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Appendix 16B
GD2 mains insertion rate forecast

Response to RIIO2 CG Deep Dive Questions

22nd October 2019

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RIIO2 CG Deep Dive Questions

This paper sets out to answer the questions raised by RIIO2 CG for deep dive discussion on 31st October 2019. This provides further information to support our Wales & West Utilities Business Plan 2021 – 2026, particularly chapters 9 – Cost Efficiency and 16 – The Distribution Network

RIIO2 CG question
Open cut repex – a large increase in open cut repex appears to be increasing costs. How has this been estimated and what evidence can you provide to support the estimated volumes?

Introduction

Wales & West Utilities replace circa 440km per annum of buried iron and steel mains. The majority of this (324km of iron and 58km of connected<=2" steel) is mandated by the HSE Iron Mains Replacement Programme (IMRP). The remainder is replaced due to high operating cost of repair, significant negative impact on environment from methane emissions as well as the safety risk to the public and our operatives from gas escapes.

There have been many innovations in mains replacement to improve the experience of the public and customers, improve safety and deliver cost efficiencies. One of the most notable and impactful is mains insertion. This technique drives down costs and minimises disruption as well as the time to complete pipe replacement. We focus on optimising the use of mains insertion and this document explains our process for doing so and the results.

What is Mains Insertion

There are two main techniques for replacing mains - insertion and open cut.

Open cut involves digging and backfilling a trench the full length of the main to be replaced, laying the new main in the trench and transferring all services.

Insertion involves digging pits at either end of the main to be replaced, then inserting the new main inside the old main. Pits are then dug at each service connection and they are transferred to the new main.

Insertion is the preferred technique as it;
- Minimises disruption to the public as there is less time involved in the replacement and less excavation in the highway or pavement
- Lowers costs due to less excavation, reinstatement and time on the operation
- Leaves the new main in a protective sleeve (the old metallic main)

Limitations

For a main to be inserted, the main being replaced must have a larger internal diameter than the external diameter of the new main. This results in a smaller pipe and therefore less capacity and bigger pressure drops along the new main than the old main.

A typical example would be inserting 75mm PE into a 4" iron main. The cross- sectional area can be calculated using 'pi x r2'

4" = pi x 50mm2 = 7,853mm2
75mm = pi x 37mm2 = 3,216mm2

The 75mm inserted pipe has half the capacity of the 4" mains it is replacing.

Mains insertion has only been possible due to the fact that most iron and steel pipe networks were designed to transport town gas which has a much lower energy content than natural gas. Therefore, the pipes required were much larger than those required to transport the same energy with natural gas or indeed with hydrogen or green gas.

Each pipe is analysed for mains insertion but this is not always possible if the capacity of the original pipe is still required.

Analysing replacement sizes - Network Analysis

We size replacement pipes using network analysis models that have all pipes in our network and gas demands for every consumer. These models allow us to simulate replacement pipe sizes and the impact on capacity and pressure.

We update the models with views on future demand in the 1, 5 and 10 year planning horizons. We are obliged as part of our Licence Conditions to design our network to keep continuity of supply in a 1:20 winter. This is the worst winter we are likely to see over a 20 year period based on historical experience of winters. When we design a replacement scheme we can assess the replacement diameters impact on the ability to meet gas demand in these 1:20 conditions. The table below shows our forecast of peak demand.

Peak demand forecasts – Long Term Development Statement

LDZ	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29
South West	254	256	263	271	276	278	281	284	287	290
Wales North	49	49	51	52	53	53	54	55	55	56
Wales South	194	194	198	201	201	201	201	203	205	207
Network Total	497	499	512	524	530	533	537	542	547	553

It can be seen that peak demand continues to rise even where annual demand is falling due to overall energy efficiency. Our replacement programme is designed to support this.

Deriving the GD2 replacement schemes

To produce the GD2 plan we have invested a significant amount of time and skill in analysing of the pipes and projects we will deliver. The process followed has involved grouping all mandatory iron replacement pipes into efficient projects.

This includes all pipes that require replacing by 2032, the end of the HSE Iron Mains Replacement Programme. These schemes were then put through the network analysis process to determine which pipes could be inserted and which would need to be laid in an equivalent or larger diameter. Appendix 1 is an illustration of a pipe manufacturers guide to pipe insertion sizes.

The results were that 80% of pipe could be inserted across the rest of the programme to 2032 with the remainder requiring open cut. This compares to an insertion rate of 90% achieved in GD1. Our GD2 programme is designed to flat phase delivery costs through to 2032.

The table below shows the GD2 forecast insertion rates by mains type.

Insertion / Open cut rates for GD2

km	Insertion	Open Cut	Total	% Insertion
Consequential Steel	106	138	244	43%
Other Steel	108	2	110	98%
Over 30m	34	16	50	68%
Tier 1	1414	205	1620	87%
Tier 2a	40	55	95	42%
Tier 2b	32	18	50	63%
Tier 3	3	8	11	23%
Total	1736	443	2180	80%

Pipe insertion rates are dropping from 90% in GD1 to 80% in GD2 and beyond as we have limited capacity left in the network. The reduction in potential to insert reflects the fact that we cannot keep reducing capacity of the pipe network and ensure security of supply to our consumers.

There is also an impact of the networks in which we need to replace pipes in GD2 and beyond. Risk of explosion is the key driver for iron mains replacement schemes. The higher level of risk in large towns and cities has led us to focus on replacement in these areas in GD1. As we enter the final third of the IMRP we are moving to network extremities and smaller towns. The network configuration in these places is such that there are less feeds into the networks. For engineering reasons this limits the opportunity for insertion.

We have also invested in data, analytics and skilled analysts through GD1. This has taken us from a place where we could only forecast a 1-3 year view of the mains replacement programme to a capability where we can accurately forecast the replacement schemes in detail through to 2032. The 80% insertion rate is a result of the analysis of the remaining programme rather than a shorter term view.

Appendix 2 illustrates the network analysis of a typical mains replacement scheme.

Cost of open cut

The cost of open cut is significantly different to insertion, there are changes to how you plan and deliver along with the costs of the work itself.

Open cut work decreases productivity due to;

- Carefully excavating a trench to avoid damaging other utility apparatus
- Maintaining access to driveways and businesses
- Maintaining traffic control and flow

Across the entire lengths of the replacement works

These productivity issues increase the labour time on projects and impact the customer experience.

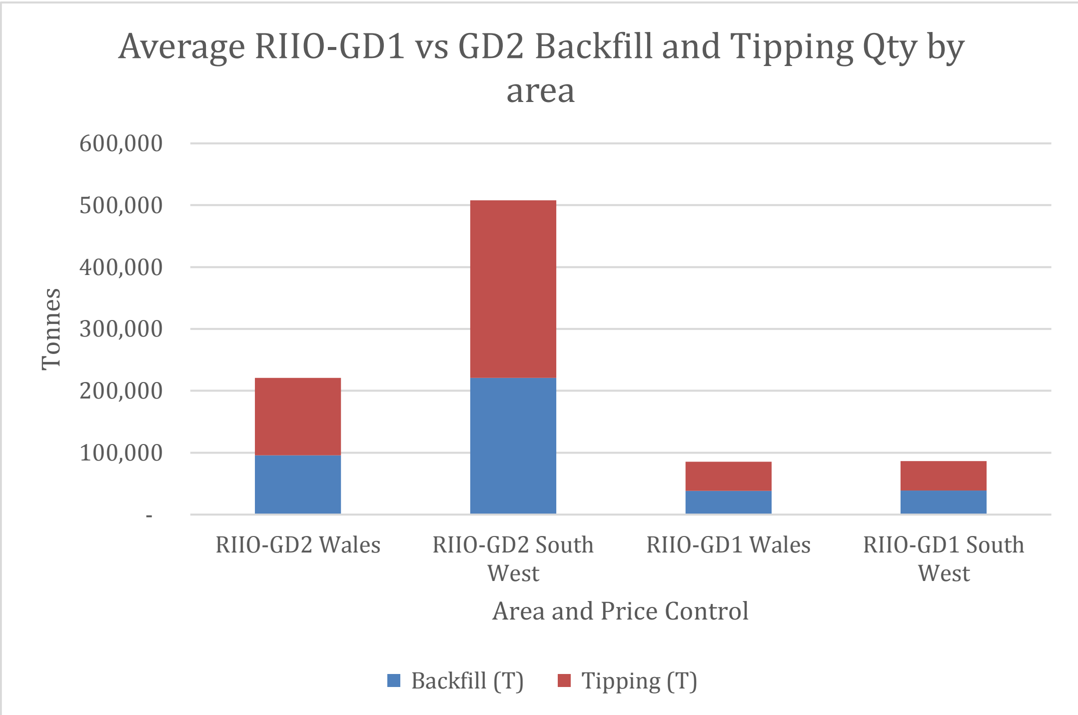
The costs of carrying out the work itself is impacted by the following;

- Additional excavated and backfilled material
- Additional travel times to quarry can be impacted depending on regions
- Additional reinstatement of surfaces and street furniture
- Additional logistical support for the work delivery
- Additional machinery and plant usage, movement and size
- Additional disruption to customers, pedestrians and road users

An example in the differences between the unit costs of this work is below;

Tier 1 >75mm to 125mm - example project - prime costs	**Insertion**	**Open cut**
Labour & Plant	43.10	90.40
Reinstatement	5.90	42.20
Logistics	4.50	32.20
Backfill & Spoil Disposal	3.00	21.50
Pipe & Fittings	16.0	23.30
NRSWA	0.80	6.10
Cost per metre £s	**73.30**	**215.70**

The difference in volumes of backfill and tipping required between price controls is shown below which is one of the largest cost drivers, resulting in average £4.4m annual increase between GD1 and GD2. The regional impacts of these moving between areas is an additional £1.7m per annum.



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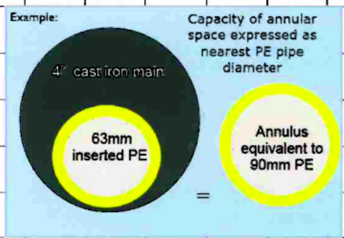
Appendix 1 – manufacturers guide to possible insertion sizes

The Steve Vick International
MATRIX

Size of main to be replaced	Diameter of PE pipe to be inserted with capacity of annulus expressed as the nearest equivalent PE pipe diameter															
	55mm	63mm	75mm	90mm	110mm	125mm	140mm	160mm	180mm	213mm	225mm	250mm	268mm	315mm	355mm	400mm
3"	63mm SDR 11															
4"	90mm SDR 17	90mm SDR 17	75mm SDR 17	63mm SDR 11												
5"		125mm SDR 17	110mm SDR 17	90mm SDR 17	75mm SDR 17											
6"		160mm SDR 17	140mm SDR17	140mm SDR 17	125mm SDR 17	90mm SDR 17	63mm SDR17									
8"					180mm SDR 17	180mm SDR 17	160mm SDR 17	140mm SDR 17	90mm SDR 17							
10"								225mm SDR17	200mm SDR 17	160mm SDR 17	125mm SDR 17					
12"									268mm SDR 17	250mm SDR 17	225mm SDR17	200mm SDR 17	160mm SDR 17			
16"												355mm SDR 17	355mm SDR17	268mm SDR 17		
18"														355mm SDR 17	250mm SDR 17	250mm SDR 17
24"	Note: Same or smaller sizes of PE can be inserted in the shaded area giving larger equivalent annulus													500mm SDR 17	500mm SDR17	500mm SDR 17



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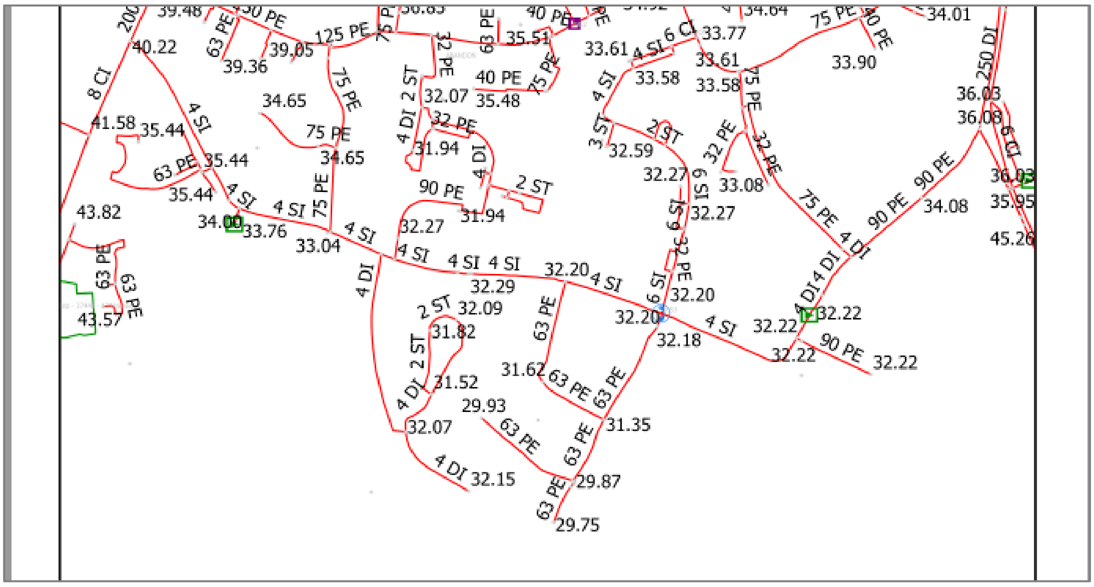
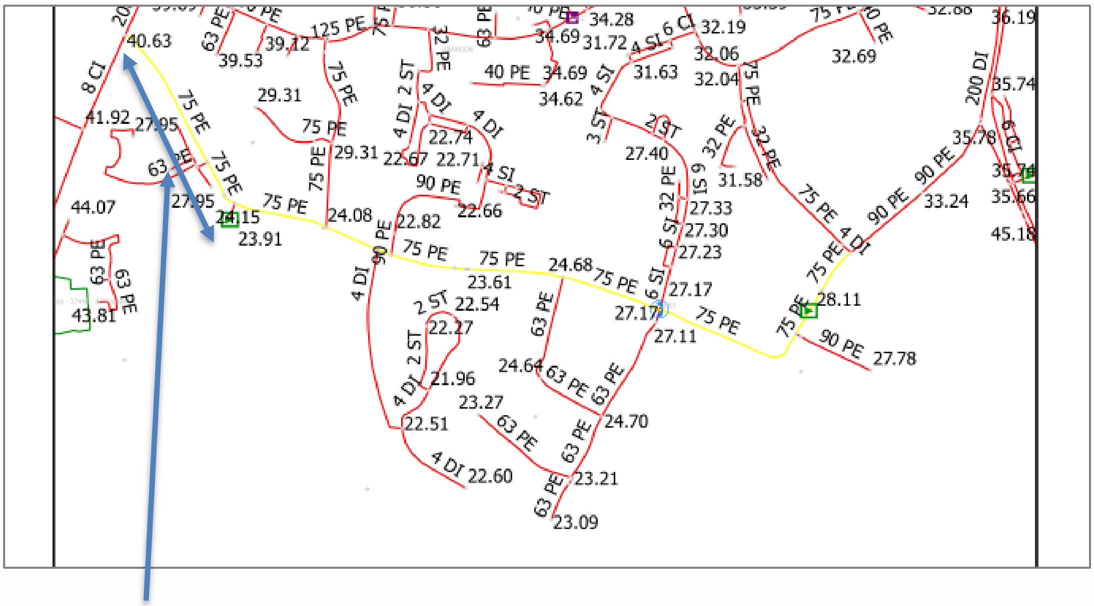
Appendix 2 – Network Analysis of a mains replacement scheme

This is a screenshot from our Network Analysis modelling tool. It shows pipe diameters and materials and pressure in mbar



There is a seed pipe to be replaced (highlighted yellow) and this screenshot shows the impact of inserting this pipe with 75mm PE



- Excessive pressure drop – 41.9 mbar to 23.9mbar
- There is a third-party site connection at this point that requires 28mbar
- Removes all pressure from the area so future opportunity to insert removed

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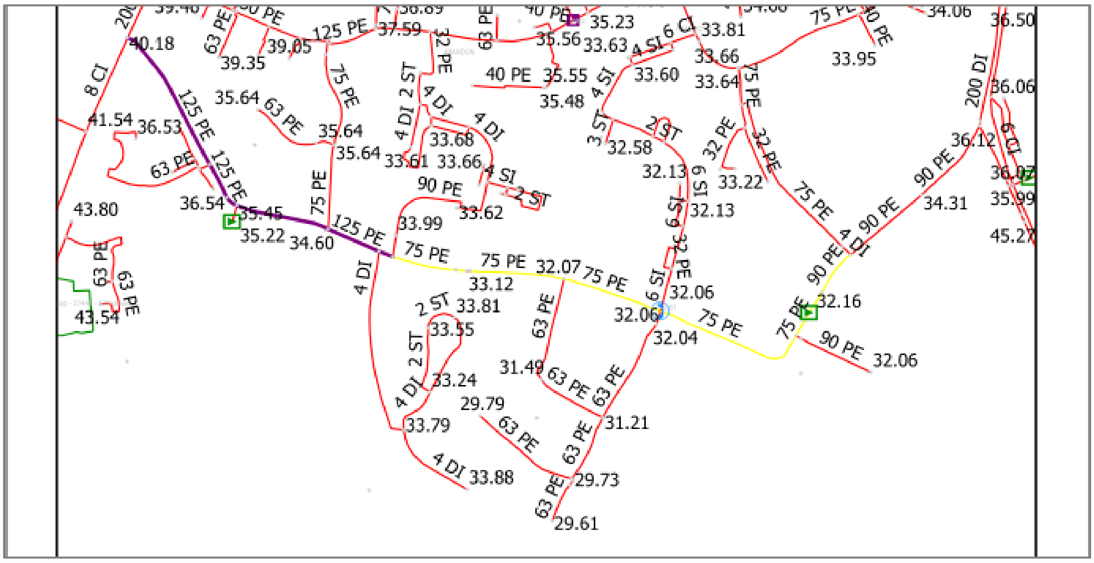
This screenshot shows a solution that is part open-cut / part insertion. This satisfies the pressure required at the third party site and leaves pressure in the area that enables future mains to be inserted – lowest total cost



Legal Notice

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