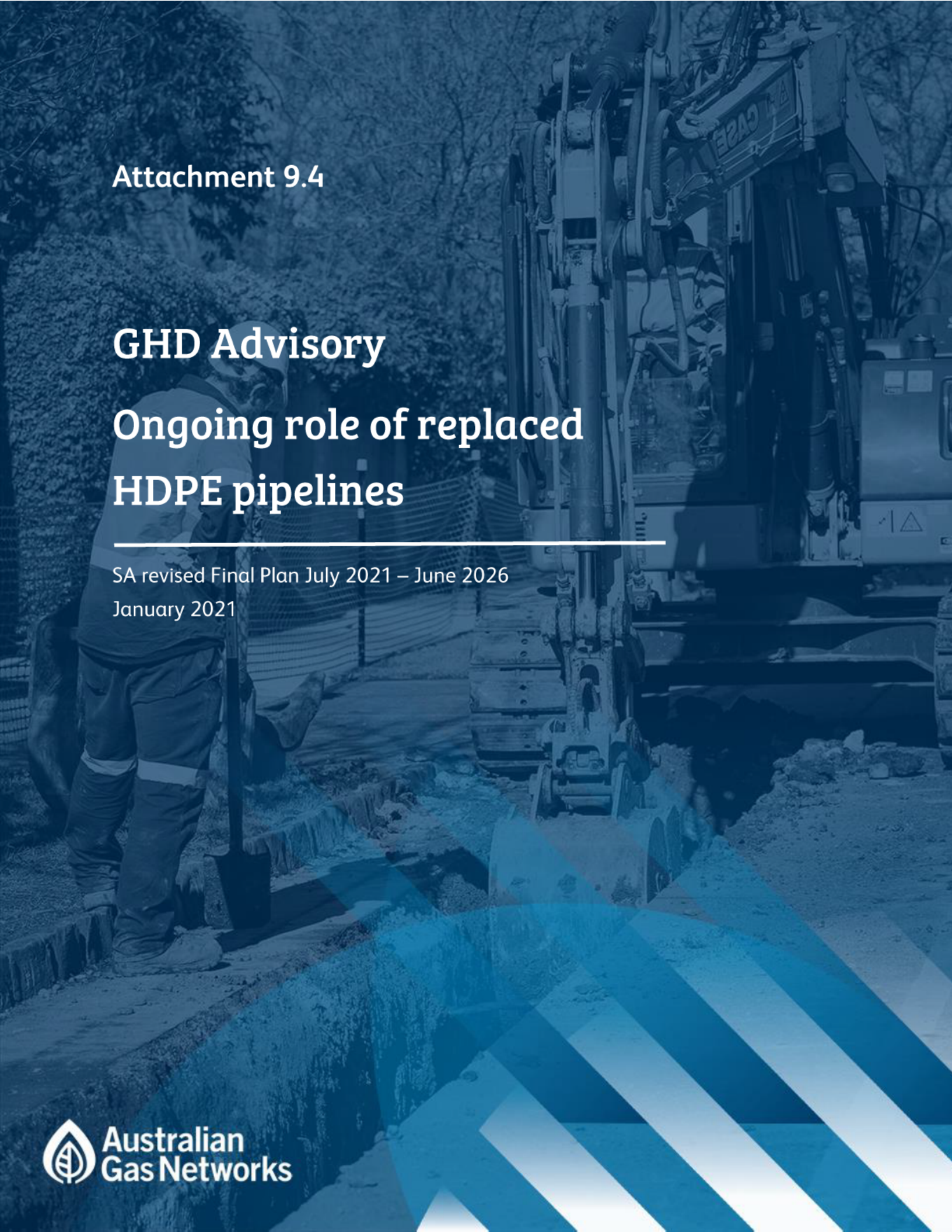


Attachment 9.4

GHD Advisory

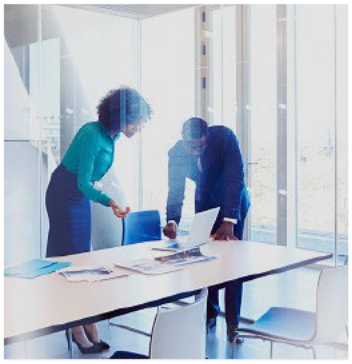
Ongoing role of replaced HDPE pipelines

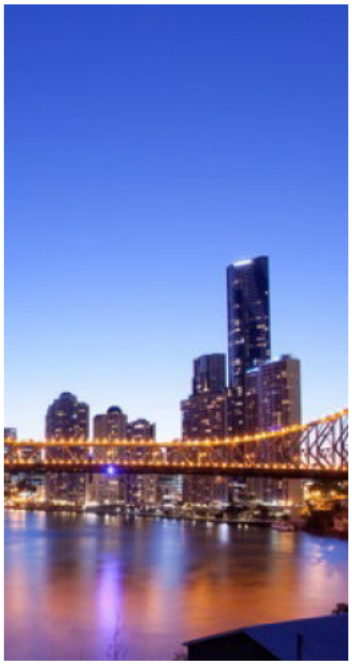
SA revised Final Plan July 2021 – June 2026

January 2021

Australian Gas Networks

GHD Advisory





Ongoing role of replaced HDPE pipelines

Australian Gas Networks (SA)

12 January 2021

Project Number: 12542885

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Executive summary

The Australian Energy Regulator (AER) is reviewing the access arrangement (AA) that will apply to Australian Gas Networks (SA) (AGN) for the 2021 to 2026 period.

As part of their submission to the AER, AGN proposed to continue their early generation HDPE mains replacement program, which is important to ensure the safe operation of the network. This program will successfully complete 325 km[1] of high pressure (HP) HDPE 575 mains replacement in the current AA period (2016-21). In the next AA period (2021-26), AGN proposes the replacement of a further 198 km of HDPE 575 DN40 HP mains by insertion[2].

The method of replacement involves inserting a new high-density polyethylene (HDPE) main through the existing pipes, which involves making cut-outs at various intervals to enable the insertion process to occur. During this process, the service connection points (or inlets) are also replaced. This method is typically used as it is lower cost, more efficient and less intrusive than alternative pipeline replacement methods, such as direct burial via trenching.

AGN proposed writing down the value of the replaced HDPE mains and associated services (i.e. inlets) that have been replaced during the current AA period (2016-21), or will be replaced during the next AA period (2021-26).[3] However, in its draft determination, the AER questioned whether the insertion was actually a modification (as opposed to a replacement) and whether accelerated depreciation of the old replaced mains was appropriate.

GHD's engagement and qualifications

AGN engaged GHD to provide a technical specialist explanation of the process of mains replacement through insertion and to make an assessment as to whether the old pipeline that remains following replacement plays a role in the ongoing delivery of gas haulage services, including any asset management benefit for the new mains.

This report has been prepared under the guidance of knowledgeable people with considerable experience in the gas industry. This experience includes design, construction, and operation of gas gathering systems, gas transmission pipelines, and gas distribution networks across Australia and New Zealand.

GHD's assessment

GHD considers there is no residual value to AGN's replaced HDPE 575 DN40 mains and, therefore, it is appropriate to accelerate the depreciation of these assets within the access period as the mains are replaced.

The replaced mains play no role in the ongoing delivery of gas haulage services and do not provide any additional asset management support to the new main.

The replaced main is unable to provide gas service or asset management benefits for several reasons:

- The old main sections that remain have been cut out every 10 to 15 metres during the insertion process such that it is no longer a continuous main and does not have any structural integrity. Disconnected

[1] The total replacement length for the program to 2021 will be 357 km. However, this includes 32 km of MP HDPE 575 mains.

[2] AER, *Attachment 5: Capital Expenditure, Draft Decision – Australian Gas Networks (SA) Access Arrangement 20121-26*, p. 15

[3] AGN, *AGN Final Plan - Access Arrangement 21-26* July 2020, p. 108

sections of mains cannot provide gas haulage services and do not provide any additional containment of leaks.

- Equipment used at inlets/service points is replaced in the process, and pipe that comprises the service connection to the customer is only used as a conduit where it is large enough for the new service pipe to be inserted (in the same way the replaced pipe is a conduit for the rest of the main). Where the service is not large enough for the new service to be inserted, a new service will be laid separately (via direct burial), or, where possible, the old service may be split to allow for the new service pipe to be installed in its place.
- There is no additional asset management support, including:
  - No additional pressure support due to the replaced mains not having sufficient ongoing structural integrity.
  - No change to damage tolerance from third-party excavation impacts as both HDPE pipe material used in the network provide no structural resistance to penetration.

The only function the old pipeline serves is to act as a conduit for laying the new pipeline and the benefit of this role is realised in the lower replacement costs compared to other replacement methods. As such, GHD does not consider mains replacement by insertion is a modification to the existing pipeline.

In GHD's opinion, if AGN were to replace the mains via direct burial rather than insertion, there would be no difference to the gas haulage service being provided, the leak protection offered, the expected life or the safety rating applied to the mains. Hence, from a functional perspective, the two methods achieve the same end and are both replacements.

Finally, we note in previous determinations the AER has approved the accelerated depreciation including of mains replaced through insertion. The most relevant examples include includes:

- AGN (Victorian gas distributor) CI/UPS and PVC mains replacement program being undertaken in the 2018-22 AA period.
- AusNet Services (Victorian gas distributor) replacement of low pressure mains and services undertaken in the 2013-17 AA period.

1. Background

The Australian Energy Regulator (AER) is reviewing the AA that will apply to Australian Gas Networks (SA) (AGN) for the 2021 to 2026 period.

As part of their submission to the AER, AGN proposed to continue their early generation HDPE mains replacement program, which is important to ensure the safe operation of the network. This program will successfully complete 325 km[4] of high pressure (HP) HDPE 575 mains replacement in the current AA period (2016-21). In the next AA period (2021-26), AGN proposes the replacement of a further 198 km of HDPE 575 DN40 HP mains by insertion[5].

The method of replacement involves inserting a new high-density polyethylene (HDPE) main through the existing pipes, which involves making cut-outs at various intervals to enable the insertion process to occur. During this process, the inlets are also replaced. This method is typically used as it is lower cost, more efficient and less intrusive than alternative pipeline replacement methods, such as direct burial via trenching.

AGN proposed writing down the value of the replaced HDPE mains and services that either have already been replaced or will be replaced during the 2021 to 2026 regulatory period. However, in its draft determination, the AER questioned whether the insertion was actually a modification (as opposed to a replacement) and whether accelerated depreciation of the old replaced mains was appropriate.[6]

In the draft determination, the AER stated it considered the insertion method used for HDPE 575 DN40 HP, can be viewed as an asset reinforcement or modification rather than a like-for-like replacement. As this distinction influences the AER's regulatory depreciation determination, the AER signalled it expected AGN to "clarify whether the existing assets will not be providing any ongoing services to consumers post insertion as well as further information on key assumptions used in Incenta's mains replacement analysis"[7].

1.1 GHD's engagement

To support AGN's response to the AER's draft determination and address the AER's queries on the ongoing value of HDPE replaced through insertion, AGN has engaged GHD Pty Ltd (GHD) to provide a specialist technical explanation of:

- The process of mains replacement through insertion.
- The condition of the replaced main after insertion.
- The role, if any, the replaced main plays in the ongoing delivery of reference services, including any asset management benefit for the new mains.

1.1.1 GHD experience and expertise

This report has been prepared under the guidance of knowledgeable people with considerable experience in the gas industry. This experience includes design, construction, and operation of gas gathering systems, gas transmission pipelines, and gas distribution networks across Australia and New Zealand. This experience includes the following:

- Operational management of 4,500 km of gas distribution networks, and operational management of 5,000 km of gas transmission pipelines

[4] The total replacement length for the program to 2021 will be 357 km. However, this includes 32 km of MP HDPE 575 mains.

[5] AER, *Attachment 5: Capital Expenditure, Draft Decision – Australian Gas Networks (SA) Access Arrangement 20121-26*, p. 15

[6] AGN, *AGN Final Plan - Access Arrangement 21-26* July 2020, p. 108

[7] AER, *Attachment 5: Capital Expenditure, Draft Decision – Australian Gas Networks (SA) Access Arrangement 20121-26*, p. 14

- Working within operating companies to support design and construction of HDPE pipeline networks for gas
- Extensive experience in pipeline risk assessments for distribution networks and transmission pipelines, as well as pipeline integrity assessments and remaining life assessments
- Delivery of integrity programs for gas networks and transmission pipelines, including the development of asset management plans and regulatory submissions
- Technical due diligence for acquisition of gas transmission pipelines and gas distribution networks

1.1.2 GHD's approach

GHD's approach consisted of the following steps:

1 Reviewed the relevant documents provided by AGN in its submission, the AER draft determination and the report prepared by the AER's technical consultant, Zincara

2 Engaged with AGN representatives via teleconference to develop a full understanding of their approach and the internal information they have relied on to support their submission.

3 Formed our technical assessment as outlined in this report.

1.1.3 Limitations

This report has been prepared by GHD for Australian Gas Networks (SA) and may only be used and relied on by Australian Gas Networks (SA) for the purpose agreed between GHD and the Australian Gas Networks (SA) as set out in this chapter of this report.

GHD otherwise disclaims responsibility to any person other than Australian Gas Networks (SA) arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Australian Gas Networks (SA) and others who provided information to GHD (including the Australian Energy Regulator, Zincara, and others as indicated in this report), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

GHD assessment is limited to a technical assessment based on the information provided. GHD has not conducted financial analysis.

2. Mains replacement through insertion

The replacement of older HDPE mains has been a priority for AGN after several significant failures of HDPE mains in previous AA periods. This section focuses on the method of insertion and what occurs to the main being replaced.

The replacement of the older HDPE 575 mains is being undertaken as the existing mains no longer have sufficient structural integrity to enable long-term safe operation. For example, deterioration of the existing HDPE 575 mains has resulted in several 'Gas-In-Building' incidents, which resulted in explosions. [8] The most efficient method of HDPE mains replacement is by insertion, which involves the insertion of a new HDPE main inside the existing HDPE main. Insertion is the most cost-effective way to replace mains rather than direct replacement which is discussed further in Section 2.3. However, this is only true when the inserted main can maintain the existing capacity; this is not the case with DN40 MP, which must be replaced by direct burial.

2.1 Overview of process

Mains replacement by insertion is a method of gas mains replacement that involves using the existing main as a conduit to install a new HDPE main, which results in a pipe inside another pipe configuration. This process is commonly used where the existing mains structural integrity is compromised and requires replacement. To achieve the replacement, cut outs of the old mains are made along the length of the existing pipe, including at bends and service connections (also referred to as inlets). The smaller replacement pipe is then inserted via a cut out in the pipeline being replaced at intervals that align with maximum insertion lengths.

GHD has reviewed AGN's insertion procedure[9], and GHD have provided a summary of this procedure below. Based on GHD's experience, this procedure is in line with good industry practice within Australia. For each section of the main being replaced via insertion, the following is carried out:

1 Excavations are dug at each end of the sections being replaced and along the length of the main at each service connection and bend.

2 An isolation procedure is used to stop gas flow and allow work to be carried out safely on sections being replaced.

3 A section of existing main is then cut out, typically between 0.5 to 1.0 meter in length, at both ends of section being replaced to allow entry and exit points for insertion. Similarly, a cut out of bends and service connections is undertaken, removing the service connection (inlet) fittings.

4 The replacement main is inserted inside the existing main using specialised equipment.

5 At each inlet (service connection), a new pipe is inserted into the existing service connection and new fittings are installed to connect the new main to the customer.

6 At each cut out section of the old main, the gap between the old main and the new main is then sealed on each side of the cut out to prevent water and soil ingress.

7 The newly replaced main is then prepared for service and isolations are removed, which returns gas flow to customers.

8 Excavations are back filled and the ground surface reinstated.

[8] GHD discussion with AGN representative 09/12/20

[9] AGN procedure 5506 Rev 5. Mains – Insertion with PE

Typically, AGN can replace section lengths of 100 to 200 metres per crew per day using insertion techniques, depending on a range of factors.[10]

Figure 1: Inserted main with service connection

Source: AGN, 2020

2.2 Condition of replaced main after insertion

As outlined in section 2.1 above, the existing main has sections cut out for insertion at the start and finish, at bends, and at each service connection. Service connections in domestic areas are typically 10 to 15 meters apart. The outcome is that the existing main is no longer a continuous pipe following the mains insertion process, rather it ends up being short sections that are no longer than the 10 to 15 meters length between the service connections.

HDPE mains are normally replaced by inserting a HDPE main of the next smallest diameter. For example, a DN50 main is replaced by a DN40 main and a DN40 main is replaced by a DN32 main. This means there is very little space remaining between the two mains, typically a few millimetres.

Figure 2 shows an inserted HDPE main with a section of the outer HDPE main removed at the cut out point. As discussed above, with HDPE insertion, there is very minimal space between the two mains. However the gap between the mains is still sealed in the manner shown below. This figure also shows the typical cut out to allow the insertion procedure or service connections, including the section of the existing main that is entirely removed.

Figure 2 shows an example of foam that is used to help seal the open ends of the cut outs. While this helps prevent soil and water ingress into the annulus, it does not offer any pressure containment for the gas.

[10] As per discussion between GHD and AGN representatives on 4/12/2020

Figure 2: Inserted main with existing HDPE main removed

Source: AGN, 2020

The outer main does not provide any residual asset management value in the form of reduced operating stresses, or the ability to manage pressure. For any substantive level of stress transfer to occur from an inner pipe to an out pipe, the outer pipe needs to be a high-stress compression fit, which does not apply to insertion.

Due to the minimal wall thickness of the HDPE mains being replaced by AGN, GHD does not consider there is any additional protection from mechanical damage. The HDPE 575 AGN historically used is too thin to offer any additional protection from any meaningful external interference event. If a strike from any mechanical machinery were to occur both mains would be penetrated.

In GHD's opinion, the only value the existing AGN mains being replaced provides is that it acts as a conduit for insertion of the new main. This value is realised in the lower installation cost and efficiency when compared to the direct buried replacement method, which benefits customers through a lower asset base (and therefore cost) than would otherwise be the case.

2.2.1 Inlets

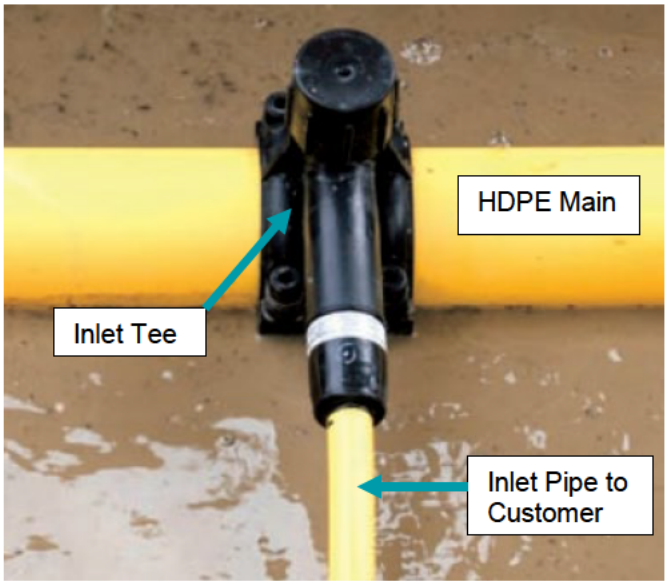
GHD understands the AER had particular questions about how the inlets (service connections) are impacted through the insertion process. Inlets consist of three parts: the inlet tee and the inlet pipe to the customer are shown in Figure 3, and the standpipe riser which attaches the underground inlet pipe to the above ground meter. Both the inlet tee and the standpipe riser are fully removed and replaced at every service connection, and the inlet pipe is replaced via insertion, direct burial replacement or pipe splitting depending on several site-specific factors.

The existing inlet tee must be replaced during the mains insertion process as it is attached to the existing main and is removed when the main is cut out. GHD's experience with mains replacement is that the inlet pipe is also replaced. This is because the pipe is normally the same age as the main and replacement during

this process is also required for safety and is more cost effective. The standpipe riser is always replaced due to the additional risks associated with aboveground gas line failure, the standpipe is also metal which is subject to corrosion, particularly at the underground to aboveground soil interface.

GHD has confirmed in discussions with AGN that GHD's experience aligns with AGN's practice.[11] AGN also replaces all inlet pipes during mains insertion that comprise of any material other than the current specification HDPE, this is typically inlet pipes older than 15 years.

Figure 3: HDPE main with inlet installed



Source: Elster Perfection [12]

2.3 Rationale for replacement through insertion

Replacing the mains through insertion provides a number of benefits compared to direct burial. It is lower cost, quicker, and less intrusive to the public area surrounding the work site.

There is a considerable cost saving associated with replacement through insertion compared to direct burial methods. AGN's proposed unit rates and Zincara's revised estimates for the same sized pipe installation via direct burial (DN40 MP) versus insertion (DN40 HP) indicate direct burial is more expensive than replacement through insertion (Table 1).

Table 1: Comparison of direct burial and insertion replacement costs (DN40 MP versus DN40 HP)

	Direct burial (DN40 MP)	Insertion (DN40 HP)	Difference
AGN's estimate	[redacted]	[redacted]	[redacted] (45 per cent less)
Zincara's estimate	[redacted]	[redacted]	[redacted] (40 per cent less)

Source: Zincara, AER Access Arrangement 2019 AGN Capital Expenditure, report prepared for the AER, November 2020, p. 31

[11] As per GHD's discussion with AGN's representative on 16/12/20

[12] Refer to: https://www.elster-perfection.com/assets/downloads/PMTT-Brochure.pdf

Insertion of mains is primarily cheaper due to the reduction in earth works, and the exposure of existing third-party utilities/services, as only bends and service connections are exposed by excavation typically every 10 to 15 metres, unlike direct burial which requires a continuous trench. The following key items highlight the benefits of insertion methods:

- Reduction in excavated trench length
- Reduction in reinstatement of hard surfaces (bitumen roads, concrete footpaths, and driveways) or eliminates trenchless crossing techniques which are costly
- Reduction in associated services (traffic control)
- Reduction in social disruptions (road closures, short term property access restrictions, noise)

Direct burial creates a greater societal impact with larger amounts of excavation required to take place and the potential closure of roads and footpaths. Insertion method still requires excavations to allow the new main to be inserted, although significantly reduced compared with direct burial.

Finally, although the inserted pipe is smaller in diameter than the replaced main, the shortfall in capacity (where replaced mains were already operating at high pressure) caused by the smaller pipe size is managed by additional 'ring main' style connections. These ring main connections enable supply of gas from various other connections in the network which also improves network reliability and eliminates dead ends in the network.

3. Previous AER determinations

Mains replacement by insertion is commonly used by gas network operators and has been the subject of several prior regulatory determinations. The AER has previously allowed for the accelerated, depreciation of mains replaced through insertion.

For example, the AER has previously approved accelerated depreciation for AGN's Victorian Network, where CI/UPS and polyvinyl chloride (PVC) non-performing mains were replaced by insertion. In the final decision, the AER states: "In the draft decision, we accepted AGN's proposed year-by-year tracking real straight-line approach to calculate the regulatory depreciation allowance and accelerated depreciation of assets to be replaced through its mains replacement programs over the 2018–22 access arrangement period." [13] It is reasonable to infer from the AER's acceptance of accelerated depreciation that they did not consider the mains replaced through insertion in the program have any residual asset value.

While the CI/UPS and PVC mains replacement programs involve different materials and sizes of pipes to that being considered in AGN's proposed mains replacement program, the functional role of the old pipe casing are the same in that it cannot be used to provide gas haulage services and does not provide any additional asset management support.

In Section 2.2.1 of the 2016 Incenta Report for AGN Victoria[14], several examples of the AER accepting adjustment of depreciation for replaced assets is provided:

- AusNet Services (Victorian gas distributor) replacement of low pressure mains and services undertaken in the 2013-17 AA period.
- AusNet Services (Victorian electricity distributor) to reflect replacement of assets in bushfire prone areas (2016 to 2020 period).
- Ergon (Queensland electricity distributor) to adjust depreciation to permit the recovery of assets damaged in a cyclone (2010 to 2015 period).
- United Energy (Victorian electricity distributor) to adjust depreciation to reflect the replacement of certain assets (2011 to 15 period).

The Essential Services Commission in Victoria has also permitted Multinet (Victorian gas distributor) to adjust depreciation to take account of its replacement of low pressure mains.

3.1 Modifications versus replacement

In its draft determination, the AER stated "the insertion method of addressing poor asset performance can be viewed as an asset reinforcement or modification rather than a like for like replacement."[15]

GHD does not consider AGN's mains replacement program can reasonably be considered a reinforcement or modification to improve performance, rather the replacement is being undertaken on safety grounds. For the program to be considered as a modification, there would need to be some residual value or use to the old replaced mains. For the reasons outlined in this report, GHD does not consider there is any residual value to the replaced pipeline, we do not consider the old and segmented main provides any ongoing asset management support. The gas supply is 100% provided through the new mains, and the replaced mains no longer have a role to play. It follows the replacement program is not a reinforcement or a modification.

[13] AER, *Attachment 5 – Regulatory depreciation Final Decision– AGN Victoria and Albury gas access arrangement 2018-2020*, p. 5-5

[14] AGN (Victoria and A bury), *2018-2022 AA submission Attachment 9.1 - Incenta - Low Pressure Mains and Services Depreciation*, December 2016, pp. 1-2

[15] AER, *Attachment 5: Capital Expenditure, Draft Decision – Australian Gas Networks (SA) Access Arrangement 2021-26*, p. 14.

4. GHD's assessment

GHD finds there is no residual value to the replaced pipeline and, therefore, it is appropriate to accelerate the depreciation of these assets within the access period as the mains are replaced.

The replaced mains play no role in the ongoing delivery of gas haulage services and do not provide any additional asset management support to the new main.

The reasons for GHD's assessment are:

- The old main sections that remain have been cut out every 10 to 15 metres during the insertion process such that it is no longer a continuous main and does not have any structural integrity. Disconnected sections of mains cannot provide gas haulage services and do not provide any additional containment of leaks.
- Equipment used at inlets/service points is replaced in the process, and pipe that comprises the service connection to the customer is only used as a conduit where it is large enough for the new service pipe to be inserted (in the same way the replaced pipe is used as a conduit for the rest of the main). Where the service is not large enough for the new service to be inserted, a new service will be laid separately, or where possible the old service is split to allow for the new service pipe to be installed.
- There is no additional asset management support, including:
  - No additional pressure support due to the replaced mains not having sufficient ongoing structural integrity.
  - No change to damage tolerance from third-party excavation impacts as both HDPE materials pipe material used in the network provide no structural resistance to penetration.

The only function the old pipeline serves is to act as a conduit for laying the new pipeline and the benefit of this role is realised in the lower replacement costs compared to other replacement methods. As such, GHD does not consider mains replacement is a modification to the existing pipeline.

In GHD's opinion, if AGN were to replace the mains via direct burial rather than insertion, there would be no difference to the gas haulage service being provided, the leak protection offered, the expected life or the safety rating applied to the mains. Hence, from a functional perspective, the two methods achieve the same end and are both replacements.

Finally, we note in previous determinations the AER has approved the accelerated depreciation including of mains replaced through insertion. The most relevant examples include includes:

- AGN (Victorian gas distributor) CI/UPS and PVC mains replacement program being undertaken in the 2018-22 AA period.
- AusNet Services (Victorian gas distributor) replacement of low pressure mains and services undertaken in the 2013-17 AA period.

GHD Advisory

Appendices

Appendix A List of acronyms

The following acronyms, terms and abbreviations have been used in this report.

Acronym / term / abbreviation	Meaning
AA	Access Arrangement
AER	Australian Energy Regulator
AGN	Australian Gas Networks
CAPEX	Capital Expenditure
CI	Cast Iron
DN	Nominal Diameter
HDPE	High Density Polyethylene
HP	High Pressure (distribution network pressure class)
MP	Medium Pressure (distribution network pressure class)
PVC	Polyvinyl Chloride
UPS	Unprotected Steel

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In addition to the author and reviewers below GHD acknowledges the contributions from Russel Mills and Haydn Scott-Kilsby.

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