THE INFRASTRUCTURE PLANNING
(APPLICATIONS: PRESCRIBED FORMS AND
PROCEDURE) REGULATIONS 2009

Preesall Underground Gas Storage Facility, Lancashire

Gas Interconnector Pipeline to the NTS

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<tr>
<td>Author:</td>
<td>McMahon Design &amp; Management Ltd. Consulting Engineers &amp; Project Managers 15 The Seapoint Building Clontarf Road Dublin 3</td>
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<tr>
<td>BV Station / Block Valve Station</td>
<td>An installation providing a facility to shut down the flow of gas in a pipeline.</td>
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<td>Brinewells</td>
<td>Underground caverns developed by ICI for the recovery of salt.</td>
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<td>Cover</td>
<td>Depth to which a pipeline is buried – measured from the top of the pipe.</td>
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<td>The National Transmission System used for the conveyance of natural gas and operated by National Grid.</td>
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<td>The connection of a branch pipeline to the NTS.</td>
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Summary

1. Halite Energy Group Limited (Halite) proposes to construct a 42” diameter pipeline from the proposed Underground Gas Storage Facility (UGS Facility) at Presall to connect with the National Transmission System (NTS) near Nateby.

2. This report is in three distinct sections. Part I deals with the establishment of the control points for the proposed interconnector pipeline to the NTS and general pipeline route. Part II deals with route considerations, and Part III covers the specific pipeline routing at the main Project site at Presall.

3. The NTS, which runs approximately 12km to the east, is comprised of two 42” diameter high pressure gas transmission pipelines. These are designated as Feeder 15 and Feeder 21 and their routing is through land in agricultural use in open countryside in the Nateby area. This aspect provides the facility for connection of the proposed pipeline from the UGS Facility without undue restriction.

4. The terminus at the western end will be at the Gas Compressor Compound (GCC) on the Halite land at Presall.

5. Considerations which were taken into account in developing pipeline route options include:
   - Proximity to normally occupied buildings,
   - Road and track crossings
   - Water courses
   - Drains
   - Land drains
   - Other pipelines
   - Utilities
   - Minimisation of property severance

6. Arising from these considerations, three potential route options were identified. One route option lies to the south of Stalmine (Route 1) and two route options (Route 2A and 2B) lie to the north of Stalmine.

7. In general terms, the environmental features for each route are common and environmental impact would therefore be broadly proportional to the length of the respective routes. On that basis Route 2A would have the least impact.

8. The possible route options were issued to the Land Agent for Halite. There is no overriding preference from a Land Agent viewpoint, however the Land Agent confirmed that Option 2A is the route option with the least impact on residential development.
9. Taking the various factors into account, the optimum route is Route 2A and this has been identified by Halite as the preferred general route.

10. An aspect which is common to all three options is a relatively short section of route at the main Preesall site on the immediate approach to the proposed GCC along the general line of Monk’s Lane. There are a number of abandoned brinewells in that area and, as the stability of these is a consideration in terms of pipeline routing, this aspect is taken into account in the assessment of route alignment over that section. Details of this are contained in Part III of this Report.

11. Part III of the Report dealing with the pipeline at Preesall is in three distinct parts. The first part highlights the necessity for the report, the second part deals with the assessment of alternative pipeline route corridors and the third and final part deals with the pipeline routing design in the preferred corridor.

12. The preferred and recommended option is in the southern corridor. It follows the general line of Monk’s Lane and then swings south to cross Back Lane before turning east to join the planned route of the link pipeline to the NTS at a point to the west of High Gate Lane (A588).

13. The preferred option traverses an area in which there are a number of brinewells and it also passes close to the abandoned underground salt mine. There are extensive records for the brinewells and the stability of individual wells has been documented in the British Geological Survey Report by D.J. Evans & E. Hough (CR/10/007) and the Pipeline Subsidence Assessment Report by Mott MacDonald (November 2011). These reports confirm that:

- Brinewells with a salt roof in place have been shown to be stable over a long period and can be considered as presenting negligible risk of roof deterioration and accordingly, negligible risk of collapse over the lifetime of the gas storage project.
- Brinewells with a marl roof have been shown to deteriorate at rates of the order of 0.5 metres to 3.0 metres per year and subsequent collapse is inevitable over time.

14. Brinewell BW45 has a salt roof with a thickness of 38-39 metres and is for all purposes considered to be stable. A recent blowout (June 2011) from BW45 was thoroughly investigated and the brinewell was found to be completely stable and unaffected by the blowout. A pocket of trapped air in the top of the well had been released when the string into the well had become corroded to the point of releasing the trapped air to rise up the string driving the brine out at the wellhead. This required local environmental remediation. The gas interconnector pipeline will be run at a suitable distance away from all of the wellheads so as to minimise any risk.
15. However, a risk, even if negligible and not significant, is never absolutely zero and this report identifies that, as a route is available which threads its way between the brinewells, this is the route that has been selected so as to ensure that risk is avoided to fullest possible extent.

16. In the case of the underground mine and the brinewells with marl roofs the following parameters have been applied in delineating a suitable pipeline corridor:

- A clearance of 30 metres southwest of Upper Mine corner points in order to limit possible settlement to 100mm.

- A 75 metre clearance from the circumference of BW50 because of the marl roof and probable crownhole development according to the Mott MacDonald calculations for a 40 metre depth of overburden.

- A 61.5 metre clearance from the circumference of BW98 because of the marl roof and potential for crownhole development, according to the Mott MacDonald calculations for a 32 metre depth of overburden.

17. The detailed route of the pipeline at Preesall therefore avoids crossing over any brinewells, keeps clear of the drawdown areas of brinewells which have marl roofs and maintains a clearance greater than 30 metres from the Upper Mine on a line which follows the potential maximum subsidence of 50 mm.

18. The detailed route of the pipeline is on stable ground throughout the corridor. However, additional measures can be taken, if required, to reinforce the stability of the corridor and this provides further confidence and assurance on the suitability of the proposed route.
Part I
Control Points
1. BACKGROUND AND INTRODUCTION

1.1 Halite Energy Group Limited (Halite) is applying to the Infrastructure Planning Commission (IPC) for a Development Consent Order (DCO) to construct and operate an Underground Gas Storage Facility (UGS Facility) at Preesall, Lancashire (the Project). The Project requires direct pipeline linkage from the UGS Facility to the National Transmission System (NTS) at Nateby, 12.3 kilometres to the east of the main Project site at Preesall.

1.2 This report is in three distinct sections. This Part I deals with the establishment of the control points for the proposed interconnector pipeline to the NTS and general pipeline route. Part II deals with route considerations and Part III covers the specific pipeline routing at the main Project site at Presall.

1.3 The schematic of the NTS in the northwest is outlined in Fig. 1, and features the following elements:

1) A Compressor Compound at Carnforth, near Lancaster,
2) A pair of 42” pipelines extending south from Carnforth. These are Feeders 15 and 21.
3) Feeders 15 and 21 extend southwards from Carnforth to Treales and on through to Warburton near Manchester. Feeders 15 and 21 are an integral element of the overall National Transmission System.

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Fig 1: Schematic of the NTS in the North West
1.4 Halite propose to connect into both NTS pipelines so as to provide maximum flexibility in terms of integrated operation of the gas storage facility and the NTS. The Halite pipeline is planned to be 42" diameter and the planned connection scenario is:

- 2 No. 36" connections into Feeder 21.
- 2 No. 36" connections into Feeder 15.

1.5 The 36" connections can technically be at any site location along the 42" NTS pipelines, subject to land availability. Ideally the connections would be in open terrain, which would facilitate the construction of an Off-Take / Metering.

1.6 Feeder 15 has a Block Valve Station at Churchtown, near Garstang. Feeder 21 has a Block Valve station at Nateby, approximately 2.5km further west.

1.7 The routes of Feeders 15 and 21, together with pipeline route options (Route 1, Route 2A and Route 2B), are shown in Fig. 2. This figure also shows the Block Valve Stations at Churchtown, (Feeder 15), and Nateby, (Feeder 21), together with the location of the proposed Gas Compressor Compound at Preesall, on the east bank of the Wyre Estuary.

1.8 The routing of Feeders 15 and 21 is through land in agricultural use and, in terms of land-use, there is every facility for locating an Off-Take/Metering Station without undue restriction.

1.9 Feeder 21 is the more westerly pipeline and the proposal is to initially connect into it with the connection to Feeder 15 to follow as the gas storage facility develops and the throughput increases. This report is therefore based on that sequence.
Fig. 2: Possible Pipeline Routes
2. **FEEDER 21**

2.1 The Block Valve on Feeder 21 is identified as Nateby BV, and its location is shown in Fig. 3.

![Fig. 3: Nateby BV Station (Location Map)](image)

2.2 The Block Valve is in a relatively remote location but is fully accessible. Vehicular access is from Cartwell Lane/Black Lane via Station Lane, and then 350 metres along a track, which is on the line of an abandoned railway.
2.3 A photograph of the Block Valve installation is shown in Fig. 4.

![Fig 4: Above ground equipment at Nateby BV Station](image)

2.4 The Block Valve station is surrounded by fields that are in use for grazing. The field to the south of the Block Valve station is shown in Fig. 5. Subject to availability of land and agreement with National Grid, there is nothing that would inhibit or restrict the 2 no. 36" off-takes and the development of a Metering Station in the immediate vicinity of Nateby.

![Fig 5: Looking south from Nateby BV Station](image)
3. FEEDER 15

3.1 The Block Valve on Feeder 15 is identified as Churchtown BV and its location is shown in Fig. 6.

![Fig 6: Churchtown BV Station](image)

3.2 The Block Valve at Churchtown is to the east of the Lancaster Canal and on the outskirts of Garstang. Access is via Nateby Hall Lane, which is quite narrow and restricted in terms of horizontal alignment. There are also a number of houses in the general area, including Nateby Hall Cottage and Nateby Bungalows.
3.3 The terrain between the Lancaster Canal and Longmoor Lane is open farmland and, subject to land availability, would readily facilitate a Metering Station with access to be provided from Longmoor Lane. This area is shown in Fig 8.
Fig. 8: Route of Feeder 15 in the area between the Lancaster Canal and Longmoor Lane
3.4 The preferred option for an Off-Take / Metering Station is in the vicinity of the Block Valve Station at Nateby on Feeder 21, as this would be consistent with the planned integration of the pipeline with the NTS. The preferred off-take on Feeder 15 would be at Long Wood. These locations in the general Nateby area, together with the Gas Compressor Compound at Preesall, are the control points for route selection.

Fig. 9: Preferred Off-Take / Metering Station Location on Feeder 15
4. GAS COMPRESSOR COMPOUND

4.1 The proposed Gas Compressor Compound at Preesall is at the northern end of the proposed UGS Facility at Preesall and west of Monk’s Lane (Fig. 10). It is approximately 575 metres west of Back Lane and the nearest dwelling is Cote Walls Farm which is 235 metres to the north. The land is currently in agricultural use.

![Fig. 10: Proposed Gas Compressor Compound at Preesall](image)
4.3 An aerial photograph of the area is presented in Fig. 11.

Fig. 11: Aerial Photo of site of proposed Gas Compressor Compound at Preesall
5. ROUTE TERMINALS

5.1 The existing Block Valve stations at Nateby and Churchtown have been located and the precise locations of Feeders 15 and 21 have been determined from roadside marker posts. The ideal would be to have off-takes upstream and downstream of the Block Valve at Nateby and in the area between the Lancaster Canal and Longmoor Lane (in the vicinity of Long Wood). There is therefore a clear definition of the preferred tie-in points on the NTS.

5.2 The proposed pipeline would tie-in at the Filters / Dryers area of the proposed Gas Compressor Compound at Preesall at a point which is effectively defined by National Grid Co-ordinates E 335737.6, N 446440.0

5.3 The two connections in the general Nateby area, together with the proposed layout for the proposed Gas Compressor Compound at Preesall (Ref. Fig. 2), have therefore been taken as "route control points" in considering the options for the interconnector pipeline to the NTS.
6. GAS PIPELINE ROUTE CONSIDERATIONS

Overview

6.1 The gas interconnector pipeline will link the proposed Gas Compressor Compound at the proposed UGS Facility at Preesall with Feeders 15 and 21 of the NTS. The proposed Gas Compressor Compound is located at Preesall. The connections to the NTS will be hot taps and can be located at any convenient location with the agreement of National Grid.

6.2 Both the Nateby Block Valve Station and the Long Wood area are located in open farmland, and are accessible for construction plant and equipment. Both locations have sufficient open area for unconstrained approach in terms of pipeline routing.

6.3 A desk study, supplemented by a field visit, has been conducted to locate potential pipeline routings. In general, the intervening countryside is a flat or gently rolling, lightly populated rural environment. The only substantial community along the route is Stalmine and the only significant road crossing is the A588, which runs through Stalmine. Accordingly, consideration was given to bypassing Stalmine, to either the north or south, and selecting the crossing point for the A588. After this initial determination, the open environment provides a high level of flexibility in terms of route selection for an interconnector pipeline.

6.4 In routing a pipeline, particular consideration is given to the proximity of occupied buildings and the number of crossings of roads, tracks, watercourses, other pipelines, utilities, and property lines. Ultimately, the objective is to optimise the pipeline routing, which generally involves minimising all of the above considerations.

6.5 These considerations are discussed individually in the following section.

Route Considerations

Proximity to Occupied Buildings

6.6 Standards for onshore gas pipelines establish two specific criteria for determining limitations for the allowable proximity of gas pipelines to normally occupied buildings. In both cases, the primary parameters affecting proximity to such buildings are pipe diameter and design pressure but wall thickness, or design factor, is also a consideration in the determination of the allowable proximity in each case.
6.7 The first case (Case 1) applies to individual structures and is absolute. This proximity distance is ascertained from Figure 2 of BS 8010, Section 2.8. For example, a 1068mm (42 inch) pipeline operating at 85 bar with a design factor of 0.72 would require a minimum distance of 103 metres from any normally occupied building. A closer proximity is allowed provided the design factor is reduced and the wall thickness increased.

6.8 The second case (Case 2) addressed in the standards deals with groups of buildings as would be the case near a community such as Stalmine or other building clusters such as an industrial complex, shopping centre, etc. This requires considering a rolling area block 1.5 km in length and 10 times the minimum distance determined from Figure 2 (see above paragraph) centred on the pipeline alignment. If the population density within this block is less than 2.5 persons/hectare, the block is subject to a design factor of 0.72. If the population density is equal to or greater than 2.5 persons/hectare then a lower design factor and Heavy Wall Pipe is required for the entire length of such development.

6.9 Because of Case 2, the routing around Stalmine both north and south was selected to keep a distance of approximately 500 metres from the denser housing. Once past Stalmine, routing was selected to avoid passing within 103 metres of a building, if possible, in accordance with the requirements of Case 1 above.

Road and Track Crossings

6.10 BS 8010 classifies “roads” as major and minor public roads. Major roads include motorways and trunk roads. All other public roads are minor roads. The use of Heavy Wall Pipe is required at all public road crossings, major and minor, but vary in the extent of Heavy Wall Pipe required. Major road crossings require Heavy Wall Pipe to the extent determined for proximity to occupied buildings (see above) each side of the crossing. Minor roads require Heavy Wall Pipe only to the extent of the road width.

6.11 The principal road encountered by any route option is the A588 running north-south through Stalmine. Technically none of the roads, including the A588, crossed by the route options is a major road, i.e., none are motorways or trunk roads. However, the A588 is heavily trafficked and it is proposed to classify it as a major road for construction purposes.

6.12 The remaining public road crossings are minor crossings and unlikely to be upgraded in the foreseeable future. These roads will typically require about 12 metres of Heavy Wall Pipe. Tracks and private roads in general do not require Heavy Wall Pipe unless it can be demonstrated that they are subject to heavy vehicle loads.
6.13 Road and track crossings are generally accomplished by either open cut or by boring under the road. There are several methods of road boring including auger bore, thrust bore (with or without casing), mini-tunnelling, and directional drilling. Generally, the local authority will require a boring method for major roads to minimise traffic disruption and road surface damage. Minor roads and tracks are usually open cut.

6.14 It is likely that a road bore method will be required for crossing the A588. Some of the roads and tracks, particularly in the eastern sector of the route corridor, are constructed on fill. In certain cases, such as Bone Hill Lane, the depth of fill does not favour open cutting and road boring will be required for such a crossing.

Water Courses

6.15 Watercourses for pipeline works are generally defined as rivers, streams, and canals and are generally of significant size requiring special works. However, for the evaluation of the routing options for the pipeline between the proposed GCC and the NTS, any “named” water way was designated as a watercourse.

6.16 The watercourses crossed by any of the routes are essentially large flowing open drains (see example at Fig. 12). When crossing flowing watercourses, provisions must be made to ensure continued flow and also to keep the pipeline trench dry. Damming either side of the trench line and pumping across, or the installation of a flume pipe in the open drain, can accomplish this. Extra cover of up to 2 metres may be required to allow for cleaning or future deepening of a watercourse. Also, concrete slabs or pre-cast concrete warning tiles are placed over the pipe to identify the presence of the pipeline to any third party undertaking work on the water course and to protect the pipe from third party damage. Extra working space for trench spoil and for the fabrication of a special pipe spool will be required at the deeper crossings and must be negotiated with the landowner prior to the start of construction.
Fig. 12: Typical open drain. This one, near Stalmine, is shallower than those at the eastern end of the pipeline, but is nonetheless typical of the watercourses encountered.
6.17 The crossing of watercourses can be accomplished either by open cut or horizontal directional drilling (HDD). Boring is usually not an option as the depth of the bore pits would require extensive dewatering. Open cut is the preferred and most practical method.

Drains

6.18 The OS maps of the general region indicate a broad system of open drains. Many of the “blue” drain lines on the OS maps are shallow boundary drains (see Fig. 13 and Fig. 14) that remain dry for most of the summer months.

Fig 13: The O.S. map shows a drain, in blue, along the line of the post and wire fence running from foreground to background.
6.19 In the usual drainage scheme, pipe or French drains (hereafter referred to as land drains) would be installed so as to empty into an open drain which would in turn drain into larger and deeper open drains perhaps feeding into a watercourse. While land drains are not a deterrent to pipe laying, they do require special treatment before, during, and after construction.
6.20 Information about land drainage schemes gained by land agents prior to construction is essential to minimise the impact of land drains on construction. In wet areas with constant drainage it is sometimes useful to install interceptor drains ahead of construction to avoid flooding of the pipeline trench during excavation. This approach is most useful in rolling countryside. Considering the relatively flat terrain of the pipeline routes, pre-construction of interceptors may not be required over much of the route.

6.21 Where interceptors are not effective but the drains are running water, the general technique is to complete a temporary land drain connection across the trench to provide continued drainage and avoid flooding the pipeline trench. Post-construction reinstatement requires replacing the section of the land drain across the trench line. A section of similar size and type of land drain is connected across the partially back filled trench and supported on an oak bearer to ensure stability. Back filling is then completed.

6.22 Open drains are crossed in the normal open trench approach of pipelining. When open drains are flowing provisions must be made to ensure the continued flow and also to keep the pipeline trench dry. The treatment is to be the same as outlined in 6.16 for watercourses.

Other Pipelines

6.23 Regardless of the route selected, the gas pipeline from the proposed Gas Compressor Compound to Feeder 15 will have to cross two active pipelines, NTS Feeder 21 and the Shell Northwest Ethylene Pipeline (NWeP). There is also a Shell out-of-service pipeline running parallel and 30m to the west of the NWeP. The out-of-service pipeline is 12" (304mm) diameter. The out-of-service ICI water supply line from the Lancaster Canal to Preesall generally parallels the northern routes but may cross the northern route (2A and 2B) lines at one or more places. In addition, ICI water pipeline pump stations have been located on lines generally perpendicular to the gas pipeline routes and water pipelines may exist between these pump stations. Regardless of the status of pipeline being crossed by the gas pipeline, details of the crossing must be agreed with the operator of the other pipeline.

6.24 Generally, other pipelines are crossed by going under the in-place pipeline. Sufficient vertical separation between the pipelines must be provided to allow access to each line for repair should this prove necessary. Most operators will likely require a minimum spacing of 300mm between the crossing pipelines.

6.25 Ferrous pipelines (except cast iron) will have some form of cathodic protection (CP) system installed to protect the pipeline from galvanic corrosion. Where pipelines cross, it is necessary to electrically bond the pipelines to prevent galvanic action from difference in ground
potential between the pipelines. The bond cables are usually connected in a bond box with a resistor to facilitate adjusting the current, and for testing the pipe-to-ground potential.

6.26 A crossing of NTS Feeder 21 will be required if / when the gas pipeline is extended to NTS Feeder 15. This crossing will be in the immediate vicinity of the Nateby Block Valve site. Consideration should be given to pre-installing this crossing during the construction of the tie-in facilities.

6.27 The NWeP is a 10” pipeline crossing the gas pipeline, which runs north-south about 300 metres east of Station Lane in the general Nateby area. The 12” out-of-service pipeline is 30 metres west of the NWeP. The crossing will be mid-field of a cultivated area (see Fig. 15 below) and no particular difficulty is foreseen.

Fig. 15: Looking Northeast from the Parking Area at the end of Station Lane. The preferred pipeline route will cross the NWeP in the top right quadrant.
6.28 The ICI water supply is known to be out of service and it is unlikely that service will be resumed. Nonetheless, agreement with the owner must be obtained to cross the line and the manner of crossing needs to be agreed. If the water pipeline is abandoned, it may be possible to have it removed to facilitate the crossing(s).

Utilities

6.29 Known utilities on the pipeline route include water, power, and communications. Numerous hydrant locations indicate that water lines will be encountered at most road crossings. Power and communication cables are generally overhead but this does not preclude the possibility of buried cables. National Grid have a high voltage power line running north-east / south-west and it crosses the pipeline route west of Black Lane Head farm. The pipeline crosses the line of the power cable at a distance of 135 metres from the nearest pylon and will not affect either the power cables or any of their support pylons.

6.30 The construction method for crossing underground utilities is generally as described for other pipelines.

Properties

6.31 The number of property lines crossed by the pipeline route is a consideration because of the individual contacts required during way leave acquisition, pre-entry meetings, crop loss compensation meetings, etc. Minimising the number of properties crossed is usually a matter of fine-tuning the routing rather than a primary consideration.

7. OPTIMISING THE PIPELINE ROUTE

7.1 Three potential routes were identified running north and south of Stalmine. The routes are indicated on Figure 2 as Route 1 south of Stalmine and Routes 2A and 2B, which run north of Stalmine.

7.2 As noted in previous sections, optimising a pipeline route is largely a matter of selecting a route that complies with standards, takes due cognisance of environmental constraints, and minimises the initial installation costs with due consideration for life-cycle costs. Pipeline length is a major consideration and an effort in reducing length of the pipeline at the route selection stage can be significant. However, in pipeline route selection the shortest distance is not always the optimum route particularly in conditions such as hilly countryside where crossing hills with a pipeline can be costly. In the case of the pipeline to the NTS, the countryside encountered by any of the proposed routings is relatively flat and straightforward in terms of pipe laying.
7.3 Crossings of all types generally entail extra depth burial, which not only increases installation costs but may also increase maintenance costs if repairs are required in the immediate area of a crossing. Heavy Wall Pipe, when required by the standards, increases the costs of pipe acquisition and installation. The primary means of reducing Heavy Wall Pipe is to avoid high density (Class 2 areas). Public road crossings also require Heavy Wall Pipe. Optimising the length of Heavy Wall Pipe is a matter of avoiding high-density areas, minimising public road crossings, and crossing major roads at a right angle to the road.

7.4 Applying the above considerations, three potential routes were selected as shown in Figure 2. Route 1 is the option for passing south of Stalmine.

7.5 There are two routes to the north of Stalmine (Routes 2A and 2B).

7.6 A comparison of route-optimising features for the route study is summarised in Table 7.1. The distance to Feeder 15 is a further 2,190 metres and requires an additional road crossing at Station Lane. As noted, these values are indicative and may vary as the engineering phase progresses. However, they provide a firm starting point for route development and finalisation.

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Table 7.1: Indicative Route Conditions from the Compressor Compound to Nately Block Valve Station

7.7 The possible route options were issued to the Land Agent for Halite. There is no overriding preference from a Land Agent viewpoint, however the Land Agent confirmed that Option 2A is the route option with the least impact on residential development, and correspondingly, the least length of Heavy Wall Pipe.

Route 1

7.8 The route to the south of Stalmine is 11.463 km in length. It requires 821 metres of Heavy Wall Pipe to comply with the standards and, as road crossing requirements are not significantly different in any of the options, the extent of Heavy Wall Pipe indicates that this route has most impact in terms of proximity to buildings.
Route 2A
7.9 Route 2A is to the north of Stalmine and is developed on the basis of minimising impact on dwellings. It is 10.25 km in length and requires 295 metres of Heavy Wall Pipe. When road crossings are taken into account, the extent of Heavy Wall Pipe is significantly reduced and this is indicative of least impact in terms of proximity to dwellings.

Route 2B
7.10 Route 2B is a variation on Route 2A. It is 10.379 km in length and is effectively the same length as Route 2A. However, the requirement for Heavy Wall Pipe is increased to 485 metres and this is indicative of a greater level of impact in terms of proximity to dwellings than Route 2A.

Preferred general route
7.11 In general terms, the environmental features for each route are common and environmental impact would therefore be broadly proportional to the length of the respective routes. On that basis Route 2A would be marginally better than Route 2B. In addition, when proximity to dwellings is taken into account the optimum route is clearly Route 2A and this was identified by Halite as its preferred route. This is presented in Fig. 16.

7.12 An aspect which is common to all three options is a relatively short section of route at the main Preesall site on the immediate approach to the proposed GCC along the general line of Monk’s Lane. There are a number of abandoned brinewells in that area and, as the stability of these is a consideration in terms of pipeline routing, this aspect is taken into account in the assessment of route alignment. Details of this are contained in Part III below.
Fig. 16: Preferred pipeline route with chainage points (KP’s) together with Road, Track and Stream Crossings
Part III
Pipeline at Proposed UGS Facility at Preesall
8. LOCATION OF GAS COMPRESSOR COMPOUND

8.1 The proposed GCC can be accessed via Monk's Lane and is situated due west of an abandoned underground mine and northwest of a group of decommissioned brinewells.

8.2 When the location and distribution pattern of brinewells is taken into account, together with water bodies and residential development, the potential for route corridors at the main Preesall site was reduced to;

1). **Southern Corridor**
   A corridor extending south east from the proposed GCC generally along the line of Monk's Lane.

2). **Northern Corridor**
   A corridor running northwards from the proposed GCC and then turning east generally following the line of the abandoned railway.

The overall pattern is shown in Fig. 17.
Fig. 17: Proposed Gas Compressor Compound, brinewells, abandoned salt mine and the two route corridors at Preesall
9. ALTERNATIVE PIPELINE ROUTES

Options
9.1 The alternative routes are designated as Options 1 to 4. Options 1 and 2 relate to a southeasterly corridor and Options 3 and 4 are in a northerly corridor. The four route options are shown in Fig. 18.

Fig. 18 – Alternative Pipeline Route Options at Preesall

9.2 The alternative route options are presented on an aerial photography base in Fig. 19.
Fig. 19: Alternative Pipeline Corridors at Preesall
General Route Features – Options 1 and 2

9.3 Option 1 and Option 2 have a common section from the proposed GCC where the route threads its way through some brinewells as it runs south eastward to Back Lane. Option 1 swings south to cross Back Lane and then turns east to join the proposed NTS link pipeline at the A588.

9.4 Option 2 extends eastwards from the end of Monk’s Lane, crosses Back Lane and then continues eastwards, parallel to and north of Cemetery Lane, to cross Park Lane (B5377) to the north of its junction with the A588. It then continues in an eastward direction to join the originally proposed NTS link pipeline route at approximately 4km east of the A588.

General Route Features – Options 3 and 4

9.5 Option 3 runs north from the proposed GCC. It can either run along the western edge of the Biological Heritage Site or it can skirt the western edge. It then veers north-easterly and threads its way through a number of abandoned brinewells to cross Park Lane and join the abandoned railway line. It then crosses Sandy Lane and continues in an easterly direction to join the proposed link pipeline to the NTS approximately 5 km east of the A588.

9.6 Option 4 is common with Option 3 as it runs north from the proposed GCC. It then continues in a northerly direction and joins the abandoned railway line to swing eastwards and rejoin the line of Option 3 before it crosses Park Lane.

10. ASSESSMENT OF ROUTES AT PREESALL

Pipeline Lengths

10.1 The lengths of the overall pipeline for the various options from the proposed GCC to the NTS at Nateby are;

<table>
<thead>
<tr>
<th></th>
<th>Nateby BV</th>
<th>Long Wood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option 1</td>
<td>10.25km</td>
<td>12.44km</td>
</tr>
<tr>
<td>Option 2</td>
<td>10.18km.</td>
<td>12.37km</td>
</tr>
<tr>
<td>Option 3</td>
<td>11.25km.</td>
<td>13.44km</td>
</tr>
<tr>
<td>Option 4</td>
<td>11.65km</td>
<td>13.84km</td>
</tr>
</tbody>
</table>
10.2 Comments are as follows;

- The length of the interconnector pipeline to the NTS is effectively the same for Options 1 and 2 at 10.25 km and 10.18 km respectively.

- Option 3 is significantly longer (11.25 km) than Options 1 or 2, has restricted crossings at Park Lane and Sandy Lane and comes into close proximity to residential development east of Sandy Lane.

- Option 4 is the longest of the pipeline route options at 11.65 km and it shares the constraints of Option 3 at Park Lane, Sandy Lane and east of Sandy Lane.

**Brinewell Considerations**

10.3 The alternative routes traverse similar terrain and similar features. Option 1 and Option 2 thread their way past a number of brinewells along Monk’s Lane. These brinewells were operational typically between 1907 and 1927 and were developed with controlled brining techniques (Ref. Pipeline Subsidence Assessment Report by Mott MacDonald – November 2011). These brinewells are generally considered to be superior to the earlier brinewell developments.

10.4 Option 3 and Option 4 extend through the former North Field brinewells where the brinewells are amongst the oldest (constructed between 1897 – 1927) and utilized brining methodology which was crude and relatively uncontrolled compared with later stage workings. Such relatively uncontrolled brining methodologies present risk of unacceptable undermining and weakening of strata. (Ref. Pipeline Subsidence Assessment Report by Mott MacDonald – November 2011). These considerations bring the stability / reliability of Option 3 and Option 4 into question.

**Preferred Pipeline Route**

10.5 Option 1 and Option 2 are preferred to either Options 3 or 4 in relation to length of pipeline (and therefore overall community and environmental impact), constraints at road crossings and proximity to residential development.

10.6 Option 1 is preferred to Option 2 in terms of least impact on development and it also follows the planned line of the proposed link pipeline to the NTS to the greatest possible extent. Insofar as the planned link pipeline has already been assessed and evaluated and found to be eminently acceptable, Option 1 is the option which Halite has selected for the Project (Fig. 20).
Fig. 20: Option 1 connecting to proposed NTS Route.
11. DETAILED PIPELINE ROUTING AT PREESALL

11.1 The preferred pipeline route (Option 1) traverses an area in which there are a number of brinewells and which passes close to the abandoned underground salt mine.

11.2 In the area being considered, three hazards to the gas pipeline need to be considered and quantified. These are;

(a). that a crown hole collapse of a brinewell would develop through the mudstone and till strata and spread its zone of collapse so as to possibly displace the gas pipeline and

(b). that settlement in the Upper Mine and/or the Lower Mine would cause settlement of the pipeline

(c). that a brinewell blowout would cause localised fluidisation of the ground and flooding in the vicinity of the wellhead which would not impair the integrity of the pipeline, but could be detrimental to the environment and may require an appropriate remediation.

11.3 There are extensive records for the brinewells and the stability of individual wells in general have been the subject of specific reports by the British Geological Survey (BGS) in 2010 incorporating data from both ICI (hooking and dipping records) and SOCON sonar survey results. Further work has been done by Mott MacDonald and this has been issued in their Pipeline Subsidence Assessment Report of November 2011.

11.4 The BGS report, Internal Report CR/10/007 by D.J. Evans and E. Haugh, 2010, has examined all the past geological and sonar survey data for all the brinewells in the area and has concluded as follows;

1). Brinewells with a salt roof in place have been shown to be stable over a long period and can be considered as presenting negligible risk of roof deterioration and accordingly, negligible risk of collapse over the lifetime of the gas storage project.

2). Brinewells with a marl roof have been shown to deteriorate at rates of the order of 0.5 metres to 3.0 metres per year and subsequent collapse is inevitable over time.

11.5 Insofar as brinewells are present throughout the lands at Preesall, the presence of mostly salt-roofed brinewells in the north east area around Monk's Lane provides possible routing having negligible risk for a gas pipeline.

11.6 The abandoned underground mine comprises an Upper Mine and a Lower Mine. The Upper Mine has a salt roof thickness of 10 metres.
and in that case the stability of the mine is in the same category as salt-roofed brinewells i.e. negligible risk of collapse within the lifetime of the gas storage project.

11.7 The Lower Mine has an additional 100 metres of salt cover over its roof, is further away from the pipeline corridor and is considered to have no potential impact on the pipeline corridor.

11.8 The locations of the underground features are presented in Fig. 21.
Fig. 21: Abandoned Mine and Brinewell Locations

Diameter of BW’S 98 and 47 based on historical ICI data
Details of Relevant Mines and Brinewells

11.9 For the projected route corridor the salt mine and brinewells which could have a possible direct impact on the pipeline are:-

(1) The SW boundary of the Upper Salt Mine – salt roof
(2) Brinewell BW51 – salt roof
(3) Brinewell BW46 – salt roof
(4) Brinewell BW102 – salt roof
(5) Brinewell BW45 – salt roof
(6) Brinewell BW49 – salt roof
(7) BW9 – Borehole – not developed as a brinewell
(8) Brinewell BW78 – salt roof

11.10 In addition, the salt mine and brinewells having a possible but more remote effect on the pipeline are:-

(9) Brinewell BW44 – marl roof
(10) Brinewell BW50 – marl roof
(11) Brinewell BW98 – marl roof (*based on historical ICI data*)
(12) Brinewell BW47 – salt roof (*based on historical ICI data*)

Descriptions of these potential hazards are given below and are summarized in Table 11.1.
# Table 11.1: Summary of Brinewell and Mine Levels

<table>
<thead>
<tr>
<th>Brinewell (BW)</th>
<th>Ground Level (mOD)</th>
<th>Top of Mudstone (mOD)</th>
<th>Top of Salt (mOD)</th>
<th>Highest Point of Cavity (mOD)</th>
<th>Roof Stratum</th>
<th>Roof of brinewell Above Top of Salt (m)</th>
<th>Roof of brinewell Below Top of Salt (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>44</td>
<td>7.4</td>
<td>-23</td>
<td>-160</td>
<td>-88.7</td>
<td>Marl</td>
<td>71.3</td>
<td>-</td>
</tr>
<tr>
<td>45</td>
<td>10.4</td>
<td>-22</td>
<td>-140</td>
<td>-178.6</td>
<td>Salt</td>
<td>-</td>
<td>38.6</td>
</tr>
<tr>
<td>46*</td>
<td>10.9</td>
<td>-28</td>
<td>-141</td>
<td>-145.8</td>
<td>Salt</td>
<td>-</td>
<td>**56 (4.8)</td>
</tr>
<tr>
<td>47</td>
<td>7</td>
<td>-28</td>
<td>-134</td>
<td>-143</td>
<td>Salt</td>
<td>-</td>
<td>9.0</td>
</tr>
<tr>
<td>49</td>
<td>13</td>
<td>-19</td>
<td>-146</td>
<td>-159.7</td>
<td>Salt</td>
<td>-</td>
<td>13.7</td>
</tr>
<tr>
<td>50</td>
<td>9</td>
<td>-20</td>
<td>-147</td>
<td>-72.3</td>
<td>Marl</td>
<td>74.7</td>
<td>-</td>
</tr>
<tr>
<td>51*</td>
<td>10</td>
<td>-32</td>
<td>-142</td>
<td>-148.5</td>
<td>Salt</td>
<td>-</td>
<td>**44 (6.5)</td>
</tr>
<tr>
<td>78</td>
<td>8</td>
<td>-20</td>
<td>-120</td>
<td>-128.7</td>
<td>Salt</td>
<td>-</td>
<td>8.7</td>
</tr>
<tr>
<td>98</td>
<td>8</td>
<td>-18</td>
<td>-126</td>
<td>-108.8</td>
<td>Marl</td>
<td>17.2</td>
<td>-</td>
</tr>
<tr>
<td>102</td>
<td>14</td>
<td>-21</td>
<td>-133</td>
<td>-147.9</td>
<td>Salt</td>
<td>-</td>
<td>14.9</td>
</tr>
<tr>
<td>9</td>
<td>8</td>
<td>-24</td>
<td>-136</td>
<td>-</td>
<td></td>
<td>Note: Shaft to Top of Salt only. No brinewell formed.</td>
<td></td>
</tr>
<tr>
<td>Upper mine</td>
<td>12</td>
<td>-23</td>
<td>-132</td>
<td>-142.4</td>
<td>Salt</td>
<td>-</td>
<td>10.4</td>
</tr>
<tr>
<td>Lower mine</td>
<td>16</td>
<td>-20</td>
<td>-120</td>
<td>-242</td>
<td>Salt</td>
<td>-</td>
<td>122</td>
</tr>
</tbody>
</table>

* BW 46 has migrated into the base of BW 50 but otherwise has a salt roof
* BW 51 has migrated into the base of BW 50 but otherwise has a salt roof
** Thickness at Brinewell (Migrated thickness)
The Upper Salt Mine

11.11. The south west area of the Upper Mine has a salt roof 10 metres thick. According to the BGS report the risk of collapse is negligible. Since the mine is flooded with static brine, the Mott MacDonald report of November 2011 establishes its stability against subsidence from pillar collapse. However, the Mott MacDonald report has also used National Coal Board (NCB) methods to calculate what the subsidence might be in equivalent coal-bearing formations. The Mott MacDonald calculations indicate that while total subsidences of up to 2.0 metres could occur within the mine area, that subsidence would be reduced to 0.1 metres at 30 metres outside the mine boundary and to 0.0 metres at 70 metres outside the mine boundary.

11.12 Accordingly, the route corridor has been located 30 metres outside the SW corners of the mine to limit the risk of subsidence, however remote, to 0.1 metres maximum adjacent to the Upper Mine area. For pipeline design purposes, Mott MacDonald have interpreted the 0.1 metres maximum subsidence as equivalent to a 2mm/metre differential settlement of the pipeline.

Brinewell BW51

11.13 The northern cavity of BW51 has a salt roof with a thickness of 44 metres and so, according to the BGS report, is stable. However, in the BGS report “stability” is “for the life of the gas project” and is not absolute. In order to provide for protection against crownhole formation, however remote, at BW51, the pipeline route corridor has been located northwards outside the short-term drawdown of the crownhole, which is 24 metres outside the plan of the brinewell in accordance with the calculations in the Mott MacDonald report of November 2011. This precaution will allow protective measures for the pipeline to be put in place should a crownhole development ever become a possibility. The basis for the Mott MacDonald calculations is shown in Fig. 23.2 which outlines the geometry of a crownhole and its drawdowns. The crownhole projects directly upwards through the intact mudstone and then splay out, at 28º to the vertical in the short term, enlarging to 59º to the vertical in the long term. Using a typical depth of 45 metres to intact mudstone, Mott MacDonald has calculated the short term and long term spreads at 24 metres and 75 metres respectively.

11.14 Brinewell BW51 has migrated west and away from the route corridor, into the caverns of brinewells BW44 and BW50, both of which are in the process of forming a combined crownhole. This migration does not affect the stability of the northern cavity of brinewell BW51 which is south of the proposed pipeline route corridor.
Brinewell BW46

11.15 Brinewell BW46 has all of the characteristics of brinewell BW51 described above and the plans of the caverns overlap. The northern cavity of brinewell BW46 has a salt roof thickness of 56 metres and so is stable. Again, as a precaution, a 24 metres northwards clearance outside the plan of the cavern is adopted for the pipeline route corridor location.

11.16 Like brinewell BW51, brinewell BW46 has also migrated west, and away from the route corridor, into the caverns of BW44 and BW50. This migration does not affect the stability of the northern cavity of brinewell BW46 south of the proposed pipeline route corridor.

Brinewell BW102

11.17 Brinewell BW102 has a salt roof thickness of 10.4 metres and may be regarded as stable in accordance with the BGS report. Again, as a precaution, a 24 metres clearance outside the plan of the cavern would be desirable, if possible. However, the clearance between the plans of brinewells BW102 and BW45 is 25 metres and so the route corridor, which passes between these brinewells, has a clearance of 12.5 metres on each side.

Brinewell BW45

11.18 Brinewell BW45 has a salt roof thickness of 38.6 metres and, having regard for the BGS report, is stable. A blow-out which occurred on 18th June 2011 has been thoroughly investigated and is discussed in paragraph 12.4. The clearance of 12.5 metres outside the plan area, described above for brinewell BW102, applies also to brinewell BW45.

Brinewell BW49

11.19 Brinewell BW49 has a salt roof thickness of 13.7 metres and in accordance with the BGS report, is stable. As a precaution a clearance of 24 metres outside the plan areas is again possible between brinewells BW45 and BW49 and onwards along the route corridor. Consequently, the length of pipeline along which the clearance is less than 24 metres is restricted to an 80 metre length between brinewells BW45 and BW102.

Brinewell BW9

11.20 Brinewell BW9 was cored only down to top of salt level and was never used for brine extraction. It presents no hazard to the gas pipeline.
Brinewell BW78

11.21 Brinewell BW78 has a salt roof thickness of 8.7 metres and in accordance with the BGS report, is stable. Brinewell BW78 has the least thickness of salt roof of any of the brinewells facing the route corridor. As a precaution, a clearance of 24 metres outside the plan area of the brinewell is again adopted.

Possible remote impact

The Lower Salt Mine

11.22 The Lower Salt Mine has a salt roof thickness of some 122 metres and its boundary approaches no closer than 100 metres to the projected route corridor for the pipeline. Any subsidence arising from the Lower Mine, however unlikely, is completely negated by the distance of the mine from the route corridor for the pipeline. Hence, the Lower Mine presents no significant hazard to the gas pipeline.

Brinewell BW44

11.23. Brinewell BW44, having a mudstone or “marl” roof, is in the process of forming a crown hole and it is reasonable to expect that this crown hole may “daylight” within the lifetime of the gas storage project. Brinewell BW44, during its process of crownhole formation, is combining with a similar crownhole formation at the adjacent brinewell BW50 so that eventually a single combined crownhole will be formed.

11.24 In addition, brineholes BW51 and BW46 have migrated, away from the route corridor area, into the area of brinewells BW44 and BW50. Such migrations, however, will not affect the formation of the combined crownhole.

11.25. The only protection against the hazard of this crownhole formation is to ensure that the route corridor is a sufficient distance away from the potential brinewell collapse and to allow for long-term draw-down conditions. This is possible and the pipeline route is not at risk from these brinewells.

Brinewell BW50

11.26 Brinewell BW50, close to and having the same marl roof as brinewell BW44, is merging with that brinewell to form a combined crownhole. Protection against the hazard of this crownhole formation is to maintain a distance of not less than 75 metres outside the plans of both brinewells BW50 and BW44 from the route corridor area, keeping the pipeline at a sufficient distance from the potential crownhole development to ensure that the pipeline is not affected. This is possible and the pipeline route is not at risk from BW50.
**Brinewell BW98**

11.27 Although brinewell BW98 is recorded as having a marl roof and of having an internal collapse, it has been dormant for many years. However, its location relative to the route corridor and behind brinewells BW45 and BW78 is such that a crownhole at brinewell BW98, were it ever to occur, would not have any major impact on the route corridor area.

**Brinewell BW47**

11.28 Brinewell BW47 has a salt roof with a thickness of 9.0 metres and, in accordance with the BGS report, is stable. As a precaution, a clearance of 24 metres outside the plan of the brinewell is adopted.

11.29 The location of a series of sections is shown on the plan in Fig. 22 and the sections themselves are shown in Figs. 23.1 to 23.8.
Fig. 22: Location of sections
Fig. 23.3: Section 12 – 12’

Fig. 23.4: Section 13 – 13’
Fig. 23.5: Section 14 – 14'
Fig. 23.6: Section 15 – 15'
Fig. 23.7: Section 16 – 16'

Fig. 23.8: Section 17 – 17'
12. PARTICULAR PIPELINE ROUTING DETERMINANTS

Route Corridor

12.1 Brinewells with salt roofs have been shown to be inherently stable for periods up to 50 years and are regarded as not being at significant risk of collapse.

12.2 Brinewells with marl roofs are liable to collapse over time and are accordingly to be avoided.

12.3 Both the Upper and Lower Mines are in salt and are also inherently stable and there is no manifestation of subsidence at ground level over the 60 odd years since the closure of the Upper Mine.

12.4 Brinewell BW45 has a salt roof with a thickness of 38-39 metres and is for all purposes considered to be stable. A recent blowout (June 2011) from BW45 was thoroughly investigated. This brinewell has a salt roof and was found to be completely stable and unaffected by the blowout. A pocket of trapped air in the top of the well had been released when the string into the well had become corroded to the point of releasing the trapped air to rise up the string driving the brine out at the wellhead. This required local environmental remediation. The gas interconnector pipeline will be run at a suitable distance away from all of the wellheads.

12.5 The other brinewells with salt roofs have a lesser thickness of salt (9 to 14 metres) and are also considered to be stable.

12.6 However, a risk, even if negligible and not significant, is never absolutely zero and the report recommends that, as a route is available which threads its way between the brinewells, this is the recommended option so as to ensure that risk is avoided or at least minimised to fullest extent.

12.7 In the case of the underground mine and the brinewells with marl roofs the following parameters have been applied in delineating a suitable pipeline corridor;

- A clearance of 30 metres southwest of Upper Mine corner points in order to limit possible settlement to 100 mm.

- A 75 metre clearance from the circumference of BW50 because of the marl roof and probable crownhole development (according to the Mott MacDonald calculations for a 40 metre depth of overburden).

- A 61.5 metre clearance from the circumference of BW98 because of the marl roof and potential for crownhole
development (according to the Mott MacDonald calculations for a 32 metres depth of overburden).

The resulting pipeline route corridor selected for the Project is outlined in Fig. 24.
Fig. 24: Pipeline route corridor

Based on Mott MacDonald Report

Extent of settlement in the event of mine collapse

Proposed Gas Compressor Compound
12.8 The 75 metres and 61.5 metres clearances from the circumferences of BW50 and BW98 respectively are for the long-term drawdown of the ground around the crownhole development for these brinewells. At and beyond these distances, the ground is expected to remain stable and unaffected by crownhole drawdown.

**Proposed monitoring**

12.9 It is proposed that a monitoring system should be implemented such that ground deformation risk may be positively monitored and in the event that ground movements were to occur they would be detected early. Monitoring measures include a detailed precise levelling programme, subsurface deformation monitoring via inclinometers and extensometers, and a programme of continued brinewell cavity monitoring. Development of action thresholds for the monitoring system will be required. In the unlikely event that monitoring detects unpredicted ground movement, outline mitigation measures have been put forward.

12.10 This monitoring programme will ensure that any change in the status of salt-roofed caverns will become apparent at the earliest possible stage. If a potential for crownhole development were to be established there would be adequate time (a period of years) in which to implement the ground stabilization measures which are outlined in the previous chapter.

12.11 These steps should ensure that the integrity of the pipeline is not compromised at any stage during the life of the Project.

**Mitigation measures**

12.12 Should the clearances from the circumferences of BW50 and/or BW 98 be considered unduly restrictive of the pipeline corridor it would be possible to reduce the clearance by the installation of piling around the periphery of either of these brinewells. Alternatively, piling could be installed on either side of the pipeline to secure the corridor containing the pipeline.

12.13 Having regard for these considerations, but excluding the benefits of sheet piling, a practical and feasible pipeline routing has been developed and is shown in Fig. 25 with key grid co-ordinates.
Fig. 25: Proposed Pipeline Route

Key coordinates of pipeline route (British National Grid):

A E 335737.6, N 446440.0
B E 335754.5, N 446449.5
C E 335822.2, N 446424.5
D E 335846.4, N 446404.2
E E 335865.4, N 446373.5
F E 335921.2, N 446264.4
G E 336053.6, N 446217.5
H E 336113.6, N 446165.0
I E 336142.1, N 446156.4
J E 336206.4, N 446159.0
K E 336229.8, N 446146.9
L E 336266.7, N 446089.3
M E 336260.8, N 446014.2

Based on Mott MacDonald Report
12.14 The basis for the design of the pipeline in detail is as follows; Point A to Point F is the approach pipeline to the proposed GCC;

- Point A – Tie-in at the proposed GCC.
- Point F - 70 metres southwest of the corner of the Upper Mine.
- Line F - G is on the line of the predicted 50 mm subsidence which would arise if the adjacent section of the Upper Mine were to collapse. It is 122 metres from the circumference of BW50 and 32 metres beyond the predicted long-term drawdown of a crownhole collapse.
- Point H is equidistant from BW46 and BW102.
- Line I - J is equidistant from BW45 and BW102.
- Point K is equidistant from BW45 and BW49.
- Line K - L is clear of BW45.
- Line L - M maintains a clearance from BW78.
- Line M onwards maintains a maximum clearance from BW47. However, there is flexibility to re-orient the line to within 24 metres of the circumference of BW47 with no risk of impact in terms of crownhole development.

12.15 The detailed route of the pipeline therefore avoids crossing over any brinewells, keeps clear of the drawdown areas of brinewells which have marl roofs and maintains a clearance greater than 30 metres from the Upper Mine on a line which follows the maximum potential subsidence of 50 mm.

12.16 The detailed route of the pipeline is on stable ground throughout the corridor. However, additional measures can be taken, if required, to reinforce the stability of the corridor and this provides further confidence and assurance on the suitability of the proposed route.

12.17 It is to be noted that the brinewells with salt roofs have a highest point of the order of -150 metres Ordnance Datum. This is equivalent to 160 metres below ground level. Pipeline construction, where the depth of the trench will be approximately 2.4 metres and installed with conventional backhoes and excavators will have no effect on those brinewells or on the underground mine.

12.18 The overall route is shown in Fig. 26.
13. PIPELINE CONSTRUCTION

13.1 The general construction sequence is as follows;

1. Prepare the road access points and construct the temporary fencing over the length of the pipeline route.

2. Commence site clearance and strip the topsoil along the pipeline route.

3. Commence construction of the Metering Station at Nateby and construction of the terminal facilities (pig traps, filters etc.) at the proposed GCC at Preesall.

   National Grid to commence construction of the connections to their 42” Ø Transmission Pipeline at Nateby complete with controls and valves (including the custody transfer valve) in accordance with National Grid’s standard procedures.

4. Commence pipe stringing and pipe welding followed by trenching, lower & lay and backfill.

5. Complete road crossings and tie-ins.

6. Complete reinstatement of the lands along the pipeline route.

7. Clean, swab and test the pipeline from the custody transfer valve at Nateby to the proposed Gas Compound at Preesall.

8. Halite, in conjunction with gas supply from National Grid via the custody transfer valve at Nateby, will commission the pipeline.

13.2 Pipeline construction invariably commences in April when lands have dried out and are trafficable. In the case of the proposed pipeline from Preesall to Nateby the construction period is estimated at 26 weeks which would give completion of construction in early October and commissioning by early November.