TECHNICAL MEMORANDUM

OFFICIAL: SENSITIVE

Oxford FAS DD: Proposed Raised Defences at Osney Mead Industrial Estate

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1.0 Background

The Oxford Flood Alleviation Scheme (FAS) Detailed Design Project is developing a detailed design and full business case (FBC) for a preferred flood risk management option that will significantly reduce the frequency and extents of flooding through Oxford.

The overall proposed Oxford FAS was developed through the Outline Design Stage and comprises numerous design elements were proposed to form the preferred option of the project. These design elements included: raised defences (walls and embankments), channels, flow control structures, bridges, and culverts. Additionally, numerous ecological and landscape features were also proposed.

The proposed wider scheme provides some level of flood risk benefits to Osney Mead Industrial Estate however there is residual flooding in the western side of the Industrial Estate, including across the access along Ferry Hinksey Road, at relatively low return periods. Parts of the industrial estate are currently at risk in the predicted 1 in 2 year event, this will reduce to between the 1 in 5 and 1 in 10 year level upon completion of the proposed Oxford FAS.

During a previous high level design review, raised defences were proposed in the Osney Mead area to protect against overbank flows from Bulstake Stream and further increase the standard of protection for the industrial estate. Drawing *IMSE500177-CH2-D00-A3D-DR-C-3400* within Appendix C shows a general arrangement of the previously-proposed raised defences at Osney Mead during Outline Design. In summary, the proposals included; a flood bund along the sports field, and floodgates to maintain access onto the National Grid compound and onto Willow Walk. Floodwalls were also proposed within the south-west boundary of the industrial estate.

2.0 Introduction

The alignment of the previously-proposed floodwalls at the industrial estate was shown to be going through several existing buildings as it was previously assumed these buildings would be demolished as part of regeneration plans for this area. This route for the defences also avoid impacts on land in third party ownership outside the extents of the existing industrial estate.

An alternative design for flood proofing the existing building was also undertaken to minimise costs. However the depth of residual post Oxford FAS flooding in the south west corner of the industrial estate for higher return period events is in the order of 1m deep which would result in water levels above existing window sill levels. Providing property protect measures above 0.6m of flood depth is typically not practical and therefore this option was discounted.

This technical note further reviews the proposed raised defences at Osney Mead area with the objective of minimising the impact/footprint of the defences on existing buildings in the Osney Mead industrial estate.

2.1 Fluvial flooding mechanism

The principal source of flooding is from the Bulstake Stream as the water level rises in the Bulstake and overflows into the surrounding floodplain. The Bulstake mainly overspills from the north west side of the recreational ground and flows into the south west corner of the industrial estate.

Additionally, the water levels in the Bulstake rises simultaneously with the levels in the River Thames, this causes the ditch that is situated to the south of the industrial estate to rise and overflow into the industrial estate.

In the existing situation flood water also enters the area from the Osney Stream to the north of the site in two localised areas. In the post Oxford FAS situation these areas could be re-landscaped or simple kerb raising would close off these flow routes, these are not considered further in this note.

Flooding from Botley Road area also currently impacts on the Ferry Hinksey Road which is the access to the industrial estate area. However, the proposed Oxford FAS will reduce the risk of flooding from this route, although it should be note that at higher return period events a left turn only will be possible out of the industrial estate (towards Botley away from the city centre) due to the inundation of Botley Road to the east of the Ferry Hinksey Road junction.

3.0 Proposed defences

For the purpose of this report; the site can be divided into three separate geographical sub-sites, namely:

- Recreation ground
- Access tracks (onto Willow Walk and onto National Grid compound)
- Osney Mead industrial estate

Drawing *IMSE500177-CH2-D00-A3D-VS-C-0001* in Appendix A shows the currently proposed designs.

3.1 Proposed defences at the recreation ground

A flood bund was previously proposed on this ground as opposed to a floodwall as a bund would better integrate with the existing green setting in this area. It is proposed to run along the eastern edge of the recreation ground but offset from the boundary to avoid impacting on the mature trees which screen the industrial estate from the nearby residential properties.

A floodwall option was considered along the edge of Ferry Hinksey Road as this is raised above the recreation ground level so would require a lower defence. The northern section of Ferry Hinksey Road is a similar level to the proposed defence, however the road levels drop further south. It may be possible to utilise an increased height kerbs along a section of this but the southernmost 110m of road would require a defence in the order of 0.45m which is too great to achieve with simple kerb raising. This would require a formal flood wall with a concrete base. However, space is limited and the foundations would have to be dug within the root zones of the mature trees along the edge of the road, this would likely affect the long-term health of these trees and ultimately lead to their removal. These trees are a significant landscape feature and screen the industrial estate from the nearby residential properties. Therefore; on review, the bund is still preferred in this area.

The proposed bund would tie-in with the existing cycle track to the north of the sports field; as a result, the height of the bund is limited by the existing level of the cycle track which is at ~+56.70 at the point where the bund would intersect. Hydraulic modelling shows that the 1 in 100 year post Oxford FAS flood level would be at +56.75; therefore the defence would just overtop at a 1 in 100 year event if the crest of the proposed is set to +56.70.

The embankment would not be fenced and public access would be maintained over the embankment. Appendix B compares the post Oxford FAS flood extents against the Do Minimum (Extend) flood extents at the 100yr event. The overall scheme provides flood defence benefits to the residential properties in this area so there are no dis-benefits of providing a defence to the same level as the cycle track.

Therefore, during events of 1 in 100 years and above there will be residual flooding in the industrial estate, the proposed raised defences will prevent any water which overtops the defences flowing back into the floodplain and therefore removal of the overtopped water would depend on the functionality of the drainage network. During flood events the drainage network will be ineffective as outlets are likely to be submerged during flood conditions and therefore the overtopped water may temporarily pond until the water levels in the main rivers begin to drop. Alternatively, a small pumping station could be provided to return flood water to the flood plain over the defences.

Raising the cycle track would not be a preferable solution as it would increase the risk of Bulstake Stream flooding the properties located on Riverside Road via the back gardens. Raising the cycle track can only be proposed in conjunction with raising the left bank (eastern bank) of Bulstake Stream up to Bulstake Bridge on Botley Road so that the cycle track ties-in with the left bank of Bulstake Stream. This would entail working in a number of private residential gardens. The cost of such works would likely outweigh the potential flooding benefits and therefore this option has been discounted. Without further detailed modelling it is also not possible to indicate how effective this may be as the additional defence could raise flood levels locally and create additional overland flood routes due to the flat topography in the area.

3.2 Proposed floodgates at access roads

Raised defences are also required across the existing access track onto Willow Walk and the access track onto the National Grid compound. Floodgates are proposed at these locations principally due to the lack of open space to construct a flood bund with ramps that could accommodate maintenance vehicles.

A 3m wide floodgate is proposed at the Willow Walk access track/bridleway, this width would be sufficient to allow maintenance vehicles to pass one at a time. A number of trees locally to the flood gate location on Willow Walk will be lost during the construction process, see Section 4 for further details.

The possibility of raising Willow Walk to the defence level has been reviewed. This would remove the construction, operational and maintenance risks and costs associated with the flood gate structure. However, to comply with access for all requirements a ramp with 1 in 20 slopes would be required. This would need the removal of a significant number of mature trees along Willow Walk to accommodate the ramp and was therefore discounted. Diverting Willow Walk into the recreational area to create a ramp was also discounted due to a significant additional loss of recreational space and additional impacts on mature trees.

A 5m wide floodgate is provisionally proposed at the access track onto the National Grid compound; the 5m width is based on the approximate width of the current access gate as it is used for HGV access. Discussions with National Grid are to be held to confirm their access requirements however this would not change any current arrangements once construction is completed, although access to the compound during a flood would be restricted due to the presence of the closed flood gate.

Initial discussions with National Grid have indicated they may still require limited pedestrian access into the compound area during low return period events in case of emergencies, therefore consideration a secure means of access over the defences at this location when the flood gate is closed should be considered in the detailed design. These discussions are ongoing at the time of writing this note.

The floodgates would be left opened in normal conditions and would only be closed during a flood event – trigger levels are yet to be confirmed. However, the floodgates may require to be periodically closed during non-flood conditions to ensure the mechanism is functional. The floodgate

at the National Grid access track would be situated separately to the security gate so that National Grid can access the compound without interfering with the flood gate in normal non-flood conditions.

3.3 Proposed defences at Osney Mead industrial estate

The principal design objective in this area is to minimise the impact of the defences on the existing buildings and on the land take within the Osney Mead industrial estate.

Floodwalls are preferable in this area due to the presence of many constraints and lack of space. These would be located on the adjacent land owned by the Cooperative Society to avoid the majority of the existing buildings in the industrial estate which were impacted by the original option.

The two main constraints for the alignment of the floodwalls are;

- The Electric Road
- A property in the southwest corner of the industrial estate (located directly opposite the entrance to the National Grid compound)

3.3.1 Electric Road

The Electric Road is an access track that has high voltage (400kV) oil filled electric cables on either side of the track. The electric cables are housed in a concrete trough that has been covered with concrete slabs either side of the single carriageway stone access track. National Grid have a 66ft (~20.20m) wide wayleave along the length of the Electric Road – the wayleave width is assumed to be equally distributed from the centreline of the access track and all designs avoid this area. However, we have also reviewed and checked that the alternative designs are all located outside of the wayleave should the track be offset from the centre of the wayleave in either direction.

Diverting the electric cables would be prohibitively costly and its undertaking for the purpose of constructing a floodwall would not be economically viable. Therefore, the proposed alignment of the floodwalls avoids encroaching within the wayleave to avoid impacting on the electric cables.

3.3.2 Property (located directly opposite the entrance to the National Grid compound)

This property in the south west corner of the industrial estate is situated within the National Grid wayleave and it abuts, or impinges on, the Electric Road wayleave preventing a floodwall to be built in-between the two constraints.

There are drainage ditches to the west and south of the property; these drainage ditches ultimately connect to the main rivers and as a result they are the source of flooding to the industrial estate once the water levels rise in the main rivers.

Furthermore, there is a footpath adjacent to the western side of the property that must be maintained as the footpath is linked to the footbridge across Bulstake Stream.

3.3.3 Options for the alignment of the new floodwall with respect to the property

Following consideration of the site constraints, two options for the alignment of the floodwall are proposed with respect to the property in question. An allowance of 1.5m clearance has been allowed on all flood walls to facilitate maintenance access for inspections and routine maintenance to joints .

Further details of the options are presented in Drawing *IMSE500177-CH2-D00-A3D-VS-C-0001* in Appendix A shows the currently proposed designs, a discussion of the options is presented in Table 1 overleaf.

These proposals are;

- **Option A**: New floodwalls to tie-in with the property and then the property to be used as part of the defences or rebuild west and southern walls of property to form flood defence
- **Option B**: Property to be decommissioned and replaced with new floodwalls

3.3.4 Comparisons of the options

Table 1. High level comparisons of the two options

	Option A *New floodwalls to tie-in with the property and then the existing or rebuilt property to be used as part of the defences.*	Option B *Property to be decommissioned, removed and replaced with new floodwalls.*
Economics (both options would provide the same Present Value Benefits). Therefore, only the construction and maintenance costs are taken as the comparators. (Effectively, the Net Present Value is being considered)	Construction costs could be lower if the existing building could be used; however, if replacement is required then likely to be cost neutral. Furthermore, there would be a need to enter a legal agreement to own the outer walls of the property to ensure the outer walls do not get modified or compromised in any way that could affect their use as a flood defence.	Construction costs would be significantly higher as there would be a need to buy the property and land as well as decommissioning the property. The maintenance costs would be lower as the new wall would be constructed using more modern and sustainable products and methods.
Technical	The threshold flood level and the structural condition of the property are not known; however, an initial visual inspection indicates that the building is unlikely to be structurally suitable to be used as a flood defence without rebuilding the west and south walls. It may be simpler to remove the building to facilitate construction access and rebuild it later with walls to act as flood defences.	Additional construction risks associated with building works may be encountered (such as asbestos). However, this is also potentially relevant to Option A should the building need complete replacement. Wall alignment could be positioned anywhere within the existing building footprint.
Environmental (a more detailed discussion is given overleaf; in this section, the environmental aspects are explored in a comparative manner). Note, landscape is considered to be neutral to the options.	Note, landscape and environmental considerations are neutral between the options.	Note, landscape and environmental considerations are neutral between the options.
Institutional Negative press coverage could be generated if the property owner decides against both options.	Will need to find temporary accommodation for the building occupier during construction but no long term impacts. The main part of the floodwall would not be within the industrial estate and therefore the Coop may object this option or request the floodwall is to be situated closer to the boundary of the industrial estate.	Building occupier will need to permanently relocate. Loss of development land within the industrial estate for future redevelopment. The main part of the floodwall would not be within the industrial estate and therefore the Coop may object this option or request the floodwall is to be situated closer to the boundary of the industrial estate.

3.3.5 Construction Access

Initial discussions with National Grid for facilitating construction access along the Electric Road have not been favourable. It is understood that the cables are relatively old and in a fragile condition, any excessive loading or vibrations could cause the cables casings to crack and leak oil. This would necessitate expensive repairs and potentially create an environmental incident.

Current usage of the track is limited to infrequent usage by light vehicles and agricultural vehicles which have a relatively low bearing pressure. Construction plant tends to create a lot more vibration

than these vehicles and also tend to have a much higher wheel and axle loading. There is concern that a large number of this type of movements in a short space of time during construction will cause damage to the cables. Therefore, access along this track has been discounted.

There are limited alternatives;

1. Access through the industrial estate from the north between existing buildings; this is limited but could be achieved by the removal of a number of trees to create a new access out of the industrial estate. The area on Coop land between any new defence alignment and the electric road could be used with a suitable exclusion zone to the cables agreed with National Grid. This exclusion zone extent will depend on the type of plant to be used.
2. Access through the edge of the industrial area at the location where the building on the south west corner is currently positioned. This would potentially only be achievable if the building was completely removed (Option B) or completely rebuilt in Option A. This would still require the land currently in Coop ownership as a working area.

There are also power cables at the flood gate locations which will require protection during construction and also require sleeving through the defence wall. This will need to be undertaken in conjunction with the relevant service authority.

Temporary footpath diversions will be required during the construction period for the section running between the industrial estate and the National Grid compound and during the installation of the flood gate on Willow Walk.

4.0 Environmental issues

A preliminary environmental screening assessment of the Osney Mead alignment (applies to both options) has been undertaken in advance of an Environmental Impact Assessment (EIA), based on the following available information:

- Predevelopment Arboricultural Survey and Tree Constraints Plans (Middlemarch Environmental, May 2017)
- Aerial photographs
- Oxfordshire Definitive Map of Public Rights of Way/Oxfordshire Countryside Map (Oxfordshire Countryside Service)
- Phase 1 Habitat Survey (CH2M 2015) and subsequent walkover in May 2017

The studies undertaken to date have highlighted the following environmental issues (note this list is not exhaustive) that require consideration in the alignment of the defences:

4.1 Amenity land

The proposed earth embankment associated would raise approximately 0.18ha of amenity grassland at Oatlands Road Recreation Ground in New Botley (based on a 179m long embankment and 10m wide), which is a Protected Public Open Space. There will be some disruption to the sports ground during construction. A temporary working area and a temporary compound site will be required to enable construction.

The proposed floodwall would cross public rights of way including a bridleway and a permissive footpath, and therefore floodgates will be provided at these locations to maintain the rights of way upon completion of the scheme. Temporary diversion of the rights of way is likely to be required during construction.

The proposed bund would tie into a pedestrian/cycle route at the northern edge of the sports field, which may result in temporary disruption during construction.

4.2 Archaeology

The floodwall would cross the Oxford Greenbelt Way (public bridleway) and Hinksey Causeway, which will require consideration in the archaeological impact assessment.

Two archaeological trial trenches are proposed to be dug along the edge of the sports ground in August 2017 to inform the design of the scheme and the archaeological impact assessment.

4.3 Nature conservation site

The floodwall would be constructed within part of the Osney Mead Site of Local Importance for Nature Conservation (SLINC) comprising good plant assemblages, scrub and a remnant ditch network. This site is protected through planning policy as a wildlife corridor and may require habitat creation to ensure no overall loss of ecological value.

4.4 Habitats and protected species

The 2015 Phase 1 Habitat Survey identified that the proposed defences would be constructed in the footprint of (and therefore result in the permanent loss of) areas of amenity grassland (edge of sports field), species rich hedgerows and semi natural broadleaved woodland. These habitats may support protected species including bats, breeding birds, reptiles and badgers, which could be impacted by the scheme.

A number of the trees at this location are noted for their bat potential and therefore a bat survey has been commissioned at this location.

EcologyLink have been commissioned to carry out an invasive species survey of this area. The results are likely to be available in July/August 2017.

The results of the recent walkover by an ecologist in May 2017 to determine if other protected species surveys are required at this location are not available at the time of writing the first draft of this note. The results will be included in the next iteration of the note.

4.5 Tree loss

The proposed floodwall associated would cut through a significant area of trees resulting in:

- Partial loss of category B and C tree groups, as follows
  - Partial loss of G59 – Crack willow and blackthorn of low quality/value (category C), of cultural/conservation value.
  - Partial loss of G54 - Blackthorn, Crack willow and Field maple, of moderate quality/value (category B). Of arboricultural, landscape and cultural/conservation value
  - Partial loss of G55 – Alder, Crack willow, hybrid Black poplar and Sycamore of moderate quality/value (category B). Of arboricultural, landscape and cultural/conservation value
  - Partial loss of G60 – Ash, hawthorn and hazel of poor quality/value (category C) Of landscape and cultural/conservation value
- Direct impact on tree roots and potential loss of isolated mature trees including two Crack willows (1151 and 1152) of low quality/value (Category C). Of arboricultural value

  The full impact on trees will be confirmed following the detailed design of the preferred alignment at this location and following an arboricultural impact assessment. Tree planting of indigenous species will be required to offset the losses.

4.6 Landscape and visual amenity

The proposed floodwall associated with both options would be constructed within the Green Belt. Additionally, part of the floodwall will be constructed within the Raleigh Park View Cone.

The crest of the proposed earth embankment may compromise the privacy of the properties that overlook the embankment. This will be reviewed further in the next stage and strategic tree planning might be required to protect the privacy of particular properties.

4.7 Nitrate Vulnerable Zone (NVZ)

The proposed defences would be constructed within a surface water NVZ.

5.0 Costs

The following option costs are high levels and provided for indicative purposes only. They have been developed in conjunction with Arcadis who are the scheme cost consultations. The cost below cover all aspects of implementation of the scheme but exclude any long-term maintenance costs.

Table 2. Option Costs

Option	**Cost Estimate (£)**
Original proposal (incl wider building removal)	£3,000,000
Option A (reconstruction / flood proofing building)	£4,548,362
Option B (complete removal of building)	£4,498,867

The above costs cover all anticipated costs associated with the implementation of the options including surveys, land costs and compensation.

6.0 Economic Review

A simple economic review of the Osney Mead defences has been undertaken in line with the published FCERM appraisal guidance. The results of this are presented in Table 3 below.

Table 3. – Economic Review

	Costs and benefits £			
Option number	**Option 1**	**Option 2b**	**Option 5b**	**Option 6**
Option name	Do Nothing	Do Minimum (extend)	Channel, Medium Culverts and Defences	5b + Osney Mead Defences
COSTS:				
PV capital costs				4.55
BENEFITS:				
PV monetised flood damages	56.1	26.1	14.2	11.5
PV monetised flood damages avoided		30.0	41.9	44.6
Total PV damages £	56	26.1	14.2	11.5
Total PV benefits £		30.0	41.9	44.6
DECISION-MAKING CRITERIA:				
excluding contributions				
Based on total PV benefits				
Net Present Value **NPV**		30	42	40
Average benefit/cost ratio **BCR**		0	0	9.8
Incremental benefit/cost ratio **IBCR**				0.60

The table above presents the impact of adding the proposed Osney Mead defences (Option 6) into the main overall preferred scheme (Option 5b) presented in the Outline Business Case document (OBC). The benefit cost ratio for the overall scheme is reduced as a result of including these works as the current cost estimate for the Osney Mead defences is greater than the benefits derived for the existing property types in this local area.

7.0 Next Steps

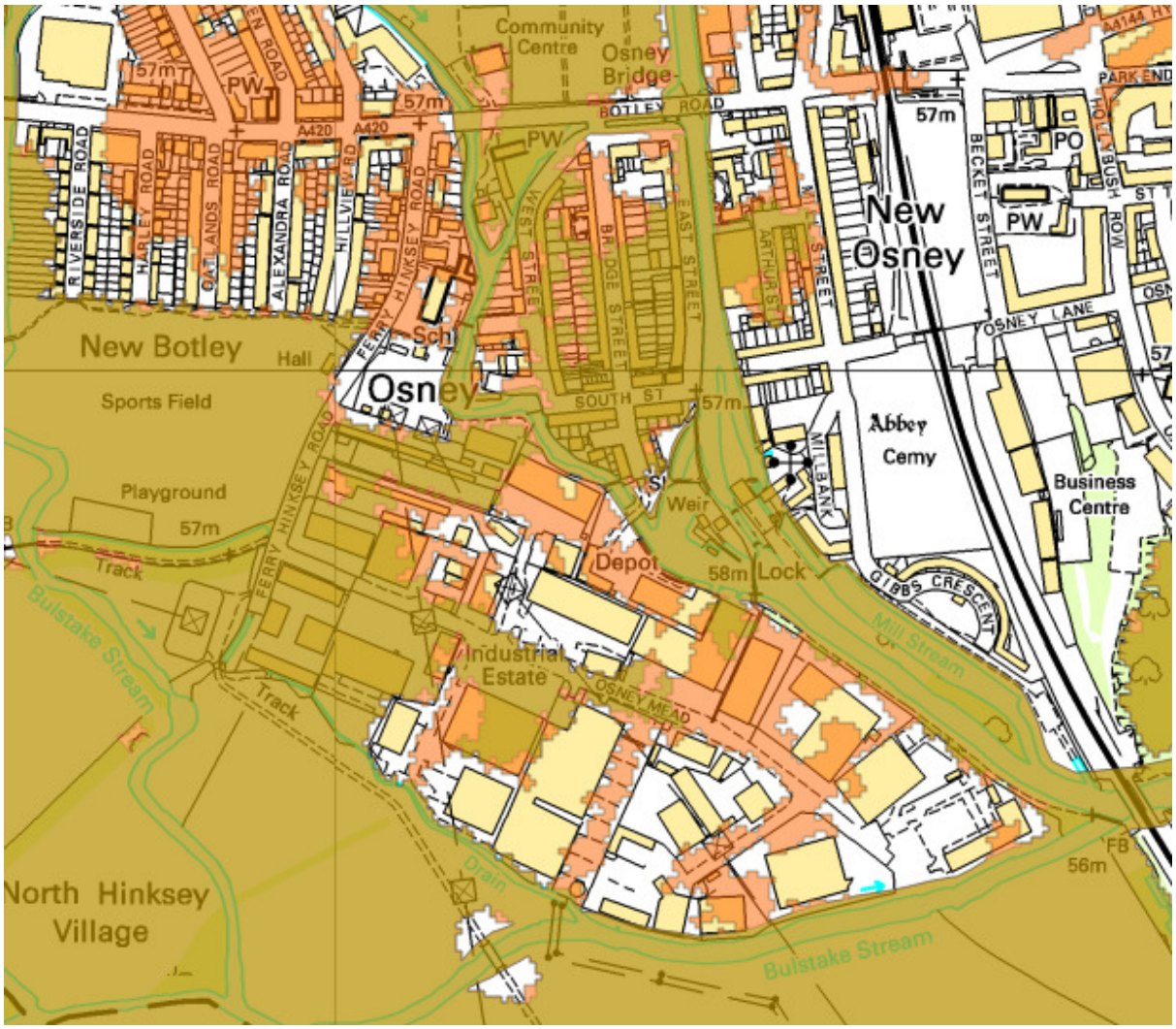
This report does not make any recommendations for option selection. Both options A and B presented in this note are technically achievable. The final decision on the alignment to be implemented should be made by the Environment Agency in conjunction with the relevant landowners.

Appendix A - Design proposals

Drawing IMSE500177-CH2-D00-A3D-VS-C-0001

AREA 3D - OSNEY MEAD: PROPOSED RAISED DEFENCES

Appendix B – 100 year flood extents plan



Orange - Do Minimum (Extend) / Existing flood risk area
Brown – Post Oxford FAS including the Osney mead Defences.

The above image shows the residual flooding of the industrial estate area at the 1 in 100 year event when the proposed defences are over topped.

Appendix C - Previous design proposals

Drawing IMSE500177-CH2-D00-A3D-DR-C-3400

RAISED DEFENCES AT FERRY HINKSEY ROAD