introduction

Royal HaskoningDHV was commissioned in March 2021, by the National Trust, to carry out a Flood Risk Appraisal for Castlefield Viaduct, Manchester, M3 4RU. The appraisal will inform proposals to develop the currently unused historic viaduct structure into an elevated urban park with integrated active travel hub.

It is proposed that the existing viaduct is to be repurposed to create a green urban park destination. This will, in turn, create local access to nature and green space, a new community amenity area and elevated walkway fitting into the wider strategic plans for Manchester. The proposed scheme is to be achieved whilst respecting the heritage fabric of the Grade II Listed structure and the surrounding area.

It is understood that the proposed re-development is to be initially piloted over the Summer of 2021 (Phase 1) prior to further appraisal and a longer term 'permanent urban park and travel hub scheme' (Phase 2) from 2022 onwards. The Phase 1 Pilot scheme will utilise the existing access from Deansgate-Castlefield car park located to the east of the viaduct. Future proposals are likely to feature an elevated walkway that can be accessed from the canal tow path beneath the viaduct.

Accordingly, this Flood Risk Appraisal has been structured to assess the risk of flooding to the site at each of the potential design phases, which have been referenced as:

- Phase 1 pilot 'micro park' scheme - This is to feature the existing access from Deansgate-Castlefield car park; and
- Phase 2 'permanent urban park and travel hub scheme' - This is to feature a proposed elevated walkway connecting the viaduct with the canal tow path beneath.

This document includes a review of detailed flood risk data available for the site, which has been obtained from the Environment Agency.

Consideration is also given to the National Planning Policy Framework (2019) (NPPF¹), Planning Practice Guidance (PPG) for Flood Risk and Coastal Change² and the Environment Agency's Climate Change Allowance³ guidance. The Climate Change Allowance guidance sets out the Environment Agency's recommended climate change allowances for development, when considering flood risk and coastal change for planning purposes.

¹ National Planning Policy Framework, Flood Risk and Coastal Change. Ministry of Housing, Communities & Local Government (Last updated 19/06/2019) <https://www.gov.uk/government/publications/national-planning-policy-framework--2> (Accessed 31/03/2021)

² Planning Practice Guidance for Flood Risk and Coastal Change. Ministry of Housing, Communities & Local Government (Last updated 06/03/2014) <https://www.gov.uk/guidance/flood-risk-and-coastal-change#site-specific-flood-risk-assessment-all> (accessed 31/03/2021)

³ Flood risk assessments: climate change allowances. Environment Agency (Last updated 22/07/2020) – <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>, (Accessed 31/03/2021)

2 Site Description and Location

2.1 Site Location

The site comprises a disused railway viaduct, known as Castlefield Viaduct, that is located at Grid Reference SJ 830976 (Figure 2-1 and Figure 2-2). The viaduct is elevated above the surrounding area and currently, the site can be accessed from Deansgate-Castlefield car park at the eastern boundary of the site. The River Medlock joins the Bridgewater Canal at a point approximately 250 west of site.

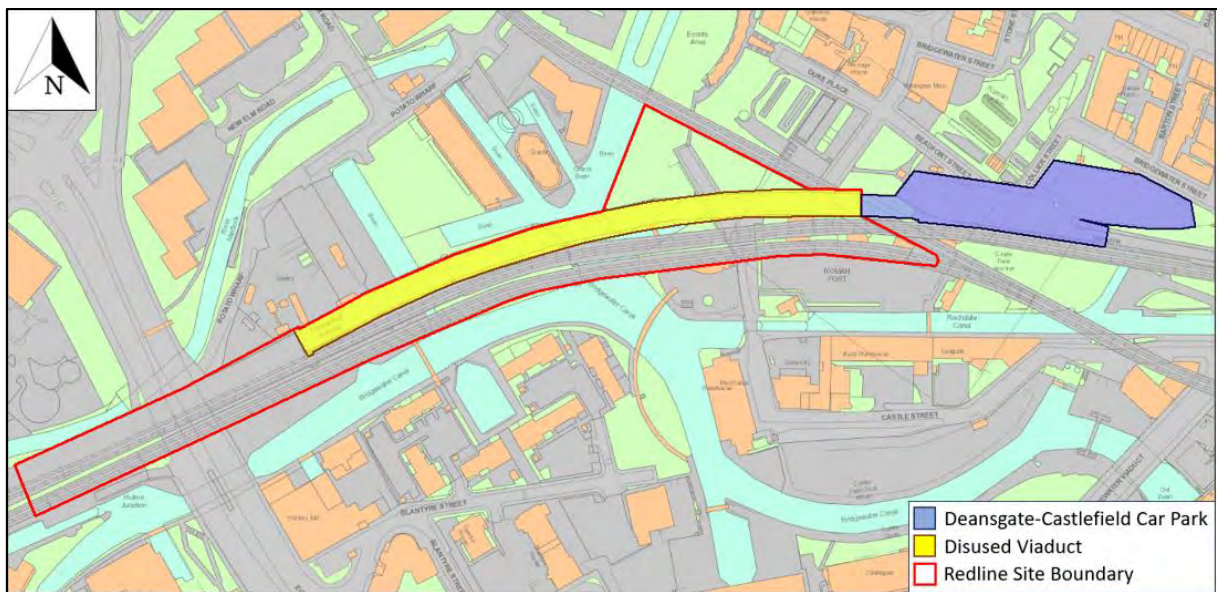


Figure 2-1: Location of Castlefield Viaduct in Manchester (Source: Historic England)



Figure 2-2: Satellite Imagery of Castlefield Viaduct (Source: Twelve Architects Masterplanners)

2.2 Existing Site Description

Castlefield Viaduct is a Victorian railway viaduct built in 1893. The viaduct is raised off the ground by approximately 15m. It is constructed predominantly of wrought iron/ steel and has decorative castellations along its length. It is Grade II Listed and currently disused. The viaduct is approximately 675m² in footprint and is currently accessed from the Deansgate-Castlefield car park to the east.

2.3 Proposed Site Description

It is proposed that the viaduct is to be re-developed to create a green urban park and travel hub. This will, in turn, create local access to nature and greenspace, a new community amenity area and an elevated walkway fitting into the wider strategic plans for Manchester (see Figure 2-3).

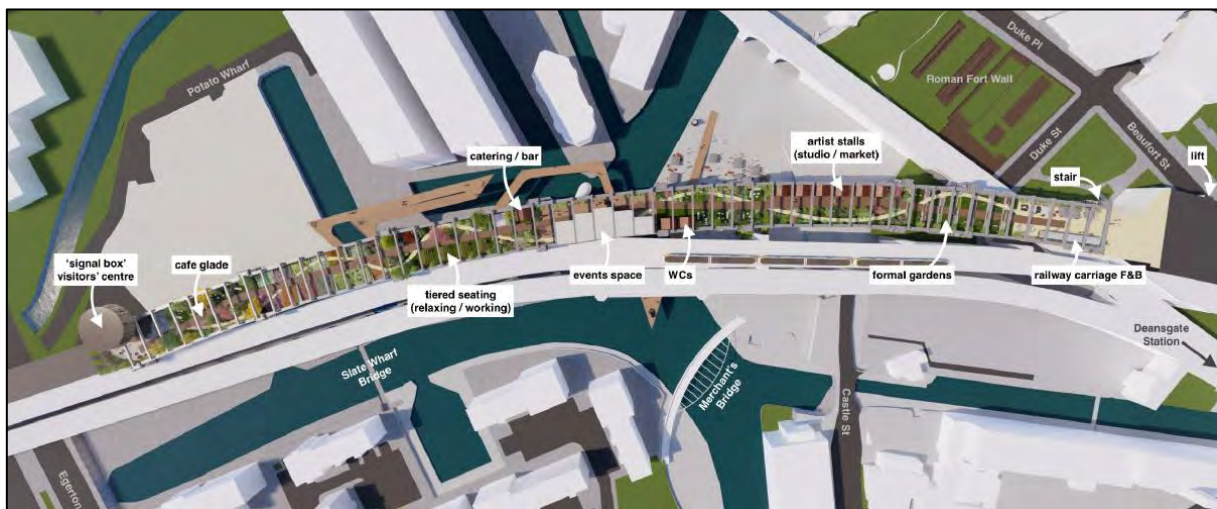


Figure 2-3: Proposed Site Layout (Source: Twelve Architects Masterplanners)

2.4 Site Topography

Topographic levels have been assessed at the site using Open Source 25cm resolution LiDAR data (Source: Environment Agency) and is presented for the site in Figure 2-4.

As the site is in an urban area and elevated above the surrounding area a review of the available LiDAR data confirmed that it is necessary to use the unfiltered Digital Surface Model data rather than the filtered Digital Terrain Model data, which removes buildings and other objects, and as a result in this location removes the definition of the viaduct.



Figure 2-4: 25cm Resolution Digital Surface Model (Source: Environment Agency)

Following reviews of the LiDAR data, the existing levels across the viaduct were found to range from approximately 40.55mAOD to 43.50mAOD. Levels rise from west to east, towards the Deansgate-Castlefield car park. Levels at the car park range from between approximately 43.50mAOD and 44.20mAOD.

It is important to note that the existing viaduct is raised approximately 15m above the canal tow path that is located beneath.

It is proposed that as part of the future design, an elevated walkway would be constructed and accessed from the canal tow path. Ground levels within this area range from approximately 25.50mAOD to 26.50mAOD. Where access would be gained to the proposed elevated walkway, the Digital Surface Model indicates an average ground level of approximately 25.70mAOD. A summary of ground levels across the access point to the walkway are provided in Figure 2-5.

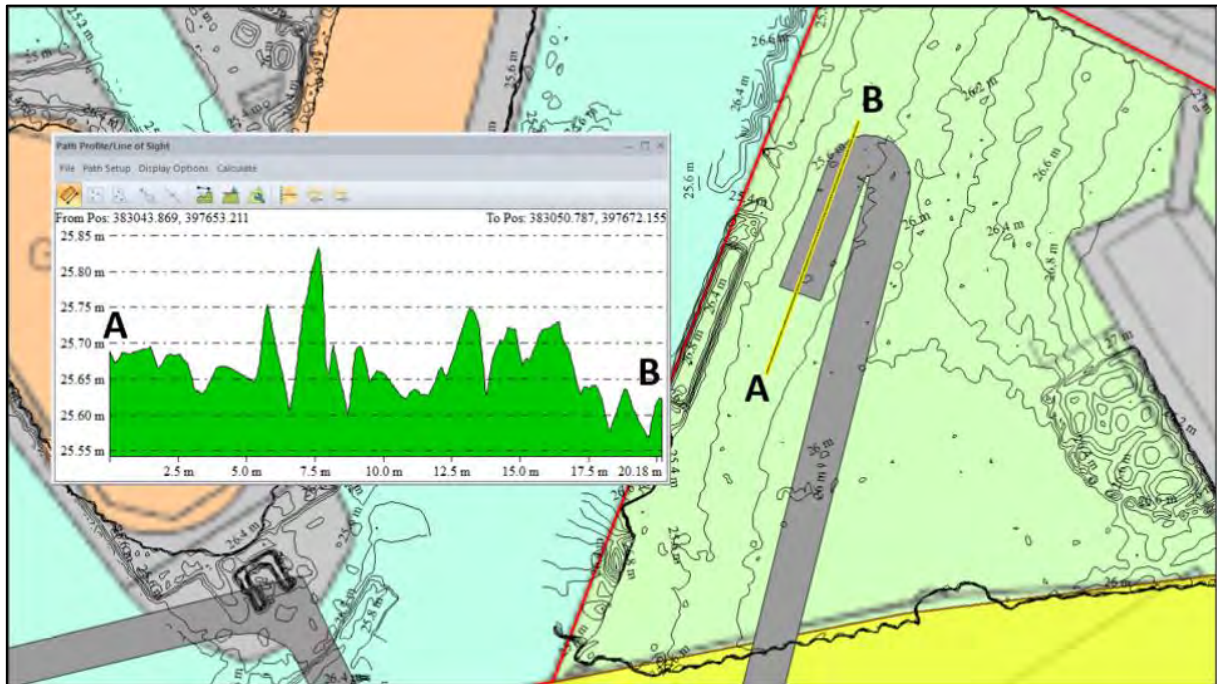


Figure 2-5: 25cm Resolution Digital Surface Model (Source: Environment Agency)

3 Environment Agency Flood Zones and Development Suitability

3.1 Environment Agency Flood Map for Planning

To inform this initial Flood Risk Appraisal a request for the Product 4 and 5 data packages was submitted to the Environment Agency on 15th March 2021. Information in relation to the data request was provided by the Environment Agency on 29th March 2021.

Following a review of the data package and specifically the Environment Agency Flood Map for Planning (Figure 3-1), the site is shown to be primarily located within Flood Zone 2, although there are areas at the western and eastern extent which are shown as being located in Flood Zone 1.

The Environment Agency's Flood Zones are defined as follows:

- Flood Zone 1 = Land at less than a 0.1% annual risk of river or sea flooding in any given year;
- Flood Zone 2 = Land at greater than a 0.1% annual risk, but less than a 1% annual risk of flooding from river sources in any year, and/or less than a 0.5% annual risk of flooding from seas in any given year; and,
- Flood Zone 3 = Land at greater than a 1% annual risk of flooding from river sources or greater than a 0.5% annual risk of flooding from seas in any given year.

It is important to note that the flood zone classification in this location is based on the modelling representing the ground levels beneath the exiting viaduct and that the viaduct is elevated 15m above the canal tow path beneath it. This assessment of flood risk is discussed further in Section 4 of this Flood Risk Appraisal.

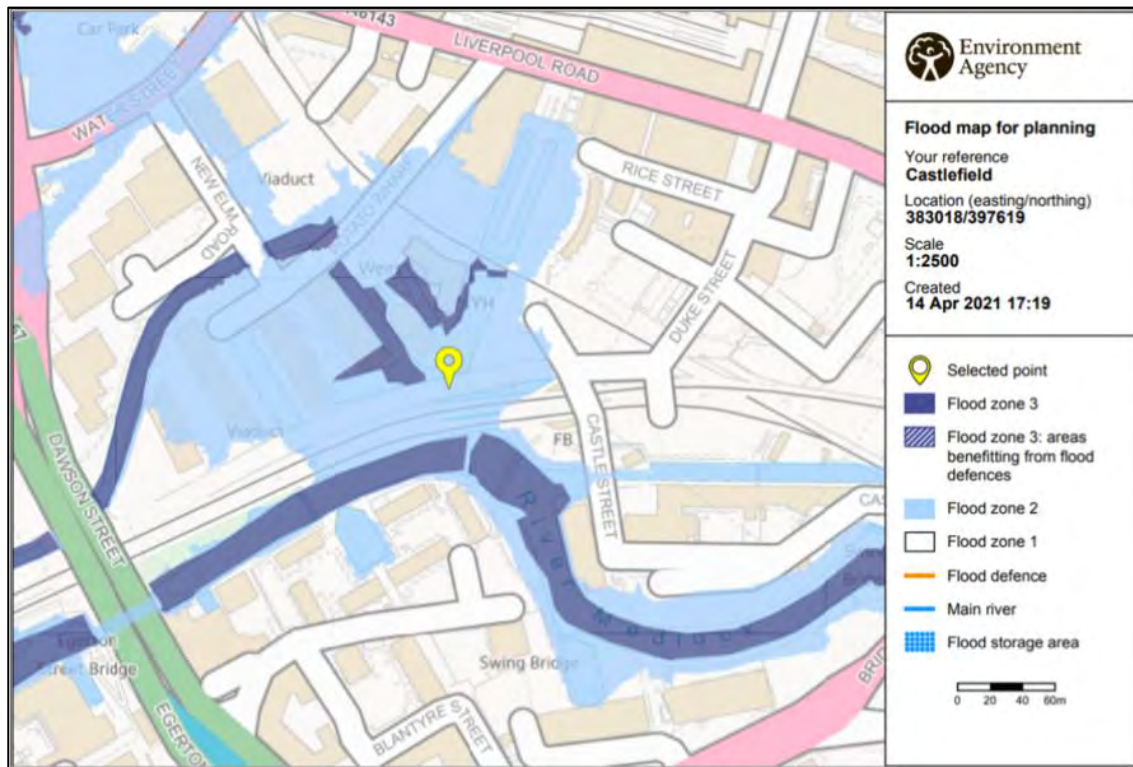


Figure 3-1: Flood Map for Planning (Source: Environment Agency)

3.2 Vulnerability Classification

With reference to the National Planning Policy Framework vulnerability classification guidelines, the proposed re-development at Castlefield Viaduct could be considered as both 'Water Compatible' and 'Less Vulnerable'.

For the Phase 1 Pilot 'micro park' scheme it is considered that the use would be limited to 'Water Compatible' uses as it would be limited to use as amenity open space only.

The 'Less Vulnerable' uses would be associated with the future proposals (Phase 2) 'Permanent urban park and travel hub scheme' for the site to feature a café, as well as the urban park comprising uses which may fall under the category 'assembly and leisure'.

3.3 Consideration of the Sequential Test

Under the NPPF, all new planning applications should undergo a Sequential Test. This test should be implemented by local planning authorities with a view to locating particularly vulnerable new developments (e.g. residential, hospitals etc.) outside of the floodplain.

The Flood Risk and Coastal Change Planning Practice Guidance (PPG) Sequential Test: Flood Risk Vulnerability and Flood Zone 'Compatibility' Table is reproduced in Table 3-1 below.

Table 3-1: Flood Risk Vulnerability and Flood Zone 'Compatibility' (NPPF, Table 3)

Flood Risk Vulnerability classification (see Table 2)		Essential Infrastructure	Water compatible	Highly vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test required	✓	✓
	Zone 3	Exception Test required	✓	✗	Exception Test required	✓
	Zone 3b 'Functional Floodplain'	Exception Test required	✓	✗	✗	✗

Key:

✓ Development is appropriate

✗ Development should not be permitted

During the Phase 1 Pilot 'micro park' scheme the proposed re-development of Castlefield Viaduct would create a green urban park destination that could be considered primarily a 'Water Compatible' development.

The longer term plans (Phase 2) 'permanent urban park and travel hub scheme' are likely to introduce some uses that could be classified as 'Less Vulnerable' development under the NPPF and the Flood Risk and Coastal Change PPG.

Based on the Environment Agency's Flood Map for Planning (Figure 3-1), the site is partially located in Flood Zone 1 and partially located in Flood Zone 2.

With reference to Table 3-1, the proposed re-development in both Phase 1 and Phase 2 would be considered appropriate within either Flood Zone 1 or Flood Zone 2.

As is noted in subsequent sections of this Flood Risk Appraisal the site is elevated above the flood risk and therefore is not directly located within the flood extent. The Flood Zone 2 extent in this location is considered to be representative of the potential extent of fluvial flooding from the River Medlock for the 1 in 1,000 year flood event.

The proposed re-development of Castlefield Viaduct relates to the structure that spans across the watercourses beneath and is situated at an elevation that is a minimum of 15m above the watercourses. Subsequently, the existing viaduct is at low risk of fluvial flooding and would be considered to pass the Sequential Test should this be submitted to the Local Planning Authority.

4 Flood Risk Appraisal

This Flood Risk Appraisal has been structured to assess the risk of flooding to the site at each design phase, which have been referenced as:

- Phase 1 Pilot / 'micro park' scheme
 - o This is to feature the existing access from Deansgate-Castlefield Car Park; and,
- Phase 2 'Permanent urban park and travel hub scheme'
 - o This is to feature a proposed elevated walkway connecting the viaduct with the canal tow path beneath.

4.1 Phase 1 Pilot 'Micro Park' Scheme

It is understood that the scheme is to be piloted initially over Summer 2021 with the existing access from Deansgate-Castlefield car park to be used for access onto and away from the site. This scheme does not include the potential proposals for an elevated walkway from the canal tow path below the viaduct.

4.1.1 Fluvial Risk

In the data package received on 29th March 2021 the Environment Agency provided maximum in-channel modelled flood levels at five in-channel model nodes (Figure 4-1). It was noted in the data package that the modelling data has been extracted from the Medlock Strategic Flood Risk Assessment (SFRA) published in 2011.

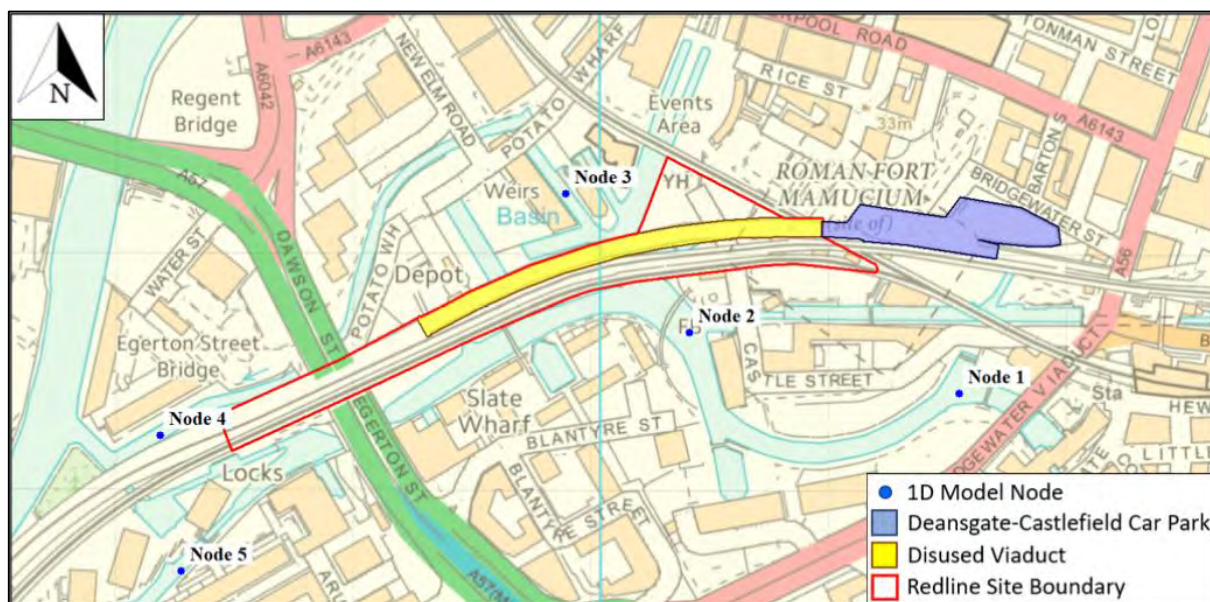


Figure 4-1: In-Channel 1D Model Node Locations (Source: Environment Agency)

The maximum undefended modelled flood levels have been reported at each model node for key return periods in Table 4-1. This includes the consideration of climate change and includes allowances for design events that include a +35% (Higher Central) and +70% (Upper End) uplift in peak flows for the 1 in 100 year event.

Table 4-1: Maximum Undefended Modelled Flood Levels (Source: Environment Agency)

Model Node	Maximum Undefended Modelled Flood Levels (mAOD)				
	4% AEP	1% AEP	1% AEP +35%CC	1% AEP +70%CC	0.1% AEP
Node 1	25.57	25.74	25.95	26.18	26.42
Node 2	25.53	25.70	25.92	26.16	26.35
Node 3	25.52	25.69	25.91	26.15	26.34
Node 4	23.56	23.64	23.76	23.84	24.15
Node 5	25.29	25.30	25.33	25.36	25.48

From Table 4-1 above, “Node 2” and “Node 3” are considered to be the closest nodes to the site and therefore provide the most representative, yet conservative, indication of fluvial flood risk.

The proposed re-development is for the disused viaduct that spans across the watercourses beneath. Following an assessment of the 25cm resolution topographic data at the disused viaduct, levels range from approximately 40.55mAOD to 43.50mAOD towards Deansgate-Castlefield car park. Levels at the car park range from between approximately 43.50mAOD and 44.20mAOD.

Subsequently, the site and existing access location is located approximately 13 – 17m above the maximum modelled flood level of 26.35mAOD for the 0.1% AEP event. The risk of fluvial flooding to the viaduct and the existing access for the Phase 1 Pilot / Temporary scheme can be considered to be **very low**.

4.1.2 Surface Water (Pluvial) Risk

The Environment Agency Flood Risk from Surface Water map (Figure 4-2) shows the majority of the site is within an area of ‘Very Low’ risk of flooding from surface water. Areas identified to be at ‘Very Low’ risk have a risk of flooding of less than 1 in 1000 (0.1%) from this source. The access on to the disused viaduct from the adjacent car park is also shown to be at ‘Very Low’ risk. The centre of the viaduct in Figure 4-2 is shown from the mapping to be at ‘Low’ risk.

The Environment Agency surface water flooding scenarios are indicative of the below definitions:

- High risk = Land that has greater than a 3.3% annual probability of flooding from surface water sources (indicative of the 1 in 30 year return period);
- Medium risk = Land that has between a 3.3% and 1% annual probability of flooding from surface water sources (indicative of the 1 in 100 year return period);
- Low risk = Land that has between a 1% and 0.1% annual probability of flooding from surface water sources (indicative of the 1 in 1,000 year return period); and,
- Very Low risk = Land that has less than a 0.1% annual probability of flooding from surface water.

As part of the Environment Agency’s modelling techniques for producing the 2013 Risk of Flooding from Surface Water (RoFSW) dataset, the “DTM was manually edited in over 91,000 locations to improve flow through ‘flyover’ features, such as rail/road embankment culverts and bridges¹” (Source: Environment Agency). Subsequently, it is understood that the DTM is likely to have been revised to remove the viaduct

¹ What is the Risk of Flooding from Surface Water Map (Last updated April 2019) – https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/842485/What-is-the-Risk-of-Flooding-from-Surface-Water-Map.pdf

that spans the River Medlock at this location so that it does not impede surface water flows over the land below.

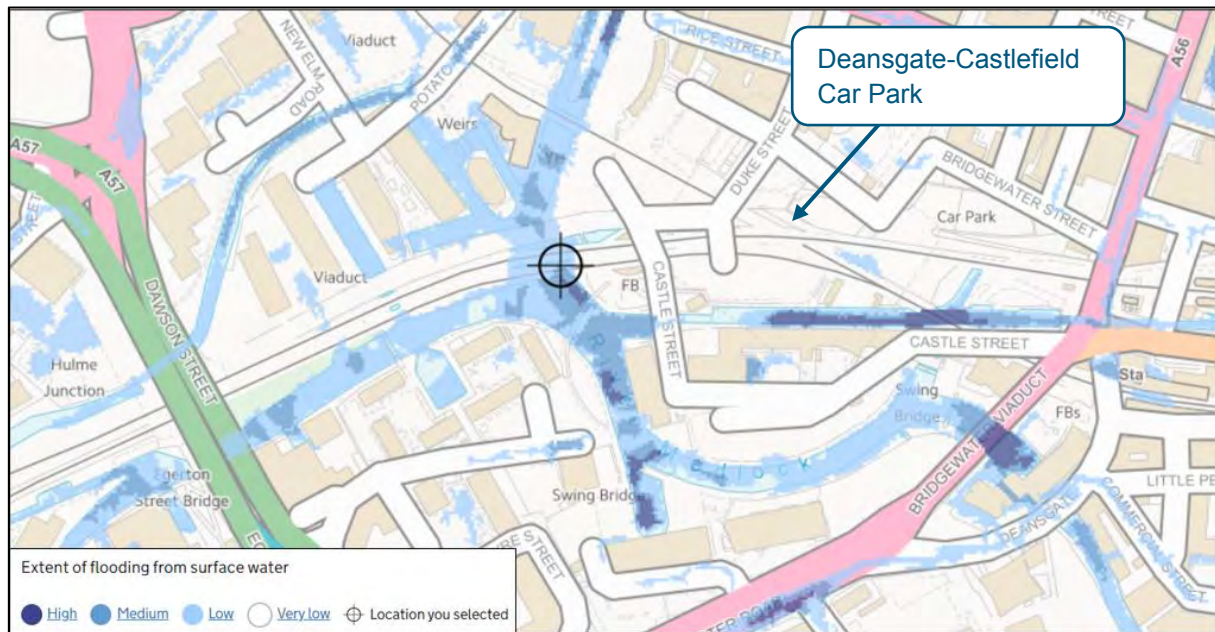


Figure 4-2: Risk of Surface Water Flooding Map (Source: Environment Agency)

As previously noted, the viaduct is set approximately 15m above the watercourse below and subsequently is not at risk of surface water flooding from overland flow beneath the structure. Furthermore, the existing access from the east (Deansgate-Castlefield car park), has been assessed as being topographically higher than the viaduct. Therefore, the car park is also unaffected by surface water flooding.

Subsequently, the risk of surface water flooding to the viaduct and the existing access for the Phase 1 Pilot / Temporary scheme' can be considered to be **very low**.

4.1.3 Groundwater Risk

The British Geological Survey (BGS) Geology of Britain Viewer indicates that the underlying bedrock is the Chester Formation, comprised of sandstone. This is considered by Defra to be a 'Principal' bedrock aquifer. These are layers of rock that have high intergranular permeability and are subsequently capable of supporting high level water storage. They are therefore capable of supporting water supply and river baseflow on a strategic scale.

No superficial deposits have been identified beneath the site through the BGS Geology of Britain Viewer. Furthermore, the site is not considered to be located within an Environment Agency Groundwater Source Protection Zone.

The BGS Susceptibility to Groundwater Flooding dataset indicates that the site is located within an area that is largely at 'limited potential for groundwater flooding to occur' (Figure 4-3).

Ultimately, the viaduct that is to be re-developed is built approximately 15m above the ground level and therefore the risk of groundwater flooding can be considered to be **very low**.

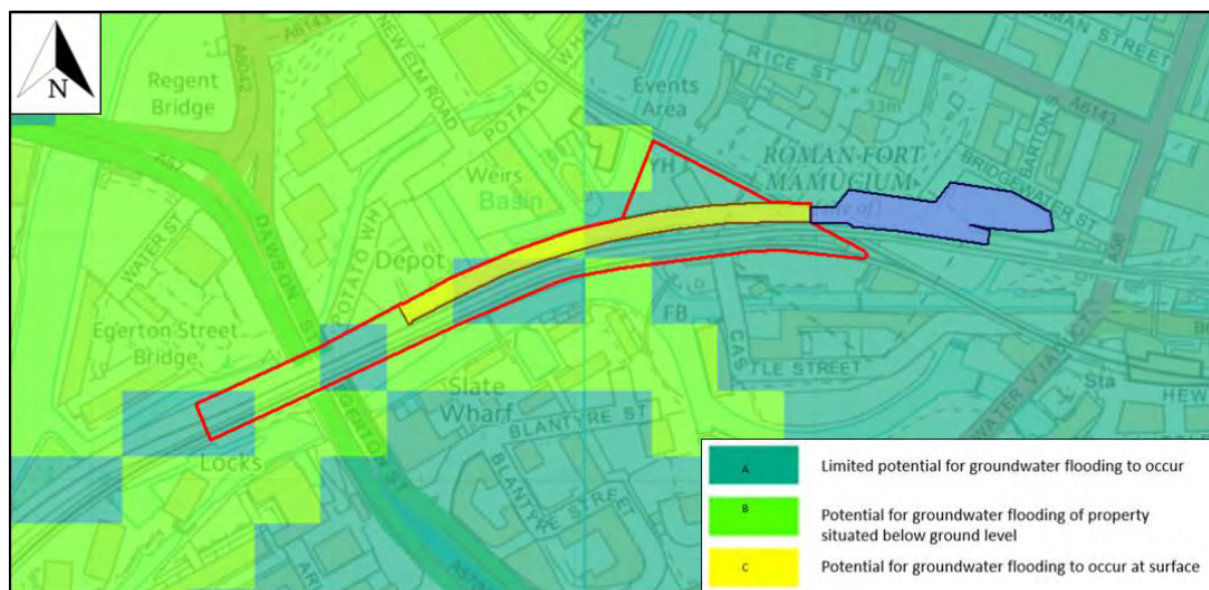


Figure 4-3: Susceptibility to Groundwater Flooding (Source: BGS)

4.1.4 Flood Risk from Sewers

The site currently features an existing disused viaduct and there is no existing sewer connection at the site. As a result, there is no history of flooding from this source to the site.

Furthermore, it is not anticipated that the future use of the site in the Phase 1 Pilot 'micro park' scheme will include a proposed sewer connection. Subsequently, the risk of flooding from sewers can be considered **very low**.

4.1.5 Residual Risk

Residual risks are those remaining after applying the sequential approach to the location of development and taking mitigating actions. Examples of residual flood risk include:

- the failure of flood management infrastructure such as a breach of a raised flood defence, blockage of a surface water conveyance system, overtopping of an upstream storage area, or failure of a pumped drainage system;
- failure of a reservoir; and,
- a severe flood event that exceeds a flood management design standard, such as a flood that overtops a raised flood defence, or an intense rainfall event which the drainage system cannot cope with.

4.1.5.1 Defence Breach

The Environment Agency has not provided information to indicate that the site benefits from the presence of fluvial defences. Furthermore, the site is located 15m above the nearest primary source of fluvial flooding. As such, the risk of flooding following a defence breach can be considered to be **very low**.

4.1.5.2 Canal Breach

A network of canals are located beneath the viaduct including the Bridgewater Canal and Rochdale Canal. The viaduct (and the existing access via Deansgate-Castlefield car park) has been built approximately 15m above the level of the canals and subsequently would not be affected if the canals were to fail.

4.1.5.3 Reservoir Failure

The Environment Agency Risk from Reservoir Flooding Map demonstrates that the site is located outside the flood extent in the event of reservoir flooding (Figure 4-4). Areas to the north of the viaduct could experience depths of between 0.3m and 2m during a reservoir failure event. However, as the viaduct (and existing access via Deansgate-Castlefield car park) are approximately 15m above the surrounding ground level and, subsequently, the risk of flooding following reservoir failure can be considered to be **very low**.

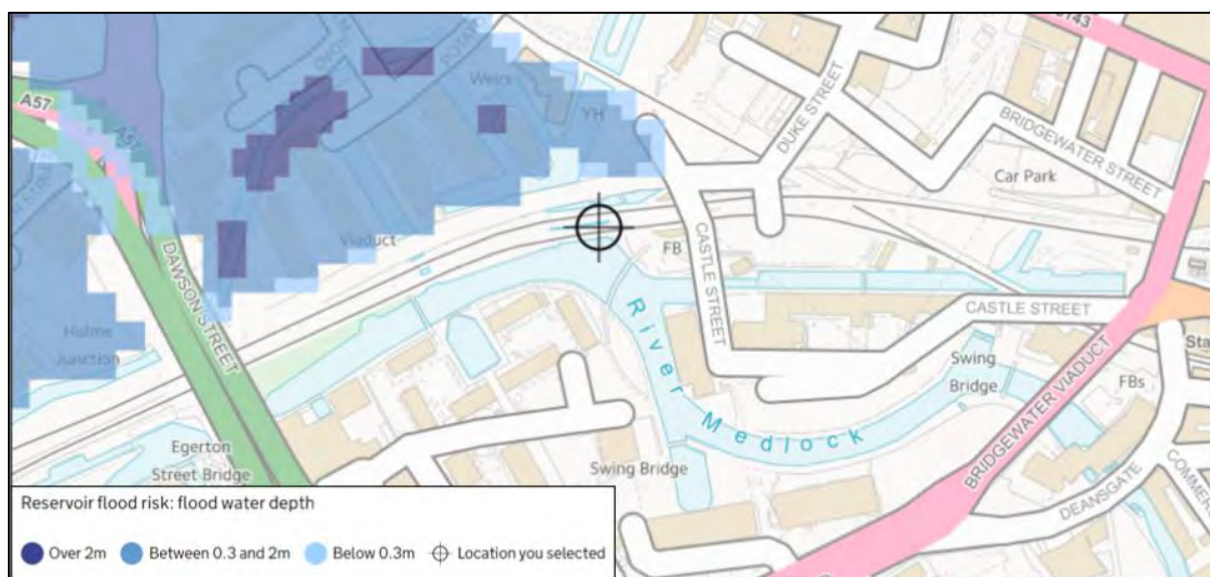


Figure 4-4: Flood Risk from Reservoir Failure Map (Source: Environment Agency)

4.1.6 Off-site Impacts

The proposed re-development of the existing disused semi-derelict viaduct is to create a green urban park destination.

As part of the Phase 1 Pilot / Temporary scheme, there is no increase in the built footprint or impermeable surface area. Access onto the viaduct will be achieved from the existing Deansgate-Castlefield car park to the east.

Given that there will be no increase in impermeable surface area or built footprint, and the site is at low risk of flooding from all sources, the Phase 1 Pilot 'micro park' scheme would not increase flood risk elsewhere.

Furthermore, a surface water drainage assessment is also being undertaken to assess the potential surface water runoff from the proposed Phase 1 Pilot 'micro park' (Ref. PC2387-RHD-ZZ-XX-RP-Z-0004).

4.1.7 Flood Risk Management Measures

Following a review of flood risk from all sources, the proposed Phase 1 Pilot 'micro park' scheme is considered to be at low risk of flooding. Subsequently, no flood risk management measures or mitigation measures are recommended for the proposed re-development.

4.1.8 Safe Access and Egress

The existing access to the viaduct is to be maintained for the Phase 1 Pilot scheme from the Deansgate-Castlefield car park. The car park is located a minimum of 15m above the surrounding ground level and is

situated above the viaduct. The car park is located wholly in Flood Zone 1 and therefore, safe access and egress can be maintained throughout the use of the viaduct for the Phase 1 Pilot scheme.

4.1.9 Summary of Flooding to Phase 1 Pilot 'Micro Park' Scheme

Numerous sources of data have been obtained and appraised within this Flood Risk Appraisal to determine the potential risk of flooding to and from the proposed re-development of the viaduct. Table 4-2 provides a summary of flood risk from each source to the pilot scheme.

Table 4-2: Summary of Flood Risk to the Pilot Scheme

Source of Flooding	Flood Risk	Chance of Flooding	Comments
Fluvial – River Medlock	Very Low	Levels at the viaduct range from between approximately 40.55mAOD and 43.50mAOD. The viaduct is located approximately 15m above the 0.1% AEP flood level of 26.35mAOD.	- No historic records of fluvial flooding at the viaduct - No historic records of fluvial flooding at access location (Deansgate-Castlefield car park).
Surface Water	Very Low	Access from Deansgate-Castlefield car park, as well as the viaduct itself, are shown to be wholly unaffected for all modelled surface water flood events.	Surface water modelling is likely to have revised the DTM to improve conveyance through structures. As a result, the viaduct appears to be affected by surface water on the Environment Agency mapping.
Groundwater	Very Low	The viaduct is located a minimum of 15m above the groundwater table.	BGS Susceptibility to Groundwater Flooding identifies the area as having 'Limited Potential for Groundwater Flooding'.
Sewers	Very Low	The existing viaduct has no existing or proposed sewer connection.	No historic records of sewer flooding at the viaduct.
Defence Breach	Very Low	Levels at the viaduct are set approximately 15m above the nearest 0.1% AEP flood level of 26.35mAOD.	Site is not identified as being located within an area that benefits from the presence of flood defences.
Reservoir Failure	Very Low	Outside of area shown to be at risk of a dam / reservoir breach.	Risk based on Environment Agency reservoir flood map.

4.2 Phase 2 Permanent Urban Park and Travel Hub Scheme

It is understood that should the project progress to the Phase 2 Permanent scheme this would include the construction of an elevated walkway which will provide access to the proposed re-developed viaduct from the canal tow path below.

4.2.1 Fluvial Risk

The detailed flood model data from the Environment Agency includes results extracted from the Medlock SFRA 2011, which have been assessed at the access location onto the proposed elevated walkway.

As previously indicated, “Node 2” and “Node 3” are considered to be the most representative indicator of flood risk to the site. These are summarised below in Table 4-3.

Table 4-3: Maximum Undefended Modelled Flood Levels (Source: Environment Agency)

Model Node	Maximum Undefended Modelled Flood Levels (mAOD)				
	4% AEP	1% AEP	1% AEP +35%CC	1% AEP +70%CC	0.1% AEP
Node 2	25.53	25.70	25.92	26.16	26.35
Node 3	25.52	25.69	25.91	26.15	26.34

The proposed elevated walkway is to be accessed from the canal tow path beneath the viaduct. Following an assessment of the 25cm resolution topographic LiDAR data, the ground levels within this area range from approximately 25.50mAOD to 26.50mAOD (see Section 2.4 and Figure 2-4). Furthermore, ground levels have been assessed at the specific proposed access point onto the elevated walkway. Here, the ground levels are approximately 25.70mAOD (Figure 2-5).

Potential flood depths have been calculated at the access location on to the proposed elevated walkway. These have been determined by subtracting the average topographic level from the maximum modelled 1D flood level for each design event provided.

Table 4-4: Maximum Undefended Flood Depths (Calculation: Depths = Modelled Flood Levels – Average Topographic Level)

Ground Level	Maximum Undefended Depths (m)				
	4% AEP	1% AEP	1% AEP +35% climate change allowance	1% AEP +70% climate change allowance	0.1% AEP
25.70mAOD	0	0	0.22	0.46	0.65

Access onto the walkway is unlikely be affected during the 1 in 25 year return period (4% AEP) and 1 in 100 year return period (1% AEP) storm event. However, depths of up to 0.65m could occur at this location during the 1 in 1,000 year return period (0.1% AEP).

The Environment Agency provided a historic flood extent showing the canal tow path historically flooded in December 1991 (Figure 4-5).

As such, there is a risk of flooding from fluvial sources at the foot of the elevated walkway during the present day 1 in 1,000 year flood event or in the future when taking climate change into account.

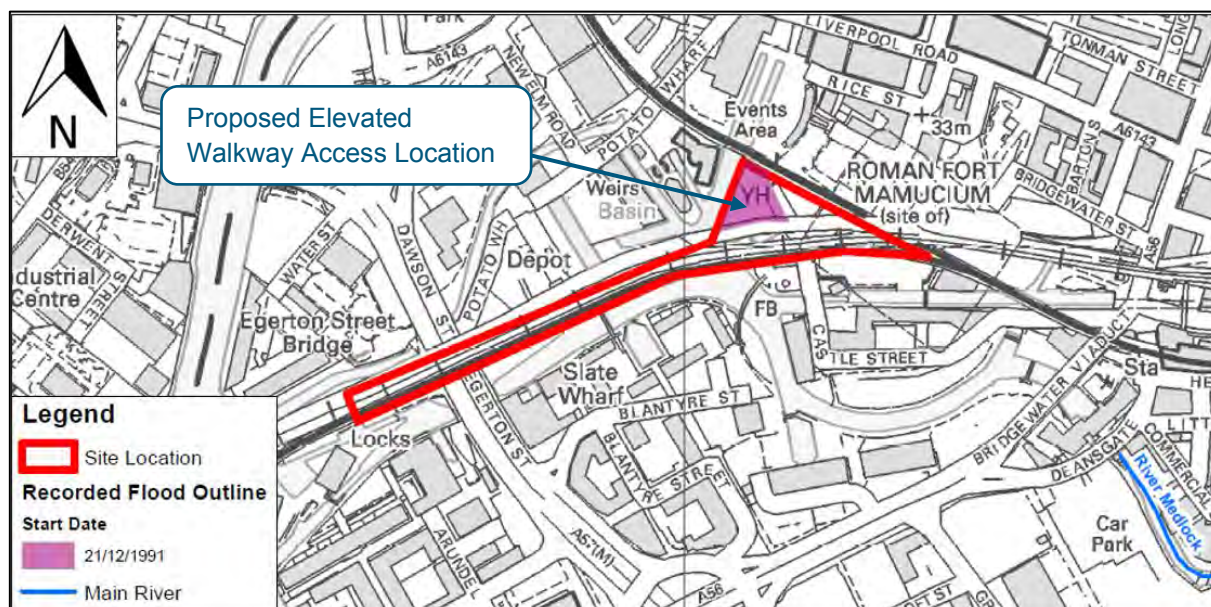


Figure 4-5: Recorded Historic Flood Outline Mapping (Source: Environment Agency)

4.2.2 Surface Water (Pluvial) Risk

To assess the risk of surface water flooding to the Phase 2 Permanent scheme, the Environment Agency's Risk of Flooding from Surface Water (RoFSW) dataset has been assessed in greater detail at the location of the access onto the proposed elevated walkway. Figure 4-6 shows that the walkway is predicted to be unaffected by surface water flooding during the 1 in 30 year rainfall event.

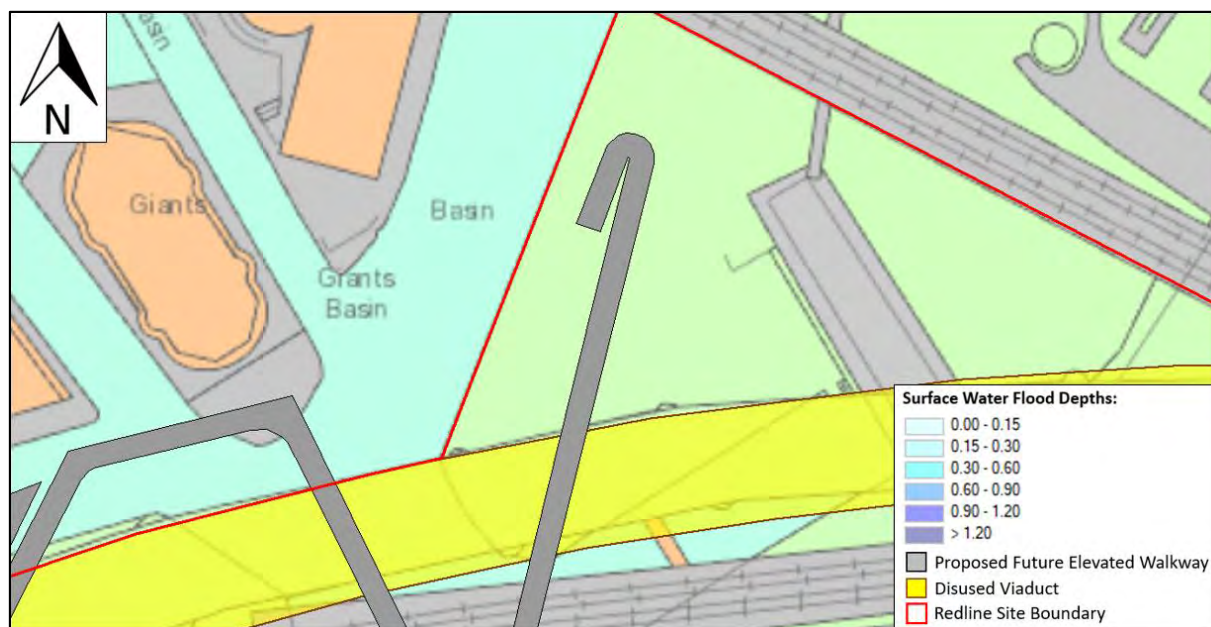


Figure 4-6: EA 1 in 30 Year RoFSW Flood Depth and Flood Extent Map (Source: Environment Agency)

During the 1 in 100 year rainfall event, the modelled flood extents and depths are likely to remain contained within the Bridgewater Canal at this location (Figure 4-7). The canal tow path, and subsequently access onto the elevated walkway, continues to remain unaffected.

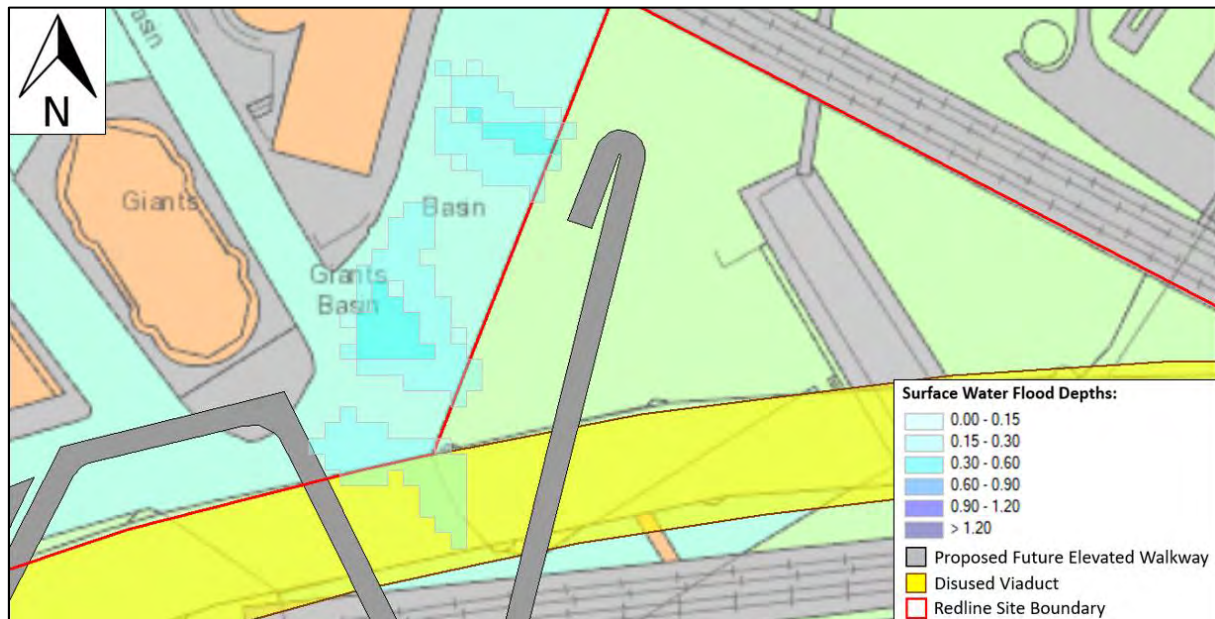


Figure 4-7: EA 1 in 100 Year RoFSW Flood Depth and Flood Extent Map (Source: Environment Agency)

Following an assessment of modelled surface water depths and extents for the 1 in 1,000 year event, the majority of the surface water extent is contained within the canal basin (Figure 4-8). However, bordering parts of the tow path are predicted to be affected by depths of between 0.3m and 0.6m. At the location of the access onto the elevated walkway, potential depths of between 0.15m and 0.3m are predicted to occur.



Figure 4-8: EA 1 in 1,000 Year RoFSW Flood Depth and Flood Extent Map (Source: Environment Agency)

Subsequently, the risk of surface water flooding to the access location onto the proposed elevated walkway can be considered to be **very low**.

4.2.3 Groundwater Flooding Risk

As per Section 4.1.3, the BGS Susceptibility to Groundwater Flooding dataset indicates that the site is located within an area that is largely at 'limited potential for groundwater flooding to occur' (Figure 4-3).

There are no records of groundwater flooding at the site. As such, the risk of groundwater flooding to the proposed elevated walkway (or access location) can be considered to be **low**.

4.2.4 Flood Risk from Sewers

It is not anticipated that the site will require a sewer connection. Subsequently, the risk of flooding from sewers can be considered to be **very low**.

4.2.5 Residual Risk

Residual risks are those remaining after applying the sequential approach to the location of development and taking mitigating actions.

4.2.5.1 Defence Breach

The Environment Agency has not provided evidence to indicate that the site benefits from the presence of fluvial defences. As such, the risk of flooding following a defence breach can be considered to be **low**.

4.2.5.2 Canal Breach

A network of canals are located beneath the viaduct and adjacent to the proposed access onto the elevated walkway including the Bridgewater Canal and Rochdale Canal.

The risk of flooding from canals is generally considered to be **low** because of their regulated nature (operated by the Canal and Rivers Trust) through the use of weirs and canal locks.

The primary driver of a canal breach event is likely to be as a result of the confluence with the River Medlock at the site. As such, this is more likely to be a result of fluvial flooding, than specifically arising from a canal breach event.

4.2.5.3 Reservoir Failure

The Environment Agency Risk of Flooding from Reservoir Map indicates that the canal tow path, and therefore access onto the elevated walkway, may be in an area with the potential to be affected by reservoir flooding (Figure 4-9).

In the unlikely event that a reservoir dam fails, a large volume of water would escape at once with little or no warning. The Environment Agency indicates that flood water on site could be between 0.3m and 2m deep. However, according to the Environment Agency, there has been no loss of life in the UK from reservoir flooding since 1925. All large reservoirs must be inspected and supervised by reservoir panel engineers as detailed by the enforcement authority for the Reservoirs Act 1975 in England. As such reservoir flooding is considered to be unlikely and the modelled flood depths are based on the worst-case scenario, and flooding from this source can be considered as a **low** risk.

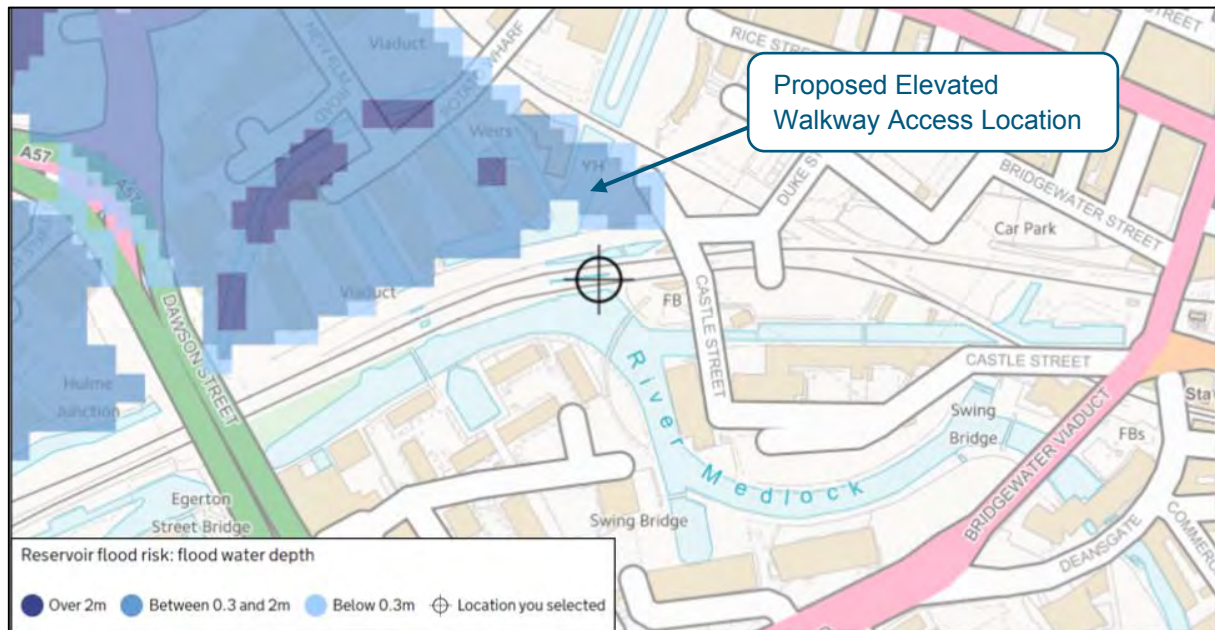


Figure 4-9: Flood Risk from Reservoir Failure Map (Source: Environment Agency)

4.2.6 Off-site Impacts

The proposed re-development of the existing disused viaduct is to create a green urban park destination.

As part of the Phase 2 Permanent scheme, there is likely to be an elevated walkway proposed to access to the re-developed viaduct from the canal tow path.

Given that the walkway is to be elevated, it is likely be raised via supporting columns / pillars above the flood extent. It is possible that the Environment Agency could request flood water displacement calculations are undertaken to understand the volumes of flood water that could be displaced by the supporting columns during a typical flood event over the lifetime of the proposed development.

However, it likely that the total volume of flood water displaced by the elevated walkway would be insignificant and unlikely to increase flood risk elsewhere.

Furthermore, a detailed surface water drainage strategy will need to be developed to assess the potential surface water runoff during the proposed Phase 2 Permanent scheme, specifically if there is any change in the proposed route or volume of runoff from the site.

4.2.7 Flood Risk Management Measures

The site is located within the Environment Agency Flood Alert and Flood Warning Service Areas. It would be recommended that following the provision of the additional access, the National Trust sign up to these services.

In the event that a flood warning is issued, it is recommended that access via the elevated walkway is suspended due to potential flood depths at the canal tow path. It would be advised that site users are evacuated via Deansgate-Castlefield car park in such circumstances.

4.2.8 Safe Access and Egress

Based on an assessment of modelled flood levels and 25cm resolution LiDAR data at the site, flood depths have been predicted for several key design events at the access location to the elevated walkway (Table 4-4).

The Environment Agency has not provided any hazard mapping as part of their modelling deliverables. As such, assumptions have been made in assessing the potential risk to the public when accessing the elevated walkway during the modelled key design events.

A typical flood velocity of 0.3m/s could be assumed for “standing / slow flowing water”. Based on this assumption, it is possible to estimate the Flood Hazard Rating at the site using the Hazard to People Classification Matrix in Figure 4-10 (Source: Table 13.1 of FD2320/TR2 – Extended version).

HR	Depth of flooding - d (m)												
	DF = 0.5				DF = 1								
Velocity v (m/s)	0.05	0.10	0.20	0.25	0.30	0.40	0.50	0.60	0.80	1.00	1.50	2.00	2.50
0.0	0.03 + 0.5 = 0.53	0.05 + 0.5 = 0.55	0.10 + 0.5 = 0.60	0.13 + 0.5 = 0.63	0.15 + 0.5 = 1.15	0.20 + 0.5 = 1.20	0.25 + 0.5 = 1.25	0.30 + 0.5 = 1.30	0.40 + 0.5 = 1.40	0.50 + 0.5 = 1.50	0.75 + 0.5 = 1.75	1.00 + 0.5 = 2.00	1.25 + 0.5 = 2.25
0.1	0.03 + 0.5 = 0.53	0.06 + 0.5 = 0.56	0.12 + 0.5 = 0.62	0.15 + 0.5 = 0.65	0.18 + 0.5 = 1.18	0.24 + 0.5 = 1.24	0.30 + 0.5 = 1.30	0.36 + 0.5 = 1.36	0.48 + 0.5 = 1.48	0.60 + 0.5 = 1.60	0.90 + 0.5 = 1.90	1.20 + 0.5 = 2.20	1.50 + 0.5 = 2.55
0.3	0.04 + 0.5 = 0.54	0.08 + 0.5 = 0.58	0.15 + 0.5 = 0.65	0.19 + 0.5 = 0.69	0.23 + 0.5 = 1.23	0.30 + 0.5 = 1.30	0.38 + 0.5 = 1.38	0.45 + 0.5 = 1.45	0.60 + 0.5 = 1.60	0.75 + 0.5 = 1.75	1.13 + 0.5 = 2.13	1.50 + 0.5 = 2.50	1.88 + 0.5 = 2.88
0.5	0.05 + 0.5 = 0.55	0.10 + 0.5 = 0.60	0.20 + 0.5 = 0.70	0.25 + 0.5 = 0.75	0.30 + 0.5 = 1.30	0.40 + 0.5 = 1.40	0.50 + 0.5 = 1.50	0.60 + 0.5 = 1.60	0.80 + 0.5 = 1.80	1.00 + 0.5 = 2.00	1.50 + 0.5 = 2.50	2.00 + 0.5 = 3.00	2.50 + 0.5 = 3.50
1.0	0.08 + 0.5 = 0.58	0.15 + 0.5 = 0.65	0.30 + 0.5 = 0.80	0.38 + 0.5 = 0.88	0.45 + 0.5 = 1.45	0.60 + 0.5 = 1.60	0.75 + 0.5 = 1.75	0.90 + 0.5 = 1.90	1.20 + 0.5 = 2.20	1.50 + 0.5 = 2.50	2.25 + 0.5 = 3.25	3.00 + 0.5 = 4.00	3.75 + 0.5 = 4.75
1.5	0.10 + 0.5 = 0.60	0.20 + 0.5 = 0.70	0.40 + 0.5 = 0.90	0.50 + 0.5 = 1.00	0.60 + 0.5 = 1.60	0.80 + 0.5 = 1.80	1.00 + 0.5 = 2.00	1.20 + 0.5 = 2.20	1.60 + 0.5 = 2.60	2.00 + 0.5 = 3.00	3.00 + 0.5 = 4.00	4.00 + 0.5 = 5.00	5.00 + 0.5 = 6.00
2.0	0.13 + 0.5 = 0.63	0.25 + 0.5 = 0.75	0.50 + 0.5 = 1.00	0.63 + 0.5 = 1.13	0.75 + 0.5 = 1.75	1.00 + 0.5 = 2.00	1.25 + 0.5 = 2.25	1.50 + 0.5 = 2.50	2.00 + 0.5 = 3.00	3.50	4.75	6.00	7.25
2.5	0.15 + 0.5 = 0.65	0.30 + 0.5 = 0.80	0.60 + 0.5 = 1.10	0.75 + 0.5 = 1.25	0.90 + 0.5 = 1.90	1.20 + 0.5 = 2.20	1.50 + 0.5 = 2.50	1.80 + 0.5 = 2.80	3.40	4.00	5.50	7.00	8.50
3.0	0.18 + 0.5 = 0.68	0.35 + 0.5 = 0.85	0.70 + 0.5 = 1.20	0.88 + 0.5 = 1.38	1.03 + 0.5 = 2.05	1.40 + 0.5 = 2.40	1.75 + 0.5 = 2.75	3.10	3.80	4.50	6.25	8.00	9.75
3.5	0.20 + 0.5 = 0.70	0.40 + 0.5 = 0.90	0.80 + 0.5 = 1.30	1.00 + 0.5 = 1.50	1.20 + 0.5 = 2.20	1.60 + 0.5 = 2.60	3.00	3.40	4.20	5.00	7.00	9.00	11.00
4.0	0.23 + 0.5 = 0.73	0.45 + 0.5 = 0.95	0.90 + 0.5 = 1.40	1.13 + 0.5 = 1.63	1.35 + 0.5 = 2.35	1.80 + 0.5 = 2.80	3.25	3.70	4.60	5.50	7.75	10.00	12.25
4.5	0.25 + 0.5 = 0.75	0.50 + 0.5 = 1.00	1.00 + 0.5 = 1.50	1.25 + 0.5 = 1.75	1.50 + 0.5 = 2.50	2.00 + 0.5 = 3.00	3.50	4.00	5.00	6.00	8.50	11.00	13.50
5.0	0.28 + 0.5 = 0.78	0.60 + 0.5 = 1.10	1.10 + 0.5 = 1.60	1.38 + 0.5 = 1.88	1.65 + 0.5 = 2.65	3.20	3.75	4.30	5.40	6.50	9.25	12.00	14.75
Flood Hazard Rating (HR)		Colour Code	Hazard to People Classification										
Less than 0.75			Very low hazard - Caution										
0.75 to 1.25			Danger for some – includes children, the elderly and the infirm										
1.25 to 2.0			Danger for most – includes the general public										
More than 2.0			Danger for all – includes the emergency services										

Figure 4-10: FD2320 Flood Hazard Matrix (Calculation: Hazard Rating = Depth x (Velocity + 0.5) x Debris Factor)

Based on the modelled flood depths provided in Table 4-4, Flood Hazard ratings have been estimated using an assumed slow flowing velocity of 0.3 m/s for all depths greater than 0. The data is provided in Table 4-5 below.

Table 4-5: Estimated Hazard Rating

Modelled Event	Flood Depth	Flood Velocity	Debris Factor	Hazard Rating	Classification
4% AEP	0	0 m/s (no flow)	0.5	0.53	Very Low (< 0.75)
1% AEP	0	0 m/s (no flow)	0.5	0.53	Very Low (< 0.75)
1% AEP +35% climate change allowance	0.22m	0.3 m/s	0.5	0.65	Very Low (< 0.75)
1% AEP +70% climate change allowance	0.46m	0.3 m/s	0.5	1.38	Danger for most
0.1% AEP	0.65m	0.3 m/s	0.5	1.45	Danger for most

Assuming a slow flowing velocity of 0.3 m/s for all depths greater than 0, the hazard rating could be considered 'Very Low' at the proposed access location to the elevated walkway for the 1 in 25 year (4% AEP), 1 in 100 year (1% AEP) and 1 in 100 year +35% climate change allowance modelled events.

A larger debris factor is applied as part of the equation when depths exceed 0.3m. Subsequently, for the 1 in 100 year +70% climate change allowance and 1 in 1,000 year (0.1% AEP) modelled events, the hazard classification is considered to be "Danger for Most".

Hazard rating model outputs are required from the hydraulic modelling in order to undertake a more accurate assessment of the risk to the public at different modelled events. However, it is important to note that the proposed re-development is likely to comprise a limited lifetime, would not be subject to use during an extreme event as set out above and includes an alternative access route, such that the elevated walkway would not be required for access during an event.

With regards to surface water flooding, hazard data has been provided by the Environment Agency for the 1 in 1,000 year surface water event. The access location is shown to be at 'Very Low' hazard rating during a 1 in 1,000 year surface water event (Figure 4-11).

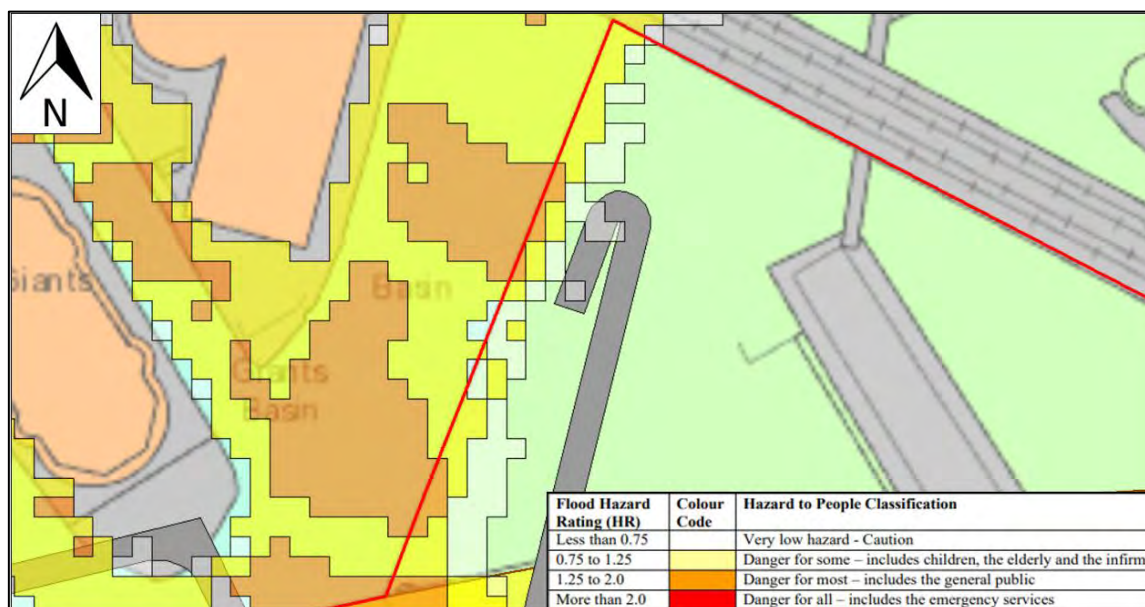


Figure 4-11: Flood Hazard Data from Surface Water Sources for the 1 in 1,000 Year Rainfall Event (Source: Environment Agency)

4.2.9 Summary of Flooding to Phase 2 Permanent Scheme

Numerous sources of data have been obtained and appraised within this Flood Risk Appraisal to understand the potential risk of flooding to and from the proposed re-development of the viaduct and specifically the future scheme incorporating an elevated walkway. Table 4-6 provides a summary of the potential flood risk from each source to the future scheme.

Table 4-6: Summary of Flood Risk to the Permanent Scheme

Source of Flooding	Flood Risk	Chance of Flooding	Comments
Fluvial – River Medlock	Moderate	The proposed access location to the elevated walkway from the canal tow path is predicted to be affected during the 1 in 100 year (1% AEP) with climate change allowance and 1 in 1,000 year (0.1% AEP) events.	The canal tow path historically flooded in December 1991.
Surface Water	Low	Access to the elevated walkway could experience depths of between 150mm and 300mm during the 1 in 1,000 year surface water flood event.	Surface water modelling is likely to have revised the DTM to improve conveyance through structures. As a result, the viaduct appears to be affected by surface water on the Environment Agency mapping.
Groundwater	Low	The viaduct and walkway are elevated above ground level	BGS Susceptibility to Groundwater Flooding identifies the area as having

Source of Flooding	Flood Risk	Chance of Flooding	Comments
			'Limited Potential for Groundwater Flooding'.
Sewers	Very Low	The existing viaduct has no existing or proposed sewer connection.	No historic records of sewer flooding at the viaduct.
Defence Breach	Very Low	The site does not benefit from flood defences.	Site is not identified as being located within an area that benefits from the presence of flood defences.
Reservoir Failure	Low	Potential for depths of between 0.3m and 2m at the canal tow path in the unlikely event that reservoir failure could occur.	Owners of reservoirs are responsible for ensuring reservoirs are inspected regularly and essential safety work is undertaken. This is in accordance with the 1975 Reservoir Safety Act.

5 Conclusions

This Flood Risk Appraisal has been structured to assess the risk of flooding to the site at each phase of the Project, which have been referenced as:

- Phase 1 Pilot 'micro park' scheme
 - This is to feature the existing access from Deansgate-Castlefield car park; and,
- Phase 2 'Permanent urban park and travel scheme'
 - This is to feature a proposed elevated walkway connecting the viaduct with the canal tow path beneath.

The following are key conclusions identified as part of the appraisal:

- General
 - The existing viaduct is located approximately 15m above the watercourses that lie beneath it and has existing access from Deansgate-Castlefield car park. It is proposed that as part of Phase 2 an elevated walkway is likely to be built from the canal tow path beneath.
 - The viaduct itself is at low risk from all sources (fluvial, surface water, groundwater, sewers and residual risks)
 - Deansgate-Castlefield car park is located topographically higher than the existing viaduct and subsequently this is also at low risk of flooding from all sources. Therefore, safe access and egress can be maintained from the car park during both the Phase 1 Pilot and Phase 2 Permanent scheme.
- Phase 1 Pilot scheme
 - The proposed re-development would not increase the built footprint or impermeable surface area during the Phase 1 Pilot scheme and therefore there are no off-site impacts to be expected.
- Phase 2 'Permanent urban park and travel scheme'
 - The elevated walkway, proposed in Phase 2, would be accessed from the canal tow path beneath the viaduct. The tow path has flooded from fluvial sources historically in December 1991 and is predicted to be affected during the fluvial 1 in 100 year (1% AEP) events including an allowance for climate change, as well as during the 1 in 1,000 year (0.1% AEP) event.
 - Access onto the elevated walkway would also be partly affected by surface water depths of between 150mm and 300mm during a 1 in 1,000 year rainfall event.
 - The risk of groundwater flooding, sewer flooding and other residual risks to the proposed elevated walkway and its access point is considered to be very low.
 - It is possible that the Environment Agency could request that flood water displacement calculations are undertaken to understand what the volumes of flood water that could be displaced by the supporting columns during a typical flood event over the lifetime of the proposed development.
 - It is important to note that the proposed re-development is likely to comprise a limited lifetime, would not be subject to use during an extreme event and includes an alternative access route, such that the elevated walkway would not be required for access during an event.
 - The site is located within the Environment Agency Flood Alert and Flood Warning Service Areas. It would be recommended that following the provision of the additional access, the National Trust sign up to this service and that access and egress via the elevated walkway is suspended. Additionally, upon receipt of flood warning, access and egress should be via the Deansgate-Castlefield car park to the east.

Appendix

Appendix A – Site Plans

“We need to give parks a reboot and start thinking about them as essential elements of our communities in the same way we think about housing or transport.”

- Hilary McGrady,
Director General
National Trust

Proposition:

Development of Castlefield viaduct as a green urban park destination providing local access to nature and greenspace, a new community amenity and an elevated walkway fitting into wider strategic movement plans of Manchester all whilst respecting the heritage fabric of the listed structure and surrounding area.

Objectives:

- A new urban greenspace providing local access to nature supporting health and wellbeing, particular for groups where need is greatest
- A place shaped by and activated by the local community through design and ongoing activities on site where everyone is welcomed
- An iconic project of regional/national significance seen as a destination attracting visitors to Manchester supporting tourism
- A catalyst for further regeneration of the wider Castlefield area
- A place of heritage and cultural expression and learning celebrating the heritage of the viaduct and surrounding area
- A new attractive walking route supporting healthy, active travel

1

VISION AND BRIEF OPERATION / ACTIVATION

- Open day time, seven days a week, all year around
- Gates closed restricting access during evening/night
- Programme of events
- Exhibitions
- Galleries
- Performances
- Cinemas
- spaces/ walls/ areas where people can interact with the place unsupervised, e.g. perhaps dedicated paint or graffiti opportunities, (safe) pedestals, echo areas, play schemes on the floor etc.

1

VISION AND BRIEF PHYSICAL ATTRIBUTES

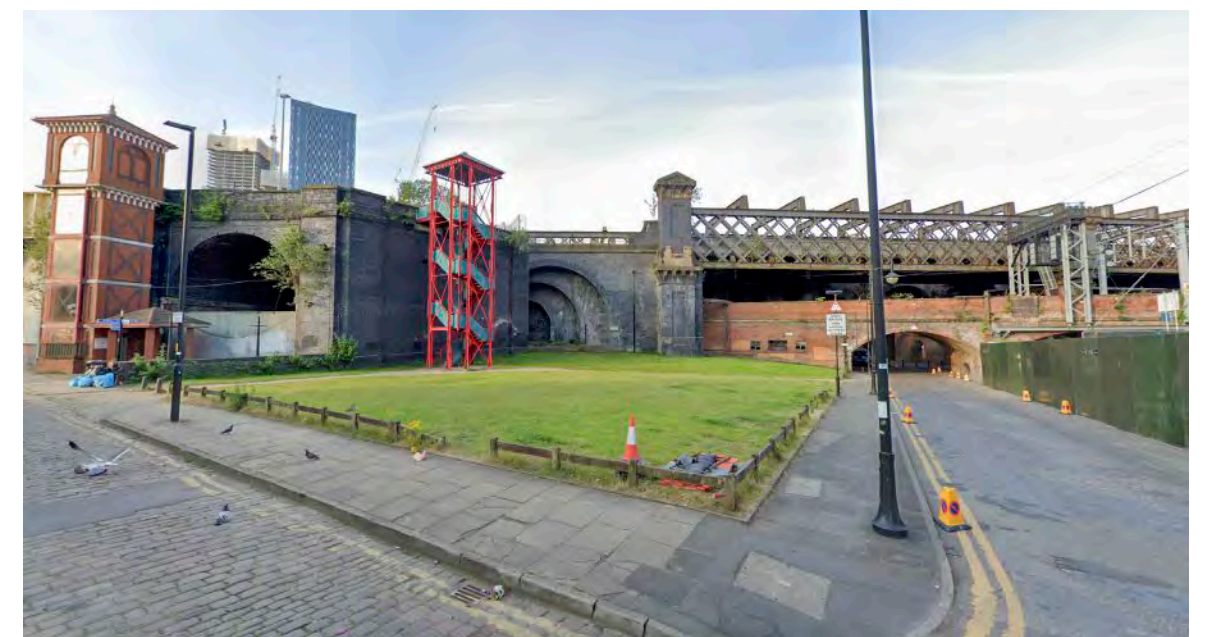
- Overall bias towards green space over material
- Primary pedestrian exit/entrance from east via car park
- A secondary pedestrian exit entrance to west – maybe just emergency access but preferably through – can poke a hole
- Acoustic dampening along southern edge adjacent to tram/rail line
- Respect heritage fabric and listed status –v. limited changes to material
- Green stuff e.g. plants, grass, flowers, veg plot – in containers or contained in some way
- Space to dwell not impacted by through ped traffic – fast and slow routes?
- A pedestrian walkway through site – maybe on southern edge?
- Removalble structures – e.g. f&B stands, seating, marquees, decking, portaloos, bins, security hut, ticket office
- Flexibility in space creation – movable bits
- Lighting – subtle as Network Rail will have issues – height might also be a problem re: this

2

ANALYSIS HERITAGE

Grade II Listed

- Cast iron and wrought iron, red brick to east of Duke Street.
- Runs south-west from former Central Station, then westwards, dividing into two over Castlefield and rejoining west of River Medlock. Cast iron drum piers rising to square castellated towers supporting metal lattice parapet.
- Castellated brick piers with stone dressings to Gothic style skew bridges over River Medlock and roadways.
- To east of Duke Street viaduct is of brick with segmental arches and castellated brick piers.
- At western end a blue brick bridge over Dawson Street.
- Designed in 1888, Opened 1893, Closed to traffic 1963
- Designed by M.W.G. Scott, Chief Engineer of the Cheshire Lines Committee and the Midland Railway
- Contractors for masonry & brickwork: Mrs M. W. Walmsley and Co., of Manchester and Southport
- Contractors for steel & ironwork Heenan and Froude of Newton Heath
- Culvert for River Medlock is underneath the viaduct somewhere.
- lattice girder work - leading feature
- a copper rivet ceremoniously placed at the end (location unknown)
- portrays the area's rich heritage and its prominence as the birthplace of the industrial revolution.
- The viaducts dramatically transformed the scale and visibility of urban exchange of the area, without disrupting the natural landscape and long established built-in environments.
- remarkable geometric shadows across arena and over Castlefield
- most visible expression of the existence of the Central Manchester Development Corporation between 1987 and 1997
- The Castlefield viaducts were the first of their type, and consequently are vital artefacts in the history of Manchester and the railways. They are noteworthy for both their design and size.



2

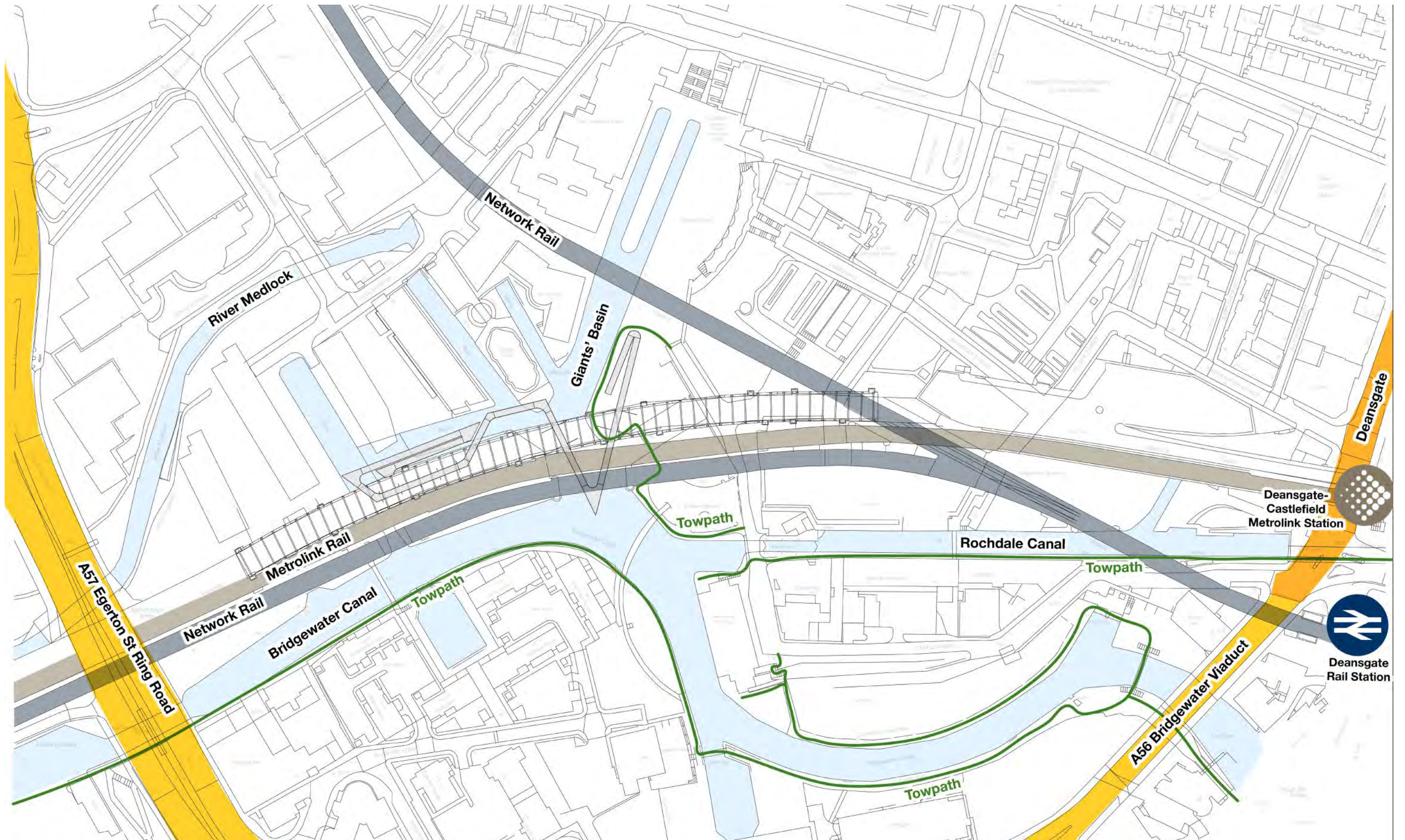
ANALYSIS LAND OWNERSHIP

Draft boundaries as provided by The National Trust



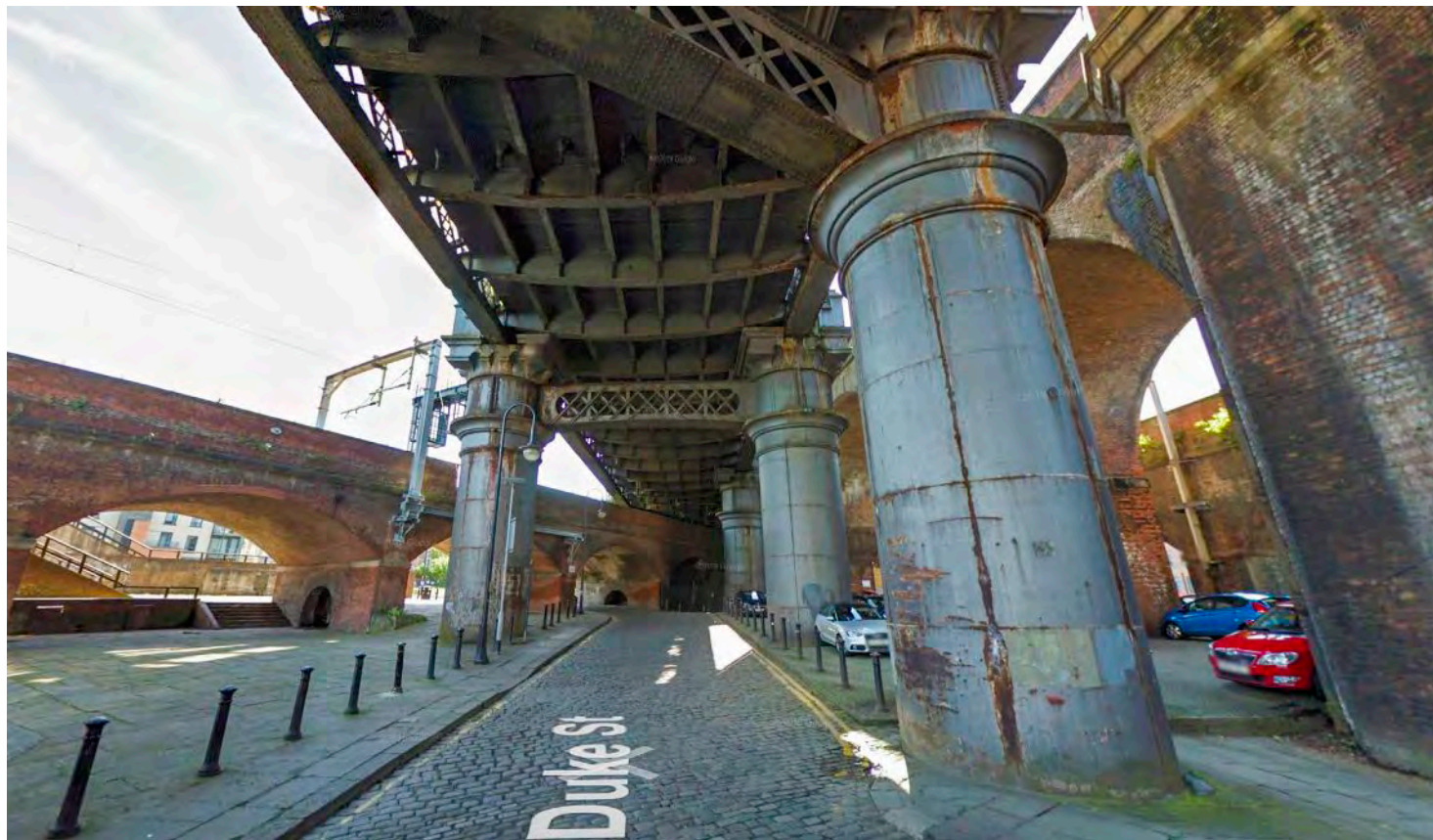
2

ANALYSIS LINKS + ACCESS



2

ANALYSIS SITE PHOTOS



2

ANALYSIS SITE PHOTOS

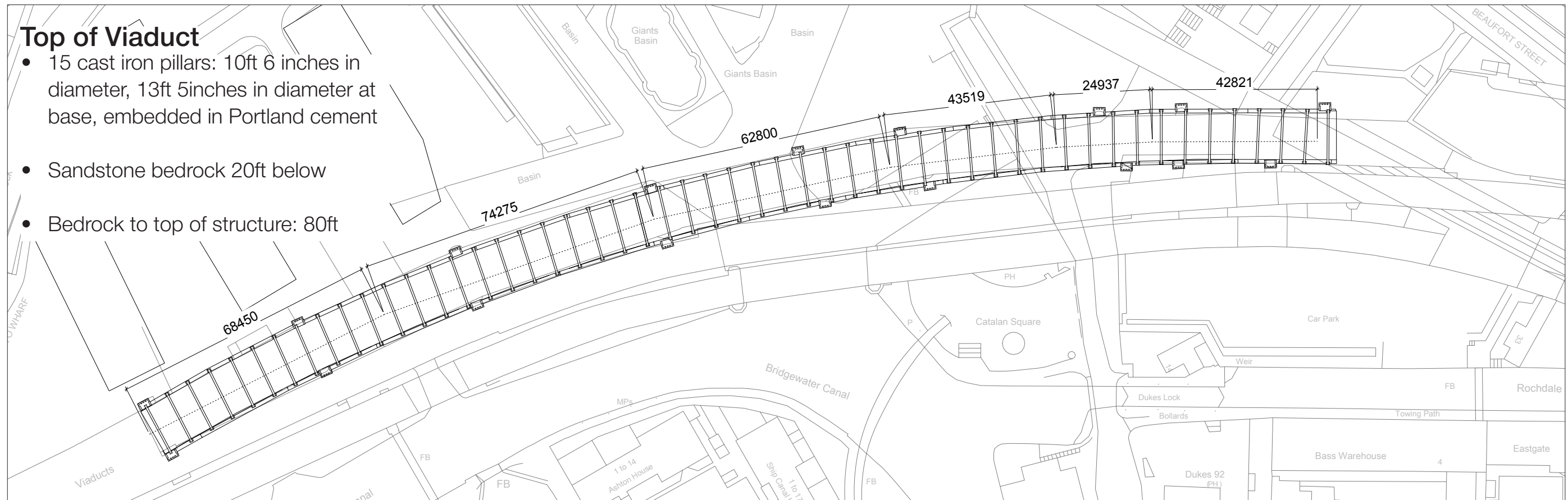


2

ANALYSIS BRIDGE DIMENSIONS

Top of Viaduct

- 15 cast iron pillars: 10ft 6 inches in diameter, 13ft 5 inches in diameter at base, embedded in Portland cement
- Sandstone bedrock 20ft below
- Bedrock to top of structure: 80ft



Underside of Viaduct

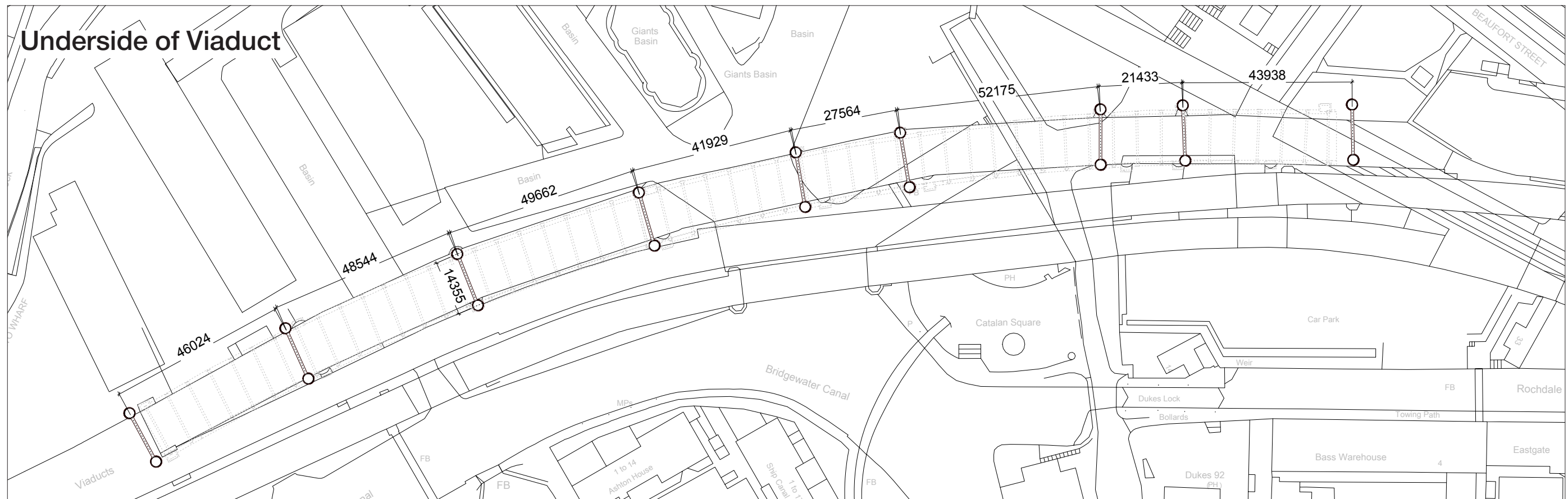


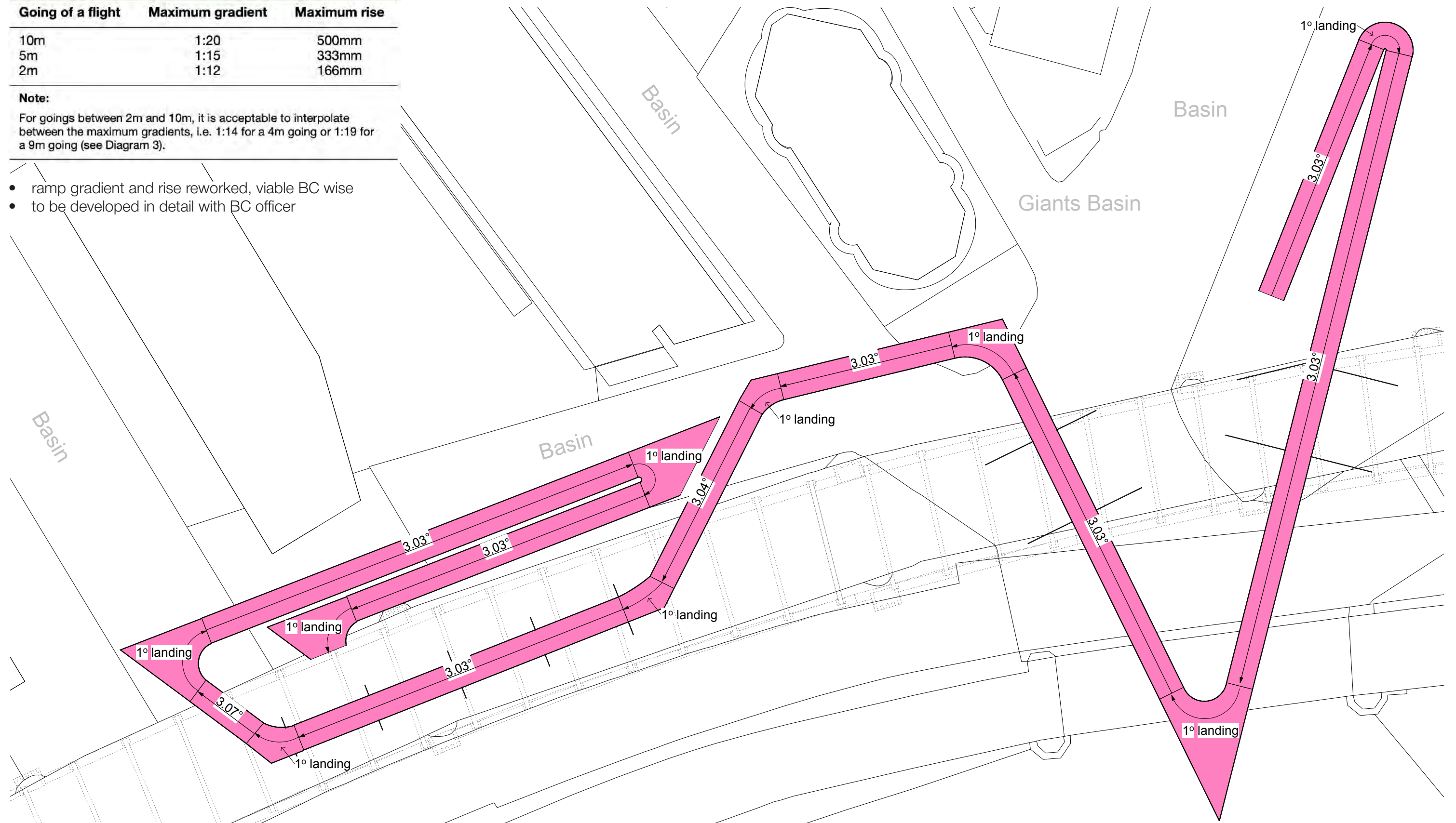
Table 1 Limits for ramp gradients

Going of a flight	Maximum gradient	Maximum rise
10m	1:20	500mm
5m	1:15	333mm
2m	1:12	166mm

Note:

For goings between 2m and 10m, it is acceptable to interpolate between the maximum gradients, i.e. 1:14 for a 4m going or 1:19 for a 9m going (see Diagram 3).

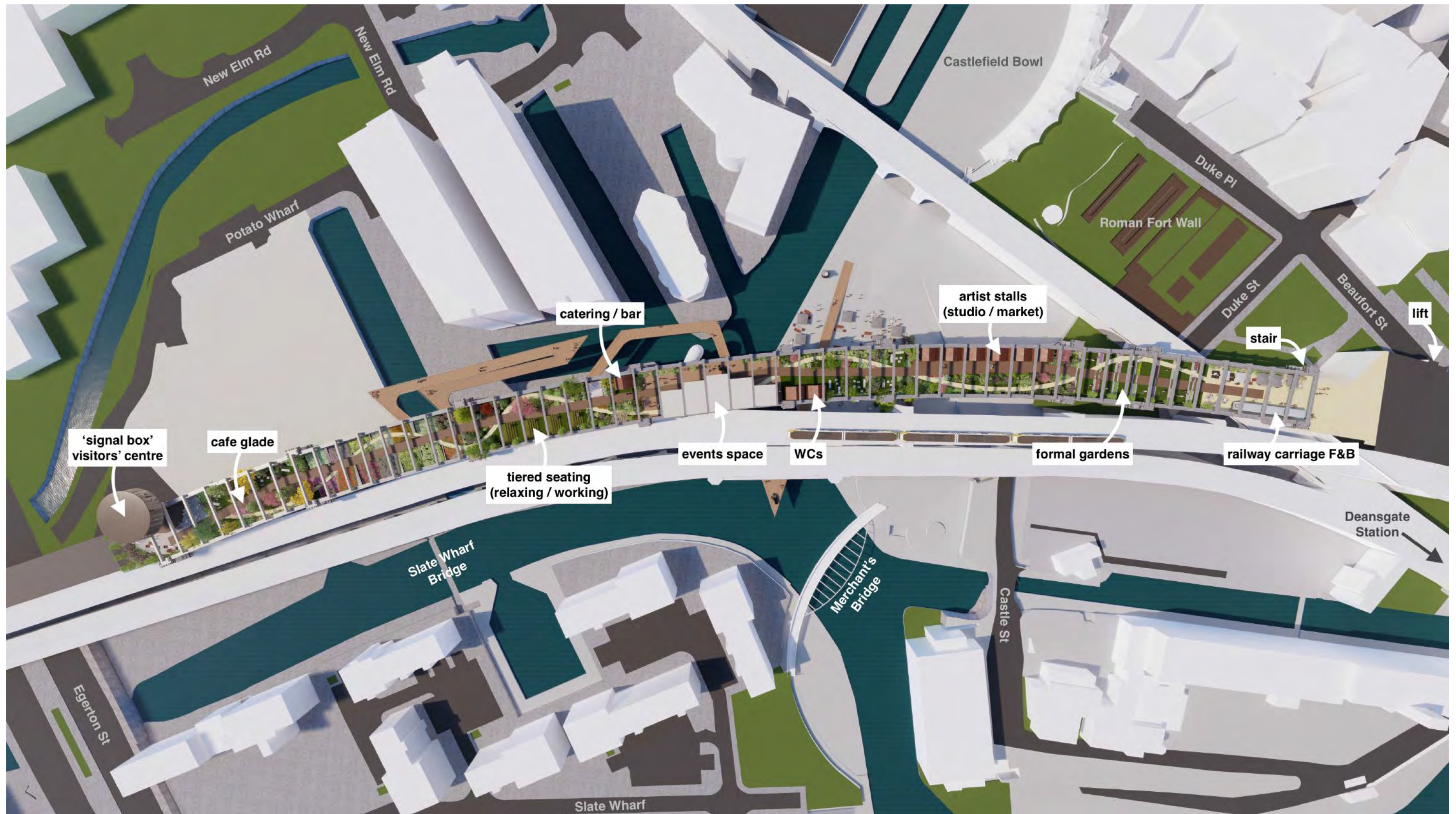
- ramp gradient and rise reworked, viable BC wise
- to be developed in detail with BC officer





5

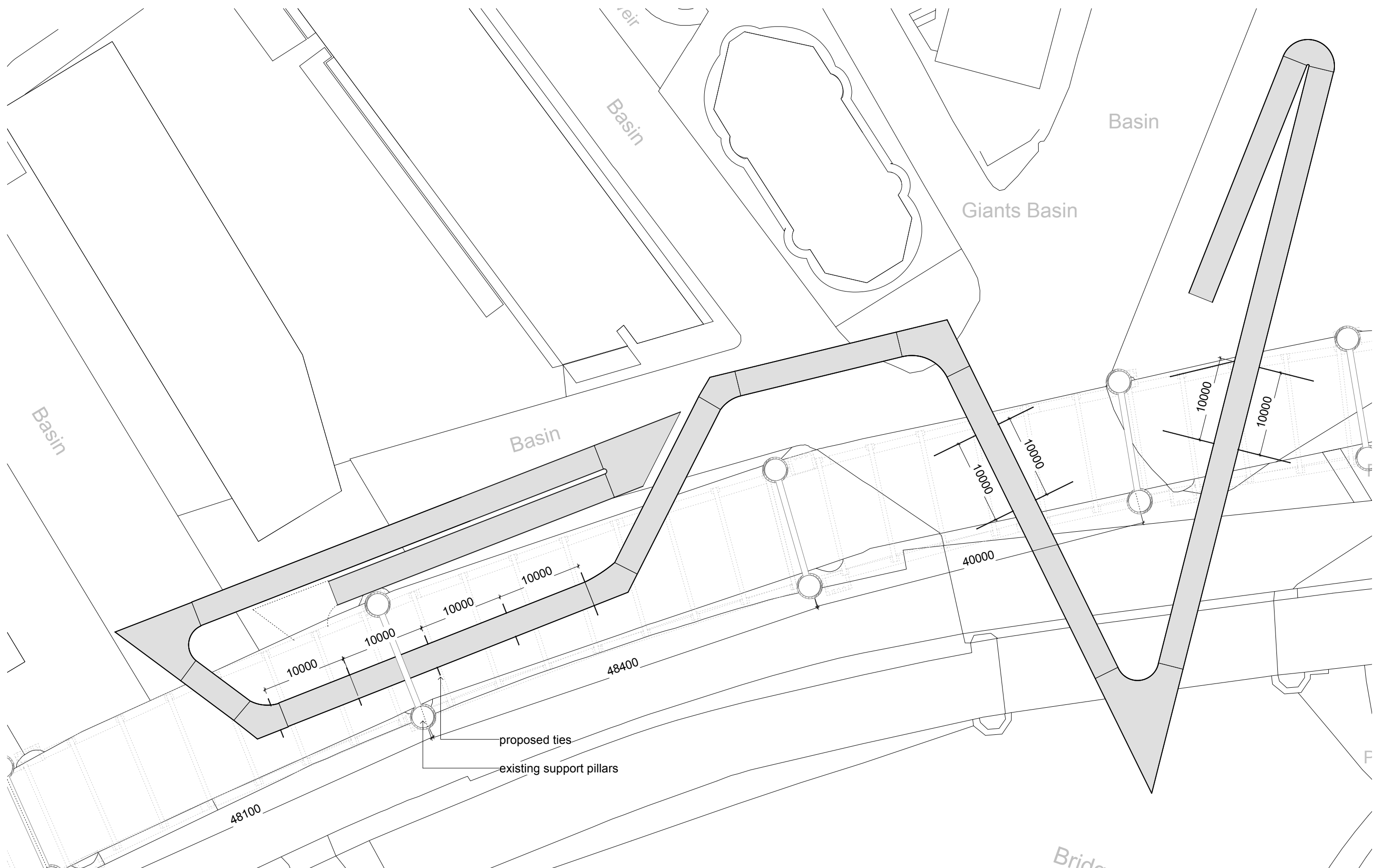
DESIGN
VISUALISATIONS



DESIGN

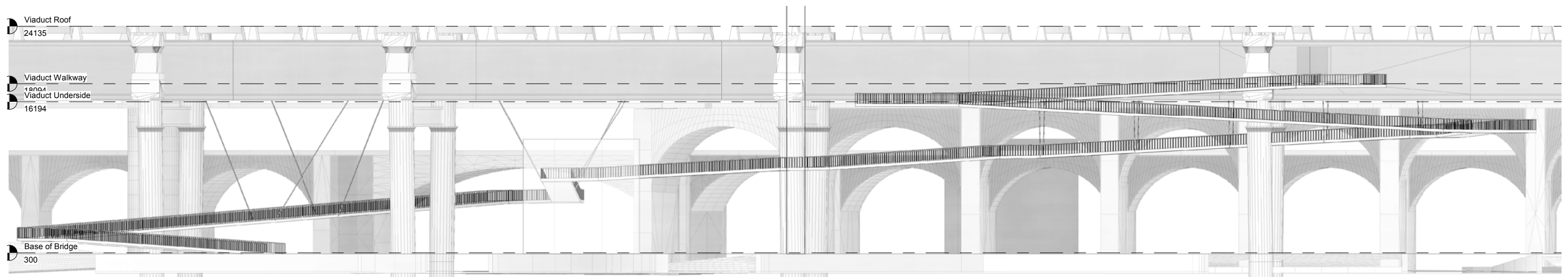
SITE PLAN



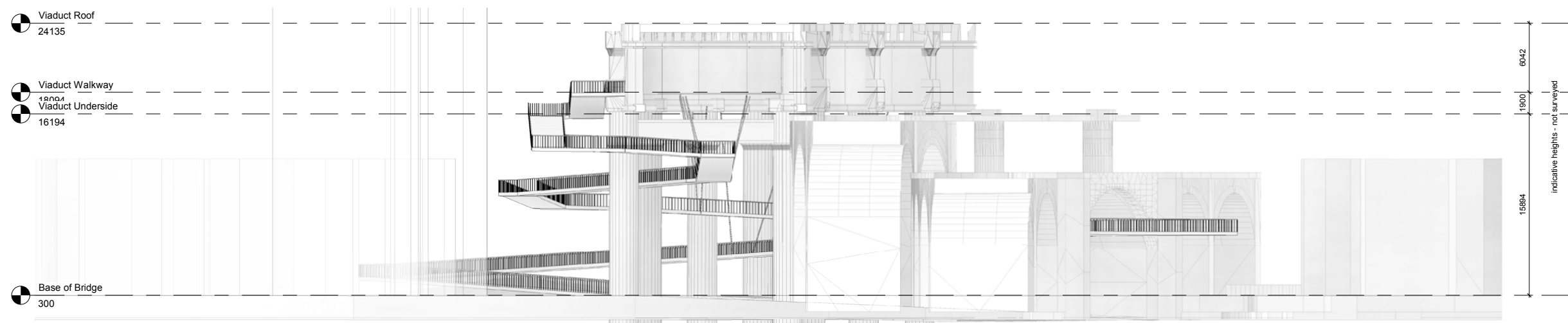


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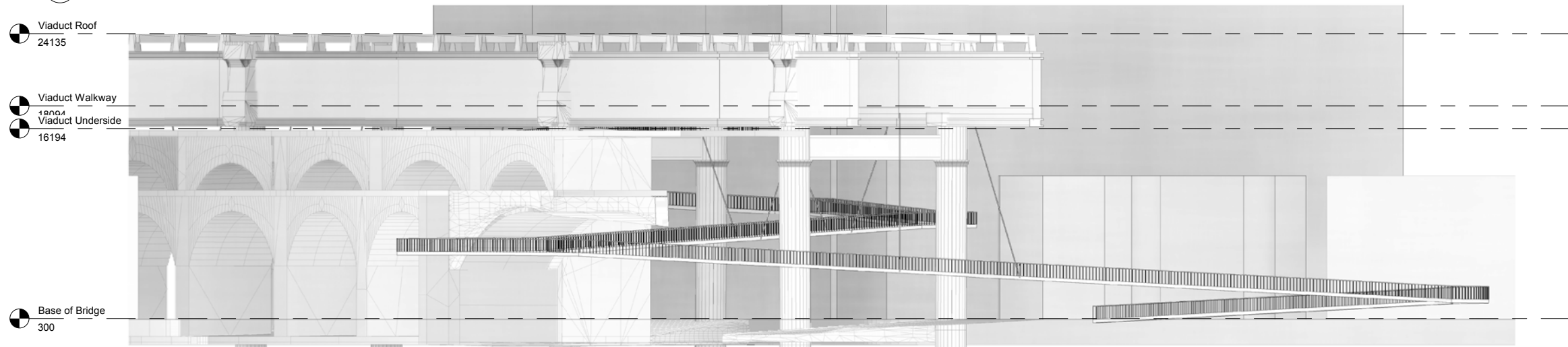
DESIGN SITE SECTIONS



1 East-West Section
1 : 200



2 North-South Section
1 : 200

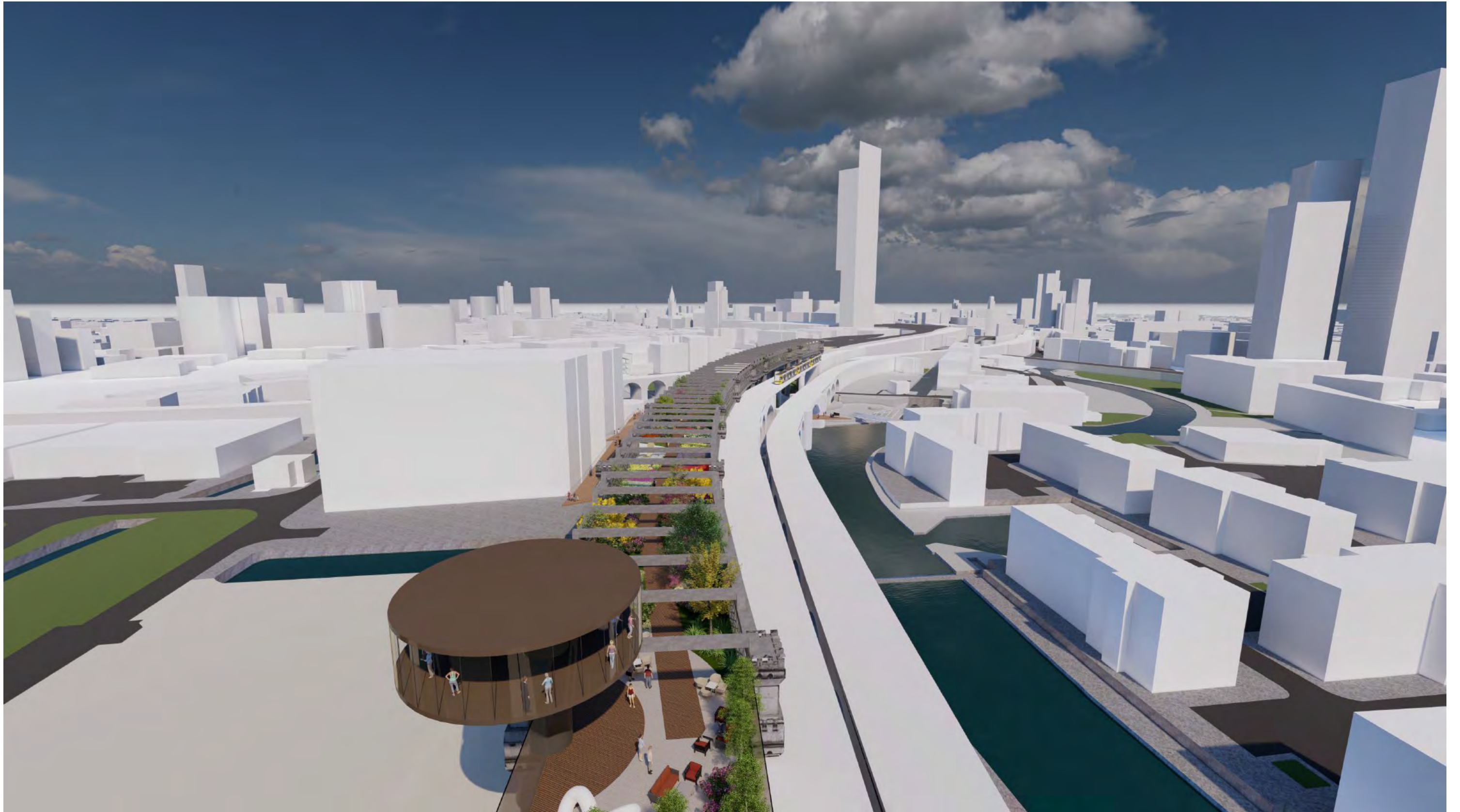


3 South-North Section
1 : 200



5

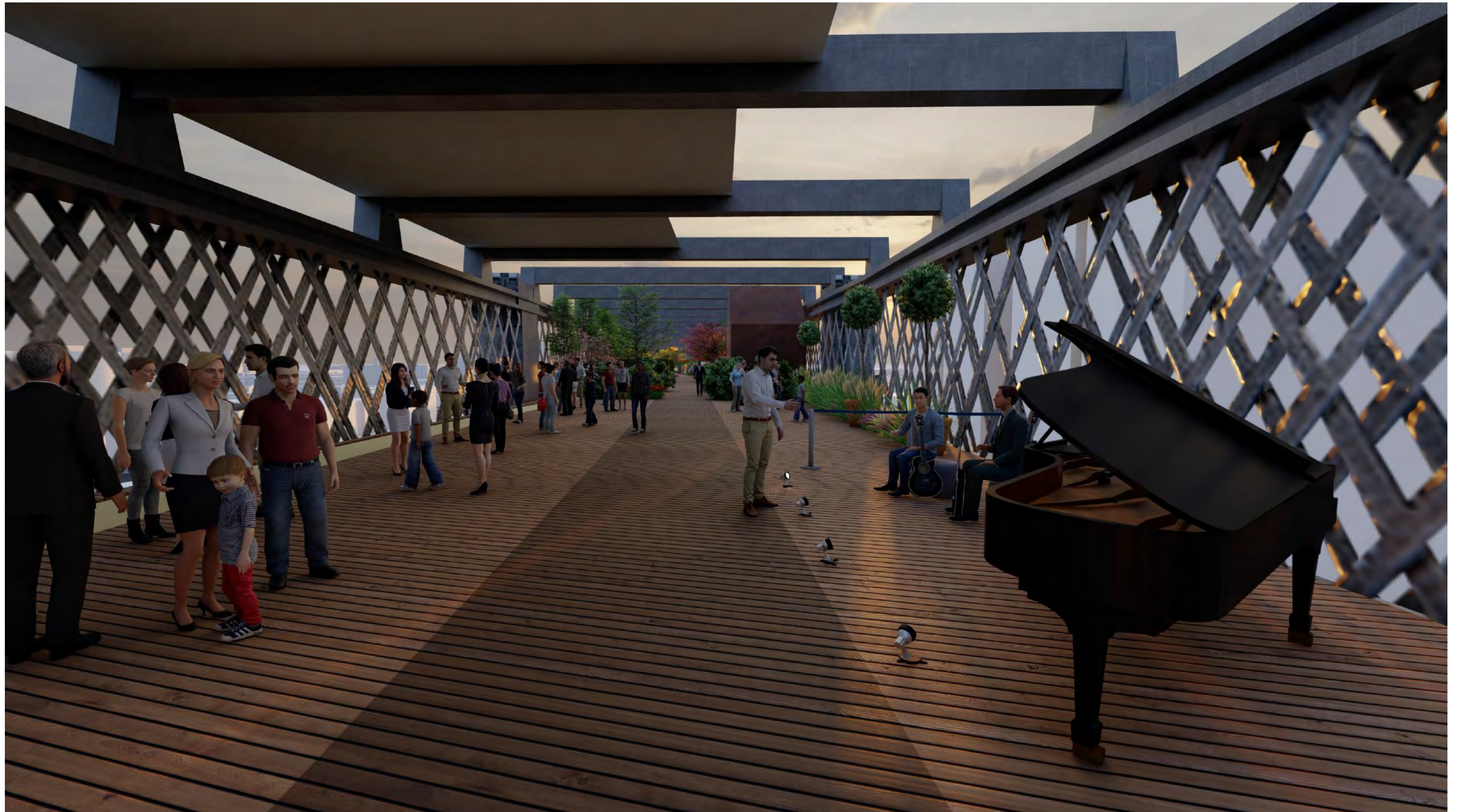
DESIGN VISUALISATIONS





5

DESIGN VISUALISATIONS



5

DESIGN VISUALISATIONS



5

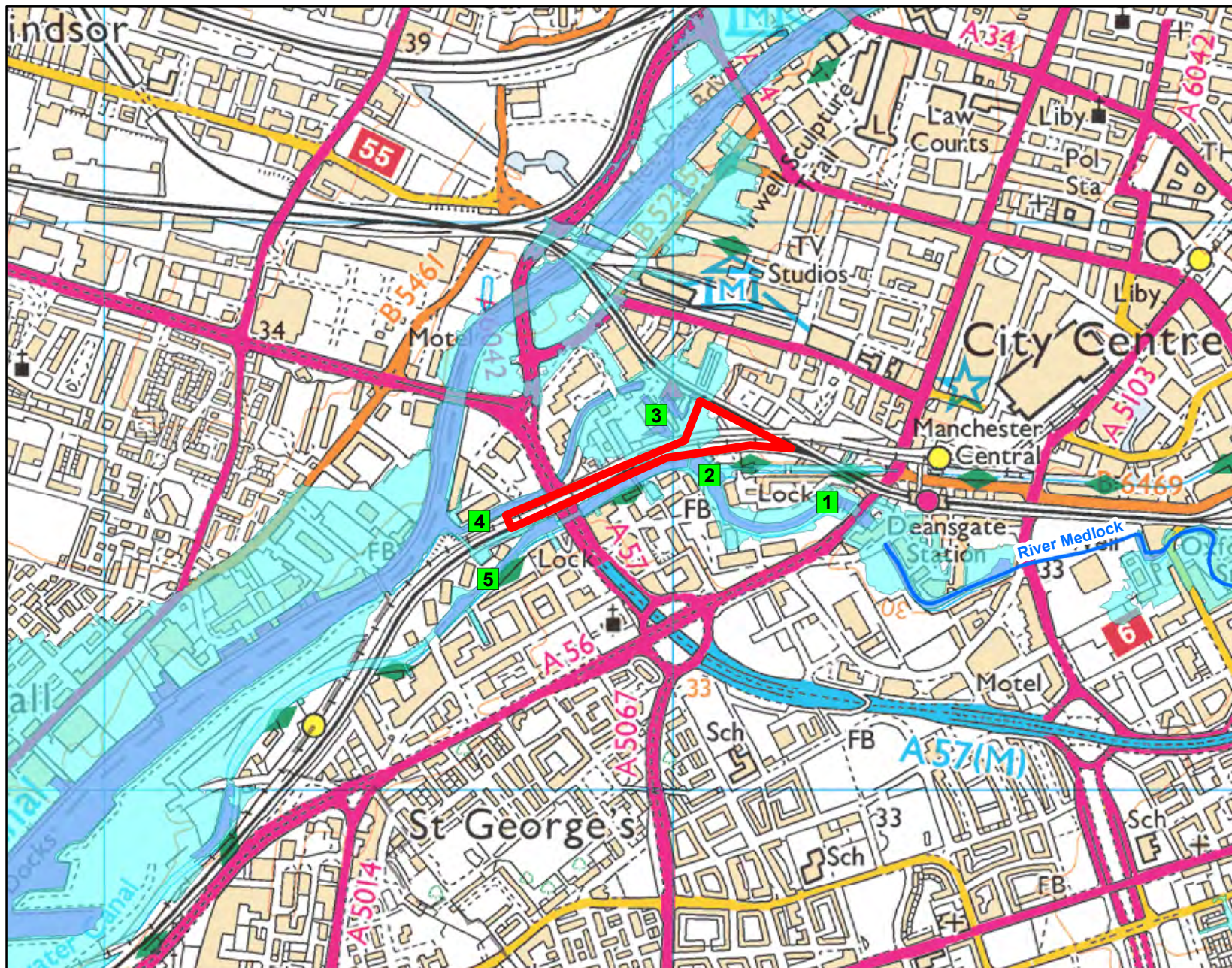
DESIGN VISUALISATIONS



Appendix

Appendix B – Environment Agency Product 4 Data Package

Detailed Flood Map centred on Potato Wharf, Manchester, M3 4PU. Created on 26/03/2021 [GMMC209584SW]



1:10,001



Legend

-  Site Location
-  Model Measurements
-  Main River
-  Flood Zone 3
-  Flood Zone 2

					Undefended				
Map Reference	Model Node Reference	Easting	Northing	Data	4 % AEP (1 in 25 year)	1 % AEP (1 in 100 year)	1 % AEP (1 in 100 year) + 35% increase in flow	1 % AEP (1 in 100 year) + 70% increase in flow	0.1 % AEP (1 in 1000 year)
1	BRGW01_0877	383274	397508	Modelled Water Level (m aodN)	25.57	25.74	25.95	26.18	26.42
				Modelled Flow (cumecs)	38.44	46.14	54.87	63.18	68.98
2	BRGW01_0600	383066	397558	Modelled Water Level (m aodN)	25.53	25.70	25.92	26.16	26.35
				Modelled Flow (cumecs)	38.40	46.12	54.77	62.65	74.97
3	GTSB_L_0022	382971	397659	Modelled Water Level (m aodN)	25.52	25.69	25.91	26.15	26.34
				Modelled Flow (cumecs)	8.18	8.67	9.19	10.12	11.51
4	MEDZ01_0107	382658	397479	Modelled Water Level (m aodN)	23.56	23.64	23.76	23.84	24.15
				Modelled Flow (cumecs)	30.18	31.46	33.25	34.58	39.69
5	BRGW01_0138	382675	397377	Modelled Water Level (m aodN)	25.29	25.30	25.33	25.36	25.48
				Modelled Flow (cumecs)	21.39	28.28	36.10	42.30	49.76

Model data taken from Medlcock SFRA 2011

AEP - Annual Exceedence Probability

m aodN - metres above ordnance datum Newlyn

cumecs - cubic metres per second

Notes:

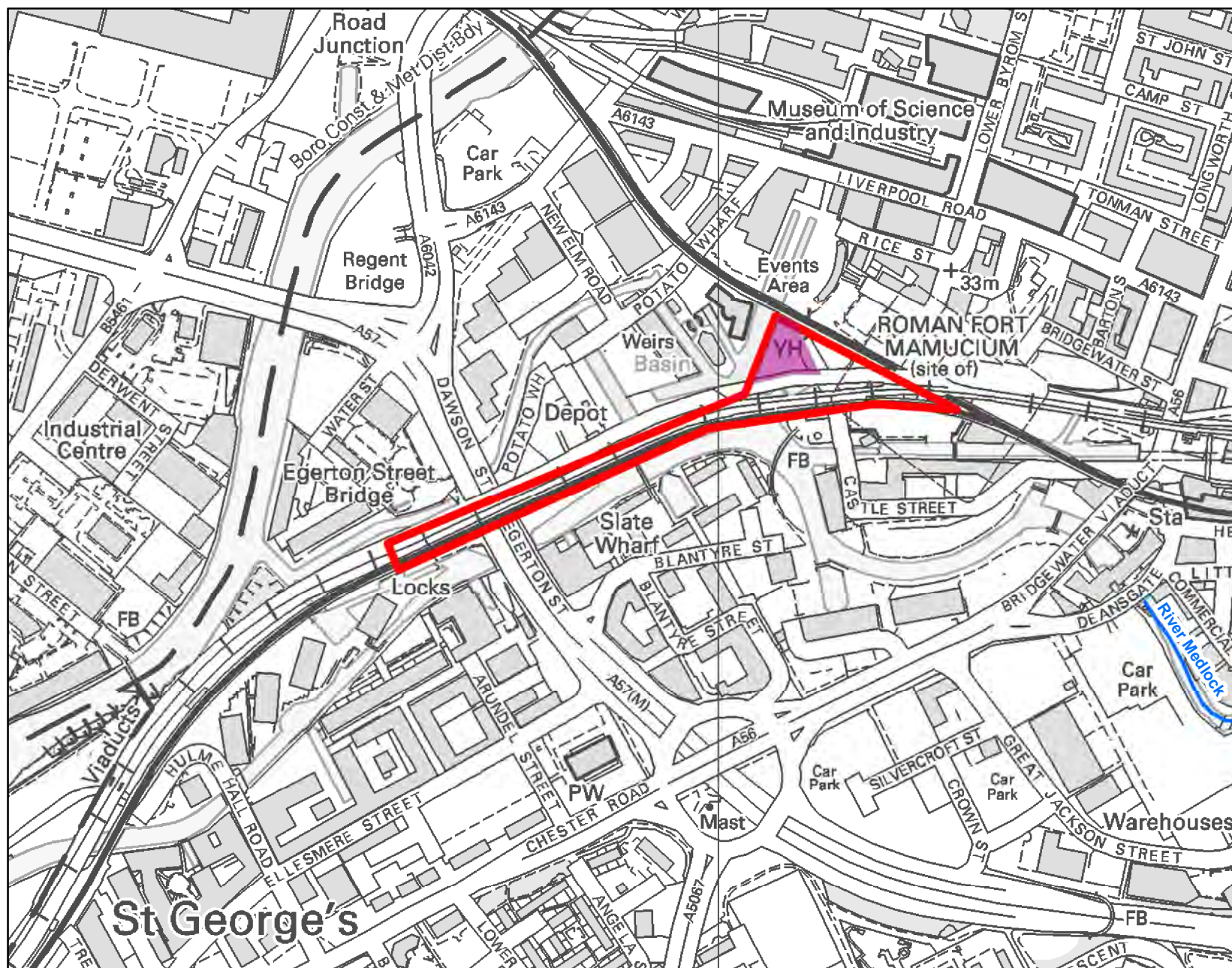
*Climate Change Scenario - 35% and 70% increases in flow calculated for the 2080's (2070 - 2115). Please see <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances> for more information regarding the new climate change guidance.

The location of the site and the type (vulnerability) of development determine the climate change allowances to consider in any flood risk assessment.

Recorded Flood Outlines

Flood Event Code	Name	Start Date	End Date	Source of Flooding	Cause of Flooding
27631	Bridgewater Canal - Castlefield	21/12/1991	22/12/1991	Other	Other

Recorded Flood Outline Map centred on Potato Wharf, Manchester, M3 4PU. Created on 26/03/2021 [GMMC209584SW]



1:5,000



Legend

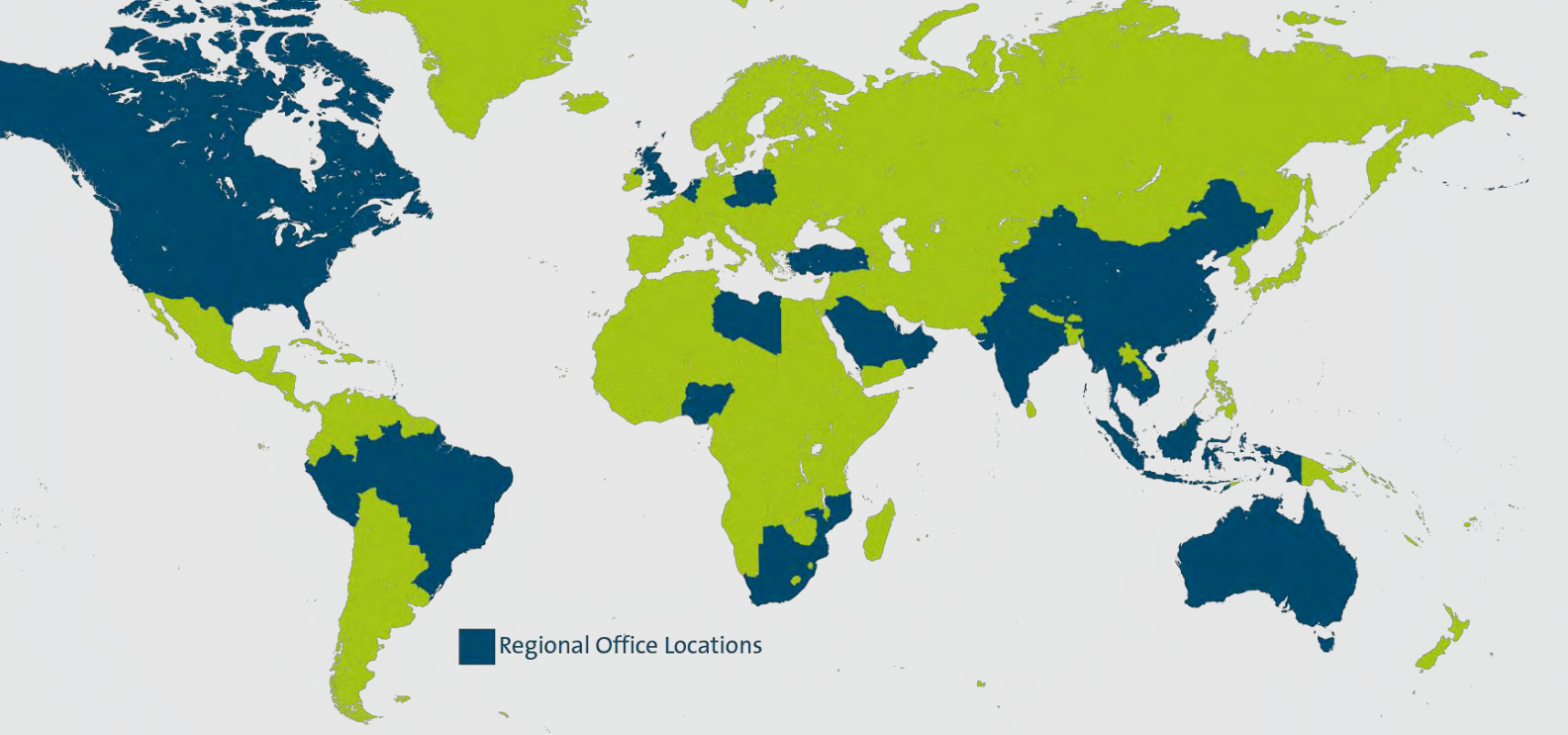
 Site Location

Recorded Flood Outline

Start Date

 21/12/1991

 Main River



Royal HaskoningDHV is an independent, international engineering and project management consultancy with over 138 years of experience. Our professionals deliver services in the fields of aviation, buildings, energy, industry, infrastructure, maritime, mining, transport, urban and rural development and water.

Backed by expertise and experience of 6,000 colleagues across the world, we work for public and private clients in over 140 countries. We understand the local context and deliver appropriate local solutions.

We focus on delivering added value for our clients while at the same time addressing the challenges that societies are facing. These include the growing world population and the consequences for towns and cities; the demand for clean drinking water, water security and water safety; pressures on traffic and transport; resource availability and demand for energy and waste issues facing industry.

We aim to minimise our impact on the environment by leading by example in our projects, our own business operations and by the role we see in “giving back” to society. By showing leadership in sustainable development and innovation, together with our clients, we are working to become part of the solution to a more sustainable society now and into the future.

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