Stacked benefits report for Lowestoft flood barrier

Draft final report

prepared for

Coastal Partnership East/East Suffolk Council

9 June 2023

RPA
Risk & Policy Analysts

Stacked benefits report for Lowestoft Flood Barrier

June 2023

Draft Final Report

Quality Assurance	
Project reference / title	J1232/Lowestoft economic appraisal
Report status	Draft Final Report
Author(s)	Teresa Fenn Pippa van Kuijk Thibault Clack Joshua Bishop Nasir Hussain
Approved for issue by	Teresa Fenn
Date of issue	9 June 2023

Document Change Record			
Report	**Version**	**Date**	**Change details**
Draft Final	1.0	9 June 2023	For client review

Executive Summary

Presentation of the findings

A summary of the economic appraisal is provided in three infographics:

1. The without barrier: do-nothing option: this assumes no flood barrier is constructed and there is no further investment on flood risk management in Lowestoft
2. With barrier: 40m barrier do-something option: this assumes the 40m flood barrier is constructed
3. Stacked benefits: a summary total of the present value benefits with the barrier in place.

Each diagram is supported by explanatory notes that provide an overview of the information and assumptions used in the calculations of the damages, damages avoided and benefits.

Summary of benefit-cost ratios

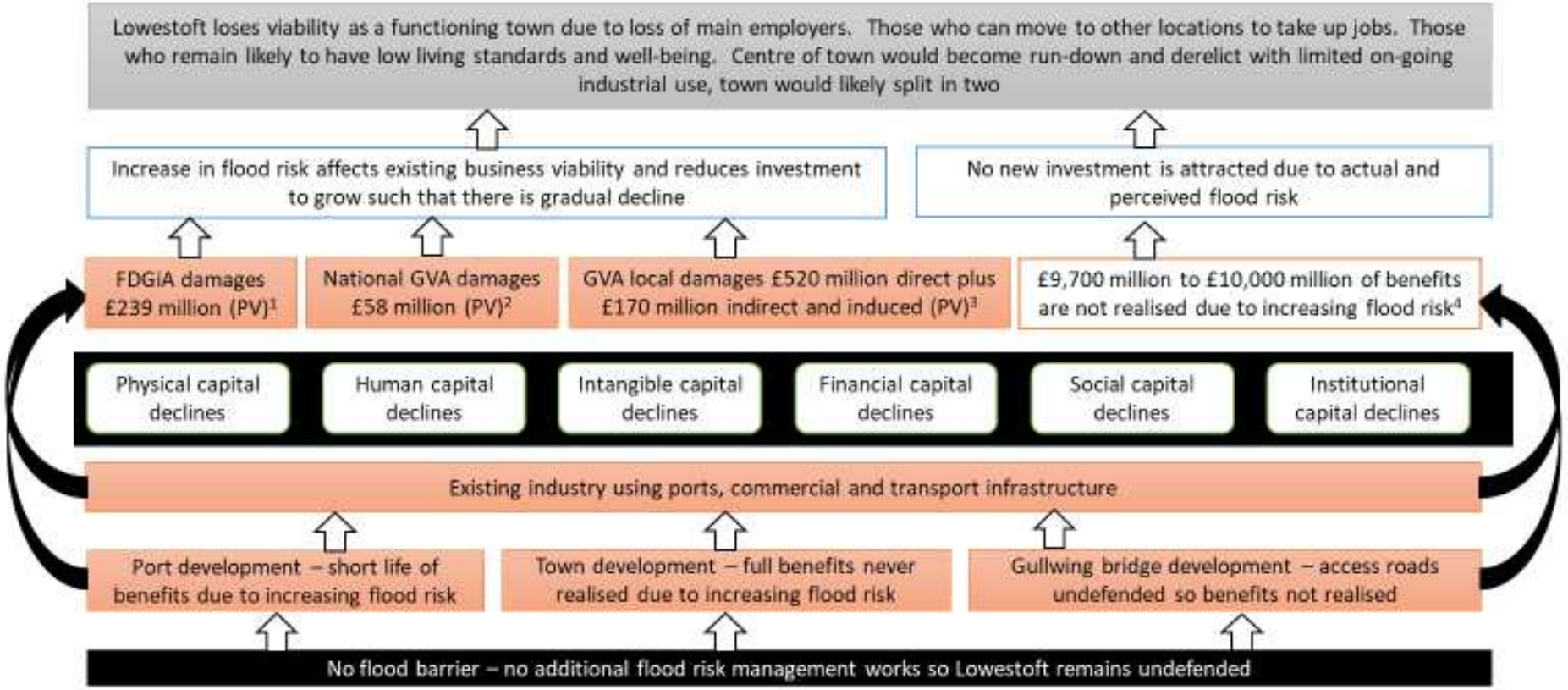
The overall message is that the 40m flood barrier is economically worthwhile at all levels of stacked benefits. The benefit-cost ratio for the barrier using just the benefits eligible for FDGiA is 1.3. When local/regional impacts are included, the benefit-cost ratio increases to 3.8.

The flood barrier also underpins a lot of existing investment and is required for those investments to realise the full value of their benefits. Taking account of the benefits that would not be realised under do-nothing, increases the benefit-cost ratio of the 40m barrier to 35 to 37.

Furthermore, investment in the barrier could attract further investment. Taking account of these potential investments increases the benefit-cost ratio to 37 to 39.

In all cases the costs used for the 40m barrier are around £200 million. Sensitivity testing is included on each of the key assumptions and shows that the BCR still remains greater than one even if 30% Optimism Bias is added to these costs.

Without barrier: 'do nothing'



Explanatory notes – without barrier do-nothing:

1: From Jacobs economic appraisal (this includes national tourism and recreation damages that are estimated at £19.7 million (PV) that were excluded from the Jacobs appraisal but given the number of conservative assumptions, are included here). This also includes wellbeing impacts on those who would lose their job due to GVA effects (note this is applied to all jobs lost as it is a wellbeing impact rather than being valued based on the job). A correction has been applied to avoid double-counting with mental health impacts on those whose properties are flooded.

2: Estimated based on other studies reporting GVA impacts following flood events and GVA at risk from Mott Macdonald report, excluding PowerPark as that is protected by walls and not the barrier (note this is excluded based on 70% of total development area being outside the PowerPark (23.4ha out of 77.8ha based on Table 4.4 in the Mott Macdonald report for future employment site summary, as the value of the various site names was not given specifically). This uses the assumptions from Mott Macdonald that 30% of GVA is at risk under do-nothing today increasing to 62% in 2117. This assumes a 9-month recovery time following a flood and 10% national losses (i.e., 90% being picked up by other businesses). Evidence to support these assumptions is scarce but following floods in Cumbria in December 2015, 'most businesses' expected to be fully operational again by autumn 2016 with 12.5% anticipating limited trading for at least another year, while a study from Yorkshire and Humber found that full recovery took 14 months. A nine-month recovery period is therefore taken as a conservative estimate for recovery time. National losses are taken at 10% to align with the assumption on tourism national losses due to a lack of evidence on alternative assumptions. It is expected that this could be an under-estimate, especially for offshore wind where alternative sites could equally be across the North Sea (e.g. Denmark).

3: Estimated based on GVA losses from the Mott Macdonald report adjusted for the non-national losses (i.e., 90% assumed local impacts); national GVA damages are subtracted to avoid double counting. Indirect and induced damages are estimated using a multiplier of 1.3 (with 1 representing direct damages and 0.3 representing indirect and induced damages) across total damages. Indirect/induced damages are all assumed to be local losses, however any direct losses that are not picked up nationally (e.g. where offshore wind expenditure moves to other European countries) would likely also have knock-on national impacts along the supply chain. Therefore, this is conservative.

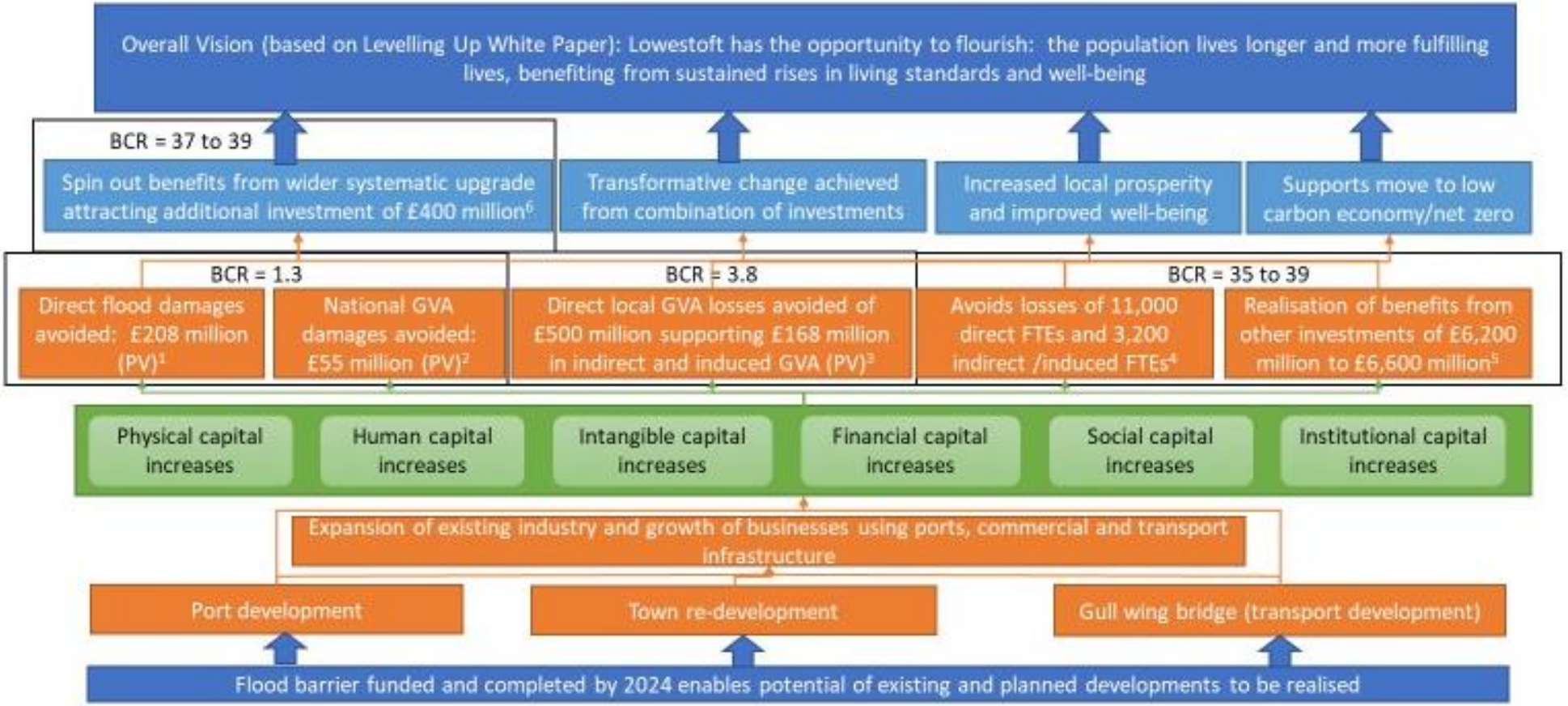
4: Estimated based on projected benefits from other investments (port, town, transport) that would not be realised. Some of the GVA future benefits may be captured within the GVA damages (from Mott Macdonald). To reduce the risk of double counting the total GVA damages have been subtracted from the future benefits:

- Port: LEEF benefits reported as £980 million to £1,360 billion to Lowestoft and East Suffolk over 60 years (extended to £1,100 million to £1,500 million over 100 years, based on increase in sum of discount factors of 1.136 (29.81 ÷ 26.23))
- Town investment plan: expected to attract £350 million of private sector investment, with £499 million of annual GVA, equivalent to £14,900 million over 100 years
- Gull wing bridge: benefits of around £300 million (based on BCR of 2.39 and costs, excluding contingency of £127 million) – benefit estimate may be conservative as takes lowest cost estimate, lowest BCR value and excludes journey time reliability benefits and wider impacts. Taking costs of £146m (including contingency) and adjusted BCR of 2.84 gives benefits of £415 million; timeframe of benefits not given so assumed over 100 years to avoid over-estimating

Total future investment over 100 years: £16,300 million to £17,200 million minus GVA benefits from Mott Macdonald estimates (£670 million) = £15,600 million to £16,500 million. Adjusted to reflect 62% of GVA at risk from flooding in future = £9,600 million to £10,000 million

All damages and job estimates are rounded to two significant figures to reflect uncertainty (other than FDGiA damages which are taken from the Jacobs economic appraisal) and are in Present Value terms over 100 years.

With 40m barrier: do something



Explanatory notes – with 40m barrier do-something:

1: From the Jacobs economic appraisal report, including tourism and recreation damages avoided that were excluded from the Jacobs assessment (see do-nothing) and includes the wellbeing damages avoided.

2: Estimated based on the Mott Macdonald report, excluding PowerPark with time for recovery from flooding based on other studies (see do-nothing). Assumes 6% of GVA would be at risk with flood barrier now increasing to 22% in 2117.

3: Estimated based on the Mott Macdonald report, excluding PowerPark including multiplier of 0.3 for indirect and induced impacts.

4: Estimated based on figures in the Mott Macdonald report that suggest £53,000 of GVA per FTE, assumed local impacts (some job losses may be national, but figure reported here is total across national, regional, and local GVA losses avoided). Direct, indirect, and induced jobs are based on total GVA impacts.

5: Estimated based on projected benefits from other investments (port, town, transport) that would be realised with flood barrier. Some of the GVA future benefits may be captured within the GVA damages (from Mott Macdonald). To reduce the risk of double counting the total GVA damages avoided have been subtracted from the future benefits:

- Port: LEEF benefits reported as £980 million to £1,360 billion over 60 years to Lowestoft and East Suffolk (extended to £1,100 million to £1,500 million over 100 years, based on increase in sum of discount factors of 1.136 (29.81 ÷ 26.23))
- Town investment plan: expected to attract £350 million of private sector investment, with £499 million of annual GVA, equivalent to £14,900 million over 100 years
- Gull wing bridge: benefits of around £300 million (based on BCR of 2.39 and costs, excluding contingency of £127 million) – benefit estimate may be conservative as takes lowest cost estimate, lowest BCR value and excludes journey time reliability benefits and wider impacts. Taking costs of £146m (including contingency) and adjusted BCR of 2.84 gives benefits of £415 million; timeframe of benefits not given so assumed over 100 years to avoid over-estimating.

Total future investment over 100 years: £16,300 million to £17,200 million minus GVA benefits from Mott Macdonald estimates (£670 million) = £15,600 million to £16,500 million. Adjusted to reflect 40% of GVA may benefit from flood barrier in future (62% GVA affected under do-nothing and 22% affected with flood barrier) = £6,200 million to £6,600 million.

6: Matvejevs & Tkacev (2023) found that public investment can attract $2 for every $1 invested in OECD countries over around 7 years after the public investment (https://www.suerf.org/suer-policy-brief/59417/invest-one-get-two-extra-public-investment-crowds-in-private-investment). The flood barrier investment is currently estimated at £200 million. This could attract a further £400 million in further investment (based on costs of £200 million).

All damages and job estimates are rounded to two significant figures to reflect uncertainty (other than FDGiA damages which are taken from the Jacobs economic appraisal and are in Present Value terms over 100 years).

Stacked benefits: summary total PV benefits

Investment future: (BCR = 37 to 39)	• Amount of investment that could be attracted due to growth of Lowestoft with flood barrier in place of an estimated £400 million
GVA future: (BCR = 35 to 37)	• GVA benefits from future investments linked to successful delivery of existing/planned investments: £6,200 million to £6,600 million (adjusted for GVA at risk from flooding)
GVA now: (BCR = 3.8)	• GVA losses avoided (local/regional): £500 million (direct) plus £170 million indirect and induced (assumed all local/regional)
FDGiA: (BCR = 1.3)	• Damages avoided: £192 million • Tourism and recreational damages avoided: £17 million • GVA losses avoided (national): £55 million (direct)

Explanatory notes – stacked benefits summary

Approach developed based on 'reverse' approach to capital stack funding, based on first sources of funders. The values given are benefits, so damages avoided compared with the do-nothing no barrier option for FDGiA and GVA now and as additional future benefits for GVA future and investment future. All numbers are Present Value over 100 years and are presented to two significant figures to reflect uncertainty:

1. FDGiA: This is the first source of funding as the project is a flood risk management project, so the benefits directly linked to flood risk management are captured there. Tourism and recreation losses were excluded from the Jacobs study but have been included here using the 10% national loss assumption as set out in Jacobs, plus the wellbeing damages avoided.
2. GVA now: some of this could be captured under FDGiA funding (as shown in the do-nothing and with barrier diagrams to reflect national losses of GVA that is already being delivered or that is already committed). Not all will be national benefits however so some additional funding sources are needed to realise the local/regional GVA benefits, with funding likely to come from other Government departments directly benefiting due to existing investments being able to be realised. Total direct GVA impacts are national + local/regional = £560 million plus £170 million indirect/induced = £730 million.
3. GVA future: this is not captured in FDGiA funding at all as it is not committed, but could deliver significant national, regional, and local benefits. This could attract additional funding from Government departments to reflect the add-on or follow-on benefits from their existing investments, and from private funders so they can realise future value such as increase in commercial property or land value. Some of the GVA future benefits may be captured within the GVA now benefits (from Mott Macdonald). To reduce the risk of double counting the total GVA now benefits have been subtracted from the GVA future benefits:
    - Port: LEEF benefits reported as £980 million to £1,360 billion to Lowestoft and East Suffolk over 60 years (extended to £1,100 million to £1,500 million over 100 years, based on increase in sum of discount factors of 1.136 (29.81 ÷ 26.23))

- Town investment plan: expected to attract £350 million of private sector investment, with £499 million of annual GVA, equivalent to £14,900 million over 100 years
- Gull wing bridge: benefits of around £300 million (based on BCR of 2.39 and costs, excluding contingency of £127 million) – benefit estimate may be conservative as takes lowest cost estimate, lowest BCR value and excludes journey time reliability benefits and wider impacts. Taking costs of £146m (including contingency) and adjusted BCR of 2.84 gives benefits of £415 million; timeframe of benefits not given so assumed over 100 years to avoid over-estimating

4. Total future investment over 100 years: £16,300 million to £17,200 million minus GVA benefits from Mott Macdonald estimates (£670 million) = £15,600 million to £16,500 million. Adjusted to reflect 40% of GVA may benefit from flood barrier in future (62% GVA affected under do-nothing and 22% affected with flood barrier) = £6,200 million to £6,600 million
5. Investment future: this is the most uncertain since it requires an assessment of the potential investments that could be attracted due to the previous investments being realised. For example, the port LEEF project is a turnkey investment that 'triggers a new wave of change…releasing the capacity needed to allow the port to grow'. Matvejevs & Tkacev (2023) found that public investment can attract $2 for every $1 invested in OECD countries over around 7 years after the public investment (https://www.suerf.org/suer-policy-brief/59417/invest-one-get-two-extra-public-investment-crowds-in-private-investment). The flood barrier investment is currently estimated at £200 million. This could attract a further £400 million in further investment assuming the 2:1 ratio holds. This is estimated additional investment over 7 years so the 100 year investment period could attract significantly more investment, as could the combination of investments but the assumption here to link it just to the flood barrier investment is taken to ensure these benefits are not over-estimated.

Table of Contents

Glossary

AAD	Average Annual Damages
ABP	Associated British Ports
BEIS	Department for Business, Energy & Industrial Strategy
DBT	Department for Business and Trade
Defra	Department for Environment, Food and Rural Affairs
DESNZ	Department for Energy Security and Net Zero
DfT	Department for Transport
DHULC	Department for Levelling Up, Housing and Communities
DWP	Department for Work and Pensions
EA	Environment Agency
FCERM	Flood and Coastal Erosion Risk Management
FDGiA	Flood Defence Grant in Aid
FTE	Full-time equivalent
GVA	Gross Value Added
HCA	Homes and Communities Agency
LEEF	Lowestoft Eastern Energy Facility
LEP	Local Enterprise Partnership
OBC	Outline Business Case
PV	Present Value
WELLBY	Wellbeing Year (a value reflecting a one-point change in life satisfaction per person per year

1 Introduction

1.1 The purpose of the study

The purpose of the study is to identify, assess and value the national and local impacts and benefits of the Lowestoft flood barrier scheme being proposed by East Suffolk Council to provide a flood resilient future for Lowestoft town and those who live and work there.

1.2 Approach

1.2.1 Literature review and evidence collation

Existing reports from Jacobs and Mott Macdonald have been used to understand and collate evidence on the national benefits provided to Lowestoft from the proposed barrier, and further evidence on other investment opportunities has been reviewed to assess the wider impacts of the scheme not being implemented. This has included the review of additional information coming from the Lowestoft Town Investment Plan[1] and Masterplan[2] that outlined the number of houses that may be built and the amount of jobs created. Information related to additional GVA generated comes from an economic impact assessment of the LEEF project[3]. Transport benefits related to journey time reliability and reduced congestion came from analysis of the Gullwing Bridge by the Department for Transport[4] and also the Planning Inspectorate[5].

1.2.2 Stacked benefits

The overall approach to the economic analysis is based on stacked benefits. This is a term used in capital finance that explores different sources of benefits from investment. We have applied the same principle here but looking instead at different sources of investment linked to the levels of uncertainty surrounding the flood risk management benefits. Stacked benefits can also be considered as a way of

[1] East Suffolk Council (2021): Town Investment Plan: Lowestoft. Available at: https://www.eastsuffolk.gov.uk/assets/Business/Regeneration-projects/Lowestoft-Investment-Plan/Lowestoft-Town-Investment-Plan.pdf on 8 June 2023.

[2] East Suffolk Council (2020): Lowestoft Town Centre Masterplan. Available at: https://www.eastsuffolk.gov.uk/assets/Business/Regeneration-projects/Lowestoft-Town-Centre-Masterplan.pdf on 8 June 2023.

[3] Opergy & Metro Dynamics (2021): Economic impact assessment of the Lowestoft Eastern Energy Facility (LEEF) project, July 2021.

[4] Department for Transport (2020): Application for the proposed Lake Lothing Third Crossing development consent order. Available at: https://gullwingbridge.co.uk/wp-content/uploads/2021/02/LLTC-SoS-Decision-letter.pdf on 26 May 2023.

[5] The Planning Inspectorate (2019): Lake Lothing Third Crossing – Examining Authority's Report of Findings and Conclusions and Recommendation to the Secretary of State for Transport. Available at: https://gullwingbridge.co.uk/wp-content/uploads/2021/02/LLTC-Examining-Authority-Report.pdf on 26 May 2023.

drawing in investors who will each pay for a specific element of the benefit (such as for different ecosystem services) such that the overall investment for an action is much greater than if just one investor paid for the benefits that they were interested in.

For the Lowestoft flood barrier, the approach is used that there will be different funders interested in different outcomes. For Defra, the focus is on the Flood Defence Grant in Aid (FDGiA) benefits, while other Government departments will be interested in investments they have made that could be undermined without the flood barrier. On top of this, are potential additional investments that could be attracted with the flood barrier in place, and once the benefits from all the other investments have been realised. Our approach has been to develop the stacked benefits associated with the flood barrier on this basis:

- FDGiA funding: this is the main source of funding as the flood barrier project is specifically designed to reduce flood risk to the town;
- GVA now: this comprises two elements:
    - GVA losses avoided that are significant at the national level: where these are planned and in place they can be linked to FDGiA benefits;
    - GVA losses avoided that are significant at the local and regional level: these would be of interest to local and regional public bodies and investors, as well as Government departments and relate specifically to GVA that is at risk from flooding.
- GVA future: this relates to investments that have been made by other Government departments that may not be realised (or fully realised) if the flood barrier is not constructed. This is because the flood risk is expected to increase to 20% (1 in 5) by 2117 under the do-nothing option which would have serious consequences for the town and its viability.
- Investment future: this relates to future private investment that could be attracted on the back of the public investment that has taken place. To avoid over-estimating these benefits (and to ensure that other investments can identify their own knock-on effects), this is linked only to the public investment in the flood barrier.

The remainder of this report describes the approach that has been taken to estimating each layer of the stacked benefits, the assumptions made, uncertainties and limitations.

1.3 The scenarios

The assessment considers two options:

- Do-nothing: where there is no further investment in flood risk management and a flood barrier is not constructed. This results in the flood risk increasing from around 0.66% now (1 in 150) to 20% (1 in 5) by 2117. Assumptions on assets at risk under do-nothing is based on work undertaken by Jacobs[6] and Mott Macdonald[7].
- 40m flood barrier: where there is investment to construct a 40m flood barrier that will avoid an increase in flood risk to the town.

[6] Jacobs (2022): Lowestoft Tidal Economics for OBC 2022, Revision P01, 14 September 2022, Appendix E1 to the OBC.

[7] Mott Macdonald (2022): Lowestoft Flood Risk Economic Footprint and Impact Report, May 2022, Appendix F3 to the OBC.

1.4 Costs of the barrier

The latest costs for the 40m flood barrier have been provided by East Suffolk Council and come to £199,932,580.59 for the AECOM assessment-most likely (costs shared 7 June 2023). These are the costs that are used in calculating the benefit-cost ratio as each benefit stack is applied. A sensitivity analysis is included looking at the impact of adding a further 30% Optimism Bias to these costs, although significant account is allowed for risk within the AECOM cost estimates.

1.5 Structure of this report

The remainder of this report is structured as follows:

- Section 2 provides a review of the FDGiA benefits;
- Section 3 summarises the GVA benefit, covering both GVA now and GVA future;
- Section 4 discusses potential future investment benefits; and
- Section 5 looks at how the various benefits identified in each 'stack' can be attributed to different Government departments.

To provide easy access to the findings, each section starts with a summary of the estimated benefits and the key assumptions and evidence that underpin those estimates. This is followed by a review of the evidence and the detailed approach to the calculations. This report draws on many sources and references to generate an estimate of the stacked benefits from the flood barrier. These references are included in each evidence section. Finally, each section considers the sensitivity of the calculations to some of the key assumptions and explores how changes to these assumptions could affect the economic appraisal and the benefit-cost ratio.

2 Review of the FDGiA benefits

2.1 Summary of findings

2.1.1 Do-nothing

Under do-nothing, no further flood risk management activities would be undertaken leaving the town largely undefended[8]. The Jacobs (2022) report estimates damages of £148 million under do-nothing. This excludes the national impact on tourism and recreation, and direct GVA impacts from flooding (although indirect damages on non-residential properties are included at £2.1 million). If the national tourism and recreational losses are included then the total damages under do-nothing become £168 million.

Mott Macdonald (2022) identifies that 30% of GVA is at risk under do-nothing, increasing to 62% in 2117. However, GVA is measured annually and needs to be adjusted to take account of the time over which GVA might be affected following a flood. A 9-month recovery time is assumed (based on evidence on actual recovery times following floods in Cumbria), so 75% of GVA is assumed to be impacted when a flood occurs. Of this, 10% is taken as national losses. These losses are converted to Annual Average Damages (AAD) using the FCERM spreadsheets to give PV damages under do-nothing of £58 million.

Impacts on those people that would lose their jobs due to the impacts on GVA from future flooding are based on WELLBYs with an assumption of 0.5 change in life satisfaction across 10,392 people (this excludes those who are flooded and assumes all those flooded would also lose their job, which is likely to under-estimate the wider wellbeing effects). These damages are converted to AAD using the FCERM spreadsheets with PV damages estimated using the health discount rate. This gives additional PV damages of £71.3 million.

The total damages under do-nothing taking into account national FDGiA damages are £297 million.

2.1.2 With flood barrier

Jacobs (2022) gives damages avoided with a 40m flood barrier of £120 million. This increases to £137 million if national tourism and recreation losses are included.

The direct national GVA losses avoided are estimated at £55 million. This increases the total damages avoided to £192 million.

The wellbeing damages avoided are estimated at £71.1 million. This increases the total damages avoided to £264 million.

The benefit-cost ratio taking into account national FDGiA damages avoided is 1.32 (costs taken as £199,933k).

[8] The only exception is the defences that have been constructed for the PowerPark but these are excluded from this economic appraisal.

2.2 Summary of evidence reviewed

The main sources of evidence are the Jacobs (2022) and Mott Macdonald (2022) reports which provide estimates of the flood damages and damages avoided with and without the barrier. Additional sources of evidence have then been reviewed to identify evidence to underpin assumptions that will allow GVA impacts to be converted to AAD at the national level, and to assess how much wellbeing might reduce for those whose jobs would be lost under do-nothing.

2.2.1 Review of Jacobs (2022)

The Jacobs (2022) report provides a comprehensive assessment of the damages and damages avoided, although the detail in terms of what is impacted under do-nothing is somewhat limited.

The report notes that flood warning benefits are excluded from the appraisal as the viability and business case for flood warning is not under assessment in this business case. There could be a case for including flood warning benefits since operation of the barrier will be reliant on flood warnings to be effectively and efficiently employed. This could potentially help reduce some of the residual damages, which are high at around £31 million even with the barrier in place. Much of this residual damage is on non-residential property (£21.3 million).

The Jacobs (2022) report considers impacts on health impacts from stress due to flooding but it does not include impacts on the wider population from the regular flooding of the town. Flood risk is projected to increase to 20% (1 in 5) by 2117 and would impact much of the centre of the town. This will result in disconnect between the north and south parts of the town and a loss of significant employment opportunities. Thus, the impact on well-being is expected to extend to a much larger population than just those impacted by flooding. Additional social benefits are therefore estimated and could be included as part of the wider, indirect effects of do-nothing on the well-being of those whose jobs could be lost. This has been explored through a review of evidence on impacts of job loss on life satisfaction (Section 2.2.2) and use of the HM Treasury supplementary guidance on wellbeing in appraisal to monetise the benefits.

2.2.2 Evidence on impacts of job loss on life satisfaction

There is a significant evidence base relating to the reduction of life satisfaction from loss of a job, with much evidence coming from Germany. For example, Akay et al (2021)[9] found that life satisfaction decreases from 6.42 to 5.83 upon loss of employment (a reduction of 0.59, based on a scoring system from 0 to 10). Nikolova et al (2020)[10] found that life satisfaction changed by around 1.4 points when going from self-employed to unemployment and by around 1 point when moving from salaried employment to unemployment (data again for Germany; again using a standard scoring system of 0

[9] Akay A et al (2021): Life satisfaction, pro-activity, and employment, GLO Discussion paper No 784, Global Labor Association, Essen. Available at: https://www.econstor.eu/bitstream/10419/230522/1/GLO-DP-0784.pdf on 7 June 2023. Data based on statistics from 1984 to 2009.

[10] Nikolova M et al (2020): Losing your own business is worse than losing a salaried job. Available at: https://www.brookings.edu/blog/up-front/2020/05/07/losing-your-own-business-is-worse-than-losing-a-salaried-job/ on 7 June 2023.

to 10). A meta-analysis by Luhmann et al (2012)[11] found a significant negative effect on cognitive well-being, although the change was variable, but with a mean of around 0.43.

To err of the side of caution, it is assumed that there is a 0.5 reduction in life satisfaction from loss of a job due to the increased risk of flooding without the flood barrier.

2.2.3 Review of Mott Macdonald (2022)

The report looks to capture the economic benefits from employment land, jobs and GVA, and land that is presently vacant or under-utilised.

The area around Lake Lothing is a key focus of strategic regeneration as set out in the Lake Lothing Area Action Plan and then within the Local Plan (2019). In addition, the Town Centre Masterplan and Towns Fund award demonstrate the regeneration activities taking place to revitalise the town centre post pandemic. The major regeneration plans for central and coastal Lowestoft increase the need to protect the area from flooding in the future. This suggests that all the benefits are avoided flood damages.

Lowestoft is designated as a growth area at national, sub-regional and local level as evidenced through its Enterprise Zone (EZ) status. The area around Lake Lothing is recognised as a strategically important area with the potential to transform former industrial sites which are now derelict or under-utilised, supporting future residential and commercial development while further developing the town's strengths in offshore renewables, offshore related engineering, and port related services. These are well aligned to the Government's clean growth and levelling up agenda.

Two scenarios are considered:

- Existing position: analysis based on current land use patterns and amount of economic activity estimated on each site.
- Future position: analysis based on economic activity associated with future development and land utilisations based on policy in the Local Plan.

Under the existing position, 30% of GVA and jobs are at risk under do-nothing, reducing to 6% with a 1 in 200 barrier. Under the future position, 62% of GVA and jobs are at risk under do-nothing, reducing to 22% with a 1 in 200 barrier. The benefits show that there would be significant impact on the local economy, but also the wider economy without the flood barrier. The area around Lake Lothing is particularly at risk from flooding, and investment in effective flood mitigation measures is required to secure the future generation of the town and accelerate the adoption of growth sectors such as offshore renewables and engineering. The Lowestoft Town Centre Masterplan reinforces the requirement to invest in effective flood mitigation to protect future development and attract inward investment.

With no changes to the existing flood defences, the impact of climate change will increase both magnitude and frequency of flooding at Lowestoft significantly. The probability of a repeat of the December 2013 event would increase from less than 1% (1 in 150) to 20% (1 in 5) by 2117.

[11] Luhmann M et al (2012): Subjective well-being and adaptation to life events: a meta-analysis on differences between cognitive and affective well-being, J Pers Soc Psychol, 102(3), 592-615. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3289759/ on 7 June 2023.

The Local Plan identifies areas with significant opportunities for development and represents land that is suitable and likely to become available for redevelopment during the period until 2036. A multiplier of 0.3 has been added to gross direct impacts to estimate the number of indirect and induced jobs supported, in line with Homes and Communities Agency (HCA) additionality guidelines.

The current economic footprint includes 6,400 direct jobs with GVA of £342 million per annum, plus 1,900 indirect and induced jobs and £101 million indirect and induced GVA. It is assumed that 30% of those benefits are at risk under do-nothing for the current situation. This is an impact of 1,900 direct jobs and £101 million GVA plus 600 indirect and induced jobs and £32 million indirect and induced GVA. With the flood barrier, these impacts reduce to 6% with 400 jobs and £21 million of GVA affected directly, plus 100 indirect and induced jobs and £5 million indirect and induced GVA.

The future economic scenario suggests 12,000 direct jobs and £641 million in GVA would be supported per annum, plus 3,600 indirect and induced jobs and £192 million indirect and induced GVA. Under do-nothing 62% is at flood risk, this is 7,400 direct jobs and £395 million direct GVA plus 2,200 indirect and induced jobs and £117 million indirect and induced GVA. Of this, 22% is assumed to be impacted by flood risk with the flood barrier which equals 2,600 direct jobs and £139 million direct GVA, plus 800 indirect and induced jobs and £43 million indirect and induced GVA.

The analysis only considered future economic activity for employment sites set out in the Local Plan or following consultation with East Suffolk Council. There is significant uncertainty around quantity, quality, scale, configuration, and design of individual developments, so the estimate is based on assumptions.

It is important to note that the GVA is the total effect of economic activity in the study area. The effect of a short-lived flood event would not be the same as the financial GVA, although it is at risk if companies are not able to recover and reinstate their productive activity.

It is also important to note that the report includes the PowerPark, but this is excluded from the Jacobs (2022) appraisal as it would be protected by the walls. Although specific values are not given for each development area separately, the PowerPark is shown as accounting for 30% of the development area, so 30% of the impacts are excluded in this assessment and assumed to relate to the PowerPark.

2.2.4 Evidence on recovery times for non-residential properties following flooding

Cumbria County Council undertook a Business Survey following flooding December 2015[12] finding that most respondents expected to be fully trading again by the autumn of 2016, although 1 in 8 (13%) anticipated limited trading until spring 2017 and one business expected to close. The survey itself was set up very quickly following the flooding and received 673 responses. It is based on self-selected responses so is expected to be biased towards affected businesses. This suggests it takes around 9 months for businesses to fully recover from flooding, but that this may be an under-estimate for 13% of businesses.

[12] Cumbria County Council (2018): Flooding in Cumbria, December 2015, Impact Assessment. Available at: https://cumbria.gov.uk/elibrary/Content/Internet/536/671/4674/17217/17225/43312152830.PDF on 8 June 2023.

A study by Mendoza-Tinoco et al (2017)[13] on the Yorkshire floods of 2007 found that half of the economic damages on the region's GVA came during the first fourteen months of recovery. The study also concludes that it takes at least 14 months for the economy to return to its pre-flood situation.

To avoid over-estimating the impacts, an assumption of a nine month recovery period is used in this assessment. This is then tested in sensitivity analysis.

2.2.5 Evidence on national losses following flooding of non-residential properties

Evidence on national losses following flooding is limited. A study by Aerts (2019)[14] found indirect losses can be offset by up to 60% through use of alternative suppliers and markets. However, as indirect losses rise with increasing flood risk, it can become more difficult to offset losses in this way. For Lowestoft, this is likely to relate to the immediate effect when existing orders, etc. may be affected by flooding of businesses who are then unable to realise those orders. Over time, it could be expected that companies in Lowestoft would be affected reputationally with organisations reluctant to place orders when there is a high risk of flooding. As such, national losses could decrease over time while local losses increase. Thus, there is no clear evidence to inform an assumption on the percentage of GVA losses that could be felt nationally.

One of the key areas of expansion for Lowestoft is in the offshore wind energy sector. The town is competing with other UK ports, but also European ports for this investment. In terms of the European supply chain, it is Germany, Netherlands and Denmark that are particularly strong, all of which would be direct competitors to Lowestoft. Were investment to move to these countries rather than other UK ports, then the national losses could be much more significant than 10%. It is not possible currently to place an estimate of what this additional national loss could be as there is no quantified evidence to draw on, but it would be much more difficult for other UK ports (given capacity limitations at east coast locations such as at Great Yarmouth and Felixstowe) to attract this investment and there is a significant risk it could move to outside the UK.

Given the lack of alternative evidence, it is assumed that 10% of damages would be felt nationally to align with the assumption used for tourism and recreation. Sensitivity analysis is used to assess how changes in this assumption could affect the benefit-cost ratio.

2.2.6 Evidence on knock-on effects outside the flood area

The regular Cumbria LEP business Survey was undertaken four months after the floods and captured 1,458 businesses of which 368 (25%) were in the Environment Agency flood extent area (reported in Cumbria County Council, 2018). This found that 65% of businesses had seen a negative impact from the storms and floods. With the Environment Agency flood extent areas, 86% reported experiencing a negative impact. Of the 65% of businesses affected (which is significantly greater than the 25% of businesses surveyed that were in the flood area), 60% reported a financial loss or additional costs. The mean financial loss was £35,759 but was £84,455 in the Environment Agency flood extent areas. The mean additional cost was £54,608 but was £99,496 in the Environment Agency flood extent areas.

[13] Mendoza-Tinoco D et al (2017): Flood footprint of the 2007 floods in the UK: The case of the Yorkshire and the Humber region. Journal of Cleaner Production, 168, 655-667. Available at: https://www.sciencedirect.com/science/article/pii/S0959652617320048 on 8 June 2023.

[14] Aerts JCJH (2019): The macroeconomic impacts of future river flooding in Europe, Environmental Research Letters, Volume 14 (8). Available at: https://iopscience.iop.org/article/10.1088/1748-9326/ab3306/meta on 8 June 2023.

This suggests that there are considerable knock-on costs for businesses outside the flood extent area. Based on the figures above, the knock-on damages are estimated at:

- Financial loss:
    - Business in flood extent area: 368 x 86% x £84,455 = £26.7 million
    - Businesses outside flood extent area (adjusted to exclude businesses reporting a loss in the flood extent area): 1,458 x 60% - (368 x 86%) x £35,759 = £20.0 million
    - Knock-on losses to businesses outside the flood extent area = 75% on top of damages in flood extent area
- Additional costs:
    - Business in flood extent area: 368 x 86% x £99,496 = £31.4 million
    - Businesses outside flood extent area (adjusted to exclude businesses reporting a loss in the flood extent area): 1,458 x 60% - (368 x 86%) x £54,608 = £30.5 million
    - Knock-on costs to businesses outside the flood extent area = 103% on top of damages in flood extent area

These additional damages are not picked up to this extent in Jacobs (2022) economics report as that uses the MCH guidance to assess non-residential indirect. Under do-nothing in Jacobs (2022), these damages are given as £2.1 million compared with non-residential property damages of £75.6 million. This equates to knock-on effects of 2.7% compared with 75% for financial losses and 103% for additional costs as reported following the Cumbria floods.

Somerset Rivers Authority (2015)[15] found business impacts from flooding were between £2.5 million and £4.1 million (central estimate of £3.3 million). GVA impacts were measured locally for Somerset Levels and Moors as £0.9 million to £2.8 million and for the wider Somerset area at £3.4 million to £10.3 million. This was based on a survey with businesses in August 2014 (so around 8-10 months following flooding). These figures likely include businesses that were flooded (with 60 businesses identified as having been impacted) with 50% of those surveyed saying they were affected by flooding. The knock-on effects from these figures are 36% to 68% for the Somerset Levels and Moors and 74% to 250% for the wider Somerset region. The range of values at the regional level (74% to 250%) is similar to that seen from the Cumbria study (75% for financial losses) but at the low end of the range. The Somerset study does not report on additional costs, but instead bases the estimates on change in GVA.

This potential increase in damages is not added to the Jacobs (2022) estimates since it is considered that these damages would be reflected in the GVA damage estimates. However, they are used in sensitivity in Section 3.4 to compare against the GVA damage estimates to provide an assessment of the extent to which the calculated indirect/induced GVA damages may reflect these reported additional losses and costs at the local/regional level.

[15] Somerset Rivers Authority (2015): Somerset Economic Impact Assessment of the Winter 2013/14 flooding, report by Parsons Brinkerhoff. Available at: http://www.somersetriversauthority.org.uk/wp-content/uploads/2018/06/22-July-2015-ITEM-8-Economic-Impact-Assessment-full-report.pdf on 8 June 2023.

2.3 Approach to estimating the benefits

2.3.1 Tourism and recreation benefits

Jacobs (2022) excludes tourism and recreational benefits even though it acknowledges that 10% of the damages would potentially be realised at the national level. It is suggested that these are included in the main assessment and excluded for sensitivity analysis. The benefits as reported in Jacobs (2022) are included in an AAD worksheet in the FCERM spreadsheets and then estimated based on risk of flooding under both do-nothing and with barrier. This gives damages of £19.7 million under do-nothing and £2.6 million under the barrier option, giving damages avoided with the barrier of £17.1 million.

2.3.2 National GVA losses

Mott Macdonald (2022) estimates the GVA at risk due to flooding. The calculations assume a nine-month recovery period following flooding for GVA so take 75% of the annual impacts. An assumption is also made that the national losses are 10%. The AAD worksheets are used to reflect the likelihood of flooding in any one year for do-nothing now and do-nothing in 2117/2119 (i.e., in 100 years' time). The total area under the curve is then used as the AAD and included in the do-nothing and flood barrier damage sheets to allow the likelihood that AAD are experienced in any one year to be calculated.

2.3.3 Change in life satisfaction for those losing their jobs

Using Mott Macdonald (2022) estimates suggests that 11,000 direct jobs and 3,200 indirect/induced jobs would benefit from the flood barrier. Jacobs (2022) shows that there are 1,804 residential properties affected in 2119. Assuming 2 adults per household and that these people are the ones whose jobs would be affected suggests that mental health effects on 3,608 adults have already been considered. This leaves 7,392 people whose mental health could be affected due to loss of their direct job plus 3,200 due to loss of their indirect/induced job and associated changes to the town (note impacts on those whose job is not affected though they would be affected by changes to the town, are not captured). HM Treasury (2021)[16] proposes the use of a change in WELLBYs to reflect change in life satisfaction. This is assumed to be more relevant here than the Environment Agency guidance on mental health impacts from flooding, since the changes relate to loss of a job, loss of access to services within the town, increasing deprivation and worsening living conditions. The value of a WELLBY is given as £13,000 (range £10,000 to £16,000) per year.

Based on the review of evidence, it is suggested that a change in life satisfaction of 0.5 be taken to be conservative (range was 0.43 to 1.4), giving annual impacts of £6,500 per person (range £5,000 to £8,000 per year). The Present Value (PV) damages are based on Annual Average Damages (AAD) with damages assumed to recur every year, i.e., once a job is lost it remains lost as flood risk increases. Over 10,392 people, the damages are thus £68 million per year. These values are entered into the FCERM spreadsheets to take account of the likelihood that flooding has occurred. As these damages relate to wellbeing, the health discount rate is applied. Adjusted for the risk of flooding over time, the PV damages under do-nothing are estimated at £71.3 million. Residual damages under the with barrier option are £0.2 million, giving damages avoided of £71.1 million.

[16] HM Treasury (2021): Welling guidance for appraisal: Supplementary Green Book guidance. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1005388/Wellbeing_guidance_for_appraisal_-_supplementary_Green_Book_guidance.pdf on 7 June 2023.

This is still likely to be an under-estimate as the impacts on the town by 2117 are such that almost all the population living in the town would be affected, not least by a reduction in their property values, and in their quality of life, in terms of access to shops and other services.

2.4 Sensitivity testing

2.4.1 Changing assumption on recovery time and national impacts

The main assessment identifies time taken for GVA to recover following flooding as 9 months (on average). Thus, the main assessment assumes 75% of GVA damages for recovery in any one year (based on evidence from previous flood events but erring on the side of caution). This is based on evidence from Cumbria County Council (2018). Evidence from Yorkshire and Humber (Mendoza-Tinico, 2017) suggests that it took 14 months for the economy to recover to its pre-flood situation. This would suggest that 100% of the GVA damages per year could be taken (and that there would be some knock-on effect into the next year). If the full 12 months impact on GVA is taken, then the national damages under do-nothing increase from £58 million to £77 million, and the damages avoided increase to £74 million.

This would increase the BCR based on national FDGiA benefits to 1.41 (from 1.32).

2.4.2 Changing assumption on national impacts

The main assessment identifies national GVA losses based on the amount of impact that would be felt nationally, assuming local/regional impacts can be compensated for through displacement or transfer to other businesses within the country. The main assessment assumes 10% of damages that are felt nationally (to align with the assumption used for tourism and recreation). There is no clear evidence from previous flood events of how much GVA impacts were felt nationally (rather than locally or regionally). The total damages avoided without any GVA damages avoided are £208 million, so this still exceeds the costs by £8.5 million. Therefore, the with barrier option is still economically worthwhile even if it is assumed that zero GVA damages felt locally result in impacts at the national level. If the national losses are higher (due to overseas competition for offshore wind investment), then the damages avoid would increase and so with it the BCR.

Changing the assumption of national GVA losses to 0% (from 10%), i.e. assuming zero GVA impact nationally, reduces the BCR to 1.04.

2.4.3 Using lower and higher WELLBY estimates

HM Treasury (2021) gives a range of WELLBY values from £10,000 to £16,000 per one point reduction in life satisfaction score. If the £10,000 value is taken, then the damages would be £5,000 per person whose job is lost and if the higher value is used then the damages become £8,000 per person whose jobs is lost. This would change the total damages and damages avoided to:

- Lower WELLBY:
    - Damages under do-nothing: £54.9 million
    - Damages under the barrier: £0.2 million
    - Damages avoided with the barrier: £54.7 million
    - **FDGiA benefits BCR: 1.24 (from 1.32)**
- Higher WELLBY:
    - Damages under do-nothing: £87.8 million

- Damages under the barrier: £0.3 million
- Damages avoided with the barrier: £87.5 million
- **FDGiA benefits BCR: 1.40 (from 1.32)**

The lower WELLBY reduces the FDGiA BCR to 1.24 which is still robustly greater than one, although conservative assumptions have already been made with the change in life satisfaction score (0.5 being much lower than estimates across some of the literature). The assessment ensures there is no double counting by excluding all those included in the human intangible stress and health benefits, even though that relates just to flooding impacts not job loss effects. This assessment also assumes that there are no impacts on life satisfaction for those living in Lowestoft but who do not work in the industries affected by flooding.

2.4.4 Including optimism bias

The cost estimates provided by East Suffolk Council include costed risk logs for construction and non-construction, plus some additional risk allowances. However, if a further 30% Optimism Bias (OB) is added then the costs would increase to around £260 million.

This increase in costs would reduce the BCR to 1.01 (from 1.32).

3 GVA benefits

3.1 Summary of findings

3.1.1 Do-nothing

GVA now

Although only 10% of the losses are assumed to be felt nationally, the remaining 90% will be felt locally and regionally. These amount to £520 million in direct GVA impacts. On top of these are the indirect and induced GVA effects that occur along the supply chain. These have not been included in the national losses as it is assumed most will be felt locally[17]. These indirect and induced damages are estimated at £190 million.

The total damages under do-nothing taking into account local/regional flood damages are £820 million.

GVA future

There are significant investments proposed, all of which rely on the flood barrier being in place to realise the full value of their potential benefits. These benefits are all at risk if the flood barrier is not constructed (all figures given as Present Value over 100 years):

- Port infrastructure investment: benefits at-risk are estimated at £1,100 million to £1,500 million
- Town infrastructure investment: benefits at-risk are estimated at £14,900 million
- Transport infrastructure investment (Gull wing bridge): benefits at-risk are estimated at £415 million[18]

Since all these investments are future benefits at-risk, it is assumed that 62% would be lost under do-nothing (based on Mott Macdonald, 2022). The 62% assumption relates to 2117 so may over-estimate impacts in the short-term. However, confirmation that the flood barrier would not be built is expected to result in significant reputational risk for Lowestoft which would likely increase the extent to which current investments can realise their benefits immediately. The potential damages in terms of 'benefits lost' under do-nothing is estimated at £9,700 million to £10,000 million (PV over 100 years).

The total damages under do-nothing taking into account the additional and wider benefits that would not be realised are £10,500 million to £10,800 million.

[17] This is a simplifying assumption that may under-estimate the national losses especially if considering the importance of industries such as offshore wind.

[18] The timescale over which these benefits had been estimated was not given so it is assumed to be 100 years

3.1.2 With flood barrier

GVA now

With the flood barrier, the direct local/regional GVA losses avoided are estimated at £500 million with a further £168 million from indirect and induced GVA damages avoided. This will avoid losses of some 11,000 FTEs and a further 3,200 indirect and induced FTEs.

The benefit-cost ratio taking into account local/regional flood damages avoided is 3.8 (costs taken as £199,933k).

GVA future

With the flood barrier, a significant proportion of the benefits from other investments would be realised. Mott Macdonald (2022) highlights that 22% would still be at risk even with a 40m barrier so these would result in realisation of benefits from other investments of £6,200 to £6,600 million[19].

The benefit-cost ratio taking into account the additional and wider benefits that will be realised with the flood barrier is 34.8 to 36.8 (costs taken as £199,933k).

3.2 Summary of evidence reviewed

The GVA now and GVA future benefits draw on Mott Macdonald (2022), as summarised in Section 2.2.3. The local damages would decrease if the percentage assigned to national benefits increases (e.g. if a higher national loss is assumed for offshore wind given that competitors are located across the North Sea), and vice versa.

3.3 Approach to estimating the benefits

The approach to estimating the local/regional GVA now and GVA future benefits follows the same approach as for the national benefits (see Section 2.3.3) with the percentage assigned to local/regional benefits being the difference between the percentage assigned to national benefits and 100%. For the main assessment, the assumption is that 10% of GVA losses under do-nothing are national, so this means that 90% of the losses are local/regional.

3.4 Sensitivity analysis

3.4.1 Comparing losses and costs outside the flood extent from Cumbria with GVA damages

The Cumbria County Council (2018) report identified the additional financial losses and additional costs that were incurred by businesses affected by flooding, whether these were inside the flood extent, or outside. The knock-on financial losses were estimated at 75% and additional costs at 103%

[19] Larger benefits may be possible with inclusion of flood warning. The current economic appraisal ignores flood warning but this would a prerequisite for appropriate and timely operation of the barrier. Furthermore, with the barrier in place there may be opportunity for the port to revise its operations upon receipt of a flood warning to reduce the impacts on GVA, e.g., by making more use of the Inner Harbour which would be protected by the flood barrier.

of those costs experienced inside the flood extent area. The knock-on financial losses are considered here alongside the additional costs for comparison with the overall GVA losses and losses avoided.

The percentage for financial loss is applied to the non-residential property damages reported in Jacobs (2022) which are given as £75,575,720, then the non-residential property damages outside the floodable area would be as follows (the same calculation is applied to the damages on non-residential property reported for the 40m barrier which are £21,316,942 in Jacobs (2022)):

- Do-nothing:
  - Financial losses: £75,575,720 x 75% = £56,681,790
  - Additional costs: £75,575,720 x 103% = £77,842,992
  - Total knock-on damages = £134,524,782
- 40m barrier:
  - Financial losses: £21,316,942 x 75% = £15,987,707
  - Additional costs: £21,316,942 x 103% = £21,956,450
  - Total knock-on damages = £37,944,157
- Damages avoided with 40m barrier:
  - Financial losses avoided: £40,694,084
  - Additional costs avoided: £55,886,542
  - Total knock-on damages avoided: £96,580,625

These estimated costs at £97 million are lower than the impacts based on the GVA calculations, which for the indirect/induced impacts are £190 million for Lowestoft. However, the Lowestoft impacts reflect repeated flooding and increasing risk of flooding over time (up to 20% by year 99). Therefore, it would be expected that such repeated flooding would result in greater impacts.

Somerset Rivers Authority (2015) reports knock-on GVA impacts of 74% to 250% at the regional (county) scale. If these values are applied to the non-residential losses, the GVA impacts are estimated at £56 million to £189 million under do-nothing and £16 million to £53 million with the flood barrier, giving GVA damages avoided of £40 million to £136 million. It is unclear if these also capture direct GVA impacts, although the description of the survey suggests that they may just be indirect/induced effects not associated with the flooded businesses themselves. These impacts were in a largely rural area so it would be expected that the knock-on GVA effects might be lower than seen in an urban area.

4 Future investment benefits

4.1 Summary of findings

4.1.1 Do-nothing

Under do-nothing, no new investment will be attracted since there will be no public investment in a flood barrier.

The total damages under do-nothing taking into account the future investment that would not be attracted are £10,900 million to £11,200 million.

4.1.2 With flood barrier

With the flood barrier, there could be additional investment attracted linked to all the other investments that are in place. To avoid over-estimating, the potential benefits are linked only to the public investment in the flood barrier (not to the other investments). Matvejevs & Tkacev (2023)[20] found that public investment can attract $2 for every $1 invested in OECD countries over a period of around seven years following the investment. Taking flood barrier costs at £200 million could therefore deliver private investment benefits of around £400 million. Given that the flood barrier is already recognised as a keystone investment in delivering other public (e.g. Towns fund) and private (e.g. ABP LEEF port investment), some of this may already have been realised.

The benefit-cost ratio taking into account the potential future investment that could be attracted once the flood barrier is constructed is 36.8 to 38.8 (costs taken as £199,933k). Note this is based on the value of the investment that is attracted, not the benefit of that investment so is likely to be an under-estimate.

4.2 Summary of evidence reviewed

4.2.1 Evidence on public investment attracting further investment

There are numerous studies that find public investment attracts further investment. Glocker et al (2019) analysed UK government spending between 1966 and 2015 and found that the multiplier varies depending on where in the cycle the economy is[21]. They concluded that the investment multiplier is at its highest during a recessionary period and is lower during a period of expansionary activity. This is supported by a working paper published by the IMF (2021) that came to a similar conclusion, stating that during periods of "high uncertainty" public investment has a larger and longer-lasting effect on output, investment, and employment, with multipliers above two[22]. Deleidi et al (2019) undertook an

[20] Matvejevs & Tkacev (2023): Invest One – Get Two Extra: Public Investment Crowds in Private Investment, SUERF Policy Brief No 499. Available at: https://www.suerf.org/suer-policy-brief/59417/invest-one-get-two-extra-public-investment-crowds-in-private-investment on 5 June 2023.

[21] Glocker et al (2019): Time-varying government spending multipliers in the UK, Journal of Macroeconomics vol. 60. Available at: https://www.sciencedirect.com/science/article/abs/pii/S0164070418301642 on 8 June 2023.

[22] International Monetary Fund (2021): Uncertainty and Public Investment Multipliers: The Role of Economic Confidence. Available at: https://www.imf.org/en/Publications/WP/Issues/2021/11/12/Uncertainty-and-

analysis of 11 Eurozone countries between 1970 and 2016 to estimate the level of fiscal multipliers [23]. They found that fiscal multipliers tend to be larger than one and that public investment leads to a permanent and persistent effect on the level of output.

4.3 Approach to estimating the benefits

The benefits are simply calculated as the level of public investment multiplied by two (following the findings of Matvejevs & Tkacev (2023). These reflect the value of the investment, *not* the benefits that would be generated from that investment. If the benefits from the investment are greater than the value of the investment, then the benefits to Lowestoft from the flood barrier enabling and attracting future investment will be under-estimated.

4.4 Sensitivity analysis

Evidence on multipliers applied to public investment is somewhat scarce but seems to support the assumption that public investment could work as an enabler for additional, follow-on investment. Given the Lowestoft is a town requiring investment, it could be assumed that the public investment in the flood barrier would have greater impact (similar to the findings on investment in recessionary periods). Thus, the multiplier could be greater than two, further increasing the benefit-cost ratio from investment in flood barrier.

Public-Investment-Multipliers-The-Role-of-Economic-Confidence-506825#:~:text=In%20theory%2C%20uncertainty%20can%20reduce,lead%20to%20larger%20private%20spending on 6 June 2023.

[23] Deleidi et al (2019): Public investment fiscal multipliers: An empirical assessment for European countries. Available at: https://www.ucl.ac.uk/bartlett/public-purpose/sites/public-purpose/files/final_working_paper_deleidi_iafrate_levrero_19_aug.pdf on 6 June 2023.

5 Attributing benefits

5.1 Summary of findings

The potential linkages of the flood barrier to the different Government Departments are set out in Section 5.2, with the benefits they could each realise then summarised in Section 5.3. Table 5-1 below summarises which departments would benefit and why. BEIS is omitted from the table as it no longer exists; instead reference is included to the Department for Business and Trade (DBT) and Department for Energy Security and Net Zero (DESNZ).

Table 5-1: Government departments benefiting from the Lowestoft flood barrier

Department benefiting	How the flood barrier could benefit each Department
DBT	Underpins increased business growth and trade (especially via port)
Defra	Underpins increased levels of walking and cycling helping to improve air quality and reduce greenhouse gas emissions Reduces flood risk
DESNZ	Supports growth in offshore wind energy through realisation of port investments Helps deliver net zero by enabling growth in offshore wind industry, and providing port support to Sizewell C
DfT	Ensures improved transport connectivity by reducing flood risk to access roads to Gull Wing bridge
DHULC	Underpins economic growth and jobs in relatively deprived area helping to level up Underpins connectivity in transport connections, including at port Enables increased pride in place by enabling investment benefits to be realised and town to develop and improve
DWP	Underpins increased employment and provision of high quality/skilled jobs from
HM Treasury	Demonstrates value for money from public investment and enables investments already made (which in many cases are predicated on the flood barrier being constructed)
Homes England	Reduces flood risk to existing properties Underpins increased opportunities for development of high quality properties

5.2 Summary of evidence reviewed

The government departments relevant to the Lowestoft flood barrier were analysed to find their visions and priority outcomes. These were then mapped against the benefits of the project to highlight how the flood barrier would help those departments to meet their objectives.

In Table 5-2, the UK government departments' vision and priority outcomes are laid out. It must be noted that BEIS (Department for Business, Energy & Industrial Strategy) no longer exists and has been succeeded by the DESNZ (Department for Energy and Net Zero) and Department for Business and Trade (DBT).

Table 5-2: Government department visions and priority outcomes		
Government department	**Vision**	**Priority outcomes**
Defra (Department for Environment, Food & Rural Affairs)	To make our air purer, our water cleaner, our land greener and our food more sustainable	• Improve the environment through cleaner air and water, minimised waste, and thriving plants and terrestrial and marine wildlife (this is a cross-cutting outcome, with Ministry of Housing, Communities and Local Government (MHCLG) and Department for Transport (DfT) as contributing departments); • Reduce greenhouse gas emissions and increase carbon storage in the agricultural, waste, peat, and tree planting sectors to help deliver net zero (this outcome reflects Defra's contribution to the Department for Business, Energy and Industrial Strategy (BEIS)-led cross-cutting net zero outcome); • Reduce the likelihood and impact of flooding and coastal erosion on people, businesses, communities, and the environment; and • Increase the sustainability, productivity and resilience of the agriculture, fishing, food, and drink sectors, enhance biosecurity at the border and raise animal welfare standards.
BEIS (Department for Business, Energy & Industrial Strategy)	To building a stronger, fairer, and greener future across the UK, fostering shared prosperity, growth and levelling up across our Union	• Fight coronavirus by helping businesses to bounce back from the impacts of COVID-19, supporting a safe return to the workplace and accelerating the development and manufacture of a vaccine; • Tackle climate change: reduce UK greenhouse gas emissions to net zero by 2050. (Cross-cutting outcome also supported by DEFRA, DfT, DHCLG and HMT); • Unleash innovation and accelerate science and technology throughout the country to increase productivity and UK global influence; and • Back long-term growth: boost enterprise by making the UK the best place in the world to start and grow a business.
DHLUC (Department for Levelling Up, Housing and Communities)	*No vision mentioned, but the About Us said,* The Department for Levelling Up, Housing and Communities supports communities across the UK to thrive, making them great places to live and work	• To increase pay, employment, and productivity in every part of the UK, with each containing "a globally competitive city" and a smaller gap between top performing and other areas; • Public transport connectivity across the UK to be "significantly closer to the standards of London" including integrated ticketing and simpler fares; • A "significant" increase in primary school children reaching expected standards in reading, writing and maths. For England – education policy is devolved – this will mean at least 90% meeting expected standards, with at least a one-third increase for this metric in the worst performing areas; • A "significant" rise in the numbers completing high-quality skills training across the UK. In England, the target is for 200,000 more doing this, including 80,000 in the lowest skilled areas; • A narrowing in healthy life expectancy between the UK areas where it is highest and lowest, with the overall average healthy life expectancy rising by five years by 2035;

Table 5-2: Government department visions and priority outcomes		
Government department	**Vision**	**Priority outcomes**
		• An improvement in perceived wellbeing in all parts of the UK, with a narrowed gap between areas with the highest and lowest levels; • A rise across the whole UK of "pride in place", defined as "people's satisfaction with their town centre and engagement in local culture and community", with a narrowing of gaps between areas with the highest and lowest levels; • An increase in the number of first-time home buyers in all UK areas. The "ambition" is for a 50% fall in the number of rented homes deemed non-decent, including the biggest improvements in worst-performing areas; • An overall fall in homicide, serious violence, and neighbourhood crime, focused on worst-affected areas; and • A devolution deal for "every part of England that wants one", with powers "at or approaching the highest level of devolution and a simplified, long-term funding settlement".[24]
DfT (Department for Transport)	No vision. Website to say to refer to priority outcomes.	• Improve connectivity across the UK and grow the economy by enhancing the transport network, on time and on budget. • Build confidence in the transport network as the country recovers from COVID-19 and improve transport users' experience, ensuring that the network is safe, reliable, and inclusive. • Tackle climate change and improve air quality by decarbonising transport (this outcome reflects DfT's contribution to the BEIS-led cross-cutting net zero outcome).[25]
Homes England	To intervene in the market to ensure more homes are built in areas of greatest need, to improve affordability. We'll make this sustainable by creating a	• Unlock public and private land where the market will not, to get more homes built where they are needed; • Ensure a range of investment products are available to support housebuilding and infrastructure, including more affordable housing and homes for rent, where the market is not acting; • Improve construction productivity; • Create a more resilient and competitive market by supporting smaller builders and new entrants, and promote better design and higher quality homes; • Offer expert support for priority locations, helping to create and deliver more ambitious plans to get more homes built; and

[24] HM Government (2022) Levelling Up White Paper. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1095544/Executive_Summary.pdf on 25 May 2023.

[25] GOV.UK (2023): About us – Department for Transport. Available at: https://www.gov.uk/government/organisations/department-for-transport/about on 25 May 2023.

Table 5-2: Government department visions and priority outcomes		
Government department	**Vision**	**Priority outcomes**
	more resilient and diverse housing market	• Effectively deliver home ownership products, providing an industry standard service to consumers.[26]
DWP (Department for Work and Pensions)	To improve people's quality of life, both now and in the future	• Maximise employment across the country to aid economic recovery following COVID-19; • Improve opportunities for all through work, including groups that are currently under-represented in the workforce; • Address poverty through enabling progression in the workforce and increasing financial resilience; and • Deliver a reliable, high-quality welfare and pensions system which customers have confidence in.[27]
DESNZ (Department for Energy Security and Net Zero)	*No vision mentioned, but the About Us said they are* securing our long-term energy supply, bringing down bills and halving inflation	• Ensure security of energy supply this winter, next winter and in the longer-term – bringing down energy bills and reducing inflation. • Ensure the UK is on track to meet its legally binding Net Zero commitments and support economic growth by significantly speeding up delivery of network infrastructure and domestic energy production. • Improve the energy efficiency of UK homes, businesses, and public sector buildings to meet the 15% demand reduction ambition. • Deliver current schemes to support energy consumers with their bills and develop options for long-term reform to improve how the electricity market works for families and businesses. • Seize the economic benefits of Net Zero, including the jobs and growth created through investment in new green industries. • Pass the Energy Bill to support the emerging CCUS and hydrogen sectors; to update the governance of the energy system; and to reduce the time taken to consent offshore wind.[28]

[26] Homes England (2022): Homes England strategic plan 2018 to 2023. Available at: https://www.gov.uk/government/publications/homes-england-strategic-plan-201819-to-202223/homes-england-strategic-plan-2018-to-2023#our-mission-and-objectives on 25 May 2023.

[27] DWP (2021): Department for Work and Pensions Outcome Delivery Plan: 2021 to 2022. Available at: https://www.gov.uk/government/publications/department-for-work-and-pensions-outcome-delivery-plan/department-for-work-and-pensions-outcome-delivery-plan-2021-to-2022 on 25 May 2023.

[28] GOV.UK (2023) About us – Department for Energy Security & Net Zero. Available at: https://www.gov.uk/government/organisations/department-for-energy-security-and-net-zero/about on 25 May 2023.

5.3 Approach to attributing the benefits

There are clearly a multitude of benefits stemming from the investments that are happening in Lowestoft and are planned for the future. These investments are taking place in-line with the visions and the priority outcomes of numerous governmental departments.

5.3.1 Port investment

Investment in the port of Lowestoft through Project LEEF is expected to deliver £1.72 billion in additional GVA over a period of 60 years (three berths). This is predicted to deliver 707 additional jobs on average per year. The investment is clearly linked to the priority outcomes of the Department of Energy Security and Net Zero (DESNZ), particularly their aims to "Seize the economic benefits of Net Zero, including the jobs and growth created through investment in new green industries". The development of the LEEF project, will be vital in realising the benefits of the transition to a Net Zero economy especially in Lowestoft and the local area.

The LEEF project is also linked to other priority objectives, particularly those related to the environment. Defra are supporting priority outcomes of other departments, such as BEIS' aim to reduce UK greenhouse gas emissions to net zero by 2050. Working towards net zero, will also have knock-on impacts on Defra's other objectives, such to "Improve the environment through cleaner air and water, minimised waste, and thriving plants and terrestrial and marine wildlife". There are also benefits to the DHLUC's twelve missions such as the first which aims "to increase pay, employment and productivity in every part of the UK". The investment in the port would also indirectly contribute to other missions from the DHLUC such as:

- A "significant" rise in the numbers completing high-quality skills training across the UK. In England, the target is for 200,000 more doing this, including 80,000 in the lowest skilled areas; and
- An improvement in perceived wellbeing in all parts of the UK, with a narrowed gap between areas with the highest and lowest levels.

The port investment would also contribute to employment in the area. Project LEEF is projected to deliver 707 additional jobs on average per year, of which many will be high skilled. This contributes to the DWP's priority outcome of to "Maximise employment across the country to aid economic recovery following COVID-19".

The large-scale investment in the port of Lowestoft will lead to a multitude of benefits for government departments such as BEIS, DESNZ and Defra's aims to reach net zero, the DHLUC's aim to "level-up" the country, and the DWP's aim to increase the number of high quality jobs.

5.3.2 Town investment

Lowestoft has an ambitious Town Investment Plan. The implementation of this plan will have a multitude of benefits if it is realised. A total of 54ha of land will be regenerated and 14,800 dwellings will be created. This investment will contribute to a series of governmental priority outcomes, particularly those from the DHLUC. Lowestoft has received funding from the DHLUC's Towns Fund so they already working towards the department's objectives. Linked to this the building of houses will contribute to the aims of Homes England. Particularly considering that the plan is expected to unlock £350 million of private investment. It must be noted that the Town Investment Plan is predicated on the creation of a flood barrier and that the GVA benefits would not be realised without it.

An important aspect of the Town Investment Plan is to encourage active and sustainable methods of transport that in turn are expected to improve connectivity, increase footfall, and reduce journey times. This is also important to the DfT that is both seeking to improve connectivity and improve air quality by decarbonising transport. Realisation of the Lowestoft's Town Investment Plan will help them move towards these goals.

5.3.3 Transport investment

The creation of a third bridge is vital for the connectivity of Lowestoft. It clearly works towards the priority outcomes of the DfT, especially as its construction is being partly financed by the department. Outside of the DfT, the bridge's construction will contribute to the aims of the DHLUC, such as:

- Public transport connectivity across the UK to be "significantly closer to the standards of London"; and
- A rise across the whole UK of "pride in place", defined as "people's satisfaction with their town centre and engagement in local culture and community", with a narrowing of gaps between areas with the highest and lowest levels.

There are also environmental benefits to the scheme. The bridge is expected to increase the levels of walking and cycling in Lowestoft, which will contribute to Defra's aims to improve air quality and reduce greenhouse gas emissions.

Annex 1 Sources used

ABP (2021): ABP unveils ambitious vision for Port of Lowestoft in support of SNS energy sector, 25 Mach 2021. Available at: https://www.abports.co.uk/news-and-media/latest-news/2021/abp-unveils-ambitious-vision-for-port-of-lowestoft-in-support-of-sns-energy-sector/ on 17 May 2023.

ABP (2021): Vision for the Port of Lowestoft (2020-2050). Available at: https://vision.abpmer.net/lowestoft-masterplan/ on 17 May 2023 (downloaded from: https://vision.abpmer.net/lowestoft-masterplan/resources/downloads/ABPLowestoftMasterplan.pdf)

ABP (2022): ABP awards design and build contract for Lowestoft Eastern Energy Facility, 21 November 2022. Available at: https://www.abports.co.uk/news-and-media/latest-news/2022/abp-awards-design-and-build-contract-for-lowestoft-eastern-energy-facility/ on 17 May 2023.

Aerts JCJH (2019): The macroeconomic impacts of future river flooding in Europe, Environmental Research Letters, Volume 14 (8). Available at: https://iopscience.iop.org/article/10.1088/1748-9326/ab3306/meta on 8 June 2023.

Akay A et al (2021): Life satisfaction, pro-activity, and employment, GLO Discussion paper No 784, Global Labor Association, Essen. Available at: https://www.econstor.eu/bitstream/10419/230522/1/GLO-DP-0784.pdf on 7 June 2023. Data based on statistics from 1984 to 2009.

Building Partnerships Limited (2020): Kirkley Waterfront Regeneration Feasibility Study – A report for East Suffolk Council, August 2020.

Byrnelooby (nd): Lowestoft Eastern Energy Facility (LEEF). Available at: https://www.byrnelooby.com/projects/lowestoft-eastern-energy-facility on 17 May 2023.

Cumbria County Council (2018): Flooding in Cumbria, December 2015, Impact Assessment. Available at: https://cumbria.gov.uk/elibrary/Content/Internet/536/671/4674/17217/17225/43312152830.PDF on 8 June 2023.

Deleidi et al (2019): Public investment fiscal multipliers: An empirical assessment for European countries. Available at: https://www.ucl.ac.uk/bartlett/public-purpose/sites/public-purpose/files/final_working_paper_deleidi_iafrate_levrero_19_aug.pdf on 6 June 2023.

Department for Transport (2020): Application for the proposed Lake Lothing Third Crossing development consent order. Available at: https://gullwingbridge.co.uk/wp-content/uploads/2021/02/LLTC-SoS-Decision-letter.pdf on 26 May 2023.

DWP (2021): Department for Work and Pensions Outcome Delivery Plan: 2021 to 2022. Available at: https://www.gov.uk/government/publications/department-for-work-and-pensions-outcome-delivery-plan/department-for-work-and-pensions-outcome-delivery-plan-2021-to-2022 on 25 May 2023.

East Suffolk Council (2019): Waveney Local Plan. Available at: https://www.eastsuffolk.gov.uk/assets/Your-Council/WDC-Council-Meetings/2019/March/Council-20-03-19/Item-11-APPENDIX-A-Waveney-Local-Plan.pdf on 23rd May 2023.

East Suffolk Council (2020): Lowestoft Town Centre Masterplan. Available at: https://www.eastsuffolk.gov.uk/assets/Business/Regeneration-projects/Lowestoft-Town-Centre-Masterplan.pdf on 19 May 2023.

East Suffolk Council (2021): Town Investment Plan: Lowestoft. Available at: https://www.eastsuffolk.gov.uk/assets/Business/Regeneration-projects/Lowestoft-Investment-Plan/Lowestoft-Town-Investment-Plan.pdf on 19 May 2023.

Glocker et al (2019): Time-varying government spending multipliers in the UK, Journal of Macroeconomics vol. 60. Available at: https://www.sciencedirect.com/science/article/abs/pii/S0164070418301642 on 8 June 2023.

GOV.UK (2023) About us – Department for Energy Security & Net Zero. Available at: https://www.gov.uk/government/organisations/department-for-energy-security-and-net-zero/about on 25 May 2023.

GOV.UK (2023): About us – Department for Transport. Available at: https://www.gov.uk/government/organisations/department-for-transport/about on 25 May 2023.

HM Government (2022) Levelling Up White Paper. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1095544/Executive_Summary.pdf on 25 May 2023.

HM Treasury (2021): Welling guidance for appraisal: Supplementary Green Book guidance. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1005388/Wellbeing_guidance_for_appraisal_-_supplementary_Green_Book_guidance.pdf on 7 June 2023.

Homes England (2022): Homes England strategic plan 2018 to 2023. Available at: https://www.gov.uk/government/publications/homes-england-strategic-plan-201819-to-202223/homes-england-strategic-plan-2018-to-2023#our-mission-and-objectives on 25 May 2023.

International Monetary Fund (2021): Uncertainty and Public Investment Multipliers: The Role of Economic Confidence. Available at: https://www.imf.org/en/Publications/WP/Issues/2021/11/12/Uncertainty-and-Public-Investment-Multipliers-The-Role-of-Economic-Confidence-506825#:~:text=In%20theory%2C%20uncertainty%20can%20reduce,lead%20to%20larger%20private%20spending on 6 June 2023.

Jacobs (2022): Lowestoft Tidal Economics for OBC 2022, Revision P01, 14 September 2022, Appendix E1 to the OBC.

Luhmann M et al (2012): Subjective well-being and adaptation to life events: a meta-analysis on differences between cognitive and affective well-being, J Pers Soc Psychol, 102(3), 592-615. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3289759/ on 7 June 2023.

Matvejevs & Tkacev (2023): Invest One – Get Two Extra: Public Investment Crowds in Private Investment, SUERF Policy Brief No 499. Available at: https://www.suerf.org/suer-policy-brief/59417/invest-one-get-two-extra-public-investment-crowds-in-private-investment on 5 June 2023.

Mendoza-Tinoco D et al (2017): Flood footprint of the 2007 floods in the UK: The case of the Yorkshire and the Humber region. Journal of Cleaner Production, 168, 655-667. Available at: https://www.sciencedirect.com/science/article/pii/S0959652617320048 on 8 June 2023.

Mott Macdonald (2022): Lowestoft Flood Risk Economic Footprint and Impact Report, May 2022, Appendix F3 to the OBC.

Nikolova M et al (2020): Losing your own business is worse than losing a salaried job. Available at: https://www.brookings.edu/blog/up-front/2020/05/07/losing-your-own-business-is-worse-than-losing-a-salaried-job/ on 7 June 2023.

Opergy & Metro Dynamics (2021): Economic impact assessment of the Lowestoft Eastern Energy Facility (LEEF) project, July 2021.

Somerset Rivers Authority (2015): Somerset Economic Impact Assessment of the Winter 2013/14 flooding, report by Parsons Brinkerhoff. Available at: http://www.somersetriversauthority.org.uk/wp-content/uploads/2018/06/22-July-2015-ITEM-8-Economic-Impact-Assessment-full-report.pdf on 8 June 2023.

Suffolk County Council (2020): Cabinet Meeting – Lake Lothing Third Crossing – The next steps – update and approval to proceed to the construction phase. Available at: https://gullwingbridge.co.uk/wp-content/uploads/2021/01/Agenda-Item-6-Lake-Lothing-Third-Crossing-aE-The-next-steps-aE-update-and-approval-to-proceed-to-the-construction-phase-4.pdf on 26 May 2023.

The Planning Inspectorate (2019): Lake Lothing Third Crossing – Examining Authority's Report of Findings and Conclusions and Recommendation to the Secretary of State for Transport. Available at: https://gullwingbridge.co.uk/wp-content/uploads/2021/02/LLTC-Examining-Authority-Report.pdf on 26 May 2023.

Risk & Policy Analysts Limited
Suite C, 2nd floor, The Atrium, St Georges Street
Norwich, Norfolk, NR3 1AB, United Kingdom

Tel: +44 1603 558442
E-mail: post@rpaltd.co.uk
Website: www.rpaltd.co.uk