Addendum to VRC Wall & Mitigation Report

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Melbourne Water Corporation

Melbourne Water Lower Maribyrnong Flood Mapping Study
25 March 2024

Addendum to VRC Wall & Mitigation Report

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Executive summary

The Maribyrnong River Flood Event Independent Review Terms of Reference outlined a number of matters to be considered. Two of these required a flood model to allow investigation, specifically:

6. Examine whether the Flemington Racecourse flood protection wall contributed to the extent and duration of the Flood Event.

7. Review the efficacy of Melbourne Water's proposed conditions of approval and mitigation measures relating to the wall and their implementation.

This addendum to the VRC Wall & Mitigation Report (Jacobs, 2024b) has been produced to address Matter 7 and overall, three documents to present the modelling outcomes have been prepared:

- VRC Wall & Mitigation Report presented the results of modelling scenarios into Matter 6 (Jacobs, 2024b).
- Summary of Investigations – 2024 Maribyrnong River Flood Model and the VRC Flood Wall presented a summary of the findings of the modelled scenarios for both Matter 6 and Matter 7 (Jacobs, 2024c).
- Addendum to VRC Wall Mitigation Report (this report) presented the results of modelling scenarios into Matter 7 (this report).

All three documents should be read in conjunction with each other, and the suggested reading order is:

- Summary of Investigations – 2024 Maribyrnong River Flood Model and the VRC Flood Wall (Jacobs, 2024c).
- VRC Wall & Mitigation Report (Jacobs, 2024b).
- Addendum to VRC Wall Mitigation Report (this report).

Jacobs developed a 2024 Maribyrnong River Flood and this forms the basis of the following results and reporting as is reported in Jacobs 2024a (in preparation). This model is considered the best available information at the time of this report. In total three hydraulic model scenarios under October 2022 flow conditions were undertaken:

- Base Case – With the VRC flood wall and with the associated mitigation measures. This represents the current catchment conditions.
- Scenario 1 – without the VRC flood wall and associated mitigation measures (see Jacobs (2024b)).
- Scenario 2 – Without the associated mitigation measures.

The mitigation measures are:

- Footscray Rail Culverts (Northern Railway Culverts) – Approximately 70 m of earth roadway embankment removed downstream of the rail culverts lowering levels from 0.8 m AHD to 0.5 m AHD[1].
- Footscray Road Bridge – Removal of bluestone abutment located on the eastern edge of the channel.
- Footscray Road Bridge – Flow training wall constructed on the eastern embankment upstream and downstream of the bridge. Fargue spiral design to minimise the energy losses through the bridge.
    - While the training wall is understood to have been installed as designed, the cladding has fallen into disrepair over time and may not have functioned as designed in the October 2022 flood event.

Efficacy of the mitigation measures

The outcome of the modelling indicates that, for the October 2022 flood event, when the mitigation works are removed, there is a relatively minor change to the peak flood levels and a negligible impact on the extent and duration of the flood peak. Removing the mitigation measures were found to increases peak water levels

generally, with an increase of up to10 mm in the vicinity of Footscray Road bridge. These increases in water levels dissipates to less than 1 mm in the Maribyrnong River at Maribyrnong Township for the October 2022 event.

To definitively assess the efficacy of the mitigation measures, its necessary to compare the pre-flood wall conditions for the 2022 event to the current conditions (base case). This would allow the determination whether the mitigation measures are meeting the intended purpose of matching the conditions without the flood wall. However, this was not considered to be feasible as available pre-wall information was not commensurate with the information available current conditions; in particular the floodplain topographic levels and bathymetry available pre-wall are far sparser the current conditions.

In reaching this conclusion Jacobs notes the following:

- The modelling methodology and software which has assessed the mitigations measures differs to the methodology adopted at the time of the 2003 assessment.
- The representation of the mitigation works at Footscray Road Bridge within the current modelling software differs to the representation in the assessment completed at the time that it was approved in 2003. This is due to the different modelling techniques undertaken 20 years apart. The earlier work was completed using a 1D steady state model whereas the current model was a 2D unsteady model which used up to date data and had fewer assumptions.
- There have been changes to the floodplain in the last 20 years that may have contributed to flood changes in flood behaviour in the Maribyrnong River including the construction of Regional Rail Link, Ascot Chase Development, changes to Smithfield Road Bridge (Lynch's Bridge) and minor changes to landscaping and works on the banks of the Maribyrnong.
- The 2022 flood event is not the same event simulated for the VRC flood wall assessment completed at the time. The initial VRC flood wall assessment was undertaken using a 1% AEP event whereas the 2022 event had an estimated AEP of around 2%. As such the outcomes of this assessment does not preclude the ability for the mitigation works to have a difference influence on another flood event. This has not been investigated as part of this engagement.

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Abbreviations and definitions

1D Hydraulic Model	1-Dimensional hydraulic model where flood levels are determined by cross sections perpendicular to the flow path.
2D Hydraulic Model	2-Dimensional hydraulic model based on terrain/elevation data at a specified grid size. Capable of modelling floods across a floodplain where flow direction varies in space and time.
1D/2D Hydraulic Model	Coupled 1D/2D modelling, typically the floodplain would be represented in 2D and the main flow paths in 1D together with small scale hydraulic structures.
12d	A civil design software package that is use can be used to create a 3-dimensional surface from 3d data points
ARR 2019	2019 release of Australian Rainfall & Runoff Guidelines.
AEP	Annual Exceedance Probability. The probability that an event of a given size will be equalled or exceeded in a given year.
ARI	Average Recurrence Interval. The inverse of the AEP expressed as a return period. For instance, the 1% AEP is equivalent to the 100-year ARI event.
Afflux	Typically referred to as a change in a water level due to an obstruction.
Attenuation	The reduction in the peak flow and shape of a hydrograph due dissipation, friction and changes in the storage characteristics within a waterway.
Bathymetry	Survey representing the underwater terrain (elevation).
Conveyance	The capacity of a waterway to carry flows and is a function of geometry and bed resistance typically expressed as Manning's values.
FFA	Flood Frequency Analysis.
Floodplain storage	The area in a floodplain which is capable of storing flood waters during a flood event.
Freeboard	Freeboard is the difference between the floor level of a building and the 100-year ARI flood level
Hydrograph	A time series of flow which changes at each timestep and naturally captures the peak flood flow.
LiDAR	Light Detection and Ranging is a remote sensing method that uses light in the form of a pulsed laser to distance to the Earth.
m AHD	Meters Australian Height Datum.
m/s	Metres per second (a measure of speed / velocity).
m^3/s	Cubic metres per second (a measure of flow).
Manning's "n" value	A coefficient which represents the roughness of terrain on which water flows over.
MW	Melbourne Water Corporation.
Steady State	A modelling method where a constant flow is applied to a hydraulic model which then determines hydraulic properties such as water level and velocity.
Total Energy Line	The level to which the WSL rises if it were stationary. The TEL is always above the water surface and decreasing in a downstream direction. The difference between the WSL and the TEL is the velocity head which is the square of the velocity divided by twice the acceleration due to gravity. Sometime referred to as the Total Energy Level, Energy Grade Line or Gradient Line.
Unsteady State	A hydraulic modelling methodology where flows are applied that vary with time.

Water Surface Elevation	Water Surface Elevation, the surface of the water at a given point.
VRC	Victoria Racing Club

Terminology between ARI and AEP

When describing the magnitude of flood events, this report uses both Average Recurrence Interval (ARI) and Annual Exceedance Probability (AEP). The ARI terminology has generally been preferred to remain consistent with the work completed in the early 2000's and to avoid confusion when cross-referencing information.

Australian Rainfall and Runoff (ARR) 2019, recommends that rare events should be expressed as an Annual Exceedance Probability (AEP). AEP is the probability of an event being equalled or exceeded within a year and may be expressed as either a percentage (%) or 1 in X. For example, a 1% AEP event or 1 in 100 AEP has a 1% chance of being equalled or exceeded in any year.

Average Recurrence Interval (ARI) was a term commonly used in the past (ARR, 1987) and was defined as the average period between occurrences equalling or exceeding a given value. The use of terms such as "recurrence interval" and "return period" are no longer recommended as they imply that a given event magnitude is only exceeded at regular intervals, such as every 100 years. The term ARI has only been applied when referencing documents developed prior to the release of ARR 2019.

1. Introduction

Jacobs was approached in March 2023 and then commissioned by Melbourne Water in April 2023 to undertake flood modelling of the Lower Maribyrnong River for provision of updated flood information for the Lower Maribyrnong River. As part of this provision of updated flood information in the Lower Maribyrnong Flood Mapping project a new TUFLOW model (along with updated hydrological models) is being developed that is reflective of current catchment conditions, 2023 survey and terrain data, revised guidance from the introduction of ARR2019 (Australian Rainfall and Runoff 2019), modelled climate change scenarios, Melbourne Water Flood Mapping Project Specifications (Melbourne Water 2023) and developments in modelling methodology. This model is hereafter referred to as the 2024 Maribyrnong River Flood Model and will replace previous 2003 1D HEC-RAS models for the Lower and Mid Maribyrnong River. This work is currently in-progress and is due for completion in April 2024.

For the purpose of this report, Jacobs used the 2024 Maribyrnong River Flood Model developed for the Lower Maribyrnong Flood Mapping Project to assess the influence of the mitigation measures associated with the of the Flemington Racecourse flood protection wall (hereafter referred to as the VRC (Victorian Racing Club) flood wall), on the Lower Maribyrnong catchment, when subject to the October 2022 flood event.

1.1 Purpose of the addendum

The purpose of the addendum was to undertake modelling to understand the effectiveness of the VRC flood wall mitigation measures. This addendum presents the findings in the context of flood extent, level and duration of flooding experienced in the Lower Maribyrnong catchment as a result of the October 2022 flood event using the 2024 Maribyrnong River Flood Model. Specifically, to report and this addendum address two of the Matter raised in the Maribyrnong River Flood Event Independent Review Terms of Reference, namely:

6. Examine whether the Flemington Racecourse flood protection wall contributed to the extent and duration of the Flood Event.

7. Review the efficacy of Melbourne Water's proposed conditions of approval and mitigation measures relating to the wall and their implementation.

This addendum to the VRC Wall & Mitigation Report (Jacobs, 2024b) has been produced to address Matter 7 and overall, three documents to present the modelling outcomes have been prepared:

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- Addendum to VRC Wall Mitigation Report (this report).

The 2024 Maribyrnong River Flood Model is calibrated to the October 2022 event and this calibrated model forms the basis of this report. Details on the model setup and the calibration can be found in:

- A summary in Appendix a 2024 Maribyrnong River Flood Model in Jacobs 2024b.
- The draft calibration report (Jacobs, 2023i).

- The final report (Jacobs, 2024a)[1].

1.2 This report

This report presents the results of the investigation into the efficacy of the mitigation measures relating to the VRC wall. VRC Wall & Mitigation Report (Jacobs, 2024b) presents the findings of model run to investigate the impact of the VRC Flood Wall. These reports should be read in conjunction with each other.

[1] Although the final reporting of the 2024 Maribyrnong River Flood Model is not yet complete, inputs to the model have been prioritised. The 2024 Maribyrnong River Flood Model has been calibrated to the October 2022 flood event to enable delivery of the results presented in this report, prior to finalisation of the 2024 Maribyrnong River Flood Model documentation.

2. Methodology

The assessment methodology was to compare two hydraulic model runs or scenarios using the calibrated 2024 Maribyrnong River Flood Model for the October 2022 flood event to assess the efficacy of these measures. An additional Scenario (Scenario 1) has also been run to understand the impact of the flood wall as reported in: VRC Wall & Mitigation Report (Jacobs 2024b). The full set of model runs are:

- Base Case – with the VRC flood wall and the catchment in its physical state in October 2022.
- Scenario 1 – without the VRC flood wall and associated mitigation measures (see Jacobs 2024b for details).
- Scenario 2 – removal of the associated mitigation from the model all of which were present in 2022.

Please note to keep consistency with naming conventions for other simulation Scenario 1 has not been adopted in this report. For the details of Scenario 1 refer to the Jacobs (2024b) report provided to Melbourne Water.

The differences between the model runs were then investigated in terms of changes to flood extent, flood depth and duration of flooding.

With respect to the VRC flood wall, the 2024 Maribyrnong River Flood Model had incorporated the details of the VRC flood wall modifications and associated mitigation. Figure 2-1 shows the 2024 Maribyrnong River Flood Model extent, locations of boundary conditions and the location of the VRC flood wall and the associated mitigation measures. Further information is available in Appendix A of Jacobs 2024b.

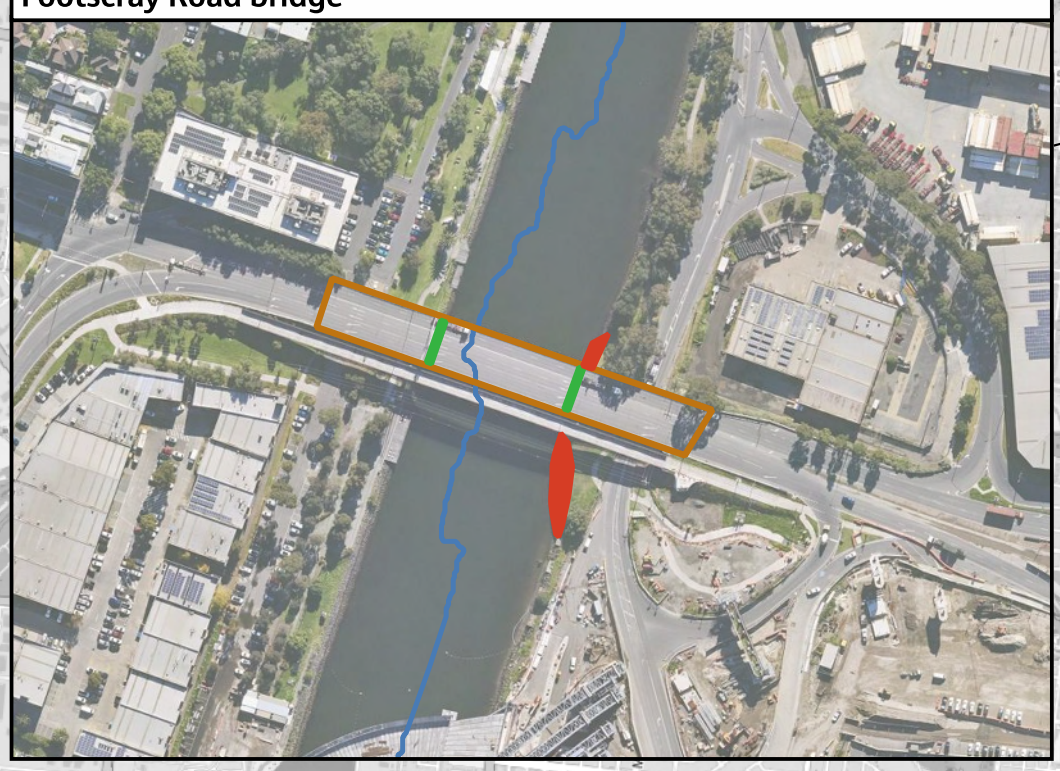
The upstream inflow boundary at the Keilor gauge and the outflow tidal boundary, both of which can be seen in Figure 2-1, had the conditions that occurred during the October 2022 event applied for both the Base Case and Scenario 2.

To examine the effect of the VRC flood wall and associated mitigation measures a comparison of results for the Base Case scenario and Scenario 2 was undertaken. The two scenarios run were:

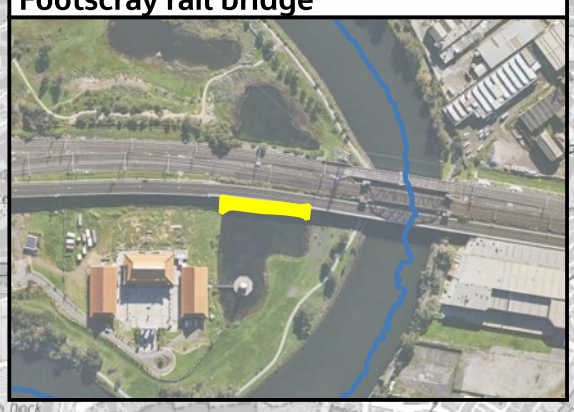
- Base Case – With Wall and With Mitigation: 2022 flood event under 2022 catchment conditions (i.e., with the VRC flood wall and with associated mitigation works in place).
- Scenario 2 –With Wall and Without Mitigation: Scenario 2 is otherwise the same as the Base Case with the below changes. As exact details of landforms and conditions pre-VRC flood wall construction were not available, various assumptions have been made about representation within the model.
    - The eastern bluestone abutment at Footscray Road bridge was added back into the model.
    - The access track modifications, downstream of the Footscray Rail culverts, are not represented in the model.
    - As there is limited data from this period, with respect to the flow 'training wall', there are several assumptions regarding alterations to the DEM to represent a pre-flow 'training wall' condition of the banks upstream and downstream of the eastern abutment of the Footscray Road bridge.

Figure 2-1 presents the 2024 Maribyrnong River Flood Model extent, locations of boundary conditions and the locations of the mitigation measures.

Footscray Road bridge



Footscray rail bridge



Legend

- TUFLOW model boundary
- Footscray Road bridge
- DEM (terrain) adjustments
- Outflow (Tidal) Boundary
- Inflow Boundary
- Maribyrnong River
- Flow training walls adjustment
- Bluestone abutments

MGA Zone 55

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0 0.5 1 1.5 km

Figure 2-1: Model extent, boundary conditions, and locations of mitigation measures

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3. Base Case Model Setup

The Base Case scenario represents a model with the VRC flood wall and with associated mitigation measures subject to the 2022 flood event under assumed 2022 catchment conditions. Details of this scenario are presented in Jacobs (2023g) and the key features with respect to this assessment are:

- The VRC flood wall was incorporated into the flood model with details for the wall being sourced from the recent 2023 survey in combination with information from 2013 survey plans.
- Ensuring that the access track immediately downstream of the Footscray Rail culverts was represented as available in 2023 LiDAR survey and is at 0.5m AHD or below in the DEM.
- Confirming that the eastern bluestone abutment under the Footscray Road bridge was not represented in the flood model.

3.1 VRC Flood Wall

The VRC flood wall is the wall that was erected around the Flemington Racecourse in 2007 with the understood intent to ensure that the racecourse is protected from floodwaters of events more frequent than the 1% AEP event. LiDAR and survey produced in 2023, along with available design drawings, were used to develop a Digital Elevation Model (DEM) that includes the VRC flood wall. The VRC flood wall varies in height from approximately 3m AHD to over 5m AHD along its alignment. Figure 3-1 is a photograph of the VRC flood wall.

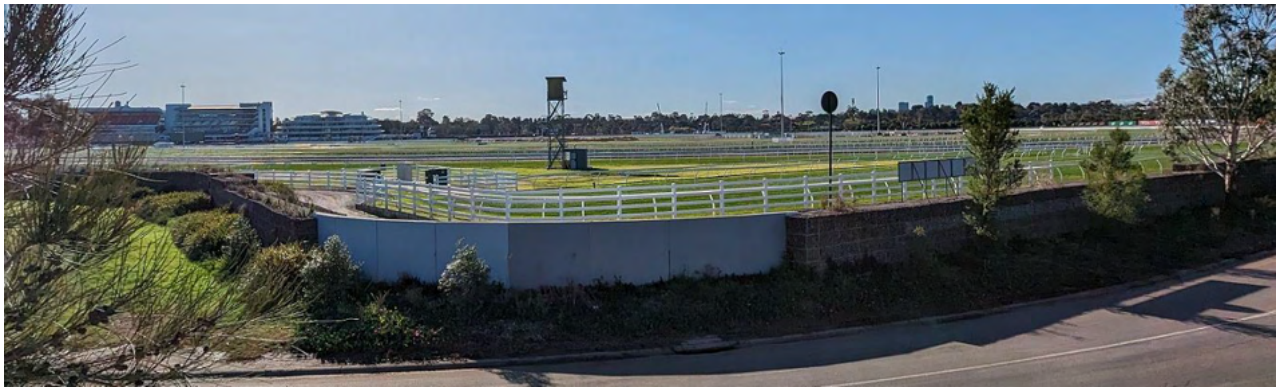

Figure 3-1: Picture of the VRC flood wall taken at the southern edge of the wall, along Chiquita Drive, looking north.

3.2 Access track downstream of Footscray Rail culverts

The LiDAR (2023), that formed the basis of the 2024 Maribyrnong River Flood Model, captured the levels downstream of the Footscray Rail culverts and confirmed that the access track was 0.5m AHD or below. The LiDAR confirmed the access track in this location generally varies from 0.4-0.5m AHD. These levels were confirmed as represented in the DEM of the Base Case model. Small 'balancing' culverts under the access track are also incorporated into the model. Figure 3-2 and Figure 3-3 are photos taken in 2023 of this area.

Figure 3-2: Access Track (gravel) downstream of the Footscray Rail culverts (photo taken in 2023).

Figure 3-3: Downstream of the Footscray Rail culverts: facing west (left) and east (right). Balancing culverts under the access track circled in red (photos taken in 2023).

3.3 Footscray Road Bridge

The Footscray Road bridge was surveyed as part of the bridges and structures survey in the data collection phase of the 2024 Maribyrnong River Flood Model build (Jacobs 2023i). Using an empirical method contained within a publication by the US Division of Hydraulic Research (Bradley,1978) the losses at the bridge were calculated taking into account the two (2) existing piers at this bridge, the existing pier's oblong 'strip' shape (visible on Figure 3-5) and the cross sectional area the piers represent as a percentage of the overall waterway cross sectional area, the pier loss factor was set at 0.11 and blockage factor set as 6% for the Base Case.

The presence of a bluestone abutment on the western abutment was represented within the 2D domain of the model.

Additionally, a flow 'training wall' on the upstream and downstream banks of the eastern abutment of Footscray Road bridge has been represented within the 2D domain of the model. This can be seen on Figure

3-6 and Figure 3-7. These figures clearly demonstrate that the flow 'training wall' is in poor condition and will not currently be functioning as designed or intended. As such an assumption has been made in the model that the flow 'training wall' is represented in the 2D DEM.

Figure 3-4: Bluestone abutment under Footscray Road bridge on the eastern bank removed as mitigation works (left) (GHD, 2003b) and the abutment that remains on the western bank (right) (photo taken in 2023).

Figure 3-5: Footscray Road bridge from the western bank, facing east towards the eastern bank (photo taken in 2023)

Figure 3-6: Footscray Road bridge from the western bank, facing east where the downstream 'training wall' is visible (photo taken in 2023).

Figure 3-7: Footscray Road bridge from the western bank, facing east where the upstream flow 'training wall' is visible (photo taken in 2023).

4. Scenario 2 Model Setup

Scenario 2 represents a model without the associated mitigation measures, when subject to the 2022 flood event[2]. This scenario was the same as the Base Case with the only difference being the mitigation measures were removed, specifically:

- The access track immediately downstream of the Footscray Rail culverts was reinstated at a level of 0.8 m AHD and this was reinforced this in the hydraulic model.
- The eastern bluestone abutment under the Footscray Road bridge was reinstated and areas of adjacent fill, both upstream and downstream, were removed. As there was a lack of available data for these mitigation measures, assumptions about the abutment and terrain modifications have been made.
- The training wall and associated fill was removed terrain.

4.1 Access track downstream of Footscray Rail culverts

The LiDAR adopted in the model captured the levels downstream of the culverts in 2023. GHD, 2003b reported that the pre-mitigation landform downstream of the Footscray Rail culverts included a road embankment at 0.8m AHD. Modifications in the terrain were necessary to increase the level of the access track for Scenario 2. A photograph with levels of the access track can be seen in Figure 4-1. The balancing culverts within the model during the Base Case have also been removed from Scenario 2 as it is assumed these were constructed as part of the reduction in level of the access track.

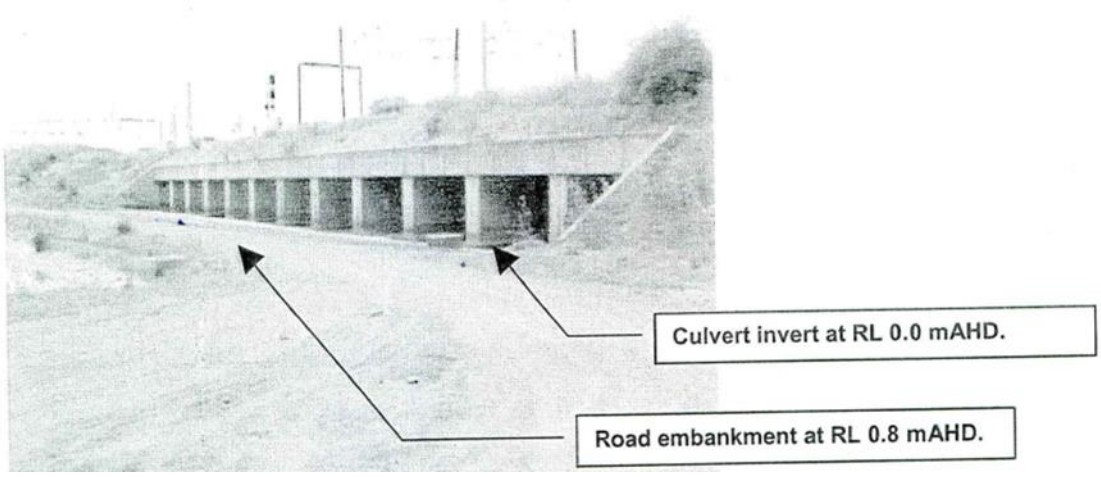

Figure 4-1: Annotated photo of downstream of the Footscray rail culverts showing the pre-mitigation elevations (GHD, 2003b).

4.2 Footscray Road Bridge

The Footscray Road bridge mitigation measures involved the removal of a bluestone abutment and the construction of a flow 'training wall' on the eastern embankment upstream and downstream of Footscray Road bridge (Fargue spiral design to minimise the energy losses through the bridge). The aim of these measures was to improve hydraulic performance in this area which was documented in GHD's report on the Flemington Racecourse (GHD, 2003b).

As detailed of the pre-wall conditions were limited, various assumptions were needed to be made. Scenario 2 included:

- The insertion into the DEM, a 2 m wide bluestone abutment on the eastern abutment of the Footscray Road bridge (in red in Figure 4-2). As no details of the dimensions of this bluestone abutment were available it was assumed to that the dimensions of this abutment were the same as the bluestone abutment on the opposite bank.
- Removal of a section of bank upstream of the eastern abutment. The upstream removal is based on Figure 4-2 which shows a receded bank on the left of the photograph (purple). The DEM modifications are assumed to represent the removal of a flow 'training wall' that was constructed in this location as part of VRC flood wall associated mitigation measures.
- The lowering of a section of bank downstream of the eastern abutment. The downstream removal is based on Figure 4-3 which shows a constructed bank (purple). The DEM modifications are assumed to represent the removal of a 'training wall' that was constructed in this location as part of VRC flood wall associated mitigation measures.

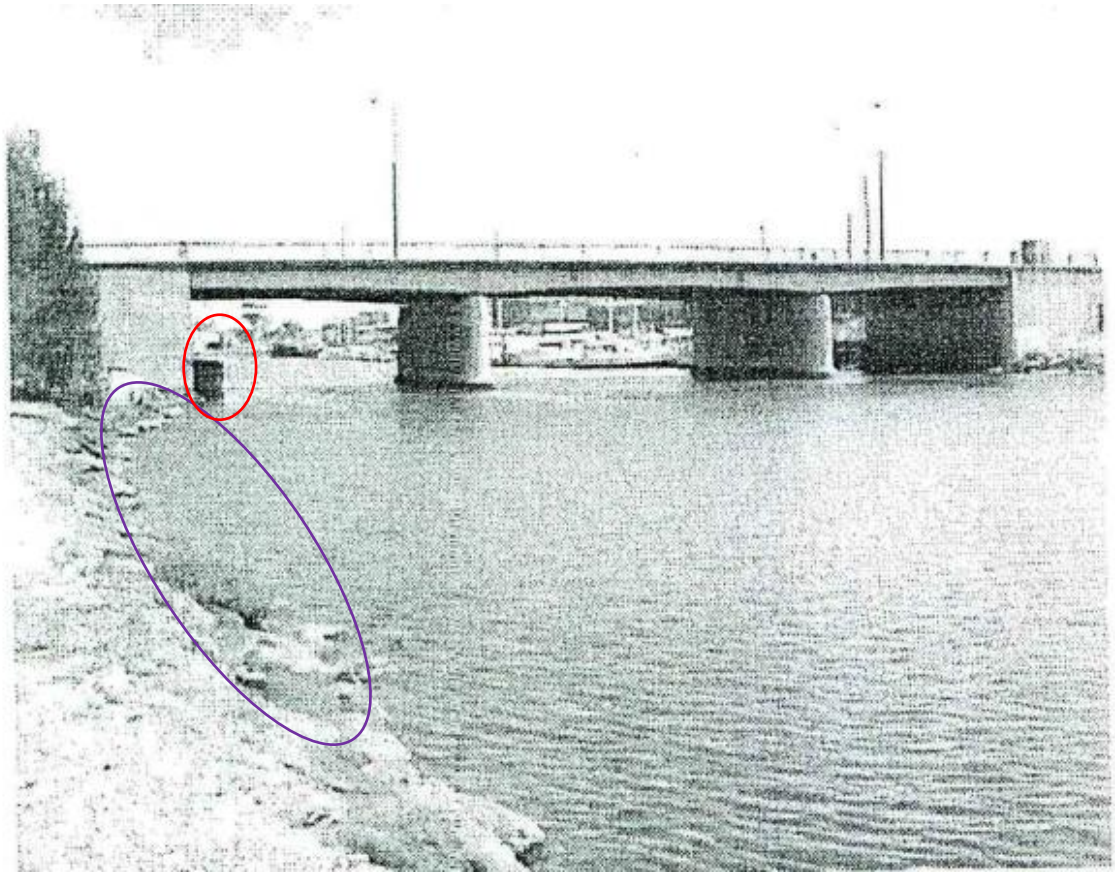

Figure 4-2: Photograph taken from the eastern bank looking downstream at the Footscray Road bridge. Eastern bluestone abutment circled in red and receded bank in purple (photograph taken pre-2003).

Figure 4-3: Photograph taken from the western bank of the eastern bank, upstream, at the Footscray Road bridge. Eastern bluestone abutment (removed) circled in red and 'training wall' bank in purple (photograph 11 September 2016).

5. Results

The results of the scenario analysis are presented in Figure 5-1 to Figure 5-7 with the details below:

- Figure 5-1 presents the modelled peak flood extents of Base Case and Scenario 2 for the October 2022 flood event.
- Figure 5-2 presents the difference in water levels between Scenario 2 and the Base Case for the October 2022 flood event. An increase ('higher') indicates the effect of removing the mitigation measures from the model lead to higher water levels.
- Figure 5-3 presents several cross sections of the peak water levels along selected roads within Maribyrnong township for the October 2022 flood event.
- Figure 5-4 presents time series of the water levels at selected locations along the Maribyrnong River for the October 2022 flood event. These time series are to assess a potential change in duration of the peak of the flood.
- Figure 5-5 presents the chainage (in metres) along the Maribyrnong River from the upstream boundary of the model (chainage = 0m) to the downstream boundary.
- Figure 5-6 presents longitudinal sections along the Maribyrnong River showing peak flood levels of Base Case and Scenario 2 for the October 2022 flood event.
- Figure 5-7 presents longitudinal sections along the Maribyrnong River showing the difference in peak flood levels between Base Case and Scenario 2 for the October 2022 flood event.

Ascot Chase

Kensington

Maribyrnong Township

Footscray Rd Bridge

Legend

- Waterway outlines
- Flooded Scenario 2 Only
- Common flood extent between Base Case and Scenario 2

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0 0.5 1 km

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Figure 5-1: Comparison of flood extents between Base Case and Scenario 2 for the 2022 flood event

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Ascot Chase

Kensington

Maribyrnong Township

Footscray Rd Bridge

Legend

- Wet only in Scn 2
- Wet only in Base
- Waterway outlines

Difference

- >15mm lower
- 10 - 15mm
- 5 - 10mm
- <5mm lower
- no change (+/- 1mm)
- <5mm higher
- 5 - 10mm
- 10 - 15mm
- >15mm higher

MGA Zone 55

0 0.5 1 km

Jacobs

Figure 5-2: Difference in flood levels between Base Case and Scenario 2 for the 2022 flood event

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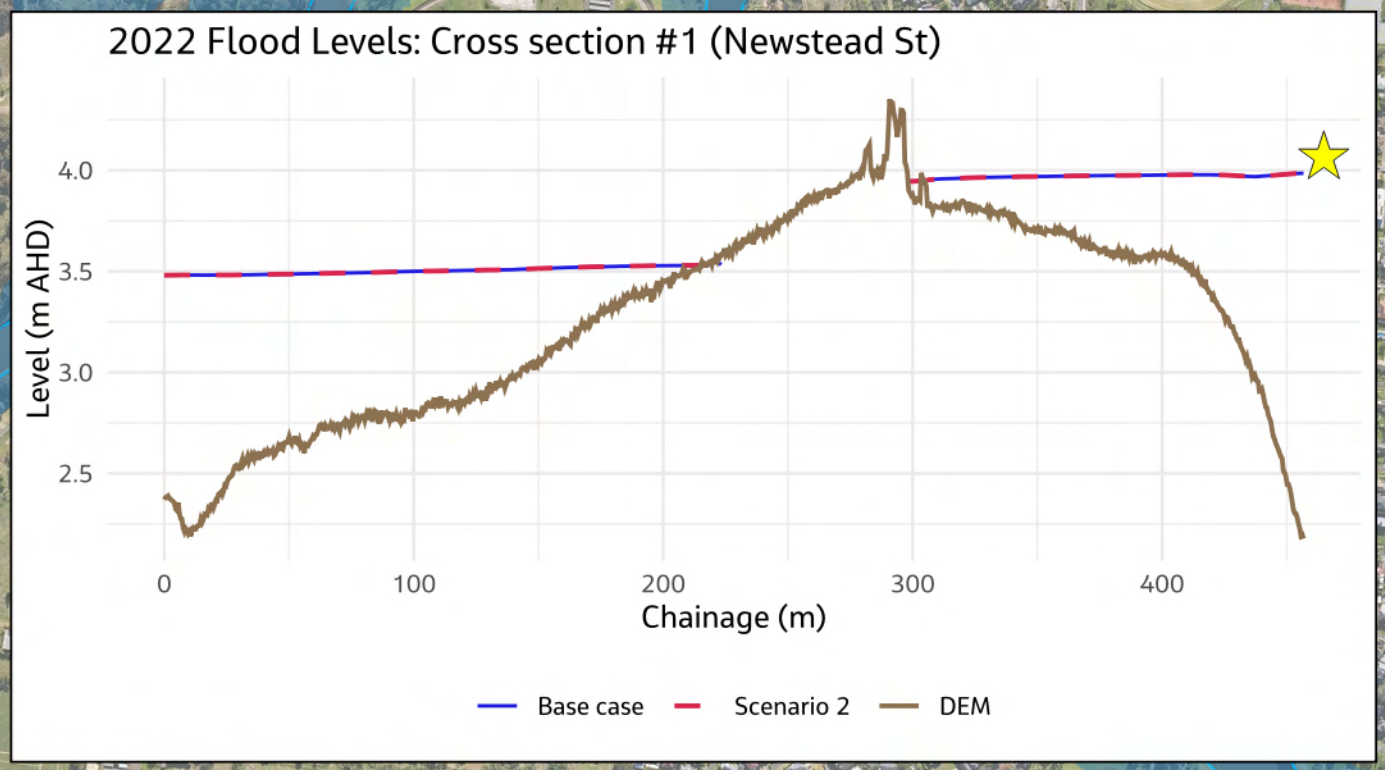

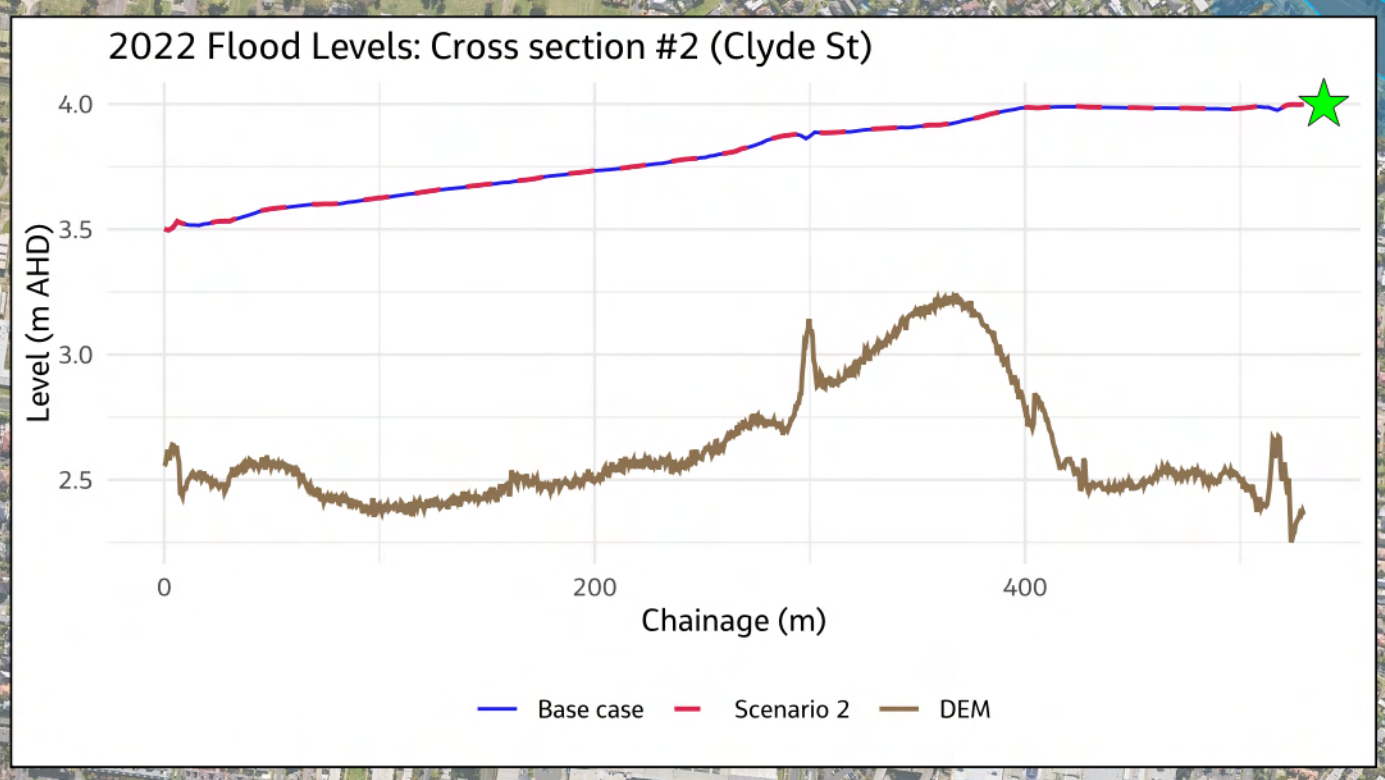

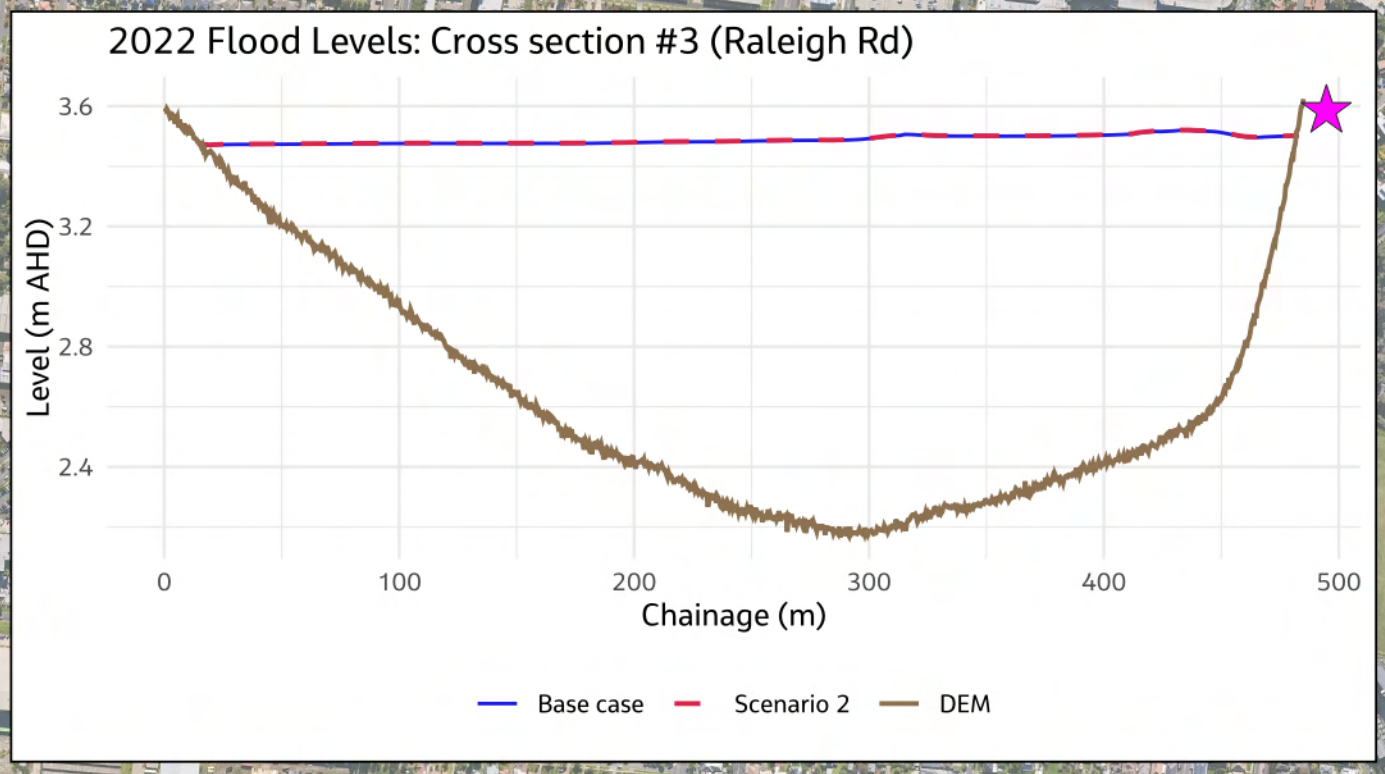

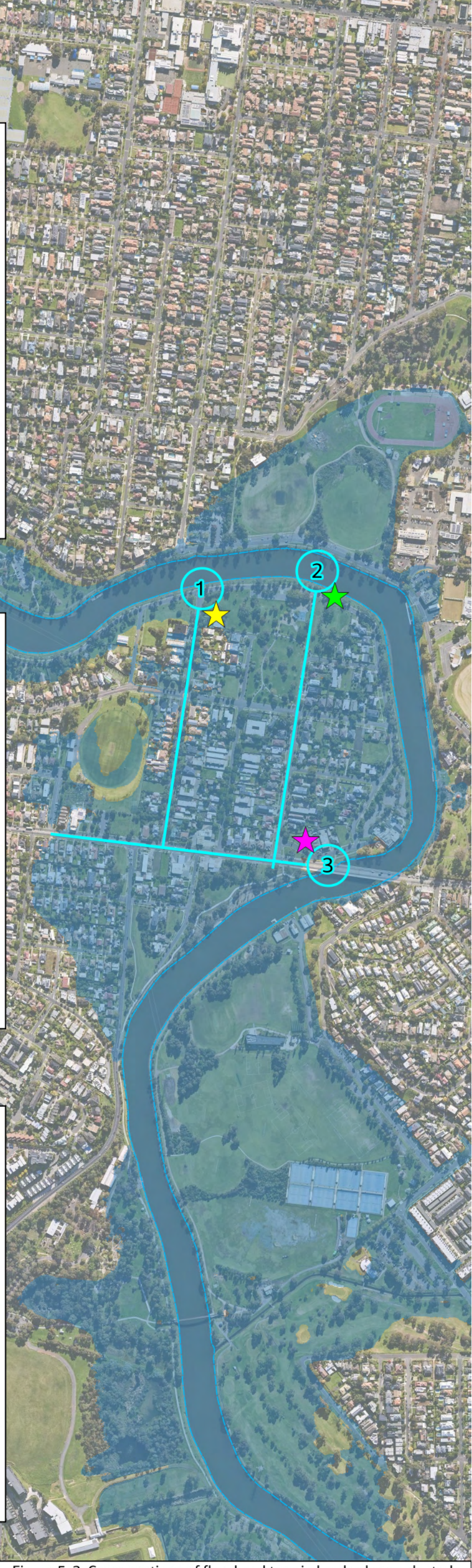

Legend

- Cross sections
- Flooded locations in Scenario 2 Only
- Flood Extents common between Base Case and Scenario 2

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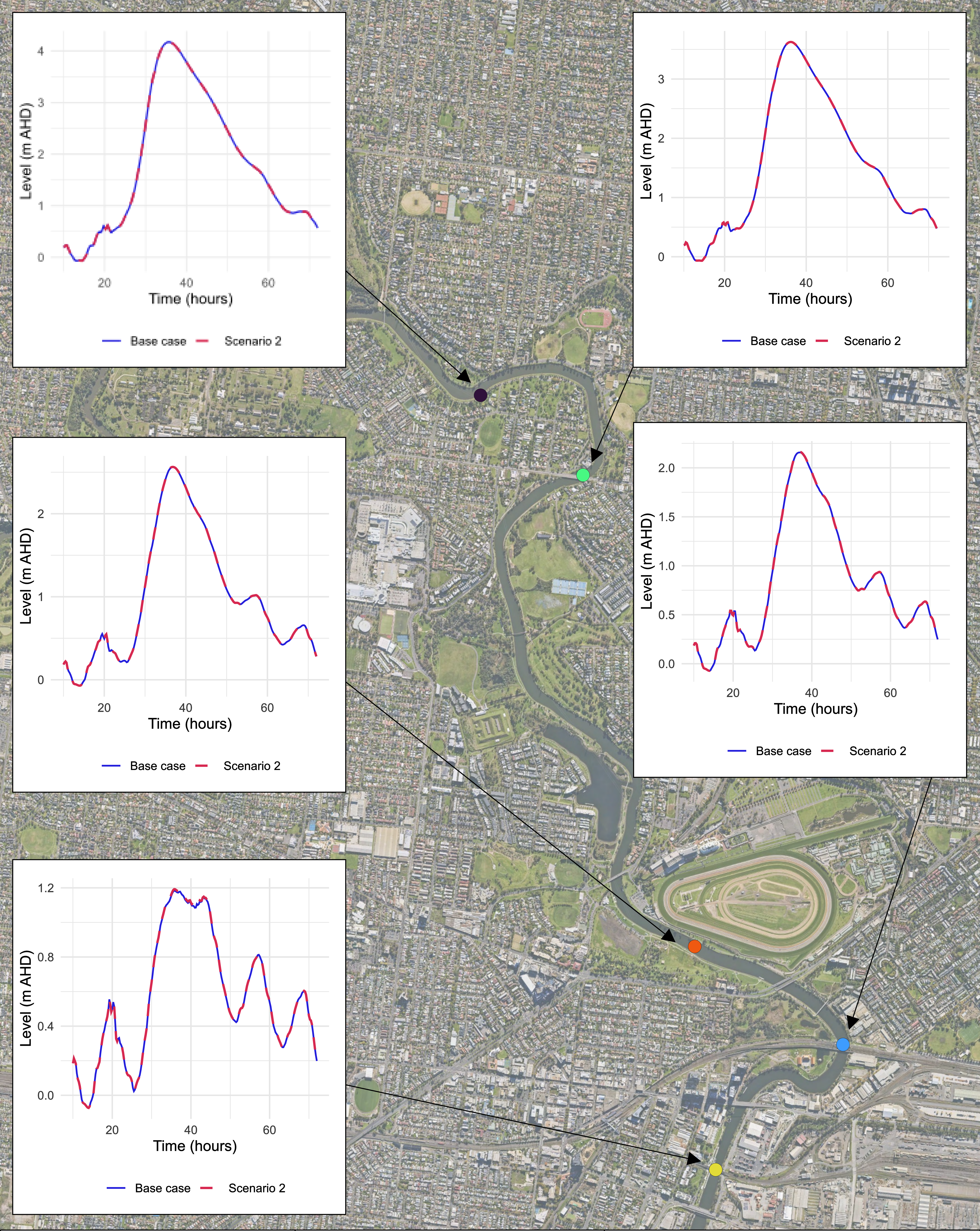
0 100 200 300 m

Figure 5-3: Cross-sections of flood and terrain levels along selected roads within Maribyrnong Township of the Base Case and Scenario 2 for the 2022 flood event

Project Number: IA5000NN	FINAL



Legend

2022 Flood Event: modelled levels at select gauges, Base Case & Scenario 2

- Chifley Street gauge
- Footscray rail bridge
- U/S Raleigh Road bridge
- U/S Footscray Road bridge
- Victorian Racing Club (VRC)

MGA Zone 55

Jacobs

0 250 500 750 m

Figure 5-4: Flood levels at selected locations along the Maribyrnong River of the Base Case and Scenario 2 for the 2022 flood event

Project Number: IA5000NN

FINAL

Legend

- Maribyrnong River
- Key Landmarks
- Chainage

MGA Zone 55

Jacobs

0 0.5 1 1.5 km

Figure 5-5: Chainage along Maribyrnong River used in Longitudinal Sections and key landmarks

Project Number: IA5000NN	FINAL

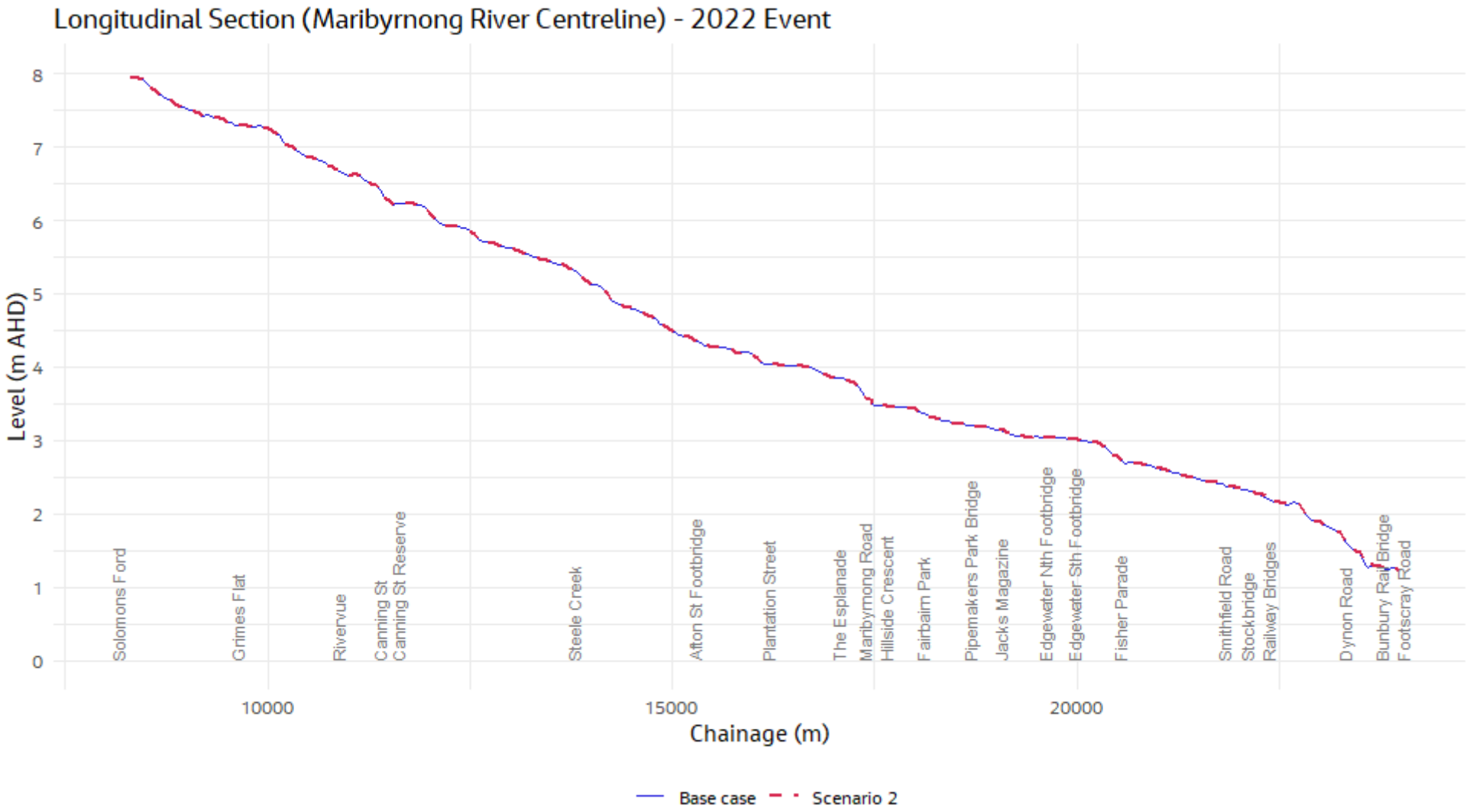


Figure 5-6: Longitudinal Section of Maribyrnong River showing modelled flood levels of the Base Case and Scenario 2 for the 2022 flood event

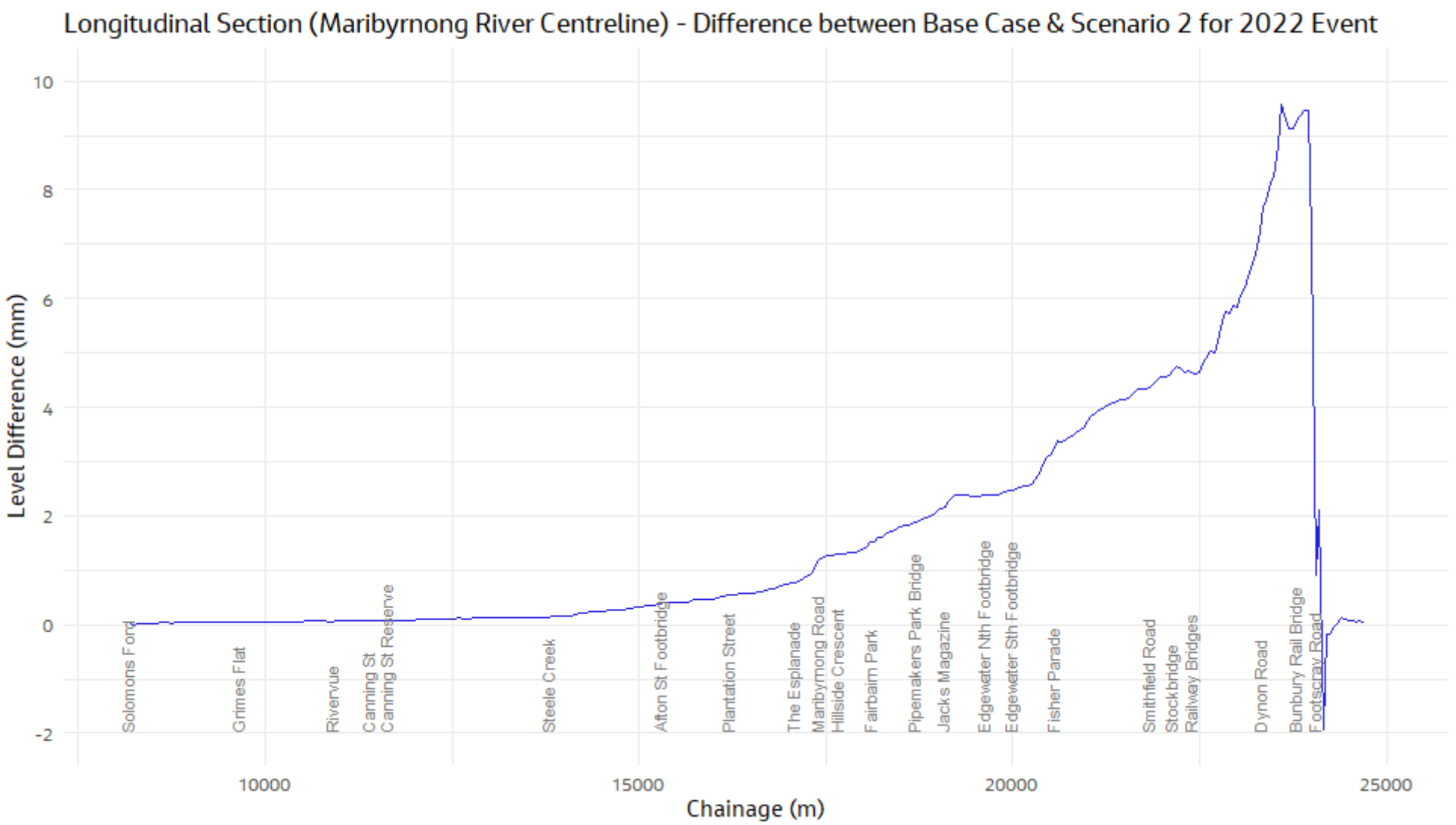


Figure 5-7: Longitudinal Section of Maribyrnong River showing the difference in modelled peak flood levels between the Base Case and Scenario 2 for the 2022 flood event (where Scenario 2 is higher than Base Case upstream of Footscray Road bridge)

6. Analysis & Discussion

When using the 2024 Maribyrnong River Flood Model to compare the Base Case and Scenario 2 the calculated influence of the mitigation measures is relatively minor for the simulated October 2022 event.

6.1 Flood Extents

The difference in flood extents between Base Case and Scenario 2 is shown in Figure 5-1. There are minor regions on the edge of the flood extent where additional flooding occurs however these areas are small, with the largest area in North Dynon Rail Yard. These are considered to inconsequential.

6.2 Flood Levels

The difference in peak flood levels between Scenario 2 (with wall and without mitigation) and the Base Case (2022 Conditions) are presented in Figure 5-2, Figure 5-6 and Figure 5-7. The following is noted:

- The mitigation measures removed the eastern bridge abutment at Footscray Road Bridge. When this was added back into the model it creates a blockage, which then increases the upstream water level, and reduces the downstream water level. This results in a reduction in peak water levels downstream of the bridge of 20-25 mm. Directly upstream of the bridge on the eastern side of the river there is an increase up to 50 mm reducing to less than 10 mm at a distance of 50 m upstream of the bridge.
- Upstream of Footscray Road to Smithfield Road, removing the mitigation measures has resulted in:
  - Generally, an increase of 8mm decreasing to 4-5 mm at Smithfield Road in the Maribyrnong River.
  - Some localised increase of up to 30 mm on the edge of the flood extent in industrial areas along Dynon Road and Kensington Road.
- Directly upstream of the Footscray Rail Culverts, removing the mitigation measures has resulted in:
  - Up to 7 mm increase decreasing to 5 mm in the Maribyrnong River.
- Between Smithfield Road Bridge and Jack's Magazine, removing the mitigation measures has resulted in 4-5 mm increase in water level, decreasing to a 2 mm increase at Jack's Magazine in the Maribyrnong River.
- Between Jack's Magazine and the Maribyrnong Township there is a 1- 2 mm increase in water levels without the mitigation measures in the Maribyrnong River:
  - Up to a 12 mm increase occurs in Walter Street Reserve Ascot vale which is at the periphery of the flood extent.

Overall, the impact of the mitigation works is a relatively small decrease in peak flood levels of up to 10 mm near Footscray Road Bridge and 1-2 mm in Maribyrnong Township.

6.3 Flood Duration

Figure 5-4 indicates there is negligible difference in flood durations between Base Case and Scenario 2 at any of the locations shown.

6.4 Discussion

The outcomes of the modelling indicate there is generally a minor increase in the peak flood levels across the Maribyrnong River Floodplain under Scenario 2 (removing the mitigation measures). The removal of the abutment on the eastern side of Footscray Road Bridge likely has the most significant influence on the flood levels in the river with the removal of this blockage improving conveyance. In the model the influence of the

training wall removal is linked to the performance of the Footscray Road Bridge abutment removal, and this has not been investigated further. Jacobs have also observed the training wall is poor condition.

Although there is a measurable increase in flood levels due to the increase in the access track level there is generally minimal to small influence on the peak flood levels for the simulated October 2022 event. The hydraulic model estimates the peak flow through the Footscray Rail Culverts during the 2022 event was approximately 70-80m^3/s (not flowing full). The peak flow in the Maribyrnong River was 767 m^3/s. Hence, the culverts were servicing approximately 10% of the flow associated with the flood. This may have reduced the ability for the mitigation measure to influence the flood levels. The peak flood levels in the October 2022 flood event in this area exceed 2 m AHD. Based on the modelling, out of banks flows from the Maribyrnong River occur in this area at 1.3 to 1.4 m AHD indicating the mitigation infrastructure was submerged out (i.e. flooded) prior to the peak of the event.

In reaching the outcomes of this assessment Jacobs note the following:

- To definitively assess the efficacy of the mitigation measures, its necessary to compare the pre-flood wall conditions for the 2022 event to the current conditions (base case). In many instances, this information was not available, such as the high-quality terrain data like LiDAR, details of the pre-mitigation works bank conditions around Footscray Road, river bathymetry, etc. This would allow the determination of whether the mitigation measures are meeting the intended purpose of matching the conditions without the flood wall. However, given the passage of time the exact conditions in 2003 are not able to be replicated to the same level of detail as the 2022 conditions.
- The modelling methodology and software which has assessed the mitigations measures in this assessment differs to the methodology adopted in 2003 and when the permit for the VRC flood wall was approved. The conclusion in this report does not infer that there were any shortcomings in the 2003 assessment of the VRC flood wall.
- The representation of the mitigation works at Footscray Road Bridge within the adopted software used in this study, differs to the representation in the assessment completed by GHD (2003b). This includes the assumed hydraulic performance of the training wall and the contraction and expansion coefficients, variables which are not explicitly represented in the 2024 Maribyrnong River Flood Model. Jacobs has not investigated these differences further as the required data was not available but note that they are not like-for-like.
- There have been changes to the floodplain in the last 20 years that may have contributed to flood impacts in the Maribyrnong River including the construction of the Regional Rail Link bridge over Maribyrnong River, Ascot Chase Development, changes to Smithfield Road Bridge and minor changes to landscaping and works on the banks of the Maribyrnong. No comparison has been made of the terrain data used in this model compared to the GHD (2003b) study.
- The 2022 flood event is not the same event simulated for the VRC flood wall assessment completed by GHD (2003b). The event assessed in GHD (2003b) was the 1% AEP event whereas the 2022 flood event had an approximate AEP of 2%. As such the outcomes of this assessment does not preclude the ability for the mitigation works to have a difference influence on another flood event.
- The training wall has deteriorated over time and this deterioration may have affected its performance as a mitigation measure.

7. Limitations and Exclusions

The sole purpose of the modelling presented in this report and associated services performed by Jacobs was to investigate the impact of the Victoria Racing Club (VRC) flood wall on the extent, depth, and duration of flooding of the October 2022 event, in the vicinity of the Maribyrnong River, in accordance with the scope of services set out in the contract between Jacobs and Melbourne Water ("MW"; the Client).

This report has been prepared on behalf of, and for the exclusive use of, Melbourne Water, and is subject to, and issued in accordance with, the provisions of the contract between Jacobs and Melbourne Water. Jacobs accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by Melbourne Water and/or from other sources. Except as otherwise stated in the report and other associated Jacobs reports, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate, or incomplete, then it is possible that our observations and conclusions, as expressed in this report, may change.

Jacobs derived the data in this report from information sourced from Melbourne Water, third parties, and/or available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations, and conclusions expressed in this report. Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures, and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report should be read in full, in conjunction with the final reporting of the 2024 Maribyrnong River Flood Model. and no excerpts are to be taken as representative of the final findings. Jacobs accepts no responsibility for using any part of this report in any other context.

A work-in-progress TUFLOW model, the 2024 Maribyrnong River Flood Model, being developed as part of the Lower Maribyrnong Flood Mapping Project has been used as the basis for the modelling presented in this report, as it is considered the best available information at the time of this request. The model(s) currently being developed have not been finalised nor documented but are due to be produced as deliverables as part of the Lower Maribyrnong Flood Mapping project (Jacobs 2024a). Noting that the Lower Maribyrnong Flood Mapping project is still a work-in-progress the results presented as part of this report will be superseded by (and may differ from) results that will be reported when the project is completed in April 2024.

The sole purpose of the flood modelling undertaken for this report is to define flood behaviour in the vicinity of the project sites. Flood extents and flood behaviour around the boundary of the TUFLOW hydraulic model domain should be interpreted with caution. The model should be reviewed in detail prior to being used for any other purpose.

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