This appendix is an extract from the City of London Riverside Survey report November 2020 undertaken by Arcadis. For a copy of the full report please contact floodrisk@cityoflondon.gov.uk

City of London Riverside Strategy

Appendix 2 Illustrative defence raising options

The options given in this extract are for illustrative purposes only and are not intended to be recommendations and do not cover all possible options for flood defence raising.

5 Options for Raising Flood Defences

This section explores potential options for raising flood defences. The table in Appendix C indicates which options could be applicable to the various areas of the wall covered in the survey. It should be noted that this does not form a comprehensive feasibility study. The options shown may not be a suitable or preferred solution and other options may become apparent following further targeted study.

5.1 Option A - Raising Existing Parapet or Wall

Increasing the existing height of many sections of the current defences could be achieved by raising the height of existing solid parapets, shown in Figure 16.

This solution would involve removing any existing coping stones and raising the height of the parapet to the required level before reinstalling copings and other features. Any lighting columns located on top of the existing defences would also need to be removed before the defences are raised but could then be replaced on top of the new section upon completion.

Raising the existing structure height can offer a cost-effective and environmentally sustainable solution which maximises the use of the existing structure. Whole life maintenance requirements and costs would also be relatively low, and new materials could match the existing defences.

The underlying river wall and existing parapet wall would need to be assessed to ensure they have suitable capacity for the flood loading. This may require intrusive investigations to obtain sufficient detail on the existing structure. If the underlying structure is found to be inadequate, then complex and costly strengthening may be required.

If the existing structure is of heritage importance, options for raising it will be constrained depending on the specific details of the listing.

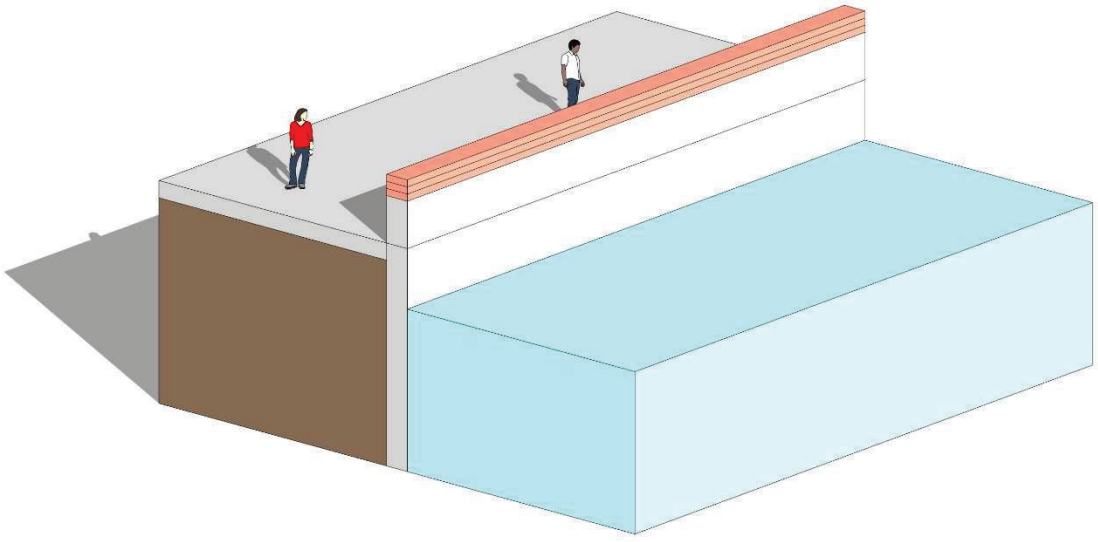

Figure 16 - Raising Existing Defences Solution Sketch

5.2 Option B - Glass Parapet on Top of Existing Defence

Existing flood defences can be raised through the use of structural glass parapet panels, as illustrated in Figure 17. Glass panels would be installed on top of the existing defences and offers a more contemporary solution to provided flood defence. The underling river wall and existing parapet wall would need to be assessed to ensure they have suitable capacity for the flood loading. This may require intrusive investigations to obtain sufficient detail on the existing structure. If the underlying structure is found to be inadequate, then complex and costly strengthening may be required.

Self-cleaning coatings can be applied to the glass to prevent build-up of surface contaminants reducing maintenance inputs.

A major advantage of this solution is that the glass panels can cause less visual intrusion and enable views to be maintained, a particular benefit if the height of the wall relative to the pavement is high.

Each glass barrier is formed of high strength structural glass within engineered frames. The glass walls are designed for marine environments and to withstand static and impact loads. The watertight glass walls can provide flood protection by up to 1.8m as standard. The glass walls can be provided as individual panels which are incorporated into solid flood defences, or as a completely free-standing glass wall. Multiple panels can be used to cover span any length of wall and can follow any contour too. Concealed tamper proof fixings are also used to reduce the possibility of vandalism.

Glass walls can however be more expensive compared to Option A above, and generally offer a 50-year design life. They may also not be suitable for structures of heritage importance.

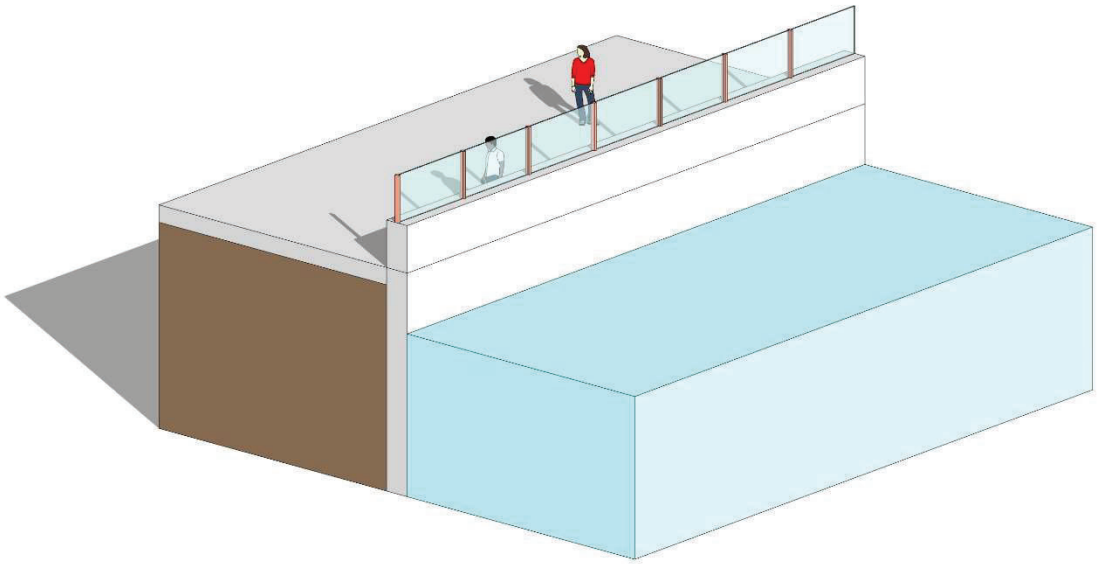

Figure 17 - Glass Parapets Solution Sketch

5.3 Option C - Demountable Barriers

Demountable barriers have the flexibility of being fully removable when not required. An example of this solution in situ is depicted in Figure 18 below. The barriers are typically formed of aluminium panels inserted into steel channel posts. Clamps are used to compress seals to create a watertight barrier against flood water. Barriers can be used on slopes up to 20° and can accommodate step and direction change for flood depths up to 4m.

The demountable barriers can be fitted to suitable existing foundations using chemically fixed sleeve anchors. When removed, only stainless steel bolt blanks are visible at each post location. Spans of 3m, unsupported, and up to 6.5m, supported with back bracing, are possible. The barrier beams weigh 8kg/m which generally allows for safe single-person lifting of beams up to 2.5m long.

The demountable barriers solution can be well-suited to locations where access or open space is required, such as at stairways and other small sections of the existing defences. Due to the assembly operation prior to a flood, this solution could have onerous operational requirements, especially if significant lengths are required to be installed due to the on-call personnel required. The underlying structure would also need to be assessed to ensure it has sufficient capacity.

This solution may be more favourable for heritage structures as it is visually less onerous.

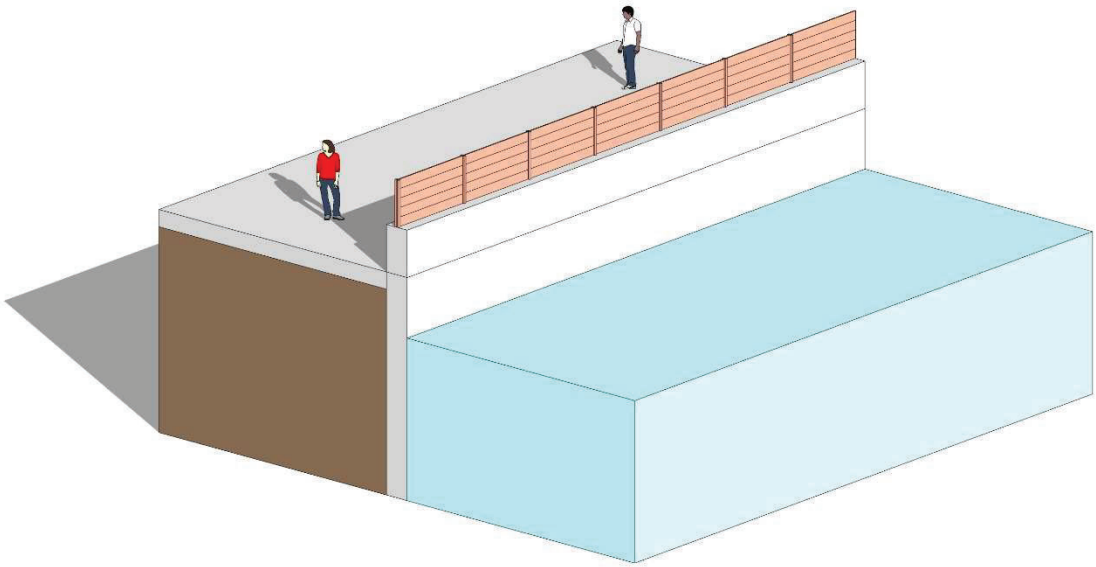

Figure 18 - Demountable Barriers Solution Sketch

5.4 Option D - Build-Out

At certain locations along the river a new, elevated, structure either cantilevered or supported on piles could be constructed in front of the existing flood defences. The form of this defence could be specified to complement existing structures and is particularly suited to areas where existing buildings form the current defences. It could be self-supporting or supported from the existing structure (subject to a suitable assessment). It could also form part of the overall riverside strategy, providing riverside access where there currently is none.

This is however likely to be an expensive option and will be visually intrusive, which may not be suitable in some areas with heritage constraints. In addition, it will likely locally impact the flood capacity of the river. The Environment Agency are usually opposed to any reduction in flood capacity on the Thames foreshore so gaining consent for this option would be onerous.

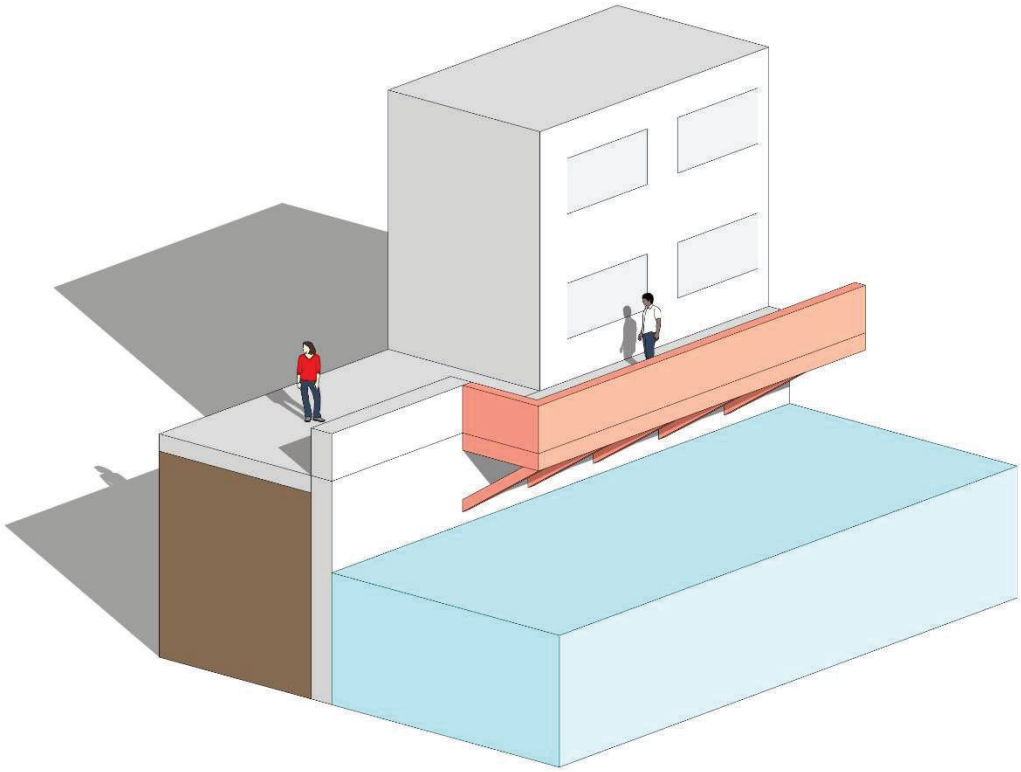

Figure 19 - Build-Out Solution Sketch

5.5 Option E - New Barrier Behind the Existing Defence

For sections of riverside walkway where there is sufficient space behind the existing wall, a new permanent flood defence barrier could be constructed, shown in Figure 20. Depending on the local site constraints, the distance of the new barrier to the existing can vary to suit its environment e.g. between a carriageway and footway.

The provision of a separate barrier discrete from the existing flood wall defences could reduce the need for structural investigations and strengthening of the existing wall. However, the new wall may require foundations in footways/carriageways that can be very congested with utilities which would complicate construction and may require diversions.

This option could be beneficial for heritage structures as it is possible to provide defences without impacting the heritage structure. Furthermore, it could be incorporated into a wider streetscape scheme with increased social benefits such as providing dedicated cycle lanes separated from traffic, or hard landscaped areas where defences levels are incorporated into the overall design. In some areas, existing set back walls could be repurposed as flood defences without materially changing the current aesthetics.

The use of set-back walls are likely to require flood gates or demountable barriers where the set-back section of wall connects to the riverside sections of flood wall. This has operation and maintenance considerations.

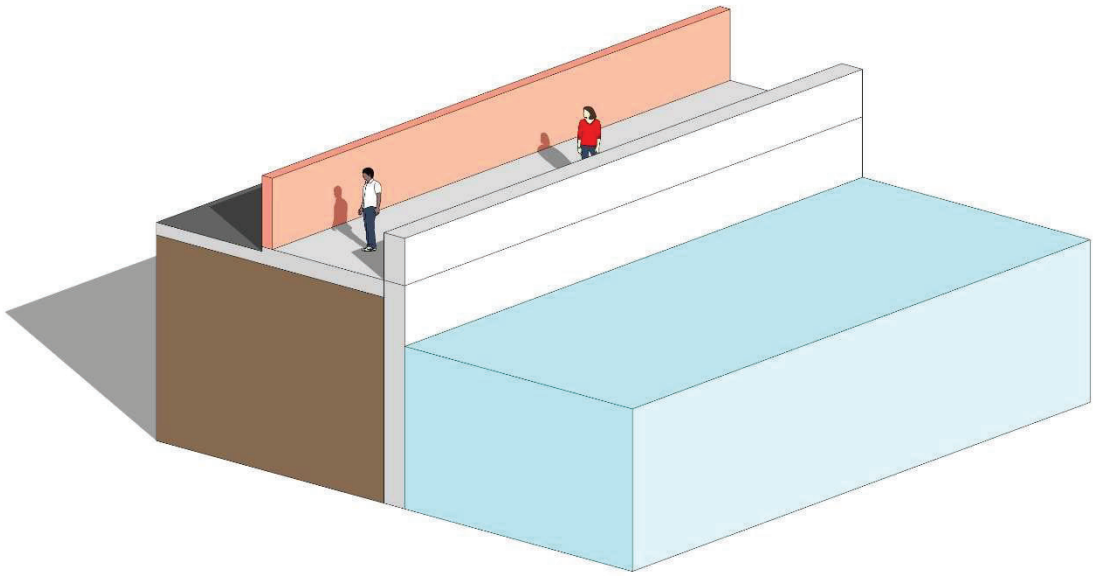

Figure 20 - Barrier Behind Existing Defence Solution Sketch

5.6 Option F - Flood and Storm Tide Gates

At locations where small gaps are present in the existing flood defence walls, such as at stairways to the foreshore and at pier or quay access points, flood gates can be provided.

Flood gates can open horizontally or vertically and can be moved manually, hydraulically, or electrically. Flood gate defence types can come in the form of lift-hinge, swing-hinge, pivot and sliding. Each of these can be operated by a single person and can be single or double leafed. The gates can be fully lockable with a single locking point, and be provided with anti-theft and vandal resistant features. An example sketch of a single leafed swing-hinge gate is depicted in Figure 21.

Gate components are typically manufactured from structural steel, aluminium, and/or stainless steel and can have low maintenance requirements. The gates are designed for extreme weather durability and have design lives in excess of 25 years, after which the seals may need to be replaced.

Depending on the product selected, both horizontally and vertically opening gates can be provided which would not impede wheelchair or pushchair access. Gate sizes can vary and can range anywhere up to 6.4m wide and 4.4m high for single gates. Double gates can also be provided for situations up to 9m wide and up to 4.5m high with a demountable central post.

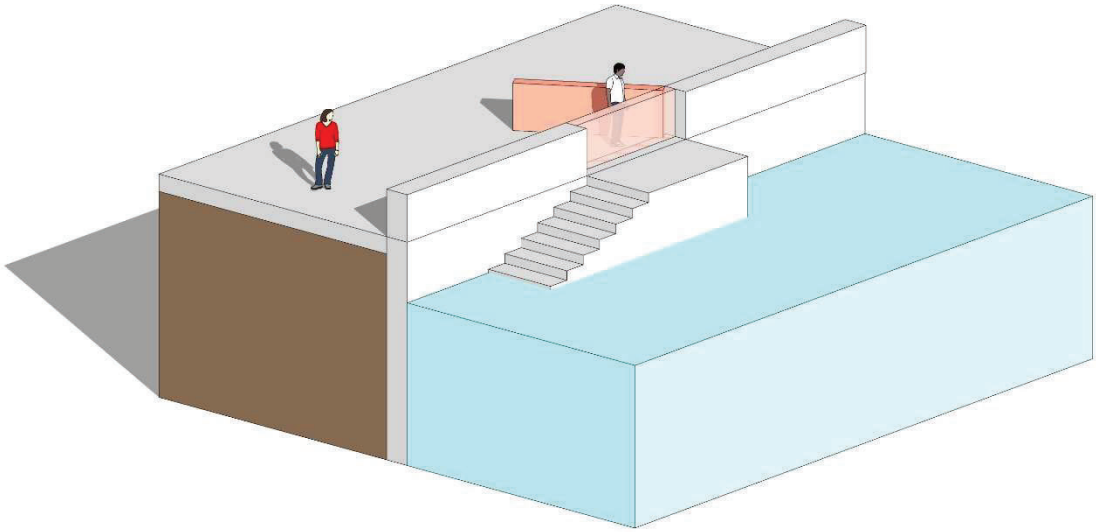

Figure 21 - Flood and Storm Tide Gates Solution Sketch

5.7 Option G - Self-Activating Barrier

The Self-Activating Barrier (SAB) is a flood defence system which uses the rising level of floodwater to automatically raise the barrier from the ground. A sketch of the barrier is shown in Figure 22 and a diagram explaining how the system works is illustrated in Figure 23.

The SAB can be installed to any length and can be constructed up to 2.5m high. Steel basins are used for lengths up to 8m and are supplied prefabricated with the floating wall for ease of installation. For lengths in excess of 8m, a concrete basin is required, with post breaks every 12m. The barrier is flush with normal ground level when not in use, allowing wheelchair, push-chair and other user users to pass unimpeded and results in an uninterrupted view.

Due to the system being powdered by the approaching floodwater, no human, mechanical or electrical intervention is required, either to raise the barrier or to act as a warning system and therefore operational costs are minimal. After 50 years the seals may need to be replaced.

The SAB is a high-cost solution compared to some alternate options and also requires a relatively deep foundation.

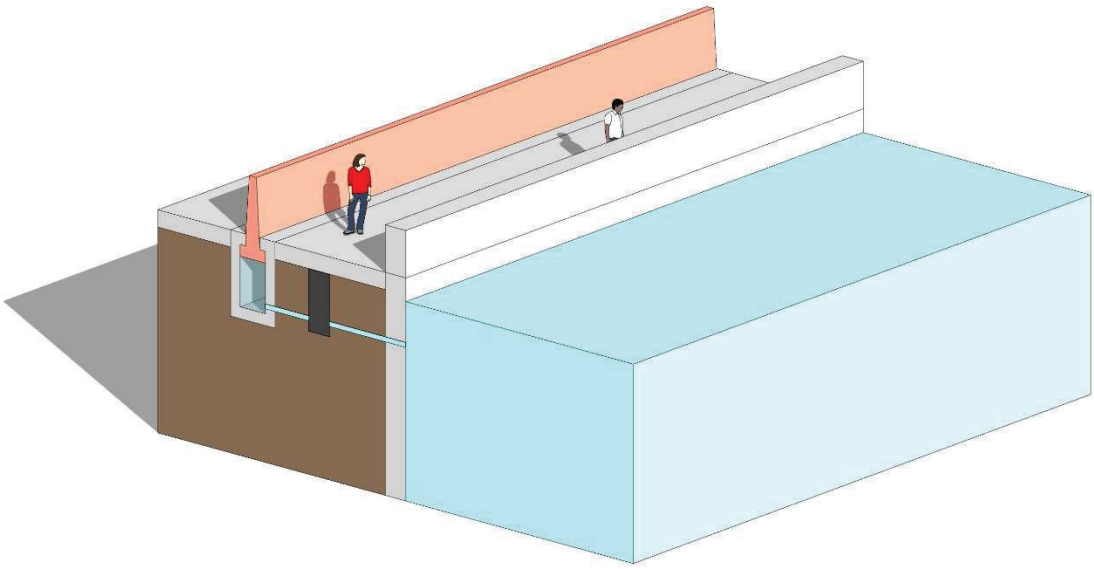

Figure 22 - Self- Activating Barrier Solution Sketch

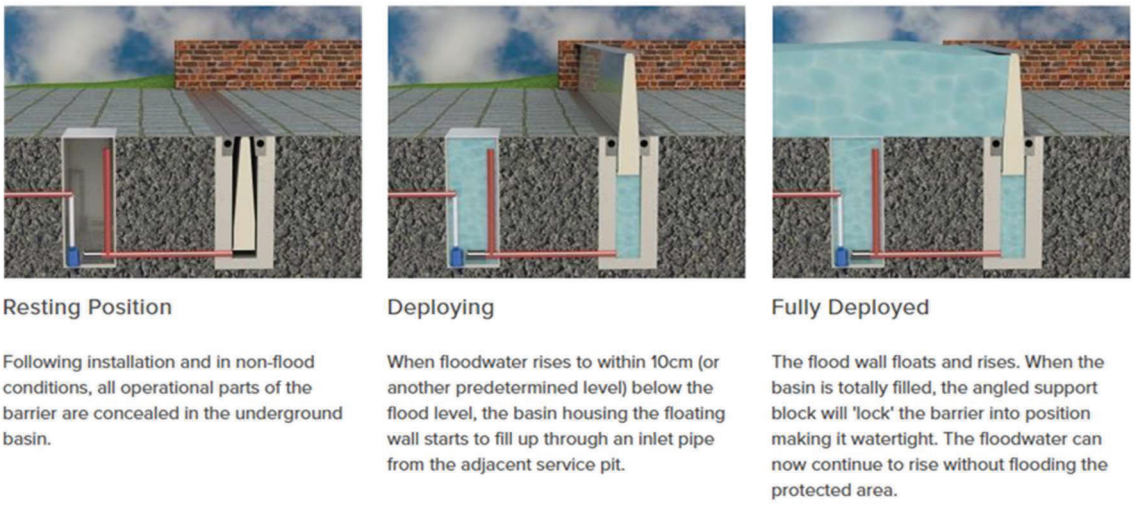

Figure 23 - Self- Activating Barrier System Mechanism (© M3 Floodtec)

5.8 Option H - Construct a New Wall and/or Parapet

This option would provide a new flood defence parapet on top of the existing river wall. This could be either to replace existing sections of open post and rail parapets, or to replace existing solid parapets where it is not economically viable to strengthen them. An example of this can be seen in Figure 24 below.

The construction of a new wall or parapet allows for greater flexibility in its specification compared to other options. A new wall could be constructed from a variety of material options, such as masonry, concrete, glass and timber. The existing river wall, or other underlying structure, would need to be assed for capacity and may need to be strengthened or even replaced. Options may also be limited in areas of heritage importance.

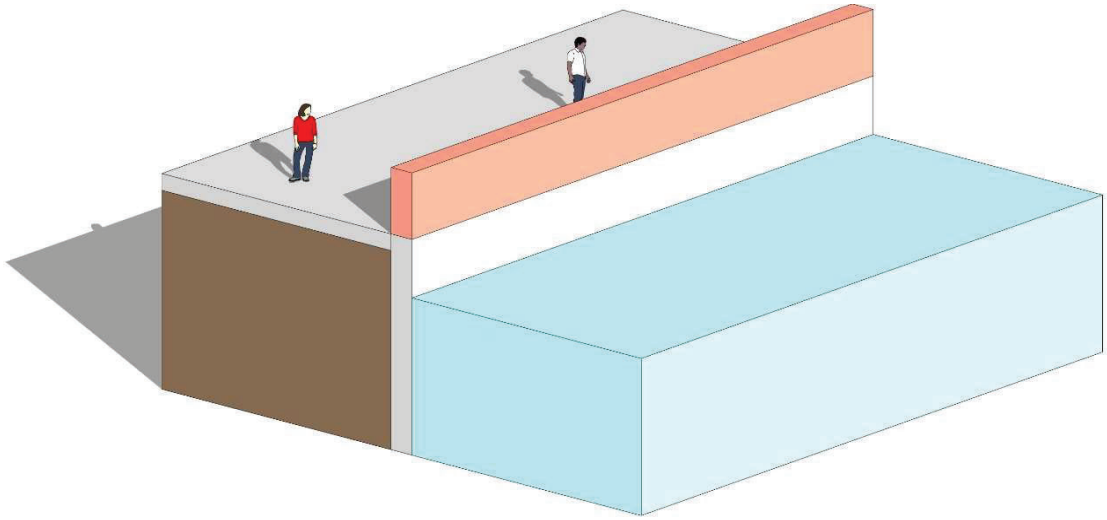

Figure 24 - New Wall or Parapet Solution Sketch

5.9 Option I - New Wall in Front of Existing

This option would construct a new wall in front of the existing wall and can be seen in Figure 25. Although this option as the benefit of providing addition riverside space it has been discounted at this stage and is noted here for purposes of completeness only. The reason for this is that building out into the Thames will have significant impacts to the flood capacity and characteristics of the river in this area. The Thames is relatively narrow at this location and it is very unlikely that consent would be given for this type of solution. In addition, large sections of the river wall are either of heritage importance or visually contribute to the unique feel and aesthetic of the Thames riverside in this area. Building a new wall in front of the existing wall would significantly change this aesthetic and is therefore likely to encounter heritage approvals issues.

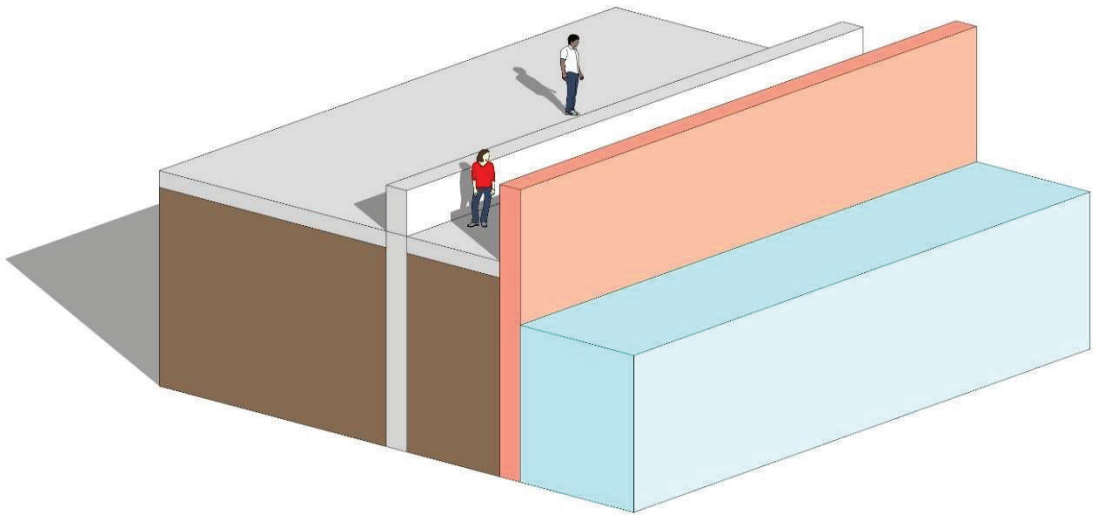

Figure 25 - New Wall in Front of Existing Defence Solution Sketch