Cadent

Your Gas Network

RIIO2 Draft Determination

Cadent Consultation Response

Cadent Question 5

4th September 2020

Navigating Our Response

Cadent's response to Ofgem RIIO-2 Draft Determination is structured as follows. This document includes the response to **Cadent Question 5**

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Cadent Q5: Do you agree with our proposals on the bespoke UMs? If not, please outline why.

Reinforcements

In our December submission, we proposed the use of a volume driver to account for additional reinforcement works beyond our base plan submission (calculated as 80% of the lowest annual volumes observed in each network). Whilst we proposed mitigating strategies to ensure that volumes claimed through the driver were both efficient and appropriate, the DD rejects our proposal given concerns that a volume driver may not create adequate incentives for us to explore 'non-build' capacity solutions.

Whilst we believe it is possible to address these concerns, we acknowledge that there is complexity in designing a common UM that can apply to all networks and maintain these incentives. We note that Ofgem has accordingly taken account of our P50 costs submitted for the re-opener to adjust baseline allowances on to the same basis as other networks which should provide a base level of funding for the requirements in this area.

The proposed position on baseline reinforcement allowances, however, will need to be joined up with the approach to the large load re-opener to deal with the risk of variance in the volume of work we may be required to undertake to meet customers' capacity requests. In GDQ50 and GD51 we set out our views of how this can be addressed in the large load reopener. If these changes are not made, the overall proposed position for reinforcements would leave Cadent significantly exposed to risk, most notably from increasing volumes of new power generation connecting to our network in RIIO-2.

Pipes above Safety Threshold (PAST)

We accept the DD proposal not to include our proposed volume driver assuming the adjustments to the PAST approach are made as set out under GDQ34.

In GDQ34 we state:

Any main breaching the risk threshold within the period will be added to the enhanced survey programme providing immediate safety management. Additionally, any PAST main which becomes NPV+ (with a 16-year payback) as a result of observed deterioration or increased costs in period can be replaced through two other mechanisms:

- The pipe could be replaced within the volume of base CBA pipe allowed on economic (rather than safety) grounds. Displacing other lower return pipes, or
- The pipe could be replaced using funding within the NARMs mechanism – justified over delivery. If PAST pipes paying back within 16 years are included as justified work in FD, they would also be justified within the NARMs methodology.

A new CBA+ PAST pipe may currently be an NPV- PAST pipe, or a pipe which is currently below the PAST threshold. This dynamic growth of PAST will not therefore require an uncertainty mechanism.

Diversions

In our December submission, we proposed a bespoke mechanism in relation to diversions. We agree with the DD proposal to include a diversions re-opener, however we propose changes are required to its proposed scope, re-opener windows and materiality thresholds. Our comments on these aspects of the mechanism are provided in response to GDQ44.

Connections

In our December submission, we proposed a bespoke volume driver in relation to connections. We support the DD proposal to adopt a mechanism for domestic connections, however we have specific concerns over the structure of unit costs proposed at Draft Determination. Our comments on the proposed approach, and recommended adjustments are provided in response to GDQ49.

Lowestoft

We propose the Lowestoft project is treated through baseline allowances and as such, we agree with the DD proposal to reject the UM as defined in our December submission. We are continuing to work with Ofgem to replace the UM with a base allowance. The project must be funded to allow us to meet our legal obligations.

The Lowestoft project is necessary to provide a safe, reliable and compliant gas supply for our customers.

When we submitted our RIIO-2 business plan in December 2019, we were still undertaking study work to identify the best permanent solution to replace an intermediate pressure (IP) pipeline in Lowestoft Harbour following the collapse of the quay. As such, we included an uncertainty mechanism within our plan which would have been able to manage the impact within the RIIO-2 period.

We also committed to working with Ofgem to update our plan to avoid the need for an additional uncertainty mechanism in RIIO-2 if the studies were completed ahead of draft determination.

Study work has now been completed giving us greater certainty over the risks, the preferred solution and the associated costs of delivery. As such we are recommending replacing our previously proposed uncertainty mechanism (Appendix 10.13 and Chapter 10) with a totex allowance within our base plan. We are proposing that this should be treated as a Price Control Deliverable (PCD) with a proposed allowance of £m.

Our study work has enabled us to develop a cost-effective solution and focus on addressing and managing the delivery risks to a suitable level of certainty. We can deliver this project for a fixed allowance and manage this project using our normal engineering delivery processes.

We set out this position in response to Ofgem's SQ45a on the 5th of June, including a new Major Project Justification Paper (Appendix 09.63) and supporting CBA data table (CBA_CAD_9.63 Lowestoft EOE 2.0).

Traffic Collision Protection

The DD proposes to reject our proposed mechanism for traffic collision protections as they did not find evidence of the materiality and likelihood of the uncertainty. We do not have any further evidence on materiality and likelihood hence we will look to manage this risk within our baseline allowance.

HP Valves

Interventions on high-pressure valves to maintain compliance with our statutory safety obligations, must be funded in RIIO-2. We accept Ofgem's challenge on the structure of this UM and have instead proposed an alternative adjustment to base allowances of £m to cover these costs. We have set out the case for this investment in Appendix 09.64 which is included with our response to the Draft Determination.

This Appendix 09.64: HP Pipeline Valves Engineering Justification Paper has been included in the Annex to Cadent Question 5.

London Medium Pressure

As requested by Ofgem, we have provided our response on London Medium Pressure in this question.

We disagree with Ofgem's DD Proposal of a bespoke re-opener. The stage gate approach is a barrier to an efficient rolling programme and the focus on individual sections fails to take account of the integrated nature of the programme and its benefits. As such the proposed approach is not in the best interests of customers or stakeholders because it will reduce our ability to deliver the LMP programme efficiently and to work effectively with external stakeholders.

The work is essential to maintain safe and reliable supplies to the heart of London. It is supported by critical stakeholders including TfL and the GLA and will reduce disruption, leakage, operating costs and interruptions to supply.

Our December submission set out the required work as a 10-year programme. The LMP programme is inherently challenging and our proposal was designed to allow flexibility to respond to in period challenges and opportunities within the boundaries of PCD with a high sharing factor. For this reason, our Investment Case submitted in December did not provide specific detail about when sections of the scheme would be delivered across RIIO-2 and RIIO-3.

Since our December submission, we have continued to develop our delivery plan for RIIO-2 and mindful of Ofgem's challenge to provide more certainty around our plans we have committed to a fixed programme of work. This evolution allows us to further demonstrate that our RIIO-2 plan is robust, deliverable and efficient. That it is based on solid engagement with stakeholders, a detailed understanding of the assets we are replacing and the challenges we need to overcome.

Our RIIO-2 plan now focusses on replacing the highest-risk mains in the programme. More complex, higher unit-cost phases of LMP (particularly subway and tunnel works), with greater delivery uncertainty, will be incorporated in RIIO-3 to allow us more time to develop innovative solutions and drive efficiency. This strikes the right balance for our customers and stakeholders.

The resulting Totex for RIIO-2 is £m (£m in our December plan), the programme total remains at £m over 10 years. Innovations and detailed enabling and planning work may lead to reductions in the RIIO-3 totex but this cannot be forecast with confidence at this stage. In our December submission we proposed a specific PCD for the LMP with a totex sharing factor of 15% recognising the lower confidence in costs at this stage of its development. As such 85% of this reduction would have been returned to customers if our December plan had been accepted.

Our response to the draft determination sets out:

- A clear needs case, complementing material already submitted in December, and supporting CBA
- A comprehensive project plan and timeline for completion, including evidence of the agreements in place with local authorities
- Technical specification of each segment, the challenges involved and therefore the numbers of key operations
- Engagement undertaken with stakeholders, underlining their support for the work and the specific (RIIO-2: Year 1) or in-principle (latter RIIO-2) agreements we have for the delivery of the programme
- Well justified costs, including evidence of market testing and of full consideration of innovative techniques to lower costs
- The basis of our unit costs and how these unit rates have been market tested, demonstrating an efficient cost of delivery
- How we have used innovation in our planning, design and construction phases to reduce cost, minimise disruption and maximise safety, to develop the optimum solution at least cost, yet minimises delivery risk.
- Our proposed commercial approach and how this will drive competition and support cost certainty.
- We have had our costs independently assured by Costain, who have looked at our basis of costs and scope of work to verify that these are robust, evidence-based and efficient. Costain state:

  "The findings from the review in its entirety are documented in this report and in Costain's opinion, utilising its experience in both cost consultancy and complex delivery, is satisfied that the estimating approach is appropriate, in line with Ofgem Guidance, represents good industry practice and has been accurately compiled to give a fair representation of the work to be undertaken in the London Medium Pressure investment line for RIIO-GD2."

We recognise that the greatest risks to delivering our defined RIIO-2 plan is:

- The changing requirements of our stakeholders specifically driving changes to our construction methodology and timing.
- Emerging works whilst we are on site; such as unforeseen pipe fittings and other services that drive changes to our construction methodology at short notice, introducing delays and additional cost.
- Availability of competent sub-contractors to deliver the defined work-volumes.

We have worked hard during RIIO-1 to develop robust working practices to mitigate these three key programme risks through stakeholder engagement, extensive surveys and pre-planning and developing and maintaining a competent supply chain.

Our DD response provides the detail to give Ofgem the certainty they require that our RIIO-2 plan is deliverable with sufficient rigour on costs and delivery timescales; we have also given this additional detail to satisfy the requirements of Ofgem's bespoke re-opener at a programme level.

Three detailed supporting documents are included in the Annex to Cadent Question 5, to provide further detail.

LMP Summary document

The Summary Document provides an overview of our response covering our reasoning behind challenging Ofgem's alternative proposal of a bespoke re-opener. It includes a reminder of our needscase for the LMP programme accompanied by a summary of the stakeholder support we have for our plan with key learning from RIIO-1 on TFLs and local highway authorities' preferred traffic management methodologies and constraints around road-occupation. We discuss why our commercial approach in RIIO-1 is efficient and market-tested and a robust basis for pricing RIIO-2. We also consider how our approach delivers optimum, low-cost solutions and provides certainty: The innovation in planning, design and construction achieved during RIIO-1 and improvements expected through our RIIO-2 commercial approach. A summary of our more specific RIIO-2 plan, and the supporting technical detail and associated scope, demonstrating that our preferred solutions are least-cost, optimum and deliverable. Finally, we consider the revised RIIO-2 costs, cost profile, including efficiencies and results of our refreshed Cost-Benefit Analysis and overall conclusions.

LMP Technical document

The Technical Document including stakeholder engagement explains the RIIO-2 scope of work in detail per section. Our approach to the planning, design and construction, how we have selected the optimum solution which minimises delivery-risk and cost, improving certainty of delivery, while providing a safe long-term solution. This technical detail has then been used with the unit costs explained in our commercial document to explain the costs and associated cost profile for the revised work phasing. Where solution-options exist, we have explained our reasoning for the preferred solution.

LMP Commercial document

The Commercial document details how we have tested the market, innovated and driven efficiency in RIIO-1, and how we intend to continue to improve efficiency through RIIO-2. The document explains the basis for our unit costs, how these build on innovation and learning during RIIO-1, how we have market tested these rates and why they are efficient.

Capacity Upgrades

In response to the Capital Projects PCDs we have provided our response on Capacity Upgrades in this question.

Ofgem's current proposal, for our Capacity Upgrades at both NTS and PRS sites applies a 28% reduction to the funds included in the BPDTs. We do not agree with the scale of reduction in costs which Ofgem have proposed, it will not provide the necessary funding to deliver this work.

1. There are mathematical errors in the BPDTs table which Ofgem are already aware of and need to be corrected (Ref Cadent SQ_CA_23) to remove costs from the NL network and to incorporate additional funding in the EoE.

2. We accept Ofgem's challenge on removing the "10% uncertainty" & "risks associated with delivery of the solution" from the cost breakdown included within the study outputs, this was a double count.
3. We note Ofgem's challenge on our Cadent direct costs, our latest view is that these are in the range of 13%-16%. As such our December position (16%) for these complex projects remains appropriate.
4. Our latest work at Dawley shows a 65% cost increase above what was submitted in December 2019; significant complexities have been identified following further survey, design work and stakeholder engagement. Risks such as these are evident across this work area and lead us to use of a higher contingency cost in our December submission.
5. We have progressed with further design work and risk assessments and have improved our quantification of risks; we now estimate that the level of contingency risk is in a range between 30% to 35%. Our experience with Dawley demonstrates that our scope is lean and that an allowance in this range is reasonable.
6. Points 1 and 2 are mathematical corrections to the December plan. Points 3 and 5 show that our December plan is still within the forecast outcome range based on the latest information we have. With these adjustments a reduction in costs compared to our December position can be achieved, as set out in the table below. The scale of reduction proposed by Ofgem in DD would not fund maintaining resilience to comply with our Licence obligations for 1 in 20 supply resilience.

Capacity Upgrades	December Plan as per BPDT	March 20 Plan as per SQ[1]	Ofgem Proposal in Draft Determination	Outturn range forecast[2]
EoE NTS				
EoE PRS				
NW PRS				

[1] Adjusting for the mathematical error discussed in this document for EoE and NL, as set out in SQ_CA_23 (20 Mar '20). Point 1 above.

[2] Based on 13-16% direct cost and 30-35% contingency

Capacity Upgrades	December Plan as per BPDT	March 20 Plan as per SQ[1]	Ofgem Proposal in Draft Determination	Outturn range forecast[2]
NL PRS				
WM PRS				

Table 1:Revised Proposal for Capacity Upgrades as part of Draft Determination

Further supporting evidence for this response is included in the Annex to Cadent Question 5.

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Appendix 09.64 Engineering Justification Paper:

HP Pipeline Isolation Valves (>7 bar)

RIIO-2 Spend: £13.63m

Investment Decision Pack Overview

This Asset Health Engineering Justification Framework outlines the scope, costs and benefits for our proposals. As this work is safety mandated, we have not developed a cost-benefit analysis (CBA).

Overview

Cadent has 3,060 Critical HP Pipeline Isolation Valves (operating at >7 bar pressure).

These valves are a critical safety feature within our Local Transmission System (LTS) and allow us to safely isolate specific pipeline sections in case of a pipeline failure, or to deliver maintenance work. An escape from an HP pipeline, if it is not controlled quickly enough, will not only cause a large release of natural gas, which is detrimental to the environment but could also lead to failure of the downstream gas distribution systems, causing widespread loss of supply to domestic and commercial consumers, including the most vulnerable.

Isolation valves enable compliance with Pipeline Safety Regulations (PSR) 1996 (in particular, Regulations 6 and 13), and Gas Safety (Management) Regulation 1996 (specifically, Regulation 7(4))

Most of these valves were installed when the pipeline was originally constructed (up to 63 years ago in the case of the Cow Lane pipeline in East Anglia). They have been subjected to various routine maintenance regimes and have required limited remediation since. However, through our maintenance and survey programmes are now recording indications of deterioration ('wear out failures'). Our visual inspection programme during RIIO-1 has raised issues around the operability and accessibility of valves. In response, we are undertaking an increasing number of interventions in RIIO-1, including rebuilding chambers which have collapsed following third-party work, reinstating pressure points which have aged or been damaged and, in a few instances, more comprehensive interventions to fully replace failed or leaking valve units. Increased intervention is to be expected as the assets age.

If valves are not accessible, for instance, due to being tarmacked over during roadworks or otherwise difficult to approach due to land changes, additional time will be needed to locate them. If they are found to be inoperable from the surface, excavation will need to be carried out (this is normally deep excavation). If the valve is found to be ceased or inoperable upon access, the pipeline will then need to be physically disconnected by specialist 'bagging off' or stopple operations. Every added minute could mean an avoidable increased risk to life and property. We therefore intend, through this continued investment, to assure ourselves that we have appropriate plans in place for the maintenance of our HP valves.

In recent years the role of our HP network has changed significantly. It now provides storage (resilience) as well as transportation of gas. As such, the consequences of pipeline failure are greater now than they were prior to the start of RIIO-1. Loss of an extended section of HP pipeline, due to operational failure or the inaccessibility of intermediate valves, would remove our ability to efficiently use line-pack storage and will increase the likelihood of loss of supply.

In our December 2019 submission, we applied for Capex allowances for HP pipeline valves through an Uncertainty Mechanism, designed to operate as a volume driver responding to both known and emerging issues. This application was rejected by Ofgem who stated that the modelled opex allowances will be sufficient to cover this work. We disagree with this rejection of capex allowances (which were available in RIIO-1) and, in absence of a volume driver, we are proposing to invest in a known volume of faults, directly extracted from our most recent survey reports, through a base capex allowance. This aligns to the low case scenario presented in December - no allowance for newly identified work, a major area of uncertainty, has been added. Whilst new work will emerge in period we cannot confidently quantify the associated costs and volumes.

We propose to invest in 237 valves which are either buried (thereby, inhibiting full maintenance) or have a known fault that requires a permanent intervention (not actionable under routine maintenance Opex allowances). Temporary safety measures, including atmospheric gas checks and visual inspections, are in place for these valves in the interim. Given our experience during RIIO-1, we are confident that the program of intervening on all the identified faults can be efficiently delivered in RIIO-2.

Summary of preferred option	£m
RIIO-2 Expenditure	£13.63
NPV	N/A

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2. Introduction

This document sets out the investment case methodology for interventions on our HP Pipeline Isolation Valve assets within our four Cadent Gas distribution networks, previously covered under the Uncertainty Mechanism Appendix 10.15. The investment for HP pipeline inspections and general maintenance will continue to be covered under base Opex and is excluded from this investment case document.

The valves within the scope of this investment case can be further broken down into the following categories:

High Pressure (>7 barg)

- Line Valves
- Block Valves
- PIG Trap Valves

This document covers investment in only the HP valves that are classified as 'Critical' (i.e. valves that directly affect the flow of gas when operated for the isolation of pipe or plant to allow for essential maintenance or to contain a safety incident). Two examples of our critical HP pipeline valves are:

- Single-feed valve at Warton, East Midlands serving an estimated 155,250 customers with a typical flow of 124.2 kscm/hr through the valve
- Barnet Way valve in London with a typical flow of 326 kscm/hr serving an estimated 407,500 customers in an integrated network.

Any fault on these valves may result in interruption of gas supply to large numbers of commercial and domestic customers and as such, this asset category has a very high customer impact.

Cadent has 3,060 Critical HP Pipeline Isolation Valves operating at >7 bar pressure. We propose to invest in 237 valves which are either buried or have a known fault that requires a permanent intervention. These 237 valves have either been identified as inaccessibly buried or having a fault that requires excavation and correction through intrusive interventions. We have used the two most recent years' (2018/19 and 2019/20) annual maintenance survey data, adjusted for work planned before the end of RIIO-1, to identify these assets. Temporary safety measures including atmospheric gas checks and visual inspections are in place for these valves in the interim.

These valves are a critical safety feature within our Local Transmission System (LTS) and allow us to isolate specific areas in case of a pipeline failure or to safely undertake maintenance work with minimal customer impact.

Isolation valves enable our compliance with Pipeline Safety Regulations (PSR) 1996 (in particular, Regulations 6 and 13) and Gas Safety (Management) Regulation 1996 (specifically, Regulation 7(4))

Ofgem's Draft Determination document, "CD-O-14-A Cadent SPIV Deep Dive Report" for Strategic Pipeline Isolation Valves (SPIVs), within the Intermediate Pressure (IP) and Medium Pressure (MP) ranges, states regarding interventions on SPIVs:

"The work is safety driven to ensure compliance to the Pipeline Safety Regulations 1996 (PSR). It is reasonable that the work is required and should go ahead. A valve is a safety device required for maintenance and emergency activities. Subsequently valves should be maintained to ensure they are accessible and operable."

This assessment would also apply to valves in the high-pressure (HP) range, which are inherently more important to the safety and security of supply of the network than those in the intermediate-pressure (IP) or medium-pressure (MP) ranges, because they serve larger areas of network and carry gas at pressure.

In the event of an emergency from an uncontrolled escape of high-pressure gas (e.g. through third-party damage or pipeline failure), it will be necessary to operate valves quickly to contain and control the situation, make the network safe and limit supply interruptions and the loss of life and property. If a valve cannot be used because it is in poor condition (with mechanical issues such as a frozen gearbox or failing sealing faces within the valve) or it is inaccessibly buried or unlocatable (due to being tarmacked over for example), alternative measures would need to be considered such as:

- Locating a valve further upstream
- Isolating the flow at an upstream above-ground installation.

- Excavating and installing a physical flow-stop in the gas pipework

All these alternative options could delay the safe isolation of the pipeline or asset involved in an emergency and increase the health and safety risk to customers and our operatives; they also increase operational costs (for routine maintenance and emergency operations) and environmental damage. Moreover, the first two options can substantially increase the number of customers who could lose supply.

Cadent had an allowance of £m (2018/19 price base) in RIIO-1 to intervene on the highest-risk valves. We are forecasting to overspend by 19.3% to manage the risks these assets present in period. During RIIO-1, we have focused on valves which were either leaking (failed) or those with a condition that posed imminent threats to safety or security of supply and, at the same time, we have continued to survey all Critical Valves annually and all Non-Critical Valves bi-annually. During these inspections, routine maintenance tasks such as re-greasing of moving parts or small repairs are being carried out as standard practice; these routine tasks are counted within our Opex allowances.

However, these routine maintenance tasks do not extend to full or partial replacements, extensive excavation work or hot works like the welding of missing pressure or logger points. Such expenditure has been documented under Capex allowances.

We have not used CBA to inform our valve investment case, recognising that we have a critical safety mandate to ensure that suitable isolation valves are provided to protect our employees and the public from gas escapes and other emergency events. This position has been accepted by Ofgem. The probability of an emergency event (i.e. loss of life and property due to a gas escape) is low, but the consequence of such an event is very high for these major pipelines. Given the move away from fixed storage assets to increased use of line-packing, the asset management requirements of our HP pipelines have also changed in recent years, consequently increasing our reliance on operational and accessible HP pipeline valves.

This is an ongoing programme of work to ensure compliance (i.e. that our valves would, in the case of an incident, be able to effectively isolate the network as per their design and to meet the performance requirements of GS(M)R Regulation 7 to safely prevent gas escaping within 12 hours).

In our December 2019 submission, we outlined a volume driver to fund work to maintain our HP valves in an efficient state, efficient working order and in good repair. We applied for Capex allowances for HP pipeline valves through an Uncertainty Mechanism, designed to operate as a volume driver responding to both known issues and issues arising from inspection in period. This proposal was rejected by Ofgem as they stated that Cadent have ‘sufficient baseline allowance through modelled opex’ for this work and that there is ‘insufficient justification of the materiality of the uncertainty’.

We agree with Ofgem that there is sufficient opex in the baseline for valve inspection and routine maintenance. However, it is important to note that the work set out here is for capital interventions, similar to those funded by Ofgem in RIIO-1. As such, we disagree that these opex allowances are adequate or appropriate to fund non-routine capital activities. This would be a change in Ofgem policy from RIIO-1, where a specific allowance, although insufficient, was made for capital interventions on HP valves. As such, Final Determinations should include sufficient allowances to enable delivery of this critical work.

We proposed to deliver this work through a volume driver in our December plan, rather than via an ex ante allowance as per RIIO-1, as there could be variance between our best forecast of what capital work our valve inspections and routine maintenance would identify and what may be found. As such, we felt a volume driver would better protect our customers from any deviation from forecast to actual. However, in absence of a volume driver, we are proposing to invest in a known volume of faults through a base capex allowance. This is a certain least-case scenario (no allowance for newly identified work, a major area of forecast uncertainty): the work is made up of known faults directly extracted from our most recent survey reports. The change in regulatory treatment is set out in section 4.3 and 9.4.

The work set out here should be monitored in the same way as the MP/IP valves programme which Ofgem have supported in the DD i.e. within the capital projects PCD. Although, as set out in GDQ22&23, that mechanism requires rework ahead of final proposals.

3. Equipment Summary

The equipment covered by this investment case is critical valves situated on the High-Pressure (>7 bar) pipeline network.

This includes:

- Line Valves: Valves located on the pipeline
- PIG Trap Valves: Valves located at PIG Trap sites which enable safe internal inspection of the HP pipeline
- Block Valves: Also situated on the HP pipeline (like line valves); block valves are located within fenced Cadent boundaries

This does not include non-critical valves on the HP network, such as operational and bypass valves (not in the line of gas flow, only required to facilitate maintenance activities) or redundant valves

The table below provides a per-network split of Critical HP Pipeline Valves:

Critical HP Pipeline Valves' Population	Line Valves	Block Valves	PIG Trap Valves	Total
EA	148	32	523	**703**
EM	34	59	439	**532**
NL	28	132	433	**593**
NW	462	22	408	**892**
WM	3	101	236	**340**
Total	675	346	2,039	**3,060**

Table 1: Critical HP Pipeline Valves Asset Stock[1]

1 Source for pipeline population data is Aug 2020's SAP extract provided by the Cadent Data team

4. Problem Statement

What is the outcome that we want to achieve, why are we doing this work and what happens if we do nothing?

We need to ensure that our network is safe to operate, specifically that we comply with the requirements of PSR 96 and GS(M)R 96. This means that, in the event of an incident such as that described below, we can easily locate and rapidly operate our HP Pipeline Valves, allowing us to manage the incident.

The investment in remediating and maintaining HP Valves will ensure that our network can be safely and effectively operated and has appropriate safeguards in place in the event of an emergency gas escape or an operational emergency. Investment will allow us to reliably isolate key areas of the gas network to limit the uncontrolled release of gas and the related risk of fire or explosion.

Failure to have a capital investment remediation programme of work in place to address known faults and/or inaccessible valves in addition to routine maintenance could lead to non-compliance with PSR and to enforcement from the HSE. Although a non-compliant valve does not present an immediate hazard, a pipeline failure cannot be effectively controlled without operational valves.

If the closest valve is non-operational, the next operational valve in the line may be used (or an excavation and flow stop operation conducted – a 'stopple'). However, this delays the time taken to respond to an incident and also widens the impact of the event (potentially cutting off more customers).

How will we understand if the spend has been successful?

This investment will enable remediation of the 237 identified valves, however, does not cater for similar faults that are identified during RIIO-2. The routine inspections and maintenance activities will continue under the separate opex allowance to ensure that we continue to keep our pipeline valves in an efficient order and in good repair (in compliance with PSR 96 – Regulation 13). The opex activities, together with this specific Capex investment into known failures will ensure that our critical HP valves are accessible and operable or, if a fault has been identified in-period, then such a fault has been included within a planned programme of work, with suitable additional safety precautions in place until resolution of the identified issue.

As such, on completion of this programme of work, we would be confident that our critical HP valves population (apart from failures identified during RIIO-2) can be located and will operate as designed in the case of an emergency or to support proactive maintenance work.

Investment Drivers

HP Valves are used infrequently but it is critical that they function reliably in the event of an emergency, to protect the safety of our employees, the general public and customers. An uncontrolled gas escape, through the lack of effective isolation, is unacceptable.

Pipeline Safety Regulations are clear on operator's requirements; these are absolute duties.

Reference of Applicable UK Legislation	HSE Guidance	How the Proposed Investment Enables Cadent to Meet Legislation Obligations
Pipeline Safety Regulations (PSR – 1996) Regulation 6 Safety systems "The operator shall ensure that no fluid is conveyed in a pipeline unless it has been provided with such safety systems as are necessary for securing that, so far as is reasonably practicable, persons are protected from risk to their health or safety."	The pipeline should be provided with such safety systems, as necessary, to protect people from risk. Safety systems cover means of protection such as emergency shut-down valves and shut-off valves which operate on demand or fail safe in the closed position, so minimising loss of containment of the pipeline inventory.	Critical HP valves are one of the most critical components of our 'safety system' on HP pipelines. A continued provision of accessible and operable 'shut-off valves' is a requirement of this regulation. This specific investment ensures our compliance with the requirement that our valves 'operate on demand' to protect the lives and property of our operatives and members of the public.
Pipeline Safety Regulations (PSR – 1996) Regulation 13 Maintenance "The operator shall ensure that a pipeline is maintained in an efficient state, in efficient working order and in good repair."	This regulation deals with the requirement to **maintain the pipeline to secure its safe operation** and to prevent loss of containment. Maintenance is essential to ensure that the pipeline remains in a safe condition and is fit for purpose. It is important to recognise that a **pipeline includes associated equipment such as valves**, bridles and other primary attachments. It may also include launch and reception pig traps. These should be maintained, as necessary, to ensure that they are kept in efficient working order. Maintenance under this regulation also includes maintaining any safety system associated with the pipeline	Fixing identified faults and known issues (i.e. 237, as per our recent survey data) within our valves' population is a core requirement of ensuring the pipeline is in kept in an 'efficient state, in efficient working order and in good repair'.

	which has been provided to secure its safe operation.	
Gas Safety (Management) Regulations – (GS(M)R - 1996) Regulation 7(4) "Where any gas escapes from a network the person conveying the gas in the part of the network from which the gas escapes shall, as soon as is reasonably practicable after being so informed of the escape, attend the place where the gas is escaping, and within 12 hours of being so informed of the escape, he shall prevent the gas escaping."	An inability to immediately access or operate the nearest isolation valves would result in either an **unreasonable delay** or that additional sections of pipeline would need to be isolated, **significantly increasing the scope of loss of supply to the customers**.	The availability of operable and accessible HP isolation valves on pipelines and around offtakes is fundamental to the management of any leak from the high-pressure system.

Table 2: Extracts from HSE publication: A guide to the Pipelines Safety Regulations 1996 (ISBN: 9780717611829) and Extract from Gas Safety (Management) Regulations 1996

4.1. Narrative Real-life Example of Problem

4.1.1 San Bruno, California Pipeline Explosion:

In 2010, a pipeline explosion within Glenview residential area of San Bruno in California resulted in eight deaths. The incident was caused by an unmanaged welded seam defect on a 30-inch gas pipeline, which caused the pipeline to rupture and explode. The incident resulted in over $4.2 billion in losses for PG&E in compensations and federal and state penalties.

After PG&E received calls about the fire, they dispatched technicians, who closed the upstream and downstream valves, which were both located approximately one mile away from the rupture. This was the first response from the network operator.

In this case, the valves were easy to locate and operable. However, PG&E still took 95 minutes to stop the flow of gas and to isolate the rupture site. This response time was considered by subsequent formal investigations as 'excessively long'. It contributed to the extent and severity of property damage and increased the life-threatening risks to the residents and emergency responders. The fire continued its devastation of the neighbourhood area and killed 8 people, injured 66, damaged or destroyed 55 homes and consumed 15 acres of land.

Figure 1: Images from San Bruno, California pipeline explosion incident

If the valves had not been operable and a wider shut had been required or an excavation needed to deploy a stopple, the situation would have been even worse. The case shows the absolute criticality of having pipeline valves that are quickly and easily accessible and operable so that any emergency incidents like this can be contained as soon as reasonably practicable.

If valves are not accessible, for instance, due to being tarmacked over during roadworks or overgrown with vegetation or otherwise difficult to approach due to land changes, additional time will be needed to locate them. If they are found to be inoperable from the surface, excavation will need to be carried out (which normally will be a deep excavation for HP valves and will require appropriate deep excavation management procedures to ensure the safety of our operatives). If the valve is found to be ceased or inoperable upon access, the pipeline will then need to be physically disconnected by 'bagging off' or stopple operations, which are carried out by specialist contractors. Every added minute could mean an avoidable increased risk to life and property. We therefore intend, through this proposed investment, to assure ourselves that we have appropriate plans in place for the maintenance of our HP valves.

Our leading indicator is compliance with the PSR '96, Regulation 13 which states: *"the operator shall ensure that a pipeline is maintained in an efficient state, in efficient working order and in good repair."* We operate a valve-maintenance regime to discharge our obligations under this regulation. To ensure that our population of critical HP valves is maintained in an operable state and in good working order, we are proposing that, in

addition to ongoing visual inspections, general maintenance and temporary solutions and mitigations, we carry out permanent repairs to faulty valves and excavate to make buried valves accessible and operable.

Where a chamber does not exist (or a valve has become buried), assurance of compliance can only be gained through excavating the valve, analysing its physical condition and ensuring access and operability are maintained.

4.1.2. Valve Remediation on Silfield to Kilverston Pipeline Valve:

In 2012, we recorded one HP valve failure where pipeline isolation was needed to contain an emergency and isolation valves were found to be inaccessible and inoperable.

The Silfield to Kilverston 19-bar pipeline (pipeline ID number 1641), operated by Cadent, was damaged by a third party ploughing a previously uncultivated section of a field in 2012. The pipeline was punctured allowing the subsequent release of gas.

The valves required to isolate the pipeline section were quickly identified. They were marked on plans and known to the local manager. However, the teams arriving on site found that the main-line valves were not all readily accessible for operation. The pressure points, which allow an operator to confirm that a valve has sealed and shut the pipeline, were also in poor condition due to being inaccessible and difficult to maintain routinely.

Due to the inability to access the valves and pressure points, external contractor teams with specialist mechanical excavation equipment were called in to do this emergency work. This caused a delay of nearly 24 hours to isolate the pipeline. Fortunately, this was a remote rural location, where the exclusion area around the damage and escaping gas was easily managed. However, the uncontrolled release of high-pressure gas did result in substantial environmental and commercial loss.

This incident provided us with a lagging indicator of failure, where the asset had failed, and the consequences were realised. In this case, the impact was low due to it being a remote rural area.

4.2. Spend Boundaries

The equipment covered by this investment case is >7 bar valves. Within the HP valves population, we will only be intervening proactively where the valve is within the flow of gas (i.e. it is a Critical Valve). Capex interventions have not been suggested for non-critical (construction or redundant) valves to prioritise investments into the most critical assets and to be appropriately conservative in our proposed allowance requirement without leaving us non-compliant with our legal obligations. The Critical Valves can be within one of the following three valve types:

- Line Valve
- PIG Trap Valve
- Block Valve

All valves which do not fall under the definition of Critical HP Pipeline Valves are excluded from the scope of this paper. This includes above-ground valves (non-pipeline valves) found at our Pressure Reduction Installations (PRI) and associated site isolation valves. Also excluded are the pipeline valves within the IP or MP pressure tiers (covered separately under Appendix 09.31) and all LP valves.

Also excluded are Opex interventions on valve population (e.g. inspection and general maintenance of its pressure points, rider points, valve plates, turning mechanism and its chamber and lid).

From our experience of remediating these valves in RIIO-1, it is anticipated that the required interventions will vary from valve to valve in the complexity (and cost) in resolving observed issues. We expect to find that some of the following activities are required during this work:

1) Full replacement of valves (including installation of new pressure and rider points)
2) Partial replacement of the system (which may include installation of new valves but keeping the pressure and rider points intact, or vice versa)
3) Refurbishment of valve components

4) Refurbishment of damaged valve chambers, pits and covers

There is no overlap between this and other pipeline investment lines. It has been carefully ensured that the capital investments associated with interventions into our critical HP valves are not included in the pipeline interventions or PIG trap intervention investment lines. There is also no identified inter-dependency of this work with any other work and as such this programme can be initiated independently.

4.3 Our Submitted Uncertainty Mechanism Case

In our December 2019 submission, we outlined a volume driver to fund work to maintain the condition and operability of valves on our high-pressure network. This application was rejected by Ofgem who referenced 'insufficient justification of the materiality of the uncertainty' and 'sufficient baseline allowance through modelled opex'.

We disagree with the removal of all capital funding for HP valve maintenance, investment is required to ensure we maintain compliance with safety legislation. The required work is not funded within our opex allowance and as such Ofgem are not providing funding to manage a known safety risk.

The levels of uncertainty have not materially changed since December – we are still managing an ageing asset to a strict standard of compliance – although we do have further survey data to help inform our position on known work volumes. Similarly, the desire to protect customers from an inflated base position, which is then not required in period, remains; which is why we are proposing to only invest in the known failures, as extracted from our most recent two-years' survey data (adjusted for work to be delivered before the end of RIIO-1).

Within our UM documentation, we presented a Monte Carlo analysis estimating the allowances that will be required for delivering the known and forecasted RIIO-2 workload for HP pipeline valves. We presented a mean cost of £m and a minimum cost of £m through this modelling. However, further to the rejection of this approach, in our current submission (£m), we have decided to submit the allowance request to cater only for the known workload as identified by our most recent surveys. This protects the customers from an over-forecast and also allows us to maintain our mandatory compliance with PSR 96 and GS(M)R 96.

To progress from Ofgem's draft determination position we are proposing the inclusion of funding in the base plan as set out in this document. The volume of work being put forward is taken from known issues that will not be resolved by the end of RIIO-1. This known work volume is, although calculated by a different method, equivalent to the minimum value proposed under the UM. This does leave the company with the potential for additional in period costs arising from survey work in the last year of RIIO-1 or emerging in RIIO-2. We propose that this risk could be mitigated by short term monitoring solutions, by trading with items in the defined valve workstack to maintain compliance or by additional funding by the company reimbursed partially through TIM.

With regards to 'sufficient baseline allowance though our modelled opex', it is important to note that the work set out here is for capital interventions. We agree with Ofgem that there is sufficient opex in the baseline for valve inspection and routine maintenance. We disagree that this is adequate or appropriate to fund non-routine capital activities. In RIIO-1 a specific (inadequate) allowance was made for capital interventions on HP valves. Our December plan proposed that a capital allowance should be made through the volume driver, our response to draft determination sets out that it should be part of our base allowance. Without this correction a significant unfunded safety risk will remain, this is clearly not in customers interests.

5. Probability of failure data assurance

We are certain of the failure data used to build this investment case, it is based on known (emerged) risks rather than the probability of new failures arising.

A valve is defined to have failed the visual assessment if at least one of the criteria below is fulfilled:

- Safe access is not available
- Operability is not available or cannot be verified
- Physical surface condition is unacceptably poor
- Appropriate equipment for the safe and efficient operation of a valve is not present (including rider and pressure points either side of the valve, valve pit and chamber, lid and marker plates)

We have recorded a variety of failures within our RIIO-1 survey programme and, using our RIIO-1 allowance and Cadent funds, we have intervened on the highest-risk failures on most critical valves serving a high population of our customers. Within the remaining population, our survey results indicate the following common issues.

Buried Valves:

This is where the valve is either completely buried with no access chambers for the valve and/or the pressure and rider points upstream and downstream of the valve. Excavation is inevitable in order to accurately locate the valve and the pressure and rider points and, thereafter, depending on their condition, these assets are replaced or refurbished. Appropriate chambers and lids are then installed for ease of future access. Considerable excavation (typically deep excavation requiring appropriate shuttering for safe working) and traffic management is usually linked to this work activity.

Faulty Valves:

A valve is included in this category when all lids for the valve and its pressure and rider points are visible, yet intervention is still required to refurbish lids, marker plates and chambers, for example, and regain assurance on the operability and accessibility of the valves, pressure points and rider points. These refurbishment and assurance activities are essential to ensuring our compliance with PSR ’96 – Regulation 13. It includes the replacement of failed concrete Gattic covers with their lighter composite-material counterparts.

This plan is based on known issues identified during RIIO-1 survey programme which require intervention. We, therefore, have a high level of confidence that the failure volumes are accurate. More issues may be identified during the surveys carried out in RIIO-2. However, our UM approach for such an unforeseen workload has been rejected by Ofgem within the Draft Determination. We are therefore only requesting allowance for a known and certain amount of work, completion of which is necessary to ensure continued compliance with our obligations under PSR ’96.

6. Consequence of Failure

A failure of a strategic isolation valve has no immediate impact on Cadent’s operations. The impact will materialise when a gas escape is detected, which then relies on the failed valve for isolation or when the valve is required to enable maintenance activities. However, any failed asset does constitute a breach of Pipeline Safety Regulations (1996).

Cadent’s comprehensive programme of asset inspection and maintenance across its pipelines means that the probability of a gas escape on these protected pipelines is low. However, as we have seen in the San Bruno, California, example, the consequences are potentially high.

The failure of the HP pipeline valve (defined as the valve being either inoperable or inaccessible), combined with an operational emergency, can have the following consequences:

- **Safety impact** from the failure: the gas escape or damage from an ongoing fire would go on for longer.
- **Loss of supply to a greater number of customers**: the use of a different valve further upstream or gas isolation at the upstream PRI within the network would be required, potentially causing supply interruptions to a greater number of customers.

- **Environmental damage:** the delay in providing effective isolation would lead to an increase in released methane gas, subsequently increasing the environmental damage.
- **Significant costs to deal with the emergency:** if a valve is inoperable, the business will need to mobilise resources (generally expensive specialist teams) to carry out an emergency stopple on the pipe, which involves a complete excavation around the pipe and physical insertion of air bags within the pipeline to temporarily stop the flow.

Although their may be variations in future gas demand, there is currently no scenario under which the valves identified in this programme would become none critical. The HP network is the core around which our local supply networks exist.

7. Options considered

7.1 Deriving valve remediation unit costs

To estimate the size and scale of valve remediation for our RIIO-2 programme of work, we have used the cost intelligence gained within the RIIO-1 remediation programme. An estimation was made of the potential scale of works required to make each valve compliant with PSR '96 in terms of being in good repair and working order.

We shared the following unit cost estimates within our previously submitted UM document:

HP Valves Intervention Unit Cost Range		
Network	Low Complexity	High Complexity
EoE		
Lon		
NW		
WM		

Table 3: HP Valves Intervention Unit Cost Range (£) – 2018/19 Prices

7.2 Intervention Options Considered:

Individual valve interventions will be specific to the failures in compliance identified. However, at a programme level, we have considered options around the rate of survey and intervention to ensure compliance. This analysis hinges on the reasonably practicable rate of investment delivery:

- Baseline: Fix the valve upon pipeline failure
- Option 1: Remediate all deficient valves during RIIO-2 (5-year program)
- Option 2: Remediate all remaining valves during RIIO-2 and RIIO-3 (10-year program)

Within option 1 and 2 we would prioritise intervention based on valve criticality and condition.

Whilst monitoring and reporting provides a short-term risk management option, failure to permanently address new faults will gradually compound network risk as more and more control points (valves) become inoperable. As such pure operational maintenance will not allow us to meet our legislative requirements.

7.3 Baseline: Fix the valve upon failure

This option is the 'do-minimum' or baseline case. In this scenario, we would stop proactive surveys and maintenance activity on our valves or continue survey work but take no corrective action on any faults or non-compliances found. This would allow issues to develop, un-remediated, on our HP valves. When the valve is required to shut the pipeline for either maintenance or under emergency circumstances, we would then intervene to make repairs.

The likelihood of a gas escape on a strategic gas pipeline is low because of the several layers of pipeline protection provisions (including, but not limited to pipeline coating, cathodic protection, line walking and aerial surveillance). However, the impact is potentially very high, as outlined above.

This option, although lower cost in the short term, does not enable us to fulfil our legal obligations and the safety standards our customers or regulators expect and has therefore been discounted.

7.4 Options 1 and 2: Proactively inspect and remediate the valves

Our visual surveys of HP valves, undertaken during RIIO-1, identified various non-compliances within the asset portfolio (such as inaccessibly buried valves or missing pressure and rider points). However, the precise scope and scale of non-compliance and the subsequently required interventions, particularly on buried valves, will not be clear until more intrusive interventions are carried out on all the valves not remediated within RIIO-1.

The following table shows the population of valves that will need intervention after completion of the RIIO-1 intervention programme as per indications from inspections carried out during 2018/19 and 2019/20:

HP Critical Valve Types	EA	EM	NL	NW	WM	Total
Line Valves (Inaccessibly Buried)	6	4	7	5	0	22
Block Valves (Inaccessibly Buried)	0	2	6	2	1	11
Remotely Operable Block Valves (Inaccessibly Buried)	0	0	0	0	0	0
Pig Trap Valves (Inaccessibly Buried)	4	0	2	3	0	9
Remotely Operable Pig Trap Valves (Inaccessibly Buried)	0	0	0	0	0	0
Line Valves (Faulty)	6	8	0	2	0	16
Block Valves (Faulty)	7	24	15	0	32	78
Remotely Operable Block Valves (Faulty)	0	0	0	0	2	2
Pig Trap Valves (Faulty)	14	9	26	7	39	95
Remotely Operable Pig Trap Valves (Faulty)	0	0	0	0	4	4
Total	**37**	**47**	**56**	**19**	**78**	**237**

Table 4: Population of HP valves requiring RIIO-2 interventions

For RIIO-2 and RIIO-3, we have looked at an appropriate intervention rate which allows us to manage the risk on our critical valves while being deliverable and affordable to customers.

We have considered two different rates of remediation.

Option 1: Remediating all valves over RIIO-2 (Chosen)

Option 2: Remediating all valves over RIIO-2 and RIIO-3

Option 1: Complete All Interventions in RIIO-2 (Chosen)

Given the importance of this work, driven by legislative compliance and safety, and the fact there is a relatively small number of valve interventions required per network, there is not a strong justification to delay the completion of this work to RIIO-3. Completing all this work within the five RIIO-2 years will be operationally deliverable and therefore will be carried out under controlled unit costs, ensuring affordability for our customers. This will also ensure that resolution of non-compliances is carried out as soon as reasonably practicable. It is also expected that we will identify further non-compliances during RIIO-2 through maintenance activities which will form the basis of the RIIO-3 workload.

We have therefore developed a workload based on spreading intervention across RIIO-2 only. Until the identified buried and faulty valves are fully fixed, we will continue to carry out mitigatory visual and leakage safety checks.

The following table shows our proposed average annual valve remediation volumes by region throughout RIIO-2 for Option 1:

Distribution Network	2021/22	2022/23	2023/24	2024/25	2025/26	Total
EoE	17	17	17	17	16	**84**
NL	12	11	11	11	11	**56**
NW	4	4	4	4	3	**19**
WM	16	16	16	15	15	**78**
Cadent	**49**	**48**	**48**	**47**	**45**	**237**

Table 5: Option 1: Proposed average annual remediation volumes

Based on evidence from historic interventions in RIIO-1 and on expert judgement from our asset strategy and operational specialists, we estimate that each region will experience at least two jobs each which will be in the high complexity level. Given their sizes, East Anglia and East Midlands have each been allocated two jobs with high complexity levels (therefore giving the EoE network four high-complexity jobs and other three networks two each). The remaining valves have been allocated to the minor intervention category. Therefore, out of the 237 total valves requiring interventions, 10 of them will have high-complexity unit costs in our estimate, and the remaining 227 will have lower-complexity unit costs.

Using the unit costs and complexity levels stated in Section 7.1 and based on the volume profile laid out in Table 5 above, the following RIIO-2 cost (£m) profile is proposed. Note that all RIIO-2 cost profiles used in this document are in 18/19 price base and efficiencies have been applied (reducing costs in later years).

Distribution Network	2021/22	2022/23	2023/24	2024/25	2025/26	Total
EoE						
NL						
NW						
WM						
Cadent						

* Indicates the year where 1 unit of major-intervention unit cost has been applied. This has been applied separately for EoE to give EA and EM two units of major intervention allowance each

Table 6: Option 1: Proposed Annual Intervention Costs (£m) – 2018/19 Price Base and Post-Efficiency

Option 2: Complete All Interventions Over RIIO-2 and RIIO-3

Within this option, the workload has been smoothly spread out across RIIO-2 and RIIO-3. This is not required in our view and would constitute an unreasonable delay in the resolution of identified faults. In addition to the legislative and safety implications of delaying this work, its efficient delivery can be carried out during RIIO-2 alone. The delivery rate would be circa 12% of the volume we will deliver for MP/IP valves.

In addition to unreasonable delays in responding to known faults, new issues will also arise during RIIO-2 increasing the backlog of work.

We have, nonetheless, mapped the volume and cost phasing for this option in the tables below:

RIIO-2 Volumes:

Distribution Network	2021/22	2022/23	2023/24	2024/25	2025/26	Total
EoE	9	9	8	8	8	**42**
NL	6	6	6	5	5	**28**
NW	2	2	2	2	2	**10**
WM	8	8	8	8	7	**39**
Cadent	**25**	**25**	**24**	**23**	**22**	**119**

RIIO-3 Volumes:

Distribution Network	2021/22	2022/23	2023/24	2024/25	2025/26	Total
EoE	8	8	9	9	8	**42**
NL	6	5	5	6	6	**28**
NW	2	2	2	2	1	**9**
WM	8	8	8	7	8	**39**
Cadent	**24**	**23**	**24**	**24**	**23**	**118**

RIIO-2 Costs:

Distribution Network	2021/22	2022/23	2023/24	2024/25	2025/26	Total
EoE						
NL						
NW						
WM						
Cadent						

* Indicates the year where 1 unit of major intervention unit cost has been applied. This has been applied separately for EoE to give EA and EM one units of major intervention allowance each

RIIO-3 Costs:

Distribution Network	2021/22	2022/23	2023/24	2024/25	2025/26	Total
EoE						
NL						
NW						
WM						
Cadent						

* Indicates the year where 1 unit of major intervention unit cost has been applied. This has been applied separately for EoE to give EA and EM one units of major intervention allowance each.

7.5 Options Technical Summary Table

	Baseline	Option 1		Option 2	
Description	Baseline: Reactive fix of valves, once valves have failed	Proactive remediation of valves that have deficiencies noted from valve surveys: Remediate all in RIIO-2 (Chosen)		Proactive remediation of valves that have deficiencies noted from valve surveys: Remediate all in RIIO-2 & 3.	
First year of spend	This option has been discounted because is it critical that we are able to reliably use an HP critical valve in an emergency; pipeline failure is a low-probability but a very high consequence event.	2021/22		2021/22	
Last year of spend		2025/26		2031 /32	
Volumes of intervention		**RIIO-2**	**RIIO-3**	**RIIO-2**	**RIIO-3**
		237 valves (227 Low Complexity and 10 High Complexity)	**0 valves (+ valves identified during RIIO-2)**	**129 (124 Low Complexity and 5 High Complexity)**	**128 (123 Low Complexity and 5 High Complexity) (+ valves identified during RIIO-2)**
Equipment design life		Various; dependent on valve remediation required.		Various; dependent on valve remediation required.	
Total installed cost		**RIIO-2 Total: £*** post efficiency **RIIO-3 Total: None**		**RIIO-2 Total: £m** * post efficiency **RIIO-3 Total: £m** * pre-efficiency	

Table 7: Technical Summary Table

8. Business Case Outline and Discussion

We considered three options for this investment case:

- Baseline: Fix the valve upon pipeline failure
- Option 1: Remediate all deficient valves during RIIO-2 (5-year program)
- Option 2 Remediate all remaining valves during RIIO-2 and RIIO-3 (10-year program)

8.1. Key Business Case Drivers Description

As stated in Section 6, we have not used CBA for this investment programme. The key business-case driver is customer and employee safety and legal compliance with Pipelines Safety Regulations, 1996 and Gas Safety (Management) Regulations 1996. This approach has been accepted by Ofgem in their draft determination for IP and MP valves.

8.3. Business Case Summary

	Baseline: Reactive fix on fail	Option 1: Proactive remediation over 5 years	Option 2: Proactive remediation over 10 years
Proposed capex investment in RIIO-2	Unknown Cost model for this option has not been built as failure data of instances where valves have not functioned in an emergency is not available	£	£m Total RIIO-2 and RIIO-3 cost is £m
Volume of valves to be remediated	N/A	237	129 (Total RIIO-2 and RIIO-3 volume is 237)
Pros	Appears to be a low-cost option – however, it leaves significant risks which, if they emerge, would be very expensive.	Faster improvement in valve condition. Resolution of issues and maintenance of legislative compliance within a reasonably practicable time	Reduction of £m to the RIIO-2 budget
Cons	Non-compliant with Pipelines Safety Regulations and Gas Safety (Management) Regulations Very high risk to safety, security of supply and has legal implications.	Increase RIIO-2 costs (£m more than Option 2)	Delayed interventions will increase the risk of failure despite the temporary mitigations in place. Buried valves, even though being checked for leakage, would remain inaccessible in an emergency situation

Table 8: Business case summary for all options considered.

Our RIIO-2 forecasts, as well as adjusting for workload and work mix factors, also include ongoing efficiencies flowing from our transformation activities including from updating and renewing our contracting strategies. Our initiatives are outlined in Appendix 9.20 Resolving our benchmark performance gap. For Capex activities, this seeks a 2.9% efficiency improvement by 2025/26 on the end of RIIO-1 cost efficiency level. We have not applied specific efficiency to this element of investment.

For HP Valves our confidence is at feasibility stage with a range of +/-35%. This assessment reflects the uncertainty of the work that will be identified following excavation.

9. Preferred Option Scope and Project Plan

9.1. Preferred option

The preferred option is Option 1, to remediate the 237 identified valves over a 5-year RIIO-2 period. In our view, this is the only option which enables our continued legislative compliance whilst ensuring known failures are acted upon in a timely manner (without unnecessary and unreasonable delay).

9.2. Asset Health Project Spend Profile

The table below shows the overall spend profile over RIIO-2 (in £m). This spend is in 2018/19 prices and is post-efficiency:

Distribution Network	2021/22	2022/23	2023/24	2024/25	2025/26	Total
EoE						
NL						
NW						
WM						
Cadent						

Table 9: Preferred spend profile for HP pipeline isolation valves

9.3. Investment Risk Discussions

This programme of work has the following delivery risks:

Reference	Risk Description	Impact	Likelihood	Mitigation /Control
09.31 - 001	Supply & Demand deliverability risk of Resource availability within the Gas industry	Potential cost increases in labour/commodity markets as demand are greater than supply	Low	Intelligent procurement and market testing. Apprenticeship and Training programmes to fill skills gaps
09.31 - 002	Stretching efficiency targets may not be deliverable (unit costs increase)	Outturn costs are not met increasing overall programme costs.	Low	Established market place - ability to manage the known commodity market
09.31 - 003	Unforeseen outages and failures restrict access for planned work	Programme and delivery slippage due to delay of planned outages and or site access	Low	Proactive asset management with ongoing condition

				surveys and response plans to prevent failures
09.31 - 004	Unseasonal weather in 'shoulder months', Autumn and Spring reduce site access/outage windows	Increased demands affecting access to sites and planned outages delay and cost increases	Low	Controlled forecasting and maintenance of flexibility to react to unforeseen events. Detailed design solutions to minimise outages and reduce exposure.
09.31 - 005	Unexpected/uncommunicated obsolescence during RIIO-2 period of equipment components	Inability to maintain equipment at full capacity with risk of impact upon supply	Low	Maintain a close relationship with equipment supply chain and manage a proactive early warning system where spares/replacements become at risk.
09.31 - 006	Legislative change - There is a risk that legislative change will impact the delivery of our work.	Potential increase in the amount of consultation and information exchange required and require us to align our plans with the safety management processes operated by 3rd Party landowner/asset owners. The potential impact is more engagement and slower delivery	Med	We have established management teams to address these issues. We have also identified UMs for key areas.
09.31 - 007	Inability to deliver increased volumes of sites	Supply chain impacts and Contractor confidence	Low	Operations, Contractor and Supply chain engagement. Robust procurement strategy

Table 10: Risk Register

9.4 Regulatory Treatment

This investment will not be processed through the NARMs reporting tool.

Cost variance for low materiality projects such as this will be managed through the Totex Incentive Mechanism (TIM).

This investment for HP Valves was previously accounted for in the Business Plan Data Table 5.18 Bespoke & Uncertain Activities within the Uncertain Activities Sub Table. This, however, has been rejected by Ofgem in the Draft Determination response.

This investment for HP Valves should be accounted for in the Business Plan Data Table 3.01 LTS, Storage & Entry within the LTS Pipelines section under Pipeline (other capex) section on the HP Valves line. We have not be re-submitting the BPDTs as part of our Draft Determination response but can make these updates if requested.

MP/IP Valves have been included in Ofgem's proposed capital projects PCD.

Date: 3 September 2020

Draft Determination Response to London Medium Pressure

Ofgem Question related to this response

Cadent Q5 Do you agree with our proposals on the bespoke UMs? If not, please outline why. [Ofgem requested in their response to Cadent_DDQ_3, for our response on London MP to be covered within this question]

In Ofgem's Draft Determination (DD) for the RIIO-2 regulatory period, the Repex and Capex requested within our December plan Appendix 09.06 for London Medium Pressure was rejected on the grounds that there was

"*insufficient evidence that Cadent had developed its project plan sufficiently to justify funding this project in the baseline. In particular, uncertainty remains over the timing and costs of the project."*

Ofgem's alternative proposal, stated in Chapter 4, was a bespoke re-opener, with two opportunities to trigger the re-opener (Jan 2022 and Jan 2024).

Executive Summary

We disagree with Ofgem's DD proposal of a bespoke re-opener. The stage gate approach is a barrier to an efficient rolling programme and the focus on individual sections fails to take account of the integrated nature of the programme and its benefits. As such the proposed approach is not in the best interests of customers or stakeholders because it will reduce our ability to deliver the LMP programme efficiently and to work effectively with external stakeholders.

The work is essential to maintain safe and reliable supplies to the heart of London. It is supported by critical stakeholders including TfL and the GLA and will reduce disruption, leakage, operating costs and interruptions to supply.

Our December submission set out the required work as a 10-year programme. The LMP programme is inherently challenging and our proposal was designed to allow flexibility to respond to in period challenges and opportunities within the boundaries of a PCD with a high sharing factor. For this reason, our Investment Case submitted in December did not provide specific detail about when sections of the scheme would be delivered across RIIO-2 and RIIO-3.

Since our December submission, we have continued to develop our delivery plan for RIIO-2 and mindful of Ofgem's challenge to provide more certainty around our plans we have committed to a fixed programme of work. This evolution allows us to further demonstrate that our RIIO-2 plan is robust, deliverable and efficient. That it is based on solid engagement with stakeholders, a detailed understanding of the assets we are replacing and the challenges we need to overcome.

Our RIIO-2 plan now focusses on replacing the highest-risk mains in the programme. More complex, higher unit-cost phases of LMP (particularly subway and tunnel works), with greater delivery uncertainty, will be incorporated in RIIO-3 to allow us more time to develop innovative solutions and drive efficiency. This strikes the right balance for our customers and stakeholders.

The resulting Totex for RIIO-2 is £m (£m in our December plan), the programme total remains at £m over 10 years. Innovations and detailed enabling and planning work may lead to reductions in the RIIO-3 totex but this cannot be forecast with confidence at this stage. In our December submission we proposed a specific PCD for the LMP with a totex sharing factor of 15% recognising the lower confidence in costs at this stage of its development. As such 85% of this reduction would have been returned to customers if our December plan had been accepted.

Our response to the draft determination sets out

- A clear needs case, complementing material already submitted in December, and supporting CBA

- A comprehensive project plan and timeline for completion, including evidence of the agreements in place with local authorities
    - Technical specification of each segment, the challenges involved and therefore the numbers of key operations
    - Engagement undertaken with stakeholders, underlining their support for the work and the specific (RIIO-2: Year 1) or in-principle (latter RIIO-2) agreements we have for the delivery of the programme
- Well justified costs, including evidence of market testing and of full consideration of innovative techniques to lower costs
    - The basis of our unit costs and how these unit rates have been market tested, demonstrating an efficient cost of delivery
    - How we have used innovation in our planning, design and construction phases to reduce cost, minimise disruption and maximise safety, to develop the optimum solution at least cost, yet minimises delivery risk.
    - Our proposed commercial approach and how this will drive competition and support cost-certainty.
    - We have had our costs independently assured by Costain, who have looked at our basis of costs and scope of work to verify that these are robust, evidence-based and efficient. Costain state:

      "in Costain's opinion, utilising its experience in both cost consultancy and complex delivery, is satisfied that the estimating approach is appropriate, in line with Ofgem Guidance, represents good industry practice and has been accurately compiled to give a fair representation of the work to be undertaken in the London Medium Pressure investment line for RIIO-GD2."

We recognise that the greatest risks to delivering our defined RIIO-2 plan is:

- The changing requirements of our stakeholders specifically driving changes to our construction methodology and timing.
- Emerging works whilst we are on site; such as unforeseen pipe fittings and other services that drive changes to our construction methodology at short notice, introducing delays and additional cost.
- Availability of competent sub-contractors to deliver the defined work-volumes.

We have worked hard during RIIO-1 to develop robust working practices to mitigate these three key programme risks through stakeholder engagement, extensive surveys and pre-planning and developing and maintaining a competent supply chain.

Our DD response provides the detail to give Ofgem the certainty they require that our RIIO-2 plan is deliverable with sufficient rigour on costs and delivery timescales; we have also given this additional detail to satisfy the requirements of Ofgem's bespoke re-opener.

Cadent's DD Proposal

1. Introduction

In response to the development of our thinking since December last year and the challenges from Ofgem at Draft Determination, we are presenting a revised 5-year GD2 plan for funding via base allowances, in place of the UM proposed by Ofgem for London Medium Pressure (LMP).

We recognise that our RIIO-1 plan has changed significantly from final determination to delivery. We understand that this variation has led to Ofgem's view that we were "*unable to complete the work forecast*" and that Ofgem's decision to reject our current RIIO-2 plan "*reflects the scope, timing and cost uncertainty we saw in RIIO-GD1*".

At the start of RIIO-1, we didn't have the experience of replacing a large programme of large diameter gas-mains in highly complex London streets, nor did we have a detailed plan. Our initial 12 to 18 months in RIIO-1, was used almost-exclusively to deliver surveys, enabling works, planning and critical stakeholder engagement to develop our delivery approach. We recognise that this led to a gap between the plan we submitted to Ofgem and the work we delivered.

At the start of RIIO-2, we are in a very different place: We have a detailed plan based on surveys, design and significant stakeholder engagement. We are drawing on the experience of a team which is successfully delivering the programme to build our future plans. For these reasons, we, and Ofgem, can be confident on executing this plan and addressing the very real risks that these aged strategic assets pose to the centre of London.

We recognise that the greatest risks to delivering our defined RIIO-2 plan is:

- The changing requirements of our stakeholders driving changes to our construction methodology and timing /cost of work.
- Availability of competent, efficient sub-contractors to deliver the defined work-volumes consistently.
- Emerging works whilst we are on site; such as unforeseen pipe fittings, below ground obstructions and other services that drive changes to our construction methodology at short notice, introducing delays and additional cost.

We have worked hard during RIIO-1 to develop robust plans to mitigate these three key programme risks through:

- Proactive and ongoing stakeholder engagement.
- Developing and maintaining a competent supply chain through training and ongoing engagement to ensure we have a larger pool of competent contractors available to deliver the planned works and to achieve appropriate levels of competition during procurement.
- Carrying out extensive and innovative surveys and pre-planning to inform the design and construction methodology in advance of mobilisation, to give greater certainty on our plan.

Our ability to mitigate the first two programme risks above and achieve certainty of delivery, are significantly impacted by Ofgem's proposal of a bespoke re-opener.

Our response also looks to provide sufficient information to satisfy the requirements stated within Ofgem's alternative bespoke re-opener quoted within the DD Cadent Annex, specifically:

- "A well justified needs case, including supporting cost benefit analysis"
- "A comprehensive project plan and timeline for completion, including evidence of agreements in place with relevant authorities."
- "Well justified costs, including evidence of market testing and of full consideration of innovative techniques to lower costs"[1]

To satisfy the requirements set out above and to provide Ofgem with greater confidence that we can reliably deliver our RIIO-2 plan, we have produced the following documents set out below.

This **Summary Document** provides an overview of our response and specifically covers:

- Our reasoning behind challenging Ofgem's alternative proposal of a bespoke re-opener.

[1] Information taken from the Draft Determination Cadent Annex paragraph 4.10,

- A reminder of our needs-case for the LMP programme.
- A summary of the stakeholder support we have for our plan.
- Why our commercial approach in RIIO-1 is efficient and market-tested and a robust basis for pricing RIIO-2.
- How our approach delivers optimum, low-cost solutions and provides certainty: The innovation in planning, design and construction achieved during RIIO-1. Key learning from RIIO-1 on TFLs and local highway authorities' preferred traffic management methodologies and constraints around road-occupation.
- Improvements expected through our RIIO-2 commercial approach.
- A summary of our more specific RIIO-2 plan, and the supporting technical detail and associated scope, demonstrating that our preferred solutions are least-cost, optimum and deliverable.
- The revised RIIO-2 costs and cost profile, including efficiencies
- The results of our refreshed Cost-Benefit Analysis and overall conclusions.

This document has two supporting documents, which cover the commercial and technical information in more detail:

- A **Commercial document**, which details how we have tested the market, innovated and driven efficiency in RIIO-1, and how we intend to continue to improve efficiency through RIIO-2. The document explains the basis for our unit costs, how these build on innovation and learning during RIIO-1, how we have market tested these rates and why they are efficient.
- **Technical Document including stakeholder engagement**, which explains the RIIO-2 scope of work in detail per section. Our approach to the planning, design and construction, how we have selected the optimum solution which minimises delivery-risk and cost, improving certainty of delivery, while providing a safe long-term solution. This technical detail has then been used with the unit costs explained in our commercial document to explain the costs and associated cost profile for the revised work phasing. Where solution-options exist, we have explained our reasoning for the preferred solution.

The following table maps the requirements of Ofgem's re-opener requirements to the structure of our response.

Ofgem requirement (4.10)	Evidence provided	Location of evidence
Well justified needs case	We have provided a summary of the needs-case for the entire LMP programme, and more details on the safety risks for the mains identified for replacement in RIIO-2. We have also provided further information on the needs	Section 3 of **Summary Document** Section 5.4 of the **Technical Document** (Governors)
Supporting cost benefit analysis	We have provided an updated CBA at both programme and scheme level and developed a business case summary to highlight the key features of our RIIO-2 LMP plan.	Section 10 and 11 of this **Summary Document**
Comprehensive project plan	We have provided details of our proposed phasing of works in our Summary document. We have provided more comprehensive detail of our RIIO-2 work plan within our Technical Document, with justification for how our preferred plan was developed.	Section 8 of the **Summary Document**. Section 2 "Our RIIO-2 plan" Section 3 "Our approach to optimising our RIIO-2 plan" within the **Technical document**
Evidence of agreements in place	We have provided a summary of all the key stakeholders that we have proactively engaged and the agreements in place. We also explain the timescales to securing firm agreements with these stakeholders.	Section 4: Stakeholder engagement in both the **Summary Document** and Section 4 of the **Technical Document**.

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Ofgem requirement (4.10)	Evidence provided	Location of evidence
Well justified costs	We explain the basis for our RIIO-2 unit rates and demonstrate how these are based on our learning from RIIO-1. We have also included a comprehensive discussion on specific innovative methods used in RIIO-1, how these have enabled us to reduce costs of delivery, and how these methods have been used to inform our scope and costs for RIIO-2. The resulting repex and capex forecast costs and cost profiles are described in detail in Technical Document & summarised in the Summary Document.	**Commercial document**: Section 3 "Our approach to deriving our current costings" Section 5.1 "General scope and methodology": **Technical document** Section 2.1.3 "Ongoing innovation in the planning, design and delivery of our solutions: **Commercial document** Section 9: **Summary document** Section 6 "RIIO-2 Forecast": **Technical Document**
Evidence of market testing	We have explained how our RIIO-1 programme has achieved competition and market testing to drive efficiency; and how we will continue to drive further efficiency through our commercial model in RIIO-2.	**Commercial Document:** Section 2.1 and 2.2.
Full consideration of techniques to lower costs	Aligned with our response to "well justified costs" above, we have provided a comprehensive discussion on specific innovative methods used in RIIO-1 and how these have been applied to inform the preferred solutions and scope / cost of the RIIO-2 plan.	Section 5.1 "General scope and methodology": **Technical document** Section 2.1.3 "Ongoing innovation in the planning, design and delivery of our solutions: **Commercial document**

Table 1: Ofgem re-opener requirements: The information provided

2. Our concerns over the use of a bespoke UM

We do not support Ofgem's Draft Determination proposal of a bespoke re-opener, and to provide zero baseline funding (as outlined in response to core question 12).

A summary of the key reasons for challenging the use of a re-opener are:

- The needs case has been accepted previously and the costs are not sufficiently uncertain for it to be proportionate or reasonable for **all funding** to be in a re-opener
- This is a programme of work; and justification by section does not reflect the wider programme benefits and overall safety risks posed by these 115 year old, fragile, deteriorating iron pipes.
- The mechanism would lead to a stop/start work programme; this reduces our ability to maximise delivery efficiency.
- The re-opener process will create confusion and uncertainty, amongst our suppliers and our stakeholders, reducing our ability to confirm and deliver to our plan.
- We have provided the additional evidence required by Ofgem, to give Ofgem the certainty to include this work as a Price Control Deliverable.

The needs case for this project has been accepted and, accordingly, the work to be delivered and the corresponding costs were never sufficiently uncertain as to warrant all funding being subject to re-opener. It is safety critical work and much of it has to be done during RIIO-2 in order to comply with our statutory obligations, for example, under the Health and Safety at Work Act 1974 and the Pipelines

Safety Regulations 1996[2]. Since our December submission, we have carried out significant further work to provide additional clarity and granularity in relation to precisely which aspects of this project will be delivered in RIIO-2 (and why).

Dealing with this project solely through a re-opener is not proportionate or reasonable. It significantly (and unnecessarily) increases the risk to Cadent and significantly (and unnecessarily) restricts Cadent's ability to deliver the project in an economic and efficient way. Ofgem must have regard to protecting the public from dangers arising from the conveyance of gas through pipes and to promoting the efficiency and economy of licensees. The uncertainty created by dealing with this project by way of a re-opener, questions the extent to which due regard has been applied to these significant and necessary considerations. In addition, anything which makes a safety critical project more uncertain and less efficient cannot be in the overall interests of customers.

Set out below, is a more detailed summary of our concerns with the proposed uncertainty mechanism, which also highlights the outcomes that any revised approach should seek to enable.

It is not proportionate, reasonable or in the overall interest of our customers for Cadent to justify each section of the London Medium Pressure mains-renewal project individually.

In Paragraph 4.10 of the Cadent Annex, Cadent is required to provide robust evidence of the following, for each of the 12 sections of the project:

- "A well justified needs case, including supporting cost benefit analysis"
- "A comprehensive project plan and timeline for completion, including evidence of agreements in place with relevant authorities."
- "Well justified costs, including evidence of market testing and of full consideration of innovated techniques to lower costs"[3]

Justification by section fails to reflect the integrated nature of the program, or its impacts on the wider network both up and downstream of the assets in scope. Although each section of pipe will generate specific costs and benefits, the cost of delivery is based on rates achieved within a programme of work. Furthermore, the benefits unlocked by the programme as a whole are greater than the individual interventions. Whilst we have now calculated CBA by section and provided these results in Section 310.3, the approach is a purely academic exercise. The CBA has not led us to conclude that we should invest to protect Buckingham Palace but not the National Gallery or Methodist Central Hall.

We cannot select to deliver only the sections of mains replacement that are most cost-beneficial. All mains within our plan have a high safety risk and therefore require action to be taken in order to ensure compliance with our statutory obligations. Selection of only the most cost-beneficial mains will also remove the opportunity to improve resilience by elevating the operating pressure to 2 bar.

Whilst we do not support this approach, this evidence by section, has now been provided and Cadent can already meet the overall requirements set out in the proposed UM, which means that the project is sufficiently certain to become a Price Control Deliverable (discussed further in Section 11 of this document):

- **Our needs case is well justified** and was supported by CBA in our December submission. The mains selected for replacement within our RIIO-2 programme present **the highest risk across all Cadent's gas mains**; the consequences of failure are extreme to businesses, residents, tourists and property / building of national importance. The mains selected all require replacement to not only reduce the risk of failure, but to also support the need for additional resilience in the London network, to prevent the risk of supply interruptions in the future from emergency events or during planned maintenance.
- We have now completed sufficient planning and design, applying our learning from RIIO-1, to be able to develop a plan with sufficient certainty over the costs and timing of each section to include within baseline allowances. This evidence is presented in this submission.

Finally, as outlined in section 9, the costs associated with many of the sections of main planned for delivery in RIIO-2 are < £m repex and fall below the proposed materiality threshold of 1% of average

[2] A summary of our obligations under these pieces of legislation appears in Section 3.

[3] Information taken from the Draft Determination Cadent Annex paragraph 4.10

annual revenues. It is a disproportionate requirement to call for justification of individual sections, whilst a materiality threshold is evaluated across the programme in its entirety.

Any mechanism must not lead to a stop/start work programme. We are 8 years into an 18-year rolling programme of work. The proposed delivery of the LMP scheme, including its efficiency and associated costs are based on an ability to deliver works with continuity. For this to be achieved, significant agreement and co-ordination with third parties is required, including relevant stakeholder approvals, supply chain availability, and procurement activity with significant lead times.

We are concerned that subjecting all costs to the re-opener process will pose an obstacle to this continuous approach, and lead to the incremental approval and delivery of works. This will limit our ability to deliver work efficiently, or to secure the required buy in from third parties. Stakeholders will understand that our funding is not certain and will behave accordingly – suppliers will rise prices due to perceived risks; local authorities will not engage fully as we are not a cash buyer. Therefore, any mechanism must allow the submission and approval of costs covering the full RIIO-2 period to enable continuous working patterns, and clear guidance must be provided by Ofgem on how forecast costs can be successfully received in this process.

In connection with this, when challenges are encountered during live works execution, our ability to make timely decisions is crucial to remaining on-track or limiting project overrun or over-spend. The requirement or potential uncertainty around evidence requirements under a UM, would hamper such decision making materially. The cost of slow decisions or indecision, and the customer and stakeholder dis-satisfaction that result, could be very significant. A UM must avoid an unmanageable and cumbersome evidence-gathering or it would represent an inefficient over-constraint to the programme.

The re-opener process will create confusion and uncertainty on what future works for the LMP scheme will be approved. This severely constraints our ability to approach stakeholders to discuss future works. We are reliant on the agreement of such parties to undertake said work; therefore, it is vital that a mechanism provides upfront assurances over approved works to enable effective engagement. We hold ultimate responsibility for our assets, and it's unlikely that stakeholders will have the resource or incentive to effectively engage with the re-opener process.

To the extent that a re-opener is still deemed appropriate, we require upfront clarity on the evidential requirements associated with any proposed mechanism and as such requirements must be reasonable, clear and not overly burdensome. The LMP scheme represents some of the most complex and challenging work on our network. Re-opener submissions will create significant regulatory burden and an unnecessary distraction for the project delivery team. For any mechanism to work effectively, it's critical that we have upfront guidance on the type of evidence that will be required. The extensive documents submitted here meet the needs which Ofgem have set out in DD, if Ofgem judge that they are not sufficient very detailed guidance will be required for the proposed mechanism to work correctly. We have already provided what Ofgem has set out is necessary and therefore we hope that it is clear that the LMP can be managed as a PCD and that it would be more appropriate to do so.

Finally, any mechanism must be calibrated to reflect the timing of work under the scheme. The Spring – Autumn period provides the best opportunity for us to undertake engineering works, when gas demand is lower across the networks. Having the opportunity to secure planning consent and access to the relevant highways in advance of this period will enable us to undertake work at the optimal time. This will require sufficient flexibility in any mechanism to receive approvals for work with adequate lead time.

3. The needs-case

The LMP programme was initially accepted by Ofgem as part of the submission for RIIO-GD1. At this time the full scope of the programme was expected to be an 8 + 8-year programme of works.

This section overviews the information provided in our Engineering Justification Paper (Appendix 09.06) submitted in December, but also provides additional information on the level of risk posed by the pipes within scope for replacement.

The primary drivers for this work are safety, security of supply (resilience) and minimising impact to London businesses, residents and tourists.

- **Safety:** The pipes within scope for replacement within the LMP programme are approaching 115 years old. (See Figure 1 for a photograph of one of these original CI mains being installed in 1906). Over the last 8 years we have had 47 mains failures on the assets within scope.

Although we have been able to manage these failures to the extent that we have prevented an explosion, they have been very disruptive to those living and working in the city. 72% of the pipes within RIIO-2 scope are above the safety threshold that the HSE would deem as acceptable, before expecting renewal. The consequences due to the proximity and density of buildings of national importance, areas of major tourism and business / theatre districts, hotels and flats / houses mean that a failure has a significantly higher consequence than anywhere else in the country. We have a regulatory obligation under the Pipeline Safety Regulations 1996 to manage our pipelines efficiently and effectively and a further duty under the Health & Safety at Work Act to manage the safety risk that these aging pipelines pose.

- **Resilience**: The renewal of these MP gas mains provides us with an opportunity to increase the operating pressure and thereby reduce the risk of supply interruptions. We will be able to move larger quantities of gas around the network in different configurations. This provides resilience to deal with future emergencies or planned maintenance of Cadent's infrastructure. Energy consumption is forecast to increase, with the gas network playing a vital role, and the enhanced network will be futureproof against new requirements.
- **Minimising the impact of failure**: A failure and then reactive repair of a major gas main in London streets, causes significant financial losses due to damage to buildings, major disruption to Londoners, businesses and tourists alike, from evacuation and unplanned disruption due to closures. We have had to evacuate office blocks with thousands of workers inside and disrupt tube stations during rush hour. A failure which damaged an iconic London landmark would cause international outcry.

The following photos shows one of the 48" gas mains, within scope for replacement, being installed in 1906. This specific section of gas main is elliptical in shape and shows the presence of vertical bends; some of the many challenges to successful-replacement as part of the LMP programme.

Figure 1: 48" Iron Elliptical main at Commercial Road c. 1906

We have included a in figures 3 & 4 photographs, showing the condition of the failed-sections.

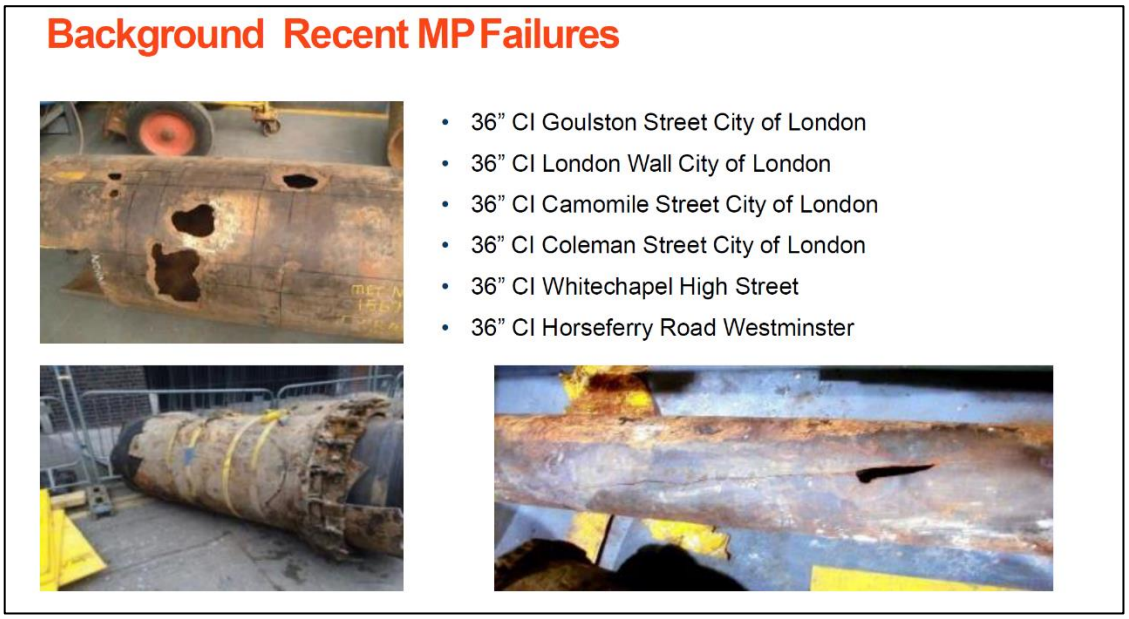

Figure 2: Photos of LMP mains-failures during RIIO-1

Figure 3: Horseferry Road Mains Failure (2018.

In our December Engineering Justification Paper (EJP), we described a recent failure of a Medium Pressure (MP) gas main at **Horseferry Road**. (2018). This 36" cast iron main split longitudinally; gas could be detected within a 30 metre radius. 200 people were immediately evacuated (50m cordon). The residents, shops and businesses were evacuated for 4 days, with alternative accommodation provided. Fortunately, this failure occurred outside peak winter demand, otherwise tens of thousands of people would have suffered pressure issues with their gas supply. The reactive cost to fix this failure, was in excess of £k.

3.1 The probability and consequence of failure

The mains targeted for replacement within our RIIO-2 LMPs programme comprise a very high volume of pipes which exceed the HSE's safety threshold.

The HSE safety thresholds (detailed in Appendix 09.02 of our December submission) are either:

- **Pipe specific risk thresholds**: To account for the variances in building density, pipe specific thresholds are calculated based on the pipes specific building density, and hence the probability of an individual being the one that experiences the incident that happens.
- **Societal risk thresholds**: Societal Risk considers the predicted potential loss of life. The risk posed on a societal level is different from the risk posed on an individual level, and so the acceptable risk level for Societal Risk is different from the acceptable risk level for Individual Risk.

72% (by length) of the mains within our RIIO-2 plan are above one or both of these safety risk thresholds. This number is suppressed by an engineering decision to run the network at just 55 mbarg.

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If the business chose to run any of these mains above this current operating pressure, then this risk score would increase exponentially.

Comparing all Tier 3 CI mains across Cadent's four gas networks, the LMP mains are > 4 times higher MRPS safety risk than the rest of the similar mains in the North London network and > 15 times higher than the mains in other networks.

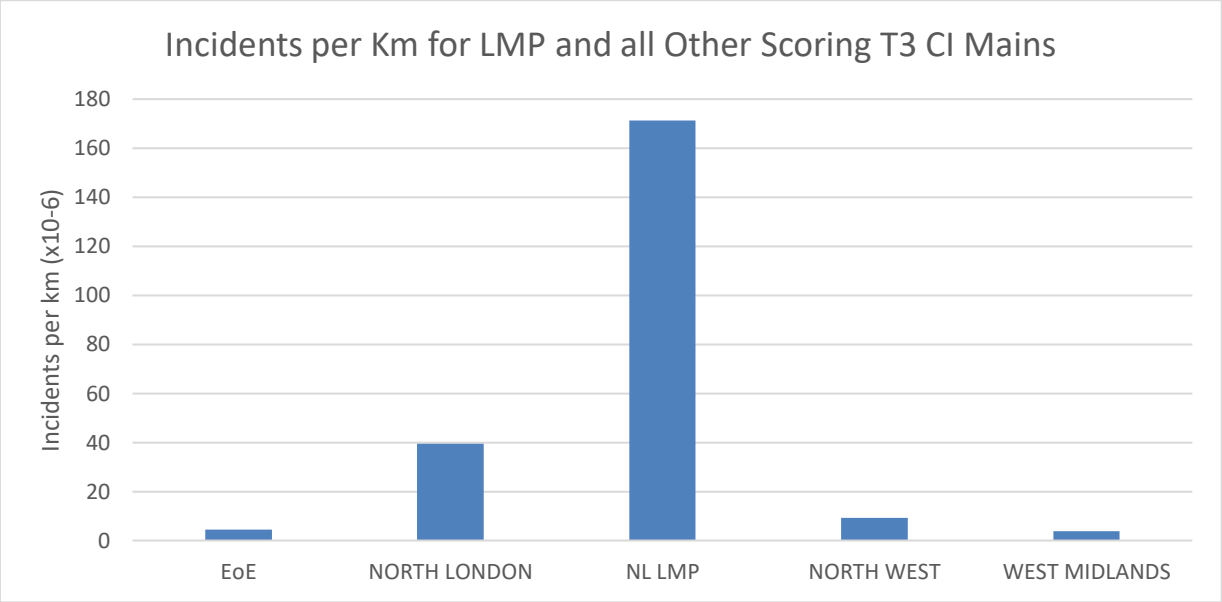

Figure 4: The MRPS risk of an explosion posed by Cadent's Tier 3 Cast Iron Mains

We have looked in detail at the individual safety risk by section of main within the RIIO-2 plan.

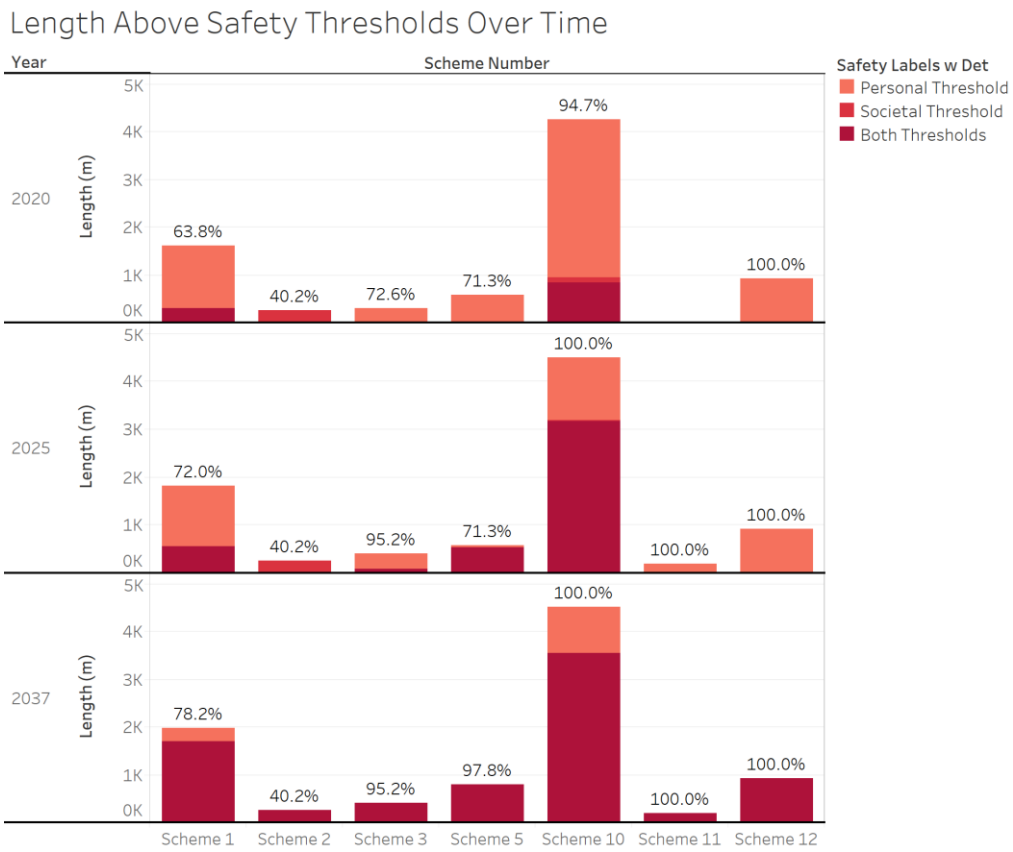

Figure 5: MRPS Safety Scores by RIIO-2 Scheme.

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The above plot shows the % of mains by lengths that fail one or both of the safety thresholds, at a scheme-level.

The MRPS risk score by scheme still shows there is a high proportion of “above threshold” pipes. Sections 2 & 11 are short lengths of mains-renewal and have a lower percentage of mains failing the safety threshold in 2020. It is important to recognise that this lower safety score is typically because some sections of pipes have not yet experienced any failures to date, however the consequences of a failure in the future are still very high, and all mains within the LMP cohort are all iron and a similar age and construction.

We then analysed how these MRPS risk scores change over RIIO-2 & RIIO-3. We applied a 3% deterioration rate to these LMP pipes, and this shows that 90% of these pipes would be above the safety threshold by 2037.

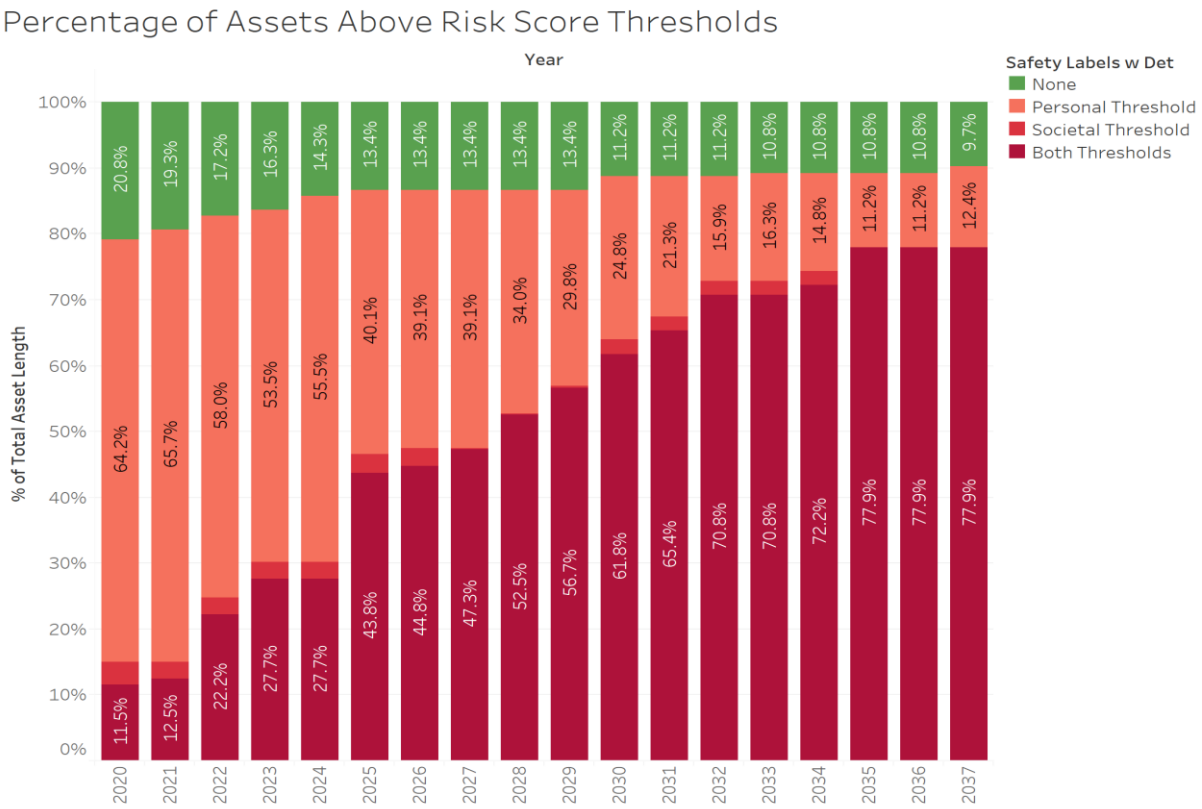

Figure 6: Safety risk scores over time for RIIO-2 LMP cohort

This data provides compelling evidence of the needs-case, for the proposed LMP pipes within scope for replacement in RIIO-2, for the following reasons:

Effective mitigation of risk: There are 79% of mains already above the safety threshold; while there are short sections of lower-risk pipes within the cohort, the consequences of failure of these pipes are still a considerable cause for concern. In recognising that these lower-risk score pipes are the same age and construction as other pipes that have failed, replacing these as part of a wider programme is a robust approach to risk management. It is also clear that by 2037, 91% of these mains will be above the safety threshold.

Improving resilience: All of these iron pipes need to be renewed to achieve the new higher operating pressure of 2 bar. Leaving short sections of iron main (with apparently lower risk scores) would prevent our ability to improve resilience in many sections of London. Our 115-year-old iron pipes cannot operate significantly above a pressure of 550 mbar.

Minimising disruption / value-for money; Renewing these large diameter (600mm to 800mm diameter) cast iron pipes is a major undertaking, with considerable expense to mobilise and planned disruption to traffic, businesses, tourists and residence. It does not make good economic sense to leave some short sections of lower-risk pipes in place. It is the right decision for our customers and key stakeholders in London to deliver this strategic work as a comprehensive and well-managed programme of work.

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4. Stakeholder support & agreement with Local Authorities

We have an ongoing and proactive engagement programme with all our external stakeholders including the Greater London Authority, Transport for London and all Highway Authorities.

The GLA and TFL have sent specific letters of support associated with our long-term plans to replace these aging gas-mains; in particular how they are committed to working collaboratively with us to deliver the programme. They agree that the work should go ahead.

Final stakeholder acceptance for this project (with approval for Cadent's access to the public highway) typically comprises Temporary Traffic Regulation Orders, these are only approved a few weeks before the works commence. It is therefore only feasible to evidence approval in principle at this stage, and most of the Highways Authorities throughout London will rarely issue this evidence formally, as all major temporary management and road closures are subject to change due to circumstances outside of their control.

Section 4 of our Technical Document discusses the stakeholder engagement completed and the agreements-in-principle in place for our RIIO-2 plan. It sets out evidence of agreements with relevant local authorities.

5. How we have delivered efficiently in RIIO-1

Our RIIO-1 plan was delivered efficiently, with robust market testing and competition and a continuous focus on innovation to drive cost-effective designs and construction methodologies. In applying this learning to RIIO-2, this section explains how we have developed a plan with well-justified costs. We now have the knowledge, competencies and learning to confidently plan for RIIO-2 and deliver to this plan with greater certainty.

We started RIIO-1 not having completed detailed planning, surveys, design or stakeholder engagement, and made reasonable assumptions around traffic management and volumes of mains-renewal per week, based on our ability to occupy key section of road at any time.

We have learnt a lot during RIIO-1; we now understand TfL and the highway authorities' traffic management preferences and the quantities of road they will allow us to occupy at any given time. This has increased our lane-rental and parking bay suspension costs and reduced the amount of active mains-laying we can be delivering at any given time. We are also aware of other critical projects planned across London, enabling us to consider timing our work to improve synergy and reduce the impact. We have used this learning to inform our RIIO-2 plans and build a plan that can be delivered with greater certainty.

Our RIIO-1 commercial approach was underpinned by an exclusive eight-year framework agreement with tRIIO (Skanska/Morrison Utilities joint venture), which enabled us to achieve low unit prices across our overall capex plan. For the LMP scheme, we agreed a Target Price for the entire RIIO-1 plan. The pain/gain mechanism included in this contract provided incentives for our sub-contractors to perform. Any out-performance was shared with our customers through the Totex Incentive Mechanism (TIM). Cadent retained responsibility as Principal Designer in order to ensure we had full control of phasing, that stakeholder engagement was retained, and to drive further efficiency and innovation.

tRIIO, as Cadent's management contractor, ran comprehensive procurement events to test and engage competent sub-contractors to drive competition. While the initial pool of competent sub-contractors was small, it was deemed robust in terms of suitable market-testing and competition. Cadent has carried out extensive training during RIIO-1 to increase the pool of competent contractors capable of main-laying gas mains >600mm diameter and, thereby, improve competition within the marketplace.

During RIIO-1 we have continually looked for opportunities to plan, design and construct all aspects of the LMP programme more efficiently and effectively through innovation. Some of our key successes are:

1. **Award-winning stakeholder engagement approach**[4]: consistently and effectively engaging with TfL, GLA) and the various London Boroughs and Highways Authorities to ensure effective planning and explore opportunities for joint-working.
2. **Maximising the use of surveys, ground-penetrating radar, in-pipe surveys and three-dimensional modelling to reduce the likelihood of unforeseen issues arising during construction**: This data enables high confidence in selecting the optimum construction method and traffic management plan and delivering appropriate enabling works before mains laying begins. These enabling works may involve diverting existing services or removing existing pipe fittings to enable greater insertion. All this additional work ensures road occupation and disruption and costs are minimised.
3. **Developing a modular buried design for our RIIO-2 governors**: these modular designs are quicker to install, and they reduce the working space required, thereby reducing the amount of road-occupation needed at any one time. The final solution removes the need for confined-space entry.

Further detail on cost efficiency are included in the supporting Commercial Document (Section 2.1). All of these cost savings and innovations are embedded in our RIIO-2 unit rates.

6. Delivering efficiently in RIIO-2

We have developed an improved operating model for delivery in RIIO-2, to build on the best of the RIIO-1 arrangement and introduce new ways of working. We have achieved cost savings in RIIO-1 and will deliver improved efficiency for customers in RIIO-2, reflected in the strategic repex and capex efficiencies applied to our RIIO-2 estimates (discussed in Section 7 below**)**. This section supports our view that our RIIO-2 plan is built from well-justified costs.

We have chosen to move to a delivery model that enables Cadent to stay in control of its delivery methods for every piece of work we undertake. We now have an internal contract management organisation which will assist Cadent in developing the optimum procurement strategy and achieving competitive tenders for all works. For LMP, Cadent will continue to act as Principal Designer, carrying out the design and stakeholder engagement and then tendering packages of work to the supply chain for delivery. This approach has been trialled in the last two years on LMP with good results.

7. Our approach to building well justified unit costs

For the reasons set out above, we are confident that our RIIO-1 approach has been efficient, with appropriate levels of market testing. We have therefore chosen to use our RIIO-1 actual costs as a basis for our RIIO-2 forecasts and then apply a further, stretching, set of efficiencies to these figures. This approach is unchanged from our December Submission.

Further detail on our approach to deriving these unit costs is contained in Section 3 of the supporting Commercial Document. Our approach to developing the optimum solution, thereby minimising delivery cost is explained in Section 5 of the Technical Document.

Our RIIO-2 forecasts are comprised of three main elements of work. This section summarises our approach to deriving the costings for these.

1. **Mains-replacement:** RIIO-1 actual out-turn costs, together with the detailed scope of work per section, were used to derive a revised repex estimate. We have included a 4% allowance for risk, based on the outputs from a quantitative risk assessment. A 13% uplift has been applied to cover Cadent's direct costs[5].
2. **Governor interventions**: We have used the out-turn costs from four RIIO-1 projects, to derive an average cost per governor intervention. This has then been used to derive a future estimate for the RIIO-2 governors on the basis that the RIIO-1 and RIIO-2 governors are comparable in capacity, complexity and design. This approach is unchanged since December.
3. **RIIO-3 Enabling Works:** We have included a capex allowance in Years 4 and 5 to fund surveys, design, stakeholder engagement and enabling works for RIIO-3 LMP schemes. This

[4] Including the City of London Gold award for Stakeholder Communication and Innovation in Environmental Management

[5] Cadent direct costs cover a wider range of activities including surveys, design, stakeholder engagement, business compensation costs, commercial and project/programme management.

has been estimated using the average costs of this activity from recent RIIO-1 out-turn costs. This investment will be critical to ensure we have developed bespoke designs for the more complex works in subways and tunnels. This element was not highlighted in our December submission, which presented a rolling programme of work.

We have applied the same efficiency factors to our repex and capex as per our December Plan.

8. Comprehensive project plan and timeline for completion

Our comprehensive work plan, as set out in the Technical Document, will consist of the following work elements:

- 9.9km mains replacement
- Four governor interventions (three governor rebuilds, and one decommission)
- Design and enabling surveys for RIIO-3 LMP scope

The scope of work for each mains-laying section has been confirmed following more detailed surveys, planning and discussion with stakeholders. We are now more confident about the volume of pipe insertion versus open cut for example, and we have developed suitable phasing to minimise road occupation at any time to comply with our stakeholders' requirements. This has, in turn, improved our confidence around mobilisation, demobilisation and the duration of construction.

This additional technical detail (expanded in the complimentary technical report), provides Ofgem greater certainty that our RIIO-2 can be delivered: that there is a comprehensive plan and timeline, with evidence of stakeholder agreements in place.

Our proposed work-plan for LMP is shown in the following diagrams. Figure 7 shows all pipes in scope of the overall LMP programme. Figure 8 shows how these will be delivered across the 3 price control periods.

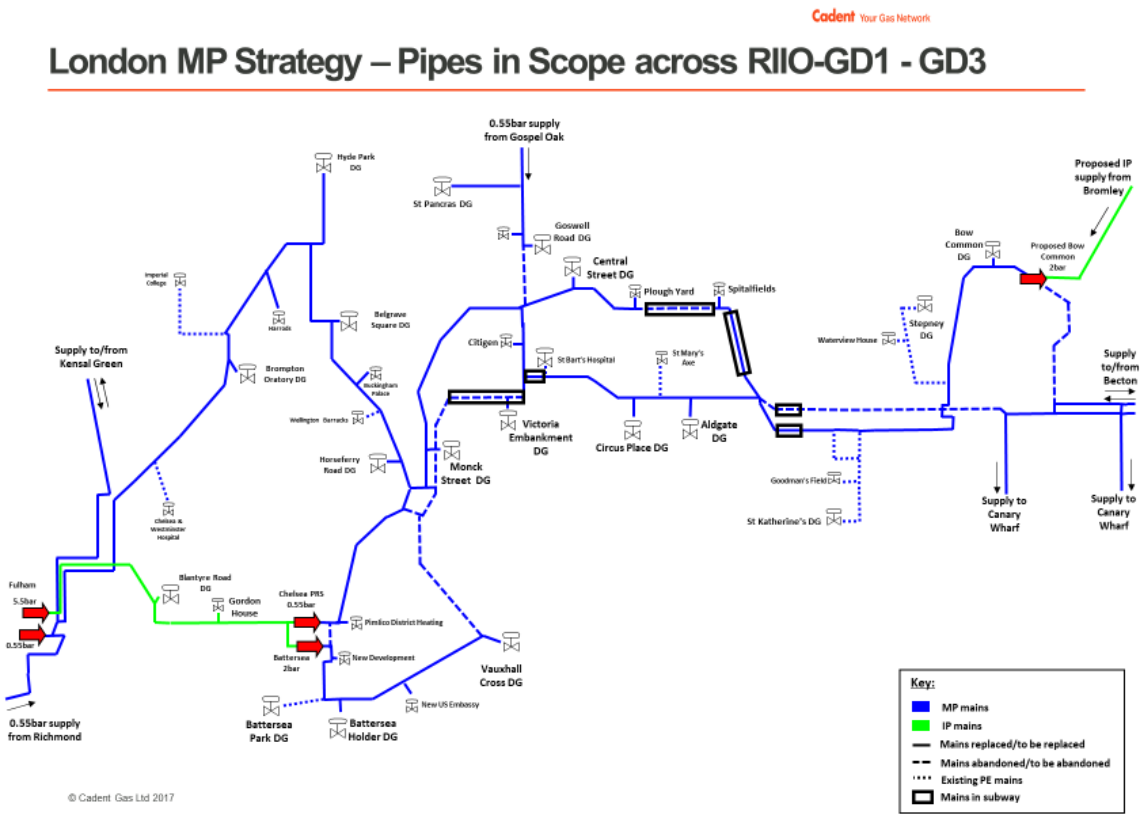


Figure 7: The overall LMP programme; scope of mains-renewal & abandonment

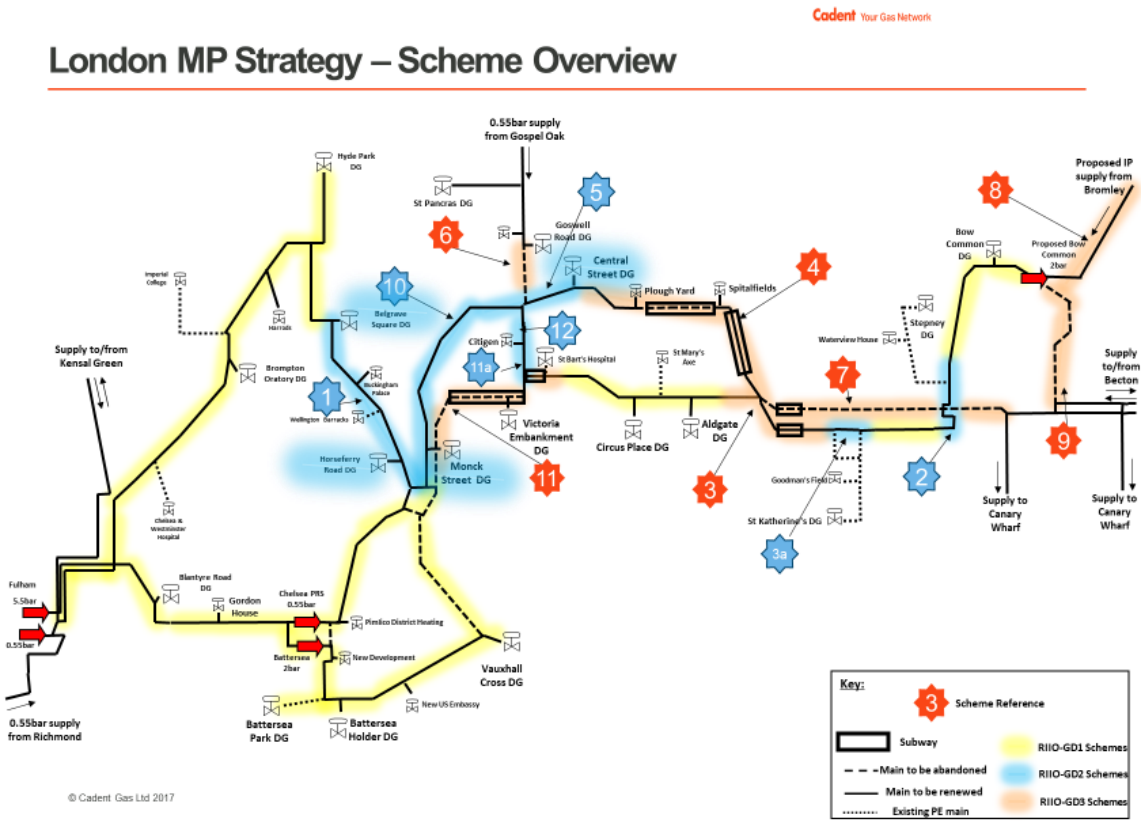


Figure 8: Proposed Phasing – Renewals completed by RIIO period

In deriving our optimum work plan we have considered a wide range of factors including:

- Securing stakeholder support:
  - A strong focus on collaboration for the avoidance of disruption.
  - Timing works to align with other planned road closures for other projects or activities (e.g. we have works planned on the approach road to Rotherhithe tunnel which will be carried out when the tunnel is shut for its periodic survey and maintenance).
  - Looking for solutions that minimise the need for road-occupation, in turn reducing the likelihood that stakeholders will reject our traffic management plans, causing costs and delays associated with re-design or additional planning.
- Outage planning:
  - Make best use of existing network resilience and availability of network outages
  - Maximising the work delivered during any one outage; working at multiple locations with the outage if traffic disruption is manageable.
  - Looking at options to work with multiple outages
- Consideration of availability of resources within our supply chain and achievable productivity levels
- Maximising benefits:
  - Prioritising the mains for replacement based on those with the greatest safety risk, or highest consequences (e.g. adjacent to buildings of national importance)
  - Prioritising some sections first to enable sections of the renewed pipe to be increased to its new, higher operating pressure of 2 bar; which in turn provides increased opportunity for outages in other parts of the network.
- Deferring the most complex, highest-cost works until RIIO-3, to enable additional planning, co-creation of design with stakeholder and to allow the most efficient, innovative solution to be selected.

As a result of this methodology, we have identified mains-renewal on the western edge of the London network which build on the mains-renewal completed in RIIO-1. This work will be delivered in the first 3

years of RIIO-1 and will enable a large section our MP network to be increased in pressure to 2 bar, as shown in the diagram below.

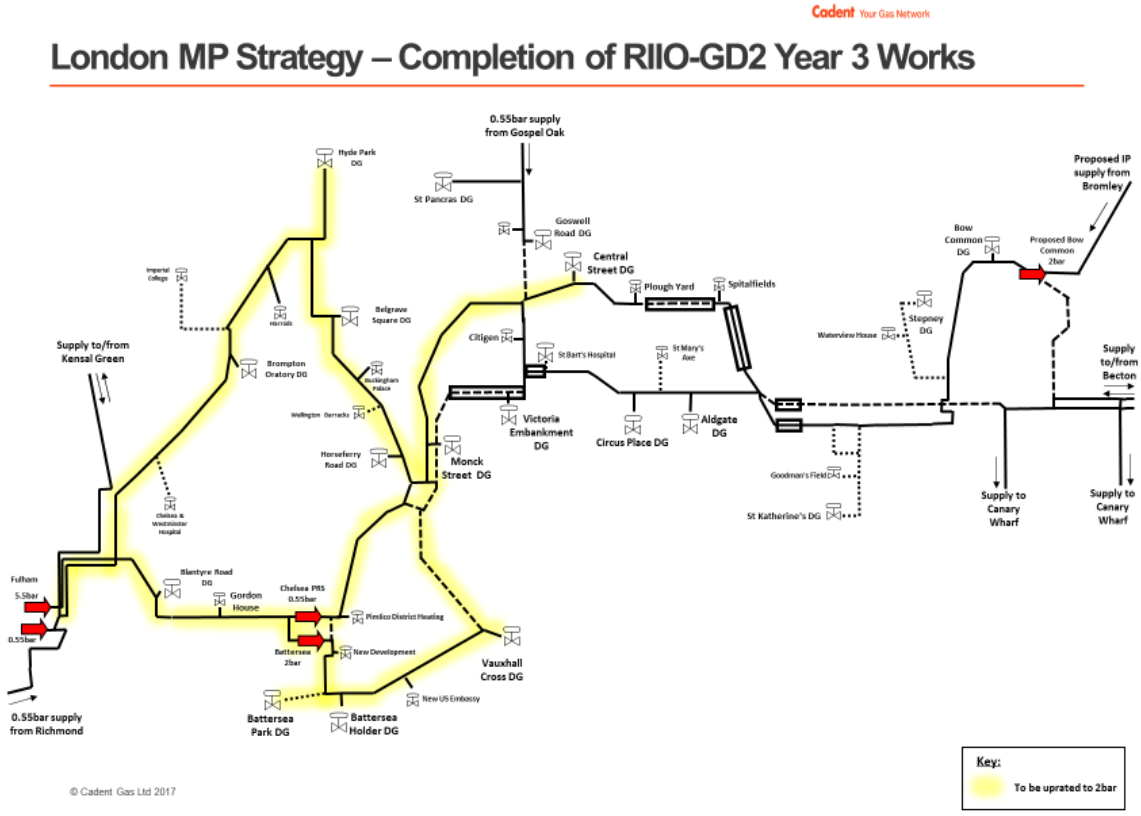
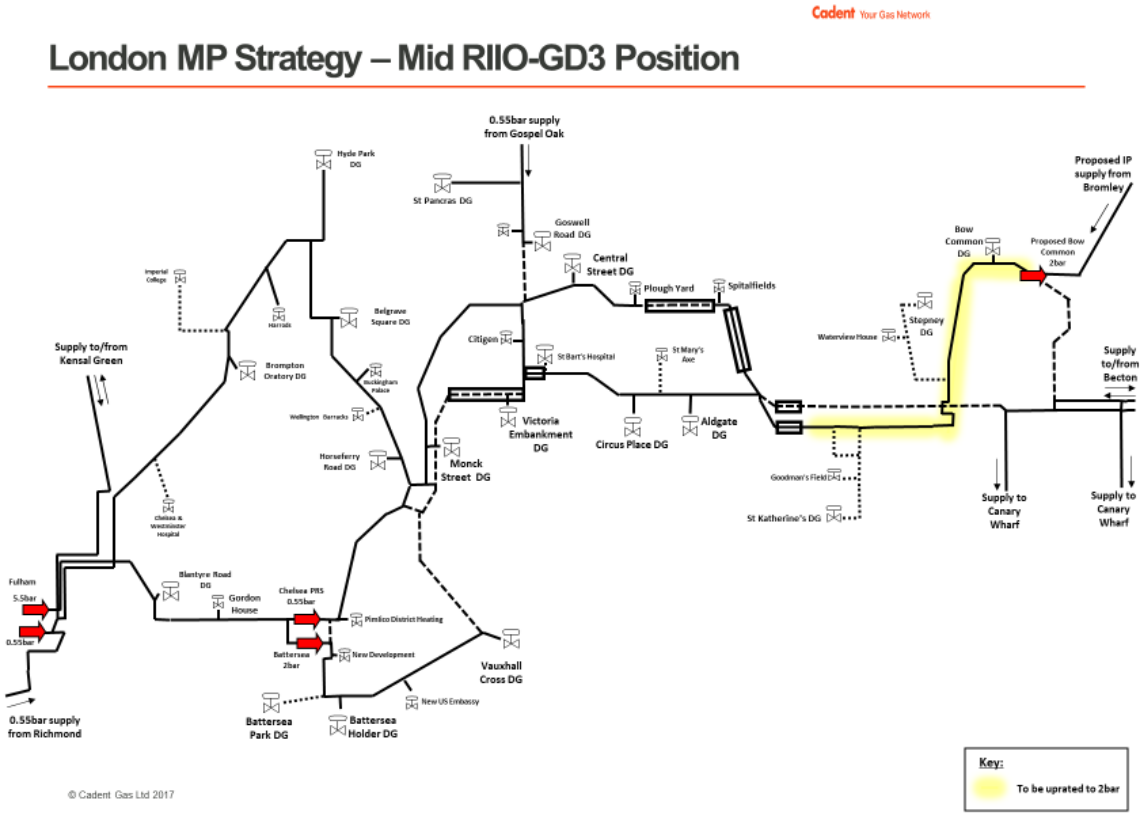


Figure 9: Phase 1: Planned changes to the London operating pressure (year 3 RIIO-2).

In RIIO-2 we will also complete work in the east. Once the IP supply from Bromley is renewed in early RIIO-3, this section can also be increased to 2 bar (Phase 2). See Figure 10 below.



Date: 3 September 2020

Figure 10: Phase 2: Planned changes to the London operating pressure (year 1/2 of RIIO-3)

This leaves the central section, to be completed in RIIO-3 - Phase 3.

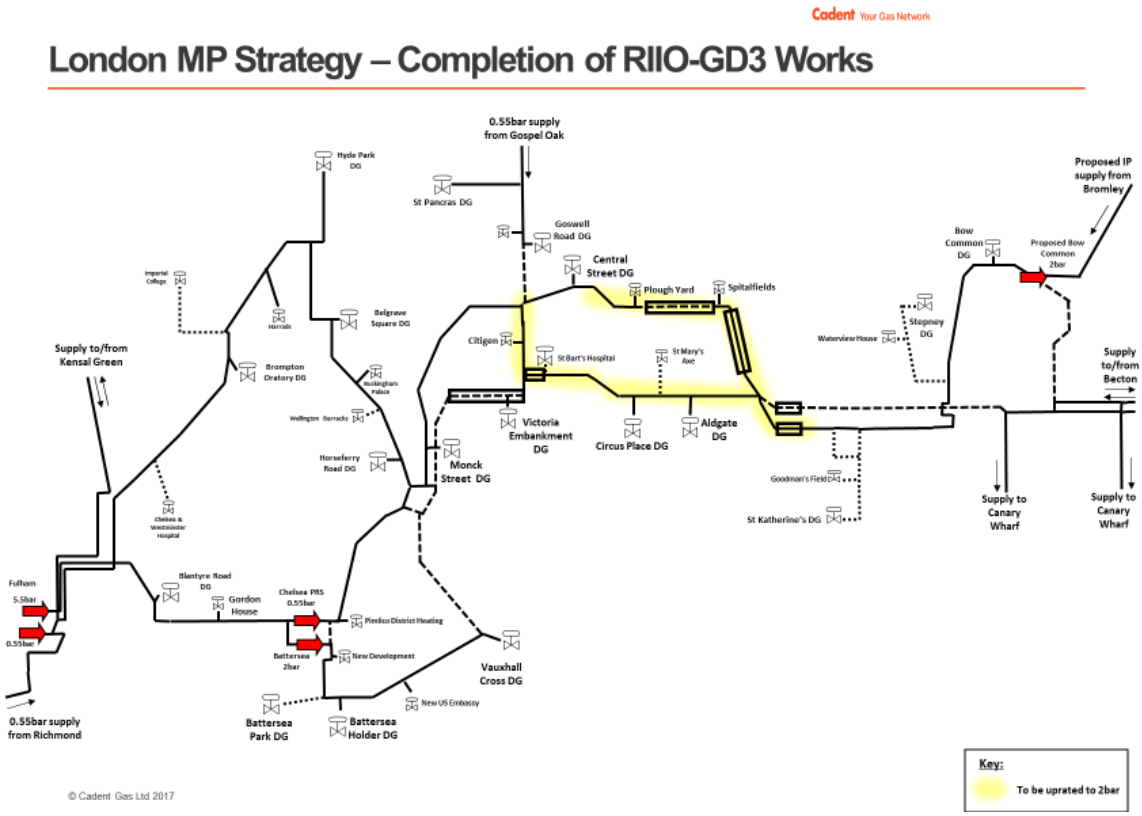


Figure 11: Elevating the final section of MP to 2 bar during late RIIO-3.

This phasing is explained in more detail in our Technical Document.

8.1 Mains replacement project plan

Our revised RIIO-2 work plan delivers 9.9km of mains replacement and is summarised below.

Section	Length to be replaced (m)	Existing pipe diameter	Delivery Year
1a: Belgrave Sq. to Buckingham Gate	1,268	36”	2021/22
1b: Buckingham Gate to Horseferry Road	795	36”	2022/23
1c: Horseferry Road to Monck St	610	36”	2023/24
2. Salmon Lane Bridge to Commercial Road	638	48”	2025/26
3a: 84 to 60 Commercial Road	149	48”	2025/26
5a. Farringdon Road	452	48”	2022/23
5b. Farringdon St	399	48”	2023/24
10a. Farringdon Rd to Bloomsbury Way	1,438	48”	2021/22
10b. Bloomsbury Way to the Mall	1,654	48”	2022/23
10c. The Mall to Storey’s Gate	625	48”	2023/24
10d. Storey’s Gate to Monck St	746	48”	2024/25
11a. New Bridge St to Farringdon St	464	36”	2024/25
12. Farringdon Road	650	36”	2024/25

Table 2: RIIO-2 Mains Replacement Plan[6]

8.2 Governor interventions

To facilitate the above mains replacement, the following governor interventions are required.

Governor	Delivery year	Scope
Belgrave Square	Spring / Summer 2021	Install new direct-buried, modular, 3 stream “Orpheus” governor units, with associated controls/vent stack, covers. Remove old equipment and demolish existing chambers.
Monck Street	Spring / Summer 2023	
Central Street		
Horseferry Road	Spring / Summer 2023	Demolish and remove old equipment/chambers, reinstate road, cap-off old pipework and valves.

Table 3: RIIO-2 Governor intervention plan

8.3 RIIO-3 remaining works

Our RIIO-3 programme will comprise the following scope:

- **10.3km of abandonment-only schemes** comprising existing 36” and 48” aging cast iron mains, that are no longer needed to for network resilience. This 10.3km of mains-abandonment is comprised of **Scheme 6 & 7** and parts of **Scheme 9 & 11** and is therefore some of our least complex works to deliver. This abandonment can only be completed once

[6] Note that the mains-replacement work requires a wide range of broad pipe-interventions and construction methodologies; the full scope assumed to facilitate safe construction is discussed in the Technical Document.

the mains-renewal in RIIO-2 is delivered and the network operating pressures increased to 2 bar.

- **3.52km of mains renewal in subways** –This total is across 5 separate subway locations:
  - **Victoria Embankment Subway** – 2.3km 36" diameter pipe – ***abandonment only*** (part of Scheme 11)
  - **Commercial Road** – Circa 350m of 48" diameter pipe renewal (part of Scheme 9)
  - **Holborn Viaduct** – Circa 220m of 48" diameter pipe renewal (part of Scheme 11)
  - **Commercial Street to Plough Lane**: Circa 470m of 48" diameter pipe renewal (part of Scheme 4)
  - **Liverpool Street Station** – 180m of 48" diameter pipe renewal. (part of Scheme 4)
- **IP network renewals in the East of London**: (Scheme 8): Circa 0.8km of mains-renewal.

  This scheme comprises of a 600m section of 48" pipe which requires renewal, however it is likely that the preferred solution may comprise installation of 800m of PE gas main along a new route. This scheme has significant complexities including special crossings that require a more detailed plan with stakeholders, land owners and engineering solutions. Specific challenges along the route are:

  - A13 Crossing
  - Blackwell Tunnel approach
  - Docklands Light Railway crossing as Devon's Road Station
  - Limehouse Cut Canal
  - Proximity issues to building

As mentioned previously, we have chosen to delay the renewal of our gas-mains within the subways until RIIO-3. This gives us time to investigate and develop innovative techniques and carry out further design and planning with our stakeholders to deliver the mains-renewals in the subways as cost effectively as possible. If we were to deliver this mains-renewal work now, the constraints and complexities would result in a very costly programme of work and reduced certainty of delivery.

The primary options available for replacement of mains within the subways, utilising current construction techniques, would comprise replacing the pipe in-situ within the subway service tunnel or laying a new pipe along an alternative route.

- **Renewing the pipe in-situ:** This option would require extensive enabling works to divert a complex array of existing services, to provide sufficient safe working space to enable the gas-main replacement.
- **Alternative route:** finding a suitable corridor to lay a large diameter replacement gas-main, along roads congested with traffic, which are also full of existing services is also complex. These works would also likely comprise service diversions and significant open-cut mains-laying.

We are confident that we have selected the optimum scope of work for delivery in RIIO-3 and that it is deliverable. In summary our RIIO-3 plan comprises:

- Five relatively short sections of complex mains-renewal work in subways and in Central and East of London totalling 4.3km of mains-renewal.
- 10.3km of much lower-complexity abandonment-only which comprises grouting the mains and leaving them in-situ.

9. Cost Certainty in RIIO-2

This section summarises the RIIO-2 repex and capex required to deliver the above work scope, based on the approach to unit costs and scope of work described above. Note, costs shown below are the total installed costs, post-efficiency, in 2018/19 price base.

For the associated cost-breakdown structure, for each work element, refer to the Technical Document.

Section	2021/22	2022/23	2023/24	2024/25	2025/26	Total
1a: Belgrave Sq. to Buckingham Gate						
1b: Buckingham Gate to Horseferry Road						
1c: Horseferry Road to Monck St						
2. Salmon Lane Bridge to Commercial Road						
3a: 84 to 60 Commercial Road						
5a. Farringdon Road						
5b. Farringdon St						
10a. Farringdon Rd to Bloomsbury Way						
10b. Bloomsbury Way to the Mall						
10c. The Mall to Storey's Gate						
10d. Storey's Gate to Monck St						
11a. New Bridge St to Farringdon St						
12. Farringdon Road						
Total						

Table 4: Cost profile for mains-replacements in RIIO-2 (£k)

Governor	2021/22	2022/23	2023/24	2024/25	2025/26	Total
Belgrave Square						
Horseferry Rd (decommission)						
Monck Street						
Central Street						
Total (Capex)						

Table 5: Cost profile for governor Interventions in RIIO-2 (£k)

Item	2021/22	2022/23	2023/24	2024/25	2025/26	Total
[7] RIIO-3 Enabling work						

Table 6: Cost profile for enabling works for RIIO-3 (£k)

Combining the above elements gives the resulting repex and capex cost profile for the proposed LMP RIIO-2 programme of works:

	2021/22	2022/23	2023/24	2024/25	2025/26	Total
Repex						
Capex						
Totex						

Table 7: Cost profile for overall revised LMP RIIO-2 delivery plan (£k)

Within our December submission (EJP Appendix 09.06), we included **Table 5**, which specifically looked at the LMP Scheme Cost Estimates and the all-inclusive costs per metre of mains laying. This table excluded Cadent Direct Costs, did not have RIIO-2 efficiency applied, and included a 3% risk allowance (rather than a 4% risk allowance).

We have inserted a similar table below. The costs for both the December plan and the Draft Determination response have had risk removed and do not include efficiency or Cadent direct costs applied. These are purely for comparison, to demonstrate how the base mains laying costs have changed as a result of our additional planning, surveys and design.

In December we stated a cost confidence of 35% to reflect that our work was at a feasibility stage. We have now move forward into conceptual design and as such would apply a 20% cost confidence in line with the costing approach set out December (see section 5.1 of Appendix 9.00).

[7] Covers surveys, stakeholder engagement, 3D modelling and BIM / CAD drawings where appropriate.

Section	Size	December submission			Revised DD response		
		Total Length[8] (m)	Total Cost (£m)	£/m	Length in RIIO-2 (m)	Total Cost (RIIO-2) (£m)	£/m
1: Belgrave Square to Monck St.	36”	2,756			2,674		
2: Salmon Lane Bridge to Commercial St.	48”	638			638		
3: Commercial Road to Farringdon St.	48”	999			149		
5: Farringdon Road to Plough Yard	48”	2,290			851		
10. Farringdon Rd to Monck St.	48”	4,567			4,463		
11. Monck St. to New Bridge St.	36”	3,701			464		
12. Farringdon Road	36”	994			650		

Table 8: Changes to mains-laying lengths and costs since our December plan.

The lengths highlighted in yellow, show that some sections will be partially delivered in RIIO-2. That is to say, the length in RIIO-2 has reduced but the length of the whole scheme has not. A few sections have changed slightly in overall length, due to revisions following further survey.

Due to the revised more detailed work plan, estimated numbers of operations or cost driver volumes (e.g. Traffic management support services) have changed leading to adjustments in the costs per metre in some sections. Other sections have reduced in cost, due to the removal of sections of mains replacement in subways.

[8] Note this length was the total length to be delivered during RIIO-2 & 3.

10. Supporting Cost Benefit Analysis

Our technical approach to the Cost Benefit Analysis (CBA) is unchanged from our submission in the December and remains in line with Ofgem's requirements. We have however refreshed data inputs to reflect the latest view of RIIO-2.

These changes have lowered our RIIO-2 costs and increased the overall cost benefit of our RIIO-2 programme of work relative to our December plan.

The programme improves safety, reduces leakage and the likelihood of interruptions and unplanned disruption. We have discussed the probability and consequence of failure earlier in section 3.1.

As previously discussed, this programme of work also provides Cadent with the opportunity to increase the operating pressure of the gas network to improve resilience. This improved resilience attracts very little weight within the CBA as it mitigates against low likelihood events. However, this improved resilience increases our ability to carry out planned maintenance and respond to unforeseen events across London. This in turn protects major customers and businesses, like Buckingham Palace, internationally important tourist destinations, central government department headquarters, University Campuses and flag-ship hotels and business head offices.

Whilst CBA can be produced for individual sections of pipe, it will not reflect the reality of the costs and benefits at a programme level. Also, where safety risks are particularly high, replacement is mandated by safety legislation rather than economic benefits. For this reason, we cannot select to deliver only the sections of mains replacement that are most cost-beneficial without losing the opportunity to improve overall resilience or maintain compliance. A comprehensive discussion on the needs-case for individual schemes is set out in Section 3 of this document.

We have still not included some tangible benefits in our CBA analysis which would improve the payback period, namely:

- We have not considered the impact of higher-than-average property price increases over time, as this is too uncertain to forecast. London house price rises have on average outstripped inflation and it would therefore be reasonable to inflate their value through time.
- We are also aware that many of the buildings contain articles of extremely high value and historic importance (i.e. art galleries and museums). Some of these are irreplaceable. We have not tried to quantify the value of these elements in the modelling.
- Any gas explosion would cause significant disruption to the locality. Businesses, workers, tourists and commuters would be affected for several days or weeks during the clean-up, reconstruction and repairs. These consequences have not been quantified and therefore have not been included in the cost benefit analysis.

The programme for LMP must go ahead for safety reasons – the majority of the assets being replaced are in the highest risk category - and the scheme is cost beneficial.

10.1 December CBA results

The results for our December proposals are shown below. Figures are relevant to the baseline of 'do nothing'.

Option Name	Change in PV Expenditure & Costs	Change in PV Environment	Change in PV Safety	Change in PV Other	NPV (relative to baseline)	GD2 spend
December RIIO-2 and 3						
December RIIO-2 only						

Table 9: Breakdown of the results of the cost-benefit analysis for LMP (£m)

Table 9 shows the benefits produced by our December plan. The RIIO-2 investment was found to be cost beneficial relative to the baseline position of reactive repair following failures (once RIIO-1 investment is

complete). This would have paid back by 2060. The bulk of the benefits are related to safety improvements.

10.2 Revised CBA results

Our revised proposal defers some of the investment we proposed in RIIO-2 to RIIO-3.

The revised CBA results are below:

Option Name	Change in PV Expenditure & Costs	Change in PV Environment	Change in PV Safety	Change in PV Other	NPV (relative to baseline)	GD2 spend
Revised plan for RIIO2						

Table 10: Updated CBA results based on revised LMP proposals (£m)

The reduction in the investment in RIIO2 has made the investment more cost beneficial (increasing the NPV for RIIO2 investment from £m to £m). The payback is shorter by approximately 15 years. In December the payback from our plans was 2060. By 2037, we have £30.3m of cumulative discounted benefits. Payback of the full scheme occurs by 2045. By 2040, customers are benefiting more than they are paying (the stream of benefits to customers is greater than the costs).

On the next page with have created a comprehensive summary for each section of our RIIO-2 LMP scheme, for ease of comparison.

10.3 Scheme Summary / Comparison

The following table provides a comprehensive summary by Scheme / Section, to enable comparison of our proposed RIIO-2 plan.

	Section 1	Section 2	Section 3	Section 5	Section 10	Section 11	Section 12
Name of section	Belgrave Square to Monck Street	Salmon Lane Bridge to Commercial Road	Commercial Road to Farringdon Street	Farringdon Road to Plough Yard	Monck Street to Farringdon Road	Monck Street to Farringdon Street	Farringdon Road
% of mains above HSE Safety Threshold	63.8% Increasing to 78% by 2037	40.2% Shows little deterioration over next 17 years.	72.6% Increasing to 95.2% by 2025	71.3% Increasing to 97.8% by 2037	94.7% Increasing to 100% by 2025	0% Increasing to 100% by 2025	100%
Delivery Dates	2021/22 - 2023/24	2025/26	2025/26	2022/23 - 2023/24	2021/22 - 2024/25	2024/25	2024/25
Length of mains-renewal in RIIO-2	2,674	638	149	851	4,463	464	650
Pipe diameter being replaced	36"	48"	48"	48"	48"	36"	36"
Governor interventions	Belgrave Square (rebuild) Horseferry Road (removal) Monck Street (rebuild)			Central Street (rebuild)			
Totex of RIIO-2 Scheme[10]							
Net-costs per meter[11] for mains-renewal							
NPV relative to baseline							

The above summary shows that not only is the overall RIIO-2 scheme cost beneficial, but the majority of sections are cost beneficial. A few short sections of mains-replacement (Scheme 2 & 5) are not cost beneficial when considered in isolation. These lower CBA results are driven by the apparently lower-risk scores (because some pipes have not experienced failures even though they are the same age and material as the wider iron-main cohort), for this reason we our CBA under-estimates the risk and as such we would expect these sections to also be cost beneficial.

In Section 3, we explained why justifying our LMP plans, by section, was flawed, and why the scope of work in RIIO-2 has a robust needs case. The key reasons are:

Effective mitigation of risk: There are 72% of mains already above the safety threshold; while there are short sections of lower-risk pipes within the cohort, the consequences of failure of these pipes are still extreme. In recognising that these lower-risk pipes are the same age and construction as other pipes that have failed, replacing these as part of a wider programme is a robust approach to risk management. It is also clear that by 2037, 91% of these mains will be above the safety threshold; replacing them now keeps customers safe.

Improving resilience: All of these iron pipes need to be renewed to achieve the new higher operating pressure of 2 bar. Leaving short sections of iron main (with apparently lower risk scores) would prevent our ability to improve resilience in many sections of London. Our 115 year old iron pipes cannot operate above a pressure above 55 mbar.

Minimising disruption / value-for money; Renewing these large diameter (600 to 800 diameter) cast iron pipes is a major undertaking, with considerable expense to mobilise and disruption to traffic, businesses, tourists and residence. Carrying out this work in a more piecemeal approach introduces additional cost; less pipework can be replaced via insertion, this introduces more pipework joints (future weak-points where failures can occur) and reduces the overall design-life of the renewed asset. It does not make good economic sense to leave some short sections of lower-risk pipes in place. It is the right decision for our customers and key stakeholders in London to deliver this strategic work as a comprehensive and well-managed programme of work.

Comparing the proposals to our December plan, it can be seen that the investment continues to deliver considerable safety benefits: these dominate the benefits of investment. The continuation of our LMP programme is still value for money to customers.

[10] The totex quoted includes the repex for mains-renewal activities and capex associated with the planned Governor Interventions.

[11] Based on net mains-laying costs without contingency / risk or cadent direct costs included for comparative purposes. Refer to Table 8, for supporting information on these calculations.

11. Regulatory Treatment

As in December we propose that this programme should be treated as a price control deliverable within the RIIO-2 framework. We have proposed this approach as it is of high value and the funding would not be transferrable to a different output or project to deliver the same outcome for our London customers.

We are proposing a specific PCD for the London medium pressure scheme given its challenging access requirements and interaction with other infrastructure developments. Although cost confidence has increased since December we believe that a totex sharing factor of 15% remains appropriate.

Given the ringfenced nature of this project we propose that this is treated separately as its own PCD and not included as part of the blended sharing factor as this will give the best protection to customers. The costs for this project are easily ringfenced as it is contracted and delivered separately so all direct costs and direct overheads are fully applicable. We would propose that to maintain the integrity of totex sharing factors that no indirect overheads are included in the PCD (our business support costs for example).

Whilst the funding would not be transferable to a different output or project utilising a PCD does provide flexibility and incentives for us to innovate and drive efficiencies in delivering this project. We commit that throughout RIIO-2 we will continue to engage with stakeholder to re-assess the most efficient way of delivering these outcomes for our London customers. Where a more efficient approach is identified we will engage with Ofgem to ensure they understand how the alternate approach still delivers the desired outcome.

This pipeline investment is accounted for in the Business Plan data Table 4.03 repex mains Tier 2B & 3. We have provided a refreshed BPDT as part of our DD response, showing the impact of the changes to LMP and other repex updates.

The capex element (governors) is accounted for in Table 3.05 (other capex), we have not refreshed the BPDT for this element but can do so if requested.

12. Conclusion

Our revised work plan is a more targeted, more deliverable and considers the availability of network outages, minimising road disruption and traffic management. Our revised RIIO-2 plan comprises Tier 3 mains replacement and four governor interventions; similar work activities are included in other sections of our RIIO-2 plan and are considered high-confidence. We have chosen to deliver the lower-complexity safety-driven mains-replacement work, outside the subways and tunnels, to improve certainty. We have prioritised the completion of the Hyde Park and Monck Street sections, to enable a new section of the LMP network to be increased in pressure to 2 bar, thereby improving the resilience of the wider London network. This selection of work for RIIO-2 delivers significant benefits to customers and strikes the right balance of cost and risk to customers and stakeholders over the remaining 10 years of the programme.

In the Draft Determination Ofgem's feedback was that our plan was insufficiently developed, to give certainty of delivery (particularly in light of the changes to our RIIO-1 work plan). The specific details contained within our revised plan address this by demonstrating that the work-volumes, phasing and repex and capex forecasts are specific, built on learning from RIIO-1 and utilise innovation wherever possible. This level of detail has also been provided to satisfy the requirements of the bespoke re-opener, specifically:

- "A well justified needs case, including supporting cost benefit analysis"
- "A comprehensive project plan and timeline for completion, including evidence of agreements in place with relevant authorities."
- "Well justified costs, including evidence of market testing and of full consideration of innovated techniques to lower costs"[12]

As a result of this revised plan, we have a more specific repex and capex cost profile which aligns to the specifics of each scheme within the RIIO-2 work plan.

We have explained why our LMP RIIO-1 plan is efficient, and why it is therefore robust to base our RIIO-2 costs on actual out-turn costs from RIIO-1. Our approach to deriving our unit costs for the work

[12] Information taken from the Draft Determination Cadent Annex paragraph 4.10,

is unchanged from December; however, our additional planning and design have changed quantities of mains laying and the related support costs including mobilisation, volumes of pits, traffic management and duration of works. These changes have all had an impact on the required investment needed to deliver our revised RIIO-2 plan.

Our Cadent direct costs have remained unchanged at 13%; these costs include a wider range of activities and include stakeholder engagement, surveys and enabling tasks using internal resources, in-house design and planning, commercial management and programme management.

Additional repex and capex efficiencies have then been applied, consistent with our December approach.

As a result, our repex and capex required for RIIO-2 has decreased and the CBA for our RIIO-2 plan has improved, with scheme payback reducing by 10 years.

Summary	December Submission	Draft Determination Proposal
Project Initiation Year	2013	2013
Project Close out	2031	2031
Total Installed Cost	£m	£m
Cost estimate accuracy (RIIO-2)	35%	20%
RIIO-2 Scope	The remaining programme which comprises 25.9km of mains-replacement and abandonment and the 15 governors.	9.9km mains-replacement 4 governor interventions
RIIO-3 Scope		10.3km of abandonment. 4.4km of mains-replacement; high complexity work. 9 governor interventions
RIIO-2 Spend	£m	£m
NPV	£m (NPV relative to baseline) Payback: 2060	£ (NPV relative to baseline) Payback: 2045

Table 11: Summary table for revised LMP proposal for Draft Determination

We are confident that our revised LMP RIIO-2 investment proposal is efficient and specific, using robust commercial arrangements that drive competition and applying suitable innovation in surveys, planning, design and construction to identify the most efficient, optimum solutions. Our plan is in the interests of, and supported by, our customers and our stakeholders.

This submission and its supporting appendices provide robust evidence on need, including cost-benefit analysis. The technical appendix sets out a comprehensive project plan and timeline for completion, including evidence provided by our engagement specialist Copper that agreements in principle are in place with relevant local authorities. Our costs are well justified, as set out in our commercial appendix (which includes discourse on market testing) and evidenced in our technical appendix. We have made best use of available innovation in both our approach to contracting and in our engineering decisions. As such we have robust evidence for the inclusion of the proposed costs in our base allowances.

This investment programme will bring significant benefits to our customers in London.

Cadent

Your Gas Network

Response to Draft Determination

London Medium Pressure

Technical appendix

2 Introduction

As we progress towards delivery we have continued to refine and add detail to our LMP plans. This document sets out our comprehensive project plan demonstrating robust evidence of scope, timing and cost certainty.

Our RIIO-2 work-plan is renewing the most critical gas distribution mains in Central London with the highest safety risk (72.8% exceed the HSE threshold). Our customer engagement tells us that safety is their highest priority and we have legal obligations under Pipeline Safety Regulations to control risk; a proactive approach to mains replacements in this case is the most appropriate solution.

Within our Appendix 09.06, submitted in Dec 2019, we explained that 12 schemes were remaining to complete the overall LMP programme of works. This revised plan is now high-confidence because it is now a blend of mains-renewal activities in roads and governor rebuilds, decommissions or new installations. These activities enable us to then increase the operating pressure of key sections of the LMP system to 2 bar which is critical to the resilience of the London gas network. The overall project adds significant benefits to customers.

We have continued to develop our design and pre-planning for the LMP programme for RIIO-2. This has enabled us to produce a more targeted and detailed work plan, identifying specific sections of main and governors that require intervention in each year of RIIO-2. We have considered network resilience, outage windows, stakeholder constraints, unit costs and potential innovation opportunities, operational and commercial risks and challenges for each section and the gas-system as a whole, to identify an achievable work plan for each year of RIIO-2.

This document provides more specific engineering insight into each sub-section of the LMP scheme that we propose to deliver during RIIO-2, to in turn demonstrate that it is deliverable and that the risks are manageable. It highlights any material changes in the scope of work for the RIIO-2 work plan, based on the information submitted in December 2019, as part of the EJP Appendix 09.06.

This document therefore provides information on:

- How we have created and optimised our RIIO-2 work plan, based on feedback and discussions with stakeholders and considering other key operational constraints.
- The scope of work of each section of this plan; and how we have optimised the scope and where options exist how we have ensured we have chosen the lowest-cost, optimum design, with minimum delivery-risk.
- The overall costs and cost-profile for each section, based on the unit costs discussed in the separate commercial document.

This **Technical Document** is one of two supporting documents that form part of Cadent's overall submission to Ofgem as part of the response to the Draft Determination. Cadent's submission is comprised of:

- A **Summary Document**, which summarises the key points within our submission and specifically how we have addressed each of Ofgem's points at Draft Determination. This document also summarises the revised business case for our revised RIIO-2 LMP work plan.
- This document (**Technical Document**), which explains the RIIO-2 scope of work in detail per section, how we have used innovation and learning from RIIO-1 to develop a plan that is deliverable and efficient, to then inform the revised costs and associated cost profile for the revised work-phasing.
- The **Commercial document,** which explains the basis for our unit costs, how these build in innovation and learning during RIIO-1 and how we have market-tested these rates as well as why we believe these are efficient

All of these three documents provide the evidence necessary to satisfy Ofgem's bespoke re-opener requirements. The following table maps these requirements to the structure of our response.

Ofgem requirement (4.10)	Evidence provided	Location of evidence
Well justified needs case	We have provided a summary of the needs-case for the entire LMP programme, and more details on the safety risks for the mains identified for replacement in RIIO-2. We have also provided further information on the needs	Section 3 of Summary Document Section 5.4 of the **Technical Document** (Governors)
Supporting cost benefit analysis	We have provided an updated CBA at both programme and scheme level and developed a business case summary to highlight the key features of our RIIO-2 LMP plan.	Section 10 and 11 of this **Summary Document**
Comprehensive project plan	We have provided a summary of our proposed phasing of works in our Summary document. We have provided more comprehensive detail of our RIIO-2 work plan within our Technical Document, with justification for how our preferred plan was developed.	Section **Error! Reference source not found.** of the **Summary Document**. Section 2 "Our RIIO-2 plan" Section 3 "Our approach to optimising our RIIO-2 plan" within the **Technical document**
Evidence of agreements in place	We have provided a summary of all the key stakeholders that we have proactively engaged and the agreements in place. We also explain the timescales to securing firm agreements with these stakeholders.	Section 4: Stakeholder engagement in both the **Summary Document** and Section 4 of the **Technical Document**.
Well justified costs	We explain the basis for our RIIO-2 unit rates and demonstrates how these are based on our learning from RIIO-1. We have also included a comprehensive discussion on specific innovative methods used in RIIO-1, how these have enabled us to reduce costs of delivery, and how these methods have been used to inform our scope and costs for RIIO-2. The resulting repex and capex forecast costs and cost profiles based are described in detail in Technical Document & summarised in the Summary Document.	**Commercial document**: Section 3 "Our approach to deriving our current costings" Section 5.1 "General scope and methodology": **Technical document** Section 2.1.3 "Ongoing innovation in the planning, design and delivery of our solutions: **Commercial document** Section 9: Summary document Section 6 "RIIO-2 Forecast": **Technical Document**
Evidence of market testing	We have explained how our RIIO-1 programme has achieved competition and market testing to drive efficiency; and how we will continue to drive further efficiency through our commercial model in RIIO-2.	**Commercial Document:** Section 2.1 and 2.2.

Ofgem requirement (4.10)	Evidence provided	Location of evidence
Full consideration of techniques to lower costs	Aligned with our response to "well justified costs" above, we have provided a comprehensive discussion on specific innovative methods used in RIIO-1 and how these have been applied to inform the preferred solutions and scope / cost of the RIIO-2 plan.	Section 5.1 "General scope and methodology": **Technical document** Section 2.1.3 "Ongoing innovation in the planning, design and delivery of our solutions: **Commercial document**

Table 1: How our LMP submission demonstrates Ofgem's bespoke re-opener requirements

This document demonstrates that our RIIO-2 investment case is based on a specific and justified work plan. It also shows how we have dealt with the challenges and difficulties of each section and scheme to provide innovative solutions, at least-cost and minimise disruption while maximising safety for ongoing operation and maintenance. Based on our RIIO-1 learning, we are confident that our RIIO-2 plan is deliverable, and its costs are well-justified.

3 Overview of our RIIO-2 LMP plan.

As outlined in detail in Appendix 09.06 Dec 2019, the project scope for the overall LMP programme consist of the following:

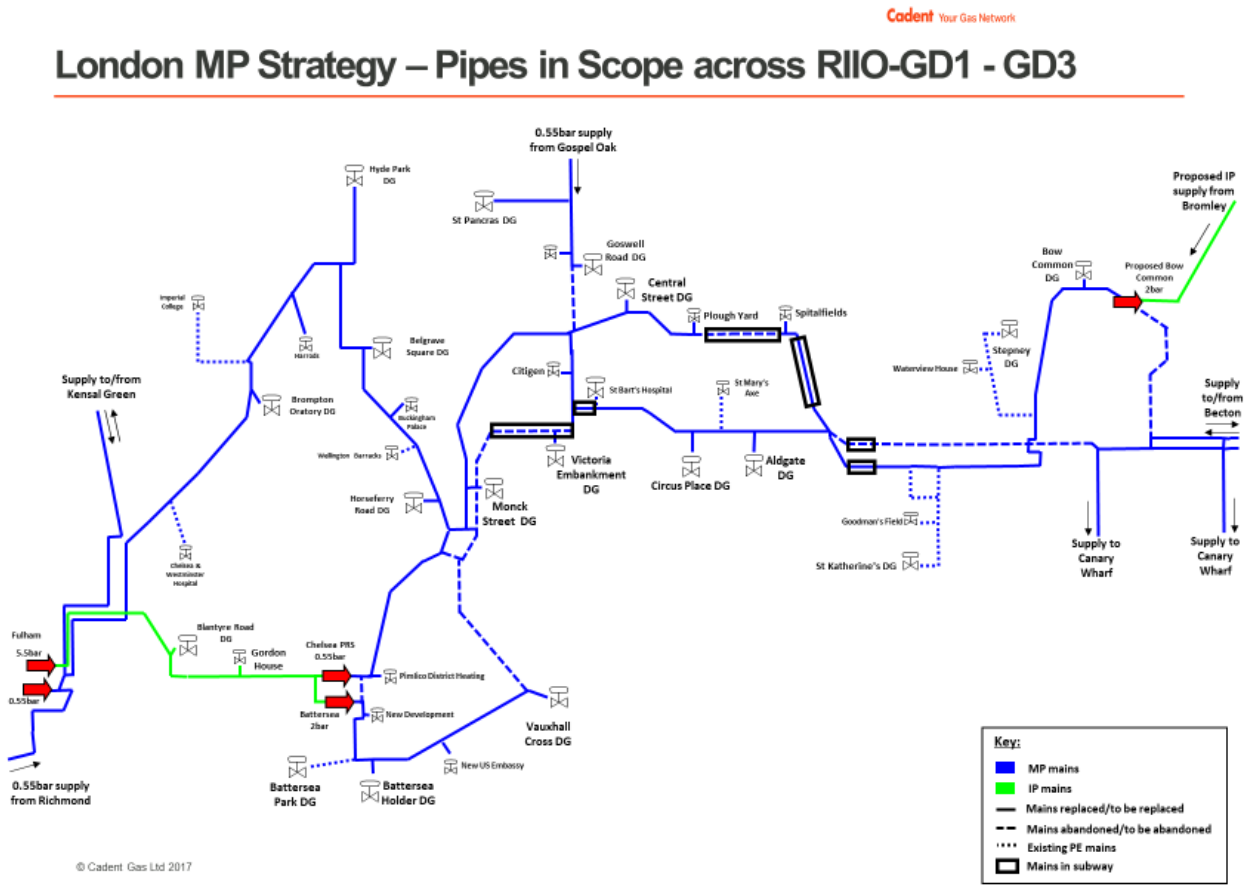


Figure 1: A schematic of the overall LMP scheme.

The following table summarises our proposed RIIO-2 LMP plan, aligned to the 12 schemes/sections discussed in our December EJP. Section 3 of this Technical Document explains how we have developed the optimum phasing and scope of work for RIIO-2 & 3.

The scope of work described herein is based on all sections being replaced via pipe insertion, except where noted otherwise. In most cases, pipe insertion along the existing route is the least disruptive and least costly option. Only a few sections of the route have complex subways or other issues/interfaces to manage, where relaying a new pipe along an alternative route has also been considered.

Many of the existing governors on the network are unable to operate at the increased 2-bar operating pressure. When this is combined with the existing equipment age, asset health and obsolescence, the existing governors need to be rebuilt. Opportunities for the rationalisation of governors was already considered within our December plan.

Section	LMP: Mains replacement scope remaining	Majority Main Size	Revised RIIO-2 work plan	Governor interventions
1	Belgrave Square to Monck Street	36”	2,674m	Belgrave Square (rebuild) Horseferry Road (removal) Monck Street (rebuild)
2	Salmon Lane Bridge to Commercial Road	48”	638m	
3	Commercial Road to Farringdon Street	48”	149m	
4	Commercial Street to Plough Yard	48”	RIIO-3	
5	Farringdon Road to Plough Yard	48”	851m	Central Street (rebuild)
6	Goswell Road Abandonment	36”	RIIO-3	
7	Commercial Road Abandonment	48”	RIIO-3	
8	Bromley by Bow to Bow Common	48”	RIIO-3	
9	Bow Common to East India Dock Road	48”	RIIO-3	
10	Monck Street to Farringdon Road	48”	4,463m	
11	Monck Street to Farringdon Street	36”	464m	
12	Farringdon Road	36”	650m	

Table 2: Summary of RIIO-2 work plan

The above 12 sections are shown on the following diagram, together with the proposed work phasing.

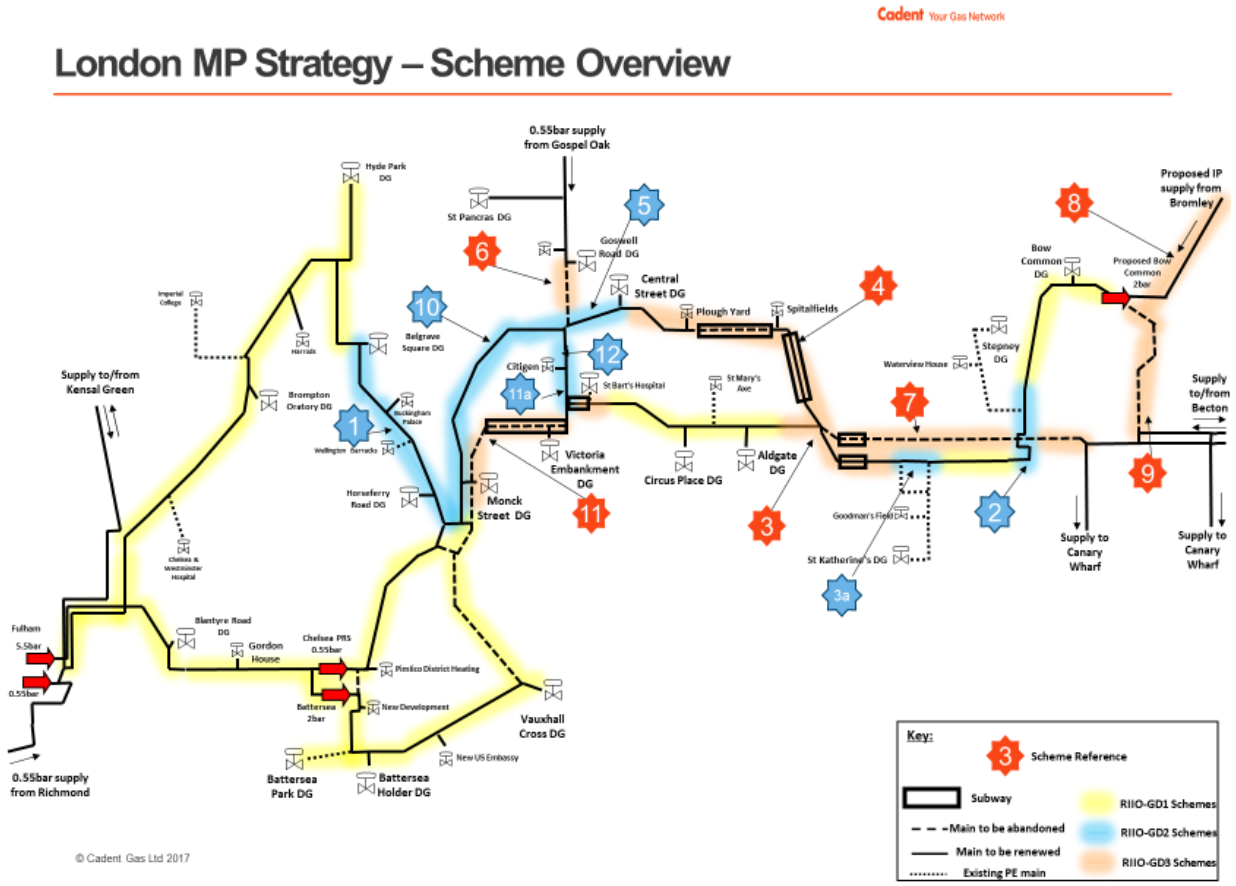


Figure 2: LMP Programme, showing location of each section and RIIO-phasing.

4 Our approach to optimising our RIIO-2 plan

Our work plan has been phased to continue working in areas that were partly complete in RIIO-1 to maximise the quantity of network that could be increased in pressure to 2-bar. Once sections of the network are operating at the higher pressures, this provides Cadent with greater network resilience for the benefit of customers and further network outage windows to undertake further mains replacement.

Our initial focus in RIIO-2 is to complete mains replacement around Chelsea embankment through Knightsbridge, Belgrave Square and Moncks Street, to create a 2-bar loop from the new Fulham PRS to Chelsea Embankment PRS, creating additional resilience on the western side of the network. This has meant that we will focus on works in Scheme 1: Belgrave Square to Monck Street and Scheme 10: Monck St to Farringdon Road in Year 1 onwards. In years 3 we then focus on Scheme 5 and Central St Governor. By the end of year 3, the following sections of LMP will be renewed and operating at the new higher 2 bar operating pressure.

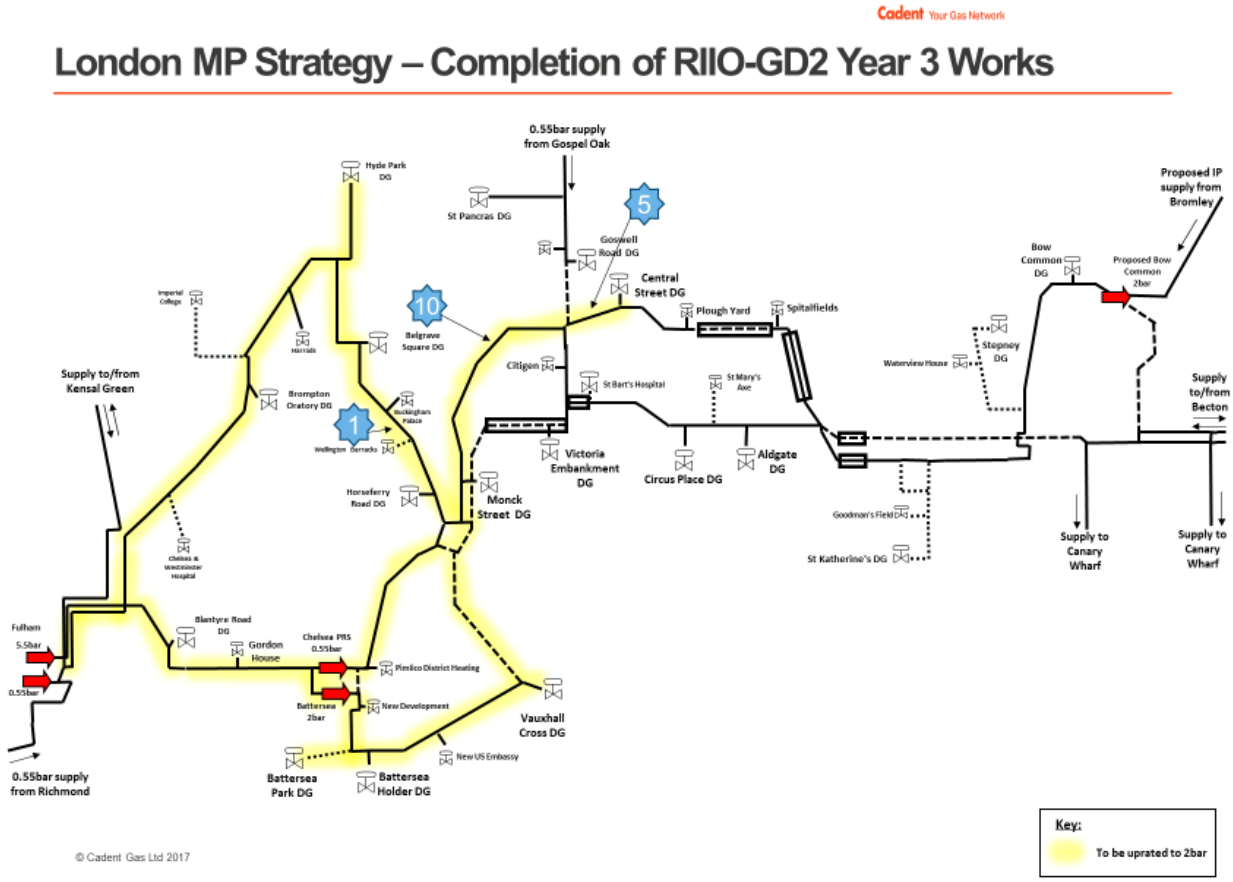


Figure 3: Operating pressures on MP network in London at end of Year 3 RIIO-2.

We have used stakeholder engagement to refine our phasing and traffic management and coordination; the role that stakeholder engagement has played in shaping our plan is discussed in the next section.

Significant network modelling has been completed to inform the phasing; this has shown us that only one governor can be removed for rebuilding at any one outage window (spring or summer), to ensure security of supply.

This additional resilience at the end of Year 3 then creates opportunities to work in multiple locations (different schemes in different parts of London) during the available summer outage windows. It has opened up opportunities to work on Scheme 5 at the same time as completing Schemes 1 and 10.

Towards the latter years of RIIO-2, we have then planned to work on other mains-insertion or open-cut sections outside subways, where work planning and the engineering solutions are more certain and unit costs with known technology are lower. This enables us to then work on 11a & 12 and also complete short sections of renewal on the eastern edge of the MP network (3a and 2). These latter sections, then enable, following the completion of the IP renewal from Bromley to Bow Common (Scheme 8 in RIIO-3), to then increase a section of the eastern side of the MP network to 2 bar in the early part of RIIO-3. This is shown in Figure 4 below.

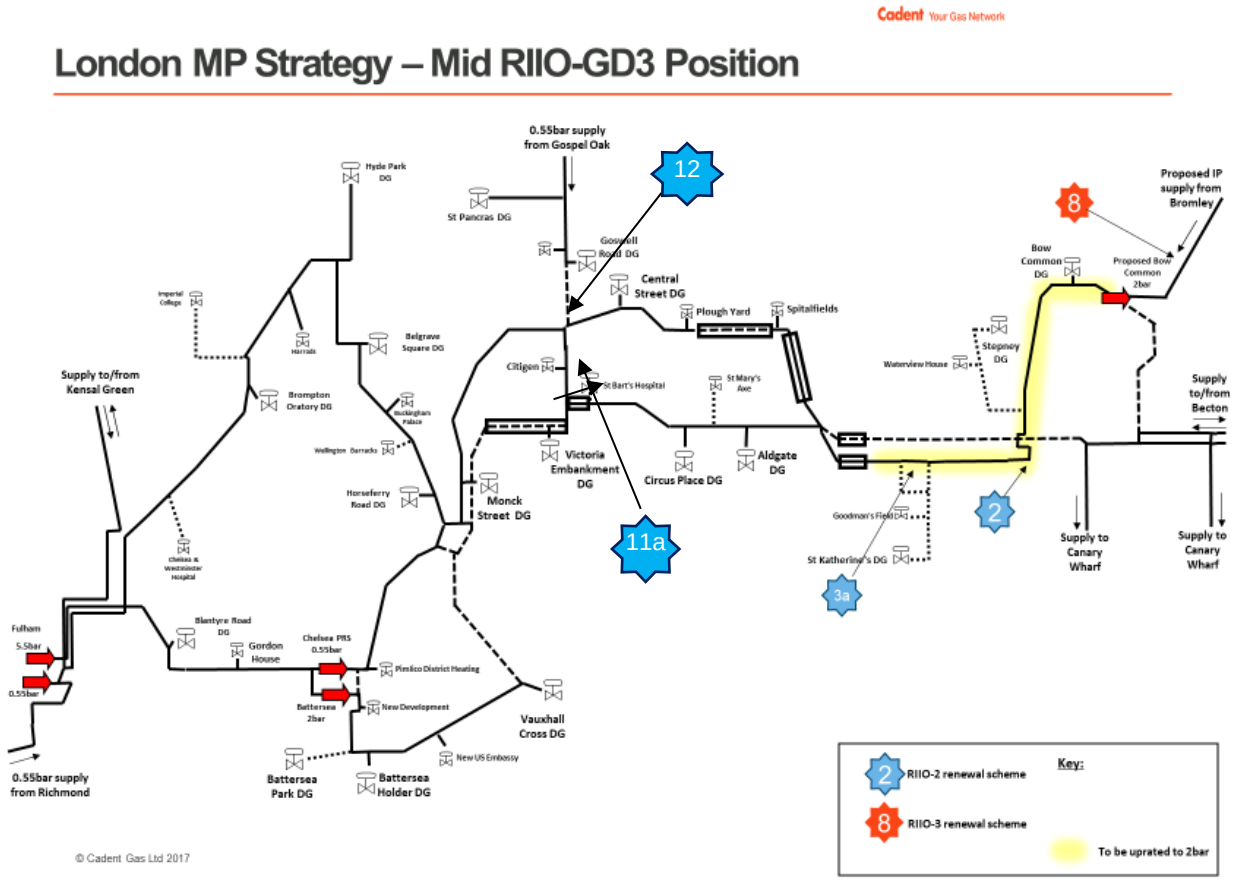


Figure 4: Operating pressure changes in early RIIO-3.

The RIIO-2 strategy is to target the highest risk distribution mains that can be replaced with known technology (i.e. not dependent on currently un-proven innovations) to enable as much up-rating of the network to 2-bar as possible, to achieve a combination of benefits for customers. These benefits are: maximum risk removed, and resilience increased for minimal cost.

Only the central section of the MP network will require renewal in RIIO-3 to enable the final increase in operating pressure. See Figure 5 below.

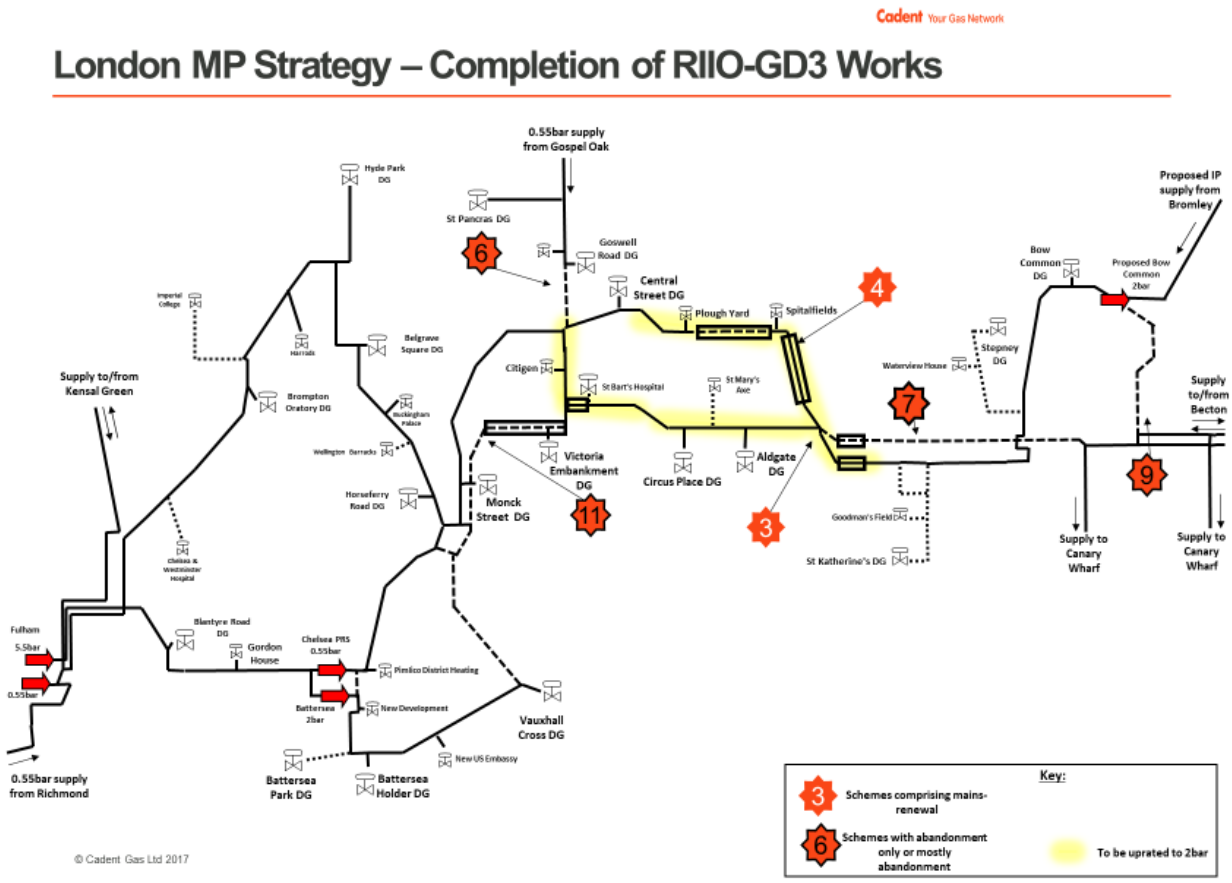


Figure 5: RIIO-3 Plan, with associated pressure increase at the end of RIIO-3.

Figure 5 above shows the remaining schemes for completion in RIIO-3. This will comprise the following scope:

- **10.3km of abandonment-only schemes** comprising existing 36" and 48" aging cast iron mains, that are now no longer needed to for network resilience. This 10.3km of mains-abandonment is comprised of **Scheme 6 & 7** and parts of **Scheme 9 & 11** and is therefore some of our least complex works to deliver. This abandonment can only be completed once the mains-renewal in RIIO-2 is delivered and the network operating pressures increased to 2 bar.
- **3.52km of mains renewal in subways** –This total is across 5 separate subway locations:
    - **Victoria Embankment Subway** - 2.3km 36" diameter pipe – ***abandonment only*** (part of Scheme 11)
    - **Commercial Road** - Circa 350m of 48" diameter pipe renewal (part of Scheme 9)
    - **Holborn Viaduct** – Circa 220m of 48" diameter pipe renewal (part of Scheme 11)
    - **Commercial Street to Plough Lane**: Circa 470m of 48" diameter pipe renewal (part of Scheme 4)
    - **Liverpool Street Station** - 180m of 48" diameter pipe renewal. (part of Scheme 4)
- **IP network renewals in the East of London**: (Scheme 8: refer to Figure 4): Circa 0.8km of mains-renewal.

This scheme comprises of a 600m section of 48" pipe which requires renewal, however it is likely that the preferred solution may comprise installation of 800m of PE gas main along a new route. This scheme has significant complexities including special crossings that require a more detailed plan with stakeholders, land owners and engineering solutions. Specific challenges along the route are:

    - A13 Crossing

- Blackwell Tunnel approach
- Docklands Light Railway crossing as Devons Road Station
- Limehouse Cut Canal
- Proximity issues to building

As mentioned previously, we have chosen to delay the renewal of our gas-mains within the subways until RIIO-3. This gives us time to investigate and develop innovative techniques and carry out further design and planning with our stakeholders to deliver the mains-renewals in the subways as cost effectively as possible. If we were to deliver this mains-renewal work now, the constraints and complexities would result in a very costly programme of work and reduced certainty of delivery.

The primary options available for replacement of mains within the subways, utilising current construction techniques, would comprise replacing the pipe in-situ within the subway service tunnel or laying a new pipe along an alternative route.

- **Renewing the pipe insitu:** This option would require extensive enabling works to divert a complex array of existing services, to provide sufficient safe working space to enable the gas-main replacement.
- **Alternative route:** finding a suitable corridor to lay a large diameter replacement gas-main, along roads congested with traffic, which are also full of existing services is also complex. These works would also likely comprise service diversions and significant open-cut mains-laying and in line with the sub-way act legislation.

We are confident that we have selected the optimum scope of work for delivery in RIIO-2 & 3.

Our RIIO-2 plan focusses on renewing the highest risk, lowest-complexity mains, to maximise the length of MP network that can be elevated to 2 bar operating pressure to maximise resilience; as a result, providing greater certainty of delivery.

RIIO-3 then focusses on delivering short lengths of high-complexity work in subways and an IP renewal on the east of London, to then enable large amounts of low-complexity abandonment and allows the final central sections of the MP network to be raised to the new 2 bar operating pressure.

This delivery strategy has enabled us to develop the following proposed RIIO-2 Work Plan.

The table shows the volumes of work by section (metres of mains replacement) or site name (for governors).

	2021/22	2022/23	2023/24	2024/25	2025/26
Scheme 1: Belgrave Sq. to Monck St **1a: Belgrave Sq. to Buckingham Gate** **1b: Buckingham Gate to Horseferry Rd** **1c: Horseferry Road to Monck St**	1268	795	610		
Scheme 2: Salmon Lane Bridge to Commercial Road					638
Scheme 3 Commercial Road to Farringdon St **3a: 84 to 60 Commercial Road.**					149
Scheme 5: Farringdon St to Plough Yard **5a: Turnmill street to Clerkenwell road** **5b: Clerkenwell road to Central St**		452	399		
Scheme 10: Monck St to Farringdon Road (via Trafalgar Sq.) **10a: Farringdon Rd to Bloomsbury Way** **10b: Bloomsbury Way to the Mall** **10c: The Mall to Storey's Gate** **10d: Storey's gate to Monck St**	1438	1654	625	746	
Scheme 11: Monck St to New Bridge St Abandonment **11a: New Bridge St to Farringdon St**				464	
Scheme 12: Farringdon St **12a: Farringdon Road**				650	
Governor interventions	Belgrave Sq.		Horseferry Central St Monck St		

Table 3: Proposed work-phasing for RIIO-2.

5 Evidence of stakeholder engagement for the RIIO-2 work plan

A significant learning-point from early RIIO-1 is the importance of comprehensive and ongoing stakeholder engagement. We under-estimated the scale of effort in the early years of our LMP programme, which led to some of the uncertainty experienced in early RIIO-1. We now have robust processes and highly capable resources in place to continue this robust approach to stakeholder engagement throughout RIIO-2. During the later years of RIIO-1. we have engaged comprehensively with all interested parties to ensure works are planned and impacts mitigated wherever possible for residents, businesses and road users.

We have used a specialist stakeholder-engagement and communications consultant to support us with this work (Copper Consultancy), and we intend to continue this approach throughout RIIO-2. Copper Consultancy has provided us with a report explaining our approach during RIIO-1 and some of our successes to date (See Appendix C of this document).

Examples of our approach to stakeholder engagement, and some of the benefits and cost savings that it has delivered for RIIO-1, are discussed in the **Commercial Document**.

We have engaged with all stakeholders regularly over the last eight years at scheme and overall project level. The average lead-in time for planning and communications at a more granular level, is six to nine months due to the location and complexity of schemes. Our work plan for RIIO-2 has been informed by early engagement with the following key stakeholders:

Stakeholder	Commentary/Progress
Greater London Authority (GLA)	We have had a continuous dialogue with the GLA and this is maintained as it supports the larger schemes and is an opportunity for collaboration. They have fully supported the schemes to date and have endorsed the plan (letter attached). Working group set up with the RIIO GD2 work shared to start looking for opportunities to support a London-wide plan
Transport for London	This is the main stakeholder with which we hold frequent meetings regarding current and future works. Since the LMPS works are planned over a greater duration, they support the TfL future planning model and allow for improved strategic planning for all major infrastructure works across London's road network Works for 2021 are being planned with TfL to allow collaboration with A40 improvements at the Westway Planning meetings are ongoing for Rotherhithe tunnel closure. The LMPS scheme is supported by a letter from the TfL Highways Director (See Appendix B)"
City of London	Very supportive, with works being endorsed by Ian Hughes Director, and Cllr leaders
Islington	Plans have been shared; further engagement required as we progress schemes 5 & 10 in the early years of RIIO-2.
Hackney	Works approved and ongoing that will carry forward into 2021
Tower Hamlets	Works currently approved and ongoing with a planning meeting for future works
Royal Borough Kensington Chelsea	Works supported by Highways Authority (HA) and Cllr Leaders; works continue in Borough with planning ongoing for 2021 schemes.

Stakeholder	Commentary/Progress
Hammersmith & Fulham	All works completed with positive stakeholder feedback
Westminster	Works approved for 2020/21 after extensive stakeholder engagement with Cllr leaders and HA mangers
Emergency services & Hospitals	We engage with all emergency services and Hospitals on every scheme, in which they form part of the scheme planning and working group.

Table 4: Summary of stakeholder engagement for RIIO-2

Copies of these letters of support are included in **Appendix B** of this document.

We have formal letters of support for this scheme from the 2 critical stakeholders that oversee, and co-ordinate works right across London:

- Greater London Authority
- Transport for London

At this stage in the programme, formal acceptance of work programmes in terms of accepted permits and Temporary Traffic Regulation Orders (TTROs) to undertake works in the public highway, is not obtainable. These formal approvals are typically agreed no more than months in advance of works. We therefore have agreements in principle at this stage. In the final stages of planning our activities focus on stakeholder consultation on the specific timing, site-layout and working arrangements. Only once those details are agreed, will the formal permit be issued, typically a few weeks before the start of physical site work.

Stakeholder approvals are typically in the form of TTRO's due to the major roads impacted. The broad timescales and working methods are discussed and agreed in principle up to 12 months in advance. TTRO applications are submitted 3 months ahead of the scheduled start date and the final working methods are negotiated and finalised between 3 to 6 weeks before start on site. Permits and final agreements may not be in place until a few days before start date. It is therefore not feasible to demonstrate any firm stakeholder agreements at this stage of planning for RIIO-2.

6 Scope of Work

6.1 General scope and methodology

We have built upon the detail within Annex 2 of our Appendix 09.06 to describe the scope of work by section and explain any specific challenges and difficulties. This information has been provided to demonstrate that we are consistently looking for the lowest risk, lowest cost, optimum solution to mains-replacements and governor interventions and that our working methods drive efficient delivery.

This section will therefore support the requirements set out in Ofgem's proposal for a bespoke re-opener specifically, full consideration of innovative techniques to lower costs. We believe our approach (described here-in) also reduces the delivery-risk and therefore improves certainty of delivery.

All mains-laying activities will consist of:

- Mobilisation and demobilisation by section
- **Mains-isolation tasks**: valve operations, pressure reductions, or mains-isolations via stopples of bypasses to enable safe working
- **Mains-insertion activities**: insertion and reception pits will be needed; the spacing varies based on valves, fittings, bends and location (e.g. road junctions)
- **Potential short sections of mains replacement via open cut:** required where there are particularly complex sections with multiple valves, fittings, bends or other complexities
- **Enabling Works:** various surveys, trial holes and camera surveys, CAD drawings and ground-penetrating radar will be needed to confirm the precise construction detail
- **Activities associated with working in highways:** each section will need varying amounts of traffic management, traffic orders, parking bay or bus-stop suspensions (and associated costs), lane rental charges, removal and reinstatement of street furniture and traffic signage (Visual Management Signs)
- **Ad hoc valve remediation**: a valve is exposed as part of mains-laying activity and Cadent takes the opportunity to carry out proactive maintenance of the valve body (sandblasting and repainting)
- **Testing** of new pipework
- **CP protection** and a CP test post installed on every valve
- **Other activities due to the complexities of the working environment**: archaeological support, night working/out of hours working (with associated tower lights) and utility diversions will be required

We have used our experience from RIIO-1 and built upon our learning, innovation, and knowledge of the specific sections of work planned for RIIO-2 to estimate volumes of the above work activities to inform the cost estimates.

All sections of main due for replacement also include existing bends, isolation valves, cathodic protection and marker posts and existing pressure and purge points and transition fittings that will all require replacement as part of the mains-replacement activity. The presence of these pipework fittings drives the need for additional insertion and reception pits and short sections of open-dig replacement. Their location heavily constrains where excavations are needed and calls for traffic management, road closures and complex third-party management.

We are confident that our mains-replacement methodology is the optimum, least cost methodology, which best-manages the risk associated with delays due to extensive road-occupation and unforeseen circumstances. This approach has been applied to all mains-laying sections and is summarised below:

- We have used mains-insertion wherever possible, as the least-cost mains-replacement technique.
- We look to carry out the work with the minimum of outages and, where possible, use live insertion and carry out pressure reduction using existing isolation valves, rather than using stopples or bypasses, to minimise costs.

- We have located insertion pits and reception pits outside of junctions wherever possible. We have minimised the number of pits as much as possible. Open-cut replacement and pits are required at every valve, bend or other major pipe-fitting.
- Open-cut replacement has been used as a last-resort mains-replacement method, and careful pre-planning, the use of ground-penetrating radar, internal camera surveys and other surveys (archaeological screening) and production of 3D CAD drawings are completed, to inform the design of the excavations and the traffic management required before work starts
- Our proposed construction methodology is developed in close liaison with all key stakeholders including Transport for London, the relevant Highways Authorities, all required London Boroughs and local community and business groups.
- We look for opportunities and mutually beneficial arrangements with other major, ongoing works in highways, to minimise impact on road users.
- We consistently look to manage the timing of our work to minimise disruption and reduce the time in which we occupy the road space wherever possible.
- We have developed innovative pipeline testing methods during RIIO-1, which have enabled us to reduce the road-occupation time further, enabling us to commission the pipes and backfill and reinstate all pits more quickly.

We have developed our governor interventions programme carefully to minimise cost and disruption during construction and to maximise safety and operability in the long term. This information has again, been presented to demonstrate that by applying this approach, we have selected the least-cost option, with manageable delivery-risk, for our RIIO-2 governor interventions and that these have been built from innovation and learning from RIIO-1 works.

Our design methodology has adopted the following principles:

- Some of our governors are at the end of their asset life; they are also unable to withstand the new higher operating pressure of 2 bar. This gives us the opportunity to rationalise our asset stock.
- We have looked for opportunities to rationalise the location or the need for the governors; through detailed network modelling. We have identified one opportunity in RIIO-2 to decommission an end-of-life governor at Horseferry Road, and provide sufficient capacity in the new Monck Street Governor (with minimal change in size of equipment) in the proposed design.
- We have selected a safer, modular governor design, that can be direct buried and maintained via individual access covers at ground level (Orpheus Units). This enables us to do away with the large, deep chambers used to house the existing governors, which were unsafe and required confined-space entry.
- We have looked at the location of these governors within the road space and have looked carefully at the optimum location to ensure adequate separation to existing buildings, yet achieve easy access, where possible, that doesn't require major traffic management for scheduled maintenance or emergency visits. At Monck Street, we are in negotiations to re-align the road and make it one-way to enable our new governor to be located outside the main road carriageway.
- The modular design of these governors also provides benefits in reducing the necessary working area during construction; each unit can be installed separately, with its own separate access cover. This provides greater opportunity for traffic management and greater flexibility in the construction and maintenance of the asset and improved aesthetics of the finished build.

We are therefore confident that our proposed solutions in RIIO-2 and RIIO-3 are efficient and represent the least cost, which means that the unit costs discussed in our commercial document are efficient.

6.2 Scope of Mains-laying activity in RIIO-2

This section has been developed to explain the technical detail associated with each section of mains-renewal within scope for RIIO-2. This section supports a detailed understanding of what challenges and pipe-features have driven the mains replacement methodology and therefore informed the cost of the work.

There are regular references in the following sections to complex features and the need for open-cut mains renewal. It should be noted that whilst there are numerous references to open-cut, we have made every attempt to remove the need for open-cut through innovation and engineering. The resulting engineering drawings are shown in Appendix A; these show that the majority of the schemes are planned to be delivered by mains-insertion.

6.2.1 Scheme 1: Belgrave Square to Monck Street

6.2.1.1 Scheme Overview and Phasing

Summary	
Mains laying scope	To abandon 2.67km of 36” main and replace with 2.67km of inserted 630mm PE pipe.
Governor scope	Rebuild Belgrave Square Governor (50 kscmh capacity) Rebuild Monck Street Governor (40 kscmh capacity) Decommission Horseferry Road Governor
Construction duration	Phased project over three years
Proposed start date	April 2021
Commissioning Date	September 2024

We have chosen to break this scheme into three specific work phases over the first three years of RIIO-2. This scheme contains gas mains from Belgrave Square to Monck Street, three district governors supplying gas to approximately 28,000 customers and two medium pressure services supplying gas to Buckingham Palace and Wellington Barracks.

The sub-sections to be delivered each year have been chosen through careful consideration of:

- Continuing mains replacement adjacent to works completed in RIIO-1, to allow sections of the network to be elevated to 2 bar as soon as possible.
- Lengths of mains-replacement that will be deliverable within the allowable spring-summer outage window, considering the complexities involved.
- Minimising disruption on the busy road junctions around Buckingham Gate and the general Westminster area of London.
- The need to manage the gas-supplies and network resilience and specifically the MP supplies to Buckingham Palace and Wellington Barracks.
- Network modelling results that show that only one governor can be taken out of service, while mains replacement is taking place during spring/summer months.

The preferred work plan is comprised of the following sections:

- Section 1a – Belgrave Square to Buckingham Gate.
- Section 1b – Buckingham Gate to Horseferry Road.
- Section 1c – Horseferry Road. to Monck Street

The overall scheme is highlighted in BLUE on the diagram below.

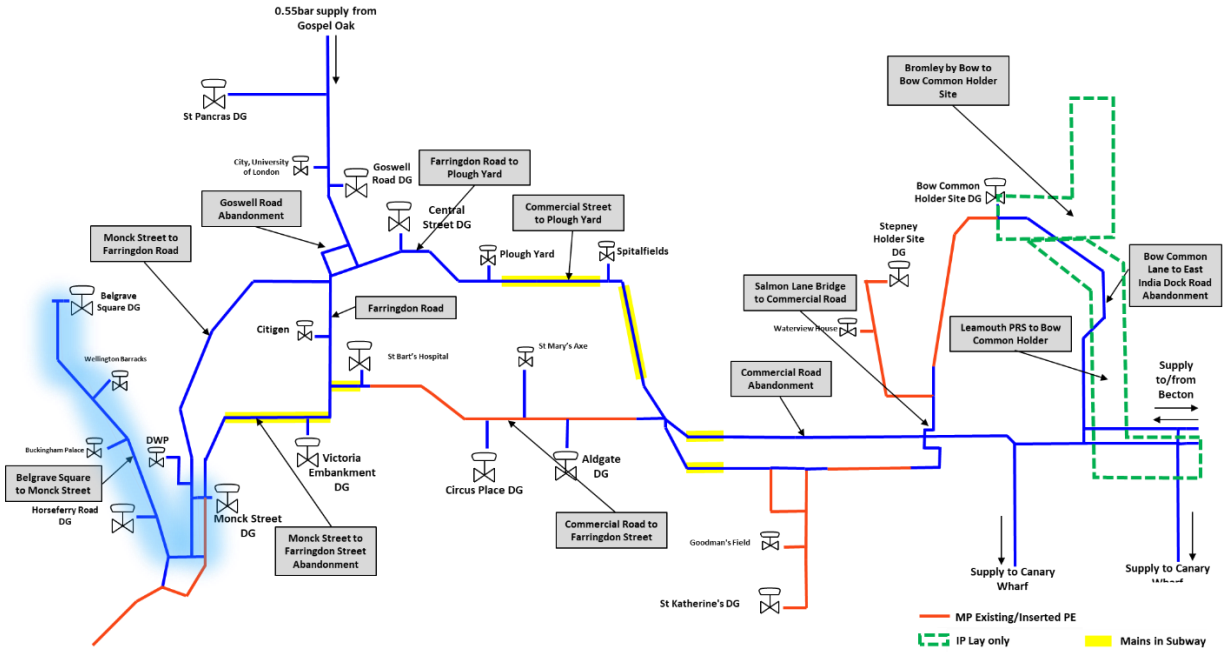


Figure 6: Location Plan for Scheme 1.

6.2.1.2 Section 1a – Belgrave Square to Buckingham Gate

This section of main is comprised of approximately 1,270 metres of existing DN900 (36") SI/CI (Spun Iron/Cast Iron) medium pressure (MP) gas main, which runs between Belgrave Square to Buckingham Gate. This existing main will be replaced with a new 630mm PE pipe.

This section ties into pipework adjacent to the Belgrave Square Governor, then crosses the intersection between Hobart Road and the A302 at Grosvenor Place and continues towards Buckingham Palace. This section terminates just before the service offtake to Buckingham Palace.

Engineering drawing 386309-MMD-BSMS-XX-STP-M-0001 Sheet 1 for Section 1a of the Belgrave Square to Monck Street provides further route details. A copy is provided in Appendix A.

Specific features and engineering challenges along the route are summarised below.

1. **Crosses the Victoria tube line at Buckingham Gate Road**; our mains replacement work must ensure there is no impact on this critical infrastructure.

2. **Belgrave Square Tie-in location:** This is a congested road through the embassy district in London and will involve careful traffic management and design to enable open-dig construction of the tie-in and insertion pits for ongoing insertion works.

3. **A302, Grosvenor Place, Lower Grosvenor Place, Hobart Place Junction**: This is another very busy road intersection with the A302 (at Grosvenor Place). The A302 forms part of the London Inner Ring Road, where most of its route is inside the Congestion Charge Zone. The A302 is a red route (under the control of TfL) which means it forms part of a network of major roads that make up 5% of the roads in London but carry up to 30% of the city's traffic.

4. **Buckingham Gate Tie-in location**: This section will terminate at a new isolation valve, at the end of Buckingham Gate road, just before the offtake towards the MP service to Buckingham Palace and before the intersection with Birdcage Walk and Spur Road. A significant proportion of this work will be open-cut. This is an extremely congested area, which means increased complexity of the installation works.

As a result of these challenges and complexities, the mains-replacement technique required for Section 1a frequently changes between pipe insertion and open cut. We have looked to maximise insertion where there are straight sections of main without major valves, predominantly around Belgrave Square, Upper Belgrave Street, Hobart Place, Lower Grosvenor Place and Buckingham Gate Road.

Belgrave Square Governor will also be rebuilt during the spring/summer outage window within the same financial year (Year 1). As part of our preparation for long-lead items, such as governors in this complex scheme, the bespoke design work of this governor work was commissioned and paid for in May 2020, in order to ensure that the planned install window is not missed. This is primarily due to the long-construction time for the governor itself, quoted at approximately 37 weeks.

6.2.1.3 Section 1b –Buckingham Gate to Horseferry Road

This section is comprised of 795m of 36” (DN900) existing SI/CI (Spun Iron/Cast Iron) medium pressure (MP) gas main which runs from Buckingham Gate to Horseferry Road. This section of main will be replaced with a new 630mm diameter PE pipeline.

Please refer to Drawing 386309-MMD-BSMS-XX-STP-M-0001 Sheet 2 for Section 1b of the Belgrave Square to Monck Street route details, contained in Appendix A.

This section ties in to the end of Section 1a at Buckingham Gate Road. The pipeline then continues to run along Buckingham Gate road after the intersection with Birdcage Walk and Spur Road, with another offtake along the road towards the existing 180PE MP service at Petty France.

The new pipeline crosses the A302 at Victoria Street to continue through Artillery Row and Greycoat Place to arrive at Horseferry Road.

> Section 1b terminates just before the Horseferry PRS offtake. This enables the Horseferry Governor to remain live and support the network during the winter, to provide extra network resilience while Section 1b installation works are taking place.
>
> Upon completion of Section 1b, all of Section 1a and 1b will be increased in pressure to 2 bar. This approach requires a double-valve arrangement to be installed adjacent to Horseferry Road, to enable the Horseferry Road Governor to continue to operate at 550 mbar.

Specific features and engineering challenges along the route are summarised below.

1. **Crosses the Circle and District Line along Buckingham Gate Road**: our mains replacement work must ensure there is no impact on this critical infrastructure.

2. **Buckingham Gate Tie in**: As discussed previously, this is a complex connection which will require a significant proportion of open cut.

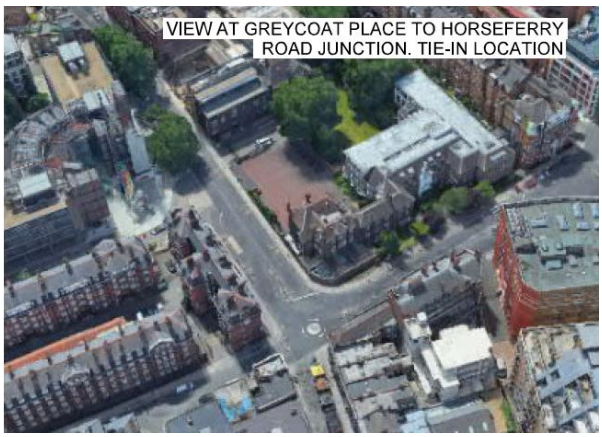
3. **Intersection between Birdcage Walk, Spur Road and Buckingham Gate Road:** This area is extremely congested and has a high density of tourists. This will require open cut due to the existing bends at this junction and will require careful stakeholder liaison and traffic management to minimise disruption. The main also crosses existing low-pressure gas mains at this junction.

4. **Junction of Petty France:** An additional section of open cut is required opposite the junction of Petty France, due to the need to cross-connect to an existing MP service in front of Westminster Chapel. The existing gas main is within 5m of an existing building, so additional blast protection is required.

5. **Junction with Victoria Street and A302:** The route then crosses the A302 at Victoria Street at another major road intersection. As mentioned previously, the A302 forms part of the London Inner Ring Road, is a Red Route controlled by TfL, and is inside the Congestion Charging Zone. Large office blocks and premises are adjacent to this junction and will require careful coordination to minimise impact.

6. **Route from Victoria Street and along Artillery Row:** This section from Victoria Street, along Artillery Row and Grey Coat Place, follows a tortuous route with many bends and across two major roundabouts close to buildings. This section therefore requires a significant amount of open-cut mains replacement, with the associated complexities, and additional blast protection.

7. **Horseferry Road Junction tie-in Location:** we are proposing to tie in to the existing pipework adjacent to the existing Horseferry Governor offtake, in front of The Grey Coat Hospital. There is a bus-stop along this section that will need careful management with London Buses to minimise disruption.



As a result of all these challenges, there are seven instances of open cut and with the remainder being mains-insertion.

6.2.1.4 Section 1c – Horseferry Road to Monck Street

This last section of Scheme 1 is a total length of 610m of existing DN900 (36") SI/CI (Spun iron/Cast Iron) medium pressure MP gas main which runs along Horseferry Road to Monck Street. The existing 36" main will be replaced with a new 630mm PE pipeline.

See Drawing 386309-MMD-BSMS-XX-STP-M-0001 Sheet 3 for Section 1c of the Belgrave Square to Monck Street refers, in Appendix A.

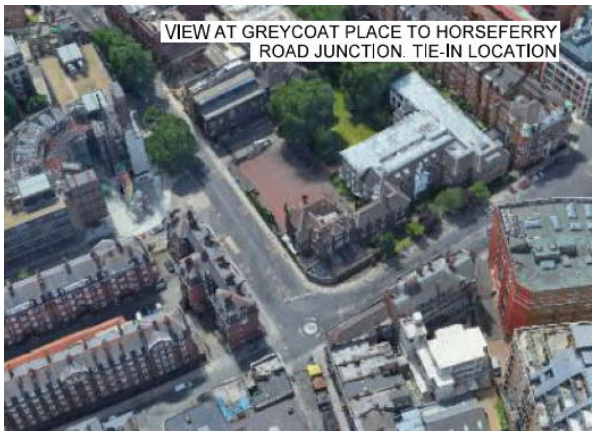
The scheme ties in to the connection point at Horseferry Road Governor offtake (as described in Section 1b). The route then follows through Horseferry Road, taking a sharp turn towards Medway Street up to the intersection with Monk Street, where the pipeline is then redirected up this road towards the end of Monck Street road towards the intersection with Great Peter Street. Section 1c consequently terminates just before the Monck Street Governor/PRS offtake at the end of the road, enabling the Monck Street Governor to remain live during the installation of Section 1c.

The route of Section 1c installations is predominantly along Horseferry Road. This major road is surrounded by smaller local roads, all feeding their traffic into it. A series of businesses and establishments, such as Channel 4 Television, the Grey Coat Hospital and the London Scottish Regimental Trust, are also adjacent to the planned works, making this area extremely busy and congested.

Upon completion of Section 1c, this section will also be elevated to the new 2-bar operating pressure. The Monck Street Governor will then be rebuilt and the capacity increased; once the rebuilt Monck Street Governor is commissioned, this will enable the governor at Horseferry Road to be abandoned.

Specific features and challenges along the route are summarised below.

1. **Greycoat Place/Horseferry Road Junction tie-in location:** As discussed in Section 1b, this is another busy junction; a bus stop will require management to minimise impact to bus users.



2. **Junction of Medway Street and Horseferry Road:** An existing pipe bend requires open-cut construction at this junction.

3. **Junction of Medway Street and Monck Street Junction:** Another complex pipework arrangement, with interfaces with an existing LP gas main and existing pipework fitting requires open cut in this junction. The gas mains are within 5 metres of buildings and require additional blast protection during the works.

4. **Monck Street/Great Peters street tie-in location:** our mains replacement work must ensure there is no impact on this critical infrastructure.

5. General management of existing Bus-stops along Horseferry Road

6. Management of the impact on high-profile businesses and properties:

As a result of these challenges, there will be three sections of mains insertion along the straight sections of Horseferry Road, Medway Street and Monck Street. There will be two open-cut excavations at the tie-in locations and a further two open-cut locations at the two other road junctions with Medway Street; one of these open-cut locations will require additional blast protection due to building proximity.

6.2.2 Scheme 2: Salmon Lane Bridge to Commercial Road

6.2.2.1 Scheme Overview and Phasing

Summary	
Scope of work	To abandon 0.64km of 48” main and replace with 0.64 km of 800mm PE and 630mm PE inserted pipe, along a major road with bus lanes.
Construction duration	6 Months
Proposed start date	April 2025
Commissioning Date	September 2025

Scheme 2 will isolate one of the key 48” mains that runs from east to west on the MP system. To enable this work, we will require an outage at our Stepney holder site. We would therefore need to carry out these works during the summer when the gas demand on the LP system is lower.

The full 638m of this existing 48” main can be replaced in one phase but can only be constructed once the closure of the Rotherhithe tunnel has been secured. An 800mm PE and 630mm PE inserted pipe will be used along major roads such as Commercial Road A13, Yorkshire Road and Salmon Lane. This route contains bus routes and a complex pipe crossing at Regents Grand Union Canal.

The diagram below shows the specific section highlighted in BLUE.

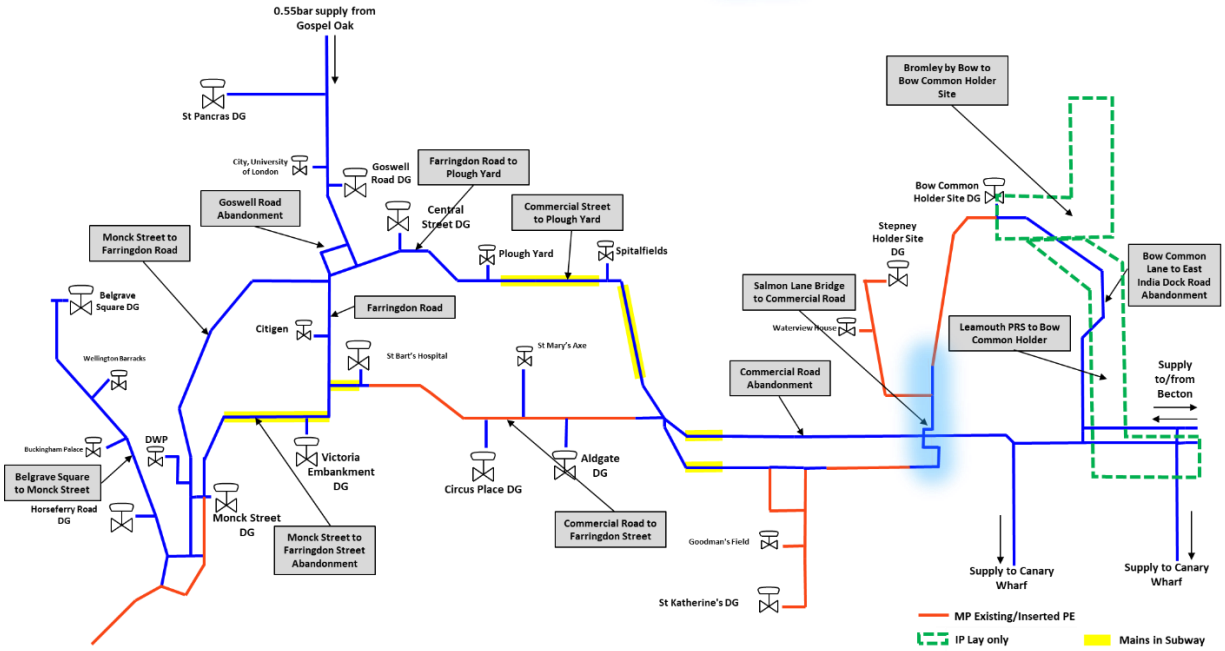


Figure 7: Location of Scheme 2

Scheme 2 has a major interface with the Rotherhithe Tunnel, and therefore the timing of our works needs to be agreed with Transport for London (TfL). A number of existing bends on the 48” main are located in the carriageway on the tunnel approach road. Thus, excavation is required to remove the bends and allow for the new MP pipeline insertion. Refer to the route drawings in Appendix A.

To date, we have engaged with TfL who have stated that our works must be coordinated with their planned tunnel repairs and the associated Rotherhithe tunnel closure due for Year 4 of RIIO-2.

This section of mains replacement will tie-into the existing main on Salmon Lane Bridge situated before the canal crossing. This forms the start of the new Salmon Lane Bridge to Commercial Road main gas pipeline.

The route then crosses Regent's Canal above ground to continue on Salmon Lane Bridge towards Yorkshire Road and into the A13 at Commercial Road, where it then terminates shortly after passing the intersection with Butcher Row Road and ties in to the 630mm PE MP in 48" CI Main.

Specific features and challenges along the route are summarised below.

- **Salmon Lane Bridge Tie-in point:** The mains replacement will tie in to an existing strategic isolation valve (no. 17622) to the east of the above-ground canal crossing.

- **Regent's Above Ground Canal Crossing (across the Grand Union Canal):** We are not currently proposing to replace the above-ground steel pipeline crossing section; from our periodic inspections of above-ground crossings it is highly likely that the asset health of the crossing is satisfactory and can be retained. Mains replacement will tie in either side of the existing crossing; a new isolation valve will be installed either side to facilitate this renewal. Due to the pipework, fittings and configuration, renewal of the pipes either side of the crossings will be via open-cut methods.

- **Yorkshire Road offtake**: The new pipeline then turns into Yorkshire Road. Pipework to an existing offtake towards Salmon Lane also requires renewal. This offtake will to tie in to the existing 500PE mains routed along Salmon Lane and is located in front of the Railway tracks in Yorkshire Road. Construction activity in Yorkshire Road will require open-cut mains replacement, will be complex due to the limited working space and will be close to the train line running adjacent. Further discussions will be needed with Network Rail, but night-working or partial train-line closure may be needed. Engagement with Network Rail on our rail-crossings work in RIIO-2 is underway now.

- **Commercial Road and A13 junction**: The route then continues along Yorkshire Road towards the A13 at Commercial Road. There is a bend here, which will require open-cut mains replacement in a major junction. The A13 is part of the TfL strategic road network and, as a major road linking Central London with East London and South Essex, it is an extremely congested area. Commercial Road has a couple of bus stops and routes that will require management as the scheme progresses. Some level of night working will be required to manage disruption in this area.

- **Rotherhithe Road Tunnel closure**: As already mentioned, a key enabler to completing this section of the scheme is coordinating our mains-replacement works with planned TfL tunnel

maintenance and tunnel closure. Once the tunnel approach road is closed, the works will likely require a number of open-cut excavations to remove existing 48” bends to allow pipe insertion.

There are estimated to be six specific sections of open cut required due to the challenges and complexities of above ground canal crossings, the connection to Yorkshire Road offtake, the existing bend at the junction between Yorkshire Road and Commercial Road A13, Butcher Row junction and the final tie-in location. There will be four different segments of pipe insertion. TfL are very well aware of the access needs of our work and are supportive of us collaborating with them for a single window of access for both gas and tunnel maintenance works.

6.2.3 Scheme 3: Commercial Road to Farringdon Street

6.2.3.1 Scheme Overview and Phasing

Summary	
Scope of work	To abandon 0.15km of 48” main and replace with 0.15 km of 630mm PE inserted pipe, along a major road with bus lanes.
Construction duration	3 months
Proposed start date	October 2025
Commissioning Date	March 2026

This scheme is 1000m overall, but we have opted to construct only a short section in RIIO-2 (section 3a) totalling 0.15km. Most of the remaining section is located within the Commercial Road utility subway and, with current technology, requires major civil works to replace the pipework. Thus, we have opted to replace the section outside the subway during RIIO-2 while we carry out detailed design works of the remaining section during RIIO-2 to inform our work plans for RIIO-3. The following diagram shows the specific section highlighted in blue.

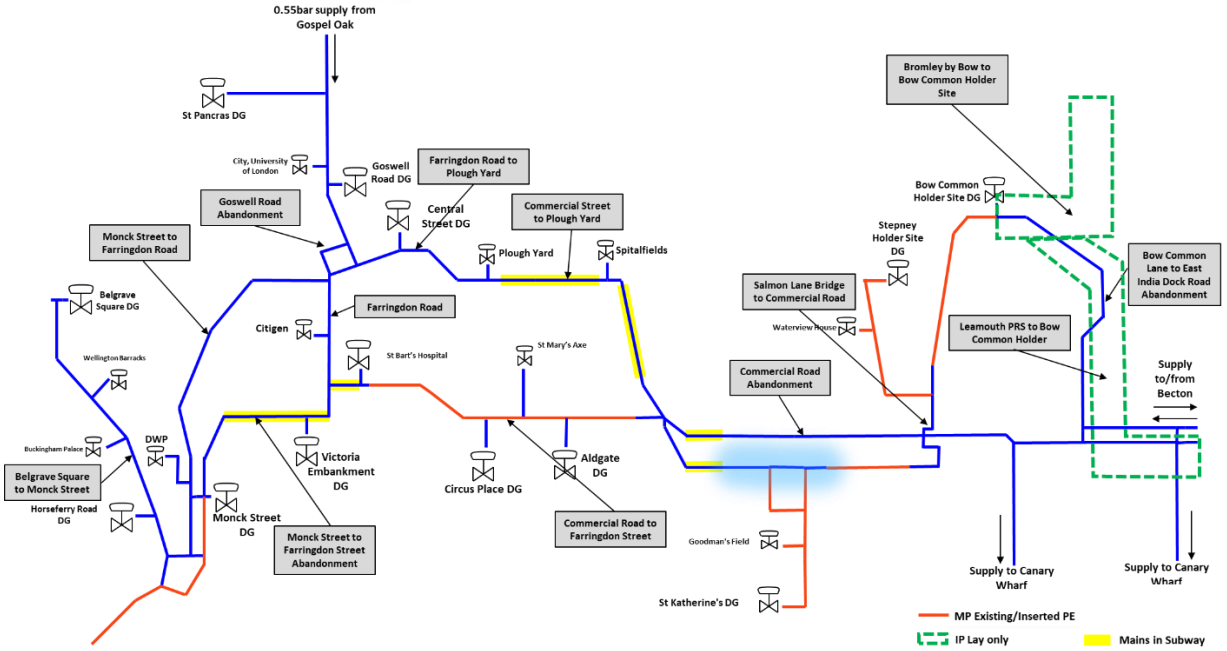


Figure 8: Location of Scheme 3a

The existing pipe is a DN1200 (48”) Cast Iron medium-pressure (MP) gas main that runs along Commercial Road (A13). Within RIIO-2, 149m of this main will be replaced with a 630mm PE pipeline.

Like the works for Salmon Lane Bridge to Commercial Road (Scheme 2), these works will isolate one of the key 48” gas mains that runs from east to west on the MP system. Network analysis shows that this would be feasible in the winter of 2025, once other areas of the MP system have been upgraded to 2-bar pressure.

This outage does result in a loss of supply to St Katherines MP-LP district governor, but we have sufficient resilience in our network and our existing Stepney Grid district governor, located to the east, is able to manage demand and sustain pressures within the LP network for a winter operational window.

6.2.3.2 Section 3a 84 Commercial Road to 60 Commercial Road

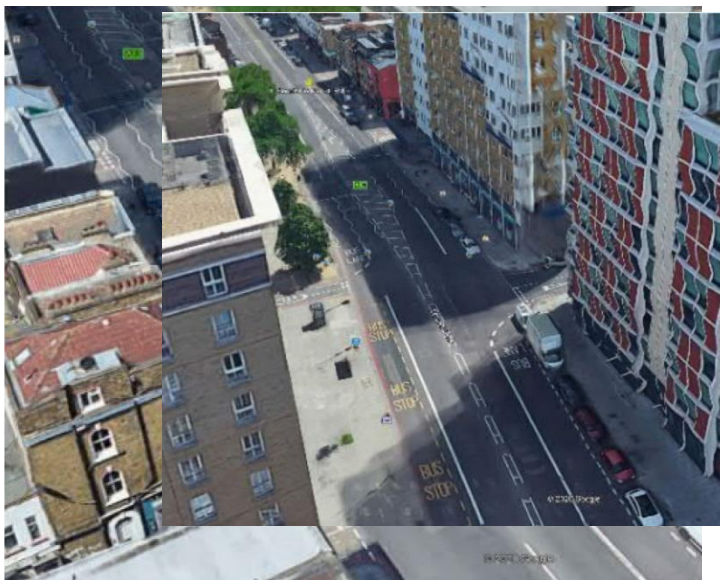
As mentioned above, during RIIO-2, only 149m of this existing 48” main will be replaced.

This gas main follows Commercial Road, which has bus lanes and is extremely congested.

This short section of mains replacement is comprised of two 24” offtakes that lead towards Back Church Lane. Refer to the route drawings in Appendix A.

Specific features and challenges along the route are summarised below.

60 Commercial Road/Back Church Lane Junction: This section of mains renewal will require open cuts in the middle of a congested junction along Commercial Road (A13), which also contain bus lanes on either side of the road. As explained previously the A13 is part of TfL’s strategic road network and a major road link between central, east London and South Essex. The mains replacement will tie in to an existing strategic valve and two 24” offtakes. A short 15m of replacement 355mm PE will be required, to replace the existing 24” offtake at Back Church Lane. This section will require careful, complex traffic management and pre-planning to minimise disruption to bus routes, road users and local businesses.



Tie in location opposite Batty Street Junction: This section will tie in to an existing strategic valve opposite 84 Commercial Road.

The short section of main between these two open-cut sections will be replaced via pipe-insertion.

6.2.4 Scheme 5: Farringdon Road to Plough Yard

6.2.4.1 Scheme Overview and Phasing

Summary	
Scope of work	To abandon 0.851km of 48inch main and replace with 0.864km of inserted 630mm PE pipe. Associated governor - Central Street
Construction duration	1.5 years (in 2 phases)
Proposed start date	April 2022
Commissioning Date	September 2023

This section will be broken into two phases of work, over two consecutive years; the primary driver for this phasing is to help ensure that the supply to Queen Mary University and Charterhouse Square Campus is maintained during the replacement works. The two phases start and end at the service offtake to the University Campus. A rebuild of the existing Central Street District Governor will be constructed to be completed at the same time as the second phase of work. The diagram below highlights the location of Scheme 5. (BLUE)

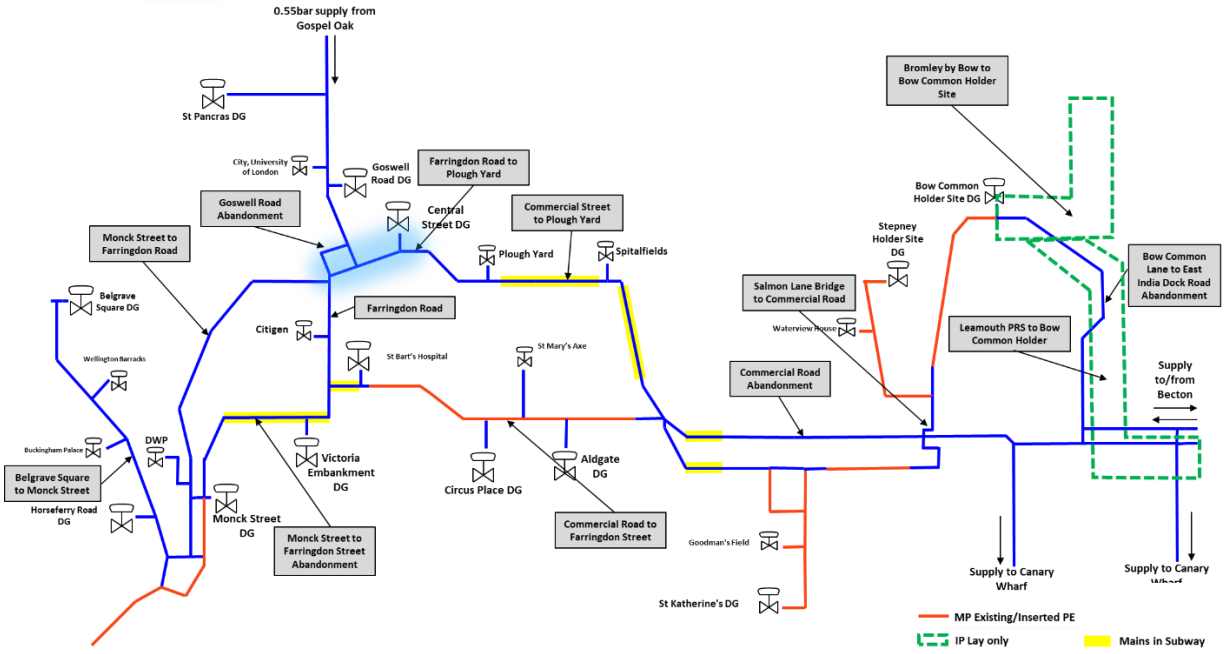


Figure 9: Location of Scheme 5

Section 5 from Farringdon Road to Plough Yard contains one MP service offtake to the University Campus and one offtake to Central Street district governor supplying gas to approximately 2,800 customers.

We are proposing the following two phases of work:

- Section 5a – Farringdon Lane to Clerkenwell Road (including a new service offtake to the University Campus)
- Section 5b – Clerkenwell Road to Central Street

By the winter of 2022/23, the new Chelsea Embankment PRS and Becton supply from the east will provide additional resilience to this network. This additional resilience has made it possible to plan for an outage

for the winter of 2022/23 at St Martin's Place and the Mall for other maintenance work. We will take advantage of this to also construct Section 5a.

Section 5b will be constructed during the outage planned for Horseferry Road to Monck Street: Section 1c, (summer 2023); this outage will also enable the construction of the Central Street Governor.

Refer to the route drawings in Appendix A.

6.2.4.2 Section 5a: Farringdon Lane to Clerkenwell Road.

The existing gas main is a 452m long DN1200 (48") Cast Iron MP pipe. The pipe will be replaced with about 452m of 630mm diameter PE pipeline.

This route contains bus lanes and has many extremely busy junctions.

The new pipeline ties in to the start of the Farringdon Road Scheme installation works at the east of the Vine Street bridge (before crossing the bridge) and follows Farringdon Lane south towards Clerkenwell Road.

The new pipeline is then routed along Clerkenwell Road crossing major roads such as St Johns Street and terminating just before the service offtake towards the Queen Mary University Charterhouse Square Campus.

Specific features and challenges along the route are summarised below.

- **Vine Street/Farringdon Lane/Clerkenwell Road Junction.** This section of the route is comprised of multiple levels of infrastructure; the route runs along a low-level railway line. The road itself is elevated on brick arches. Vine Street Bridge is an extremely congested road that crosses an existing LP main, and other services also occupy the road space. The existing 48" main has a number of bends. For this reason, the section between the tie-in point and new isolation valve, and south along Farringdon Lane and then east along Clerkenwell street will be open cut and will require careful traffic management.

- **Clerkenwell Road and St John Street Junction**: At this junction, there are a number of bends and fittings, that will require open-cut replacement. Again, this is a very congested junction requiring careful traffic management and phasing.

- **Clerkenwell bus route**: There are a number of bus stops and bus routes that follow Clerkenwell Road, and we will need to work with TfL to manage these during the construction period.

As a result of these challenges, there will be four sections of open cut; two at the tie-in points, one section at the Clerkenwell Road/St John Street junction, and another section at an existing bend to the west of St John Street along Clerkenwell Road. The remaining lengths, which comprise the majority of the length of this section, will be replaced via pipe insertion.

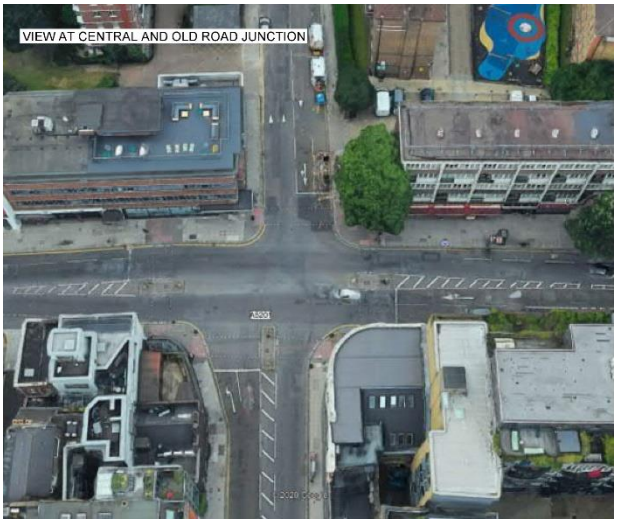
6.2.4.3 Section 5b: Clerkenwell Road to Central Street

This section is an existing 48” DN1200 Cast Iron MP gas main, which runs between the service offtake from the university campus on Clerkenwell Street to Central Street. It is a total of 400m long; the pipe will be replaced with a 630mm diameter PE pipeline.

The route follows Clerkenwell road towards the intersection with Old Street, crossing major junctions with Goswell Road and running through Old Street, terminating just outside 68 Old Street, at the junction with Central Street.

Specific features and challenges along the route are summarised below.

(A1) Goswell Road/Clerkenwell Road: This is a wide-sweeping, congested road junction, with the existing gas main consisting of a number of bends. The main across this junction will therefore need to be open cut. The A1 is a strategic road and travels through the city and three London Boroughs, linking the M1. This work will require careful coordination with TfL for traffic management.



Tie-in point at Old Street: At this junction, there is an existing tee and three isolation valves, so this section will need to be replaced using open-cut techniques.

Clerkenwell Road Bus Routes: As discussed for section 5a, this section also requires careful management to minimise the impact on bus routes/customers.

As a result of these challenges, there will be two complex open-cut sections at the tie-in points, within complex traffic junctions. The remaining sections of pipe along Clerkenwell Road and Old Street can be replaced via two sections of pipe insertion.

6.2.5 Scheme 10: Farringdon Road to Monck Street

6.2.5.1 Scheme Overview & Phasing

Summary	
Scope of work	To abandon 4.46km of 36” main and replace with 4.46 km of 630mm PE inserted pipe Proposed delivery within four phases, across four years.
Construction duration	4 years
Proposed start date	April 2021
Commissioning Date	March 2025

We are proposing to deliver this scheme in four phases, starting in Year 1 of RIIO-2. The phasing has been chosen purely on the grounds of minimising the footprint of the works throughout Westminster at any given time, to minimise disruption and meet expectations of key stakeholders. There are no outage constraints on this section, the works can be delivered continuously, dependent on agreements on traffic management and wider stakeholder approval. Refer to the route drawings in Appendix A.

The four phases of work proposed are:

- Section 10a – Farringdon Road to Bloomsbury Way
- Section 10b – Bloomsbury Way to The Mall
- Section 10c – The Mall to Storey’s Gate
- Section 10d – Storey’s Gate to Monck Street

See the sections shaded in BLUE, within the schematic.

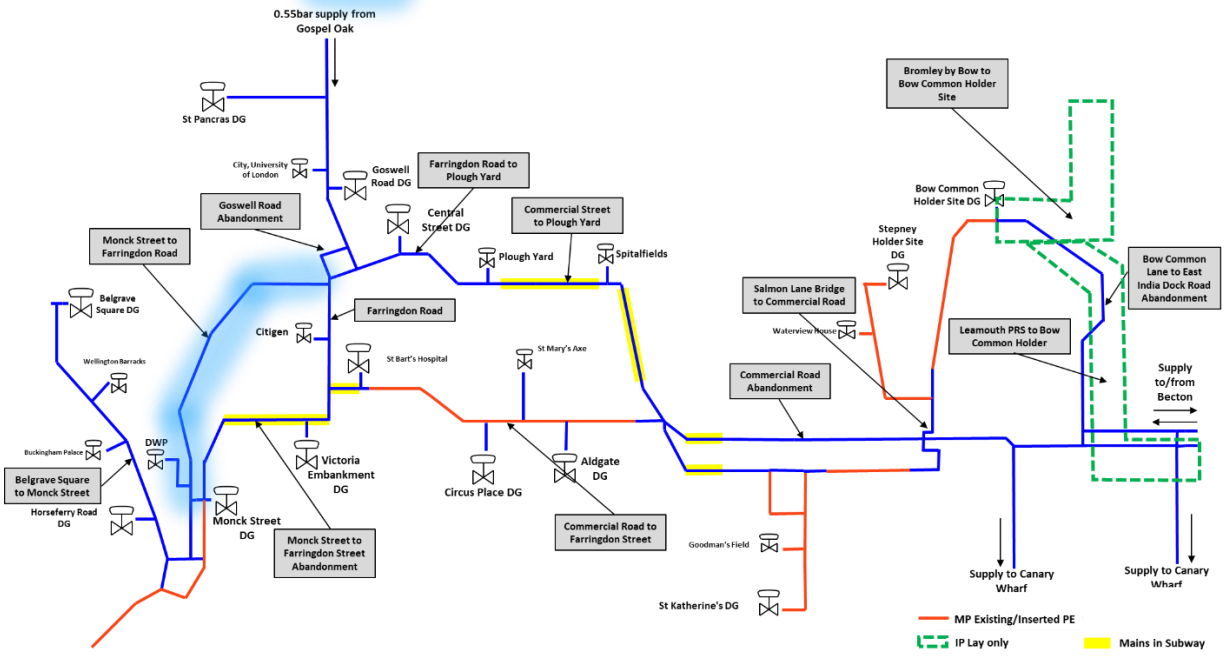


Figure 10: Location of scheme 10

This existing gas main is wholly within the borough of Westminster.

6.2.5.2 Scheme 10a: Farringdon Road to Bloomsbury Way Route

The existing gas pipe is a 48" (DN1200) Cast Iron MP gas main. We are proposing to replace 1,438m of this main with 630mm PE pipeline as part of this first phase.

The new pipeline will tie in to the existing valve V16784 at Vine Street Bridge, crossing the bridge towards Farringdon Road in a similar arrangement to the existing pipeline.

The pipeline is then routed through Clerkenwell Road towards Theobald's Road and into the A40 at Bloomsbury Way, crossing other major roads such as Southampton Row and Gray's Inn Road. Section 10a terminates at the intersection between Bloomsbury Way and New Oxford Street with a new valve. (The start of Section 10b)

Please refer to Drawing 386309-MMD-MSFR-XX-STP-M-0001 Sheet 1 for the Farringdon Road to Monck Street Section 10a Farringdon Road to Bloomsbury Way route details.

Specific features and challenges along the route are summarised below.

This whole route has a number of existing LP/MP gas services, with multiple crossing points identified along the route. This requires open-cut replacement.

The pipeline route crosses three of the major tube lines in London (between Vine Street and Farringdon Road): Metropolitan line, Circle Line and Hammersmith & City Line.

The Piccadilly line is crossed adjacent to Theobald's Road/Southampton Row. Construction work must ensure no interference with this tube lines.

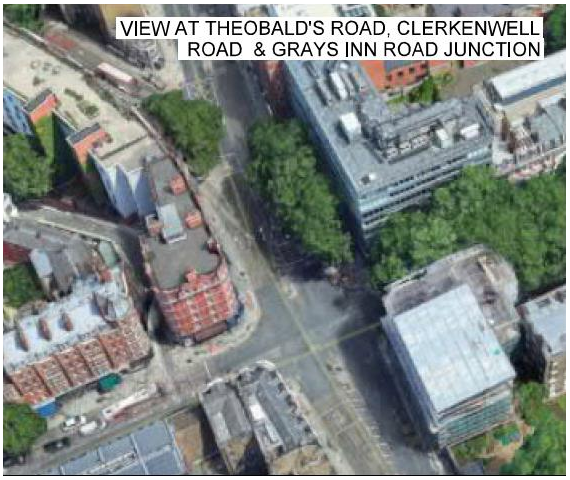
The whole route also has a number of key bus routes and bus stops that will need to be managed during the works to minimise disruption.

Tie-in at Vine Street Bridge: This section will tie in to an existing valve and then cross Vine Street Bridge. Due to the presence of existing MP gas mains, this section will be open cut. This open cut will cross Farringdon Road and extend into Clerkenwell Road as there are existing pipe fittings and bends. The pipework arrangement at the tie-in is a complex cross-connection with the existing MP system. As mentioned previously, Vine Street Bridge is extremely congested. This section is the interface with section 5a.


VIEW AT VINE STREET BRIDGE

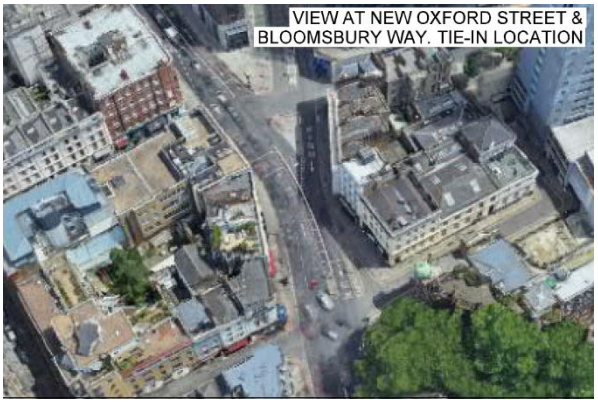
Adjacent to Junction between Leather Lane/Clerkenwell Road: An additional two sections of open cut are needed due to known interfaces and crossing with existing LP gas mains. Our records also show a number of existing pipe fittings and bends in this location.

Theobalds Road/Red Lion Street: An additional section of open cut is needed adjacent to this road junction because of known pipe fittings and interfaces with our existing LP gas main. This section of mains replacement also requires additional blast protection due to the proximity of buildings.


VIEW AT THEOBALD'S ROAD, CLERKENWELL ROAD & GRAYS INN ROAD JUNCTION

Southampton Row/Theobalds Way Junction: An additional section of open cut is needed adjacent to this road junction because of known pipe fittings and interfaces with our existing MP gas main.

New Oxford Street/Bloomsbury Way (A40): There are a further two open-cut sections along Bloomsbury Way, towards the tie-in point at New Oxford Street. Again, these are required due to the presence of the LP mains and existing pipe fittings and bends. The A40 is another major strategic road; traffic management will require agreement with TfL.



Due to the above challenges, there eight specific open-cut sections along this route, a number have complex interfaces with existing gas-mains. Many of these sections will be at congested junctions particularly the tie-in point at Bloomsbury Way. The remaining sections can be replaced via pipe-insertion.

6.2.5.3 Scheme 10b: Bloomsbury Way to the Mall Route

This section is comprised of the replacement of 1654 metres of DN1200 (48”) Cast Iron MP gas main with a 630mm PE pipeline.

This section continues from the Section 10a tie-in point at New Oxford Street and Bloomsbury Way (A40), following the A400 Bloomsbury Street, crossing the A40 at High Holborn into Endell Street and running along this road until turning towards Long Acre road. At the intersection with Cranbourne Street, Garrick Street and Upper St. Martin’s Lane, the pipe is directed towards St. Martin’s Lane merging again to the A400 at Trafalgar Square and exiting the Square through The Mall. This section terminates in a new isolation valve just after crossing Trafalgar Square and The Mall.

This route passes national monuments, through the busy Theatre district at St Martin’s Lane and passes numerous large shops and businesses such as TK Maxx, Jack Wills and multiple restaurants.

There are seven bends and two existing isolation valves, including other pipeline fittings, that will require open-cut replacement.

Please refer to Drawing 386309-MMD-MSFR-XX-STP-M-0001 Sheet 2 for the Farringdon Road to Monck Street Section 10b Bloomsbury Way to The Mall route details, contained in Appendix A.

Specific features and challenges along the route are summarised below.

Tie-in point at New Oxford Street and Bloomsbury Way (A400): Refer to discussions in Section 10a previously.

Endell St to Bloomsbury Way (A400) and Long Acre: At both ends of Endell Street the existing gas main intersects with existing LP mains and turns sharply, requiring open-cut replacement. Additional blast protection is also required in one location.

Long Acre: Due to the presence of existing bends, two other open-cut sections have been identified along this road.


VIEW AT ENDELL STREET AND LONG ACRE JUNCTION.

Junction of Cranbourn Street, Garrick Street and Upper St Martin Junction: Another pipework bend at this six-way junction requires another section of open cut. This is the busy 'Theatre District' and has a large number of major shops and restaurants.

St Martins Lane: Along St Martins, the presence of existing LP gas mains and identified crossing points requires two additional open-cut sections. Additional impact protection is required due to the proximity of buildings.


VIEW AT CRANBOURN STREET, GARRICK STREET & UPPER ST. MARTINS LANE JUNCTION

Trafalgar Square and the Mall tie-in location: The existing pipework changes direction numerous times around these last sections of the route. There are existing LP mains throughout, with known crossing points. These fittings and crossing points require four additional open-cut sections. These works pass by a number of national monuments including the Mall, Trafalgar Square and the National Gallery. Trafalgar Square is probably one of the most congested and complicated sections to manage. Trafalgar Square is owned by Crown Estates and is managed by the Greater London Authority, with Westminster City Council owning the surround roads, including the pedestrianised area of the North Terrace. There is much complexity in securing all the necessary permissions to undertake this work.

Multiple crossings of London Tube Lines: The pipeline route crosses the Central line at the intersection between Bloomsbury Way and New Oxford Street. The pipeline then follows the Piccadilly tube line along Long Acre road. It then crosses the same tube line as it turns into St. Martin's Lane. Both the Northern Line and the Bakerloo Line are then crossed between St. Martin's Lane and Trafalgar Square A4 road.

Multiple bus routes and Bus Stops: Again, these bus routes will need to be managed throughout the works.

Due to the complexity of the route (multiple bends and fittings) and the interfaces with existing LP gas mains, the pipeline changes continuously between open cut and pipe-insertion. We have currently estimated about 12 instances of open cut along this route. Additional blast protection is needed for many of the sections.

6.2.5.4 Scheme 10c: The Mall to Storey's Gate Route

This existing section of DN1200 (48") Cast Iron medium pressure pipe will be replaced with 625m of 630mm PE pipeline.

Please refer to Drawing 386309-MMD-MSFR-XX-STP-M-0001 Sheet 3 for the Farringdon Road to Monck Street Section 10c Farringdon Road to Bloomsbury Way route details, contained in Appendix A.

This route continues from the tie in at the Mall, described in Section 10b. The route then follows the Mall, runs towards Horse Guards Road, running along this road adjacent to St James's Park until it reaches the intersection with Birdcage Walk, Great George Street and Storey's Gate. The pipeline terminates at a new valve in Storey's Gate. This area is surrounded by national landmarks including Buckingham Palace, Clarence House, Downing Street, Whitehall. Adjacent to Great George Street and Storey's gate there is the Imperial War Museum and a number of major institutions adjacent to Great George Street.

We estimate there to be more than five existing bends and two isolation valves in addition to other pipework features and fittings that will require open-cut replacement.

Specific features and challenges along the route are summarised below.

Trafalgar Square and the Mall tie-in location: Refer to information described above for Section 10b.

The Mall into Horseguards Parade: Throughout this section, there are numerous sections of open cut required due to the presence of existing bends or due to crossings with known LP gas mains.

Staggered junction: Horseguards Parade/Bird Cage Walk/Storey's Gate: At this awkward congested junction, the pipes changes direction multiple times and required open cut. Additional blast protection is needed due to building proximity.

Significant buildings of national importance/theatres and major businesses; potential for major disruption to tourists, road users and businesses that will require careful management

As a result of these challenges, the replacement method changes frequently between insertion and open cut along this route. We have identified six open cut sections; some requiring additional blast protection.

6.2.5.5 Scheme 10d: Storey's Gate to Monck Street

This existing DN1200 (48") cast iron medium pressure gas main will be replaced with 746m of 630mm PE pipeline.

This pipe connects to the tie-in at Storey's Gate (section 10c) before the offtake towards the Methodist Central Hall.

The pipe follows Storey's Gate until the junction with A302 Victoria Street, it then follows along Victoria Street until the intersection with Abbey Orchard Street. It then follows Abbey Orchard Street, Great Smith Street and into Great Peter Street, eventually reaching Monck Street and the tie-in point. This connects to Section 1c for Belgrave Square to Monck Street Scheme.

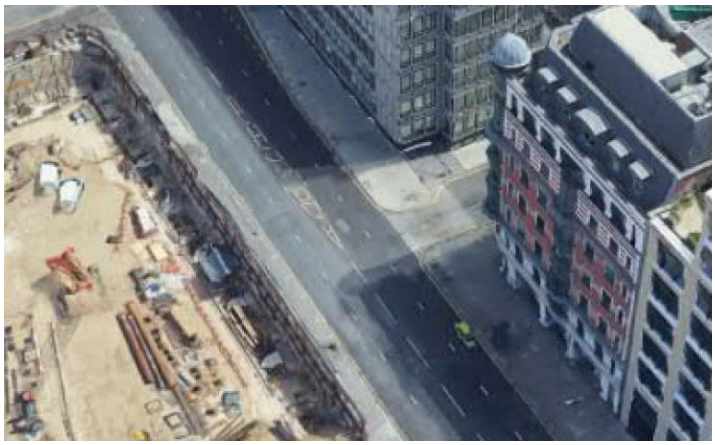
We estimate more than five bends and one valve plus other pipework fitting are within this section.

Please refer to Drawing 386309-MMD-MSFR-XX-STP-M-0001 Sheet 4 for the Farringdon Road to Monck Street Section 10d Farringdon Road to Bloomsbury Way route details, contained in Appendix A.

Specific features and challenges along the route are summarised below.

Storey's Gate to Victoria Street: Due to the proximity of existing bends and presence of existing LP/MP gas mains, two sections within Victoria Street require open-cut replacement. Close to the offtake to Methodist Central Hall, this pipeline crosses the Circle & District line.

Victoria Street (A302) to Great Smith Street: The existing gas main changes direction a number of times. The numerous bends require this section to be open cut in a number of locations. The pipe is also close to an LP gas main. The pipe route follows the A302, which forms part of the London Inner Ring Road and is inside the Congestion Charging Zone. This is also a red route, very congested and under TfL control. It passes a number of major business buildings including the Department for Business, Energy and Industrial Strategy Conference Centre. The picture opposite shows the Victoria St/Abbey Orchard Street section.



There are bus routes and stops along the proposed route that will require management with London Buses/TfL.

Great Peter's Street/Monck Street Tie-in: Another congested junction.

Due to the complexities in this route, the replacement method varies from open cut to insertion throughout, with an estimated six open-cut sections in busy junctions.

6.2.6 Scheme 11: Farringdon Street to Monck Street

6.2.6.1 Scheme Overview and Phasing

One section of Section 11 will be completed in RIIO-1.

Summary	
Scope of work	To abandon 0.46km of 36" main and replace with 0.46km of inserted 630mm PE pipe.
Construction duration	6 months
Proposed start date	April 2024
Commissioning Date	September 2024

This scheme is 3.7km in overall length, but we have opted to construct Section 11a Farringdon Street to New Bridge Street in RIIO-2 (totalling 0.46km). The remaining 3,300 metres of which 2,300 are located within the Victoria Embankment utility subway and will be decommissioned in RIIO-3.

This section of work can be safely carried out in tandem with the Farringdon Road outage (Scheme 12), during the summer of 2024. This work has to wait until the western section of the MP system has been increased to 2 bar in year 3 of RIIO-2, to give sufficient network resilience to the wider network. This is preferable so that supply can be maintained to the existing Victoria Embankment Governor, supplying 5,300 customers. The summer window of the works ensures the network impact is kept to a minimum.

Refer to the route drawings in Appendix A.

6.2.6.2 Scheme 11a: Farringdon Street to New Bridge Street

This scheme consists of the replacement of a DN900 (36") Spun Iron/Cast Iron medium pressure (MP) gas main, with a 630mm diameter PE pipeline along the same route. This new pipeline will tie in to the end of Scheme 12 installation works, to the new valve on Turnagain Lane. See the BLUE shaded section on the schematic below.

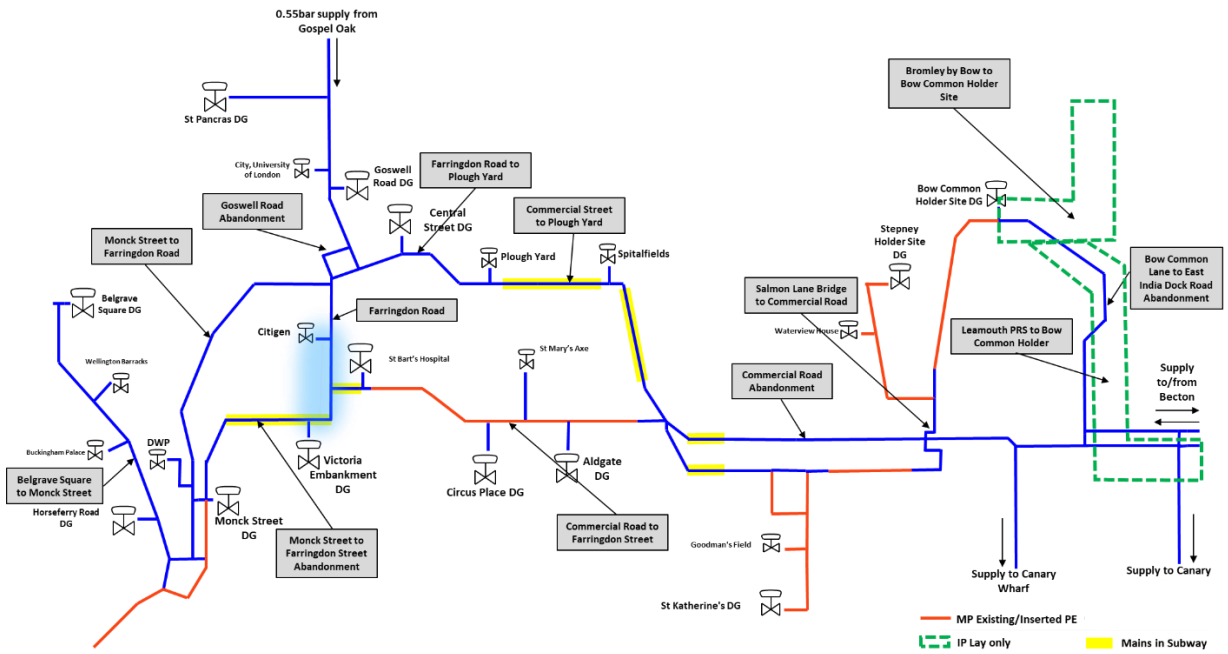


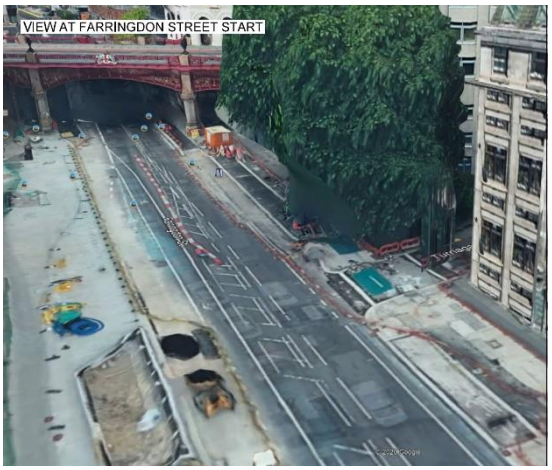
Figure 11: Location of Scheme 11

The pipeline then follows Farringdon Street, with an offtake on Stonecutter Street, continuing across a junction with Fleet Street and Ludgate Hill, crossing towards New Bridge Street, the pipeline continues down this road, passing City Thameslink and other major businesses until the proposed tie-in point just before the junction between Queen Victoria Street and New Bridge Street.

Specific features and challenges along the route are summarised below.

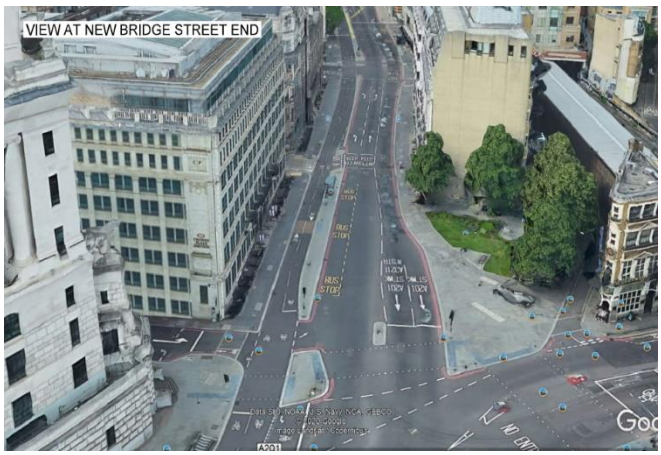
This whole section runs along the A201 (Farringdon Street and New Bridge Street), is within the London Congestion Charging Zone and is a classified red route (under TfL control)

The tie-in point at Turnagain Lane/Farringdon Street, this connects to the end of Scheme 12, described below.



Offtake at Stonecutter Street: There is an existing MP offtake that needs to be replaced at this junction. The pipeline is in the pavement where the 'Boris-Bikes' are located.

Ludgate Circus/New Bridge Street Junction: While this is a busy junction, we currently expect that we can replace the pipes via insertion, with carefully located insertion and reception pits to minimise disruption. This is adjacent to City Thameslink railway station and particularly busy for pedestrian, road and bus traffic.



Tie-in point at New Bridge Street: Another very busy complex junction, that will require open-cut replacement to enable a new valve to be installed. This junction is close to a major hotel, the Crown Plaza London.

Based on the challenges set out above, this section can be replaced predominantly by pipe-insertion, with three sections of open cut at each tie-in point and at the MP offtake at Stonecutter Street.

6.2.7 Scheme 12: Farringdon Road

6.2.7.1 Scheme Overview and Phasing

This scheme is comprised of approximately 1km of 36” pipework replacement; a 650m section (referred to as Section 12a) between Vine Street Bridge and Turnagain Road (near the Holborn viaduct) will be replaced in RIIO-2 with a 630mm PE pipeline. The remaining 340m section has high complexity network outages to manage and it also interfaces with complex sections of gas main in the Victoria Embankment subway and has hence been planned for RIIO-3 works to tie-in with the subway mains-replacement.

This section of pipeline will tie in to the existing 36” MP main east of the Vine Street Bridge coming through Clerkenwell Green. After crossing the Vine Street Bridge, the new pipeline runs south along Farringdon Road to Turnagain Lane, with an offtake at the intersection with Chartered House Street.

The Farringdon Road Scheme terminates just before reaching Turnagain Lain, where the pipework ties-in to the existing main just before the 24” offtake towards the Holborn Viaduct.

This route is estimated to consist of approximately three bends and three isolation valves and other fittings, including purge and pressure points, all requiring open-cut replacement.

The following diagram highlights the specific section in BLUE.

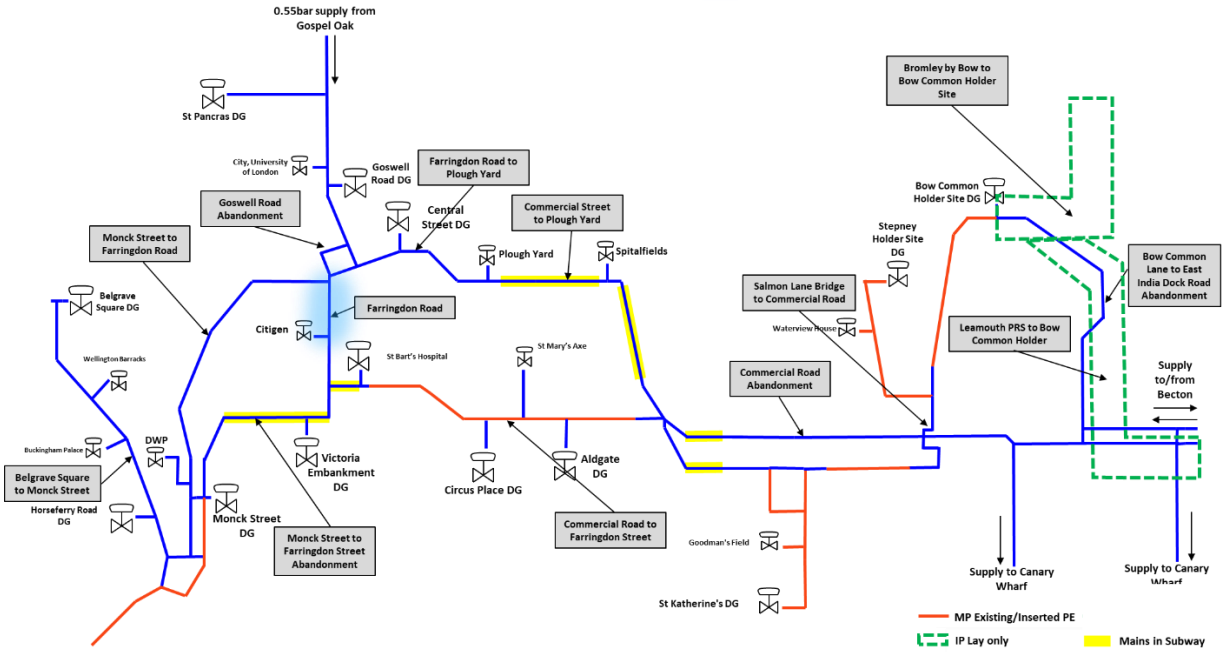


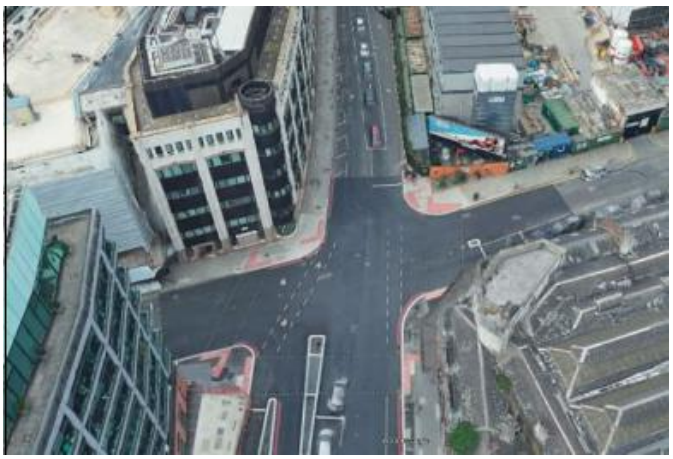
Figure 12: Location of Scheme 12

Refer to the route drawing in Appendix A.

Specific features and challenges along the route are summarised below.

Vine Street Bridge: Refer to Schemes 5a and 10a for discussions around the complexities at this junction. This tie in is comprised of a large section of open cut across the bridge and into Farringdon Road due to the presence of numerous bends and fittings, together with crossing existing LP gas mains.

Farringdon Road is part of the A201 route, is a major route in London, a red route and under TfL control. There are several bus routes and bus stops along the length of Farringdon Road that will require management during the works.



Charterhouse Street/Farringdon Road Junction: The replacement of an offtake and the associated fittings and valves are required at this junction, requiring open cut.

Tie in point Farringdon Road/Turnagain Road: This tie-in point is adjacent to the Holborn Viaduct, which passes above Farringdon Road, close to the proposed tie-in point.

A significant length of the remaining portion of Farringdon Road pipework can be replaced via insertion. This length is comprised of three open-cut sections, at the two tie-in points and at the offtake at Charterhouse Street.

6.3 Governor Interventions during RIIO-2

Three governor Interventions are required to facilitate the construction of the three sections of Scheme 1 (completed over the first three years of RIIO-1). A further governor intervention is then required as part of Scheme 5.

This section provides more details on the scope of work for each of the four governor interventions.

6.3.1 Belgrave Square Governor

This existing governor requires rebuilding to enable the mains within Section 1a and 1b to be elevated in pressure to 2 bar. The plan is to construct and commission the rebuilt governor during the summer of Year 1 (April – September 2021).

6.3.1.1 The current arrangement

Belgrave Square Governor is a below-ground installation located beneath a road island to the immediate west of Belgrave Square Gardens, with a vent stack and Pressure Management and Control (PMAC) cabinet installed adjacent. The site is fed from the North London Medium Pressure system operating at 0.55 bar and supplies the local low-pressure gas network and surrounding area. Approx. 12,500 customers are supplied from this Pressure Reduction Installation. Belgrave Square contains a large number of Embassies.

The existing governor is established within a below-ground reinforced concrete pit. The Donkin regulators were originally designed and manufactured to operate at a maximum pressure of 1 bar, these RMG Donkin 678 series regulators are now considered obsolete and will need to be replaced to allow inlet pressures to be increased from 0.55 bar to 2 bar, which is required to maximise insertion techniques in the delivery of the London MP Replacement strategy RIIO GD2.

The following picture shows an example of the type of governor which is being replaced at Belgrave Square. These governors are within small, below-ground chambers, they have very poor access, ladders and safety equipment to get to the regulators. The chambers are confined spaces.

a) Typical Pit Governor

b) Belgrave Sq. Governor Location

The works have the following specific challenges and complexities:

- Limited outage window; works must be complete between April to September.
- Working close to other buried services
- The governor is located within a paved area outside multiple embassies and close to an existing zebra crossing.
- Westminster council are the key stakeholder for the agreement of required traffic management.
- Both road and pavement closures will be required.

6.3.1.2 Proposed solution

To achieve a safe design that can meet the required peak capacity and can be installed quickly within the available outage window at minimum cost, our preferred option is a package triple stream 'Orpheus' unit of modular design, which will be direct buried in the existing location. The use of the modular Orpheus units allows us to install each module one at a time, which in turn will minimise the temporary working area required at any one time. This will minimise the impact on road users and pedestrians.

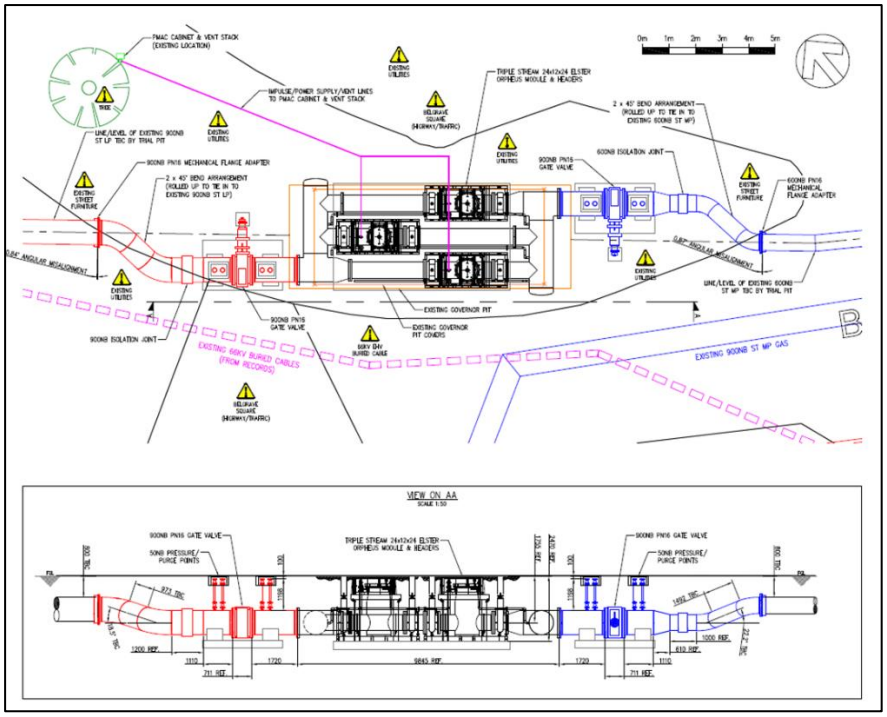
We selected the Orpheus Units after considering a wide range of different makes & models of governor. The Orpheus Units as well as being compact and modular, allowing rapid installation in the busy London streets with minimum working space, also had a number of technical advantages. The technology is proven and known to be reliable, they are cost effective; the equipment is also quick to respond to changing supply-demand balance and is cost-effective and low maintenance (once every 33 months).

The general arrangement drawings of the proposed solution are shown here.

The existing regulator pit will need to be broken out to accommodate the new governor streams. A new PMAC[1] cabinet and vent stack will be installed in place of the existing vent and profiling equipment.

The new solution benefit from a reduced need for maintenance visits. Frequency of visits will reduce from 6 months to 33 months, as a result of the new, more reliable equipment.

This governor arrangement is very similar in configuration and size to the Brompton Governor installed in RIIO-1; however, this governor will require three instead of two streams, to achieve the required capacity.



[1] Pressure Management and Control (PMAC)

6.3.1.3 Summary for Belgrave Square Governor

Summary	Details
Scope of work	• 3-off DN600 Orpheus streams with steel inlet and outlet headers, direct buried (units have slam-shut valves, filters and valve vents etc); units are battery powered; batteries are charged via by solar panels • Concrete foundations for governor units • New concrete covers with associated ring-beam foundation • Replacement integrated vent stack and PMAC cabinet, associated ducting • Cathodic protection via sacrificial anodes with associated CP test post • Removal and disposal of existing equipment • Demolition of existing chamber walls and covers
Driver for investment	**Capacity**: Maximum operating pressure of existing equipment is insufficient to meet new 2-bar operating pressure. Currently design capacity is 23kscm/h which does not meet the 1 in 20 yr peak day demand. Increased design capacity of 50kscm/h required as part of rebuild. **Asset health**: Current regulators require maintenance twice annually under the reliability centred maintenance programme and are obsolete. No spare parts are commercially available. **Safety:** poor access for maintenance/confined space entry.
Capacity	50 kscmh (required 1 in 20 year peak)
Customers	Current 12,500, New 15,000.
Construction duration	6 months
Proposed start date	April 2021
Commissioning date	September 2021
Design life (yrs.)	40years
Specific challenges & complexities	• Lengthy and complex works in a high-traffic area, outside several international embassies • Existing governors located in the pavement in a busy road junction, adjacent to a zebra crossing • Traffic management requires agreement with Westminster council

6.3.2 Monck Street

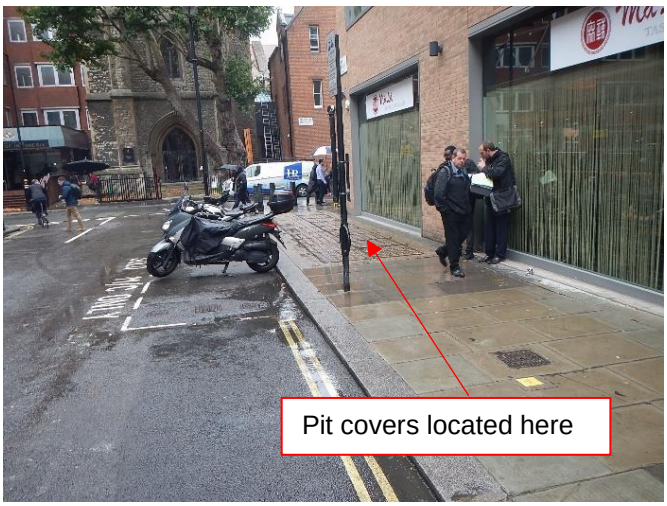
6.3.2.1 The current arrangement

The existing governor is located within a below ground reinforced concrete pit. The Donkin regulators were originally designed and manufactured to operate at a maximum pressure of 1 bar, these RMG Donkin 678 series regulators are now obsolete and will need to be replaced to allow inlet pressures to be increased from 0.55 bar to 2 bar, which is required to maximise insertion techniques in the delivery of the RIIO-2 London MP Replacement strategy.

The governors are a similar arrangement to those installed at Belgrave Square and Horseferry Road.

The current Monck Street Governor and associated vent stack and PMAC Cabinet are adjacent to an existing building wall (shop), in the pavement of Monck Street. This adds significant complexity when considering how to demolish the existing pit walls without impacting on the structural integrity of the buildings.

The optimum future location of the governor needs to be considered, moving it away from buildings and into the road, which would then involve potential traffic management during construction and thereafter for maintenance.



6.3.2.2 The proposed solution

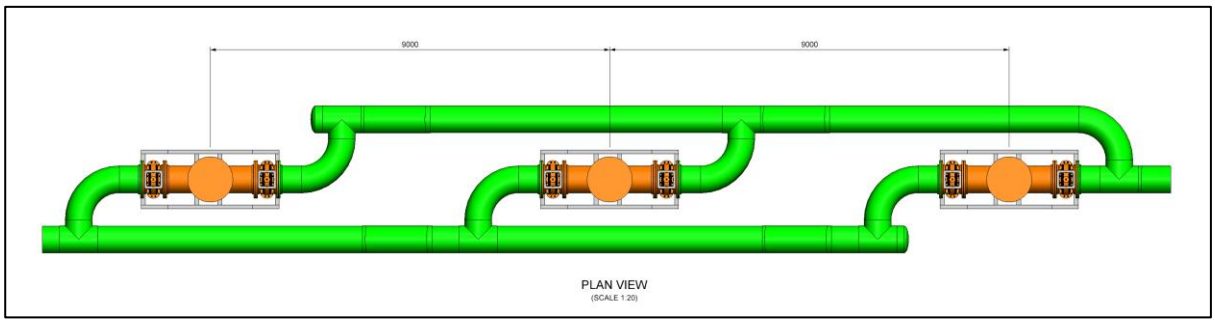
We propose to replace the existing governor with a buried triple stream (package) Orpheus unit of modular design. This will be direct buried adjacent to the existing governor on new concrete bases (as per the typical design image below). We are in discussions with Westminster Council about the possibility of

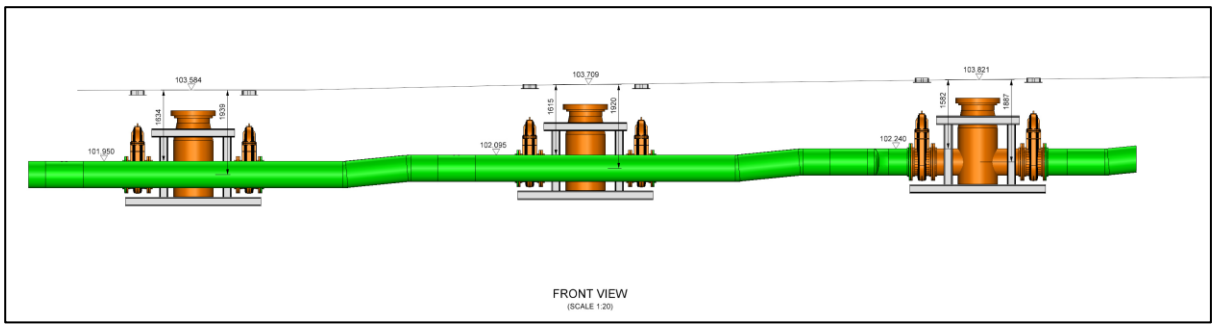
reducing the width of the road at this location and making it one-way to allow us to locate the new governor in a new, wider pavement, away from the building. This will allow future maintenance visits without disruption to road users. The proposed arrangement is shown below; this arrangement has been chosen to minimise how much road is taken up, this reduces the risk of delay during delivery because there are greater options to manage traffic during construction. This solution has also improved access for long-term maintenance.

The existing regulator pit wall will need to be broken out to accommodate the new streams. A new pressure profiling (PMAC) cabinet and vent stack will be installed in place of the existing vent and profiling equipment. The new governor will operate with a maximum inlet pressure of 2 bar.

Other benefits from this solution include:

- The modular design will enable us to install the governors sequentially reducing the working space needed at any one time.
- The new governor units will require less frequent maintenance visits. These visits will reduce from every 6 months to 33 months in frequency.





The size and configuration of this governor is very similar to Vauxhall Cross Governor installed in RIIO-1 but has one additional stream.

6.3.2.3 Summary for Monck Street Governor

Summary	
Scope of work	• 3-off DN600 Orpheus streams with steel inlet and outlet headers, direct buried (units have slam-shut valves, filters and valve vents etc); units are battery powered; batteries are charged via by solar panels • Concrete foundations for governor units • New concrete covers with associated ring-beam foundation • Replacement integrated vent stack and PMAC cabinet, associated ducting • Cathodic protection via sacrificial anodes with associate CP test post. • Removal and disposal of existing equipment • Re-alignment/modification of Monck Street to widen pavement and turn the road into one-way • Demolition of existing chamber walls and covers
Driver for investment	**Capacity**: Maximum operating pressure of existing equipment is insufficient to meet new 2-bar operating pressure. Current capacity 31kscm/h. Capacity will increase to 50kscm/h with the incorporation of Horseferry Road. **Asset health**: Current regulators require maintenance twice annually under the reliability centred maintenance programme and are obsolete. No spare parts are commercially available. **Safety:** Not compliant with current legislation. Building development has encroached on the governor and is within the allowable building proximity distance. Poor access for maintenance/confined-space entry. The governor is in a busy footpath adjacent to a motorcycle parking bay. This makes routine maintenance visits difficult and necessitates a partial closure of both the footpath and motorcycle parking bay.
Capacity	50kscmh
Customers	Current 5,900, Proposed 13,100
Construction duration	6 months
Proposed start date	April 2023
Commissioning date	September 2023
Design life (yrs.)	40 years
Specific challenges & complexities	• Proximity to existing buildings requiring repositioning of a new governor • Modifications to road layout to enable safe access to the future governor • Lengthy and complex works immediately adjacent to working businesses • Working between existing large diameter (36” LP and 48” MP) pipelines amongst other services • Tie-in configuration to two MP inlet pipelines • Delays to construction of Monck Street will delay the decommissioning works at Horseferry Governor

6.3.3 Horseferry Governor

6.3.3.1 The current arrangement

This existing governor is located in the middle of Horseferry Road, adjacent to the Channel 4 building, next to a busy bus stop.

This governor is similar in design to the Belgrave Square Governor, with Donkin Regulators within a reinforced below-ground pit. Through network modelling, we have found that this governor can be decommissioned, once the new rebuilt Monck Street Governor is commissioned.

The photos below show a street-level view of this governor.

b) Pit Covers in Road/Bus Stop

c) Vent Stack and PMAC Cabinet Location

The current governor at Horseferry Road is subject to an HSE improvement notice, due to its unsafe access and egress for maintenance: under a busy bus stop, requiring a temporary road closure and a bus-stop relocation.

6.3.3.2 The proposed solution

The existing equipment and chamber covers will be removed. The chamber walls will be broken down, the base-slab left in, the hole then back-filled and the road reinstated. The vent stack and PMAC cabinet will be removed and the pavement and road reinstated.

The inlet and outlet valves would be closed, blanked-off, cocooned and buried with the surface boxes removed. The proposed solution was discussed and is being agreed in principle with Westminster Council Streetworks department at the end of 2019.

The primary difficulty with these works is their location at a bus-stop within the main-carriageway of the road. Careful traffic management will be required to undertake them.

6.3.3.3 Summary for Horseferry Governor

Summary	
Scope of work	Decommission the Horseferry Governor and provide the required capacity as part of the new rebuilt Monck Street Governor, allowing us to remove this unsafe, obsolete installation from our operational assets. • Demolish/break down existing chamber covers and walls. Base slab to remain. Backfill and reinstate road • Remove PMAC cabinet and vent stack: reinstate • Blank off & busy inlet & outlet valves; remove surface box.
Driver for investment	**Asset health**: Current regulators are obsolete and spares can no longer be sourced. **Safety:** Cadent has a HSE Improvement Notice on the Horseferry Road governor installation due to its location and very difficult access.
Construction duration	3 months
Proposed start date	April 2023
Commissioning date	June 2023
Specific challenges & complexities	Demolition of the Horseferry Governor in the middle of an existing road junction, outside a busy bus stop. A road closure and bus-stop relocation will be required. This work can only be completed once Monck Street Governor is ready to be commissioned.

6.3.4 Central Street

6.3.4.1 The current arrangement

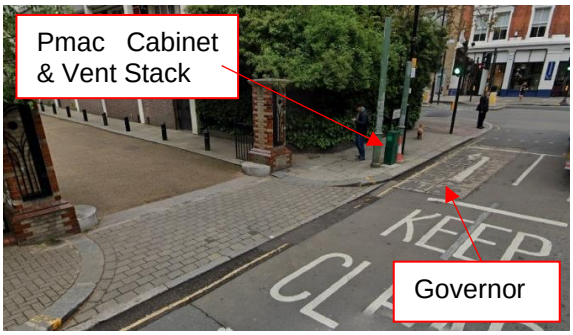
Central Street governor is a below-ground installation located beneath the carriageway at the junction with Old Street, with a vent stack and PMAC cabinet installed adjacent. The site is fed from the North London Medium Pressure system operating at 0.55 bar and supplies the local low-pressure gas network and surrounding area. Approximately 2,800 customers are supplied from this PRI currently.

These works will be constructed as part of Scheme 5 (Farringdon Road to Plough Yard)

The existing governor is established within a below ground reinforced concrete pit. The Donkin regulators were originally designed and manufactured to operate at a maximum pressure of 1 bar, these RMG Donkin 678 series regulators are now considered obsolete and will need to be replaced to allow inlet pressures to be increased from 0.55 bar to 2 bar, as part of the overall LMP strategy.

The governor design is similar in design to Monck Street (see below). The governor is located on the edge of Central Street as shown in the following photos.

a) Typical Pit Governor (Monck Street Example)

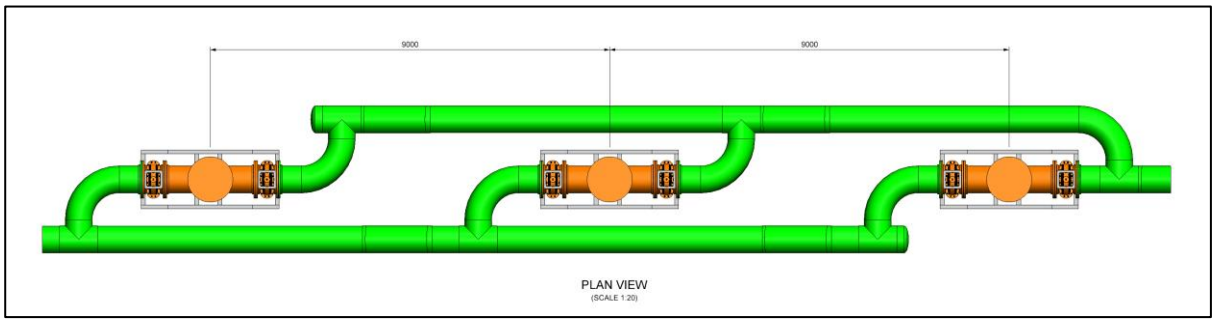


b) Governor Location

The challenges are similar to those of other governors: the works will require road closures and traffic management. The demolition of the existing chambers must be done in a way that does not undermine adjacent structures. The governor is also very close to access to car parks for a large block of flats (as seen in the photo above). The construction works will need to allow safe access or alternative arrangements for safe parking.

6.3.4.2 The proposed solution

The proposed solution, for all the reasons set out for the Belgrave and Monck Street Governors, will be to install the same modular Orpheus Unit (3 stream), direct buried with new D400 access covers in the existing location. The governor layout is very similar in size and configuration to the Brompton Governor installed in RIIO-1, but will require an additional stream.



6.3.4.3 Summary for Central St Governor

Summary	
Scope of work	• 3-off DN600 Orpheus streams with steel inlet and outlet headers, direct buried (units have slam-shut valves, filters and valve vents etc); units are battery powered; batteries are charged via by solar panels • Concrete foundations for governor units • New concrete covers with associated ring-beam foundation. • Replacement integrated vent stack and PMAC cabinet, associated ducting • Cathodic protection via sacrificial anodes with associate CP test post. • Removal and disposal of existing equipment • Demolition of existing chamber walls and covers
Driver for investment	**Capacity**: Maximum operating pressure of existing equipment is insufficient to meet the new 2bar operating pressure. Current capacity 31kscm/h. Capacity will increase to 50kscm/h with the incorporation of Horseferry Road. **Asset health**: Current regulators are obsolete and spares cannot be sourced. **Safety:** Poor access for maintenance/confined-space entry. The governor is located in a junction with traffic lights. This makes routine maintenance visits difficult and necessitates 4-way temporary traffic lights and the resulting impact on traffic.
Capacity	45 kscmh
Customers	19,500
Construction duration	6 months
Proposed start date	April 2023
Commissioning date	September 2023
Design life (yrs.)	40 years
Specific challenges & complexities	• Works adjacent to junction with traffic lights; full road closure at the Central Street Junction during construction. • Impact to access to Flats car parking. • Works adjacent to residential properties and associated disruption.

6.4 Scope Summary

The following table summarises the scope of work for the proposed RIIO-2 work plan, based on the detailed information contained in this document.

This list has been used in conjunction with the agreed unit rates and assumptions stated in the Commercial Document to derive a cost profile for the proposed works.

The resulting RIIO-2 forecast costs and cost profile are discussed in the London Medium Pressure Summary Document.

6.4.1 Mains-laying

Section	Length (m)	Dia.	Valve Ops	Stopples	Bagstops	Insertion/ Reception Pits total	Insertion length	Open Cut	Other key features impacting costs & scope[2]
1a: Belgrave Sq. to Buckingham Gate	1,268	36"	2	0	2	9	1,238	30	Working adjacent to Buckingham Palace and on the London Inner Ring Road (red route)
1b: Buckingham Gate to Horseferry Road	795	36"	2	0	2	6	765	30	
1c: Horseferry Road to Monck St	610	36"	2	0	3	6	580	30	Open cut within 5m of existing buildings
2. Salmon Lane Bridge to Commercial Road	638	48"	3	0	1	8	608	30	Complex mains-replacement around an existing above ground gas-main pipe crossing. Works on the A13 (red-route.)
3a: 84 to 60 Commercial Road	149	48"	2	0	1	3	80	69	Management of bus lanes, working in the A13 (red route)
5a. Farringdon Lane	452	48"	2	0	2	4	432	20	Complex works on Vine-street bridge.

[2] All sections involve complex traffic management around busy road junctions, management of bus stops and parking bays. This column, specifically refers to any outliers or special features only.

Section	Length (m)	Dia.	Valve Ops	Stopples	Bagstops	Insertion/ Reception Pits total	Insertion length	Open Cut	Other key features impacting costs & scope[2]
5b. Clerkenwell Road	399	48"	2	0	1	4	379	20	Intersects with the A1 Bus-roads / Bus lanes
10a. Farringdon Rd to Bloomsbury Way	1,438	48"	2	0	2	8	1,398	40	Complex works on Vine-street bridge Close proximity to existing buildings. Works in Oxford St / A40.
10b. Bloomsbury Way to the Mall	1,654	48"	2	0	2	10	1,604	50	Works in theatre district, Trafalgar Square. Close proximity to buildings of national importance. Crosses tube-lines
10c. The Mall to Storey's Gate	625	48"	2	0	2	9	605	20	
10d. Storey's Gate to Monck St	746	48"	1	0	2	8	726	20	Crosses Inner Ring Road (Red-route) Significant numbers of bends and fitting requiring open cut.
11a. New Bridge St to Farringdon St	464	36"	3	0	3	4	444	20	Adjacent to Thameslink station & major hotels
12. Farringdon Road	650	36"	3	0	2	5	620	30	Works along Farringdon road, a red route.

Table 5: Summary of Mains-laying scope.

6.4.2 Governors

	Belgrave Square	Monck Street	Central Street	Horseferry
Intervention	Rebuild	Rebuild	Rebuild	Decommission
Construction/commissioning dates	April to Sept 2021	April to Sept 2023	April to Sept 2023	April to June 2023
Proposed Capacity	2 bar, 50 kscmh	2 bar, 50 kscmh	2 bar, 45 kscmh	N/A
Specific challenges	Works in Embassy District Busy area/Traffic management Management of zebra crossing	Proximity to existing building Modification to road alignment Traffic management Impact on businesses	Road closures at junction Impact to adjacent flats Traffic management	Located under a busy bus stop in the middle of a busy road: Road closure required.
Scope	• 3-off DN600 Orpheus streams with steel inlet and outlet headers, direct buried (units have slam-shut valves, filters and valve vents etc); units are battery powered via by solar panels • Concrete foundations for governor units • New concrete covers with associated ring-beam foundation • Replacement integrated vent stack and PMAC cabinet, associate ducting. • Cathodic protection via sacrificial anodes with associated CP test post • Removal and disposal of existing equipment • Demolition of existing chamber walls and covers			• Demolish/break-down existing chamber covers and walls. Base slab to remain. Backfill and reinstate road • Remove PMAC cabinet and vent stack: reinstate • Blank-off and bury inlet & outlet valves; remove surface box; reinstate.

Table 6: Summary of Governor interventions for RIIO-2

7 RIIO-2 forecast costs

The following section sets out the resulting costs for the revised RIIO-2 LMP programme. These are based on the scope of work described in this Technical Document and the unit costs and basis of costings described in the Commercial Document.

A 4 % risk allowance and a 13% management fee have then been applied.

We have applied efficiencies consistent with our approach in December 2019.

Our costs for the RIIO-2 plan comprise the following three main elements:

- Mains laying
- Governor rebuilds/modifications
- RIIO-2 enabling activities

An allowance for RIIO-3 enabling surveys, design and stakeholder engagement has been included in the last two years of RIIO-2 to allow us to develop our preferred solutions and associated costings for the remaining sections of LMP.

This has been developed based on an average cost of the enabling activities per meter of mains replacement, using three recent RIIO-1 work packages. The basis for this rate is discussed in our Commercial Document. This rate has been applied to the remaining meterage in RIIO-3 and summarised below.

7.1.1 Mains-laying

The overall cost-breakdown structure for the mains laying elements for the proposed RIIO-2 work plan is shown below.

Item	Cost	% of Total Installed Cost
Engineering Design[3]		1%
Project management		26%
Materials		12%
Main Works Contractor		40%
Specialist Services		7%
Vendor Package Costs		0%
Direct Company Costs[3]		11%
Indirect Company Costs		0%
Contingency		3%
Total installed cost		100%

Table 7: Cost breakdown structure for RIIO-2 mains laying

The associated cost profile (£k), based on the works-phasing is summarised below.

[3] Note that Cadent's Direct Company Costs include an element of directly delivered design, stakeholder engagement, surveys and business compensation costs, as well as project/programme and commercial management. The Engineering Design allowance refers to the out-sourced 'design and survey' work carried out by suppliers.

Name	2021/22	2022/23	2023/24	2024/25	2025/26	Total
1a: Belgrave Sq to Buckingham Gate						
1b: Buckingham Gate to Horseferry Road						
1c: Horseferry Road to Monck St						
2. Salmon Lane Bridge to Commercial Road						
3a: 84 to 60 Commercial Road						
5a. Farringdon Road						
5b. Farringdon St						
10a. Farringdon Rd to Bloomsbury Way						
10b. Bloomsbury Way to the Mall						
10c. The Mall to Storey's Gate						
10d. Storey's Gate to Monck St						
11a. New Bridge St to Farringdon St						
12. Farringdon Road						
Total						

Table 8: RIIO-2 Cost Profile for Mains-laying (£k)

7.1.2 Governors: Cost summary

As discussed in the Commercial Document, we have derived an average cost breakdown structure for our proposed RIIO-2 governors, based on actual costs of comparable governors constructed in RIIO-1.

The resulting cost breakdown structure for the governor rebuilds and the governor decommission are summarised below.

Item	Governor interventions (Total)	
	Cost	% of TIC
Engineering Design		1%
Project management (supplier)	Included in MWS	
Materials		4%

Item	Governor interventions (Total)	
	Cost	% of TIC
Main Works Contractor		61%
Specialist Services	Include in MWS	
Vendor Package Costs		8%
Direct Company Costs		12%
Indirect Company Costs	0	0
Contingency		14%
Total installed cost		**100%**

Table 9: Cost breakdown for Proposed RIIO-2 governor interventions (post-efficiency)

Governor	2021/22	2022/23	2023/24	2024/25	2025/26	Total
Belgrave Square						
Horseferry Rd (decommission)						
Monck Street						
Central Street						
Total (Capex)						

Table 10: Cost profile for governor Interventions in RIIO-2 (£k)

7.1.3 Enabling Works for RIIO-3

No specific scope for this activity has been described in this document. The basis of estimating this work for RIIO-2 is described in detail in the Commercial Document. This is an allowance for RIIO-3 enabling surveys, design and stakeholder engagement activities that will be delivered in the last two years of RIIO-2 to allow us to develop our preferred solutions and associated costings for the remaining sections of LMP, to maintain the rolling programme of work.

This has been developed based on an average cost of these enabling activities per meter of mains replacement, using three recent RIIO-1 work packages. The basis for this rate is discussed in our Commercial Document. This rate has been applied to the remaining meterage of mains replacement in RIIO-3 (14.7km) and the resulting total is summarised below.

As discussed in the commercial document we have derived an average cost of £ per meter (18/19 prices); given the increased complexity of work in RIIO-3 we have not applied an efficiency to preparatory work.

RIIO-3 Enabling work	2021/22	2022/23	2023/24	2024/25	2025/26	Total
Surveys, stakeholder engagement, design for 14.7km of LMP scheme.						

RIIO-3 Enabling work	2021/22	2022/23	2023/24	2024/25	2025/26	Total
Total (Capex)						

Table 11: Cost profile for RIIO-3 Enabling Works

7.1.4 Overall Cost Profile for RIIO-2 LMP works

Combining the above elements gives the resulting repex and capex cost profile for the proposed LMP RIIO-2 programme of works:

RIIO-3 Enabling work	2021/22	2022/23	2023/24	2024/25	2025/26	Total
Repex						
Capex						
Totex						

Table 12: Cost profile for overall revised LMP RIIO-2 delivery plan (£k)

8 Conclusion

Through more targeted phasing and the completion of more pre-planning and design, we have developed a specific cost for each of the sections of LMP that will be delivered in RIIO-2.

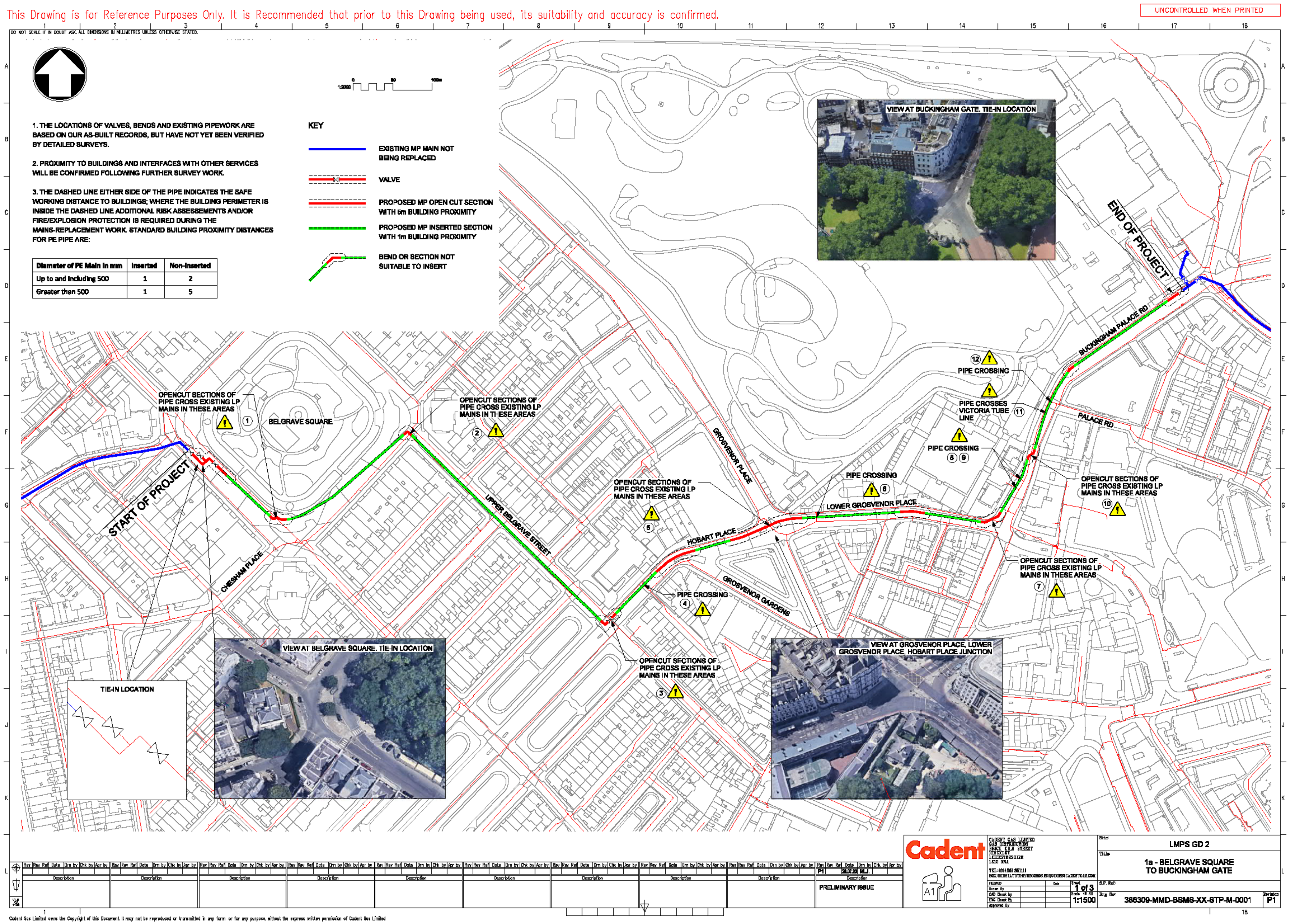
The technical document explains the high level of complexity that is involved with implementing the mains replacement and the associated governor interventions. We have also demonstrated how we have been innovative in our approach to deriving the preferred solutions to minimise cost, by careful stakeholder engagement and looking for buildable solutions that reduce road occupation and minimise disruption without compromising the safety and operability of the final solutions.

We are confident that this detail provides sufficient evidence at scheme-section level and at programme level to satisfy the requirements as set out in Ofgem's initial response to our December Plan, specifically that there is a comprehensive plan, with evidence of agreements in place, and we have considered innovative techniques in deriving the RIIO-2 costs.

We are confident our proposals also demonstrate that our plan is robust and deliverable, based on knowledge of the specific challenges on each section and applying the learning from RIIO-1.

Safety is the primary driver for doing this work. The assets described for replacement in this paper are some of the very highest risk and their proximity to people, property and nationally significant treasures and institutions warrants this programme of work beyond all reasonable doubt.

Appendix A: Design Drawings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2. PROXIMITY TO BUILDINGS AND INTERFACES WITH OTHER SERVICES WILL BE CONFIRMED FOLLOWING FURTHER SURVEY WORK.
3. THE DASHED LINE EITHER SIDE OF THE PIPE INDICATES THE SAFE WORKING DISTANCE TO BUILDINGS; WHERE THE BUILDING PERIMETER IS INSIDE THE DASHED LINE ADDITIONAL RISK ASSESSEMENTS AND/OR FIRE/EXPLOSION PROTECTION IS REQUIRED DURING THE MAINS-REPLACEMENT WORK. STANDARD BUILDING PROXIMITY DISTANCES FOR PE PIPE ARE:
Diameter of PE Main in mm | Inserted | Non-Inserted
Up to and Including 500 | 1 | 2
Greater than 500 | 1 | 5
KEY
EXISTING MP MAIN NOT BEING REPLACED
VALVE
PROPOSED MP OPEN CUT SECTION WITH 5m BUILDING PROXIMITY
PROPOSED MP INSERTED SECTION WITH 1m BUILDING PROXIMITY
BEND OR SECTION NOT SUITABLE TO INSERT
VIEW AT BUCKINGHAM GATE. TIE-IN LOCATION
END OF PROJECT
BUCKINGHAM PALACE RD
PIPE CROSSING
PIPE CROSSES VICTORIA TUBE LINE
PALACE RD
OPENCUT SECTIONS OF PIPE CROSS EXISTING LP MAINS IN THESE AREAS
BELGRAVE SQUARE
START OF PROJECT
CHESHAM PLACE
UPPER BELGRAVE STREET
GROSVENOR PLACE
HOBART PLACE
LOWER GROSVENOR PLACE
GROSVENOR GARDENS
TIE-IN LOCATION
VIEW AT BELGRAVE SQUARE. TIE-IN LOCATION
VIEW AT GROSVENOR PLACE, LOWER GROSVENOR PLACE, HOBART PLACE JUNCTION
PRELIMINARY ISSUE
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CADENT GAS LIMITED
GAS DISTRIBUTION
BRICK KILN STREET
HINCKLEY
LEICESTERSHIRE
Site: LMPS GD 2
Title: 1a - BELGRAVE SQUARE TO BUCKINGHAM GATE
Sheet 1 of 3
Scale 1:1500
Drg No: 386309-MMD-BSMS-XX-STP-M-0001
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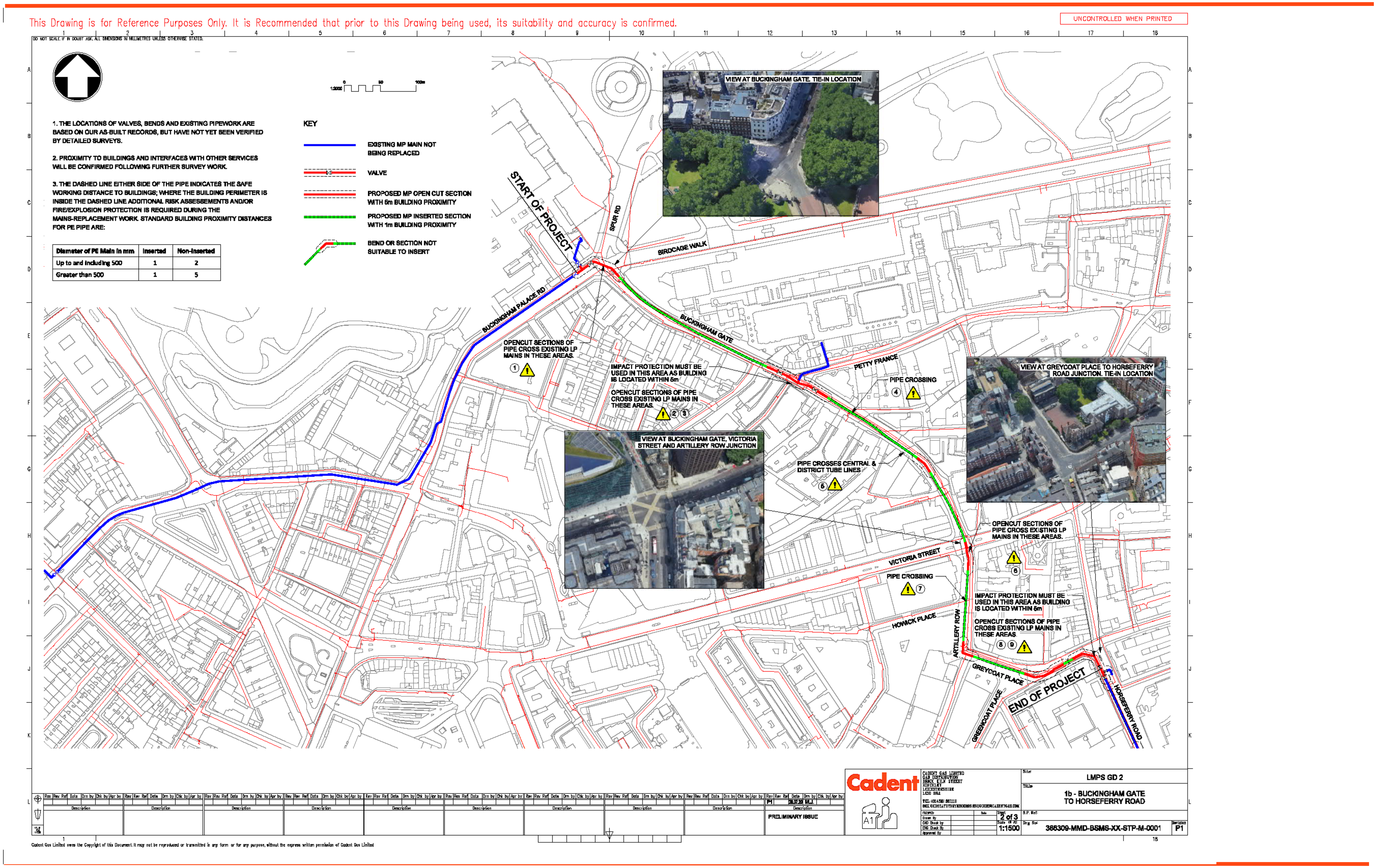
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VALVE
PROPOSED MP OPEN CUT SECTION WITH 5m BUILDING PROXIMITY
PROPOSED MP INSERTED SECTION WITH 1m BUILDING PROXIMITY
BEND OR SECTION NOT SUITABLE TO INSERT
START OF PROJECT
SPUR RD
BIRDCAGE WALK
VIEW AT BUCKINGHAM GATE TIE-IN LOCATION
BUCKINGHAM PALACE RD
BUCKINGHAM GATE
OPENCUT SECTIONS OF PIPE CROSS EXISTING LP MAINS IN THESE AREAS.
IMPACT PROTECTION MUST BE USED IN THIS AREA AS BUILDING IS LOCATED WITHIN 5m
OPENCUT SECTIONS OF PIPE CROSS EXISTING LP MAINS IN THESE AREAS.
PETTY FRANCE
PIPE CROSSING
VIEW AT GREYCOAT PLACE TO HORSEFERRY ROAD JUNCTION. TIE-IN LOCATION
VIEW AT BUCKINGHAM GATE, VICTORIA STREET AND ARTILLERY ROW JUNCTION
PIPE CROSSES CENTRAL & DISTRICT TUBE LINES
OPENCUT SECTIONS OF PIPE CROSS EXISTING LP MAINS IN THESE AREAS.
VICTORIA STREET
PIPE CROSSING
IMPACT PROTECTION MUST BE USED IN THIS AREA AS BUILDING IS LOCATED WITHIN 5m
OPENCUT SECTIONS OF PIPE CROSS EXISTING LP MAINS IN THESE AREAS.
HOWICK PLACE
ARTILLERY ROW
GREYCOAT PLACE
END OF PROJECT
HORSEFERRY ROAD
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1b - BUCKINGHAM GATE TO HORSEFERRY ROAD
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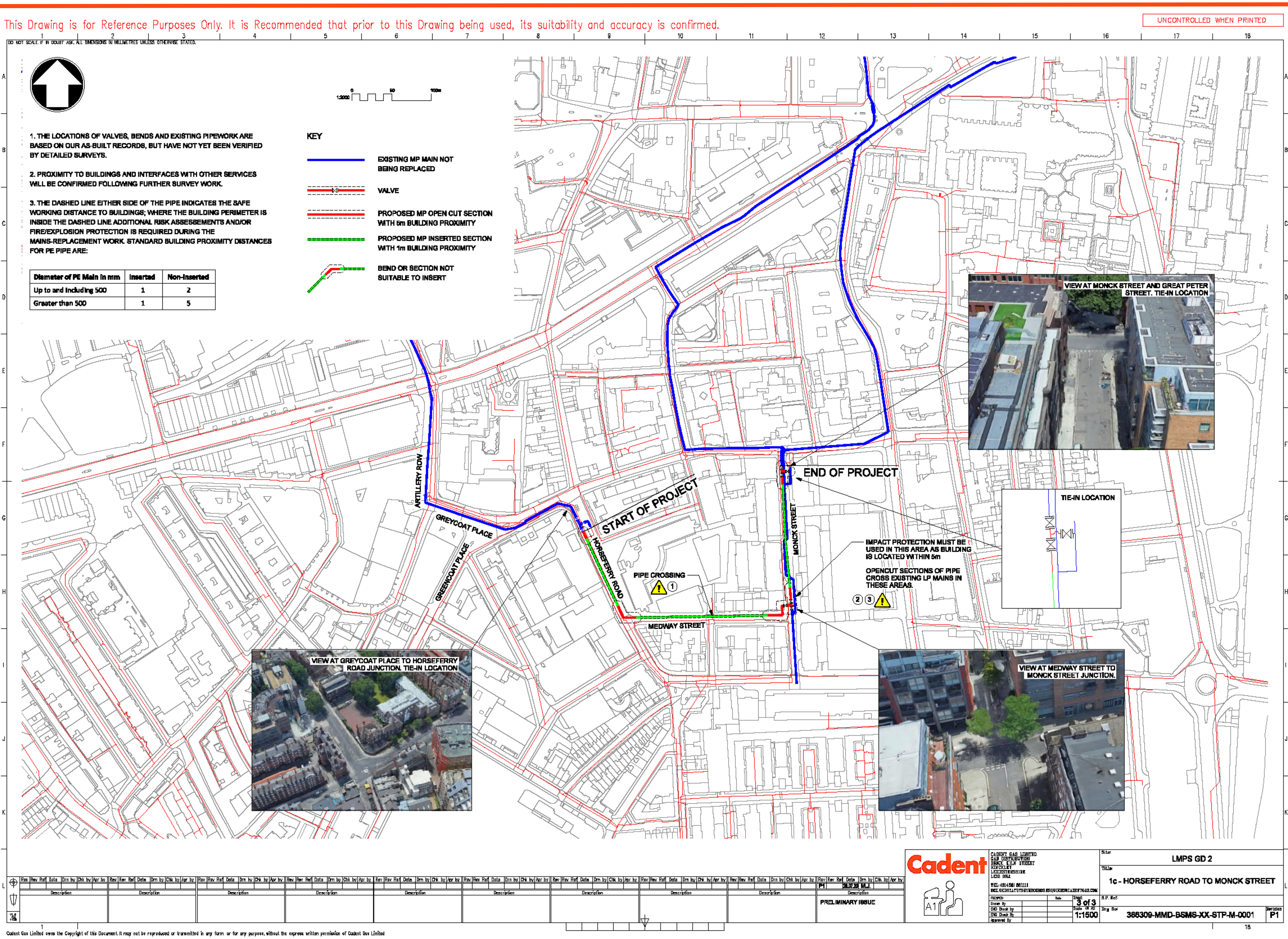
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VALVE
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PROPOSED MP INSERTED SECTION WITH 1m BUILDING PROXIMITY
BEND OR SECTION NOT SUITABLE TO INSERT
VIEW AT MONCK STREET AND GREAT PETER STREET. TIE-IN LOCATION
END OF PROJECT
START OF PROJECT
TIE-IN LOCATION
ARTILLERY ROW
GREYCOAT PLACE
GREENCOAT PLACE
HORSEFERRY ROAD
MONCK STREET
MEDWAY STREET
PIPE CROSSING
IMPACT PROTECTION MUST BE USED IN THIS AREA AS BUILDING IS LOCATED WITHIN 5m
OPENCUT SECTIONS OF PIPE CROSS EXISTING LP MAINS IN THESE AREAS.
VIEW AT GREYCOAT PLACE TO HORSEFERRY ROAD JUNCTION. TIE-IN LOCATION
VIEW AT MEDWAY STREET TO MONCK STREET JUNCTION.
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3 of 3
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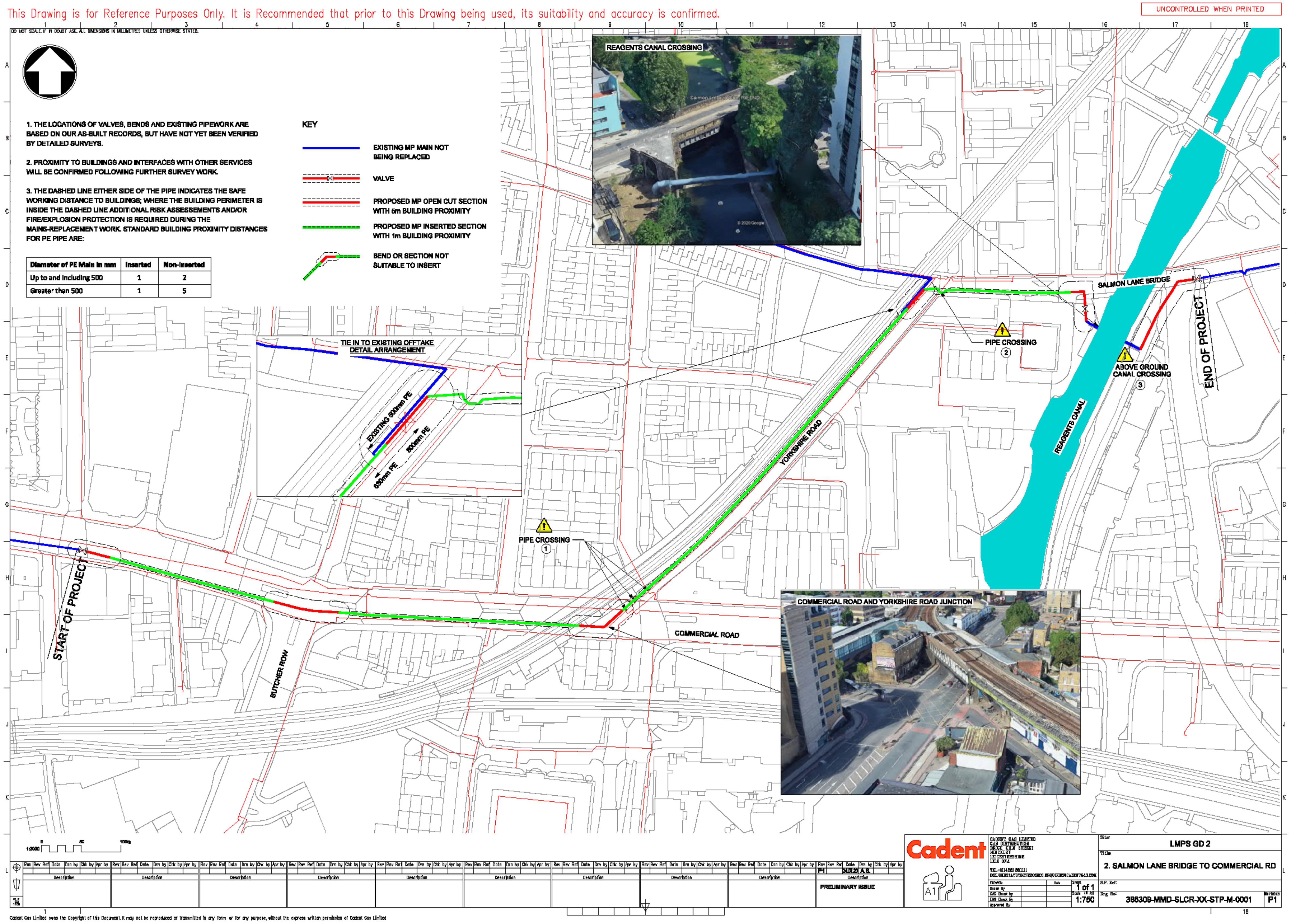
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VALVE
PROPOSED MP OPEN CUT SECTION WITH 6m BUILDING PROXIMITY
PROPOSED MP INSERTED SECTION WITH 1m BUILDING PROXIMITY
BEND OR SECTION NOT SUITABLE TO INSERT
REAGENTS CANAL CROSSING
TIE IN TO EXISTING OFFTAKE DETAIL ARRANGEMENT
EXISTING 600mm PE
800mm PE
630mm PE
SALMON LANE BRIDGE
PIPE CROSSING 2
ABOVE GROUND CANAL CROSSING 3
END OF PROJECT
REAGENTS CANAL
YORKSHIRE ROAD
PIPE CROSSING 1
START OF PROJECT
BUTCHER ROW
COMMERCIAL ROAD
COMMERCIAL ROAD AND YORKSHIRE ROAD JUNCTION
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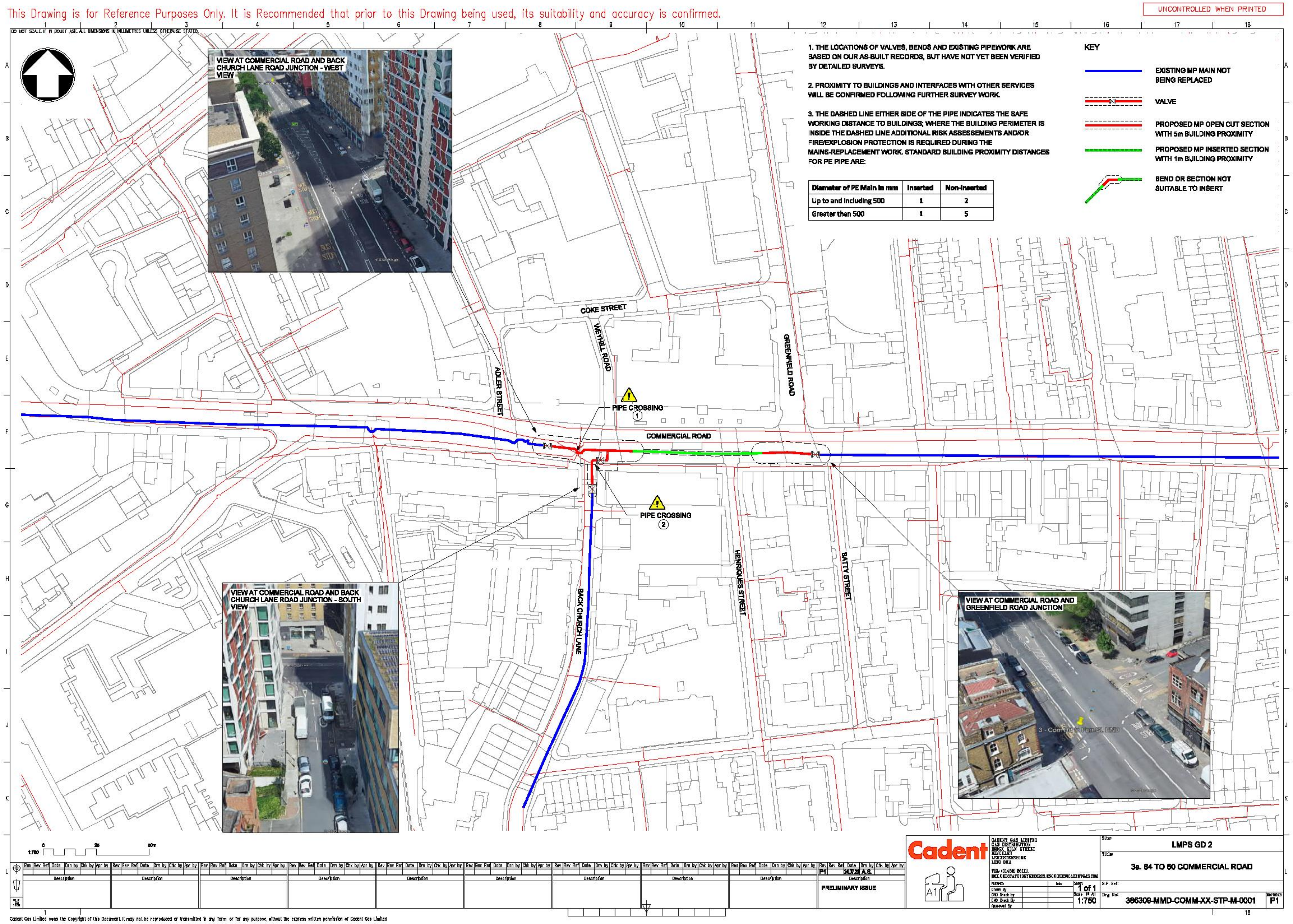
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VIEW AT COMMERCIAL ROAD AND BACK CHURCH LANE ROAD JUNCTION - WEST VIEW
VIEW AT COMMERCIAL ROAD AND BACK CHURCH LANE ROAD JUNCTION - SOUTH VIEW
VIEW AT COMMERCIAL ROAD AND GREENFIELD ROAD JUNCTION
COKE STREET
WEYHILL ROAD
ADLER STREET
GREENFIELD ROAD
COMMERCIAL ROAD
PIPE CROSSING 1
PIPE CROSSING 2
BACK CHURCH LANE
HENRIQUES STREET
BATTY STREET
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Diameter of PE Main in mm | Inserted | Non-Inserted
Up to and including 500 | 1 | 2
Greater than 500 | 1 | 5
KEY
EXISTING MP MAIN NOT BEING REPLACED
VALVE
PROPOSED MP OPEN CUT SECTION WITH 5m BUILDING PROXIMITY
PROPOSED MP INSERTED SECTION WITH 1m BUILDING PROXIMITY
BEND OR SECTION NOT SUITABLE TO INSERT
PRELIMINARY ISSUE
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BRICK KILN STREET
HINCKLEY
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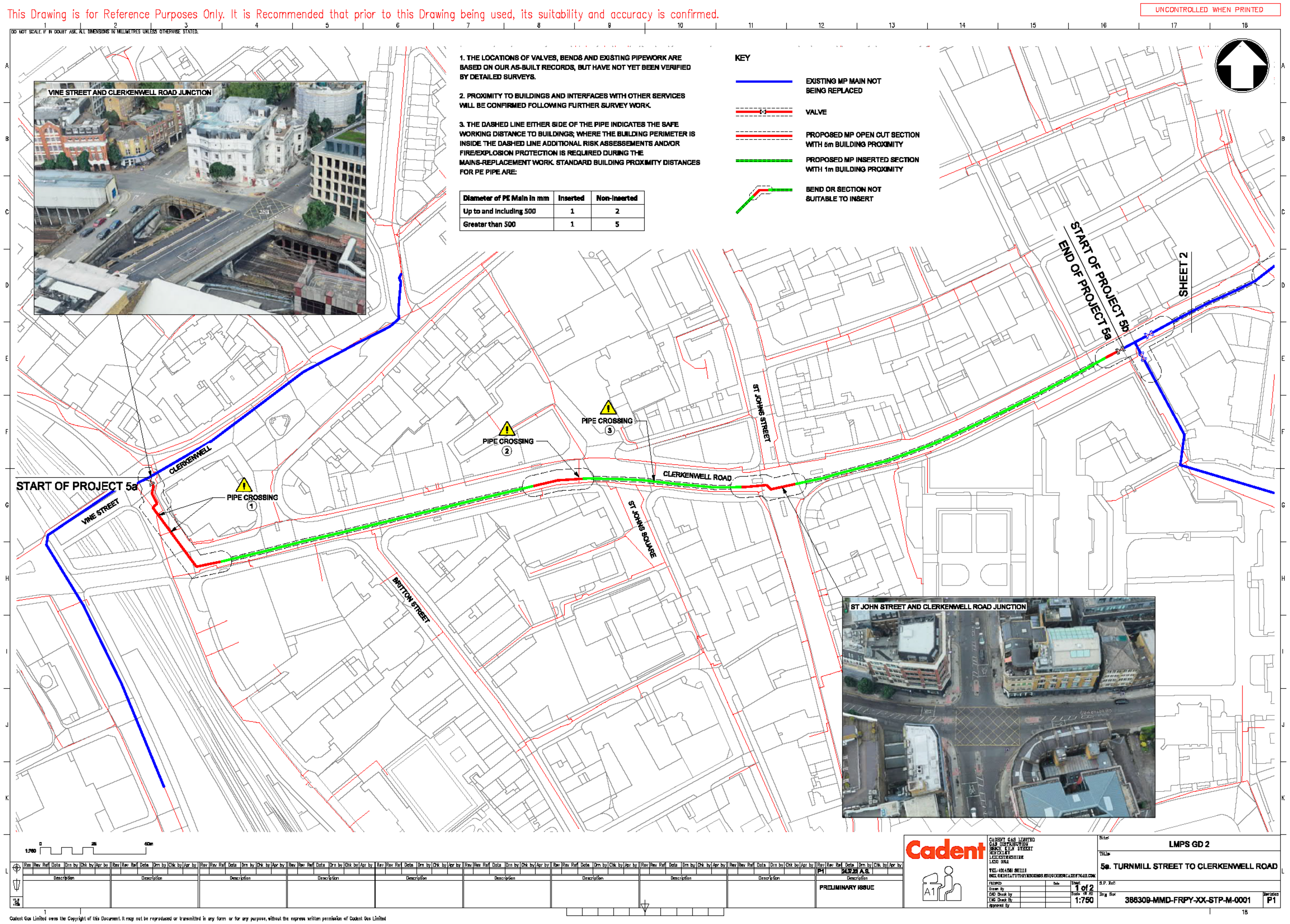
Site: LMPS GD 2
Title: 3a. 84 TO 60 COMMERCIAL ROAD
Sheet 1 of 1
Scale 1:750
Drg No: 386309-MMD-COMM-XX-STP-M-0001
Revision P1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VINE STREET AND CLERKENWELL ROAD JUNCTION
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Diameter of PE Main in mm | Inserted | Non-inserted
Up to and including 500 | 1 | 2
Greater than 500 | 1 | 5
KEY
EXISTING MP MAIN NOT BEING REPLACED
VALVE
PROPOSED MP OPEN CUT SECTION WITH 5m BUILDING PROXIMITY
PROPOSED MP INSERTED SECTION WITH 1m BUILDING PROXIMITY
BEND OR SECTION NOT SUITABLE TO INSERT
START OF PROJECT 5b
END OF PROJECT 5a
SHEET 2
START OF PROJECT 5a
CLERKENWELL
VINE STREET
PIPE CROSSING 1
PIPE CROSSING 2
PIPE CROSSING 3
CLERKENWELL ROAD
ST JOHNS STREET
ST JOHNS SQUARE
BRITTON STREET
ST JOHN STREET AND CLERKENWELL ROAD JUNCTION
PRELIMINARY ISSUE
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LE10 0NA
Site: LMPS GD 2
Title: 5a. TURNMILL STREET TO CLERKENWELL ROAD
Sheet 1 of 2
Scale 1:750
Drg No: 386309-MMD-FRPY-XX-STP-M-0001
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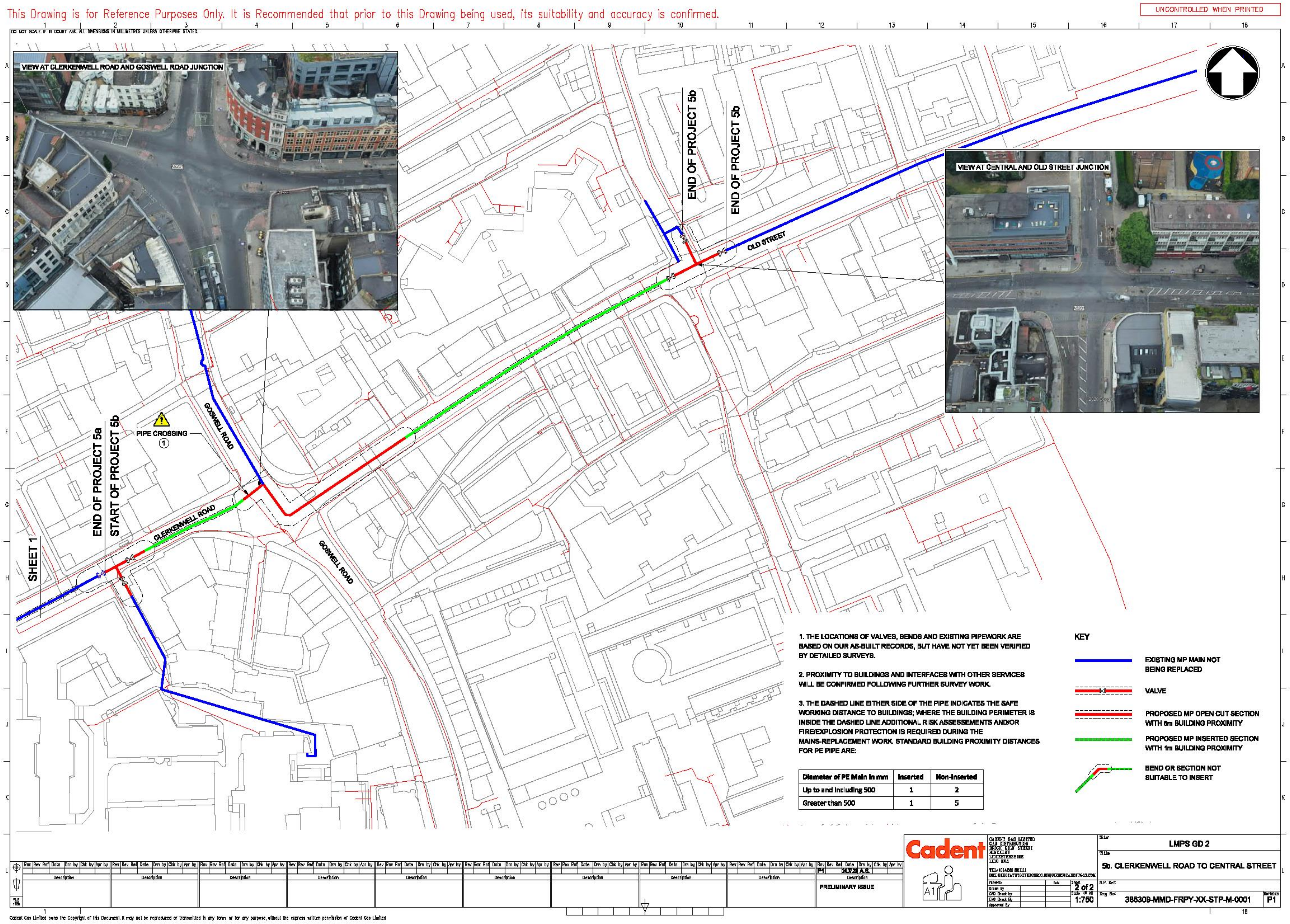
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VIEW AT CLERKENWELL ROAD AND GOSWELL ROAD JUNCTION
VIEW AT CENTRAL AND OLD STREET JUNCTION
END OF PROJECT 5b
END OF PROJECT 5b
OLD STREET
GOSWELL ROAD
GOSWELL ROAD
CLERKENWELL ROAD
PIPE CROSSING
END OF PROJECT 5a
START OF PROJECT 5b
SHEET 1
1. THE LOCATIONS OF VALVES, BENDS AND EXISTING PIPEWORK ARE BASED ON OUR AS-BUILT RECORDS, BUT HAVE NOT YET BEEN VERIFIED BY DETAILED SURVEYS.
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Diameter of PE Main in mm | Inserted | Non-Inserted
Up to and including 500 | 1 | 2
Greater than 500 | 1 | 5
KEY
EXISTING MP MAIN NOT BEING REPLACED
VALVE
PROPOSED MP OPEN CUT SECTION WITH 6m BUILDING PROXIMITY
PROPOSED MP INSERTED SECTION WITH 1m BUILDING PROXIMITY
BEND OR SECTION NOT SUITABLE TO INSERT
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PRELIMINARY ISSUE
Site:
LMPS GD 2
Title:
5b. CLERKENWELL ROAD TO CENTRAL STREET
Sheet
2 of 2
Scale
1:750
Drg No:
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Diameter of PE Main in mm	Inserted	Non-Inserted
Up to and including 500	1	2
Greater than 500	1	5

1:2000 0 50 100m

KEY

- EXISTING MP MAIN NOT BEING REPLACED
- VALVE
- PROPOSED MP OPEN CUT SECTION WITH 6m BUILDING PROXIMITY
- PROPOSED MP INSERTED SECTION WITH 1m BUILDING PROXIMITY
- BEND OR SECTION NOT SUITABLE TO INSERT

VIEW AT THEOBALD'S ROAD, CLERKENWELL ROAD & GRAYS INN ROAD JUNCTION

VIEW AT VINE STREET BRIDGE

VIEW AT NEW SOUTHAMPTON ROW & THEOBALD'S ROAD JUNCTION.

VIEW AT NEW OXFORD STREET & BLOOMSBURY WAY. TIE-IN LOCATION

OPENCUT SECTIONS OF PIPE CROSS EXISTING MP MAINS IN THESE AREAS (1)

PIPE CROSSES CIRCLE, METROPOLITAN AND HAMMERSMITH & CITY TUBE LINES (2)

FARRINGDON ROAD

VINE ST. BRIDGE

EXISTING VALVE 'UNKNOWN NUMBER'

EXISTING VALVE TO BE REPLACED

EXISTING VALVE 16784 (TIE-IN LOCATION)

CLERKENWELL ROAD

LEATHER LANE

OPENCUT SECTIONS OF PIPE CROSS EXISTING LP MAINS IN THESE AREAS (3)

PIPE CROSSING (4)

THEOBALD'S ROAD

GRAYS INN ROAD

TIE-IN LOCATION (START OF PROJECT)

V16784

UNKNOWN

RED LION ST.

IMPACT PROTECTION MUST BE USED IN THIS AREA AS BUILDING IS LOCATED WITHIN 6m

OPENCUT SECTIONS OF PIPE CROSS EXISTING LP MAINS IN THESE AREAS (5)

OPENCUT SECTIONS OF PIPE CROSS EXISTING LP MAINS IN THESE AREAS (6)

OPENCUT SECTIONS OF PIPE CROSS EXISTING LP MAINS IN THESE AREAS (7)

IMPACT PROTECTION MUST BE USED IN THIS AREA AS BUILDING IS LOCATED WITHIN 6m (8)

SOUTHAMPTON ROW

PIPE CROSSES PICADILLY TUBE LINE (9)

PIPE CROSSING (10)

KINGSWAY

OPENCUT SECTIONS OF PIPE CROSS EXISTING LP MAINS IN THESE AREAS (11)

PIPE CROSSING (12) (13)

OPENCUT SECTIONS OF PIPE CROSS EXISTING LP MAINS IN THESE AREAS

END OF PROJECT

BLOOMSBURY WAY

NEW OXFORD ST

PIPE CROSSING

Rev	Rev Ref	Date	Drn by	Chk by	Apr by	Description
P1		24.07.25	MJ			PRELIMINARY ISSUE

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A1

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CAD Check by		
ENG Check By		
Approved By		

Sheet 1 of 4
Scale @ A1 1:2000

Site: LMPS GD 2

Title: 10a - FARRINGDON ROAD TO BLOOMSBURY WAY

S.P. Ref:

Drg No: 386309-MMD-FRMS-XX-STP-M-0001

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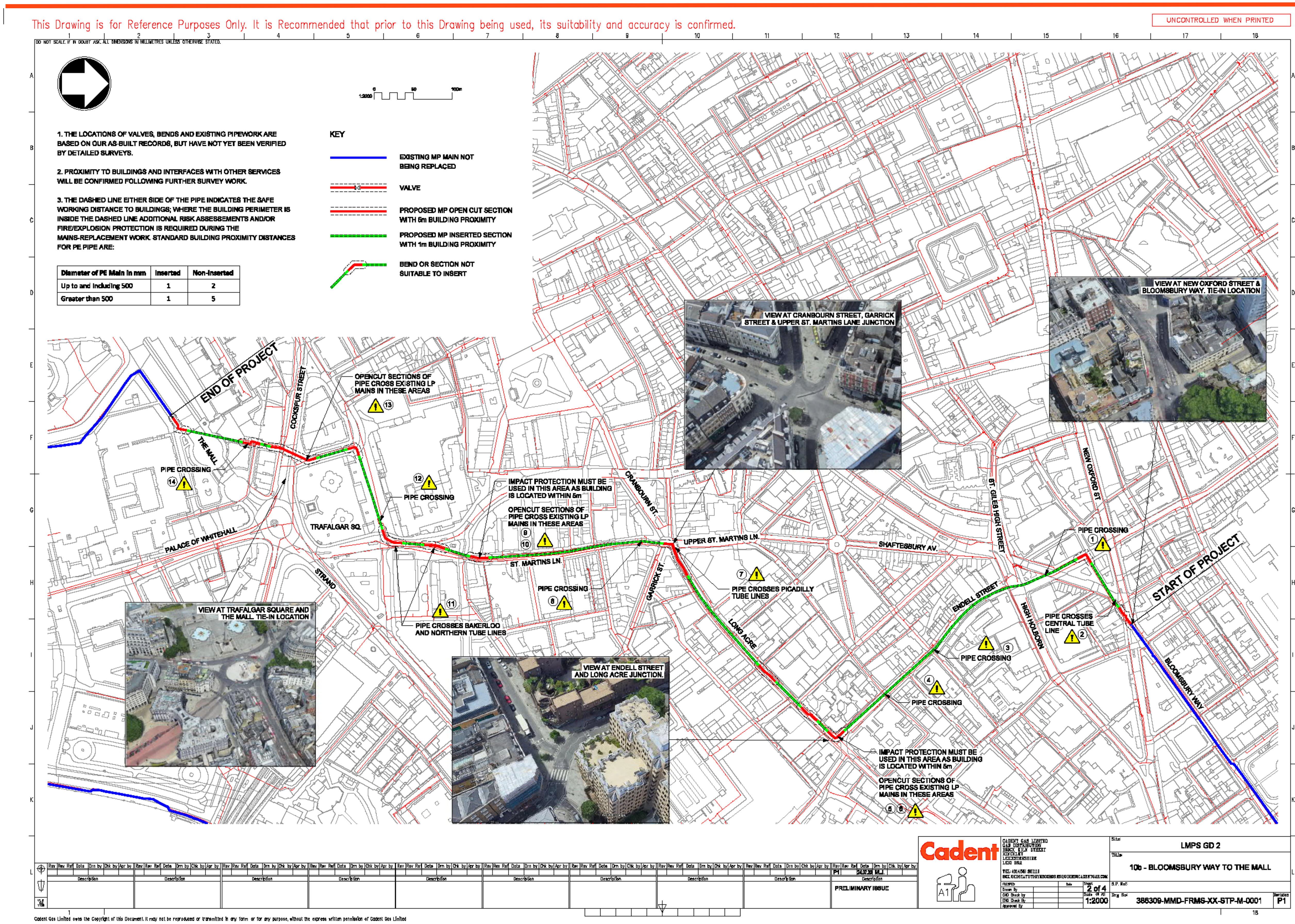
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Greater than 500 | 1 | 5
KEY
EXISTING MP MAIN NOT BEING REPLACED
VALVE
PROPOSED MP OPEN CUT SECTION WITH 5m BUILDING PROXIMITY
PROPOSED MP INSERTED SECTION WITH 1m BUILDING PROXIMITY
BEND OR SECTION NOT SUITABLE TO INSERT
END OF PROJECT
START OF PROJECT
COCKSPUR STREET
THE MALL
PALACE OF WHITEHALL
TRAFALGAR SQ.
STRAND
ST. MARTINS LN.
UPPER ST. MARTINS LN.
CRANBOURN ST.
GARRICK ST.
LONG ACRE
SHAFTESBURY AV.
ENDELL STREET
ST. GILES HIGH STREET
HIGH HOLBORN
NEW OXFORD ST
BLOOMSBURY WAY
OPENCUT SECTIONS OF PIPE CROSS EXISTING LP MAINS IN THESE AREAS
PIPE CROSSING
IMPACT PROTECTION MUST BE USED IN THIS AREA AS BUILDING IS LOCATED WITHIN 5m
PIPE CROSSES BAKERLOO AND NORTHERN TUBE LINES
PIPE CROSSES PICADILLY TUBE LINES
PIPE CROSSES CENTRAL TUBE LINE
VIEW AT TRAFALGAR SQUARE AND THE MALL TIE-IN LOCATION
VIEW AT ENDELL STREET AND LONG ACRE JUNCTION.
VIEW AT CRANBOURN STREET, GARRICK STREET & UPPER ST. MARTINS LANE JUNCTION
VIEW AT NEW OXFORD STREET & BLOOMSBURY WAY. TIE-IN LOCATION
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LEICESTERSHIRE
Site: LMPS GD 2
Title: 10b - BLOOMSBURY WAY TO THE MALL
Sheet 2 of 4
Scale 1:2000
Drg No: 386309-MMD-FRMS-XX-STP-M-0001
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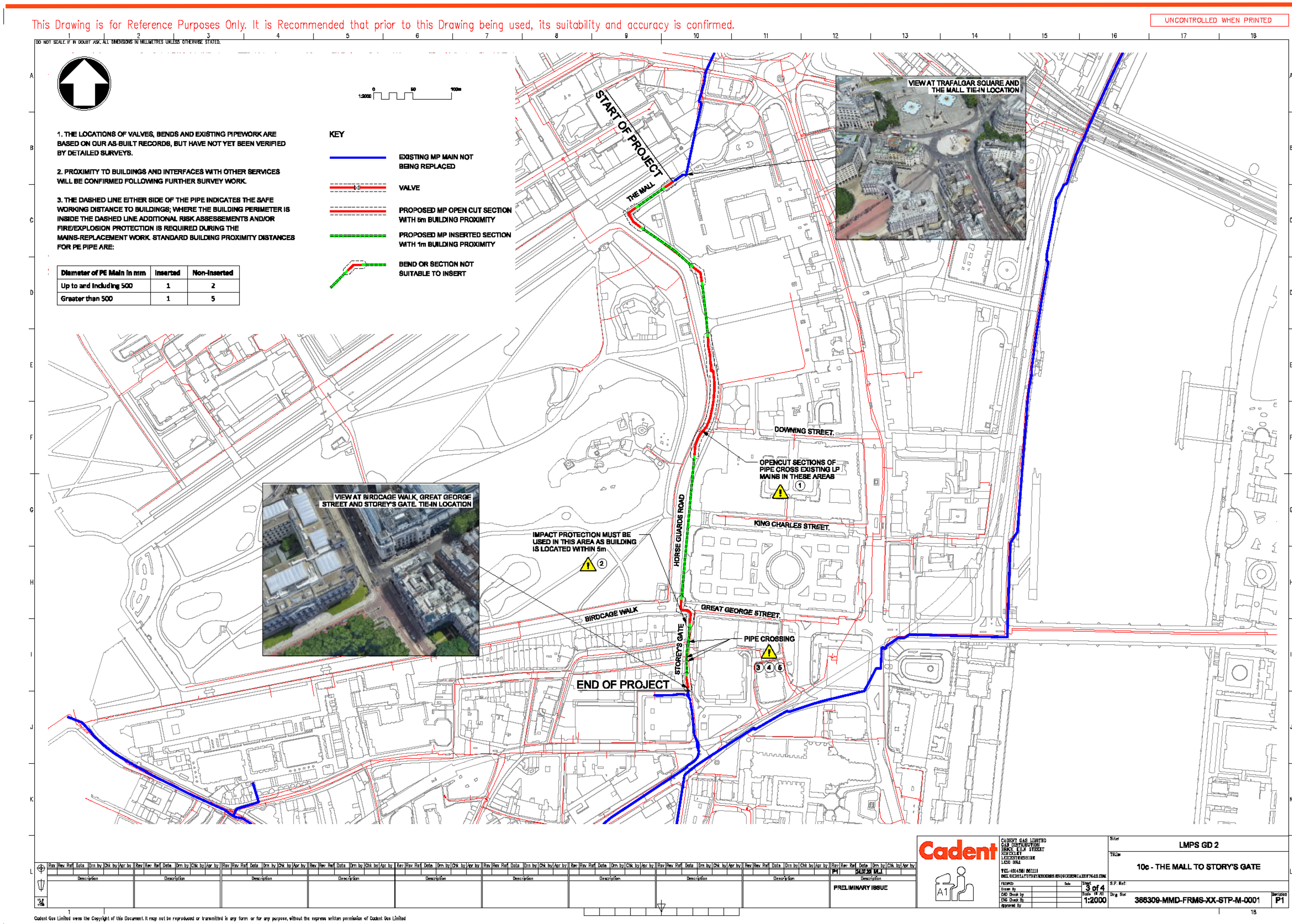
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Up to and Including 500 | 1 | 2
Greater than 500 | 1 | 5
KEY
EXISTING MP MAIN NOT BEING REPLACED
VALVE
PROPOSED MP OPEN CUT SECTION WITH 5m BUILDING PROXIMITY
PROPOSED MP INSERTED SECTION WITH 1m BUILDING PROXIMITY
BEND OR SECTION NOT SUITABLE TO INSERT
1:2000
START OF PROJECT
THE MALL
VIEW AT TRAFALGAR SQUARE AND THE MALL TIE-IN LOCATION
DOWNING STREET
OPENCUT SECTIONS OF PIPE CROSS EXISTING LP MAINS IN THESE AREAS
KING CHARLES STREET
HORSE GUARDS ROAD
IMPACT PROTECTION MUST BE USED IN THIS AREA AS BUILDING IS LOCATED WITHIN 5m
VIEW AT BIRDCAGE WALK, GREAT GEORGE STREET AND STOREY'S GATE TIE-IN LOCATION
BIRDCAGE WALK
GREAT GEORGE STREET
PIPE CROSSING
STOREY'S GATE
END OF PROJECT
PRELIMINARY ISSUE
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Site: LMPS GD 2
Title: 10c - THE MALL TO STORY'S GATE
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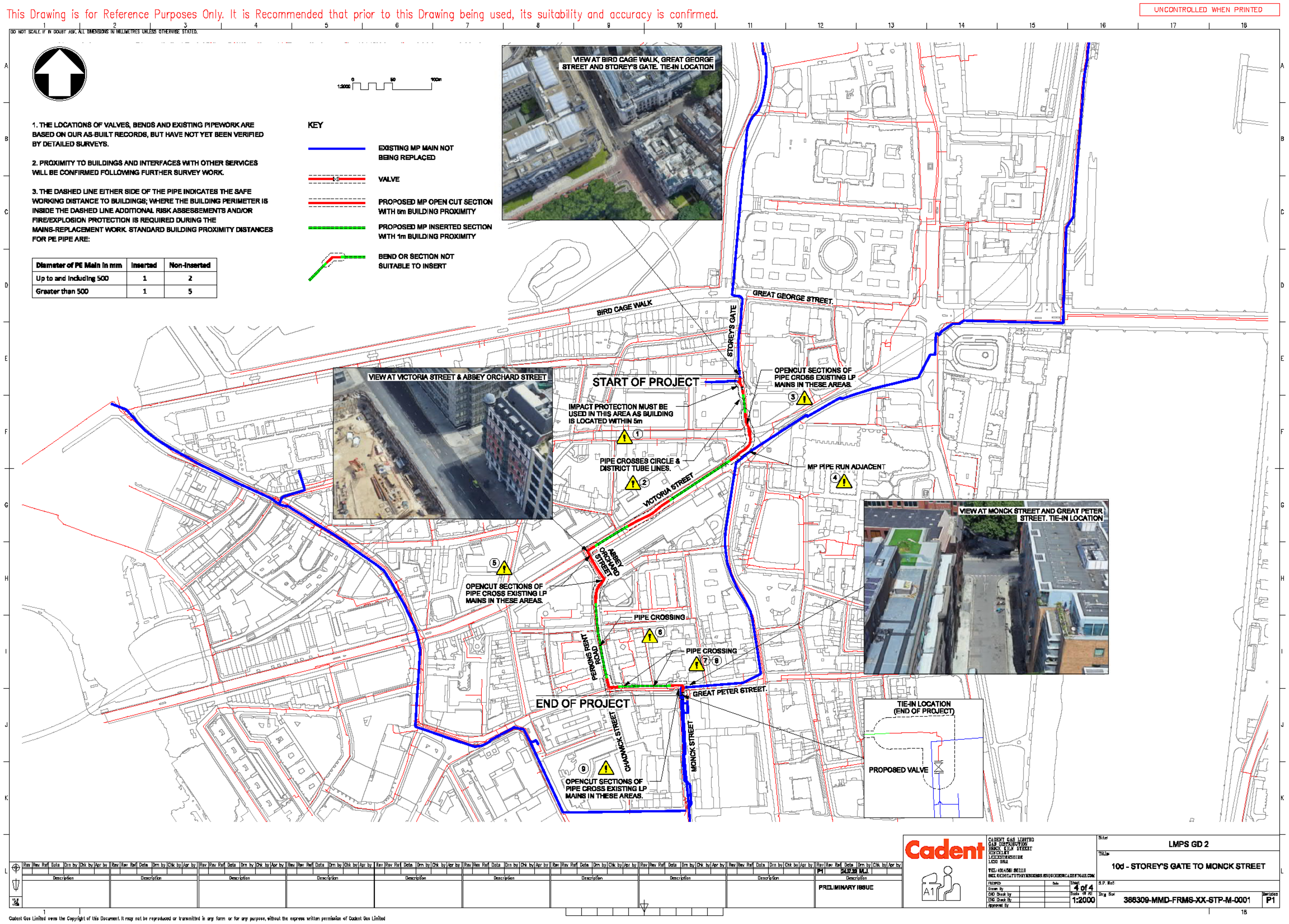
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EXISTING MP MAIN NOT BEING REPLACED
VALVE
PROPOSED MP OPEN CUT SECTION WITH 5m BUILDING PROXIMITY
PROPOSED MP INSERTED SECTION WITH 1m BUILDING PROXIMITY
BEND OR SECTION NOT SUITABLE TO INSERT
VIEW AT BIRD CAGE WALK, GREAT GEORGE STREET AND STOREY'S GATE. TIE-IN LOCATION
VIEW AT VICTORIA STREET & ABBEY ORCHARD STREET
VIEW AT MONCK STREET AND GREAT PETER STREET. TIE-IN LOCATION
BIRD CAGE WALK
GREAT GEORGE STREET
STOREY'S GATE
START OF PROJECT
OPENCUT SECTIONS OF PIPE CROSS EXISTING LP MAINS IN THESE AREAS.
IMPACT PROTECTION MUST BE USED IN THIS AREA AS BUILDING IS LOCATED WITHIN 5m
PIPE CROSSES CIRCLE & DISTRICT TUBE LINES.
MP PIPE RUN ADJACENT
VICTORIA STREET
ABBEY ORCHARD STREET
OPENCUT SECTIONS OF PIPE CROSS EXISTING LP MAINS IN THESE AREAS.
PIPE CROSSING
PIPE CROSSING
PERKINS RENT ROAD
GREAT PETER STREET
END OF PROJECT
CHADWICK STREET
MONCK STREET
OPENCUT SECTIONS OF PIPE CROSS EXISTING LP MAINS IN THESE AREAS.
TIE-IN LOCATION (END OF PROJECT)
PROPOSED VALVE
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LMPS GD 2
10d - STOREY'S GATE TO MONCK STREET
4 of 4
1:2000
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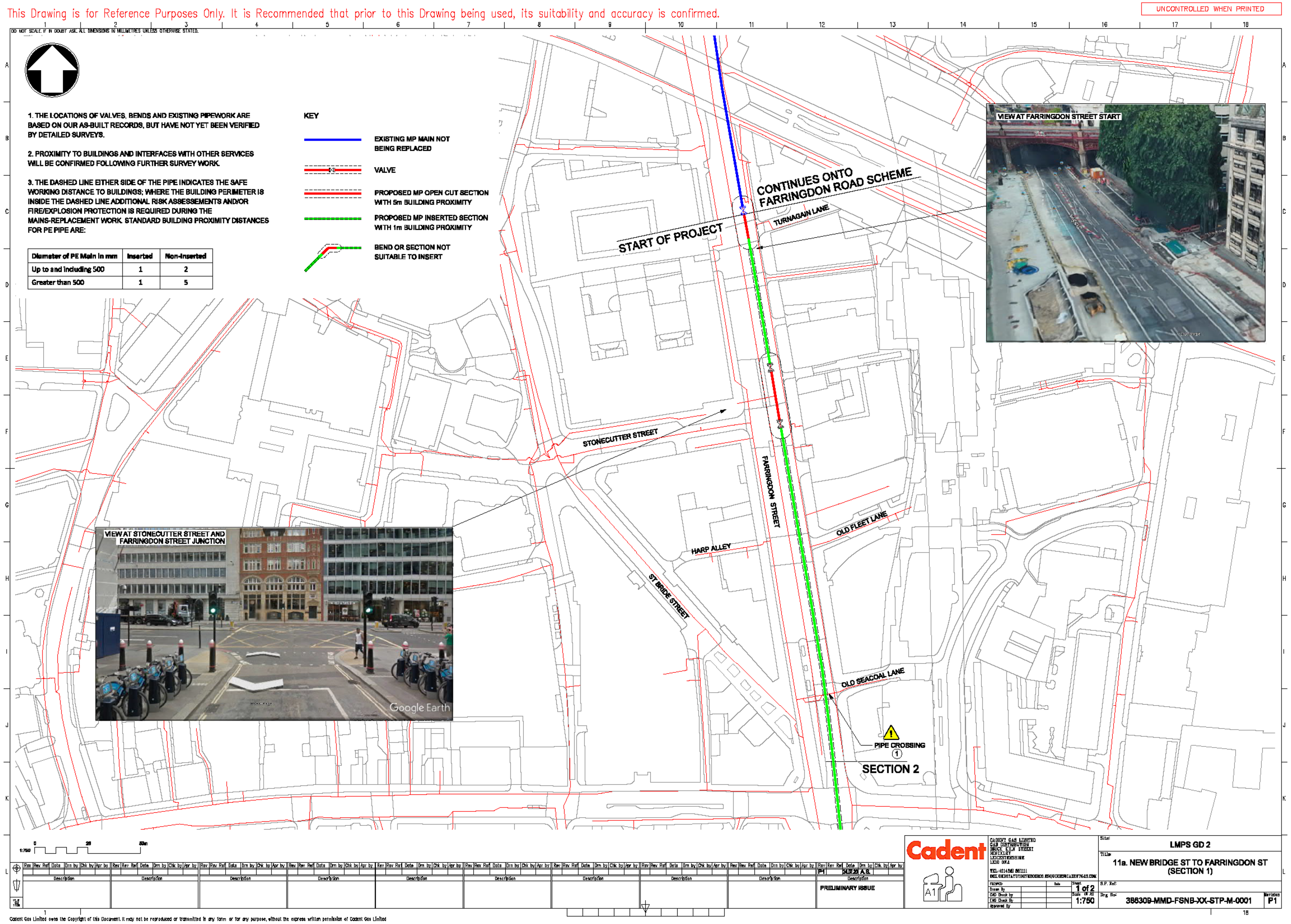
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VALVE
PROPOSED MP OPEN CUT SECTION WITH 5m BUILDING PROXIMITY
PROPOSED MP INSERTED SECTION WITH 1m BUILDING PROXIMITY
BEND OR SECTION NOT SUITABLE TO INSERT
VIEW AT FARRINGDON STREET START
CONTINUES ONTO FARRINGDON ROAD SCHEME
START OF PROJECT
TURNAGAIN LANE
STONECUTTER STREET
FARRINGDON STREET
OLD FLEET LANE
HARP ALLEY
ST BRIDE STREET
OLD SEACOAL LANE
PIPE CROSSING
SECTION 2
VIEW AT STONECUTTER STREET AND FARRINGDON STREET JUNCTION
Google Earth
PRELIMINARY ISSUE
Cadent
LMPS GD 2
11a. NEW BRIDGE ST TO FARRINGDON ST (SECTION 1)
1 of 2
1:750
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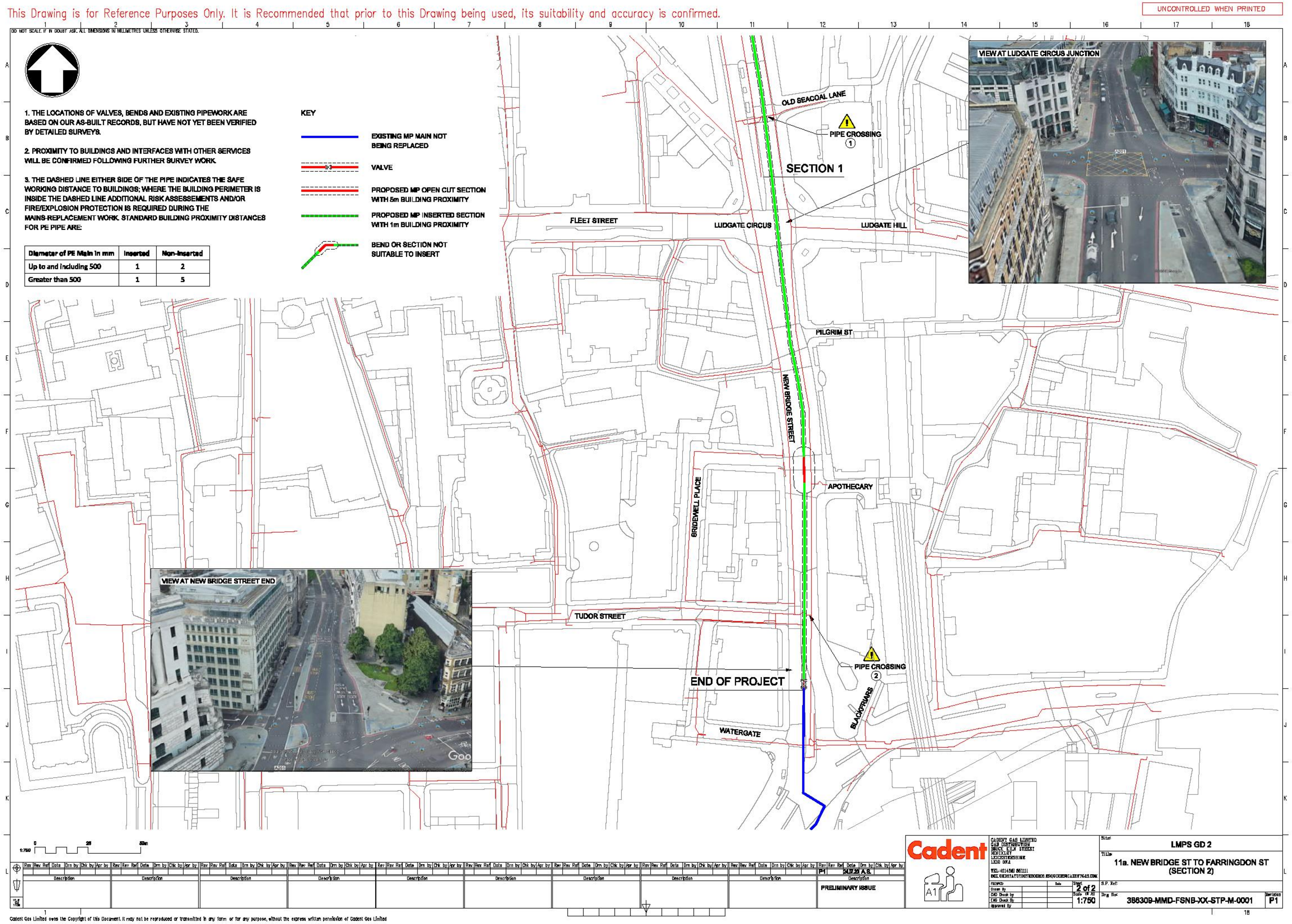
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KEY
EXISTING MP MAIN NOT BEING REPLACED
VALVE
PROPOSED MP OPEN CUT SECTION WITH 5m BUILDING PROXIMITY
PROPOSED MP INSERTED SECTION WITH 1m BUILDING PROXIMITY
BEND OR SECTION NOT SUITABLE TO INSERT
VIEW AT LUDGATE CIRCUS JUNCTION
OLD SEACOAL LANE
PIPE CROSSING 1
SECTION 1
FLEET STREET
LUDGATE CIRCUS
LUDGATE HILL
PILGRIM ST
NEW BRIDGE STREET
APOTHECARY
BRIDEWELL PLACE
VIEW AT NEW BRIDGE STREET END
TUDOR STREET
PIPE CROSSING 2
END OF PROJECT
BLACKFRIARS
WATERGATE
PRELIMINARY ISSUE
Cadent
LMPS GD 2
11a. NEW BRIDGE ST TO FARRINGDON ST (SECTION 2)
2 of 2
1:750
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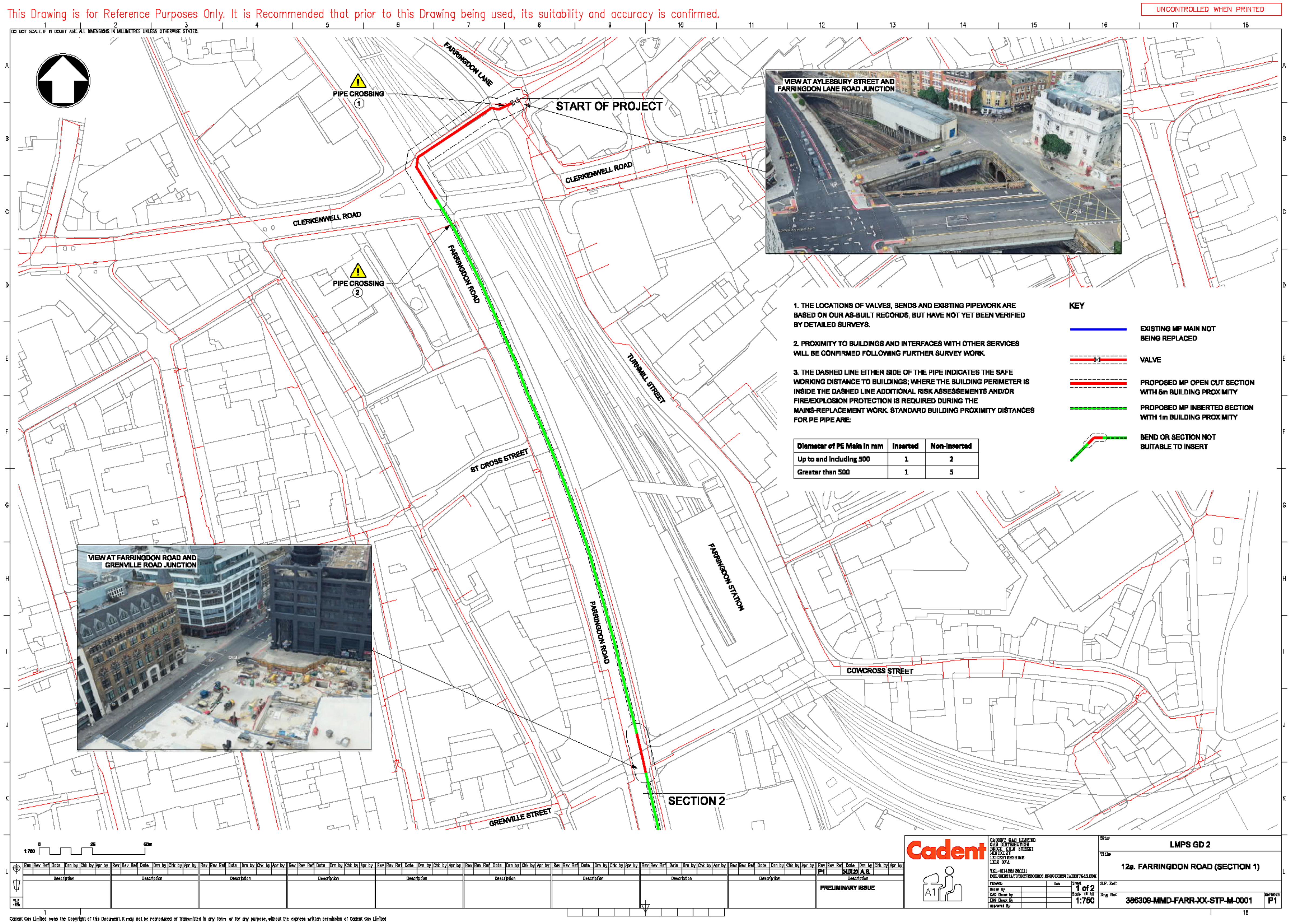

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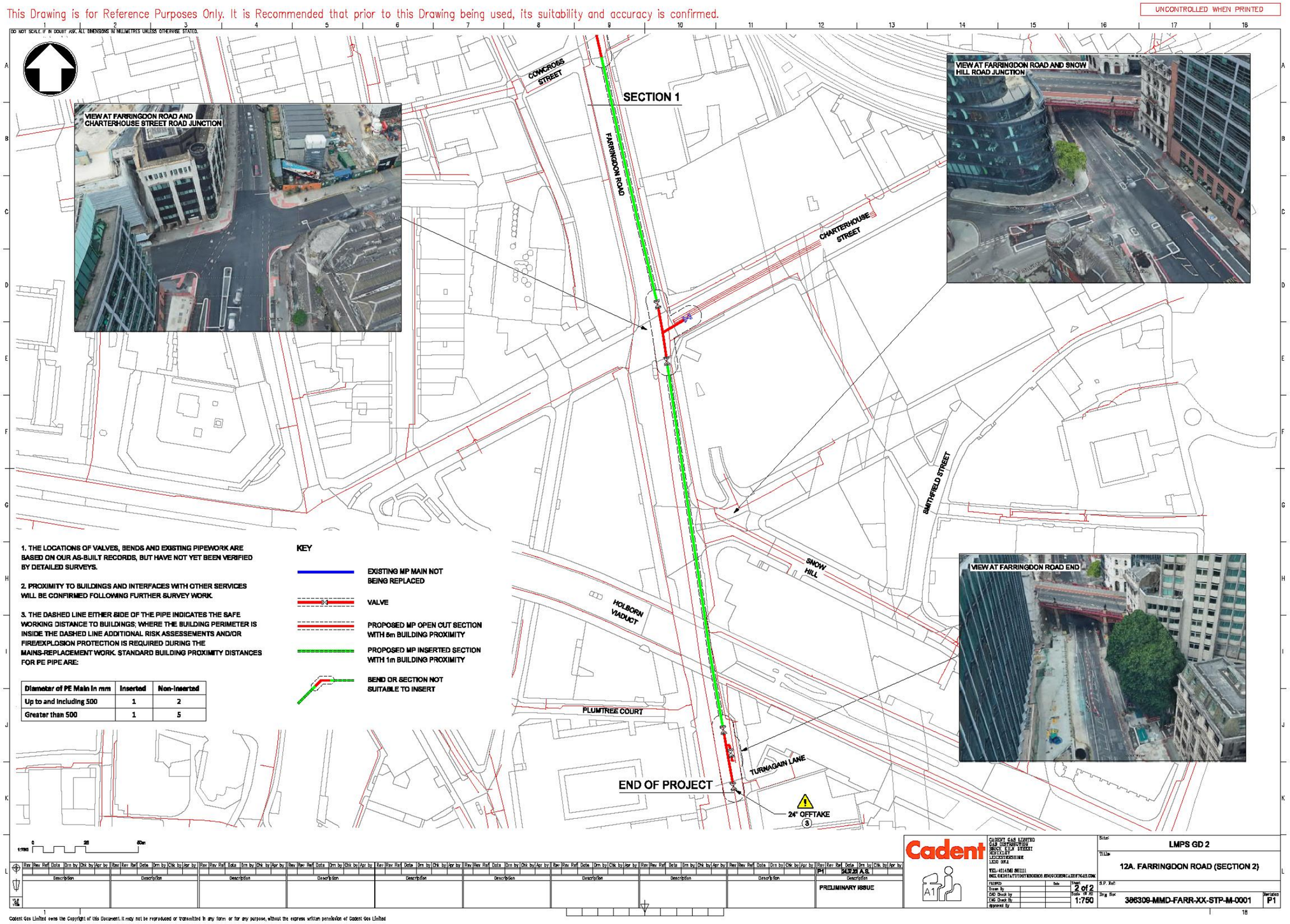
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VIEW AT FARRINGDON ROAD AND CHARTERHOUSE STREET ROAD JUNCTION
VIEW AT FARRINGDON ROAD AND SNOW HILL ROAD JUNCTION
VIEW AT FARRINGDON ROAD END
SECTION 1
COWCROSS STREET
FARRINGDON ROAD
CHARTERHOUSE STREET
SMITHFIELD STREET
SNOW HILL
HOLBORN VIADUCT
PLUMTREE COURT
TURNAGAIN LANE
END OF PROJECT
24" OFFTAKE
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VALVE
PROPOSED MP OPEN CUT SECTION WITH 5m BUILDING PROXIMITY
PROPOSED MP INSERTED SECTION WITH 1m BUILDING PROXIMITY
BEND OR SECTION NOT SUITABLE TO INSERT
PRELIMINARY ISSUE
Cadent
LMPS GD 2
12A. FARRINGDON ROAD (SECTION 2)
2 of 2
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Appendix B: Stakeholder letters

GREATER**LONDON**AUTHORITY

Mr Steve Fraser
CEO
Cadent Gas
Ashbrook Court
Coventry
CV7 8PE

22 May 2020

Dear Steve,

GLA Support for Cadent RIIO-2 Investment schemes in London Network

We have compiled this open letter to document our support for the next proposed GD2 phase of the 'London Medium Pressure' (LMP) scheme. It is our view that this work will support resilience of gas supplies in Central London as well as reduce unplanned disruption and improve safety. These are important priorities of the Mayor of London, Sadiq Khan, and as such we fully support your proposals in this regard.

You have outlined your commitment to improving the level of stakeholder engagement, collaboration and customer service that you deliver, and we welcome this ambition and commitment. Your plan underlines that some of your services are ultimately dependent on your case for allowances being met in Ofgem's regulatory settlement and that for the London Network regional factor allowances are particularly important. We have reviewed your regional factors appendix and offer our support in principle for the additional costs of working in London that are noted. From our experience those additional costs of business in London are legitimate and the services you outline are valued highly by people in London.

Given the inherent costs of operating in London, improving how these works are delivered will be of critical importance. The Mayor, alongside his London Infrastructure Group, has committed to piloting new approaches to reduce disruption caused by streetworks through facilitating collaborative infrastructure delivery. Collaborative approaches also present opportunities for savings and can be further supplemented by incentives in areas such as lane rental and parking bay suspension charges being waived.

As such there is a heightened need for investment in resources to unlock those collaborations and close dialogue with local authorities, the Greater London Authority (GLA) and Transport for London (TfL) in delivering your proposed works throughout the years ahead so that benefits can be mutually achieved.

City Hall, London, SE1 2AA • london.gov.uk • 020 7983 4000

I would like to thank you and your team for the ongoing dialogue and briefings to the GLA and TfL on proposed plans for the LMP.

Yours sincerely,

Madalina Ursu
Head of Infrastructure
Greater London Authority

Cc:
Emily Wilson-Gavin, Cadent
Paul Matthews, Transport for London

From: Barton Glynn (ST) <Glynn.Barton@tfl.gov.uk>
Sent: 17 June 2020 14:22
To: Fraser, Steve <Steve.Fraser@cadentgas.com>
Cc: Rison, Chris <chris.rison@cadentgas.com>; Matthews Paul <PaulMatthews@tfl.gov.uk>; Sherry Andrew (ST) <Andrew.Sherry@tfl.gov.uk>
Subject: London Medium Pressure Replacement Programme

Dear Steve

London Medium Pressure Replacement Programme

I am writing following the letter you received from the GLA on 22 May supporting delivery of Cadent's London medium pressure (LMP) replacement programme. During this early stage of our restart and recovery from COVID-19, the resilience of London's utility networks remains as essential as ever as we support the economy, jobs and growth. I wanted to confirm that my Network Management team at Transport for London (TfL) will work closely with you to deliver these vital works.

Of course, the national and London-wide picture with regard to COVID-19 continues to develop apace. As part of the Government's strategy for a gradual and contingent easing of lockdown measures we have governmental guidance on construction works and social distancing, as well as guidance from the Health and Safety Executive on social distancing, and guidance from HAUC. We will need to work together under the above guidance (and future guidance as it is issued) to support safe and sustainable transport during works.

So, owing to the exceptional circumstances we continue to deal with, I think it is worth noting that at key locations where measures have been installed through the Streetspace for London programme to help people walk and cycle while observing social distancing, plus locations adjacent to our busiest bus, tube and rail stations, there are particular conditions that apply in undertaking works, including:

- Prioritising permits for emergency and urgent works. Planned works at these locations will also be given precedence, but only where robust justification has been provided to evidence that works are required to prevent an imminent failure to service

- We are asking all utility companies to provide a list of any other planned works at these locations during the next 12 months. We will work with you to establish how these works may be facilitated while still maintaining satisfactory social distancing provision. We are also asking to see all traffic management plans for all planned works as soon as possible at these locations

- When undertaking works, promoters will be expected to provide the same amount of road space as currently allocated to pedestrians and cyclists. We recognise this may be challenging in some situations, so you should please contact the relevant Area Manager in our Coordination & Permitting team to discuss suitable solutions

I have written separately this week to all works promoters, including utility companies, explaining this current approach in more detail. The situation and context for works will no doubt change further as we approach the scheduled LMP works, so I have asked my Coordination & Permitting team to work closely with you to ensure the latest guidance is followed in the planning and execution of works.

As above, in delivering the LMP programme we need to very carefully assess and mitigate the impacts on residents and road users, focusing particularly on the safety and wellbeing of pedestrians, cyclists and bus passengers, as well as freight and servicing - all of which are vital to our recovery.

In their letter the GLA also mentioned the economic cost of doing works in London. Working together and with the GLA on collaborative opportunities is an essential step in reducing the impact on sustainable modes, but we will also need to consider innovative approaches such as those we have recently implemented on Chelsea Embankment and London Bridge/Gracechurch Street - where Cadent covering the cost of lost bus passenger revenue ultimately helped the works gain political and stakeholder support. Again, my team will work closely with you in planning mitigations necessary to deliver the LMP.

I would like to thank you for the productive relationship that has been developed over the years and hope this can be built on as we face an ever-increasing challenge to support London's recovery through sustainable travel.

Yours sincerely,

Glynn Barton
Director of Network Management
Transport for London

Appendix C:

Report from Copper Consultancy:

Stakeholder engagement and Communications during RIIO-1

Gas mains replacement

Stakeholder Engagement Report

Cadent

August 2020

Introduction

Cadent undertakes a programme of best-practice stakeholder engagement and community relations in support of its medium pressure mains replacement work in London.

This includes on-the-ground communications activities such as public exhibitions, distributing letters and maps to show the impact of the work on the local community and community liaison groups. Through our communications work we engage with a variety of stakeholders including businesses, residents, MPs, councillors, residents' associations, hospitals, emergency services and schools.

The objective of our communications is to minimise inconvenience by ensuring the local community are well informed about our work, the timescales and what it will mean to them. It is also to create understanding of the need for the work and to enhance Cadent's reputation for being considerate.

We work with the relevant local authorities and Transport for London (TfL) to join up communications surrounding our works as much as possible. Our communications are valuable in obtaining the required permits to carry out the programme of medium pressure mains replacement work and maintain positive relationships with streetworks teams and other key decision-makers going forward.

Summary

The densely populated nature of London makes any mains replacement a challenge. Keeping the traffic moving and minimising disruption to members of the public is our focus. Our approach is to provide good communications before and during a project to help establish and maintain positive relationships.

The London Gas Mains Replacement team have regularly liaised with local communities and key stakeholders throughout the work to replace 100-year-old strategic gas mains in highly congested areas of London. The team collaborated with the council, businesses and residents to substantially minimise the impact of the work on everyday life through a well-planned programme of work supported by open, timely and accurate communications. They are working with customers and building a trusting relationship with stakeholders, involving them in Cadent's plans throughout the mains replacement process.

Early engagement and collaboration with the entire supply chain, stakeholders, other infrastructure projects and service and utility providers is key to the ongoing successful delivery of gas mains replacement across London. With several other major infrastructure projects being undertaken concurrently, we proactively engaged with Crossrail, Thames Tideway Tunnel and the Cycle Super Highway to ensure a coordinated approach to working in similar areas. This successfully minimised stakeholder and environmental impact and increased productivity.

For example: In the City of London, collaborative working with other utilities enabled them to carry out work within our traffic management. This contributed towards a total saving of 64 days of road occupation while undertaking work to replace large diameter gas mains in London.

Our engagement and project management approach has achieved awards:

- City of London Gold award for Stakeholder Communication and Innovation in Environmental Management.
- Highly commended gold award from the City of London Considerate Contractor Streetworks Scheme (CCSS). The CCSS awards promote the highest standards for utilities and their contractors and awards are made after a site visit by the judges.
- The Utility Project of the Year award from the Pipelines Industries Guild.

Community engagement

Examples of specific projects and the positive impact of the engagement on the way the work was carried out include:

King's Road, Chelsea

Work took place on King's Road, one of London's busiest roads, which lies within the Royal Borough of Kensington and Chelsea (RBKC) and London Borough of Hammersmith and Fulham. The only way to replace

the Victorian gas mains, which were laid deep within a shallow road bridge over the railway line and were critical to supply hundreds of thousands of customers, required a directional road closure.

As a result of our engagement strategy, we were able to gain permission to carry out this work in an area already busy for traffic and pedestrians, with lots of ongoing development, sensitivity to traffic delays and in close proximity to the Chelsea Football Stadium. This required extensive engagement and coordination with the local authorities and Transport for London, with some conflicting views on the proposed direction of the required road closure as this affected the wider London road network.

Through an extensive communications programme, the team took the time to understand and resolve different, and sometimes conflicting, priorities with stakeholders. Stakeholders that we regularly engaged and maintained strong relationships with are listed below:

- Transport for London
- Royal Borough of Kensington and Chelsea
- London Borough of Hammersmith and Fulham
- Emergency services
- Chelsea Football Club
- Residents' associations
- Businesses and residents

The project team developed a continuous line of communication with local authorities, key stakeholder organisations and Transport for London. A collaborative working group was established, bringing together stakeholder representatives with members of the project team. The members included Cadent Gas, tRIIO, Priority Traffic Management, TfL (network planning, parking and buses), council officers for Royal Borough of Kensington and Chelsea and London Borough of Hammersmith and Fulham, emergency services, Chelsea Football Club, Chelsea and Westminster Hospital and the Metropolitan Police. The joined-up approach taken by the working group allowed an effective two-way dialogue to be developed that facilitated effective planning and coordination of the work and a 'one-team' approach to minimising the inconvenience of the work to residents and businesses and resulted in reduced congestion.

As Chelsea experiences high volumes of traffic, its management was an extremely sensitive topic that needed extensive communications with local residents and businesses as well as wider road users. The project team worked together with the coordination group of external stakeholders to devise a community engagement programme to create awareness of the traffic management that would be in place; to encourage drivers to plan ahead and use alternative routes to minimise inconvenience; and to demonstrate to the community that work was being carried out in an efficient and considerate way. The open, transparent and inclusive engagement programme was very successful, with higher than expected engagement with local businesses and residents. Ultimately, it successfully minimised stakeholder impact and, by increasing productivity, saved time on site.

An initial analysis of the Chelsea and Fulham area revealed a complex range of disparate stakeholders, with potentially conflicting aspirations. On the one hand there were business owners with the desire to accelerate the project using 24-hour working, while on the other hand there was a need for families to get respite from noise and overnight disruption.

A strategy of forging a positive working relationship with stakeholders was implemented, with the need for the work communicated in a clear and accessible way. To achieve this, stakeholder meetings and exhibitions were held, postal and web updates issued and a dedicated project contact centre with Freephone number, email and FREEPOST address established. Stakeholder acceptance of the scheme was gained by maximising their understanding of the type of work Cadent and tRIIO do, and enhancing their reputation for delivering economic growth through sensitive infrastructure investment. This strong relationship between the project team and stakeholders fostered a wider culture of acceptance and understanding of the project team's decisions and adjustments to proposed timescales.

Additionally, a survey of businesses affected by previous mains replacement gave us a good grounding in stakeholders' expectations for the upcoming work, enabling the team to put together a programme which gained and maintained maximum acceptance.

A number of concerns were raised by residents and businesses. As a result of the exhibitions and meetings with the project team and local authorities, the traffic management plan was optimised and left a legacy of better road markings and signage. 'KEEP CLEAR' markings on two essential junctions in Tadema Road and Cremorne Road were created, with additional signage around Lots Road that residents have said will make their lives considerably better.

The road restrictions were also lifted two weeks early, leading the secretary of Lots Village Residents' Association to comment:

"…then we should like to thank you both most sincerely for including us in your consultations at the initial stage of the work and letting us know your plans, for listening to our concerns, requests and suggestion, for taking these into account and seeing that they were acted on where ever possible."

The community engagement programme ensured the project team and the local authorities were able to assist individuals and organisations that were particularly affected by the work. The project team are continuing to collaborate with the external coordination group to obtain the required permissions to do the next phase of this essential mains replacement work in a timely manner, in a way that maintains community acceptance, and allows the project to continue running smoothly.

Chelsea Embankment

Transport for London (TfL) agreed to a five -month closure of the westbound carriageway of Chelsea Embankment. This positive move demonstrates the trust TfL have in us to deliver on our promises and reflects the strong relationship we have built up with them over this RIIO period.

In November 2017 we held a public exhibition at the National Army Museum, Royal Hospital Road, Chelsea and sent 30,000 letters to residents and businesses affected, with a follow-up postcard advertising the exhibition.

To convey the purpose and scope of the project there were several different banners describing the works, with a large banner with a map of the traffic management plan, and another with a map depicting the location of VMS signage advertising the westbound closure. Newsletters were also produced for the exhibition describing the project and giving background to the wider gas mains replacement programme.

Members of the project team and coordination group, including representatives from Cadent, tRIIO, Priority TM, Royal Borough of Kensington and Chelsea (RBKC) and Transport for London (TfL), attended the exhibition to engage with businesses/residents and their representatives. They were on hand to talk to members of the public and to answer any questions they had, or pass them onto the relevant team member.

In total 113 people attended the exhibition, and 24 left formal feedback. From the feedback we learnt that residents were mainly concerned with the impacts on traffic in the area, and also how the buses, notably the 170, would be diverted. Following the exhibition all feedback was reviewed and it was decided that a replacement bus service should be provided to service the three bus stops on Royal Hospital Road. This required us to work closely with TfL.

Responding to feedback from residents, we arranged for a temporary shuttle bus service and bus stops. We placed 'Residents Access Only' signs in streets around the King's Road to stop them being used by others.

A similar pre-work communications programme was delivered for the Fulham Road project, with an exhibition held in Hume Hall at Chelsea Methodist Church on the King's Road. Letters were sent to 25,000 residents and businesses.

The traffic management plan was shared with attendees and we ran films showing a virtual representation of the street works. Using our experience of the earlier Chelsea Embankment work, we arranged temporary traffic lights and bus stops in agreement with the Royal Borough of Kensington and Chelsea.

Working with TfL

The replacement bus service was agreed with TfL to help service the Royal Hospital Road. The number of people who depended on these bus stops was brought to our attention at the public exhibition. A temporary shuttle bus was agreed to circulate between Sloane Square, Royal Hospital Road and the westbound embankment route. This ran every 20-40 minutes from 06:00 to 24:00.

This temporary bus route meant that all normal bus stops would be serviced without major amendment to the traffic management plan. The traffic management plan consisted of a five-month westbound closure along the Chelsea Embankment, with general traffic diverted up Sloane Street towards Knightsbridge, then westward down the Brompton Road. After careful consideration, this was determined to be the least impactful programme, compared with the alternative of using temporary traffic lights on the Chelsea Embankment.

Traffic Management monitoring and review

In the first two weeks of the project, it became apparent that many road users were diverting away from the official signed diversion, and accessing the King's Road via residential side roads. This caused significant congestion and impacted on the commute times of many residents living in the streets surrounding the King's Road.

To mitigate this impact, we placed 'Resident Access Only' signs at various key streets between Royal Hospital Road and the King's Road to dissuade traffic from using the streets. To further ease congestion in these streets, RBKC put on extra parking supervision in residential roads to prevent illegal parking and enforce fines.

To help manage the flow of traffic in the Chelsea area throughout the five-month closure, two traffic signal engineers at TfL monitored the traffic lights and made adjustments as required to ease the flow of traffic.

Community Liaison Group meetings

To follow up from the public exhibition, a Community Liaison Group was established to openly discuss any ongoing issues regarding the works and maintain an open dialogue between the project team and the community.

The meetings were advertised to local politicians and residents' associations, with the resulting meeting minutes circulated to them as well, ensuring a continuous dialogue was maintained.

Coordination with Thames Tideway Tunnel

The work on the Chelsea Embankment and the associated westbound closure was coordinated with the Thames Tideway Tunnel project. As they are also required to carry out extensive work on the Chelsea Embankment, their worksite footprint lies adjacent to Cadent's. This liaison allows both projects to take advantage of the westbound lane closure and carry out work at the same time. By incorporating Tideway's work programme into Cadent's, the amount of long-term disruption to all living and working in the area has been considerably reduced.

Brompton Road

Our previous stakeholder engagement in Chelsea shaped the preparation for our London mains replacement in the Royal Borough of Kensington and Chelsea.

We set up a coordination group with the network management team for the Royal Borough of Kensington and Chelsea and the London Borough of Hammersmith and Fulham and established a working group, bringing together stakeholder representatives with members of the project team, which met monthly.

Members of the group included Cadent, tRIIO, Priority Traffic Management, Transport for London (network planning, parking and buses), council officers for Royal Borough of Kensington and Chelsea and London Borough of Hammersmith and Fulham, emergency services, Chelsea Football Club, Chelsea and Westminster Hospital and the Metropolitan Police.

Working collaboratively and coordinating with the key authorities made sure that there was minimal disruption as a result of these works. At the same time as our works, a different company was working to replace the drains in the area. Our collaborative approach enabled them to use the traffic management that was already in place for the gas mains replacement. This reduced the overall impact on the local area and avoided a need to extend the duration of the road closure. Through diligent communications the team have built long-lasting ties with the local community and clearly demonstrated that the work is essential to provide a safe and reliable gas supply that supports economic growth.

A key benefit of this coordination group was a reduction in the amount of unforeseen work, meaning that there was less risk of potential impact on the programme. This was achieved by greater ground investigation work as part of our planning process and an increase in the number of trial holes and camera surveys of the mains to provide greater details on their condition and identify a more precise location for the existing infrastructure.

While this meant that there was an increase in road closures while we carried out the survey work, it was beneficial in getting agreements and approval for the work from TfL and local authorities. On Brompton Road, the use of innovative camera technology has identified the location of bends in old metallic gas mains and led

to changes in the 2020 programme of works to avoid delays which could have occurred if the location of these bends had not been more precisely identified.

We also continued to operate our business compensation scheme for those affected by the works and as part of our engagement with local businesses, we liaised specifically with Sub-Zero, a business heavily impacted by our works, to provide signage indicating that their business was open as usual.

Through early engagement with Harrods we have coordinated our works. We have worked with their facilities team to check the route of the existing mains to reduce the length of time they need to use an alternative fuel while we replace their gas supply. We established an ongoing relationship with representatives of the business and carry out regular catch-up meetings in order to find collaborative solutions.

Cheyne Walk

Replacing the gas pipes on the Chelsea Embankment required extensive coordination with Thames Tideway to fit in with their programme of work. We had to demonstrate to RBKC and TfL that work was being coordinated to minimise the disruption to road users.

One of the criteria to obtain consent to progress works around Cheyne Walk was to hold best practice community engagement events. These were held prior to the commencement of works and allowed local residents and businesses to voice their concerns and discuss any issues with the project team.

During the event in January 2020 one of the key concerns the team addressed centred on parking. The Chairman of the Cheyne Walk Trust took the time to talk us through the local parking issues and his suggested approach to mitigating this.

As a result, the team liaised with Royal Borough of Kensington and Chelsea and they agreed to look into the possibility of converting accessible single yellow line areas in Munro Terrace into temporary residents parking spaces in order to minimise disruption to the everyday lives of residents.

Hyde Park

Early and ongoing engagement has been vital while working in Hyde Park due to the sensitive location, other works being carried out in the area and the number of high-profile events, such as Winter Wonderland. Our programme of work has needed to be continually reviewed based on information provided by the Royal Parks and the Metropolitan Police.

Early engagement meant we were able to install a new gas regulating governor and reinstate the park to meet their programme, while still maintaining the critical gas supply to customers, which includes many of London's historic buildings, prestigious shops and tourist attractions.

Hackney Mains Replacement

This work was part of our gas mains replacement programme and took place in a busy area with multiple challenging stakeholders on Chatsworth Road, Hackney. Our objective was to create a supportive and accepting environment to enable the team to continue with their mains replacement work, resulting in stakeholders who understood what needed to be achieved and were reassured that it was being done in the least disruptive way.

Our initial stakeholder mapping resulted in a distribution zone of 4,640 residents and businesses and three letters were sent between February and June 2018 to share our traffic management and programme of works. Based on feedback from the community this was increased to 8,212. Our programme of work was organised so as not to interfere with the weekly Sunday Chatsworth Road Market. In order to communicate this information to the relevant people a stall was set up at Chatsworth Road Sunday Market. We provided banners to be displayed in key community locations – Homerton Hospital, Chats Palace and Homerton Library – so that we could provide stakeholders with immediate information about our works.

We held two exhibitions, the first at St Barnabas Church, Hackney on Monday 5 March 2018 with 19 attendees, with an additional drop-in session the next day for representatives from Chatsworth Road Market and the local fire and rescue service. After receiving public feedback that an additional exhibition in more of a community hub area would be beneficial to our communications, we organised an additional exhibition to take place within

Chatsworth Road Market itself on Sunday 22 July 2018. This enabled us to reach the community by immersing ourselves in their day-to-day environment – allowing us to talk to harder-to-reach stakeholders and communicate the reasons behind our work in a more accessible and easily digestible way.

The organisers of Chatsworth Road Market appreciated that we had communicated our works in a digestible and easily accessible way and thanked us for 'listening and sorting' the exhibition. Benefits were extensive as we generated increased goodwill amongst the local community and reduced future levels of complaints after the second exhibition.

We proved how on-the-ground, direct engagement with stakeholders produced positive results that reduced future misunderstandings and helped communicate the works in a more accessible and supportive environment. This approach was used with a market stall for the 2019 programme of works in Hackney.

We also used this approach in later works and adopted an outside venue in Hammersmith, in our works on King Street, to reach communities affected by the mains replacement in this busy shopping area.

Canonbury Square governor and mains replacement

The Islington works by Canonbury Square consisted of both the replacement of the gas governor equipment in Canonbury Square and the replacement of the ageing gas mains on Canonbury Road. The governor regulates the pressure to supply gas to 50,000 homes and needs to be connected into the existing gas network.

We needed to clearly demonstrate and explain to the stakeholders how the projects were coordinated, and that the two schemes had to be undertaken at the same time to enable the works to progress on schedule and with as little disruption as possible.

We set up a forum to maintain ongoing dialogue with stakeholders, using community groups and local representatives as a 'sounding board' to decide the position of the covers for the new governor and to get feedback on how to best integrate this within the important community facility of Canonbury Square Gardens.

We also engaged in dialogue with the office of Emily Thornberry MP about the arrangements for the works, and assured her of the mitigation efforts we were making and how consideration for the local community was at the heart of our works.

We held a public exhibition in a marquee in Canonbury Square on Wednesday 17 October 2018 to listen to the local community and to collate their feedback, which enabled us to develop the design and location of the governor. At the event the project team explained the works programme to key stakeholders and directly answered any questions and concerns that they had about the works.

We regularly provided updates and responded to queries about both the mains replacement and governor work to political and community representatives, alongside other key stakeholders that were likely to be affected by the works.

By actively engaging with stakeholders in the space that was of such local significance and importance to them, we proved that we cared about the area and wanted to protect it and minimise the visual impact of our works on the square, whilst carrying out our vital works to improve the gas supply as efficiently and safely as possible.

We adapted to the audience of key stakeholders and community groups (local councillors, local businesses, the Friends of Canonbury Square and residents of the square as these were the people most likely to be directly affected by the works) and their localised concerns by tailoring our communications strategy to focus on preserving the unique character of the square for local people. The integrated design was at the heart of our plans for the new governor and stakeholders were informed on a regular basis about any related additional mains replacement works in the area.

Our engagement was personal, taking into account the concerns of local people and community groups with strong interests in the square, which has memorial benches and trees for loved ones. We ensured that we listened to all stakeholders and addressed their potential concerns by clearly explaining our plans and engaging with them throughout the works. This was crucial for the smooth running of the programme.

Through regular meetings with the Friends of Canonbury Square, a landscaping scheme was agreed. This provided improvements to the iconic square for residents, while enhancing its appearance. The scheme also restored an area of hard landscaping, while not interfering with and maintaining access to the essential gas regulating equipment.

This engagement was successful, as stakeholders felt reassured and offered much less opposition to the project after we engaged with them directly. By involving stakeholders throughout the works process, we created a positive relationship that forged a strong foundation for any subsequent communications.

Benefits included:

- Improved stakeholder relationships with local councillors and community groups

- Ongoing constructive dialogue with the Friends of Canonbury Square, who passed on the relevant communications to members and provided valuable feedback to our landscaping experts, helping them to develop the reinstatement and improvements to the replanting and restoration of the gardens

- Useful feedback to influence the design of the governor equipment, including visual appearance of the vent stack to be as simple as possible.

Feedback/Output:

We received the following testimonials from community representatives and local stakeholders:

Many thanks to you and the Cadent team for making the time to see us yesterday. It was a very helpful meeting and good to meet the team. Please keep us posted on the information day and any further developments. **– Friends of Canonbury Square**

> *Thanks Cadent for allowing local residents the opportunity to share their views and to listen to what local residents have to say about the proposals.* ***– Canonbury Society and Friends of Canonbury Square***

> *Appreciate your time and effort in accommodating our worries + concerns****. – Friends of Canonbury Square***

> *I think the proposal is just perfect. The plan I think would be the most tolerable to most of the residents****. – Local resident***

Embracing innovative ways of digital communication

In order to adapt to these unprecedented times and as an alternative to a face-to-face information session, the communications team hosted virtual engagement sessions for multiple mains replacement projects. The webinars aimed to support our key construction workers so that they could keep doing their job in a safe manner and ensure that local communities, including the local authorities, were well informed and understood why work was continuing.

Project manager Trevor Trent said: ‘The digital engagement webinar was a great success and proved to be a very efficient way of engaging with customers – I think that these would also add great value once things return to normal.’

The questions and answers section of the webinar was structured, different stakeholders with the same concern could input collectively and follow-up actions were properly defined. The main issues and key concerns became apparent very quickly and a solution or compromise was found, with a course of action agreed.

Stakeholders expressed their concerns in a constructive manner. Because of the structured format of the webinar and the fact that all parties were able to hear individual responses, discussions were arguably more efficient than those within the format of a typical public exhibition and this resulted in tangible outcomes which the client team, assisted by Copper, can now help to implement.

Stakeholders less comfortable with using the technology were offered tutorials via phone to ensure that they felt confident to join the webinar. Additionally, we followed up with stakeholders personally and provided them with the information on a one-to-one basis.

Webinars are by no means a replacement for real life engagement, but they certainly add value to a communications strategy if implemented correctly. The structured nature of webinars allowed for focused engagement, achieving a desired outcome in a relatively short time.

Webinars are not only a cost-effective way of engaging with customers; they also tend to be more convenient as they can be designed around the teams' – and most importantly stakeholders' – busy schedules, helping stakeholders to participate with minimum impact and generate more efficient direct engagement.

As a result of Covid-19 permission to carry out works in these areas was made contingent on the successful implementation of a digital communications strategy. These information sessions were highly praised by both Ealing Council and the Royal Borough of Kensington and Chelsea.

Conclusion

Cadent's work in providing strong community relations and stakeholder engagement support around the London mains replacement programme has strengthened relationships with local communities and authorities. We have adapted our works plans and programmes to suit stakeholders' needs where possible by taking into account their individual feedback.

By holding additional events, providing extra information, signage and on-the-ground support when requested, where possible Cadent has gone above and beyond the usual requirements of stakeholder engagement from a regular construction project, to create a positive environment around our works.

Cadent

Your Gas Network

Response to Draft Determination

London Medium Pressure

Commercial appendix

1 Background

This document responds to Ofgem's request for robust commercial evidence for the approach and work proposed in London Medium Pressure (LMP) RIIO-2 programme. It is our response to Ofgem's statement "provide evidence of well justified costs, including evidence of market testing and of full consideration of innovative techniques to lower costs"[1].

This section also explains the learning we have gained through delivering RIIO-1 and how this has been applied to develop our RIIO-2 plan. Some of the engineering innovations are covered in more detail in the Technical Document. As a result of this learning, we have a plan that we are certain can be delivered, because we have a solid approach to mitigating the greatest programme-delivery risks.

This section discusses in more detail our commercial approach for RIIO-1 and RIIO-2 and how we are confident that our costs are efficient, and market tested:

1. How we tested the market in RIIO-1 and managed our LMP contracts to manage cost and risk and why we are confident these costs are efficient
2. Specific innovations and learning from RIIO-1; how this has helped reduce delivery costs and drive efficiency and also how these have helped mitigate delivery-risk and provide certainty-of-delivery.
3. How we have used these tendered unit costs and actual out-turn costs to build unit costs for RIIO-2 mains laying and governor upgrades
4. How we have improved our view of risk and contingency.

This document is one of two supporting documents that form part of Cadent's overall submission to Ofgem as part of the response to the Draft Determination.

Cadent's submission is comprised of:

- A **Summary Document**, which summarises the key points within our submission and specifically how we have addressed each of Ofgem's points at Draft Determination. This document also summarises the revised business case for our revised RIIO-2 LMP work plan.
- The **Technical Document** which explains:
    - How we have developed the work-phasing for RIIO-2 based on stakeholder engagement, network outage windows and the priority of increasing sections of the LMP network to 2bar as soon as possible to improve resilience
    - The scope of work and challenges specific to each section or scheme; how we have used innovation in design and construction to mitigate delivery-risk.
    - How we have applied the unit rates discussed in this **Commercial Document**, to develop a revised cost breakdown for the key works and an associated repex and capex forecast for RIIO-2
- This (**Commercial)** document**,** which explains the basis for our unit costs, how these build in innovation and learning during RIIO-1 and how we have market-tested these rates as well as why we believe these are efficient.

All of these three documents provide the evidence necessary to satisfy Ofgem's challenges made in their draft determination. The following table maps these requirements to the structure of our response.

Ofgem requirement (4.10)	Evidence provided	Location of evidence
Well justified needs case	We have provided a summary of the needs-case for the entire LMP programme, and more details on the safety risks for the mains identified for replacement in RIIO-2.	Section 3 of **Summary Document**

[1] Refer to Ofgem's Draft Determination documentation: section 4.10 within the Cadent Annex.

Ofgem requirement (4.10)	Evidence provided	Location of evidence
	We have also provided further information on the needs-case for each section.	Section 5.4 of the **Technical Document** (Governors)
Supporting cost benefit analysis	We have provided an updated CBA at both programme and scheme level and developed a business case summary to highlight the key features of our RIIO-2 LMP plan.	Section 10 and 11 of this **Summary Document**
Comprehensive project plan	We have provided a summary of our proposed phasing of works in our Summary document. We have provided comprehensive detail of our RIIO-2 work plan within our Technical Document, with justification for how our preferred plan was developed.	Section 8 "of the **Summary Document**. Section 2 "Our RIIO-2 plan" Section 3 "Our approach to optimising our RIIO-2 plan" within the **Technical document**
Evidence of agreements in place	We have provided a summary of all the key stakeholders that we have proactively engaged and the agreements in place. We also explain the timescales to securing firm agreements with these stakeholders.	Section 4: Stakeholder engagement in both the **Summary Document** and Section 4 of the **Technical Document**.
Well justified costs	We explain the basis for our RIIO-2 unit rates, and the section demonstrates how these are based on our learning from RIIO-1. We have also included a comprehensive discussion on specific innovative methods used in RIIO-1, how these have enabled us to reduce costs of delivery, and how these methods have been used to inform our scope and costs for RIIO-2. The resulting repex and capex forecast costs and cost profiles are described in detail in Technical Document & summarised in the Summary Document.	**Commercial document**: Section 3 "Our approach to deriving our current costings" Section 5.1 "General scope and methodology": **Technical document** Section 2.1.3 "Ongoing innovation in the planning, design and delivery of our solutions: **Commercial document** Section 9: **Summary document** Section 6 "RIIO-2 Forecast": **Technical Document**
Evidence of market testing	We have explained how our RIIO-1 programme has achieved competition and market testing to drive efficiency; and how we will continue to drive further efficiency through our commercial model in RIIO-2.	**Commercial Document:** Section 2.1 and 2.2.
Full consideration of techniques to lower costs	Aligned with our response to "well justified costs" above, we have provided a comprehensive discussion on specific innovative methods used in RIIO-1 and how these have been applied to inform the preferred solutions and scope / cost of the RIIO-2 plan.	Section 5.1 "General scope and methodology": **Technical document** Section 2.1.3 "Ongoing innovation in the planning, design and delivery of our solutions: **Commercial document**

Table 1: How our LMP submission demonstrates Ofgem's bespoke re-opener requirements

2 Our commercial approach

Basing our RIIO-2 plan on RIIO-1 actual costs derives an efficient and accurate forecast cost. We are also confident that we can achieve further efficiencies in RIIO-2 through evolving our delivery model and continuing to innovate, learn-lessons and maintain our strong working relationships with our stakeholders.

This section discusses our approach to:

- Procurement of a capable supply chain, and our approach to market testing and driving efficiency in our contracts during RIIO-1
- Lessons learnt and how this has driven further improvements in delivery and cost reductions throughout RIIO-1
- How we are evolving our operating model in RIIO-2 to build on RIIO-1 efficiencies

2.1 Delivering efficiently in RIIO-1

Within this section, we explain why our approach to delivery in RIIO-1 has been efficient, and therefore why unit rates derived from RIIO-1 actuals are a robust approach for pricing RIIO-2.

We discuss:

1. Our over-arching commercial arrangement with tRIIO (our selected sub-contract partner) for delivering RIIO-1
2. How tRIIO achieved further market testing and competition with their competent sub-contractors
3. How Cadent and tRIIO jointly drove efficiency through innovation in the planning, design and construction methodologies used. How this innovation and learning has helped reduce delivery-risk during RIIO-1, and how this will improve certainty of delivery in RIIO-2.

2.1.1 Our over-arching commercial arrangement for delivering RIIO-1

Our RIIO-1 commercial approach was underpinned by an exclusive eight-year contract with tRIIO (Skanska/Morrison Utilities joint venture), which enabled us to achieve low unit prices across our overall investment plan. For the LMP scheme, we agreed a Target Price for the entire RIIO-1 plan. The pain/gain mechanism included in this contract provided incentive for our sub-contractors to perform. Any out-performance was shared with our customers through the Totex incentive mechanism (TIM). Cadent retained responsibility as Principal Designer to ensure full control of phasing and stakeholder engagement was retained to drive further efficiency and innovation. This is discussed in more detail below.

At the beginning of RIIO-1, National Grid implemented a new strategy that was designed to optimise the efficient delivery of investment work in RIIO-1. The arrangements put in place were arguably the backbone of the RIIO-1 organisational structure for what are now Cadent's four gas distribution networks.

The strategy was to create the largest possible economies of scale by bundling the vast majority of investment work types, providing contractual exclusivity, and using the eight-year RIIO-1 period to maximise security of demand. The large scale and security of demand was a strong basis on which to outsource significant blocks of work to the most efficient suppliers and to incentivise their performance with target-price contracts.

Our RIIO-1 approach attracted major Tier-1 suppliers and enabled us to maximise competition. The facility for joint ventures (one of which came into existence) widened our access to the market. The tender process led to the creation of a 'West' strategic partnership in the North West and West Midlands GDNs with Balfour Beatty Utility Services and an 'East' strategic partnership with tRIIO (a Skanska-Morrison Utilities joint venture) covering London and East of England.

Due to the knock-on economic impacts from the 2008 financial crisis, construction-market prices reached a particularly low point around the tendering event and low prices were bid by some large organisations in order to shore-up their order books.

The contracts established were mainly target-price contracts. Competitive unit prices were negotiated as the target rates. Based on the unit prices of these competitive targets, a pain/ gain mechanism provided ongoing incentive to the strategic partners to outperform the target price. Customers therefore would benefit from both the competitive target prices and any further reduction below the target prices.

National Grid, and subsequently Cadent, have monitored and overseen the design, planning and execution of works as part of our client responsibilities under the CDM (2015) regulations and as part of the monitoring and management of these large contracts. Due to the complexity and stakeholder sensitivity of the LMPS, this monitoring and support has been extensive. Furthermore, due to the particular subject matter expertise, scheme knowledge and competency of some of our employees we have been best placed to intervene on plans, stakeholder engagement and work execution – over and above tRIIO's staff and their sub-contractors.

In a rare exception to the rest of the contract with tRIIO, Principle Designer (PD) duties (under CDM (2015)) were retained by National Grid/Cadent on the LMPS. While PD duties are primarily related to the effective avoidance of risk through good design, the fact that design work was undertaken by Cadent provided opportunity for us to optimise the design that would then be constructed by tRIIO as Principle Contractor, through its sub-contractors. This is an important and special arrangement that applied to the LMPS uniquely against all other 2-bar and below-mains replacement works in RIIO-1.

During the last two years of RIIO-1, after the exclusivity clauses of the strategic contracts expired, Cadent has explored 'self-delivery' of some LMPS work. This 'innovation' in our approach to delivery of the LMPS has been adopted to further maximise Cadent's core strengths in building strong relationships with stakeholders and the engineering competency and problem-solving capabilities that are demanded by the LMPS. Feedback from stakeholders and the supply chain has been positive, and early signs indicate that the cost efficiency of self-delivery has improved through more effective and more timely decisions of Cadent's engineers.

In summary, National Grid/Cadent entered into strategic framework agreements at the beginning of RIIO-1 with three large management contractors on an exclusive basis. This generated efficiencies through economies of scale across its entire capex programme. The unit rates agreed within this contract were very competitive and formed the basis for the overall Target Prices agreed for delivery of LMP. These competitive rates under-pin our RIIO-2 plan, for the ongoing benefit of customers.

2.1.2 tRIIO's approach to market-testing and efficiency

Throughout RIIO-1, tRIIO has run comprehensive procurement events in order to test and engage competent sub-contractors to deliver the work that Cadent have designed. tRIIO had a target price for the LMP programme in RIIO-1. As Cadent's management contractor, tRIIO were responsible for procuring competent and efficient sub-contractors in order to deliver the programme of works.

This section of the report covers more detail on the procurement, evaluation and selection of suppliers that tRIIO has used in awarding contracts for London Medium Pressure schemes (LMPS) and demonstrates how they have applied robust market testing to achieve good levels of competition and efficiency.

During RIIO-1, to date, we have managed the delivery of circa 24km of large diameter MP mains-replacement in and around Fulham, Chelsea and Albert Embankment, Hyde Park and also delivered 4 governor rebuilds and one governor decommission. We have used the same robust procurement approach across this entire programme.

Following an extensive procurement enquiry and using companies from our approved vendor list (AVL) that have previously been identified as competent, capable and competitive suppliers, approaches were made to the supply chain to establish an expression of interest in bidding for the LMP schemes. This process identified a relatively small pool of suppliers; we discuss how we have increased this list of competent suppliers to drive improved competition below.

Individual procurement events were held for each scheme. These adopted a thorough and detailed Invitation to Tender (ITT) approach designed to provide a fair and transparent bidding process while ensuring that bids received were market tested to demonstrate best value.

A balanced scorecard was adopted, which led to tRIIO and Cadent making a recommendation based on a selection process which considered the following:

- **Technical Assessment** – the majority of suppliers invited to bid for work were already working on the tRIIO project and had demonstrated a thorough understanding of the scope of work offered in the packages of work. Those who were not already working with us on earlier projects have undergone a thorough assessment to establish their competence. Particular attention was given to suppliers who were able to offer innovations which lowered cost, increased safety and reduced programme times.
- **Resource Plan** – work packages have been discussed and agreed based on available competent resource.
- **Commercial** – a thorough analysis of rates was carried out by the Commercial team to ensure that rates were both competitive and sustainable
- **Risk** – Particular consideration was given to reducing the risk of failure by placing an emphasis on checking the availability of competent and capable resource and ensuring that the suppliers were financially stable.

tRIIO awarded the contract using NEC3 Engineering and Construct Contract Option A, a priced contract with an activity schedule where the risk of carrying out the work at the agreed price is largely borne by the sub-contractor. This gave Cadent and tRIIO greater certainty over the out-turn costs, with the main areas of risk being associated with changes in work volumes or due to unforeseen risk. These risks have been consistently mitigated to a high degree through the extensive surveys and associated designs, pre-planning and stakeholder engagement, which has enabled Cadent and tRIIO to produce robust solutions and construction methodologies prior to letting the contracts.

We are therefore confident that Cadent and tRIIO's approach to procurement has driven good levels of efficiency in their contracts through an appropriate level of competition amongst a pool of competent suppliers.

2.1.3 Ongoing Innovation in the planning, design and delivery of our solutions

Throughout the RIIO-1 period, Cadent and tRIIO have worked together to look at ways to optimise their design and construction methodologies to reduce risk and ultimately develop solutions that can be implemented more quickly at a lower cost while delivering safe, maintainable solutions.

These lessons learnt and innovations have reduced delivery cost and timescales. The innovations have been applied in delivering work for RIIO-1 and therefore underpin our view that our RIIO-1 rates and costs are efficient.

Our experience of delivery in RIIO-1 also enables us to define a robust delivery plan for RIIO-2, with work volumes that are deliverable based on known traffic management requirements and constraints from TfL and the various highways authorities across London.

Providing certainty of delivery is about identifying and managing delivery risk effectively. We recognise that the greatest risks to delivering our defined RIIO-2 plan is:

- The changing requirements of our stakeholders driving changes to our construction methodology and timing /cost of work.
- Availability of competent, efficient sub-contractors to deliver the defined work-volumes consistently.
- Encountering unforeseen works whilst we are on site; such as unforeseen pipe fittings, below ground obstructions and other services that drive changes to our construction methodology at short notice, introducing delays and additional cost.

We have worked hard during RIIO-1 to develop robust plans to mitigate these three key programme risks through:

- Proactive and ongoing stakeholder engagement.
- Developing and maintaining a competent supply chain through training and ongoing engagement to ensure we have a larger pool of competent contractors available to deliver the planned works and to achieve appropriate levels of competition during procurement.
- Carrying out extensive and innovative surveys and pre-planning to inform the design and construction methodology in advance of mobilisation, to give greater certainty on our plan.

Key areas of improvement and innovation that have been used to mitigate delivery-risk and achieve efficient delivery, are discussed below.

- **Award-winning stakeholder engagement and communications approach:** We have developed an award-winning approach to stakeholder engagement and communications with all our third-party stakeholders, including all the London Boroughs/Local authorities and Transport for London (TfL). This has enabled us to save delivery costs and time, when negotiating traffic management and associated permits, and to minimise disruption to businesses and the general public. Our approach to stakeholder engagement is discussed in detail in our Technical Overview document. We will continue to engage proactively and look for joint working-opportunities with our stakeholders to reduce costs wherever possible. A recent example of our successful approach was through our proactive engagement with both TfL and various highway authorities, which enabled Cadent to agree one joint temporary traffic regulation order (TTRO), reducing cost and saving time. A report from our sub-consultants **Copper**, has been included in ***Appendix C of our Technical Document***, which covers some of our achievements in RIIO-1.
- **Extensive and detailed investigations, surveys and pre-planning:** We are now carrying out a higher level of investigation, survey works and pre-planning to inform the location, size and depth of our insertion and reception pits. This risk mitigation and pre-planning is helping us to ensure that the pits are as small as possible by choosing the optimum locations with fewest interfaces with existing services and the least disruption to road users and the general public. This also offers greater certainty, avoiding unforeseen changes during construction, which typically give rise to the greatest increases in cost.
  - **Working on live gas-mains with reduced pressure in order to reduce the need for costly outages**: We are continuously looking to maximise the insertion and pipe-replacement lengths that can be completed safely under reduced operating pressures through valve-operations, rather than needing full stopples or bypasses. We have successfully avoided the need for stopples in recent years and are assuming this will be possible in RIIO-2. While safety needs to be carefully managed during pipe-replacement during a pressure reduction, the costs are ten times less than stopples or bypasses.
  - **Mains-testing innovations:** We have developed an innovative acoustic mains-testing technique during RIIO-1, which has enabled us to reduce testing times by 50%. This reduced testing period has been factored into our unit rates.
  - **Sharing resources with TfL:** We have built strong relationships with TfL and have negotiated where possible to use its Variable Message Boards (VMS), instead of needing to hire additional VMSs during construction works.
  - **Reducing the need to remove 'Weco Seals' within the existing iron pipes:** We have an ongoing innovation project, looking at ways that pipes can be inserted without the need to remove Weco seals within the existing pipework. At present, Weco seals need to be removed to prevent irreparable damage to the inserted PE pipe.
- **Expanding the pool of competent sub-contractors to drive increased competition:** In early RIIO-1, through our rigorous supplier pre-qualification exercise, Cadent, supported by tRIIO, shortlisted a small pool of highly competent contractors to undertake the particularly complex mains-laying work within the congested London streets. This drove a good level of competition and efficiency, but we acknowledge that competition was not as extensive as it would have been had the pool of competent contractors been larger. During RIIO-1, we have looked at ways of growing the competency and volume of capable contractors that can undertake this mains-replacement work for Cadent. Cadent has invested in in-house training packages with its suppliers, which has allowed for further competition in tendering future LMP sections of work. Skill retention has been good because Cadent London Network is the only organisation requiring gas distribution work at this scale. These in-house training packages are embedded within our Cadent training and assessment procedures and are endorsed by the Energy Utilities Skills Register.

- **A robust approach to optimising the design and scope of each solution**: section 5.1 in our Technical Document discusses the standard design and construction methodologies used for mains-laying and governor interventions to deliver cost effective solutions.
- **Using 3D virtual mapping technology:** This technology is allowing stakeholders, for the first time, to 'walk the route' in a virtual world and, more importantly, to 'walk in the shoes of the project team' in order to have a better understanding of the challenges associated with projects. This enhances our stakeholder approval process.
- **Innovative pipe jointing techniques:** We are using ground-breaking vacuum-jointing products and techniques to install branch saddles, which reduces time and effort on site.
- **Innovative camera technology for use in live medium-pressure mains**: This technology is being used to enable us to identify the location of old Weco seals, other existing pipe features and pinch points, which will require specific interventions to enable pipe insertion or to enable suitable planning for open-cut methods. This method is fully supported by TfL.
- **New technology for installing pipe tappings on the inserted pipe.** We have trialled and approved the use of bonded saddles for installing tappings on newly inserted PE pipe. This method requires a smaller excavation, only requiring access to the crown of the pipe, in turn reducing excavation size, road-occupation time and the resulting costs.

We have also learnt important lessons about factors outside our control that have driven cost increases during our RIIO-1 delivery. This learning has also enabled us to build a RIIO-2 plan with greater certainty due to understanding deliverable work-volumes better, due to the constraints from the various Local Authorities:

- **Parking-bay suspensions and associated costs:** Early in RIIO-1, we built up our allowances for parking-bay suspension charges, assuming the number of bays that would require suspension and the charge per bay. We found that there was a high degree of variance between the approaches of each Local Authority. Some areas required a significantly higher number of bays to be suspended, maintaining traffic flow rather than using traffic lights. Charges per parking bay were also higher than assumed in some areas.
- **Permissible working space within the road at any one time has been significantly restricted**. Local Authorities have restricted the amount of road space we could access in any single phase, dramatically reducing push lengths (the length of the section being inserted), which directly increased the number of isolation pits required and, therefore, costs. This was not envisioned in early RIIO-1 when initial target costs were estimated. Early in our programme, long sections of insertion were thought to be more time-efficient and cause less disruption to areas. However, this assumption turned out not to be true.

These incorrect working assumptions in early RIIO-1 have led to the perception that the LMP programme has suffered from significant overspend and inefficiency. In fact, many of the cost increases and delays in delivery have come about due to changes in approach driven by the Local Authorities and TfL. Our approach to negating these cost increases and delays has been to look at multiple ways of further reducing road-occupation time as well as continuing robust stakeholder engagement with all these stakeholders. The experience gained from these early setbacks has provided valuable learning for the project and we are now working much more effectively as a result.

This section demonstrates that we are constantly looking for ways to deliver our solutions cost effectively and mitigate our delivery risks and therefore achieve greater certainty in delivering our plan. This information further-supports our view that using actual costs from RIIO-1 is an efficient basis for costing our RIIO-2 LMP programme, and that we have learnt important lessons around how to manage our delivery risks, through innovation and effective stakeholder engagement.

2.2 Delivering efficiently in RIIO-2

2.2.1 How our new commercial model will support efficiency

We have developed an improved operating model for delivery in RIIO-2, to build on the best of the RIIO-1 arrangement and maximise new opportunities. We are confident that we will deliver improved efficiency in RIIO-2, reflected in the strategic repex and capex efficiencies applied to our RIIO-2 estimates.[2]

The strategic partnerships of RIIO-1 did result in low unit prices, particularly during the first half of the period, but they have suffered a variety of problems. In Cadent's view the main problems with the RIIO-1 strategic contracts are:

- The size and complexity of the contract and organisations that it led to were hard to manage, making the theoretically optimal economies of scale hard to obtain in practice.
- Contract exclusivity prevented changes from being made unless the contractor benefitted from them.
- The target-price contracts with pain/gain sharing had the potential to put the contractor in financial stress, leading to defensive behaviours, against customers' interests.
- While constraints were in place to protect regulatory and legislative compliance, the amount of control outsourced to the contractor supported low unit prices in the short term, through commercially focussed work selection. In some cases, this has compromised other performance areas that customers value.

In RIIO-2, Cadent will adopt a significantly different operating model that is intended to take the best of the RIIO-1 arrangements while addressing its shortcomings. Cadent will operate smaller contracts in which much less control is outsourced to a contractor. The intent of these arrangements is to:

- Retain the 'controlling mind' within Cadent to a much greater extent than in RIIO-1 (e.g. over work selection, design and customer processes);
- Maximise market participation from the supply chain by reducing the contract size and scope
- Maximise flexibility (with some risk premium);
- Ensure Cadent, not a contract partner, accesses, engages and controls the supply chain;
- In-source more responsibility and risk by contracting out only the capabilities that the market can provide more efficiently.

The structural options of the investment business operating model are summarised in the figure below.

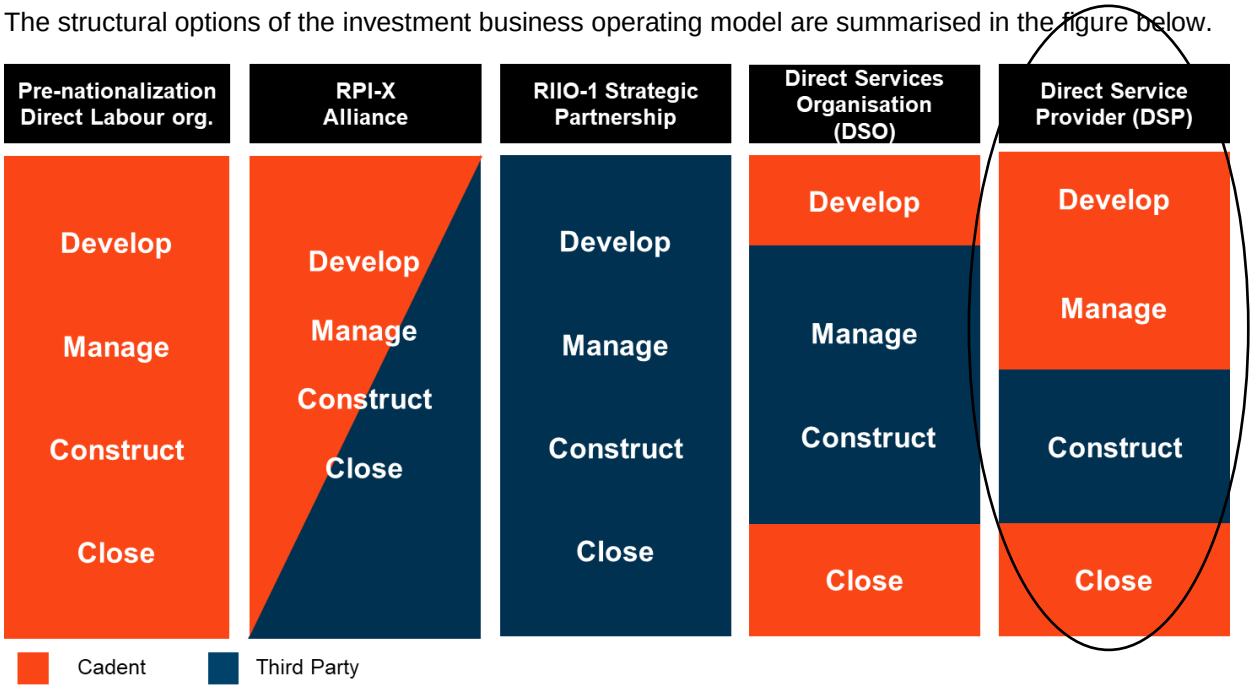

Figure 1: The RIIO-2 commercial options considered by Cadent

[2] These repex and capex efficiencies that have been applied to the base-RIIO-2 estimates are discussed in section 6, of the Technical Document.

This shows that there are just a few ways the in/outsourcing of the key stages of end-to-end investment programmes can be split. Each model has its pros and cons in theory and in practice.

In RIIO-2, Cadent is pursuing in RIIO-2 a Direct Services Organisation (DSO) model, which will be managed individually by each network. In this model, Cadent will operate at no-larger than the scale of one GDN, with a third-party contractor supporting the management of construction through a 'construction management organisation' (CMO). The role of the CMO is to programme the workstack, engage local authorities for access to road space, notice the works, site manage and support delivery, support supplier commercial arrangements and support the customer processes. Construction itself will be delivered through multiple tier-2 contractors ('local delivery partners' – LDPs) who have contracts directly with Cadent.

The Direct Service Provider (DSP) model is effectively the 'self-delivery' model noted in section 2.1, which we have been effectively trialling in later RIIO-1. Early indications are that the customer outcomes and cost-efficiency of this approach are improvements upon the strategic partnership model. During RIIO-2, Cadent has the freedom to explore and refine the approach between the DSP and DSO models on the LMPS because the CMO contract negotiated for London is not exclusive.

Cadent has tendered the CMOs for each of its four GDNs and is in the final stages of making appointments. LDP procurement is ongoing.

The contracts are set out so that following competitive tender and negotiation, CMOs' costs are covered via an agreed fee. This will prevent any excessive financial stress and defensive behaviour. Performance-related incentives can be earned and are attractive, driving strong customer, cost and safety performance.

Through competitive tendering processes of CMOs and LDPs, wide participation and flexibility are provided to ensure competitive tension within the market. In RIIO-2, delivery of LMPS construction activities will be outsourced to LDPs through a similar approach taken in RIIO-1, tendering specific LMPS works packages to as wide a market as possible before contracts are awarded and managed.

This market testing and innovation in approach will deliver the stretching year on year efficiencies which we have applied to our submitted plan.

3 Our approach to deriving our current costings

LMP is a unique project which requires us to work throughout major London streets, replacing very large strategic and old iron gas mains while managing gas supply-demand and managing the impact on businesses, stakeholders and the general public. The work, the working environment and the stakeholder challenges are without an equivalent that we know of. As such, we have not identified any similar/comparable projects that have been delivered in recent years against which we can benchmark ourselves. This project is unique.

To date, during RIIO-1, we have taken a rigorous approach to deliver the LMPS efficiently, as discussed in section 2 of this document.

The evidence and justification in this document explains why our RIIO-1 approach has been efficient with a robust level of market testing and the use of continuous innovation in planning, design and construction to reduce costs wherever possible. For this reason, we have used out-turn actual costs from delivering the early phases of RIIO-1 LMP or applied the agreed rates from our current LMP contracts, to inform our RIIO-2 estimates for the continuation of this project. As discussed later, we have then applied additional efficiencies to these repex and capex base-costs to derive a suitable RIIO-2 forecast.

This approach has enabled us to derive a range of granular unit rates, based on RIIO-1 experience. We acknowledge that the market for delivering this work is relatively small and therefore the level of competitive tension is lower. To reduce this issue, we have invested in training for the supply chain to sustain and broaden it where reasonably practicable.

The following sections summarise how we have approached the costing of our RIIO-2 plans, their basis, any key assumptions made, and how these rates have been aligned with Ofgem's requested cost breakdown structure:

The costs for our revised proposal are comprised of the following main cost-elements:

- Direct mains-laying activity
- Support costs for mains-laying (including mobilisation and traffic management)
- Governor interventions (rebuilds/decommissions) including design, construction and commissioning
- Enabling works, surveys and designs for the RIIO-3 work plan (carried out in RIIO-2)
- Risk and contingency allowances informed by a quantitative risk assessment

We have then applied these unit costs to the proposed scope of work for each phase of work in RIIO-2 to derive a robust estimate. Further detail on the scope of work per section and the resulting cost breakdown and cost profiles are discussed in the **Technical Overview document**.

3.1 Direct Mains-laying activities

This section looks at the works directly associated with either open-cut mains laying or insertion-mains laying activities.

All rates have been taken from current sub-contract rates for completed and ongoing RIIO-1 works.

Work-element	Basis of costs/Assumptions	Rate[3]	Unit	Alignment with Ofgem cost breakdown
Valve Operation/Pressure Reduction Activity	A lump-sum cost to operate a valve to achieve the required safe working pressure within the gas network, to facilitate insertion works. This activity reduces the need for stopples, which are considerably more expensive. This pressure-reduction activity is engineering best practice from an efficiency and safety perspective. The procedure is undertaken on valves some distance from where the phase of the works is planned to commence. It therefore requires separate mobilisation/site set-up etc., which explains circa 1 weeks allowance.	£k	Item	Mains Work Contractor
Stopples	A priced activity by pipe-size per stopple required. 36" to 48" rate quoted.	£	Lump sum	Mains Work Contractor
Bagstops	A lump-sum rate by pipe-size per two-way bagstop required. 36" to 48" rate quoted.	£	Item	Mains Work Contractor
Valve Operation	A lump-sum rate by pipe size, to isolate mains using an existing or recently installed valve, inclusive of inserting a safety bag to ensure isolation seal. This differs from valve works at 'pressure-reduction' as the excavation will be used for the replacement activities. This also allows for a gas-free operation in line with Safe Controls of Operation SCO 36" to 48" rate quoted.	£	Item	Mains Work Contractor

[3] Unit rates are 19/20 Price base.

Work-element	Basis of costs/Assumptions	Rate[3]	Unit	Alignment with Ofgem cost breakdown
Insertion Pits	A lump-sum rate for a typical size insertion pipe (varies by pipe size) based on typical road/footway mix and average depth of main. All RIIO-1 insertion pits have been in the carriageway, with very few exceptions, requiring breaking out of reinforced roads and reinstating to HAUC specification. The size of the PE replacement pipe and, therefore, its wall thickness will influence the size of an insertion pit. The thicker PE pipe wall (and relative reduction in flexibility), will require a longer launch pit to allow for it to be fed through the existing cast iron main. We minimise/optimise the size of our Insertion & Reception pits through careful pre-survey and planning (understanding location of other utilities and ground conditions) so that the optimum size of pit is planned (excavation design, traffic management etc). We look to minimise any unforeseen changes due to their significant impact on efficiency and duration due to third-party interfaces.	£	Per pit	Mains Work Contractor
Reception Pits	A lump-sum rate for a typical size reception pipe (varies by pipe size) based on typical road/footway mix and average depth of main. RIIO-1 reception pits have nearly always been in the carriageway with high costs for carriageway breaking-out and reinstatement. Size of pit will depend on main size and the need for enough space to accommodate fittings to re-connect all replacement PE mains together.	£	Per pit	Mains Work Contractor
Insertion Activity (pipe replacement)	Materials have been excluded from this rate, and are averages based on actual out-turn costs for the most recent RIIO-1 contracts.	£	Per m of pipe inserted	Mains Work Contractor
Open Cut pipe replacement	This assumes that we are installing a PE main (not steel). The rate includes for the excavation, muck-away, installation, backfill and reinstatement for each metre. Again, due to the type of works and central-London location, this is assumed to be in the carriageway, based on our RIIO-1 experience. Our RIIO-2 work is also within carriageways, evidenced by our Engineering Drawings in Appendix A of the Technical Document. Pipework and fitting material costs are excluded.	£	Per m of pipe inserted	Mains Work Contractor

Table 2: LMP Average Unit Costs used for RIIO-2 estimating

3.2 Mains-laying Support Cost Activities

The unit costs for the support activities have been derived using two main approaches:

- Using actual sub-contract rates from LMP RIIO-1 work
- Using actual out-turn costs for key activities to derive an average cost per meter of main replaced. Again, these are based on current LMP RIIO-1 ongoing works at Fulham MP and Bow Common Lane. The projects are the most recent and most relevant projects that factor in much of the innovation and learning from early RIIO-1, therefore reflect efficient unit rates for use in RIIO-2.

Work-element	Basis of costs/Assumptions	Rate	Unit	Alignment with Ofgem cost breakdown
Mobilisation	This includes site set-up, plant delivery, cabin offices, Heras fencing, surrounding pedestrian barriers. Assumes 1 week for set up.	£	Lump sum	Main Works Contractor
Traffic management	This includes alteration to signalling, modelling the impact on traffic, submitting Traffic Management (TM) plans and permits and negotiating, TM set up, monitoring, maintenance, labour for manual control of traffic. New technology in mobile traffic signals allow real-time interfaces with TfL's central control centre, which enables it to manage changes in traffic demands and to form a wider strategic communications plan, reducing costs associated with manned operations.	£	Cost /m of mains replacement	Specialist Services
CAD/GPR/surveys	The results of trial holes and initial investigations (ground penetrating radar) will be updated into survey plans, to enable design, programming, access negotiation with councils, material procurement and construction. Based on sub-contractor rate for 1km (typical length of each section) Enabling works provide real benefits in our ability to build a robust programme with deliverable milestones that then forms the basis for our customer/stakeholder plans that are shared with the local community for challenge and review. Our separate Stakeholder Document provides further detail.	£	Lump sum per LMP section	Engineering Design
Trial Holes & Camera Surveys	An allowance of 1 week of work-gang time to plan and carry out appropriate trial holes, for every 500m of pipe replaced, in advance of works. Trial holes and camera surveys give valuable information for precisely where to excavate from a safety and efficiency perspective but also to support the customer and business impacts and subsequent communications strategy.	£	Per 500m of mains replacement	Specialist Services
Material costs (Pipes & fittings)	This is a per metre cost, to cover the supply of all required materials (pipe & associated fittings)	£	Cost/m of mains replacement	Materials

Work-element	Basis of costs/Assumptions	Rate	Unit	Alignment with Ofgem cost breakdown
Traffic Orders	RIIO-1 experience has shown that an average of £10k per 500m is needed to manage required traffic orders. This figure is dependent on the route of a main, durations and how many streets it intersects. Prices also vary by Local Authority. As an example, we are planning to undertake 150m of mains replacement at Monck St. at a forecast cost of £2,457 (17-07-2020). Excludes traffic orders for parking bays; charged per bay per day. Where the project footprint covers multiple Highway Authorities and TfL, we have used thorough collaborative working to agree that all amendments can be covered in one joint temporary traffic regulation order (TTRO), which has reduced cost and saved time.		Per 500m of mains replacement	Project Management
Network Testing & Valve Remediation	This is an enabling activity prior to project commencement, to ensure all valves are functioning effectively. It is based on RIIO-1 duration per 500m of 1 to 2 weeks and allows for some excavations at valves for required inspection. We also need to prove the Network with a load test which can be done via this operation and forms part of the safety Contingency Planning. It is an essential part of demonstrating that the main can be shut down safely, in the event of an emergency, while maintaining supply.		Per 500m of mains replacement	Mains Works Contractor
Sandblast & repainting of valves	Based on RIIO-1 experience, we have assumed that there will be valves every 200m, and that every valve that is uncovered will receive basic sandblasting and repainting, as a proactive exercise. More major valve remediation is excluded from costings.		Cost per valve for basic remediation.	Mains Works Contractor
Mains Testing (excluding steel)	All-inclusive rate to test and commission newly replaced gas-main (includes for PE pipework with known small sections of steel). Based on average test durations which have significantly reduced through innovation and new technology during RIIO-1.		Per 500m section	Mains Works Contractor
Installation of CP test posts within Footways	Lump-sum rate to install new CP test posts in the footway. By installing 'in footway', we avoid potential H&S risks. We assume that a CP test post is required every 200m, with associated valves.		Cost per new test post	Specialist Services
Installation of CP schemes	Includes for installing appropriate sacrificial anode protection at every valve location. Valves are typically installed every 200m of gas main.		Unit rate per 200m of mains replacement	Specialist Services
Management of Parking Bay or Bus-stop suspension	Based on Fulham MP contract and is a general additional allowance per meter of pipe replaced, to manage parking bays and bus-stops. Used cost is incurred to that period. Our RIIO-1 costs have		per m of mains replacement	Project management

Work-element	Basis of costs/Assumptions	Rate	Unit	Alignment with Ofgem cost breakdown
	increased for this activity, specifically due to increased charges imposed by Westminster and Royal Borough of Kensington & Chelsea on works throughout their Boroughs. This has been challenged through their Cllr Leaders forums with varying levels of success. This is an area of cost risk.			
Lane Rental costs	Weekly charges are set by TFL. "Schedule of Lane Rental Charges" (www.tfl.gov.uk) Our RIIO-2 costs consider sections of mains-renewal where lane rental charges are likely.		Per week	Project management
Pit Increases/Additional Excavations/ Weco Seals	Sub-contractor price per insertion pit. Allowance as scope to cover unforeseen additional pit requirements. Could be due to unidentified bends or requirements for a safer access points to remove Weco seals		Per insertion pit	Mains Works contractor
Weco Seals	Cost per meter of pipe replaced; based on Fulham MP project. Allowance for the entry and physical removal of Weco seals within the existing cast iron main pipes. Weco seals must be removed prior to pipe insertion as integrity tests have proven they will damage the new PE pipe to the point of failure.		Cost/meter of mains replacement	Materials
Archaeological Support (per meter)	Cost per meter of pipe replaced, based on Kings Road Fulham and London Wall City of London MP projects		per m of mains replacement	Specialist Services
Sunday/Night Out of Hours (additional costs per meter)	All RIIO-1 works have included some requirement for OOH works, to overcome disruption to the local areas. There may also be a permit requirement from a Local Authority to allow access to their road space. We use night/off peak deliveries for the larger materials and pipes to reduce our impact on congestion.		per m of mains replacement	Mains Works Contractors
Utility Diversions (average on-cost per meter of pipe laid)	Estimated rate per meter. We have applied an efficiency to our RIIO-2 rate, because of innovations expected using improved camera technology and improved pre-planning.		per m of mains replacement	Specialist Services
Specialist road reinstatement (colour resurfacing)	Sub-contractor quote.		Provisional sum per instance	Specialist Services
Use of Tower Lights, for night working	Hire-costs to provide tower lights: assumes that 4 tower lights are needed for the duration of the mains-laying activity per section. Duration based on 50m of mains-laying per week.		Per tower per week	Main works Contractors

Work-element	Basis of costs/Assumptions	Rate	Unit	Alignment with Ofgem cost breakdown
Additional VMS requirements from LA	This activity refers to the provision of Electronic Variable Message Boards (VMS) on each section of the LMP project. We have assumed that 8 boards are required per section. The length of time the VMS boards are required is based on delivering 50m per week. Price provided by our TM supplier We have reduced the overall requirement of VMS boards due to collaboration with TfL to use their fixed messaging boards situated on the strategic road networks with real time updates.		Per VMS per week	Project management
Street Furniture Removal and replacement	Based on an estimate to remove all road furniture in a 500m length. Included but not limited to powered traffic separators, display planter beds, benches, trees, traffic islands. Includes reinstatement post-completion. Our experience during RIIO-1 has shown that, because the gas mains are over 100 years old, road configuration has changed significantly, resulting is additional street furniture placed above the pipes.		Provisional sum per 500m of mains replaced	Main Works Contractor
Demobilisation	Costs based on 2 weeks to dismantle compound, including waste collection, road sweepers.		Per item	Main Works Contractor
Prelims	An average contract rates from LMP project, Fulham MP. The costs included in prelims cover LMPS-specific staff members exclusively used on LMPS, LMPS Office, associated running costs of water, electricity, heating, printer, paper, ink, PPE, mobiles etc. There is also project located cabins, 4/5G services to increase productivity, water supplied, fuel for generators etc.		Cost per m	Project management
Contingency	A small contingency has been included based on the risk that additional insertion and reception pits might be required 1 in every 800m of mains-replacement.	See insertion & reception pits above	See above	Contingency

Table 3: Mains-laying support-cost unit rates used for RIIO-2.

Exclusions from the above unit costs:

- Any valve remediation needed (other than sandblasting and repainting) is not included in the above project costs. The ability to safely isolate using existing valves, without extensive valve remediation is a project risk, which could result in a considerably higher volume of stopples or bypasses than currently estimated.
- Loss of income for local businesses, national business and trade are excluded; any potential compensation costs are deemed to be covered by the Cadent direct costs, included separately.
- Risks and contingency for variations in work-scope. We have undertaken a quantitative risk assessment, to inform a reasonable risk and contingency figure to include across the programme; this is discussed in section 3.5 of this document.

3.3 Governor interventions

Since our Final Business Plan submission in December 2019, we have continued to develop our RIIO-1 governor engineering, planning, stakeholder engagement and commercial pricing.

We now have a more detailed work-plan and tendered-work packages that have been through rigorous challenge and review cycles, while also identifying pre-enabling and collaborative opportunities between the governor and LMP associated works.

As discussed in the **Technical Overview Document**, our RIIO-2 work plan is now comprised of three governor rebuilds and one governor requiring decommissioning. This Technical Document provides more detail around these existing governors and the required scope of work and difficulties and challenges associated with the RIIO-2 interventions. It also discusses how we have developed the preferred engineering solution.

In comparison, this section provides the basis for deriving the capex costs for delivery of the RIIO-2 governor interventions, based on learning from RIIO-1 governor works.

We have provided a summary of the proposed RIIO-2 works below for the purposes of comparing scope with the existing RIIO-1 governors, to inform our costing approach.

	Belgrave Square	Monck Street	Central Street	Horseferry Road
Location	SW1X 8PZ	SW1P 2EQ	EC1V 8AA	SW1P 2EQ
Intervention	Rebuild	Rebuild	Rebuild	Decommission
Capacity	45 kscmh	50 kscmh	50 kscmh	n/a
Year of construction	Summer 2021	Summer 2023	Summer 2023	Summer 2023
Scope of work	Replace existing obsolete under-capacity governors, with a 3 stream new package governor plant (Orpheus) which can operate at the increased pressure of 2mbar, within the existing buried chamber.			Remove and cap-off existing gas pipework, remove existing equipment; demolish below-ground chamber walls, backfill void, reinstate surfacing.

Table 4: Proposed governor work-plan

The three governor upgrades proposed in RIIO-2 are largely comparable to projects that have been delivered in RIIO-1 against which we can benchmark ourselves. Further detail is summarised below. We have applied lessons learnt from delivering these projects in order to improve, innovate and become more efficient. Our **Technical Document** explains how our preferred solution has been developed to minimise cost and disruption to stakeholders while maximising operability and safety.

The three comparable RIIO-1 governor rebuilds which have been used to inform our RIIO-2 pricing are summarised below.

Governor Name	Brompton Oratory	Blantyre Road	Vauxhall Bridge
Project Stage	Fully commissioned	Fully commissioned	In-construction current Target Price)
Year of Construction/commissioning	2019/20	2019/20	2020/21
Capacity/Size	17 kscmh (kilo standard cubic meters per hour)	36 kscmh	25 kscmh

Governor Name	Brompton Oratory	Blantyre Road	Vauxhall Bridge
Summary scope of works	Remove existing equipment within governor pit, install 2 new Orpheus package governors within existing chamber, with new pressure management and control equipment and control cabinet. Ground Penetrating Radar surveys, property surveys, hazardous areas design, temporary works design, decommissioning & commissioning, design of deep excavation, stakeholder engagement, supply & installation of a new governor package & control system, new structural base, install new vent stack and protective bollards at ground-level.		
Specific difficulties & challenges	Deep Excavations Complex traffic management/lane-rental/permits	Closure of Park and sports-area, reinstatement of playground. Hot-tapping required for new connections. Deep Excavations	Deep Excavations Complex traffic management/lane-rental/permits

Table 5: RIIO-1 Governor interventions.

We have used the detailed out-turn cost, cost breakdowns for these three governors and then adjusted each work element as necessary to account for the different challenges and scope identified for the four RIIO-2 governor interventions. These cost breakdown's also included risk & contingency spend. An average contingency allowance per RIIO-2 governor has been derived from this. Excavation and backfill volumes, time-on-site, traffic management, materials and other specialist services including hot-tapping or deep-excavation have all been adjusted as necessary. Our design fees are based on an actual quotation received for Monck St RIIO-2 governor. The resulting cost breakdowns for the RIIO-2 governors, based on this approach are included in **Section 6.1.2 of the Technical Document**.

3.4 Early design work to inform RIIO-3 work plan

As mentioned previously, we have chosen to deliver some of the more complex works in subways and tunnels in RIIO-3, to enable us to develop bespoke solutions and look for further innovation to reduce our delivery costs where possible.

Through RIIO-1, we have improved our delivery efficiency through a high level of stakeholder engagement and collaborative planning, to coordinate works-programmes in the busy London streets and negotiate appropriate solutions. We intend to continue the high level of focussed, ground-penetrating radar surveys and stakeholder engagement in RIIO-2 in order to inform our work plan for the future.

To enable this, we have specifically included additional capex in Years 4 and 5 to carry out key enabling tasks for our RIIO-3 work-plan; this funding will enable us to develop a robust and efficient delivery plan for RIIO-3.

We have used the average costs of surveys on three recent LMP sections delivered in RIIO-1, to estimate an average cost of £ for these enabling tasks per meter of mains to be replaced. These enabling activities are comprised of ground-penetrating radar, Building Information Management (BIM) / CAD drawings and stakeholder engagement.

3.5 Our approach to estimating risk and contingency

Since December, we have undertaken a detailed quantitative risk assessment for the largest and first phase of mains-laying planned for RIIO-2 (Scheme 1: Belgrave Square to Monck Street).

We have included our completed risk register in an Appendix to this document.

Our Quantitative Risk Assessments have given us a P80 figure of £k, which has enabled us to confirm that a risk allowance of 4% is appropriate as an allowance for Scheme 1. We propose to apply this to all RIIO-2 mains-laying activities since the risks and challenges are similar on all sections.

Appendix: Risk Register for Scheme 1: Belgrave Square to Monck Street

ID	Project Stage	Risk Title	Risk Description	Cause	Impact/Effect	Action Description
1	Construction	**Ground Contamination**	Contamination (oils, asbestos, etc.) may be encountered during excavations	Ground conditions found on site differ from that assumed in Scheme Cost Estimates	1. Increased cost of disposal costs 2. Potential programme delay of specialists involvement	1. Undertake GI in high risk areas, such as Bromley By Bow Tunnel as works are undertaken near a Holder Site. 2. Continually monitor excavated arisings and provide early warning of any potentially contaminated material.
2	Construction	**Unknown utilities**	Full extent of utilities on sites unknown at design stage	Damage to third party assets during the main works construction	1. Potential programme delay 2. Increased cost of diversions. Programme delay to allow for the protection/diversion.	1. Undertake site investigations to identify any underground services 2. Contact third parties such as Thames Water, UK Power Network, etc. for drawings.
3	Construction	**Archaeological findings**	Archaeological remains are discovered during excavation works	Proximity to unknown buried assets (archaeological or heritage)	1. Additional cost for specialists 2. Delays to the programme while the finds are examined/removed	Have a contingency plan - commission surveys (not intrusive) Arrange land access, watch & brief.

ID	Project Stage	Risk Title	Risk Description	Cause	Impact/Effect	Action Description
4	Consents	**Stakeholders Approvals**	A stakeholder/stakeholders might not approve proposed construction approach within programme timescales which include: TTRO, Permits, third party structures and utilities, water discharge plan, traffic management, etc.	1. Late submission of documentation for approval 2. Third parties take longer issuing permit approvals 3. Increased external constraints - To carry out this work we depend on the acceptance of multiple stakeholders. There is a risk that obtaining consents proves to be more difficult than expected slowing work output. 4. Strategic works with permits depend on security levels in London.	1. Delays to construction start dates 2. Failure to meet programme delivery and cost profiles on London based projects. 3. Changes to programme with additional demobilisation/remobilisation.	Ensure early engagement with local planning authority (LPA) to determine the requirements for planning permission (if any).
5	Management	**Resources**	Project delivery may be affected by resources	1. Staff competency is not up to standard 2. Brexit influence 3. Labour availability i.e. busy construction period in London. Availability of skilled labour and local cost increases in London weighted zones, including competition for skilled workforce.	Higher cost for premium prices associated with skilled labour.	1. Ensure contractor competency meet criteria to deliver the work 2. Develop staff competency matrix to ensure that the right personnel are working on site 3. Appropriate resource plan and terms of conditions for employment
6	Construction	**Construction Durations**	Durations for construction activities are greater than expected.	Estimating uncertainty associated with the programme of works	Increased cost of pre-commencement conditions	Ensure robust programme management and stakeholder engagement is undertaken to confirm duration of works.

ID	Project Stage	Risk Title	Risk Description	Cause	Impact/Effect	Action Description
7	Construction	**Traffic management**	Risk that the movement of plant and equipment might be hindered due to the size of the site locations	Constraint space on site (works takes place on busy streets/junctions)	1. Decreased lorry movements impact on construction activities 2. Reputational damage, complaints from local residents 3. Night working and deliveries out of hours	1. Compound layout plan for each site 2. Monitor traffic management plan and make amendments if necessary during construction 3. Provision for traffic marshals on site if required 4. Supply chain engagement for deliveries in compliance with section 61
8	Construction	**Working Hours**	Out-of-hours working pattern including weekend working is required in order to achieve programme or working constraints on site. Governed by permit system. 10:00-12:00 and 14:00-16:00 no works allowed. Restrictions to working areas.	Permit conditions requires weekend working	1. May incur additional costs and re-sequencing of works. 2. Additional labour for restricted working hours during the day.	Liaise with Local Authorities and EA to assess requirements for out of hours working (e.g. London events, noise impact).
9	Management	**Commercial Governance Approvals**	Contract and price negotiation between Cadent and CMO, Contractors and supply chain is more onerous than anticipated	Governance takes longer than anticipated	Programme slippage impacting start day on site	1. Client to specify requirements in terms of cost breakdown in advance 2. MWC to provide budget early for client's consideration 3. Arrange a meeting for price review with Cadent, CMO and LDP
10	Construction	**Ground Water**	There is a risk that site ground conditions require de-watering activities for excavation works.	High water table/rising water levels	Additional time and cost required	GI undertaken to better understand Ground Conditions prior to construction and finalisation of Detailed Design

ID	Project Stage	Risk Title	Risk Description	Cause	Impact/Effect	Action Description
11	Design	**Design Changes**	The preliminary design put forward is subject to alteration leading to redesign and delay to construction programme	Cost estimate based on limited available site information and may be subject to changes following site surveys and development of Detailed Design.	Delays and additional cost to the Project	Regular design reviews with relevant stakeholders, in order to ensure that aspects of the designs are understood and there's 'no surprises' at later stages of the project life cycle
12	Design	**Material Quantities/Long Lead Items**	Increase in material quantities for civil and mechanical works (including firming up of prices); e.g. larger foundations, additional pipe trench/duct routing etc. (not including governors)	The quantities of pipe and fittings required after detailed design are more than originally planned in size, quantity and price	Delays and additional cost to the Project	Ensure that there is an effective procurement strategy in place throughout the entire programme/project lifecycle.
13	Procurement	**Supplier Risks**	Supplier of items not classified as long lead may have design and manufacture issues leading to delays and additional cost	Potential risks with continuation of Covid restrictions should they continue. Delays have been encountered in GD1.	Delays and additional cost to the Project	Ensure that there is an effective procurement strategy in place throughout the entire programme/project lifecycle.
14	Construction	**Existing Valves**	Existing valves that are part of the capacity increase work may not provide suitable isolations	Mechanical failure of valves due to age and condition.	Delays and additional cost to the Project	Implement a valve remediation plan

ID	Project Stage	Risk Title	Risk Description	Cause	Impact/Effect	Action Description
15	Construction	**Site Security**	Unexpected security breaches	Interest by communities	1. Delays and additional costs of equipment/repair 2. Potential reputational damage if shown in the media	1. Contractor to ensure adequate security measures on site to avoid any trespassing, 24 hrs security, CCTV
16	Design	**Cathodic Protection**	Replacement/repair of the existing CP system resulting in additional cost.	The existing cathodic protection system on steel mains may not be in working order and be unable to protect the new work required as part of the mains replacement works.	Delays and additional cost to the Project	Regular testing of the electrode potential
17	Construction	**Access/Protection**	Access to below ground plant and equipment	Access to Cadent's below-ground plant and equipment may require significant additional protection works to buried services/structures. Gap in records during WW2 (e.g. tunnels).	If mains above underground tunnels or encased in tunnel structure, significant additional costs could be incurred	1. Thorough search of archive records 2. Trial holes 3. Ground radar surveys
18	Commissioning	**Availability of network outage**	Availability of network outage	Constraints/third party interferences on the network	Contractor stand down time, programme delay	1. Continual liaison with Cadent Network Control centre to undertake programme reviews and ensure network analysis is being undertaken. 2. The diversion has already been split up into three phases of work to give greater certainty on outages and minimise disruption to the network.

ID	Project Stage	Risk Title	Risk Description	Cause	Impact/Effect	Action Description
19	Construction	**New technologies**	New/novel technologies and processes	Escalating costs due to the complex engineering for technical solutions for replacing mains	Increased outage time, delays to programme	Have a contingency plan in place whereby other trusted/well-known technologies are used in new technologies are not up to required standard
20	Scope & Brief	**Changes in scope of work/variations**	Increased scope as project progresses through the construction phase	Changes in scope of work through variations/potential contractor claims	Compensation Events - cost and programme implications (potential adjustment of the completion date or key dates)	1. Confirm the project scope and execution plan with the stakeholders and sponsors before the start of the project. 2. Ensure the schedule and resource plan is centred on how to complete the defined deliverables. 3. Objectively evaluate scope, schedule impact, and resource requirements before any new activities are included within the schedule
21	Detailed Design	**Programme Delay - Development Phase (Planning & Design)**	Development/Design Phase programme delay cost risk	Combination of causes of risks impacting on the project schedule during development phase	Increased Cadent running costs	As the entry is not a risk, no mitigation plan is required.
22	Construction	**Programme Delay - Construction Phase**	Construction Phase programme delay cost risk	Combination of causes of risks impacting on the project schedule during construction phase	Increased MWC running costs and claims from contractor for extension of time	As the entry is not a risk, no mitigation plan is required.
23	Construction	**Ground Obstructions - Open Cut**	Obstructions are encountered during the construction phase in the open cut sections	Unknown ground conditions	Cost and programme delay associated with removal of obstruction or small diversion around large obstruction.	1. GI undertaken to better understand Ground Conditions prior to construction and finalisation of Detailed Design. 2. Undertake scans prior to excavating and provide early warning of any buried obstructions encountered

ID	Project Stage	Risk Title	Risk Description	Cause	Impact/Effect	Action Description
24	Construction	**Ground Obstructions - Insertion**	Obstructions are encountered during the construction phase in the Insertion sections	Unknown ground conditions	Insertion of new pipe prevented by ground obstructions requiring open cut to remove. Potential for further traffic management. Consequential reputational impact on Cadent.	1. GI undertaken to better understand Ground Conditions prior to construction and finalisation of Detailed Design. 2. Undertake scans prior to excavating and provide early warning of any buried obstructions encountered
25	Construction	**UXO**	Unexploded Ordnance	Unexploded ordnance is identified on site during construction works.	Cost and programme implications associated with expert clearance. Stand down time and delays to diversion programme.	Contractor to undertake a GPR and UXO survey
26	Construction	**Market Forces**	Estimating uncertainty (rates and quants)	Changing market appetite from suppliers to diversion schemes	Cost is different from current budget estimates.	Approach contractor/other project consultants to gain a better understanding of the current market conditions
27	Construction	**Industrial Action**	Industrial Action	Industrial Action (contractors or internal staff)	Delay to construction programme. Cost of premium prices for alternative resources.	Ensure affect contingency planning and measures are drawn up prior to the project starting, to ensure delivery of the project is not affected
28	Construction	**COVID-19**	Further restrictions associated with COVID-19	Local lockdown and/or ‘second wave' of Coronavirus results in restrictions on people movements and material deliveries.	Prolongation of construction works to meet government guidelines. Potentially significant delays if works are temporarily stopped as a result.	1. Programmes to ensure social distancing guidelines are adhered to. 2. Contingency plans to be put into place should sites need to be temporarily closed.

ID	Project Stage	Risk Title	Risk Description	Cause	Impact/Effect	Action Description
29	Construction	**Adverse Weather**	Weather - winter working	Adverse weather may cause delays to construction or GI progress. This risk is enhanced when working over winter months.	Programme delays, delays to construction phase etc.	Controlled forecasting and maintenance of flexibility to react to unforeseen events. Detailed design solutions to minimise outages and reduce exposure.
30	Construction	**Land Access - Road Possessions**	Late award of local authority road possessions	Road space in London is at a premium. Where we are required to open cut sections of pipe (approx. 100m for Belgrave to Monck Street section), finding a route can be challenging.	Delay to construction programme. Cost of programme acceleration.	This risk has already been mitigated significantly by constructing the vast majority of new pipeline using the insertion method. A small proportion of open cut is required at bends and change in vertical alignment.
31	Construction	**Legislative Change**	There is a risk that legislative change will impact the delivery of our work.	New legislation (e.g. New Roads and Street Works Act) is changed or enacted during project delivery.	Potential increase in the amount of consultation and information exchange required and require us to align our plans with the safety management processes operated by 3rd-party landowner/asset owners. The potential impact is more engagement and slower delivery.	We have established management teams to address these issues. We have also identified UMs for key areas.
32	Construction	**Obsolescent Equipment Components**	RIIO-2 equipment components	Unexpected/uncommunicated obsolescence during RIIO-2 period of equipment components	Inability to maintain equipment at full capacity with risk of impact upon supply.	Maintain a close relationship with equipment supply chain and manage a proactive early warning system where spares/replacements become at risk.

Cadent Q5: Do you agree with our proposals on bespoke UMs? If not, please specify.

This section responds to the total capex investment stated in Table 23 of Cadent's Annex relating to NTS and PRS Capacity upgrades.

Summary of response

Ofgem's current proposal, for our Capacity Upgrades at both NTS and PRS sites applies a 28% reduction to the funds included in the BPDTs. We do not agree with the scale of reduction in costs which Ofgem have proposed, it will not provide the necessary funding to deliver this work.

1. There are mathematical errors in the BPDTs table which Ofgem are already aware of and need to be corrected (Ref Cadent SQ_CA_23) to remove costs from the NL network and to incorporate additional funding in the EoE.
2. We accept Ofgem's challenge on removing the "10% uncertainty" & "risks associated with delivery of the solution" from the cost breakdown included within the study outputs, this was a double count.
3. We note Ofgem's challenge on our Cadent direct costs, our latest view is that these are in the range of 13%-16%. As such our December position (16%) for these complex projects remains appropriate.
4. Our latest work at Dawley shows a 65% cost increase above what was submitted in December 2019; significant complexities have been identified following further survey, design work and stakeholder engagement. Risks such as these are evident across this work area and lead us to use of a higher contingency cost in our December submission.
5. We have progressed with further design work and risk assessments and have improved our quantification of risks; we now estimate that the level of contingency risk is in a range between 30% to 35%. Our experience with Dawley demonstrates that our scope is lean and that an allowance in this range is reasonable.

Points 1 and 2 are mathematical corrections to the December plan. Points 3 and 5 show that our December plan is still within the forecast outcome range based on the latest information we have. With these adjustments a reduction in costs compared to our December position can be achieved, as set out in the table below. The scale of reduction proposed by Ofgem in DD would not fund maintaining resilience to comply with our Licence obligations for 1 in 20 supply resilience.

Capacity Upgrades	December Plan as per BPDT	March 20 Plan as per SQ[1]	Ofgem Proposal in Draft Determination	Outturn range forecast[2]
EoE NTS				
EoE PRS				
NW PRS				
NL PRS				
WM PRS				

Table 1: Revised Proposal for Capacity Upgrades as part of Draft Determination

1 Unrealistic reduction in costs

We have reviewed your proposal for a 28% reduction and have concluded that this would excessively reduce our risk and contingency allowance given the risks associated with these projects. This hazard is evidenced by our further work on Dawley PRS and our specific quantitative risk assessments (QRA) undertaken on three other sites in our north-west region (see details below). The cost reduction

[1] Adjusting for the mathematical error discussed in this document for EoE and NL, as set out in SQ_CA_23 (20 Mar '20). Point 1 above.
[2] Based on 13-16% direct cost and 30-35% contingency

proposed by Ofgem is unrealistic and would lead to inadequate cost recovery for delivery of a licence obligation.

2 Mathematical correction

As picked up during the SQ process, SQ-CA-23 (20 March 2020) identified that there were two misalignments in the submitted BPDTs, which resulted in:

- omitting design costs in the EOE PRS Capacity (understating the funding required by £m)
- including costs for North London in error, when we were not proposing to deliver any sites in this network within our base-case.

Our base-estimate prior to any adjustment from Ofgem should have been **£**for EOE PRS Capacity Upgrades and **£nil** for North London PRS upgrades.

We raised these issues through the SQ process and they should be adjusted for at FD.

3 Ofgem's challenge: Removal of "10% uncertainty" and "Risk associated with delivering solution"

We accept Ofgem's challenge associated with removing the 10% uncertainty and the "Risks associated with delivering solution" from the costs quoted within our study outputs, this was a double count.

We have therefore reduced the Engineering Total Installed Costs from Study (excluding contingency / Cadent direct costs) stated in our EJP Appendix 2 as follows:

Site	Total installed cost from study (excluding contingency & Cadent direct costs) – as quoted in EJP 09.23 Appendix 2.	
	December Plan	Draft Determination Proposal
Eye Green Offtake		
West Winch Offtake		
Teversham		
Westfield		
Ashton under Lyne		
Thornton		
Barrowford		
Longridge Road		
Hambleton		
Kinver		
Match (meter-only)		
Maltby (meter-only)		

Table 2: Revised total installed costs with "10% uncertainty" & "risks associated with delivering solutions" removed.

Note, Dawley PRS did not have these additional costs included and have no amendments as a result of this challenge.

Match & Maltby only included 10% for uncertainty and had no additional allowance for "Risks associated with delivering solution".

Date: 3 September 2020

4 Ofgem's Challenge: Cadent's direct costs

We acknowledge Ofgem's challenge in this area and have reviewed this investment case in line with other major projects within our Investment Plan. Due to the wide geographic spread, across our four Cadent networks, there is a reduced opportunity for programme level synergy. Our Dawley work has also demonstrated that these works are diverse and complex, and require a higher level of supervision than more routine projects involving like-for-like asset replacement. Our latest view is that these costs are in the range 13% to 16%.

5 Further Engineering Design completed for Dawley PRS

Since December, as part of project mobilisation we have completed a more in-depth analysis for Dawley PRS and have a revised cost estimate, with improved confidence.

5.1 The existing site and it's challenges

Dawley PRS is a HP to IP / MP AGI in the West Midlands, fed by a 300mm 19-bar HP pipeline, and feeds 71,000 customers. In December, the costs submitted were based on the need to upgrade the regulators and filters. It was assumed that this increased capacity could be achieved within the existing site boundary.

Following further study, additional constraints were identified namely:

- The **outage window** is too short to accommodate the planned component by component replacement which had been assumed.
- Achieving a suitable separation between the new equipment and the site boundary to comply with the ***Dangerous Substances and Explosive Atmospheres Regulation 2002*** (DSEAR) has shown us that the site could not be rebuilt within the existing site boundary.

As such the only available option was to rebuild the various components on an adjacent piece of land.

- When land availability was reviewed, it was clear that there were many external constraints limiting the options to extend the site boundary (these constraints where known but as the planning assumption was to act within the footprint were not previously relevant).
    - There is a High Voltage existing overhead power line (Western Power Distribution) along the northern boundary line.
    - There is a 21" water distribution main (Severn Trent Water) slightly further north of the existing site. The easement required by STW (12 m wide strip of land) effectively sterilises all available land to the north of the site.
    - Further to the north, the land rises steeply towards a major road.
    - On the southern site boundary, there is an existing railway line (Network Rail) although it has low usage. Whilst land to the south of the railway line is available, the cost of crossing the railway line was found to be excessive.
    - All available parcels of land are long and thin, placing considerable constraints on the possible site layouts for the larger equipment required.

Four site extension options were considered, to the north, south, east and west of the existing perimeter fence. The only viable option found, which met DSEAR legislation was an extension to the west of the site. To allow safe construction on the existing site, the HV power line on the north boundary of the site must also be diverted / buried. The existing equipment will be retained to manage gas-supply, whilst constructing a new configuration on the adjacent land. Once the new equipment is commissioned the existing equipment and residual site would be decommissioned.

5.2 Key Risks identified

Considerable risks still exist, to the overall scope of works and associated out-turn cost of the capacity upgrade namely:

- The condition of the existing HP gas main (the pipeline is classified as P18 and as such any welds must be inspected); Weld locations are unknown and could result in significant extra cost if weld remediation is needed.
- Ecology: there is extensive woodland and natural habitat surrounding the site, which will require careful management during construction.

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- Unknown services within or around the site, requiring additional diversions or alternative site layouts.
- Ground conditions, contaminated land, water-table: the ground conditions on the extended site to the west are unknown and could comprise additional ground improvement or more extensive foundations or possible soil remediation.
- Intrusive surveys have identified potential tie in locations at a depth of 4 metres, deep excavation required.
- Existing HP and IP isolation valves do not provide an adequate gas tight seal and will require remediation.
- The current AGI ties together two different IP pipelines and the new design will need to determine how to achieve this.

5.3 Proposed solution

The scope of work to achieve the required capacity on the new adjacent land-parcel, based on the current design study, is summarised below:

- New pressure reduction and metering building (14m x 7m footprint) comprising:
  - HP / IP pressure reduction skid (filters, regulators): duty/ standby streams: 300DN
  - IP / MP pressure reduction skid (regulators):
  - Meter skid (Ultrasonic Meters preferred due to the reduced space requirements and associated accuracy)
- 3 nr connections to HP inlet, IP outlet, MP outlet. HP / IP have no allowable outages so will need to be completed via hot-tappings.
- Interconnecting pipework; sizes range from 300 to 200mm nominal bore between all asset components across the site.
- Preheat on the MP / IP pressure reduction module, due to the changed pressure drops within the new system design.
- HP / IP & IP /MP Isolation valves
- Re-located Pig Trap
- GRP kiosk for instrumentation, comms, control and electrical equipment
- Civil works comprising: access road, perimeter fencing, drainage and building and kiosk/skid foundations & pipework and valve supports.
- Upgrade of electrical supply from single phase to three phase. New instrumentation, telemetry and control system on extended site.
- Modifications to existing cathodic protection (CP) ground bed system, to protect the buried steel pipelines.

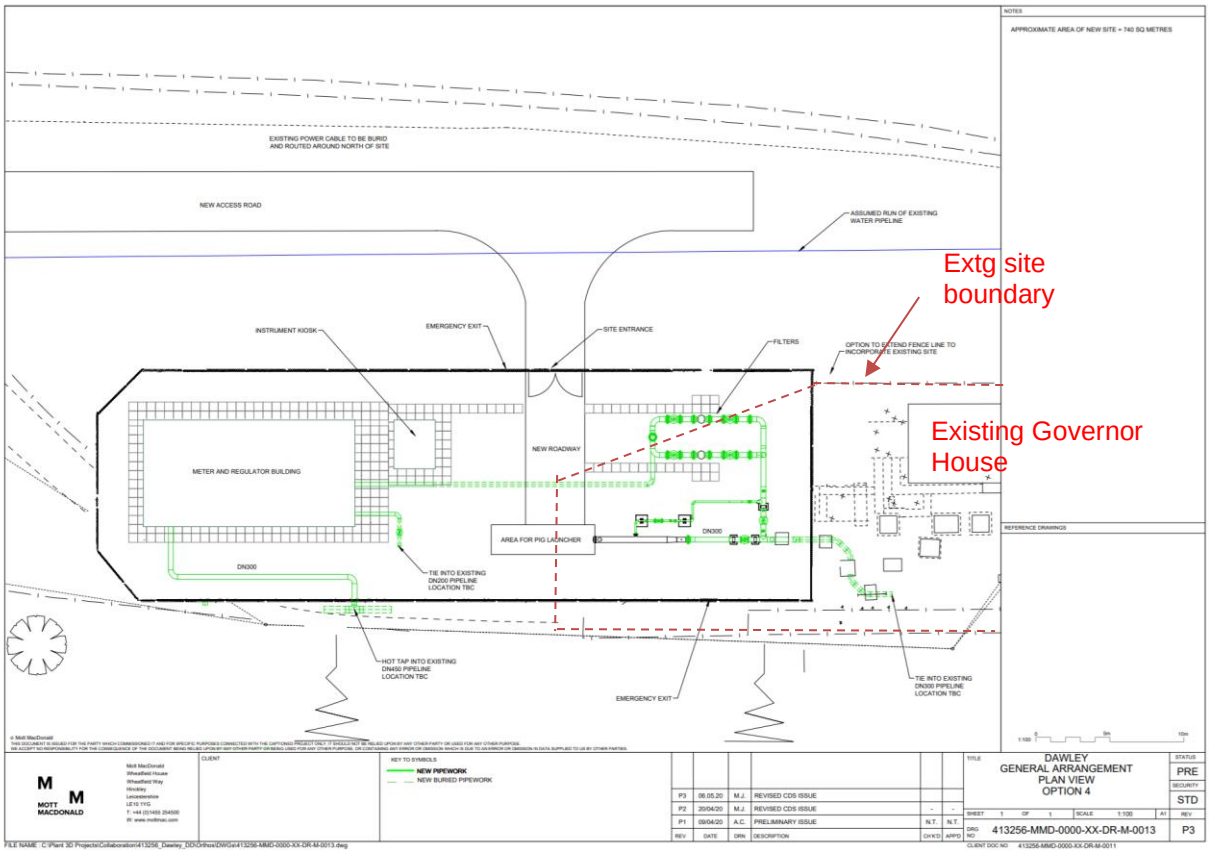

Figure 1: General Arrangement of preferred option for Dawley PRS capacity upgrade

5.4 Cost estimate

The proposed scope of work has been priced by Fastflow engineering, using Cadent's existing framework suppliers. A quantitative risk assessment and a P80 risk and contingency sum has also been produced.

The detailed design, surveys and payment for the HV diversion by Western Power, will be completed in RIIO-1. The resulting cost breakdown for the design, construction and commissioning of the preferred design in RIIO-2 is set out below.

Work Breakdown structure	Cost Estimate	% of RIIO-2 Total installed Costs (low range)
Engineering Design	RIIO-1	RIIO-1
Materials		9%
Project Mgmt., preliminaries and Site Accommodation		15%
Main Contractor Works, including insurances and fees		37%
Specialist surveys (surveys, data, procurement)	RIIO-1, including HV diversion	RIIO-1
Vendor Package Costs		18%
Risk & Contingency (P80 QRA)		9%
Cadent Direct Costs		12%

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Work Breakdown structure	Cost Estimate	% of RIIO-2 Total installed Costs (low range)
Total Installed Cost	**RIIO-1**: £ **RIIO-2**: £ **TOTAL: £**	
Cost estimate accuracy	Within ± 20 %	Full concept design study completed.

Table 3: Cost estimate for Dawley PRS capacity upgrades.

The risk and contingency figure is based on the actual P80 from the Quantitative Risk Assessment undertaken. In-line with Section 4, we have applied a range of 13 to 16% for Cadent direct costs.

As a result of this additional work our RIIO-2 investment for Dawley PRS needs to increase from £m to £m-£m, a 65% increase from our December submission.

5.5 Learning from Dawley: Risk and Contingency

Dawley PRS is the most mature project within our RIIO-2 programme of capacity upgrades. The further design work completed since late 2019, has shown a 65% increase from our initial estimate of £m to £m. This demonstrates the level of risk and uncertainty that is inherent in these complex capacity upgrades. Outages, site constraints and third-party interfaces drive unique buildability issues which have a considerable influence on the out-turn cost.

All other sites within the Capacity Upgrades programme still need to complete their design cycle, with similar change to scope and cost expected as the engineering constraints become better-understood.

6 Revised proposal: Risk and Contingency

These sites are complex and based on the level of design completed to date, our Dawley learning has shown us that our base-costs and solutions can change significantly following more intrusive surveys, stakeholder engagement and more detailed considerations around buildability and construction methodology.

To better understand these risks Cadent commissioned a further piece of work to carry out an independent review of the work prepared for our December submission. Three representative sites in the North West network were re-examined, to validate the “total installed costs” provided by Mott MacDonald’s study, and to inform a more robust view of risk and contingency.

6.1 Confidence in submitted sub totals

Mott MacDonald carried out a feasibility / concept-level study to assess the optimum engineering solution and provide a cost estimate of materials, design and construction costs for all sites in our base case, except for Dawley, Match & Maltby[4].

Since December, Fastflow have reviewed three sites in the NW. The independent review produced total costs across all 3 sites which were + 10% higher than Mott MacDonald's costs.

We are therefore confident that the sub-totals for design and construction provided by Mott MacDonald’s study are both efficient and lean.

The Mott MacDonald study assessed the components that were under-capacity and then assessed the least cost option for replacing these components.

The limited or no outage windows provides a large constraint on construction methodology, only a limited number of components can be swapped out in situ; some sites do not have sufficient space within the existing pipework arrangement to achieve this; other components will need to be - rebuilt in

[4] Match & Maltby were estimated from component level estimates provided from Mott MacDonald’s cost breakdown structure and included Cadent direct costs and risk and contingency on top of these component costs.

an alternative location - this will either be driven by the outage window or due to safety or space constraints.

Many of these sites have a small footprint and when the DSEAR regulations are considered a number of sites could require additional land or require complex construction sequences to keep within the existing site boundary - this increases risk and cost.

Another major risk is in the completeness of our as-built records. Some critical detail is unclear; details such as the depth and configuration of incoming and outgoing mains (their depth, size and isolation); these are tie-in points for the new designs and carry considerable risk of cost increases. Trial pits and intrusive surveys have not yet been completed to confirm this detail.

We have specifically excluded any asset health or any assets that do not comply with Cadent Policies from the scope of works defined. We have only included scope if it needs increasing in capacity. We are therefore confident the scope proposed only addresses the identified capacity issues.

We have used our existing Cadent framework suppliers as a basis for estimating vendor & material costs.

For all of the above reasons, our sub-total design and construction cost estimates are realistic and efficient.

6.2 Refined approach to risk and contingency

We note Ofgem's challenge around our 35% uplift applied for risk and contingency.

Our independent review, undertaken by Fastflow, specifically focussed on developing a more robust Quantitative Risk Assessment (QRA), to inform reasonable levels of risk and contingency. Their team comprised both designers and contractors, to ensure we received robust buildability advice.

The quantitative risk assessment produced by Fastflow was then used within a Monte Carlo analysis to derive a P50 & P80 risk and contingency allowance. This reduced the risk and contingency allowances for all three sites compared to December.

The QRA outputs from this cost review have shown that an uplift of between 25% and 35% is reasonable, based on the QRA's across these sites. However, using Dawley as an example, there is a risk that there are other outliers in our programme of works that could result in increases to the total installed cost of circa 65%, as we move to full detailed design.

We have therefore quoted a range of total installed costs from 30% to 35% for risk and contingency, for discussion with Ofgem, through this consultation process.

7 Summary of Revised Proposal

As a result of our review our proposal for Capacity Upgrades is based on the following revised approach.

Sites	Revised approach to deriving the Total Installed Cost (TIC)
Dawley	A detailed bottom up cost estimate produced based on the finalised study and detailed quantitative risk assessment (P80 monte carlo analysis).
Match & Maltby meter-only upgrades	Use metering skid component costs within the Mott MacDonald cost breakdown structure, to derive an average cost for meter-only capacity upgrade. Sub-total then uplifted by 30% to 35% for risk and contingency. Then uplifted by 13% to 16% for Cadent direct costs.

Sites	Revised approach to deriving the Total Installed Cost (TIC)
Eye Green Offtake **West Winch Offtake** **Teversham** **Westfield** **Ashton under Lyne** **Thornton** **Barrowford** **Longridge Road** **Hambleton** **Kinver**	Use the costs quoted within Mott MacDonald's study reports as a basis. Remove "10% uncertainty" and "risk associated with delivering solution" from the total installed costs quoted from the study report. Apply 30% to 35% uplift for risk and contingency, then a further uplift of 13% to 16% for Cadent direct costs.

Table 4: Basis for revised proposal to Ofgem: Capacity Upgrades

We have not applied further efficiencies to these numbers.

Applying this approach enables us to compare the revised cost build up, with that provided in our December plan. Refer to Table 5 below.

Network	Site Name	December Plan	DD Response					% Reduction from Dec Plan
			Revised sub-total	Risk & contingency		TIC including Cadent direct costs		
		Total installed Cost[5]		Min	Max	Min	Max	
EOE	West Winch							16 - 21
EOE	Eye Green							20 - 24
EOE	Teversham							27 -32
EOE	Westfield							21 -25
EOE	Match							9 - 15
EOE	Maltby							9 - 15
NW	Thornton							19 - 24
NW	Barrowford							16 - 21
NW	Longbridge Road							21 - 25
NW	Ashton under Lyne							13 - 18
NW	Hambleton							14 - 19
WM	Kinver							18 - 23
WM	Dawley PRS							66% increase

Table 5: Revised Total Installed Cost per site within Base Case.

[5] These costs are pre-efficiency.

Due to our experience with Dawley and our learning from Fastflow's independent review, our response shows a range of 30-35% uplift for risk and contingency (20% of total installed costs).

The revised total RIIO-2 spend, per network is summarised below. The December 2019 figures within our Final Business Plan have been included for comparison purposes.

Capacity Upgrades		December Plan as per BPDT	March 20 Plan as per SQ[6]	Ofgem Proposal in Draft Determination[7]	Outturn range forecast[8]
EoE NTS	EoE NTS Capacity Upgrades				
EoE PRS	EoE PRS Capacity Upgrades				
NW PRS	NW PRS Capacity Upgrades				
NL PRS	NL PRS Capacity upgrades				
WM PRS	WM PRS Capacity upgrades				

Table 6 (duplicate of Table 1): Revised Total Costs for RIIO-2 by network & PRS /Offtake.

Table 7 in the Business Case Summary of the EJP 09.29 submitted in December 2019 has been updated with the above costs, to provide the following revised cost profile using the low range assumptions.

	2021/22	2022/23	2023/24	2024/25	2025/26	Total
EOE: NTS						
EOE: PRS						
NW: PRS						
NL:PRS						
WM: PRS						
Total						

Table 7: Revised Total Costs for RIIO-2 by network & PRS /Offtake based on minimum range quoted above.

[6] Adjusting for the mathematical error discussed in this document for EoE and NL, as set out in SQ_CA_23 (20 Mar '20). Point 1 above.
[7] As stated in Table 23 of the Cadent Annex within the Draft Determination.
[8] Based on 13-16% direct cost and 30-35% contingency