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

Final evaluation

LFFN Schools PSBU project

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.

Contents

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 final evaluation findings for the LFFN Schools Public Sector Buildings Upgrade project.

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 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. The LFFN schools PSBU project was selected as one of these four projects.

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 Fibre to the Premises (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 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.

[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

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]
- 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]

[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)
[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)

- 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)
	Demand-led delivery approaches

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.

[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)

- **Workshop with key stakeholders:** Prior to final evaluation fieldwork, workshops were held with each wave one project to establish whether alterations were needed in the Theory of Change, which outcomes to focus on and how to evidence wider benefits of projects.

- **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 representatives of the local councils, BDUK project leads, the Department for Education and LFFN school staff. Interviews covered developments in the delivery and management of the project, issues encountered in delivery, emerging demand for fibre services and connections and impacts of the LFFN project on schools 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 a network provider that delivered some of the contracts. 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 / gigabit-capable coverage, ultrafast, download speeds, number of connections and data usage in the areas surrounding the LFFN build. The research team worked with BDUK to identify a suitable comparator area for the LFFN schools PSBU project. The comparator group selected were areas surrounding Rural Gigabit Connectivity (RGC) project[17] schools – the Rural Gigabit Connectivity schools were being provided connectivity in a similar way to the LFFN schools, but at a later point in time. These schools were selected as a comparator group as they were expected to share similar characteristics as the LFFN schools before the LFFN project was implemented. These were poor connectivity to the school and surrounding area and being located in rural or semirural locations.

  A matching exercise was completed using postcode level data for the LFFN school areas and the comparator areas, to enhance the comparability between the treatment and comparator group. The matching exercise sought to find areas matching in characteristics including details of the telecommunications infrastructure of the postcodes, including distance from the serving exchange as well as the availability of ultrafast and gigabit-capable connections in previous

[17] The Rural Gigabit Connectivity Programme is a BDUK funded programme which aims to deliver nationwide gigabit-capable connections in locations that are unlikely to benefit from commercial investment. The programme was launched in 2019 and as part of the programme aimed to provide enhanced connectivity to rural schools.

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 were:

  - **Engagement with schools where research was not priority:** Many of the schools that the LFFN schools PSBU project targeted were small schools with a small number of staff, who covered many different roles. This meant that IT, and the broadband connection, was not any staff members main responsibility, and this research was not their primary focus. This meant it was challenging to engage with schools.

  - **Lack of contact details for indirect beneficiaries:** The initial evaluation plan aimed to explore the impact of the LFFN wave one projects on businesses in the areas surrounding LFFN PSBU Schools project. The delivery of this project was delayed, as shown below, which means that take up of gigabit connections in project areas is still low. As a result, there are limited businesses that have upgraded at this stage. Secondly, the projects do 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.

- **Limitations of Management Information:** LFFN wave one projects faced some challenges in collecting useful Management Information. This was partially the result of projects being set up as pilots with the aim of generating learning. An issue was the timeliness, and 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.

- **Limitations given progress of projects:** The completion of the LFFN schools PSBU project was slightly slower than anticipated. There were a variety of reasons for the slow progress which are discussed in this report. A challenge for the evaluation of the LFFN schools PSBU project is that, because of these delays, there are fewer years between the project completion and the final evaluation research than expected, meaning outcomes have had less time to materialise. 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. For example, take-up and economic impacts could be expected to be achieved four to five years post completion, meaning these would not have been fully achieved or be observable in the data at this stage.

Table 1.2: Progress of projects

Project	Baseline (prior to build activity)	Project completed	Interim evaluation research	Years post network build / connections completion for final evaluation fieldwork
Schools	2017	2018 – 2020 (most schools connected in 2019)	Early 2022	1.5 to 2.5

- **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 the 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 their Fibre First Programme[18] has been rolled out have been excluded from the analysis.

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

[18] The Fibre First programme from Opnereach delivered commercial roll out of gigabit-capable networks to over eight million premises between 2018 and 2022.

- **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 schools PSBU project has contributed towards as of 2022.

1.6 Structure of the report

The remainder of this report is set out as follows:

- Section 2 provides the intervention logic for the project;
- Section 3 provides details of how the LFFN schools PSBU project has been delivered;
- Section 4 provides the broadband outcomes for the LFFN schools PSBU project;
- Section 5 presents the wider outcomes and impacts of the LFFN schools PSBU project; and
- Section 6 presents the conclusions from the evaluation of the LFFN schools PSBU project.

2 Intervention logic

This section provides a detailed description of the LFFN schools PSBU project, providing a brief description of the project, the anticipated outcomes and impacts, an assessment of how far the project has achieved its intended outcomes and the key learnings from the project.

2.1 Rationale for intervention

Public sector buildings, like schools, have to be distributed across the UK in order to provide services to people wherever they live. This means that they are sometimes in areas with poor connectivity and reliability. This poses problems to these schools as it limits their ability to use technology and systems which rely on internet access, like pupil registration and attendance systems or Department for Education (DfE) systems. In particular, the lack of connectivity presents difficulties to school administration, teachers and pupils. These issues include:

- Difficulties in accessing online systems. Many educational administration and DfE data systems are online, and require schools to upload and download data. Poor connectivity makes this difficult and time consuming for school administrative staff.

- Difficulties in accessing teaching, planning and assessment materials and delivering interactive lessons. Poor connectivity means that teachers do not have reliable access to online resources in the classroom, or at home which can limit their lesson plans, increase workload and impact their ability to teach effectively.

- Pupils cannot access online content in the classroom or at home. Poor connectivity means that not all pupils in a class can access online content at the same time. If a lesson requires online content, the poor connectivity negatively influences a pupil's ability to learn and could therefore negatively contribute to their academic performance. Poor connectivity in areas surrounding the school also means that pupils are restricted from accessing learning materials at home, making it more difficult to continue their learning outside of the classroom.

Poor connectivity in these areas also presents problems to local businesses and households, potentially hampering economic performance and individual wellbeing. The LFFN schools PSBU project aimed to tackle the issue of poor connectivity to the schools – making sure that the schools themselves had a good broadband connection to deliver education, rather than directly targeting poor connectivity in the surrounding area.

2.2 Description of the intervention

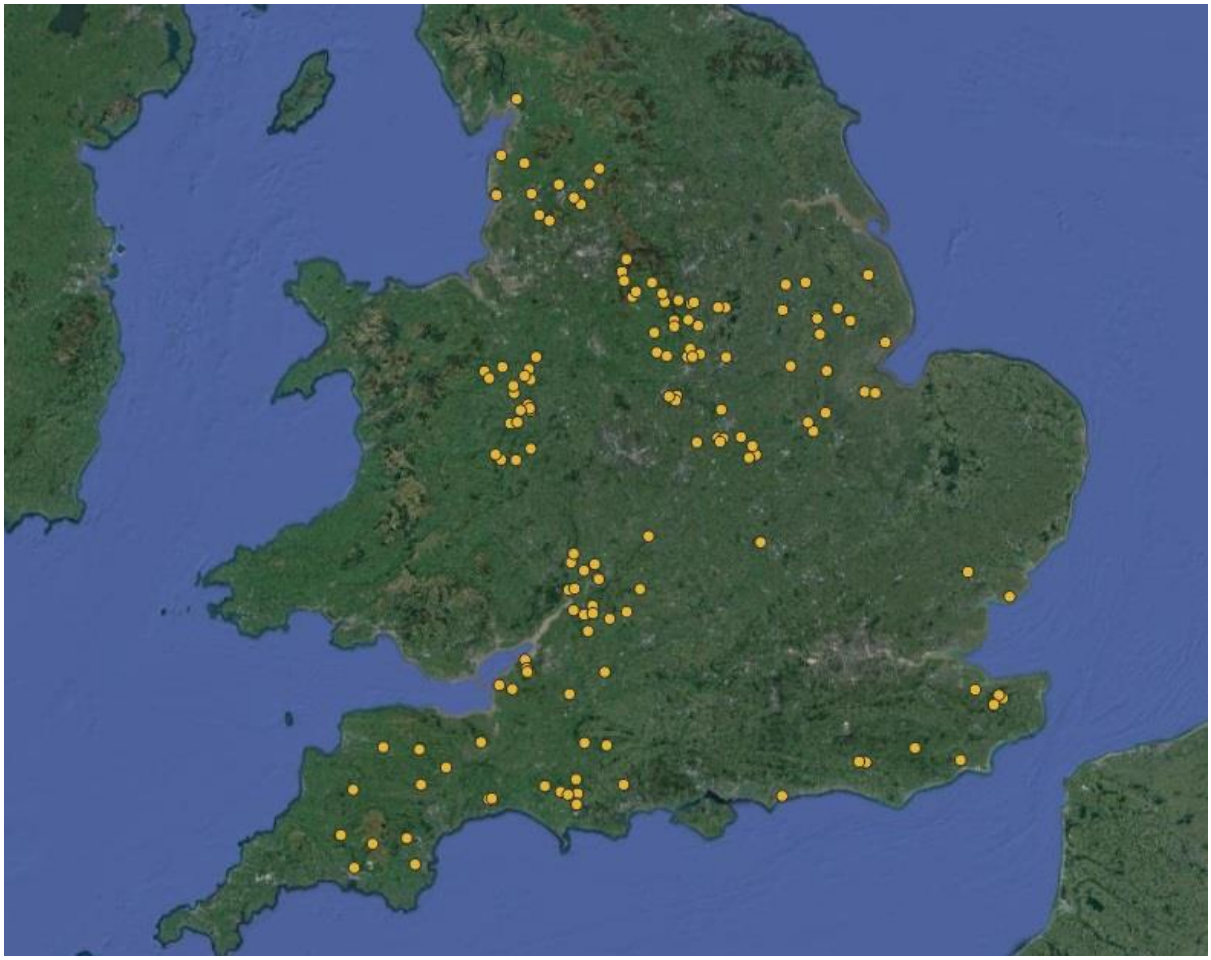
Initially, the LFFN schools PSBU project aimed to provide gigabit-capable connections to 104 primary schools across England. This formed the first example of a PSBU project delivered through the LFFN programme, a model that would be used in subsequent waves of LFFN funding. As the project progressed it became clear that the upgrades were less expensive than originally planned, so the number of LFFN schools was increased to 151.

The initial business case for the LFFN schools PSBU project set out a number of objectives for the project. The improved connectivity at the schools is expected to provide positive outcomes for the schools and indirectly for the local area. It was anticipated that the improved connectivity would improve the learning provided in LFFN schools. It would do this in two ways; by allowing teachers to access a wider variety of teaching materials, and by giving pupils access to online resources in the classroom. Better connectivity would also increase efficiency of support staff within LFFN schools, which would allow for public sector cost savings. Additionally, the improved connections within

schools were expected to improve resilience (remove or reduce the time when the school had no internet connection) and future proof their provision, allowing further changes to teaching and school operations in the future. The project also aimed to help wider connectivity issues, by increasing gigabit-capable coverage in the areas surrounding the school (although this was not explicitly stated in any documentation). A further aim was to generate learning from the project, about how similar interventions could be delivered in the future.

The upgrades were mainly delivered by OpenReach, who laid the fibre to connect existing networks to the schools, whilst a small number of upgrades were delivered by Wessex Internet. Schools may not necessarily be purchasing services through BT or Wessex Internet – other Internet Service Providers can provide services to the schools using the upgraded network.

Figure 2.1: Locations of LFFN schools



Source: BDUK Project Management Information

2.3 Theory of change

2.3.1 Project inputs

For the LFFN Schools PSBU project, the most significant expected input was capital investment, in the form of funding that would be provided to schools to access gigabit-capable connections. In addition to the capital funding, resources from within BDUK, DfE, the schools and local bodies, such as the East Midlands Public Services Network and local authorities would be used to deliver the project. These were administrative costs – staff time and expertise.

There was no private sector investment specified in the LFFN schools PSBU business case. It was hoped that the project would lead to private investment in the form of spillover building activity by

suppliers. Future private sector contributions would include maintenance costs for the expanded network and staff time.

2.3.2 Activities

The key activities outlined for the project were:

- Identification of schools to take part in the project: The first activity for BDUK and DfE would be to identify schools to take part in the project. This involved examining data including location, connection speed and networks in the area for 22,000 schools. Schools would be ranked in order of need for fibre connections, based on digital infrastructure variables. The top 30 percent of schools were included as potential beneficiaries of the project.

- Engaging with local aggregators: DfE were responsible for engaging with local aggregators, such as East Midlands Public Services Network and local authorities. These organisations would be able to add local intelligence to the initial list of schools to narrow down the list of potential beneficiaries, for example providing information about where Gigabit vouchers were being used.

- Engaging with suppliers and operators: This would be undertaken by local aggregators and the DfE. OpenReach were approached and negotiations took place to:

  - Reduce the duration of time between applying for network build and the build being completed (from one year to 14 weeks);

  - Provide an estimated cost for the network upgrade at each of the school sites; and

  - Provide a guaranteed maximum price for the network upgrade (through Network In Advance agreement).

- Refining the list of schools to take part in the project: Once schools were identified and ranked by need, DfE and BDUK would then use the information collected from local aggregators and OpenReach to refine the list of potential beneficiaries. Schools where the network upgrade was estimated to be over £35,000 were ruled out, as this was too expensive. Schools where the upgrade was estimated to be between £25,000 and £35,000 were placed on a reserve list.

- Marketing fibre connections and the project to selected schools: DfE and local organisations would explain the project and ensure demand for fibre connections. They would do this by providing marketing information to schools and visiting selected schools.

- Procurement of services: The schools involved in the project would carry out their own procurement.

- Laying of cable: The contracted operators would lay cable from existing networks to the school.

- Connection: The schools would be connected to the fibre network by suppliers.

- Invoicing: The DfE would hold the payment from BDUK centrally. Once the cable had been laid and the connection completed, suppliers invoiced the school, who then contacted DfE to send the grant funding on to the school to process the payment.

2.3.3 Outputs

The key outputs of the LFFN schools PSBU project were expected to be:

- Develop procurement framework: The schools involved in the project did not have sufficiently developed procurement processes or experience to efficiently procure this type of service. An output of the project was to build capacity within schools to procure similar services in the future.

- Lay ducting and cable: The LFFN schools PSBU project aimed to lay ducting and cable to connect the schools to the fibre network. There was no set target for the length of cable that will be laid.

- Connect schools to FTTP connections: The project aimed to provide fibre connections to over 100 schools. These schools were identified by the DfE. The fibre was expected to be owned and maintained by operators, but could be accessed by other suppliers through open access requirements.

The fibre cable laid by the project was expected to pass premises located close to the schools. However, the documentation reviewed and stakeholder consultations did not provide the number of premises the new network was expected to pass.

2.3.4 Outcomes and impacts

The project was expected to lead to several medium and longer-term outcomes and impacts that can be summarised into the following categories:[19]

- **School level outcomes:** Faster internet connection was expected to benefit LFFN schools in numerous ways. Cost savings were expected by moving to online communication systems instead of postal or phone communication and enabling LFFN schools to move to cloud based solutions to reduce financial and energy costs. Some of these changes would also help with the second anticipated benefit which is improved efficiency. Lastly, it was also expected that improved connectivity would allow LFFN schools to provide more online learning materials to support teaching and improve pupil attainment.

- **Connectivity outcomes:** The network delivered to the schools was expected to reduce the cost of further fibre investment, meaning new areas will likely become commercially viable for suppliers. This was 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 connected to the network take-up FTTP connections whilst businesses and residents would likely benefit should spill over build occur. For businesses and public sector organisations, this benefit could be due to better data storage and processing power through access to the cloud and faster transmission of files and records, leading to productivity gains, or by supporting more employees to telework.

[19] The expected outcomes and impacts were agreed with BDUK during the planning phase of the evaluation in 2019 following a series of consultations with BDUK and key stakeholders, review of project documentation, literature review and review of secondary data.

- **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 raise 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 close to the upgraded schools.

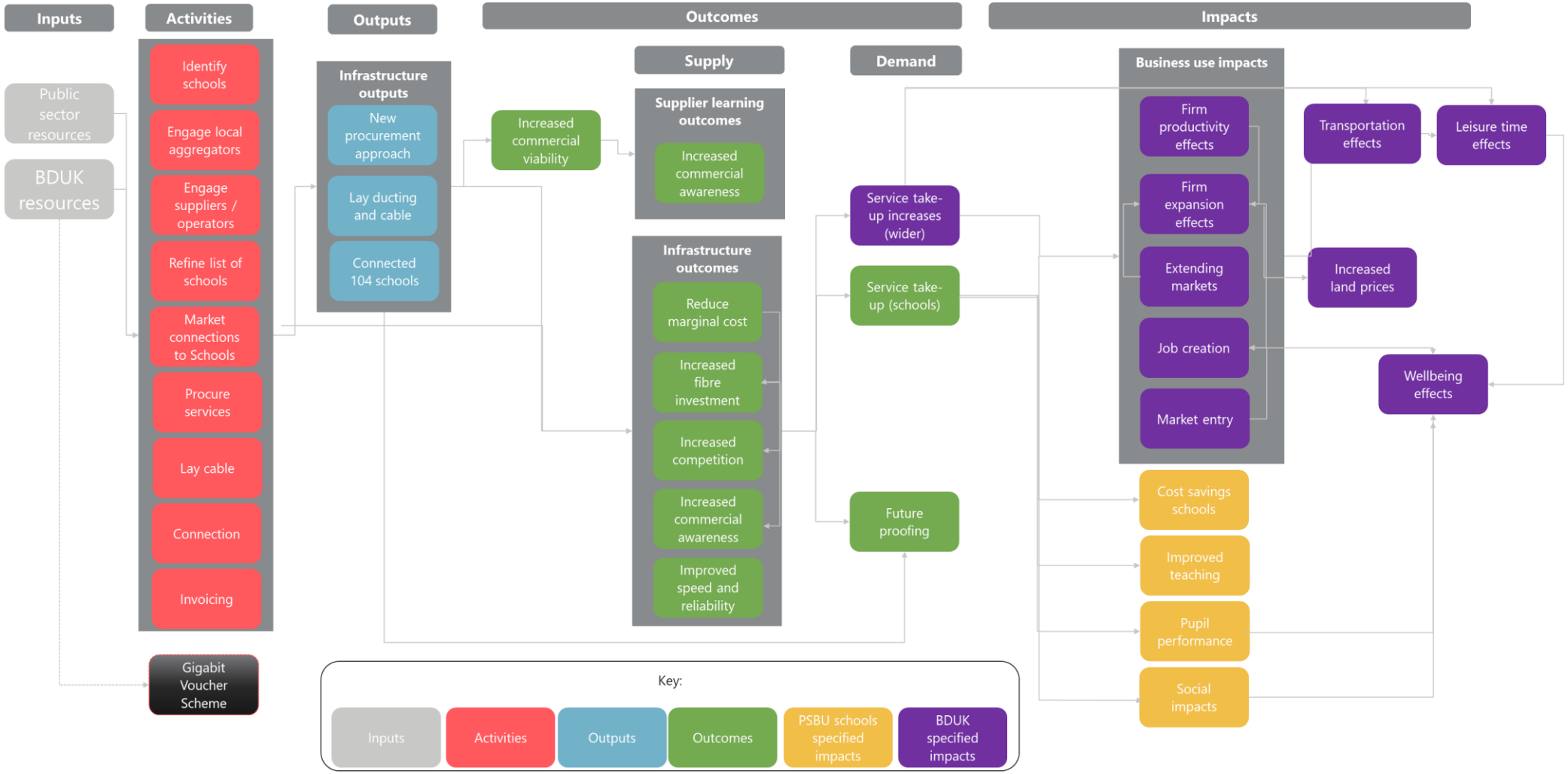
  - Business relocations: The availability of a full fibre network close to upgraded schools is also expected to lead to a range of firm relocation effects. The increased desirability of areas with a full fibre network is expected to attract businesses to these areas and in particular young start-ups dependent 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 2.2.

Figure 2.2: LFFN schools PSBU project logic model



3 Delivery

This section discusses the physical works and subsequent activity which was required to deliver the LFFN schools PSBU project. It presents the expenditure, an assessment of the physical works, and the schools connected.

3.1 Funding

Data for the total cost of the funding awarded to schools has been provided by BDUK, although this does not include any administration costs associated with managing and delivering the project. The table below presents the total amount of funding awarded and the average size of the grant provided. Whilst connections under the LFFN school PSBU project came with high costs, there were no noticeable patterns between size of the grant awarded and the rurality of the school. This is noteworthy as it is typically more expensive to lay fibre to rural areas. The increased cost is due to the fact that rural build covers more distance to connect to existing network infrastructure which increases all associated resource costs. The fact that rural LFFN schools did not cost more to connect than urban LFFN schools could therefore suggest that the rural LFFN schools connected were potentially closer to existing network infrastructure, and therefore were easier to reach.

Table 3.1: Funding of the LFFN schools PSBU project

	Value (£'000)
Total cost of funding awarded to schools	£2,900
Average value of funding awarded to schools	£19
Average grant awarded to maintained schools	£19
Average grant awarded to academy schools	£20
Smallest grant	£0.8
Largest grant	£54

Source: BDUK Management Information

Local bodies, such as the East Midlands Public Services Network and local authorities contributed significantly to the programme. This was primarily in terms of staff time, which involves some regional management of the project and negotiating with schools to utilise the LFFN schools PSBU project grant offer to obtain fibre connectivity.

Additionally, DfE contributed staff time to the project, in the form of identifying potential schools to be included in the project, negotiating with the schools and suppliers and managing the project. BDUK transferred the grant funding to DfE, who then transferred the grant funding value to the schools once the contractor raised an invoice. There was no capital investment from the DfE. These costs are not included in the funding estimates presented in the table above.

3.2 School decision making

Schools were initially approached by BDUK about the LFFN schools PSBU project. However, there was a limited response to the initial offer. BDUK and DfE stakeholders reported that this was because schools were suspicious of offers not from DfE or the local authority, as these are trusted channels. Therefore, the LFFN PSBU schools project utilised a second approach, where DfE or local aggregators contacted the schools to explore their interest in the project. This approach led to higher levels of engagement with LFFN schools. LFFN schools reported that the initial contact was made by email. Some LFFN schools had to check with the local aggregators that this was a legitimate offer, as *"it seemed too good to be true."* The DfE also followed up with a visit to schools, to discuss

the project in more detail, however, it was left to the schools to decide whether they would participate in the project. At this stage, some schools did decline the offer, although no consistent reasons for declining the offer were reported.

LFFN schools had to go through their formal decision-making channels before they could agree to take part in the project. This meant that the offer was taken to the board of Governors for a decision. In some schools, there were multiple boards that the decision had to go through, for example separate financial boards. One interviewee reported that the board of Governors had asked them a series of clarification questions about the project, which they had to collect information to answer before a decision could be made. In schools, the board of Governors would usually meet once a term, equal to three times annually. Therefore, this decision-making process could take a long time, which had an effect on the timeliness of the project delivering connections.

LFFN schools were responsible for commissioning their Internet Service Provider and network provider to build the fibre connection, though they were often supported by their local authority. LFFN schools did not report any problems with this approach, and the process appeared to work well.

3.3 Connections

The fibre cable was laid to schools in the period between Autumn 2018 and the end of 2020. The data provided indicates a total of 151 schools have been connected to fibre networks. The initial target for the project was to connect 104 schools, but as cost of the connections to many of the schools was lower than anticipated, the project was able to connect more schools. 131 schools, the vast majority of LFFN schools, were connected in 2019, with six schools being connected in 2018, and 14 being connected in 2020.

The key characteristics of LFFN schools varied greatly, which can be seen below. This shows that a variety of schools have been connected through the programme:

- **Type of school:** 105 LFFN schools were local authority maintained, although 40 were academies. There was one special school included in the project. There were 5 schools which could not be matched to DfE data.
- **Size of school:** there was a variety in the size of schools supported. 10 percent of LFFN schools had less than 50 pupils, and a further 33 percent of LFFN schools had between 50 and 100 pupils. LFFN schools with between 100 and 199 pupils represented another 30 percent, with the final 27 percent having more than 200 pupils.
- **Rural Urban indicator:** 50 LFFN schools, close to a third of all schools, were located in urban areas. Two thirds of the total number of LFFN schools were located in rural areas, with 79 LFFN schools, over half the total number, located in villages or hamlets, and 15 percent located in town fringes.

The schools connected were located across England, in 20 different local authority areas, and there is an over-representation of schools from the East Midlands. The table below presents the number of LFFN schools connected by local authority area.

Table 3.2: LFFN schools connected by local authority area

Local Authority	Schools connected	Local Authority	Schools connected
Derbyshire	26	East Sussex	4
Shropshire	22	Kent	4
Gloucestershire	18	Wiltshire	2
Lancashire	12	Peterborough	1
Dorset	12	Nottinghamshire	1
Lincolnshire	16	Somerset	1
Leicestershire	11	Bath and North East Somerset	1
Devon	11	Nottingham	1
North Somerset	6	Cumbria	1
		Northamptonshire	1

Source: BDUK Management Information

Some LFFN schools reported delays in when their connection was made available, compared to their initial expectations. There were two explanations for the difference, which were:

- **Unrealistic initial expectations:** The expected time from commissioning to completion was around 13 weeks, or a quarter of a year, and some schools had the impression that the connection would be made sooner than this, leading the schools to think the connection had been delayed.

- **Lack of communication:** Some LFFN schools reported being unclear about who to contact about the project and their upgrade, although other schools had a named contact to provide them with progress updates on their connection. The LFFN schools without a named contact reported not receiving any updates about progress or timelines. In some cases there were delays to the delivery which were not reported to the school.

The delivery of the LFFN schools PSBU project was completed by the end of 2020, which was around one year later than the initial estimate. One of the main reasons for this delay was that the project connected around 45 percent more connections than were initially planned.

3.4 Invoicing

The Internet Service Provider would receive notification from the network provider that the build was complete, and they would make arrangements with the LFFN schools to install the connection. Interviews with LFFN schools and other stakeholders did not highlight this as being problematic or leading to any delays.

The Internet Service Provider would invoice the LFFN schools once the connection had been installed. As the schools were responsible for commissioning the work from their Internet Service Provider and network provider, the invoice came in to the LFFN school directly. The DfE and LFFN schools agreed in advance of taking up the connection that the DfE would transfer the grant to the LFFN schools prior to the invoice needing to be paid. This was in recognition that the connection was a large expense, and the LFFN schools would not have sufficient reserves to pay for the connection up front and be reimbursed by the DfE. All LFFN schools reported that the grant funding from the DfE arrived before their invoice.

4 Broadband coverage in the local area

4.1 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 schools PSBU project 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.

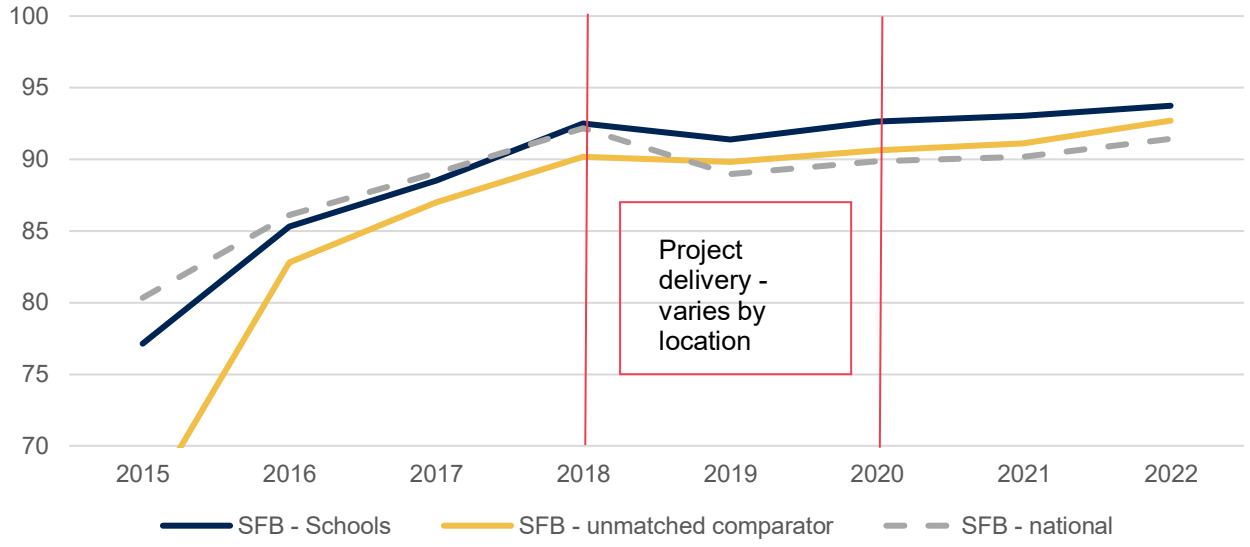
The figures below present the evolution of superfast[20], ultrafast[21] and FTTP / gigabit[22] coverage in the areas within 1km of LFFN schools. This shows that prior to the LFFN funding, superfast coverage within 1km of LFFN schools was slightly below the national average, but has since increased to be slightly above the national average. Ultrafast coverage was close to zero in 2015 and 2016, which was broadly in line with the national average. In 2017 and 2018, there was a large increase in ultrafast coverage nationally which was not experienced by postcodes within 1km of LFFN schools. As a result, ultrafast coverage fell below the national average. This picture has continued since, with ultrafast coverage increasing within 1km of LFFN schools at a similar rate to the national increase. In 2022 ultrafast coverage within 1km of the LFFN schools was 46 percent, 16 percent lower than the national average.

Gigabit-capable coverage within 1km of LFFN schools did not increase in line with the national average from 2019, following a similar trend to ultrafast broadband. Although gigabit-capable network coverage has increased in the areas surrounding the LFFN schools to 44 percent by 2022, this was still 16 percentage points below the national average.

A comparator area for the LFFN schools project has been formed using postcodes surrounding Rural Gigabit Connectivity Scheme schools. For more details see the technical annex. The evolution of superfast, ultrafast and gigabit-capable networks in the comparator area is also presented in the figures below. This shows that in postcodes surrounding Rural Gigabit Connectivity Scheme schools the evolution of coverage has been similar to that observed in postcodes surrounding LFFN schools, but at a slightly slower rate of increase. Current ultrafast coverage is 17 percentage points lower than in LFFN school areas at 29 percent and gigabit-capable coverage is 15 percentage points lower at 29 percent. This reflects the fact that the Rural Gigabit Connectivity schools are generally in more rural areas than LFFN schools.

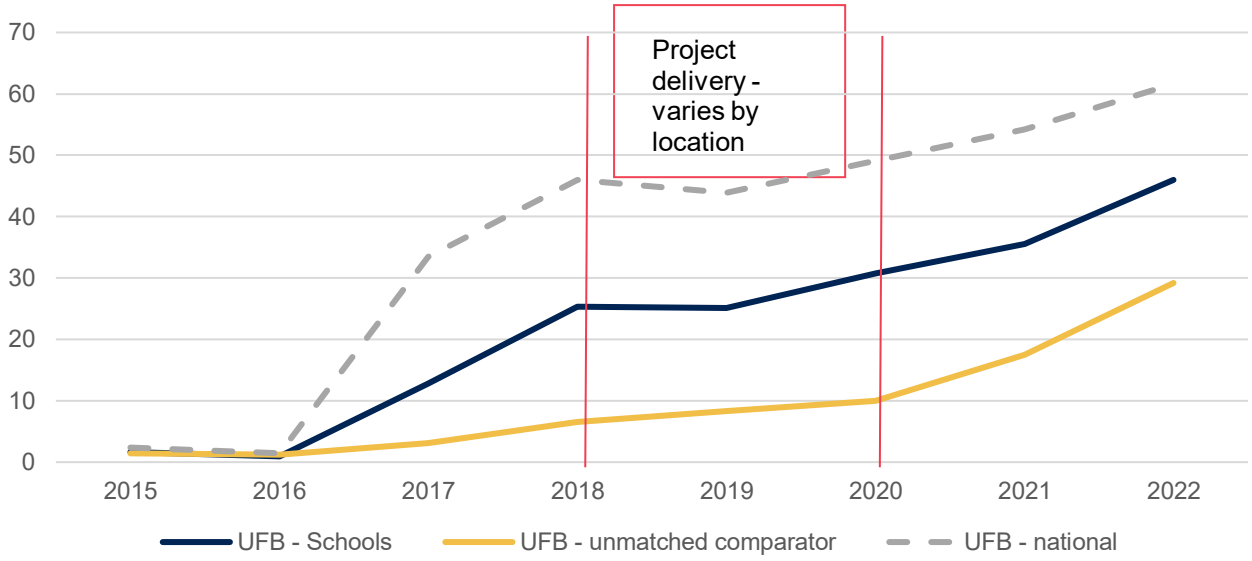
[20] Superfast broadband connections provide download speeds from 30 Mbps up to 300 Mbps.
[21] Ultrafast broadband connections provide download speeds of over 300 Mbps.
[22] FTTP / Gigabit broadband connections provide download speeds of over 1,000 Mbps.

Figure 4.1: Superfast broadband coverage within 1km of LFFN schools, nationally and within 1km of Rural Gigabit Connectivity schools, 2015 - 2022



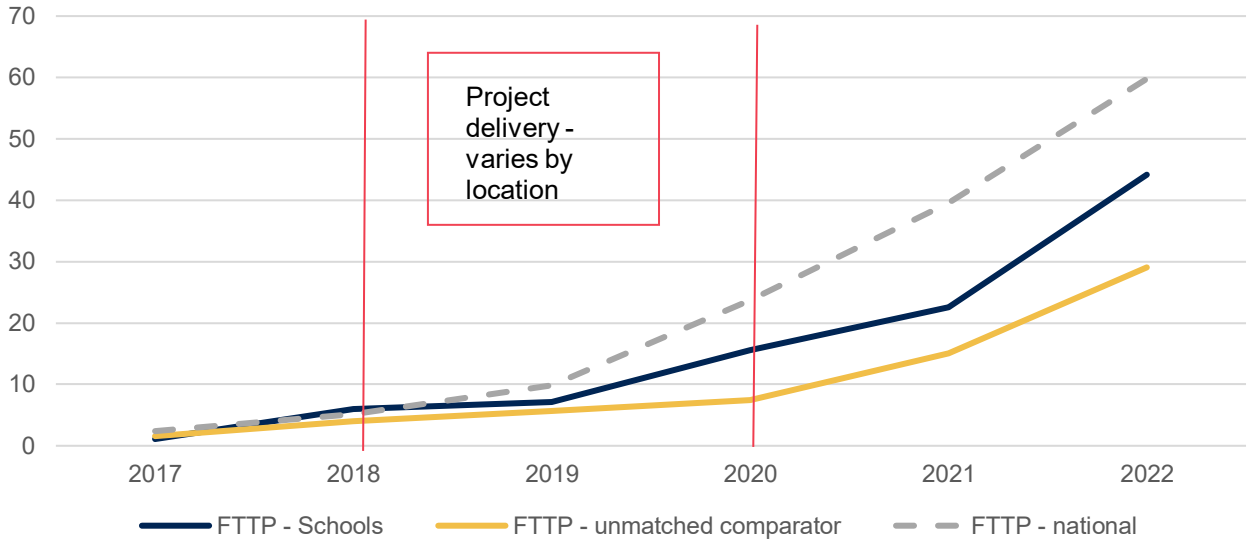
Source: Connected Nations, Ofcom

Figure 4.2: Ultrafast broadband coverage within 1km of the LFFN schools, nationally and within 1km of Rural Gigabit Connectivity schools, 2015 - 2022



Source: Connected Nations, Ofcom

Figure 4.3: Gigabit-capable broadband coverage within 1km of the LFFN schools, nationally and within 1km of Rural Gigabit Connectivity schools, 2017 - 2022



Source: Connected Nations, Ofcom

4.1.1 Impact of the LFFN Schools PSBU project

As mentioned previously, schools upgraded in the Rural Gigabit Connectivity scheme served as a comparator for LFFN schools. Similarly characterised postcodes within 1km of LFFN schools and Rural Gigabit Connectivity scheme schools were compared to provide insight into the impact of the LFFN schools PSBU project on gigabit-capable coverage. An econometric analysis was undertaken using a fixed effects analytical framework, with a variable included which matches the upgrade date of each school. For more details of the analytical approach please see the technical annex. The analysis comparing gigabit-capable and ultrafast availability in areas within matched areas close to LFFN schools and comparator schools found that the LFFN programme had no significant impact on gigabit-capable coverage. There was a statistically significant positive impact on ultrafast coverage of three percentage points, which was significant at the 95 percent confidence level.

These results appear counterintuitive as the network provided to LFFN schools were gigabit-capable. One possible explanation could be due to most of the schools being connected via the Openreach network. Openreach's LFFN build or subsequent activity could mean some premises in the area had their existing network enhanced to ultrafast capable but not to gigabit-capable networks in the early stages of LFFN Schools PSBU project. However, this would not cover schools upgraded later in the project, as Openreach paused ultrafast technology roll out in 2019.

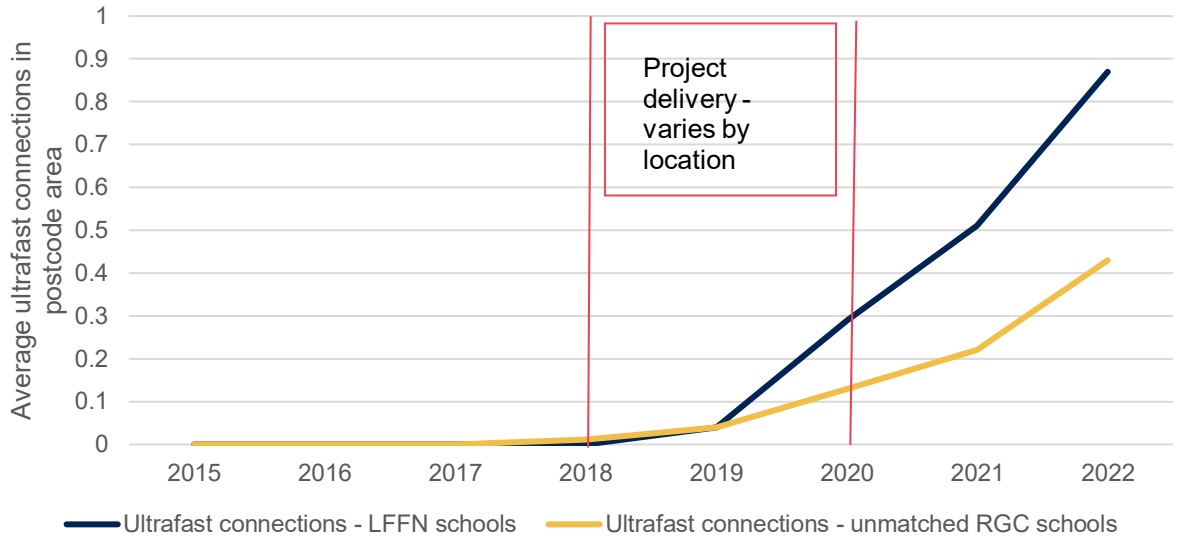
This estimated increase in gigabit-capable coverage around the LFFN schools is similar to those seen in two other project areas, where there was not a positive impact on gigabit-capable coverage. This differs from the findings from the other LFFN wave one projects. Only the Trans Pennine Initiative demonstrated a positive impact on coverage, and this could be due to the urban areas the route passes through.

4.2 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 surrounding LFFN schools has altered over time. The Connected Nations data does not suggest widespread take-up of FTTP or ultrafast in the areas surrounding LFFN schools as of 2022 with the average number of

connections per postcode below one connection. However, the take-up has increased since 2018, and is higher than in the areas surrounding the Rural Gigabit Connectivity schools. This is illustrated in the figure below.

Figure 4.4: Ultrafast broadband connections, 2015-2022



Source: Connected Nations, Ofcom

4.2.1 Impact of the LFFN Schools PSBU project

As mentioned previously, schools upgraded in the Rural Gigabit Connectivity scheme served as a comparator for LFFN schools. Similarly characterised postcodes within 1km of LFFN schools and Rural Gigabit Connectivity scheme schools were compared to provide insight into the impact of the LFFN schools PSBU project on take up of faster broadband connections. An econometric analysis was undertaken using the same fixed effects analytical framework as described above. The analysis found that the LFFN Schools PSBU project had no significant impact on the take-up of faster broadband connections.

This estimated increase in ultrafast take-up around the LFFN schools is broadly in line with the findings from the other LFFN wave one projects. The estimations for the other projects mostly showed either no significant impact or a negative effect on take-up, which again is in line with the estimated changes in gigabit-capable coverage in the other project areas. Only the Trans Pennine Initiative showed any positive effect on take up of ultrafast connections.

5 Knowledge and spillover benefits

This section provides an overview of the evidence obtained of the wider outcomes and impacts generated by the LFFN schools PSBU project. These include knowledge outcomes, outcomes for the LFFN schools and wider social and economic outcomes.

5.1 School level benefits

The discussion below draws on information collected through qualitative interviews and on an analysis of secondary data sources. It should be noted that because of the COVID-19 pandemic there are challenges with the DfE schools data. There is no relevant data available for the school years of 2019/20 and 2021/22. Additionally, in 2020/21 there is no data available for any schools about attendance or attainment. The lack of data means that there is no analysis of the trends in attendance and attainment presented here, as all of the data predates the installation of fibre under the LFFN schools PSBU project.

5.1.1 Use of improved connections

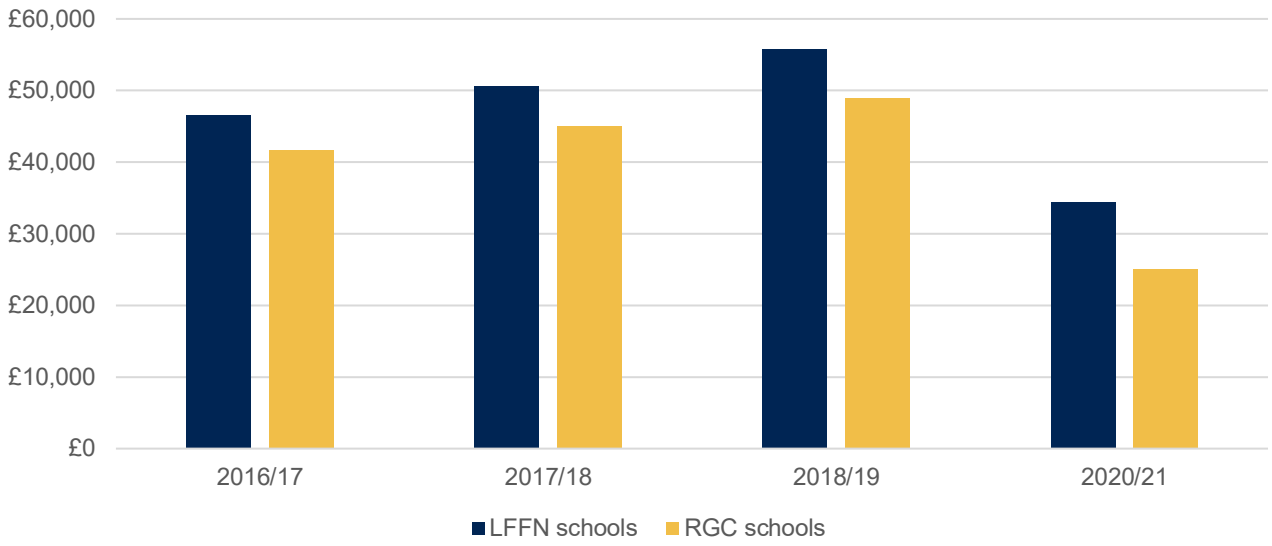
Early interviews with representatives of some of the LFFN schools identified some of the uses for the connections. Respondents reported that connections had primarily been useful in supporting administrative functions by making related tasks quicker to complete.

Teaching had also been affected in a number of cases with more stable connections enabling the use of online learning tools to support teachers in classes. Evidence suggests that pupils were enjoying the variation in teaching methods but that it was not yet clear the extent to which this would have knock on impacts on factors such as attainment and absence.

5.1.2 Self-generated income

The provision of fibre internet connections to schools could help support them in generating new streams of income, for example through providing more services to the local community. The DfE statistics provide data on the value of self-generated income for schools. The figure below shows that between 2016/17 and 2018/19, on average LFFN schools had increased their self-generated income from £47,000 to £56,000. There was also a slight increase in the self-generated income for Rural Gigabit Connectivity schools which were expecting to receive their connection in 2021, from £42,000 to £49,000. However, the most recent data on self-generated income shows a decline for both LFFN and Rural Gigabit Connectivity schools, to £34,000 and £25,000 respectively. The COVID-19 pandemic is likely to have impacted upon schools ability to generate income. Evidence from the school interviews did not identify income as something that was significantly impacted by improved connections and requires further exploration.

Figure 5.1: Average self-generated income at LFFN schools and Rural Gigabit Connectivity schools, from 2016/17 to 2020/21



Source: DfE schools statistics, matched to BDUK MI

5.1.3 Expenditure

The provision of faster internet connections was expected to have an impact on LFFN school expenditure. Findings from previous research suggested that schools could change the ways in which they communicated with parents and carers, and that they could combine their phone and internet connections to save money by running their phone system through their internet connection. It was also suggested that there could be efficiency savings in administration and teaching preparation tasks. These outcomes could have an effect on the amount LFFN schools are spending on different expenditure items. This was explored in the schools expenditure data from the DfE, however there is a discontinuity in the data due to COVID-19, with no data reported in 2019-20, and no financial data reported in 2021/22. These data gaps limit the conclusions that can be drawn from this data analysis.

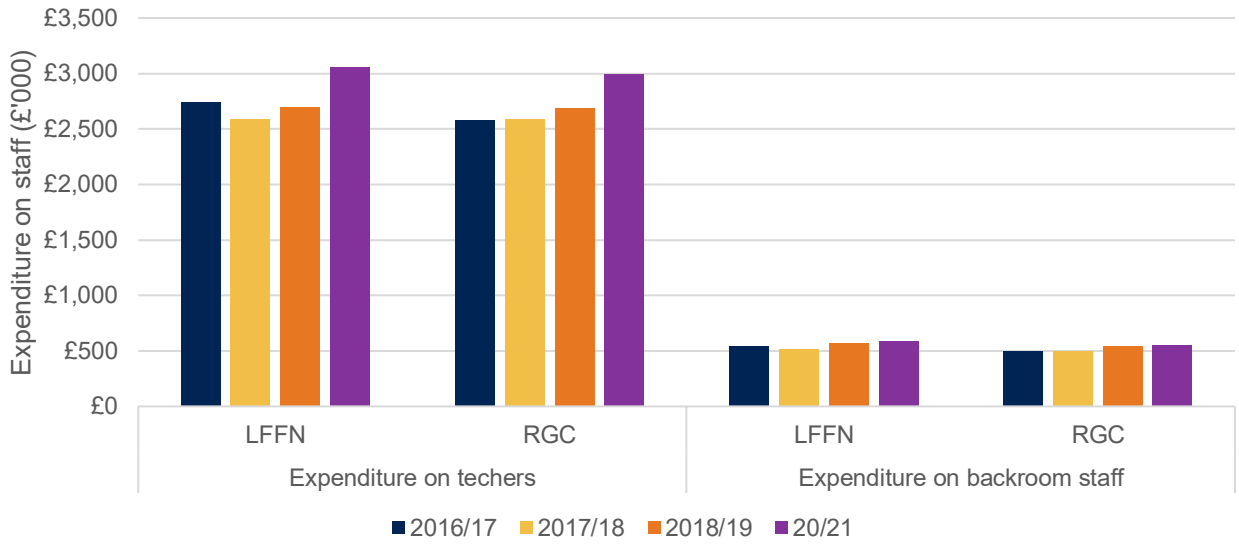
The figure below shows that the expenditure on teaching staff at both LFFN schools and Rural Gigabit Connectivity schools remained relatively stable at an average of a little over £2.5 million up to 2018/19. It spiked in 2020/21 at around £3 million for both LFFN schools and Rural Gigabit Connectivity schools. The expenditure on backroom staffing had remained fairly consistent for both groups at around £500,000 per year over the entire period.

The level of expenditure on a selection of other categories was also explored. From 2016/17 to 2018/19, ICT equipment spend remained at a similar level for LFFN and Rural Gigabit connectivity schools, averaging between £70,000 and £80,000. This increased in 2020/21 to £100,000 for Rural Gigabit Connectivity schools and rose even more to £120,000 for LFFN schools. Energy expenditure in both sets of schools was comparable, with slight increases up to 2018/19 and then a slight decrease in 2020/21. There had, however, been a decrease in the level of expenditure on learning resources for both LFFN and Rural Gigabit Connectivity schools in 2020/21.

In interviews school staff suggested that costs would not be expected to decrease immediately but were more likely to fall in the medium term as they shift to alternative methods and practices. In some of the very rural areas, some staff and parents still lack the ability to fully exploit new

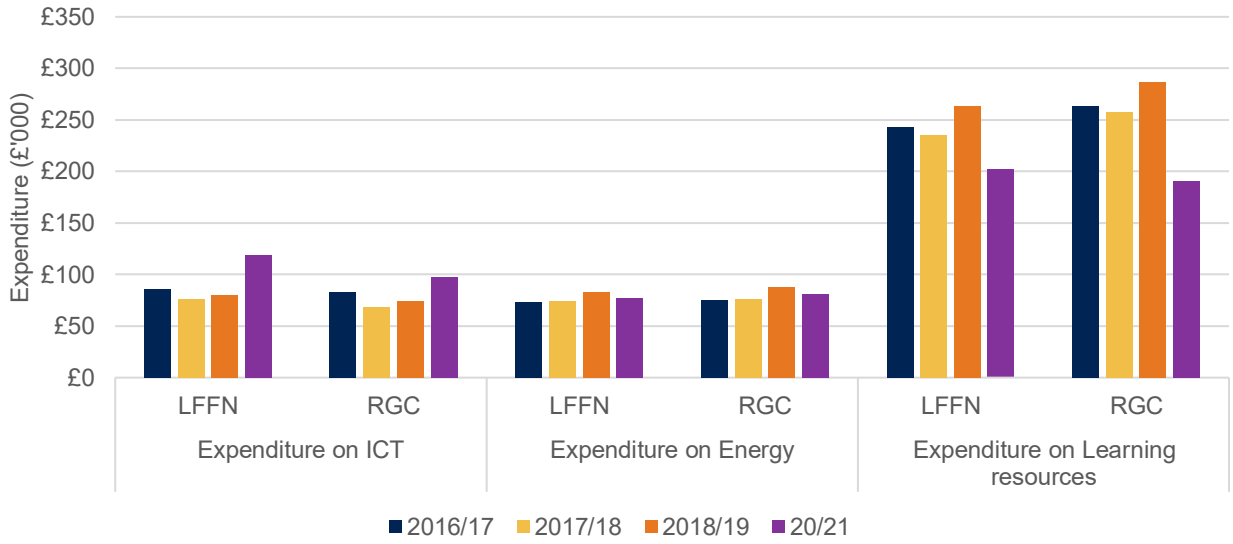
technologies, whether this is due to lacking skills or due to a lack of fast and reliable connectivity in the home.

Figure 5.2: Expenditure on staffing at LFFN schools and Rural Gigabit Connectivity schools, from 2016/17 to 2020/21



Source: DfE schools statistics, matched to BDUK MI

Figure 5.3: Expenditure on ICT, Energy and learning resources at LFFN schools and Rural Gigabit Connectivity schools, from 2016/17 to 2020/21



Source: DfE schools statistics, matched to BDUK MI

5.2 Knowledge and learning benefits

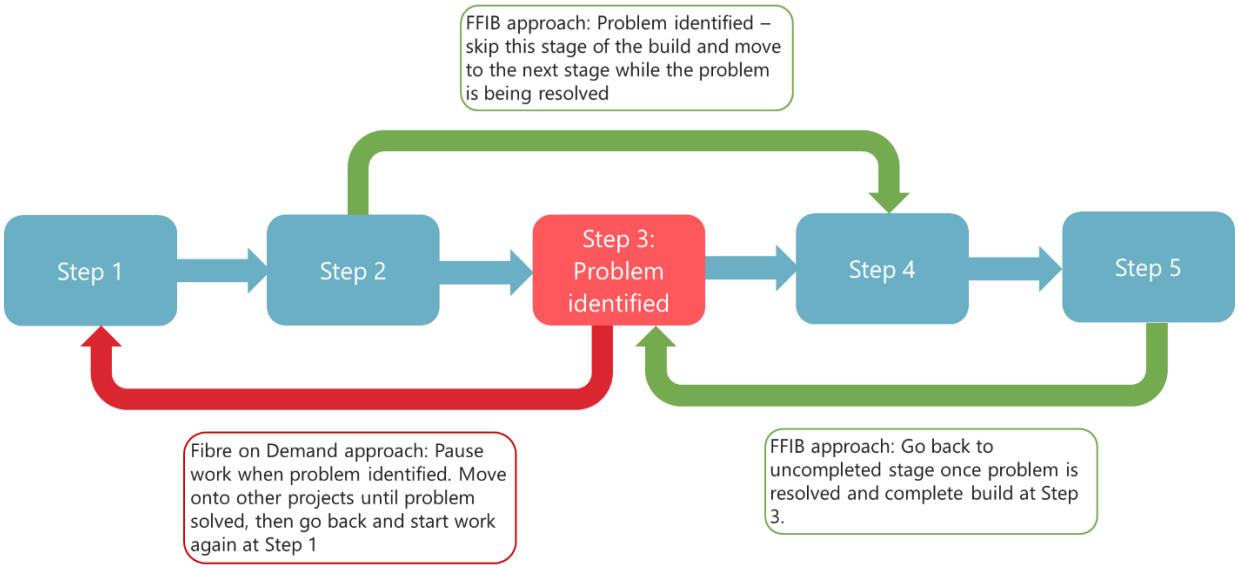
The DfE were able to negotiate with OpenReach to receive a better product from the LFFN schools PSBU project. Under the existing suite of products OpenReach offered, there were no suitable products for the DfE. The closest was “Fibre on Demand”, which would provide FTTP connections including capital build. These contracts typically took longer than a year to be delivered, and OpenReach had a limit which meant they could only deliver 20 per month. This product would not work for the LFFN schools PSBU project which required a high volume of schools to be connected within a shorter timescale. As a result of the scale of the project and the large number of connections

in the LFFN schools PSBU project, the DfE were able to encourage OpenReach to offer a new product.

Therefore, OpenReach developed a new product specifically for this 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 DfE) asking for a high volume of connections. The components of the product ensured a faster turnaround of the connection. These components included:

- A desk-based assessment of the requirements of the connection and cost instead of a site survey;
- A price cap of the estimated cost to ensure LFFN schools would not have to pay more due to unforeseen complications. If the cost was lower, the LFFN schools paid the lower price;
- Shorter build time. The targeted build time was 13 weeks. This was achieved by introducing a new working practice that problem areas during build activity would be skipped in order to maintain momentum with build. The problem would then be revisited after completion of the remaining connection work, as demonstrated in the figure below; and
- Designated project managers for the product at OpenReach to ensure delivery.

Figure 5.4: New delivery model for FFIB



Source: Ipsos UK visualisation of qualitative interview findings

This approach benefitted DfE by having a known maximum cost and a shorter delivery time. This allowed them to plan with more certainty how many schools they could upgrade. It benefitted OpenReach as it allowed a high volume of contracts from LFFN schools. There was a risk that they could lose money on individual contracts with schools, but they looked across the whole portfolio of the product to inform whether it offered value for money. The evidence gathered identifies the development of the Full Fibre Infrastructure Build model as a positive outcome from the LFFN schools PSBU project with the potential for use in future projects.

The development of the Full Fibre Infrastructure Build product was successful in reducing delivery time at a known maximum cost. In turn this allowed for better planning and the delivery of a higher volume of contracts.

5.3 Key learning

The delivery of the LFFN schools PSBU project has led to several learning opportunities for the public sector. In addition to the development of the market product described above, there has also been significant learnings in terms of how to deliver similar projects in schools. These include:

- **Communication with schools:** BDUK initially contacted schools directly, however they found that engagement with schools was low using this approach. Therefore, the project adapted and utilised the DfE and local aggregators like local authorities or the East Midlands Public Services Network to support engagement with schools in later stages, and this approach worked well.

- **Invoicing:** In the LFFN schools PSBU project, invoices for network connections could only be sent to schools after the work had been completed. The price was also agreed in advance and these two factors meant that the DfE was able to transfer sufficient funds to the schools in advance of the invoice. This provided LFFN schools with reassurance that they could pay the invoice, as schools would not have sufficient capital to pay the invoice and wait for reimbursement from DfE or BDUK. Stakeholders felt it was unlikely schools would have upgraded their internet connection in absence of this reassurance.

- **School infrastructure:** Some schools reported that they were not able to fully utilise the greater connection speed from their 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[23], which provides funding to the LFFN schools and those receiving upgrades through the Rural Gigabit Connectivity programme to upgrade their internal infrastructure. The LFFN schools PSBU project and the Rural Gigabit Connectivity programme highlighted the need for an intervention to support schools to upgrade their internal infrastructure.

5.4 Economic impacts

LFFN schools are located across England and not concentrated in a single area, which makes assessing the economic impact of the project more challenging as there is not a single area to examine. However, by identifying the postcodes and output areas which surround LFFN schools, it is possible to explore some of the economic effects of the LFFN schools PSBU project.

It should be noted that the qualitative research suggested that the economic impacts of the LFFN schools project may be limited. This is because there was no evidence that the local areas surrounding LFFN schools had received faster internet connections.

5.4.1 Impact on unemployment

The Department for Work and Pensions provide data on unemployment claimant counts at a Lower Super Output Area (LSOA) level on a monthly basis. To provide a clearer view of the impact of the LFFN schools PSBU project on unemployment, LSOAs which contained a postcode within 1km of the LFFN schools were compared to similar LSOAs sharing similar characteristics which are within 1km

[23] The Connect the Classroom Programme is a £180 million intervention run by DfE and aims to improve internet speed in schools. This is to be done by upgrading internal hardware and systems, such as wifi access points and network switches.

of Rural Gigabit Connectivity schools. An econometric analysis was undertaken using the fixed effects analytical framework as described in Section 4. The analysis found that the LFFN schools PSBU project had no significant impact on unemployment.

5.4.2 Impact on earnings

The Office for National Statistics Secure Research Service allows access to granular data on earnings at an Output Area level. To provide a view of the impact of the LFFN schools PSBU project on earnings, the research team undertook econometric modelling, using a similar framework to that described in Section 4.2.2. The econometric modelling explored wages paid by employers within 1km of the LFFN schools and employers based within 1km of Rural Gigabit Connectivity schools. The analysis found that the LFFN schools PSBU project had no statistically significant impact on earnings. More details on the modelling approach are presented in the technical annex.

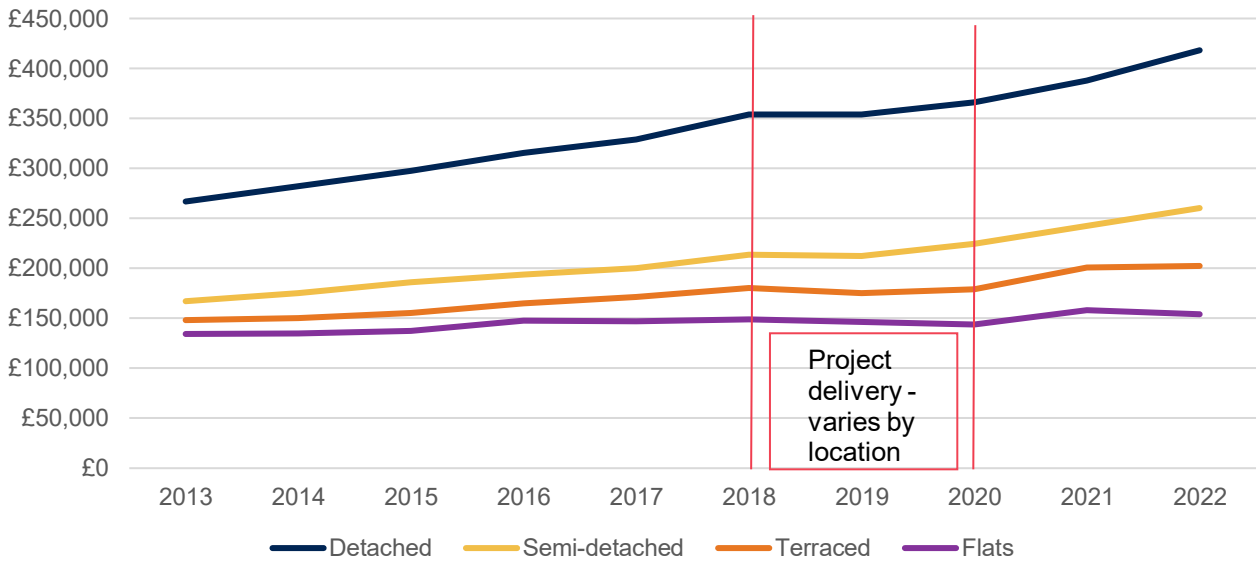
5.4.3 Impact on businesses

The Office for National Statistics Secure Research Service allows access to granular data on business performance through the Business Structure Database. This data was also examined using a similar framework to that described in Section 4.2.2, and explored the impact of the LFFN schools PSBU project on the number of jobs, turnover and productivity (turnover per worker) on businesses located within 1km of the project. The analysis found that there was no statistically significant impact on the number of jobs, turnover or productivity.

5.4.4 House prices

Data from the Land Registry provides information about the prices paid for premises at a postcode level. Using this data, the research team have been able to explore the evolution of house prices within 1km of the LFFN schools. The figure below presents the evolution of house prices within 1km of LFFN schools from 2013 to 2022. This shows that there has been a general positive trend in house prices, particularly for detached houses, although there has only been a relatively modest increase in the price of flats in areas surrounding LFFN schools.

Figure 5.5: Evolution of house prices within 1km of LFFN schools, by type of premises (2013 to 2022)



Source: Land Registry, 2013 to 2022.

Exploring the change in prices in more detail, house prices have increased most markedly for semi-detached and detached properties, with increases of 30 and 27 percent respectively between 2017 and 2022 (2017 being the year prior to work starting on the LFFN Schools PSBU project). These changes were compared to the changes in house prices for properties within 1km of the Rural Gigabit Connectivity schools. The base prices for properties surrounding LFFN schools and Rural Gigabit Connectivity schools in 2017 were broadly comparable, although prices surrounding Rural Gigabit Connectivity schools were slightly higher. In general, the increase in house prices in areas surrounding LFFN schools and Rural Gigabit Connectivity schools are broadly similar, as illustrated in the table below. The exception is for semi-detached properties, where the increase has been much higher in areas surrounding LFFN schools.

The analysis here presents an overview of house prices in two areas, but does not attempt to draw inferences of the impact the LFFN schools PSBU project has had 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 within 1km of LFFN schools. Therefore there is limited evidence that any changes in house prices would be driven by the LFFN schools PSBU project itself.

Table 5.1: Change in house prices, 2017 to 2022

Area	LFFN schools		Rural Gigabit Connectivity schools	
	Average price 2017 (£)	Increase in price 2017-2022 (%)	Average price 2017 (£)	Increase in price 2017-2022 (%)
Flat	£147,200	4.7%	£183,000	9.4%
Terraced	£171,300	18.2%	£192,300	16.9%
Semi-detached	£200,400	29.9%	£229,400	11.9%
Detached	£328,800	27.2%	£368,600	33.7%

Source: Land Registry data (2017-2022).

6 Conclusions

The key findings from the LFFN schools PSBU project evaluation are:

- The installation of the fibre was completed by April 2021, and all 151 schools were connected. This was a higher number of schools than originally planned due to the cost per upgrade being lower than initially estimated. The majority of these schools were connected by 2020, with only four schools being connected in 2021.

- Improved connections are being used to support administrative functions and teaching within LFFN schools. Teachers report being better able to access digital resources and get hands on with pupils more often with fewer issues relating to technology. There were also some anecdotal reports of satisfaction from pupils using digital resources including online learning materials. The enhanced broadband has also led to some LFFN schools amending how they communicate with parents and carers.

- There was evidence of reduction in costs faced by schools. Administrative tasks that require internet connections could be done quicker, saving time. Schools could also run their telephone line through the internet instead of having a dedicated line, which allows for cost savings.

- The LFFN schools PSBU project provided significant learning for future projects. The key areas of learning were that many schools were unable to fully exploit the enhanced connectivity they received due to their internal infrastructure. Therefore, to ensure that schools could exploit faster connectivity, the DfE launched the Connect the Classroom Programme. There was also significant learning for Openreach, who have introduced the new 'Full Fibre Infrastructure Build' product as a result of the LFFN schools PSBU project.

- Evidence available up to 2022 does not identify any significant spill over connectivity impacts in terms of gigabit-capable coverage or take-up of ultrafast connections resulting from LFFN connections delivered to schools. More time may be required for these to materialise. Interviews with schools also suggest some issues resulting from a lack of available connections in surrounding villages. Schools with connections were better able to support remote learning through the COVID-19 pandemic but parents sometimes lacked suitable connections.

The table below summarises the LFFN schools PSBU project achievements against its original stated objectives and those included in the Theory of Change:

Table 6.1: Summary of LFFN schools PSBU project achievements

Objective	Achieved
Generate learning	Learning generated for Openreach, DfE, BDUK (using same model of delivery of Rural Gigabit Connectivity) and Schools.
Public sector cost savings	Evidence some LFFN schools have experienced cost savings.
Enhanced (public sector) service provision	Evidence that some LFFN schools have been able to introduce enhanced learning for pupils.
Improve resilience	Evidence that broadband is more reliable in LFFN schools.
Future proofing	Evidence that LFFN schools have scope to offer more services in the future.
Broaden connectivity	Limited evidence of enhanced connectivity in areas surrounding LFFN schools.
Introduce new commercial models (not a stated objective)	*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 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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