Appendix A - Cuckmere Estuary Option Impact Study Option Tables

CAPITA SYMONDS

Policy Option	Baseline		
Policy Reference	Do nothing		
Scenario summary	This option is based on the current situation of the Environment Agency withdrawing maintenance of defences from April 2011, but continuing to clear the river mouth for either 15 years or until the river system becomes self regulating as a result of the increased volume of water flowing in and out of the estuary as the embankments are lost. Beyond that, the assumption for this scenario is that the beach and river mouth remain largely in their current positions and form, although the river mouth may widen and once the training walls have deteriorated, the river mouth will almost certainly become more mobile. It is intended that this scenario reflects the baseline, highlighting the consequences of taking no further action, and against which the options listed above can be compared.		
Scenario modelling assumptions	Modelling assumptions will be: • Embankments are initially left in their current condition and height and will overtop in the future and erode. We assume intact for current scenario, partly reduced in 20 years, and largely eroded away in 50 years time, with only a small trace in 100 years time. We also assume natural breaches occur at specific locations. • We assume the river mouth and beach remains approximately in its current form. • We assume the current scenario on the floodplain is the existing topography. • Future scenarios (50 and 100 years in the future) will have varying degrees of rivulets and gullies cut into the floodplain – determined by where the preferential flow paths occur. • Where a breach is created through and embankments, we assume the breach initially is through the embankment only, and does not result in a channel below ground level. A channel will begin to form however and will be represented at the 50 and 100 year time horizons. • We assess the likelihood of the river channel moving from the current position by looking at erosion and deposition along the sections where embankments will erode. • Key flood events looked at are: the regular inundation that will occur at neap and spring tides (combined with mean annual flow in the river) now and in the future, and a 1% AEP flood event (separate fluvial and tidal events, and a combined fluvial and tidal event). • We have assessed the sediment content of incoming sea water and determined it is sufficient to allow accretion to take place at least at the same rate as sea level rise.		
Location within study area	Predicted change for:		
	0 – 20 years	20 – 50 years	50 – 100 years
River channel	<u>Change</u> The river channel will remain in its existing position over this period, constrained by the current embankments. It is likely that the embankments will remain largely intact for a	<u>Change</u> The river channel is likely to remain in its existing position over this period, constrained to some extent by the current embankments. It is likely however that the embankments will	<u>Change</u> The river channel is likely to remain in its current well established position over this period, constrained to some extent by the remnants of the current embankments.

	number of years however they may be overtopped and could fail at a number of possible locations during flood events within the next 20 years. Occasional inundation of parts of the floodplain is likely to occur during these larger events. The channel will begin to deepen and widen slightly as the volumes of water entering the river under each tidal cycle (tidal prism) increases – due to rising sea levels, and potentially any breach that may occur. <u>Habitat</u> The river channel will remain largely unchanged, however where it is slightly wider, there will be a very small increase in the area of exposed mud at low tide. As the existing revetment along parts of the river channel continues to break up and erode, the area of exposed mud at low tide will increase. It is unlikely that any significant additional saltmarsh will form within the channel during the next 20 years. The flow regime will remain largely unchanged, as increases in flow volumes over the initial 20 years will be compensated by increases in channel width and to a lesser extent, depth. <u>Landscape</u> The look of the river channel will remain largely unchanged, although there will be very slightly more exposed mud on the	be overtopped and fail at a number of possible locations during flood events over the next 50 years, and inundation of the floodplain will become more frequent. The channel will continue to deepen and widen as the volumes of water entering the river under each tidal cycle (tidal prism) increases – due to the increased volume of water able to spread across the floodplains once the embankments have been breached, and rising sea levels. <u>Habitat</u> The river channel habitat will remain largely unchanged over this period, however where it is slightly wider, there will be a small increase in the area of exposed mud at low tide. As the existing revetment along parts of the river channel continues to break up and erode, the area of exposed mud at low tide will increase. It is unlikely that any significant additional saltmarsh will form within the channel over this period The flow regime will remain largely unchanged, as any increases in flow volumes will be compensated by increases in channel width and to a lesser extent, depth. Water velocities at the mouth of the river during ebb tides however will increase. <u>Landscape</u> The look of the river channel will remain largely unchanged, although there will be	However, as the river becomes less affected by the old embankments below the cut, it is possible that the river will widen, particularly to the west, and may change its route slightly. However, the river mouth is likely to remain in its current position as there is already a relatively straight run to the mouth and there are no obvious reasons for the channel location to change. It is likely that as the embankments will disappear, smaller channels, or creeks will continue to form connecting the main channel to the floodplain. The channel will widen further as the volumes of water entering the river under each tidal cycle (tidal prism) increases – largely due to the increased volume of water able to spread across the floodplain and continued rising sea levels. <u>Habitat</u> Where the embankments have gone completely, the river will become an integral part of the intertidal habitat of saltmarsh and mudflat. Small pockets of saltmarsh vegetation may remain in or close to the channel, although much of the existing saltmarsh close to the river will be eroded and lost as the channel widens and spreads. The existing concrete revetment along parts of the river channel will have largely gone by this stage. The flow regime will remain largely unchanged, as any increases in flow volumes will be compensated by increases in channel width and to a lesser extent, depth. Water velocities at the mouth of the river during ebb

	margins of the river, and where the existing revetment is lost. Being tidal, the river channel will vary in appearance significantly from appearing to be in flood when the tide is in, to being largely empty when the tide is out with a small fluvial flow running down the central channel within steep sloping muddy banks.	slightly more exposed mud on the margins of the river, and where the existing revetment is lost. Being tidal, the river channel will vary in appearance significantly from appearing to be in flood when the tide is high, to being largely empty when the tide is out with a small fluvial flow running down the central channel within steep sloping muddy banks. As none of the defences will be maintained, the raised embankments along the river will begin to erode and disappear.	tides however will increase. Landscape From a visual perspective, in 100 years, the river channel will have changed its character, particularly in the lower stretch below the cut, where most of the raised embankments will have completely gone, and the river will have become an integral part of the intertidal habitat. It will have widened significantly, and may have begun to migrate or meander towards the west due to the lower ground surface in Cell B, although this will be relatively insignificant, particularly if the river mouth remains fixed. The main channel will also have developed extensive tidal creeks providing connection to the surrounding floodplain.
Intervention	None proposed	None proposed	None proposed
The floodplain	Change Flooding within Cell A will be relatively infrequent over this period as the defences are generally well above the spring tide level. Flooding will only occur through overtopping of defences initially, although this overtopping is likely to cause long term damage and potential breach, resulting in more frequent inundation during spring tides or from combined high tides and high river flows. The ground surface in Cell A is significantly higher than the typical high tide, so even if a breach were to occur, the cell would only be inundated for a short period during a high spring tide.	Change Even with the embankments being lost through erosion, Cell A will still only flood during spring high tides or higher flood levels in the river (either from high tides or high river flows combined with high tides). The old meanders will continue to widen and silt up through erosion gradual collapse of their edges, and from occasional flooding. They will become less of a prominent feature. Once a breach has occurred on the western bank of the river, the floodplain in Cell B will begin to inundate regularly during even normal tides. Drainage from the cell we be	Change The frequency of flooding within Cell A will continue to increase with time, although even with sea level rise, the expected neap tide in 100 years time is not sufficiently high to inundate the area. Spring tides however, by 2100 are expected to reach 3.5m AOD, which is high enough to inundate most of the area for at least a short time with shallow water. With the loss of most of the existing embankments, spring high tides will therefore be able to reach most of the cell. Small sections of tidal creek will form into the area, with associated areas of saltmarsh and mud flats on their margin. The old meanders will continue to widen and

	The ground surface in Cell B is significantly lower than the other two cells, however due to the embankments along this section of river, flooding is also relatively unlikely during this period. However, once a breach of the defence has occurred, small amounts of regular inundation would occur during even normal tides. Drainage from the cell will be slow due to the low flat topography and in many places will be restricted by the existing embankments. This will encourage deposition of sediment and a gradual raising of ground levels. This process will be particularly important here for the creation of flood conditions where saltmarsh will develop. Cell C is protected by the existing defences, and also by the strip of relatively high ground to the east of the river. Flooding here is unlikely, and even if the defence was breached at some time in the near future, inundation would only occur during a spring tide or higher. <u>Habitat</u> Once breaches occur in the embankments, Cell A will only flood very occasionally, and the habitat will not change significantly. It will remain mainly grassland, although if a large flood occurs and the area is inundated, drainage will be slow, and standing water may remain for long periods. Cell B is likely to become an intertidal habitat towards the end of this period, with the lower poorly drained parts being permanently wet,	slow due to the low flat topography and in many places will be restricted by the existing embankments. This will encourage deposition of sediment and a gradual raising of ground levels. This process will be particularly important here for the creation of flood conditions where saltmarsh will develop. Cell C is protected by a strip of relatively high ground to the east of the river, and will be less prone to flooding under normal tides, but will be inundated during spring tides or higher. Again, drainage from the cell we be slow due to the higher ground next to the river, resulting in areas of standing water. This will encourage deposition of sediment and a gradual raising of ground levels. <u>Habitat</u> Once breaches occur in the embankments, Cell A will only flood occasionally, and the habitat will not change significantly. It will remain mainly grassland, although if a large flood occurs and the area is inundated, drainage will be slow, and standing water may remain for long periods with a possibility of reed beds forming in the saline or brackish lagoons, particularly around the old meanders. Cell B will continue to develop as intertidal habitat, with the lower poorly drained parts being permanently wet, with silt and mudflat becoming established in areas that are regularly inundated. Small pockets of saltmarsh will begin to form, whilst existing pockets of saltmarsh nearest the river	silt up through erosion and gradual collapse of their edges, and from occasional flooding. They will become an almost negligible feature. With the old defence embankments largely gone, Cell B, to the west of the river, will inundate regularly during even normal tides and will become an established intertidal system integrated fully with the river. Cell C will still be protected by the area of relatively high ground to the east of the river, but with sea level rise, will be more prone to flooding. Although still not inundated on every tide, it is likely that the area will be at least partly submerged several times a month. The low lying ground in the area further away from the river will have become a mix of saline or brackish lagoons and ponds, surrounded by salt tolerant grassland, but intersected with tidal creeks with patches of saltmarsh ponds and with standing water <u>Habitat</u> Once breaches occur in the embankments, Cell A will only flood occasionally, and the habitat will not change significantly. It will remain mainly grassland, although if a large flood occurs and the area is inundated, drainage will be slow, and standing water may remain for long periods. The grassland species will begin to change to a more salt tolerant mix of coastal grazing marsh with lowland wet grassland on its edges. The meanders will largely disappear, although they will still provide low spots where standing water will collect. The increased

	with silt and mudflat becoming established in areas that are regularly inundated. Small pockets of saltmarsh may begin to form, colonised by Salicomia (existing saltmarsh species). The higher slightly better drained land will remain grassland, although there will be a gradual change towards more salt resistant species. Cell C is likely to remain grassland, although occasional inundation towards the end of this period may encourage a change in vegetation to a more salt tolerant mix of coastal grazing marsh with lowland wet grassland on its edges. <u>Landscape</u> From a visual perspective, Cell A and C will remain largely unchanged, although there may be periods of several weeks with standing water lying in low lying areas. Cell B will change in parts, with some low lying areas being permanently wet, and the areas which start to become inundated more frequently and which do drain within the cell will begin to accrete a layer of light brown silt and mud.	channel are likely to be lost. Due to the strip of raised land between Cell C and the river, this area is likely to remain grassland, although due to more frequent inundation and tidal creeks forming, areas of mudflat and saltmarsh will begin to develop, and with standing water and saline lagoons forming, the surrounding grassland species will begin to change to a more salt tolerant mix of coastal grazing marsh with lowland wet grassland on its edges, and with the possibility of saline reed beds colonising the more permanent lagoons. <u>Landscape</u> From a visual perspective, Cell A and C will remain largely unchanged, although there is likely to be periods of several weeks with standing water lying in low lying areas, and possibly more permanent ponds and lagoons with other pockets of saltmarsh and possibly saline reedbeds. The reduction in the impact of the meanders in Cell A will have an impact on the landscape in this area. Cell B will change considerably, with some low lying areas being permanently wet, and the areas which do drain within the cell will begin to accrete a layer of brown silt and mud. Cell B will take on the form of an intertidal landscape, with any remaining grassland confined to the landward boundary.	frequency of tidal inundation will mean that any wetland forming will be saline rather than fresh water. Low lying areas near the river are likely to develop tidal creeks, with the possibility of small areas of saltmarsh at their margins. Cell B will be a well established area of intertidal mud flat and saltmarsh, interacting naturally with the river. As the lowest lying area within the estuary, it is likely that as sea levels rise, some of the areas which may have built up through deposition whilst protected by the original defences will erode once the defences have completely gone. The saltmarsh will recede to the western edge of the cell and the areas nearest the river will revert back to mud flats. The river will widen and the channel will spread out towards the west, particularly below the cut, perhaps forming a wide expanse of mud flat in this area. Cell C is likely to become more like Cell B, as the area of slightly higher ground is likely to be eroded and sea level continues to rise. Areas of mudflat and saltmarsh will begin to form, and any remaining grassland will be confined to the higher ground further from the river. <u>Landscape</u> Cell A will remain largely unchanged, although the increased frequency of inundation will result in more prolonged periods of standing water, and will support different species of grass and vegetation that will have a small impact on the landscape.

			Low lying areas near the river are likely to develop tidal creeks, with the possibility of small areas of saltmarsh at their margins. The loss of the meanders as a major feature will have a significant impact on the landscape in this area. Cells B and C will now begin to look relatively similar and will have changed dramatically from their current form with areas of saltmarsh and mudflat dominating both areas.
Intervention	None proposed	None proposed	None proposed
The mouth of the Estuary	The estuary mouth will require dredging for some time to prevent build up of shingle which could increase flood risk upstream in Alfriston. However, towards the end of this period, (within 15 years) the increased area of regular inundation will have increased the volume of water flowing in and out of the estuary sufficiently to make the river mouth largely self clearing. The mouth of the river is likely to widen, bypassing the failing training walls, and will become more mobile.	The river mouth will be largely self clearing and the training walls will have fallen into disrepair. The mouth of the river is likely to widen further and remain mobile. Its exact location is impossible to determine, however it may tend to stabilise in a relatively central location.	The river mouth will remain largely self clearing and all traces of the training walls will have gone. The mouth of the river is likely to remain mobile, however it may tend to stabilise in a relatively central location.
Intervention	Continued dredging until the mouth becomes self cleansing – possibly up to 15 years.	None – unless blockage threatens to increase flood risk upstream at Alfriston. Occasional dredging may then be required.	None – unless blockage threatens to increase flood risk upstream at Alfriston. Occasional dredging may then be required.
The beach	Continued re-cycling of beach material from the river mouth will help maintain the volume of material on the west beach. The east beach is likely to remain largely unchanged.	The west beach will lose material quite rapidly and what remains may swing round to face a more south easterly direction allowing the river mouth to widen. The east beach will remain largely unchanged, although it is likely that it will move landwards slightly and will swing round to face a more south westerly direction. As it lengthens it will lower, increasing the probability of being over	The smaller west beach will remain quite stable once established around the toe of the western cliffs and into the .mouth of the estuary where it will be protected from direct southerly and south westerly gales and wave action. The east beach will remain largely unchanged, although it is likely that it will continue to move landwards slightly and will tend to face a south westerly direction. As it

		topped during a storm. Sea level rise may also increase the probability of overtopping, although as the beach moves landwards it is likely that the beach will actually end up sitting on slightly higher ground so the net change could be a slight increase in height. The overall volume of material within the beach system as a whole is likely to remain the same.	continues to lengthen it will lower, increasing the probability of being over topped during a storm. Continued Sea level rise may also increase the probability of overtopping, although as the beach moves landwards it is likely that the beach will actually end up sitting on slightly higher ground so the net change could be a slight increase in height. The overall volume of material within the beach system as a whole is likely to remain the same.
Intervention	Re-cycling of beach material from the river mouth will continue for up to 15 years. Small amounts of maintenance may be required on the timber training walls. It is likely that the requirement to dredge the river mouth will reduce under this option as the area of inundation within the estuary increases and associated increased water velocities through the mouth helps reduce the build up of shingle.	None – unless blockage threatens to increase flood risk upstream at Alfriston. It is likely that the requirement to dredge the river mouth will be minimal under this option as the area of inundation within the estuary increases and associated increased water velocities through the mouth helps reduce the build up of shingle.	None – unless blockage threatens to increase flood risk upstream at Alfriston. It is likely that the requirement to dredge the river mouth will be minimal under this option as the area of inundation within the estuary increases and associated increased water velocities through the mouth helps reduce the build up of shingle.

Policy Option	**A**
Policy Reference	Partial Breach Managed Realignment
Scenario Summary	Partial breach realignment involves the admission of tidal water into cells B and C through artificially created breaches in the existing embankments, which are otherwise to be left intact. The purpose of this scheme is to encourage saltmarsh development in cells B and C and allow siltation in an up warping saltmarsh environment; this will keep the land level building up at the same rate as the rising sea level. An additional embankment 200m long would connect the current east bank of the river to the eastern valley side, to stop the tidal water that enters Cell C from flooding Cell A and also give flood protection to the Foxhole valley. The existing east bank of the Cuckmere would require raising and strengthening twice – once at the start and once after 50 years; it would also require annual maintenance. The area of the canoe barn and meanders, Cell A, would be left entirely unchanged, including the footpath access. Diversions or raising of valley-side rights of way would be necessary. Short footbridges could ensure continuing access along the valley-centre right of way. The assumption for this scenario is that the increased volume of water flowing in and out of the river mouth resulting from the increased area inundated, will make the river mouth self clearing. The Environment Agency would continue to dredge the mouth if necessary, but it is assumed that all maintenance of the beach would cease. The beach and river mouth will remain largely in their current positions and form, although it is possible that much of the west beach material would transfer to the east beach, the east beach would move inland slightly, pivoting on its eastern end. The river mouth may widen and once the training walls have deteriorated, the river mouth will almost certainly become more mobile.
Scenario modelling assumptions	Modelling assumptions will be: • Where east bank embankments are retained or created, they will continue to be raised in order to keep pace with climate change – i.e. they will not overtop up to a 1% AEP flood event (tidal or fluvial or combined) • Where west bank embankments are breached at specific locations, they are left in their current condition and height and will overtop in the future and erode. We will assume intact for current scenario, partly reduced in 20 years, and largely eroded away in 50 years time with only small traces in 100 years time. • We will assume the river mouth and beach remain approximately their current form and location. • We will assume the current scenario on the floodplain is the existing topography. • Future scenarios (50 and 100 years in the future) will have varying degrees of rivulets, gullies and tidal creeks cut into the floodplain – determined by where the preferential flow paths occur. • Where a breach is created through and embankments, we will assume the breach initially is through the embankment only, and does not result in a channel below ground level. A channel will begin to form however and will be represented at the 20, 50 and 100 year time horizons. • The likelihood of the river channel moving from the current position is assessed by looking at erosion and deposition along the sections where embankments will erode.

	• Key flood events looked at are: the regular inundation that will occur at neap and spring tides (combined with mean annual flow in the river) now and in the future, and a 1% AEP flood event (separate fluvial and tidal events, and a combined fluvial and tidal event). • We have assessed the sediment content of incoming sea water and determined it is sufficient to allow accretion to take place at least at the same rate as sea level rise.		
Location within study area	Predicted change for:		
	0 – 20 years	20 – 50 years	50 – 100 years
River channel	<u>Change</u> The river channel will remain in its current position over this period, constrained by the current embankments. Embankments along the east side of the river protecting Cell A will be maintained and so overtopping or breach of these defences is very unlikely. Where the embankments have been artificially breached, the flows through the breach will begin to form established channel onto the floodplain. It is likely that the rest of the embankments, although not maintained, will remain largely intact for a number of years. However, they may be overtopped and could fail at a number of possible locations during flood events within the next 20 years. The channel will begin to deepen and widen slightly as the volumes of water entering the river under each tidal cycle (tidal prism) increases – due to rising sea levels, and additional water allowed to spread onto the floodplain. <u>Habitat</u> The river channel habitat will remain unchanged over this period, however where it is slightly wider, there will be a very small increase in the area of exposed mud at low tide.	<u>Change</u> It is probable that river channel is likely to remain generally in its existing position over this period, constrained to some extent by the current embankments. Whilst the embankments protecting Cell A will remain intact, it is likely that the remaining embankments will be overtopped with additional breaches forming at a number of possible locations during flood events over the next 50 years. Where the embankments have been artificially or naturally breached, the flows through the breach will continue to form and extend tidal creeks onto the floodplain. The channel will continue to deepen and widen as the volumes of water entering the river under each tidal cycle (tidal prism) increases – due to the increased volume of water able to spread across the floodplains once the embankments have been breached, and rising sea levels. <u>Habitat</u> The river channel habitat will remain largely unchanged over the 50 year period, however as it continues to widen, particularly below the cut, the extent of exposed mud at low tide will increase.	<u>Change</u> The river channel is likely to remain in its current general position over this period, constrained in the upper reaches by the maintained embankment protecting Cell A, and to some extent by the remnants of the original embankments. As the river becomes less affected by the old embankments below the cut, it is possible that the river will widen, particularly to the west, and may change its route slightly. However, the river mouth is likely to remain in its current position as there is already a relatively straight run to the mouth and there are no obvious reasons for the channel location to change. The channel will continue to widen as the volumes of water entering the river under each tidal cycle (tidal prism) increases – largely due to the increased volume of water able to spread across the floodplain and continued rising sea levels. <u>Habitat</u> The river channel habitat, particularly along the upper section where the east bank defences are maintained, will remain largely unchanged. Where the embankments disappear completely below the cut, the river will become an integral part of the intertidal

	As the existing revetment along parts of the river channel continues to break up and erode, the area of exposed mud at low tide will increase. It is unlikely that any significant additional saltmarsh will form within the channel during the next 20 years. Flow regime will remain largely unchanged, as increases in flow volumes over the initial 20 years will be compensated by increases in channel width and to a lesser extent, depth. <u>Landscape</u> Where maintenance is continued on the embankments protecting Cell A and the additional embankment at the top of Cell C, there will be some visual impact and noticeable difference from the existing embankments which are not maintained. Being tidal, the river channel will vary in appearance significantly from appearing to be in flood when the tide high, to being largely empty when the tide is out with a small fluvial flow running down the central channel within steep sloping muddy banks.	As the existing concrete revetment along parts of the river channel continues to break up and erode, additional areas of mud will be exposed at low tide. It is unlikely that any significant additional saltmarsh will form within the channel over this period, and any existing pockets are likely to be lost as the river widens. Flow regime will remain largely unchanged, as any increases in flow volumes will be compensated by increases in channel width and to a lesser extent, depth. Water velocities at the mouth of the river during ebb tides however, will increase. <u>Landscape</u> The look of the river channel will remain largely unchanged, although there will be slightly more exposed mud on the margins of the river, and where the existing revetment is lost. Where maintenance is continued on the embankments protecting Cell A and the additional embankment at the top of Cell C, there will be some visual impact and noticeable difference from the existing embankments which will not have been maintained, and will have deteriorated to the point where they may no longer be recognisable as flood embankments. Being tidal, the river channel will vary in appearance significantly from appearing to be in flood when the tide is high, to being	habitat of saltmarsh and mudflat. The existing concrete revetment along parts of the river channel will have largely gone by this stage. Small pockets of saltmarsh vegetation may remain, although much of the existing saltmarsh within the channel will be eroded and lost as the river channel widens. Flow regime will remain largely unchanged, as any increases in flow volumes will be compensated by increases in channel width and to a lesser extent, depth. Water velocities at the mouth of the river during ebb tides however, will increase. <u>Landscape</u> From a visual perspective, in 100 years, the river channel will have changed its character in the lower stretch below the cut, where most of the raised embankments will have gone, and the river will have become an integral part of the intertidal habitat. It will have widened significantly, particularly towards the river mouth and may have begun to migrate or meander towards the west due to the lower ground surface to the west of the current course. The river channel itself will still look very similar to the current river, although it will be set in a more natural estuarine environment with more gently sloping mud and silt either side. The main channel will also have developed tidal creeks providing connection to the surrounding floodplain.

		largely empty when the tide is out with a small fluvial flow running down the central channel within steep sloping muddy banks.	
Intervention	Embankments protecting Cell A will require maintenance and strengthening during this period. Maintenance to the revetment along the river channel adjacent to Cell A will also be required. Maintenance will be required of land drainage structures within the retained embankments. Building the 200m length of embankment between in Cell C to protect Foxhole valley.	Embankments protecting Cell A and dividing cells A and C will require continual maintenance during this period, but also need to be raised, strengthened and widened to keep pace with climate change. On-going maintenance to the revetment along the river channel adjacent to Cell A will also be required, with some areas requiring complete replacement.	Embankments protecting Cell A and dividing cells A and C will require continual maintenance during this period, but may need further raising, strengthening and widening to keep pace with climate change. On-going maintenance to the revetment along the river channel adjacent to Cell A will also be required.
The floodplain	<u>Change</u> Flooding within Cell A is unlikely over this period as the defences are generally well above the spring tide level and will be maintained. Flooding will only occur through overtopping of defences, and although this overtopping is likely to cause damage and even a potential breach, the embankment protecting this area will be repaired, preventing ongoing or frequent inundation. The ground surface in Cell A is significantly higher than the typical high tide, so even if a breach were to occur, the cell would only be inundated for a short period during a particularly high tide, combined high tide and high river flows. The embankments protecting Cell B will not be maintained, and therefore following inundation, the embankments close to the manmade breaches will become more likely	<u>Change</u> With the continued maintenance and raising of the embankments protecting Cell A, the risk of flooding will remain low. The old meanders will continue to widen and silt up, through gradual collapse of their edges, and will become less of a prominent feature. Once a breach has occurred on the western bank of the river, the floodplain in cell B will begin to inundate regularly during even normal tides. Drainage from the cell we be slow due to the low flat topography and in many places will be restricted by the existing embankments. This will encourage deposition of sediment and a gradual raising of ground levels. This process will be particularly important here for the creation of flood conditions where saltmarsh will develop.	<u>Change</u> With the continued maintenance and raising of the embankments protecting Cell A, the risk of flooding will remain low. The old meanders will continue to widen and silt up, through gradual collapse of their edges, and in the long term will become a relatively insignificant feature. <u>Habitat</u> The frequency of flooding in Cell A will remain low, and will only be inundated under extreme flood conditions. The habitat will not change significantly and will remain mainly grassland, although if a large flood occurs and the area is inundated, drainage will be slow, and standing brackish water may remain for long periods. The meanders will largely disappear, although they will still provide low spots where standing water will collect. This will provide wetland habitat

	to fail as time goes on. The ground surface in Cell B is also significantly lower that the other two cells, and once a breach of the defence has occurred, small amounts of regular inundation would occur during even normal tides. Drainage from the cell will be slow due to the low flat topography and in many places will be restricted by the existing embankments. This will encourage deposition of sediment and a gradual raising of ground levels. This process will be particularly important here for the creation of flood conditions where saltmarsh will develop. Cell C is protected by the existing defences, and also by the strip of relatively high ground to the east of the river. Flooding here is unlikely, and even if the defence was breached at some time in the near future, inundation would only occur during a spring tide or higher. <u>Habitat</u> The risk of flooding in Cell A will remain low, and will only be inundated under extreme flood conditions. The habitat is unlikely to change over this period, and will remain mainly grassland, although if a large flood occurs and the area is inundated, drainage will be slow, and standing brackish water may remain for long periods. The meanders will continue to silt up and the edges erode, becoming less prominent with time, although they will still provide a channel where standing water will collect. This may provide fresh water wetland habitat (although it is at risk from occasional saline intrusion).	This Cell C is protected by a strip of relatively high ground to the east of the river, and will be less prone to flooding under normal tides, but will be inundated during spring tides or higher. Again, drainage from the cell will be slow due to the higher ground next to the river, resulting in areas of standing water. This will encourage deposition of sediment and a gradual raising of ground levels. This process will be particularly important here for the creation of flood conditions where saltmarsh will develop. <u>Habitat</u> The risk of flooding in Cell A will remain low, and will only be inundated under extreme flood conditions. The habitat will not change significantly and will remain mainly grassland, although if a large flood occurs and the area is inundated, drainage will be slow, and standing brackish water may remain for long periods. The meanders will become less prominent, although they will still provide a channel where standing water will collect. This may provide fresh water wetland habitat (although it risk from occasional saline intrusion). Cell B will continue to develop as intertidal habitat, with the lower poorly drained parts being permanently wet, with silt and mudflat becoming established in areas that are regularly inundated. Small pockets of saltmarsh will begin to form, whilst existing pockets of saltmarsh nearest the river channel are likely to be lost.	(although any fresh water habitat will be at risk from occasional saline intrusion). Cell B will be a well established area of intertidal mud flat and saltmarsh, interacting naturally with the river. As the lowest lying area within the estuary, it is likely that as sea levels rise, some of the areas which may have built up through deposition whilst protected by the original defences will erode once the defences have completely gone. The saltmarsh will recede to the western edge of the cell and the areas nearest the river will revert back to mud flats. The river will widen and the channel will spread out towards the west, particularly below the cut, perhaps forming a wide expanse of mud flat in this area. Cell C is likely to become more like Cell B, as the area of slightly higher ground is likely to be eroded and sea level continues to rise. Areas of mudflat and saltmarsh will begin to form, and any remaining grassland will be confined to the higher ground further from the river. <u>Landscape</u> The overall look of Cell A will remain largely unchanged in the future, although the continued maintenance and raising of the embankments will be noticeable when compared to the surrounding areas. The gradual loss of the meanders as a feature in this area however, will have a significant impact on the landscape.

	Cell B is likely to become an intertidal habitat towards the end of this period, with the lower poorly drained parts being permanently wet, with silt and mudflat becoming established in areas that are regularly inundated. Small pockets of saltmarsh may begin to form, colonised by Salicomia (existing saltmarsh species). The higher slightly better drained land will remain grassland, although there will be a gradual change towards more salt resistant species. Cell C is likely to remain grassland, although occasional inundation towards the end of this period may encourage a change in vegetation to a more salt tolerant mix of coastal grazing marsh with lowland wet grassland on its edges. <u>Landscape</u> From a visual perspective, Cell A and C will remain largely unchanged, although there may be periods of several weeks with standing water lying in low lying areas in Cell C as the defences deteriorate. Cell B will change in parts, with some low lying areas being permanently wet, and the areas which start to become inundated more frequently and which do drain within the cell will begin to accrete a layer of brown silt and mud.	Due to the strip of raised land between Cell C and the river, this area is likely to remain grassland, although due to more frequent inundation and tidal creeks forming, areas of mudflat and saltmarsh will begin to develop, and with standing water and saline lagoons forming, the surrounding grassland species will begin to change to a more salt tolerant mix of coastal grazing marsh with lowland wet grassland on its edges, and with the possibility of saline reed beds colonising the more permanent lagoons. <u>Landscape</u> From a visual perspective, Cell A will remain largely unchanged, although the continued maintenance and raising of the embankments will be noticeable when compared to the surrounding areas where the raised embankments will erode and begin to disappear. The old meanders will continue to widen and silt up, through gradual collapse of their edges, and will become less of a prominent feature. Cell B will change considerably, with some low lying areas being permanently wet, and the areas which do drain within the cell will become mudflat in character. Cell B will take on the form of an intertidal landscape, with any remaining grassland confined to the landward boundary. Cell C will change less than Cell B due to the less frequent and extensive inundation,	The landscape in Cell B will have changed change considerably over the period of 100 years, having become a mature fully functioning intertidal system. Low lying areas being permanently wet, and the remainder of the area being a mix of saltmarsh and mudflat, with any remaining grassland confined to the landward boundary. The landscape in Cell C will also change considerably, and over a 100 year horizon will develop in the same way as Cell B, becoming established intertidal saltmarsh and mudflat.

		although there is likely to be periods of several weeks with standing water lying in low lying areas. It is likely that there will also be more permanent ponds and lagoons with pockets of saltmarsh and mudflats forming and possibly saline reedbeds.	
Intervention	None proposed	None proposed	None proposed
The mouth of the Estuary	The estuary mouth may require some dredging for a short period to ensure no further build up of shingle which could increase flood risk upstream in Alfriston. However, once the breaches are established and Cell B begins to inundate regularly, the increased area of inundation will have increased the volume of water flowing in and out of the estuary sufficiently to make the river mouth largely self clearing. The mouth of the river is likely to widen, bypassing the failing training walls, and will become more mobile.	The river mouth will be largely self clearing and the training walls will have fallen into disrepair. The mouth of the river is likely to widen further and remain mobile. Its exact location is impossible to determine, however it may tend to stabilise in a relatively central location.	The river mouth will remain largely self clearing and all traces of the training walls will have gone. The mouth of the river is likely to remain mobile, however it may tend to stabilise in a relatively central location.
Intervention	It is likely that the requirement to dredge the river mouth will reduce under this option as the area of inundation within the estuary increases and associated increased water velocities through the mouth helps reduce the build up of shingle. Small amounts of maintenance may be required on the timber training walls.	None – unless blockage threatens to increase flood risk upstream at Alfriston. Occasional dredging may then be required.	None – unless blockage threatens to increase flood risk upstream at Alfriston. Occasional dredging may then be required.
The beach	Once re-cycling of beach material from the river mouth ceases, the general eastern movement of material along the coast will quite quickly reduce the west beach, adding to the volume of material on the east beach. Apart from a slight increase in material from the west beach, the east beach is likely to remain largely unchanged.	The west beach will have lost much of its current volume, and what is left will probably swing round to face a more south easterly direction allowing the river mouth to widen. The east beach will remain largely unchanged, although it is likely that it will move landwards slightly and will swing round to face a more south westerly direction. As it lengthens it will lower, increasing the probability of being over topped during a storm. Sea level rise may also increase the	The smaller west beach will remain quite stable once established around the toe of the western cliffs and into the mouth of the estuary where it will be protected from direct southerly and south westerly gales and wave action. The east beach will remain largely unchanged, although it is likely that it will continue to move landwards slightly and will tend to face a south westerly direction. As it continues to lengthen it will lower, increasing the probability of being over topped during a

		probability of overtopping, although as the beach moves landwards it is likely that the beach will actually end up sitting on slightly higher ground so the net change could be a slight increase in height. This will have little impact, as the area behind the beach will be regularly inundated anyway. The overall volume of material within the beach system as a whole is likely to remain constant.	storm. This will have little impact, as the area behind the beach will be regularly inundated anyway. Continued Sea level rise may also increase the probability of overtopping, although as the beach moves landwards it is likely that the beach will actually end up sitting on slightly higher ground so the net change could be a slight increase in height. The overall volume of material within the beach system as a whole is likely to remain the same.
Intervention	Re-cycling of beach material from the river mouth onto the west beach will continue for up to 5 years.	None	None

Policy Option	B
Policy Reference	Full Breach Managed Realignment
Scenario Summary	Full breach realignment involves the admission of tidal water into cells B and C as above but also cell A (the area of the floodplain containing the canoe barn and canoe lake). Tidal water would be admitted by way of breach points artificially created in the embankments, lowering them down to the surrounding ground level. Otherwise, the embankments will be left intact; with no further intervention or maintenance. It is envisaged that the embankments will create a more sheltered environment for saltmarsh to develop. The breach point for cell A would be at the southern end of the canoe lake, admitting water into the meanders and flanking floodplain, with the aim of fostering saltmarsh development there. This option also involves the creation of a major new embankment running across the floodplain from approximately 30m south of Exceat Bridge to the eastern valley side about 100m south east of the Visitor Centre. The intention is to prevent tidal water from reaching the A259, form a northern boundary for cell A and leave a small segment of the meanders as a truncated canoe lake. A second new bank would be created to separate cells A and C, following a different route from the bank in Option A and allowing inundation of the Foxhole valley. An area at the western edge of cell C will be excavated to create a reservoir that will enlarge the Cuckmere's tidal compartment and help to increase flow at the river mouth on a falling neap tide. It is envisaged by the Environment Agency that the river mouth would maintain itself in its present position, because of the larger volume of water flowing through it. Diversions or raising of valley-side rights of way would be necessary, as in Option A. Short footbridges could ensure continuing access along the two valley-centre rights of way. The assumption for this scenario is that the increased volume of water flowing in and out of the river mouth resulting from the increased area inundated, will make the river mouth self clearing. The Environment Agency would continue to dredge the mouth if necessary, but it is assumed that all maintenance of the beach would cease. The beach and river mouth will remain largely in their current positions and form, although it is possible that the west beach transfer to the east beach. The river mouth may widen and once the training walls have deteriorated, the river mouth will almost certainly become more mobile.
Scenario modelling assumptions	As above in Option A – except all embankments both sides of the river will erode over time. The proposed additional tidal lagoon excavated on the east side of the river in Cell C will require the following assumptions: • Will be represented in the model by lowering the DTM. • The breaches in the embankment will form a channel deep enough for the lagoon to fully drain at low tide, i.e. the opening will be made below current ground level. • The lagoon will silt up over time and its impact will diminish into the future. • We have assessed the sediment content of incoming sea water and determined it is sufficient to allow accretion to take place at least at the same rate as sea level rise.
Location within	Predicted change for:

study area	0 – 20 years	20 – 50 years	50 – 100 years
River channel	<u>Change</u> The river channel will remain in its current position over this period, constrained by the existing embankments. Apart from the artificially created breaches, it is expected that the embankments will remain in reasonable condition for several more years. However; they may be overtopped and could fail at a number of possible locations during flood events within the next 20 years. The channel will begin to deepen and widen slightly as the volumes of water entering the river under each tidal cycle increases, due to rising sea levels, and the increased amount of water able to spread across the floodplain through the breaches. In particular, the additional volume of water entering the estuary due to the artificial tidal lagoon will increase the velocity through the river mouth during the ebb tide. <u>Habitat</u> The river channel habitat will remain unchanged over this period, however where it is slightly wider, there will be a very small increase in the area of exposed mud at low tide. As the existing revetment along parts of the river channel continues to break up and erode, the area of exposed mud at low tide will increase. It is unlikely that any significant additional saltmarsh will form within the channel during the next 20 years.	<u>Change</u> The river channel is likely to remain generally in its existing position over this period, constrained to some extent by the current embankments. It is likely however that the embankments will be weakened and fail at a number of possible locations during flood events over the next 50 years, and the extent of inundation of the floodplain will increase. The channel will continue to deepen and widen as the volumes of water entering the river under each tidal cycle increases, due to rising sea levels, and the increased amount of water able to spread across the floodplain through the breaches. <u>Habitat</u> The river channel habitat will remain largely unchanged over this period, however where it is slightly wider, there will be a small increase in the area of exposed mud at low tide. As the existing revetment along parts of the river channel continues to break up and erode, the area of exposed mud at low tide will increase. It is unlikely that any significant additional saltmarsh will form within the channel over this period The flow regime will remain largely unchanged, as any increases in flow volumes will be compensated by increases in channel width and to a lesser extent, depth. Water velocities at the mouth of the river during ebb	<u>Change</u> The river channel is likely to remain in its current well established position over this period, constrained partially by the remnants of the current embankments. However, as the river becomes less affected by the old embankments, particularly below the cut, it is possible that the river will spread, particularly to the west, and may change its route slightly. However, the river mouth is likely to remain in its current position as there is already a relatively straight run to the mouth and there are no obvious reasons for the channel location to change. It is likely that as the embankments disappear, additional smaller channels, or tidal creeks will form connecting the main channel to the floodplain. The channel will continue to widen as the volumes of water entering the river under each tidal cycle increases, due to the increased volume of water able to spread across the floodplain and continued rising sea levels. <u>Habitat</u> Where the embankments have gone completely, the river will become an integral part of the intertidal habitat of saltmarsh and mudflat. Small pockets of saltmarsh vegetation may remain in or close to the channel, although much of the existing saltmarsh close to the river will be eroded and lost as the channel widens and spreads. The existing concrete revetment along parts of the river channel will have largely gone by this stage.

	The flow regime will remain largely unchanged, as increases in flow volumes over the initial 20 years will be compensated by increases in channel width and, to a lesser extent, depth. Water velocity through the river mouth during the ebb tide will increase due to the artificial tidal lagoon. <u>Landscape</u> The artificial breaches in the embankments will form a small feature on the landscape, with tidal creeks developing through the breaches onto the floodplains. Being tidal, the river channel will vary in appearance significantly from appearing to be in flood when the tide is high, to being largely empty when the tide is out with a small fluvial flow running down the central channel within steep sloping muddy banks	tides will increase partly due to the increased volume of water spreading across the floodplain, and partly due to the additional volume of water accommodated by the artificial tidal lagoon. <u>Landscape</u> As none of the defences will be maintained, the raised embankments along the river will begin to erode and disappear. As the embankments erode and become less of a feature, and other tidal creeks form, the artificial breaches in the embankments will be less obvious. Being tidal, the river channel will vary in appearance significantly from appearing to be in flood when the tide is high, to being largely empty when the tide is out with a small fluvial flow running down the central channel within steep sloping muddy banks.	The flow regime in the channel will remain largely unchanged, as any increases in flow volumes will be compensated by increases in channel width and to a lesser extent, depth. Water velocities at the mouth of the river during ebb tides will increase however, partly due to the increased volume of water spreading across the floodplain, and partly due to the additional volume of water accommodated by the artificial tidal lagoon. <u>Landscape</u> From a visual perspective, in 100 years, the river channel will have changed its character, particularly in the lower stretch below the cut, where most of the raised embankments will have completely gone, and the river will have become an integral part of the intertidal habitat. It will have widened significantly, and may have begun to migrate or meander towards the west due to the lower ground surface in Cell B, although this will be relatively insignificant, particularly if the river mouth remains fixed. The main channel will also have developed extensive tidal creeks providing connection to the surrounding floodplain.
Intervention	Initial breach of the defences at the planned locations.	Ongoing maintenance and raising of the two new embankments to keep pace with climate change.	
The floodplain	<u>Change</u> Regular flooding within Cell A is unlikely over this period as the ground level is significantly higher than the typical high tide, and most of	<u>Change</u> The frequency of flooding within Cell A will increase with time, although the average ground level is well above the expected neap	<u>Change</u> The frequency of flooding within Cell A will continue to increase with time, although even the expected neap tide in 100 years time is

	the area is above even a spring tide level. Even with an existing breach, only parts of the cell would only be inundated for a short period during a high spring tide or above. The bed level in the meander is approximately 1m above the neap tide level, so even with the breach in the defence created at the bottom end of the meander, inundation would only occur occasionally and for short periods. Over time however, it is likely that this occasional flooding of the meanders through the breach would begin to erode a deeper channel which would extend into the meander, eventually turning it into a tidal creek. The ground surface in Cell B is significantly lower than the other two cells and with a breach through the embankment along this section of river, small amounts of regularly inundation would occur during even normal tides. Drainage from the cell will be slow due to the low flat topography and in many places will be restricted by the existing embankments. This will encourage deposition of sediment and a gradual raising of ground levels. This process will be particularly important here for the creation of flood conditions where saltmarsh will develop. The creation of a tidal lagoon next to the river will remove the strip of high ground which currently prevents inundation of Cell C, and creating a breach in the existing defence embankment will provide a pathway for water to reach the area. The average ground level in this area is above the current neap tide level of 1.64m AOD, but below the spring tide	tide in 50 years time and large parts of the area will still be above the future spring tide level. With the existing breach, only parts of the cell would only be inundated for a short period during a high spring tide or above, and the tidal creek would continue to extend up the meander, branching out into other low lying parts of the cell. Further breaches will form through the eroding embankments and will result in additional areas being occasionally inundated. The ground surface in Cell B is significantly lower than the other two cells and with an engineered breach as well as natural breaches through the embankment along this section of river, regular inundation would occur across large parts of the cell during even normal tides. Drainage from the cell will be slow due to the low flat topography and in many places will be restricted by the existing embankments. This will encourage deposition of sediment and a gradual raising of ground levels. This process will be particularly important here for the creation of flood conditions where saltmarsh will develop. The tidal lagoon next to the river will fill and empty on every tidal cycle, and the remaining parts of Cell C, behind the lagoon will inundate more and more frequently as sea levels rise. The average ground level in this area will still be above the expected future neap tide level of 1.9m AOD, but will be low enough to flood during average tide levels and above.	not sufficiently high to inundate the area. Spring tides however, by 2100 are expected to reach 3.5m AOD, which is high enough to inundate most of the area for at least a short time with shallow water. With the loss of most of the existing embankments, spring high tides will be able to reach most of the cell, particularly if a tidal creek forms in the low lying former meander channel. Small sections of tidal creek will form into the area from other parts of the river, with associated areas of saltmarsh and mud flats on their margin. The ground surface in Cell B is significantly lower than the other two cells and with most of the embankments eroded away, regularly inundation would occur across large parts of the cell during even normal tides. The river will be a fully integrated part of the intertidal mud flat and saltmarsh system. The tidal lagoon next to the river will be less well defined by 2100, with the original engineered edges eroded away, and partly filled with sediment, it will be difficult to recognise it from the more natural mud and saltmarsh of the rest of cell C. <u>Habitat</u> Even in 100 years time, cell A will retain significant areas of salt tolerant grassland. Parts of the area will develop into an intertidal habitat, with an area of tidal creek extending at least part way up the old meander, and small lengths of tidal creek extending into low lying areas from other parts of the main channel. Small areas of wetland will be well

	level of 3.07m AOD. Inundation is therefore likely to occur relatively frequently, although not regularly. The lagoon, to work effectively will be dug out to the same depth as the river bed, with the connecting breach also lowered to the river bed level. As a result it will fully drain at low tide, and fill on every high tide. <u>Habitat</u> Cell A will only flood very occasionally and the habitat will not change significantly. It will remain mainly grassland, although if a large flood occurs and the area is inundated, drainage will be slow, and standing water may remain for long periods. The existing meanders, although becoming less well defined, will still retain water and will provide a mainly fresh water wetland habitat. Cell B is likely to become an intertidal habitat towards the end of this period, with the lower poorly drained parts being permanently wet, with silt and mudflat becoming established in areas that are regularly inundated. Areas of saltmarsh will begin to form, colonised by Salicomia (existing saltmarsh species). The higher slightly better drained land will remain grassland, although there will be a gradual change towards more salt resistant species. The tidal lagoon area in Cell C is likely to create a slightly unnatural habitat which will fill and drain on each tide, with artificially engineered sides. This should lesson with	<u>Habitat</u> Even in 50 years time, cell A will only experience wide scale flooding very occasionally, and the habitat will not change significantly. It will remain mainly grassland, although if a large flood occurs and the area is inundated, drainage will be slow, and standing water may remain for long periods. The existing meanders will become less well defined, and will be fed with tidal water from the breach at the southern end. This will create a tidal creek, deepening the old meander channel over time and extending up the meander with branches forming into adjoining low lying areas. Cell B is likely to become a fully established intertidal habitat towards the end of this period, with the lower poorly drained parts being permanently wet, with silt and mudflat becoming established in areas that are regularly inundated. Small pockets of saltmarsh may begin to form, colonised by Salicomia (existing saltmarsh species). The higher slightly better drained land will remain grassland, although there will be a gradual change towards more salt resistant species. Cell C is likely to progress towards an intertidal habitat, with areas remaining as grassland, subject to more frequent but still shallow inundation. There will be a more general move towards a salt tolerant mix of coastal grazing marsh with lowland wet grassland on its edges.	established in the low lying poorly drained areas, with a mix of fresh water and brackish habitats. The old meanders will have largely disappeared, although it is probable that the ground will still be low lying and will contain areas of wetland habitat. Cell B will be a well established area of intertidal mud flat and saltmarsh, interacting naturally with the river. As the lowest lying area within the estuary, it is likely that as sea levels rise, some of the areas which may have built up through deposition whilst protected by the original defences will erode once the defences have completely gone. The saltmarsh will recede to the western edge of the cell and the areas nearest the river will revert back to mud flats. The river will widen and the channel will spread out towards the west, particularly below the cut, perhaps forming a wide expanse of mud flat in this area. Cell C will have become an intertidal habitat, although some raised areas around the edges will remain a mix of salt tolerant coastal grazing marsh with lowland wet grassland. The artificial lagoon will be unrecognisable as a man made feature, the edges will have eroded, and the lagoon will have at least partially filled with sediment. It is probable though that it will still be lower than the surrounding areas, with deeper water at high

	time, and will begin to fill with marine silt and mud, and form a more natural shape. The remainder of Cell C will be inundated on occasion, and the existing grassland will change a more salt tolerant mix of coastal grazing marsh with lowland wet grassland on its edges. In low lying areas, standing water and ponds will form providing a brackish habitat or where drainage is better, mud flats will begin to develop, Landscape From a visual perspective, Cell A will remain largely unchanged, although there may be periods of several weeks with standing water lying in low lying areas. Cell B will change significantly, beginning to resemble a functional intertidal zone. Low lying areas becoming permanently wet, and the areas which start to become inundated more frequently but which do drain within the cell, forming mudflat and saltmarsh. Cell C will look very different, with a large area dug out next to the river to create a tidal lagoon. This will create a significant visual impact at low tide, and at high tide will result in a considerable additional expanse of open water. In other parts of Cell C, regular inundation will create wetland areas, with standing water and ponds, and where drainage is better, mud flats and some pockets of saltmarsh will begin to form.	The artificial lagoon will have merged into a more natural habitat and will have begun to level out as it fills with sediment. It will still be significantly lower than the surrounding areas, with deeper water at high tide and little chance for saltmarsh vegetation to form. Landscape Cell A will continue to look much as it does at present, although the duration and extent of standing water will increase, and the breach at the bottom of the meanders will allow the intertidal habitat to extend into the area through more regular inundation along the tidal creek which would form. Cell B will now be a fully functional intertidal zone with areas of saltmarsh and mudflat covering most of the cell. Any remaining grassland will be restricted to the higher ground at the periphery. Cell C will look very much like Cell B, although more areas of grassland will be seen as the land is slightly higher. The large area dug out next to the river to create a tidal lagoon will become less prominent as it begins to fill with sediment and form a more natural shape. In other parts of cell C, regular inundation will create wetland areas, with standing water and ponds, and where drainage is better, mud flats and some pockets of saltmarsh will begin to form.	tide and no saltmarsh vegetation. Landscape Cell A will continue to look much as it does at present, although the duration and extent of standing water will increase, and the breach at the bottom of the meanders will allow the intertidal habitat to extend into the area through more regular inundation along the tidal creek which would form. Cell B will now be a fully functional intertidal zone with areas of saltmarsh and mudflat covering most of the cell. Any remaining grassland will be restricted to the higher ground at the periphery. Cell C will look very much like Cell B, although more areas of grassland will be seen as the land is slightly higher. The large area dug out next to the river to create a tidal lagoon will become less prominent as it begins to fill with sediment and form a more natural shape. At high tide it will result in a large expanse of open water, and at low tide will result in a large depressed area of mudflat. In other parts of cell C, regular inundation will create wetland areas, with standing water and ponds, and where drainage is better, tidal creeks, mud flats and saltmarsh will have formed.
Intervention	Raise the concrete road on the east side of the valley by 2.5m and continue it along the floodplain edge to the beach.	Ongoing maintenance and raising of the two new embankments to keep pace with climate change.	Ongoing maintenance and raising of the two new embankments to keep pace with climate change.

	Raise the middle section of the Vanguard Way by 2.5m (to 5-5.5m OD), to ensure that it is above flood level. Building the raised embankment across the top of Cell A to protect the A259, and the top section of the historic meanders. Build the short length of embankment between Cells A and C Digging out large area on the eastern side of the river to form a tidal lagoon which will increase the tidal prism for the estuary.		
The mouth of the Estuary	The estuary mouth may require some dredging for a short period to ensure no further build up of shingle which could increase flood risk upstream in Alfriston. However, once the breaches are established and Cells A, B and C begin to inundate regularly, the increased area of inundation will have increased the volume of water flowing in and out of the estuary sufficiently to make the river mouth largely self clearing. The mouth of the river is likely to widen, bypassing the failing training walls, and will become more mobile.	The river mouth will be largely self clearing and the training walls will have fallen into disrepair. The mouth of the river is likely to widen further and remain mobile. Its exact location is impossible to determine, however it may tend to stabilise in a relatively central location.	The river mouth will remain largely self clearing and all traces of the training walls will have gone. The mouth of the river is likely to remain mobile, however it may tend to stabilise in a relatively central location.
Intervention	Continued dredging until the mouth for a short period to ensure it has become self cleansing – possibly up to 5 years. It is likely that the requirement to dredge the river mouth will reduce under this option as the area of inundation within the estuary increases and associated increased water velocities through the mouth helps prevent the build up of shingle. Small amounts of maintenance may be required on the timber training walls.	It is likely that the requirement to dredge the river mouth will reduce under this option as the area of inundation within the estuary increases and associated increased water velocities through the mouth helps prevent the build up of shingle. If a blockage threatens to increase flood risk upstream at Alfriston, occasional dredging may then be required.	It is likely that the requirement to dredge the river mouth will reduce under this option as the area of inundation within the estuary increases and associated increased water velocities through the mouth helps prevent the build up of shingle. If a blockage threatens to increase flood risk upstream at Alfriston, occasional dredging may then be required.
The beach	Once re-cycling of beach material from the river mouth ceases, the general eastern movement of material along the coast will	The west beach will have lost much of its current volume, and what is left will probably swing round to face a more south easterly	The smaller west beach will remain quite stable once established around the toe of the western cliffs and into the mouth of the

	quite quickly reduce the west beach, adding to the volume of material on the east beach. Apart from a slight increase in material from the west beach, The east beach is likely to remain largely unchanged.	direction allowing the river mouth to widen. The east beach will remain largely unchanged, although it is likely that it will move landwards slightly and will swing round to face a more south westerly direction. As it lengthens it will lower, increasing the probability of being over topped during a storm. This will have little impact, as the area behind the beach will be regularly inundated anyway. Sea level rise may also increase the probability of overtopping, although as the beach moves landwards it is likely that the beach will actually end up sitting on slightly higher ground so the net change could be a slight increase in height. The overall volume of material within the beach system as a whole is likely to remain constant.	estuary where it will be protected from direct southerly and south westerly gales and wave action. The east beach will remain largely unchanged, although it is likely that it will continue to move landwards slightly and will tend to face a south westerly direction. As it continues to lengthen it will lower, increasing the probability of being over topped during a storm. This will have little impact, as the area behind the beach will be regularly inundated anyway. Continued Sea level rise may also increase the probability of overtopping, although as the beach moves landwards it is likely that the beach will actually end up sitting on slightly higher ground so the net change could be a slight increase in height. The overall volume of material within the beach system as a whole is likely to remain the same.
Intervention	Re-cycling of beach material from the river mouth onto the west beach will continue for up to 5 years.	None	None

Policy Option	**C**
Policy Reference	Engineered Reactivation of Meanders and Saltmarsh Creeks
Scenario Summary	The valley floor would be restored as a fully functioning tidal estuary, complete with active tidal river meanders and branching networks of tidal creeks with flanking saltmarshes. The landscape would retain much of its present visual appeal (meanders crossing a vegetated floodplain), together with branching networks of small meandering creeks nested within the larger meanders of the tidal river channel. There would be changed access along both sides of the valley to the beach, though the two valley-centre rights of way would be lost. The scheme goes further than other managed realignment schemes in reconnecting and restoring remnants of the historic creek system. The following engineering works are likely to be needed: • Raise the A259 causeway by 2m (to 5.7mOD). Revet the causeway's seaward slope. • Raise the concrete road on the east side of the valley by 2.5m and continue it along the floodplain edge to the beach. • Raise the middle section of the Vanguard Way by 2.5m (to 5-5.5m OD), to ensure that it is above flood level. • Dredge the canoe lake of accumulated silt down to current river bed level. • Reconnect the meandering reach at upper and lower ends, re-establishing river flow round the meanders. • Revet the outer bank of the river bend at Exceat Bridge to ensure flow is diverted into the meandering reach. • Backfill the 1846 cut using material from the embankments on each side. • Topography creation. Excavate the floors of silted 'fossil' creeks and reconnect the creeks to the river. Create artificial creeks where the original creeks have been effaced. Raise selected areas between the creeks, creating subdued local relief where lower saltmarsh, upper saltmarsh and safe higher nesting sites can be generated. • From workshop on the 14th for engineered reactivation, revetment would need to continue to the bridge – impacts on the road need to be assessed. The assumption for this scenario is that the increased volume of water flowing in and out of the river mouth resulting from the increased area inundated, will make the river mouth self clearing. The Environment Agency would continue to dredge the mouth if necessary, but it is assumed that all maintenance of the beach would cease. The beach and river mouth will remain largely in their current positions and form, although it is possible that the west beach transfer to the east beach. The river mouth may widen and once the training walls have deteriorated, the river mouth will almost certainly become more mobile.
Scenario modelling assumptions	• The re-profiling of the estuary will be carried out exactly as described, taking geomorphological advice regarding the location of exactly where the artificial creeks and land raising would be carried out and to what level. This will be built into the DTM forming the model grid. • The flood events, flow conditions and future time horizons will be the same as for the above options • The form and location of the river mouth and beach will be remain largely as at present. • We will assume the revetment to the outer banks on the tight corner just below Exceat Bridge will prevent any future meandering at this point • We have assessed the sediment content of incoming sea water and determined it is sufficient to allow accretion to take place at least at the same rate as sea level rise.

Location within study area	Predicted change for:		
	0 – 20 years	20 – 50 years	50 – 100 years
River channel	Change The cut will be filled, and levelled, although the ground level to the east of the cut in Cell A is typically 1 to 2 metres higher than the ground to the west in Cell B. The meanders in Cell A will be dug out to create a flow path through Cell A, re-joining the existing river channel just below the now filled in cut. The river channel below the cut will remain largely unchanged, although the embankments will be removed to ground level. The main river channel will also be reconnected to the 'fossil' tidal creeks, which will be dug out and reactivated. Once the river starts to flow through the old meanders, it is likely that the meanders will change. Although it is recognised that the meanders took this form prior to the cut being installed in 1846, the existing course of the meanders is not natural, particularly the right angled bend downstream of Exceat Bridge, and the tight 'U' bend at the Canoe Club car park. The modelling work carried out for this study indicates that the velocity contours within the river channel will result in a strong tendency for the meanders to migrate. The engineering works proposed for this option will hold the existing bend in place downstream of Exceat Bridge. However; it is likely that the tight 'U' bend will either open up with time, moving southwards and taking out the car park and canoe club, or perhaps more likely, the river will by-pass the tight bend and form a new channel cutting off the entire loop.	Change It is likely that at least some downstream migration of the meanders will occur. The hydraulic modelling carried out as part of this study suggests that the distribution of velocities, particularly in the tighter bends, will encourage the river to erode the outside and downstream edge of the bends. As the eastern extent of the meanders is already up against the steepening slopes of the South Downs, the most likely movement direction for the meanders is downstream. The western extent of the meanders (the single turn) is likely to move westwards, across the location of the now filled in Cut. There is some uncertainty about what would happen in this situation. The unconsolidated fill could easily be eroded, and the channel may naturally migrate back to the old Cut, or; the river channel could find a new channel across the lower ground levels in Cell B. For the purposes of this option assessment, we have assumed the river will stay in the old meander system, but with the natural meandering process described above which creates a more stable and lower energy system. The lower part of the river channel is already relatively straight, and although it will widen considerably and the low water channel may change dynamically within the wider system, it will most likely remain in the same general location – especially if the river mouth remains fixed.	Change The meanders will continue to move, but having reached a more low energy state in the first 50 years, it is likely that any changes will be slow. Assuming the river mouth remains in the same location, the lower channel will remain largely unchanged. Habitat The river habitat will have reached equilibrium and will not have changed appreciably over the 50 years period. Landscape As the overall river system will have reached a natural equilibrium in the medium term or even before, there will be little significant change over this period other than the slow migration of the meanders.

	It is also probable that where the tight bend in the meanders passes close to the now filled in route of the cut, unless stabilising engineering works is carried out here, the channel will migrate quite rapidly to the lower ground levels to the west. With no embankments to constrain the river channel anywhere along its length, the channel will widen and the profile of the channel sides will change to a more convex shape merging naturally with mud flats and saltmarsh along the margins. The river will remain largely in-bank through Cell A, spilling out onto the floodplain only during spring tides, and even then, only inundating small areas. Through Cell B, the river will spill out-of-bank every day on each high tide. Downstream of the old Cut, the river flows will be prevented from spilling onto Cell C by the raised ground level along the eastern side of the channel. However, re-activated tidal creeks through this strip of raised ground will provide a flow route for water during high tides. Water velocities through the mouth of the river will increase dramatically if constrained to the existing form by the training walls, particularly during ebb flows, but also as the tide rises. This is due to the very large increase in volume of water entering the estuary as a result mainly of the extent of inundation of Cell B.	<u>Habitat</u> Once the engineering works have all settled down, the channel may move and change slightly over time, but in 50 years time, the river system will have established a natural equilibrium. The habitat will therefore not change significantly over this period. <u>Landscape</u> The overall river system will have reached a natural equilibrium relatively quickly after the engineering works were finished. The landscape of the river channel will look more natural as the engineering works will have been softened by the natural processes and there will be the possible migration of the meanders.	

	<u>Habitat</u> The river channel habitat will change, particularly through the meanders to a slower moving estuarine habitat. The slope will be less (as the route is longer), so the system will generally have less energy. The water will move slower, and it is likely that more mud and sediment banks will form. As the channel widens more mud will be exposed at low tide. Water velocities through the mouth of the river will increase dramatically if constrained to the existing form by the training walls, particularly during ebb flows, but also as the tide rises. <u>Landscape</u> The landscape of the river will change dramatically in a relatively short time. Once the engineering work of the realignment and removal of the embankments has settled down, the meanders will become a natural tidal watercourse, approximately 3m deeper than at present. When the tide is high, they will not look very different as they will be full of water. When the tide is out, the channel will be a muddy tidal creek. The river throughout, will gradually become more connected with the surrounding mudflat and saltmarsh that will be forming, and the river banks will begin to appear as an active intertidal zone.		
Intervention	Remove all raised embankments, and remove any in-channel revetment below the Cut. Dig out the meanders to form a channel	None proposed.	None proposed.

	connecting to the existing river channel, ensuring bed levels tie in and slope gently throughout the meander. Form a smooth transition where the river enters the meander at Exceat Bridge, and revet the channel to prevent scour.		
The floodplain	Change Even although the embankments will all have been removed and the meanders re-activated, the floodplain in Cell A will not change dramatically. Flooding within Cell A is unlikely over this period as the ground level is significantly higher than the typical high tide, and most of the area is above even a spring high tide level. Despite the re-activated tidal creeks helping to bring the water onto the floodplain, only parts of the cell would be inundated and only for a short period during a high spring tide or above. Once all the embankments have been removed and the larger 'fossil' tidal creeks have been re-activated, the current floodplain in Cell B will change dramatically. The change will happen very rapidly, where regular inundation will commence immediately. Initially the water would fill the low lying areas and form large areas of standing water with depths even at low tide in excess of 0.5m. At high tide, the area would be almost entirely covered by water with depths up to 2m in some areas. Large areas of mudflat will develop, but water depths will be too great for significant saltmarsh to develop. With average accretion rates of typically 6mm/yr for the South Coast in similar habitats, the majority of the area will remain mudflat over this period, although	Change The frequency of inundation within Cell A will have increased to over this period, both in terms of frequency and extent, although much of it still will not be flooded on every tide. More of the area will have developed into an intertidal system, with areas of saltmarsh and mudflat extending across the cell. Cell B will continue to act as an intertidal zone, with extensive mudflats and areas of saltmarsh. Continued sedimentation will have raised the surface level of the mudflat, and it is expected that the extent of saltmarsh will increase. However, sea level rise is likely to squeeze the intertidal zone towards the western side of the cell. Similarly, Cell C will continue to develop as an intertidal zone as the interaction between rising sea levels and sedimentation continues. The ground level is slightly higher in this cell than in Cell B, and the slightly raised strip of land along the eastern side of the river both favour the development of saltmarsh. Habitat The habitat in Cell A will still be dominated by salt tolerant grassland, supporting habitats	Change The frequency of inundation within Cell A will have increased to over this period, both in terms of frequency and extent, although much of it still will not be flooded on every tide. More of the area will have developed into an intertidal system, with areas of saltmarsh and mudflat extending across the cell. Habitat The habitat in Cell A will still be dominated by salt tolerant grassland, supporting habitats such as coastal grazing marsh. The extent of saltmarsh and mudflats will have increased slightly, but the ground surface will generally be too high in relation to the neap and spring tides to support these habitats. Low lying depressions will still support areas of saline or brackish wetland where standing water is trapped. Cell B habitat will continue to change, with significant deposition of sediment and a gradual raising of mudflat. Although the cell will remain dominated by mudflats, saltmarsh will extend as water levels in relation to the ground levels across the cell become more favourable for saltmarsh species. It is likely however, that sea level rise over the period will reduce the impact of some of the

	patches of saltmarsh will begin to form around the margins. If accretion rates are higher, and recent water samples suggest as much as 20 to 30 mm/year could occur (i.e. 400 to 600 mm in 20 years), a significantly larger area of saltmarsh could develop Cell C will change less dramatically, as it is currently protected not only by flood embankments, but by a strip of higher ground along the eastern side of the river. Tidal creeks will bring water into the lower lying ground within the cell, and high spring tides will inundate the area. Drainage will be slow, and standing water will be widespread, encouraging rapid accretion of mudflat, and because the ground is slightly higher than in Cell B, saltmarsh should begin to develop quite widely. <u>Habitat</u> The habitat in Cell A will become mixed, with the re-activation of the meanders, and any fossil tidal creeks, small areas of mudflat and saltmarsh will form. Areas of saline or brackish wetland will develop where standing water is trapped with the possibility of saline reedbeds developing. Much of the area will remain grassland, but with a transition to salt resistant species as the area is inundated more frequently. Cell B habitat will change significantly, with wide scale regular inundation of sea water with depths of up to 2m in places. When the tide goes out, it will leave large areas of ponded water with depths still of up to 0.5m. The area will become largely mud flat, but	such as coastal grazing marsh. The extent of saltmarsh and mudflats will have increased slightly, but the ground surface will generally be too high in relation to the neap and spring tides to support these habitats. Low lying depressions will still support areas of saline or brackish wetland where standing water is trapped. Cell B habitat will continue to change, with significant deposition of sediment and a gradual raising of mudflat. Although the cell will remain dominated by mudflats, saltmarsh will extend as water levels in relation to the ground levels across the cell become more favourable for saltmarsh species. It is likely however, that sea level rise over the period will reduce the impact of some of the saltmarsh growth. The habitat in Cell C will also continue to change as water levels rise with climate change and the ground levels increases with on-gong sedimentation. With a range of ground levels within the cell, different environments will be created and colonised by a range of different species. Areas of salt resistant grassland will remain, wetland habitats will remain due to the low lying but poorly drained areas, the re-activated tidal creeks will extend in response to rising sea levels, and mudflat and saltmarsh intertidal zones will increase in response to high rates of sediment accretion. It is likely that these conditions are likely to favour the ongoing development of saltmarsh. <u>Landscape</u>	saltmarsh growth. The habitat in Cell C will also continue to change as water levels rise with climate change and the ground levels increases with on-gong sedimentation. With a range of ground levels within the cell, different environments will be created and colonised by a range of different species. Areas of salt resistant grassland will remain, wetland habitats will remain due to the low lying but poorly drained areas, the re-activated tidal creeks will extend in response to rising sea levels, and mudflat and saltmarsh intertidal zones will increase in response to high rates of sediment accretion. <u>Landscape</u> The change in landscape to Cell A will be largely down to the continued increase in the frequency of inundation as sea levels continue to rise, this will change the balance of grassland and intertidal zone in favour of the intertidal zone, with increased saltmarsh and mudflat formed. The change in the overall landscape across the floodplains in Cell B will be minimal over this time frame. After 100 years, the system will have developed into a mature intertidal zone, with a slow rate of accretion nearly balanced by a slow rate of sea level rise. It is thought most likely that the accretion rate will exceed the sea level rise, and the ground levels in many areas within cell will continue to rise with expanding extent of saltmarsh.

	with saltmarsh developing on the margins left uncovered during neap high tides. The habitat in Cell C will also change, with a range of ground levels allowing different environments and colonisation by a range of different species. Areas of salt resistant grassland will remain, wetland habitats will form due to the low lying but poorly drained areas, tidal creeks will be re-activated and mudflat and saltmarsh intertidal zones will develop in response. <u>Landscape</u> The change in landscape to Cell A will be dominated by the loss of embankments allowing occasional inundation of the parts of the cell, and the affects of the re-activation of the meanders. The vegetation across the cell will change to become more salt tolerant, however the grassland will still look largely the same. Additional wetland and areas of standing water will be a feature, and small areas of mudflat and saltmarsh will begin to form around the re-activated tidal creeks. The change in landscape across the floodplains in Cell B will be enormous. With the loss of the raised embankments there will be rapid change from the current grazing land and fields to an intertidal system with extensive areas of inundation at high tide, and large areas of standing water when the tide goes out, vast areas of developing mudflats, and pockets of developing saltmarsh.	The change in landscape to Cell A will be dominated by the loss of embankments allowing occasional inundation of the parts of the cell, and the affects of the re-activation of the meanders. The vegetation across the cell will change to become more salt tolerant, however the grassland will still look largely the same. Additional wetland and areas of standing water will be a feature, and small areas of mudflat and saltmarsh will begin to form around the re-activated tidal creeks. The change in landscape across the floodplains in Cell B will be enormous. With the loss of the raised embankments there will be rapid change from the current grazing land and fields to an intertidal system with extensive areas of inundation at high tide, and large areas of standing water when the tide goes out, vast areas of developing mudflats, and pockets of developing saltmarsh. The landscape in Cell C will also change with a variety of habitats, and in particular, more wetlands and intertidal habitats becoming prevalent, and in particular, an increase in the coverage of saltmarsh.	The landscape in Cell C will probably not have changed significantly over this 50 year period, having reached equilibrium over the preceding 50 years. There will inevitably be on-going dynamic changes to tidal creeks and distribution of saltmarsh, but the overall landscape will remain largely the same.

	The landscape in Cell C will also change with a variety of habitats, and in particular, more wetlands and intertidal habitats becoming prevalent.		
Intervention	Raise the concrete road on the east side of the valley by 2.5m and continue it along the floodplain edge to the beach. Raise the middle section of the Vanguard Way by 2.5m (to 5-5.5m OD), to ensure that it is above flood level.	The A259 causeway will be raised by 2m (to 5.7mOD). Revet the causeway's seaward slope.	None proposed.
The mouth of the Estuary	Once completed, the re-engineering of the tidal creeks and extensive areas of inundation is likely to keep the river mouth free from the build up of any shingle. The mouth of the river is likely to widen, bypassing the failing training walls, and will become more mobile.	The river mouth will be largely self clearing and the training walls will have fallen into disrepair. The mouth of the river is likely to widen further and remain mobile. Its exact location is impossible to determine, however it may tend to stabilise in a relatively central location.	The river mouth will remain largely self clearing and all traces of the training walls will have gone. The mouth of the river is likely to remain mobile, however it may tend to stabilise in a relatively central location.
Intervention	None – unless blockage threatens to increase flood risk upstream at Alfriston. Occasional dredging may then be required.	None – unless blockage threatens to increase flood risk upstream at Alfriston. Occasional dredging may then be required.	None – unless blockage threatens to increase flood risk upstream at Alfriston. Occasional dredging may then be required.
The beach	Once re-cycling of beach material from the river mouth ceases, the general eastern movement of material along the coast will quite quickly reduce the west beach, adding to the volume of material on the east beach. Apart from a slight increase in material from the west beach, The east beach is likely to remain largely unchanged.	The west beach will have lost much of its current volume, and what is left will probably swing round to face a more south easterly direction allowing the river mouth to widen. The east beach will remain largely unchanged, although it is likely that it will move landwards slightly and will swing round to face a more south westerly direction. As it lengthens it will lower, increasing the probability of being over topped during a storm. This will have little impact, as the area behind the beach will be regularly inundated anyway. Sea level rise may also increase the probability of overtopping, although as the beach moves landwards it is likely that the beach will actually end up sitting on slightly higher ground so the net change could be a slight increase in height. The overall volume of material within the beach	The smaller west beach will remain quite stable once established around the toe of the western cliffs and into the mouth of the estuary where it will be protected from direct southerly and south westerly gales and wave action. The east beach will remain largely unchanged, although it is likely that it will continue to move landwards slightly and will tend to face a south westerly direction. As it continues to lengthen it will lower, increasing the probability of being over topped during a storm. This will have little impact, as the area behind the beach will be regularly inundated anyway. Continued Sea level rise may also increase the probability of overtopping, although as the beach moves landwards it is likely that the beach will actually end up sitting on slightly higher ground so the net change could be a slight increase in height.

		system as a whole is likely to remain constant.	The overall volume of material within the beach system as a whole is likely to remain the same.
Intervention	Re-cycling of beach material from the river mouth onto the west beach will continue for up to 5 years. It is likely that the requirement to dredge the river mouth will reduce under this option as the area of inundation within the estuary increases and associated increased water velocities through the mouth helps prevent the build up of shingle.	None - It is likely that the requirement to dredge the river mouth will reduce under this option as the area of inundation within the estuary increases and associated increased water velocities through the mouth helps prevent the build up of shingle.	None - It is likely that the requirement to dredge the river mouth will reduce under this option as the area of inundation within the estuary increases and associated increased water velocities through the mouth helps prevent the build up of shingle.

Policy Option	D		
Policy Reference	Maintain the existing defences		
Scenario Summary	The existing flood embankments along the river would be maintained at their present height by carrying on maintenance work as at present. No raising or strengthening work would be carried out to keep pace with climate change. According to previous modelling by the Environment Agency, continuing maintenance as at present can only be short-term. As a result of climate change there will be increased numbers of storms and sea level will rise, so the risk of overtopping will increase; in time, even if maintained, the present defences will become inadequate to prevent flooding. Beach sediment would be regularly artificially recycled from the river mouth to the West Beach as at present to keep the river mouth clear of shingle and nourish the West Beach. The training groynes at the river mouth and the groynes on the West Beach would be maintained as at present, though long-term the training walls at the river mouth will need to be replaced.		
Scenario modelling assumptions	Assume baseline model, with climate change at current levels, 50 and 100 year time horizons. Modelling will assess Increased frequency of overtopping and likely impact on floodplain behind defences.		
Location within study area	Predicted change for:		
	0 – 20 years	20 – 50 years	50 – 100 years
River channel	Change There will be very little change to the river channel over the short term, and will maintain its existing form and location. There is a possibility that a significant storm and flood event would overtop and damage the embankments, but it is assumed that the damage and any breach that occurred would be repaired. Habitat The river channel habitat will remain essentially the same as at present. Landscape The landscape will remain unchanged.	Change The river channel will remain in its current position constrained by the embankments. It is likely to become wider and slightly deeper up to the limit of the embankments to accommodate the increase in volume of water. The embankments on the northern boundary of Cell B are likely to be overtopped and possibly damaged during the spring tide, but it is assumed that the damage and any breach would be repaired. The neap tide remains within the river channel. Habitat The river channel habitat will remain similar although there may be an increase in the area of exposed mud at high tide.	Change The river channel will remain in its current position constrained by the embankments. It is likely to become wider and slightly deeper up to the limit of the embankments to accommodate the increase in volume of water. During the neap tide, all water remains within the river channel. During the spring tide, the embankments of Cell C are overtopped (at the northern boundary) but it is assumed that the damage and any breach would be repaired. Habitat The river channel habitat will remain similar

		It is unlikely that any significant additional saltmarsh will form within the channel within this period. The flow regime will remain largely unchanged as any increases in flow volumes will be compensated by increases in channel width and to a lesser extent, depth. <u>Landscape</u> The look of the river channel will remain largely unchanged, although there will be slightly more exposed mud on the margins of the river. The defences will be maintained and will therefore retain their current appearance.	although there may be an increase in the area of exposed mud at high tide. It is unlikely that any significant additional saltmarsh will form within the channel within this period. The flow regime will remain largely unchanged as any increases in flow volumes will be compensated by increases in channel width and to a lesser extent, depth. <u>Landscape</u> The look of the river channel will remain largely unchanged, although there will be slightly more exposed mud on the margins of the river. Any existing saltmarsh within the river channel will likely be eroded. The defences will be maintained and will therefore retain their current appearance.
Intervention	Continued maintenance of raised embankments, revetment where it currently exists, and clearance of the river mouth. Maintenance will be required of land drainage structures within the retained embankments.	Continued maintenance of raised embankments, revetment where it currently exists, and clearance of the river mouth. Maintenance will be required of land drainage structures within the retained embankments.	Continued maintenance of raised embankments, revetment where it currently exists, and clearance of the river mouth. Maintenance will be required of land drainage structures within the retained embankments.
The floodplain	<u>Change</u> There would be little change to the floodplains in the short term, however; the probability of a major flood event (although still very low) will increase slightly. The impact of a major flood event would have a	<u>Change</u> Due to the fairly regular inundation of Cell B during the spring tide, the landscape in the northernmost part of this cell is likely to change to a more saline tolerant species. Once inundated, the water is likely to stand	<u>Change</u> Due to the fairly regular inundation of Cell B during the spring tide, the landscape in the northern half of this cell is likely to change to a more saline tolerant species over a wider area. Once inundated, the water is likely to

	temporary impact on the floodplain, creating large areas of standing water. This water would be saline and would damage the current vegetation and would potentially leave behind significant deposits of sediment across the floodplain – particularly in Cell B. Habitat The general habitat will remain largely unchanged, although if the frequency of overtopping the existing embankments increases, the surrounding grassland will change to more salt resistant species. Landscape The landscape will remain essentially unchanged.	for a long period before draining. Neither Cell A nor Cell C are inundated during the spring tide, however it is likely that embankments of Cell C would be overtopped in a large tidal or combined tidal and fluvial event. Habitat The habitat in Cells A and C will remain virtually unchanged as they will rarely be inundated. The habitat in Cell B, particularly in the northern area will change to a more saline environment with areas of mud. Landscape The landscape will remain essentially unchanged in Cells A and C, however Cell B is likely to have some standing water for long periods and areas of mud.	stand for a long period before draining, particularly in the existing ditches and fossilised creeks. Habitat The habitat in Cells A and C will remain essentially unchanged although if inundated during a large tidal event, vegetation would be damaged and sediment deposited. The habitat in Cell B will become more widely saline. Landscape The landscape will not change significantly in cells A and C, however Cell B is likely to have much larger areas of standing water which last for long periods of time.
Intervention	None.	None.	None.
The mouth of the Estuary	The estuary mouth will require continued dredging to ensure no build up of shingle which could increase flood risk upstream in Alfriston. The river mouth will be maintained by the training walls	The estuary mouth will require continued dredging to ensure no build up of shingle which could increase flood risk upstream in Alfriston. The river mouth will be maintained by the training walls	The estuary mouth will require continued dredging to ensure no build up of shingle which could increase flood risk upstream in Alfriston. The river mouth will be maintained by the training walls
Intervention	Continued dredging to keep the river mouth free flowing. Some maintenance may be required on the timber training walls.	Continued dredging to keep the river mouth free flowing. Ongoing maintenance and replacement will be required for the timber training walls.	Continued dredging to keep the river mouth free flowing. Ongoing maintenance and replacement will be required for the timber training walls.
The beach	Re-cycling of beach material from the river mouth will prevent the general eastern movement of material along the coast, and the beach on both sides of the river will	Re-cycling of beach material from the river mouth will prevent the general eastern movement of material along the coast and the beach on both sides of the river will	Re-cycling of beach material from the river mouth will prevent the general eastern movement of material along the coast, and the beach on both sides of the river will

	remain largely unchanged.	remain largely unchanged. Sea level rise is likely to result in more frequent overtopping with potentially damaging inundation to the normally protected areas behind the beach.	remain largely unchanged. Continued sea level rise is likely to result in more frequent overtopping with potentially damaging inundation to the normally protected areas behind the beach.
Intervention	Re-cycling of beach material from the river mouth onto the west beach will continue and the beach groynes will be maintained.	Re-cycling of beach material from the river mouth onto the west beach will continue and the beach groynes will be maintained and replaced as required.	Re-cycling of beach material from the river mouth onto the west beach will continue and the beach groynes will be maintained and replaced as required.

Policy Option	E		
Policy Reference	Sustaining the defences: raising banks as sea level rises		
Scenario Summary	The river embankments would be built up to accommodate the expected future sea level rise. Raising the height and increasing the bulk of the existing defences would counteract the increasing flood risk as sea level rises. River embankments would be made higher and wider. They would be raised by 300mm at the beginning, with the addition of stone or concrete revetments in places vulnerable to erosion. In the medium term (20-50 years) the channel would be reinforced with concrete walls or sheet piling to support the second phase of bank-raising, a further 300mm to make 600mm in all, to meet the expected rise in sea level indicated in Defra guidelines. Beach sediment would be regularly artificially recycled from the river mouth to the West Beach as at present to keep the river mouth clear of shingle and nourish the West Beach. The training groynes at the river mouth and the groynes on the West Beach would be maintained as at present, though long-term the training walls at the river mouth will need to be replaced.		
Scenario modelling assumptions	As above in Option D – assuming increased flows and water levels, but will result in the same likelihood and frequency of overtopping as at present.		
Location within study area	Predicted change for:		
	0 – 20 years	20 – 50 years	50 – 100 years
River channel	<u>Change</u> There will be very little change to the river channel over the short term, and will maintain its existing form and location. It is unlikely that a significant storm and flood event would overtop the embankments. <u>Habitat</u> The river channel habitat will remain essentially the same as at present. <u>Landscape</u> The landscape will appear mostly unchanged other than the embankments will be at a higher elevation.	<u>Change</u> The volume of the river will increase as sea level rises and any saltmarsh areas within the channel will be eroded. The channel is likely to widen and possibly deepen to the constraints of the embankments. <u>Habitat</u> The current saltmarsh areas within the channel will be lost and reverted to mudflat due to much more regular inundation. <u>Landscape</u> The areas that are currently saltmarsh within the channel will be lost and replaced by mud. The embankments will be at a higher elevation.	<u>Change</u> The volume of the river will increase as sea level rises. The channel is likely to widen and possibly deepen to the constraints of the embankments. <u>Habitat</u> There will be no change from the medium term. <u>Landscape</u> There will be no change from the medium term.

Intervention	River embankments raised by 300mm. Additional stone or concrete revetments in places vulnerable to erosion.	River embankments raised by a further 300mm. Channel reinforced with concrete walls or sheet piling.	None.
The floodplain	<u>Change</u> There will be no change to the existing floodplain. The occasional overtopping of the defences that occurs in the current baseline is unlikely to occur once the defences are raised. <u>Habitat</u> The floodplain habitat will remain the same as present. <u>Landscape</u> The landscape would not change significantly, but there would be no periodic inundation.	<u>Change</u> The meanders would become shallower from siltation. <u>Habitat</u> The habitats in the meanders in Cell A would be lost. The habitats in Cells B and C would likely remain unchanged. <u>Landscape</u> The meanders would be less prominent in Cell A. The landscape in Cells B and C would likely remain unchanged.	<u>Change</u> The meanders would have been silted up and lost. <u>Habitat</u> There would no longer be water related habitats in the meanders in Cell A. The habitats in Cells B and C would likely remain unchanged. <u>Landscape</u> The meanders would be barely visible in Cell A. The landscape in Cells B and C would likely remain unchanged.
Intervention	None.	None.	None.
The mouth of the Estuary	The estuary mouth will require continued dredging to ensure no build up of shingle which could increase flood risk upstream in Alfriston. The river mouth will be maintained by the training walls	The estuary mouth will require continued dredging to ensure no build up of shingle which could increase flood risk upstream in Alfriston. The river mouth will be maintained by the training walls	The estuary mouth will require continued dredging to ensure no build up of shingle which could increase flood risk upstream in Alfriston. The river mouth will be maintained by the training walls
Intervention	Continued dredging to keep the river mouth free flowing. Some maintenance may be required on the timber training walls and groynes.	Continued dredging to keep the river mouth free flowing. Ongoing maintenance and replacement will be required for the timber training walls and groynes.	Continued dredging to keep the river mouth free flowing. Ongoing maintenance and replacement will possibly be required for the timber training walls and groynes.
The beach	Re-cycling of beach material from the river mouth will prevent the general eastern movement of material along the coast, and the beach on both sides of the river will	Re-cycling of beach material from the river mouth will prevent the general eastern movement of material along the coast and the beach on both sides of the river will	Re-cycling of beach material from the river mouth will prevent the general eastern movement of material along the coast, and the beach on both sides of the river will

	remain largely unchanged.	remain largely unchanged. Sea level rise is likely to result in more frequent overtopping with potentially damaging inundation to the normally protected areas behind the beach.	remain largely unchanged. Continued sea level rise is likely to result in more frequent overtopping with potentially damaging inundation to the normally protected areas behind the beach.
Intervention	Re-cycling of beach material from the river mouth onto the west beach will continue and the beach groynes will be maintained.	Re-cycling of beach material from the river mouth onto the west beach will continue and the beach groynes will be maintained and replaced as required.	Re-cycling of beach material from the river mouth onto the west beach will continue and the beach groynes will be maintained and replaced as required.

Policy Option	**F**		
Policy Reference	Sustaining the defences: raising banks by 300mm		
Scenario Summary	This scheme differs from Option E in envisaging a single raising of the river's flood banks by 300mm at the outset, to cater for predicted sea level rise during the next 50 years. The proposed design involves raising the river's flood embankments by 300mm while maintaining a minimum crest width of 1.5m. Beach sediment would be regularly artificially recycled from the river mouth to the West Beach as at present to keep the river mouth clear of shingle and nourish the West Beach. The training groynes at the river mouth and the groynes on the West Beach would be maintained as at present, though long-term the training walls at the river mouth will need to be replaced.		
Scenario modelling assumptions	As above in Option E for the 20 and 50 year time horizon, however in the long term, the impact of flooding will increase, as above in Option D.		
Location within study area	Predicted change for:		
	0 – 20 years	20 – 50 years	50 – 100 years
River channel	<u>Change</u> There will be very little change to the river channel over the short term, and will maintain its existing form and location. It is unlikely that a significant storm and flood event would overtop the embankments. <u>Habitat</u> The river channel habitat will remain essentially the same as at present. <u>Landscape</u> The landscape will appear mostly unchanged other than the embankments will be at a higher elevation.	<u>Change</u> The volume of the river will increase as sea level rises and any saltmarsh areas within the channel will be eroded. The channel is likely to widen and possibly deepen to the constraints of the embankments. <u>Habitat</u> The current saltmarsh areas within the channel will be lost and reverted to mudflat due to much more regular inundation. <u>Landscape</u> The areas that are currently saltmarsh within the channel will be lost and replaced by mud.	<u>Change</u> The volume of the river will increase as sea level rises. The channel is likely to widen and possibly deepen to the constraints of the embankments. It is unlikely that the embankments will overtop other than in large events. <u>Habitat</u> There will be little change from the medium term. <u>Landscape</u> There will be little change from the medium term.
Intervention	River embankments raised by 300mm.	None.	None.
The floodplain	<u>Change</u> There will be no change to the existing	<u>Change</u> The meanders would become shallower from	<u>Change</u> The meanders would have been silted up

	floodplain. The occasional overtopping of the defences that occurs in the current baseline is unlikely to occur once the defences are raised. <u>Habitat</u> The floodplain habitat will remain the same as present. <u>Landscape</u> The landscape would not change significantly, but there would be no periodic inundation.	siltation. <u>Habitat</u> The habitats in the meanders in Cell A would be lost. The habitats in Cells B and C would likely remain unchanged. <u>Landscape</u> The meanders would be less prominent in Cell A. The landscape in Cells B and C would likely remain unchanged.	and lost. <u>Habitat</u> There would no longer be water related habitats in the meanders in Cell A. The habitats in Cells B and C would likely remain unchanged. <u>Landscape</u> The meanders would be barely visible in Cell A. The landscape in Cells B and C would likely remain unchanged.
Intervention	None.	None.	None.
The mouth of the Estuary	The estuary mouth will require continued dredging to ensure no build up of shingle which could increase flood risk upstream in Alfriston. The river mouth will be maintained by the training walls	The estuary mouth will require continued dredging to ensure no build up of shingle which could increase flood risk upstream in Alfriston. The river mouth will be maintained by the training walls	The estuary mouth will require continued dredging to ensure no build up of shingle which could increase flood risk upstream in Alfriston. The river mouth will be maintained by the training walls
Intervention	Continued dredging to keep the river mouth free flowing. Some maintenance may be required on the timber training walls.	Continued dredging to keep the river mouth free flowing. Ongoing maintenance and replacement will be required for the timber training walls.	Continued dredging to keep the river mouth free flowing. Ongoing maintenance and replacement will be required for the timber training walls.
The beach	Re-cycling of beach material from the river mouth will prevent the general eastern movement of material along the coast, and the beach on both sides of the river will remain largely unchanged.	Re-cycling of beach material from the river mouth will prevent the general eastern movement of material along the coast and the beach on both sides of the river will remain largely unchanged. Sea level rise is likely to result in more frequent overtopping with potentially damaging inundation to the normally protected areas behind the beach.	Re-cycling of beach material from the river mouth will prevent the general eastern movement of material along the coast, and the beach on both sides of the river will remain largely unchanged. Continued sea level rise is likely to result in more frequent overtopping with potentially damaging inundation to the normally protected areas behind the beach.
Intervention	Re-cycling of beach material from the river mouth onto the west beach will continue and	Re-cycling of beach material from the river mouth onto the west beach will continue and	Re-cycling of beach material from the river mouth onto the west beach will continue and

	the beach groynes will be maintained.	the beach groynes will be maintained and replaced as required.	the beach groynes will be maintained and replaced as required.