Northern Gas Networks

A22.i Reinforcements

Engineering Justification Paper

Contents

1. Summary table

Name of Project	*Reinforcements* Programme		
Scheme Reference	*N/A*		
Primary Investment Driver	A22.i.NGN		
Project Initiation Year	*2026*		
Project Close Out Year	*2031*		
Total Installed Cost Estimate (£)	£26.98		
Cost Estimate Accuracy (%)	*+/-5%*		
Project Spend to date (£)	£0m		
Current Project Stage Gate			
Reporting Table Ref			
Outputs included in RIIO-GT3 and RIIO-GD3 Business Plan	*As per BDPT above, impact of programme in NARM BPDT*		
Spend Apportionment	**GD2**	**GD3***	**GD4**
	£27.71m	£26.98m	c£20-25m

* Expecting all investments listed for RIIO-GD3 to complete in RIIO-GD3, GD4 spend will continue to be customer and demand driven so an indicative figure is given.

2. Executive summary

This Engineering Justification Paper (EJP) sets out the interventions that we plan to undertake for Network Reinforcement during RIIO-GD3. Our Gas Transporter Licence conditions require us to provide a reliable service to customers. This means that we need to have enough network resilience to cope with extreme events (including a 1 in 20-year event). There are three main drivers we need to invest in reinforcement:

• Where there is growth in demand (either general growth in demand or a new point load at a specific location) that impacts the capacity of the network

• Where we are replacing mains via an insertion technique which reduces network capacity.

• Where growth in the network or local network changes result in existing Governors been close to or over capacity.

Our preferred option is to carry out 56km of reinforcements and 61 individual interventions at a cost of £26.98m throughout RIIO-GD3 across our network. This consists of:

- 28km of general reinforcement
- 28km of specific reinforcement
- 31 new governors
- 30 governor capacity upgrades

The profile of the workload across the price control period is shown in more detail in Section 9.4 and the spend profile is detailed in Section 9.2. Unit costs used within the cost benefit analysis have been fully detailed within Section 8.2.

Our preferred option for RIIO-GD3 is set out in the table below detailing the driver for 5..

	RIIO GD2 EJP Prefered Option			RIIO GD3 EJP Prefered Option		
Intervention	Workload units	Capex £m 23/24 Prices	Driver	Workload Units	Capex £m 23/24 prices	Driver
General Reinforcement - <=180mm pipe	13.63	£10.00	Operational / Compliance	13	£7.09	Operational / Compliance
General Reinforcement - >180mm pipe	10.50	£1.40	Operational / Compliance	7.5	£6.15	Operational / Compliance
General reinforcement - governors	44.00	£6.70	Asset Health / Compliance	26	£2.60	Asset Health / Compliance
Specific Reinforcement - <=180mm pipe	27.60	£0.20	Operational / Compliance	22.578	£6.76	Operational / Compliance
Specific Reinforcement - >180mm pipe	8.40	£1.30	Operational / Compliance	5.63	£3.39	Operational / Compliance
Specific Reinforcement - governors	2.00	£0.90	Operational / Compliance	5	£0.40	Operational / Compliance
General reinforcement - DG capacity	24.00	£2.80	Operational / Compliance	30	£0.60	Operational / Compliance

Table 1 RIIO-GD3 and RIIO-GD2 workload, cost and driver

Costs for reinforcements for the RIIO-GD3 EJP (£26.98m) are comparable to projected RIIO-GD2 spend (£27.71m) on a comparable 23/24 price basis. As its difficult to predict the specific location and length of mains that will need to be reinforced our preferred option is a based on known length from our global model program to reduce opencut mains on our Repex mandatory mains program and a conservative view. Our proposals are based on the minimum level of activity that might be required. Further details on each of these investments are given in the body of the report. Our preferred option is to promote a level of reinforcement to enable insertion which provides the minimum net cost at a Totex level, as well as addressing governors already identified with capacity and compliance issues. The investments listed above in our preferred scenario and detailed further in the body of the EJP will enable for us to continue to meet our licence obligations over the course of RIIO-GD3.

3. Introduction

This Engineering Justification paper details our proposals for investment on reinforcement program during RIIO-3. It explicitly follows Ofgem's guidance and is set out in accordance with the headings therein. It includes narrative for investment into our Governors for capacity and compliance reasons as well as investment into new mains.

We have obligations under the Gas Act and our Gas Transporters licence to ensure we can supply our customers in a winter of 1 in 20 severity and demand growth may mean we have to reinforce our network to ensure we comply with these conditions.

Predicting the exact locations and lengths of mains that will require reinforcement during RIIO-GD3 is challenging because such work is reactive, driven by changes in customer demand from both domestic and industrial users, as well as the specific locations and volumes of new connections. Accurate forecasting requires a detailed understanding of how demand will change and its impact on the local network.

For instance, if a large new housing estate is built on the site of a former industrial complex that previously had a high gas demand, it is unlikely to require network reinforcement. Conversely, if the same development is constructed on the outskirts of a town, where network pressure is typically lowest, reinforcement would likely be necessary.

Despite these uncertainties, we anticipate that a similar level of reinforcement will be required during RIIO-GD3 as RIIO-GD2 to ensure adequate pressure and flow across the network. To protect customers amid this uncertainty, we have proposed a balanced approach: basing our reinforcement plans on a minimum expected level of activity. Should further reinforcement be required, as a result of a large load connection from a peaking power plant for example, we would utilise the appropriate re-opener mechanism in period to fund this work. This approach minimises the risk of customers funding unnecessary costs while ensuring flexibility to address unforeseen needs. We remain open to collaborating with Ofgem to refine how this uncertainty is managed effectively.

This engineering paper aims to outline the justification for our proposed RIIO-GD3 Reinforcement investment for both general and specific. It explains the different options we have considered and the reasons why we have derived at our forecasts.

4. Equipment summary

Local transmission system (LTS) – Approximately 1,300km of high-pressure pipelines (greater than 7 bar) which are used to transport volumes of gas over long distances around our network. The pipelines connect the National Transmission System (NTS) offtakes, pressure reduction stations and governors and feed the intermediate, medium and low-pressure networks. Our high-pressure pipelines are considered to have enough capacity to meet current and future demand and so we have not included for any LTS reinforcement in RIIO-GD3. However, an unknown new large load connection or an increased load from an existing supply point may require LTS reinforcement and we would look to use an appropriate re-opener mechanism if that was the case.

Distribution network – 265 networks consisting of approximately 36,000km of mains and over 2.5 million services which provide gas to domestic, commercial and industrial consumers. The distribution network is operated at < 7 bar and can be split into three pressure tiers: intermediate, medium and low pressure. This predominantly below ground network is constructed from a variety of materials: pit-cast iron, spun-cast iron, ductile iron, steel and polyethylene.

District governors – 2638 district governors which are a pressure regulating system operating with an inlet below 7 bar supplying the medium or low-pressure networks.

1:20 – The 1:20 peak 6-minute demand is defined as the maximum demand that will occur, on average, in not more than 1 winter out of 20 years. This is defined as an average in any period of 6 minutes, expressed as an hourly rate - standard cubic metres per hour (scmh).

General reinforcement – General reinforcement is usually identified following either a model validation or the annual IDS demand refresh. Both processes give our modelling capabilities a sound footing for analysis and design of new connections and network changes.

Network Validation - is a process to establish confidence in a graphical network model by comparing the model to the actual characteristics of a network and is used for the purpose of predicting pressures. The benefit of validation is that the network analysis model can be used to support decision making regarding holistic network development as required by NGN/PL/NP/18 'Policy for Network Planning', together with the management of source pressures and operational activities affecting gas supplies.

The IDS demand refresh takes place annually during June and is the process of updating individual demands within the network analysis models. It follows an annual update based on actual demands from Xoserve.
If, once the network analysis model has been validated or updated, any pressures within the model are simulated to fall below the minimum design pressure, a general reinforcement will be identified to rectify those pressure issues. These reinforcements are fully funded by NGN and will not be subject to an Economic Test.

Specific reinforcement – Specific reinforcement is customer driven in that it is required when a new customer wishes to connect to our network or when a customer is wanting to increase their existing load. When a customer wishes to connect, they contact the Connections team, who will run network analysis to ascertain whether the network has the available capacity to accept the new connection. New connections can range between one single domestic property, a full housing development, a new factory, a commercial office building or a power generation plant. These are all analysed on an individual basis.

The Connections and Large Loads teams will establish if reinforcement is required to be able to accept the new demand on our network and will establish a charging point for the reinforcement. The charging point is the closest economically feasible point (considering any customer request for gas to be made available at a particular pressure) on our system, which is deemed to have enough capacity to supply the new load disregarding existing loads. It is identified by network analysis and if the network minimum design pressure can be maintained at the connection point with the new connecting customers load applied, this will be the charging point. If the new load cannot be supported to maintain at least the network minimum design, or minimum supply pressure in accordance with GRM requirements, then the load should be retested at points upstream, until the load can be supported with all other demands removed, this will then become the charging point.

The economic test determines the maximum economic investment NGN can make in respect of a specific annual load, and where appropriate daily and hourly loads. The test compares the anticipated transportation charges with the incremental costs of the new load. Where the criteria of the economic test are not met, we require a connecting party to pay a contribution towards the cost of the reinforcement in order to avoid our existing customers subsidising a new load. However, if a new connection passes the test, reinforcement costs are not recovered from the connecting party.

5. Problem / opportunity statement

Under the Gas Act we are obliged to develop and maintain an efficient and economical pipeline system for the conveyance of gas and to comply with any reasonable request to connect to our system any premises or any pipeline system operated by an authorised transporter.

Our customers appliances require 14.25mbar to allow them to operate safely. NGN need to allow for pressure loss down service pipes and a customer's emergency control valve (ECV) and meter which means that we must provide a minimum of 21mbar in our low-pressure mains and 26mbar for all PE pipe networks. If the network analysis models predict that these minimum pressures will not be met in a 1 in 20 winter, reinforcement of the network will be required to ensure security of supply for our customers.

Reinforcement is driven by demand growth which we analyse and design in our network analysis models in Synergi Gas System. Reinforcement is carried out when the Synergi Gas network analysis models predict that one of the following will occur in a 1 in 20 winter:

- Pressures will drop below design minimum pressures following network validation or addition of a new connection or increase of existing connection.
- CSEP (Connected System Exit Point) pressures will drop below their contracted pressures.
- District governors are showing signs of going out of capacity.

If we do not reinforce the network, capacity for new connections may not be available. Security of supply could be compromised, ultimately resulting in loss of gas to customers which could run into the thousands. For non-domestic customers, this could also result in loss of income. This would result in significant compensation and remediation costs, negative publicity, reduced confidence from our regulator and customers, breaching licence obligations, quality of service guaranteed standards (GSOS) payments and safety concerns to the public and our workforce.

What is the outcome that we want to achieve?

From our stakeholder research (for example, see Insight 1, 9 and 10 from Appendix A3 below) we know that network reliability and cost remain key priorities for our stakeholders. Customers also value the importance of improving resilience against extreme weather, such as storms. From the risk analysis in Section 5 of this document, for this group of assets environmental (carbon) followed by compliance risk are the main risk drivers.

We know that our customers expect value for money and that we need to make the right investment decisions for both our existing and future customers. We have proposed four objectives covering risk, cost, service, and uncertainty. These will be used to determine how successful each option considered is at delivering against our customers' expectations.

What we heard	Appendix A3
Keeping bills as low as possible continues to be domestic and SME (Small Medium Enterprise) customers' top priority, however stakeholders are supportive of investment to respond to significant challenges of climate resilience and decarbonisation. Balancing the trade-off between investing now to future-proof and minimising expenditure to prioritise essentials poses a challenge.	Insight 1
Customers expect our top sustainability commitment to be keeping our infrastructure resilient. This means continuing to reliably supply customers in the short and long term, regardless of climatic conditions and impacts experienced by interconnected sectors (such as telecommunications, road networks etc). As customers are satisfied with the performance and availability of our services, they prefer us to maintain service levels at levels similar to today and asked for us to reduce future risk with targeted investments to enhance removal, reduction, resistance and recovery strategies.	Insight 9
The impact of climate change requires us to proactively reduce the vulnerability of networks to storms, particularly in rural areas, and a collaborative, cross-network approach. 'Preventing supply interruptions from extreme weather by providing back up power' was the most highly valued service improvement among billpayers in our Customer Value Perception study (on average, respondents were willing to pay £0.53pp at 75%).	Insight 10

Table 2 Customer Insights

Risk objective: to maintain total risk to the same level as the starting position of RIIO-GD3 (plus or minus 10%)

We want to manage total risk

We know that our customers value safety and reliability as their number one priority within the RIIO-GD3 period. In addition, we want to manage increasing risks to provide a safe working environment for our operatives and avoid loss of supply events. We will aim to maintain risk throughout RIIO-GD3 to plus or minus 10% from the RIIO-GD3 starting position. However, we understand the need to balance this ambition with service and cost constraints. Reinforcement Is mostly demand, capacity and customer driven. However, it does make a key contribution to ensuring we can meet 1 in 20 peak demand and therefore ensure a safe and resilient supply of gas. Therefore, provision for this is required to continue to meet our minimum obligations.

We are on track to meet our NARM target in RIIO-GD2. RIIO-GD3 is considered to be a roll-over price control so we have seen no need to take a step change approach to risk and have therefore adopted a risk objective that is consistent with that adopted in RIIO-GD2.

Efficiency objective = to minimise RIIO-GD3 spend over and above RIIO-GD2 levels

We know that our customers expect us to invest their money wisely and efficiently to enable a reduction in their bills. To do this we need to make sure we maximise value from our existing assets before we replace them However, we must understand the whole life cost of the decisions we make to ensure we are doing the right thing both now and in the future. As risk is rising sharply in RIIO-GD3, it is expected that we will need to intervene on more assets than we have during RIIO-GD2 to meet our objectives around managing total risk. To avoid escalating costs we therefore need to think of pioneering solutions to ensure we are delivering value for money for our customers. Reinforcement spend is reduced slightly from RIIO-GD2 and that includes a provision to undertake some reinforcement to make savings on open cut Repex, which has a net Totex saving overall. This is discussed later in the paper.

We view maintaining risk and service levels and delivering a reliable, safe, and compliant network for customers as a higher priority than maintaining cost at RIIO-GD2, given the evidenced need for additional investment which

is explored in our options appraisal. We are continually committed to providing a balanced programme of work and delivering value for customers. We have therefore updated our efficiency objective in RIIO-GD3 to minimise cost in RIIO-GD3 over and above RIIO-GD2 levels.

Service objective = to maintain supply interruptions to the same level as the starting position of RIIO-GD3 (plus or minus 10%)

We want to continue to provide exceptional service

The key service measure for our governor and mains assets, which reinforcement impacts, is the total expected number of supply interruptions. Table 1.06 of the 2023/24 Regulatory Reporting Pack (RRP) submission highlights that our current customer satisfaction scores for unplanned interruptions are exceeding the targets set by Ofgem (9.37 target against our actual performance of between 9.543 and 9.650 between 2022 and 2024). We therefore consider that current service levels are acceptable to our customers and provide a suitable benchmark.

As the regulatory landscape is likely to broadly remain the same in RIIO-GD3, adopting risk and service level objectives that are consistent with that adopted in RIIO-GD2 seems appropriate. Other Reliability metrics outlined in Table 1.06 of 2023/24 RIIO-GD2 RRP demonstrate that we are currently operating a highly reliable network. Our aim therefore to maintain our RIIO-GD2 industry leading service levels in RIIO-GD3.

Reinforcement expenditure will contribute to this objective and ensure we continue to maintain safe and reiliable demand during peak periods. Our RIIO-GD3 investments need to target this service measure and reduce it back down to a more acceptable level.

Certainty objective = to ensure our investments pay back within 16 years

We will protect our customers from future uncertainty

To ensure the investments we make in RIIO-GD3 are right for both our existing and future customers, and to avoid the risk of asset stranding, we must ensure that our investments offer a payback before either the asset life or a point in time where future uncertainty could reduce the forecasted benefits, whichever is the smallest time period. The RIIO-GD3 Business Plan Guidance states that a 16-year payback period is appropriate for the GD sector (page 45)[1], meaning that any new, refurbished or replaced equipment that pays back within this time frame will be deemed suitable for investment. While our demand, capacity and customer driven reinforcement programme does not meet this criteria. It is necessary for us to continue to meet licence obligations for peak demand and we are making value for money investments to make Totex cost savings in Repex, as discussed later.

Compliance objective = to ensure we are compliant with legislation relevant to each asset class

We want to ensure compliance with all relevant health and safety, or technical regulations.

During RIIO-GD3 we are required to undertake several interventions for compliance reasons. Demand, capacity and customer driven reinforcement work is necessary to meet our 1 in 20 peak demand obligations and to ensure the continued safe and reliable supply of gas to customers.

We want to ensure that any customer who wants to connect to our network can and that existing customers do not suffer from poor pressures or a supply interruption. In addition, we want to deliver our connections service and reinforcement projects in the most safe and efficient way possible. This means managing pressures with

[1] https://www.ofgem.gov.uk/publications/riio-3-business-plan-guidance

operational solutions before installing new mains where a cost benefit analysis (CBA) proves this is beneficial, meeting our customers' expectations in terms of time scales and minimising disruption to the public and our stakeholders.

Our reinforcement process is carried out in three stages to ensure that we meet our objectives:

Stage 1 – categorise the scheme.

There are 3 categories of reinforcements:

- Category A reinforcements are schemes where increasing pressures as a contingency is not an option (i.e. the pressure would have to be increased beyond the district governor's capacity or above the maximum operating pressure (MOP) for the pressure tier). Category A reinforcements are pipelaying schemes, they are progressed for approval and completed at Stage 1.
- Category B reinforcements are schemes where a pressure increase is an option, but the pressure needs to be higher than the MOP of the district governor (the maximum source pressures which should not be exceeded without the consent of the responsible engineer appointed by the network director). Category B reinforcement schemes are put through Stage 2.
- Category C reinforcements are schemes where a pressure increase is a viable option and the pressure is lower than that MOP of the district governor. Category C reinforcement schemes are pressure increases. These are progressed for approval via the NP37 process and are completed at Stage 1.

Stage 2 – assess the pressure increase.

For all Category B reinforcements, a contingency pressure increase option is reviewed against a risk matrix that was developed following discussions between the pressure management, validation, and connections team representatives. The matrix balances several network factors including the type of pressure management existing in the relevant subsystem, the percentage pressure increase required and the length and percentage of metallic mains in relevant subsystem. Dependent on the output from the matrix, the project could either be progressed under an NP37 pressure increase request (as per Category C) or given further consideration in Stage 3.

Stage 3 – Cost Benefit Analysis (CBA)

This stage compares the differences between the average system pressure in the relevant subsystem with the proposed reinforcement in place, to the average system pressure with the contingency pressure increase in place. Synergi software is used to calculate the Average System Pressures (ASP's) which feed into the National Leakage Reduction Model to calculate the difference in shrinkage / leakage. The cost of the increase in shrinkage / leakage is compared to the cost of the project and a payback period calculated. Dependent on the output from this CBA, the reinforcement could either be progressed as an NP37 pressure increase request (as per Category C above) or the pipe scheme progressed for approval and construction. A payback period of 16 years has been used:

- If payback <=16 years progress for approval to construct
- If payback >16 years progress under an NP37 pressure increase request

Benefits of the three-stage process

The three-stage process ensures we carry out the most efficient and total cost-effective reinforcement scheme in order to maintain minimum design pressures within the network.

If we can increase district governor pressures in the area instead of pipe reinforcements this will benefit our customers and the general public as there will be less disruption on the roads and pavements. In addition, it

means that customers can connect sooner to our network as they do not have to wait for the reinforcement scheme to be authorised and constructed.

If a contingency pressure is not available or a design is required, extensive analysis of the network is carried out by skilled analysts to identify the most effective, best value for money scheme for our customers. Whilst evaluating potential schemes, the analyst must take into consideration the following:

- Least disruption to our customers
- Assess environmental impact
- Avoid areas with S58 restrictions or environment agency restrictions
- Constructability – is the scheme viable?
- Reinstatement implications
- Optimum route, i.e. avoid geographic obstructions, major roads, waterways
- Abandon metallic mains where practicable
- Hybrid schemes (minor pressure increase alongside a small pipe lay scheme)
- Multiple options designed and considered
- Holistic approach to network reinforcement

How will we understand if the spend has been successful?

Our overriding objectives are to:

- Deliver the project within the required timescales to allow the customer to connect and have their contracted pressure available to them;
- No poor pressure reports following reinforcement completion;
- No PRE's reported following reinforcement completion;
- Reduction in mandatory Repex opencut; and
- Build sufficient network resilience to cope with extreme events (including a 1 in 20 year event).

5.1. Narrative real-Life example of problem

CASE STUDY 1 – [redacted]

Following acceptance of a load of 432.64scm/h for an industrial site reinforcement was required to provide the minimum design pressure of 450mbar.

Reinforcement required – 5 sections totalling approx. 4215 x 355mm PE Open Cut reinforcement main required to satisfy the network pressure.

The key drivers for that project where:

- To fulfil Northern Gas Networks statutory obligations
- To ensure system minimum pressures are maintained under 1 in 20 peak conditions.
- To provide a connection point pressure above the minimum parent main supply pressure for this sub-system of 350mbars.
- To ensure any committed pressures are maintained.
- To ensure gas velocity within the system is not increased over 40m/s due to this increased load.

[redacted]

CASE STUDY 2 – [redacted] DG – DG REPLACEMENT

The current DG was a small kiosk and a small governor with no scope to increase the size of the streams. Increasing the orifice size did not improve the issue hence a new DG is to be installed.

This project was to replace the existing Donkin 270 2" 25mm unit. The new unit is on a new site adjacent to the existing site.

5.2. Project boundaries

The boundaries of spend provided in this EJP relate:

- Pipeline reinforcements - the spend will only apply to pipe materials, labour, traffic management, enabling, plant, reinstatement, purge & relights, special ops, legal costs.
- District Governor capacity reinforcements - the spend will apply to design, construction, commissioning, pipe materials (inlet and outlet), labour, traffic management, enabling, plant, reinstatement, purge & relights, special ops, legal costs.

Costs excluded from this Engineering Justification Paper are:

- Type of work – upsizing due to global models, capacity upgrades at offtakes and PRS's
- Costs – exclude elements paid for by the customer
- Network analysis design work, CBA analysis, commercial costing time, SPM's
- NP37 survey work, additional leakage costs, Pressure Management costs, maintenance costs

6. Probability of failure

Reinforcement predominantly relates to governors, mains and services assets. We discuss the detail of failure on these assets in the relevant EJPs (A22.h, A22.l & A22.m) and do not repeat it here. However, we include some further narrative specific to reinforcement below.

Our responsibility is clear: we must meet customer-driven connections and develop our networks or, if necessary, interrupt gas supply in a controlled manner to meet a defined level of customer demand. This defined level

corresponds to a peak demand scenario that, based on historical weather data from at least the past 50 years and other relevant considerations, is expected to occur only once every 20 years. This “1-in-20-year” peak demand drives our network capacity requirements and defines our output targets for RIIO-GD3.

Accurately forecasting future network capacity is challenging due to evolving consumer energy preferences and climate change. The Future Energy Scenarios (FES) provide a range of plausible energy projections for the next 30 years and beyond. These scenarios highlight significant uncertainty in forecasting peak gas demand, which will depend heavily on future government energy policies and changes in consumer behaviour.

For example, if a property transitions from a gas boiler to an electric heat pump, both annual and peak gas demands decrease. Similarly, energy efficiency improvements reduce peak and annual demand by enabling better heat retention in winter and lowering gas usage during cold spells. Conversely, hybrid heating systems, which combine electric heat pumps and gas boilers, may reduce annual gas demand significantly. However, on peak demand days, the gas boiler could activate, keeping peak gas demand relatively high even as overall annual consumption.

6.1. Probability of failure data assurance

The data used in our Probability of Failure (PoF) calculations comes directly from the NARM methodology. The failure models are based on various industry standard guidelines (see GDN Asset Health Risk Reporting Methodology document) and the failure rates have been statistically derived using actual asset information such as age or material and historic failure data taking into consideration other influencing factors such as weather or temperature.

We have an annual process for gathering asset data from the business to support NARM RRP delivery, with majority of data coming ultimately from SAP. There is a documented process where the business leads supplying the data carry out reasonableness checks on the data supplied to the Asset Strategy team, who then undertake validation and consistency checks.

Our 2024 data improvement plan assess key areas of data for robustness and completeness:

Our **core asset data** for offtake and PRS includes location, fault data, health bandings, customers, capacity, obsolescence and maintenance costs. Each year we update the fault data within our systems as a requirement for RRP, therefore this data is up to date as of 2023/24. Our core asset data is assessed to be robust and complete.

Our **asset health and failure data** includes design specification, age, condition, duty, capacity, location and environmental health factors. All other factors within this category are static and are only updated when we install new assets. Our asset health and failure data has been assessed as having some data gaps and assumptions have been applied. This applies in particular to default condition data being applied to some kiosks and no condition data for fences or control systems. Through smarter work management systems, field work capture capabilities will be developed to improve this. If assumed condition assumptions are lower than reality, this will lead to a conservative calculation of baseline risk and risk reduction on intervention; and vice versa.

Our **financial data** includes all the financial data held in the core system that is used within the risk models. We have recently updated all the interventions costs within the system using historical project cost knowledge and SME input on current cost trends (See section 8.2). Data relating to cost nodes in the modelling have been inflated to 2023/24 prices using the Ofgem agreed inflation factors. Our financial data has been assessed as having some data gaps and assumptions have been applied. If assumed financial costs are lower than reality, this will lead to a conservative calculation of baseline risk and risk reduction on intervention, and vice versa.

It is recognised in the NARM methodology that the GDNs will have data gaps and will not hold the same level of asset data in every area. To facilitate the population of the monetised risk modelling, a flexible but consistent methodology (with options) will be utilised to derive the PoF, deterioration, probability of consequence and associated impacts of Intervention. This is set out in Table 6 of the NARM methodology and ranges from Option A (GDN specific data from company systems) to Option B (Pooled/Shared data – where applicable) to Option C (Global/Assumed). Assumed data could be data that has been analysed to be representative of the population, arrived at by expert elicitation, or arrived at by researching relevant published studies/reports.

7. Consequence of failure

Reinforcement predominantly relates to governors, mains and services assets. We discuss the detail of failure on these assets in the relevant EJPs (A22.h, A22.l & A22.m) and do not repeat it here. However, we include some further narrative specific to reinforcement below.

If we fail to provide sufficient capacity in the network to meet peak demand, we will not fulfil our core responsibility. This means we must ensure that customer-driven connections are met and that our networks are developed appropriately. In situations where supply cannot match demand, we may need to implement controlled interruptions to gas consumption to meet defined customer demand levels.

Failing to meet this obligation would have serious consequences. Customers could lose access to gas precisely when they need it most—during the coldest days of winter, when heating is essential. Additionally, inadequate network capacity could hinder or delay economic growth and development projects, depriving local communities of potential benefits such as jobs, improved infrastructure, and increased prosperity.

8. Options considered

There are various ways in which we can manage increased demand on our network. Options that are available to us include:

- Increase pressures.
- Install remote pressure management to increase pressures.
- Install new mains.
- Join two networks by installing mains.
- Install new District Governor
- Upgrade existing District Governor (stream change)
- Separate networks by installing valves.
- Offer alternative connection points to customers.

Options that we have looked at for our RIIO-GD3 mains reinforcement workload forecast considered both general and specific reinforcements, together with historical trends from RIIO-GD1 and RIIO-GD2. We have also looked at the option of specific reinforcement based on CSEP applications for RIIO-GD3 and general reinforcements that maintain pressures over 21mbar to enable insertion for our distribution mains renewal program. For this element we have undertaken a cost analysis to determine the appropriate level of investment.

Ofgem CBA Template Assumptions

For all CBAs in our RIIO-GD3 submission, we used an assumed weighted average cost of capital (WACC) of 3.92% based on Ofgem guidance (a real average basis). We have assumed a depreciation Acceleration Factor of 100% across all CBAs and scenarios, i.e. no additional acceleration of depreciation. For Capex CBAs we have assumed a

capitalisation rate of 33.7% based on our Totex forecasts in BPDTs and 100% for Repex CBAs. First year of expenditure outflow is set to 2027 in all scenarios for consistent relative NPV calculations. This is in line with Ofgem guidance for RIIO-GD3 and the approach taken in RIIO-GD2. We consider that the plausible ranges of these parameters would not materially affect CBA outcomes and have provided only one version of templates with these consistently applied (as they can be adjusted by Ofgem in any case).

We have not provided direct Opex associated with each CBA scenario as it would require us to artificially and subjectively divide up our maintenance and repair expenditure into each sub-asset class (CBA) and make a judgement on how this would be affected by each scenario. We do not record or report data at this level and we have no robust basis on which to provide it. In reality, maintenance and repair teams attend to multiple asset classes in single visits as part of an efficient function. Instead, we have provided the objectively calculated VF Financial risk, which is based on agreed industry NARM based calculations for estimating impacts on Opex under each CBA scenario. For those asset groupings not covered by NARM we have only included benefits and impacts of key benefits e.g. leakage. We consider this to be a more robust and objective approach to our CBAs. We have completed the NARM monetised risk memo lines from values in the NARM BPDT for baseline and preferred where they are available and relevant.

8.1. Baseline – Do minimum/nothing

This option is used as the baseline for which all other options are measured against. It does not include any capital investment but instead considers the cost of ongoing maintenance activities and repairs on failure. There are no direct benefits accrued under this option, however it does include societal impacts associated with leakage, fatality and injury.

The baseline option shows that there will be an increase of risk of 19.11% and an increase of supply interruption levels of 15% above start of RIIO-GD3 levels if we were to adopt this Do Nothing/ Do Minimum option. All categories of risk contribute significantly to this increase in risk. These risks do not include that we would have governors over capacity and unable to supply customers in a 1:20, any new connections and or demand increase would cause the network to be unable to achieve a 1 in 20 winter and cause a loss of supply to customers.

8.2. First options summary – Totex approach (preferred option)

This Option aims to build a plan that would best reflect customer and stakeholder expectations and enable us to meet our obligations, this requires us to reinforce the network in the most cost effective and efficient way using historical evidence, we need to proactively address demand and capacity issues to ensure customers do not suffer supply interruptions during periods of peak demand.

Our preferred option is to carry out 56km of reinforcements and 61 individual interventions at a cost of £26.98m. We would expect a risk position of a 18.5% increase compared to start of GD3 RIIO-3throughout RIIO-GD3 across our network.

This consists of:

- 28km of general reinforcement
- 28km of specific reinforcement

- 31 new governors
- 30 governor capacity upgrades

This approach would see us use the average length of reinforcement carried out to forecast RIIO-GD3, whilst we see a variance throughout the years due to the nature of reinforcements. We do not see a substantial difference throughout these years to suggest in RIIO-GD3 it would differ.

General Reinforcement sees an average of 4.17km a year.

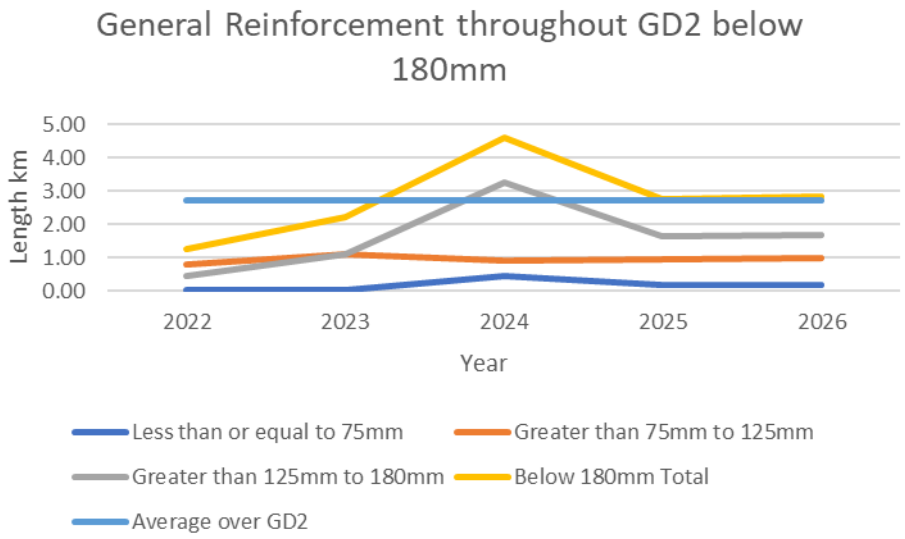

Figure 1 General Reinforcements below 180mm throughout RIIO GD2 graph

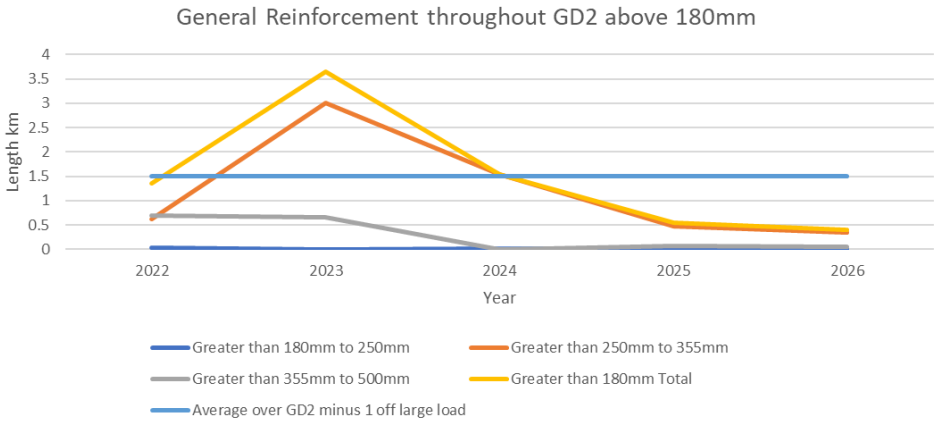

Figure 2 General reinforcements throughout RIIO GD2 above 180mm graph

Specific Reinforcement sees and average of 5.6km a year.

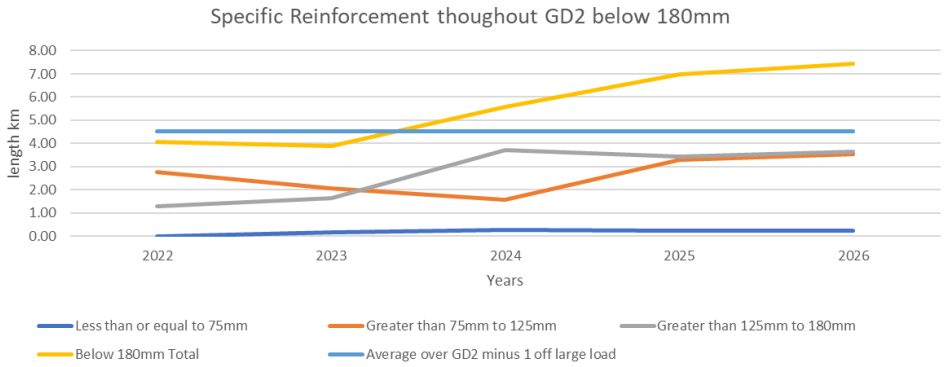

Figure 3 Specific reinforcement below 180mm throughout RIIO GD2

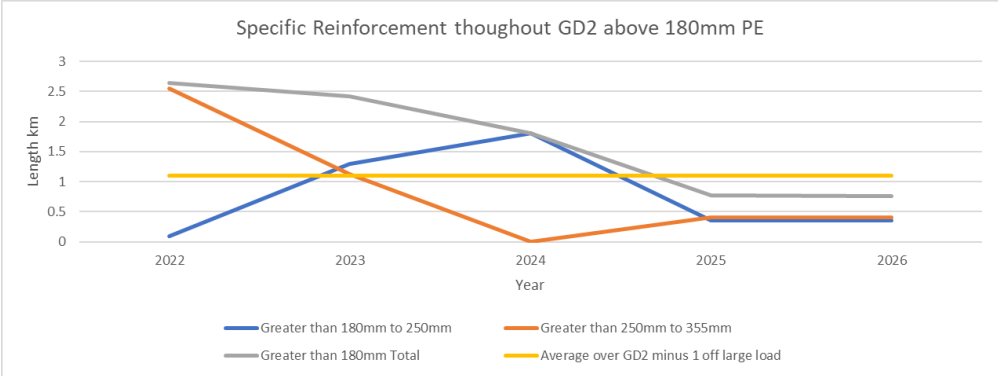

Figure 4 Specific reinforcements above 180mm throughout RIIO GD2

NGN has looked at a Totex approach allowing us to make cost efficiencies where possible. We have established mains on the Repex mandatory mains projects that are still required and need replacing we have optimised the design enabling the use of no-dig techniques such as insertion. Whether we can insert a pipe is the most significant driver of total scheme costs and, on aggregate, the most significant driver of cost in our mains replacement programme.

Insertion is generally the most efficient method of replacing mains. This technique, when compared to other options, dramatically reduces the amount of excavation work needed, which in turn reduces cost and disruption to the public. The method does, however, reduce the capacity of the network – the newly inserted pipe is smaller and therefore can transport less gas.

To understand the optimal level of network reinforcement to enable insertion NGN used our experienced network analysis to identify the highest level of insertion achievable by reinforcing the network where it is cost beneficial. Analysis of 126 Repex projects with open cut pipes shows that with an additional 6.43km of general reinforcement we could reduce the amount of open cut on Repex projects by 26.29km

Number of Reinforcement Projects	Total Length of Projects (km)	Open Cut Alternative (km)	Reduces Open Cut by (km)	New DGs
126	6.43	26.29	20.2058	0

Table 3 Totex Projects

Throughout RIIO-GD2 we upgraded 68 district governors that are out of capacity we have identified 80 Governors that are out of capacity 46 of which need to be upgraded during GD3 whilst the final 34 can be run at capacity at current demands and therefor left until RIIO-GD4. Policy documents TD13 and NP18 state that a DG should be

designed to ensure the flow through the working stream does not exceed 90% of the capacity of this stream. The stream capacity is calculated as per NGN/PL/NP18 (Policy for Network Planning) Sect 7.7 as follows: Pressure Regulating Installations (PRIs) must be designed so that the working stream has sufficient capacity to supply the forecast gas flow (1 in 20 demand conditions) at its forecast inlet pressure (1 in 20 demand conditions). The gas flow and inlet pressure will be derived from an approved network analysis process. Also, the capacity of all streams combined must be sufficient to supply the forecast gas flow (1 in 20 demand conditions) at the system minimum design pressure (e.g. 0.35 bar for a 2 bar system). This requirement is to maintain security of supply during atypical circumstances (e.g. reduction of system pressure for emergency mains repairs).

In respect of our objectives set out in Section 5:

Totex objective (Reduction in mandatory Repex open cut) – we are delivering on this objective by reducing potential open cut on Repex projects by 20.2km

Compliance objective (Build sufficient network resilience to cope with extreme events including a 1 in 20-year event.) we are delivering on this objective by completing the upgrade on all governors with a that exceed 90% capacity of stream by the end of RIIO-GD3.

Efficiency objective (minimise RIIO-GD3 spend over and above RIIO-GD2 levels) – RIIO-GD3 spend under this option is comparable to forecast RIIO-GD2 spend levels (-£0.73m). We believe we are meeting this objective by using our SME's high level of site expertise and knowledge in combination with analysis from our experienced network validation analysts develop a balanced programme of work meeting the requirement of workload driven by capacity and compliance, whilst minimising the cost for customers in our investment solutions.

Uncertainty objective: This option pays back in 43 years delivering positive NPV from 2070 onwards.

8.3. Second options summary – Do more and increase volume of interventions capacity upgrades.

We have assessed a second option whereby we could increase the volume of capacity governors to complete all governors that exceed 90% capacity of stream by the end of RIIO-GD3 this option would result in an acceleration of interventions in the RIIO-GD3 period. Under this option, interventions would increase to 95 with 56km of Reinforcements overall, at a cost of £28.5m. For the increased spend of £1.5m we would expect a risk position of a 17.7% increase compared to start of GD3 RIIO-3. The interventions for this Do More option consist of:

- 28km of general reinforcement
- 28Km of specific reinforcement
- 36 new governors
- 54 governor capacity upgrades

In respect of our objectives set out in Section 5:

Totex objective (Reduction in mandatory Repex open cut) – we are delivering on this objective by reducing potential open cut on Repex projects by 20.2km

Compliance objective (Build sufficient network resilience to cope with extreme events including a 1 in 20-year event.) we are delivering on this objective by completing the upgrade on all governors with a that exceed 90% capacity of stream by the end of RIIO-GD3.

Efficiency objective (minimise RIIO-GD3 spend over and above RIIO-GD2 levels) – This option costs £1.4m more than the preferred option. For this additional cost we do not see any significant decrease in either risk or service levels and compliance needs have been assessed to have been met by the Preferred option. This Do More option therefore does not align with our customers' expectations of keeping bills as low as possible.

Uncertainty objective: This option pays back in 25 years delivering positive NPV from 2050 onwards.

8.4. Third option summary – Do less and reduce volume of general reinforcement

We have assessed a third option whereby we could decrease the volume of general reinforcement by not including a Totex approach and keep the Repex program and reinforcement program separate. Under this option, interventions would stay the same at to 61 with 49km of Reinforcements overall, at a decreased cost of £3.2m. For the decreased spend of £3.2m we would expect a risk position of a 18.7% increase compared to start of RIIO-GD3. The interventions for this Do Less option consist of:

- 21km of General Reinforcement
- 28Km of Specific Reinforcement
- 31 New Governors
- 30 Governor Capacity upgrades

In respect of our objectives set out in Section 5:

Totex objective (Reduction in mandatory Repex open cut) – we are under delivering on this objective as there is no cost efficiencies to the Repex workload included in the General reinforcements.

Compliance objective (Build sufficient network resilience to cope with extreme events including a 1 in 20-year event.) we are delivering on this objective by completing the upgrade on all governors with a that exceed 90% capacity of stream by the end of RIIO-GD3.

Efficiency objective (minimise RIIO-GD3 spend over and above RIIO-GD2 levels) – This option costs £3.2 less than the preferred option. For this decreased cost we do not see any significant decrease in either risk or service levels and compliance needs have been assessed to have been met but we lose the efficiencies of a Totex approach. This Do less option therefore does not align with our customers' expectations of keeping bills as low as possible as whilst reinforcements costs are lower Repex costs would increase with additional opencut.

Uncertainty objective: This option pays back in 46 years delivering positive NPV beyond 2070.

8.5. Fourth option summary – Deferral of investment

The fourth option we considered was deferral of the investments detailed in option 8.2 to RIIO-GD4. This was not modelled as it was not considered a viable option as it would put our ability to meet compliance and gas licence objectives at significant risk.

8.6. Options technical summary table

NGN's expenditure forecasts are built on a tried and tested, robust and efficient process. This is founded in asset management principles that has seen NGN consistently benchmarked as the most efficient gas distribution company by Ofgem since 2005. It should be noted that "robust and efficient costs" should not be interpreted as lowest cost. We have and are currently experiencing external and internal cost drivers that are increasing the cost to deliver some workloads and maintain service and compliance objectives. At NGN robust and efficient costs are defined as those which address the network, customer service and environmental risk in an effective and enduring way, to avoid future additional costs or service interruptions. Notably, health and safety and security of supply are priority drivers in determining the appropriate balance of risk and cost which enables investment decision making. As such, our costs are efficient over the life of the intervention and not just at a point in time, which would reduce cost but risk service failures or increased costs in future periods.

NGN's efficient and robust process to determine expenditure is as follows:

- Historic analysis of previous investment programmes to understand how expenditure has been effective in managing network risk (NARM) and the service levels that have been delivered. This provides the actual delivered cost of reducing risk and delivering services levels.
- Forward looking analysis of risk profile, cost drivers and pressures to understand what the forecast programme of work is and the cost associated with maintaining or enhancing performance. This allows a clear articulation of how actual delivered efficiency translates into future cost, accounting for any cost variance.
- A comparison of historic cost base versus forward projection to ensure costs are targeted at addressing compliance requirements (HSE), supply demand and account for additional costs drivers or challenging areas of work. To ensure costs are robust we embed the following process:
    - Compare asset specific costs against third party industry database to understand where deviations from average costs might be and the reason for these changes. The third party data base is provided by Aqua Consultants who maintain databases for regulated sectors.
    - Compare costs against Yr3 Industry RRP to assess how NGN costs compare to current delivered costs across GDNs.
    - Compare future investment programme to current actuals using Ofgem RIIO-GD2 benchmarking to understand where NGN may be benchmarked on a like for like basis.
    - Undertake robust Internal challenge with Independently appointed experts to weigh pros and cons of the business case and relevance of costs to meet service levels and manage network risk.
    - The costs are then deemed to be robust and efficient from an NGN perspective and will be subject to a final technical scrutiny by an external consultant to ensure costs, benefits and risk removal are justified.

As demonstrated above, the unit costs used in both our CBA and capital expenditure forecasts have been derived using historical project cost knowledge, SME input on current cost trends and current cost quotations, to provide confidence in their accuracy, consistency and credibility. Since the introduction of SAP HANA S4 in Oct 2019 we have captured project costs at a more granular level to support regulatory reporting and to aid future investment decisions. During RIIO-GD1 the Unit Cost Database (UCD) was developed, this used extensive volumes of project cost data to derive cost curve models and provide a cost trend allowing for an accurate cost estimate, the allowances for GD2 were driven by the UCD. External project management, untimely delivery by contractors and 3rd party delays could all impact on costs, but uncertainty risk relating to unit cost was built in during the development of the UCD in RIIO-GD1 and has carried through as these costs have been developed into the unit

costs for developing the RIIO-GD3 business plan, as described below. The RIIO-GD3 unit rates incorporate analysis of efficient historical projects. No explicit efficiency over and above this is included within this EJP appendix as our efficiency target is covered within the main business plan - a 0.5% Ongoing Efficiency (OE) target. This means that in reality, NGN will be subject to a further 0.5% cost reduction target throughout RIIO-GD3 in order to meet the OE objectives that will be set by Ofgem (refer to Chapter 6 of NGN's business plan).

As a reliable starting point, our RIIO-GD2 unit cost allowances were converted to 23/24 prices, RIIO-GD2 project costs and forecasts were then compared against the 23/24 allowances. Where there were significant variances time was spent with delivery and commercial SMEs. Technology improvements (new functionality), resource scarcity and project management are examples of where we have seen deviations in the GD2 allowance, these have been reflected in the base RIIO-GD3 unit costs.

We have Framework partners in place for Capex delivery projects which improve certainty and ensure efficiency of costs.

The table below provides a summary of the assumed unit costs applied in modelling and CBA analysis for pressure control. For the avoidance of doubt, costs are shown in 2023/24 prices.

Intervention	RIIO-GD3 Unit Cost 23/24 prices
General Reinforcement - <=180mm pipe	£400,330
General Reinforcement - >180mm pipe	£639,267
General reinforcement - governors	£100,000
Specific Reinforcement - <=180mm pipe	£299,225
Specific Reinforcement - >180mm pipe	£601,926
Specific Reinforcement - governors	£80,000
General reinforcement - DG capacity	£20,000

Table 4 RIIO-GD3 unit costs

Option	First Year of Spend	Final Year of Spend	Volume of Interventions	Length of Reinforcement (km)	Equipment or Investment Design Life	Total Installed Cost (RIIO-GD3 Capex) 23/24 prices
Baseline (Do Nothing)	N/A	N/A	N/A		N/A	N/A
First Option Summary – TOTEX Approach (Preferred Option)	2026/27	2030/31	61	56	7 - 40 yrs	£26,980,350
Second Option Summary – Do more and increase interventions by 20%	2026/27	2030/31	95	56	7 - 40 yrs	£28,383,638
Third Option Summary – Do less and reduce interventions by 20%	2026/27	2030/31	61	49	7 - 40 yrs	£23,743,552
Fourth Option Summary - Deferral of investment	2031/32	2036/37	61	56	7 - 40 yrs	£26,980,350

Table 5 Options Cost Technical Summary Table

9. Business case outline and discussion

Option	Description	Objectives				
		TOTEX	Efficiency	Uncertainty	Compliance	Comments
	Baseline	Not Met	N/A	N/A	Not met	Does not meet the risk or compliance objective
1	Preferred	Met	Met using SME expertise (comparable to RIIO-GD2 spend	Not Met 43 years	Met	Network would be complient with our gas licence and has the ability to improve to ensure we can connect new demands without effecting existing customers supply in a 1:20
2	Do More	Met	Not Met additional £1.5m	Not met 25 years	Met	Increase in spend does not increase our network resiliance significantly and misaligned with customers expectations of keeping bills as low as possible
3	Do Less	Not Met	Met Cost Reduction of £3.2m	not met 46 years	Met	Slight Cost reduction comes at cost to REPEX and is inefficent
4	Deferral	Not modelled	Not modelled	Not modelled	Not modelled	Risk increases over GD3 and places compliance at risk

Table 6 Options appraisal summary

Table 6 details a summary of the options appraisal against objectives carried out in Sections 8.1 to 8.5.

In Summary:

The baseline option has been rejected as this increases risk levels over start of RIIO-GD3 levels. We would be unable to cope with changes in network demand breaking our gas licence conditions as we wouldn't be able to supply in a 1:20 scenario. This is unacceptable and misaligned with our objectives of compliance.

Option 2, the Do More, has been rejected as this costs an additional £1.5m (over the preferred option) and does not result in any significant improvement in risk or service level position. This option is therefore misaligned with our customers' expectations of keeping bills as low as possible.

Option 3, Do Less, comes at £3.2m less than the preferred option, delivering slightly worse risk and service levels. It does also not meet our objective to run an efficient network using a Totex approach by spending less in reinforcement we cannot make savings to the mandatory Repex program. For these reasons it has been discounted.

Option 4, Deferral, has been discounted due to the risk to compliance.

Option 1 has been assessed to be the preferred option as it delivers the best-balanced programme of work combating, compliance, capacity whilst minimising spend for customers. The additional general reinforcement included as part of the Totex analysis allows 26.29 km of opencut on Repex work to now be inserted, reducing costs. This has a social benefit of not impacting customers as directly with deep excavations, back garden trenches and an increase in road closures.

Our Preferred option is detailed in full in Section 9.1.

9.1. Key business case drivers description

This section discusses the development of the preferred strategy and sensitivity analysis then undertaken.

We have assessed the present value of each investment option utilising Ofgem's CBA template. To calculate all present value figures, we have compared the capital and operational costs associated with each option and overlaid them against the leakage reductions (associated with reduced numbers of failures) and reductions in risk relating to customer, compliance, financial and health and safety we expect each to attain.

All alternative options should be compared to the baseline counterfactual of the baseline position, which is shown in below. The baseline position outlines what we expect our annual shrinkage position to be assuming zero interventions on pressure control assets across Offtakes and PRS. The present value of each alternative relates to our expected reduction in shrinkage given the funding received under each option. To value each of these efficiency gains we have used the non-traded price of carbon dioxide, as quoted by Ofgem. As noted above, each alternative option also analyses the impact of the change in customer, compliance, financial and health and safety risk. The preferred strategy development is discussed in Section 7.2 with the options (sensitivity analysis) detailed in Sections 7.1 to 7.5.

The key drivers for investment in pressure control assets are as follows:

- **Compliance:** Given our Gas Transporter Licence conditions require us to provide a reliable service to customers. This means that we need to have enough network resilience to cope with extreme events (including a 1 in 20-year event). Where there is growth in demand, or where we are undertaking other changes on the network that impact capacity, we may need to reinforce the network to ensure that we can continue to meet this requirement.
- **Asset health:** It is imperative that our governors remain in good condition in order to ensure gas continues to flow through our network in a safe and reliable manner. Where it is not been deemed possible to perform a capacity upgrade due to condition of the governor we will replace the governor.
- **Capacity:** Capacity constraint investments have been considered where we have sites already exceeding capacity limits, or narrowly approaching them.

Further details can be found in Section 5.

Conditionalities included within our options analysis are detailed in Section 7.

9.2. Business case summary

The analysis results for each of the options detailed in Sections 7.1-7.5 are summarised in 4. Options appraisal is detailed in Sections 7.1 to 7.5 for each option and option selection is detailed at the start of Section 8.

Option	Description	RIIO-3 Primary Interventions			Total NVP compared to Baseline at 2070 (£m)	Total Risk Change from 2026 %	RIIO-3 Total Capex Cost (£m)	Payback (years)
		Replace	Refurb	New Mains (km)				
	Baseline	0	0	0	-£9,294.1	19.11	-	-
1	Preferred	31	30	56	£0.1	18.59	26.9	43
2	Do More	36	54	56	£34.3	17.79	28.4	25
3	Do Less	31	30	49	-£1.3	18.90	23.7	46

Table 7 Options summary risk and CBA

Option	Description	No.of Primary Interventions in RIIO-3	Km of New Mains in RIIO-3	Forcast		Total NPV Compared to Baseline (£m)					Payback (years)	Preferred Option
				Capex RIIO-3 (£m)	Totex RIIO-3 (£m)	2035	2040	2045	2060	2070		
	Baseline	0	0			-£1,888.9	-£2,907.1	-£3,908.4	-£7,051.5	-£9,294.1		N
1	Preferred	61	56	£15.18	£21.6	-£14.7	-£15.0	-£14.2	-£6.3	£0.1	2	Y
2	Do More	90	56	£28.89	£35.3	-£10.9	-£8.1	-£4.4	£17.1	£34.3	6	N
3	Do Less	61	49	23.7	£16.8	-£16.6	-£16.5	-£15.6	-£7.7	-£1.3	2	N

Table 8 Options summary including NPV

10. Preferred option scope and project plan

10.1. Preferred Option

Our preferred option is to carry out 56km of reinforcements and 61 individual interventions throughout RIIO-GD3

- 28km of general reinforcement
- 28km of specific reinforcement
- 31 new governors
- 30 governor capacity upgrades

We have arrived at this position through a combination of the use of historical data to accurately anticipate the future reinforcement work. We have selected our RIIO-GD2 historical workload because it provides a baseline that we can be confident will almost certainly be required, ensuring customers won't be impacted through over payment. Additional general reinforcement is based on detailed analysis of our Global Models (Hydraulic analysis models created in Synergi that accurately replicate the current network with all T1 replacement work with maximum insertion). Additional reinforcement to the network was only considered if it had a material impact on no dig techniques on otherwise opencut projects.

A Key consideration in this strategy has been the district governors that are out of capacity and carry an inherent risk score calculated by network validation risk matrix, the top 46 that must be completed by the end of RIIO-GD3 are included in this strategy whilst the remaining 36 have been deemed to be able to be monitored and assessed for RIIO-GD4.

Costs for Reinforcements for the RIIO-GD3 EJP (£26.9m) are comparable to projected RIIO-GD2 spend (£27.7m) on a comparable 23/24 price basis.

Long Term Risk impact on Preferred Option

Table provides details of the Preferred option Capex spend alongside Single Year Risk benefit and Long Term Risk benefit output as shown in our NARM BPDT. Long Term Risk calculations allow for accrual of benefit over the life of the intervention. These intervention lives are detailed in full in our NARM BPDT submission. Section 5.2 Project boundaries detail the investments within our Preferred option where we have been able to model risk and risk reduction under NARM.

We have provided undiscounted Long Term Risk benefit both here and in the NARM BPDT. Further clarification with SRWG is needed around the requirement for discounting LTR.

		NARM BPDT	
	Capex Spend (£m)	Single Year Risk Benefit (R£m)	RIIO-3 Long Term Benefit Output (R£m)
Reinforcement	3.60	0.00	0.01

Table 9 Long term risk presentation for Reinforcement (Governors)

10.2. Asset Health Spend Profile

The total forecast capital expenditure for Reinforcements has been included within the accompanying CBA. The Table below shows our spend per individual asset category across the 5 years.

£m 23/24 prices	2026/27	2027/28	2028/29	2029/30	2030/31	Total (£m)
General Reinforcement - <=180mm pipe	£1.42	£1.42	£1.42	£1.42	£1.42	**£7.09**
General Reinforcement - >180mm pipe	£1.23	£1.23	£1.23	£1.23	£1.23	**£6.15**
General reinforcement - governors	£0.60	£0.50	£0.50	£0.50	£0.50	**£2.60**
Specific Reinforcement - <=180mm pipe	£1.35	£1.35	£1.35	£1.35	£1.35	**£6.76**
Specific Reinforcement - >180mm pipe	£0.68	£0.68	£0.68	£0.68	£0.68	**£3.39**
Specific Reinforcement - governors	£0.08	£0.08	£0.08	£0.08	£0.08	**£0.40**
General reinforcement - DG capacity	£0.12	£0.12	£0.12	£0.12	£0.12	**£0.60**
Total	**£5.48**	**£5.38**	**£5.38**	**£5.38**	**£5.38**	**£26.98**

Table 10 asset health spend profile

As demonstrated below, we have endeavoured to maintain consistency in spend as far as possible.

10.3. Investment Risk Discussion

We have controls and processes in place throughout the development of our RIIO-3 capital expenditure programme to ensure we mitigate both our customers' and our own exposure to risk. Workload and unit cost risks are inherent when forecasting third party driven work. The bullet points below outline the steps we have undertaken to ensure we limit these risks to provide an accurate capital programme.

Workload risk mitigations

- We have used the NARM methodology to calculate individual assets Probability of Failure which uses asset attributes to determine specific failure rates.
- We have considered various options including workload volumes and chosen the solution which provides our customers with the most appropriate balance between cost, risk and service.
- There is an increase in workload for RIIO-GD3 over RIIO-GD2, therefore there are increasing risks around delivery of project workload to timescales, however we have experienced project managers who have a proven track record of delivering this type of work. Some particular risks to delivery have been discussed in Key Business Risks (Section 9.5).
- We have already identified some new connections and all out of capacity district governors for RIIO-GD3 and we have Network Analysts who have a proven track record of designing and validating this type of work have already.
- We have consistently engaged on our preferred strategy with our SMEs and operational colleagues to ensure that our strategy is both viable and deliverable.
- As part of the above, we have ensured adequate internal and external resource for design and delivery.
- We have procurement strategies in place which take into account the likely volumes and lead times we could experience. Our Workforce and Supply Chain Resilience Strategy (Appendix A7) has been developed with this in mind.
- Our project managers have been engaged throughout so that we have developed appropriate workload planning procedures.

- Land requirements have been factored into our project plans to ensure that they are dealt with well in advance of project construction to avoid undue delays.

Unit Cost Risk Mitigations

We have used our updated unit cost analysis (see section 7.6) to determine our unit costs.

We are not planning to undertake new work activities. We have undertaken all interventions previously and have historic costs allocated within our unit cost analysis.

We have experienced Project Managers who have a proven track record of delivering this type of work in the past and we have a commercial team of quantity surveyors who are focussed on delivering value for money.

We have well developed processes and assurance activities in place, with scrutiny and challenge provided throughout. This ensure that we can deliver value for money by driving cost efficiency. Details on unit cost processes are provided within Section 8.6.

Section 4.1 of **Appendix A7 – Workforce and Supply Chain Resilience Strategy** sets out some of the supply chain challenges that we have faced throughout RIIO-GD2. It acknowledges how NGN is a comparatively smaller GDN, which reduces our buyer power (section 4.1.2) and also discusses the significant inflationary pressures that have been placed on GDNs (section 4.1.4). For example, it discusses how the prices charged for coiled pipes have increased by 82% in the period from January 2020 to August 2023. Despite these challenges, we are confident that our input unit costs remain efficient. This appendix also touches on a number of external shocks which have impacted on things such as lead times. Examples include the Covid-19 pandemic, the Suez Canal blockage, Russia's invasion of Ukraine and rising geopolitical tensions. We outline in the strategy how we expect volatility to continue across our supply chain, and that we will utilise storage facilities in order to mitigate against supply input shortages. We plan to resource our supply chain and procurement team appropriately to help us overcome these challenges.

Appendix A21 – Cost Assessment and Benchmarking Approach demonstrates how, despite challenges facing us, NGN leads the industry in terms of cost efficiency, having been ranked the most efficient operator by Ofgem in both RIIO-GD1 and RIIO-GD2. This Appendix further outlines the value of NGN in Ofgem's cost assessment modelling at RIIO-GD2 by showing how NGN's frontier setting performance enabled Ofgem to set cost allowances that were £211 million lower than they would otherwise have been. In other words, our efforts to lead the sector on cost efficiency have resulted in significantly lower bills for consumers across the whole country.

We have achieved this position by being innovative in our thinking and directly and aggressively challenging industry norms and practices by bringing forward market-led, commercially focussed business solutions across almost every area of our business. For example:

- NGN introduced modern labour terms and conditions (T&Cs) for the majority of its operational workforce, leading to a significant reduction in legacy staff costs.
- NGN introduced a Direct Service Provider (DSP) model, leveraging small local engineering firms to deliver its replacement program instead of relying on the traditional 'tier 1' companies that have typically dominated the industry.
- Given that NGN has made strong productivity improvements over time, we have re-invested our outperformance payments in areas that (among other things) improve our productivity further. For example, we have used outperformance to invest heavily in IT systems through the SAP4 Hana investment and 'Future Ways of Working' programme. These projects are expected to significantly improve the customer experience and enable NGN to become a data-focused business.

We also outline in this Appendix our suggestion to target a 0.5% Ongoing Efficiency (OE) target, alongside the reasons why this is an appropriate level (see section 6 of the Appendix). This means that in reality, NGN will be

subject to a further 0.5% cost reduction target throughout RIIO-GD3 in order to meet the OE objectives that will be set by Ofgem.

We outlined above how we have faced price increases significantly above inflation during RIIO-GD2. The Real Price Effects (RPE) methodology attempts to adjust for the difference between input price inflation and consumer price inflation. We outline in the Appendix our broad support for RPEs, however we note that during RIIO-GD2, all networks have seen relatively large swings in real term allowances year to year due to RPE and inflation volatility from the geopolitical energy shocks in 2022 and 2023. RIIO-GD3 therefore presents an opportunity to refine the basket of reference indices to better capture GDNs actual input price movements and better mitigate this risk. The impact of RPEs have not been factored into our unit cost pricing.

10.4. Project Plan

This section sets out how we plan to deliver or Reinforcement interventions throughout RIIO-GD3. The vast majority of our interventions relate to the upgrade of capacity governors this work is known and can be designed evenly throughout RIIO-GD3.

As shown below, we have planned work throughout the period to ensure that we have a steady flow of interventions throughout the year. For example, we have staggered our capacity Governors evenly each year

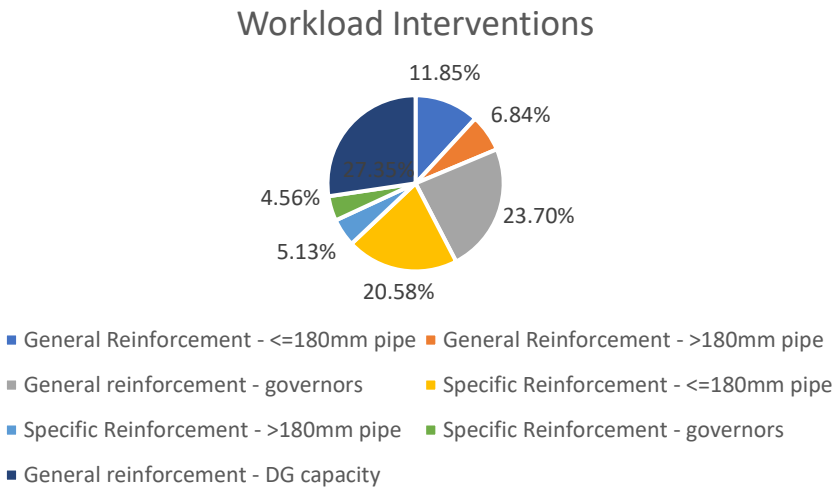

Figure 5 RIIO GD3 workload interventions

Workload Interventions	2026/27	2027/28	2028/29	2029/30	2030/31	Total
General Reinforcement - <=180mm pipe (km)	3	3	3	3	3	**13**
General Reinforcement - >180mm pipe (km)	2	2	2	2	2	**8**
General reinforcement - governors	6	5	5	5	5	**26**
Specific Reinforcement - <=180mm pipe (km)	5	5	5	5	5	**23**
Specific Reinforcement - >180mm pipe (km)	1	1	1	1	1	**6**
Specific Reinforcement - governors	1	1	1	1	1	**5**
General reinforcement - DG capacity	6	6	6	6	6	**30**
Total	**23**	**22**	**22**	**22**	**22**	**110**

Table 11 Planned pressure control intervention workload profile

Project planning is currently underway for RIIO-GD3.

A Risk Register for Reinforcement investment over RIIO-GD3 is included within the CBA and the key risks and mitigations are covered in Sections 10.3 and 10.5.

10.5. Key Business Risks and Opportunities

Risks

- **Internal delivery capability** –We will need to resource at the right level and there will need to be a robust training programme in place to ensure this knowledge can be rolled out across the maintenance teams. We are currently assessing the current structure of the team to determine any changes required to ensure delivery is achievable.
- **Contractor/resource availability** – Risk around market resource for over 31 new District Governors, the ability for these to be manufactured at a pace required by the delivery programme with the appropriate 'lead' time. It is vital to ensure that commercial value is extracted and that the delivery of the products meet the project installation timing requirements. We are employing early engagement and preparatory works in RIIO-GD2 year 4 and 5 to help mitigate these risks.
- **Cost variability** - External Project management, untimely delivery by contractors and 3rd party delays could all impact on costs. However, framework partners who deliver the capex workload are rigorously challenged to deliver value for money and alternative partners are continually being used were cost or delivery is a challenge. Uncertainty risk associated with unit costs has also be built into the analysis for unit costs used in the RIIO-GD3 planning process (see Section 8.6 for further details).Supply chain risk – NGN have had issues with the supply chain recently (in particular for volumetric skids) and also issues with Liability levels associated with the failure of equipment and the level of liability held by the manufacturer in the event of this. This has been recently resolved with one supplier. However, this is occurring more regularly and will need to continue to be closely managed in RIIO-GD3.
- **Temporary increased maintenance** – Potential for "bedding in" periods of the new soft parts to cause maintenance callouts. This is a potential but will also be a temporary issue if it occurs.
- **NARM impact** – Potential for NARM risk reduction to be impacted by the change in strategy. This will be closely monitored.
- **Opportunities**
- As the network develops overtime there may be opportunities utilising our Network validation team to combine more reinforcement projects with mandatory T1 Repex work. Work has already been done on potential CSEP sites to see if the reinforcement on these projects if they were to go ahead could mean more no dig techniques could be utilised on adjacent Repex works.
- **Efficiencies** – the level of efficiency depends on the site we are working on, the type of asset being replaced, and whether the site gas supply can be isolated. Ideally if we were carrying out 3 separate replacements (crossing asset types) on a single site we would look to do all the work at the same time to minimise mobilisation and demobilisation cost for instance.

We discuss in Chapter 5 of our Business Plan how we are mitigating against the immediate risks facing our business in the RIIO-GD3 period. In terms of network asset management we have identified asset condition deterioration, obsolescence and compliance – all of which are relevant to the pressure control interventions set out in our preferred strategy. There are also wider considerations which indirectly impact on our investment decisions. Our Workforce and Supply Chain Resilience Strategy (Appendix A7) sets out our plans to tackle potential future skills shortages. Whilst we are not envisaging specific skills shortages in the RIIO-GD3 period thanks to our long standing commitment to ensuring we have a 24/7, highly skilled workforce, we do need to ensure that our longer term investment proposals are deliverable given the future challenges we may face as an industry. This strategy also discusses how we ensure that we have a resilient supply chain that can withstand

shocks and unforeseen circumstances. This is also an important consideration given the limited supplier and resource pool facing increased demand as we move towards Net Zero.

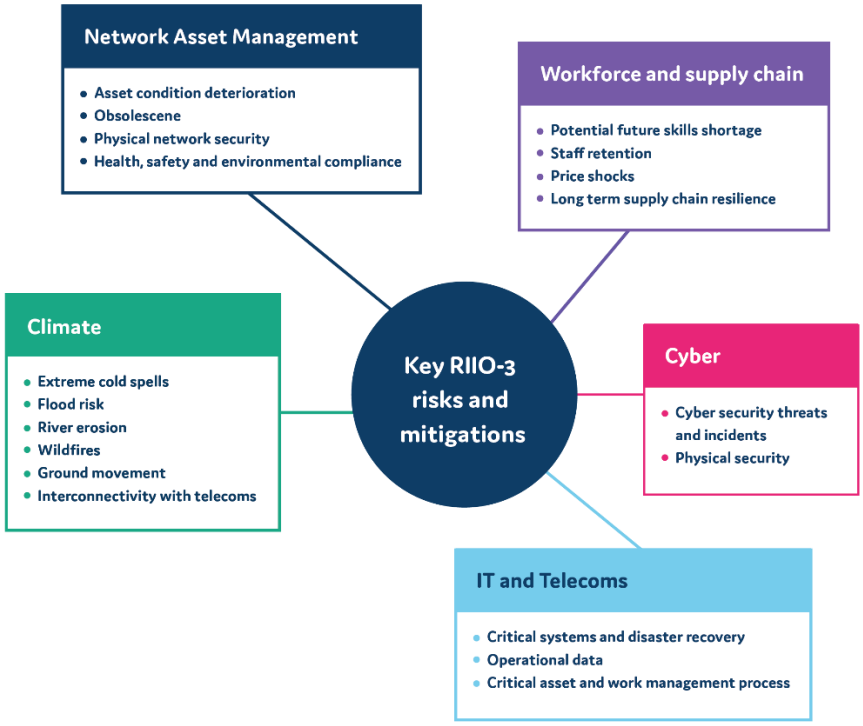

Figure 6 RIIO-GD3 Key Risks and Mitigations

10.6. Outputs Included in RIIO-GD2 Plans

We do not expect to carry over any RIIO-GD2 interventions into RIIO-GD3