Local Full Fibre Network (LFFN) Wave one: Programme evaluation

Final evaluation

Synthesis report

Ipsos

For the avoidance of doubt, the principle purpose of the Local Full Fibre Network (LFFN) wave one projects was not to provide the secondary benefits laid out in this report. For Public Sector Building Upgrades (PSBU)/ Public Sector Anchor Tenancy (PSAT) and Public Sector Asset Reuse (PSAR) projects that purpose is the improvement of public sector connectivity to meet a need, generally demonstrated through a business case, either to reduce the cost of equivalent connections or to provide improved connections which will enable a concomitant improvement in productivity or the provision of public services. PSAR projects followed what is known as the Market Economy Operator Principle (MEOP), which means that they had clear projected commercial outcomes and that these outcomes have been externally validated before the projects began. MEOP is an EU test as to whether a measure is commercial, and thus not State aid, which is a test relevant for those projects commenced prior to the end of the transition period.

The wider benefits which this report describes are secondary to these purposes; however, that does not mean that they are not of legitimate interest to government, local and central, as part of ongoing monitoring of digital connectivity.

To situate this report and the analysis within, note that it was submitted in November 2023.

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Executive summary

Ipsos UK was commissioned by Building Digital UK (BDUK) in May 2018 to undertake an evaluation of the wave one projects funded through the Local Full Fibre Network (LFFN). This report sets out the synthesis report for the final evaluation findings for the wave one projects.

Description of the programme

BDUK launched the LFFN Programme in 2017 with £200 million funding. The aims of the programme were to accelerate and de-risk the deployment of the next generation of digital infrastructure, create UK digital leadership and drive productivity and growth. The programme provided funding to local councils and other public bodies to achieve these aims.

Wave one of the LFFN programme comprised of a selection of pilot projects for the wider LFFN programme, which aimed to demonstrate how the interventions can operate and provide learning for the remaining LFFN projects. These projects are:

- **The Public Sector Asset Reuse (PSAR) Tameside project.** This project seeks to demonstrate how far it is feasible to deploy assets owned by the public sector to stimulate the market to increase the supply of Fibre to the Premises (FTTP) connectivity.

- **The West Sussex Public Sector Anchor Tenancy (PSAT) project.** This project provides public sector buildings with gigabit-capable connections and seeks to use these connections as long-term tenants.

- **The PSAR Trans Pennine Initiative project.** This project aims to demonstrate the feasibility of deploying assets owned by the public sector to stimulate the supply of FTTP connectivity.

- **The Public Sector Buildings Upgrade (PSBU) Schools project.** This project has been delivered in partnership with Department for Education (DfE) and aims to provide connectivity to schools.

Study aims

The key research questions for the evaluation of wave one projects are set out in the table below. This report builds on a baseline, process and early impacts assessment that was completed in July 2019 and the interim evaluations which took place in 2020-2022.

Key evaluation questions

Question area	Sub-questions
What outcomes can be attributed and were they as intended?	What is the range of local level outcomes from LFFN?
	What local level changes made a difference, were there other explanations?
	What, if any, were the wider benefits of LFFN?
	Were there any unintended outcomes?
How has LFFN achieved these outcomes?	To what extent is this affected by context or circumstance?
	How can LFFN achievements be enhanced?
What can we learn to improve future policy designs and implementation?	LFFN Programme
	Other Government broadband infrastructure policy or programmes
	Other Government future telecommunications infrastructure policy or programmes (including 5G)
	Demand-led delivery approaches

Source: BDUK Invitation to Tender

Key evaluation findings

Project delivery for the wave one projects was generally slower than anticipated, meaning there were delays in project completion. There were a variety of reasons for the slow progress which are discussed in the individual project evaluation reports. Some of these can be assigned to the innovative nature of the projects, and involving organisations with limited experience of delivery of publicly funded telecommunications projects. However, one of the key findings across the projects was importance of early planning in ensuring civil engineering work could take place as anticipated. Instances where early planning proved beneficial included applying for wayleaves, exploring the route, and engagement with beneficiaries.

The areas that the LFFN wave one projects have built networks vary significantly, and the projects differed in terms of their aims as to how they would make the target areas more commercially viable. There is mixed evidence on how successful the projects have been in making their areas more commercially viable to network providers. For all four projects, there is evidence that the delivery of the project has helped to support the further use of a commercial vehicle or mechanisms. This has been achieved either by utilising a local commercial vehicle, or by using learnings from the projects to develop a new commercial offering. This demonstrates that crucial learning has been taken from the LFFN wave one projects.

There is evidence that gigabit-capable and ultrafast coverage has increased in all areas that the LFFN wave one projects have operated in. There is also evidence that take-up of ultrafast connections has also increased in these areas. However, the evaluation cannot conclude that the projects other than Trans Pennine Initiative have had an additional impact on gigabit-capable coverage up to 2022 in the areas within 1km of the project network build. Due to the late completion of most of the projects though, the impacts may be generated in the future.

There is evidence that all the projects have led to public sector cost savings, and that the LFFN wave one projects have contributed to these savings. These are both direct and indirect cost savings. Examples of the cost savings include: direct savings from a reduced cost of connections and maintenance in Tameside, and public sector buildings receiving a better broadband connection for the same price as they were previously paying in West Sussex and in Schools; and indirect cost savings from reduction in the resources required to undertake administrative tasks and a reduction in other outgoings, such as the telephone costs, which can now be provided through the broadband connection.

The findings from the evaluation indicate that there are some challenges to be addressed in delivering demand led broadband interventions. These interventions appear to be successful in achieving the public sector outcomes and impacts, however they appear to have struggled so far, to 2022, to provide additional gigabit-capable networks in the local area, above what would have happened in the absence of the projects. This limits the longer term benefits the projects have been able to generate in terms of economic, social and environmental impacts to 2022.

Additionally, it appears that there are challenges associated with setting up new commercial vehicles to deliver gigabit-capable connectivity. The Trans Pennine Initiative project experienced issues in being able to sell connectivity as Network Rail due to price constraints and a lack of track record in delivering fibre connectivity. The Tameside PSAR project has seen similar challenges around Service Level Agreements which may have contributed to the absence of additional impact in gigabit-capable coverage in Tameside.

The table below summarises the key findings from the evaluation.

Summary of LFFN project achievements – green highlights strong evidence of achievement, orange indicates limited evidence of progress towards objective

Objective	West Sussex PSAT project	Tameside PSAR project	Trans Pennine Initiative	LFFN Schools project
Generate learning	Learning generated West Sussex county council and CityFibre in terms of delivering publicly funded infrastructure projects.	Learning generated for Tameside Metropolitan Borough Council, BDUK, other local authorities and Cooperative members.	Learning generated for Network Rail in terms of delivery and commercial environment.	Learning generated for Openreach, Schools, DfE, and BDUK, who have since gone on to use the same model of delivery of Rural Gigabit Connectivity programme.
Public sector cost savings	Evidence that public sector buildings have gigabit-capable connections at no additional cost.	Evidence public sector buildings have experienced cost savings.	Evidence some stations have experienced cost savings, and the potential for further savings along the route.	Evidence some LFFN schools have experienced cost savings.
Enhanced (public sector) service provision	Evidence that there have been some changes in public service provision.	Evidence that public service providers have been able to enhance the services they provide.	Evidence that services at some stations have improved, and the potential for further improvements along the route.	Evidence that some LFFN schools have been able to introduce enhanced learning for pupils.
Improve resilience	Evidence that broadband connections are more reliable than previous connections.	Evidence that there is improved resilience for organisations connected to the fibre network.	Evidence that broadband providers have utilised the network to improve resilience for customers.	Evidence that broadband is more reliable in LFFN schools.
Future proofing	Evidence that public service providers will be able to enhance services in the future as a result of better internet connections.	Evidence that public service providers have capacity to deliver more services in the future, and Tameside has futureproofed broadband provision in the area.	Evidence that Network Rail and stations can further exploit the fibre network in the future.	Evidence that LFFN schools have scope to offer more services in the future.

Objective	West Sussex PSAT project	Tameside PSAR project	Trans Pennine Initiative	LFFN Schools project
New broadband providers	Evidence that CityFibre has entered West Sussex as a result of the project.	N/A	Limited evidence that new broadband providers are offering services along the route.	N/A
Broaden connectivity	Limited evidence of additional gigabit-capable connectivity, above what is expected to have been delivered in the absence of the project, within 1km of the project build in West Sussex.	Limited evidence of additional gigabit-capable connectivity above what is expected to have been delivered in the absence of the project, within 1km of the project build in Tameside.	Evidence of enhanced connectivity along the route, in spite of limited use of the network by broadband providers.	Limited evidence of additional gigabit-capable connectivity, above what is expected to have been delivered in the absence of the project, within 1km of the project build.
Introduce new commercial models	N/A	Evidence that the Cooperative Network Infrastructure commercial model is established and is being used in other Local Authority areas.	Evidence of demand for a commercial model to provide access to rail fibre. Limited evidence that Network Rail can and should enter the market as a new broadband provider to offer commercial access.	*Not a stated aim of the project, but it has led to a new commercial product being developed, which has been used in other settings by Openreach.*
Economic and social outcomes	Limited evidence that the project has led to economic and social benefits.	Limited evidence that the project has led to economic and social benefits.	Limited evidence that the project has led to economic and social benefits.	Limited evidence that the project has led to economic and social benefits as no evidence of increased take-up.

Green highlights strong evidence of achievement; orange indicates limited evidence of progress towards objective

1 Introduction

Ipsos UK was commissioned by Building Digital UK (BDUK) in May 2018 to undertake an evaluation of the wave one projects funded through the Local Full Fibre Network (LFFN). This report sets out the synthesis report for the final evaluation findings for the wave one projects.

1.1 Description of the programme

BDUK launched the LFFN Programme in 2017 with £200 million funding. The aims of the programme were to accelerate and de-risk the deployment of the next generation of digital infrastructure, create UK digital leadership and drive productivity and growth. The programme provided funding to local councils and other public bodies to achieve these aims. Local councils could choose from three delivery models to apply and deliver locally, in addition to a national voucher scheme which was outside the scope of this evaluation:

- **Public Sector Anchor Tenancy (PSAT):** Bringing together local public sector customers, to create enough broadband demand to reduce the financial risk of building new full-fibre networks;

- **Public Sector Building Upgrades (PSBU):** Directly connecting public sector buildings, such as schools and hospitals, and

- **Public Sector Asset Re-use (PSAR):** Opening up public sector assets, such as existing ducts, to allow fibre to be laid more cheaply.

A Gigabit Broadband Voucher Scheme offering full-fibre broadband connection vouchers for businesses, to increase take-up of services is operated in parallel to the three delivery models above. However, the Gigabit Broadband Voucher Scheme is subject to a separate evaluation, and is therefore not covered in this study.

Wave one of the LFFN programme comprised of a selection of pilot projects for the wider LFFN programme, which aimed to demonstrate how the interventions can operate and provide learning for the remaining LFFN projects. These projects are:

- **The PSAR 'Thin Layer Model' Tameside project.** This project seeks to demonstrate how far it is feasible to deploy assets owned by the public sector to stimulate the market to increase the supply of Fibre to the Premises (FTTP) connectivity.

- **The West Sussex PSAT project (otherwise known as the West Sussex Gigabit project).** This project provides public sector buildings with gigabit-capable connections and seeks to use these connections as long-term tenants.

- **The PSAR Trans Pennine Initiative project.** This project also aims to demonstrate how far it is feasible to deploy assets owned by the public sector to stimulate the market to increase the supply of FTTP connectivity.

- **The PSBU Schools project.** This project has been delivered in partnership with Department for Education (DfE) andaims to provide connectivity to schools.

1.2   Context

1.2.1 Context at time of LFFN launch

At the time the LFFN programme was designed and launched in 2017, the government had recognised that there was a growing need for ultrafast and gigabit-capable networks in the UK, in order to support businesses and residents. Faster broadband was of growing importance to firms, with greater bandwidth required to take advantage of a range of new digital services and assure reliability and continuity of operations. For residents, ultrafast speeds were needed to support growing demand for data – for example, content-rich websites, streaming services, and cloud services. They were also expected to produce significant social benefits by supporting the development of applications enabling remote service delivery such as remote medical diagnostics.

At the end of 2016, the UK lagged behind a range of international comparators in terms of gigabit-capable deployment, with just 2 percent of premises covered by gigabit-capable networks at the end of 2016 compared with 100 percent in South Korea, 97 percent in Japan, and 86 percent in Portugal.[1] The UK was third from the bottom of 22 European countries for FTTP coverage[2]. Traditional copper-based circuits are insufficient to support the high-capacity and highly reliable infrastructure which ultrafast broadband and 5G infrastructure depend upon. 92 percent of homes in the UK were connected through part-fibre, part-copper lines that operate at superfast speeds[3], such as Fibre to the Cabinet (FTTC). The Superfast Broadband Programme has significantly bolstered the coverage of FTTC networks[4]. However, these technologies are insufficient to meet the demands outlined above.

Several factors were thought to have constrained the roll-out of full fibre networks in the UK in 2017. These included:

- Other countries having a greater share of the population dwelling in highly dense buildings of multiple occupation, increasing the commercial viability of the technology.

- Topological issues, with other countries being flatter, making investment less costly.

- Uncertainty around the willingness of consumers to pay for a service which they may not currently need.

- Regulatory barriers such as requirements in relation to wayleaves.

- Market structure issues, with dominant suppliers in the UK utilising technologies which could not, at that time, provide gigabit-capable networks.

- Lack of public investment, with other countries having significant public investment to boost FTTP coverage. For example, in France the state-owned telecoms company rolled out FTTP

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[1] The most recent Ofcom Connected Nations Report (2018) estimated that there were almost 1.8 million homes and businesses (6%) with FTTP connections compared to 840,000 (3%) in 2017. However, the 2% presented in the main text is the most recent estimate available for international comparison.
[2] Ofcom (2017), "International Communications Market Review"
[3] Ofcom (2017), "International Communications Market Review"
[4] Ipsos MORI, Simetrica, Barrett, G. Koutroumpis, P. (2018). Evaluation of the Economic Impact and Public Value of the Superfast Broadband Programme

in response to regulatory pressure, and the French government invested EUR 20 billion in FTTP rollout.

1.2.2 Current context

Since 2017, there have been significant changes to the landscape of the broadband market. There has been a lot of venture capital investment. Investors recognised the position of the UK regarding fibre networks and the need to provide these, which could offer long-term returns on their investment. This meant that some smaller network providers had more resources to expand their fibre networks, and there were many new market entrants who provide gigabit-capable networks. The regulatory position of Ofcom, which encouraged competition in the market, also contributed to this increase in competition in the market. Finally, a period of low interest rates also encouraged network providers to utilise finance to further expand their networks.

This increase in market competition has also been characterised by small network providers trying not to overbuild each other's networks, as it would reduce the returns they could generate from their network build.

Further to this, the larger providers of broadband networks, Openreach and Virgin Media, have also increased their investment in fibre networks. In early 2022, it was reported that Virgin Media was seeking to raise hundreds of millions of pounds of investment to support their fibre network rollout.[5] Openreach have also committed to expanding their fibre network, and in 2021 the cost of this additional roll out was estimated to be £15 billion to provide fibre coverage to 80 percent of UK premises.[6]

With an increase in finance and planned commercial roll out, and small competitors trying to avoid each other, the coverage of gigabit-capable networks has grown rapidly over the past six years. This is shown by the latest Ofcom Connected Nations publication (2022), which shows that 70 percent of premises in the UK now have gigabit-capable coverage, compared to two percent in 2016.

Examples of the increase in investment include:

- Connectfibre receiving "significant" investment in March 2022;[7]

- Lightspeed Broadband receiving a cumulative total of £115 million investment by December 2021;[8]

- Truespeed receiving £75 million in January 2022;[9]

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[5] https://www.ispreview.co.uk/index.php/2022/01/virgin-media-o2-uk-reportedly-seeks-funding-for-fttp-rollout.html (Accessed March 2022)

[6] https://www.ispreview.co.uk/index.php/2021/05/bt-raise-fttp-broadband-target-to-25-million-uk-premises.html (Accessed March 2022)

[7] https://www.ispreview.co.uk/index.php/2022/02/connect-fibre-get-funding-for-full fibre-rollout-in-east-of-england.html (Accessed March 2022)

[8] https://www.ispreview.co.uk/index.php/2021/12/lightspeed-broadbands-uk-fttp-rollout-gets-gbp60m-funding-boost.html (Accessed March 2022)

[9] https://www.ispreview.co.uk/index.php/2022/01/truespeed-start-2022-with-gbp100m-boost-for-uk-full fibre-rollout.html (Accessed March 2022)

- ▪ Borderlink receiving a cumulative £174.5 million investment by January 2022;[10]

- ▪ Toob receiving £87.5 million in December 2021;[11]

- ▪ Zzoomm securing £100 million debt investment in October 2021;[12]

- ▪ Cityfibre receiving £1.1 billion in finance in September 2021;[13]

- ▪ Digital Infrastructure (DI) launching after receiving £100 million investment in 2021;[14]

- ▪ Gigaclear securing £525 million in debt funding in 2020;[15] and

- ▪ Hyperoptic securing £750 million in two deals in 2018;[16]

This shows that the context for the evaluation is hugely different to the context the UK faced when the LFFN programme was designed and launched.

1.3 Study aims

The key research questions for the evaluation of wave one projects, as defined in the Invitation to Tender, are set out in the table below. These broad questions were further refined as part of an initial planning stage that was completed in May 2019, which involved the agreement of bespoke evaluation questions for each of the projects and evaluation approach. This report builds on a baseline, process and early impacts assessment that was completed in July 2019 and the interim evaluations which took place in 2020-2022.

This evaluation report focuses on both the short-term outcomes around coverage and connectivity, alongside the longer-term outcomes and impacts relating to public sector service provision.

Table 1.1: Key evaluation questions

Question area	Sub-questions
What outcomes can be attributed and were they as intended?	What is the range of local level outcomes from LFFN?
	What local level changes made a difference, were there other explanations?
	What, if any, were the wider benefits of LFFN?
	Were there any unintended outcomes?
How has LFFN achieved these outcomes?	To what extent is this affected by context or circumstance?
	How can LFFN achievements be enhanced?
What can we learn to improve future policy designs and implementation?	LFFN Programme
	Other Government broadband infrastructure policy or programmes
	Other Government future telecommunications infrastructure policy or programmes (including 5G)

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[10] https://www.ispreview.co.uk/index.php/2022/01/borderlink-get-gbp164m-for-full fibre-rollout-in-north-england-and-scotland.html (Accessed March 2022)

[11] https://www.ispreview.co.uk/index.php/2021/12/toob-gets-gbp87-5m-funding-to-boost-uk-fttp-broadband-rollout.html (Accessed March 2022)

[12] https://www.ispreview.co.uk/index.php/2021/10/zzoomms-uk-gigabit-fibre-rollout-boosted-by-gbp100m-investment.html (Accessed March 2022)

[13] https://www.ispreview.co.uk/index.php/2021/09/cityfibre-secure-gbp1-1bn-to-fuel-uk-fttp-broadband-rollout.html (Accessed March 2022)

[14] https://www.digitalinfra.co.uk/latest-news/new-era-full fibre-network-operator-accesses-ps100m-investment (Accessed March 2022)

[15] https://www.ispreview.co.uk/index.php/2020/04/rural-isp-gigaclear-signs-525m-long-term-funding-strategy.html (Accessed March 2022)

[16] https://www.ispreview.co.uk/index.php/2022/02/hyperoptic-aim-gigabit-broadband-at-2-million-uk-homes-by-2023.html (Accessed March 2022)

Source: BDUK Invitation to Tender

1.4 Methodology

The evidence compiled for this report comprised:

▪ **Review of Management Information and project documentation:** Documentation on the design and the operation of the project, such as business cases, contractual information provided by BDUK, information about premises passed and buildings connected, annual project and project close down reports have been reviewed to aid understanding of the projects objectives and progress made.

▪ **Analysis of secondary data:** A range of secondary sources were examined to explore changes in the supply and demand for FTTP in areas nearby the assets brought into use for broadband deployment with LFFN funding. This drew primarily on the Connected Nations dataset published by Ofcom which provides postcode level data on superfast and ultrafast availability, FTTP coverage, connections and data usage. Further data was drawn from ThinkBroadband and the published FTTP roll-out plans of Openreach and other telecommunications suppliers to provide local and regional context for the project. Finally, a variety of additional Office for National Statistics data on the evolution of the local economy was drawn on to provide further evidence on local trends on employment growth and unemployment.

▪ **Semi-structured qualitative interviews with project stakeholders:** Consultations with stakeholders in the projects were undertaken in between September 2022 and April 2023 to gather views on how the projects had delivered against their intended objectives, the wider impacts achieved, barriers encountered and lessons learned. Stakeholders consulted included project leads and local stakeholders either involved in the delivery of the projects or who benefitted from them. Interviews covered emerging demand for fibre services and connections and impacts of the LFFN project on organisations and the local area. The report also builds on previous consultations undertaken for the interim and early impacts research, which included interviews with the same stakeholder groups as above, alongside those involved with the management of the infrastructure build, and BDUK staff. The findings from the interviews were analysed thematically.

▪ **Econometric analysis:** The most recent longitudinal Connected Nations dataset available at the time of research was for 2022. This data was used to explore the connectivity impacts of the projects to date in terms of FTTP, ultrafast, download speeds, number of connections and data usage in the areas surrounding the LFFN build. The research team worked with BDUK to identify suitable comparator areas for the LFFN wave one projects. This was based on knowledge of commercial roll out plans, Government interventions and a series of economic and telecommunication attributes, such as job density and ultrafast availability respectively. The selected comparator areas are presented in the table below.

Table 1.2: Comparator areas

Wave one project	Comparator area
West Sussex PSAT project	Areas surrounding towns in Kent
Tameside PSAR project	Liverpool (excluding central Liverpool)
Trans Pennine Initiative	Reading to Bristol rail route
LFFN Schools PSBU project	Schools being connected through the Rural Gigabit Connectivity (RGC)

A matching exercise was completed using postcode level data for the projects and the comparator areas, to enhance the comparability between the treatment and comparator group. The matching sought to find areas matching in characteristics including the details of the telecommunications infrastructure of the postcodes, like the distance from the serving exchange, as well as the availability of ultrafast and gigabit-capable connections in previous years. More details of the selection of the counterfactual areas and the matching approach are provided in the technical annex.

1.5 Limitations

There are several limitations to the methodological approach described above. These are:

- **Connected Nations discontinuity:** The results make extensive use of the Ofcom Connected Nations datasets. The Connected Nations dataset is the most comprehensive dataset which provides data on broadband coverage and usage. Therefore, it has been used extensively in this research. However, there are some challenges when utilising the dataset to undertake longitudinal analysis. The network providers which provide information to inform the dataset are not consistent over time. Additionally, the methodology used to compile this data has evolved and there are inconsistencies between years. For the years 2018 and 2019, there are notable decreases in some postcodes in terms of broadband coverage. This was due to a change in the methodology used by Ofcom. This change related to the method used to identify premises, with the addition of more premises in areas diluting coverage in some places. This means that we are unable to clearly separate the impact of changes in the data to those impacts on coverage driven by LFFN. Ipsos initially conducted analysis on LFFN areas, which includes approximately 10,000 postcodes, which was then extended to all postcodes in the 2018 and 2019 cross sections. A fuller breakdown of the analysis conducted is available in the technical annex for the wave one reports. These challenges should be considered when interpreting the results presented.

- **Challenges with qualitative research:** There were challenges with undertaking the planned qualitative research for this evaluation. The main challenge was arranging interviews with stakeholders with a knowledge of the programme and how the projects have supported their organisation. Some of the key challenges have been:

  - **Project completion:** The project has been completed and project closure activities have taken place. This means that some of the staff involved in the projects have moved onto other projects or roles. Therefore, it has been challenging to arrange interviews, and where they have been some interviewees did not have insight into the history of the project or the longer-term impacts.

  - **Lack of contact details for indirect beneficiaries:** The initial evaluation plan aimed to explore the impact of the projects on businesses which had subsequently obtained gigabit-capable connections to explore how the connection had affected their business. However, the project does not hold any details of businesses that are utilising the network, creating an additional challenge for the researchers. The route to obtaining business contact details would have been through their Internet Service Provider, which was not possible.

  - **Staff turnover:** Some of the direct beneficiaries were public sector staff based in buildings that had been upgraded by the projects, however this presented a challenge due to staff turnover. Many staff currently in position were not able to comment on what

the situation was prior to the connection upgrade. This meant they felt they were unable to provide information as part of the interview.

- **Limitations of Management Information:** LFFN wave one projects faced some challenges in collecting useful Management Information. This was partially the result of the projects being set up as pilots with the aim of generating learning. An issue was the timeliness, completeness and accuracy of Management Information, there were some issues with delays in BDUK receiving Management Information and some inconsistencies between Management Information provided by the same project. These issues were addressed by BDUK for subsequent phases of the LFFN programme delivery, but they did present challenges for the wave one evaluation.

- **Challenges with approach to measure impact:** The approach to measure the impact of the four projects, has some limitations. The first of these is that the geographic boundary to measure the impact of the project has been selected at 1km away from the network build. However, some of the projects aimed to provide greater gigabit connectivity to a wider region. The geographic area was selected as the areas closer to the network build were anticipated to be the most likely to benefit from the project, and measuring the impact at a wider geographic area would be difficult (at a larger geographic level the impact would need to be much larger to be detectable in the analytical framework). Therefore, the analysis focuses on a smaller geographic area for practical reasons, while it should be acknowledged that some impacts of the project may be overlooked. A second limitation is the selection of a comparator area, which has been selected to closely match the characteristics of the project area. However, it was not possible to know at the point of selection what network provider commercial roll out plans were, which could mean that there were unobservable differences between the project and comparator areas.

- **Limitations given progress of projects:** Project delivery for the wave one projects was generally slower than anticipated, meaning there were delays in project completion, as seen in Table 1.3 below. There were a variety of reasons for the slow progress which are discussed in the subsequent sections of the report. A challenge for the evaluation of the LFFN wave one projects was the COVID-19 pandemic, which hampered businesses ability to plan and will have prevented longer term outcomes from being realised as quickly as anticipated. A further challenge is that there has still been a limited amount of time for the longer-term impacts to be realised due to the nature of the interventions providing infrastructure for other commercial network providers to build from, we would anticipate that even more time is needed for the longer-term impacts to be realised. Therefore, it is still possible that some of the longer-term outcomes and impacts for the projects could be realised in the future and it is still early to form conclusions about the wider impact of some projects.

Table 1.3: Progress of projects

Project	Baseline (prior to build activity)	Project completed	Interim evaluation research	Years post network build / connections completion for final evaluation fieldwork
West Sussex PSAT project	2017	2019 – 2020 (all buildings connected by Q3 2020/21)	Late 2020	2
LFFN Schools PSBU project	2017	2018 – 2020 (most schools connected in 2019)	Early 2022	1.5 to 2.5

| Trans Pennine Initiative | 2017 | 2019 | Late 2020 | 3 |
| Tameside PSAR project | 2017 | 2018 | Early 2020 | 4 |

- **Limitations of matching approach:** Undertaking a PSM to improve the comparability of the treatment and comparator areas has some limitations. These are that the approach is data intensive, it discards observations in both the treatment and comparator areas that are not matched. A reduction in the number of observations reduces the statistical power of the regression models, despite increasing the comparability of the two areas. Therefore, large samples are needed, and the LFFN projects were delivered in relatively small local areas, meaning that the statistical power of the models is low. Secondly, the matching between treatment and comparator areas can only use variables where data exists, but there are factors which could influence broadband rollout and economic performance where data does not exist (such as broadband rollout plans). Therefore, the matching can only be as good as data availability.

- **Openreach Fibre First:** Openreach rolled out their Fibre First programme in many of the areas the LFFN programme has operated in, and also in comparator areas. This presents a challenge for the analysis. The impact the LFFN programme had on Fibre First roll out is unclear. For example, would Openreach have brought forward FTTP deployments at this speed without the leadership displayed by BDUK in the LFFN programme? Therefore, for the econometric analysis, areas where the Fibre First Programme has been rolled out have been excluded from the analysis.

In addition to the wave one portfolio level limitations, there were also some project specific limitations These were:

- **Pre-existing initiatives in Tameside:** Wave one LFFN funding was used to add spurs to an existing fibre ring developed by Tameside Metropolitan Borough Council from 2012 onwards. Additionally, a digital infrastructure cooperative was established in 2018 to commercialise the network, with BDUK providing support to help establish the cooperative. Attempts to separate the impact of two were made in the econometric analysis by allowing effects to vary by both distance from the LFFN funded spurs and distance from the existing fibre ring. However, this may not fully identify the marginal effect of the LFFN funded spurs as extending the network may have produced positive externalities by making the existing fibre ring more commercially attractive.

- **LFFN funded expansion of the Tameside Cooperative:** The Cooperative Network Infrastructure network has also expanded to include Blackpool and Manchester City Centre, which received funding from waves two and three of the LFFN programme and will also soon include a link to the Trans-Pennine Initiative. Tameside Metropolitan Borough Council also received further funding under LFFN wave two to expand their network from Mossley station, via Stalybridge and Guide bridge stations to the Manchester Internet Exchange. These LFFN funded expansions of the network may also produce further externalities that drive further commercial FTTP deployments closer to the fibre ring, creating further challenges in isolating the marginal effect of the LFFN project. These types of effect cannot be identified through econometric modelling.

- **Tameside PSAR and Trans Pennine Initiative operating in the same area:** There is a potential attribution challenge in some areas as the LFFN wave one Trans Pennine Initiative project and the Tameside PSAR project operate in the same area. As these two projects are

contributing towards similar outcomes and impacts, it may be difficult to disentangle the effects of the two programmes within the Tameside area.

- **Data limitations in the Department for Education (DfE) schools dataset:** The DfE provides school level data, which has been used as part of this evaluation. In the baseline and early impacts reports, measures were taken for schools relating to income and expenditure, and attendance and attainment. However, during the COVID-19 pandemic, the DfE did not request data returns from schools. Therefore, there is no data available for the school year 2019/20. In the 2020/21 dataset, there is no information collected for school attendance or attainment and the data for 2021/22 does not currently include any variables of interest for the evaluation. Therefore, the analysis of this dataset presented in the final report focusses on the expenditure and income measures, and the analysis concludes at the academic year 2020/21.

These limitations relate to different strands of the research. However, by combining the findings from across the different research strands, the evaluation provides robust conclusions about the likely outcomes and impacts the LFFN wave one projects have contributed towards as of 2022.

1.6 Structure of the report

The remainder of this report is set out as follows:

- Section 2 provides an overview of the LFFN interventions and the Theory of Change;

- Section 2 provides the broadband outcomes for the LFFN wave one projects;

- Section 3 presents the wider outcomes and impacts of the LFFN wave one projects;

- Section 4 presents the conclusions from the evaluation of the LFFN wave one projects.

2 Broadband coverage in the local area

This section presents the findings around broadband coverage in the LFFN wave one project areas. It begins with discussion of network providers, before presenting the findings around ultrafast and gigabit-capable broadband coverage.

2.1 Rationale for intervention

Gigabit-capable broadband is rapidly becoming critical strategic infrastructure. It is regarded as the next generation of connectivity, capable of delivering speeds of 1gigabit per second and beyond. It is important that households, businesses and public sector buildings have access to ultrafast internet connections in the future, so that they can efficiently deliver public services. To ensure organisations and households have access to this infrastructure, the LFFN pilot projects placed fibre infrastructure in specific geographic locations, which enabled some buildings to be directly connected to the enhanced broadband network.

2.2 Description of the interventions

The LFFN wave one projects all involved the provision of gigabit-capable infrastructure which allowed sites to be connected to faster internet connections. This included:

- A dark fibre network which connected 148 public sector buildings to the fibre network in the West Sussex PSAT project.

- A dark fibre network running along the railway line from York to Manchester with break out points along the route in the Trans Pennine Initiative.

- Fibre connections made directly to 152 schools as part of the Schools PSBU project.

- Fibre infrastructure, including rackspace and mini digital exchanges and additional fibre network in the Tameside PSAR project.

2.3 Theory of change

2.3.1 Inputs

The most significant expected input for the LFFN wave one projects was capital investment. The capital investment would come from BDUK mostly, although there were contributions from the delivery partners, such as local authorities and Network Rail, the scale of which varied between the projects. Alongside the capital investment, staff time and expertise from within BDUK and the delivery partners would be used to deliver the projects. These were administrative costs – staff time and expertise required to deliver the project.

2.3.2 Activities

The key activities outlined for the LFFN wave one projects were:[17]:

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[17] Note this summarises the key activities from each project. For a more detailed description of the activities, please see the individual project reports.

- **Marketing of project:** The project, and fibre connectivity, would be marketed to interested organisations in order to develop interest.

- **Laying of fibre cable ('dark fibre'):** The fibre cable would be laid to ensure fibre connections can be provided to the buildings signed up to the project.

- **Connecting public sector buildings (where appropriate) to the fibre network:** The public-sector buildings involved in the project would be connected to the fibre network.

2.3.3 Outputs

The key expected outputs of the projects were:

- **Lay cable:** The projects involved laying fibre cable. Not all projects specified the distance of fibre that would be laid as part of the project.

- **Connecting public sector buildings to the network (where appropriate):** Note that the public buildings were not required to take-up a gigabit-capable service as a result of the projects.

- **Pass residential and businesses premises:** All the networks built were expected to pass by businesses and households, which could support further ultrafast connections to be made. Note all projects specified how many businesses or households the networks would pass.

- **Install Points of Presence / Fibre Interface Points:** These are locations where telecommunications companies, or any other company requiring fibre access, can physically connect to the built fibre network.

2.3.4 Outcomes and impacts

The projects did not all specify longer-term outcomes and impacts, however BDUK developed some expected outcomes during an evaluation scoping exercise. BDUK expected the projects to lead to several medium- and longer-term outcomes and impacts that can be summarised into the following categories:

- **Connectivity outcomes:** the networks were expected to reduce the marginal cost of further fibre investment, meaning new areas will likely become commercially viable for suppliers. These additional investments were expected to encourage suppliers to make additional investments in fibre connectivity, increasing the size of the network in the medium and long-term.

  - Linked to the above, end users would expect to experience **improved speed and reliability** in their connectivity service. More extensive FTTP deployments can be expected to produce a range of network benefits in terms of increased speeds, latency, and resilience. FTTP also has potential to reduce maintenance costs.

  - On the **demand side**, direct take up effects are expected to arise as public sector organisations take up faster connections through the new network. Businesses and residents could subsequently benefit from spill over build.

- **Public sector impacts:** The projects which connect public sector buildings will provide enhanced connections which were expected to reduce costs to public sector occupants. These savings are anticipated to come about through various means including: potential direct

reductions in connection costs, costs saving from changing means of main communications from telephone to internet.

▪ **Downstream economic impacts:** Wider access to FTTP connections was expected to lead to increases in firm productivity, by increasing firms' consumption of telecoms services or the efficiency of telecoms use, it could potentially raising average labour productivity. In the medium term, adoption of FTTP may raise productivity in other ways. For example, if firms have access to higher quality labour inputs, or if they can develop more efficient business models.

  − Market entry: By providing easier access to FTTP connections, new firms which require reliable and fast internet connections, such as digital businesses, may be able to start up within the local areas.

  − Business relocations: The availability of a full fibre network is also expected to lead to a range of firm relocation effects. The increased desirability of areas with a full fibre network is expected to attract businesses to these areas and in particular young start-ups dependent on full fibre connectivity or similar technologies.

  − Firm expansions and market entries: As a result of the provision of FTTP, connections could, in turn, create jobs, specifically in digital industries. This could also reduce unemployment in these areas.

▪ **Social and environmental:** Specific social and environmental effects were not to be achieved within the evaluation period, and have not been included in the Theory of Change. However, as the project has the potential to lead to spill over FTTP build, general social and environmental impacts could potentially be anticipated. This may include reduced commuting enabled by remote working, increases in leisure time or reducing the digital divide in the community through, for example, digital education programmes. The latter stages of the evaluation will explore the extent to which the project led to these types of impact.

A summary of the initiative's pathways to impact, outlining how the inputs and activities are expected to translate into immediate outputs, short and medium-term outcomes and longer-term impacts, is set out in Figure 2.1.

Figure 2.1: Logic model for the LFFN wave one projects
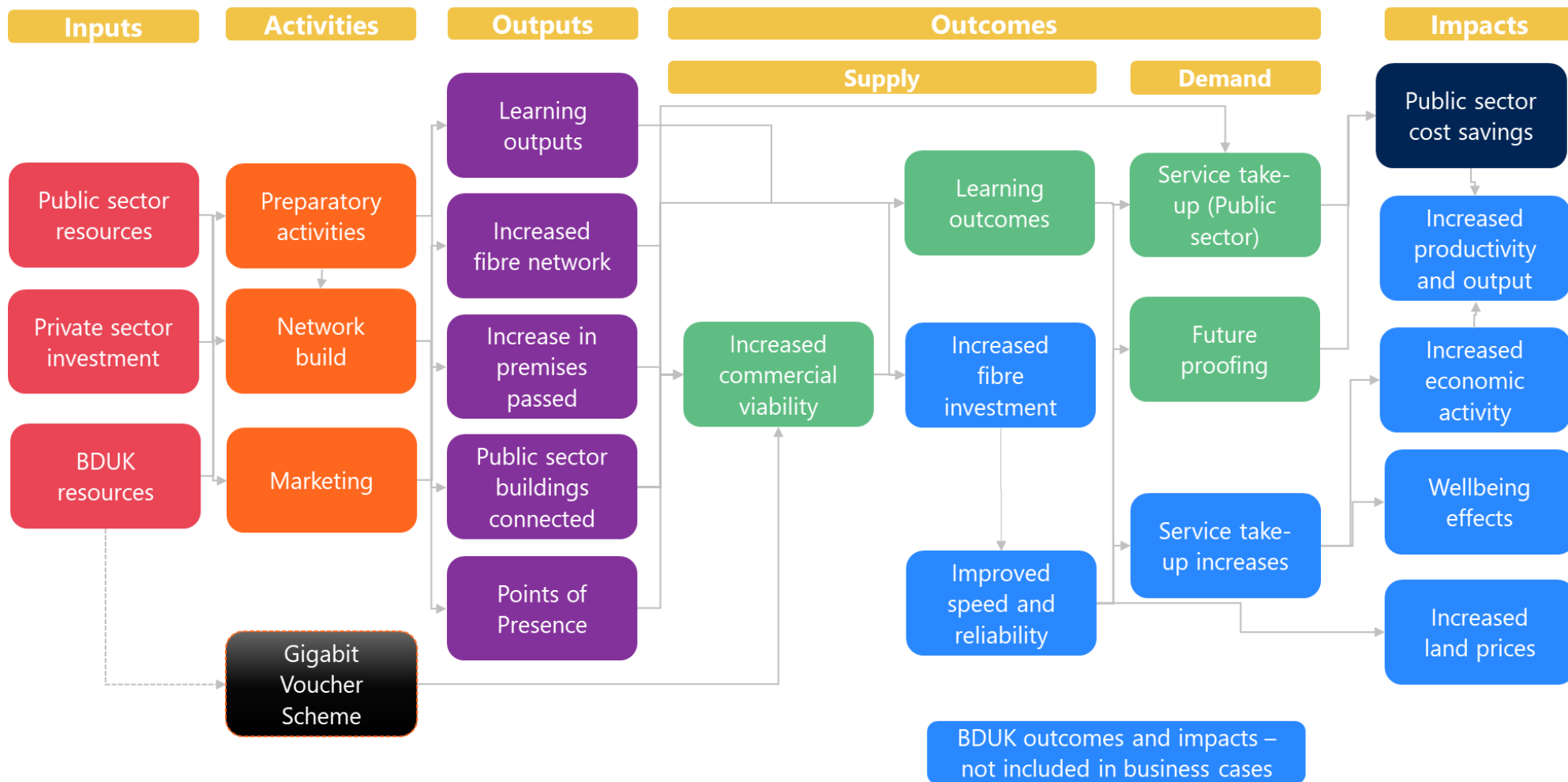
2.4 Delivery

2.4.1 Network build

The key findings from the delivery of the four projects were:

- The total cost of the four projects was £21.2 million. This was in line with the initial expectations of the cost of the projects, with the following expenditure by project:

  - £4.7 million on the West Sussex PSAT project;

  - £2.3 million in the Tameside;

  - £11.3 million in the Trans Pennine Initiative; and

  - £2.9 million on the LFFN schools project.

- The projects delivered their expected outputs in terms of fibre network infrastructure build, such as the fibre network laid, meet me points installed, and other project specific fibre outputs.

- This infrastructure passed the expected number of businesses and households, providing the opportunity for network providers to offer gigabit-capable connections to the wider population.

- The projects which aimed to connect public sector buildings provided connections to more than the expected numbers of buildings, with at least 294 public sector buildings connected.

However, there were some common challenges with the delivery of the network and providing connections to the buildings. The key challenges were:

- **Changes to original plans:** Three of the four projects required changes to original plans for the project. These changes included alterations to the public sector buildings which were to be connected, additional buildings to be connected, and alterations to where some of the infrastructure was to be installed. This led to delays with the completion of the projects.

- **Challenges in building networks:** Two of the projects experienced challenges with the network build, which led to some delays in delivery, but provided opportunities for learning for future project delivery. One challenge in the Trans Pennine Initiative project was delivering on the railways, where work to ensure rail services are delivered take priority. Other challenges were around administration, like accessing wayleaves, and the quality of the network installed and remediation work, like fixing pathing stones, in the West Sussex PSAT project. There were also challenges faced by three of the projects from the COVID-19 pandemic, which led to difficulties in completing the civil engineering work or marketing activities.

3 Broadband coverage in the local area

3.1 Number of network providers

The Connected Nations dataset does not break down coverage by supplier, making it difficult to establish how far changes in coverage can be linked to the scheme or attributed to individual suppliers with that dataset. ThinkBroadband provides a breakdown by supplier and is more up to date than Connected Nations and was used to provide some insight into how far changes in gigabit-capable coverage could have been driven by different suppliers in the areas the projects have delivered in.

The table below presents the key findings from the analysis of the ThinkBroadband data. This shows that the project areas have generally seen an increase in the number of network providers operating in that region. Coverage of gigabit-capable networks among those providers with an existing presence in the area has also increased.

Examples of this increase in network providers presence in the areas include:

- An increase in Openreach fibre networks along the Trans Pennine Initiative route, within areas surrounding the Tameside PSAR and West Sussex PSAT projects, where they had a presence at baseline, and an increase in Virgin media presence in all areas.

- New network providers present in West Sussex, including Cityfibre, the provider delivering the LFFN contract, Box, Trooli and FW Hey.

- New network providers present in Tameside, like ITS, a Cooperative Network Infrastructure member which has used the LFFN infrastructure to provide coverage across Tameside. New network provision from OFNL and Fibrenest Persimmon, Internetty, Swish and Zzoomm offer services close to the Trans Pennine Initiative route.

Table 3.1: Changes in network provider coverage in project areas

	Enhanced presence by the provider delivering LFFN project	Increase in the number of network providers in LFFN project area	Evidence of use of LFFN network to provide
West Sussex PSAT project	✓✓	✓✓	
LFFN Schools project	N/A	N/A	
Trans Pennine Initiative		✓✓	
Tameside PSAR project	✓	✓	✓✓

✓: Evidence that outcome has been observed in the project area; ✓✓: Strong evidence that outcome has been observed in the area; N/A: outcome could not be assessed due to small and dispersed geographic area of the project.
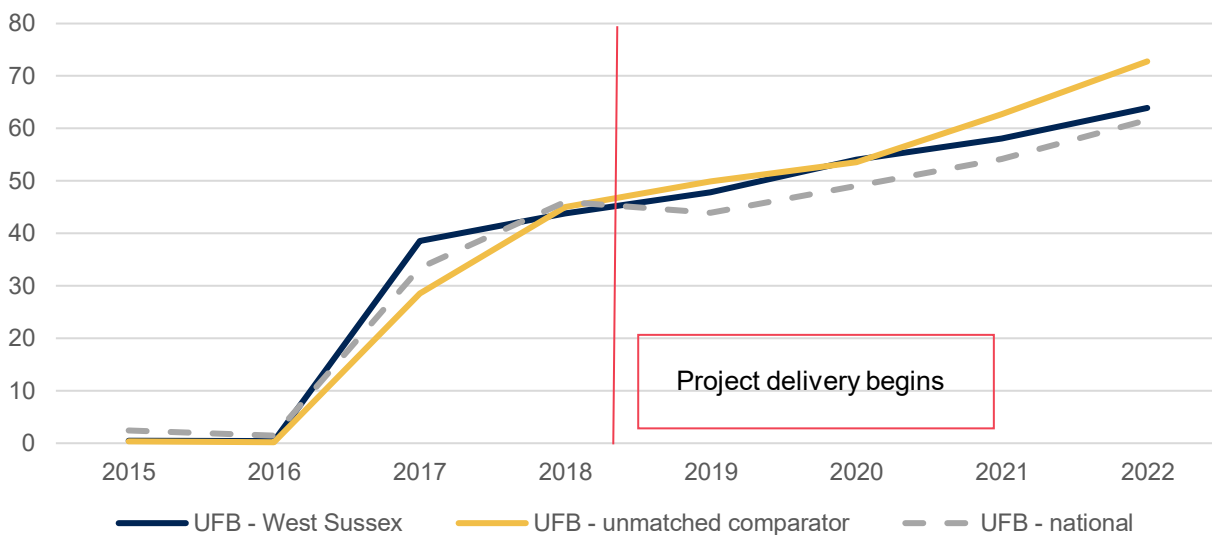
3.2 Broadband coverage

The Connected Nations dataset provides data on broadband coverage at the postcode level. This allows a detailed analysis of how broadband coverage in areas close to the LFFN build has altered over time. However, there have been some changes to the Connected Nations dataset which

impacts upon this analysis. In 2020, Connected Nations introduced gigabit-capable coverage as a new variable, whilst removing the FTTP variable from their publicly available data. FTTP and gigabit-capable are similar, in that all FTTP coverage is gigabit-capable, however the gigabit-capable variable also includes other technologies that deliver gigabit-capable speeds but are not FTTP, such as cable. The analysis below presents the FTTP and gigabit-capable variables together as a single time series, but the change in definition explains the large increase in 2020.

The figures below present the evolution of superfast, ultrafast and FTTP / gigabit-capable coverage in the areas within 1km of the LFFN funded network build in the LFFN projects. These show that:

- There have been significant increases in ultrafast and gigabit-capable coverage in all areas that the LFFN programme has delivered in. These increases are largely observed after the project has completed.

- For most areas, these increases have been broadly in line with changes at a national level, and in areas selected as a comparator for the LFFN schemes.

Figure 3.1: Ultrafast broadband coverage within 1km of the LFFN network build in West Sussex, nationally and in Kent comparator area, 2015 - 2022
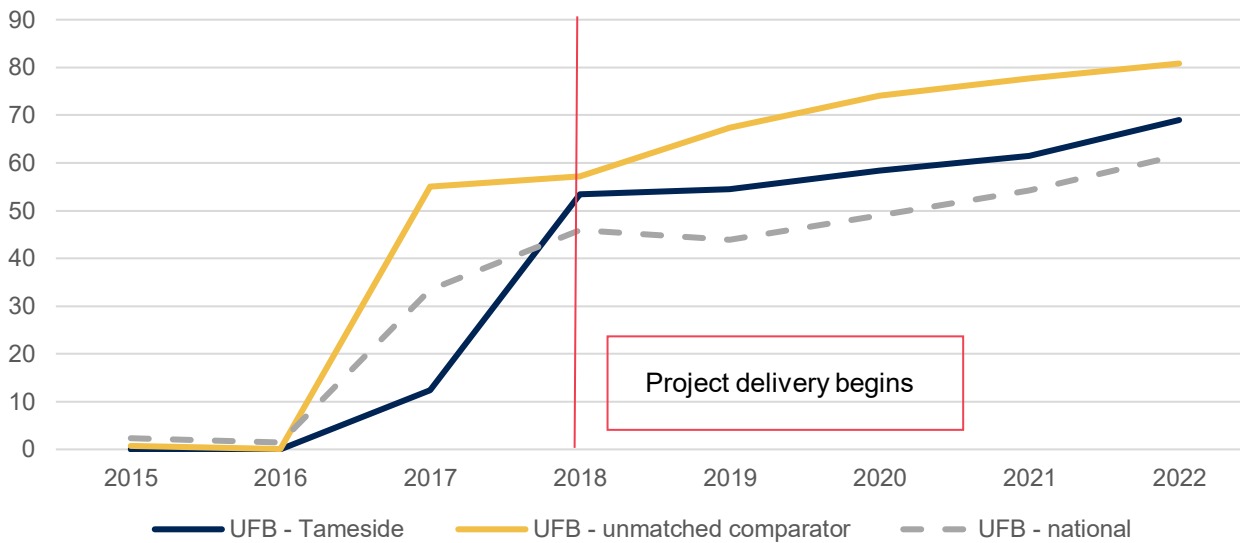

Source: Connected Nations, Ofcom

Figure 3.2: Gigabit-capable / FTTP broadband coverage within 1km of the LFFN network build in West Sussex, nationally and in Kent comparator area, 2015 - 2022
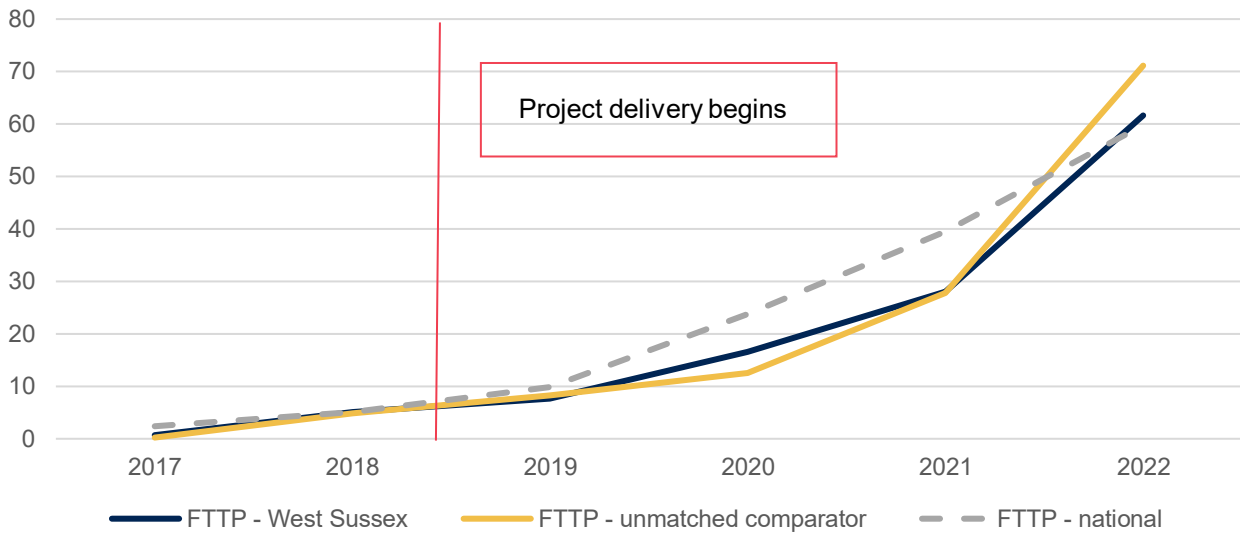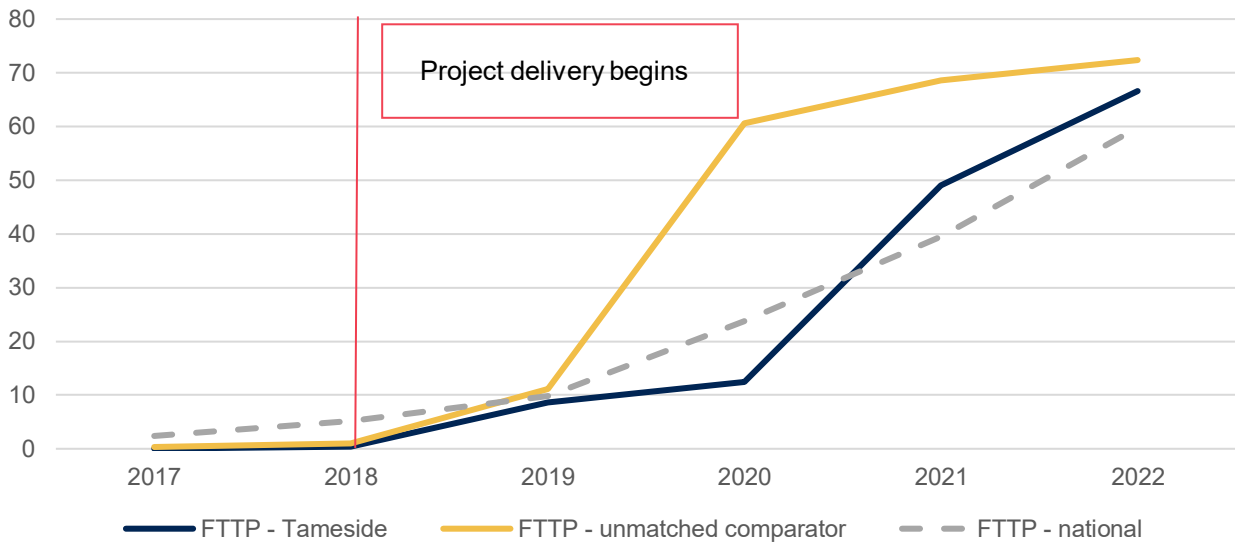

Source: Connected Nations, Ofcom

Figure 3.3: Ultrafast broadband coverage within 1km of the fibre-8 ring in Tameside, nationally and in Liverpool comparator area, 2015 - 2022
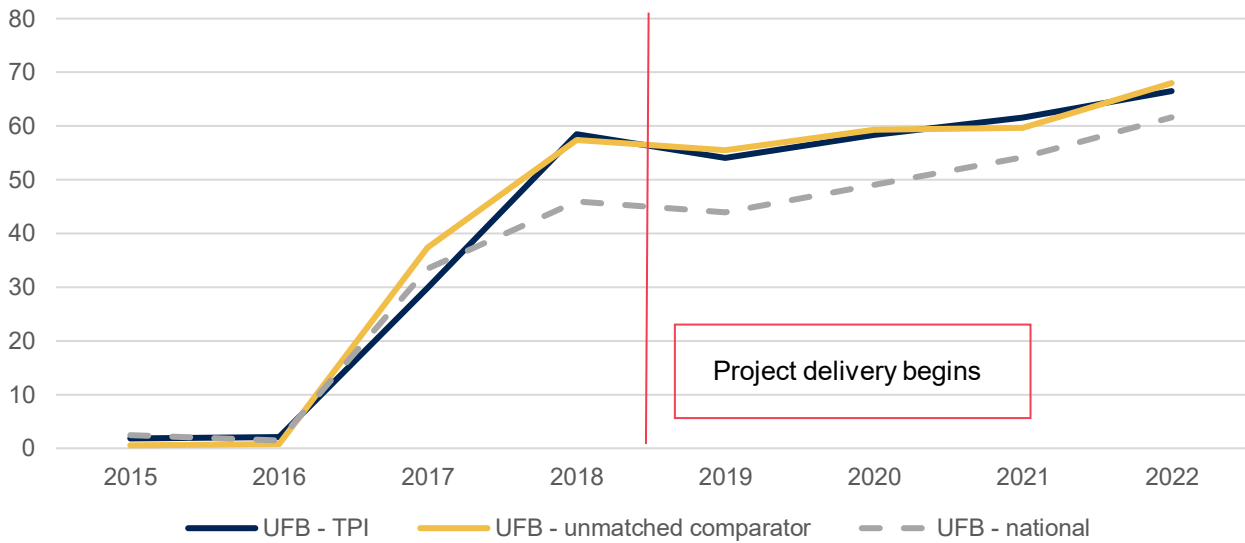

Source: Connected Nations, Ofcom

Figure 3.4: Gigabit-capable / FTTP broadband coverage within 1km of the fibre-8 ring in Tameside, nationally and in Liverpool comparator area, 2015 – 2022
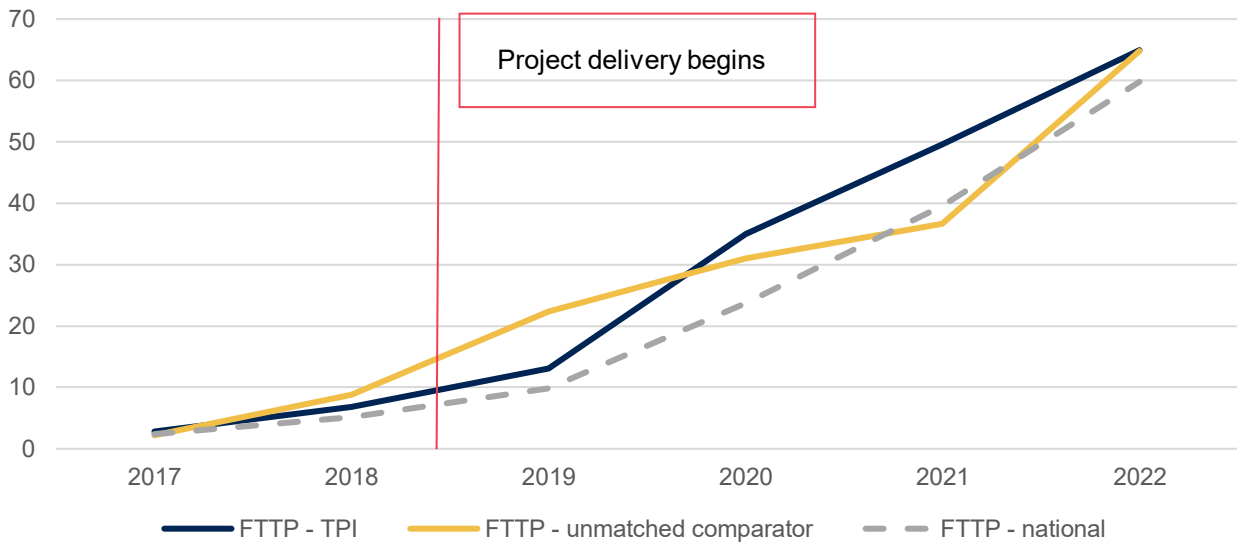

Source: Connected Nations, Ofcom

Figure 3.5: Ultrafast broadband coverage within 1km of the Trans Pennine Initiative route, nationally and along Reading to Bristol comparator area, 2015-2022
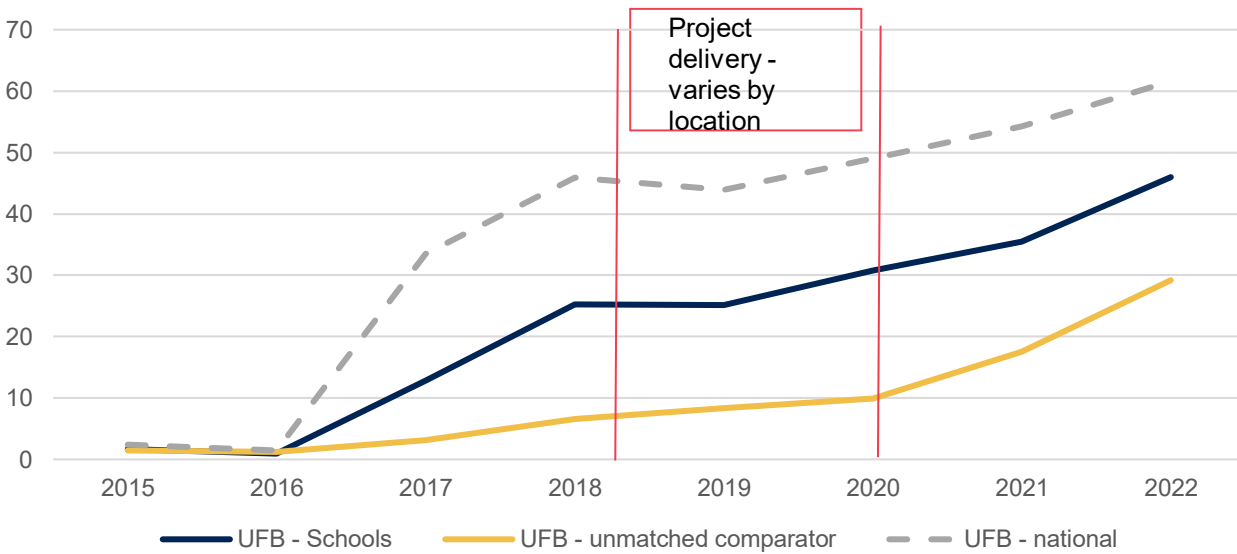

Source: Connected Nations, Ofcom

Figure 3.6: Gigabit-capable / FTTP coverage within 1km of the Trans Pennine Initiative route, nationally and along Reading to Bristol comparator area, 2015-2022
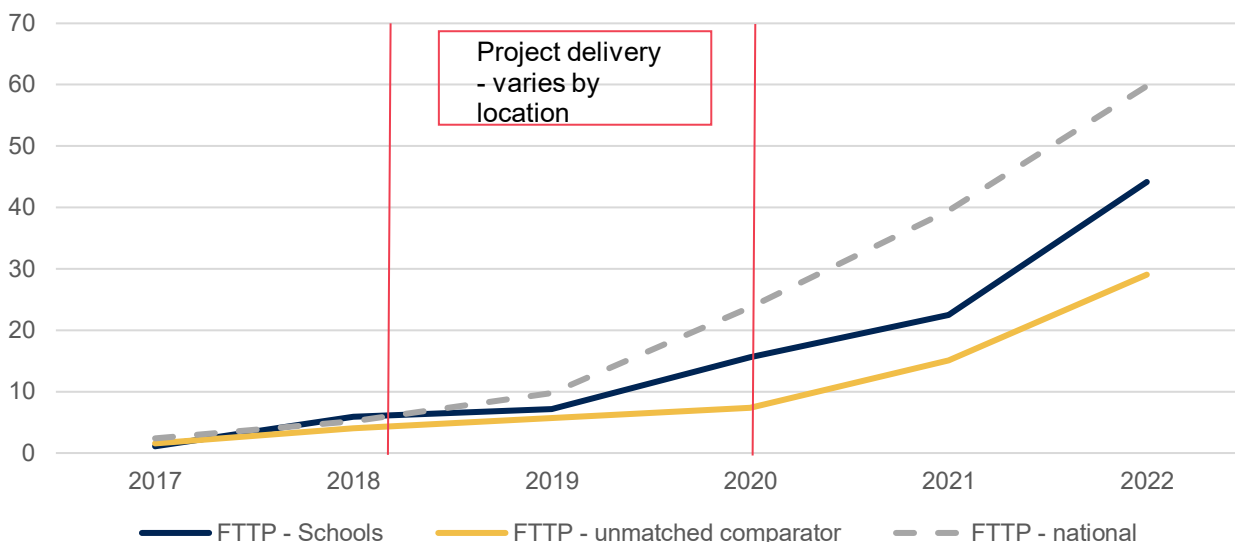

Source: Connected Nations, Ofcom

Figure 3.7: Ultrafast broadband coverage within 1km of the LFFN schools, nationally and within 1km of RGC schools, 2015 - 2022

Source: Connected Nations, Ofcom

Figure 3.8: Gigabit-capable broadband coverage within 1km of the LFFN schools, nationally and within 1km of RGC schools, 2015 - 2022

Source: Connected Nations, Ofcom

3.2.2 Impact of the LFFN programme

To provide a clearer view of the impact of the LFFN wave one projects on gigabit-capable coverage, postcodes within 1km of the LFFN network build were compared to similar postcodes sharing similar characteristics in comparator areas (see the Technical annex for the LFFN wave one evaluations).

An econometric analysis was undertaken using a fixed effects analytical framework. The analysis compared gigabit-capable and ultrafast availability in the project areas and matched comparator areas. For more details of the analytical approach please see the technical annex for the LFFN wave one evaluations. The impacts are presented in the table below, which suggests that the projects the West Sussex PSAT project and Tameside may have contributed to a slower roll out of gigabit-capable networks in the areas surrounding the project build, but contributed to a faster roll out along the Trans Pennine Initiative route. The analysis also identified significant positive impacts on ultrafast coverage in Tameside and around LFFN schools, with significant negative impacts in the areas surrounding the West Sussex PSAT project and along the Trans Pennine Initiative route.

The explanation for these results could be that the subsidised coverage has discouraged other network providers from building in the adjacent area as much as they would have done in the absence of the project, or that roll out is occurring at a slower rate. Where there has been an increase in ultrafast coverage but a decrease in gigabit-capable coverage, one explanation could be that the increase in gigabit-capable networks has discouraged investment in networks which offer gigabit-capable, but not ultrafast networks. This could be satellite or wireless solutions in more rural areas.

Table 3.2: Changes in network provider coverage in project areas

|	Impact on ultrafast coverage	Impact on Gigabit-capable coverage	Impact on maximum download speeds	Impact on maximum upload speeds
West Sussex PSAT project	(-)	(-)	(-)	No impact
LFFN Schools project	(+)	No impact	No impact	No impact

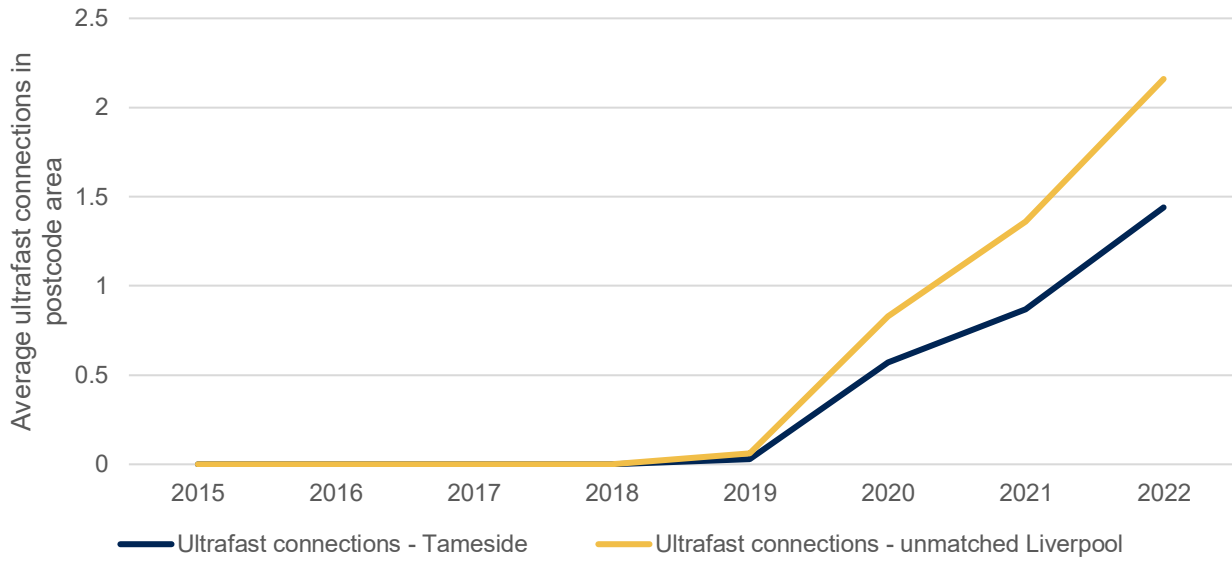| Trans Pennine Initiative	(-)	(+)	(+)	(+)
Tameside PSAR project	(+)	(-)	(-)	(-)

3.3 Take-up

The Connected Nations dataset provides data on the number of connections taken up at a postcode level. This allows a detailed analysis of how broadband coverage in areas close to the LFFN build has altered over time. The Connected Nations data does not suggest widespread take-up of FTTP or ultrafast in the LFFN project areas as of 2022. However, the take-up has shown a rapid increase since 2019, where connections per postcode were still hovering around zero. The increase in take-up of ultrafast connections in LFFN project areas has been mirrored by the increase in comparator areas. This is illustrated in the figures below.

Figure 3.9: Ultrafast broadband connections within 1km of West Sussex PSAT project and in comparator areas in Kent, 2015-2022
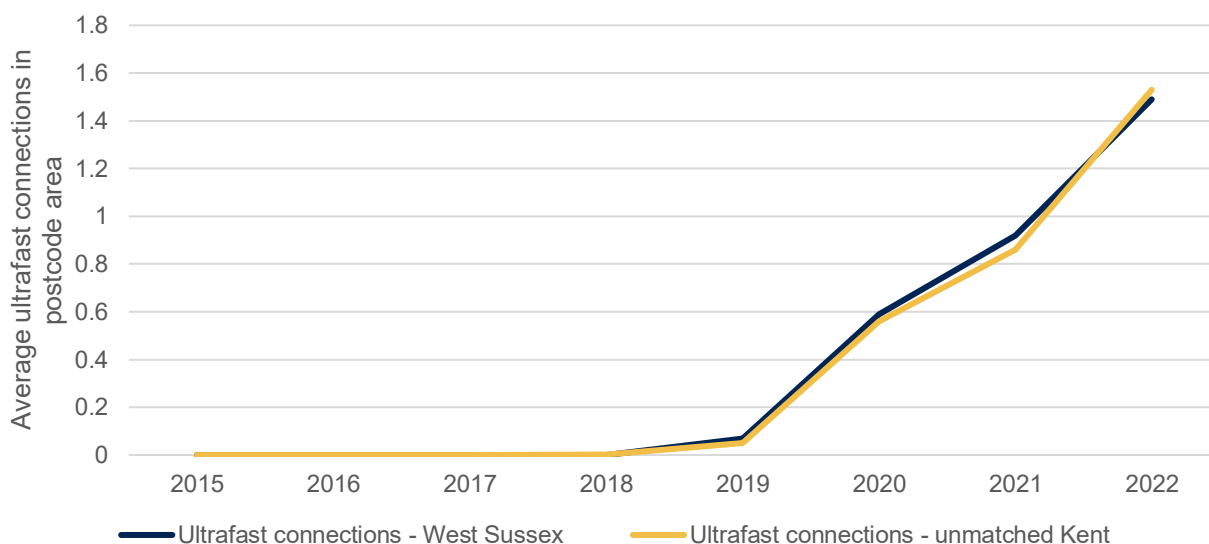
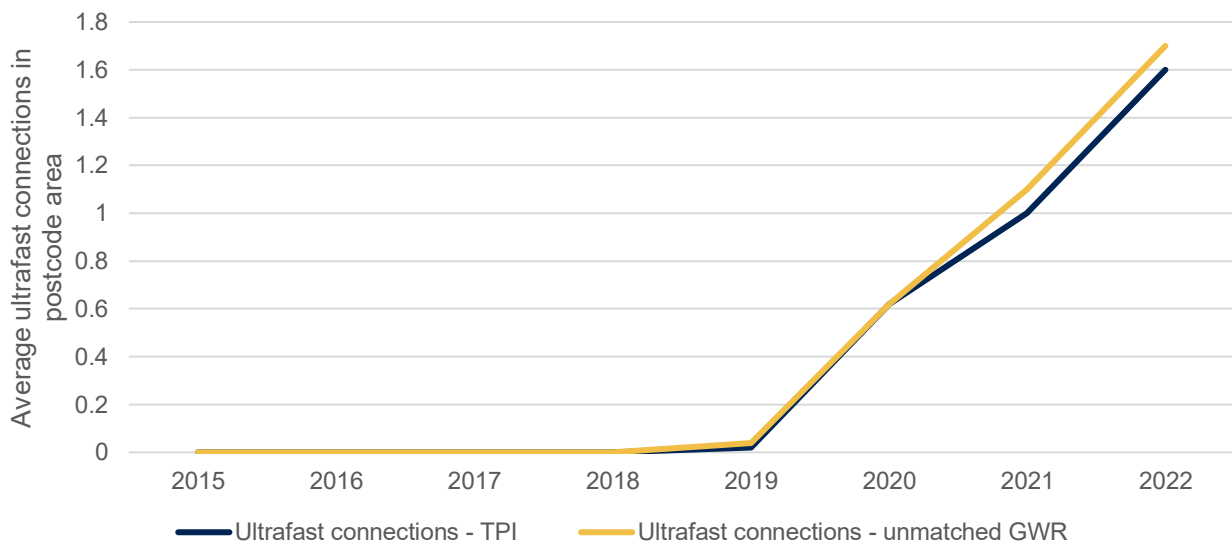*Source: Connected Nations, Ofcom*

Figure 3.10: Ultrafast broadband connections within 1km of the fibre-8 ring in Tameside and in Liverpool comparator area, 2015-2022
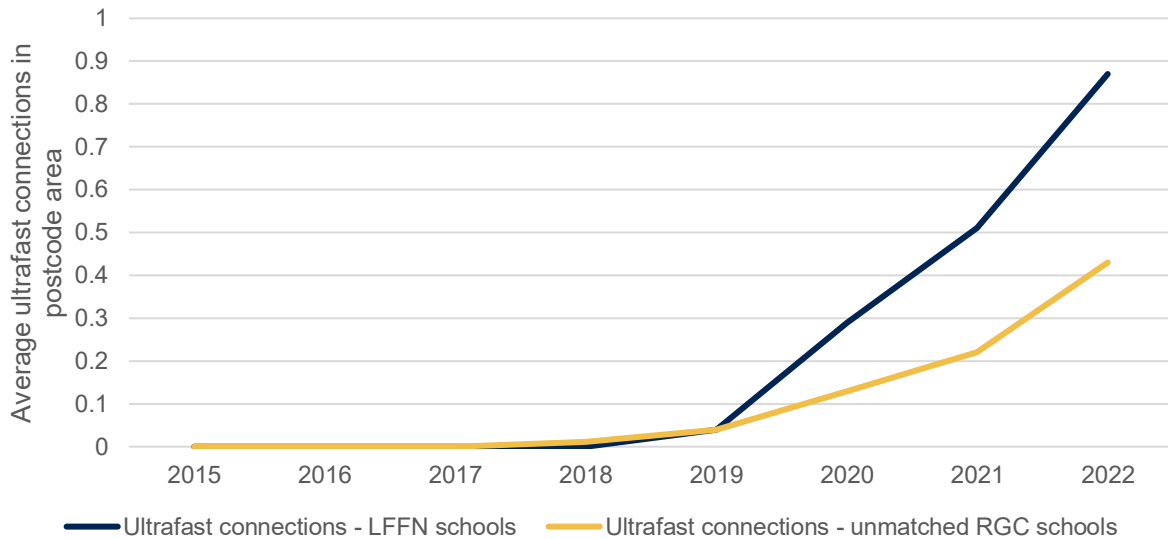

Source: Connected Nations, Ofcom

Figure 3.11: Ultrafast broadband connections within 1km of the Trans Pennine Initiative route and along Reading to Bristol comparator area, 2015-2022

Source: Connected Nations, Ofcom

Figure 3.12: Ultrafast broadband connections within 1km of the LFFN schools and within 1km of RGC schools, 2015-2022

Source: Connected Nations, Ofcom

3.3.1 Impact of the LFFN programme

To provide a clearer view of the impact of the LFFN wave one project on take-up of faster broadband connections, postcodes within 1km of the LFFN project network build routes were compared to similar postcodes sharing similar characteristics in the comparator areas. An econometric analysis was undertaken using the same fixed effects analytical framework as described above. The analysis found that the LFFN programme had either contributed to a slower take-up of ultrafast broadband connections in the areas surrounding the project builds or had no effect. This was the case for all areas except for along the Trans Pennine initiative route, where the project may have contributed to a small increase intake-up. These changes are in line with the impact on coverage described above.

Table 3.3: Changes in take up of gigabit-capable connections and data usage in project areas

	Impact on number of connections (above 300mbs)	Impact on data usage
West Sussex PSAT project	(-)	(-)
LFFN Schools project	No impact	No impact
Trans Pennine Initiative	(+)	No impact
Tameside PSAR project	(-)	No impact

4 Knowledge and spillover benefits

4.1 Public sector outcomes

Some of the key benefits of the LFFN wave one projects have been:

- **Cost neutrality / cost savings for public sector organisations:** all four of the projects led to either a decrease in the direct costs of broadband connections, or no increase in costs despite an improvement in their broadband connection. These are both direct and indirect cost savings. Examples of the cost savings include:

  - **Direct cost savings:** In Tameside and some LFFN schools, there was a reduction in the cost public sector organisations pay for their broadband connection. In West Sussex and other LFFN schools, public sector organisations receiving an enhanced broadband connection for the same price as they were previously paying. There are further direct savings for stations along the Trans Pennine Initiative route that have reduced the number of broadband connections they require to run different operations. More stations in the future can also benefit in this way. In the West Sussex PSAT project and Tameside, there is also evidence that the projects have contributed to a reduction in the maintenance costs associated with managing connections to public sector buildings.

  - **Indirect cost savings:** There is evidence that the projects have led to indirect cost savings, through helping public sector organisations work more efficiently. For example, faster connectivity has helped administrative tasks become more straightforward to complete. Public sector organisations have also been able to reduce outgoing services which can be provided through the broadband connection, and introducing new services which utilise online connectivity. Both of these are less costly to deliver, which then results in indirect cost savings.

- **Public service provision and future proofing:** The LFFN projects had supported some changes in public service provision already, for example offering communication and some services online, utilising online phone services, providing more online teaching in schools and supporting more efficient administrative tasks. There was also evidence of future proofing, with the connections providing opportunity to enhance public service provision in the future, such as supporting the implementation of digital strategies and supporting digitisation in health and social care.

4.2 Commercial outcomes

There were commercial learnings from the delivery of the projects, for both the network providers delivering the contracts and the public sector bodies responsible for the contracts. These learnings included:

- **Improved knowledge and understanding:** This knowledge was generated both among network providers and public sector organisations. Network providers learned more on the requirements of publicly funded programmes, for example what public sector organisations required from a project in terms of final outcomes and ongoing relationships. For public sector bodies, an improved knowledge about how network providers operate and their motivations, why infrastructure is placed in specific locations and how to operate as a commercial vehicle, including client demands on Service Level Agreements.

- **Delivery learnings:** The projects have generated significant learning about how to deliver broadband network contracts. These include learnings around contractual and supplier relationships and how these can be implemented to best ensure the project is delivered as intended, and how to deliver telecommunications projects on other existing infrastructure, for example the railways.

In addition to these outcomes, there is evidence that the delivery of the project has helped to support the further use of a commercial vehicle or mechanisms to deliver further connectivity within the UK in all four projects. This demonstrates that crucial learning has been taken from the LFFN wave one projects. The ways in which the delivery model or commercial mechanism have been used are:

- **West Sussex PSAT project:** The provision of a procurement framework to allow local councils in West Sussex to commission network build to public sector buildings efficiently, and stakeholders explained that without the framework much of this network build would not have been commissioned. This was put down to both the ease of using the framework and the increased awareness of how to procure network build in West Sussex. The procurement framework has been used to its maximum value. The procurement framework has been used to deliver further public sector building connections and additional fibre coverage in the area.

- **Tameside PSAR project:** Cooperative Network Infrastructure has welcomed new members from outside Tameside, including Blackpool, Manchester and Mid-Sussex. This demonstrates that other local authorities feel that the Cooperative model is an option for them to acquire gigabit-capable connections for their public sector buildings and enhance connectivity in their area.

- **Trans Pennine Initiative:** A different approach to selling access to trackside fibre has been developed, which has utilised the key learnings from the Trans Pennine Initiative project. In 2022 Network Rail announced the launch of Project Reach. This project aims to utilise Network Rails trackside infrastructure. Project Reach offers a private sector concessionaire the opportunity, using its own capital, to deploy fibre along the totality of the rail network, up to around 16,000km. The fibre will be owned by Network Rail, and capacity will be reserved for the rail network to ensure that rail services can be delivered. The concessionaire can then use a portion of the fibre capacity for their own commercial purposes. The fibre laid as part of the Trans Pennine Initiative has been included in Project Reach. This is a new commercial model for Network Rail, and has attracted significant interest from the telecommunications market. In February 2023, Network Rail announced its preferred partner for Project Reach. The lessons learned from the Trans Pennine Initiative project informed Network Rail that using a commissionaire approach would work better than trying to sell services directly from Network Rail.

- **LFFN Schools PSBU project:** A new product offered which was specifically for the LFFN Schools PSBU project called 'Full Fibre Infrastructure Build'. The product connected buildings to existing OpenReach fibre spines. The new product was based on organisations, in this case the DfE, asking for a high volume of connections. The components of the product ensured a faster turnaround of the connection.

- **LFFN Schools PSBU project:** The LFFN Schools PSBU project approach has been used subsequently, to support the delivery of the RGC Schools project. This project has utilised the lessons learned from the LFFN schools project, particularly the Full Fibre Infrastructure Build product.

4.3 Investment

Two of the projects were able to demonstrate further investment into the local areas following the delivery of the LFFN projects. In the West Sussex PSAT project, the contract provider has committed to investing in the wider area to deliver further gigabit-capable networks, which would not have occurred in the absence of the project. In Tameside, there has been significant inward investment to redevelop the local area surrounding the LFFN project, which the LFFN project was stated to have contributed towards.

Further to this, the LFFN Schools project has also led to further public investment in schools' digital infrastructure. Following the connection of schools to the faster internet connection, stakeholders reported that some schools were not able to fully utilise the new internet connection. This was because the internal infrastructure at the schools such as routers, network wiring, computers and laptops, were not equipped to use the faster internet speeds. Therefore, schools needed internal upgrades to generate the benefits of the LFFN schools PSBU project. The DfE has responded to this by launching the Connect the Classroom Programme, which provides funding to the LFFN schools and those receiving upgrades through the Rural Gigabit Connectivity programme to upgrade their internal infrastructure. This programme would not have been introduced in the absence of the LFFN schools PSBU project and the Rural Gigabit Connectivity programme.

4.4 Economic impacts

It should be noted that the qualitative and quantitative research findings described above suggested that the economic impacts of the project may be limited. This is because there was no evidence that the local areas surrounding the projects experienced any additional growth in connectivity growth when examined alongside a comparator area, and this would be required to drive the economic impacts described in Section 2. However, the economic impacts were explored.

An econometric analysis utilising the same fixed effects framework as described in Section 4 was used to explore the impact of the projects on unemployment, employment, turnover, earnings and productivity in the 1km area surrounding the LFFN projects. This analysis found no significant positive impact on any indicator.

The analysis also explored the evolution of house prices in the areas that the LFFN projects had operated in. The table below presents this evolution, demonstrating that house prices have increased markedly in all areas. However, these increases were largely in line with increases observed in the comparator areas for the projects.

The analysis presents an overview of house prices but does not attempt to draw inferences of the impact the LFFN projects on house prices. This is because the qualitative findings did not suggest that there has been widespread use of the networks to provide additional gigabit-capable coverage to areas, therefore there is limited evidence that any changes in house prices would be driven by the projects themselves.

Table 4.1: Change in house prices, 2017 to 2022

	West Sussex PSAT project		Tameside		Trans Pennine Initiative		LFFN Schools	
	Average price 2017 (£)	Increase in price 2017-2022 (%)	Average price 2017 (£)	Increase in price 2017-2022 (%)	Average price 2017 (£)	Increase in price 2017-2022 (%)	Average price 2017 (£)	Increase in price 2017-2022 (%)
Flat	£198,000	10.5%	£83,700	37.7%	£147,600	18.3%	£147,200	4.7%
Terraced	£296,200	15.0%	£109,100	41.0%	£130,000	28.0%	£171,300	18.2%
Semi-detached	£348,200	22.4%	£153,300	38.0%	£169,600	32.7%	£200,400	29.9%
Detached	£480,900	25.6%	£226,300	42.0%	£292,500	23.8%	£328,800	27.2%

Source: Land Registry data (2017-2022).

5 Conclusions

5.1 Context

At the time the LFFN programme was launched, the UK had very little gigabit-capable infrastructure in place, with only two percent of the UK having gigabit-capable coverage, and the market was dominated by technologies which could not provide the gigabit-capable speeds which UK businesses and households would require in the future. Therefore, there was a case for the UK government to invest in fibre infrastructure.

However, the context in which the LFFN programme operated in has altered significantly since the programme was launched. There has been an influx in investment into the market, leading to small network providers that existed in 2017 to expand their fibre networks, and an increase in the number of network providers offering gigabit-capable connectivity. In addition to this, larger network providers have committed to investing in and rolling out gigabit-capable networks to replace or enhance their existing networks. This means that in 2022, 70 percent of premises in the UK have gigabit-capable connectivity. There has been a large amount of investment across the UK broadband market in this time. Network providers have indicated that investment and the regulatory position from Ofcom have driven this more than being led by Government programmes.

As the telecommunications market has changed so significantly over the course of the programme, the findings on the additional impact the projects have contributed to in terms of gigabit-capable coverage and take-up need to be placed viewed through this context.

5.2 Project delivery

Project delivery for the wave one projects was generally slower than anticipated, meaning there were delays in project completion, as shown in Table 5.1 below. There were a variety of reasons for the slow progress which are discussed in the individual project evaluation reports. Some of these can be assigned to the innovative nature of the projects, and involving organisations with limited experience of delivery publicly funded telecommunications projects. However, one of the key findings across the projects was importance of early planning in ensuring civil engineering work could take place as anticipated. Instances where early planning proved beneficial included applying for wayleaves, exploring the route, and engagement with beneficiaries.

The delay in the delivery of the projects, and some difficulties undertaking activities post build, like connecting building, or undertaking marketing due to COVID-19, has led to evaluation challenges, in that the projects have not moved as far along their logic chains as may be expected. Therefore, it is still possible that some of the longer-term outcomes and impacts for the projects could be realised in the future and it is still early to form conclusions about wider impact of some projects.

Table 5.1: Progress of projects

Project	Baseline (prior to build activity)	Project completed	Interim evaluation research	Years post network build / connections completion for final evaluation fieldwork
West Sussex PSAT project	2017	2019 – 2020 (all buildings connected by Q3 2020/21)	Late 2020	2
LFFN Schools PSBU project	2017	2018 – 2020 (most schools connected in 2019)	Early 2022	1.5 to 2.5

| Trans Pennine Initiative | 2017 | 2019 | Late 2020 | 3 |
| Tameside PSAR project | 2017 | 2018 | Early 2020 | 4 |

5.3   Commercial viability of areas and delivery models

The areas that the LFFN has built networks vary significantly, and the projects differed in terms of their aims as to how they would make the target areas more commercially viable. There is mixed evidence on how successful the projects have been in making their areas more commercially viable to network providers:

▪ The West Sussex PSAT project has been successful in bringing a new network provider into their area, as previously Cityfibre did not have a footprint in West Sussex. As a result of the project, they now have a footprint and have committed to spending a further £190 million rolling out fibre network in West Sussex. Additionally, there has also been an increase in the number of network providers that offer gigabit-capable services in West Sussex.

▪ Within Tameside ITS, a Cooperative Network Infrastructure member, previously had no gigabit-capable network in Tameside. Through Cooperative Network Infrastructure and the LFFN funded build, they now offer extensive gigabit-capable services in Tameside. There is limited evidence of other network providers entering Tameside and utilising the LFFN funded infrastructure, although some existing network providers have slightly increased their coverage in Tameside.

▪ Although the Trans Pennine Initiative project has not made many sales to network providers to provide coverage in the areas surrounding the route, there has been an increase in the number of network providers offering services along the route. The Trans Pennine Initiative project has contributed to at least one provider offering services in the area, but this is not visible in the ThinkBroadband data.

▪ The evaluation was unable to uncover any evidence that the schools project had contributed to making the areas surrounding the schools more commercially viable, although this was not an initial aim of the project.

For all four projects, there is evidence that the delivery of the project has helped to support the further use of a commercial vehicle or mechanisms. This has been achieved either by utilising a local commercial vehicle, or by using learnings from the projects to develop a new commercial offering. This demonstrates that crucial learning has been taken from the LFFN wave one projects.

5.4   Gigabit-capable coverage and take-up of connections

There is evidence that gigabit-capable and ultrafast coverage has increased in all areas that the LFFN wave one projects have operated in. There is also evidence that take-up of ultrafast connections has also increased in these areas.

However, when econometric analysis was undertaken, it indicated that only the Trans Pennine Initiative project had contributed to a faster roll out of gigabit-capable network. Areas surrounding the Tameside PSAR and West Sussex PSAT projects could have contributed to a slower roll out of gigabit-capable network in the areas surrounding their network build, although they could have had contributed to different outcomes in other areas of their local authority. As mentioned in Section 5.1, the changing context of the broadband market will have had an effect on the additional impact the projects were able to generate. The increased investment and roll out of gigabit-capable networks

means that comparator areas may have received gigabit-capable roll out commercially and at a faster rate than in the project areas. This may be compounded by some network providers potentially decided against building in the treatment areas as there was a publicly funded incumbent in place.

The evaluation cannot conclude that the projects other than Trans Pennine Initiative have had an additional impact on gigabit-capable coverage up to 2022 in the areas within 1km of the project network build. Due to the late completion of most of the projects though, the impacts may be generated in the future.

5.5   Public sector costs savings

There is evidence that all the projects have led to public sector cost savings, and that the LFFN wave one projects have contributed to these savings. These are both direct and indirect cost savings. Examples of the cost savings include:

- **Direct cost savings:** Public sector organisations in Tameside and some schools in the LFFN schools PSBU project experienced a reduction in the cost for their broadband connection. In West Sussex and some of the other schools in the LFFN schools PSBU project, they received an enhanced broadband connection for the same price as they were previously paying. There are further direct savings for stations along the Trans Pennine Initiative route that have reduced the number of broadband connections they require to run different operations, with more stations in the future able to do so as well. In West Sussex and Tameside, there is also evidence that the projects have contributed to a reduction in the maintenance costs associated with managing connections to public sector buildings.

- **Indirect cost savings:** There is evidence that the projects have led to indirect cost savings. Public sector organisations reported that administrative tasks were faster and more straightforward to complete. Public sector organisations in the project areas also reported that they were able to reduce other outgoings services, such as the telephone, which can be provided through the broadband connection. Lastly, they were able to introduce new services which utilise online connectivity that are less costly to deliver than face-to-face services.

5.6   Summary

The discussion above highlights that the projects have largely achieved the objectives that they set out in their original business plans, however there has been less progress towards the wider connectivity and economic and social outcomes.

The findings from the evaluation indicate that there are some challenges to be addressed in delivering demand led broadband interventions. These interventions appear to be successful in achieving the public sector outcomes and impacts, however they appear to have struggled so far, to 2022, to provide additional gigabit-capable networks in the local area, above what would have happened in the absence of the projects. This limits the longer term benefits the projects have been able to generate in terms of economic, social and environmental impacts to 2022.

Additionally, it appears that there are challenges associated with setting up new commercial vehicles to deliver gigabit-capable connectivity. The Trans Pennine Initiative project experienced issues in being able to sell connectivity as Network Rail due to price constraints and a lack of track record in delivering fibre connectivity. The Tameside PSAR project has seen similar challenges around Service Level Agreements which may have contributed to the absence of additional impact in gigabit-capable coverage in Tameside.

The table below summarises the key findings from the evaluation.

Table 5.2: Summary of LFFN project achievements – green highlights strong evidence of achievement, orange indicates limited evidence of progress towards objective

Objective	West Sussex PSAT project	Tameside PSAR project	Trans Pennine Initiative	LFFN Schools project
Generate learning	Learning generated West Sussex county council and CityFibre in terms of delivering publicly funded infrastructure projects.	Learning generated for Tameside Metropolitan Borough Council, BDUK, other local authorities and Cooperative members.	Learning generated for Network Rail in terms of delivery and commercial environment.	Learning generated for Openreach, Schools, DfE, and BDUK, who have since gone on to use the same model of delivery of Rural Gigabit Connectivity programme.
Public sector cost savings	Evidence that public sector buildings have gigabit-capable connections at no additional cost.	Evidence public sector buildings have experienced cost savings.	Evidence some stations have experienced cost savings, and the potential for further savings along the route.	Evidence some LFFN schools have experienced cost savings.
Enhanced (public sector) service provision	Evidence that there have been some changes in public service provision.	Evidence that public service providers have been able to enhance the services they provide.	Evidence that services at some stations have improved, and the potential for further improvements along the route.	Evidence that some LFFN schools have been able to introduce enhanced learning for pupils.
Improve resilience	Evidence that broadband connections are more reliable than previous connections.	Evidence that there is improved resilience for organisations connected to the fibre network.	Evidence that broadband providers have utilised the network to improve resilience for customers.	Evidence that broadband is more reliable in LFFN schools.
Future proofing	Evidence that public service providers will be able to enhance services in the future as a result of better internet connections.	Evidence that public service providers have capacity to deliver more services in the future, and Tameside has futureproofed broadband provision in the area.	Evidence that Network Rail and stations can further exploit the fibre network in the future.	Evidence that LFFN schools have scope to offer more services in the future.

New broadband providers	Evidence that CityFibre has entered West Sussex as a result of the project.	N/A	Limited evidence that new broadband providers are offering services along the route.	N/A
Broaden connectivity	Limited evidence of additional gigabit-capable connectivity, above what is expected to have been delivered in the absence of the project, within 1km of the project build in West Sussex.	Limited evidence of additional gigabit-capable connectivity above what is expected to have been delivered in the absence of the project, within 1km of the project build in Tameside.	Evidence of enhanced connectivity along the route, in spite of limited use of the network by broadband providers.	Limited evidence of additional gigabit-capable connectivity, above what is expected to have been delivered in the absence of the project, within 1km of the project build.
Introduce new commercial models	N/A	Evidence that the Cooperative Network Infrastructure commercial model is established and is being used in other Local Authority areas.	Evidence of demand for a commercial model to provide access to rail fibre. Limited evidence that Network Rail can and should enter the market as a new broadband provider to offer commercial access.	*Not a stated aim of the project, but it has led to a new commercial product being developed, which has been used in other settings by Openreach.*
Economic and social outcomes	Limited evidence that the project has led to economic and social benefits.	Limited evidence that the project has led to economic and social benefits.	Limited evidence that the project has led to economic and social benefits.	Limited evidence that the project has led to economic and social benefits as no evidence of increased take-up.

Green highlights strong evidence of achievement; orange indicates limited evidence of progress towards objective

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