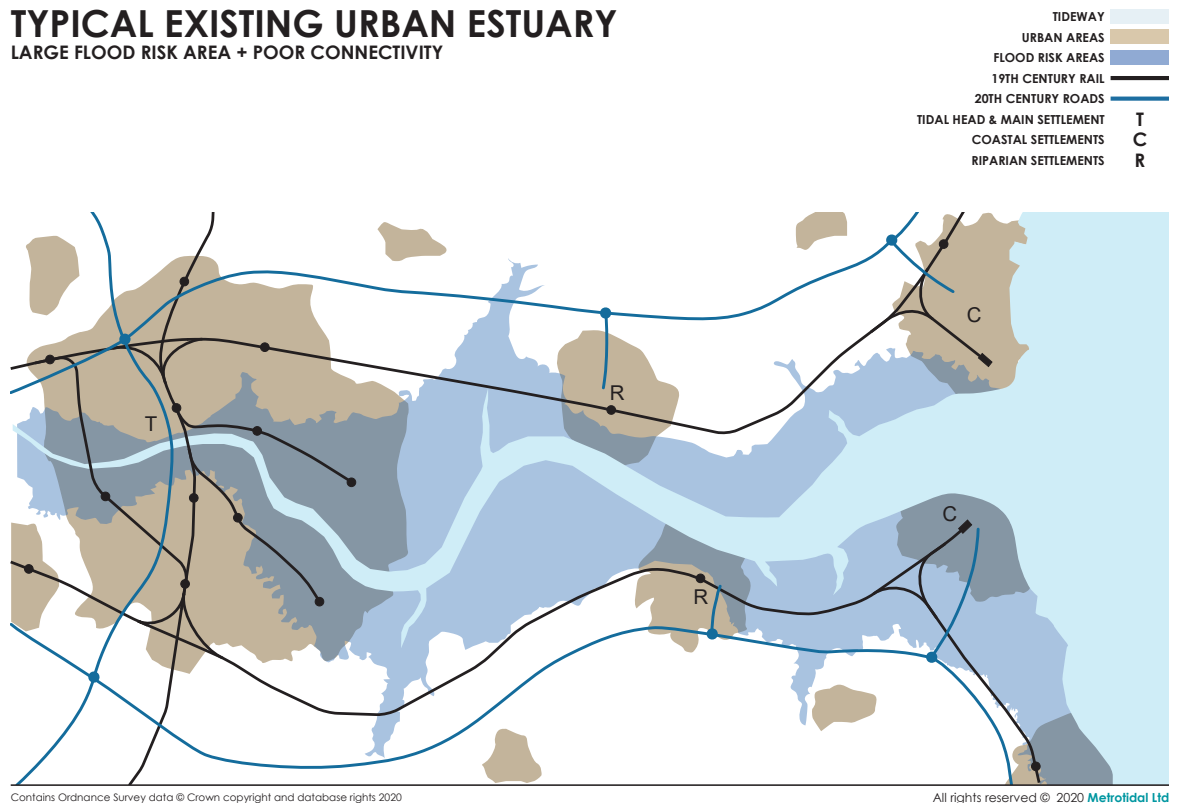


# Coastal flood defence and urban connectivity

Mark Willingale expands on his thinking on taming the tides for green-growth across the Thames Estuary in the last issue.

## TYPICAL EXISTING URBAN ESTUARY LARGE FLOOD RISK AREA + POOR CONNECTIVITY



The generic Metrotidal Urban Orbital, developed from the Thames case with detailed hydraulic modelling by HR Wallingford, integrates a throttle flood defence system with a new rail link to provide improved flood defences for an estuary region while generating agglomeration benefits by uniting estuary and coastal communities around an urban transport and data orbital. A current flood defence programme of managed retreat that sacrifices land to the sea while increasing the length and height of inland flood defences would be replaced by a shorter, lower, more robust flood defence line that protects a greater area from flooding for a longer period. The new coastal flood defences incorporating a short new rail link transform a vulnerable estuary and radial network into a robust and sustainable urban orbital system with substantially improved transport and data connectivity.

A climate change scenario is emerging in which actions taken around the world will not prevent a rise of sea level in the

low to mid-range of the UK CP18 predictions by 2050, with a corresponding increase in the severity of storms, the two factors combining to create an increase in sea flood risks. Except for the Netherlands, few large national economies have a higher proportion of urban assets exposed to the risk of rising sea levels than the UK. These assets are located around urban estuaries including the Thames and Medway, Tyneside and Teesside, Humberside and Clydeside. UKCP18 data and on-going research will show that, even with co-ordinated international action, sea levels are likely to rise significantly before being brought under control in the 22nd century. If the latest predictions indicate a rise of 1m this

century we should be considering another meter rise in the next before climate change policies can bring matters under control. This means that the current programme of managed retreat, to cope with a one meter rise this century, will need to be repeated in the next century and again if the rise continues to exceed current projections.

Fortunately, most urban >>>

**The Spring Budget 2020 investment policies for coastal flood defences, urban rail, data connectivity, FTTP, freeports, the levelling-up of the North and the strengthening of the Union are all addressed by the Metrotidal Urban Orbital and its applications**



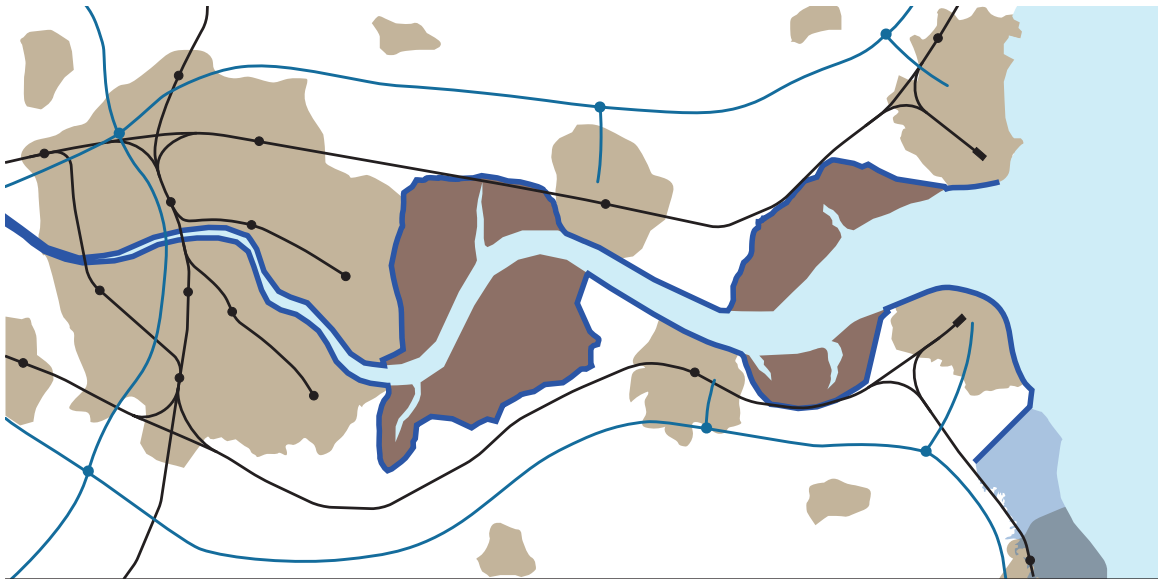
Mark Willingale is director of Metrotidal Limited

## MANAGED RETREAT

### FLOOD DEFENCE ONLY

- LONGER FLOOD DEFENCE LINE
- HIGHER FLOOD DEFENCES
- LOSS OF LAND
- LOSS OF EXISTING HABITATS
- ISOLATION OF COASTAL AND RIPARIAN SETTLEMENTS
- LOW RESILIENCE

- FLOOD DEFENCE LINE
- MANAGED RETREAT
- FLOOD RISK AREAS



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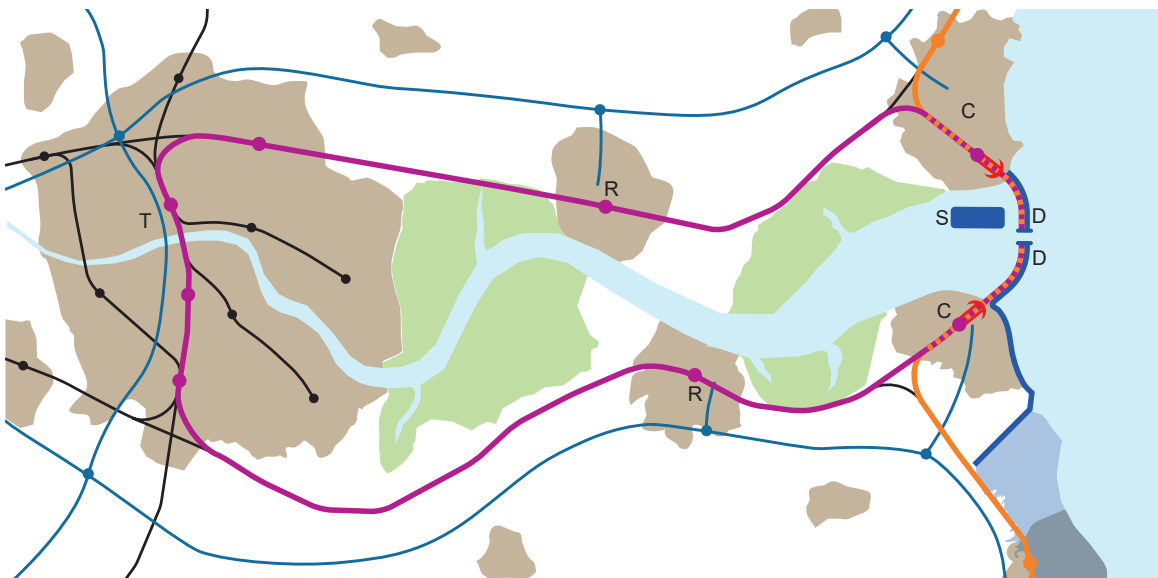
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## METROTIDAL URBAN ORBITAL

### FLOOD DEFENCE + TRANSPORT AND DATA ORBITAL + RENEWABLES

- SHORTER FLOOD DEFENCE LINE
- LOWER FLOOD DEFENCES
- PROTECTS ALL LANDWARD ASSETS AND HABITATS
- UNITES THE ESTUARY AND COASTAL ECONOMIES
- PROVIDES GREEN GROWTH
- HIGH RESILIENCE

- FLOOD DEFENCE THROTTLE AND LINE
- FLOOD RISK AREAS
- PROTECTED HABITAT
- NEW RAIL LINK & TUNNEL
- URBAN ORBITAL
- URBAN COASTAL
- FLOATING SOLAR S
- DATA AND COLD STORAGE D



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>>> estuaries around the UK already experience a tidal range in excess of 3m, with flood defences raised to meet the associated risks including storm surges. Accordingly, most urban estuaries around the UK can manage a significant rise in mean sea level, subject to the tides being tamed by a flood defence system across the outer estuary. It is also fortunate that most of these estuaries have an extensive network of existing and former railway lines, with routes running each side to the coast, so that only a short new connection across the estuary is required to transform a vulnerable radial network into a robust orbital system. The assets at stake are huge compared with the costs of the integration. The expense of the flood defence system across the outer estuary is offset by the green-growth agglomeration benefits of the integrated urban orbital infrastructure and by the greater resilience of the shorter flood defence line, allowing the flood datum to be raised easily as required to meet the risk of rising sea levels.

The typical urban estuary in the UK has a radial transport network developed from a first crossing some way inland towards the tidal head. From this crossing radial roads served each side of the estuary downstream before heading along the coast; the roads were supplemented by railways in the 19thC and motorways in the 20th Century without significantly chang-

ing the network. Separate riparian settlements developed on the banks downstream to serve docks and industry followed by the growth of resorts and dormitory towns at the mouth of the estuary and along the coast. With the gradual rise in sea level since the 18thC the result is an urban network with a large flood risk area and poor connectivity.

Flood risks are currently managed by raising sea walls along the banks of estuaries and creeks, providing gates and sluices where required. As areas become vulnerable a strategy of managed retreat is applied in which the cost of maintaining a flood risk is compared with the value of the public assets protected. Defences retreat from areas where protected asset values are too low, and a new flood defence line is formed further inland. The loss of land increases the isolation of defended riparian and coastal settlements.

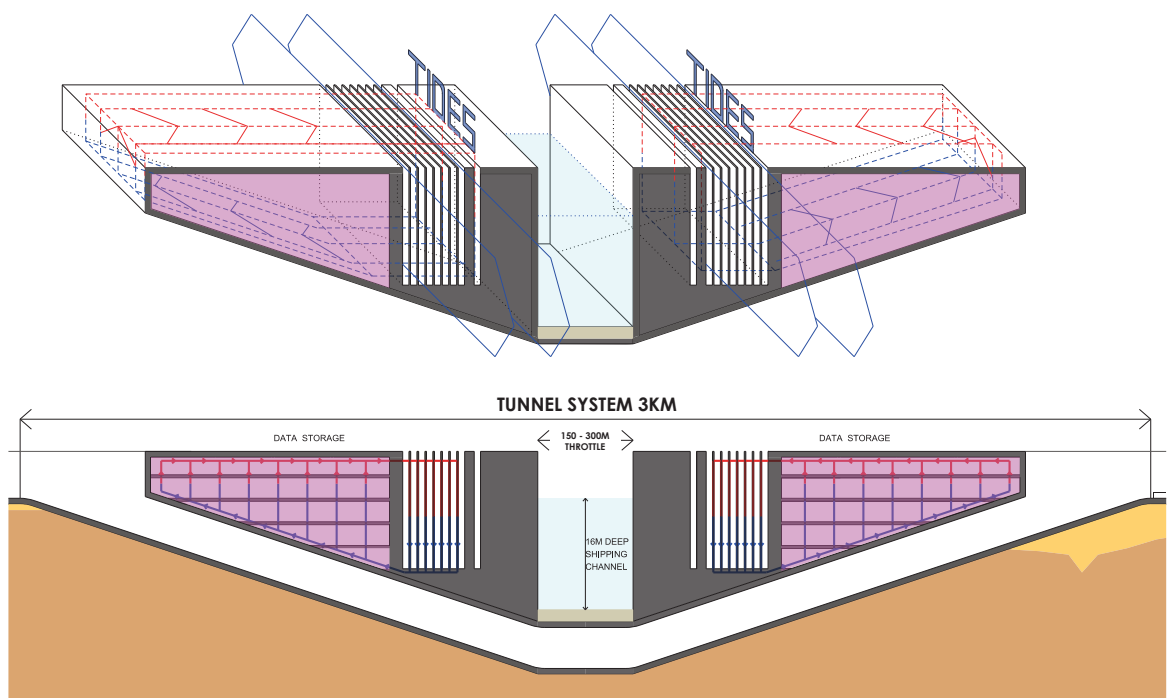
Valuable freshwater habitats are lost and replaced by salt-marshes and intertidal flats that take decades to mature by which time the sea will have risen again. Managed retreat follows an adaptive flood management plan designed to spend as little as possible as late as possible to maintain the current levels of flood risk for the public assets being protected. With increased rates of rising sea levels, the big-ticket costs for coastal flood defences are coming sooner rather than later.

>>>

## GENERIC 3KM THROTTLE FLOOD DEFENCE SYSTEM

TIDAL COOLING FOR DATA AND COLD STORAGE

TIDAL COOLING SYSTEM   
 DATA AND COLD STORAGE 

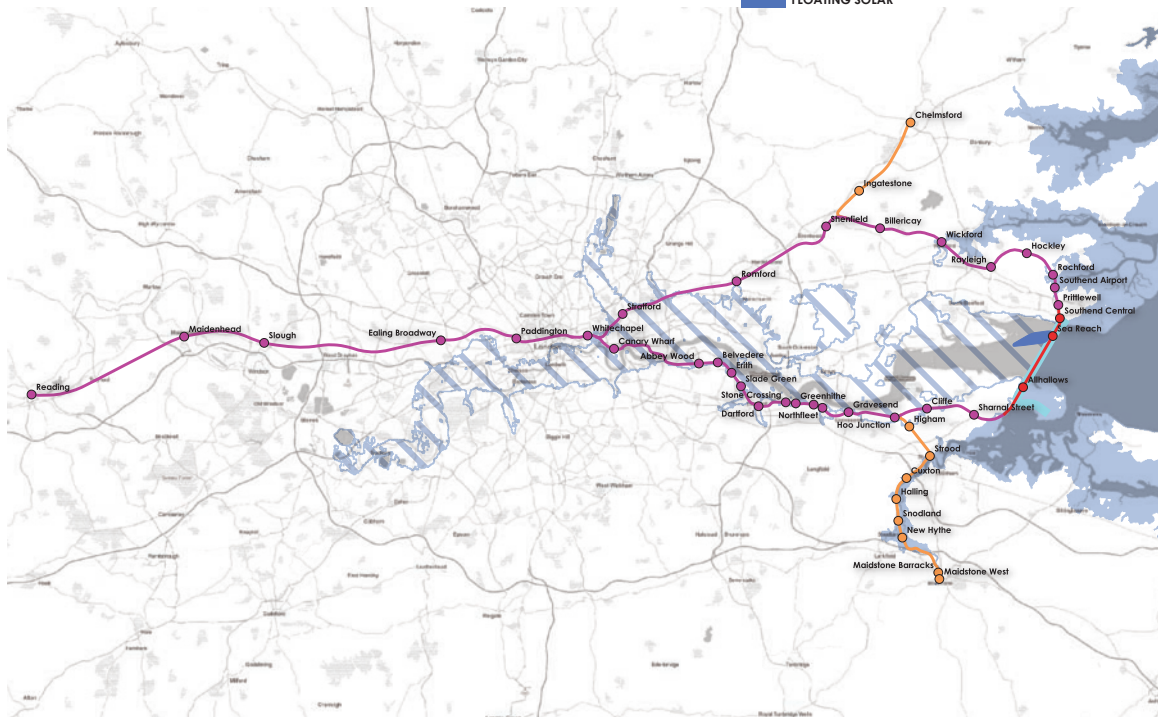


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# METROTIDAL THAMES ORBITAL

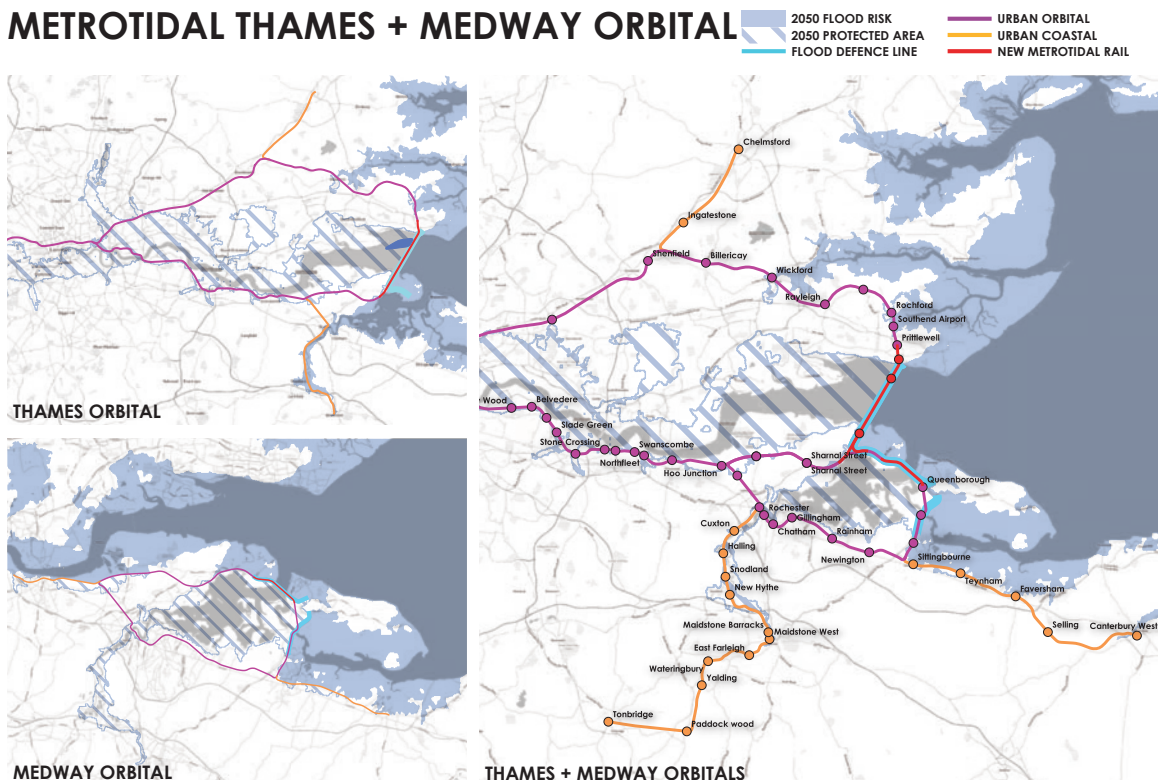
PROTOTYPE FOR THE GENERIC METROTIDAL URBAN ORBITAL



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# METROTIDAL THAMES + MEDWAY ORBITAL



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The Metrotidal Urban Orbital integrates a flood defence throttle with a short new rail link to transform a radial network into an orbital system. The landward tidal range is reduced while leaving the shipping channel open to navigation. The flood defence line is shorter and the flood datum lower, as the tidal range on the outer estuary is lower than inland. All existing landward assets and habitats are protected. The transport and data orbital unites the urban estuary

and coastal communities to provide green-growth agglomeration benefits. The improved urban connectivity enables railways and micro-mobility to replace cars. Wayleaves around the orbital accommodate fibre optic cables for FTTP services.

A generic 3km flood defence system across an estuary enables the railway to dive below a 300m wide, 16m deep shipping channel, this setting a maximum requirement that can be tailored to local circumstances. The navigation remains open with gates fitted later this century when required by rising sea levels and then only closed for surge tides. Sluices reduce peak flows during normal tides. Relatively short lengths of sea wall from the throttle, with an upgrade of local coastal defences to high ground, complete the system. The new flood defence line is a fraction of the length of existing landward defences. The short new rail link creates a high-capacity urban orbital.

For the Metrotidal Thames Orbital, the prototype for the generic system, an 8km throttle flood defence system and seawalls across the lower estuary replace proposals for a flood defence barrier across the Thames at Purfleet that would require 106km of sea walls, sluices and gates downstream. Precedents for the connectivity and agglomeration benefits of the urban orbital railway are found in the Circle Line completed 1884 and the London Overground network of 2007. The benefits are also recognised by the current Transport for the South East (TfSE) "R25" rail orbital between Reading and Rochester, around the southeast and southwest quadrants of London, for which the Metrotidal Thames Orbital is a natural extension to the northeast quadrant. Just 12km of new rail link across the Lower Thames Estuary creates a 132km orbital from Central

**The Metrotidal Urban Orbital integrates a flood defence throttle with a short new rail link to transform a radial network into an orbital system. The landward tidal range is reduced while leaving the shipping channel open. The flood defence line is shorter and the flood datum lower. All existing landward assets and habitats are protected.**

London, formed from the eastern limbs of Crossrail, the C2E Crossrail Extension to Ebbsfleet and the Medway HIF bid that includes re-opening the Isle of Grain Branch Line to passengers. Similar benefits can be achieved for the Medway where a 2.7km throttle and 5.5km of new railway link replace a managed retreat programme that requires the sacrifice of 14.5sq.km and the raising of 52.5km of sea walls. The combined Metrotidal Thames and Medway Orbital makes use of

the same Isle of Grain Branch Line, providing significant distance and journey time savings for coastal journeys across the estuaries. For example, Southend to Sittingbourne, a current journey of some 115km taking 122 minutes with four changes, in part using HS1, becomes a direct journey of 28.3km taking 25 minutes.

The Metrotidal Urban Orbital, developed from the Thames and Medway cases, is readily applied around the UK as part of the levelling-up policy of investment and opportunity between the North and South. Tyneside, Teesside, Humberside and Clydeside are all strong applications where a short new flood defence line and rail link protects a large flood risk area while uniting large estuary and coastal communities around efficient urban orbitals.

Managed Retreat vs the Metrotidal Urban Orbital is a case for debate as part of the 5-year flood defence review of the Thames and Medway estuaries, due this year, and for the run up to COP26, the 2020 UN Climate Change Conference in Glasgow. Here the Clyde provides a useful demonstration, with a lower tidal range than many other UK urban estuaries but still some 3m with storm surges, where a relatively short flood defence line across the outer estuary protects a large urban area and radically improves urban and coastal connectivity.

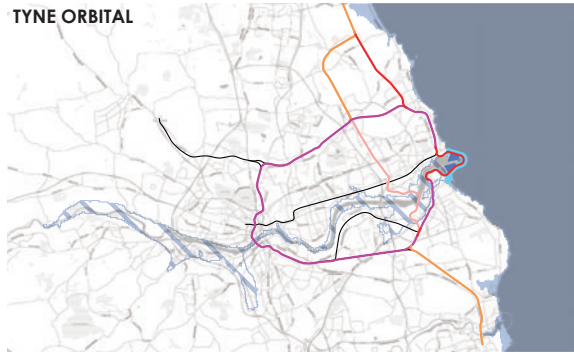
The Spring Budget 2020 investment policies for coastal flood defences, urban rail, data connectivity, FTTP, freeports, the levelling-up of the North and the strengthening of the Union are all addressed by the Metrotidal Urban Orbital and its application to Tyneside, Teesside, Humberside, Clydeside and elsewhere, including the Thames and Medway between Southend and Sittingbourne. ■

**For the Metrotidal Thames Orbital an 8km throttle flood defence system and seawalls across the lower estuary replace proposals for a flood defence barrier across the Thames at Purfleet**

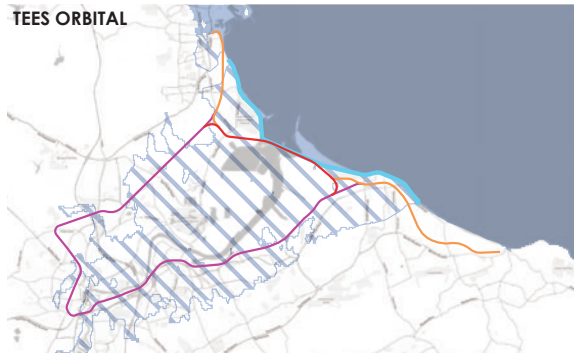
# METROTIDAL TYNE + TEES ORBITALS

COMBINED TYNE AND TEES COASTAL 97.2KM

## TYNE ORBITAL



## TEES ORBITAL

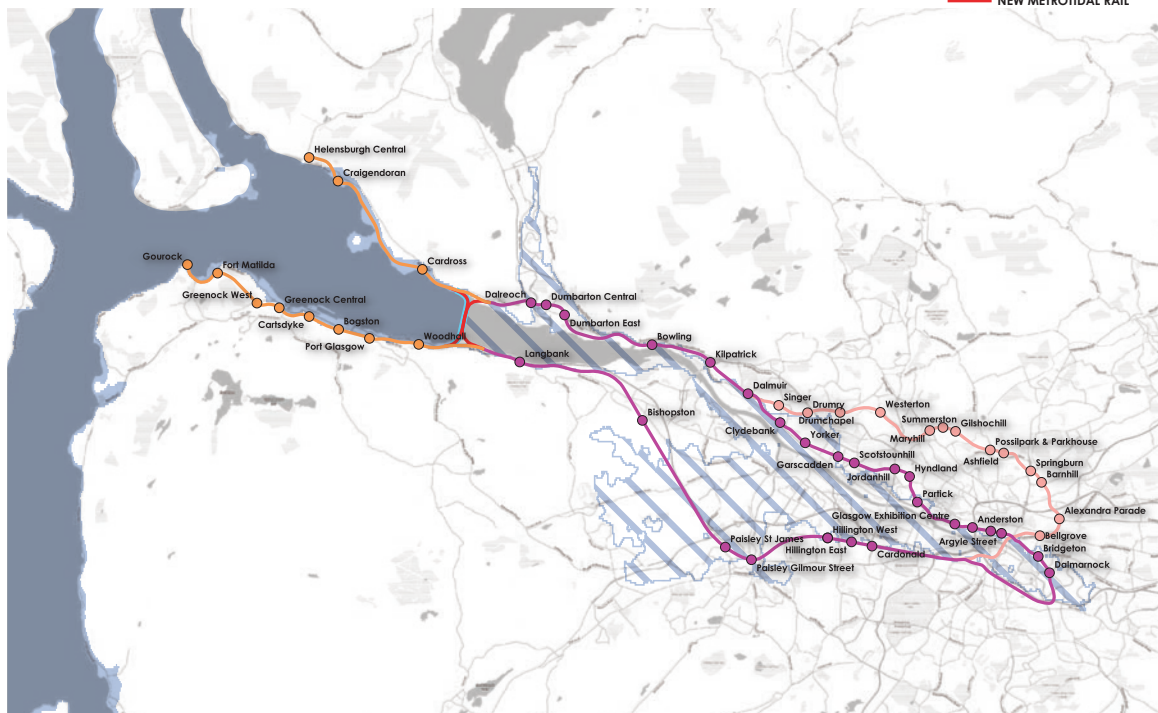


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# METROTIDAL CLYDE ORBITAL

NEW RAIL LINE 3.1KM + FLOOD DEFENCE LINE 2.5KM + URBAN ORBITAL 64.1KM



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