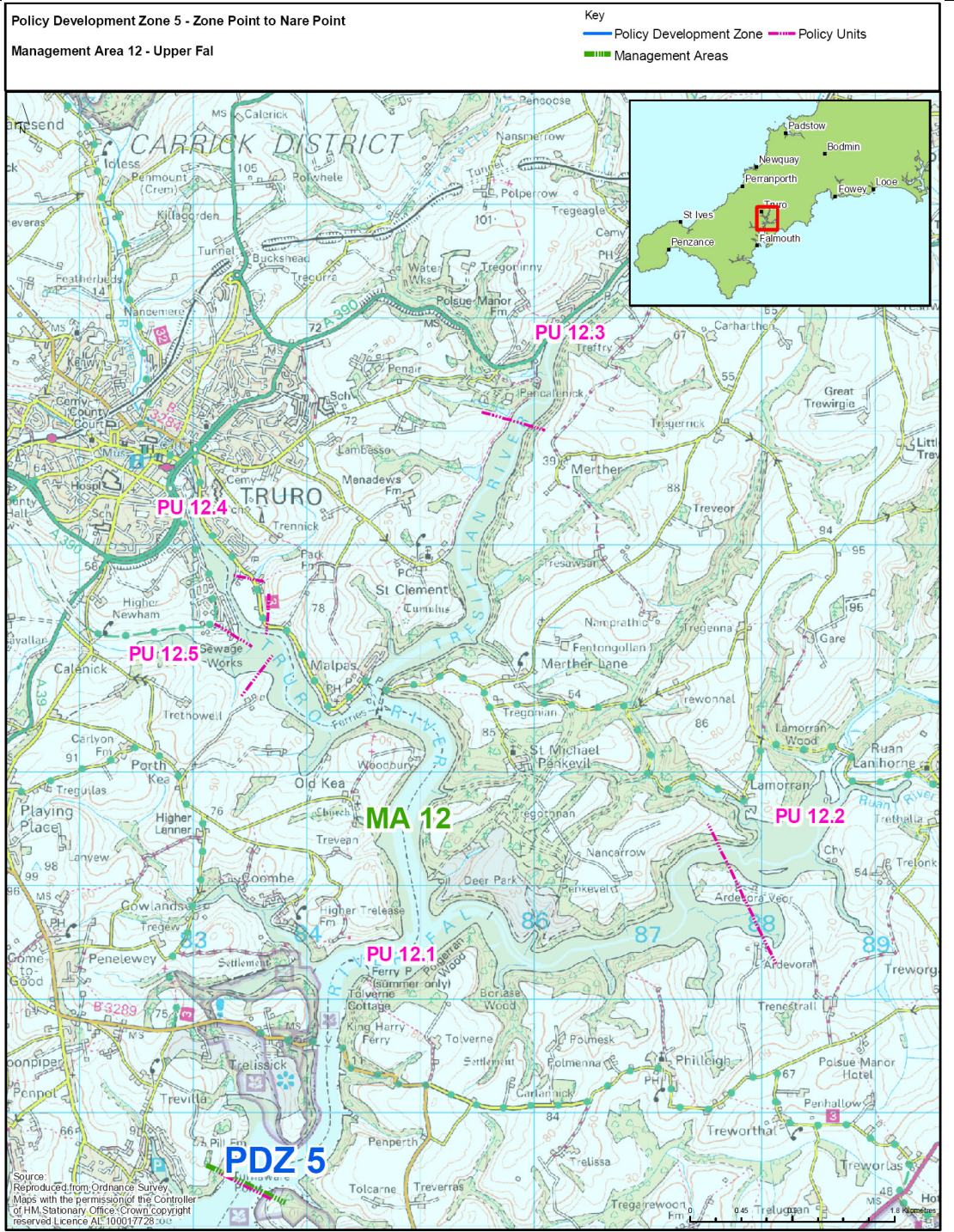


Location reference: Upper Fal
Management Area reference: MA12
Policy Development Zone: PDZ5



Cornwall & Isles of Scilly
 Shoreline Management Plan Review

CORNWALL COUNCIL **Cornwall and the Isles of Scilly Coastal Advisory Group** **ROYAL HASKONING**

DISCUSSION AND DETAILED POLICY DEVELOPMENT

General discussion

As with the Lower Fal Management Area, the preferred plan for the Upper Fal aims to balance the provision of support to the core settlements with a management approach which does not adversely impact on intertidal areas and habitats and importantly takes account of any potential impacts on the Fal & Helford SAC. It is important to note that there is a legal requirement to not adversely affect the integrity of the SAC; through impacts such as the loss of intertidal feeding areas by not allowing the high water mark to move inland due to climate change.

The upper estuary differs physically and socio-economically from the lower estuary. There is much more intertidal exposed mud-flat in the upper estuary – in places the banks are quite steep and wooded, constraining the movement of mean high water but there are also significant areas where topography is low-lying, typically close to the settlements. There also appears to be a greater propensity for the accretion of sediment in the upper estuary and creeks – at Truro the artificial narrowing which has occurred at Lighterage Quay and the Tidal Barrier has served to increase the amount of sedimentation in the tidal basin adjacent to the Newham and Boscawen Park frontages, and as far up at Truro Town Quay, where frequent maintenance dredging is required to keep the channel navigable. Human development is much less prominent than in the lower estuary – only Truro (and to a lesser extent Tresillian) has significantly modified lengths of the estuary shoreline. Smaller settlements at Ruan Lanihorne, Cowlands and St Clement have only a marginal presence in terms of development and shoreline defences.

A number of different SMP policy options are proposed to implement the preferred plan at different locations. From a high level view-point, there may be a trend toward a reduction in intertidal area due to sea level rise wherever the landward movement of MHWS is constrained by the naturally rising topography or defences.

However, for much of the upper Fal estuary, it is anticipated that the effects of sea level rise will be almost entirely contained within the low-tide channels, at least in the short to medium term and is unlikely to result in any net loss of intertidal habitat. However it must be acknowledged that the picture is actually much more complex than this – erosion, accretion, sedimentation, changes in the tidal prism, increases in rainfall and fluvial flow will also affect the current pattern of intertidal exposure. Reaching quantitative conclusions for this level of detail is outside the remit of the SMP review and therefore forthcoming detailed studies at Truro should be advised to look at these factors more closely.

Importantly, this is only one aspect of geomorphic evolution due to climate change. Another very important factor which will also dictate future geomorphology of the estuary is sedimentation (both erosion and accretion). Sea level rise will lead to increased volumes of water entering the estuary system during the flood tide and this may well increase tidal flow velocities, therefore increasing erosion within the channels and on the flats. It could however promote accretion in some areas. This will result in changed patterns of deposition, possibly depositing more material in the lower estuary and scouring channels in the upper estuary. However increasing rainfall due to climate

change will increase fluvial flows coming into the estuary - and subsequently will increase the sediment load carried with them from further inland. Increased deposition due to higher fluvial flows could therefore increase sedimentation in any of the estuary channels to an extent that intertidal exposure is actually increased. Increased fluvial flows could also result in periodic erosion of the upper channels.

Ultimately the conclusion to be drawn is that the estuary is a finely balanced system and any one of these factors may become the dominant factor under a number of different climate change scenarios. For instance if sea level rise is slower than currently predicted but increasing rainfall exceeds current expectations, increased sedimentation throughout the estuary may more than balance the effects of sea level rise, leading to increased intertidal area exposure. In support of this scenario is the conclusion (presented in Appendix C) that disequilibrium has been noted for the estuary length/tidal wave length, indicating that the estuary is relatively deep throughout the Carrick Roads and that there is potential for large amounts of accretion throughout the SMP2 study area. Anecdotal evidence supports this view in certain areas of the estuary, for instance at Town Quay (Truro) regular dredging of the channel and banks is undertaken in order to keep the quay area navigable for watercraft. At St Just-in-Roseland siltation of the St Just Creek and its banks is observed on an on-going basis. .

A principal constraint for the SMP assessment therefore is that it is fairly simple to simulate changes in the current MLWS and MHWS positions within the estuary (based on current channel morphology). It is however extremely difficult (and beyond the scope of the SMP), to simulate changes in the erosional and accretional patterns due to both increases in tidal prism and increased fluvial flow and sediment availability, based on future predictions of climate change. A very detailed numerical modelling exercise may be able to provide some indication of likely changes but in reality there are so many variables that even this could never be more than vaguely indicative for time periods beyond 20 years or so.

Policy Unit discussions

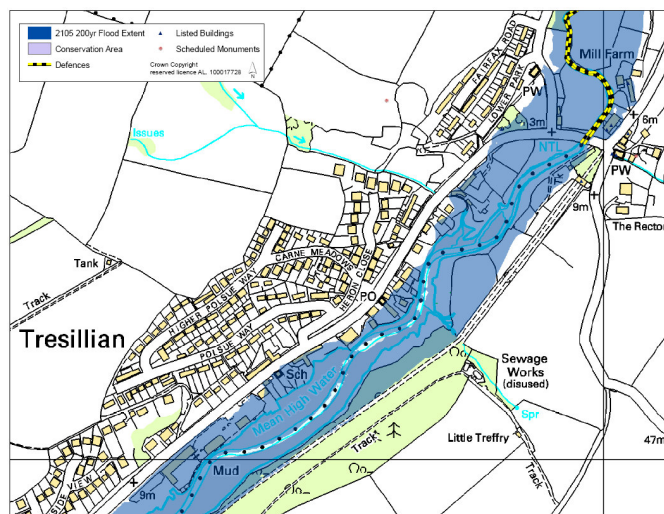
To meet the wider objectives of the Fal and Helford SAC, No Active Intervention along the **undefended estuary banks** is preferred. This would not preclude isolated and localised (privately funded) maintenance of privately owned quays along the main estuary and its tributaries. As indicated above, where the topography dictates, some squeeze between the MLW and MHW positions would be expected resulting in some potential loss of intertidal, however the accretion potential within the estuary system may offset this. The main channel of the upper estuary system from Turnaware Point to Malpas retains water at low tide however the estuary above Malpas and the Tresillian River, Laniorne Creek and Calenick Creek all contain large areas of intertidal mudflats which dry at low water.

The more significant issues at **Ruan Laniorne** relate to the SAC habitat (which comprises mudflat and saltmarsh) and the effects of sea level rise. It is likely that there will be some changes to the tidal regime (extent of inundation, duration of coverage and extreme tide heights) due to climate change and sea level rise, even at these far upstream extents of the estuary. Possible increases in the duration of inundation across the saltmarsh may change the nature of the habitat, transforming it gradually into mudflat as its coverage increases and duration of exposure decreases. The preferred plan of no active intervention essentially assumes that there will be no constraint of the

shoreline and therefore the saltmarsh habitat should be able to naturally migrate upstream or landward of the channel. In reality there may be some constraint due to the topography and in some places due to the presence of agricultural field boundaries which are privately maintained and due to the settlement of Ruan Lanihorne itself which may constrain upstream migration of the saltmarsh. Clearly whilst there will be some natural and

There are some increasing risks likely for local transport routes at Ruan Lanihorne and a small number of properties are indicated to be at risk - but this seems very unlikely to justify significant investment in defences. Risk of inundation to the road running from Ruan Lanihorne to Trelonk will increase through time. Monitoring of water levels during extreme events should continue to be part of the management approach under the preferred no active intervention policy at this location.

Tresillian - Reducing risks to the main A390 through route is a key driver at this location along with aiming to minimise losses of intertidal habitat within the Fal and Helford SAC due to squeeze. The right hand bank of the main Tresillian River Channel has been squeezed and artificially narrowed over time, as both residential and commercial development has encroached within the natural river corridor. It is this area of development encroachment which is now at primary risk from flooding during an extreme event.



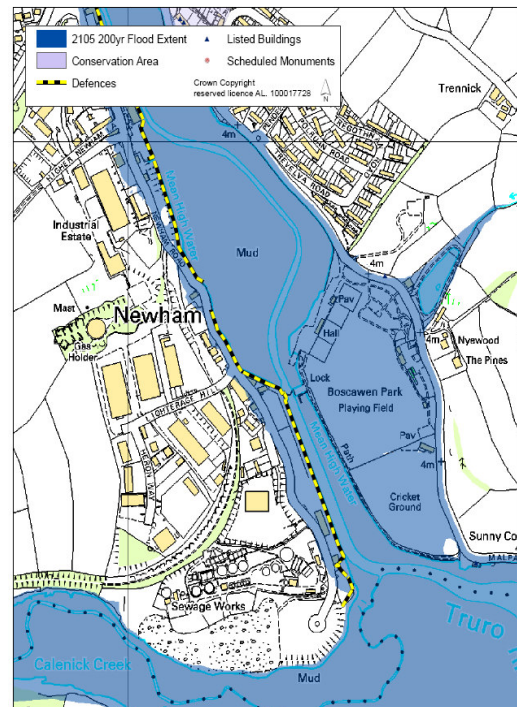
The lower section of the channel which has commercial property situated along its length may be more suited to a managed realignment approach. The upstream extent of the commercial property also coincides approximately with the upstream boundary of the SAC. Therefore undertaking realignment along this section would reduce impacts on the SAC habitats. It may also be suitable to consider some realignment and capacity for increased flood storage on the left hand bank where a road and small embankment provides an existing barrier. This would have the benefit of potentially providing some additional intertidal habitat.

The suggested approach therefore would be to consider a managed realignment strategy which looks at opportunities for creating more channel width and flood storage capacity, along both the right and left banks. It is anticipated that this could be done with the loss of only commercial properties, with minimal impacts on residential areas. The A390 should be sustainable in its current position as part of the realignment. This approach could potentially consider the area above the A390 road bridge as well. Land use planning decisions and policy should support managed realignment as part of community adaptation to sea level rise as well as increased resilience and resistance to flooding of remaining at risk property and infrastructure. Allocations to set land aside for the landward migration of the SAC should also be considered.

Truro – Upper Basin

This section of the estuary, (effectively everything upstream of the confluence with the Calenick Creek mouth, as far as the normal tidal limit at Town Quay), is treated as one policy unit (PU 12.5). It is made up of a number of frontages with differing characteristics, so a general discussion of each of these in relation to the wider policy unit and the management intent is given below.

Along the main Truro River channel, the **Boscawen Park** frontage provides some potential realignment opportunity. The preferred plan suggests that some realignment of the current shoreline position along the left hand bank adjacent to Boscawen Park could be considered in the medium term to relieve sea level rise pressure on the current channel and tidal barrier and to better manage risks to the wider area. This would also provide potential intertidal habitat creation opportunities. This would be undertaken as part of the HTL/MR policy for the wider Truro Upper Basin policy unit (12.5). The future 1:200 year flood extent for 2105 can be seen in the inset map, right.



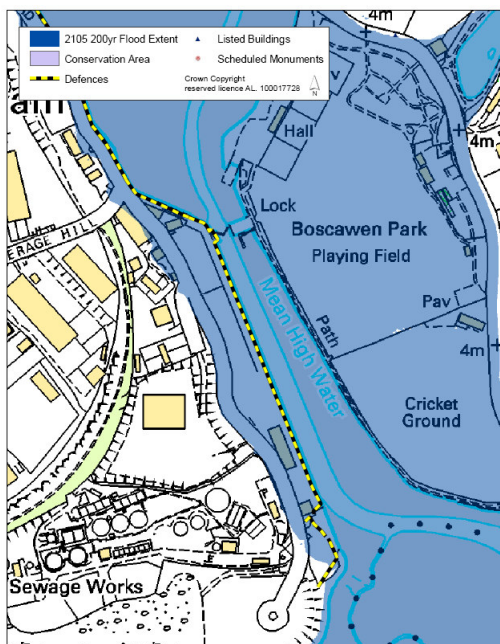
Boscawen Park itself is an area of reclaimed land, formerly part of the upper estuary basin. This reclamation, along with the construction of Lighterage Quay and the much more recent introduction of the Truro tidal barrier, has placed artificially induced pressures on the estuary channel and in particular has caused a constriction of the channel at the point of the barrier. This has had the effect of encouraging sediment accretion within the basin adjacent to the Newham frontage above the barrier and at Town Quay. Although realignment could provide channel capacity and habitat benefits, this is weighed up against the socio-economic benefits of the parks open spaces and sports playing surfaces. In addition, there has historically been a period of waste tipping and some of this refuse is starting to be exposed in the ground layers beneath the top soil where the current banks are suffering some erosion. The controlled removal of this waste would have to be managed as part of any realignment strategy. Despite the complexities, the preferred plan would be to consider managed realignment – but a more detailed investigation would be required to decide on the extent of realignment and the position of the set-back banks, and to ascertain the actual composition and nature of the waste material.

The most northerly section of the estuary considered within the SMP and the upstream extent of tidal influence, the **Truro & Town Quay** frontage is by nature of its location heavily developed. Maintenance of quay walls and channel



structures at Town Quay is important in maintaining the contribution these areas make to the socio-economic well-being of Truro. Whilst there may be interest in proposals to permanently impound water behind the tidal barrier, this would lead to a significant adverse impact on the Fal and Helford SAC and would significantly increase fluvial flood risks to the city centre. This proposal would not be likely to obtain necessary permissions to be delivered and is therefore not considered further.

Although it is possible that with sea level rise and a constrained shoreline, some squeeze of the intertidal will occur, the current bathymetry of the estuary basin and the depth of the central channel actually dictate that any losses of intertidal are likely to be very limited. In addition, potential sedimentation in the upper basin may offset or even keep pace with sea level rise.



Downstream of Town Quay, **Newham, Lighterage Quay and the Truro Tidal Barrier** form the basis for the Port of Truro commercial operations. Although nowhere near the scale of port operations seen at Falmouth, there are still significant cargo movements centred on Lighterage Quay. Channels are maintained at appropriate navigable depths for commercial vessels. The commercial Newham shoreline is fronted by a series of channel retaining walls – the navigable channel running up to Town Quay is located alongside much of this frontage. There is some limited flood risk along the frontage, which will increase through the epochs, in places this risk zone (for the 1:200 year event) may extend 4 or 50 metres inland by 2105, but rising topography then limits further inundation (see inset map, left). The tidal barrier is closed on extreme high tides to reduce tidal

flood risk to Truro.

The preferred plan would be to hold the line along Newham and Lighterage Quay as part of the wider HTL/MR policy for the Truro Upper Basin (policy unit 12.5). As with Town Quay, although some impact from sea level rise would be anticipated in terms of squeeze against the constrained shoreline, it is not anticipated that this would manifest itself as a significant loss of intertidal area. The upper basin of the river adjacent to and above Lighterage Quay is fairly typical of an upper estuarine area. The tidal hydrodynamics are influential in shaping the wide basin and creating the conditions for widespread sedimentation and accretion of fluvial derived, muddy sediments. The fluvial flows from upstream of the basin (from the Rivers Kenwyn and Allen which meet at Town Quay) are dominant in scouring out the low-tide channel.

An important characteristic of this channel is that at mean low water, the water level within the channel sits well below the level of the surrounding mudflats. Although this obviously varies throughout the basin, in general the current MLW level in the channel is around a metre below the level of the surrounding mudflats.

Therefore sea level rise is unlikely to translate into any significant horizontal movement of MLW, due to the nature of the cross-sectional profile of the wider basin and the low tide channel. Subsequently it follows that there is unlikely to be any significant reduction in the amount of intertidal mudflat exposed at low water due to the proposed policy of hold the line along the Litterage Quay and Newham frontages. So although MHW is constrained at Litterage Quay and at the tidal barrier, there would in reality be a negligible net reduction in the intertidal habitat, as the impacts of sea level rise are effectively 'contained' within the low-tide channel and these effects will occur independently of (and therefore not be linked to) any policy choice due to the estuary basin bathymetry and centre channel depth, which will tend to confine the effects of sea level rise within the channel itself.

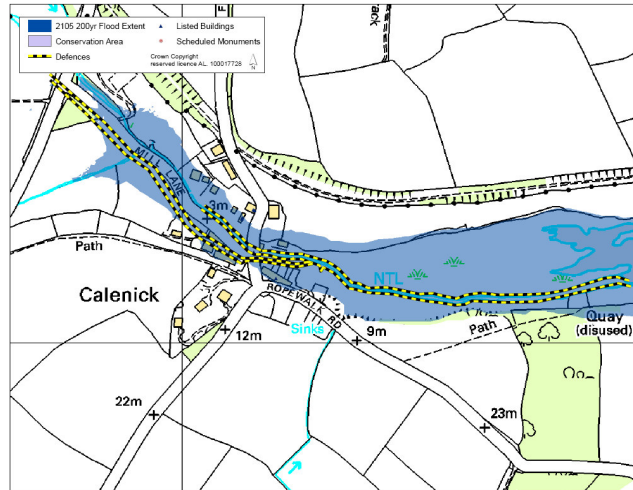
The tidal barrier at Litterage Quay maintains protection to Truro at 1:200 year standard (photo, right). Under the preferred plan the barrier would form part of a continued strategy to provide and maintain a 1:200 year standard of protection into the future. Improvements along the Litterage Quay frontage may be part of wider management of the flood risks within the upper estuary. As mentioned above, a potential area for realignment and intertidal habitat creation has been identified directly south of Litterage Quay, at the mouth of the Calenick Creek. The Local Development Framework should consider managed realignment options further as part of its aims to protect and enhance the biodiversity of the Truro River basin and to improve the waterfront and links from the water to the city.



The preferred plan for the whole tidal basin upstream of the mouth of Calenick Creek is to balance requirements for continued port and quay operations with an identification of where environmental and landscape improvements can be made. This would include maintenance of historic quay walls and channel structures at Town Quay, and Litterage Quay to be maintained with regard to commercial viability. At the same time managed realignment options are to be sought at Garras Wharf, along the Boscawen Park frontage and in the area to the south of the sewage works at Litterage Quay at the mouth of Calenick Creek. This partially reflects the high level objectives for the SMP in managing risk to communities (particularly given the high level of risk at Truro) but also recognizes the international importance of the Fal and Helford SAC. HTL is generally the preferred option as there is no scope for managed realignment around most of Town Quay, however theoretically there is scope for quite large scale realignment on the right bank, this would entail use of the Garras Wharf car park and the Tesco superstore site. It is felt that proposals to realign through this area are likely to be controversial despite the longer-term landscape and social benefits that such a strategy could deliver. However it is understood that Tesco wish to relocate to another site and land-use planners have already held initial discussion with a view

to a changing land-use type at Garras Wharf and the SMP supports this potential improvement. Again, this is something requiring more detailed assessment.

In the upper reaches of the **Calenick Creek**, there are maintained open channels and culverted channels for flood water storage (see inset map, right). Future flood risk at Calenick is indicated to affect the Old Falmouth Road along with some residential properties and commercial assets. More detailed assessment of future risk may be required with appropriate future flood warning services considered and improvements made to the resilience of estuary-side community through managed realignment.



A realignment approach provides emphasis in terms of managing the flood risks to the community – it may also provide some intertidal habitat creation opportunities, though these would probably be limited. It has been considered that this unit could be managed under a no active intervention policy, with an acceptance that NAI does not preclude the management of the channels for the purposes of flood water movements. Essentially MR (or NAI) are preferred to a hold the line approach, because there would be no intention to place a constraint on the evolution and natural of the estuary, just an allowance of the With Present Management scenario to maintain the channel and culvert for their current purpose.

The economic assessment for Management Area 12 provides a more robust benefit / cost ratio (1.97) than that provided for the Lower Fal. There is therefore less sensitivity to increasing or decreasing costs (see the Economic Summary Table below and Appendix H). This more robust ratio is almost entirely a function of the higher populated area at Truro which is at risk of flooding. It is felt overall there is economic support for the preferred plan, particularly of the combined hold the line and managed realignment approach which is preferred for the upper basin area at Truro, including the Literage Quay, Tidal Barrier, Newham, Garras Wharf, Town Quay and Boscawen Park frontages.

SUMMARY OF PREFERRED PLAN RECOMMENDATIONS AND JUSTIFICATION PLAN:

Location reference:	Upper Fal
Management Area reference:	MA12
Policy Development Zone:	PDZ5

PREFERRED POLICY TO IMPLEMENT PLAN:	
From present day (0-20 years)	NAI along undefended estuary banks. NAI at Ruan Lanihorne. HTL at Tresillian. HTL/MR for Truro - Upper Basin. MR at Calenick Creek.
Medium term (20-50 years)	NAI along undefended estuary banks. NAI at Ruan Lanihorne. MR at Tresillian. HTL/MR for Truro - Upper Basin. MR at Calenick Creek.
Long term (50 -100 years)	NAI along undefended estuary banks. NAI at Ruan Lanihorne. MR at Tresillian. HTL/MR for Truro - Upper Basin. MR at Calenick Creek.

SUMMARY OF SPECIFIC POLICIES

Policy Unit		SMP1 Policy	SMP2 Policy Plan			Comment
		50 yrs	2025	2055	2105	
12.1	Undefended Estuary banks	<i>Not considered in SMP1</i>	NAI	NAI	NAI	To meet wider objectives of Fal and Helford SAC
12.2	Ruan Lanihorne	<i>Not considered in SMP1</i>	NAI	NAI	NAI	Some increasing risk to local transport route and small number of properties is indicated but this seems unlikely to justify significant investment in defences. Monitoring of water levels during extreme events should continue to be part of the management approach under the preferred NAI.
12.3	Tresillian	<i>Not considered in SMP1</i>	HTL	MR	MR	Reducing risks to the main A390 through route is a key driver at this location. A longer-term managed realignment approach would be preferred along this length.
12.5	Truro – Upper Basin	<i>Not considered in SMP1</i>	HTL/MR	HTL/MR	HTL/MR	Preferred plan is to balance requirements for continued port and quay operations with an identification of where environmental and landscape improvements can be made.
12.6	Calenick Creek	<i>Not considered in SMP1</i>	MR	MR	MR	More detailed assessment of future risk may be required with appropriate future flood warning services considered and improvements made to the resilience of estuary-side community through MR.
Key: HTL - Hold the Line, A - Advance the Line, NAI – No Active Intervention MR – Managed Realignment						

ENVIRONMENTAL ASSESSMENT

Strategic Environmental Assessment (SEA):

For the Upper Fal, the long-term policy of NAI will allow natural processes to prevail benefiting the Upper Fal Estuary & Woods SSSI, saline lagoon and reedbed BAP priority habitats. The other policies for this management area of HTL and MR will also ensure the continued protection of residential and commercial properties and assets associated such settlements as Truro.

Although such policies may have minor impacts on designated sites the Fal & Helford SAC through coastal squeeze as a result of sea level rise and the constraint of hard or high ground on the boundary of the site. The absolute quantity of loss of intertidal features such as mudflats throughout the estuary as a whole as a result of this is not known. This loss from coastal squeeze as a result of natural topographic constraint will occur in-combination with the constraints resulting from HTL policies (or semi-constraints provided by MR policies). However, given the MR proposals for the sections of the sites that will be constrained, overall there would be a greater area for intertidal mudflats to migrate, or intertidal mudflats will experience accretion rates in line with sea level rise, such that there would be no overall loss (and potentially an increase), as a result of SMP policies.

Appropriate Assessment (AA):

In summary, up to 11.1ha of intertidal habitats could be lost in a conservative scenario for locations where intervention (HTL or MR) is to be undertaken by Epoch 3, however, overall, MR actions are expected to result in the provision of 14.05ha of area for intertidal habitat to migrate to, and overall this shows there would be no net loss in intertidal habitat extent.

IMPLICATION WITH RESPECT TO BUILT ENVIRONMENT

Economics Summary		by 2025	by 2055	by 2105	Total £k PV
Property	Potential NAI Damages (£k PV)	3944.9	2321.1	876.6	7142.6
	Preferred Plan Damages (£k PV)	591.7	348.2	131.5	1071.4
	Benefits of preferred plan (£k PV)	3353.1	1973.0	745.1	6071.2
	Costs of Implementing plan £k PV	1538	773	768	3079
				Benefit/Cost ratio of preferred plan	1.97

Notes

Robust B/C ratio, with higher ratio for the highly populated areas of Truro.

Traffic losses not considered which would inflate B/C ratio.