Design considerations

There are many different considerations, so good forward planning will help you immensely.

Most importantly:

- Softer solutions should be used where possible
- Look to the surrounding area to influence your design

Many other factors will all influence your choice between design options. These will include:

- your key masterplan aims
- the land value of the project site and adjacent areas
- the flood risk assessment and the locations of the first inland constraints at any point.

Also, bear in mind that any designs are site-specific and depend on local circumstances.

Adjacent land use

The estuary edge will normally be just part of a larger development area that will have detailed development proposals or a masterplan of some kind. There may well be opportunities for a landscape design that highlights the interesting estuary character – this can create exciting landscapes that are not common in the wider urban environment. All elements of masterplanning, including water access and transport routes, wider wildlife corridors, and Sustainable Drainage Systems, should be considered in parallel with the estuary edge and waterside design options.

Land drainage

You should also consider your land drainage strategy and how it will interact with any intertidal system. Such an approach can lead to other benefits. For example, you might choose to discharge rainwater above the highest astronomical tide into a waterside habitat sequence – this helps create a variety of edge salinities and habitat variety. It could also avoid 'tidal locking' (this is when drainage outlets may be below low water level and pumping is required to discharge the run-off).

Bad drainage design can lead to problems with estuary habitats. For example, poorly designed outfalls can lead to local erosion damage, possibly increasing flood risk or damaging habitats. In addition, you need to consider land contamination – there are generally ecological solutions even at the most contaminated sites. This is addressed in some detail in the *Building a better environment: A guide for developers*, Section 2.2.7.

Flood risk management

The features of the flood risk management system that need to be considered include:

- Land-based loadings (for example, soil, water, buildings, vehicles, etc.).
- Current flow, waves, boat and propeller wash, and risk of illegal mooring.

- Anticipated future estuary uses.
- Durations of all forces, especially peak forces.
- Frequency and duration of inundation of the waterside area under consideration (tidal level).
- Ground conditions and geology.
- Gradients of any maximum slopes necessary in the space available and stability of substrates at those gradients.
- The strength and durability of individual components and the elements included in the design.
- Water chemistry and factors affecting growth of plants in the intertidal zone.
- The overall desired lifespan of the design.
- Monitoring and maintenance.

You will need to set out your proposals clearly, both in terms of what you propose to build and how you intend to build it. You will need to specify how both the integrity of the estuary edge structure and flood risk management functions depend on elements other than hard engineering.

Navigational safety

Some engineering designs may create submerged hazards that may be necessary to day-mark for boats. In the case of softer margins, signage to deter unwanted mooring may be necessary both for protection of the edge and public safety. You also need to think about safety features for escaping from the water, such as grab chains.

Archaeology and heritage

We will be keen to hear how your design will both respect and celebrate heritage. It is important to check whether you are likely to affect any features of archaeological or heritage importance (such as those listed on the National Sites and Monuments Record or by local museums). In London, for example, the entire foreshore is considered to be of 'high archaeological potential'. Along many of our estuaries, historic wharves are protected by specific planning policies.

Wildlife and green space

83.5% of the estuaries in England and Wales carry one or more designations as a Special Area of Conservation, Special Protection Area or Site of Special Scientific Interest. Many estuaries also carry local designations, so it is highly likely that your site will be in, next to, or close to a designated wildlife site. These designations need not, however, be a constraint. On the contrary, soft-engineering solutions are almost always going to improve the local conditions for valued flora and fauna and hence the integrity of the designated areas.

As with any development project in any habitat, you will need to fully assess how you will manage legally protected species.

In order to minimise any adverse effects on wildlife during construction itself, you should have a construction management code. This would, for example, check whether waterfowl feed or roost in the shoreline or on the nearby mud and shingle flats. Your proposals should seek to minimise disturbance, perhaps using various types of temporary and permanent screens or by timing the works around these seasons. You should also be aware of likely movements and behaviour of fish locally (The Environment Agency can often provide these data) and whether your site is close to key spawning areas.

The key zone for the growth of true saltmarsh is between Mean High Water Neap and Mean High Water Spring tide level and in many cases the aim should be to maximise the area of habitat created in this zone. However, the whole zone, from lowest tide mark to highest astronomical tide, is 'foreshore' and considered to be valuable habitat. The zone between 0.5 to 1 metre above highest astronomical tide, especially where there is a splash zone, is also of ecological importance and may support important shingle beach species. When designing areas of significant salt influence, you should note that naturally occurring saltmarsh in the UK is rarely stable at a slope greater than 1:7 and hence you should try to ensure that this slope is not exceeded in any area that you hope to support saltmarsh. Where substrates are made of larger particle sizes (such as shingle beach or boulder), steeper natural slopes supporting at least some vegetation can be stable.

You should always encourage and promote natural colonisation in the design as this will create locally appropriate communities. However, planting may be needed when:

- there appears to be limited scope for such natural colonisation, such as a lack of a seedbank that can reach the site naturally.
- early vegetation establishment is required for slope stability.

Timing of the planting and pre-establishment of species of the correct genetic strain will be important considerations. Use of rhizome or root barriers may be necessary to maintain the integrity and appearance of planted stands and prevent domination by particular species such as Common Reed, which can otherwise become completely dominant and diminish biodiversity. You should obtain specialist ecological advice from a consultant with prior experience of intertidal plantings to ensure that plants are of appropriate species and, wherever possible, of local origin. Plants also need to be selected at the correct size, planted at the correct tidal level, and in appropriate groupings to ensure maximum chance of establishment.

Some invasive species that may be particularly problematic in the intertidal margins include Japanese Knotweed and Chinese Mitten Crab. You should consult us directly for specific advice if such species occur on site or in the local vicinity and we will advise you how to meet design and legal requirements. Wildfowl themselves may be a problem as they feed on intertidal marginal plant growth. This risk needs to be assessed and if necessary protection measures put in place, such as fencing or mesh netting.

Many of our estuaries through urban areas include areas of derelict land that have been colonised naturally by numerous species of plants, invertebrates, birds and other species of notable ecological value. For example, along the urban Thames, the nationally rare breeding bird, the Black Redstart is often associated with tidal fringe habitats and benefits from low-nutrient, flower-rich habitat. Such low-nutrient species-rich swards can very readily be created along the water's edge itself or on nearby roof spaces. In the case of the roof space, creating such habitats will give multiple environmental, architectural and economic benefits.

You should also consider providing artificial refuges and freshwater wetland features for bats, some species of which may focus their feeding activities along the tidal water.

The importance of sustainable urban drainage and its integration with intertidal habitat creation is explained in *Building a better environment: A guide for developers*.

Careful waterside design will complement the ecologically designed flood defences. For example, at Barking Barrier the creekside was developed as wildflower-rich parkland to complement the set back flood defences. In another of our projects, in Essex, excavations from shoreline were used to make the new retreated revetments and create a saltwater lagoon. Behind the revetments the area of the excavation was developed as a freshwater lagoon, creating a sequence of complementary habitats of considerable value to wildlife.

Black Redstart on brownfield substrate

Top of river wall along Deptford Creek, London

Low-nutrient eco-roof in London

Public access

It is a key element of our policy to promote good, safe public access to estuaries. This may be achieved in many ways:

- Highways authorities are obliged by law to produce Local Rights of Way Improvement Plans.
- There may also be opportunities to work in collaboration with Natural England and Countryside Council for Wales to meet the aims of their Coastal Access initiatives.

When improving access, careful consideration should be given both to ensuring public safety and protecting wildlife. It may be appropriate to deter access to certain areas of foreshore where substrates are dangerous. In other areas, protection of waterfowl from disturbance may be a concern.

Education, aesthetics and art

With any project you should take every opportunity to make design references to environmental issues and social history. Extending the landscape design from the intertidal into the water's edge can produce striking landscapes. You should also consider seasonal changes in appearance – for example, Common Reed may remain as attractive stands in winter, whilst other species may die back to root stock or need to re-establish each year from seed. You should, however, avoid creating monocultures. This is both in the interests of biodiversity and of plant protection, as it reduces the risk of pest species reaching 'plague' proportions and damaging the planting severely.

The shoreline offers opportunities for artistic and aesthetic expression in the design. Signage for example can be dramatic and multifunctional. Sculptures in the intertidal zone can be particularly spectacular and also educational in terms of our relationship with nature and natural forces. Examples include Anthony Gormley's *Another Place*, at Crosby near Liverpool where 100 statues of men stand looking out across Liverpool Bay. Remember that any installations would have to be compatible with navigational safety requirements.

Intertidal sculpture by Anthony Gormley, Crosby

Last but not least all of these installations need to be explained to the observer, or they will be misunderstood and may even be criticised. Environmental signage should be eye-catching, artistic and robust.

Vertical sign illustrating the tidal range, Greenwich, London

Another key consideration is the trapping of litter, flotsam and jetsam. Litter collection barges could be installed in conjunction with the port authority or estuary clean-up groups. You can consult the Environment Agency and the local navigation authority about such initiatives.

Sustainability of materials

You should use recycled materials wherever appropriate. A recurring issue is the use and re-use of timbers. You should ensure that there is a mechanism for regular checks of the integrity of any intertidal timberwork, as well as a suitable maintenance regime.

Treated timber should be avoided due to their risk to river life from toxic wood preservatives leaching into the river. Timbers with a relatively limited lifespan (such as untreated pine) may also be used but particular attention will need to be given to monitoring their condition for repairs (see the Section 8 on aftercare and monitoring).

Vertical timbers and wood panelling, Deptford Creek, London

Wherever possible, when choosing other construction materials, you should opt for those of the greatest surface roughness for claddings in the intertidal zone. This is to provide stable colonisation by surface-dwelling algae and plants.

Unexploded ordnance

You should take reasonable steps (by desk-based research and, if necessary, remote survey) to assess the likely risk of unexploded ordnance. Deep estuarine silts can harbour dangerous unexploded ordnance that can migrate downstream over time, ending up in unexpected locations and at unexpected depths. In high-risk areas of unexploded ordnance, traditional hard-engineering techniques will be more hazardous.

Indemnity

You need to consider various factors when indemnifying intertidal defences:

- Indemnities applied to component products
- Frequency of repair and maintenance.
- Precedent projects
- Safety and cost implications of worst-case failure.

Sometimes more than one party can be involved in providing the overall indemnification for a design. For example, when timbers were added to a vertical wall for visual and ecological reasons (see Case Study 9 in the section on structurally engineered designs), the Local Authority may accept responsibility for their insurance and maintenance.