

A SUBMISSION TO THE NATONAL INFRASTRUCTURE COMMISSION CALL FOR EVIDENCE

Metrotidal Lower Thames Pool is an integrated infrastructure proposal that addresses two of the three national challenges identified in the call for evidence:-

London Evidence: Large-scale transport infrastructure improvements in London

Energy Evidence: Improving how electricity demand and supply are balanced.

The ten pages, accompanied by illustrations, address both challenges.

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1 INTRODUCTION AND EXECUTIVE SUMMARY

Metrotidal Lower Thames Pool integrates new flood defences for London with energy storage, a multi-modal tunnel, data storage, utility wayleaves and enabling development for 250,000 homes with corresponding employment. The integrated infrastructure provides economic growth without an associated increase in carbon audit. This green-growth is achieved through the integration of a flood defence system with a sustainable power plant that generates and stores zero-carbon energy for supply-on-demand. This offsets the energy demands of the new transport connectivity, led by rail, and the enabled development. The sustainable pool system includes energy-efficient data storage and distribution with an exceptionally low power usage effectiveness (PUE) and new utility wayleaves that serve the enabling development.

The result is full-spectrum enabling development in which housing, employment, energy, transport, data and utilities are fully integrated to generate green-growth benefits across the Greater Thames Estuary region.

2 THE METROTIDAL LOWER THAMES POOL AGENDA

2.1 Integration Benefits

The combination of the separate initiatives into a single, well-integrated infrastructure project reduces the planning overheads, construction costs and environmental impacts while increasing the net economic benefits, thereby producing integration benefits. Substantial integration benefits are realised by combining separate developments for new flood defence, a sustainable power plant, a Lower Thames Tunnel, data storage and utilities into one integrated system that supports growth across the Greater Thames Estuary region.

2.2 Flood defence

The Metrotidal agenda provides a new system of flood defence to protect London and the Thames Estuary from surge tides through to the 22nd century. The defences are provided in the form of a throttle working in tandem with flood storage capacity to reduce the level of an incoming surge tide. The throttle is located on the shipping channel and the associated flood storage is provided by a pool beside the Hoo Peninsula, with additional emergency storage across the marshes to the Isle of Grain.

The throttle has a weir and floodgates that admit water to the pool during the incoming surge and return it to the sea on the ebb tide. Existing monitoring systems provide over 24 hours advance-warning of the storm surge. This allows the pool to be drained during the preceding low tide and the floodgates closed to reserve the maximum flood storage capacity ahead of the surge tide. The variables of the incoming surge waveform and duration are recorded and analysed as the tide advances down the North Sea coast, enabling the most effective use of the available flood storage in the pool to be programmed before the storm surge arrives in the Thames Estuary. The level of the weir and area of the flood gates are then controlled to suit the programme. If additional storage is required in an emergency a weir and flood gates from the pool allows controlled flooding of the marshes beside the Isle of Grain.

The system is designed to allow the free movement of normal tides while restricting and limiting the incoming storm surge. The throttle and flood storage capacity of the pool then works in tandem with the existing Thames Barrier and capacity of the tideway to reduce the incoming peak surge. Accordingly the system protects all the flood risk areas upstream from the throttle including both the metropolitan areas and existing fresh water meadow habitats that remain at risk in the event of a surge under the current TE2100 proposals.

The flood risk to very substantial property, infrastructure and habitat assets upstream is reduced, enabling the Association of British Insurers (ABI) to redirect a proportion of the

premiums raised under the new Flood Re agreement towards funding the flood storage system. The balance of the flood defence cost can be made up by riparian rates and government grant comparable to that required for the TE2100 proposals. The flood storage pool impoundment doubles as a sustainable energy storage system and reduces the construction cost of the multimodal tunnel, consequently increasing the net economic benefits of the integrated system. The resultant net economic benefits are much higher than for the TE2100 investment programme, which addresses only the flood risks.

2.3 Sustainable Energy Storage

The Metrotidal agenda integrates flood storage and tidal power within the same impoundment, allowing the range within the impoundment to be pumped to treble the natural tidal range within the estuary. This allows the tidal power plant to increase peak output when required or store energy in the pool for delivery on demand. The energy for the pumping is provided by solar, wind and tidal power along with the forthcoming option of nuclear power from Bradwell in Essex. The solar energy is provided by floating arrays within the protection of the impoundment that generate up to 50MW per sq.km. The wind energy is provided from the London Array in the outer estuary and the tidal energy from the natural range at the throttle in the Thames generating power through turbines below the flood weir.

The combined solar, wind and tidal pumped-storage system can deliver sufficient energy to offset the energy demands of the multimodal tunnel and new rail systems, leaving surplus energy to be sold to the grid.

2.4 Lower Thames Tunnel

The Metrotidal agenda includes a multimodal, D2T2 Lower Thames Tunnel formed from a combination of cut-and-cover and immersed tube tunnel construction techniques. The costs

are reduced by maximising the proportion of cut-and-cover and minimising the length of the immersed-tube construction. For a Lower Thames Tunnel running between Leigh-on-Sea in Essex and Allhallows-on-Sea in Kent the pool impoundment reduces the cost of the tunnel by increasing the cut-and-cover approaches and reducing the length of immersed-tube tunnel across the remaining open tideway. The immersed tube tunnel sections are formed in a casting basin, towed into position and sunk into a prepared trench across the open estuary. There is sufficient width in Sea Reach to maintain port operations during the immersed tube tunnel construction.

Northern Portal Connections

The northern portals of the tunnel provide:-

- rail connections to the C2C services from Pitsea, the Southend Victoria services at Wickford and the Crossrail services at Shenfield
- a new chord at Shenfield to the Great Eastern Main Line
- road connection to the A13/A130 at Sadler's Hall Farm
- access to a new Southend Park-and-Ride bus service between Southend Eastern Esplanade and Leigh-on-Sea via the Pier, Western Esplanade, Chalkwell Esplanade and a new Leigh Esplanade that replaces the existing C2C tracks

Southern Portal Connections

The southern portal of the tunnel provides:-

- rail connection to the Isle of Grain Line, which is twin-tracked
- a new chord to the North Kent Line and Southeastern network services at Strood
- road connection to the A228/A229/A2

2.5 Data Storage and Utilities

The Metrotidal Lower Thames Pool system generates and stores energy by moving large volumes of seawater between the pool and the sea. Data storage centres require reliable, sustainable energy supplies and efficient cooling systems. Modern Tier 4 centres secure alternative energy supplies for resilience and aim to achieve the lowest power usage effectiveness (PUE: total facility energy divided by the IT equipment energy). Data storage centres also require substantial cooling loads to maintain a steady-state environment for the IT equipment.

The seawater of the Thames Estuary maintains uniform temperatures throughout the year, suitable for providing a steady-state environment for the IT equipment and since the sustainable energy system moves large volumes of sea water this can be used to serve the cooling loads of the data centre, thereby achieving an exceptionally low PUE. The range of sustainable energy supplies used for pumping the pool provides additional resilience for the data centre supplies. The transport connections from the portals provide utility wayleaves for distributing the data across the enabling development.

Utilities

Several existing utilities have key network connections that pass under the estuary not far from the line of the proposed tunnel. The immersed-tube tunnel cross-section includes passages for utilities with the benefit of access for maintenance and renewal. The transport corridors north and south of the tunnel provide routes for extending and connecting existing utility networks across the Thames Estuary region. The utility way leaves (broadband, communications, electricity, gas, mains water and other private-sector services) contribute to tunnel revenues.

The Hoo Peninsula in Kent is one of the driest areas of the country and has a distant fresh water supply, pumped from the Medway Valley. The Lower Thames Tunnel opens a new

water supply grid connection between South Essex and North Kent to provide a more resilient service with less pumping.

2.6 Tunnel Transport Services

The Lower Thames Tunnel provides the following new rail and road services:-

Crossrail Plus: The eastern limbs of Crossrail, to Shenfield in Essex and Abbey Wood in Kent, are linked to create the “Crossrail Plus” orbital system serving the Greater Thames Estuary and Central London. The new orbital rail route reconnects populations north and south of the Thames with existing and new stations becoming the foci for commercial and residential development. Crossrail Plus connects with HS1 at Stratford and Ebbsfleet thereby providing convenient connectivity to Northern Europe without requiring access into Central London.

Pitsea-Isle-of-Grain-Strood Shuttle: A rail shuttle service links the South Essex conurbation and the Medway Towns, with terminals at Pitsea, the Isle-of-Grain and Strood. The shuttle interconnects with Crossrail Plus at South Benfleet, Leigh-on-Sea, Allhallows-on-Sea, Stoke Harbour, Cliffe and Higham, the C2C services at Pitsea and the Southeastern Network at Strood.

Rail freight services: A rail-freight bypass to the east of London, via the new chord at Shenfield, opens a new long distance freight route between the Haven Ports, Thames Estuary and Channel Tunnel.

Road connections: The highway between the A13/A130 at Sadlers Hall Farm and the A228/A289 on the Hoo. A road-freight route between the Channel Ports and the eastern seaboard ports north and south of the Thames that avoids the congested M25/Dartford Crossing.

Southend Park-and-Ride: a new shuttle bus service between Southend Eastern Esplanade and Leigh-on-Sea Station Carpark via the Pier, Western Esplanade, Chalkwell Esplanade and a new Leigh Esplanade that replaces the existing C2C tracks

2.7 Enabling Development

Residential Development: Growth-zones for a projected 250,000 homes, including the Shelter Wolfson Prize 2014 Housing Scheme on the Hoo Peninsula, served by the stations of the Crossrail Plus orbital, the Pitsea-Isle-of-Grain-Strood Shuttle and the adjoining C2C and Southeastern networks.

Commercial Development: Office developments served by the stations of the Crossrail Plus orbital, the Pitsea-Isle-of-Grain-Strood Shuttle and the adjoining C2C and Southeastern networks.

Industrial Development: New industrial development on existing sites at the London Gateway Port, Basildon, Canvey Island, Isle-of-Grain, Kingsnorth, Hoo Junction and the Medway City Estate with convenient employee access provided by the Crossrail Plus orbital, Pitsea-Isle-of-Grain-Strood shuttle and the adjoining C2C and Southeastern networks.

Benfleet Esplanade: The existing station and rail tracks through Benfleet are replaced by a new 4-platform station and underpass beneath Benfleet Esplanade accompanied by commercial and residential development that restores South Benfleet to Benfleet-on-Sea.

Leigh Esplanade: The existing station and rail tracks through Leigh-on-Sea are replaced by a new 4-platform station and underpass beneath the existing station car park. This becomes the terminus of Leigh Esplanade, which runs on the line of the existing tracks through Leigh-

on-Sea to Chalkwell, accompanied by commercial and residential development that restores Leigh to being On-Sea.

Southend Park-and-Ride: Mixed use commercial development over the new station and underpass at Leigh-on-Sea to receive visitors arriving via the tunnel and its connections and distribute them to the attractions of the Southend seafront via the Southend-Park-and-Ride service. Along with the enhanced rail access Leigh-on-Sea becomes a principal portal for visitors to the Southend conurbation thereby easing traffic on the notoriously congested A13 and A127 arteries.

2.8 Environmental Benefits

The environmental impact of the pool is assessed in terms of the impacts on intertidal and low-lying freshwater habitats. The area of the pool occupied by the St. Mary's Marshes is already identified for managed retreat by the current TE2100 programme. The impact on the remaining intertidal area occupied by the pool are offset by the benefits from protecting intertidal areas upstream from tidal squeeze and large areas of low-lying freshwater habits from a storm surge. When the zero-carbon energy generated and stored by the system is taken into account the net environmental assessment is beneficial.

2.9 Green-Growth

The integrated infrastructure provides economic growth without an associated increase in carbon audit. This green-growth is achieved through the integration of a flood defence system with a sustainable power plant that generates and stores zero-carbon energy for supply-on-demand. This offsets the energy demands of the new transport infrastructure and enabling development. The sustainable pool system includes energy-efficient data storage and distribution with an exceptionally low power usage effectiveness (PUE) and new utility

wayleaves that serve the enabling development. The result is full-spectrum enabling development in which housing, employment, energy, transport, data and utilities are fully integrated to generate green-growth benefits across the Greater Thames Estuary region.

2.10 Agglomeration Benefits

New transport infrastructure creates an agglomeration benefit if the group economy exceeds the sum of the separate economies and the cost of the new transport links. Traditional agglomeration operates radially drawing satellite settlements into an ever expanding urban nucleus.

The economic history of London can be seen as a series of agglomeration benefits, first arising from London Bridge agglomerating the trade route of the Thames with a radial Roman road network, accelerated by development of the regions, expanding sea trade, subsequent bridges, docks, warehouses and offices, all in turn rapidly increasing the urban economy and drawing in yet more investment. After WW2 the relocation of the port and trade from the Thames Estuary led to the contraction and separation of the economies in Essex and Kent. The Thames Estuary, for centuries the main artery of trade uniting the region into a single riparian economy from Central London to the coast had become a barrier to growth. As a result there are latent agglomeration benefits to be realised simply by re-uniting the economies north and south of the Thames through improved transport infrastructure. A relatively modest investment in new connectivity provides a large agglomeration benefit across the Greater Thames Estuary region. The Metrotidal Lower Thames Pool provides the new connectivity and enabling development, placing emphasis on orbital connectivity rather than extending existing radials. The congestion of Inner London arteries is avoided while full use is made of the counter-cyclical commuting capacity, providing greater transport capacity for lower cost, thereby increasing the agglomeration benefits.