BALANCED DEFENCE

The ambitious Lagoon Hull project aims to protect the city from flooding, while improving transport connectivity and reinvigorating the local economy. **Nadine Buddoo** reports.

Hull is one of the cities in the UK which are most vulnerable cities to coastal flooding and rising sea levels.

But the proposed Lagoon Hull project aims to change all that.

The £1.5bn scheme will involve the construction of an 11km causeway in the Humber estuary, creating a non-tidal lagoon along Hull's waterfront. A four lane highway will also be built along the causeway in the Humber estuary for 9.6km, relieving congestion on the A63, currently the main route into the city.

Construction is expected to take 10 years, and the completed lagoon could provide flood protection for at least 100 years. Lagoon Hull project director Paul Hatley says the scheme is primarily centred on providing the best solution for local people, as well as for the environment.

Hull sits in what was originally swamp land and is mostly below sea level. During heavy rain, surface water from neighbouring areas drains towards the city. The River Hull runs through the centre, while the Humber estuary – on the southern edge of Hull – compounds its vulnerability to flooding.

"The city is almost trapped by water," says Hatley. "There has been pluvial flooding, which we saw in 2007, where a massive downpour into saturated land led to surface water runoff just pooling everywhere throughout the city before it even got to the drains. The devastation was immense."

Hatley explains that the city also remains at risk of fluvial, tidal surge and groundwater flooding.

"It is relatively unusual because in most places the area is vulnerable to one or two types of flooding, but Hull is vulnerable to all of them. It is a perfect storm of all the risk factors."

Lagoon Hull aims to deliver a holistic solution that alleviates all of these risks.

"There's no point fixing pluvial flooding, if people are still at risk of flooding from something else," says Hatley.

The project has also been designed to consider the needs of the city, as well as the requirements of the Port of Hull. The scheme is divided into two parts: the 5km^2 impounded lagoon and the 2km^2 outer harbour development.

For the outer harbour development – which has already received development consent and includes more than 84ha of land for quayside operations – the main requirement is ease of access for shipping vessels, large areas of quay space and water berths.

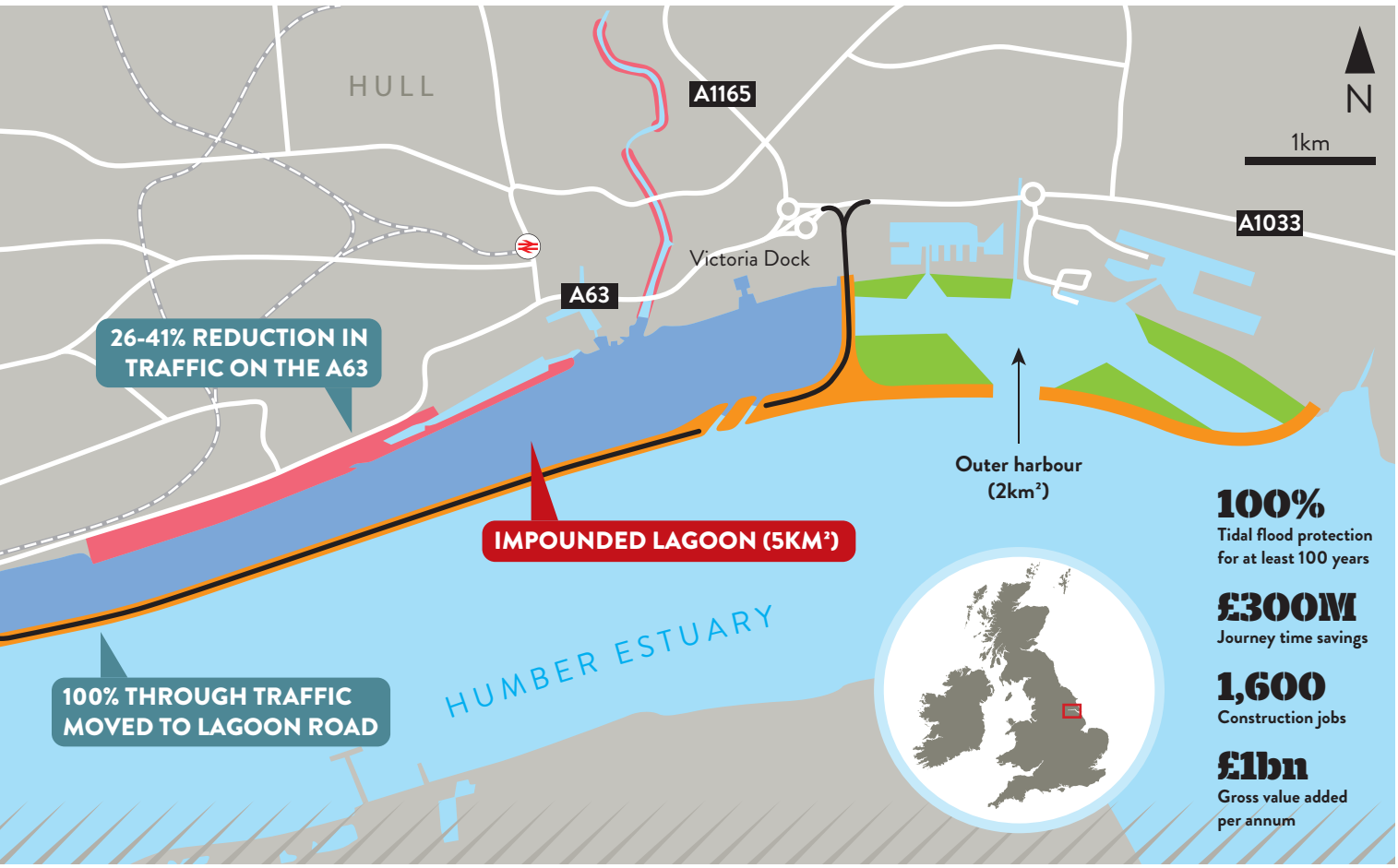
But the needs of the city are fundamentally different to those of the port. The impounded lagoon borders the

KEY FACTS

£1.5bn
Cost of Lagoon Hull project

11km
Length of Lagoon Hull causeway

> **"With flood water attenuation, we are dealing with a vast amount of water. A metre level difference is about 5M.m^3**



city and will play a vital role in providing a comprehensive flood defence.

"It will also allow us to regulate the water levels," Hatley says. "With flood water attenuation, we are dealing with a vast amount of water. A metre level difference is about 5M.m^3."

By lowering water levels in the lagoon, it can be used to store stormwater and alleviate the risk of flooding in the area.

COMPLEX MODELLING

Around five years of design and planning have already gone into the project, but submitting an application for planning permission is still some way off. While the modelling undertaken so far is promising, there is more work to be done. "We've been in discussion with the Environment Agency and it is intrigued, but not completely convinced," Hatley admits.

The sticking point is that the proposed scheme seems to run

Lagoon Hull aims to address all of the flood risk types affecting the city

> **"There's no point fixing pluvial flooding, if people are still at risk of flooding from something else**

counter to traditional engineering logic. Traditional thinking assumes that constructing the causeway in the Humber would cause a coastal squeeze effect, with the causeway displacing flood water onto the south bank of the Humber estuary. But modelling carried out independently by the University of Hull and marine consultancy service ABPmer suggests that the causeway will, in fact, protect both sides of the estuary from flooding.

The University of Hull found that had the lagoon been in place during the tidal surge that hit the area in 2013, the city would have had 100% protection and the rest of the estuary would have seen an 80% reduction in flood volume.

According to Hatley, these results are caused by the fact that the estuary is not a contained body of water. As such, the proposed causeway would reduce the volume of water entering it from the sea in the event of a tidal surge. This is because the causeway would narrow the estuary, reducing volumes of water that can pass into it before the surge ends.

As the average depth of the Humber estuary is a relatively shallow 6.5m, the ability of the causeway to reduce tidal surge impacts is expected to be greater than that of deeper rivers and estuaries, as less water can enter it during a tidal surge.

"The model is effectively showing us that by introducing a restriction

> It is not about trying to make a profit out of the scheme, but about trying to contribute to the city

in a certain part of the river, less water flows in because there is more resistance," he says. "It's not a barrage or a barrier, it's a constriction that seems to have the potential for wider flood protection benefits."

Hatley is, of course, encouraged by the modelling data but remains cautious. "There is more work to be done to prove that this effect would really happen," he says.

The Environment Agency has agreed to undertake further modelling work and, before delays caused by the coronavirus pandemic, the team behind Lagoon Hull was expecting to meet environment secretary George Eustice to discuss the need for government investment to fund further modelling and research.

"Worst case scenario: if the design doesn't make flooding any worse, the overall lagoon project would still be hugely beneficial in terms of supporting a range of other outputs including placemaking, economic regeneration, port growth and improved transport links," Hatley insists."Even if there was just a 5% estuarial flood protection benefit, quite frankly, it's worth the investment to at least do the research."

ECONOMIC DRIVER

Further in-depth feasibility studies require a cash injection of around £25M from the government, so ultimately the funding for the project will be a mix of public and private.

Hatley describes the funding model for the scheme as particularly unusual.

"It isn't a public scheme, so it is currently entirely backed by private organisations in the region," he explains. "However, it is not a directly commercial project. It is not about trying to make a profit out of the scheme, but about trying to contribute to the city and giving the region a brighter future."

The project includes a causeway incorporating a 9.6km relief road

Building the new highway on the estuary would not just expand the city's traffic capacity, it would improve access for cyclists and pedestrians.

Highways England has also undertaken traffic modelling which has demonstrated that 100% of through traffic in the city would be transferred to the lagoon road, which would ease congestion on the A63 and improve access to the port.

Improving connectivity to the region would also position Hull as the Northern Powerhouse's gateway to Europe. Driving the region's economic renaissance is a focus on green energy.

Historically, the Humber estuary has been the heart of the UK's coal powered energy industry with coal brought in by rail and river to nearby power stations including Drax, Ferrybridge and West Burton.

But with energy production in the Humber region slowly being transitioned away from high carbon towards green energy and offshore renewables, Hatley believes the region will play a vital role in producing the energy of the future.

"That transition is really important for the role the Humber will play in the prosperity of the UK," he says. "The Humber has a direct impact on the ability of UK PLC to function economically. And that is why there is such a focus on flooding."

> If we get it right, we will achieve the perfect balance between engineering and nature

CHALLENGES AHEAD

The future of UK trade and energy might rely heavily on the Humber and the Lagoon Hull development, but the economic benefits must be aligned with a considered approach to the surrounding ecology and the river's characteristics.

"Trying to find ways of building in harmony with nature is a major challenge, but this project takes it to a completely different level," says Hatley.

"The construction phase will involve lots of dredging and reclamation, but there's nothing massively complicated in terms of the construction techniques."

But Hatley says the real engineering challenge will be balancing the development of the project with the characteristics of the estuary and its dynamic morphology.

He adds: "If we get it right, we will achieve the perfect balance between engineering and nature." **N**