Southampton to London Pipeline Project

Volume 6

Environmental Statement (Volume B)
Chapter 4 : Design Evolution

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Contents

4 Design Evolution

4.1 Introduction

4.1.1 The project design is the result of a process of iterative design development that was introduced at project inception. Environmental considerations have had a key influence on the project, with knowledge gained through the Environmental Impact Assessment (EIA) process, input from the engineering teams, consultees and Esso.

4.1.2 Throughout the iterative design development process, the proposed pipeline route and above ground permanent and temporary infrastructure were systematically reviewed. This was achieved through feedback from the multi-disciplinary project team being recorded and incorporated as appropriate in the next stage of the proposed design. Examples of design adjustments include revisions made to reflect consultations and meetings with interested parties (such as land owners, local authorities and regulators), feedback from the formal consultation process, modelling or survey results (e.g. ecology surveys, flood levels, geotechnical surveys), or adding further technical design detail.

4.1.3 This chapter focuses on the way in which environmental considerations have influenced the design of the project. As context:

- Section 4.2 sets out the project need;
- Section 4.3 outlines consideration of alternatives to the project;
- Section 4.4 provides an overview of the two-stage approach adopted to progress the design from options stage through to a final project design;
- Sections 4.5 and 4.6 explain these stages in further detail; and
- Sections 4.7 and 4.8 explain the design considerations for above ground permanent (operational) and temporary (installation) infrastructure.

4.1.4 This chapter contains a number of project commitments to reduce impacts on the environment. These are indicated by a reference number like this (G20). Good practice measures are set out in the REAC and secured through Development Consent Order (DCO) requirements such as the Code of Construction Practice (CoCP).

4.2 Project Need

4.2.1 The existing pipeline was built between 1969 and 1972. It runs from the Fawley Refinery near Southampton to the West London Terminal storage facility in Hounslow. The existing pipeline was originally used to transport a type of oil used by large industrial facilities and oil-fired power stations. During the 1980s when natural gas became more widely available in the UK, the need for this type of heating fuel dwindled. With the growth of air travel, the pipeline was then used to transport aviation fuel.

4.2.2 The purpose of the current project is to replace 90km (56miles) of existing pipeline from Boorley Green to the West London Terminal storage facility in Hounslow. The

pipeline needs to be constructed as a replacement pipeline, with the existing pipeline remaining operational until the replacement pipeline is completed and operational. This is to ensure secure supplies to customers, as the existing pipeline cannot be taken out of operation for more than short periods. As explained in Chapter 3 Project Description, the existing pipeline will be decommissioned once the replacement pipeline is operational, and does not form part of the project assessed in this ES. The nature of the pipeline network means that at no point will both pipelines be operational at the same time.

4.2.3 The Overarching National Policy Statement for Energy (NPS EN-1) sets out the Government's assessment of the importance of energy infrastructure. NPS EN-1 states that oil distribution pipelines (meeting the thresholds and conditions set out in the Planning Act 2008), such as is proposed in this project, are considered nationally significant, and that the Government requires decision makers to start from an assessment point of there being a significant need for the provision of such infrastructure. Further details regarding the policy context and need for the project can be found within Chapter 2 Regulatory and Planning Context, and the Planning Statement (**application document 7.1**).

4.2.4 The replacement pipeline will provide essential aviation fuel transport infrastructure to the West London Terminal storage facility. This comprises a key element of the need for the project.

4.3 Consideration of Alternatives

4.3.1 This section provides a description of the alternatives considered for the replacement pipeline, including the 'do nothing' (no development) scenario.

Do Nothing Scenario

4.3.2 A 'do nothing' scenario would not take forward any development proposals associated with the project. To be a viable alternative to the project, the continued operation of the existing pipeline would be required for another 60 years (the intended design life of the replacement pipeline). This has been rejected as unfeasible as the need for increased repairs would necessitate an increased shutdown of the pipeline. In effect, the 'do nothing' scenario equates to the eventual closure of the existing pipeline and the consequent cessation of this supply of aviation fuel.

4.3.3 The main issues associated with a 'do nothing' scenario are:

- an increasing need for inspections, excavations and repairs to the existing pipeline;
- an increased risk of interruption and failure to supply aviation fuels from Fawley Refinery to airports in southeast England; and
- loss of potential economic development opportunity for south and southeast England.

Alternatives to the Project

4.3.4 The existing pipeline is working adequately, but the need for inspections and maintenance is increasing. Due to the lack of viable alternative technologies and systems, the use of road tankers or in-line renewal of the existing pipeline were considered to be the main alternatives to the replacement pipeline. These were rejected for the reasons explained below, and Esso concluded that there was no feasible alternative to the project.

Road Transportation

4.3.5 At a preliminary stage, Esso considered alternative ways of transporting fuel, particularly by road. Based on an estimate of the volume of aviation fuel transferred from the Fawley Refinery to the West London Terminal via pipeline in 2015, the replacement pipeline would keep around 100 road tankers off the road every day.

4.3.6 Transporting such large quantities of fuel by road on a daily basis would be unreliable, uneconomic and have long-term environmental and social consequences. This is compared to the mainly short term construction-related effects associated with the installation of the replacement pipeline.

4.3.7 The alternative option of transporting aviation fuel by road was therefore rejected.

In-Line Renewal of Existing Pipeline

4.3.8 Esso also considered in-line renewal of the existing pipeline. This process would involve a series of in situ replacements of sections of the existing pipeline over time. However, the requirement to maintain operation of the existing pipeline to supply to the West London Terminal storage facility would severely limit the amount of time the pipeline could be shut down for engineering work, would not allow for efficient working, and would mean that only relatively small sections of pipeline could be renewed at any one time. The renewal of the entire pipeline could therefore not be achieved within the necessary time frame. In addition, it was considered that this alternative would offer no environmental benefit over the installation of a replacement pipeline.

4.3.9 The alternative option of in-line renewal of the existing pipeline was therefore rejected.

4.4 Development of the Project

4.4.1 This section provides an overview of the approach taken to the development of the project. The approach comprised of two distinct stages, namely:

- Stage 1: selection of consultation corridors and preferred corridor; and
- Stage 2: development of the pipeline route.

4.4.2 These stages are explained more fully in Sections 4.5 and 4.6 of this chapter respectively.

4.4.3 A pipeline corridor (Stage 1) is an area which would allow the design of one or more route options. A pipeline corridor may:

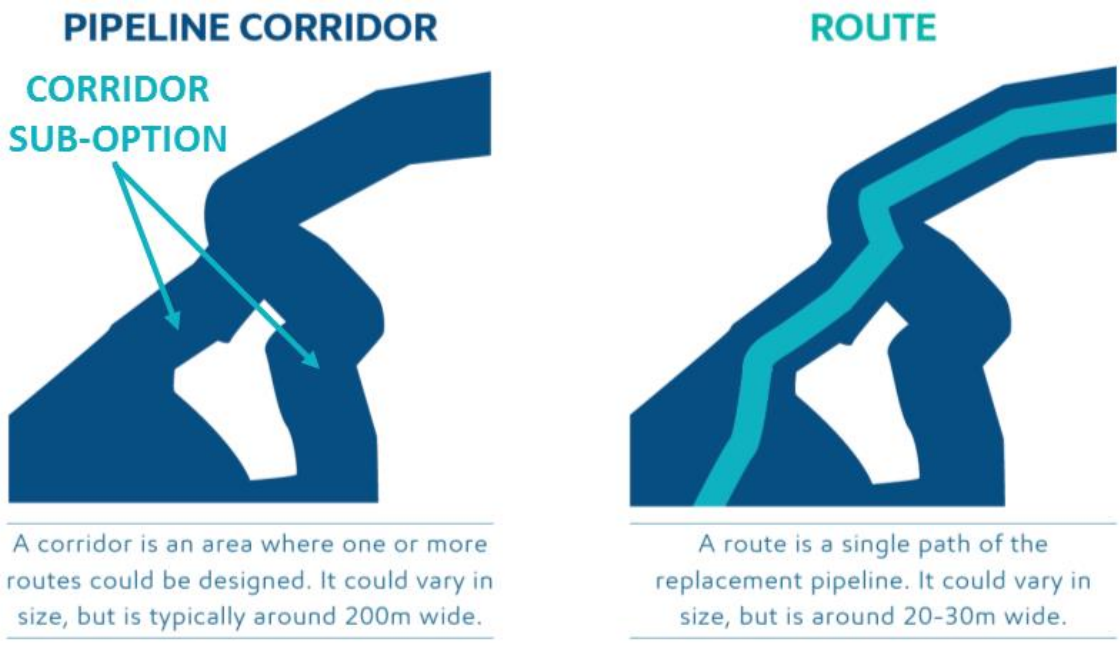
- vary in size, but is typically around 200m wide;
- be locally widened or contracted to avoid constraints or mitigate impacts; and
- include multiple 'sub-options' (minor diversions that have yet to be fully resolved by the project team).

4.4.4 A pipeline route (Stage 2) is a single path for the replacement pipeline, and for the purposes of pipeline route considerations was typically 30m wide.

4.4.5 It should be noted that land required for the project may be referred to in this ES in the context of Order Limits (the outer limits for the project, including the route and any temporary working areas that would be required), and Limits of Deviation (LoD) (the maximum area within which the pipeline could be installed). These terms are described more fully in Chapter 3 Project Description.

4.4.6 Illustration 4.1 provides a schematic demonstrating the relationship between a pipeline corridor and a route.

Illustration 4.1: Relationship Between a Pipeline Corridor and a Pipeline Route



Project Objectives and Guiding Principles

4.4.7 To enable the identification of a preferred pipeline corridor (Stage 1) and a pipeline route within the corridor (Stage 2), a number of project objectives and guiding principles were established against which all options could be objectively reviewed. These are set out below.

Project Objectives

4.4.8 The following project objectives were developed as fundamental requirements for delivering a successful project:

- to replace the pipeline from Boorley Green to the West London Terminal storage facility in Hounslow, via Alton in Hampshire, to connect to existing pipeline infrastructure;
- to meet all the relevant planning requirements;
- to maintain fuel supply during replacement; and
- to develop and install a safe, buildable, operational and economically feasible pipeline.

Guiding Principles

4.4.9 By definition, a feasible corridor must meet the project objectives. To ensure this was the case, a set of guiding principles were prepared to support the selection process.

4.4.10 Any individual corridor was considered as having an advantage over other feasible alternatives if it:

- would benefit from existing equipment (infrastructure) and relationships with landowners;
- would be likely to have better environmental outcomes versus the other options considered, especially relating to internationally and nationally important features along the final route;
- would provide social and economic outcomes of greater benefit compared to the other corridors;
- would pass through less complex or built-up areas (where possible);
- would achieve compliance with relevant National Policy Statements; and
- could be installed in a timely and realistic manner at reasonable cost.

Environmental Stakeholder and Landowner Feedback

4.4.11 The project design has been informed by discussions with environmental stakeholders. Chapter 5 Consultation and Scoping describes this process, and key examples of where environmental feedback from consultation and engagement has influenced the project design are as follows:

- Environment Agency input in relation to watercourse crossing methodologies;
- Natural England input in relation to pipeline routing associated with the Special Protection Area (SPA) and Site Special Scientific Importance (SSSIs);
- South Downs National Park Authority input in relation to pipeline routing through the South Downs National Park; and
- Local Planning Authority input in relation to allocated or committed developments within their Districts or Counties.

4.4.12 The design of the project has also been informed by discussions with affected landowners. Key examples of where landowner feedback has influenced the project design are as follows:

- pipeline routing through Thomas Knyvett and St James Senior Boys' Schools to reduce disturbance;
- pipeline routing at Boorley Green to avoid potential development land;
- pipeline routing to avoid a commercial development site on Beacon Hill Road, Church Crookham;
- pipeline routing around the SC Johnson site in Frimley;
- changing the Order Limits on the Brett Aggregates Littleton Lane site to avoid a clash with the River Thames (flood alleviation) Scheme Bund; and
- pipeline routing to avoid Silverlands Stonemasons.

4.5 Stage 1: Selection of Consultation Corridors and Preferred Corridor

4.5.1 This section explains the first of the two stages of project development, as listed in paragraph 4.4.1 of Section 4.4.

Overview of Corridor Selection Methodology

Evaluation Approach

4.5.2 The corridor selection process included evaluation of multiple corridor options to identify corridors, incorporating sub-options where required, that provided the best opportunity against the known constraints to meet the project objectives and guiding principles. This was an iterative process that comprised:

- consideration of corridors against the project objectives;
- comparative appraisal based on guiding principles;
- review of collated data on constraints and other information relating to guiding principles, and the development of 'criteria' to inform the above; and
- a multi-disciplinary workshop to discuss overall, relative performance of corridors.

4.5.3 There were three key steps to the corridor selection process:

- Step 1: corridor creation to produce a longlist of multiple corridor options;
- Step 2: sifting of the longlist to create a shortlist of a reduced number of corridor options (the term sifting describes the process of comparing longlist options to create the shortlist); and
- Step 3: review of shortlist appraisal taking into account information received from the Corridor Options consultation (non-statutory) held between 19 March 2018 and 30 April 2018, and the selection of a preferred corridor.

Data Sources

4.5.4 During the corridor creation, longlist sifting and shortlist appraisal stages, available data was progressively collected relating to:

- Esso's existing pipeline assets and facilities;
- 'Linesearch before U dig' data (including information relating to BP, Shell, National Grid, Scottish Power, Veolia and INEOS assets);
- strategic utility assets;
- ground conditions;
- existing environmental conditions, designations and constraints (from available public open access datasets);
- mapping (Ordnance Survey and web-based);
- aerial and satellite imagery;
- local authority records;
- committed development records (planning permissions and development plan policy allocations);
- authorised and historic landfill sites;
- unexploded ordnance;
- Open space (including commons);
- land referencing; and
- schools and hospitals.

4.5.5 Collected data were used to:

- identify corridor constraints, e.g. to identify the locations of known crossings and major obstacles including roads, railways, watercourses and utilities;
- identify viable construction techniques for various locations; and
- confirm the existence of a feasible path within each corridor.

4.5.6 Based on the collected data, further information gathering, and assessment was then undertaken, including:

- Targeted site visits, in particular at sensitive or difficult locations.
- Preliminary desktop assessment of ground conditions.
- Identification of potential crossings of major motorways, railway lines, rivers and areas of high environmental value, such as Ancient Woodland and wetlands. These have an important influence on the path of potential pipeline routes and were therefore considered during corridor creation.
- Identification of potential environmental and socio-economic constraints, including Special Protection Areas (SPAs); Special Areas of Conservation (SACs); Sites of Special Scientific Interest (SSSIs); National Nature Reserves (NNRs); Ancient Woodland; National Parks; Areas of Outstanding Natural

Beauty; Scheduled Monuments; Registered Parks and Gardens; Registered Battlefields; Groundwater Source Protection Zones (SPZs) 1 and 2; land used by the community including recreational areas; authorised and historic landfills; proximity of populated areas; residential properties; schools; hospitals; cemeteries; and potential for disruption to communities.

- Use of local authority planning portals. All relevant adopted or emerging Local Plans were reviewed to identify development allocations and local planning policy constraints for the longlist options. Pipeline corridors were also assessed against criteria including the National Policy Statements and related guidance (high level review), land use designations/allocations including proposed development, open space, Green Belt, Crown Land, Common Land, allotments and National Trust land.

4.5.7 The collection of data relating to pipeline corridor constraints is a progressive process, and therefore the various stages of the corridor selection process were informed by the data available at the time each stage was undertaken. As new data became available that could have implications for corridor options, it was reviewed, and any implications were fed back into the decision-making process.

Longlist of Corridors (Stage 1, Step 1 of 3)

4.5.8 The overarching principle that directed the creation of a longlist of pipeline corridors was that any corridor must have at least one defined path that appeared to be technically feasible and was considered likely to meet the project objectives and guiding principles.

4.5.9 The following three key geographical constraints informed the creation of the longlist:

- the existing aviation fuel pipeline had already been renewed between Hamble and Boorley Green in Hampshire. Therefore, the pipeline must begin at Boorley Green;
- replacement pipeline must be routed via the existing pumping station facility at Alton to connect to existing infrastructure; and
- replacement pipeline must terminate at the West London Terminal storage facility.

4.5.10 These constraints split the replacement pipeline into two geographic areas; south of Alton and north of Alton, so it was decided that a longlist of corridor options would be progressed separately for the north and south areas.

4.5.11 To produce the longlist of corridor options, a set of corridor creation criteria was developed, as set out in Table 4.1. The use of these criteria helped to create multiple corridors and assisted in identifying the need for specialised construction techniques. The criteria aimed to avoid a wide variety of potential constraints. However, it was recognised that avoidance of all constraints, whilst preferable, would not be possible.

Table 4.1: Corridor Creation Criteria

Topic Area	Criteria
Engineering/ constructability	• major infrastructure, such as motorways, roads and railways; • waterlogged areas; • steep slopes; • historic extraction/landfill areas; • ground stability; and • major urban areas.
Environmental and social	• designated sites including SPAs, SACs, SSSIs and NNRs; • classified Ancient Woodland; • National Parks and Areas of Outstanding Natural Beauty; • Scheduled Monuments, Listed Buildings and Registered Parks and Gardens; • Groundwater Source Protection Zones 1 and 2; • land used by the community, including recreational areas; • authorised and historic landfills; • proximity of populated areas, residential properties, schools, hospitals, cemeteries; and • potential for disruption to communities.
Planning	• Common Land; • Crown Land; • National Trust Land; • Ministry of Defence Land; and • Allocated Land and Committed Development.
Cost/schedule	• corridor length; and • economic viability.

4.5.12 The criteria listed in Table 4.1 were aimed at avoiding a wide variety of potential constraints. However, it was recognised that whilst avoidance of all constraints along a route is preferable, it would not be possible due to the length of the entire route. The use of these criteria helped to create multiple corridors for the north and south areas, and also assisted in identifying the need for specialised construction techniques.

4.5.13 For the purposes of determining the alignment of a pipeline corridor, the standard working width was assumed to be 30m wide to allow flexibility regarding detailed routing and the working direction for pipeline installation. This was varied as follows:

- narrower corridor widths were assumed where specific constraints on working width existed (e.g. for streetworks in urban areas):
- wider corridor widths were assumed where it was expected that specialist trenchless techniques such as horizontal directional drilling (HDD) would be required, as these may require additional working space compared to standard ‘open cut’ techniques (see Chapter 3 Project Description); and
- areas of remaining routeing uncertainty due to specific constraints in certain locations were also addressed by inclusion of a number of ‘bulges’ in the corridors.

4.5.14 Review against the criteria in Table 4.1 informed a longlist of seven corridors to the south of Alton Pumping Station (corridor references A to G), and 10 to the north of Alton Pumping Station (corridor references H and J to R, with 'I' not being used).

4.5.15 The 17 corridors on the longlist are shown on Figure 4.2 (south options) and Figure 4.3 (north options). Table 1 of Appendix 4.1 provides a general description of the corridor routes, and the reasoning behind their creation.

Shortlist of Corridors (Stage 1, Step 2 of 3)

4.5.16 Before sifting the longlist, the 17 corridors were reviewed again and updated where there were opportunities to take account of any additional environmental, planning and engineering information. This included early stakeholder feedback.

4.5.17 The longlist corridors were then sifted in accordance with the adopted methodology in a multi-disciplinary workshop. Each corridor option was assessed using a set of sifting criteria developed to cover the same topic areas as were used to produce the longlist, namely engineering/constructability, environmental and social, planning and cost/schedule.

4.5.18 The assessment identified strengths and weaknesses, with each specialist discipline using a five-grade system ('very weak' to 'very good') to inform selection of the shortlist. Assessments considered the project objectives and guiding principles.

4.5.19 As a result of the longlist sifting process, the following six corridors were taken forward to the shortlist:

- South: Options D, F and G; and
- North: Options J, M and Q.

4.5.20 The main reasons for taking these six corridors forward to the shortlist, and non-statutory consultation, are outlined in Table 4.2.

Table 4.2: Corridors Taken Forward to Shortlist

Corridor	Main Reasons for Progression to the Shortlist
South	
D	Shares the same alignment as Option G until West Tisted. At this point, this corridor travels northeast, skirting to the south of Lasham. This is to avoid Chawton Wood and Bushy Leaze Wood. In common with Option F, this is one of the shortest corridors within the SDNP.
F	This corridor avoids development areas to the north of Alton, sharing the same alignment as Option G until West Tisted. At this point, this corridor travels northeast, skirting to the northern edge of Four Marks. In common with Option D, this is one of the shortest corridors in the SDNP.
G	Developed to follow the existing aviation fuel pipeline where practicable to make best use of existing infrastructure and landowner and stakeholder relationships. The corridor avoids Ancient Woodland, and its alignment through Hampshire and Surrey has taken account of features that were not built or protected in the 1960s, when the existing pipeline was built.
North	
J	Developed to follow the existing aviation fuel pipeline where practicable to make best use of existing infrastructure and landowner and stakeholder relationships. Its alignment through

Corridor	Main Reasons for Progression to the Shortlist
	Hampshire and Surrey has taken account of features that were not built or protected in the 1960s, when the existing pipeline was built.
M	Developed to avoid national and European designated sites that Option J passes through. It also avoids the SDNP, that Option Q passes through.
Q	Developed to avoid national and European designated sites that Option J passes through, as well as to avoid the community of Farnham that Option M passes through. This corridor follows the route of another Esso pipeline, along a route through Alice Holt Forest and within the SDNP.

4.5.21 The main reasons for the remaining 11 corridors not being taken forward to the shortlist are outlined in Table 4.3.

Table 4.3: Corridors Not Taken Forward to the Shortlist

Corridor	Main Reasons for Corridors Not Taken Forward to the Shortlist
South	
A	Created to avoid the SDNP by passing to the west of Winchester, making it the longest of the southern corridors. However, it does pass through environmentally sensitive areas between Otterbourne and Colden Common, including the River Itchen SSSI and SAC, and an important Groundwater SPZ 1. Therefore, this corridor was unlikely to have better environmental outcomes than others. The cultural heritage features around the northeast of Winchester, as well as emerging housing allocations, were also considered to be material challenges for this corridor.
B	Similar to Option C, this was developed to reduce the length of replacement pipeline in the SDNP (but not to avoid it completely). The corridor was unlikely to have better environmental outcomes than other corridors, as it crossed the River Itchen SSSI and SAC and partially encroached on the historic battlefield at Cheriton.
C	Developed to reduce the length of replacement pipeline in the SDNP. The corridor was unlikely to have better environmental outcomes than other corridors as it crossed the River Itchen SSSI and SAC and partially encroached on the historic battlefield at Cheriton.
E	Similar to Option C, this was developed to reduce the length of replacement pipeline in the SDNP. The corridor was unlikely to have better environmental outcomes than other corridors, as it crossed the River Itchen SSSI and SAC and partially encroached on the historic battlefield at Cheriton.
North	
H	Created to avoid going through Chobham Common SSSI, NNR, SPA and SAC. A length of the pipe would be installed in Staplehill Road and Longcross Road (B386), making installation much more complex and time-consuming and result in greater disruption and impact for communities.
K	This corridor was not taken forward as a major section between Farnborough and Lightwater would need to be laid in roads. This would make it significantly more complex and time-consuming to install and result in greater disruption and impact for communities.
L	This corridor was similar to Option O, other than the section between Worplesdon and Byfleet. Here, it passed further northwest to avoid the floodplain and mineral extraction areas to the east and southeast of Old Woking and Pyrford. This took Option L into Woking, increasing the impacts on roads and communities from those identified for Option O.
N	This corridor was similar to Option O, other than the southern section where it passed through Bentley, Dippenhall and Farnham to avoid the SDNP around Blacknest. As such, it shared similar issues to Option O in terms of installation, disruption and community impact and so was not taken forward.
O	This corridor was not taken forward as it would mainly be installed in roads through Whiteley Village, Walton-on-Thames, Upper Halliford and Staines. This would make it much more

Corridor	Main Reasons for Corridors Not Taken Forward to the Shortlist
	complex and time-consuming to install and result in greater disruption and impact on communities.
P	This corridor was very similar to Option O, other than the final 5km section approaching the West London Terminal storage facility. This section passed round the southwest of Feltham to try to reduce the length of the pipeline installed in roads. On assessment, this Option showed no reduction in road installation could be achieved and so was not taken forward.
R	Similar to Option O, other than the final 12km section where it passed to the west of the Queen Mary Reservoir. This reduced the length of pipeline installed in roads but encroached into the floodplain along the River Thames between Chertsey Meads and Walton-on-Thames. The considerable complexity of installing the pipeline in the floodplain was a particular issue for this corridor. There also remained substantial lengths of pipeline requiring installation in roads. For these key reasons, this corridor was not taken forward.

Selection of Preferred Corridor (Stage 1, Step 3 of 3)

Post Consultation Appraisal and Selection of Preferred Corridor

4.5.22 Following the close of the non-statutory consultation on corridor options on 30 April 2018, an independent consultation organisation collated all of the consultation responses, which were then analysed by the Project's senior management team with support from the environmental, engineering and planning teams.

4.5.23 To take in to account information received from the consultation (non-statutory) in March and April 2018, a review of the shortlist appraisal was undertaken that included all new information available to the project.

4.5.24 Following further review of technical data, one southern corridor and one northern corridor was selected.

4.5.25 Corridor Option G in the south and corridor Option J in the north were selected and combined to progress as the preferred corridor. These corridors performed best when measured against the project objectives and guiding principles and are those that most closely follow the existing pipeline.

4.5.26 The alignments of Options G and J are illustrated on Figure 4.4, and the main reasons for selecting these as the preferred corridor are outlined in Table 4.4.

4.5.27 The selection of the preferred pipeline corridor was announced on 30 May 2018.

Table 4.4: Main Reasons for Preferred Corridor Selection

Corridor	Main Reasons for Corridor Selection
G	Option G performed more strongly overall than Options D and F. There was a strong representation from the consultation responses that the replacement pipeline should be located near to the existing pipeline. Key reasons given were the positive existing relationships with landowners and the opportunity to use land and land access routes along the existing pipeline. Option G is significantly shorter from the point the corridor options diverge and there are fewer engineering challenges in this corridor. It also has a lower risk of disruption to residential areas such as Alton and Ropley and less potential to affect cultural heritage assets and groundwater systems. Unlike Options D and F, Option G does re-enter approximately 5km of the SDNP to the south of Alton. When installation is complete, and the land has been reinstated where practicable to its previous state, it is anticipated that there would be no permanent effect on the special

Corridor	Main Reasons for Corridor Selection
	qualities of the SDNP, such as the natural beauty of the landscape and countryside. The project is committed to continue working closely with the South Downs National Park Authority to develop the route. This will assist in ensuring that short or medium-term effects on the special qualities of the SDNP are avoided or reduced. Option G is preferable to the community-related impacts and engineering challenges associated with Options D and F. For these reasons, Option G was selected for the preferred corridor.
J	Option J performed more strongly overall than Options M and Q. There was a strong representation from respondents that the replacement pipeline should be located near to the existing pipeline, due to existing positive relationships with landowners and the opportunity to use land and land access routes along the existing pipeline. Option J was favoured due to its avoidance of Farnham, Alice Holt Forest, the River Wey and high-water table in that area. Option J passes through or near more designated nature conservation sites, but the team concluded that careful route development and appropriate design and mitigation measures would reduce the risk of adverse effects on these sites. There was a common theme raised about the impact on communities and traffic during installation, especially around the Farnborough and Frimley area. The project team has worked to reduce these potential impacts through careful route design and planning of the installation of the pipeline. For these reasons, Option J was selected as the preferred corridor.

4.5.28 The main reasons for the four corridors not being taken forward as the preferred corridor are outlined in Table 4.5.

Table 4.5: Main Reasons Corridors Were Not Selected for the Preferred Corridor

Corridor	Main Reasons for Corridor Rejection
D	Option D performed less strongly than Option G due to its significantly longer length – 22.5km from the point the corridors diverge (Option F being around 19.9km and Option G being around 17.8km). Compared to Options G and F, this corridor had greater engineering and installation challenges, such as the hilly landscape and groundwater SPZs near Lasham. It also had additional crossings over the Watercress railway line and A31 road. Respondents highlighted these issues, as well as impacts on wildlife and the potential issues of installing in an area where many roads are narrow country lanes. When compared to Option G, there was less potential to benefit from existing infrastructure and landowner relationships, as once it diverged from the other two corridors it did not follow any existing pipelines. Option D also included part of the Cuckoo Corner Roman site, a Scheduled Monument. For these reasons, Option D was not taken forward.
F	Option F performed less strongly than Options D and G due to the possibility of greater disruption to communities such as Alton and needing additional crossings over the Watercress railway line and A31 road. This option also performed less strongly when compared to Options D and G due to its proximity to areas of woodland, such as Chawton Wood. In addition, during the consultation, the project also received new information that identified a priority habitat for hydrology in this area. Concerns were also raised by respondents about maintaining easy access to Alton Community Hospital and the impact on growing local communities during installation of the pipeline. For these reasons, Option F was not taken forward.
M	Option M passes through Pyrford and Byfleet and these areas presented major engineering and installation challenges. These include crossing the River Wey and the high-water table in this area that results in frequent flooding. Consultation responses strongly highlighted the rich cultural and historical heritage in these areas. There was a lower potential for benefiting from existing infrastructure and landowner relationships. Consultation responses showed that many respondents who opposed Options M felt the replacement should, where possible, follow the existing pipeline. Option M performed less strongly due to its path through the historic town of Farnham. Many consultation responses highlighted the community, heritage and business impacts of the route passing through Farnham. These themes included the engineering challenges of the narrow roads, archaeology around Farnham Park, the number of Listed Buildings and the planned redevelopment of the town centre. The traffic impact of installation

Corridor	Main Reasons for Corridor Rejection
	was likely to be greater in Farnham, when compared to other areas, due to the relatively narrow roads and the volume of traffic.
Q	Option Q also passes through Pyrford and Byfleet, and as described above for option M, these areas presented major engineering and installation challenges. Like Option M, Option Q also has a lower potential for benefiting from existing infrastructure and landowner relationships. Consultation responses also showed that many respondents who opposed Option Q felt the replacement should, where possible, follow the existing pipeline. Option Q performed less strongly due to the potential impact on Alice Holt Forest (part of the SDNP). The forest was highlighted by many in the consultation responses as being an important community and environmental asset. It also crossed about 5.2km of the Surrey Hills Area of Outstanding Natural Beauty. For these reasons, Option Q was not taken forward.

Review of Option J Sub-options

4.5.29 Following the selection of Option J for the preferred corridor, a further review was undertaken accounting for strong feedback from the pipeline options consultation (non-statutory) relating to the sub-options in Frimley, Chobham Common and Queen Mary Reservoir.

4.5.30 As a result of this review, the Frimley Park Hospital sub-option was de-selected from Corridor Option J due to the potential impact on the hospital, schools and local roads during installation. This sub-option was in the favoured corridor but was deleted from the design to reflect the consultation feedback.

4.5.31 The Option J sub-options in Chobham Common and Queen Mary Reservoir were included within the SLP Scoping Report (Esso, 2018), as further work would be required through later stages of design development to address potential technical challenges associated with these and identify the optimal solution.

4.6 Stage 2: Development of the Pipeline Route

4.6.1 This section explains the second of the two stages of project development, as listed in paragraph 4.4.1 of Section 4.4. As explained previously, design development was an iterative and ongoing process. However to help explain the design evolution, the summary of Stage 2 in this section is presented under subheadings of the initial working route, the refinement of this route, and then the final pipeline route.

4.6.2 Key considerations for development of the pipeline route, in addition to the project objectives and guiding principles, comprised of:

- avoiding or reducing effects to environmentally sensitive areas, e.g. SSSI, SAC, Ancient Woodland;
- reducing impacts to residential areas, farmhouses and businesses;
- ensuring that the routeing took account of constraints imposed by major infrastructure crossings (e.g. motorways, trunk roads, canals, rivers and railways);
- reducing crossing and diversions of other services;
- avoiding steep gradients and side slopes where practicable; and

- avoiding difficult geological features and unsuitable ground conditions where practicable.

Initial Working Route

4.6.3 Following announcement of the preferred corridor on 30 May 2018, an initial working route, which refined the 200m corridor to approximately 30m in width, was then released via the project's website in June 2018.

4.6.4 The Scoping Report (Esso, 2018) was being finalised over the same period, based on an indicative design. The Scoping Report (Esso, 2018) was published in July 2018 and set out anticipated embedded design measures, reflecting the design evolution at that stage of the project.

4.6.5 Ten overarching project commitments were identified in the Scoping Report (Esso, 2018) to help guide the development of the initial working route, and ultimately the final route. These are listed in Table 4.6.

Table 4.6: Project Commitments – Development of the Pipeline Route

Embedded Design Measures	Purpose
Commitment to only utilise a 10m width when crossing through boundaries between fields where these include hedgerows, trees or watercourses. (O1)	To reduce loss of habitats.
Design route alignment to avoid all areas of existing classified Ancient Woodland. (O2)	To avoid loss of existing classified Ancient Woodland.
The standard working width for open trench construction in rural areas is a nominal 30m. (O3)	To reduce working area and loss of habitats, and soil impacts.
Trenchless techniques are to be used for all crossings of trunk roads, motorways and railways. (O4)	To avoid the need for closures resulting in major effects on commuters and communities.
Trenchless crossing technology to be used for crossings of waterways over 30m wide. (O5)	To avoid or reduce construction effects to the environment, and navigation.
The pipeline as laid will not lie within existing Source Protection Zone 1 (SPZ 1) areas. (O6)	To reduce risk of potential effects on protected aquifers.
Where required, water stops (or "stanks") would be installed at intervals through the pipe bedding and side fill. (O7)	To reduce groundwater flow along the pipeline.
The principles of inherent safe design have been incorporated into the design of the pipeline as per Esso design standards for fuel pipelines, relevant industry codes of practice and standards and the requirements of the Pipeline Safety Regulations 1996. (O8)	To avoid potential impacts to sensitive environmental receptors.
Inclusion of remotely operated valves to allow isolation of sections of the pipeline if required. (O9)	To avoid potential impacts to sensitive environmental receptors.
24-hour remote monitoring of pipeline operation to detect leaks and enable remote shut down of the pipeline if required. (O10)	To avoid potential impacts to sensitive environmental receptors.

4.6.6 The Scoping Report also set out anticipated embedded design measures, reflecting the design evolution at that stage of the project. These measures aimed to avoid constraints or reduce the potential for environmental impacts such as:

- avoiding or reducing encroachment into areas of valued habitat (e.g. woodland, wetland/bog);
- considerations relating to landscape and visibility, particularly in SDNP; and
- areas used by the community (e.g. tennis courts, playing fields, golf course).

4.6.7 A list of the location-specific embedded design measures assumed for Scoping and retained as part of the project design is provided in Table 2 of Appendix 4.1.

Refinement of the Pipeline Route

4.6.8 Further development of the pipeline route at this stage of design included creation of outline designs for permanent infrastructure, comprising the following elements:

- the replacement pipeline;
- the new “pigging” station at Boorley Green;
- 14 remotely operated in-line valves along the pipeline;
- Pressure Transducer;
- 6 above ground cathodic protection (CP) transformer rectifier cabinets; and
- modifications to the PIG station at the West London Terminal storage facility.

4.6.9 In addition, locations were identified where trenchless crossings would be implemented to install the replacement pipeline, to avoid an impact on a potential receptor. The full list including the proposed construction method is included in Appendix 3.1 Table of Trenchless Crossings.

4.6.10 Outline designs were also created for temporary infrastructure that would be required for the installation of the pipeline, including:

- construction and pipe storage compounds;
- additional working areas; and
- access to the working areas.

4.6.11 Throughout the iterative design development process, the project elements listed in paragraphs 4.6.8 and 4.6.10 were systematically reviewed and updated. As explained in paragraph 4.1.2, this was achieved through feedback being incorporated as appropriate in the next stage of the proposed design.

4.6.12 Through the process described in paragraphs 4.6.2 to 4.6.11, the initial working route design evolved into the preferred route (with some sub-options). This was presented during the initial statutory consultation between 6 September 2018 and 19 October 2018. Further details can be found in Chapter 5 Consultation and Scoping.

The Final Pipeline Route

4.6.13 Following statutory consultation on the preferred route, changes continued to be made as part of the design development. A list of location-specific embedded design

measures incorporated since the Scoping stage design is provided in Table 3 of Appendix 4.1.

4.6.14 Following the initial statutory consultation on the preferred route, a further review was undertaken in response to the feedback and alongside environmental and engineering information in relation to the sub-options. These are shown on Figure 4.5, and Table 4.7 documents the reasons for the sub-option selection.

Table 4.7: Reasons for Sub-Option Selection

Sub-Options	Main Reasons for Sub-Option Selection
A1a and A1b: Boorley Green	A1b was selected as it takes into consideration residential development proposals around Maddoxford Lane. A1b also provides more space for trenchless installation than A1a.
A2a and A2b: Hinton Ampner	Both options have been taken forward and both options have been assessed within the ES.
D1a and D1b: Oak Park Golf Course	D1b was selected to reduce disruption to Oak Park Golf Course.
D2a and D2b: Fleet Business Park	D2b was selected as it would have less potential traffic disruption during installation than D2a, and also has fewer crossings of the existing pipeline. It would also reduce impacts on Fleet Business Park and Naishes Lane.
D3a and D3b; Beacon Hill Road	D3a was selected, but with some refinements, to reduce the impact on development plan sites.
D4a and D4b: Norris Hill	D4a was selected because it closely follows the existing pipeline. D4b follows as established track and would only be used for temporary access route during installation.
E1a and E1b: Cove Brook Park	E1a was selected, as E1b had a number of planning, environmental and engineering concerns.
E2a and E2b: Cove Road	Following consultation feedback and further technical work, neither sub-option was progressed, and an amended route was taken forward. Technical work on E2a confirmed that it would not be possible to install the trenchless crossing from Cove Brook Park to the north of the railway, and would have meant lengthy pipeline installation delays and continued disruption to communities. E2b was not progressed due to narrow roads and the need to remove garages. Cranes would also have been required on E2b to move equipment to the working area between the homes and the railway, and a local footpath would also have to be closed for a long period of time.
E3a, E3b and E3c: Cabrol Road	E3a was selected, as it follows the existing pipeline more closely than sub-options E3b or E3c. It would reduce the potential impacts on access to residential properties and street works during installation, and also reduces the impact on Stakes Lane and the allotments near Prospect Road.
E4a and E4b: Farnborough North	E4a was selected, but with some refinements. This sub-option was preferred by many local landowners and reduces the direct impacts on Henry Tyndale School and Farnborough North Station. The angle at which E4a crosses the Reading to Redhill and Ascot to Guildford railway lines is also preferable from an engineering perspective. Whilst a trenchless crossing remains the first choice in this area, open-cut trench techniques may be used due to the unpredictable ground conditions. Both techniques have been assessed within the ES.
E5a and E5b: Pine Ridge Golf Course	E5a was selected as although there are potential impacts on the golf course, there was strong feedback from the consultation regarding potential disruption to traffic along Deepcut Bridge Road.
F1a, F1b and F1c: Red Road	F1a and F1b were merged; the route will follow F1b for the first section and then F1a for the remaining section. This was chosen in response to consultation feedback, to

Sub-Options	Main Reasons for Sub-Option Selection
	reduce the loss of trees along the start of F1a and to reduce the impacts on protected bird and reptile habitats along the second section of F1b.
F2a and F2b: Chobham Common	F2a was selected, as this option would reduce any potential impacts on residential areas to the south of the common, and most closely follows the existing pipeline alignment. Feedback from the consultation strongly favoured F2a, with F2b not favoured due to the need for street works and potential traffic disruption. Further technical work has been completed to identify how the environmental impacts can be reduced to Chobham Common.
F3a and F3b: Silverlands	F3a was selected based on consultation responses and from site visits with local landowners. F3b was not selected because of potentially significant impacts it could have on a local business.
F4a and F4b: Guildford Road (A320) and M25	F4b was selected due to F4a having engineering constraints associated with crossing the M25.
G1a and G1b: Chertsey railway	G1b was selected to avoid impacts on an area of Ancient Woodland. Consultation feedback highlighted concerns regarding the effect on traffic along Canford Drive, and a traffic management plan would therefore be implemented to control traffic flow and maintain assess for residents. Further technical work was then undertaken to reduce impact on the golf course.
G2a and G2b: River Thames	G2a was selected as it has more suitable ground conditions for installation than G2b and would have reduced engineering challenges associated with crossing the M3. Further technical work was then undertaken to reduce the biodiversity impact on Chertsey Meads.
H1a and H1b: Queen Mary Reservoir	Both sub-options were rejected following consultation feedback and a review of the engineering challenges, with an alternative route taken forward. H1a had major engineering challenges (such as installing close to the edge of the reservoir, alongside a major gas main and overhead power lines), and there were concerns about the impact of H1b on narrow residential roads and on the reservoir from an engineering and logistics perspective.
H2a, H2b and H2c: Ashford Station	H2c was selected as it is the most feasible option from an engineering perspective, and consultation feedback confirmed concerns about H2a and H2b in this area. H2a challenges included technical constraints including the angle of the railway crossing and the proximity to a road bridge over the railway. Consultation responses included concerns from local residents regarding the space needed for safe installation of the pipeline. H2b received strong opposition in consultation feedback, due to concerns about the impact on local businesses and the car park at Ashford Station.
H3a and H3b: Thomas Knyvett College	H3b was selected because it is a more direct and shorter option.

4.6.15 In addition to the identified embedded design measures (see Tables 2 and 3 of Appendix 4.1), numerous smaller amendments to the route or width of Order Limits and LoD were incorporated as part of the development of the project design, for example to:

- avoid individual or groups of trees and hedges;
- use existing openings in boundary hedges for access;
- use existing access tracks; and
- avoid flood risk areas.

4.6.16 Examples of design evolution taking account of environmental constraints are provided in Table 4.8. These environmental examples are taken from a wider list of

design refinements which were consulted on between 21 January and 19 February 2019. This was the targeted second statutory consultation on design refinements (see Chapter 5 Scoping and Consultation).

Table 4.8: Examples of Design Evolution due to Environmental Constraints

Area/Location	Design Refinement	Illustration (not to scale)
Water Lane (Section C – South of Alton to Crondall)	Order Limits revised both sides of Water Lane to avoid protected species and an area of Ancient Woodland.	
Blind Lane (Section F – Bisley and Pirbright Ranges to M25 crossing)	Revised alignment to reduce proximity to a residential property and to maintain a safe working area during installation. This change required installation of the pipeline within land to the north of Blind Lane, rather than the previously proposed route to the south of the lane.	
Chertsey Meads (Section G – M25 to M3)	Order Limits amended in response to consultation feedback from the local council regarding floral biodiversity within Chertsey Meads. Order Limits refined to install the pipeline alongside the access road for the car park at Chertsey Meads.	

4.7 Design of Above Ground Infrastructure

4.7.1 Above ground infrastructure is described in Chapter 3 Project Description. Environmental considerations that influenced the design (including siting) of these elements of the project through the iterative design process are described below.

Pigging Station at Boorley Green

4.7.2 Considerations for the development of the pigging station design comprised of:

- recognition that the location should be as close to the start of the replacement pipeline as practicable;
- locations south of Ford Lake stream were not viable due to the conflict with land proposed for future residential development;
- two locations north of Ford Lake stream were rejected due to unacceptable visual impacts;
- refinement of the proposed location to reduce impacts to a badger sett and woodland Priority habitat.

Valve Chambers

4.7.3 The number and locations of valves and associated cabling were informed by:

- topography, to limit drain down of pipeline contents at low points; and
- the environmental sensitivities of each location.

4.8 Design of Temporary Construction Infrastructure

4.8.1 Temporary logistics hubs and construction compounds, required during installation of the pipeline are described in Chapter 3 Project Description. The design development for these also followed an iterative design development process, particularly in terms of siting. Areas of high environmental and social sensitivity were avoided where practicable, and the design development also sought to reduce potential effects on receptors.

Logistics Hubs

4.8.2 Six logistics hubs would be established in locations close to the strategic road network. The logistics hubs would serve as points for accepting deliveries and storage of materials. Each of the hubs would include a pipe laydown area, secure plant storage area, bunded fuel storage, single-storey offices, staff welfare facilities and a vehicle parking area.

4.8.3 The six proposed locations were selected, taking into account environmental considerations. Some options were not chosen due to environmental concerns such as impacts on areas of safeguarded mineral allocation. Others were adjusted in scale to reduce impacts on environmental designations such as groundwater SPZs. No significant ecological effects are predicted at any of the locations, they avoid the SDNP, and as far as practicable are located away from residential areas. The proposed logistics hubs were consulted on as part of the targeted second statutory consultation (design refinements), held between 21 January 2019 and 19 February 2019.

Construction Compounds

4.8.4 The fenced compounds would be accessed from the existing road network. These are small satellite areas close to the route that are used for storing equipment, hosting staff facilities, and laying down pieces of the pipeline.

4.8.5 The compounds need to be adjacent to the working area, the location and number of construction compounds was determined through a balanced appraisal of the most efficient locations for construction management purposes, while accounting for potential environmental impacts. With the exception of one, all compounds were located outside of Flood Zone 3 to reduce impacts to flooding. Their locations were also chosen to be away from designations such as Priority Habitats and Ancient Woodland.

4.9 References

Esso (2018). Southampton to London Pipeline Project: Scoping Report (Volume 1). Planning Inspectorate Reference Number EN070005. July 2018.