

Flood Risk Assessment

Date:	4 April 2022	Jacobs New Zealand
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Revision no:	B	

Purpose

This memo provides an assessment of the potential impacts of the construction of the proposed inundation protection bunds at South New Brighton Park and Southshore on flooding in the protected areas.

The purpose is to perform a check on whether ponding may become an issue in these areas because of the bunds. We have used existing information on ground levels from LiDAR survey data, GIS stormwater asset data, previous flood modelling¹ undertaken for the area and the design crest level and indicative alignment of the bunds. We have considered the potential for ponding both from rainfall and from overtopping of the bund in a design exceedance event.

This assessment will help to understand whether any more detailed assessment, such as flood modelling, is needed to confirm the effects of the bunds and whether any mitigation measures are needed.

Description of the site and the proposed works

Figure 1 shows the indicative alignment of the two proposed bunds, the ground levels in the project area and the stormwater pipe drainage network. The bunds will protect the low-lying residential areas from inundation by storm tides in the Avon-Heathcote estuary. These areas are protected from the sea itself by the high dune ridge along the coastal shoreline. Ground levels along the estuary shoreline are generally much lower than the dunes. However, to the south of South New Brighton Park existing bunds along the estuary shoreline already provide some protection from flooding from the estuary and to the north of the Park the recently constructed Bund South of Bridge Street provides protection against tidal flooding from the estuary.

Ground levels in South New Brighton Park are around 0.5 m to 1.0 m higher than in Southshore where Rocking Horse Road follows the lowest ground levels running north to south. Ground levels at the southern end of Southshore Spit rise to around 4 m above sea level, providing protection from inundation. To the north of South New Brighton Park, ground levels rise by around 1 m before falling to Bridge Street.

The piped stormwater drainage network in the project area collects runoff from the roads. The network drains entirely to the estuary through gravity outfalls which are fitted with "duck-bill" non-return valves. The pipes pass beneath the existing bunds in Southshore. Land movements resulting from the Canterbury Earthquake Sequence has caused a significant reduction in the functionality of the stormwater system in Southshore. Temporary pump sites have been established on many of the pipe outfalls and are often used in storm or high tide events. The design crest level of the new inundation bunds is 11.5 m CDD. This includes an allowance of 100 mm to account for settlement and survey and construction tolerances to achieve a minimum long-term crest level of 11.4 m CDD, equivalent to 2.01 m NZVD2016.

¹ LDRP525 Southshore and South New Brighton Short Term Floodplain Management Modelling Report, CH2M Beca Ltd, 19 March 2018

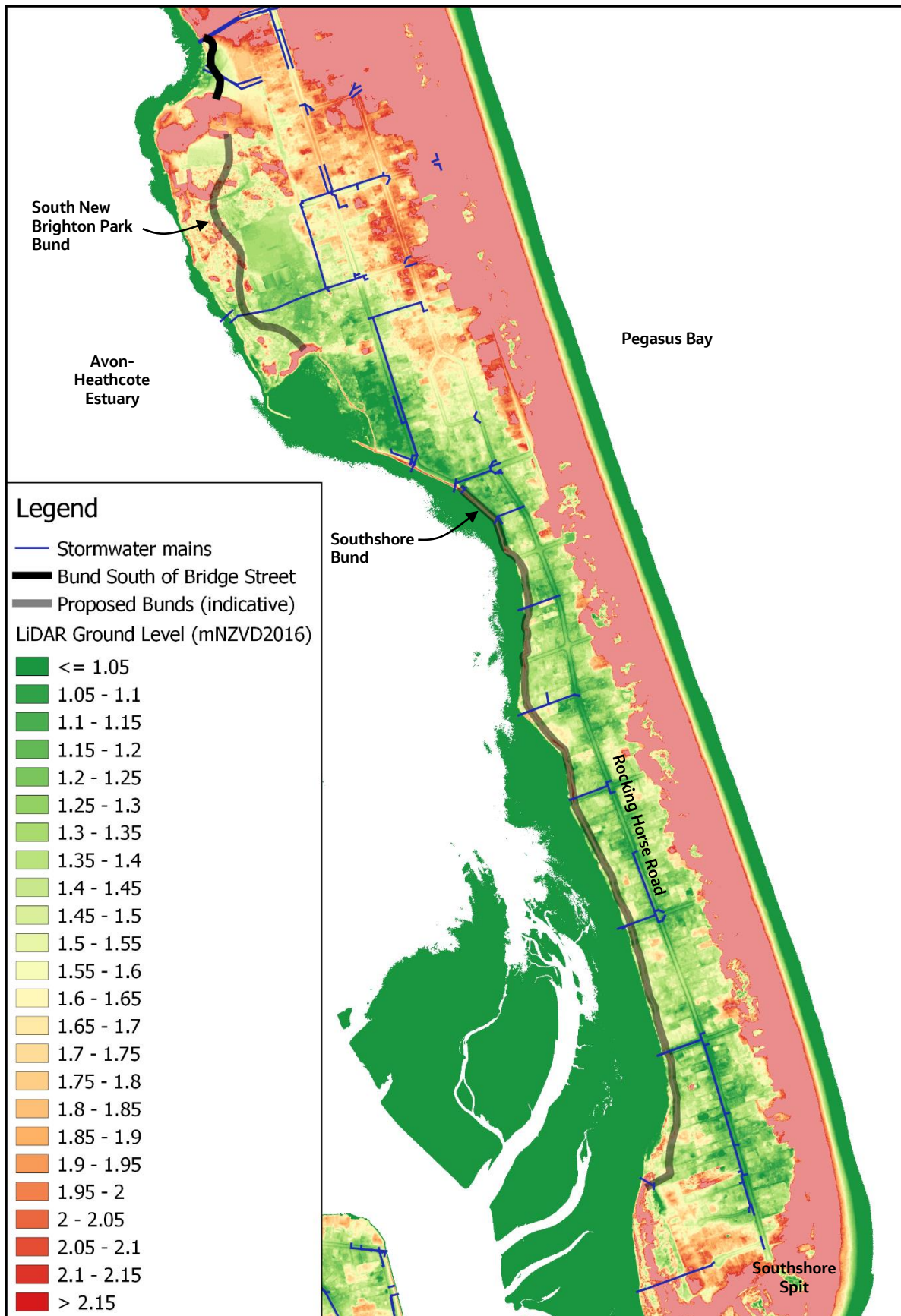


Figure 1. Main features and topography of the project site

Flood mechanisms

The main sources of flood risk in the areas protected by the two proposed bunds are storm tides in the estuary and heavy rainfall over the catchments on the spit. The proposed bunds will provide protection from storm tides up to the 2% AEP, including a freeboard allowance but excluding any allowance for sea level rise. More extreme storm tides could overtop the bunds resulting in ponding in the protected areas.

Ponding could also occur through runoff from heavy rainfall when this exceeds the capacity of the gravity stormwater network. The drainage capacity of the network is limited by the tidal water level in the estuary which, in Southshore, also results in ingress of water through some of the duck-bill valves. This exacerbates flooding and requires additional pumping of stormwater during flood events. Christchurch City Council (CCC) is currently adding new raised manholes fitted with non-return valves to many of these mains with the objective of eliminating ingress of seawater. The project will address the current issues with outfalls and therefore modify how CCC manage flooding in the future. However, these works will not modify the risk of flooding from rainfall ponding behind the new bunds considered in this assessment which assumes no active management of the flood waters is being undertaken.

Figure 3 shows the approximate lines of highest ground along the estuary and of lowest ground along the spit. The ground levels along these lines are shown in Figure 2.

Under existing conditions, any ponding of surface water in South New Brighton Park will start to spill into Southshore once the water level reaches around 1.4 m NZVD2016. Overflow into the estuary to the west of the park will start to occur if the ponding level rises above around 1.5 m NZVD2016. Overflow into the north of the park, west of Estuary Road will occur if the ponding level exceeds 1.6 m to 1.7 m NZVD2016 but the recently constructed Bund South of Bridge Street blocks the onward flow path into the estuary.

Ponding in Southshore will start to spill into South New Brighton Park at a water level of around 1.4 m NZVD 2016 and will start to overflow into the estuary along the western shoreline at a level of around 1.5 m NZVD 2016.

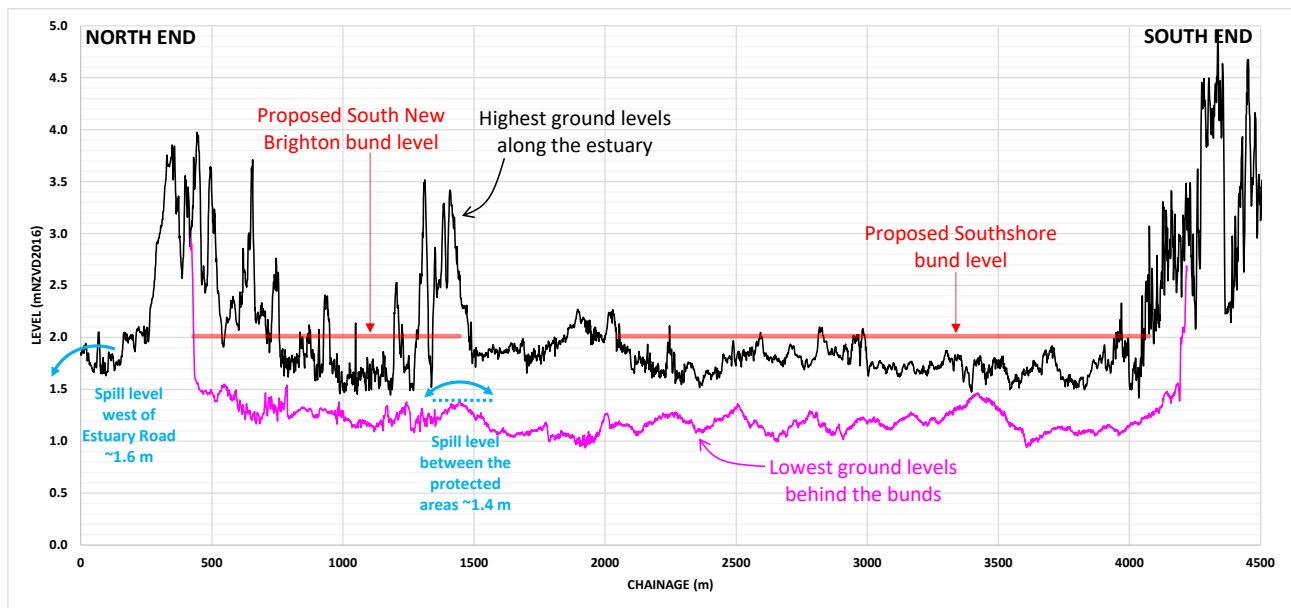


Figure 2. Highest and lowest ground levels along the Southshore Spit (Canterbury - Christchurch and Ashley River LiDAR 1m DEM, 2018-2019)

Figure 4 shows some of the expected overland flow paths for excess surface water through South New Brighton Park together with the ground profiles along the flow paths, showing how the proposed bund will obstruct the flows.

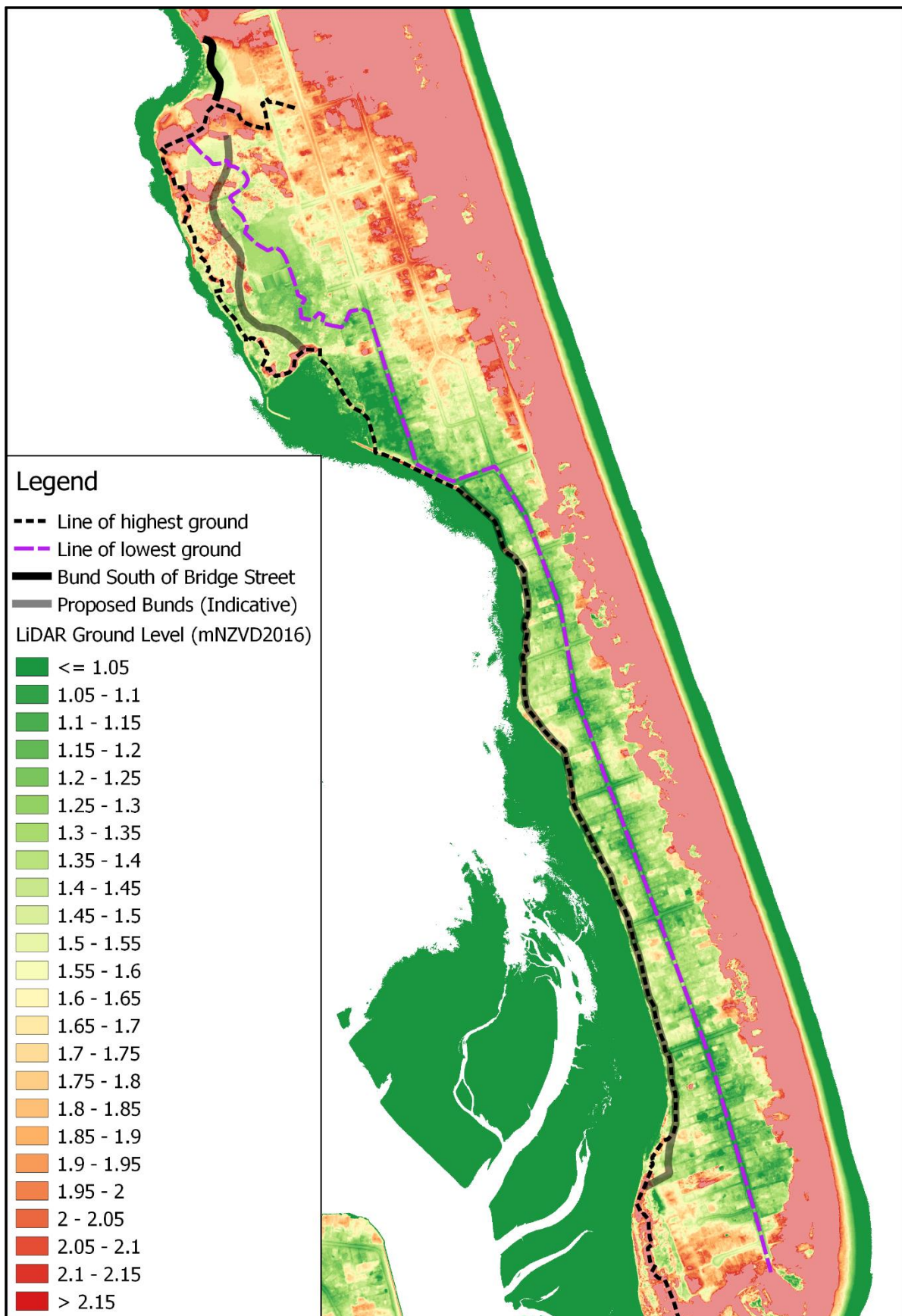


Figure 3. Lines of highest and lowest ground along the Southshore Spit

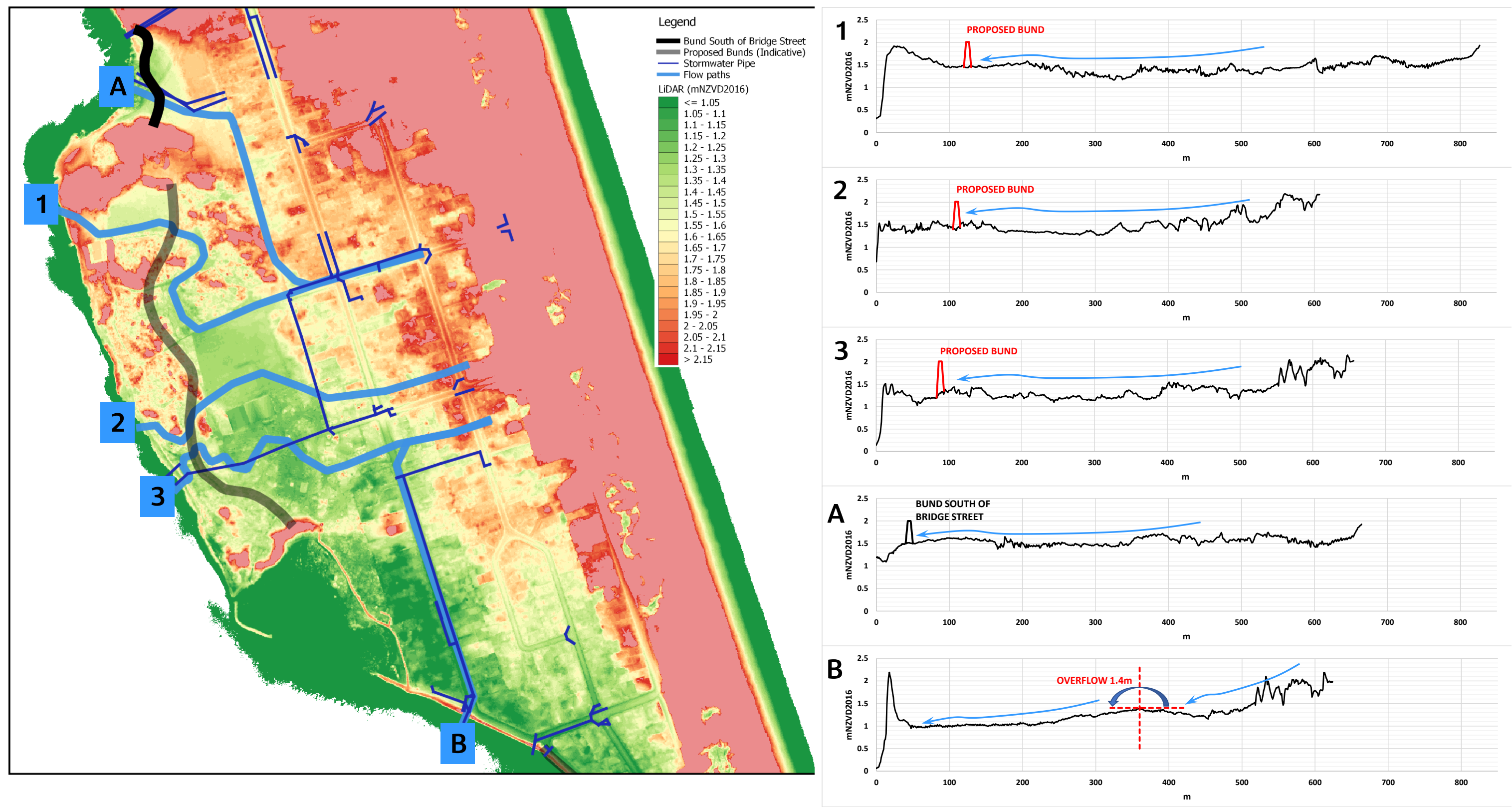


Figure 4. Overland flow paths through South New Brighton Park and ground profiles along the flow paths

Impact of the bunds on flooding

Flood modelling has previously been carried out to understand flood extents and depths in South New Brighton Park and Southshore and to assess the effects of the previously constructed Southshore bund and for the recently constructed Bund South of Bridge Street^{2,3}. The proposed bunds will reduce flooding to properties during large storm tide events in the estuary.

Figure 5 shows an extract of the flood map for the 200-year rainfall event in the South New Brighton Park area. The modelling in this map did not include the proposed bund or the Bund South of Bridge Street but did allow for the bund in Southshore. The map shows that in a relatively extreme event the proposed bund will result in a small loss of flood storage for runoff from South New Brighton at the Pleasant Point Yacht Club. This area also receives runoff from the local catchment around the yacht club so that the bund may impede drainage of this area. The bund will also block a narrow flow path over the lowest point in the estuary boundary. However, this flow path also allows tidal flooding into the Park and so blocking this route would be likely to reduce flooding in the protected area rather than increase it in the combined event that is mapped.

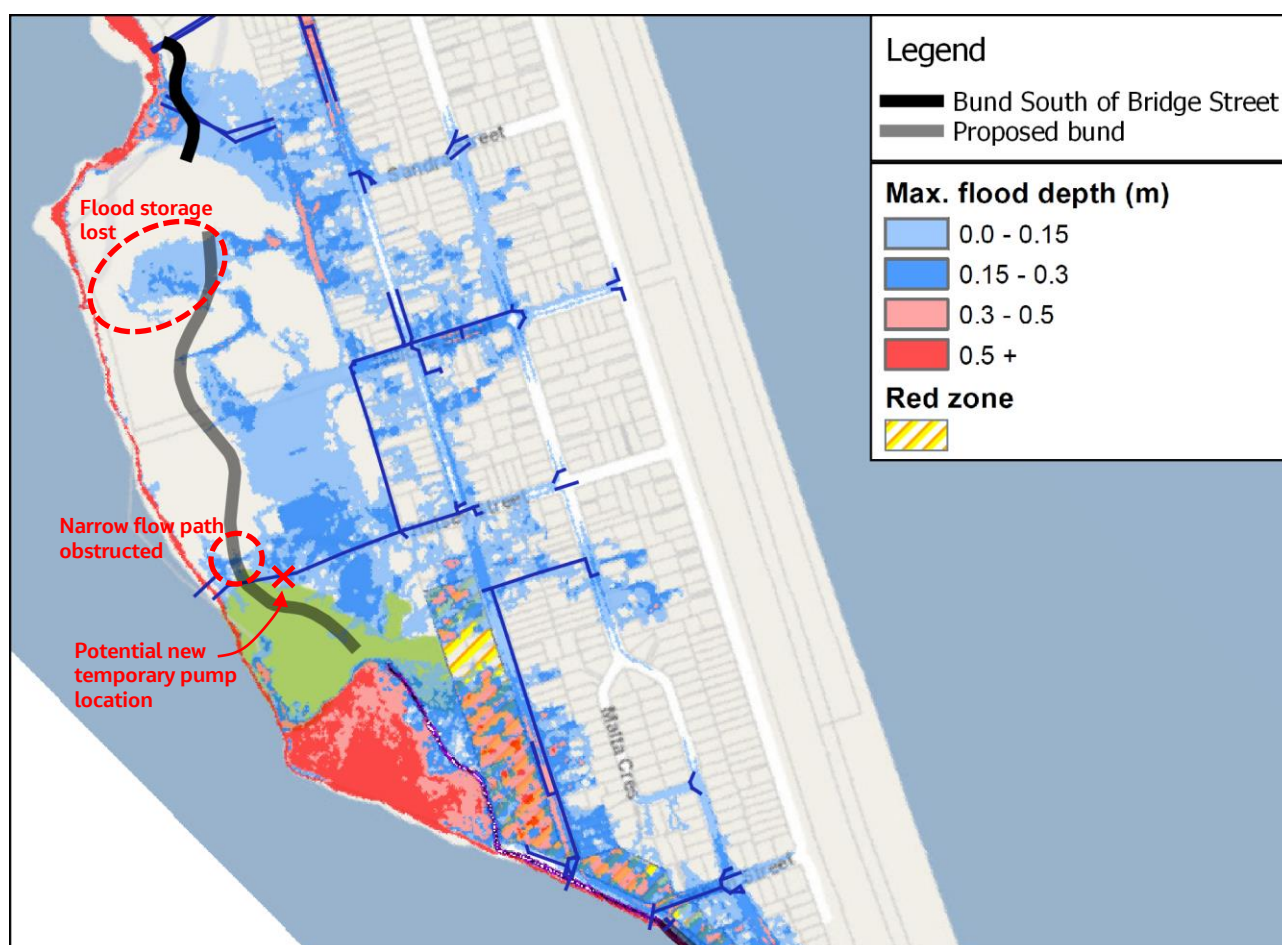


Figure 5. Extract of flood map for 200-year rainfall and 20-year tide from LDRP525 report² (modelling and mapping for conditions prior to construction of Bund South of Bridge Street and without proposed bund at South New Brighton Park, Southshore bund is included)

The loss of flood storage at the northern end of the bund, and potentially the loss of the small overland flow path in the south during rainfall dominated events, will tend to increase flood depths in the protected area. However, the volume lost is small and in this size of event the protected area is connected with the much

² LDRP525 Southshore and South New Brighton Short Term Floodplain Management Modelling Report, CH2M Beca Ltd, 19 March 2018

³ Bund South of Bridge Street 85% Detailed Design Report, Beca Ltd, February 2020

larger protected area in Southshore to the south so that the change in overall water level due to redistribution of the flood volume over the large area will be small.

The previous modelling indicates there is currently a risk of flooding to properties due to runoff in large rainfall events exceeding the stormwater network capacity in large rainfall events. The existing flood hazard could be reduced through temporary pumping of water at the location indicated in Figure 5. Temporary pumping would also mitigate the loss of flood storage volume and overland flow.

In smaller events the flow path at the southern end of the bund will not be active and storage will not extend as far (or at all) into the northern part of the bund such that the bund will have less effect on pluvial flooding.

The flood map in Figure 5 does not allow for the effect of the recently constructed Bund South of Bridge Street. The effects of that bund were assessed for the design of the bund as shown in the map extract in Figure 6. The map shows that construction of the Bund South of Bridge Street does not significantly alter the extent and depth of flooding in the area protected by the proposed bund or along its alignment.

Figure 6 also shows the relatively local effect that the Bund South of Bridge Street has in obstructing a more significant overland flow route in this area. The map also gives an indication of the likely magnitude of the effect of blocking the much narrower and shallower flow route at the south end of the proposed bund on flood depths – i.e., possibly 10 mm to 20 mm change in flood depth in a large (50-year) rainfall event.

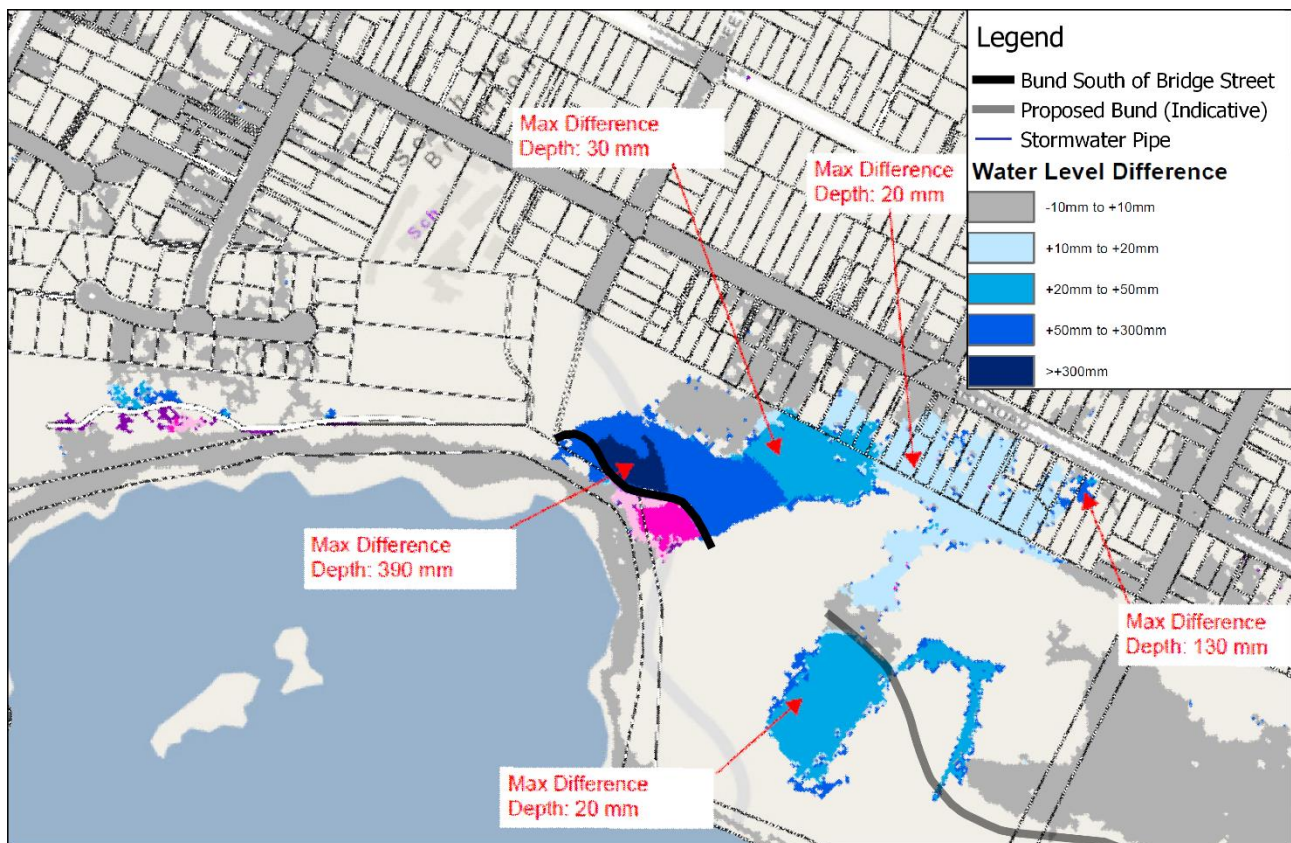


Figure 6. Extract of flood depth difference map³ showing the effect of the Bund South of Bridge Street in a 50-year rainfall and 5-year tide (modelling and mapping excludes proposed bund at South New Brighton Park)

The effect of the existing bund in Southshore has previously been assessed through flood modelling by CH2M Beca Ltd. The study found that in rainfall dominated events, flooding with the bund in place is similar (10-year rainfall) or reduced (50-year rain and 200-year rainfall) compared to without the bund, with the biggest improvement in the 200 year rainfall model.

The minimum crest level on the existing bund is estimated to be around 1.5 m NZVD2016 from LiDAR data (Figure 2). The design crest level of the proposed bund is 2.01 m NZVD2016. Therefore, the new bund will further impede overland flow into the estuary only if the ponded water level exceeds 1.5 m NZVD2016 in the

protected area. Figure 7 compares the modelled 200-year rainfall flood extent and with a simple “bathtub” projection of the water level at the minimum crest level (1.5 m NZVD2016).

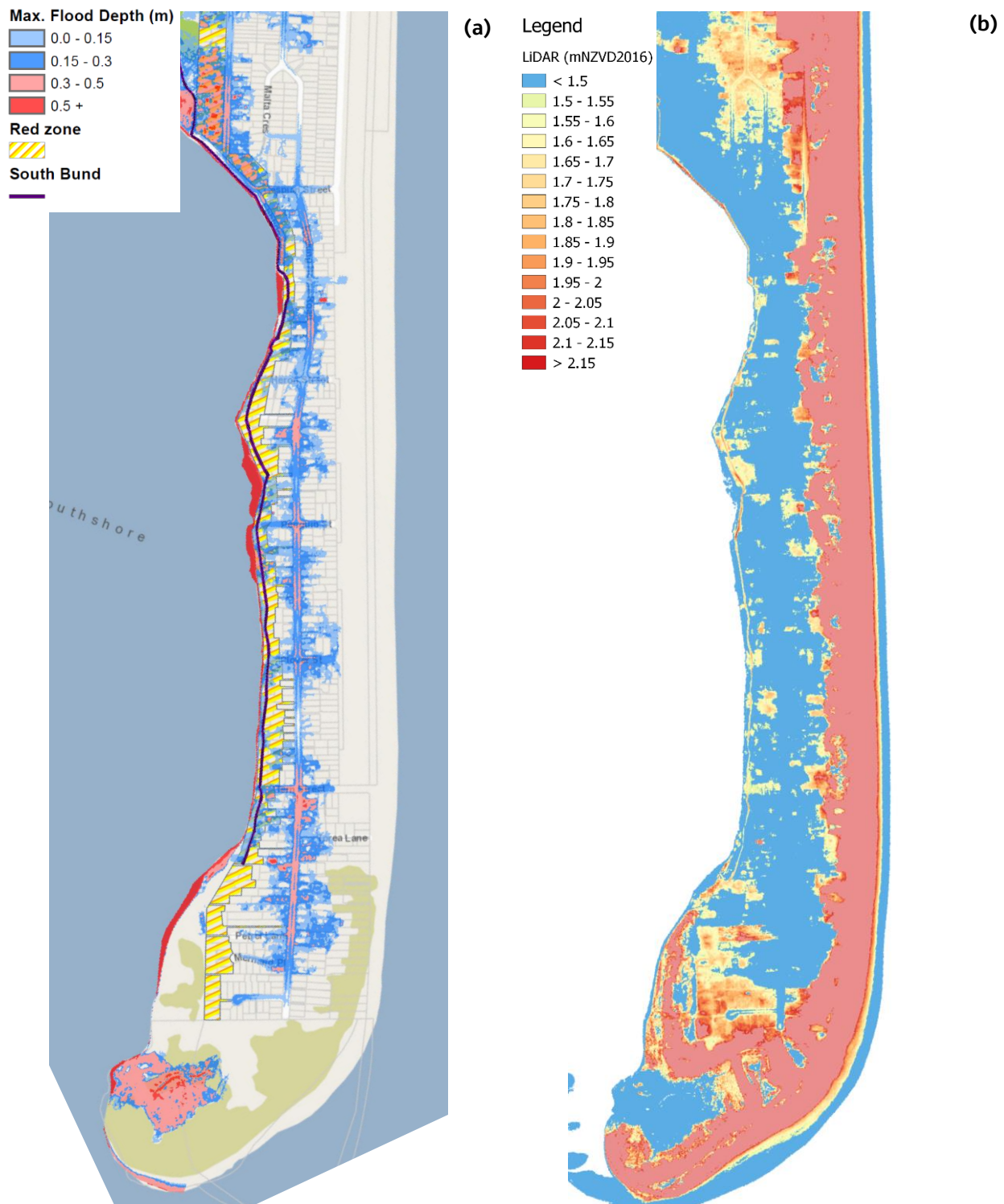


Figure 7. Flooding in Southshore from (a) flood modelling of a 200-year rainfall and 20-year tide with the existing bund in place²; and (b) bathtub map of the 1.5 m NZVD2016 water level (corresponding to approximately the minimum crest level of the existing bund) and LiDAR ground data

The map shows that flooding in the 200-year rainfall event is less extensive than the bathtub water level, confirming that the 200-year flood level is lower than the minimum crest level on the existing bund. In this way, construction of a new, higher bund in parallel with the existing bund will not further impede flow paths to the estuary. The new bund will result in a reduction in the flood storage volume available in the protected area which will tend to increase the flood level. However, given the large volume of flooding in the area relative to the volume displaced by the bund, any increase in flood level will be small.

Summary

We have assessed the potential impacts of the construction of the proposed inundation protection bunds at South New Brighton Park and Southshore on flooding in the protected areas using available data.

Our assessment shows that the areas which will be protected from tidal flooding are also susceptible to pluvial flooding.

South New Brighton Park bund

- South New Brighton Park and the surrounding properties are currently susceptible to flooding from surface water. The lowest ground levels in the Park are typically around 250 mm below the ground level along the proposed alignment of the bund between the Park and the estuary. Ponding of surface water up to this depth, which results in flooding in the South Brighton Holiday Park, will not be affected by construction of the bund.
- For higher flood levels, construction of the bund will result in the loss of a small volume of flood storage at the northern end of the bund and obstruction of a narrow overland flow path to the estuary at the southern end of the bund. In these larger flood events (ponding level of over 1.5 m NZVD2016), flooding is more widespread and includes properties along Estuary Road. The flooded area is also connected to the low-lying land in Southshore through overland flow along Estuary Road. The loss in flood storage volume and overland flow volume will be relatively small compared to the area of land flooded so that any increase in flood level and extent will also be small.
- There is potential to alleviate the existing flood risk in this area by providing a temporary pumping location for use in a large flood event.

Southshore bund

- Construction of the new Southshore bund will not further obstruct overland flow into the estuary because previous flood modelling indicates that ponding levels in extreme rainfall events will not reach the crest level of the existing bund. Therefore, providing a higher crest level will not impede existing flow paths.
- The new bund will result in a reduction in the flood storage volume available in the protected area through filling over the footprint of the bund and this will tend to increase the flood level. However, given the large volume of flooding in the area relative to the flood volume displaced by the bund, any increase in flood level will be small.

Overall

The two bunds will reduce the current risk of tidal flooding to properties in South New Brighton and Southshore. Properties in these areas are also currently susceptible to pluvial flooding due to runoff exceeding the capacity of the gravity stormwater network.

The effect of both bunds on pluvial flooding to properties is considered to be minor given the small volumes of flood storage displaced by the bunds relative to the flooded area.