ENVIRONMENT AGENCY

FEASIBILITY STUDY & APPRAISAL REPORT

PART 2 : ALTERNATIVE SCHEME OPTIONS

VOLUME 1 : Main Report

STANMOOR BANK
G7655
MAY 1998

EA. South West/13

THE ENVIRONMENT AGENCY
SOUTH WEST REGION

STANMOOR BANK

Feasibility Study
& Appraisal Report

Project Reference G7655

PART 2 : ALTERNATIVE SCHEME OPTIONS

MAY 1998

PREPARED	CHECKED	APPROVED
D A Worth	P L Woods	I Haken
T Bonner	N Richardson	
Document Status:	FINAL	Dated: May 1998

POSFORD DUVIVIER
Consulting Engineers

Rightwell House
Bretton Centre
Peterborough
Cambridgeshire
PE3 8DW
Tel: 01733 334455
Fax: 01733 262243

1 Alba Court
Emperor Way
Exeter
Devon
EX1 3QS
Tel: 01392 447999
Fax: 01392 446148

THE ENVIRONMENT AGENCY
SOUTH WEST REGION

STANMOOR BANK
Feasibility Study & Appraisal Report

Project Reference G7655

PART 2 : ALTERNATIVE SCHEME OPTIONS

MAY 1998

CONTENTS OF VOLUME 1 – MAIN REPORT

FIGURES

APPENDICES

CONTENTS OF VOLUME 2 – APPENDICES D TO I (bound as a separate volume)

1.0 SUMMARY

1.1 INTRODUCTION

The Stanmoor Bank Feasibility Study and Appraisal Report is being carried out in three parts:

- Part 1: Scheme viability
- Part 2: Alternative Scheme Options
- Part 3: Outline Design and Engineer's Report

This report represents the findings from Part 2, examining alternative scheme options for flood defence at Stanmoor Bank with a view to selecting the preferred course of action to be taken by the Environment Agency.

1.2 STUDY AREA

Stan Moor is located on the Somerset Levels approximately 12km east of Taunton and 10km south-east of Bridgwater. It is bounded by the River Tone to the north-west, the River Parrett to the north-east and the high ground of Stoke St Gregory to the south. A location plan is given as *Figure 1*, with a site plan of the Stan Moor area being given in *Figure 2*.

Stanmoor Bank runs alongside the south side of the River Tone from Stanmoor Bridge, near the confluence with the River Parrett, to a point 150 metres downstream of Hook Bridge at the village of Curload. The length of the bank is 3,100 metres. The River Tone is tidal along this length. The Bank is an earth embankment having a mass concrete core wall. The core wall is about 2 metres deep from the crest level of the bank; it was constructed over the period 1957 - 1965.

The whole of the Stan Moor area falls within the Somerset Levels and Moors Environmentally Sensitive Area designated by the Ministry of Agriculture, Fisheries and Food (MAFF). The River Tone, and adjacent Stanmoor Bank, is a County Wildlife Site. However, Stan Moor is not a Site of Special Scientific Interest (SSSI) and is therefore outside the Somerset Levels and Moors proposed Special Protection Area and proposed Ramsar site.

1.3 PURPOSE

Stanmoor Bank provides protection against flooding from the River Tone to Stan Moor itself, the villages of Curload and Athelney, and properties along Stathe Road. The area potentially at risk from flooding damage covers 350 ha of land.. Most land is in agricultural use, but the area also includes 136 properties, minor roads such as Stanmoor Road and Stathe Road, and the Exeter to London main line railway.

1.4 THE PROBLEM

Stanmoor Bank has three basic problems:

i) The principal problem is that the concrete core wall combined with the bank itself does not have an adequate factor of safety for stability; therefore the defences are vulnerable to a breach at times of high water level in the River Tone. High water levels typically occur at least twice a year and can be sustained for continuous periods greater than a month on each occasion. The core wall is cracked in some places.

ii) It is suffering from increasing seepage which adversely affects many adjacent properties built into the toe of the Bank, along Stanmoor Road.

iii) It has settled over a number of years, which has lead to increased maintenance requirements to prevent local overtopping of the defences at low spots. The present standard of defence against overtopping is 1 in 85 years.

The indicative standard of protection against overtopping is considered to be in the range 1 in 50 to 1 in 150 years.

Without improvement of the flood defence it is considered that a breach will occur within twenty years, causing flooding damage to properties, infrastructure and agricultural land within the protected area. Stan Moor would be flooded to a depth of about 2 metres, with the properties at Curload, Athelney and along Stathe Road being flooded to one metre depth. Based on experience in 1929, when a breach occurred in Stanmoor Bank, most residents in the Stanmoor area would have to be evacuated from their homes. There is a risk of loss of life if the breach is close to one of the properties adjacent to the bank.

1.5 OPTIONS

The following options for action by the Agency have been considered:

i) Do Nothing

Cease all maintenance and remedial work on the Bank. Eventually a breach will occur and, by not being repaired, the Stan Moor area would become permanently exposed to tidal and fluvial flooding from the River Tone.

ii) Do Minimum

Continue maintenance of the Bank. Eventually a breach will occur but would be repaired. There would be flooding in the protected area. Further breaches and flooding would occur periodically.

iii) Diversion Channel

Divert the River Tone away from Stanmoor Bank to a new alignment west of its existing alignment. The diversion would run from Hook Bridge to Stanmoor Bridge. Although technically feasible, this option would have a high cost and is not viable on economic grounds.

iv) Improve On-Line Defences

Carry out works to provide a secure flood defence at Stanmoor Bank, having a design life of 50 years. Various techniques have been considered, with steel sheet piling or stabilisation of the existing concrete core wall being considered technically acceptable. The choice of technique would vary with location along the Bank, depending on the nature of the problem in each area, construction practicalities such as space limitations, and the desire to avoid adverse impact on the houses and their residents alongside the Bank. The specific technique appropriate for each location would be determined in the design stage of this scheme.

v) **Other Strategic Options**

Other strategic options, such as a tidal barrier downstream of Stanmoor Bank, have been examined but all are considered to be unacceptable for technical and/or economic reasons.

The "improve on-line defences" option is the only viable one which adequately reduces the risk of a breach and its associated danger to public safety.

Five possibilities for the crest level of the improved defences have been considered, as shown in *Table 1.5a*. All allow for settlement of Hook Bridge spillway, on the left bank of the River Tone just upsteam of Hook Bridge, to be corrected to restore the spillway to its original design level without giving detriment to flood defences along Stanmoor Bank.

Table 1.5a

Crest Level Options Considered

Crest Level Option	Description	Minimum standard of defence against overtopping (years)	Minimum freeboard allowance (mm)
A	Minimum standard as existing pre-scheme	85	None
B	Existing standard but with freeboard allowance	85	150
C	Higher standard, with freeboard allowance	200	150
D	Existing standard, with freeboard allowance plus allowance for predicted sea level rise over the next 50 years	85*	150
E	Higher standard, with freeboard allowance plus allowance for predicted sea level rise over the next 50 years	200*	150

Note: (*) The standard of defence quoted is that which would be existing in 50 years time. Initially, on completion of the works, a greater standard would be achieved.

Works to improve the stability of the Bank would be needed over the following approximate lengths:

- Crest level Option A 1730m
- Crest level Option B 1760m
- Crest level Option C 1960m
- Crest level Option D 1960m
- Crest level Option E 2200m

The lengths have been identified from preliminary survey and analysis. The length of works necessary increases with higher design defence level. This arises because more parts of the existing core wall would have an unacceptable factor of safety against failure with the higher river water levels then possible.

1.6 ECONOMIC COMPARISON OF OPTIONS

The economics of the "do nothing" option and the viable improvement options are compared below.

Economic Comparison of Options

Item	Present Value (£K) or Benefit/Cost Ratio					
	Do Nothing	Crest Level option for improved defences				
		A	B	C	D	E
Cost, PVc	100	2,034	2,117	2,351	2,367	2,644
Damage, PVd	7,373	1,969	1,958	1,934	1,934	1,921
Damage avoided, PVda	Nil	5,404	5,415	5,439	5,439	5,452
Benefit, PVb	-	5,404	5,415	5,439	5,439	5,452
Net Present Value, NPV	-	3,370	3,298	3,088	3,072	2,808
Average Benefit/Cost Ratio	-	2.66	2.56	2.31	2.30	2.06
Incremental change	-	-	from A	from A	from A	from A
Incremental cost	-	-	83	317	333	610
Incremental benefit	-	-	11	35	35	48
Incremental Benefit/Cost Ratio	-	-	0.13	0.11	0.11	0.08

Under the terms of the Decision Rule in the MAFF Project Appraisal Guidance Note, the scheme is economically justified with crest level option A (improve on-line defences at their present standard of defence against overtopping) being the economically most advantageous option. This finding is robust to foreseeable changes in costs or benefits of the options.

The economic evaluation of options assumes the improvement works will be carried out over a period of three years commencing in 2000/2001. There is economic advantage in completing the works as soon as is feasible.

1.7 ENVIRONMENTAL IMPACTS

Under the "do nothing" option, Stanmoor Bank will eventually breach, with flooding then causing the total loss of use of the land and properties in Stan Moor.

The "improve on-line defences" option would secure the bank against breach, thereby preserving present land use and assets.

Temporary impacts, during construction of the on-line defence improvement works , include:

- Disturbance of flora and fauna along the whole riverward face of Stanmoor Bank; the area is a County Wildlife Site.

- Disturbance to residents, from the noise of construction plant and from the presence of construction activity close to their homes.

- Obstruction to local roads, and accesses to properties, from the lorry traffic, such as concrete delivery trucks, needed to supply the works.

The construction period over which these impacts would arise is anticipated to be six months each year for three years. The work would be carried out in the summer months. Work in front of any one property should last no more than a month, but the general construction activity would be noticeable throughout the whole work period.

Permanent impacts from construction of the on-line defence works would include:

- Stabilisation of Stanmoor Bank such that it is secure against breach failure, thereby sustaining flood protection to 136 properties, 330 ha of agricultural land, main line railway and other assets in the Stan Moor area.

- Reduced seepage through Stanmoor Bank, giving relief to those many houses along the bank which presently suffer from damp and shallow flooding by seepage through and under the core wall.

- Potential damage to properties from the construction activities, eg. through vibration, although the techniques proposed will minimise the risk of any impact on properties.

- Partial closure of a badger sett.

- Intrusion of the new defence works along Stanmoor Bank. The extent of intrusion would increase with the increase in top level of the defence from cest level option A to option E. Raising the defence level would affect the visual appearance of the bank from both sides, would require alteration to some accessways from properties onto the Bank, and would alter the aspect from property windows which face onto the bank. In some cases works would be needed to accommodate windows which otherwise would be partly blocked by the raising of the defence. A summary illustrating the effect of raising the defence level for each crest level option is given below.

Crest Level Option	Bank length raised (m)	Maximum raising (m)	Average height over raised part (m)	Number of houses having windows affected
A	130	0.08	0.04	Nil
B	1330	0.23	0.08	1
C	2020	0.35	0.15	8
D	2320	0.36	0.15	9
E	2760	0.59	0.28	16

1.8 PREFERRED OPTION

The Agency wish to promote a preferred option and confirm its acceptability to other interested parties. The information which has led to this selection is set out within this report and supported by the details given in Volume 2. The extent of the information required was determined by the Agency following wide consultation with internal staff and other interested parties.

The Do Nothing and the only viable options have been assessed on engineering, economic and environmental grounds, with findings as summarised below.

Option preference on engineering grounds. The engineering preference, enabling the most effective flood alleviation to be achieved, is for construction of a diversion channel taking the River Tone wholly on a new alignment between Hook Bridge and Stanmoor Bridge. Improvement of the on-line defences along Stanmoor Bank is also viable.

Option preference on economic grounds. The options have been evaluated in accordance with the MAFF Project Appraisal Guidance Notes. The economically most advantageous option is for improvement of the on-line defences to crest level Option A (providing security against breach failure plus a 1 in 85 years minimum standard of defence against overtopping).

The option preference on engineering grounds, a diversion channel, is not viable in economic terms.

Option preference on environmental grounds. The impact of all the five on-line defences improvement options is similar in scale. Nevertheless, Crest Level Option A provides the minimum height raising of the existing defences and thus the minimum intrusion of the final product. Crest Level Option A is preferred on environmental grounds.

The Agency, in considering the range of options, wish to promote improvement of the on-line defences with Crest Level Option A. This option provides security against breach failure and gives a 1 in 85 years minimum standard of protection against overtopping. It is a viable option on engineering grounds and is the preferred option on economic and environmental grounds.

2.0 BACKGROUND

2.1 RIVER TONE

The River Tone is tidal from its confluence with the River Parrett up to New Bridge; a locality plan is given as *Figure 3.* High water levels in this part of the River Tone are caused by tides, fluvial floods or a combination of both.

Any floodwater which cannot be accommodated within the watercourse overtops the floodbanks above Hook Bridge into the adjacent moors of Hay Moor, Curry Moor and beyond. To guard against the possibility of these floodbanks being washed out by heavy overflow, Hook Bridge spillway was formed in 1956. Here, a 330 metre length of bank was lowered and provided with an armoured crest to carry flood flows safely to Curry Moor. In order to prevent return flows when the Curry Moor storage has been filled, there are spillways at Baltmoor Wall and Athelney Hill to allow overflow of excess water into Higher Salt Moor during the more severe flooding events. Flood water is stored on the moors until river levels drop sufficiently for the water to be returned to the river by pumping or gravitation.

Downstream of Hook Bridge, both banks of the River Tone are higher than on the upstream side. The higher bank levels aim to ensure that any over-topping only occurs upstream of Hook Bridge.

2.2 STANMOOR BANK

Stanmoor Bank runs alongside the south side of the River Tone from Stanmoor Bridge, near the confluence with the River Parrett, to a point 150 metres downstream of Hook Bridge at the village of Curload. The Bank then turns southward for 80 metres to close into high ground at Curload Farm. The total length of the Bank is 3,100 metres.

The Bank is an earth embankment with a mass concrete core wall. The core wall is about 2 metres deep from the crest level of the bank; it was constructed over the period 1957-1965. This concrete core wall is not present in the Bank return from alongside the River Tone to Curload Farm. Some houses along the road (here termed Stanmoor Road) between Curload and Stanmoor Bridge are set into the landward side of the Bank. Photographs of the Bank are presented in *Appendix A.*

Bank crest levels are generally between 7.7m OD and 8.1m OD; the variation of level with location is given in *Schedule 1* of this report. Along most of the length, the present crest level is below the design level adopted in the 1960's.

Stanmoor Bank provides protection against flooding from the River Tone to Stan Moor itself, the villages of Curload and Athelney, and properties along Stathe Road.

2.3 TOPOGRAPHY

The southern and eastern boundaries of Stan Moor are formed by the relatively steeply rising ground forming a ridge at some 20 to 30m OD between Stathe and Curload. The field level in the moor is at approximately 5m OD, some 3m below both bank and extreme water level. The main London to Exeter railway line crosses both the moor and Stanmoor Bank in an east/west direction, on a raised embankment at a level in excess of 8m OD.

The topography is illustrated in *Figure 4.*

2.4 GEOLOGY/SOIL

Along the line of Stanmoor Bank there is believed to be a natural outcrop of clay along which the river was cut, and now flows. Surface soils within Stan Moor are alluvial clays; these overlie peat.

2.5 AGRICULTURE

Stan Moor is used for agricultural activity, with approximately 20% of the area as arable, 10% as withy beds or orchards, and 70% being used for cattle grazing on improved grassland. The agricultural area totals 330 ha. Most of the area is classified as Grade 3 agricultural land, but a band about 200m wide alongside the River Tone is classed as Grade 4 land.

Water level management within Stan Moor is controlled by Stan Moor Internal Drainage Board. The management is assisted by use of Stanmoor Pumping Station which has two pumps (each of 2.5m^3/second capacity) and discharges to the River Parrett; it is owned and operated by the Agency.

2.6 PROPERTIES

Within the area protected by Stanmoor Bank are a total of 19 properties in the village of Curload, 83 properties in Athelney village along Stanmoor Road, and 34 properties along Stathe Road. Most properties are domestic residences. In Curload and Athelney there are also a basket works, public house, shop, repair garage, and a farm. More than thirty-eight of the houses adjacent to Stanmoor Bank are estimated to be between 100 and 350 years old; they therefore have some local historic interest.

2.7 LOCAL AUTHORITIES

The Stan Moor area lies within the jurisdiction of Somerset County Council and Taunton Deane Borough Council.

2.8 ENVIRONMENTAL DESIGNATIONS

2.8.1 Conservation

The whole of the Stan Moor area protected by Stanmoor Bank falls within the Somerset Levels and Moors Environmentally Sensitive Area (ESA) designated by the Ministry of Agriculture, Fisheries and Food (MAFF). The River Tone, and adjacent Stanmoor Bank, is a County Wildlife Site. However, Stan Moor is not a Site of Special Scientific Interest (SSSI) and is therefore outside the Somerset Level and Moors proposed Special Protection Area and proposed Ramsar site.

2.8.2 Landscape

The ESA, see above, is designated *inter alia* for its unique landscape. The area falls almost entirely within a Special Landscape Area, identified within the Somerset County Council Structure Plan as of high landscape quality meriting special efforts to conserve its character. Landscape types in the area, using categories from the Landscape Assessment of the Somerset Levels and Moors ESA (MAFF 1990), are: domesticated moor (along Stanmoor Road and Stathe Road), semi-open moor (around the southern edge of Stan Moor), and open moor (the main part of Stan Moor); Athelney Hill and Burrow Mump are hillock features close to the Stan

Moor area, from which extensive views over the area are available.

2.8.3 Tree Preservation Orders

There is a tree protected by a Tree Preservation Order (TPO) along Stanmoor Road.

2.8.4 Archaeology and Heritage

Within the Stan Moor area and adjacent lands there are, according to the County Sites and Monuments Record, twelve sites of archaeological or historic interest. Two of the sites have Scheduled Ancient Monument designation.

Curload Farm is a Grade II Listed Building.

2.8.5 Location of Sites

The respective location of the designated sites described above is shown on *Figure 5.*

2.9 OTHER ENVIRONMENTAL ATTRIBUTES

2.9.1 Bio-Diversity Key Species and Protected Species

Bio-diversity key species (as defined by the Agency in conjunction with English Nature and the RSPB) and legally protected species known to exist in the vicinity of Stan Moor are listed in *Table 2.9.1.*

Table 2.9.1
Biodiversity key species and protected species

Species	Location
Otter *Lutra lutra*	River Tone, River Parrett and surrounding rhynes
Badger *Meles meles*	Active sett within Stanmoor Bank
Barn Owl *Tyto alba*	River Parrett downstream of Burrow Bridge
Hairy Click Beetle *Synaptus filformis*	River Parrett upstream from Burrow Bridge

2.9.2 Flora and Fauna of the River Tone

The riverward face of Stanmoor Bank is intensively managed, with mowing several times per year, and so generally supports little botanical interest; ruderals and grasses dominate. A small floristically rich area was identified, however, about 200m upstream of Stanmoor Bridge; this area is near overhead power lines, which may inhibit mowing operations. Where the river channel has not recently been subject to dredging, reed fringes are established which provide habitat for fish, invertebrates and birds.

2.9.3 Flora and Fauna of Stan Moor

Results from a land use survey made in 1982, as updated by surveys undertaken for this Feasibility Study, are given in *Appendix B.*

Stan Moor is predominantly improved grassland, though with 20% of fields identified as arable and 10% as withy bed or orchards. There is no unimproved grassland. Stan Moor therefore is of little conservation interest although some of the ditches are of good quality at a local level, supporting frogbit *(Hydrocaris morsus-ranae)*, purple loosestrife *(Lythrum salicaria)* and other freshwater species.

Stan Moor does not attract large numbers of wildfowl or wading bird species.

2.9.4 Fisheries

The River Tone past Stanmoor Bank is utilised as a commercial eel fishery. The river also supports a coarse fishery. Whilst the river is identified as a salmonid migratory route, it does not support a salmonid fishery.

There is a public right to fish along the river, with regular use by Taunton Angling Club between June and March.

2.9.5 Abstractions and Discharges

There are no licensed abstractions from the River Tone in the Stanmoor Bank reach. There are two licenced discharges to the River Tone: a farm discharge from Athelney Farm and an outfall from a private sewage treatment plant serving a residential property on Stanmoor Road.

2.9.6 Recreation and Amenity

Whilst there are navigation rights associated with the tidal rivers in this area, in practice the River Tone is not readily navigable along the reach past Stanmoor Bank. However, it is used by canoeists.

There is a public footpath only along the short length of Stanmoor Bank which runs from the River Tone to high ground at Curload Farm. Elsewhere along the Bank there are no public rights of way. Footpaths in the area are shown on *Figure B5* in *Appendix B.*

2.9.7 Further Detail

A more detailed description of the existing environmental conditions in the Stan Moor area is given in *Appendix B.*

2.10 HISTORY OF FLOODING EVENTS

The most recent breach of the bank occurred in 1929. Two sections of the bank breached, most likely due to overtopping weakening the crest of the bank, causing widespread flooding of Stan Moor. It was necessary to evacuate all the properties along Stanmoor Road (approximately 260 people) due to flooded depths in excess of 1m in certain locations. The floods remained for four weeks and caused significant damage, including the collapse of several properties. Photographs of the flooding event and a newspaper extract are contained in *Appendix D.*

Overtopping of the river banks occurred during floods in 1960. Although the Bank improvement works being constructed at the time were almost complete, the design was then uprated to provide an increase in the flood bank level by raising certain sections of the new core wall.

In 1995 overtopping immediately downstream of Athelney railway bridge, due to localised settlement of the crest in this location, caused flooding to one property and standing water along Stanmoor Road.

Hook Bridge spillway and the generally lower river banks upstream of Hook Bridge prevent any significant overtopping of the Stanmoor Bank defences. The spillway has operated between one and four times each year since 1981.

2.11 PREVIOUS SCHEMES AND ASSOCIATED WORKS IN THE AREA

Stanmoor Bank was constructed in the 14th century. Over the past four hundred years, houses have been built very close to the landward slope of the bank, with some cut into the bank itself.

Between 1957 and 1965 a mass concrete core wall was constructed within Stanmoor Bank and the bank height was also increased. The core wall is approximately 2m in depth and between 0.4 and 0.6m in width over the full length of Stanmoor Bank. The core wall was intended to help protect against a possible breach and to reduce the considerable seepage which had been occurring. Initially designed to 7.62m OD, the wall was raised to 7.92m OD downstream of Athelney Bridge, and to 8.23m OD upstream of the bridge, following overtopping events during the 1960's.

In 1961/62, as a result of severe overtopping into Curry Moor and Higher Salt Moor, the Baltmoor Wall was modified and the spillway at a level of 7.13m OD was formed in Athelney Hill; for locations see *Figure 3.* Hook Bridge spillway had been created in 1956.

Between 1965 and 1974 channel widening was carried out along the River Tone between New Bridge and the confluence with the River Parrett. These works were part of the Tone Valley Comprehensive Scheme.

In 1970/71 a 50m length of Stanmoor Bank which had settled was brought back up to its design level. Minor bank raising works to correct settlement at the Bank, mostly near the railway bridge, were carried out in 1995 following localised overtopping in that year.

2.12 REASONS FOR CONSIDERING THE SCHEME

The scheme is being considered at this time because potential deficiencies with the Bank, already known to the Agency, were highlighted during the period of prolonged high river water levels in the flood event of early 1995. That flood event produced overtopping of the Bank and complaints of seepage through the Bank affecting adjacent properties.

3.0 THE PROBLEM

3.1 GENERAL

Stanmoor Bank has three basic problems:

i) The principal problem is that the existing concrete core wall combined with the bank itself does not provide an adequate factor of safety for stability; therefore the defences are vulnerable to a breach at times of high water level in the River Tone. High water levels typically occur at least twice a year and can be sustained for continuous periods greater than a month on each occasion.

ii) It is suffering from increased seepage which adversely affects many of the adjacent properties built into the toe of the Bank, along Stanmoor Road.

iii) It has settled over a number of years which has led to increased maintenance requirements to prevent local overtopping of the defences at low spots. The present standard of defence against overtopping, with no freeboard, is 1 in 85 years.

Without improvement of the flood defence it is considered that a breach will occur within twenty years, causing flooding damage within the protected area. There is a risk of loss of life if the breach is close to one of the properties adjacent to the bank. The problems of settlement, overtopping and seepage would also continue.

3.2 EXISTING BANK: LEVELS/SETTLEMENT/PROFILE

Stanmoor flood bank is built on weak, compressible soils. Since the addition of the mass concrete core wall in the 1950's/1960's the bank and core wall have experienced considerable settlement; some of the adjoining properties have been similarly affected. The settlement has, however, probably been ongoing since creation of the Bank in the 14th century.

At a number of places, the core wall is now some 380mm lower than its designed level; a comparison of actual and as-constructed crest levels is given in *Schedule 1*. The core wall is seen to be cracked in some places; other cracks may be obscured by the earth embankment. Apart from the core wall, the earth embankment itself has also settled by differing amounts.

The original (1960's) bank crest width of 3.7m (3.0m in front of the houses) has decreased to less than 1.0m in some places due to settlement and slumping of the bank. This situation is particularly prevalent between Athelney Bridge and the railway crossing, and for a distance upstream of the railway. The riverside slopes of the embankment (originally constructed at a slope of 1 in 2) are now considerably steeper in places. Shallow slips are evident on the riverward face of the Bank near the normal water line.

The result of all the above changes is that high water levels in the River Tone can now reach the core wall, without there being any, or very little, protection to its riverside face from the clay embankment. A visual inspection also suggests that the top part of the remaining embankment, in at least some of these areas, is composed of a pervious silty, sandy material, rather than cohesive and impermeable clay. This assessment has been confirmed by a ground investigation carried out in 1996.

3.3 BANK STABILITY

An assessment of stability of the Bank indicates that inadequate factor safety (of less than 1.5) would arise over about 50% of the wall length if water levels are close to the top of the existing core wall (eg. above level 7.5m OD). In some places a factor of safety less than unity would arise. These areas where stability is lowest are distributed along the full length of the Bank. They arise where the core wall is substantially exposed on its landward side (as is common where houses are adjacent). This low factor of safety suggests that a failure could occur when water levels are high. Such water levels occur two or three times per year and can be sustained for several weeks.

Short-term remedial works, including a restriction on use of the Bank by heavy plant (such as plant used for maintenance dredging of the River Tone) are in hand and should mitigate, but will not remove, the risk of a breach failure. Nevertheless, the stability of the existing core wall is a significant cause for concern. There may be loss of life if a breach failure occurs close to one of the properties adjacent to the bank.

3.4 FLOOD RISK FROM STABILITY FAILURE

The area at risk from flooding in the event of a stability failure in the Bank comprises Stan Moor itself, the villages of Curload and Athelney, the latter including many of the properties along Stanmoor Road, and properties along Stathe Road. The total area covers 350ha of land. Most land is in agricultural use, but the area also includes 136 properties, minor roads such as Stanmoor Road and Stathe Road, and the Exeter to London main line railway. Although the railway line would not be inundated, the track foundation could be damaged by floodwaters. Flooding of the roads would cut direct access from Burrow Bridge to Stoke St Gregory and other villages to the south of Stan Moor. The shortest alternative route would involve a detour of about 10km.

The flooding could extend as far as the 7m OD contour, see *Figure 4*, giving a flood depth in Stan Moor of about 2 metres. Properties along Stanmoor Road and Stathe Road may be flooded to 1 metre depth. In the vicinity of a breach, the effects would be severe, possibly leading to demolition of houses plus damage to Stanmoor Road and to utilities along the road. Most residents in the Stan Moor area would have to be evacuated from their homes.

If the breach is not repaired, Stan Moor would remain permanently flooded. Water levels would fluctuate as governed by ingress and egress of water through the breach opening between Stan Moor and the River Tone. The area would become uninhabitable.

3.5 FLOOD RISK FROM SEEPAGE

Seepage affects many of the properties adjacent to Stanmoor Bank. These properties have been built close to the Bank's landward toe or actually cut into the back slope since the original bank construction. Some floors are more than a metre below peak water level in the River Tone and those which are not separated from the core wall tend to suffer from leakage when the Tone is in flood.

Other properties experience seepage into their gardens only, although some residents appear to have solved the effects of this problem by draining the water to the ditch on the Stan Moor side of Stanmoor Road.

A survey was conducted by the Environment Agency in 1995/96, by interviews with residents, to determine the location and extent of problems being experienced. Reported problems include:

- Seepage into houses, and damp interior walls
- Movement of house structure
- Septic tanks filling and overflowing to gardens
- Waterlogging and standing water in gardens and orchards.

The results indicate that seepage in properties is more prevalent when the core wall is against the house wall. Within the survey several residents said that the problem of seepage appears to be becoming more frequent and more severe.

Water levels in the river high enough to cause seepage affecting properties arise two or three times per year and often are sustained for several weeks.

3.6 FLOOD RISK FROM OVERTOPPING

The present standard of defence against overtopping is 1 in 85 years. In practice, high water levels in the River Tone past Stanmoor Bank are limited by spill of water from the Rivers Tone and Parrett. The spillage is partly controlled, such as via Hook Bridge spillway to Curry Moor, but in the more extreme events (eg. 1 in 100 years or greater) also by overtopping of the river embankments. The net result is that overtopping of Stanmoor Bank will not be widespread for events up to 1 in 200 years return period. This can be seen from *Schedule 2.*

Flooding by overtopping affects properties along Stanmoor Road. Some have damboards provided to limit the amount of water entering the house. The flooding also affects Stanmoor Road, though the road is believed to remain passable, and contributes to drainage problems within Stan Moor.

4.0 DESIGN PARAMETERS/CONSIDERATIONS

4.1 STANDARD OF DEFENCE

The scheme should aim to provide a flood defence secure against breach failure at all river water levels occurring over the lifetime of the defences. If the overtopping defence standard is exceeded, the design must ensure that overtopping does not lead to a breach.

As regards overtopping, it would be acceptable to sustain (rather than improve) the Bank's existing standard in view of the limited physical consequences of overtopping at present. The scheme should aim to give no reduction in standard of defence against overtopping. The indicative standard of flood protection is considered to be between 1 in 50 and 1 in 150 years. The existing standard of protection against overtopping is 1 in 85 years.

The scheme should aim to sustain or reduce present seepage through the Bank.

4.2 SCHEME LIFE

A scheme life of fifty years is appropriate for the flood defence asset.

4.3 RIVER WATER LEVELS

Design water levels in the River Tone have been established through use of a hydrodynamic river model. Details of the hydrological and hydraulic analysis, and its results, are given in *Appendix E*, with key aspects noted below.

The river model covered the River Parrett from just downstream of Bridgwater to Langport (about 10km upstream from the River Tone confluence) and the River Tone from its confluence with the Parrett to the tidal limit at New Bridge Sluice. The modelling included representation of the associated spillways within the river system, such as Hook Bridge spillway on the River Tone and similar flood flow outlets on the River Parrett. Out of channel flow other than at designated spillways and side-spill sluices was not represented. Fluvial discharge was estimated using the Flood Studies Report methods.

Modelling considered the river system as existing, and with Hook Bridge spillway restored to its original design level. Settlement over the forty years since the spillway's construction has reduced its crest level to about 7.4m OD from about 7.6m OD as constructed. The scheme design for Stanmoor Bank allows for the spillway to be restored to its original crest level without giving detriment to flood defence along Stanmoor Bank.

Model calibration included correlation with recorded river levels in the River Tone at the outfall of Currymoor Pumping Station. The records included the major flood event of early 1995.

In accordance with Agency policy, the influence of relative sea level rise over the scheme design life of 50 years was taken into account by allowing rise at a rate of 5mm/year to 2030 and 7.5mm/year thereafter. The resulting predicted rise in sea level is 293mm.

Events of return period in the range 1 in 2 years to 1 in 200 years were modelled. Consideration was given to:

- events dominated by fluvial flow, taken with a high spring tide at the downstream limit of the model

- events dominated by extreme tides, taken with a mean daily fluvial discharge
- combined events of mean monthly fluvial discharge and extreme tide.

Design river water levels for each point along Stanmoor Bank are taken as the highest level, for a given return period, from the three types of event. The water levels used for scheme options are listed in *Schedule 3.*

4.4 FREEBOARD

It is the Agency's practice to adopt a freeboard of 0.15m for hard crest defences and 0.30m for soft crest defences. This freeboard, an allowance above design water level to the built crest level of the defence, provides for security against any uncertainty in the estimated design water level as well as against settlement in the defence.

4.5 AGENCY STANDARD DESIGN FEATURES

The Agency require the following design features to be incorporated into flood defence works, insofar as is practicable:

i) Foundations shall be designed to permit the raising of defences by a further 500mm if found necessary at a later date, without the need to alter the foundations.

ii) Embankments shall be graded to permit grazing, and mowing by tractors. Top widths of flood embankments to be 3 metres.

iii) The defences shall be designed so as not to obstruct existing access routes without provisions being made for alternative means of access. Floodgate openings for access shall be minimised.

iii) Flood defences shall incorporate facing materials that compliment existing surrounding structures, which may vary around the scheme.

v) The design shall take full account of existing structures and land uses. All efforts shall be made to ameliorate the visual effects of the flood defences. This feature is particularly important at Stanmoor Bank, where houses are adjacent to the present flood defences structure. Improvement to the defence should aim to avoid damage to the houses; also to avoid blocking windows and doors.

vi) Due consideration shall be given to the effect of the scheme (in its final form and during construction) on natural drainage and surface water drainage. There shall be provision within the scheme for the evacuation of any water collecting within the protected area, by overtopping of the defences or any other means. Any drainage outlets to the river shall be protected by two lines of defences wherever possible ie. two flap valves in series or flap valves/penstock combination.

vii) Environmental enhancements should be developed as part of the scheme's detailed design to include landform, landscape planting, habitat creation and recreational facilities. These should be considered where they can be achieved without prejudice to the flood defence function.

4.6 GROUND CONDITIONS

A ground investigation was carried out in December 1996/January 1997. A representative soil profile through the bank is soft - very soft silty clay to 2m depth, with soft-firm slightly silty slightly sandy clay for a further 11m depth.

4.7 SERVICES AND DISCHARGES

The following services run along Stanmoor Road:

- low voltage electricity
- gas
- mains water
- main drainage (combined system)
- telephone

There are eight overhead electricity line crossings of the River Tone along the length of Stanmoor Bank. An overhead telephone cable crosses the river just upstream of Stanmoor Bridge. Piped services cross the river on Stanmoor Bridge and on Athelney Bridge.

Two consented discharges to the River Tone need to be accommodated in any works:

- farm discharge at Athelney Farm (ST 340 291)
- discharge from private sewage treatment plant serving a residential property on Stanmoor Road (ST 347 291)

4.8 ACCESS

Stanmoor Bank has a defined access track on its crest for approximately 1km upstream of Stanmoor Bridge. The access track is composed of a quarry fill layer, some 0.3 metres in depth with a variable width of up to 2 metres. This track, although now covered with a layer of topsoil, would be suitable for the tracking of normal construction plant. For the remainder of the frontage there is no defined track; access would have to be along the bank top or berm. In various places it is unlikely that heavy plant (such as conventional piling plant) would be able to travel along the Bank without preparatory work to ensure the bank's integrity.

Other than along the length of Stanmoor Bank which runs out from the River Tone to high ground at Curload Farm, there is no designated footpath or other public right of way along the Bank.

The majority of Stanmoor Bank is privately owned and several householders have extensions of their gardens/vegetable patches across the bank. Although the Agency have rights of access along the Bank to carry out necessary work, the agreement of the residents has to be obtained.

Present vehicle access onto the Bank from public roads is available at Stanmoor Bridge, adjacent to Maybank House (150 m downstream of Athelney Bridge), at the railway bridge, and near the upstream end of the Bank at Curload.

The public roads in the immediate vicinity of the Bank are minor roads only. The design of flood defence works for Stanmoor Bank should take into account the potential risk of structural damage to the public roads by construction traffic, and the potential impact on other traffic using the roads. There is an automated level crossing where the railway crosses Stanmoor Road.

4.9 RIVER MAINTENANCE

The River Tone is subject to siltation and regular maintenance dredging is currently undertaken. This dredging is usually carried out either by an agitation process or using a tracked mechanical excavator and dragline from the bank, with dredgings deposited on the bank itself.

Any flood defence improvement works should be designed such that future river maintenance is not inhibited and so the disposal of dredgings will not adversely affect the stability of the bank once improvement works have been completed.

4.10 CONSTRUCTION CONSTRAINTS

The following construction constraints apply to the design of any works at Stanmoor Bank:

i) The stability of the Bank under construction loading must not be jeopardised.

ii) The form and alignment of works should be such as to avoid damage, eg. as may be caused by vibration, to the buildings adjacent to the Bank and to the railway and road crossings over the river. It will be necessary to liaise with the railway authorities regarding any works near the railway.

iii) Noise impact on residents should be kept to an acceptable level and duration.

4.11 ENVIRONMENTAL FACTORS

Whilst the River Tone, and the riverward face of Stanmoor Bank, is a County Wildlife Site the bank is intensively managed and generally supports little botanical interest. An exception to this is a floristically rich area about 200m upstream of Stanmoor Bridge.

A badger sett is present in Stanmoor Bank. It is preferable to accommodate the sett within any works, rather than encourage relocation to an unknown place. If the sett is found to be used by pregnant or nursing sows, no construction work or other disturbance should be allowed within the vicinity of the sett between 1 November and 30 June. A licence is required from MAFF prior to construction near a sett.

The design should guard against the risk of pollution which may arise if there is disturbance of oil storage areas at Stanmoor Garage or of potentially contaminated land at the railway.

At a few locations there are well established shrubs and trees (willow) on the Bank. These should be accommodated within any works, so far as is practicable.

Reed fringes to the Bank provide good habitat for nesting birds. The breeding period is March to July. If any proposed construction works cannot be undertaken outside this breeding period, the reeds could be kept cut back from the end of February onwards so birds nest elsewhere for that season. Similarly, any removal of trees for the scheme should be undertaken before the end of February.

5.0 BENEFIT ASSESSMENT

5.1 GENERAL

This section presents the assessment of the economic consequences if the "do nothing" option is adopted, and of implementing the feasible defence improvement options. The economic loss associated with the "do nothing" option provides a baseline against which other options can be compared and their benefit determined. Details of the benefit/damages assessment for the "do nothing" option, and for other options, are given in *Appendix F.*

Only benefits and damages in relation to flooding of properties, agricultural land, and infrastructure are valued here. Environmental consequences are presented in *Section 7* and *Appendix C.*

All values are at 1997 (final quarter) prices. Discounting to Present Value uses a 6% discount rate. The assessment has been made in accordance with the MAFF Project Appraisal Guidance Note (PAGN).

5.2 DO NOTHING OPTION

5.2.1 Introduction

Under the "do nothing" option a breach in Stanmoor Bank will eventually occur, causing flooding of land, property and infrastructure in the Stan Moor area. In the "do nothing" case the breach would not be repaired, so the area would remain permanently flooded and exposed to ingress of water from the tidal River Tone.

5.2.2 Flooding due to Breach

Damages are calculated as being the value of land, properties and infrastructure lost after a breach in the flood defence. Although there is a risk of loss of life if the breach occurs close to one of the properties adjacent to the bank, no value has been included for this risk in the assessment here. The risk of a breach is taken as increasing with time over ten years from now, at which time a breach is certain to have occurred.

The damages are valued from the loss of 330 ha agricultural land in Stan Moor, 136 properties around Stan Moor, plus damage to roads, the main line railway, and public utilities. The assessed value of flood damage is:

• Loss of agricultural land	£547,000
• Loss of properties	£8,300,000
• Damage to infrastructure	£400,000
Total	£9,247,000

5.2.3 Flooding due to Seepage

Damage to properties due to seepage through the bank would occur until such time as the breach occurs. The value of damages has been assessed based on the findings from the survey of residents carried out in 1995/96 *(see Section 3.5)*. It is taken that the 65 properties adjoining the bank are affected. The estimated value of damage due to seepage is £38,000 p.a.

5.2.4 Flooding due to Overtopping

Damages due to the risk of flooding by overtopping of the Bank during the period until a breach occurs are ignored. Their value is insignificant in relation to damages arising from a breach.

5.2.5 Present Value

The magnitude of loss (damages) under the "do nothing" option is assessed as having Present Value £7,373,000.

5.3 OTHER OPTIONS

Other options considered in this appraisal aim to reduce or eliminate the damages arising under the "do nothing" option. The options considered here are the "improve on-line defences" options described in *Section 6* and identified in that Section as being the only viable means of meeting the scheme flood defence objectives.

Corresponding residual damages and benefits are stated in *Table 5.3*. In each case the residual damages comprise three elements, as for the "do nothing" option:

- Due to the residual risk of a breach until the improvement works are completed.
- Due to the residual risk of damage due to seepage through the bank.
- Due to the residual risk of damage due to overtopping of the bank.

Table 5.3

Residual Damages with Flood Defence Improvement Options

Source of Damage	Present Value (£K) with Crest Level Option				
	A	B	C	D	E
Residual risk of a breach	1,678	1,678	1,678	1,678	1,678
Seepage through the Bank	280	280	256	256	243
Overtopping of the Bank	11	Nil	Nil	Nil	Nil
Total	1,969	1,958	1,934	1,934	1,921

6.0 OPTIONS FOR CONSIDERATION

6.1 STRATEGIC WORKS OPTIONS

The following strategic works options are considered:

i) Do Nothing

ii) Do minimum

iii) Tidal Barrage

iv) Flood relief channel/diversion channel

v) River channel improvement

vi) On-line defence works

Each option is considered in terms of its effectiveness in solving the problems at Stanmoor Bank, ie. overcoming vulnerability to a breach, reducing seepage, and reducing overtopping. Securing the Bank against breach is essential to achieve the principal scheme benefits.

6.2 REVIEW OF STRATEGIC OPTIONS

6.2.1 Do Nothing

Under the "do nothing" option no improvement works would be carried out on the Bank and present maintenance activities on the Bank would cease.

This option is taken as a benchmark for economic comparison of all other options.

The "do nothing" option does not meet the standard of defence objectives for the scheme. Stanmoor Bank would remain increasingly vulnerable to breach, seepage and overtopping. It is considered that a breach will occur within twenty years, causing permanent flooding damage within the presently protected area. There is a risk of loss of life if the breach is close to one of the properties adjacent to the Bank.

6.2.2 Do Minimum

Under the "do minimum" option, maintenance work on the Bank would continue but there would be no improvement in the Bank's stability. The Bank would remain increasingly vulnerable to breach and seepage, but the present standard of defence against overtopping would be sustained. It is considered that a breach would occur within twenty years. With the "do minimum" option the breach would be repaired. It is expected that further breaches would occur periodically; each would be repaired.

Each breach occurrence would cause flooding damage in the protected area. The damage would be temporary, but there is a risk of loss of life in each of the breach events if the breach is close to one of the properties adjacent to the bank.

Adopting this option, ie. having a policy whereby breaches with possible catastrophic consequences are allowed to occur from time to time, would have damaging consequences on the local community and therefore is considered to be socially unacceptable.

The "do minimum" option does not meet the standard of defence objectives for the scheme. Thus it is considered to be not viable on engineering as well as social grounds.

6.2.3 Tidal Barrage

This option considers the provision of some form of barrage to protect the area from the influence of tidal flows. The barrage would be constructed downstream of the River Parrett and Tone confluence and be operated at times of extreme tidal events.

Under all conditions the storage area within the river system upstream of the barrage would have to be sufficiently large to be able to accept the volume of fluvial discharge without overtopping of the existing banks. The barrage would have to be closed sufficiently early within the tidal cycle to balance storage capacity with both tidal and fluvial flows.

In practice the available storage capacity within the river systems would not be adequate to accommodate the extreme fluvial flows that exist at present, since even with the large additional storage areas of Curry Moor and Hay Moor, flooding into Higher Salt Moor still takes place. Therefore, a tidal barrage would not solve the problems at Stanmoor Bank..

The idea of building a barrage across the River Parrett for flood relief purposes was first mooted in the early 1970's. The Somerset Rivers Division of the former Wessex Water Authority conducted an appraisal of three potential barrage locations:-

a) Steart at the mouth of the Parrett Estuary
b) Dunball on the northern outskirts of Bridgwater
c) Saltlands in Bridgwater

A report for financial appraisal was produced in August 1975, which concluded that a barrage located at Dunball would be the most economically viable. However, further investigations highlighted several engineering, political and environmental difficulties, which stopped the project from progressing at the time.

In the early 1990's, a consortium including Somerset County Council, the District Councils, National Rivers Authority and British Waterways investigated the possibility of promoting an amenity barrage across the River Parrett, providing a focal point for regeneration and tourism and flood alleviation for the Somerset Levels and Moors. Between 1993 and 1995 the consortium considered engineering, environmental and economic factors, but the project did not progress beyond the feasibility stage. In response to the severe floods on the Levels and Moors in 1989, 1993/4 and 1995, a review of the 1975 barrage proposals was carried out in early 1995 in accordance with current Treasury rules.

The reassessment of the scheme indicated that the cost of building the barrage would be in the order of £55 million to £70 million. The benefits, though, would only be in the region of £11million As a result, further investigations into the scheme could not be justified due to the large gap between benefits and cost.

This option is considered to be not viable on engineering and economic grounds.

6.2.4 Flood Relief Channel

This option considers increasing the overall capacity of the River Tone through the construction of a flood relief channel, supplementing flow capacity of the existing River Tone.

In this area, the flood regime of the river system is characterised by long duration fluvial discharge, sometimes coincident with extreme high tides. Water levels in the river system frequently rise to near bank full and are then sustained at this level while flood waters overspill to the moors. Water levels can remain high for several weeks. Any flood relief channel for the River Tone would not reduce flood water levels.

Since there is no hydraulic advantage in providing greater waterway area for the River Tone, a flood relief channel serves no purpose towards the scheme since it would not overcome any of the problems at Stanmoor Bank.

Options for a flood relief channel are considered to be not viable on engineering grounds.

6.2.5 River Channel Improvement

Improvement of the River Tone channel to increase its waterway area gives no advantage in reduced flood water levels at Stanmoor Bank, as described for the relief channel option in *Section 6.2.4.*

This option is considered to be not viable on engineering grounds.

6.2.6 Diversion Channel

This option considers the construction of a new channel whereby the River Tone is diverted to a new alignment between Hook Bridge and Stanmoor Bridge. The present length of the River Tone past Stanmoor Bank would become redundant; it could be infilled or landscaped in some way. The flood defence risk along Stanmoor Bank would no longer exist.

The diversion channel would have to run west of the existing River Tone alignment. Although this would avoid the village of Curload and the properties along Stanmoor Road, three farms would have to be displaced. Also needed would be a new Currymoor pumping station and a new crossing under the London-Exeter main line railway. Material excavated to form the channel could be used in creating the bounding embankments of the new river alignment. However, since the ground locally has low strength, some better quality material would probably have to be transported in from elsewhere for the works.

In engineering terms alone, the option appears to be viable. However, the cost of the diversion channel is estimated to be about £6.5million. If the works are phased over the same period considered for other options, ie. a three year period commencing in 2000/2001 (*see Section 6.5.2*), the Present Value cost of the diversion channel would be £5.8million. Its Present Value benefit would be £5.45million (as for evaluation of Option E in *Section 5)*. On this basis the option is considered to be not viable on economic grounds.

6.2.7 On-line Defence Works

This option provides for improvement works to Stanmoor Bank with no change to the channel of the River Tone. Routine maintenance of the Bank would be continued.

There are various techniques which could be adopted to alleviate the problems at the Bank, these problems being:

i) Risk of breach failure due to instability of the core wall
ii) Seepage through the Bank
iii) Risk of overtopping

iv) Ongoing settlement of the bank and core wall, exacerbating the three problems above.

Specific techniques are discussed in *Section 6.3*. In principle, however, the "on-line defence works" option is considered to be viable in engineering terms.

6.2.8 Resumeé of Strategic Options

The viability of each strategic option is given below:

i)	Do Nothing	Does not meet scheme flood defence objectives. Option taken as baseline for economic comparison of options.
ii)	Do Minimum	Does not meet scheme flood defence objectives. Not viable on engineering or social grounds.
iii)	Tidal Barrage	Not viable on engineering grounds.
iv)	Flood Relief Channel	Not viable on engineering grounds.
v)	River Channel Improvement	Not viable on engineering grounds.
vi)	Diversion Channel	Not viable on economic grounds.
vii)	On-line defence works	In principle, viable in engineering terms.

The strategic options which are not viable are not considered further. The "on-line defence works" strategic option, the only viable option which could meet the scheme flood defence objectives, is detailed in *Section 6.3*.

6.3 ON-LINE DEFENCE WORKS

6.3.1 Standard of Defence

The standard of defence is considered in terms of:

- security against breach failure
- protection against seepage
- protection against overtopping

All variations in form of the on-line defence works considered here aim to improve stablity of the Bank such that is would be secure against breach failure for the scheme design life of 50 years.

The flood defence improvements also aim to improve protection against seepage. Measures which reduce seepage through the Bank beneath the existing core wall would provide a higher standard than those which only reduce seepage through the existing core wall, or do not reduce seepage at all.

As regards protection against overtopping, a range of crest level options are considered, see *Table 6.3.1.* Resulting design crest levels are listed in *Schedule 4.* These are the minimum crest levels which would apply on completion of the works; existing crest levels higher than given in *Schedule 4* would remain.

Table 6.3.1

Crest Level Options Considered

Crest Level Option	Description	Minimum standard of defence against overtopping (years)	Minimum freeboard allowance (mm)
A	Minimum standard as existing pre-scheme	85	None
B	Existing standard but with freeboard allowance	85	150
C	Higher standard, with freeboard allowance	200	150
D	Existing standard, with freeboard allowance, plus allowance for predicted sea level rise over the next 50 years	85*	150
E	High standard, with freeboard allowance, plus allowance for predicted sea level rise over the next 50 years	200*	150

Note: (*) The standard of defence quoted is that which would be existing in 50 years time. Initially, on completion of the works, a greater standard would be achieved.

6.3.2 Crest Raising Along Stanmoor Bank

Each of the crest level options A - E would require raising of the crest level along some parts of Stanmoor Bank. The extent of raising for each option is shown in *Schedule 5* and summarised in *Table 6.3.2*

Table 6.3.2

Crest raising needed with improvement options

Crest level option	Raising from existing Crest level		
	Linear extent (m)	Maximum height (m)	Average height (m) over raised part
A	130	0.08	0.04
B	1330	0.23	0.08
C	2020	0.35	0.15
D	2320	0.36	0.15
E	2760	0.59	0.28

6.3.3 Effect Elsewhere in the River System

Raising the crest level along Stanmoor Bank would, in events of return period greater than 1 in 85 years, reduce overspill of water from the River Tone into Stan Moor. Containing this water in the river system may be thought to cause problems elsewhere along the Rivers Tone and Parrett. In practice, however, that would not be the case.

Locally, the crest level of the River Tone left bank opposite Stanmoor Bank is generally above the 1 in 200 year flood level arising if Stanmoor Bank is raised. Flooding in that direction therefore would not occur.

Further afield the result would be a slight increase in the volume of water discharged over the designated spillways to the already flooded moors. It is estimated that flood levels in these moors could rise by about 1mm during the once in 100 years flood, and by about 15mm during the once in 200 years flood. In each case there would be no change of consequence in the flooded condition of the moors compared to their state if Stanmoor Bank is not raised.

6.4 TECHNIQUES FOR IMPROVING ON-LINE DEFENCES

6.4.1 Techniques Considered

The various techniques considered as potentially feasible for improving the flood defence at Stan Moor Bank are detailed below. These may be used for any of the five crest level options detailed in *Section 6.3.1*. A summary of the techniques, noting their respective suitability and estimated cost, is given in *Section 6.4.8*. Schematic arrangements of the techniques are given in *Figures 6a to 6d.*

6.4.2 Technique 1 - Steel Sheet Piled Wall

This technique adopts the provision of a steel sheet pile wall along the bank. The wall would secure the stability of the bank and would be constructed to prevent or at least significantly inhibit the passage of water through the bank. *Figure 6a* - refers.

The sheet piling would be constructed close to the existing core wall on the level crest of the bank. This has the advantage of facilitating relatively easy driving and avoids the difficulty of working on the steep soft slopes of the embankment.

The core wall would be tied to the piling; in this way the stability of the core wall would be ensured.

At this stage it is envisaged that the piling will be of LX12 or LX16 section, approximately 8 metres long, and would be pitched into a trench alongside and close to the existing core wall. After driving, the trench would be backfilled with good quality clay and the defence will be completed with a concrete capping beam. The piles would be driven to an approximate toe level of 0.0m OD. The capping beam constructed over the sheet pile wall would be similar in appearance to the existing core wall.

At several locations along Stanmoor Bank, properties are close to, or are touching, the existing core wall and are likely to be affected by vibration from the piling operations. Several of the properties have already been affected by subsidence and imposed vibrations may lead to damage. The areas that are likely to be of concern would be identified at the design stage and either a different technique considered or the pile alignment adjusted riverward.

6.4.3 Technique 2 - Sheet Piling by Hush Piling Method

This technique considers the use of steel sheet piling and capping to the same specification as that described in Technique 1, but with piles installed by the "Hush" system whereby they are pushed into the ground rather than driven by percussion or vibration. The method gives much reduced noise and vibration than does conventional pile driving. It is therefore useful for lengths where buildings are close to proposed works on the Bank because there will be less disturbance to residents and less risk of damage to the buildings.

Proprietary equipment is used. An initial group of piles is installed by normal driving. This pile group is then used to develop a reaction (through skin friction with the soil) to install the next single pile. The equipment is then moved progressively to install each pile in turn.

The technique is most suited for installation in soft-stiff cohesive soils so that sufficient reaction force is developed. The geotechnical report indicates that ground conditions along the bank should be suitable for this method of pile installation.

6.4.4 Technique 3 – Stabilising Works on Riverward Side of Core Wall

This technique would stabilise the existing core wall by adding an L-shape reinforced concrete section on its riverward side, see *Figure 6b*. The new wall section would be fixed to the core wall by tie bars. Acting in conjunction with the core wall and the soil overburden, the total structure would be stable against overturning failure. The technique would not enhance stability against failure by piping beneath the core wall. As such it would only be suitable where failure in this mode is not expected.

At this stage it is envisaged that the new concrete section would be cast in-situ, with concrete pumped to each location. Use of pumped concrete would avoid the need for repeated travel along the bank crest to deliver the material. Accesses for the pumping pipeline could be obtained over open spaces between the buildings along the Bank. Spoil from excavations for construction of the new concrete section would be stored temporarily on the berm of the bank. The face of the bank would require reseeding and other reinstatement on completion of the main construction.

An advantage of this technique is that the works can be carried out using relatively small construction plant. This should minimise difficulty with access along the bank for carrying out the works. Use of small plant would also help avoid overloading the bank and creating a slip failure.

A disadvantage of the technique is that excavation for the new wall section may disturb the core wall and affect adjoining buildings. Additionally, the excavated area could be prone to flooding from the river, even if the works are carried out in summer, possibly giving difficulties for construction.

6.4.5 Technique 4 – Stabilising Works on Landward Side of Core Wall

This technique would stabilise the existing core wall by placing earth fill, concrete or brickwork against the landward side of the wall. *(Figure 6c refers).* Such works would only be feasible where there is sufficient space and where the works themselves would not be an unacceptable intrusion into the property. The works would be landscaped to suit individual properties.

6.4.6 Technique 5 – Impermeable Membrane to Core Wall

In this relatively simple and cheap technique, lining of the 'riverside' face of the existing core wall with an impermeable membrane is considered *(Figure 6d refers).* Due to the nature of installation it is not feasible to extend the membrane below the base of the existing core wall as the wall may then become unstable; also the membrane has to have the support of the wall to be effective. Seepage below the core wall therefore would not be reduced.

This technique is currently used at several places along Stanmoor Bank, having been installed in response to complaints from residents about seepage. Residents say that the membrane has not always been successful, apparently due to poor installation.

Where the stability of the wall is not in question, but there is a minor problem associated with seepage, this technique would provide an effective and efficient protection system. Where seepage rates are high, it is unlikely that the technique would provide an effective solution as defined flow paths beneath the wall probably are already established. The technique provides no improvement to the stability of the defence.

6.4.7 Technique 6 – Raise Defence

Where the core wall is sufficiently stable, but a higher defence level is required, the core wall itself could be raised. With suitable preparation, a new concrete section could be cast on top.

6.4.8 Technique Summary

The various techniques discussed for improving the flood defence at Stanmoor Bank are summarised in *Table 6.4.8.* Their suitability towards overcoming the problems at Stanmoor Bank is identified and estimated costs of construction quoted. The costs are at 1997 (final quarter) prices and relate to crest level Option A as *Section 6.3.1,* ie. the standard of defence as existing; derivation of costs is detailed in *Appendix F.*

Within the limitations of suitability stated and subject to local detailing, all the costed techniques could satisfy the design parameters/considerations given in *Section 4* of this report. Only Techniques 1 and 2 give security against settlement of the finished crest level.

Table 6.4.8

Techniques for On-line Defence Works

Technique	Estimated Cost per 100m constructed	Potential Suitability		
		Improved Stability	Reduced Seepage	Reduced Overtopping
1 - Steel sheet piled wall	£90,000	Yes	Yes	Yes
2 - Sheet piling by Hush piling method	£95,000	Yes	Yes	Yes
3 – Stabilising works on riverward side of core wall	£25,000	Yes	Yes, but not seepage beneath core wall	Yes
4 – Stabilising works on landward side of core wall	£5,000	Yes	Yes, but not seepage beneath core wall	Yes
5 – Impermeable membrane to core wall	£3,000	No	Yes, but not seepage beneath core wall	No
6 – Raise defence	£4,000 plus £750 per 100mm height raising	No	No	Yes

It is likely that a variety of techniques would be used in the scheme. The appropriate technique would be chosen for each location depending on the nature of the problem (stability, seepage, overtopping) in that area and taking account of working space, proximity of buildings, or other local restrictions on the acceptable form of works. Selection of the technique appropriate to each location will be confirmed in the design phase of the scheme. In some places two techniques may be used jointly. Within the constraints of the engineering design criteria, the technique adopted in any location would aim to be that which has least local impact and minimises the scheme cost.

6.5 ESTIMATED SCHEME COSTS

6.5.1 Basis of Cost Estimates

For the purposes of scheme evaluation in this report it is taken that:

i) Works to improve stability of the Bank are needed over the following lengths.

- Crest Level Option A 1730m
- Crest Level Option B 1760m
- Crest Level Option C 1960m
- Crest Level Option D 1960m
- Crest Level Option E 2200m

The lengths have been identified from preliminary survey and analysis. They include sections of the Bank at intervals along its full length. The length of works necessary increases with higher design defence level. This arises because more parts of the existing core wall would have an unacceptable factor of safety against failure with the higher river water levels then possible.

ii) The technique to improve stability used throughout will be Technique 2 – steel sheet piling installed by the Hush piling method. This technique provides adequate stability and should virtually eliminate seepage through the Bank. Use of the Hush piling system is preferred to conventional driving methods as being less likely to cause damage to nearby buildings. It is recognised that cheaper techniques may be acceptable in some locations. For this evaluation, however, it is thought prudent to be conservative with the cost estimates used.

iii) Other than where the steel sheet piling is used, works to reduce seepage through the Bank will carried out using Technique 5 – impermeable membrane.

iv) Raising the defence level above that provided for crest level Option A is costed as if carried out using Technique 6.

v) An allowance for compensation payments is included. This provides for the cost of a structural survey of properties in advance of the works, compensation for unavoidable damage, and fees for negotiated accesses.

vi) The cost estimates include an allowance for the necessary investigations, design, supervision and administration associated with the works.

6.5.2 Option Cost

The derivation of option estimated costs is given in *Appendix G*; they are summarised in *Table 6.5.2*. Present Value costs assume any scheme is implemented over a three year period commencing in 2000/2001.

Table 6.5.2

Estimated Costs for Scheme Options

Item	Cost (£K) for Option					
	Do Nothing	Improve on-line defences to crest level option				
		A	B	C	D	E
Initial capital works	nil	1,691	1,772	2,000	2,015	2,285
Investigations, Environment Agency and Consultants costs	nil	400	413	451	454	499
Contingency	nil	209	219	245	247	278
Compensation		130	130	130	130	130
Sub-total	**nil**	**2,430**	**2,534**	**2,826**	**2,846**	**3,192**
Annual maintenance	nil	4	4	4	4	4
Present Value	nil	2,034	2.117	2,351	2,367	2.644

6.6 MAINTANING DEFENCE AGAINST SEA LEVEL RISE

The economic merit of maintaining the defence crest level against the predicted effects of sea level rise has been tested. The option used for this test is Option A, being the option where overtopping of Stanmoor Bank would be greatest now and with sea level rise.

The economic evaluation considers whether, and when, it would be worthwhile rising the crest level of the defence to reduce damages due to overtopping. After completion of the proposed bank stabilisation works within Option A, sea level rise would not jeopardise the security of the bank against breach failure.

The costs of raising the defence are calculated in *Appendix G.* The flood damages due to overtopping until the defence is raised are estimated in *Appendix F.* Findings are summarised in *Table 6.6.* The Present Value benefit is taken over the 50 years scheme design life.

Table 6.6

Economics of providing for predicted sea level rise

Time to crest level raising (years)	Present Value of overtopping damages (£)	Present Value benefit of crest raising (£)	Present Value cost of crest raising (£)
0	0	20,278	205,000
5	3,804	16,474	153,000
10	6,558	13,720	114,000
20	11,185	9.093	64,000
30	14,950	5,328	36,000
40	18,062	2,216	20,000
50	20,278	nil	11,000

From *Table 6.6* it is seen that the cost of raising the crest level of the defence is at all times greater than the value of the flood defence benefit achieved. Therefore, under present circumstances it is not economically worthwhile to provide for predicted sea level rise within the proposed scheme.

This conclusion can be reviewed at a later date, taking account of any changed circumstances. For example, a future strategy for the Rivers Parrett/Tone/Sowy may accommodate the effects of sea level rise in ways other than simply raising all the river banks.

6.7 ECONOMIC COMPARISON OF OPTIONS

The economics of the "do nothing" option and the "improve on-line defences" crest level options (the only potentially feasible works options) are compared in *Table 6.7*.

Table 6.7

Economic Comparison of Options

Item	Present Value (£K) or Benefit/Cost Ratio					
	Do Nothing	Crest Level option for improved defences				
		A	B	C	D	E
Cost, PVc	100	2,034	2,117	2,351	2,367	2,644
Damage, PVd	7,373	1,969	1,958	1,934	1,934	1,921
Damage avoided, PVda	nil	5,404	5,415	5,439	5,439	5,452
Benefit, PVb	-	5,404	5,415	5,439	5,439	5,452
Net Present Value, NPV	-	3,370	3,298	3,080	3,072	2,808
Average Benefit/Cost Ratio	-	2.66	2.56	2.31	2.30	2.06
Incremental change	-	-	From A	from A	from A	from A
Incremental cost	-	-	83	317	333	610
Incremental benefit	-	-	11	35	35	48
Incremental Benefit/Cost Ratio	-	-	0.13	0.11	0.11	0.08

Crest level options A to E each have a benefit/cost ratio greater than unity. Comparing Option D with Option B, and Option E with Option C, it is seen in each case that the former has a lower Net Present Value. Options D and E are those which provide now for predicted sea level rise over the next 50 years. From the economic comparison, such provision is not economically worthwhile; Options B and C are preferred at their respective standard of defence.

The Decision Rule, as MAFF PAGN Annex J, is applied to identify the economically most advantageous operation.

I The average benefit cost ratio of Options A to E is greater than unity.

II The option with the greatest average benefit/cost ratio is Option A (ratio = 2.66).. This option meets the indicative standard of defence against overtopping. However, continue with the Decision Rule process to test the economics of providing a higher standard of protection against overtopping.

III The option having the next higher standard than Option A is Option B. Its average benefit/cost ratio is greater than unity but its incremental benefit/cost ratio with respect to Option A is much less than unity.

IV Similar comments apply to Option C.

Under the terms of the Decision Rule the scheme is justified, with crest level Option A (improve on-line defences but at their present standard of defence against overtopping) being the economically most advantageous option.

6.8 SENSITIVITY OF ECONOMIC CHOICE

Each of the crest level options has been costed on the same basis. The choice between options therefore is not sensitive to changes in costing of the scheme. The economic evaluation has been made assuming that Hush piling will be the adopted technique for stabilising the bank. This assumption gives a conservative cost estimate. If cheaper techniques can be adopted in some places the economic justification for the scheme would be enhanced.

The principal benefits of the scheme arise by securing Stanmoor Bank against breach failure. The estimation of these benefits has used realistic values for the loss of land and properties which would be a consequence of a breach. The justification of the scheme is therefore robust in this respect.

The economic evaluation changes if different assumptions are made as regards timing of events. Most of residual damages with the improvement options arise because it is expected that the works will be carried out over three years commencing in 2000/2001. There is thus a risk of a breach in the Bank over the next six years. If the works were carried out over two years commencing in 1999/2000 the Net Present Value of Option A, would increase by £782,000.

Examining the seepage reduction works included in each improvement option shows them to be economically worthwhile in their own right, with a benefit/cost ratio of 2.4.

7.0 ENVIRONMENTAL IMPACT OF OPTIONS

7.1 GENERAL

The potential impacts of the Do Nothing and the On-line Defence Options are summarised in Table 7.1, with detail of impacts being given in *Appendix C.*

7.2 DO NOTHING OPTION

Under the "do nothing" option, Stanmoor Bank will eventually breach, with flooding then causing the total loss of use of 330ha of agricultural land and 136 properties in Stanmoor. A permanent water body would be formed, the depth of which would fluctuate with the tide.

7.3 ON LINE DEFENCE OTIONS

7.3.1 Description

The "improve On-line Defences" option would secure the bank against breach, thereby preserving present land use and assets.

A number of different techniques could be used at appropriate locations along the bank, depending on the technical and environmental constraints at each site.

One of five Crest Level Options could be implemented.

7.3.2 Temporary Impacts in the Construction Phase

Temporary impacts, during construction of the on-line defence improvement works, include:

- Disturbance of flora and fauna along the whole riverward face of Stanmoor Bank; the area is a County Wildlife Site and supports legally protected species.
- Disturbance to residents in 100 houses, from the noise of construction plant and from the presence of construction activity close to their homes.
- Obstruction to local roads, and accesses to properties, from the lorry traffic, such as concrete delivery trucks, needed to supply the works.

The construction period over which these impacts would arise is anticipated to be six months each year for three years. The works would be carried out in the summer months. Work in front of any one property should last no more than a month, but the general construction activity would be noticeable throughout the whole work period.

7.3.3 Permanent Impacts in the Operational Phase

Permanent impacts from construction of the on-line defence works would include:

- Stabilisation of Stanmoor Bank such that it is secure against breach failure, thereby sustaining flood protection to 136 properties, 330 ha of agricultural land, a main line railway and other assets in the Stan Moor area.

Table 7.1 Summary of Potential Impacts for Alternative Options

Option	Nature Conservation		Landscape	Water Resource	Water Quality	Archaeology & Heritage	Landuse & Ownership	Local Community			Recreation & Amenity	Infrastructure & Access		Technical Considerations	ECONOMICS
	General Ecology	Badgers						Noise	Vibration	Effect on community		No. 10t lorries	Impact on local road network		
Do Nothing *Operational Phase*	Creation of permanent body of water	Potential loss of badger exit and habitat	Long term change in landscape	Change to hydrological regime of River Tone	Release of contaminants from septic tanks and contaminated land	Loss of 1 listed building and at least 38 houses 100-300 years old	Long term change in land use	None	None	Fear of flooding and sudden breach Loss of 138 houses	Creation of a permanent body of water	None	Loss of local road network and railway	Increase in flood risk to properties and permanent flooding in places	PVd=£7.4m
On-line Defences *Construction Phase*	Temporary disturbance to birds Temporary disturbance to vegetation adjacent to store wall	Potential damage to badger exit	Visual intrusion during construction	No impact	No impact if siltation risk controlled	Potential vibration damage to old buildings along Bluemoor Bank	Temporary loss of land	Disturbance from high noise levels 85 - 120 dB(A) for Technique 1 Owners' construction noise for Techniques 2-6 85-95 dB(A)	Potential for vibration damage	Temporary disturbance to the local community (including noise, vibration, disruption to gardens, blockage of access etc.)	Temporary disruption	360	Minor disruption to local road network	Short term disruption	PVb=£5.4m PVt =£2.0m B/C Ratio=2.7
Operational Phase	No long term impact	Protection of habitat Potential long term damage to badger exit Piling may allow badgers to remain in exit	No long term impact	Protection of existing resources Hydrological regime maintained	Reduction in flooding of septic tanks	Flood protection of old buildings	Protection of current land use in Bluemoor	No impact	No impact	Reduction in fear of flooding	Protection of amenities from flooding	None	Protection of local road and railway network from flooding	Long term reduction in flood risk	

Based on Crest Level Option A

- Reduced seepage through Stanmoor Bank, giving relief to those many houses along the bank which presently suffer from damp and shallow flooding by seepage through and under the core wall.

- Potential damage to properties from the construction activities, eg, through vibration, although all such damage would be repaired under a compensation scheme.

- Partial closure of a badger sett.

7.3.4 Comparison of On-line Defence Techniques

Technique 1 would result in noise and vibration impacts close to houses. Use of hush piling (Technique 2) would offer a relatively quiet and almost vibration-free alternative to Technique 1 for sensitive locations. Techniques 1-4 and 6 would have short term traffic congestion implications on Stanmoor Road during piping of concrete from a standing vehicle and movement of piles etc. This would affect the local community. Technique 5 (geotextile membrane to core wall) has the advantage of requiring only minor traffic movements and limited disturbance. The use of Technique 5, however, would be restricted to areas where only seepage (and not a stability problem) needs to be resolved. Similarly, Technique 6 would be restricted to areas where the height (rather than the stability) of Stanmoor Bank is a problem.

Potential impacts on the badger community are common to all the techniques, although the piling techniques (1 and 2) may allow the badgers to remain landward of the core wall, rather than be translocated to preserve the flood defence integrity of Stanmoor Bank.

Other than impacts related to noise, vibration, disruption to the community and disturbance to badgers, the remaining temporary and permanent potential impacts can generally be mitigated for all the techniques.

7.3.5 Comparison of Crest Level Options

The extent of intrusion would increase with the increase in top level of the defence from Crest Level Option A to Option E. Raising the defence level would affect the visual appearance of the bank from both sides, would require alteration to some access ways from properties onto the Bank, and would alter the aspect from property windows which face onto the bank. In some cases works such as dam boards or glass walls within the main defence, would be needed to accommodate windows which otherwise would be partly blocked by the raising of the defence. A summary illustrating the effect of raising the defence level for each crest level option is given below.

Crest Level Option	Bank length raised (m)	Maximum raising (m)	Average height over raised part (m)	Number of houses having windows affected
A	130	0.08	0.04	Nil
B	1330	0.23	0.08	1
C	2020	0.35	0.15	8
D	2320	0.36	0.15	9
E	2760	0.59	0.28	16

8.0 SELECTION OF THE PREFERRED OPTION

8.1 INTRODUCTION

The Agency wish to promote a preferred option and confirm its acceptability to other interested parties. The information which has led to this selection is set out within this report and supported by Volume 2 which contains the more technical details, which need to be considered but have limited general interest. The extent of the information required was determined by the Agency following wide consultation with internal staff and other interested parties.

The Do Nothing and the only viable options have been assessed on engineering, economic, and environmental grounds. The reasons for the selection of the preferred option are set out below.

8.2 ENGINEERING GROUNDS

8.2.1. General

The engineering requirements are to provide effective flood alleviation to the 136 properties, infrastructure, and 330 ha of agricultural land of Stan Moor. Flood risk occurs from three sources: stability failure of the bank, seepage through/under the bank, and from overtopping (as identified in *sections 3.4-3.6*)

The current defence provides an overtopping design level of service capable of meeting a once in 85 years flood event but has does not have adequate structural stability. Increasing amounts of seepage from the River Tone occur through or under the bank.

The options available to deal with the problem have been presented in *section 6.0.* The Agency in considering these options have found only two viable engineering solutions, a diversion channel and on-line defences.

8.2.2 Option preference on engineering grounds

The diversion channel is the preferred option on engineering grounds, as the construction of a entirely new defence would enable the most effective flood alleviation to be achieved.

8.3 ECONOMIC GROUNDS

8.3.1 General

The following three options were considered in economic cost benefit terms. Only those schemes that have been shown to be viable in engineering terms were considered together with the do nothing option.

8.3.2 Do Nothing

A breach is estimated to occur within twenty years causing damage to properties, infrastructure and agricultural land. Damages due to seepage and overtopping are assumed to occur until a breach occurs.

The present value of damages (Pvd) is £7,373,000

8.3.3 Diversion channel

The Present Value cost (PVc) is £5.8 million with the Present Value of Benefits (PVb) being £5.45 million. This gives a Benefit/Cost ratio of less than unity. This option is not viable in economic terms.

8.3.4 On-line defence works

The on-line defence option, although a single defence line, has identified five possible crest levels (A-E) for the flood alleviation works. The economic analysis of these options demonstrates that all five options have a cost/benefit ratio of greater than unity. Option A provides the best average benefit/cost ratio at 2.66:1.

Additional analysis to determine the incremental benefit/cost ratio for all the remaining options (B-E) found them to be less than unity. These finding are robust to foreseeable changes in costs or benefits with regard to the construction techniques which may be adopted after detailed design.

8.3.5 Option Preference on economic grounds

The options have been compared in accordance with MAFF Project Appraisal Guidance Notes (PAGN) and this is set out in *Section 6.7.* The economically most advantageous option is On-line defence works Option A.

8.4 ENVIRONMENTAL GROUNDS

8.4.1 General

Only those options which are viable on engineering and economic grounds are assessed for their environmental impacts.

The environmental value of the study area in the National and local context is set out in the body of the main report together with the recognised impacts and are summarised in *Table 7.1.*

8.4.2 Do Nothing

The result of a breach would have significant safety implications to the residents of the 136 houses protected by the defences. The properties, some of heritage interest, would become uninhabitable. A tidally inundated lake approximately 2 metres deep would develop within Stan Moor on the existing agricultural land. The ecological changes would have serious implications for the nature conservation interest in Stan Moor and the surrounding moors

8.4.3 On-line defences

The report identifies two main elements relating to the on-line option. The first is the height of the defence. The second is the technique applied to achieve the defences. The impact of the defence height is simply that the greater the level of protection against overtopping the higher the defences needs to be. This results in a longer construction time and a more visually intrusive/obstructive final product. Option A provides the minimum height raising of the existing defences required to provide an effective defence. The impact of all the five options during construction is similar in scale and the technique applied to achieve the

defence is more significant than the crest height.

At this stage of design six different construction techniques have been identified. These are required to meet the range of problems in dealing with seepage and stability problems and constraints relating to close working to buildings. It is not possible at this stage to be precise as to which technique will be applied in each location. Additional site investigation is required to reveal the full extent of the stability problem and the exact location constraints that will apply. An environmental action plan has been developed to guide the selection of the appropriate technique and ensure that the mitigation and reinstatement work is implemented.

8.4.4 Option preference on Environmental Grounds

The Agency's preferred option on environmental grounds is on-line defence Option A,

8.5 SUMMARY

The Agency, in considering the range of options, wish to promote Option A of the on-line strengthening options. It is the preferred option on economic and environmental grounds, and meets the required engineering standards.

FIGURES

THE ENVIRONMENT AGENCY
SOUTH WEST REGION

STANMOOR BANK

Feasibility Study
& Appraisal Report

Project Reference G7655

PART 2 : ALTERNATIVE SCHEME OPTIONS

MAY 1998

PREPARED	CHECKED	APPROVED
D A Worth	P L Woods	I Haken
T Bonner	N Richardson	
Document Status:	FINAL	Dated: May 1998

POSFORD DUVIVIER
Consulting Engineers

Rightwell House
Bretton Centre
Peterborough
Cambridgeshire
PE3 8DW
Tel: 01733 334455
Fax: 01733 262243

1 Alba Court
Emperor Way
Exeter
Devon
EX1 3QS
Tel: 01392 447999
Fax: 01392 446148

THE ENVIRONMENT AGENCY
SOUTH WEST REGION

STANMOOR BANK
Feasibility Study & Appraisal Report

Project Reference G7655

PART 2 : ALTERNATIVE SCHEME OPTIONS

MAY 1998

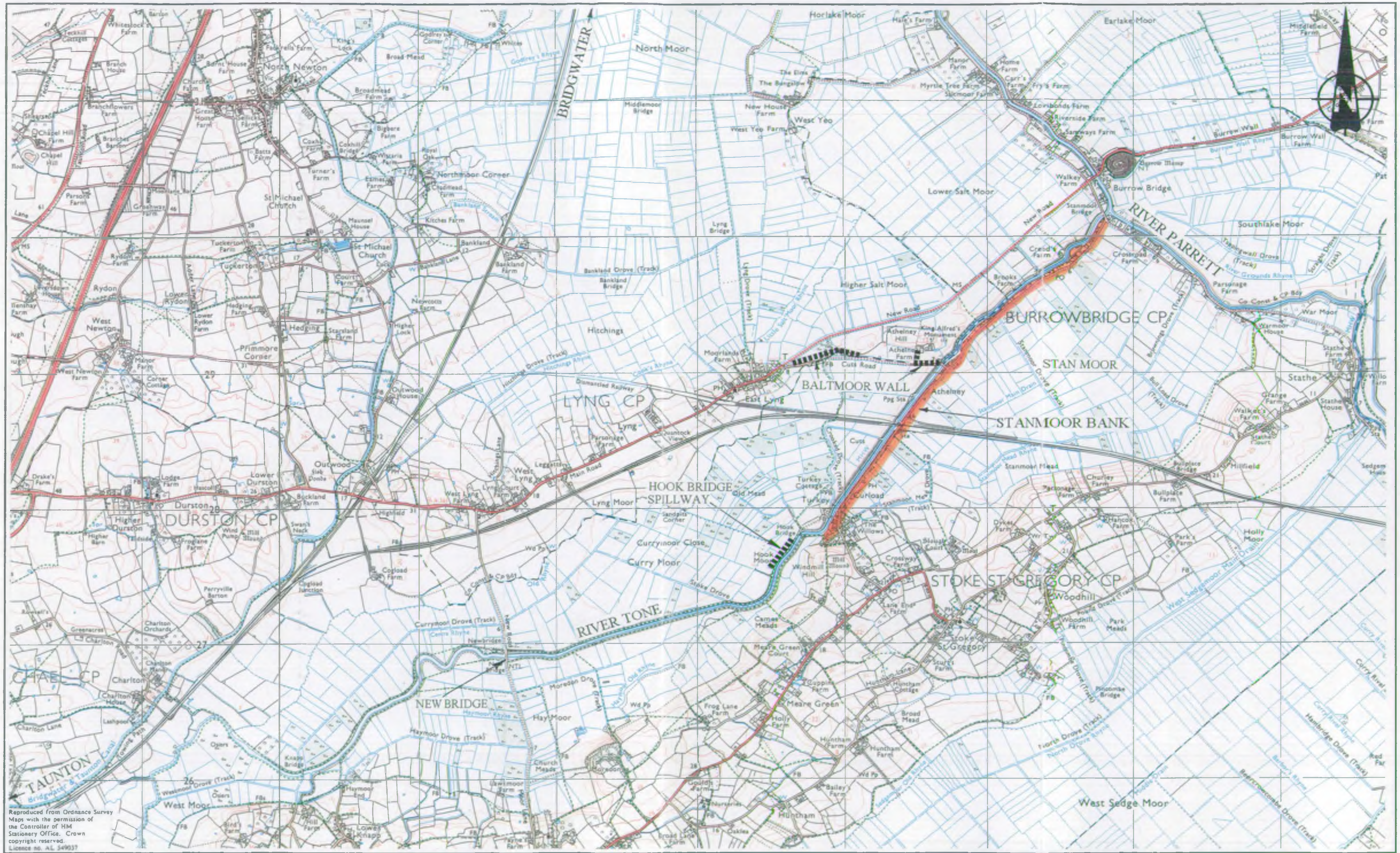
CONTENTS OF VOLUME 1 – MAIN REPORT

Reproduced from Ordnance Survey Maps with the permission of the Controller of HM Stationery Office. Crown copyright reserved Licence no. AL 549037

PROJECT	TITLE		DATE	SCALE
STANMOOR BANK FEASIBILITY STUDY AND APPRAISAL REPORT	KEY PLAN	POSFORD DUVIVIER CONSULTING ENGINEERS	MAR 98	1:200,000
			DRAWN MJM	CHKD
			FIGURE 1	

PROJECT: STANMOOR BANK FEASIBILITY STUDY AND APPRAISAL REPORT	TITLE: STAN MOOR AREA	POSFORD DUVIVIER CONSULTING ENGINEERS	DATE MAR 98 · SCALE 1:12,500 · DRAWN MJM · CHKD · FIGURE 2

C1026



PROJECT	TITLE			
STANMOOR BANK FEASIBILITY STUDY AND APPRAISAL REPORT	TIDAL RIVER TONE	POSFORD DUVIVIER CONSULTING ENGINEERS	DATE MAR 98 DRAWN MJM FIGURE 3	SCALE 1:25,000 CHKD

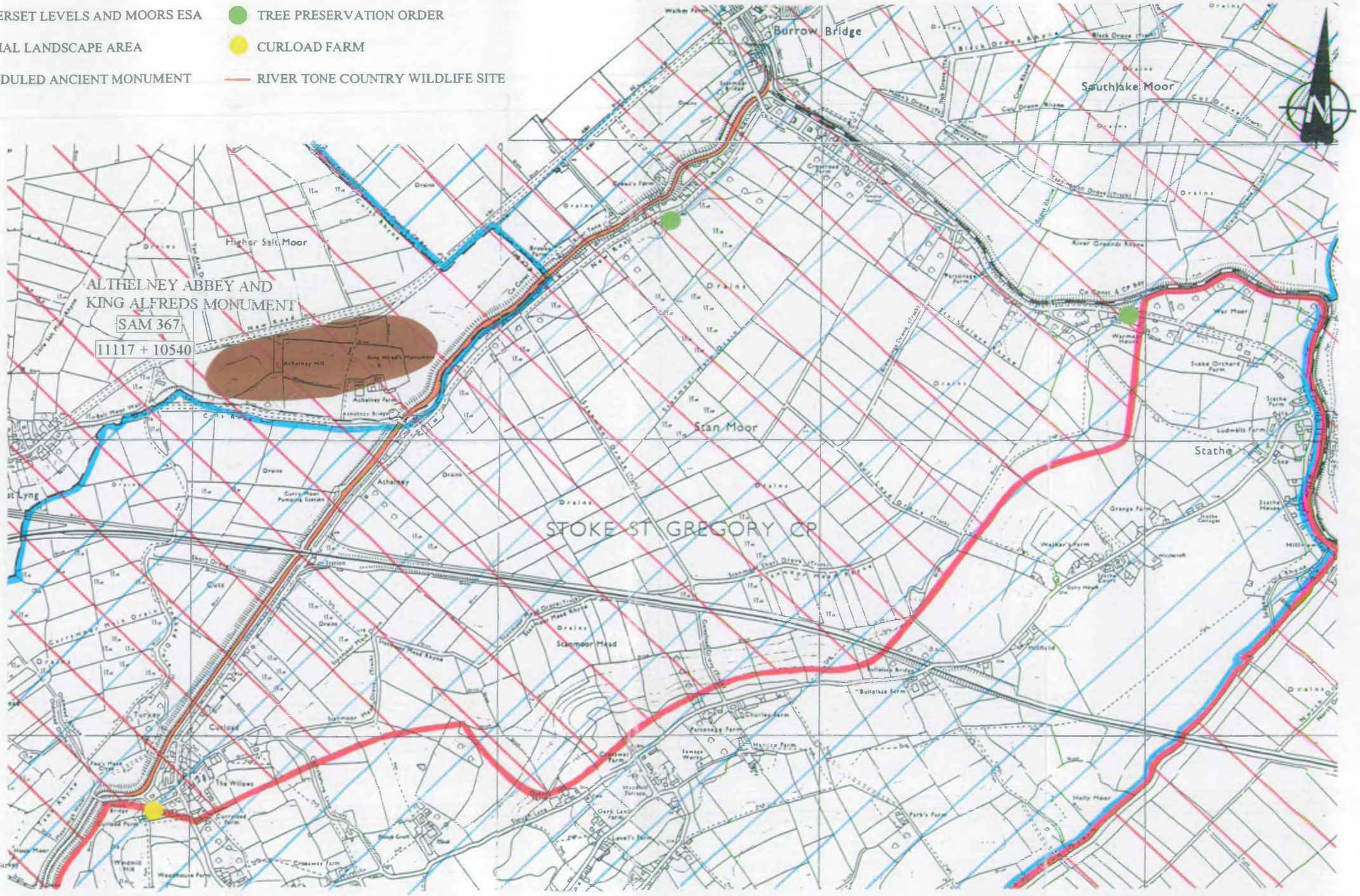
B0510

PROJECT	TITLE		DATE MAR 98	SCALE N.T.S
STANMOOR BANK FEASIBILITY STUDY AND APPRAISAL REPORT	STAN MOOR AREA TOPOGRAPHY	POSFORD DUVIVIER CONSULTING ENGINEERS	DRAWN MJM	CHKD
			FIGURE 4	

C1026

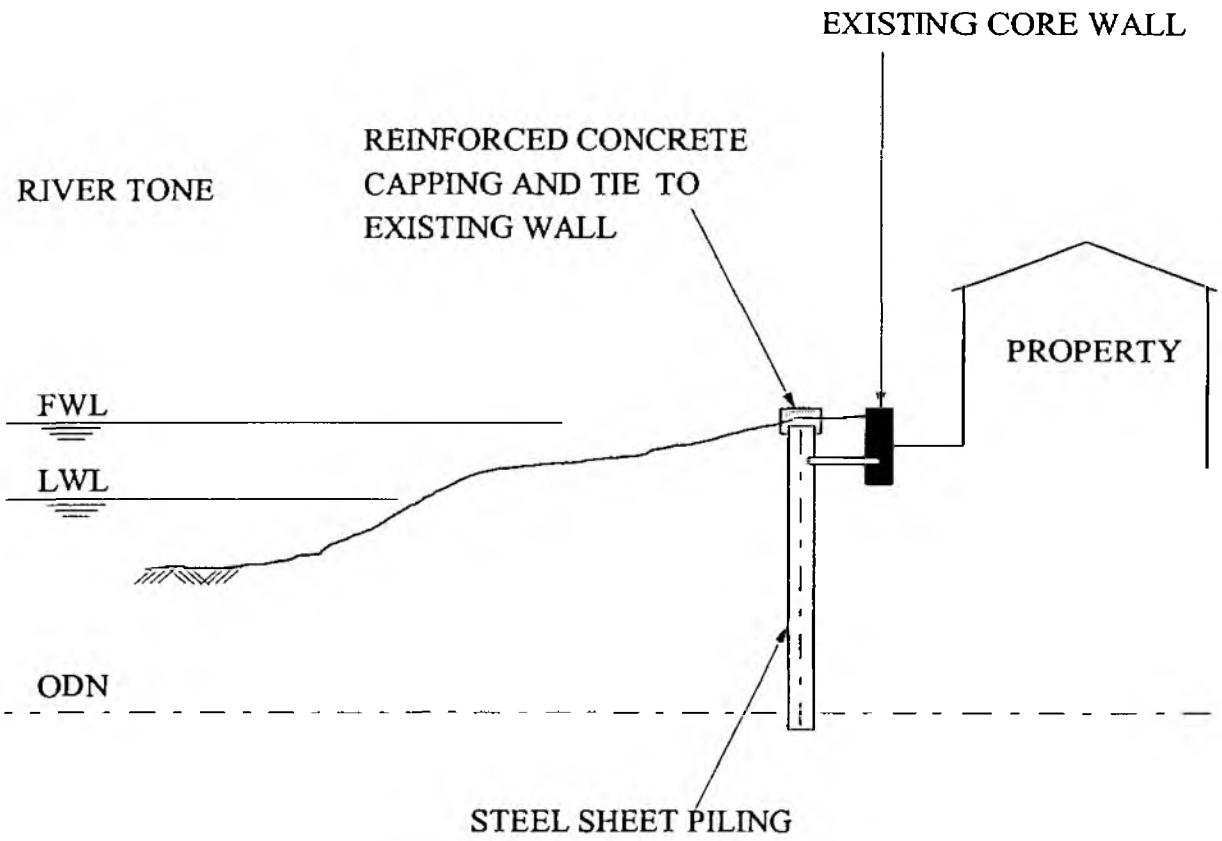
KEY

- SOMERSET LEVELS AND MOORS ESA
- SPECIAL LANDSCAPE AREA
- SCHEDULED ANCIENT MONUMENT
- TREE PRESERVATION ORDER
- CURLOAD FARM
- RIVER TONE COUNTRY WILDLIFE SITE



PROJECT: STANMOOR BANK FEASIBILITY STUDY AND APPRAISAL REPORT	TITLE: STAN MOOR AREA ENVIRONMENTAL INTERESTS	POSFORD DUVIVIER CONSULTING ENGINEERS	DATE MAR 98 · SCALE 1:12,500 · DRAWN MJM · CHKD · FIGURE 5

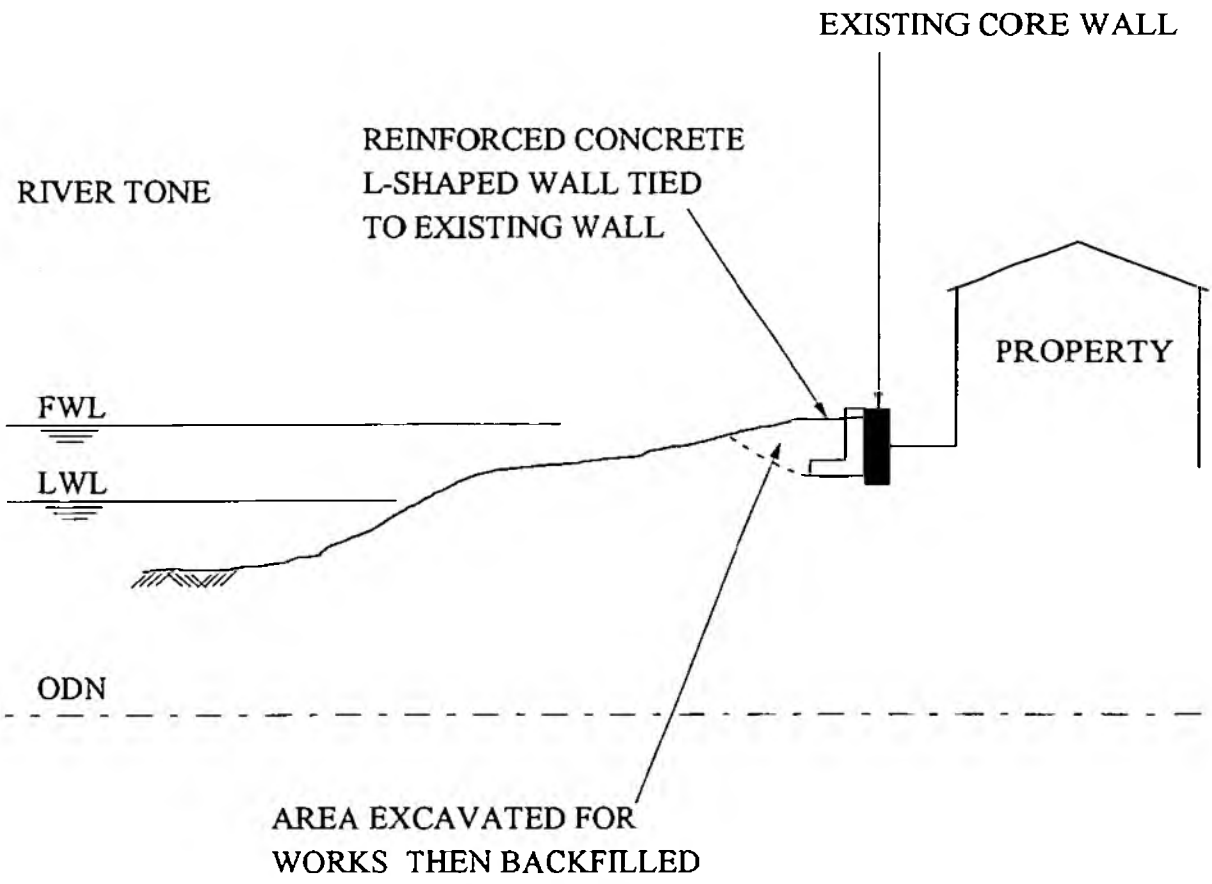
C1026



FWL = FLOOD WATER LEVEL
LWL = NORMAL LOW WATER LEVEL

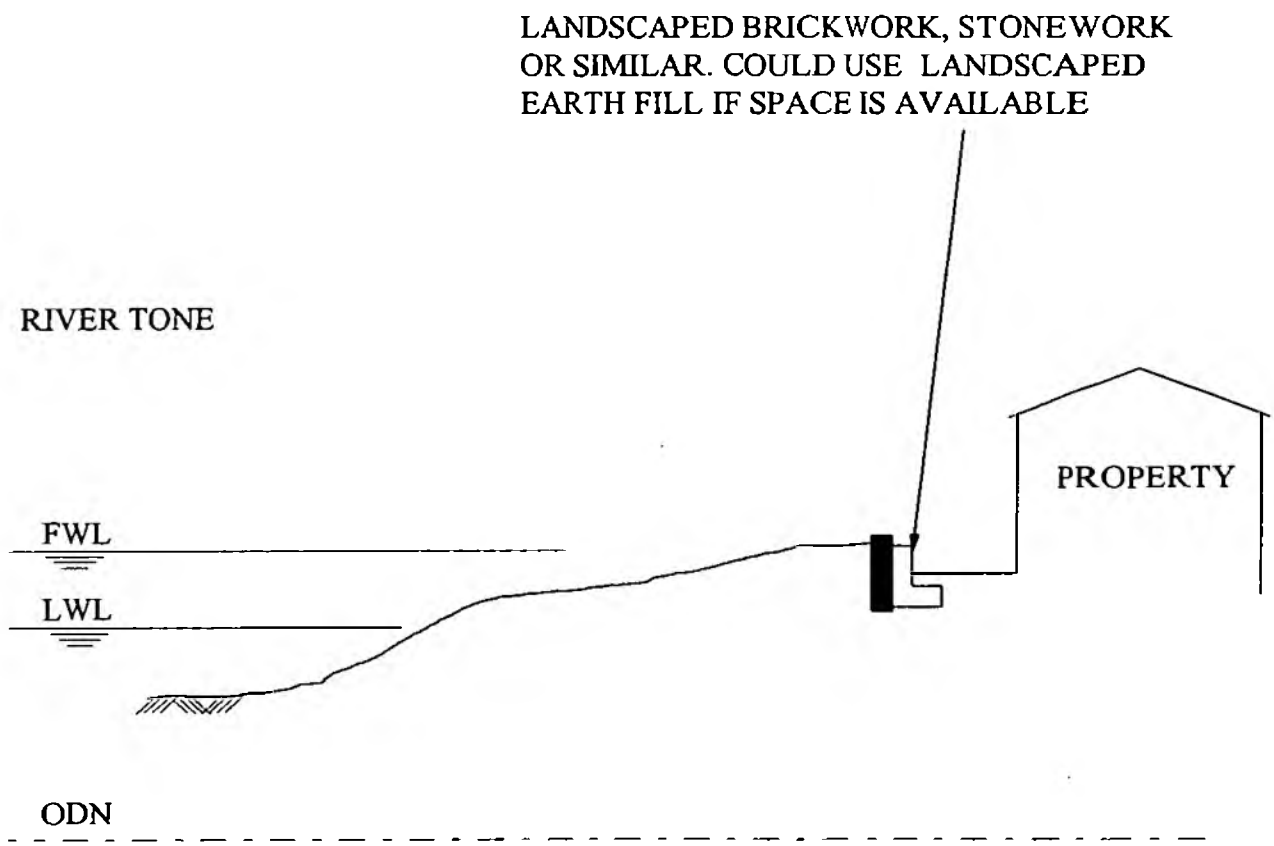
PROJECT	TITLE		DATE	SCALE
STANMOOR BANK FEASIBILITY STUDY AND APPRAISAL REPORT	TECHNIQUES 1 & 2 STEEL SHEET PILING	POSFORD DUVIVIER CONSULTING ENGINEERS	MAY 98	1:200
			DRAWN MJM	CHKD
			FIGURE 6a	

BD510



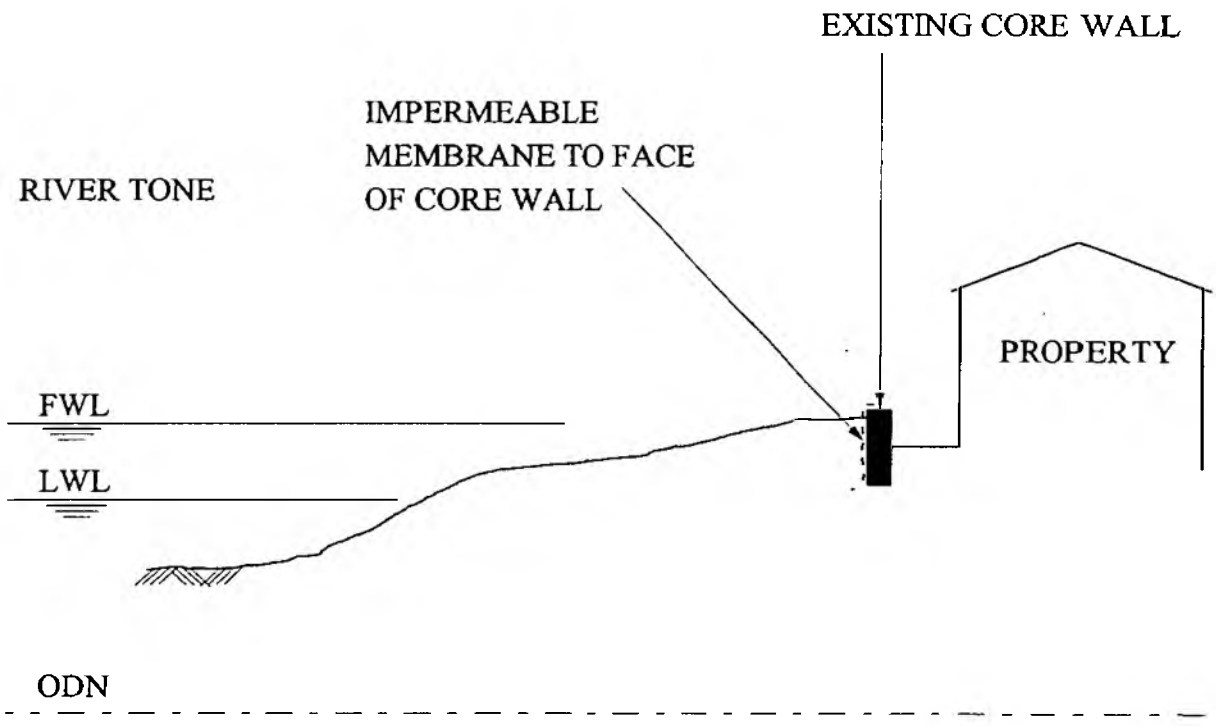
FWL = FLOOD WATER LEVEL
LWL = NORMAL LOW WATER LEVEL

PROJECT	TITLE		DATE	SCALE
STANMOOR BANK FEASIBILITY STUDY AND APPRAISAL REPORT	TECHNIQUE 3 STABILISE CORE WALL	POSFORD DUVIVIER CONSULTING ENGINEERS	MAY 98	1:200
			DRAWN MJM	CHKD
			FIGURE 6b	



FWL = FLOOD WATER LEVEL
LWL = NORMAL LOW WATER LEVEL

PROJECT	TITLE		DATE	SCALE
STANMOOR BANK FEASIBILITY STUDY AND APPRAISAL REPORT	TECHNIQUE 4 STABILISE CORE WALL FROM LANDWARD SIDE	POSFORD DUVIVIER CONSULTING ENGINEERS	MAY 98	1:200
			DRAWN MJM	CHKD
			FIGURE 6c	



FWL = FLOOD WATER LEVEL
LWL = NORMAL LOW WATER LEVEL

PROJECT	TITLE		DATE / SCALE
STANMOOR BANK FEASIBILITY STUDY AND APPRAISAL REPORT	TECHNIQUE 5 IMPERMEABLE MEMBRANE	POSFORD DUVIVIER CONSULTING ENGINEERS	DATE MAY 98 · SCALE 1:200 · DRAWN MJM · CHKD

FIGURE 6d

BD510

SCHEDULES

Schedule 1

Crest levels along Stanmoor Bank

Location	Chainage	Existing Crest		1960's design
		Core Wall	Bank*	Crest Level
	m	m ODN	m ODN	m ODN
Stanmoor Bridge	30			
	50	7.72		7.92
	100	7.78		7.92
	150	7.81		7.92
	200	7.77		7.92
	250	7.87		7.92
	300	7.80		7.92
	350	7.78		7.92
	400	7.81	8.27	7.92
	450	7.83	8.19	7.92
	500	7.93		7.92
	550	7.86		7.92
	600	7.86		7.92
	650	7.73		7.92
	700	7.68		7.92
	750	7.74		7.92
	800	7.78		7.92
	850	7.72		7.92
	900	7.89		7.92
	950	7.94		7.92
	1000	7.85		7.92
	1050	7.83		7.92
	1100	7.93		7.92
	1150	7.95		7.92
	1200	8.01		7.92
	1250	7.96		7.92
	1300	7.80	8.06	7.92
	1350	7.99	8.02	7.92
	1400	7.83	7.90	7.92
	1450	7.86		7.92
	1500	7.80	7.83	7.92
	1550	7.65	7.68	7.92
	1600	7.75		7.92
	1620	8.09		7.92
Athelney Bridge				
	1630	8.09		8.23
	1650	7.95	8.09	8.23
	1700	8.05		8.23
	1750	8.03		8.23
	1800	8.01		8.23
	1850	8.00		8.23
	1900	7.95		8.23
	1950	8.09		8.23
	2000	8.00		8.23
	2050	7.90		8.23
	2100	7.85		8.23
	2150	7.97		8.23
Railway Bridge				8.23
	2200	7.96		8.23
	2250	7.96		8.23
	2300	8.03		8.23
	2350	7.96		8.23
	2400	8.05		8.23
	2450	8.07		8.23
	2500	8.04		8.23
	2550	8.04		8.23
	2600	8.14		8.23
	2650	8.14		8.23
	2700	8.17		8.23
	2750	8.19		8.23
	2800	8.09		8.23
	2850	8.03		8.23
	2900	7.99		8.23
	2950	8.02		8.23
	3000	8.14		8.23
	3050		8.02	8.23
Bank returns to Curload Farm				
	3100			
	3150			
	3200			
Hook Bridge				

* Bank level only shown where it is above the core wall level

Schedule 2

Present flood water levels

Location	Chainage	Existing Crest Level	Envelope of Water Levels (m OD) at return Period			
			50	85	100	200
	m	m ODN	Years	Years	Years	Years
Stanmoor Bridge	30		7.63	7.68	7.70	7.92
	50	7.72	7.63	7.68	7.70	7.91
	100	7.78	7.63	7.68	7.70	7.91
	150	7.81	7.63	7.68	7.70	7.91
	200	7.77	7.63	7.68	7.70	7.91
	250	7.87	7.63	7.68	7.70	7.90
	300	7.80	7.63	7.68	7.70	7.90
	350	7.78	7.63	7.68	7.70	7.90
	400	8.27	7.63	7.68	7.70	7.90
	450	8.19	7.63	7.68	7.70	7.90
	500	7.93	7.63	7.68	7.70	7.89
	550	7.86	7.63	7.68	7.70	7.89
	600	7.86	7.63	7.68	7.70	7.89
	650	7.73	7.63	7.68	7.70	7.88
	700	7.68	7.63	7.68	7.70	7.88
	750	7.74	7.63	7.68	7.70	7.88
	800	7.78	7.63	7.68	7.70	7.87
	850	7.72	7.63	7.68	7.70	7.87
	900	7.89	7.63	7.68	7.70	7.87
	950	7.94	7.63	7.68	7.70	7.86
	1000	7.85	7.63	7.68	7.70	7.86
	1050	7.83	7.63	7.68	7.70	7.86
	1100	7.93	7.63	7.68	7.70	7.85
	1150	7.95	7.63	7.68	7.70	7.85
	1200	8.01	7.63	7.68	7.70	7.85
	1250	7.96	7.63	7.68	7.70	7.84
	1300	8.06	7.63	7.68	7.70	7.84
	1350	8.02	7.63	7.68	7.70	7.84
	1400	7.90	7.63	7.68	7.70	7.84
	1450	7.86	7.63	7.68	7.70	7.83
	1500	7.83	7.63	7.68	7.69	7.83
	1550	7.68	7.64	7.68	7.69	7.83
	1600	7.75	7.64	7.68	7.69	7.83
	1620	8.09	7.64	7.68	7.69	7.82
Athelney Bridge						
	1630	8.09	7.65	7.68	7.69	7.82
	1650	8.09	7.65	7.68	7.69	7.82
	1700	8.05	7.65	7.68	7.69	7.82
	1750	8.03	7.66	7.68	7.69	7.81
	1800	8.01	7.66	7.68	7.69	7.81
	1850	8.00	7.66	7.68	7.69	7.81
	1900	7.95	7.66	7.68	7.69	7.81
	1950	8.09	7.66	7.68	7.69	7.80
	2000	8.00	7.67	7.68	7.69	7.80
	2050	7.90	7.67	7.68	7.69	7.80
	2100	7.85	7.67	7.68	7.69	7.79
	2150	7.97	7.68	7.68	7.69	7.79
Railway Bridge						
	2200	7.96	7.68	7.68	7.69	7.79
	2250	7.96	7.68	7.69	7.69	7.78
	2300	8.03	7.69	7.69	7.69	7.78
	2350	7.96	7.69	7.69	7.69	7.78
	2400	8.05	7.69	7.69	7.69	7.77
	2450	8.07	7.70	7.70	7.70	7.77
	2500	8.04	7.70	7.70	7.70	7.76
	2550	8.04	7.70	7.70	7.70	7.76
	2600	8.14	7.71	7.71	7.71	7.75
	2650	8.14	7.71	7.71	7.71	7.75
	2700	8.17	7.72	7.72	7.72	7.74
	2750	8.19	7.72	7.72	7.72	7.74
	2800	8.09	7.72	7.72	7.72	7.74
	2850	8.03	7.73	7.73	7.73	7.73
	2900	7.99	7.73	7.73	7.73	7.73
	2950	8.02	7.74	7.74	7.74	7.74
	3000	8.14	7.74	7.74	7.74	7.74
	3050	8.02	7.74	7.74	7.74	7.74
Bank returns to Curload Farm						
	3100		7.74	7.74	7.74	7.74
	3150		7.74	7.74	7.74	7.74
	3200		7.75	7.75	7.75	7.75
Hook Bridge						

Black shading indicates overtopping would occur

Schedule 3

Design water levels for the defence improvement works

Location	Chainage	Existing Crest Level	Design Water Levels m ODN				
	m	m ODN	Option A	Option B	Option C	Option D	Option E
Stanmoor Bridge	30		7.71	7.71	7.91	7.90	8.15
	50	7.72	7.71	7.71	7.91	7.90	8.15
	100	7.78	7.71	7.71	7.91	7.90	8.15
	150	7.81	7.71	7.71	7.91	7.90	8.15
	200	7.77	7.71	7.71	7.91	7.89	8.14
	250	7.87	7.71	7.71	7.90	7.89	8.14
	300	7.80	7.71	7.71	7.90	7.89	8.14
	350	7.78	7.71	7.71	7.90	7.89	8.14
	400	8.27	7.71	7.71	7.90	7.88	8.14
	450	8.19	7.71	7.71	7.90	7.88	8.13
	500	7.93	7.71	7.71	7.89	7.88	8.13
	550	7.86	7.72	7.72	7.89	7.88	8.13
	600	7.86	7.72	7.72	7.89	7.88	8.13
	650	7.73	7.72	7.72	7.88	7.89	8.12
	700	7.68	7.72	7.72	7.88	7.89	8.12
	750	7.74	7.72	7.72	7.88	7.89	8.12
	800	7.78	7.72	7.72	7.88	7.89	8.11
	850	7.72	7.72	7.72	7.87	7.89	8.11
	900	7.89	7.73	7.73	7.87	7.89	8.10
	950	7.94	7.73	7.73	7.87	7.89	8.10
	1000	7.85	7.73	7.73	7.87	7.89	8.10
	1050	7.83	7.73	7.73	7.87	7.89	8.10
	1100	7.93	7.73	7.73	7.87	7.89	8.09
	1150	7.95	7.74	7.74	7.87	7.89	8.09
	1200	8.01	7.74	7.74	7.87	7.89	8.08
	1250	7.96	7.74	7.74	7.87	7.89	8.08
	1300	8.06	7.75	7.75	7.87	7.89	8.08
	1350	8.02	7.75	7.75	7.86	7.89	8.07
	1400	7.90	7.75	7.75	7.86	7.89	8.07
	1450	7.86	7.75	7.75	7.86	7.89	8.07
	1500	7.83	7.76	7.76	7.86	7.89	8.06
	1550	7.68	7.76	7.76	7.86	7.89	8.06
	1600	7.75	7.76	7.76	7.86	7.89	8.06
	1620	8.09	7.76	7.76	7.86	7.89	8.06
Athelney Bridge							
	1630	8.09	7.77	7.77	7.86	7.89	8.05
	1650	8.09	7.77	7.77	7.86	7.89	8.05
	1700	8.05	7.77	7.77	7.86	7.89	8.05
	1750	8.03	7.78	7.78	7.86	7.89	8.05
	1800	8.01	7.78	7.78	7.86	7.89	8.05
	1850	8.00	7.78	7.78	7.86	7.89	8.04
	1900	7.95	7.79	7.79	7.86	7.89	8.04
	1950	8.09	7.79	7.79	7.86	7.89	8.04
	2000	8.00	7.80	7.80	7.86	7.89	8.04
	2050	7.90	7.80	7.80	7.86	7.89	8.03
	2100	7.85	7.80	7.80	7.86	7.89	8.03
	2150	7.97	7.81	7.81	7.86	7.89	8.03
Railway Bridge							
	2200	7.96	7.81	7.81	7.86	7.89	8.02
	2250	7.96	7.82	7.82	7.86	7.89	8.02
	2300	8.03	7.83	7.83	7.86	7.89	8.02
	2350	7.96	7.83	7.83	7.86	7.89	8.01
	2400	8.05	7.84	7.84	7.86	7.89	8.01
	2450	8.07	7.84	7.84	7.86	7.89	8.00
	2500	8.04	7.85	7.85	7.86	7.90	8.00
	2550	8.04	7.85	7.85	7.86	7.90	8.00
	2600	8.14	7.86	7.86	7.86	7.90	7.99
	2650	8.14	7.86	7.86	7.87	7.90	7.99
	2700	8.17	7.87	7.87	7.87	7.90	7.98
	2750	8.19	7.87	7.87	7.87	7.90	7.98
	2800	8.09	7.88	7.88	7.88	7.90	7.97
	2850	8.03	7.89	7.89	7.89	7.90	7.97
	2900	7.99	7.89	7.89	7.89	7.91	7.97
	2950	8.02	7.90	7.90	7.90	7.91	7.96
	3000	8.14	7.90	7.90	7.90	7.91	7.96
	3050	8.02	7.90	7.90	7.90	7.92	7.96
Bank returns to Curload Farm							
	3100		7.91	7.91	7.91	7.92	7.95
	3150		7.91	7.91	7.91	7.93	7.95
	3200		7.92	7.92	7.92	7.93	7.95
Hook Bridge							

Schedule 4

Design crest levels for flood defence improvement options

Location	Chainage	Design Crest Levels m ODN				
	m	Option A	Option B	Option C	Option D	Option E
Stanmoor Bridge	30					
	50	7.71	7.86	8.06	8.05	8.30
	100	7.71	7.86	8.06	8.05	8.30
	150	7.71	7.86	8.06	8.05	8.30
	200	7.71	7.86	8.06	8.04	8.29
	250	7.71	7.86	8.05	8.04	8.29
	300	7.71	7.86	8.05	8.04	8.29
	350	7.71	7.86	8.05	8.04	8.29
	400	7.71	7.86	8.05	8.03	8.29
	450	7.71	7.86	8.05	8.03	8.28
	500	7.71	7.86	8.04	8.03	8.28
	550	7.72	7.87	8.04	8.03	8.28
	600	7.72	7.87	8.04	8.03	8.28
	650	7.72	7.87	8.03	8.04	8.27
	700	7.72	7.87	8.03	8.04	8.27
	750	7.72	7.87	8.03	8.04	8.27
	800	7.72	7.87	8.03	8.04	8.26
	850	7.72	7.87	8.02	8.04	8.26
	900	7.73	7.88	8.02	8.04	8.25
	950	7.73	7.88	8.02	8.04	8.25
	1000	7.73	7.88	8.02	8.04	8.25
	1050	7.73	7.88	8.02	8.04	8.25
	1100	7.73	7.88	8.02	8.04	8.24
	1150	7.74	7.89	8.02	8.04	8.24
	1200	7.74	7.89	8.02	8.04	8.23
	1250	7.74	7.89	8.02	8.04	8.23
	1300	7.75	7.90	8.02	8.04	8.23
	1350	7.75	7.90	8.01	8.04	8.22
	1400	7.75	7.90	8.01	8.04	8.22
	1450	7.75	7.90	8.01	8.04	8.22
	1500	7.76	7.91	8.01	8.04	8.21
	1550	7.76	7.91	8.01	8.04	8.21
	1600	7.76	7.91	8.01	8.04	8.21
	1620	7.76	7.91	8.01	8.04	8.21
Athelney Bridge						
	1630	7.77	7.92	8.01	8.04	8.20
	1650	7.77	7.92	8.01	8.04	8.20
	1700	7.77	7.92	8.01	8.04	8.20
	1750	7.78	7.93	8.01	8.04	8.20
	1800	7.78	7.93	8.01	8.04	8.20
	1850	7.78	7.93	8.01	8.04	8.19
	1900	7.79	7.94	8.01	8.04	8.19
	1950	7.79	7.94	8.01	8.04	8.19
	2000	7.80	7.95	8.01	8.04	8.19
	2050	7.80	7.95	8.01	8.04	8.18
	2100	7.80	7.95	8.01	8.04	8.18
	2150	7.81	7.96	8.01	8.04	8.18
Railway Bridge						
	2200	7.81	7.96	8.01	8.04	8.17
	2250	7.82	7.97	8.01	8.04	8.17
	2300	7.83	7.98	8.01	8.04	8.17
	2350	7.83	7.98	8.01	8.04	8.16
	2400	7.84	7.99	8.01	8.04	8.16
	2450	7.84	7.99	8.01	8.04	8.15
	2500	7.85	8.00	8.01	8.05	8.15
	2550	7.85	8.00	8.01	8.05	8.15
	2600	7.86	8.01	8.01	8.05	8.14
	2650	7.86	8.01	8.02	8.05	8.14
	2700	7.87	8.02	8.02	8.05	8.13
	2750	7.87	8.02	8.02	8.05	8.13
	2800	7.88	8.03	8.03	8.05	8.12
	2850	7.89	8.04	8.04	8.05	8.12
	2900	7.89	8.04	8.04	8.06	8.12
	2950	7.90	8.05	8.05	8.06	8.11
	3000	7.90	8.05	8.05	8.06	8.11
	3050	7.90	8.05	8.05	8.07	8.11
Bank returns to Curload Farm						
	3100					
	3150					
	3200					
Hook Bridge						

Schedule 5

Crest level raising for each flood defence improvement option

Location	Chainage	Amount to raise Stanmoor bank crest m				
	m	Option A	Option B	Option C	Option D	Option E
Stanmoor Bridge	30					
	50		0.14	0.34	0.33	0.58
	100		0.08	0.28	0.27	0.52
	150		0.05	0.25	0.24	0.49
	200		0.09	0.29	0.27	0.52
	250			0.18	0.17	0.42
	300		0.06	0.25	0.24	0.49
	350		0.08	0.27	0.26	0.51
	400					0.02
	450					0.09
	500			0.11	0.10	0.35
	550		0.01	0.18	0.17	0.42
	600		0.01	0.18	0.17	0.42
	650		0.14	0.30	0.31	0.54
	700	0.04	0.19	0.35	0.36	0.59
	750		0.13	0.29	0.30	0.53
	800		0.09	0.25	0.26	0.48
	850		0.15	0.30	0.32	0.54
	900			0.13	0.15	0.36
	950			0.08	0.10	0.31
	1000		0.03	0.17	0.19	0.40
	1050		0.05	0.19	0.21	0.42
	1100			0.09	0.11	0.31
	1150			0.07	0.09	0.29
	1200			0.01	0.03	0.22
	1250			0.06	0.08	0.27
	1300					0.17
	1350				0.02	0.20
	1400			0.11	0.14	0.32
	1450		0.04	0.15	0.18	0.36
	1500		0.08	0.18	0.21	0.38
	1550	0.08	0.23	0.33	0.36	0.53
	1600	0.01	0.16	0.26	0.29	0.46
	1620					0.12
Athelney Bridge						
	1630					0.11
	1650					0.11
	1700					0.15
	1750				0.01	0.17
	1800				0.03	0.19
	1850			0.01	0.04	0.19
	1900			0.06	0.09	0.24
	1950					0.10
	2000			0.01	0.04	0.19
	2050		0.05	0.11	0.14	0.28
	2100		0.10	0.16	0.19	0.33
	2150			0.04	0.07	0.21
Railway Bridge						
	2200			0.05	0.08	0.21
	2250		0.01	0.05	0.08	0.21
	2300				0.01	0.14
	2350		0.02	0.05	0.08	0.20
	2400					0.11
	2450					0.08
	2500				0.01	0.11
	2550				0.01	0.11
	2600					
	2650					
	2700					
	2750					
	2800					0.03
	2850		0.01	0.01	0.02	0.09
	2900		0.05	0.05	0.07	0.13
	2950		0.03	0.03	0.04	0.09
	3000					
	3050		0.03	0.03	0.05	0.09
Bank returns to Curload Farm						
	3100					
	3150					
	3200					
Hook Bridge						

APPENDIX A
PHOTOGRAPHS

Plate 1. View downstream from ch.150

Plate 2. View downstream from Brooks Farm ch.150

Plate 3. View downstream of Athelney Bridge from ch.1600

Plate 4. View downstream from Athelney Railway Bridge

Plate 5. View downstream from ch.2300

Plate 6. Curload, View downstream from ch.2900

APPENDIX B
EXISTING ENVIRONMENT

APPENDIX B

EXISTING ENVIRONMENT

1.0 INTRODUCTION

The following sections describe the baseline environmental conditions for various parameters within the Stanmoor Bank study area.

2.0 NATURE CONSERVATION

2.1 Data Sources

The ecological characteristics of the study area were determined from the following:

- Site of Special Scientific Interest (SSSI) citation (English Nature, 1992, presented in *Appendix H);*
- Two River Corridor Surveys (National Rivers Authority, 1991 and Environment Agency, 1997a, presented in *Appendix H*);
- Site visit;
- The Biodiversity Species Study (Environment Agency, 1997b);
- The Somerset Levels and Moors Schemes Land Use / Grassland Survey (Environment Agency, 1997c);
- Data searches undertaken by Somerset Environmental Research Centre (SERC, 1996/97);
- Consultation and other literary sources.

2.2 Designated Sites

The study area lies within the Somerset Levels and Moors, which is the largest area of lowland wet grassland and associated wetland habitat remaining in Britain, covering approximately 35,000 ha in the floodplains of the Rivers Axe, Brue, Parrett, Tone and their tributaries.

Most of the study area comprises Stanmoor Bank (which is the floodbank along the right bank of the River Tone) and Stan Moor (which is protected from flooding). The study area lies within or adjacent to a number of designated conservation sites. The location of the designated sites is presented in *Figure B1.*

Designated Sites within the Study Area

- Somerset Levels and Moors Environmentally Sensitive Area (ESA)
- River Tone County Wildlife Site

Adjacent Designated Sites

- Curry and Hay Moors Site of Special Scientific Interest (SSSI)
- Somerset Levels and Moors Special Protection Area (SPA)

- Somerset Levels and Moors Ramsar Wetland of International Importance
- North Moor SSSI
- Southlake Moor SSSI
- River Parrett County Wildlife Site

The Somerset Levels and Moors ESA covers Stan Moor, Stanmoor Bank and the River Tone. The ESA was designated because of the threat to its unique landscape, wildlife and archaeological interest from intensification of farming methods.

The internationally important SPA and Ramsar Site comprise a series of SSSIs, including Curry and Hay Moors SSSI, Southlake Moor SSSI and North Moor SSSI. Curry and Hay Moors comprise seasonally flooded grazing marshes and support nationally significant numbers of wildfowl and waders (particularly breeding lapwing and redshank).

The River Tone County Wildlife Site is designated by Somerset Wildlife Trust and Somerset County Council because it is a biologically rich river with a variety of associated habitats. The special interest of the River Tone is its aquatic flora and invertebrates, fish, bankside flora and mammals. The River Parrett is a river with legally protected species and rare invertebrate species (ie. the hairy click beetle, *Synaptus filiformis*) (SERC, 1997) (see *Plate B2* and *Annex 3* in *Appendix H*).

2.3 Legally Protected and Biodiversity Key Species

A data search was undertaken by SERC in February 1997 to identify the presence of notable and protected species within the study area. In addition, the Environment Agency, English Nature and the RSPB have drawn up a list of 44 key species which are considered to be particularly important for maintaining the biodiversity of the Somerset Levels and Moors. Using information available from SERC and other sources, the known distribution and abundance of each of these species has been documented for the Stanmoor study area (Environment Agency, 1997b).

The results of the data search (Environment Agency, 1997b) are presented in *Appendix H*. This information is summarised in *Table 2.3* which presents the key species present, their approximate location and their preferred habitat.

2.4 Flora and Fauna of the River Tone

The grass floodbank along the River Tone is intensively managed (mown) and generally supports little botanical interest, being dominated by ruderals and grasses. A small floristically rich area was, however, identified upstream of Stanmoor Bridge (NGR ST 357 300). Where management of the channel was less intense, reed fringes are well established, providing good habitat for fish, invertebrates and birds (see River Corridor Surveys from 1991 and 1997 in *Appendix H*).

Table 2.3 Biodiversity Key Species and Protected Species within (or immediately adjacent to) the Stanmoor Bank Study Area

Species	Location	Status / Protection	Habitat
Otter *Lutra lutra*	River Tone, River Parrett and surrounding rhynes	EC Habitats Directive Appendix II Bern Convention Wildlife and Countryside Act, 1981 Biodiversity Key Species	Mainly solitary, occupying a large home range of up to 15km. Usually found near water. Predominant food is fish. Breed in holts with good cover and no disturbance.
Badger *Meles meles*	Active sett within Stanmoor Bank	Appendix III Bern Convention Wildlife and Countryside Act, 1981 Badger Act, 1992 Biodiversity Key Species	Setts dug in areas with well drained, easily dug soil. Require cover, plentiful food and water supply and avoid disturbance.
Barn Owl *Tyto alba*	River Parrett downstream of Burrow Bridge	EC Birds Directive. Appendix II Berne Convention. Wildlife and Countryside Act, 1981 Red Data Book Species.	Nests in dark, draft-free sites in buildings and tree cavities. Food predominantly consists of voles, mice, rats and shrews.
Water Vole *Arvicola terrestris*	Southlake Moor	Biodiversity Key Species	Well vegetated banks of lowland ponds, rivers and drainage ditches. Feeds mainly on grasses and usually nests underground or in reed tussocks.
Hairy Click Beetle *Synaptus filiformis*	Burrow Bridge – Oathe Lock River Parrett	Red Data Book Species Biodiversity Key Species	Recorded on river banks within sweeping grasses. Larvae probably develops in rotting willow wood.
Greater Water Parsnip *Sium latifolium*	Tappingwell Drove Pathe (in Southlake Moor)	Nationally Scarce Biodiversity Key Species	Perennial umbellifer found in shallow water, especially fen ditches.

There were no plant Biodiversity Key Species (see *Section 2.3*) or nationally rare or scarce plant species (as determined by Stewart *et al*, 1994) identified within the 1991 and 1997 River Corridor Surveys for the River Tone.

Otter tracks are commonly observed (by River Corridor Surveyors, local householder and during site visits) in the bare mud exposed by the tide along the River Tone from Hook Bridge to Stanmoor Bridge. No otter holts were observed along this intensively managed section of the river.

A badger sett is present in Stanmoor Bank. Local householders have observed this active sett since 1993.

Reed warblers are known to breed in the reed fringes of the River Tone (Environment Agency, 1997a), and barn owls have been observed hunting in the area (see *Section 2.3*).

2.5 Flora and Fauna of Stan Moor

The 1982 Phase 1 Habitat Survey (presented in *Figure B3*) (English Nature, 1982) shows that Stan Moor was predominantly improved grassland with approximately 20% of the fields identified as arable and around 10% shown as withy beds or orchards. There are no known semi-improved or unimproved grasslands within Stan Moor (Environment Agency, 1997c).

Typically, an MG7 plant community would be anticipated under the National Vegetation Classification system within the improved grassland areas, although this has not been confirmed by site survey. Such communities are common and of little nature conservation interest (Rodwell, 1992).

There are no formal surveys of the ditches on Stan Moor. However, consultation with Jane Brookhouse of RSPB indicated that some of the ditches are of good quality (in terms of local biodiversity), supporting frogbit (*Hydrocaris morsus-ranae*), purple loosestrife (*Lythrum salicaria*) and other freshwater plant species.

Records indicate that Stan Moor does not attract large numbers of wildfowl and wader species and does not support bird Biodiversity Key Species (see *Section 2.3*).

3.0 FISHERIES

The River Tone within the study area downstream to Burrow Bridge is utilised as a commercial eel fishery. The river also supports a coarse fishery with a wide variety of fish species (including roach, bream, pike, perch, gudgeon, minnows and chub). Whilst the river is identified as a salmonid migratory route, it does not support a salmonid fishery nor is it a salmonid spawning ground.

There is a public right to fish along the tidal section of the River Tone, which is regularly fished by Taunton Angling Club with agreement for access from the riparian owners and public access along the opposite bank to Stanmoor Bank. Fishing is, however, only allowed between June to March, in order to allow a closed season for fish breeding. Approximately 5-6 fishermen are present along the bank at weekends, with less fishing activity during the week.

It is not known if there are any fish populations within the ditch systems of Stan Moor.

4.0 LANDSCAPE

As noted in Section 2.2, the study area lies within the Somerset Levels and Moors ESA, which is designated *inter alia* for its unique landscape. The ESA falls almost entirely within a Special Landscape Area (SLA) (see *Figure B4*), which is identified within Somerset County Council's Structure Plan (SCC, 1993) as an area of high landscape quality meriting special efforts to conserve its character. In addition, The Character of England Map (Countryside Commission and English Nature, 1997) defines both the natural area and countryside character of Character Area Number 142: The Somerset Levels and Moors.

A Landscape Assessment of the Somerset Levels and Moors ESA (MAFF, 1990) identified three different landscape types within the Stanmoor study area and an

additional landscape type just outside the study area (see *Figure B2*). These are described in *Table 4.1*.

Table 4.1 Landscape Types in (and adjacent to) Stanmoor Study Area

Landscape Type	Description
Domesticated Moor	This is found along the linear raised river banks of the Rivers Tone and Parrett, where the land is higher than the adjacent moor and therefore slightly drier. It is a managed and domesticated small-scale landscape and is associated with the linear settlements of Athelney, Curload and Stathe.
Semi-open Moor	The visually continuous grassland around the southern edge of Stan Moor has a strong patterning. A regular rectilinear network of rhynes as "wet fences" and grassy droves create a framework which sub-divides the grass fields. Distinct concentrations of vegetation in groups or lines (eg. withy beds, hawthorn, mature trees and pollarded willows) create the characteristic patterned and punctuated openness.
Open Moor	The low intensity grassland of hay fields and dairy pasture creates a visually unified landcover across the central section of Stan Moor. A regular, rectilinear lattice of rhynes as "wet fences" and grassy droves sub-divide the fields. In places, arable conversion is visually intrusive as it breaks the expanse of dappled grassland. The lack of cover is important to the spacious moor and its wet and wild natural character.
Hillocks (adjacent to the study area)	Athelney Hill and Burrow Mump are areas of higher land with relatively steep slopes which are visually significant within the surrounding low-lying moor.

Consultation with Taunton Deane District Council indicated that there is a tree protected by a Tree Preservation Order (TPO) within the corridor of the River Tone in the study area. The location of the tree is shown on *Figure B4.*

Almost all the houses adjacent to the right bank of the River Tone have windows overlooking the bank, the river channel and the agricultural land on the opposite bank (see *Plate B4-B8*). In addition, the river is visible from the public footpaths downstream of Athelney Bridge and across Hook Bridge and the whole landscape of the study area can be viewed by visitors from the top of the prominent hill known as Burrow Mump (a proposed Special Landscape Feature) (see *Plate B2*) in the village of Burrow Bridge to the north of the study area (see *Figure B4*).

5.0 GEOLOGY AND SOILS

The solid geology comprises Mercia Mudstone. The drift geology of the area comprises of mainly alluvial clays overlying peat, known as the Midelney series. Along the line of Stanmoor Bank and the present course of the River Tone, there is believed to be a natural outcrop of clay, from which the bank, and the cut in which the river now flows, was originally constructed.

6.0 WATER RESOURCES

6.1 Water Level Management

Curry Moor Pumping Station (on the left bank of the River Tone, opposite Stanmoor Bank at NGR ST345 287) (see *Figure B5*), is owned and operated by the Environment Agency. A principal duty of this pumping station is the evacuation of flood water from Curry Moor during the winter, as well as controlling the flow of water from the Curry Moor drainage rhynes into the River Tone during normal conditions.

The water level management of Stan Moor provides for water to be retained in the summer and drained during the winter. Summer water levels within the Stan Moor rhynes are controlled by the amount of water fed into the system via a large bore pipe from Hay Moor (as there is no direct connection to the river) and by the pumping regime to the River Parrett at Stanmoor Pumping Station (NGR ST361 299) (see *Figure B5*). In winter, the pipe from Hay Moor is cut off, such that flooding of Stan Moor, via Hay Moor, is prevented.

The Environment Agency own and operate Stanmoor pumping station, although Stanmoor Internal Drainage Board manage water levels in the immediate area. Stanmoor pumping station has two pumps, each with an approximate maximum pumping capacity of 33000 gallons per minute (2.5 m^3/second). The pumping regime of Stanmoor pumping station is detailed in *Table 6.1* below.

Table 6.1 Stanmoor Pumping Station Regime

Period of Year	Pump Start Level (m AOD)	Pump Stop Level (m AOD)	Target Water Level in Rhynes (m AOD)
Summer months	4.24	4.12	4.22
Winter months	3.70	3.55	3.65

6.2 Groundwater

The Mercia mudstone underlying the study area is utilised as a source of groundwater by two farms within the study area, Churley Farm and Curload Farm (licence numbers 16/52/07/094 and 16/52/07/098 respectively) (see *Figure B5*), even though it is classified as a non aquifer. This is because of the fissured nature of the mudstone and presence of localised coarser grained lens which in combination allow small groundwater yields to be obtained.

6.3 Surface Water

There are no licensed abstractions from the River Tone, within the study area, although there is an abstraction approximately 2 kilometres upstream at NGR ST317 269 (licence number 16/52/05/407). In addition, there are two surface water abstractions from rhynes within Stan Moor which are utilised for agricultural purposes by Dyke Farm and Parsonage Farm (licence numbers 16/52/07/005 and 16/52/07/132 respectively) (see *Figure B5*).

7.0 WATER QUALITY

The River Tone along Stanmoor Bank was classified as Class A, of good quality, in the 1990 River, Canals and Estuaries River Quality review utilising the National Water Council (NWC) classification scheme (NRA, 1991). More recent water quality data for the River Tone at the tidal limit at Newbridge (upstream) indicated generally good water quality (with Biological Oxygen Demand between 1.1-4.1 mg/l; Dissolved Oxygen 46-112 %; and Ammonia 0.1-2.3 mg/l) (Environment Agency, 1995-1997). Whilst the River Tone at Stanmoor Bank is below the tidal limit, it is thought to remain non-saline at this point.

The presence of freshwater plant species in the rhynes within Stan Moor suggests that the ditches are not subjected to saline water input. This is as expected, given that the rhynes are fed from a pipe from Hay Moor which receives water from the River Tone upstream of the tidal limit at Newbridge.

There are two consented discharges to the River Tone within the study area:

- a farm discharge from Athelney Farm at ST340 291 (consent number 080573)
- a private sewage treatment plant serving a residential property on Stanmoor Road at NGR ST347 291 (consent number 070626).

In addition, three further discharge consent applications are currently being processed, two adjacent to Stanmoor House (NGR ST358 301) and one opposite Crossroad Farm (NGR ST361 299). There is a possibility that all three will be granted a consent to discharge to the River Parrett.

A number of unconsented septic tank effluents discharging to soakaways and/or rhynes within the study area have been identified. These discharges contribute to the overall organic pollution load of the catchment, however, their effect on the water quality of the River Tone is minor as the NWC classification demonstrates. This stretch of the River Tone has not been involved in any recent major pollution incidents.

8.0 CONTAMINATED LAND

Historical maps of the study area from 1889-91, 1904-5 and 1930-31 were studied in order to identify any significant land uses which may have given rise to areas of contaminated land in the past.

Historic maps identified that the majority of properties along Stanmoor Bank were residential and therefore unlikely to have given rise to any contaminated land. There was no evidence of buildings on Stan Moor itself. The maps identified, however, a number of areas used for commercial and/or light industry which may be associated with contamination, either resulting from current or historic use. Such areas include: the railway line and associated buildings, the electricity sub-stations and various agricultural activities. During the site visit, old unbunded oil drums and oil tanks, scrap metal and tyres were standing on bare ground at Stanmoor Repair Garage. It is possible that the storage of these objects may have given rise to localised contamination.

9.0 ARCHAEOLOGY AND HERITAGE

Review of the Somerset County Council's Sites and Monuments Record (SMR) showed that the Stanmoor Bank study area contains 12 recorded sites of interest, two of which are Scheduled Ancient Monuments (SAMs). A brief description of the sites is given in *Appendix H* and the locations of the sites are shown on *Figure B6* in *Appendix H*. The SAMs are associated with King Alfred and his rallying of the English against the Vikings in the 9th Century. In addition, it is thought that Stanmoor Bank was constructed by monks during the 14th Century. More recently, the presence of a number of used and disused withy boilers highlights the importance

of basket weaving in the area, the boiler being used as part of the colouring process of the willow.

With respect to the unknown archaeological potential of the study area, it is difficult to predict the likelihood of other finds as any deposits are likely to be very deep. The study area is of historic importance, however, and any archaeological remains would be anticipated to be well preserved in their buried state.

A search by Taunton Deane Borough Council indicated that Curload Farm is the only listed building (Grade II) within the corridors of the Rivers Tone and Parrett in the study area (see *Figure B6*). In addition, at least 38 houses adjacent to the flood bank on Stanmoor Road are estimated to be between 100-350 years old (based on interviews with house-holders in 1995/6).

10.0 RECREATION AND AMENITY

The River Tone and the environs are used for a variety of recreation and amenity purposes. This use is likely to increase with the anticipated growth in population within the Taunton area. There are several public footpaths within the study area (*Figure B4*), which are utilised for general amenity such as dog walking. East Deane Local Plan, Policy ED/RT/2 (TDBC, 1992), proposes that existing rights of way along the Bridgwater-Taunton Canal and the River Tone are designated as long distance footpaths, able to link up with a network of shorter walks within the study area.

The Environment Agency lease their land along the River Tone to Taunton Angling Club for recreational fishing. The river is not designated as a bathing water and its steep banks and tidal nature would suggest that no swimming takes place. Whilst there are navigation rights associated with the tidal river, the river is not navigable along the stretch within the study area due to relatively recent siltation of the channel. However, it may be utilised by canoeists (canoes were observed on the river bank during the site visit).

11.0 LAND USE AND OWNERSHIP

Ownership along Stanmoor Bank is effectively riparian, with individual residents owning the bank and channel to the centre of the river on the south side. However, the Environment Agency have permissive powers allowing a right of access to undertake maintenance works along the bank. The Environment Agency own the north bank and channel (to the centre) as well as some small stretches of the south side. In addition, the Environment Agency own, and operate, Curry Moor Pumping Station, which is located on the north side of the River Tone at NGR ST 345 288 (see *Figure B5*). Many individual residents who are riparian owners utilise the river bank as an informal extension to their gardens installing washing lines, growing rose bushes and shrubs and laying stone steps into the river bank. However, any growing of shrubs and trees etc. is in contravention to the requirements of the Environment Agency and is therefore discouraged.

In a wider context, large areas of Curry Moor and Stan Moor are in private ownership, forming parts of farm estates. The Stanmoor area is mainly utilised for agricultural purposes, most of the area being classified as Grade 3 agricultural land. Grade 3 land has moderate limitations due to soil, relief or climate or some

combination of these which restrict the type of crop grown, periods of cultivation and expected yield. However, a wide band of land either side of the River Tone is Grade 4, of poor quality (TDBC, 1992). The farmland is principally utilised for livestock grazing on improved grassland, with the remaining area used for arable crops.

12.0 LOCAL COMMUNITY

There are two small villages within the study area: Athelney and Curload. Adjacent villages include Burrow Bridge (north), Stoke St Gregory (south), Stathe (east) and Lyng (west) (see *Figure B4*). The nearest major towns are Taunton and Bridgwater.

The Feasibility Study identified 136 residences within the area considered to be susceptible to flooding. Of these, the majority of residences at risk lie in close proximity to the River Tone along Stanmoor Road (see *Plates B3 and B4*), in low lying areas of Curload (Stanmoor Road and Stan Moor Mead Drove) and in low lying areas on Stathe Road near Burrow Bridge.

Letters were sent to 95 residences in the study area by the Environment Agency in 1995/96 and interviews were undertaken with 38 residents in order to identify the location and extent of current seepage problems being experienced. The anecdotal information obtained from this exercise indicated that flooding had been observed in a number of gardens and flooding of houses was not uncommon, with severe seepage observed in seven houses.

A number of houses have windows that over look the River Tone, some of which are very close to the crest of the core wall (see *Plates B5-B8*)

13.0 INFRASTRUCTURE AND ACCESS

The Intercity Main Line Railway from London to the South-West bisects the study area between Athelney and Curload and crosses the River Tone at the former Athelney Station (see *Figure B5*). An automated level crossing is provided on Stanmoor Road.

Athelney is approximately 12km east from Junction 25 of the M5 motorway and lies adjacent to the A361 (Taunton to Glastonbury) primary route. Access to the river is, however, limited to the Burrowbridge to Stathe "C" road and the single track "Cuts Road" (from East Lyng to Athelney). The latter road has poor sight lines, few passing places and is known to flood in winter. Stanmoor Road runs straight and parallel to the River Tone along the length of the study area and, in general, provides sufficient width for two light vehicles to pass (see *Plate B4*).

Access to the River Tone bank along the north side (opposite Stanmoor Bank) is good as the Environment Agency already have a tarmac track to their pumping station from Athelney Bridge and a rough track continues on from here towards the railway. Downstream of Athelney Bridge access may be available via Brooks Farm and Creeds Farm.

Access to Stanmoor Bank on the south side is more difficult. The houses have frequently been built into the bank (see *Plate B3*). There are, however, a few places where the Environment Agency's maintenance vehicles currently gain access to the bank. Such locations include *inter alia*: via a gate at Stanmoor Bridge; via a gate by

the railway; at Hook Bridge; and at least one place in between the houses (eg. adjacent to May Bank House 150m downstream of Athelney Bridge) (see *Figure B5*).

Stanmoor Bank has a defined access track on its crest for approximately 1km upstream of Stanmoor Bridge. The access track is composed of a quarry fill layer, some 0.3m in depth with a variable width of up to 2m. This track, although now covered with topsoil, would be suitable for the tracking of normal construction plant. For the remainder of the frontage, there is no defined track. Access would have to be along the bank top or berm.

Whilst the River Tone is tidal, its narrow width precludes navigation by all but small row boats or canoes (see *Section 10*). However, further downstream near Bridgwater, the River Tone is used as a commercial navigation.

14.0 PLANNING AND DEVELOPMENT

The study area lies within the jurisdiction of Somerset County Council (SCC) and is covered by Somerset Structure Plan (SCC, 1993 and 1997). With respect to local councils, the majority of the study area lies within Taunton Deane Borough Council (TDBC) (East Deane Area) with a small section within Sedgemoor District Council (SDC) (Bridgwater Area) (see *Figure B4*). The East Deane Area Local Plan (TDBC, 1992) currently provides the local planning framework for most of the study area, with the Bridgwater Area Local Plan (SDC, 1995) covering the Athelney Farm and Athelney Hill section adjacent to the study area. However, the consultation responses to a recent Issues and Options Report (TDBC, 1995) will form the basis of a district-wide Taunton Deane Local Plan in the future.

The River Tone Catchment Management Plan: Action Plan highlights Stanmoor Bank and Hook Bridge Spillway as two areas requiring investigation in terms of their design level and their consequential effects on flood defence (Environment Agency, 1997d).

REFERENCES

Countryside Commission and English Nature (1997). Character Map of England.

English Nature (1992). Citation for Curry and Hay Moors Site of Special Scientific Interest.

English Nature (1995). Contribution to Curry and Haymoors Water Level Management Plan.

Environment Agency (1997a). River Corridor Survey of the River Tone (Hook Bridge to Parrett Confluence). Posford Duvivier for the Environment Agency, Bridgwater.

Environment Agency (1997b). Somerset Levels and Moors Species Study. Posford Duvivier for the Environment Agency, Exeter.

Environment Agency (1997c). Somerset Levels and Moors Land Use/Grassland Survey. Posford Duvivier for the Environment Agency, Exeter.

Environment Agency (1997d). River Tone Catchment Management Plan: Action Plan. March 1997. Environment Agency, Bridgwater.

Environment Agency (1995-97). Water Quality Data. Environment Agency, Bridgwater.

Dewar, SM and Shawyer, CR (1996). Boxes, Baskets and Platforms. Artifical Nest Sites for Owls and Other Birds of Prey. Hawk and Owl Trust, London.

MAFF (1990). Environmentally Sensitive Areas: Somerset Levels and Moors Landscape Assessment for Monitoring. Ministry of Agriculture, Fisheries and Food.

MAFF (1992). Somerset Levels and Moors Environmentally Sensitive Area. Baseline Land Cover. Ministry of Agriculture, Fisheries and Food.

NRA (1991a). River Corridor Survey of the River Tone. National Rivers Authority, Bridgwater.

NRA (1991b). Water Quality Data for the River Tone. National Rivers Authority, Bridgwater.

NRA (1992). PPG6: Pollution Prevention Guidelines. Working at Demolition and Construction Sites. National Rivers Authority, Peterborough.

NRA (1993). PPG5: Pollution Prevention Guidelines: Works in, near or liable to affect watercourses.

NCC (1982). Phase 1 Habitat Survey. Nature Conservancy Council, Peterborough.

Rodwell, J S (1992). British Plant Communities. Volume 3: Grassland and Montane Communities. Joint Nature Conservancy Council. Cambridge University Press.

SDC (1995). Bridgwater Area Local Plan. Sedgemoor District Council, Bridgwater.

SERC (1996-97). Data Search. Somerset Environmental Records Centre, Taunton.

Somerset County Council (1993). Somerset Structure Plan Alteration Number 2, Explanatory Memorandum. Somerset County Council, Taunton.

Somerset County Council (1997). Somerset Structure Plan Review, Deposit Plan. Somerset County Council, Taunton.

Stewart, A, Pearman, D A and Preston, C D (1994). Scarce Plants in Britain. Joint Nature Conservancy Council, Peterborough.

TDBC (1992). East Deane Local Plan. Taunton Deane Borough Council, Taunton.

Plate B1. River Tone upstream of Hook Bridge at location of Spillway to Curry and Hay Moors SSSI

Plate B.2 Confluence of the Rivers Tone and Parrett (note Burrow Mump in background)

Plate B3. Stanmoor Bank and Core Wall (note proximity of houses and level of windows)

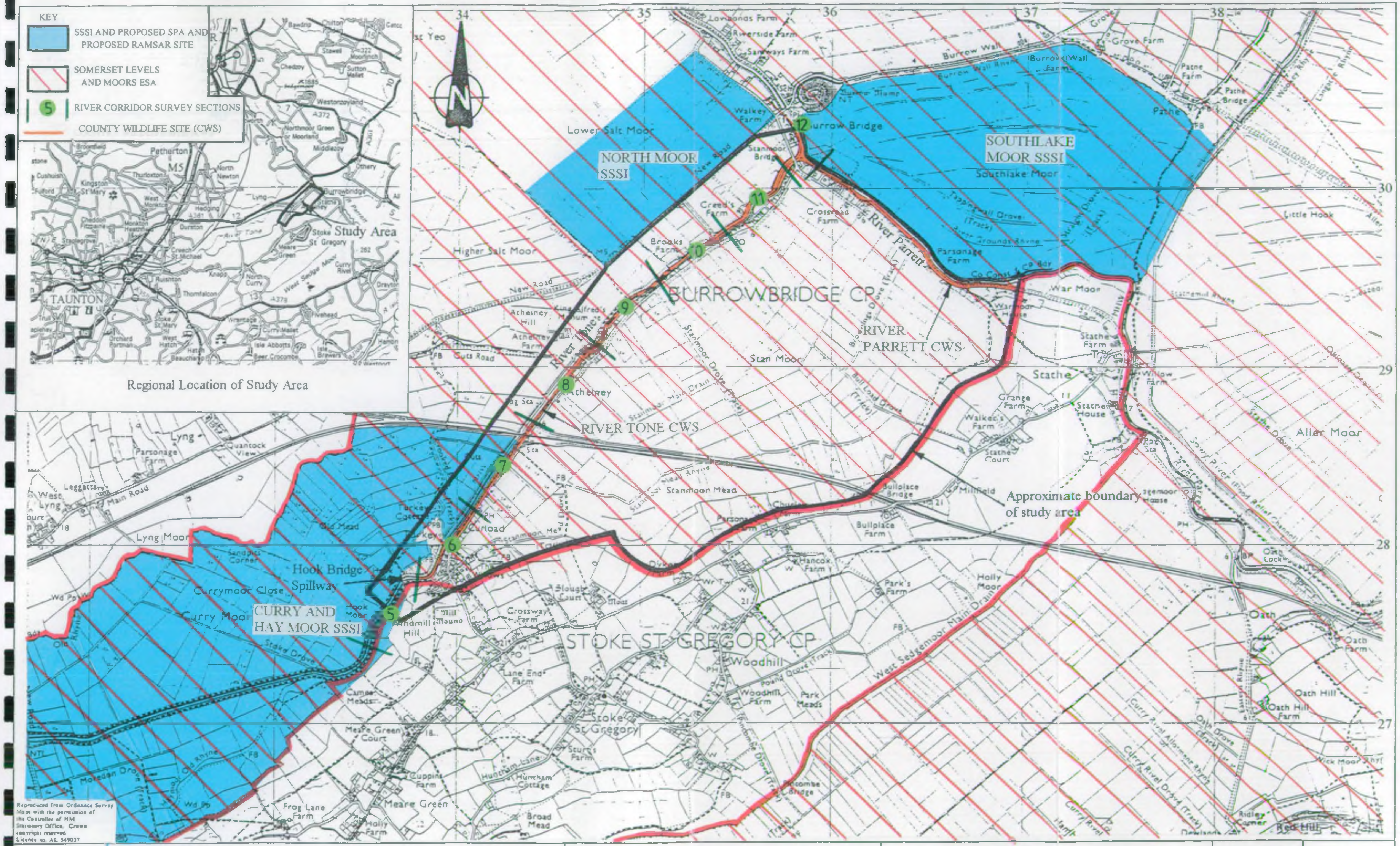
Plate B4. Stanmoor Road at Curload

Plate B5. St. Elmo

Plate B6. Drove House

Plate B7. Musgrove Cottage

Plate B8. Lorna Doone



Project	Title			
STANMOOR BANK FEASIBILITY STUDY AND APPRAISAL REPORT	DESIGNATED NATURE CONSERVATION SITES	POSFORD DUVIVIER CONSULTING ENGINEERS	Date MAR 98	Scale N.T.S
			Drawn MJM	Chkd. TmB.
			FIGURE B1	

H:\FLW20\A3BDR.PRE

KEY

- OPEN MOOR
- SEMI-OPEN MOOR
- DOMESTICATED MOOR
- HILLOCKS

Regional Location of Study Area

Approximate boundary of study area

BURROWBRIDGE CP

STOKE ST GREGORY CP

Lower Sale Moor

Higher Sale Moor

Southlake Moor

Stan Moor

War Moor

Aller Moor

Lyng Moor

Curry Moor

Hook Bridge Spillway

Burrow Bridge

Athelney

Stoke St Gregory

Meare Green

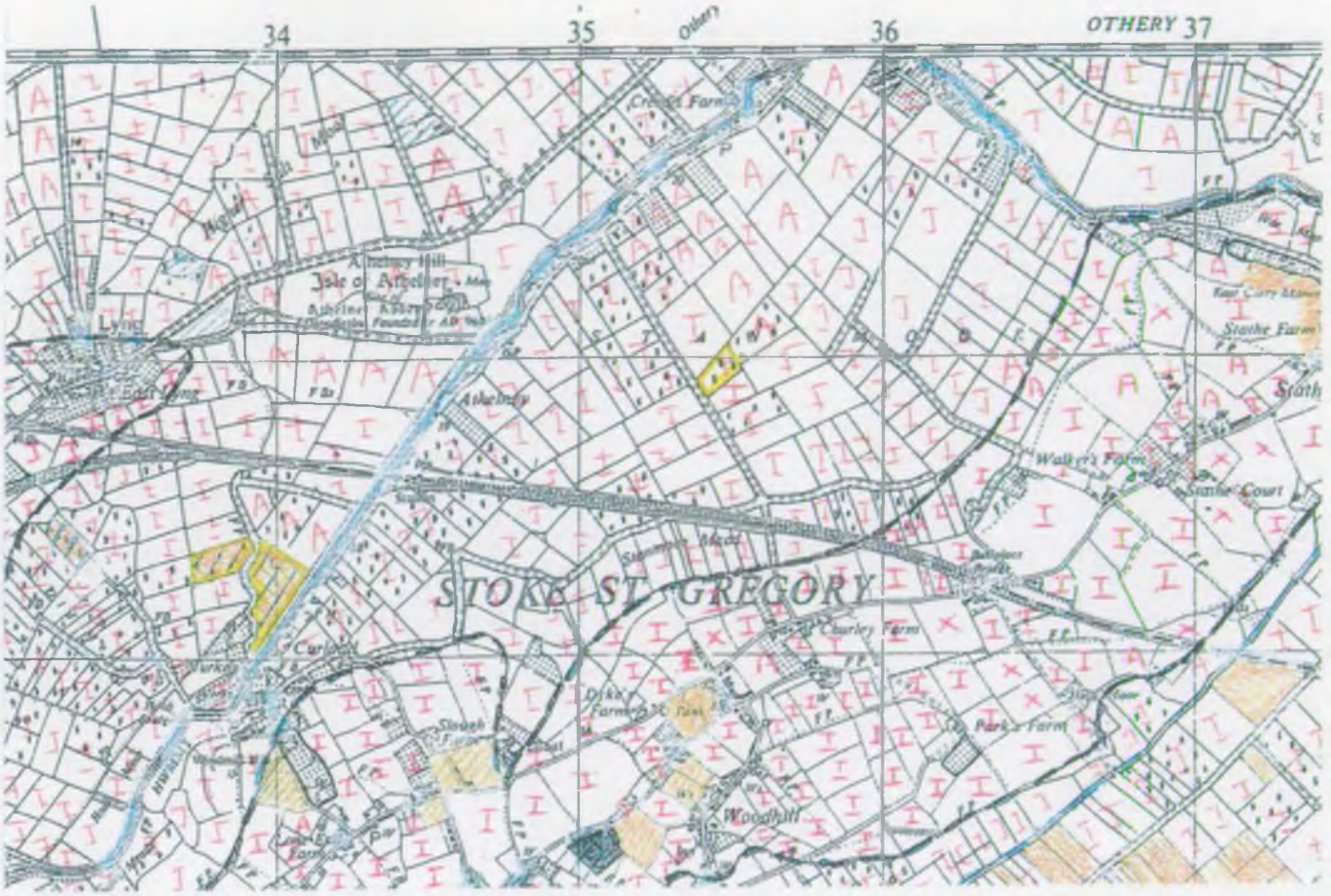
Scathe

Woodhill

Oath

Reproduced From Ordnance Survey Maps with the permission of the Controller of HM Stationery Office. Crown copyright reserved. Licence no. AL 349037

Project: STANMOOR BANK FEASIBILITY STUDY AND APPRAISAL REPORT	Title: LANDSCAPE TYPES	POSFORD DUVIVIER CONSULTING ENGINEERS	Date MAR 98 · Scale N.T.S · Drawn MJM · Chkd. TMS · FIGURE B2



KEY

A ARABLE

I IMPROVED GRASSLAND

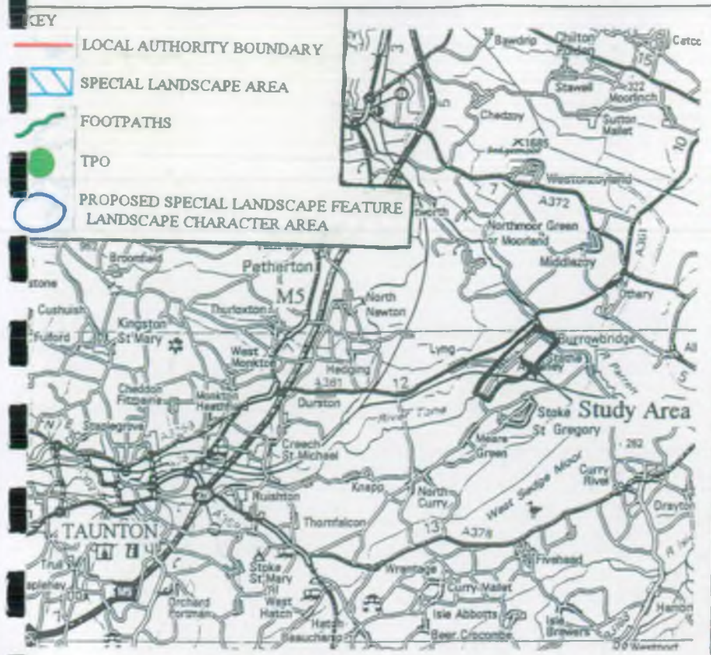
SEMI-IMPROVED GRASSLAND

RIVER

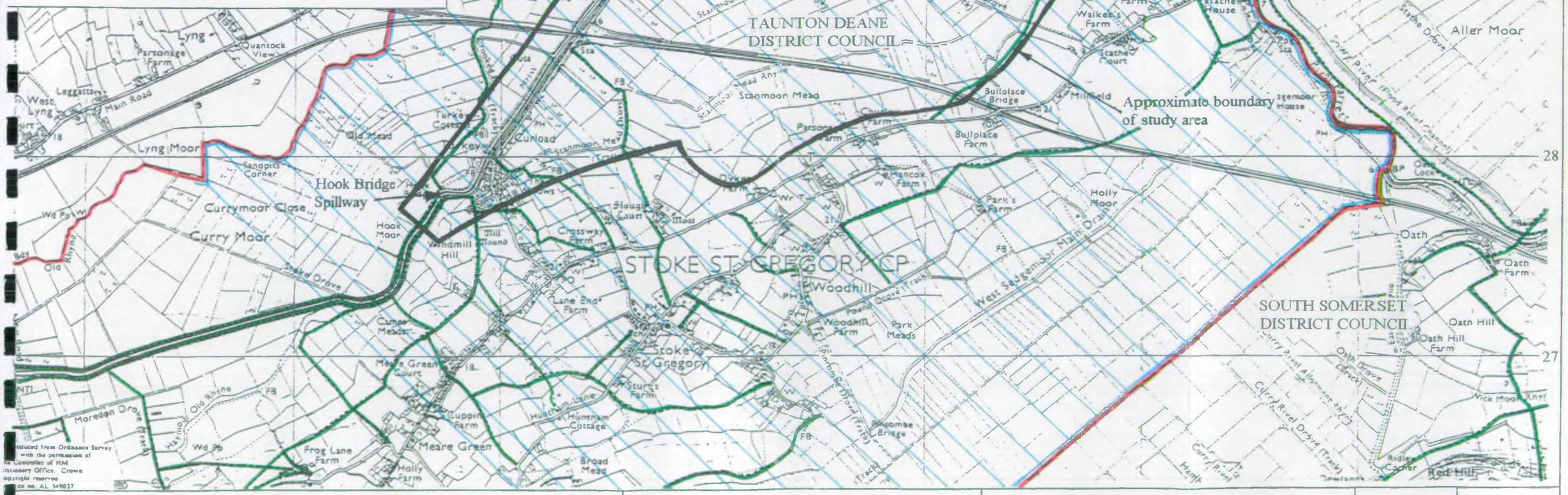
PROJECT	TITLE		DATE MAR 98	SCALE
STANMOOR BANK FEASIBILITY STUDY AND APPRAISAL REPORT	PHASE 1 HABITAT SURVEY (1982)	POSFORD DUVIVIER CONSULTING ENGINEERS	DRAWN MJM	CHKD TMB.
			FIGURE B3	

KEY

- LOCAL AUTHORITY BOUNDARY
- SPECIAL LANDSCAPE AREA
- FOOTPATHS
- TPO
- PROPOSED SPECIAL LANDSCAPE FEATURE
  LANDSCAPE CHARACTER AREA



Regional Location of Study Area



Project: STANMOOR BANK FEASIBILITY STUDY AND APPRAISAL REPORT	Title: PLANNING AND DEVELOPMENT CONSTRAINTS	POSFORD DUVIVIER CONSULTING ENGINEERS	Date MAR 98 · Scale NTS · Drawn MJM · Chkd TMB · FI

W20A3BDR.PRE

KEY
- MOTORWAY
- A ROAD
- B ROAD
- C ROAD
- POTENTIAL ACCESS POINT
- PUMPING STATION
- SURFACE WATER (SW) ABSTRACTION POINT
- BOREHOLE (BH) ABSTRACTION POINT

Study Area

Regional Location of Study Area

Approximate boundary of study area

BURROWBRIDGE CP

STANMOOR BRIDGE

STATHE ROAD

STANMOOR ROAD

STANMOOR PUMPING STATION

CUTS ROAD

MAY BANK

ATHELNEY BRIDGE

CURRY MOOR PUMPING STATION

PUMPING STATION ACCESS ROAD

RAILWAY

CURLOAD FARM BH ABSTRACTION

STANMOOR MEAD DROVE

PARSONAGE FARM SW ABSTRACTION

CHURLEY FARM BH ABSTRACTION

DYKE FARM SW ABSTRACTION

HOOK BRIDGE

STOKE ST GREGORY CP

Hook Bridge Spillway

Project

STANMOOR BANK
FEASIBILITY STUDY
AND APPRAISAL REPORT

Title

WATER ABSTRACTION,
INFRASTRUCTURE AND ACCESS

POSFORD DUVIVIER
CONSULTING ENGINEERS

Date MAR 98	Scale N.T.S
Drawn MJM	Chkd TMB.
FIGURE B5	

W20\A3\EDR.PRE

KEY

SMR REFERENCE NUMBER (SEE TABLE)

LISTED BUILDING

AREA OF HIGH ARCHAEOLOGICAL POTENTIAL

Regional Location of Study Area

ALTHELNEY ABBEY AND KING ALFREDS MONUMENT
SAM 367
11117 + 10540

10547

43653

43654

43655

43663

43657

43101

45002

43658

44256

BURROWBRIDGE CP

STOKE ST GREGORY CP

CURLOAD FARM

BURROW MUMP

Approximate boundary of study area

Project

STANMOOR BANK
FEASIBILITY STUDY
AND APPRAISAL REPORT

Title

ARCHAEOLOGICAL
AND HERITAGE FEATURES

POSFORD DUVIVIER
CONSULTING ENGINEERS

Date MAR 98 | Scale NTS

Drawn MJM | Chkd TMB

FIGURE B6

APPENDIX C
ENVIRONMENTAL IMPACT OF OPTIONS

APPENDIX C

ENVIRONMENTAL IMPACT OF OPTIONS

1.0 INTRODUCTION

As discussed in *Section 6* of the main report, a number of Strategic Options were initially considered on technical and economic grounds for resolving the threat of a breach at Stanmoor Bank. These included:

1 Do Nothing
2 Do Minimum
3 Tidal Barrage
4 Flood Relief Channel / Channel Diversion
5 Partial Channel Diversion
6 On-line Flood Defence Works

Of the strategic options investigated, the On-line Flood Defence Works is the only viable option which can reduce the risk of a breach and flooding. The remaining Strategic Options 1-5 were rejected as they would not fulfil the technical and/or economic objectives of the scheme. On this basis, the options of Tidal Barrage, Flood Relief Channel, Channel Diversion and Partial Diversion have not been considered further within the environmental appraisal.

However, in order to comply with the requirements of PAGN, the Do Nothing option has been considered in more detail, along with the viable engineering option of On-line Flood Defence Works.

The following sections therefore discuss the potential environmental impacts of the Do Nothing and On-line Flood Defence Works Strategic Options. The potential short term impacts during construction of each option are discussed in this section, followed by an appraisal of the potential long term impacts during the operational phase. The potential impacts are appraised according to each baseline environmental parameter. Mitigation measures integral to the scheme are noted where appropriate and information that is limited in extent, coverage and / or detail is identified.

The potential impacts are summarised in *Table 4.1* in Section 4.

2.0 THE DO NOTHING STRATEGIC OPTION

2.1 DESCRIPTION OF THE OPTION

Under the Do Nothing Option, no improvement works would be carried out on the Bank and present maintenance activities would cease.

2.2 TEMPORARY IMPACTS IN THE CONSTRUCTION PHASE

There is no construction phase associated with this Option And there are subsequently no related environmental impacts.

2.3 PERMANENT IMPACTS IN THE OPERATIONAL PHASE

2.3.1 Flooding Regime

Under the Do Nothing Scenario, minor local overtopping and seepage into houses would continue (becoming progressively worse over time). In addition, a breach of Stanmoor Bank would be likely to occur within 20 years.

If a significant breach occurred, it has been estimated that 136 properties and 330 hectares of agricultural land would become flooded. Without repair of the breach, pumping from Stanmoor Pumping Station would not keep up with the inflow of water from the river. Permanent flooding would therefore occur in Stan Moor, with water levels fluctuating on every tide.

2.3.2 Nature Conservation and Landscape

Under the "Do Nothing" Option, flooding of the arable and pasture land across Stan Moor would eventually occur because the flood defences would continue to deteriorate and would eventually breach. Whilst there is no National Vegetation Classification data available for the fields in Stan Moor, the land is predominantly a mixture of arable and improved pasture (MG7), and is therefore of little nature conservation interest. Semi-permanent surface water flooding would therefore be anticipated to provide a 2m deep water body for wildfowl and the margins would provide a wetland habitat for waders, particularly throughout the winter.

Flooding of Curry and Hay Moors SSSI, adjacent to the River Tone, may be reduced if water flows through a breach in Stanmoor Bank to Stan Moor. English Nature are currently contributing to the Water Level Management Plan for Curry and Hay Moors. Two of their objectives for this site are: "*to encourage a greater degree of stability of water levels and a finer degree of control to meet specific nature conservation needs*" and "*To avoid prolonged and deep flooding where this is damaging to the nature conservation interest of the moor*" (English Nature, 1995). A reduction in flooding of Curry and Hay Moors may therefore achieve the second objective. Complete loss of flooding (particularly in winter) could, however, reduce the nature conservation interest of this internationally important wetland.

Loss of habitat for protected species such as badgers would be anticipated under the Do Nothing option due to uncontrolled flooding.

2.3.3 Fisheries

A breach of Stanmoor Bank may result in the movement of fish into the rhynes within Stan Moor. This may enhance the local fish habitat within Stan Moor, unless significant changes in salinity of the rhynes resulted. The change in the hydrological regime of the Rivers Tone and Parrett would affect the fish communities of these rivers.

2.3.4 Water Quality and Contaminated Land

The flood water may rapidly wash fertilisers and pesticides off the arable land and result in a short term increase in turbidity as soils and sediments are transported due to the movement of flood water. With the cessation of arable farming, additional input of fertilisers would not occur, such that long term effects would not be anticipated. In addition, oils and chemicals from flooded storage areas (the garage site on Stanmoor Road) may cause pollution of the drainage channels and the Rivers Tone and Parrett. Prolonged flooding of the pastures on Stan Moor would result in decay of the vegetation and a subsequent reduction in oxygen levels. However, the increased volume of water would effectively dilute and disperse most pollutants, although short term damaging effects on the rare invertebrates (particularly the Red Data Book hairy click beetle within the River Parrett) and fish communities could result.

2.3.5 Archaeology and Heritage

Permanent flooding of Stan Moor would protect the known and unknown buried archaeological remains from dewatering. Drainage of Stan Moor has been evident for more than 50 years. Drying out of artefacts is likely, therefore, to have already occurred and is irreversible. Flooding would damage the listed building at Curload Farm (and other old buildings in the area). The archaeological interest of the bank itself was essentially lost during previous works in the area in the 1960s, further deterioration is therefore not anticipated.

2.3.6 Land Use and Ownership

A breach, and the resulting extensive flooding within Stan Moor, would have a long-term impact upon the existing land use within the area. Farming practices would essentially cease as the area would become a permanently flooded area. In addition, the flooding would affect the properties along Stanmoor Bank, as they would become uninhabitable (see *Section 2.3.8* below).

2.3.7 Local Community

Under the Do Nothing Option, the rate and extent of seepage through the bank would increase, causing flooding of houses adjacent to the bank. This would be of concern to the local residents.

Due to the unstable nature of the bank, a breach is predicted within 20 years. If the flooding occurred as a result of a sudden catastrophic breach, loss of life could occur. Approximately 136 residential properties would be affected by flooding.

Once a breach occurred, the houses would be uninhabitable and the villages of Athelney and Curload would be likely to be abandoned. The "Do Nothing" Option is therefore unacceptable to the local community.

2.3.8 Recreation and Amenity

Low lying footpaths within the study area (eg. across the moor near Curload and to the north east near Stathe) would be lost due to flooding.

A permanent body of shallow water would offer a potential amenity enhancement to the area.

2.3.9 Infrastructure and Access

Uncontrolled breaching of Stanmoor Bank and subsequent flooding of the area could result in damage to the main line Intercity Railway between London and the South-west. This would cause disruption to passengers.

Stanmoor Road and the Burrow Bridge to Stathe Road would be regularly flooded. This would inconvenience out-lying villages such as Stoke St Gregory, although alternative routes are available, diverting around Stan Moor by approximately 10km.

2.3.10 Planning and Development

Local communities and the rural economy would suffer from to the uncontrolled flooding in the area. This would contravene a number of planning policies (as defined in the East Deane Area Local and the Somerset County Structure Plans).

3.0 ON-LINE FLOOD DEFENCE WORKS

3.1 DESCRIPTION OF OPTION

3.1.1 Objectives

The On-line Defence Works Option would involve works to alleviate one, or more, of the following problems:

- strengthen the flood bank to reduce the risk of a breach;
- reduce seepage through the core wall; and
- raise low spots to reduce overtopping.

3.1.2 On-line Flood Defence Works Techniques

A number of On-line Flood Defence Techniques were considered (see *Section 6.4* of the main report). The following six techniques were considered to be economically viable and technically acceptable in appropriate locations along the core wall.

- Technique 1 Steel Sheet Piled Wall
- Technique 2 Sheet Piling by Hush Piling Method
- Technique 3 Stabilising Works on the Riverward Side of the Core Wall
- Technique 4 Stabilising Works on the Landward Side of the Core Wall
- Technique 5 Impermeable Geotextile Membrane to Core Wall
- Technique 6 Raise the Level of the Defence

3.1.3 Crest Level Options

In addition, the flood defence standard against overtopping could be increased from the current standard of 1 in 85 years to a higher standard. Each of the techniques described above for the On-line Flood Defences could be constructed to achieve varying levels in the flood defence standard. A number of Crest Level Options were therefore considered. These are summarised in *Table 3.1.3*.

Table 3.1.3 Crest Level Options

Option	Standard of Defence (years)	Freeboard (mm)	Average change in height (m)	Max change in height (m)	Linear Extent (m)
Option A	1 in 85	None	0.04	0.08	130
Option B	1 in 85	150	0.08	0.23	1330
Option C	1 in 200	150	0.15	0.35	2020
Option D	1 in 85	150	0.15	0.36	2320
Option E	1 in 200	150	0.28	0.59	2760

Note: For Options D and E the standard of defence quoted is that which would be existing in 50 years time allowing for predicted sea level rise. Initially, on completion of the works, a greater standard would be achieved.

3.1.4 Environmental Appraisal

An environmental appraisal of the temporary and permanent impacts of these six techniques was undertaken and is presented in *Sections 3.2* and *3.3* respectively. In

addition, an appraisal of the potential impacts of varying the crest level was also undertaken (*Sections 3.4* and *3.5*).

The level of environmental appraisal reflects the current design detail that has been developed for each technique and option (as described in *Section 6* of the main report).

3.2 TEMPORARY IMPACTS OF THE TECHNIQUES DURING CONSTRUCTION

3.2.1 Introduction

The following section describes the potential impact associated with the construction phase of each of the On-line Flood Defence Techniques.

The environmental appraisal quantifies impacts for each technique over a 100m standard length. Where potential impacts are time related, the duration of the works for each technique over a 100m length has been estimated as follows:

Table 3.2.1 Estimated Duration of Works

Technique		Estimated Duration per 100m
1	Piling	3 weeks
2	Hush Piling	3 weeks
3	Stabilisation Works Riverward of Core Wall	5 weeks
4	Stabilisation Works Landward of Core Wall	4 weeks
5	Impermeable Geotextile to Core Wall	2 weeks
6	Raise Defence	2 weeks

Works would be undertaken for six months over three years and would be carried out in the summer period (March to October) to avoid high water levels in the River Tone.

Work in front of any one property should last no more than one month, as short lengths of bank would be completed before moving to the next length. However, construction activities on the bank would be evident throughout the whole construction period.

3.2.2 Nature Conservation

Disturbance to Bankside Vegetation

Whilst there is little botanical interest along most of Stanmoor Bank (other than a floristically rich area within Section 11 of the River Corridor Survey, see *Appendix H*), rutting and compaction of the soil by construction machinery, and the digging of temporary trenches, would be anticipated to disturb the existing vegetation within the River Tone County Wildlife Site.

Disturbance of vegetation across the whole bank would be anticipated with Techniques 1, 2, 3, 5 and 6, whilst Technique 4 would not affect the vegetation on the riverward side of the bank at all.

Removal of trees and scrub vegetation (predominantly planted by residents) will be avoided where possible. Some loss of vegetation is, however, anticipated and may take a number of years to grow back to its current condition.

On completion of the construction works, the bank will be reinstated. In many locations on the bank, reseeding with a wildflower seed mix would be anticipated to enhance the botanical interest of the bank, though the seed should be spread in a random fashion, rather than within the parallel confines of a filled-in trench.

Disturbance to Birds

Noise and activities associated with the construction works may disturb breeding and wintering birds.

Whilst Stan Moor does not support rare species or significant numbers of wildfowl and waders, the adjacent Curry and Hay Moors SSSI does (see SSSI citation in Annex 3). The 1997 Breeding Wader Survey (RSPB, in prep.) indicates that there are declining numbers of breeding lapwing and redshank on the eastern side of Curry Moor SSSI. Information on breeding and overwintering birds outside the SSSI was not available, although reed warblers (an infrequent species in the Somerset Levels and Moors) are known to breed in the reed along the River Tone.

The noise from construction activities such as piling (Technique 1) may carry at potentially disturbing levels over 500m away. Background noise levels are generally quiet, although the mainline London to Exeter railway passes through the study area with trains at frequent intervals throughout the day. A short-term impact (ie. 3 weeks per 100m) associated with the piling noise (Technique 1) would therefore result. Disturbance to birds within the SSSI is less likely to be significant for Techniques 2-5 (due to the lower, more constant noise levels), though breeding species in the reeds (eg. reed warblers) on the right bank would be affected.

It is recognised that birds can acclimatise to continuous but short-term noise disturbance if it is located some distance away (200-500m, depending on ambient conditions) and if weather conditions are not severe. In addition, the birds could move away from the area temporarily as similar alternative habitats are available in Curry and Hay Moors SSSI, adjacent SSSIs and further afield at West Sedgemoor. Whilst the potential impact is short-term, the following mitigation measures should be considered in the Environmental Action Plan:

- Timing of works (to commence before the nest building season (March) and to avoid periods of severe weather conditions);
- Habitat removal on the right bank prior to works (eg. cutting of reeds, scrub removal before March);
- Planting of reed upstream and downstream of the works to provide suitable alternative habitat for breeding birds prior to construction.

Disturbance to Barn Owls

Removal of scrub and tree cover and disturbance of tussocky vegetation may impact on this protected species which relies on the vegetation for providing suitable habitat for its main prey of shrews, voles and mice. The barn owl has become rare in Britain and Ireland as a whole and now numbers only 5,000 pairs (Dewar and Shawyer,

1996). As noted in *Section 2 of Appendix B*, barn owls have been observed feeding in the study area.

As described earlier, all techniques would require some form of vegetation removal either landward or riverward of the bank.

Scrub and trees should be left *in situ* wherever possible (taking account of flood defence needs) and vegetation should be re-established along the bank on completion of the works.

Disturbance to Otters

Disturbance during the construction phase of all six techniques could affect otters in the area. However, otters frequently have large territories (up to 40km along rivers), such that it is likely they would avoid the disturbance by feeding elsewhere in the short-term. The duration of disturbance would depend on the technique selected (see *Table 3.2.1*).

Disturbance to Badgers

Construction works may temporarily disturb badgers and their habitats in the local area and may cause permanent damage to the sett within Stanmoor Bank. The presence of an uncontained badger sett in a flood defence structure is unacceptable in flood defence terms. However, to interfere with a sett by damaging or destroying it is an offence under the Protection of Badgers Act, 1992.

All five techniques could result in damage to the sett and disturbance to badgers for the duration of the construction phase (see *Table 3.2.1*).

The standard Environment Agency procedures should be followed in order to minimise potential impacts during the construction phase. These procedures may include the following and will be detailed in the Environmental Action Plan:

- Use of a badger specialist to identify the exact location and status of the sett(s)
- Obtaining a licence from MAFF in good time
- Timing of construction works in the vicinity of the sett to avoid disturbance to pregnant or nursing sows (ie. construction between June to October)
- Sensitive engineering design to avoid sett closure if possible

3.2.3 Fisheries

It is unlikely that the On-line defence techniques considered here would adversely impact the fisheries and invertebrate communities within the River Tone as direct disturbance to the channel and marginal vegetation is not anticipated. Impacts from potential siltation resulting from run-off from the bank during construction are considered in *Section 3.2.6*.

3.2.4 Landscape

During construction, the works would be visible from: the houses on Stanmoor Bank; from the farms and Curry Moor Pumping Station on the left bank of the River Tone; from the five bridges (including the public footpath at Hook Bridge) and from the

tourist viewpoint on Burrow Mump in Burrowbridge. Visually intrusive elements may include: mechanical plant; security fencing; site offices; temporary haul roads; disturbed ground; and storage areas. The visual disturbance represents a short-term impact associated with the duration of the construction works (see *Table 3.2.1*).

The extent of the disruption would be minimised by working in sections of about 100m at a time and any unnecessary storage of equipment and materials would be limited. Screening of the works is unlikely to be successful due to the immediate proximity of the houses and their windows.

3.2.5 Water Resources

The construction phase would not be anticipated to have an impact on the groundwater resources or the identified surface water abstractions within the area. There would be no impact on the operational regime of Curry Moor pumping station, (as it is on the opposite side of the channel), or Stan Moor pumping station on the River Parrett during the construction works.

3.2.6 Water and Land Quality

Deterioration in Water Quality of the River Tone

The water quality of the River Tone may be affected by run-off of muddy waters from disturbed areas on the banks and haulage routes and from the discharge of any dewatering waters (pumped out of the trenches during construction). This impact is most likely to be associated with the excavation techniques (3-5). In addition, there is a risk of spillage when pumping wet concrete to construct Techniques 1-4 and 6.

The Environment Agency's standard Pollution Prevention Guidelines would be adhered to (NRA, 1992 and 1993). In this way, any potential short-term impacts should be reduced to an acceptable level.

Uncovering Foul and Surface Water Drainage

Construction works may uncover foul and surface water drainage systems. Observations on site indicated that there are a number of surface water drains (principally from roof drainage) which pass over Stanmoor Bank and discharge to the River Tone. Foul drains, (eg. septic tank discharges and soakaways) are also known to be in the vicinity of the bank, serving the residential properties along Stanmoor Bank. Disruption to these drainage systems would be short-term (*see Table 3.2.1*).

Prior to construction, a survey of surface and foul water drainage arrangements should be undertaken and incorporated into the detailed design. If re-routing of foul and surface water drainage to the sewer is undertaken this may enhance the water quality of the River Tone.

Disturbance of Contaminated Land

Construction works may disturb potentially contaminated land within the vicinity of the railway and the garage on Stanmoor Road. Construction works landward of the core wall (eg. Technique 4) would be of particular concern at the garage.

A site investigation of potentially contaminated sites should be undertaken prior to the construction works. Mitigation measures should be implemented (according to standard Environment Agency procedures) if contaminated areas are to be disturbed.

3.2.7 Archaeology and Heritage

Damage to Archaeological Features

Known archaeological features of interest are unlikely to be affected by the construction works associated with any of the techniques as they lie outside the potential area of disturbance (see *Annex 4* in *Appendix H* and shown in *Figure B*). In addition, disturbance of the river bank has occurred on numerous occasions in the past during construction and maintenance of the flood defences, such that further archaeological finds (even within this archaeologically rich area) are not anticipated. An archaeological watching brief could, however, be commissioned as a precaution.

Damage to Buildings of Heritage Interest

The listed building at Curload Farm is unlikely to be damaged by the construction works, as it located outside the potential area of disturbance (see *Figure 6*). Excavation works and piling (ie. all techniques) may, however, affect houses along Stanmoor Bank, of which at least 38 are aged between 100-350 years old and are therefore of heritage interest.

However, risk of damage to houses would be minimised through appropriate detailed design and selection of working methods (also see *Section 3.2.9*). In addition, a pre-condition survey of the houses would be undertaken prior to commencement of the works, and any works related defects would be made good on completion (as for *Section 3.2.9*).

3.2.8 Land Use and Ownership

The construction of On-line Defence Works would not impact upon land use in the wider context, namely the surrounding arable and grazing land. Riparian owners may, however, experience disruption for the duration of the works (see *Table 3.2.1*; see *Sections 3.2.9* and *3.2.11*).

3.2.9 Local Community

Construction Noise

Noise nuisance during construction works for On-line defences would mainly be associated with the construction plant activities (such as excavation, piling works and pumping of concrete from lorries on Stanmoor Road) along Stanmoor Bank and the traffic movements along the local road network. At least 26 of the houses along Stanmoor Road immediately abut the core wall in Stanmoor Bank. A further 10 houses are less than 10m away, and the remaining houses along Stanmoor Road are within 100m of the proposed works. Whilst background noise measurements have not been recorded, the area could be described as generally peaceful, disturbed only by trains and the occasional tractor and other agricultural vehicles along Stanmoor Road and Stathe Road (resulting in periodic noise levels reaching approximately 70-85 decibels dB(A)).

BS 5228 "Noise Control on Construction and Open Sites" (BSI, 1992) indicates that account should be made of the existing noise climate. However, daytime operations are likely to be considered acceptable if the levels of noise at the nearest residents do not exceed 60-70 dB L_{Aeq} (continuous equivalent noise level in decibels) during daylight hours. Average noise levels for conventional piling are in the range 85-120 dB L_{Aeq}, whilst for hush piling noise levels are likely to be less than 40 dB L_{Aeq}. The remaining techniques are unlikely to cause significant levels of noise disturbance over and above general construction disruption and traffic movements associated with the pumping of concrete and transport of materials. The level of disturbance to residents would also be related to the duration of the works (*see Table 3.2.1*).

In addition to the selection of the technique, the noise impact may be mitigated in a number of ways and these measures would be described in the Environmental Action Plan and implemented as part of the Environment Agency's normal procedure. Such measures would include:

- Ensuring construction only takes place during reasonable hours (8.00 am to 6.00 pm, or as defined by the Environmental Health Officer);
- Controlling the movement of vehicles to and from the site. For instance, vehicles should not be revved or allowed to stand idle outside residences wherever possible;
- Locating the site offices and compound away from residential areas where possible.

In addition, all people involved in construction should be made aware of the need to keep noise to a minimum. Good public relations and early warning of noisy activities (which could be achieved by the distribution of leaflets, provision of information boards and by undertaking presentations at public meetings prior to the works) should be maintained with local people to ensure the noise impact is not unacceptable and the above specifications should be included in the contractor's brief for the works. Whilst these mitigation measures should reduce the potential impacts, a residual noise and disturbance impact is anticipated.

Vibration

Construction activities may cause detectable levels of motion in the ground (at least in the immediate vicinity of the activity). At Stanmoor Bank, at least 26 houses lie immediately adjacent to the core wall. Many of these houses are more than 100 years old and some houses along the bank show evidence of settlement. There is therefore concern that structural damage could occur.

The conventional piling (Technique 1) would be of particular concern as might Technique 6. Hush piling (Technique 2) and the remaining excavation techniques (3-5) would be unlikely to cause vibration at levels which could cause structural damage.

The benefits of selecting a reduced vibrating technique (eg. Techniques 2-5) should be considered during the detailed design stage of the scheme where houses are close to the proposed works. Any damage caused by vibration would, however, be made good as part of the construction contract, following a pre-condition and post works survey.

Disturbance to Gardens

Technique 4 may involve physical disturbance to gardens during works landward of the core wall. Reinstatement and landscaping is, however, integral to the proposed Technique and the design would be discussed and agreed with the landowner. In addition, pipelines for pumping concrete to construct stabilisation works may affect gardens between the core wall and Stanmoor Road. However, all accesses would be arranged by agreement with landowners, with reinstatement of any damage after use of the accessway.

Mud and Dust on Roads

The importation of construction materials, and the movement of construction traffic on and off the construction site, could lead to the deposition of mud (and subsequent dust creation) on the local roads. Standard procedures: Environment Agency require works contractors to clear such mud from the roads. No impact is therefore anticipated.

Unauthorised Access to Construction Sites

The site compounds and on-site works may attract children and other unauthorised people during and outside construction working hours. Procedures require work areas and machinery to be secure against unauthorised access, with the aim of providing public safety. No impact is therefore anticipated.

3.2.10 Recreation and Amenity

Disruption to Angling

Disturbance to the informal recreational fishing along the river would be anticipated during construction. The duration of the disturbance would vary for each technique from between 1-5 weeks per 100m (see *Table 3.2.1*). Taunton Angling Club estimated that approximately 5-6 fisherman are present along the banks at weekends, with less fishing activity during the week. It is believed that fishing is predominantly from the left bank, opposite the works and which is served by a public footpath.

In order to minimise potential disturbance to anglers during the construction works, liaison with Taunton Angling Club should be undertaken in advance and a warning notice should be placed at Stanmoor, Athelney and Hook Bridges.

Diversion of Footpaths

Although there are no public footpaths along most of the right bank of the River Tone at Stanmoor Bank, there is a short stretch (approximately 200m) downstream at Hook Bridge (see *Figure B4*). Potential short-term disruption to the use of the footpath would be anticipated during the construction phase, particularly if this area is used as a materials storage area or turning point for lorries.

Disruption to users of the footpath should be reduced through identification and signing of an appropriate diversion route prior to works commencing (in line with the requirements of Somerset County Council's Public Rights of Way Officer).

3.2.11 Infrastructure and Access

Traffic Congestion

The importing of materials for construction of the On-line flood defences could result in congestion of the local road network, particularly along narrow roads with poor sight lines.

Stanmoor Bank may be accessed via Stanmoor Road which, in-turn, may be accessed via Cuts Road (East Lyng to Athelney) and Stathe Road (past Burrow Bridge).

Table 3.2.11 Comparison of Haulage Requirements

Technique		Estimated Number of 10t lorries per 100m
1	Piling	20
2	Hush Piling	20
3	Stabilising Works Riverward of Core Wall	20
4	Stabilising Works Landward of Core Wall	20
5	Impermeable Geotextile to Core Wall	1
6	Raise Defence	1

Where heavy vehicles are required (eg. for Techniques 1-4), careful selection of routes and traffic management would be necessary. A traffic management strategy should therefore be prepared with the Highway Authority during detailed design and should be implemented for the duration of the construction works.

Exceptional Wear and Tear of Local Roads

Exceptional wear and tear of the local roads may be anticipated during the construction phase due to the increase in heavy vehicle usage. Prior to commencement of the works, the condition of the road should be established in the presence of the Highway Authority (Somerset County Council) and remedial action to maintain the road in its pre-contract condition would be undertaken as required. This is normal procedure for the Environment Agency.

Access

If not managed appropriately, machinery and materials (particularly for Techniques 3 and 4) could block access to houses. As discussed in *Section 13 of Appendix B*, access to Stanmor Bank is limited and the Bank is in close proximity to many of the houses which could result in a short-term impact on local residents. Potential access locations are shown on *Figure B5*.

Techniques 1-4 may cause disruption related to use of concrete mixers and pipelines. Techniques 1 and 2 may cause disruption when manoeuvring long sheet piles and when gaining access to the bank for the piling rig and associated machinery.

Care is therefore required to ensure materials are stock-piled in designated areas away from houses and that machinery is quickly moved away from access routes.

Disruption to Railway

Disruption to the railway (eg. through blockage or damage to the tracks at the level crossing) would be prevented by liaison with the appropriate railway authorities.

Alternative Forms of Transport

There is unlikely to be an opportunity to import materials by rail, as this is a fast main line route from London to Exeter. Use of the industrial development at the site of the old railway station could be considered, both for storage of materials and as a site compound. Transportation of materials by river is unlikely to be viable due to the shallow and narrow nature of the River Tone other than at times of flood.

3.2.12 Planning and Development

Given that mitigation measures to avoid potentially significant impacts are successfully implemented, there should be no impact on planning and development during the construction phase.

3.3 PERMANENT IMPACTS OF THE TECHNIQUES IN THE OPERATIONAL PHASE

3.3.1 Introduction

The following sections discuss the potential impacts of the techniques in the operational phase.

3.3.2 Nature Conservation

Maintenance of the Channel and Existing Hydrological Regime

On-line defence works would maintain the existing channel line and associated hydrological regime, thereby preserving the County Wildlife Site.

Change in Bankside Vegetation

Whilst the vegetation of the right bank of the River Tone is generally of little interest, it does provide some habitat for birds, invertebrates and mammals. The success of reinstatement of the vegetation (as discussed in *Section 3.2.2*) should be monitored.

Loss of, or Damage to, The Badger Sett

Long term impacts on badgers within the flood bank could occur with all the construction techniques located close to the flood bank.

A licence to allow for closure or potential disturbance to the badger sett may therefore be required from MAFF and specialist advice should be sought, as discussed in *Section 3.2.2*. By comparison to non-piling techniques (Techniques 3-5), piling (Techniques 1 and 2) offers the opportunity to stabilise the bank in the vicinity of the sett without necessarily closing it completely. In this way, permanent translocation of the badgers may be avoided. It should be noted that it would be

necessary to prevent further damage to the flood bank by badgers anyway, even under a maintenance regime.

3.3.3 Fisheries

No permanent impact on fisheries would be anticipated.

3.3.4 Landscape

Visual Amenity

The use of hard defences along the flood bank would not affect the visual amenity of the immediate area anymore than is already the case with the core wall. This is because sensitive design includes burying the capping structure associated with the flood defence techniques to make them appear as a small hummock. For Techniques 1-3, the capping structure would be tied in to the existing core wall whilst for Technique 4 use of cladding materials, such as local stone or brick, is proposed.

Maintenance of the Existing Landscape

The wider landscape interest of the ESA and SLA would be maintained through on-going flood protection of Stan Moor.

3.3.5 Water Resources

Maintenance of Water Resources

Protection of Stan Moor through stabilisation of the floodbank would allow continued management of existing water resources within the study area.

Maintenance of the Existing Hydrological Regime

On-line Flood Defence works would not affect the existing hydrological regime of the River Tone and River Parrett.

3.3.6 Water Quality

Flooding of septic tanks behind Stanmoor Bank would be reduced, thereby reducing the risk of polluted water entering dykes and gardens.

3.3.7 Archaeology And Heritage

Maintenance of the Ancient Line of Flood Defence

Improvement of the On-line Flood Defences would ensure the maintenance of the ancient line of defence, constructed by monks during the 14th Century. On Stan Moor, there would be no anticipated change to the existing level of waterlogging of artefacts.

Protection of Historic Buildings

Whilst there is only one listed building in the study area (Curload Farm), Stanmoor Bank also protects at least 38 houses constructed prior to 1900. The On-line Defences would allow the long term protection of these listed and old buildings.

3.3.8 Land Use and Ownership

Continuation of Current Land Management Practices

Stabilisation of the floodbank would allow continuation of current land management practices on Stan Moor (ie. arable, grazing, withy beds, orchards).

3.3.9 Local Community

Reduction in Worry and Fear of Flooding

Given that the On-line Flood Defence Techniques achieve the following technical requirements where necessary:

- reduced seepage,
- increased bank stability,
- reduced risk of overtopping

It is anticipated that the residents of 136 houses would benefit from a reduction in fear of flooding and the threat of a breach.

3.3.10 Recreation and Amenity

Protection of Amenity Facilities

Use of On-line flood defences would enable current recreation and amenity facilities (eg. footpaths, angling sites, riverside areas etc.) to continue to be enjoyed by local people.

3.3.11 Infrastructure and Access

Flood Protection of Infrastructure

Improvement of the On-line flood defences should protect the infrastructure from flooding for the next 50 years. This would prevent flood damage to the mainline Intercity Rail link between London and the South West and would ensure maintenance of the existing local road network.

3.3.12 Planning and Development

Improvement of the On-line Flood Defences should ensure the continued protection of the local agricultural economy, 136 houses, infrastructure (including the main railway and the local B and C road network) and the integrity of designated nature conservation sites (ie. River Tone County Wildlife Site, River Parrett County Wildlife Site and part of the Somerset Levels and Moors ESA), as required within the Structure and Local Plans (SCC, 1997 and TDBC, 1992 respectively).

3.4 TEMPORARY IMPACTS OF THE CREST LEVEL OPTIONS IN THE CONSTRUCTION PHASE

3.4.1 Introduction

The construction phase of each of the Crest Level Options is dependant on the technique used (as discussed in *Section 3.2*). The construction impacts are unlikely to increase or decrease with the change in crest level required. The exceptions are: the increase in the duration of the works and the potential increase in traffic movements required to transport the additional materials for raising the crest level.

3.4.2 General

Change in Duration of the Works

Construction of each Technique to varying crest levels may result in an increase in the duration of the construction works. To allow for comparison between the Crest Level Options, an arbitrary "scheme" comprising use of Techniques 2, 5 and 6 has been considered (see *Section 6.5* in main report).

Table 3.4.2 Estimated Duration of Works

Crest Level Option	Technique 2		Technique 5		Technique 6		Total Duration for Option
	Linear Extent (m)	Duration (weeks)	Linear Extent (m)	Duration (weeks)	Linear Extent (m)	Duration (weeks)	
Option A	1730	52	1370	28	130	3	83
Option B	1760	53	1340	27	1290	26	106
Option C	1960	59	1140	23	2020	41	123
Option D	1960	59	1140	23	2320	47	129
Option E	2200	66	900	18	2760	56	140

The following impacts, previously identified in *Section 3.2* are susceptible to changes in the duration of the works.

- Disturbance to otters
- Disturbance to breeding birds
- Disturbance to badgers
- Visual intrusion
- Disruption to drainage systems
- Disruption to land use
- Noise and vibration disturbance to the local community
- Disruption to angling
- Disruption to access

As previously noted, the works will be timed for the summer months and will be phased over a three year period. The maximum duration of works would therefore be 5-6 months per year.

3.4.3 Infrastructure and Access

Increase in Construction Related Traffic

Raising the level of Stanmoor Bank would affect the number of vehicles required for each technique. The estimated number of lorries required for Techniques 2, 5 and 6 for each Crest Level Option (using the arbitrary "scheme" described in *Section 3.4.2*). is presented in *Table 3.4.3* below.

Table 3.4.3 Comparison of Haulage Requirements

Crest Level Option	Technique 2		Technique 5		Technique 6		
	Linear Extent (m)	No. Lorries	Linear Extent (m)	No. Lorries	Linear Extent (m)	No. Lorries	Total No. Lorries for Option
Option A	1730	346	1370	14	130	2	362
Option B	1760	352	1340	14	1290	13	379
Option C	1960	392	1140	12	2020	21	425
Option D	1960	392	1140	12	2320	24	428
Option E	2200	440	900	1	2760	28	469

From *Table 3.4.3*, it can be seen that the number of lorries required increases from Option A to E (by 23%) due to the increased length of bank requiring raising to meet the higher flood defence standard. An increase in the number of lorries on the local road network could affect the local community. However, over the three year period (of six months per year), the average number of lorries only varies from 5 to 7 per week between Options A and E.

3.5 PERMANENT IMPACTS OF THE CREST LEVEL OPTIONS IN THE OPERATIONAL PHASE

3.5.1 Introduction

A change in the hydrological regime of the River Tone would not be anticipated with an increase in the Crest Level. This is because the River Tone currently spills over at Hook Bridge Spillway. For events greater than 1 in 100 years, overtopping of the embankments throughout the River Tone system also occurs. Overtopping of Stanmoor Bank at its current level would therefore not be anticipated to be widespread for flood events of up to 1 in 200 years (see *Section 3.6* of the main report) and the hydrological regime of the River Tone would remain unaffected by Crest Level Options A to E.

Nature conservation, the natural landscape, archaeology and heritage and land use interests on Stan Moor would not be affected by the Crest Level selection for Stanmoor Bank.

The main impacts associated with the selection of the crest level are those associated with the local community within the houses adjacent to the core wall. These impacts are discussed below.

3.5.2 Local Community

Obstruction of Windows

The five Crest Level Options would affect the view and would attenuate light through windows overlooking Stanmoor Bank to varying degrees (see *Table 3.5.2a* and *Plates B5-B8.*). In the case of Crest Level Options B, C, D and E this would represent a long-term impact for the residents concerned.

Careful design is required to ensure the view from, and the light entering windows is not obstructed wherever possible. Detailed design options include use of stop logs (ie. wooden planks temporarily placed into slots within the defence to keep out flood water) or use of glass walls in front of windows. *Table 3.5.2b* compares the advantages and disadvantages of these design options.

Consultation with residents should be undertaken at an early stage in detailed design, in order to fully evaluate the significance of the potential impact on their particular house and to identify a satisfactory solution.

Table 3.5.2a Potential Obstruction to Windows

Crest Level Option	Houses Affected				
	Number	% of houses affected along Stanmoor Bank	House Name	No. Windows / Doors Reduction in View	Loss of Light for Affected Windows
Option A	0	0	-	-	-
Option B	1	2	St Elmo	2+1 door	Partial
Option C	8	16	As above plus:		
			Loma Doone	3	Full
			White House	2	Partial
			Willow Cottage	2	Full
			Drove House (grey)	1	Full
			(new house – brick)	1	Full
			Musgrove Cottage	1+2 patio doors	No Change
			May Bank	3	No Change
Option D	9	18	As above plus:		
			Riverleigh	1	Full
Option E	16	31	As above plus:		
			Small House	1	Partial
			Toneside	2	No Change
			Homelea	6	No Change
			(cream tiled cottage)	2	Full
			(white house flat roof)	2	Partial
			Myrtle Tree House	3	Partial/Full
			Athelney Cottage / House	4	Partial

Source: Site Visit 1997

Table 3.5.2b Comparison of Glass Walls versus Stop Logs

Designation	Advantages	Disadvantages
Glass walls	- Allow light through all year round - Maintain view all year - Always in place	- Tend to get scratched and dirty – prone to damage - Slightly distorted view - Cannot open windows
Stop Logs	- Normal light conditions when removed - Normal view when removed - Can open windows	- Prone to leakage - No light or view when in place - Get lost, damaged or forgotten, so may not be in place when required

Reduction in Worry and Fear of Flooding

The standard of defence for each of the options is presented in *Table 3.1.1*. Option A does not improve the standard of defence (1 in 85 years), which will continue to decline with sea level rise. Option E would provide a 1 in 200 year standard against overtopping for the next 50 years.

As discussed in *Section 3.5.1*, however, overtopping of Stanmoor Bank is not a significant issues at the current level of defence (due to the presence of Hook Bridge spillway etc.). The benefit in increased flood protection from overtopping of the raised Crest Level Option (B-E) is therefore minimal compared to the loss of view and light from windows (discussed above).

4.0 KEY FINDING AND SUMMARY OF IMPACTS

4.1 GENERAL

The potential impacts of the Do Nothing and the On-line Defence Options are summarised in *Table C4.1*.

4.2 DO NOTHING OPTION

Under the "do nothing" option, Stanmoor Bank will eventually breach, with flooding then causing the total loss of use of 330ha of agricultural land and 136 properties in Stan Moor. A permanent water body would be formed, the depth of which would fluctuate with the tide.

4.3 ON-LINE DEFENCE OPTIONS

4.3.1 Description

The "Improve On-line Defences" option would secure the bank against breach, thereby preserving present land use and assets.

A number of different techniques could be used at appropriate locations along the bank, depending on the technical and environmental constraints at each site.

One of five Crest Level Options could be implemented.

4.3.2 Temporary Impacts in the Construction Phase

Temporary impacts, during construction of the on-line defence improvement works, include:

- Disturbance of flora and fauna along the whole riverward face of Stanmoor Bank; the area is a County Wildlife Site and supports legally protected species.
- Disturbance to residents in 100 houses, from the noise of construction plant and from the presence of construction activity close to their homes.
- Obstruction to local roads, and accesses to properties, from the lorry traffic, such as concrete delivery trucks, needed to supply the works.

The construction period over which these impacts would arise is anticipated to be six months each year for three years. The work would be carried out in the summer months. Work in front of any one property should last no more than a month, but the general construction activity would be noticeable throughout the whole work period.

4.3.3 Permanent Impacts in the Operational Phase

Permanent impacts from construction of the on-line defence works would include:

- Stabilisation of Stanmoor Bank such that it is secure against breach failure, thereby sustaining flood protection to 136 properties, 330 ha of agricultural land, a main line railway and other assets in the Stan Moor area.

Table C4.1 Summary of Potential Impacts for Alternative Options

Option	Nature Conservation		Landscape	Water Resource	Water Quality	Archaeology & Heritage	Landuse & Ownership	Local Community			Recreation & Amenity	Infrastructure & Access		Technical Considerations	ECONOMICS
	General Ecology	Badgers						Noise	Vibration	Effect on community		No. lost lorries	Impact on local road network		
Do Nothing *Operational Phase*	Creation of permanent body of water	Potential loss of badger sett and habitat	Long term change in landscape	Change to hydrological regime of River Tone	Release of contaminants from septic tanks and contaminated land	Loss of 1 listed building and at least 38 houses 100-300 years old	Long term change in land use	None	None	Fear of flooding and sudden breach Loss of 136 houses	Creation of a permanent body of water	None	Loss of local road network and railway	Increase in flood risk to properties and permanent flooding in places	PVd=£7.4m
On-line Defences *Construction Phase*	Temporary disturbance to birds Temporary disturbance to vegetation adjacent to core wall	Potential damage to badger sett	Visual intrusion during construction	No impact	No impact Siltation risk controlled	Potential vibration damage to old buildings along Stanmoor Bank	Temporary loss of land	Disturbance from high noise levels 85 - 120 dB(A) for Technique 1 General construction noise for Techniques 2-6 60-85 dB(A)	Potential for vibration damage	Temporary disturbance to the local community (including noise, vibration, disruption to gardens, blockage of access etc.)	Temporary disruption	300	Minor disruption to local road network	Short term disruption	PVb=£5.4m PVc=£2.0m B/C Ratio=2.7
Operational Phase	No long term impact	Protection of habitat Potential long term damage to badger sett Piling may allow badgers to remain in sett	No long term impact	Protection of existing resources Hydrological regime maintained	Reduction in flooding of septic tanks	Flood protection of old buildings	Protection of current land use in Stan Moor	No impact	No impact	Reduction in fear of flooding	Protection of amenities from flooding	None	Protection of local road and railway network from flooding	Long term reduction in flood risk	

Based on Crest Level Option A

- Reduced seepage through Stanmoor Bank, giving relief to those many houses along the bank which presently suffer from damp and shallow flooding by seepage through and under the core wall.

- Potential damage to properties from the construction activities, eg. through vibration, although the techniques proposed will minimise the risk of any impact on properties.

- Partial closure of a badger sett.

4.3.4 Comparison of On-line Defence Techniques

Technique 1 would result in noise and vibration impacts close to houses. Use of hush piling (Technique 2) would offer a relatively quiet and almost vibration-free alternative to Technique 1 for sensitive locations. Techniques 1-4 and 6 would have short term traffic congestion implications on Stanmoor Road during piping of concrete from a standing vehicle and movement of piles etc. This would affect the local community. Technique 5 (geotextile membrane to core wall) has the advantage of requiring only minor traffic movements and limited disturbance. The use of Technique 5, however, would be restricted to areas where only seepage (and not a stability problem) needs to be resolved. Similarly, Technique 6 would be restricted to areas where the height (rather than the stability) of Stanmoor Bank is a problem.

Potential impacts on the badger community are common to all the techniques, although the piling techniques (1 and 2) may allow the badgers to remain landward of the core wall, rather than be translocated to preserve the flood defence integrity of Stanmoor Bank.

Other than impacts related to noise, vibration, disruption to the community and disturbance to badgers, the remaining temporary and permanent potential impacts can generally be mitigated for all the techniques.

4.3.5 Comparison of Crest Level Options

The extent of intrusion would increase with the increase in top level of the defence from Crest Level Option A to Option E. Raising the defence level would affect the visual appearance of the bank from both sides, would require alteration to some access ways from properties onto the Bank, and would alter the aspect from property windows which face onto the bank. In some cases works would be needed to accommodate windows which otherwise would be partly blocked by the raising of the defence. A summary illustrating the effect of raising the defence level for each crest level option is given below.

Table 4.3.5 Effect of Raising Crest Level

Crest Level Option	Bank length raised (m)	Maximum raising (m)	Average height over raised part (m)	Number of houses having windows affected
A	130	0.08	0.04	Nil
B	1330	0.23	0.08	1
C	2020	0.35	0.15	8
D	2320	0.36	0.15	9
E	2760	0.59	0.28	16

4.3.6 Conclusion

As a strategic option therefore, construction of On-line Flood Defence Works would allow protection of the local community against the risk of breach and long-term flooding and would enable existing land management practices to continue on Stan Moor. Maintenance of the current hydrological regime would also be assured.

memo

ENVIRONMENT AGENCY

To	Library, Exeter	Our ref	G7655/30/PP&L
From	Murray Palmer	Your ref	
Ext. Number	2021	Date	30 May 2000

LOWER TONE FLOOD DEFENCE IMPROVEMENTS

I attach a copy of the SI 1783 advert to be placed in local Somerset papers on Thursday 1st June and Tuesday 6 June. (Somerset County Gazette & Bridgwater Mercury)

I also enclose one copy each of the following reports:

1. Feasibility Study and Appraisal Report Part 2: Alternative Scheme Options – Volume 1: Main Report
2. Feasibility Study and Appraisal Report Part 2: Alternative Scheme Options – Volume 2: Appendices D to I
3. Addendum to the Feasibility Study and Appraisal Report

These reports need to be available for view by members of the public until Monday 3 July 2000.

Public Relations and Reception also need to know who is holding the reports and how they can be reviewed, when members of the public enquire.

Many thanks

Murray Palmer

MURRAY PALMER
Project Manager

Enc.

cc PR (Please note that reports will be held in library)
Reception (Ditto)

Environment Agency
Manley House, Kestrel Way, Exeter, EX2 7LQ
Tel: 01392 444000 Fax: 01392 442041

ENVIRONMENT AGENCY
SOUTH WEST REGION
THE ENVIRONMENTAL IMPACT ASSESSMENT (LAND DRAINAGE IMPROVEMENT) REGULATIONS 1999 (SI No. 1783)

The Environment Agency is proposing to carry out strengthening on Stanmoor Bank on the Lower River Tone between Hook Bridge and Stanmoor Bridge. (OS grid- references ST 338278 to ST 358301.) The works will be carried out during 2001, 2002 and 2003.

The works will:

- Strengthen the flood bank to reduce the risk of a breach,
- Raise the crest level to reduce the risk of overtopping,
- Reduce seepage through the bank.

The work on Stanmoor Bank will include where required:

- sheet piling using a low vibration method,
- placing an impermeable membrane against the existing core wall and,
- raising the bank using material dredged from the river.

Works will also be undertaken to raise and strengthen the Stanmoor Cut-Off Embankment, which is located near Hook Bridge and lies between the riverbank and the high ground of Windmill Hill to the south.

The Agency has carried out an environmental assessment of these works and has determined that they are not likely to have significant environmental effects. The Agency, therefore, does not intend to prepare an Environmental Statement in respect of this proposal. An Environmental Report is however available which gives an environmental assessment of the proposed works and the reasons for the Agency's decision.

Copies of the Feasibility Study and Appraisal Reports, illustrating the Agency's proposals, may be inspected during normal office hours at the Agency's offices at Exeter or Bridgwater.

Any person or organisation wishing to make representations in relation to the likely environmental effects of the proposed works, or the decision not to prepare a formal Environmental Statement, should do so in writing to David Pilkington, quoting reference DWP/MHP/G7655/30/PP&L, within 28 days of the publication of this notice.

Dated this 1st day of June 2000

Mr David Pilkington
Capital Works Manager
Environment Agency South West
Manley House
Kestrel Way
Sowton
Exeter
EX2 7LQ

Environment Agency
North Wessex Area Office
Rivers House
East Quay
Bridgwater
TA6 4YS