Musselburgh Flood Prevention - some natural thoughts
Roger Crofts

1. **What are the issues?**

Esk valley and adjacent coast are important nature, residential, business and recreation areas. There are nature hotspots from source to sea.

The river basin is not well managed with overgrazing and lack of natural vegetation cover in the upper reaches.

The river is not natural any longer due to reservoirs for water supply, weirs for power for past industrial activity, and canalisation ostensibly to prevent flooding.

Flood risk is thought to be highest at the interaction of river and sea in the estuary intertidal area and from the river basin. Sea level rise and predicted greater storminess will increase the probability of flooding along the lower reaches of the river and along the coast. Action is needed. But what should that action be?

In a world of twin biodiversity and climate change crises, we need an approach therefore which is carbon and other GHG neutral and delivers biodiversity benefits, as well as benefits to resident people. More imaginative approaches are available and can result in gains for the environment and for people over generations at a lesser cost than the proposed scheme. When many experts in Scotland and around the world are arguing for and implementing Nature Based Solutions why is this approach not being adopted throughout the catchment of the Esk, both North Esk and South Esk? It should be! This approach has been successfully adopted in The Borders for example on the Eddleston Water. So let the public authorities, SEPA, Nature Scot and the two local councils, East Lothian and Midlothian work productively together to bring about this transformative change in the whole Esk catchment. It will improve amenity and landscape, it will reduce water flow into the river channel, it will improve the value of the land and will help to reduce, although not eliminate, the flood risk in Musselburgh.

2. **What should be done?**

My emphasis is on nature based solutions as now being advocated and used around the world. The Esk valley and Musselburgh should not be exception.

The river catchment

Six points to be addressed to reduce flood risk and result in improved biodiversity and landscape. The river is short and ‘flashy’ for a range of reasons: overgrazing in the uplands in The Moorfoot and Pentlands Hills, artificial structures channelling and increasing the speed of flow, cut off from its natural floodplains.

1. **Slow the flow of water in the river** by blocking drains in the uplands; reducing or stopping grazing through public benefit agriculture scheme post Brexit proposed by the Scottish Government; using permeable surfaces in all new housing developments as part of planning and building consents; planting trees on permanent grassland, as market for lamb is declining rapidly, and along riparian margins to capture water and carbon and produce nutrients to improve water quality. Formal consideration should be given to re-introducing the European Beaver as a natural water engineer which would also improve biiodiveisty and increase carbon sequestration. That would be preferable also to killing beaver that have caused damage on the Tay catchment.

2. **Reduce sediment into the river** by riparian planting of native trees.
3. **Store water** by opening up natural flood plains through the proposed land restoration schemes of Scottish Government and agree compensatory storage in all of the reservoirs on both rivers in deals with Scottish Water.
4. **Let the river behave naturally** by removing all artificial barriers which are no longer needed, and which mean that the river cannot fulfil the EU Water Framework Directive 'good ecological quality' now adopted in Scottish legislation.
5. **Reduce plant debris**, especially large tree trunks, from blocking the river in its lower course by installing spikes in the river just above the Jugglie Bridge, and therefore safeguarding the two protected bridges, Roman and Rennie, from damage.
6. **Protect all soil** in the catchment from loss downstream and to enable it to store more carbon and reduce the sediment load in the river channels, through the existing Codes of Good Agriculture Practice and the Principles of the Statement of Rights and Responsibilities for the land approved by the Scottish Parliament.

The river estuary

The issue in the river estuary is a short term high water levels, about 2 hours either side of the highest spring tides, that can fill the channel and breach the retaining walls, especially below the Pipe Bridge and potentially above there to the Roman Bridge with increased storm events and higher sea levels. Therefore, does a hard engineering solution make sense and is it necessary? What are the alternatives?

1. **Do not replace the three bridges** Why remove the existing 3 bridges: Store Bridge, Electric Bridge and Pipe Bridge just because a few tree trunks might possibly get caught on the pillars in the river and raise the water levels? Not only is this not needed for the reasons stated below, but it is also costly, about £20m perhaps, and the disruption effect on the nearby residences, on all of those who use these bridges, including school children and elderly people, will be excessive. Also, this is not an environmentally friendly solution. The energy requirements will be carbon intensive for demolishing the bridges and for making the concrete for the new ones and will be out of all proportion to the benefit of having a single span in each case. The simple alternative is to place tree catchers above the Jugglie Bridge downstream of the main concentration of willows. The willows are the most prone to breaking off as they lean over the river from the Jugglie Bridge up stream through The Grove as far as Cowpits. The money saved can then be redeployed to more imaginative solutions along the coast.

2. **Block the Mill Lade** The Mill Lade should be blocked off at the upstream end to ensure that any water does not flood the town and enter the river downstream of the bottom weir and raise the water level at times of high sea and river flows.

3. **Manage the grass areas as water parks** The grass areas with flowers beds and trees below the Roman Bridge are a very important amenity for the town and should be retained at all costs. They could be used as a flood area when needed and provide a greater natural diversity of habitats.

4. **Provide barriers to stop water ingress to properties** Rather than build the wall planned for the river banks from the Roman Bridge to the coast, simple, cheap and visually unintrusive barriers should be provided for the entrance to the grounds of

each property for use when water levels are predicted to be high. Also all drainage pipes from properties should be fitted with non-return valves.

5. **Consider an offshore barrier** to reduce amount of seawater in the estuary. This is discussed further below.

The coast

With sea level already rising and the likelihood of more extreme weather events bringing storm surges the naturally soft coastal edge will be under threat. The Dynamic Coast assessment led by Glasgow University indicates that the coast has built out and heightened since the sea wall to the east of the river was built. However, that study predicts that the coast will be very vulnerable to erosion over the coming decades.

It is clear what cannot be done. The tides are predicted for decades forward and are a given with the lunar monthly spring tides. The estimated sea level rise provides a range of predictions by the exerts working in the IPCC groups; the middle range forecast for 2050 +and 2100 seem at the present point in time to be the best to accept for working purposes. Despite what the consultants say, it will not be possible to future proof the defences until 2100 as major changes in sea level could occur due to accelerated melting of the West Antarctic Ice Sheet and the Greenland Ice Sheet which are the two biggest influences on additional global sea level rise, beyond the present ice melting and thermal expansion of the oceans. However, weather conditions still remain difficult to forecast, but climate forecasting predictions all show increased storminess and high intensity events.

The consequences for Musselburgh are available in the Dynamic Coast work. In brief, it suggests (subject to confirmation from the expert team) that there will be intense coastal erosion nd coastal edge retreat by the middle of the century. This might mean that natural coastal defences such as dune reinforcement or beach nourishment will not work. All of this needs answers to the questions I have put to the experts.

What are the options?

1. **Beach nourishment**

The higher the beach the more wave energy it takes to naturally remove it. Beach nourishment, along with groynes to stop longshore drift has worked well at Portobello. Why not try at Fisherrow Sands where there is a plentiful supply of sand out beyond the river delta?

2. **Dune reinforcement**

Although not perfect to resist high intensity waves, dunes with the deep and extensive root systems of marram and lime grasses can provide some resistance. This is obvious long the beach between the river mouth and Mountjoy and immediately west of the harbour. Planting more grasses and placing brash along the drift line can aid the natural process which has been occurring for some decades at the river end and more recently at the harbour end.

3. **Offshore wave energy disperser**

Some coasts, for instance the North Sea and Baltic Sea coasts of Germany, have natural offshore barrier bars. These disperse the energy of the waves before they reach the intertidal area. We do not have this natural feature, but a constructed barrier, made out of redundant materials, such as tyres, is possible. This has been tried for instance in Norfolk with some success. It represents humans mimicking nature.

4. **Offshore barrier**

Developing an offshore barrier between the lagoons sea wall and the Brunstane Burn, or even as far as Portobello, should be considered at this stage. This is a more fundamental approach, not really natural and carries both benefits and costs. It would be very costly, would raise issues about the protection of shore bird habitat of international significance in the intertidal area and perhaps on adjacent shorelines. However, it would provide potential new habitat in the form of tidal mud flats and salt marsh, would create new low intensity recreation opportunities, create potentially new travel opportunities and fundamentally negate the need for traditional sea walls along the coast or along the promenade.

5. **Sea wall along the coast**

This is what we might call the King Canute potion, i.e. digging a deep trench for the base of the sea wall, to fossilise the dune system behind it, and to cause more rapid erosion of the upper sandy/gravelly beach than currently occurs. It does not make any natural common sense and should be discarded.

6. **Sea wall behind the sand systems**

This is the traditional solution of engineers with the potential to raise the level of the wall as sea levels rise to resist later water incursions. However, it is unsightly, blocking the land from the sea, ignores working with nature, is energy intensive and therefore not carbon neutral in the context of climate change, and means that the beach and dunes will be lost over time. It is not recommended until the other options have been properly studied and coastal expert assessments provided.

Conclusions

It is clear from all of the expert scientific and environmental management advice available that a Nature Based Solution for the whole catchment of the Esk, alongside some small amount of engineering work in Musselburgh and Fisherrow, is the most beneficial solution. It will be an exemplar of best practice which all of the communities and public authorities within the catchment can be proud of. It will cost significantly less than the so called Preferred Scheme approved by East Lothian Council. It will have substantial net climate change mitigation and adaptation, as well as biodiversity, benefits, for the whole area. But it needs the key public authorities to both recognise the potential that is available and to work effectively together to enable the solutions to be put in place. I call on SEPA, Nature Scot, Midlothian and East Lothian Councils, with the active engagement and financial support of The Scottish Government to bring about this approach which benefits people and nature.

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