

Technical Note

Project Mayfield Appointments 2020
Subject Hydraulic Modelling – Mayfield Park Design Changes
Project no 0046688
Date 11 February 2022

Revision	Description	Issued by	Date	Approved (signature)
00	Draft	HM	03.12.2021	JF
01	Update to include modelling of Engine Base	HM	17.12.2021	JF
02	Update following EA review	HM	11.02.2022	JF

1 Introduction

1.1 Purpose

This Technical Note has been prepared by Buro Happold to summarise the hydraulic modelling that has been carried out to assess the impact of amendments to the layout of the Mayfield Park development that have been proposed since consent was granted under planning application ref. 124972/FO/2019, hereafter referred to as the 'design changes'.

This revision (Rev. 02) has been updated following a review by the Environment Agency (EA). Clarification has been added to Section 3.3.1 regarding the proposed levels and landscape drawings.

1.2 Hydraulic Modelling Background

Detailed hydraulic modelling of Mayfield Park was carried out by Buro Happold between November 2020 and February 2021, as part of the work to discharge Condition 22 of planning application ref. 124972/FO/2019. The hydraulic modelling assessed the impact of the proposed Mayfield Park development on flood risk, within the site and elsewhere in Manchester, for the completed development and during the construction phase.

This Technical Note should therefore be read in conjunction with the following Buro Happold reports:

- Hydraulic Modelling – Mayfield Park Enabling Works (Rev. 01, dated 05/02/2021) – hydraulic modelling to assess the impact of the Mayfield Park development during the construction phase; and
- Hydraulic Modelling – Mayfield Park Full Build Out (Rev. 02, dated 20/04/2021) – hydraulic modelling to assess the impact of the Mayfield Park development in the case where all landscaping works are complete, referred to as the Full Build Out model.

The hydraulic modelling was approved by the EA in March 2021 and Condition 22 was discharged in May 2021.

1.3 Environment Agency Consultation

A meeting was held with the EA on the 9th November 2021 to discuss the design changes and their potential hydraulic impact. The following points were agreed with the EA:

- The location of the slide structures within the immediate Medlock flood plain requires hydraulic modelling to assess and quantify the impact of the structures on water levels in and around the site;
- The results will be compared with the previously approved Full Build Out model (197) and the BHE Baseline 2020 hydraulic model (142); and
- The design flood event will be the 1 in 100 year plus 35% climate change. Checks will also be undertaken for the 1 in 25 year and the 1 in 100-year return period events.

2 Proposed Design Changes

The landscape general arrangement plan for Mayfield Park is shown in Figure 2-1, including the annotations with the proposed design changes. The proposed design changes include the following, which have potential to be hydraulically significant, and therefore have an impact on the flood levels and extent in areas outside the site.

1. Addition of a footbridge and slide crossing the river at chainage 50m, with two tower structures either side of the channel, as shown in Figure 2-1; and
2. Pre-existing concrete / masonry structure, referred to as the 'engine base', discovered during excavation works within the Wildscape Area and proposed to be retained.

The design changes will be modelled sequentially, in the order presented above, in order to be able to determine the individual impact of each item.

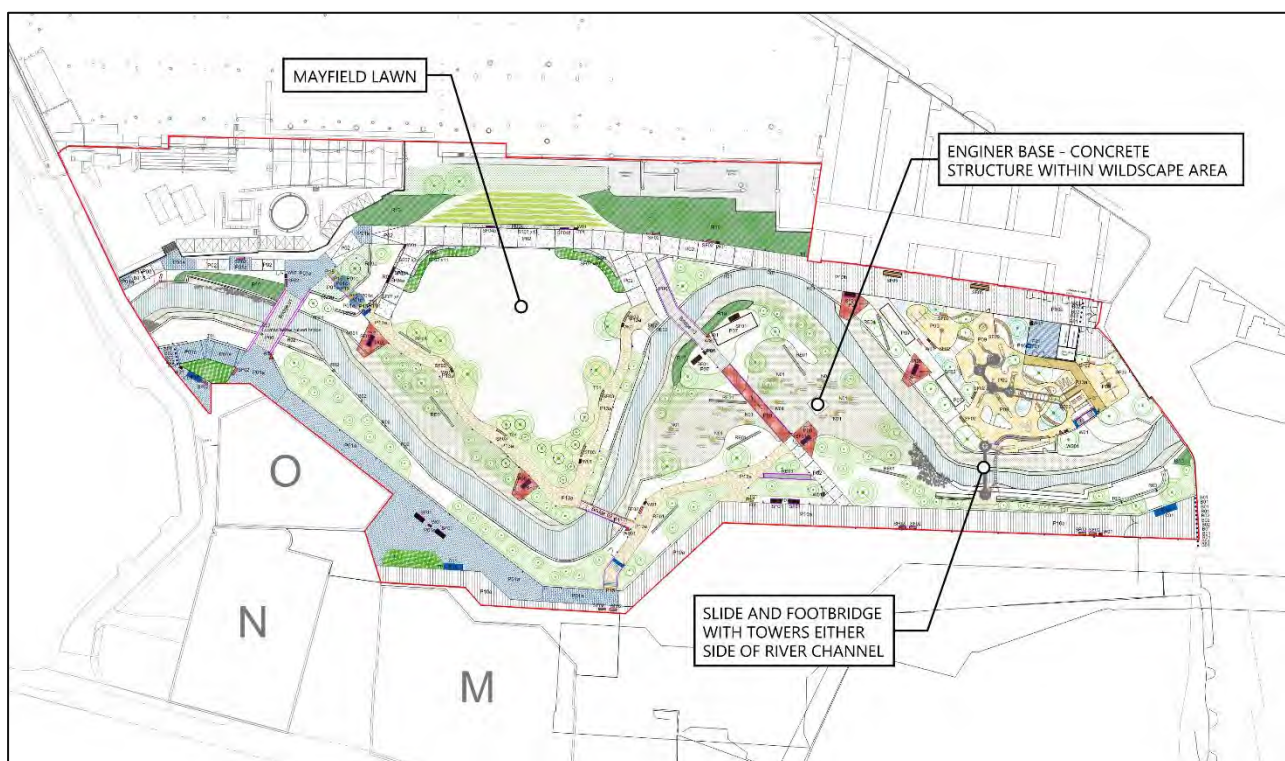


Figure 2-1: General arrangement plan with proposed design changes

3 Hydraulic Modelling

3.1 Design Flood Event

The design flood event is the 1 in 100 year plus 35% climate change. Checks will also be undertaken for the 1 in 25 year and the 1 in 100 year return period events. The results for each return period have been assessed and are included in this note.

The peak inflows for the return periods used in the BHE Baseline 2020 model as estimated in the 2019 Hydraulic Analysis report have been used in the Full Build Out model, and in the Design Changes model. These are summarised in Table 3-1.

Table 3-1: Summary of modelling elements in Baseline, Full Build Out and Design Changes models

Return period	Peak flood flow (m ³ /s)
1 in 25 year	49.92
1 in 100 year	63.09
1 in 100 year plus 35% Climate Change	85.17

3.2 Summary of Modelling Elements and Surveys

The following modelling elements were used for the model run including the proposed design changes, referred to as the Design Changes Model.

Table 3-2: Summary of modelling elements in Baseline, the Full Build Out and the Design Changes model

Model Element	BHE Baseline 2020 model	Full Build Out Model	Design Changes Model
Model reference	Medlock_SFRA_v0e_MM_002_BH_142	Medlock_SFRA_v0e_MM_002_BH_197	Medlock_SFRA_v0e_MM_002_BH_227
Software	Flood Modeller 4.4.1 combined with TUFLOW 2018-03-AD-ISP		
2D grid cell size	3mx3m		
Digital terrain model	Updated 1m resolution LiDAR data for Manchester, provided by the EA in 2019. Mayfield site topographic survey completed by Malcolm Hughes in July 2017.	As per baseline. Final landscaping and topography of the Mayfield site updated as per the latest masterplan drawings.	As per full build out model.
Information on hydraulic structures	Hydraulic structure information according to a survey completed by Atkins Consultants Ltd in July 2008.	As per baseline. Modelling of altered bridges included in the masterplan based on bridge design drawings.	As per full build out model. Modelling of the slide bridge structure based on the slide structure design drawings.

3.3 Methodology

Changes in flood risk caused by the proposed design changes included in the Design Changes Model have been assessed against each of the following model scenarios, to allow comparison against the existing site conditions and the approved Mayfield Park layout:

- BHE Baseline 2020 Model (numbered 142); and
- Phase 1 Full Build Out Model (numbered 197).

The Design Changes model (227) includes the following alterations from the Full Build Out model:

1D space:

- No change to the 1D space

2D space

- Manning's n roughness patch for the slide structure area
- Elevation patch for the engine base

3.3.1 2D Model Alterations

Table 3-3 details the amendments that have been made in the Design Changes Model to the 2D TUFLOW domain and how these changes relate to the Mayfield Park Full Build Out model. The 2D flood domain amendments have been based on the design drawings for the slide included in Appendix A.

The approach that has been followed includes a Manning's n roughness patch across the base of the slide structures as shown on Figure 3-1. A Manning's n value of 0.1 has been used in the 2D domain to represent the structure. This value is typically reserved for buildings within the flood plain. 2D domain cells with a value of 0.1 do permit some flow through them, however at a much-reduced rate. Therefore, representing a 'leaky wall' which is typical of most non flood defence buildings.

The two tower structures which support the slide, are designed such that the panels which sit below the maximum water level are detachable. In accordance with the Mayfield Park Flood Warning and Evacuation Plan (FWEP), these panels will be removed in the event of a flood warning, reducing the surface area of the structure interacting with high flow event and therefore reducing the impact that the structure has on flows.

It is noted that while the recommendation in the FWEP is for the slide panels to be removed in the event of a flood warning, there is a risk that a high flow event could occur with little or no warning. In order to assess the most conservative scenario, the slide structures in the Design Changes Model have therefore been modelled for the scenario where the panels remain in place. The model therefore represents the flow blockage that would occur if the panels were not removed.

The approach uses a Z shape polygon to represent the engine base by altering the elevations of the model DEM at that location to the roof levels of the engine base. The elevations have been raised to the top level of the block, set to 33.4mAOD. The structure is a concrete block with only a singular opening on the downstream face. Due to the low porosity the approach followed for the slide structure was not followed.

Following the review of Rev. 01 of this Technical Note by the EA and subsequent correspondence via email, the following statement is provided:

Other than the addition of the slide towers and engine base, there have been no changes to proposed levels since the approval of the Full Build Out model in March 2021. The topography represented by the Design Changes model is therefore in accordance with the following Gillespies landscape drawings, included in Appendix A:

- MAY101-WSL-EXT-GIL-DR-7060-0101 SHEET 1 OF 3 (Rev. B03, dated 21/01/2022)
- MAY101-WSL-EXT-GIL-DR-7060-0101 SHEET 2 OF 3 (Rev. B03, dated 21/01/2022)
- MAY101-WSL-EXT-GIL-DR-7060-0101 SHEET 3 OF 3 (Rev. B05, dated 23/01/2022)



Figure 3-1: 2D domain model alteration to represent the slide structure and the wildscape engine base

Table 3-3: Mayfield park TUFLOW 2D model amendments for the Design Changes Model

TUFLOW Control File	Based on	Files Added	Files Removed	Description
Medlock_ER_Q100_35CC_MM_001_BH_227.tcf	Medlock_ER_Q100_35CC_MM_001_BH_197.tcf	Medlock_ER_3m_BH_227.tgc	Medlock_ER_3m_BH_197.tgc	The TUFLOW control file (tcf) is updated with the new TUFLOW Geometry Control (tgc) file,
Medlock_ER_3m_BH_227.tgc	Medlock_ER_3m_BH_197.tgc	Read GIS Mat == mi\2d_mat_SlideBase_R_219B.shp Read GIS Z Shape == mi\2d_zsh_WSSstructure_R_220.shp	None	<p>The tgc file includes an additional materials layer to represent the slide structures in the 2D domain either side of the Medlock channel. The materials layer is set to 0.1 mannings n, representing a building or structure.</p> <p>The tgc file includes an additional Z shape layer to represent the top of the engine base structure that has been retained within the wildscape area. The elevation has been set to 33.4mAOD to represent the roof elevation.</p>

3.4 Results

The following results sections review the impact of the Design Changes Model against first the Full Build Out Model and then against the BHE Baseline 2020 model. This provides an understanding of the impact of just the inclusion of the Design Changes when comparing against the Full Build Out Model, as well as an understanding of the overall impact should the proposed Design Changes become a part of the full build out plan.

The impact on the results are assessed by impact on depth with a tolerance of +/- 15mm in accordance with previous analysis and reporting, as well as an impact on flood extent.

3.4.1 Comparison to Full Build Out

Figure 3-4, Figure 3-3, and Figure 3-4 show the impact of the Design Changes model on the flood water levels both upstream and downstream of the site compared against the Full Build Out Model for the 1 in 25 year, the 1 in 100 year and the 1 in 100 year plus 35% climate change return period events. The key changes are:

- No changes in water level greater than 15 mm in the 1 in 25 year flood event.
- No changes in water level greater than 15 mm in the 1 in 100 year flood event.
- No changes in water level greater than 15 mm in the 1 in 100 year plus 35% allowance for Climate Change flood event.



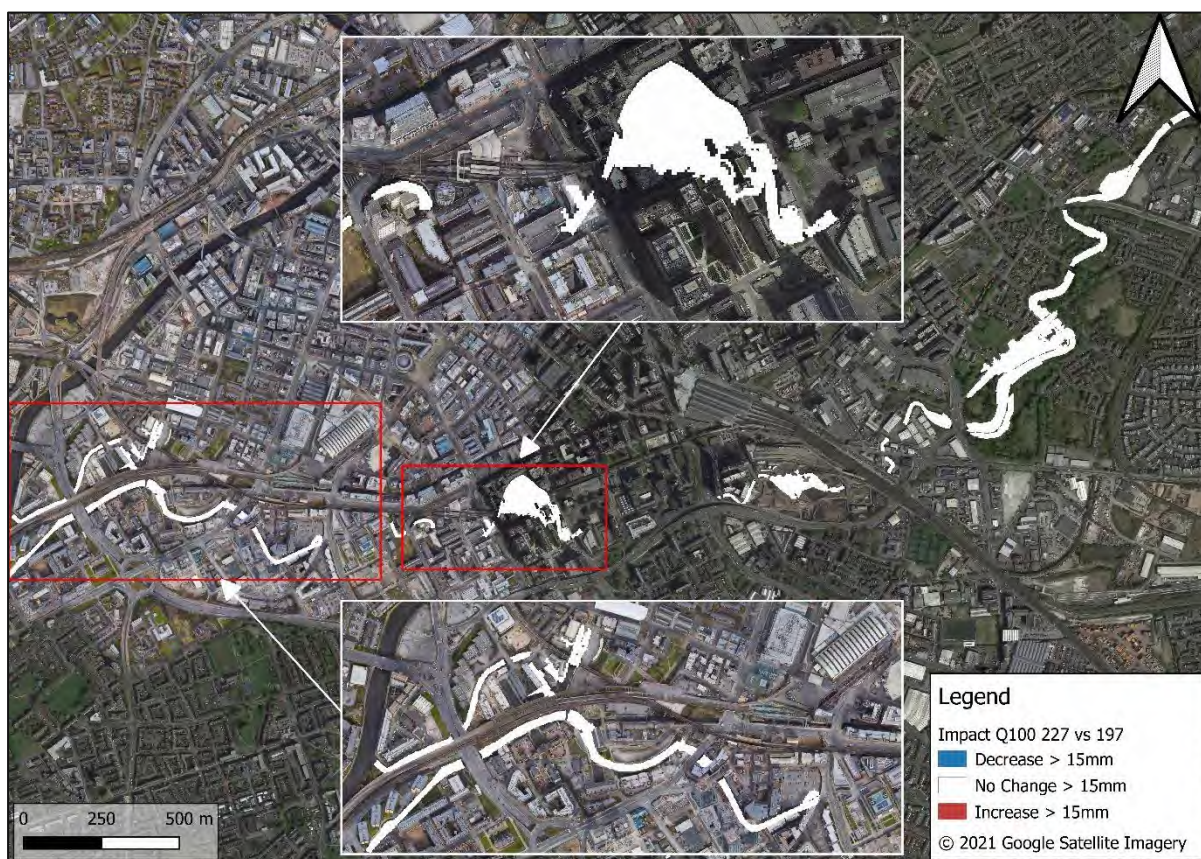


Figure 3-3: Impact on flood water levels as a result of the Design Changes Model (227) as compared to the Full Build Out Model (197) for the 1 in 100-year return period event

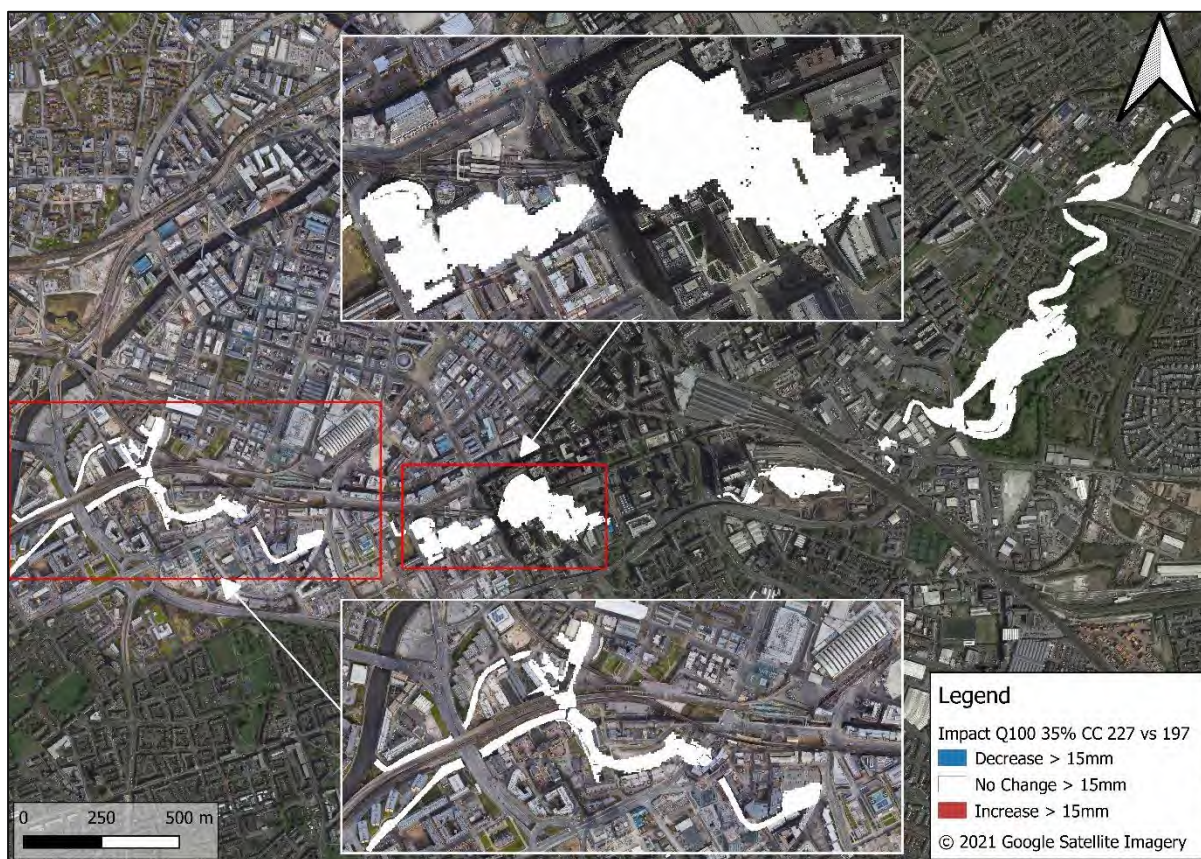


Figure 3-4: Impact on flood water levels as a result of the Design Changes Model (227) as compared to the Full Build Out Model (197) for the 1 in 100 year plus 35% climate change return period event

Table 3-4 summarises the impact of the Design Changes model on the maximum recorded 1D water levels upstream, immediately downstream and further downstream of the site. The locations that the data is summarised from is shown on Figure 3-5.

Table 3-4: Impact of the Design Changes model on the maximum recorded 1D water levels, compared to the Full Build Out model

Model Run	Change in level compared to Full Build Out model (197)								
	Upstream of site			160m downstream of site			>700m downstream of site		
	Q25	Q100	Q100 +35% CC	Q25	Q100	Q100 +35% CC	Q25	Q100	Q100 +35% CC
Design Changes Model (227)	<0mm	<1mm	<6mm	<0mm	<0mm	<6mm	<0mm	<2mm	<0mm

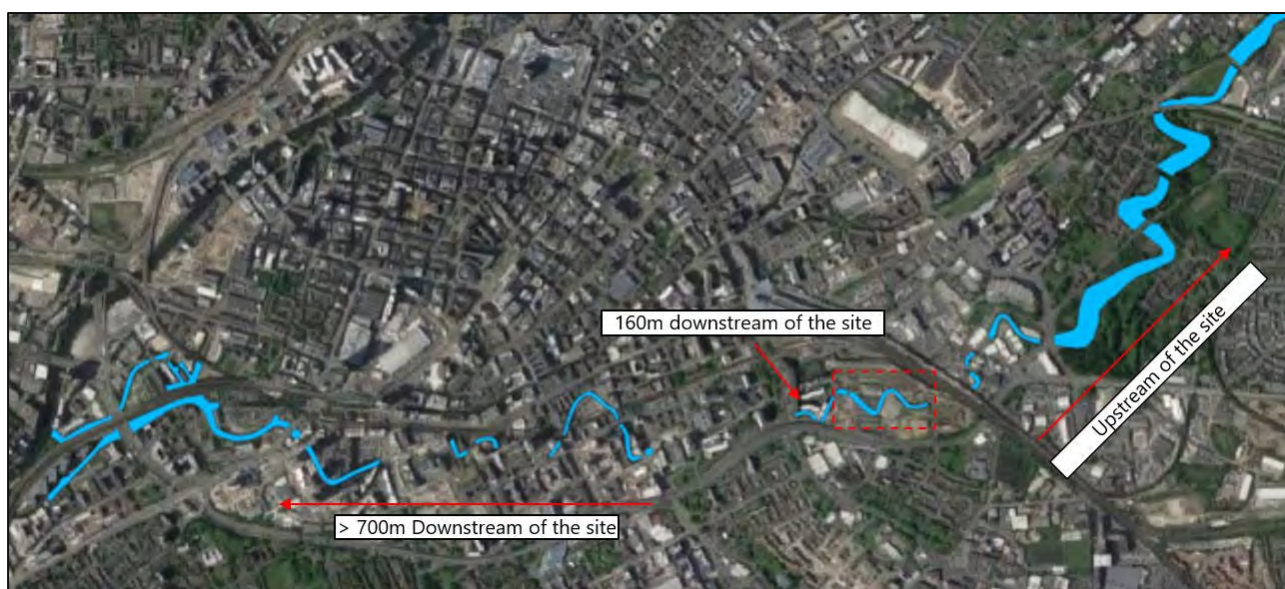


Figure 3-5: Key locations summarised in Table 3-4 and Table 3-5

Figure 3-6, Figure 3-7, and Figure 3-8 show the impact of the Design Changes Model (227) on the flood extent both upstream and downstream of the site for the 1 in 25 year, the 1 in 100 year and the 1 in 100 year plus 35% climate change return period event respectively. Extents have been compared against the Full Build Out Model (197). The key changes are:

- No changes in extent upstream nor downstream of the site for the 1 in 25 year return period event;
- No changes in extent upstream nor downstream of the site for the 1 in 100 year return period event;
- No changes in extent upstream nor downstream of the site for the 1 in 100 year plus 35% climate change return period event.

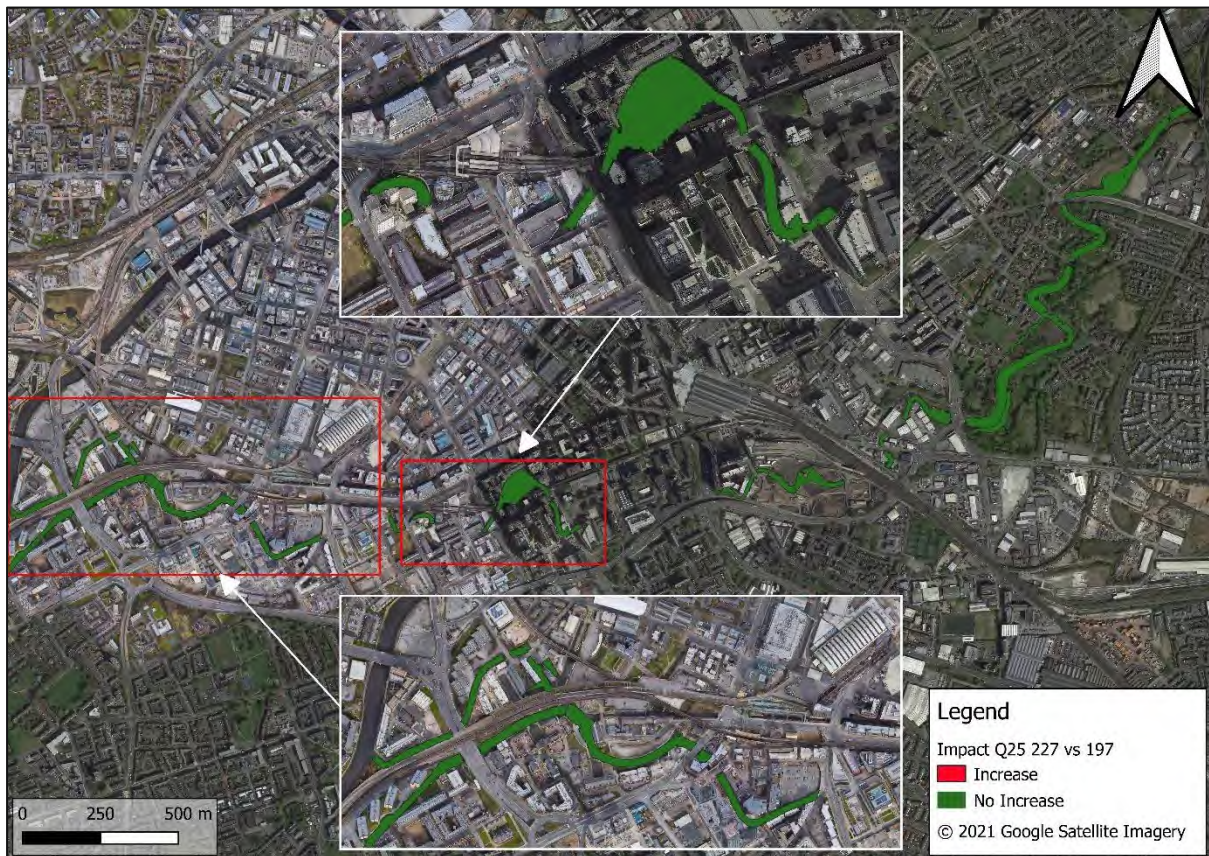


Figure 3-6: Impact on flood extent as a result of the amended Design Changes Model (227) as compared to the Full Build Out Model (197) for the 1 in 25 year return period event

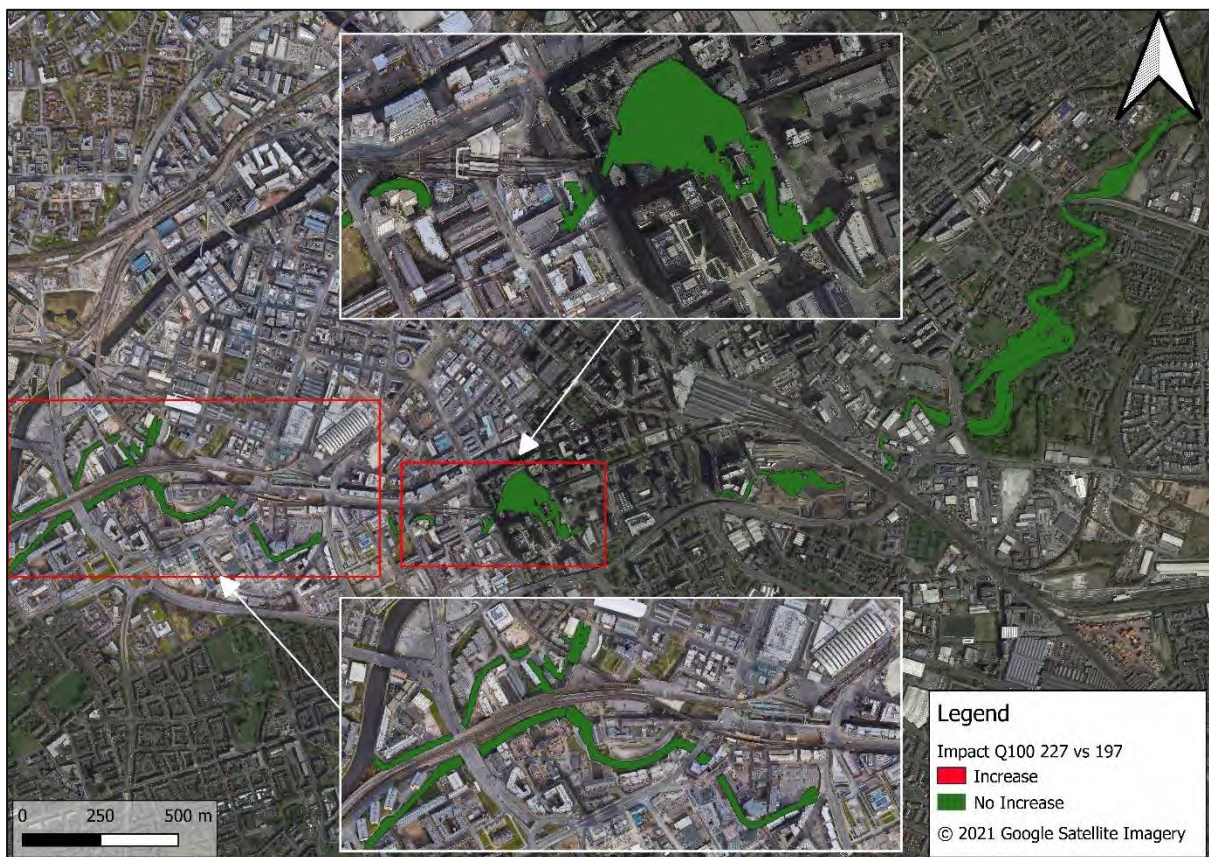


Figure 3-7: Impact on flood extent as a result of the amended Design Changes Model (227) as compared to the Full Build Out Model (197) for the 1 in 100 year return period event

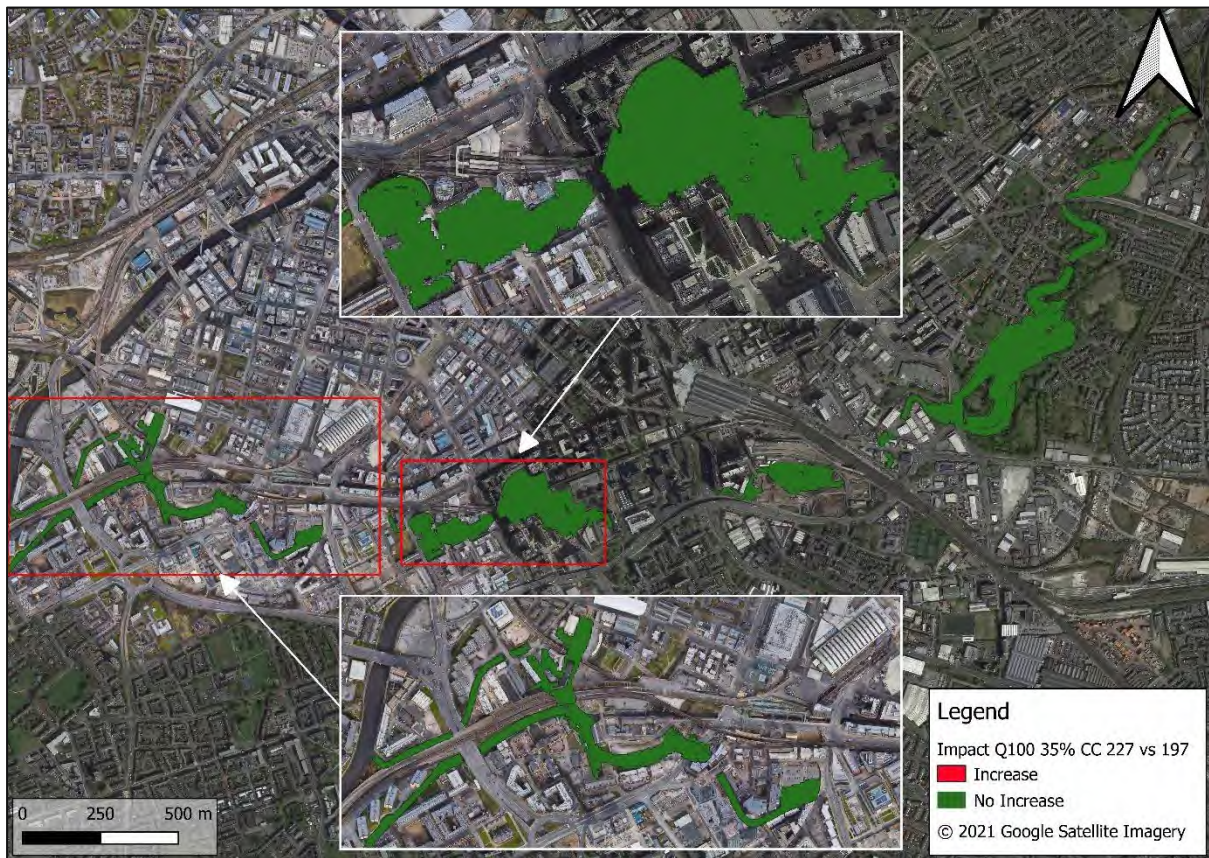


Figure 3-8: Impact on flood extent as a result of the amended Design Changes Model (227) as compared to the Full Build Out Model (197) for the 1 in 100 year plus 35% climate change return period event

3.4.2 Comparison to BHE Baseline 2020

Figure 3-9, Figure 3-10, and Figure 3-11 show the impact of the Design Changes model on the flood water levels both upstream and downstream of the site compared against the BHE Baseline 2020 model for the 1 in 25 year, the 1 in 100 year and the 1 in 100 year plus 35% climate change return period events. The key changes are:

- No increases in water level greater than 15mm in the 1 in 25 year event upstream and downstream of the site. Some localised decreases in water level downstream of the site greater than 15mm.
- No changes in water level greater than 15mm upstream of the site in the 1 in 100 year flood event. Some increases in water level greater than 15mm downstream of the site. The water level changes in this location are < 15.3mm therefore are only marginally outside of the threshold.
- No changes in water level greater than 15mm upstream of the site in the 1 in 100 year plus 35% allowance for Climate Change flood event. Decreases in water level greater than 15mm downstream of the site.

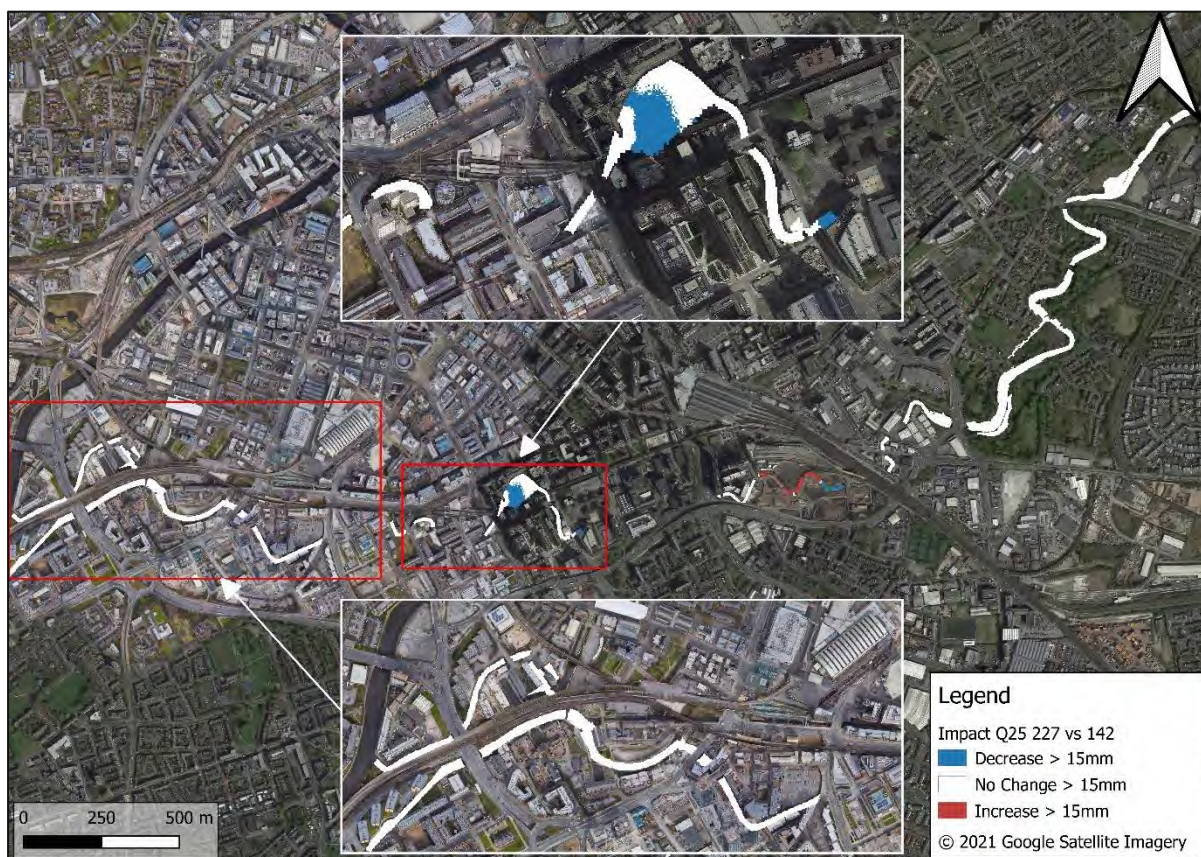


Figure 3-9: Impact on flood water levels as a result of the Design Changes Model (227) as compared to the BHE Baseline 2020 model (142) for the 1 in 25 year return period event

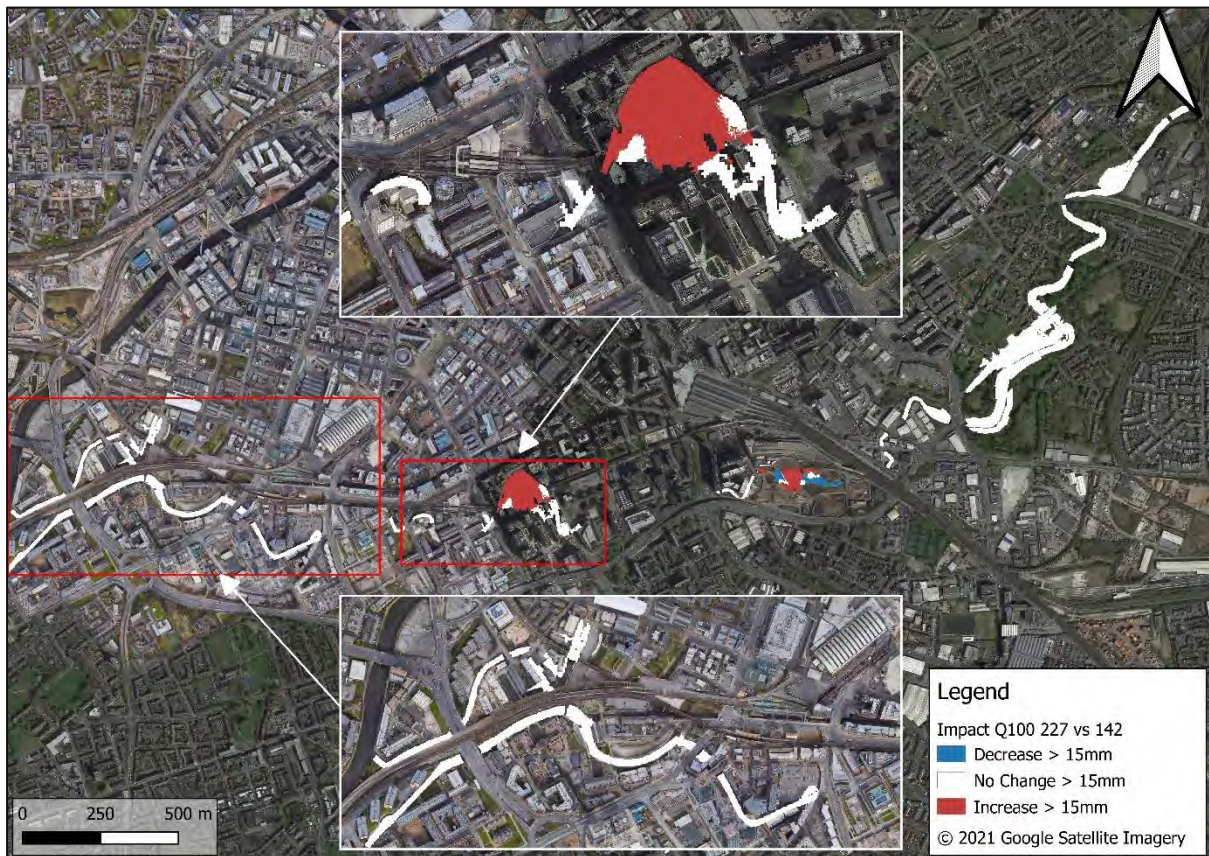


Figure 3-10: Impact on flood water levels as a result of the Design Changes Model (227) as compared to the BHE Baseline 2020 model (142) for the 1 in 100 year return period event

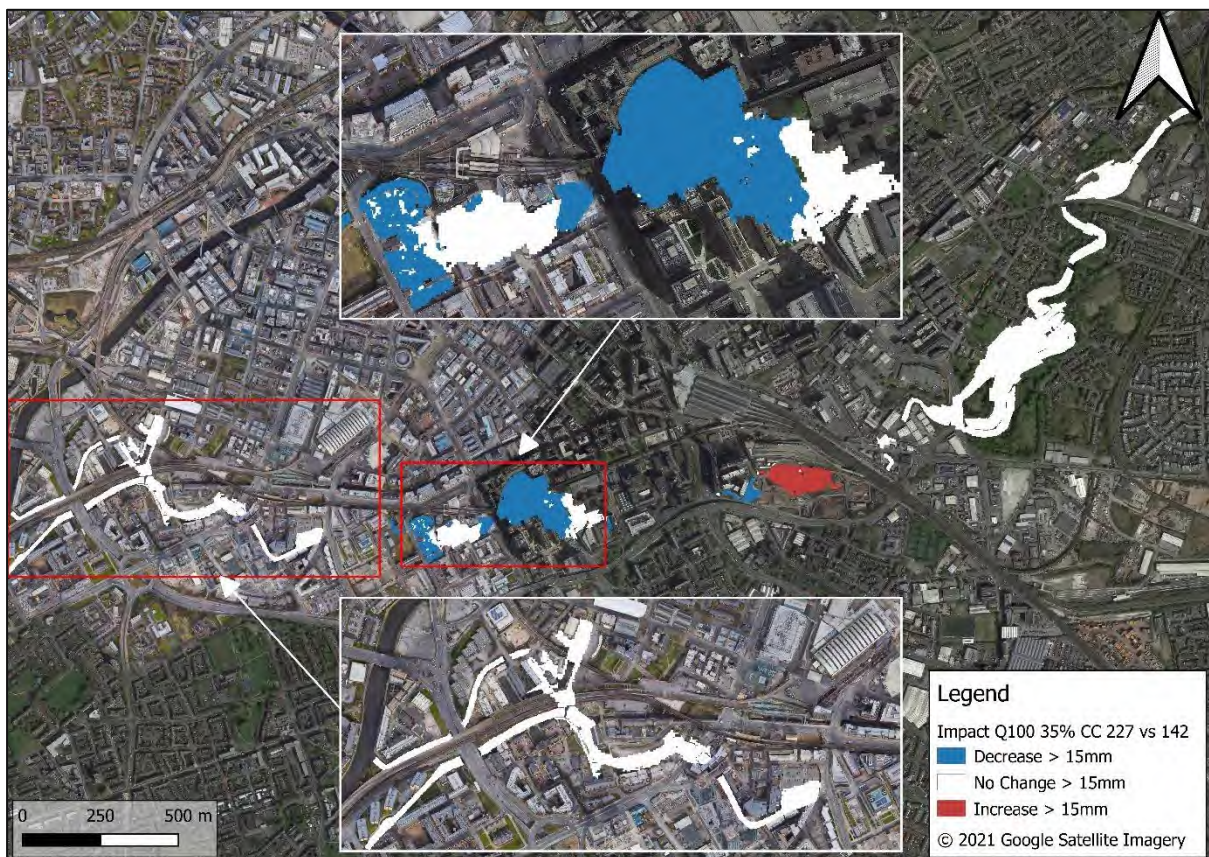


Figure 3-11: Impact on flood water levels as a result of the Design Changes Model (227) as compared to the BHE Baseline 2020 model (142) for the 1 in 100 year plus 35% climate change return period event

Table 3-5 summarises the impact of the Design Changes model on the maximum recorded 1D water levels upstream, immediately downstream and further downstream of the site. The locations that the data is summarised from is shown on Figure 3-5.

Table 3-5: Impact of the Design Changes model on the maximum recorded 1D water levels, compared to the BHE Baseline 2020 model

Model Run	Change in level compared to BHE Baseline 2020 (142)								
	Upstream of site			160m downstream of site			>700m downstream of site		
	Q25	Q100	Q100 +35% CC	Q25	Q100	Q100 +35% CC	Q25	Q100	Q100 +35% CC
Design Changes Model (227)	<0mm	<9mm	<15mm	<0mm	<0mm	<15mm	<0mm	<15.3mm	<1mm

Figure 3-12, Figure 3-13, and Figure 3-14 show the impact of the Design Changes Model (227) on the flood extent both upstream and downstream of the site for the 1 in 25 year, the 1 in 100 year and the 1 in 100 year plus 35% climate change return period event respectively. Extents have been compared against the Full Build Out Model (197). The key changes are:

- No changes in extent upstream nor downstream of the site for the 1 in 25 year return period event;
- No changes in extent upstream nor downstream of the site for the 1 in 100 year return period event;
- No changes in extent upstream nor downstream of the site for the 1 in 100 year plus 35% climate change return period event.

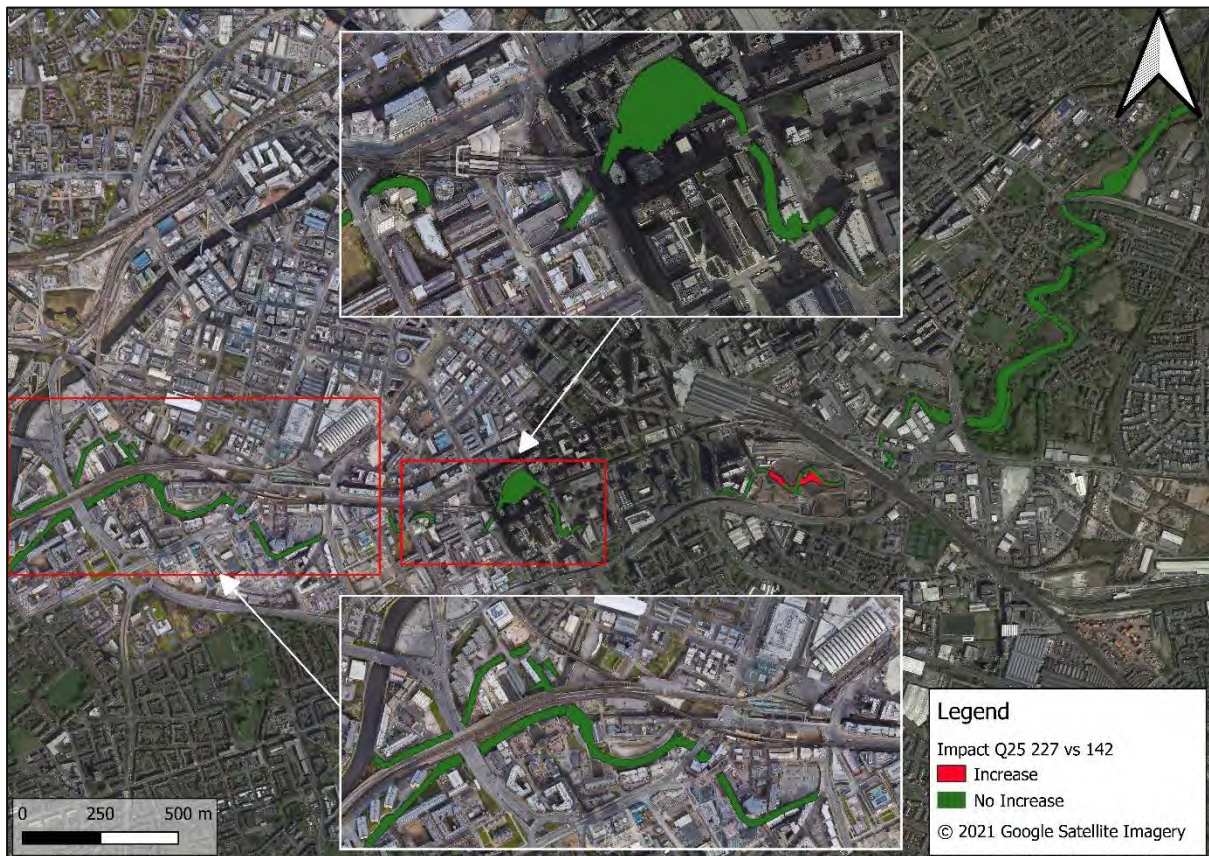


Figure 3-12: Impact on flood extent as a result of the amended Design Changes Model (227) as compared to the BHE Baseline 2020 model (142) for the 1 in 25 year return period event

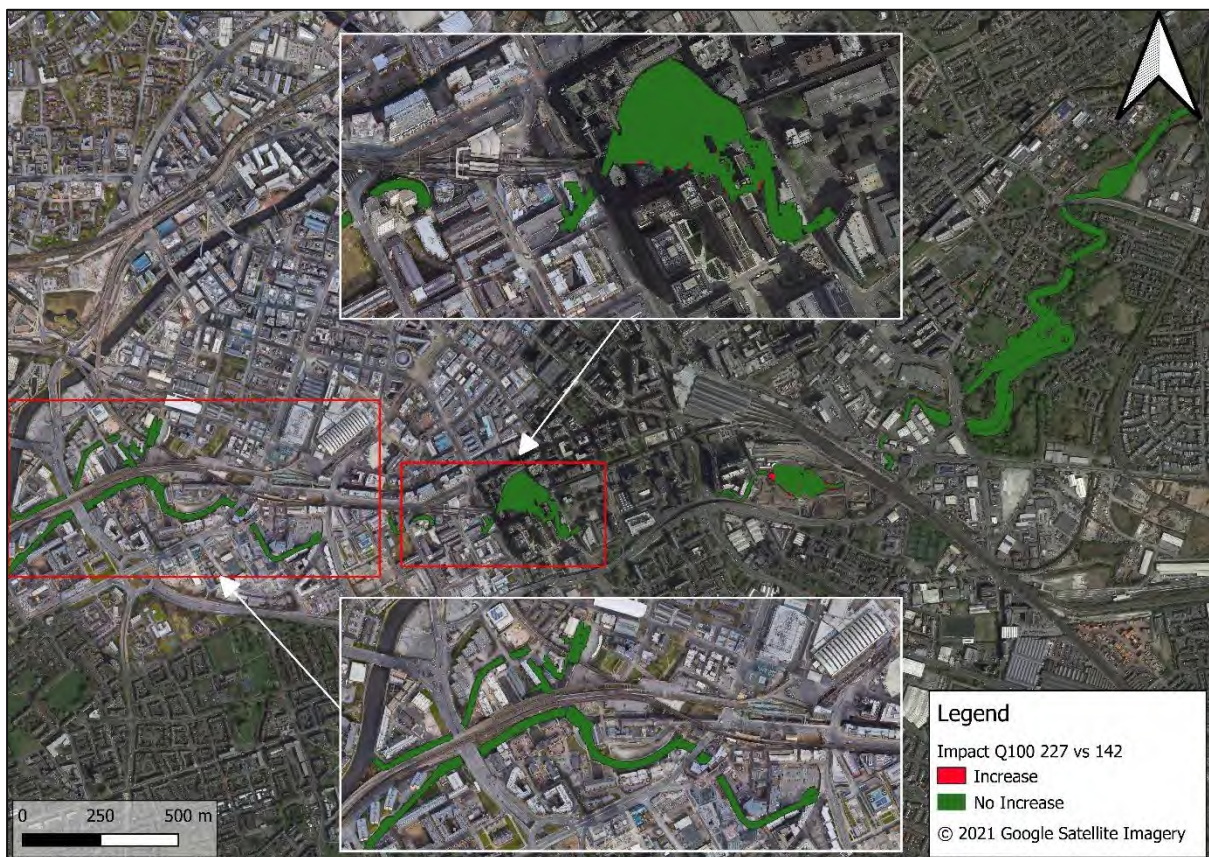


Figure 3-13: Impact on flood extent as a result of the amended Design Changes Model (227) as compared to the BHE Baseline 2020 model (142) for the 1 in 100 year return period event

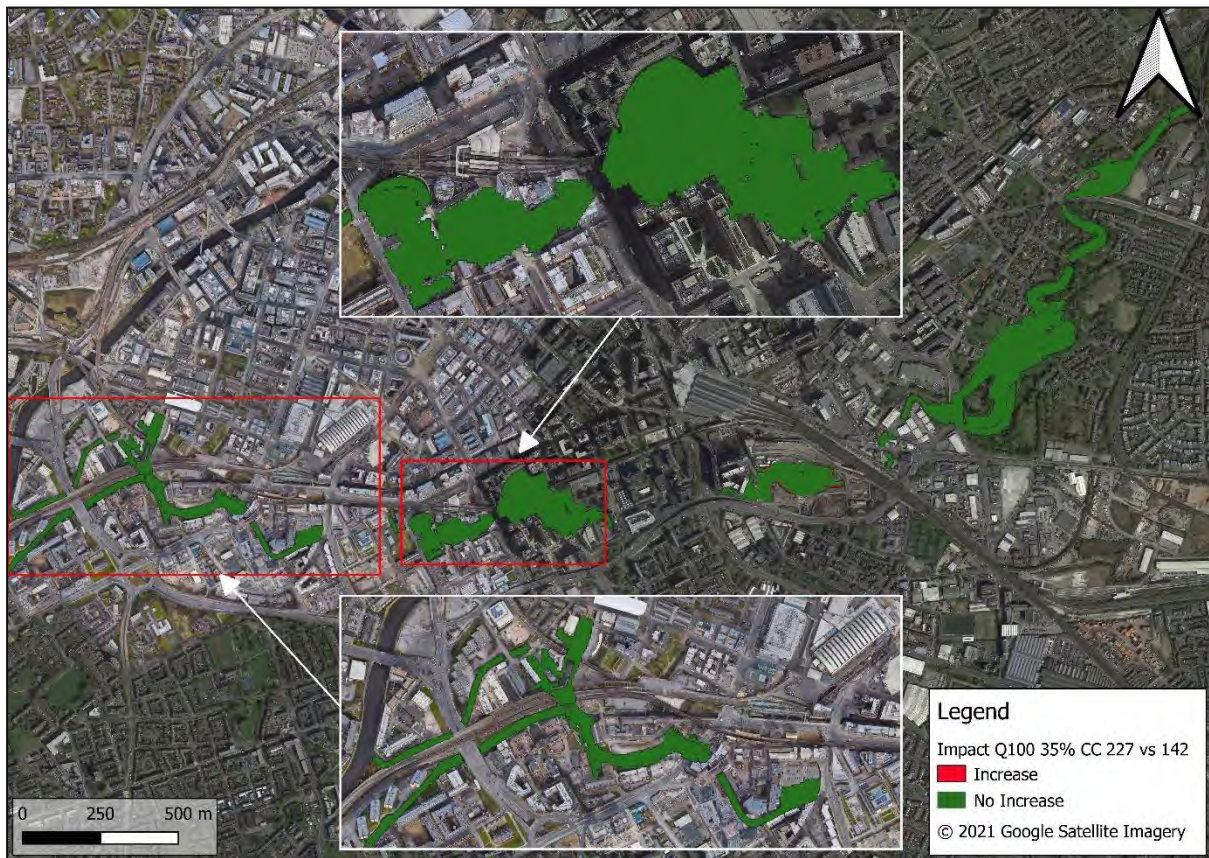


Figure 3-14: Impact on flood extent as a result of the amended Design Changes Model (227) as compared to the BHE Baseline 2020 model (142) for the 1 in 100 year plus 35% climate change return period event

4 Summary and Conclusion

This Technical Note provides a description of the hydraulic modelling carried out to assess the impact of amendments to the layout of the Mayfield Park Development that have been proposed since consent was granted under planning application ref. 124972/FO/2019.

The proposed design changes include the following:

1. Addition of a footbridge and slide crossing the river at chainage 50m, with two tower structures either side of the channel; and
2. Pre-existing concrete / masonry structure, referred to as the 'engine base', discovered during excavation works within the Wildscape Area and proposed to be retained.

The two structures supporting the slide interact with the 1 in 100 year or greater return period event. The design and location of these structures is described in Appendix A. The Design Changes Model (227) has been developed to represent these structures in the hydraulic model.

The engine base interacts with all of the return periods studied in this technical note. The design and location of this structure is described in Appendix A. The design changes model (227) has been developed to represent this structure in the hydraulic model.

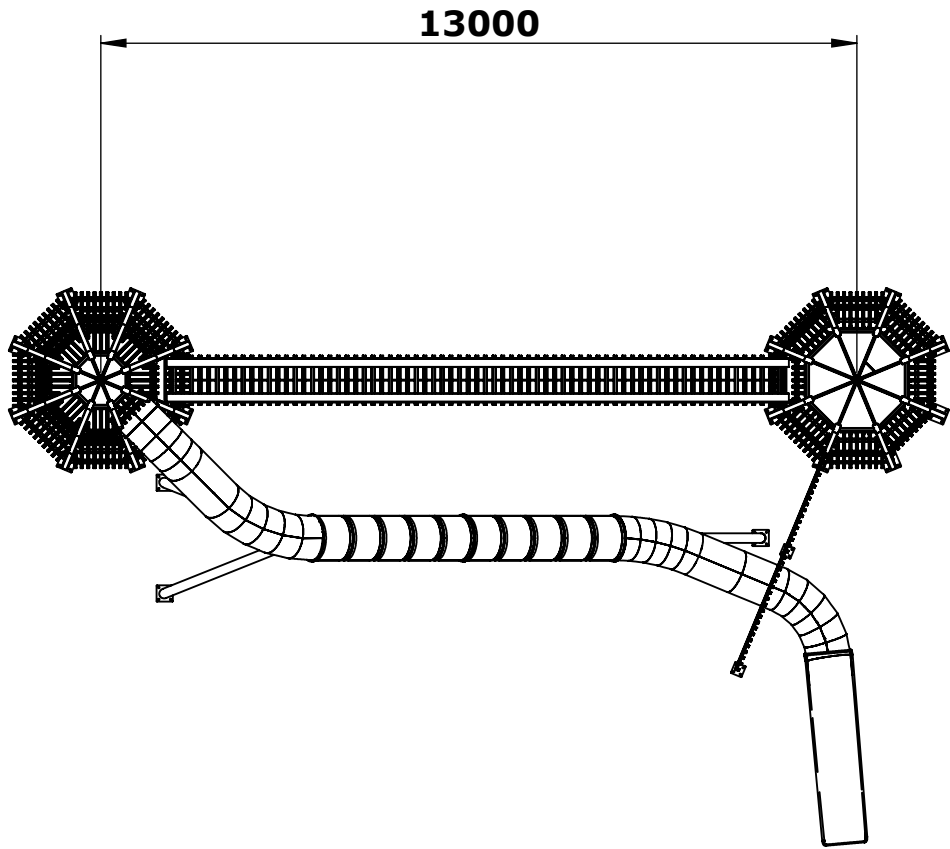
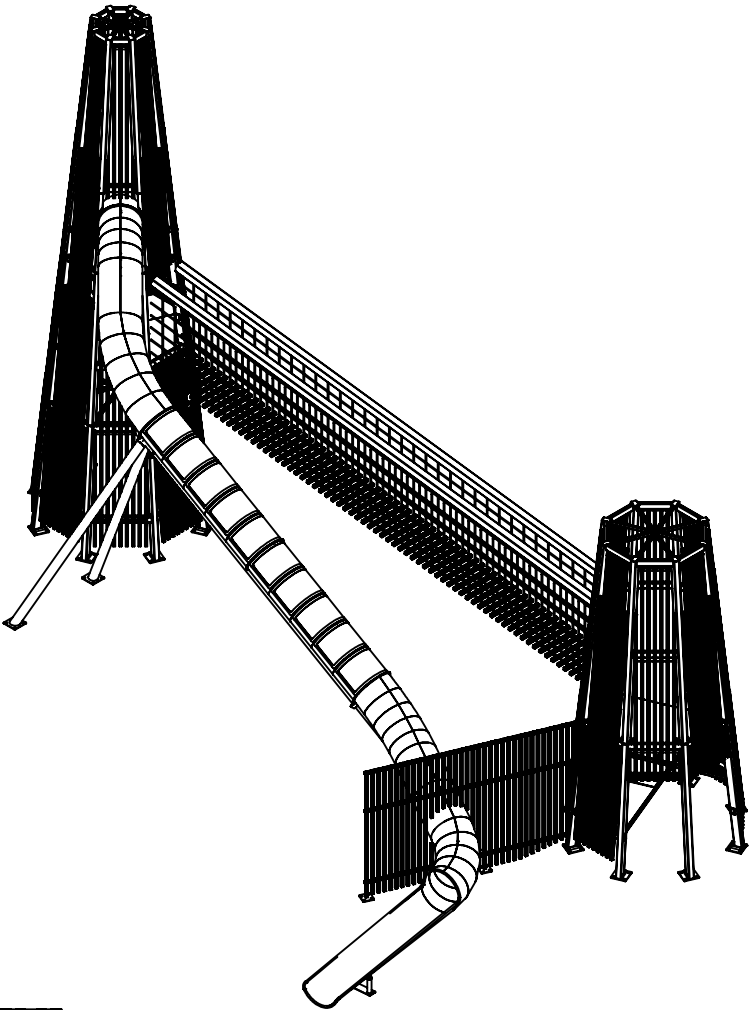
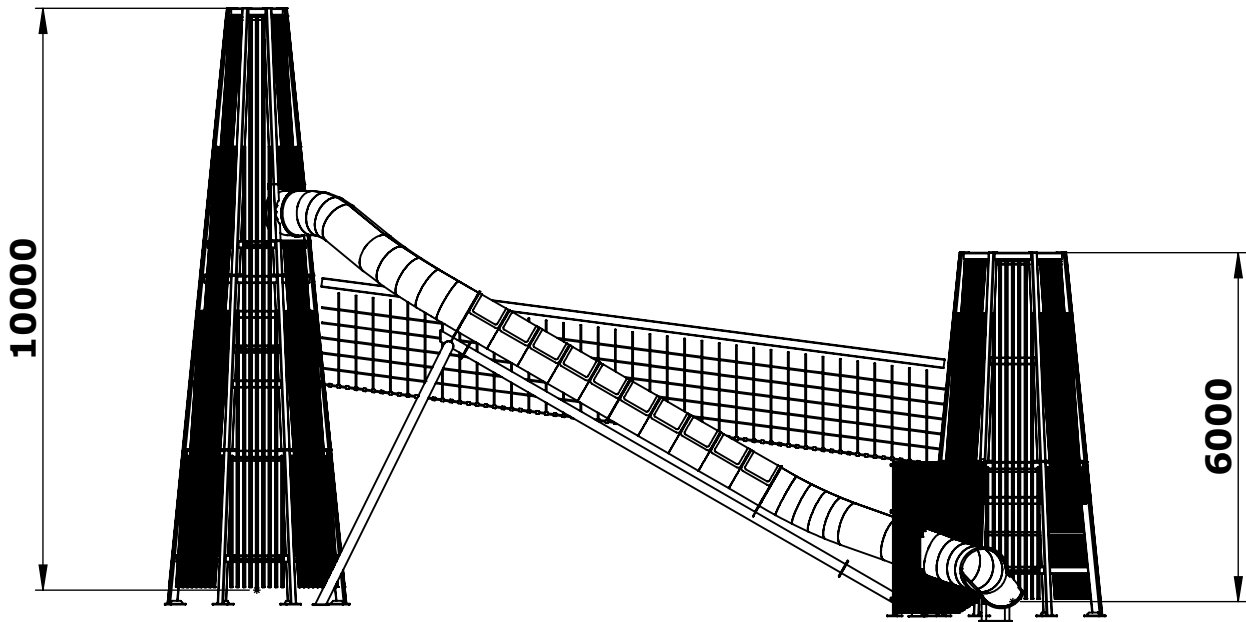
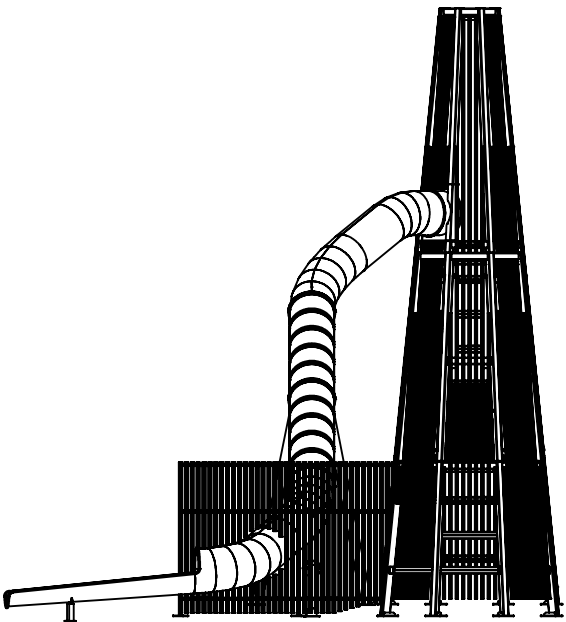
The results have been compared against the Full Build Out Model (197) to quantify the impact of the proposed design changes, compared to the previously approved hydraulic modelling of the Mayfield Park Development.

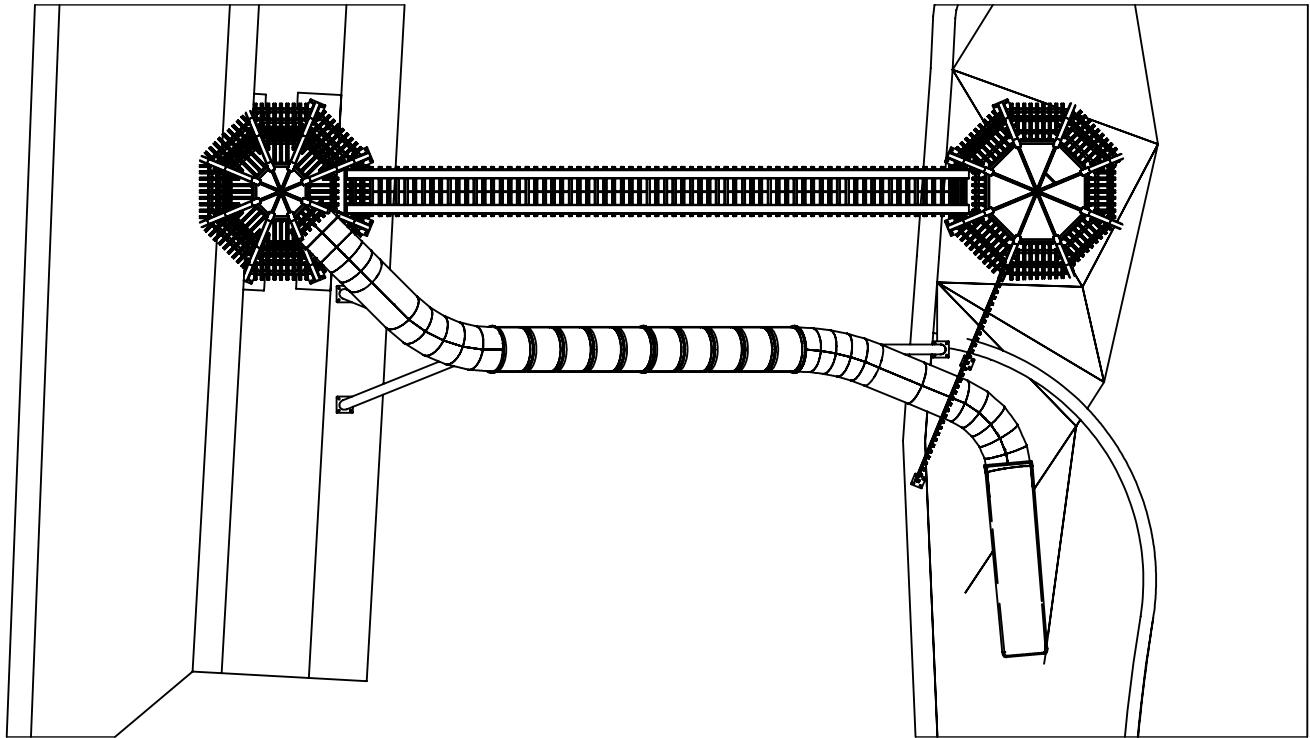
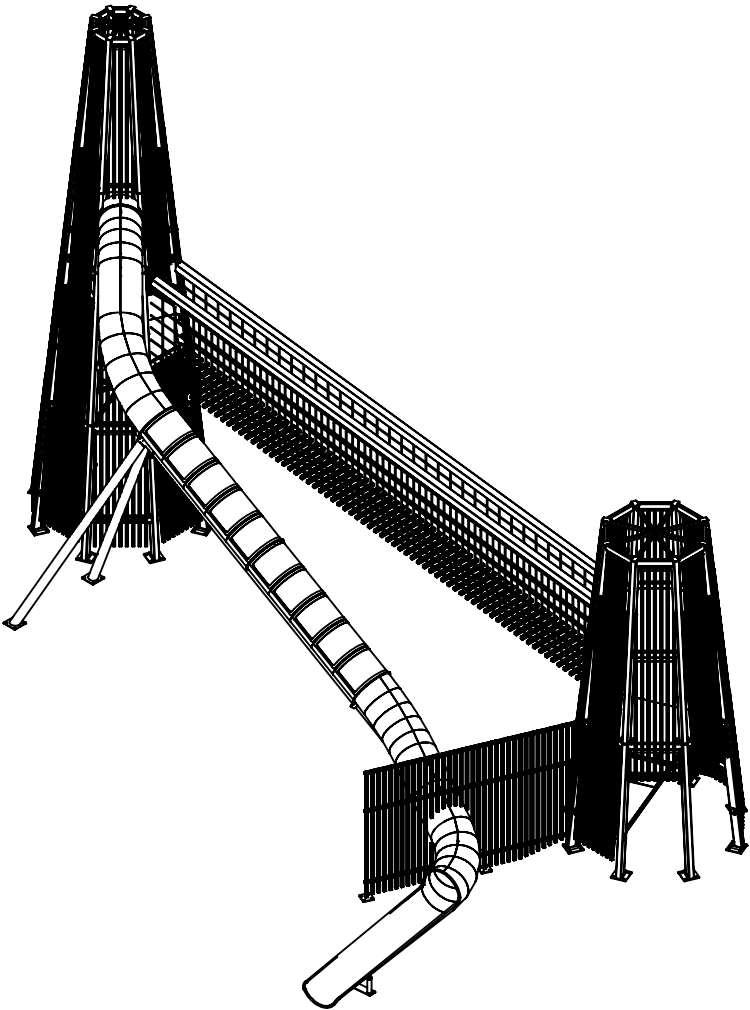
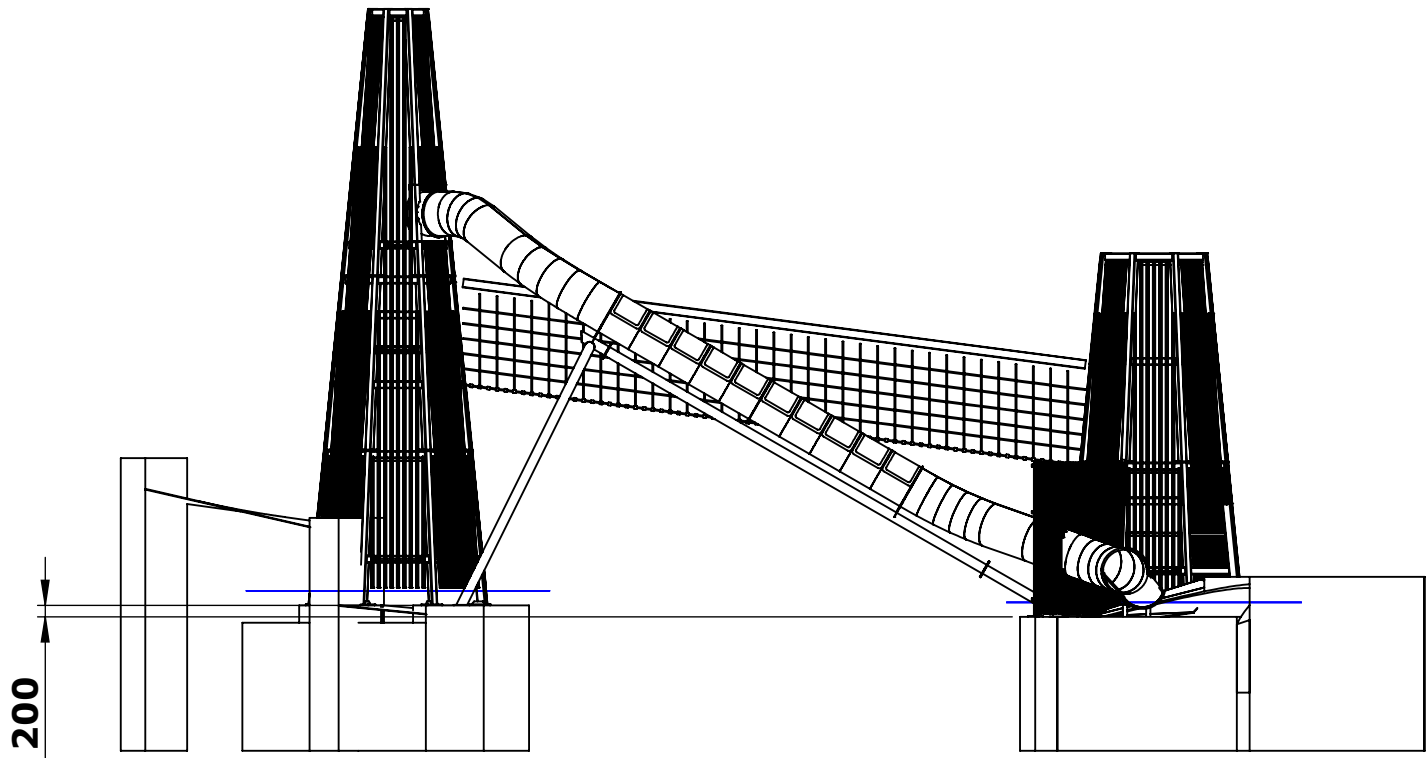
The results have also been compared against the BHE Baseline 2020 Model (142) to quantify the cumulative impact of Mayfield Park development, including the design changes, on the baseline site hydraulics. It is intended that the Design Changes model (227), if approved by the EA, becomes the new Full Build Out model for the Mayfield Park development.

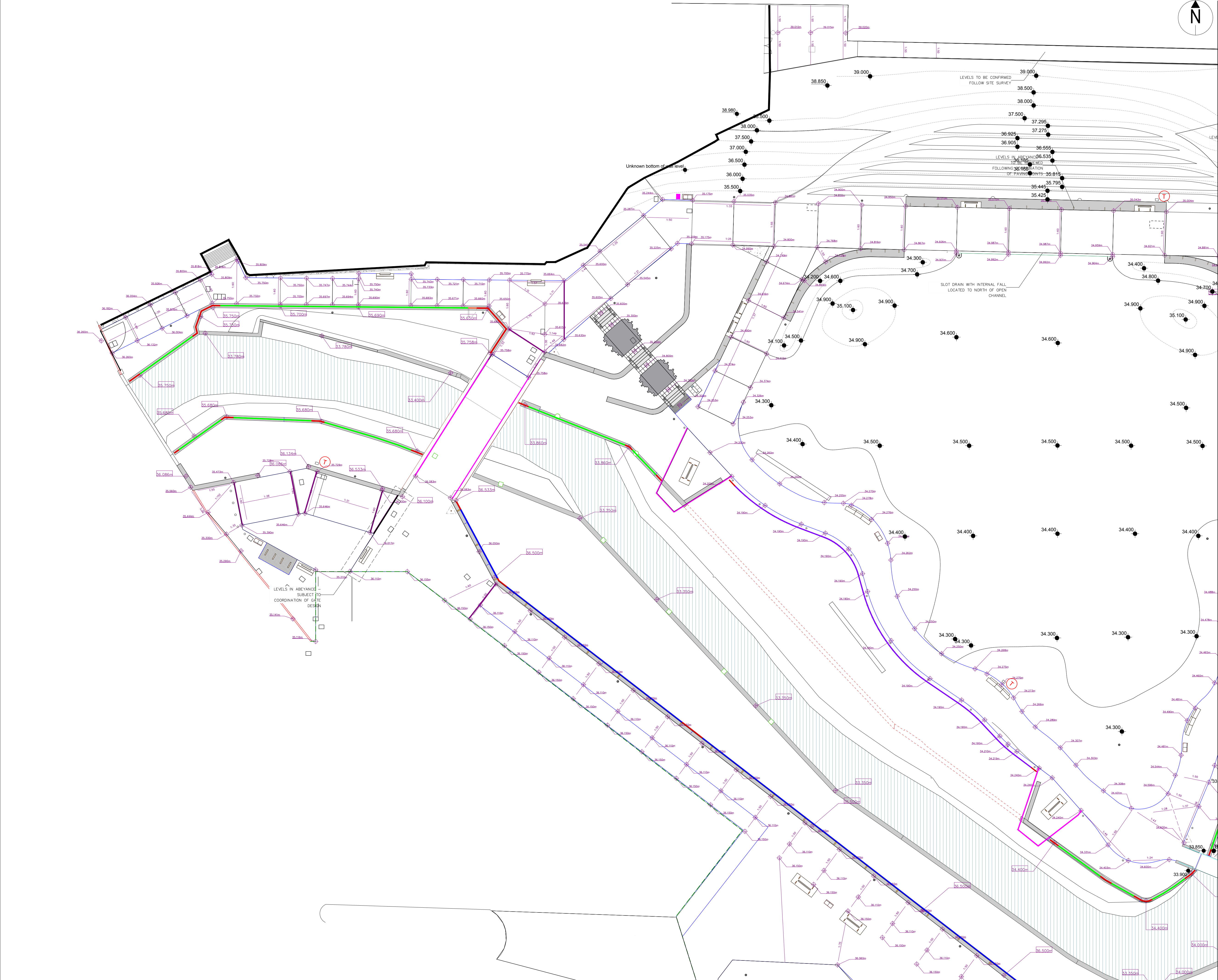
The results of the Design Changes Model (227) compared against the Full Build Out Model (197) show that the combined impact of the slide structure and the engine base is slight. The slide structures inhibit some of the flow, and result in a build up in head immediately upstream of the slide. However compared to the BHE Baseline 2020 Model (142), the changes in depth are within the 15mm tolerance established for approval of the previous Full Build Out model in March 2021.

The results of the Design Changes Model are considered to be in line with the conclusions reported in the 2019 FRA which accompanied the original planning application, and demonstrate that the inclusion of the proposed design changes within the Mayfield Park development does not cause an adverse impact on flood levels or extent, either upstream or downstream of the site.

Appendix A Design Drawings







rev	details	by	date
01	Levels adjusted to accommodate archeology, existing concrete and improve gradients	JF	23.04.21
02	Gradients added	JF	11.05.21
03	Headwall levels amended	JF	16.06.21
04	Status updated to S4	JF	03.08.21
05	Levels adjusted where shown. Area adjacent to Baring St omitted	JF	24.09.21
06	Top of wall level adjusted	JF	28.09.21
B01	Revision changed to B01	JF	12.10.21
B02	Scale Changed to 1:200. Levels along top of Mayfield bank altered to allow 1:50 crossfall	JF	19.10.21
B03	Levels in Wildlife area reverted back to tender and adjusted for engine base. Levels adjusted generally to hardworks areas	JF	21.01.22

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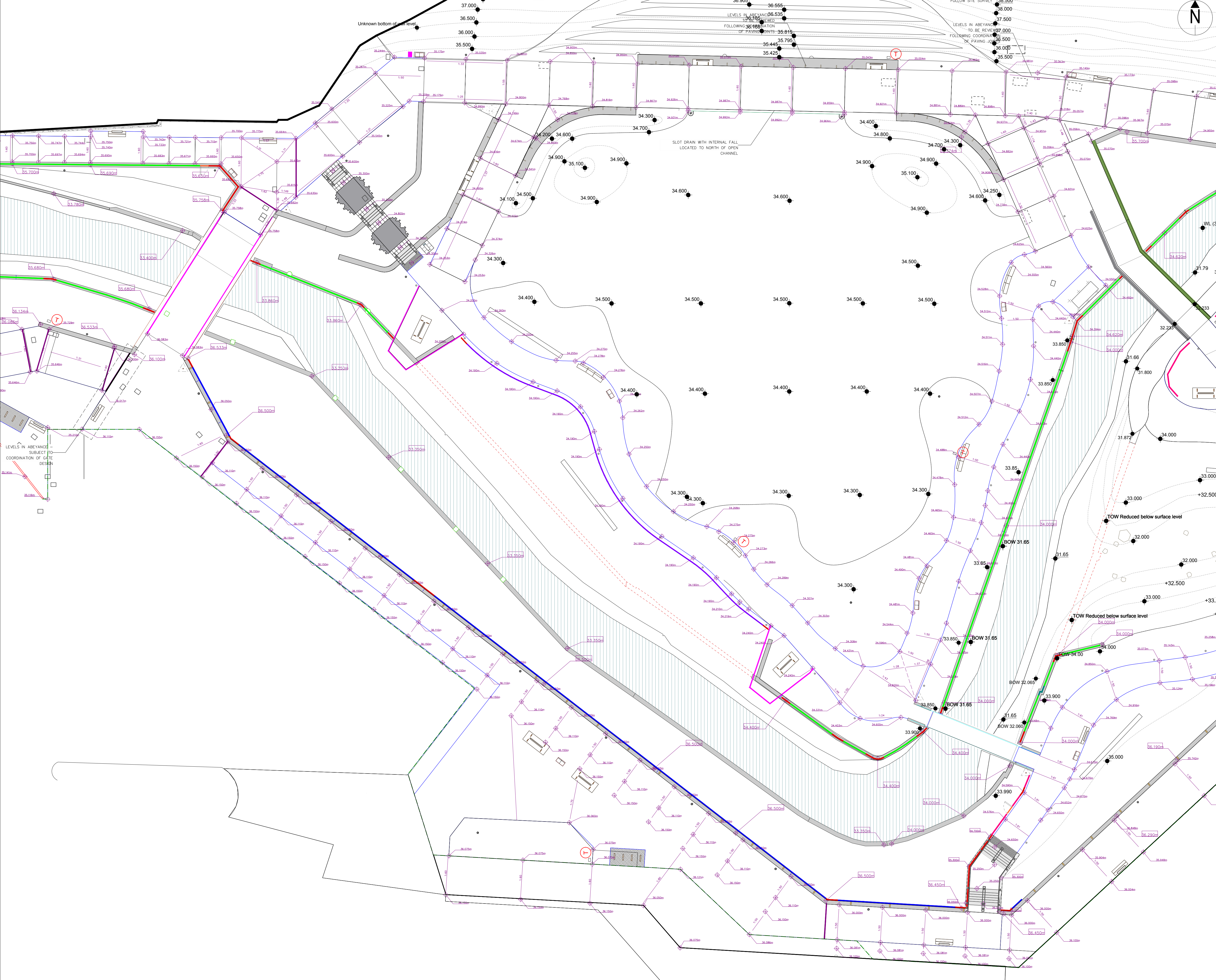
Drawing title
Landscape
Levels (1 of 3)

Drawing status B	Scale 1:200 @ A1	Drwn JF
	Date 23.04.21	Chk'd WC
Drawing number MAY101-WSL-EXT-GIL-DR-7060-0101		Rev 03

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01	Levels adjusted to accommodate archeology, existing concrete and improve gradients	JF	23.04.21
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B01	Revision changed to B01	JF	12.10.21
B02	Scale Changed to 1:200. Levels along top of Mayfield bank altered to allow 1:50 crossfall	JF	19.10.21
B03	Levels in Wildscape area reverted back to tender and adjusted for engine base. Levels adjusted generally to hardworks areas	JF	21.01.22

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Project title
Mayfield Park

Drawing title
Landscape
Levels (2 of 3)

Drawing status
B

Scale
1:200 @ A1

Date
23.04.21

Drwn
JF

Chk'd
WC

Rev

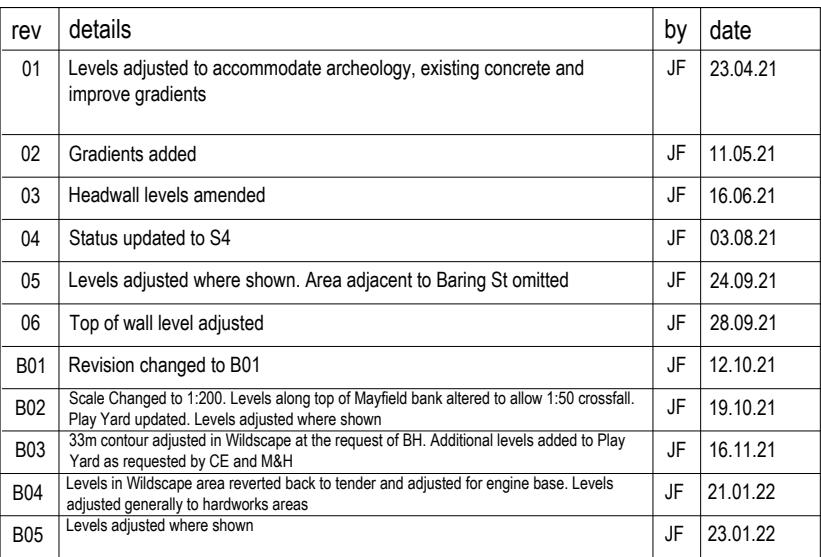
Drawing number
MAY101-WSL-EXT-GIL-DR-7060-0101

03



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