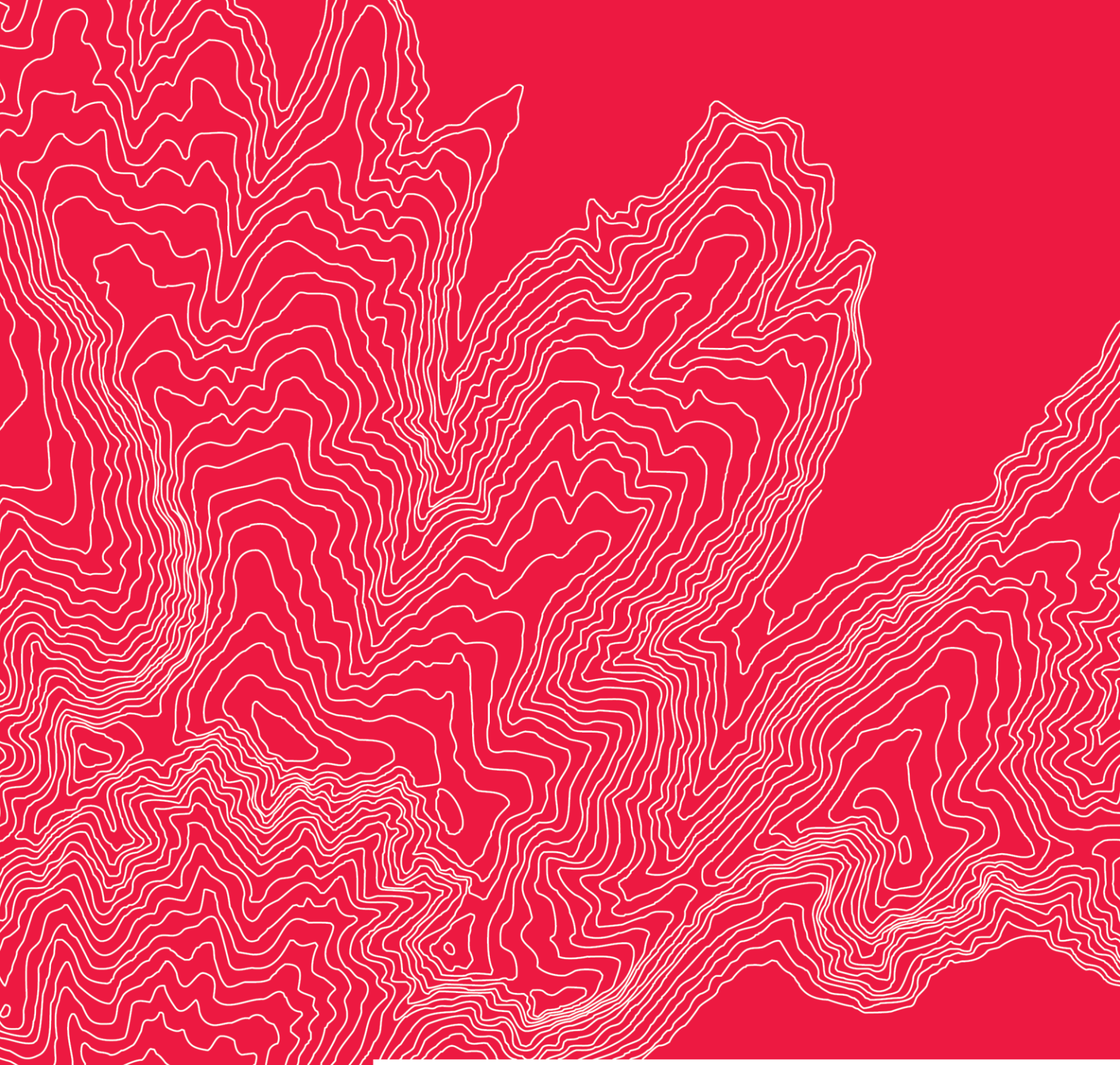

200 Year Flood Modelling Assessment

eliot sinclair

South West Rangiora

Prepared for Townsend Fields Limited

503245

200 Year Flood Modelling Assessment

South West Rangiora

Prepared for Townsend Fields Limited

503245

Quality Control Certificate

Eliot Sinclair & Partners Limited

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Contents

1. Introduction

Fluent Solutions and Eliot Sinclair have been engaged by Townsend Fields Limited to undertake a 200 year ARI and Ashley River Breakout flood assessment for the South West Rangiora Outline Development Plan (ODP) Area, to support a rezoning proposal. The assessment area covers Stages 1-8 of the Townsend Fields residential development. Townsend Fields Stages 1-3 are constructed and there is currently a subdivision consent application lodged with the Waimakariri District Council (WDC) for Stage 4.

The development area entirety (Stages 1-8) is bordered by Johns Road to the north, Townsend Road to the east, Lot 3 DP 495345 to the South (117 Townsend Road) and RS 852 to the west (205 Johns Road).

Flood modelling (carried out by Fluent Solutions) and a flood management strategy (designed by Eliot Sinclair) for Stages 1-4 of the Townsend Fields subdivision has been completed and reporting has been submitted to WDC as part of the Stage 4 subdivision consent application. This report for the ODP entirety (Stages 1-8) builds on the work completed previously.

Figure 1 shows the Townsend Fields Stages 1-8 site location.

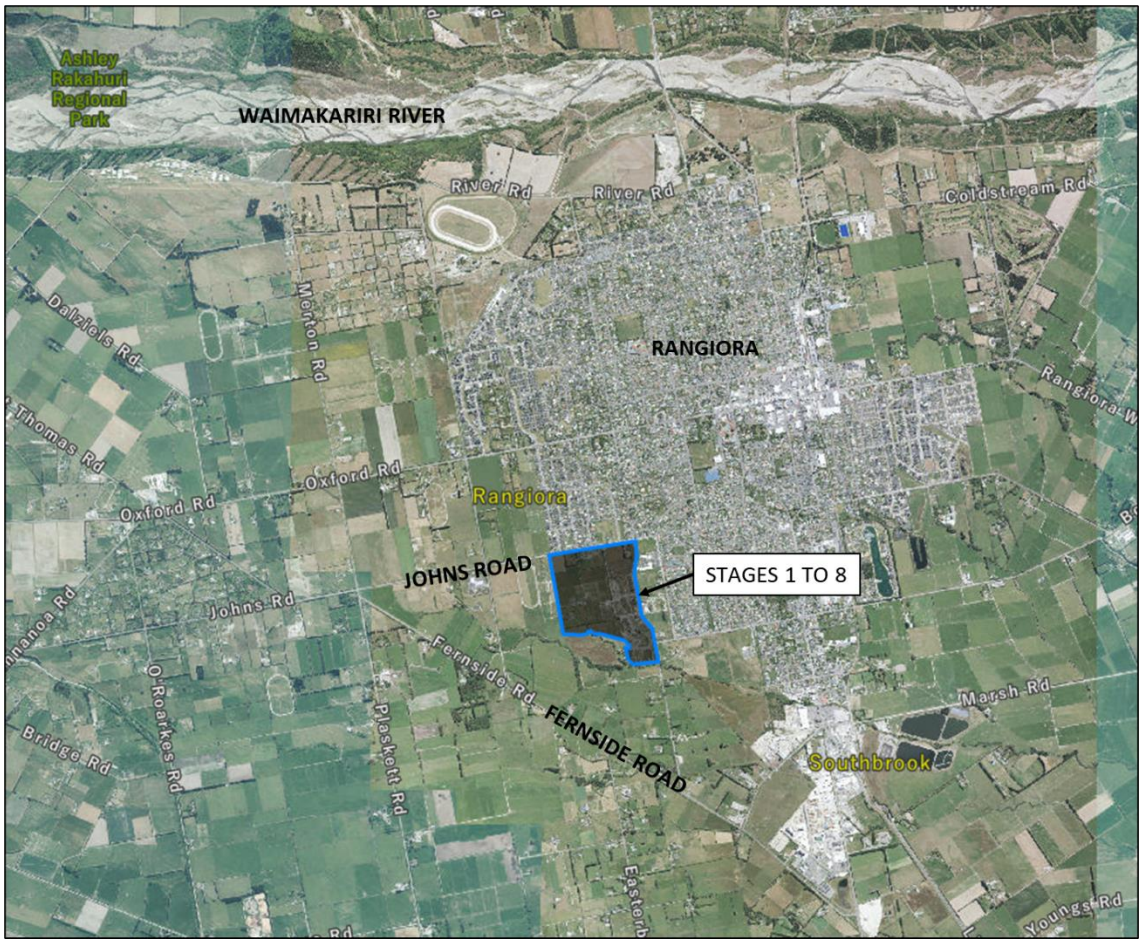


Figure 1. Townsend Fields Stages 1-8 Site Location

2. Flood Flow Assessment

2.1. Stages 1-8 Site Layout

The Stages 1-8 layout surface used for modelling of the 200 year ARI and Ashley River Breakout scenario includes the following:

- New access roads aligned to maximise the conveyance of flood waters through the development area.
- Flood management bund and channel along the western boundary of the ODP development area, extending between Johns Road up to the northern boundary of 117 Townsend Road (Lot 3 DP 495345). The purpose of the bund and channel is to divert the bulk of flood waters away from the development area.
- Maintaining the natural flow path of the two existing spring feed streams.

Figure 2 shows the Townsend Fields Stages 1-8 site layout used for the modelling. The red outline represents Stages 1-3 which are already constructed and Stage 4 which currently has a subdivision consent application lodged with WDC. The blue outline represents the future Stages 5-8.

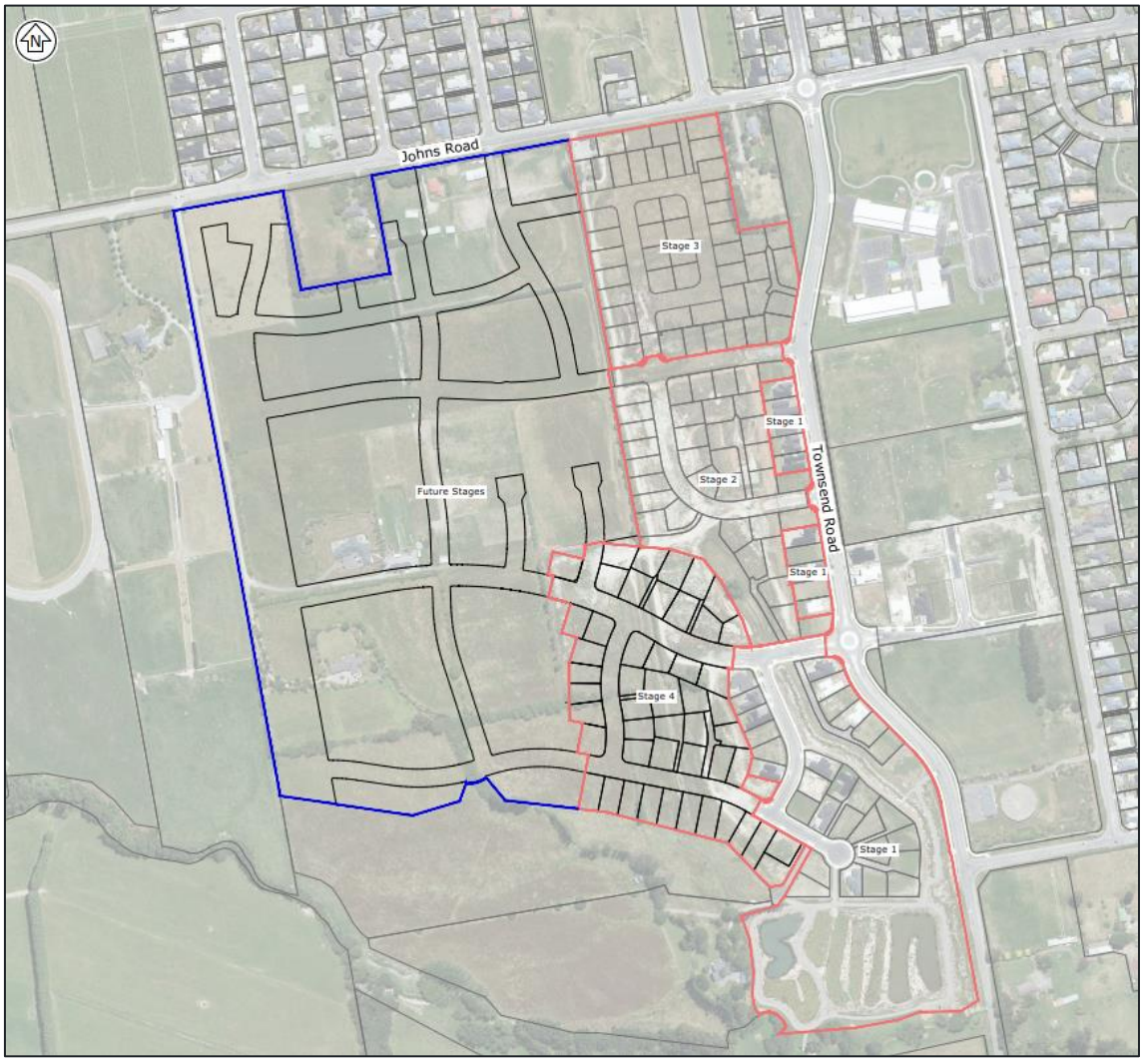


Figure 2. Townsend Fields Stages 1-8 Site Layout

2.2. Model Derivation Background

Environment Canterbury (ECan) and WDC have previously modelled the 200 year ARI and Ashley River Breakout scenario, this was further updated by DHI in 2019 – 2020. The updated DHI 2020 model was used by Fluent Solutions as the basis for the assumptions for the modelling of Stages 1-8. The results of the updated Fluent Solutions model (this report) were then compared to the DHI 2020 model results to check for consistency with the previously estimated flood flow patterns.

The modelling has used a combination of the most recent LiDAR information local to the site, topographical survey data and a Stages 1-8 design surface provided by Eliot Sinclair.

2.3. Analysis Methodology

Infoworks ICM hydraulic and hydrological modelling software was used to drive the flood flow patterns of the Ashley River breakout scenario and to review and compare the pre-developed flood regime with the post development flood analysis for the development site (Stages 1-8) and surrounding areas.

Figure 3 below shows the extent of the model layout, which was trimmed from the updated DHI model. The model utilises 2D hydraulic calculation algorithms built from 3D ground surface data.

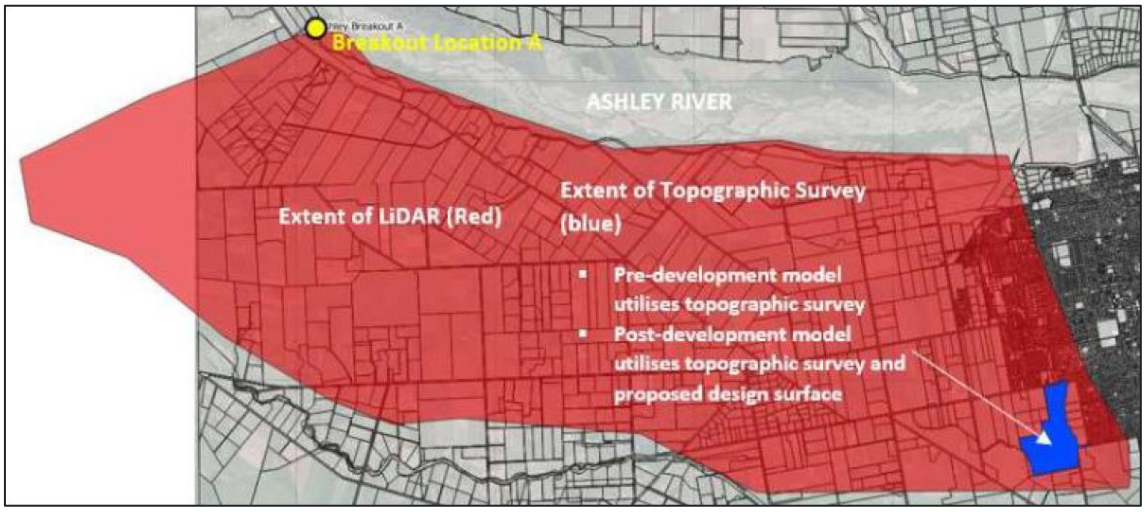


Figure 3. Model Layout

The parameters used for the modelling have not deviated from those described in the Fluent Solutions Report titled "*Townsend Fields Limited 200 Year ARI Ashley River Breakout Preliminary Flood Assessment and Flood Management Strategy*" submitted to WDC as part of the Townsend Fields Stage 4 subdivision consent application, dated May 2022. Therefore, the parameters used for the modelling have not been further discussed within this report.

3. Model Results & Analysis

3.1. Flood Modelling Overview

The flood model was run to examine the effects of the proposed Townsend Fields Stages 1-8 development (post development) in comparison to the existing pre-development conditions. The results of the pre and post development modelling have been used to further develop a flood management strategy for the subdivision area entirety, as well as to ensure the future development of Stages 5-8 does not cause any adverse effects on surrounding dwellings. It should be noted that

Stages 1-3 are already constructed and Stage 4 currently has a subdivision consent application lodged with WDC (Stages 1-4 have undergone separate flood modelling).

3.2. Flood Modelling Results

The following 200 year ARI and Ashley River Breakout post development flood modelling maps are located in **Appendix A**:

1. Full 200 year ARI and Ashley River Breakout flood map.
2. Post development "Flood Depth Map" showing the total depth of water passing through Stages 1-8 and surrounding land areas.
3. "Flood Difference Map" showing the difference between the pre and post development flood depths within Stages 1-8 and surrounding land areas.

The flood difference map is displayed as "post minus pre flood depth", as follows:

- Negative flood level differences indicate that the post development scenario results in a reduction of the flood depth below pre-development levels. Negative flood level differences are represented by blue/green/purple colours.
- Positive flood level differences indicate that the post development scenario results in an increase of the flood depth beyond pre-development levels. Positive flood level differences are represented by yellow/orange/red colours.

3.3. Assessment of Effects

The flood modelling produced the following results (the items below should be read in conjunction with the flood modelling maps located in **Appendix A**):

1. There is an approximate 50-300 mm reduction in flood depths within northern and eastern areas of Lots 2 and 3 DP 495345, which is owned by Coral and John Broughton (113 & 117 Townend Road, respectively).
2. There are no adverse effects on any existing dwellings (e.g. the post development flood height around all dwellings in the vicinity does not exceed the pre-development flood height).
3. There is an approximate 50-100 mm reduction in the flood depth around the dwelling located at 113 Townsend Road (Broughton's).
4. A large proportion of the 200 year flood flow is captured by the western channel and bund and is conveyed to the south (e.g. the channel and bund perform their design function).
5. There is an approximate 50-300 mm increase in flood depth along the south eastern boundary of RS 852 and along the western boundary of Lots 2 and 3 DP 495359. The increase is due to the bund and channel diversion capacity being exceeded (water spills out of the channel). The increase in flood depth is considered less than minor as there are no dwellings within the vicinity and the overall flood depth within this location ranges from approximately 0.5 m – 1.0 m. Further, the increase in flooding does not prolong the length of time the land area is subject to flooding (or water ponding) as the additional flood depth disperses in a similar manner to the pre-development flood conditions. The channel itself has the positive effect of being an efficient method of conveying flood waters to the south once the ARI and breakout flood event ends.
6. There is an increase in the flood depth on Johns Road ranging from approximately 50-200 mm. The increase in flooding is considered to be less than minor as Johns Road is already subject to a significant flood flow being discharged from Walnut Way and the additional increase is contained within the road corridor and does not adversely affect surrounding dwellings. The Johns Road flooding effects are further discussed in (7) & (8) below.
7. There is a significant flow discharging off Walnut Way and onto Johns Road which must pass through the Townsend Fields Stages 1-8 subdivision area to the south (this water cannot be diverted by the channel and bund). The flood flow passing down Walnut Way is due to the

subdivision directly north of Johns Road being approximately 200-300 mm lower in elevation than the pasture land to the west (and north of Johns Road).

8. The flood waters running down Walnut Way are not directly crossing Johns Road; rather the Johns Road grade is diverting the flood waters to the east (e.g. only a limited flow of water crosses Johns Road at the Walnut Way intersection), as a result the new central subdivision road is being forced to take the bulk of the flow and is subject to a water depth of around 0.5 m. Mitigation measures are discussed in Section 3.4.

9. There is no increase in flood depth within the Townsend Fields Stormwater Management Area (SMA) to the south. The "Flood Difference Map", located in **Appendix A**, suggests that there is an increase; however, the pre-development conditions modelled do not have the SMA and therefore the increase in flood depth in this area is only a result of the water storage availability. The basin is not having any adverse effects on surrounding land areas.

10. There is an increase of up to 0.5 m of water depth within the Oxford Estate SMA, located to the north of Johns Road (to the east of Walnut Way). The additional water is contained within the SMA and does not cause flooding to any of the adjacent properties. The pre-developed land provided a more direct and unhindered flow path to the south and the development of Stages 5-8 limits this, pushing more water towards the SMA. This is also compounded by the issue noted in item (8) above.

3.4. Flood Mitigation (Solutions)

Several subdivision and roading layout design surfaces have been prepared and modelled to help define the best methodology to minimise the 200 year flood effects on the Stage 1-8 subdivision, and to ensure there are no adverse effects on surrounding infrastructure. Overall, it is considered that the flood mitigation measures and final subdivision layout are 95% complete and that the current modelled increase in flooding on Johns Road can be resolved with further iterations of the flood model, topographic design and refinement of the subdivision design.

There are several plausible solutions to resolve the current increase in flood depth on Johns Road, such as:

1. Adjust (lower) the elevation of Johns Road, in the vicinity of the Walnut Way intersection. The Johns Road site frontage will be "urbanised" in a similar manner to works that took place as part of Stage 3 and therefore this work could be incorporated into the second segment of the Johns Road urbanisation. The purpose of the redesign of the intersection would be to divert as much flow as possible discharging off Walnut Way towards the west (refer to Figure 4) and to allow the remaining flood flow to more easily cross Johns Road (at the Walnut Way intersection). The road elevation/grade would also be designed to continue to allow the existing and far smaller 50 year flows to discharge to the Oxford Estate SMA to the east (if it is found this currently occurs). This would divert the bulk of the flood flow onto the western most internal subdivision Road (as shown by the blue arrows in Figure 4) and would reduce the current depth of flood water passing down the central subdivision road (note the western most corridor is wider than the central road so the water depth will be shallower). This mitigation option would also reduce the flood depth within Johns Road and the Oxford Estate SMA. This is the preferred option.

2. Adjust the current subdivision levels adjacent Johns Road and provide additional flood flow paths through the subdivision. This is the least preferred option.

Figure 4 shows the current modelling flood flow path and the proposed future flow path (Option 1).

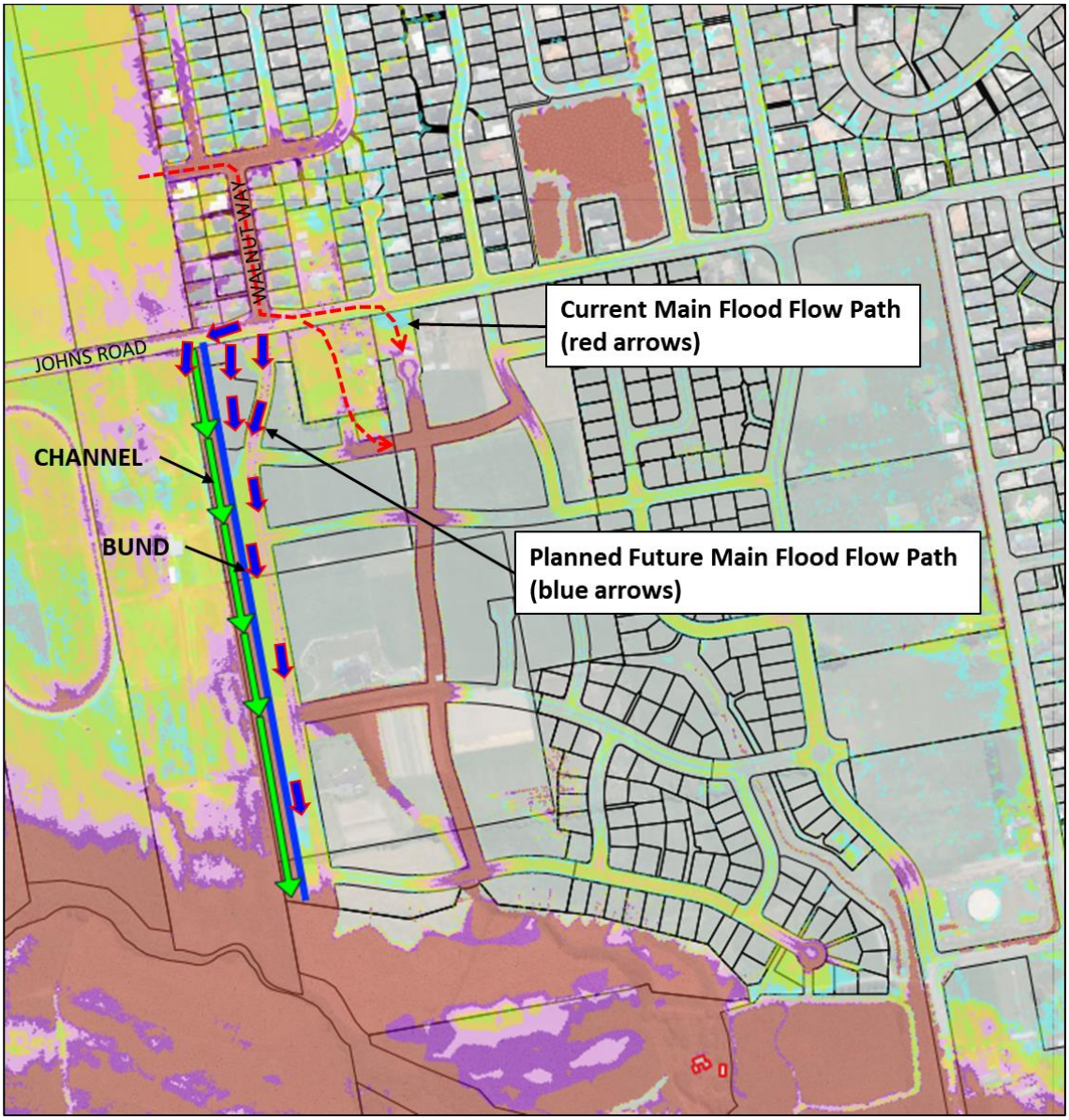


Figure 4. Current and Proposed Flood Flow Paths

4. Conclusion

The flood management strategy for Stages 1-8 of the Townsend Fields residential development (current and future stages) focuses on ensuring the development area is protected against the effects of the 200 year ARI and Ashley River Breakout flood scenario and that the proposed flood management for the site does not negatively impact the surrounding properties.

The Stages 1-8 flood modelling has shown that the proposed future subdivision has no effects on surrounding dwellings and less than minor effects on surrounding pasture land. There is an increase in the flood depth within Johns Road and the Oxford Estate SMA, however this can be mitigated by either changing the Johns Road elevation (preferred option) or adjusting the subdivision elevation adjacent Johns Road and allowing for additional flow paths through the development area (least preferred option).

As a result of the current flood modelling results, it is considered that any remaining mitigation required will be able to be addressed by subsequent flood model iterations and refinement of the detailed design. It is anticipated that the refined design be provided as part of the application to support the next subdivision consent application.

Overall, it is considered that the flood mitigation measures and final subdivision layout are 95% complete and that the increase in flooding on Johns Road can be resolved and mitigated.

Disclaimer

This report has been prepared by Eliot Sinclair & Partners Limited ("Eliot Sinclair") only for the intended purpose as a preliminary flood assessment and flood management strategy for the 200 year ARI Ashley River Breakout flood.

The report is based on:

- Flood modelling carried out by Fluent Solutions Limited.
- Preliminary engineering design surface.
- Topographical survey data and LiDAR (of surrounding land areas).

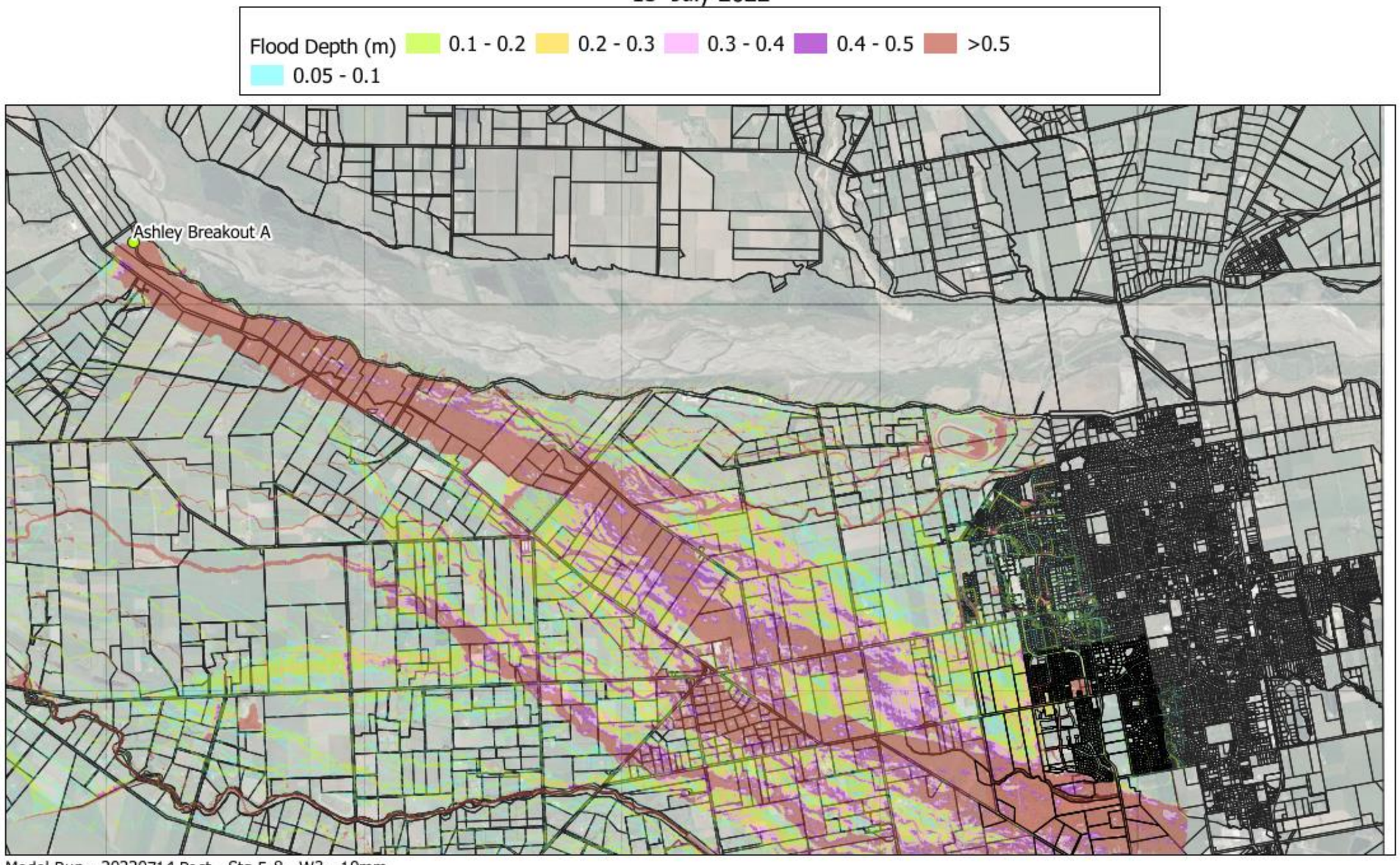
Where data supplied by Townsend Fields Limited or other external sources, including previous site investigation reports, have been relied upon, it has been assumed that the information is correct unless otherwise stated. No responsibility is accepted by Eliot Sinclair for incomplete or inaccurate data supplied by other parties.

Whilst every care has been taken during our investigation and interpretation of the flood modelling assessment results to ensure that the conclusions drawn, and the opinions and recommendations expressed are correct at the time of reporting, Eliot Sinclair has not performed an assessment of all possible conditions or circumstances that may exist at the site. Variations in conditions may occur as a result of the use of LiDAR (for the wider land area) or due to modelling input data. Eliot Sinclair does not provide any warranty, either express or implied, that all conditions will conform exactly to the assessments contained in this report.

This report has been prepared for the benefit of Townsend Fields Limited and the Waimakariri District Council for the purposes as stated above. No liability is accepted by Eliot Sinclair or any of their employees with respect to the use of this report, in whole or in part, for any other purpose or by any other party.

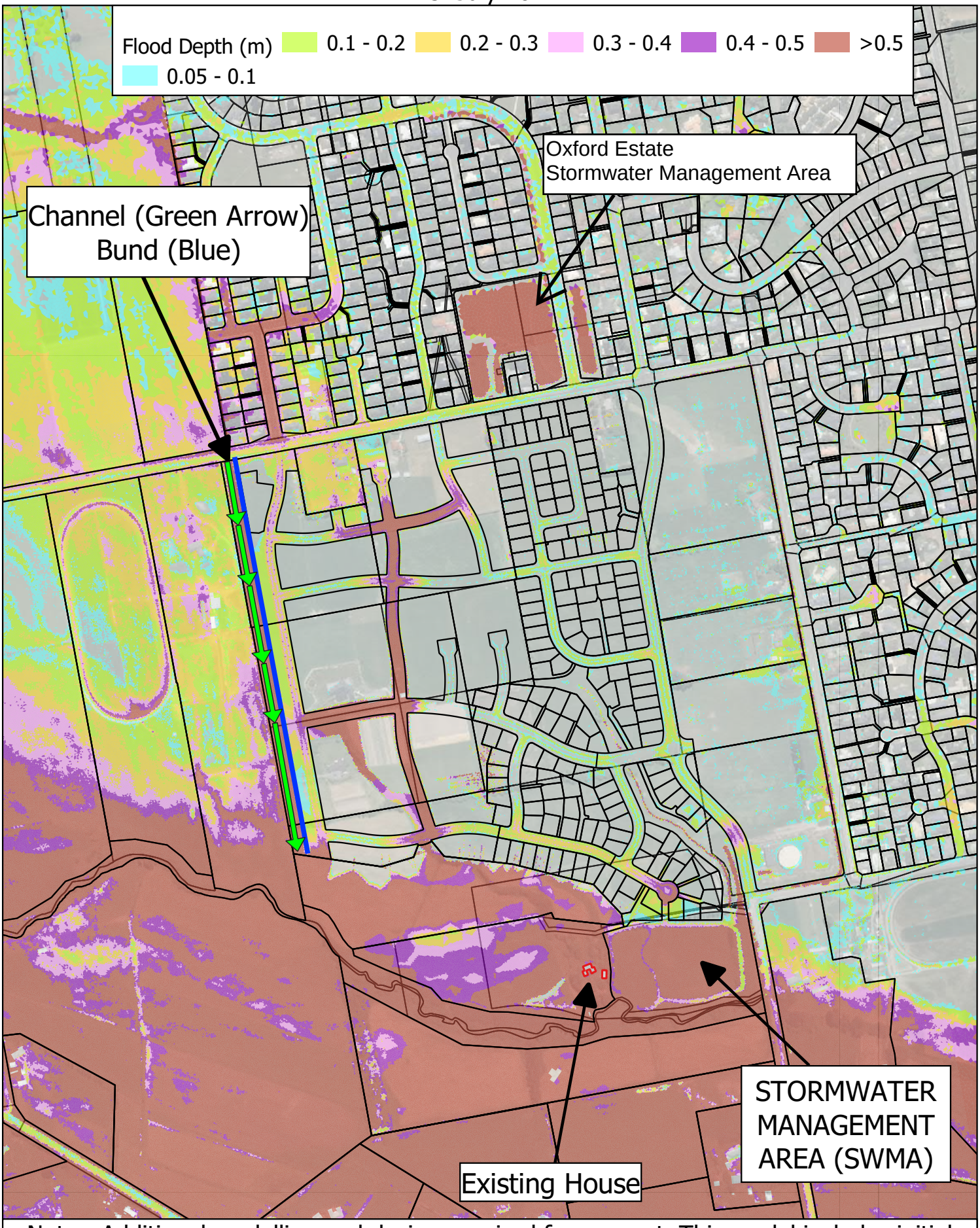
Appendix A. Post Development (Stages 1 – 8) Flood Modelling Maps

TOWNSEND FIELDS – FULL CATCHMENT – POST-DEVELOPMENT
ASHLEY RIVER BREAKOUT + RAINFALL – 200YR ARI
Stage 1-8 Preliminary Flood Depth Results
15 July 2022



Model Run - 20220714 Post - Stg 5-8 - W3 - 10mm

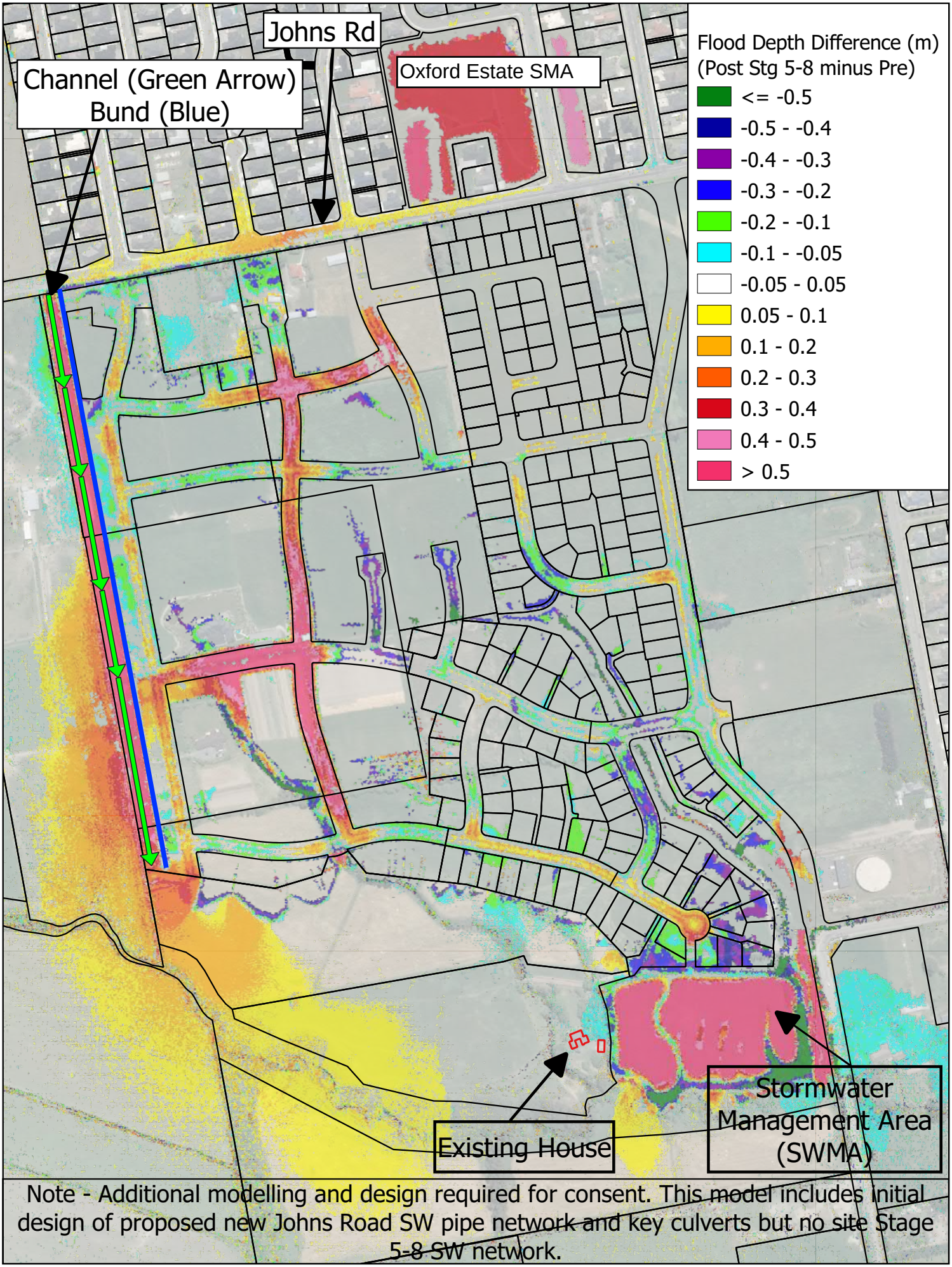
TOWNSEND FIELDS – LOCAL SITE – POST-DEVELOPMENT
ASHLEY RIVER BREAKOUT + RAINFALL – 200YR ARI
Stage 1-8 Preliminary Flood Depth Results
15 July 2022



Note - Additional modelling and design required for consent. This model includes initial design of proposed new Johns Road SW pipe network and key culverts but no site Stage 5-8 SW network.

Model Run - 20220714 Post - Stg 5-8 - W3 - 10mm

TOWNSEND FIELDS –FLOOD DEPTH DIFFERENCE
ASHLEY RIVER BREAKOUT + RAINFALL – 200YR ARI
Stage 1-8 Preliminary Results – Subdivision Consent
15 July 2022



Note - Additional modelling and design required for consent. This model includes initial design of proposed new Johns Road SW pipe network and key culverts but no site Stage 5-8 SW network.

Model Run - 202220714 Post - Stg 5-8 W3 - 10mm minus Pre