Southampton to London Pipeline Project

Volume 6

Environmental Statement (Volume B)
Chapter 14: Major Accidents

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Contents

14 Major Accidents

14.1 Introduction

14.1.1 This chapter reports the potential for a major accident or disaster, resulting in a risk of significant effect on the environment. A major accident in the context of this assessment is an undesirable extreme event resulting in damage or harm, such as a major pollution incident. A disaster is taken to relate to extremes of natural occurrences, such as a major flood event or earthquake.

14.1.2 The assessment of major accidents and disasters considers the occurrence of extreme incidences. As such, whilst this chapter uses baseline information relevant to other environmental topic chapters of this Environmental Statement (ES), it considers scenarios that would not reasonably be covered by the assessments reported in Chapters 7 to 13.

14.1.3 The requirement to consider major accidents and disasters as part of the Environmental Impact Assessment (EIA) process was established by the amended EIA Directive 2014/52/EU. This is transposed into UK law by the 2017 EIA Regulations, which state that:

> *'the significant effects to be identified, described and assessed … include, where relevant, the expected significant effects arising from the vulnerability of the proposed development to major accidents or disasters that are relevant to that development'.*

14.1.4 The assessment considers two aspects: the vulnerability of the project to a major accident or disaster, and the potential for the project to cause a major accident or disaster.

14.2 Approach and Methods

Overview

14.2.1 There is currently no published guidance specific to assessment methods for major accidents and disasters as part of the EIA process. However, it is briefly covered in European Commission guidance, 'Environmental Impact Assessment of Projects' (European Union, 2017), which confirms that the focus should be on '*significant risk and/or a risk that could cause significant environmental effects*'.

14.2.2 As consideration of major accidents and disasters is a relatively recent requirement, currently available guidance has principally been developed to meet the requirements of other UK regulatory processes and is generally related to the Control of Major Accident Hazard Regulations 2015 (COMAH). The proposed replacement pipeline does not meet the hazard thresholds to fall under the remit of COMAH, and similarly does not classify as a Major Accident Hazard Pipeline (MAHP) under the Pipelines Safety Regulations (PSR) 1996. However, in the absence of specific EIA methodological guidance, COMAH and MAHP guidance and techniques have been adopted as/where appropriate, as a precautionary approach. The approach and methodology for the project was confirmed through the scoping process and through subsequent discussion with the Health and Safety Executive (HSE) in December 2018 (refer to paragraph 14.2.19).

14.2.3 Risk assessment and management in the UK is typically based on 'risk tolerability', with the focus on risk being 'As Low As Reasonably Practicable' (ALARP). The Chemicals and Downstream Oil Industries Forum (CDOIF) (2016) has developed guidance on environmental risk tolerability for COMAH sites. Whilst the project is not a COMAH site, this guidance has informed the approach to assessment of environmental risk in relation to major accidents and disasters, with environmental risk identified as meeting the category of 'broadly acceptable' interpreted as being equivalent to 'no significant effect' in EIA terminology.

14.2.4 CDOIF guidance (CDOIF, 2016; Energy Institute, 2017) sets out an approach to identify the threat of a 'Major Accident To The Environment' (MATTE) in terms of classification based on:

- scale and severity (degree of harm and extent of impact, i.e. area/distance); and
- duration (i.e. how quickly the environment will recover).

14.2.5 CDOIF guidance relates specifically to environmental (non-human) effects, excluding human populations. However, the risk tolerability approach also aligns with the HSE decision-making process guidance 'Reducing Risks, Protecting People (R2P2)' (HSE, 2001).

14.2.6 The CDOIF principles and approach to identify a MATTE have been adopted as appropriate for this assessment. The assessment has therefore followed the following basic steps:

- review of potential sources (causes) of major accidents and disasters;
- identification of vulnerable environmental receptors; and
- consideration of any credible pathways to receptors and the potential for consequent significant environmental harm to occur.

Scope of Assessment

Major Accidents

14.2.7 There is no specific guidance on the assessment of the potential for major accident hazards for cross-country pipelines carrying aviation fuel. As noted previously, as a precautionary approach for the purposes of this assessment, techniques developed for COMAH installations have been adopted.

14.2.8 A 'major accident' is defined within COMAH as:

> '*an occurrence such as a major emission, fire, or explosion resulting from uncontrolled developments in the course of the operation of any establishment to which these Regulations apply, and leading to serious danger to human health or the environment (whether immediate or delayed) inside or outside the establishment, and involving one or more dangerous substances*'.

14.2.9 HSE is the competent authority for (non-nuclear) COMAH installations in England, together with the Environment Agency. HSE also has responsibility for MAHPs in terms of enforcing health and safety legislation. HSE provided a list of major accident installations (COMAH and MAHP) to be included within this assessment, which were considered in terms of both the vulnerability of the project to a major accident at a COMAH site or MAHP and the potential to cause or influence an occurrence at such a site.

14.2.10 The scope of this assessment has been informed by the Scoping Opinion provided by the Planning Inspectorate in September 2018, on behalf of the Secretary of State, following the submission of the Scoping Report (Esso, 2018). The scope has also been informed through engagement with relevant consultees.

14.2.11 The Scoping Opinion for the project requested that the following aspects be considered within the scope of the major accidents assessment:

- diesel spills/releases from construction plant and equipment (during pipeline installation);
- methane release from landfills (during pipeline installation);
- release of aviation fuel (during pipeline operation); and
- fire, explosions or smoke (during pipeline operation).

<u>Natural Disasters</u>

14.2.12 A ‘disaster’ in the context of this assessment is taken to relate to natural hazards. UK Cabinet Office guidance (2011) indicates that the main natural hazards that can disrupt infrastructure in the UK are hydrological (e.g. drought, floods), geological (e.g. earthquakes, landslides) and climatic and atmospheric (e.g. extremes of heat and cold, windstorm). UK Cabinet Office guidance (2011) lists natural hazards in the UK and their potential consequences as follows:

- Storms and gales:
  - flooding;
  - land instability; and
  - wildfire.
- Prolonged period of hot weather:
  - thunderstorms;
  - drought;
  - dust/smog/haze/fog;
  - land instability; and
  - wildfire.
- Prolonged period of dry weather:
  - dust/smog/haze/fog;
  - reduced ground water flow;

  - water quality;
  - land instability; and
  - drought.
- Excessive cold with snow:
  - ice/ice accretion;
  - wind chill;
  - fog; and
  - flooding (snow melt).

Study Area

14.2.13 The study area for this assessment was informed by professional judgment. An initial study area of 10km was considered, based on CDOIF (2016) guidance for environmental risk tolerability for COMAH sites. This was then refined as appropriate, recognising that the CDOIF guidance indicates that evaluation beyond this area could be required for COMAH sites where a receptor could act as a pathway over an extended distance (such as connected watercourses), whilst also taking into account the specific details of the project and recognising that the project is not a COMAH site (with the exception of the proposed modification of the pigging station, which is part of the Esso West London Terminal storage facility COMAH site).

14.2.14 Consequences of major accidents or disasters could extend beyond the immediate environs of the project, and a study area of up to 1km was established to identify potentially sensitive land, groundwater or surface water receptors. For surface watercourses, a wider study area of up to 10km downstream was considered.

14.2.15 As noted previously, any sites categorised by HSE as major accident installations, sites or pipelines) and identified by HSE in relation to the project were included within this assessment.

Baseline Conditions

Desk-Based Assessment

14.2.16 The primary sources of information to identify potential major accident and disaster sources and receptors were the environmental topic chapters of this ES. Key information sources are set out in Table 14.1.

Table 14.1: Major Accidents and Disasters – Information Sources

Data Source	Information
Chapter 3 Project Description	• Diesel • Aviation fuel • Design measures
Chapter 7 Biodiversity	• Protected fauna • Protected plants

Data Source	Information
Chapter 8 Water	• Surface water • Flooding • Water quality
Chapter 9 Historic Environment	• Historic buildings
Chapter 11 Soils and Geology	• Methane (from landfills) • Land instability • Reduced groundwater flow
Chapter 12 Land Use	• Land • Groundwater • Soil
Chapter 13 People and Communities	• Population and human health
HSE (2019) website	• Establishments covered by COMAH
UK Met Office (2019a, 2019b) Various other online data sources (see references)	• Climate and natural hazards

Site Walkover and Surveys

14.2.17 The assessment is informed in part by various other environmental surveys as reported in the chapters of this ES as listed in Table 14.1. No additional site walkovers or field surveys were required for this assessment.

Engagement Relevant to the Assessment

14.2.18 The opportunity to provide input in relation to major accidents was discussed with an Environment Agency Strategic Planning Specialist in advance of a meeting with the Hertfordshire & North London Region on 19 November 2018. As the project is not a COMAH development, and the only proposed works to the Esso West London Terminal (which is a COMAH site) comprise modifications to the pigging station, the Environment Agency confirmed that their input would not be necessary on this topic.

14.2.19 The HSE is appointed by the UK Government as the statutory consultee to planning authorities for certain developments, due to its expertise in major accident hazards. HSE is identified as a consultee for this project. A teleconference was held with HSE on 11 January 2019 to discuss the scope and approach for this assessment. After the teleconference, HSE confirmed that, based on the information provided on the call, there did not appear to be any major concerns within HSE's remit regarding the project. HSE subsequently confirmed that their Nationally Significant Infrastructure Projects (NSIP) team would not advise against the project from a land use planning perspective, as it is a fuel pipeline and would not fall within HSE Land Use Planning (LUP) zones.

Limitations of Assessment

14.2.20 There were no identified gaps in the baseline data needed to inform the level of assessment reported in this chapter.

Impact (Risk) Assessment

14.2.21 As explained in paragraphs 14.2.3 to 14.2.6, the assessment of major accidents and disasters differs from the standard EIA approach described in Chapter 6 Overview of Assessment Process, as it focuses on risk. The intention of this assessment is to identify major risks in the context of potential for significant environmental effects.

14.2.22 As noted in paragraph 14.1.2, this assessment considers the occurrence of extreme incidences and considers scenarios that would not reasonably be covered by the environmental assessments reported in Chapters 7 to 13. This assessment considers a significant effect in the context of a major accident or disaster would be an extreme event that resulted in:

- serious damage to human populations (multiple serious injuries and/or requirements for medical attention, or death); and/or
- serious damage to the environment (based on extent, severity and duration).

14.2.23 Risks were assessed using a combination of CDOIF guidance-based assessment and professional judgment, informed where relevant by the findings of other assessment chapters of this ES.

<u>Vulnerability of the Project</u>

14.2.24 The assessment considered vulnerability of the project as described in Chapter 3 Project Description, including the pipeline and above ground installations between Boorley Green and the Esso West London Terminal storage facility.

14.2.25 The integrity of the pipeline in terms of aspects such as construction type and installation depth was reviewed. Vulnerability of all elements of the project was considered based on potential for damage due to a major accident or disaster, such that a significant effect would occur in this context.

<u>Potential to Cause a Major Accident</u>

14.2.26 This assessment was based on a review of the project and of the environmental baseline as set out in ES Chapters 7 to 13. In addition, specific risk calculations were undertaken for potential fuel release (either aviation fuel from the pipeline or diesel release during construction) and of fire risk if fuel were to ignite.

Fire

14.2.27 Within the scope of this assessment, the primary receptors for the effects of fire sufficient to cause a major accident or disaster in line with the definitions set out in paragraph 14.2.22 are identified as humans (nearby residential areas) and built heritage.

14.2.28 Two types of potential fire risk were considered:

- jet fire: where a pressurised leak of fuel forms a burning jet; and
- pool fire: where a release leads to a pool of flammable fuel that then ignites.

14.2.29 The above scenarios were assessed with reference to the potential volume of fuel available for release, the conditions required for the fire to occur, the likelihood of a fire occurring and the estimated area that could be directly affected.

14.2.30 For built heritage, potential fire risk as a consequence of a major accident or disaster was considered for listed buildings within 1km of the pipeline.

Fuel Release (Pollution)

14.2.31 To consider accidental aviation fuel release during pipeline operation, pipeline failure rates were utilised, taking into account recent data presented in Concawe (2018) report 6/18 'Performance of European cross-country oil pipelines - statistical summary of reported spillages in 2016 and since 1971'. Concawe is the technical body focusing on environmental science for the European refining sector. Report 6/18 forms part of the HSE RR1035 report (HSE, 2015a) and is based on data from liquid hydrocarbon pipelines. The assessment considered all sizes of leaks, as if left unmitigated, any size leak has potential to cause harm to a receptor.

14.2.32 The maximum credible release of aviation fuel from the pipeline was taken to be a complete loss of fuel between two valves (these would be shut down when a fault in the pipeline was detected). Further information regarding valves is provided in Section 14.4.

14.2.33 To consider diesel fuel release during construction, the maximum anticipated point source containment of diesel on site was used as a basis for considering risk of release. This was taken to be a 950 litre capacity towable bowser, and a 4,500 litre static double containment fuel tank.

14.2.34 Receptors potentially vulnerable to a fuel release were identified, informed by review of the findings of each topic assessment (see Table 14.1). In accordance with the steps set out in paragraph 14.2.6, this was based on:

- receptor sensitivity and national/international importance;
- the presence of a potential source-pathway-receptor linkage; and
- the potential for a major accident or disaster to occur.

14.2.35 The following steps, informed by the CDOIF (2016) guidance, were taken to identify potential significant effects from damage to the pipeline:

1) The maximum credible release of fuel for each section of pipeline between block valves was identified.
2) These values were compared with the thresholds for severity of harm classification for the different types of receptor (see Table 14.2).
3) The likely harm duration categories were identified.
4) The corresponding potential MATTE classes were identified together with their 'broadly acceptable' incident frequencies (see Illustration 14.1).
5) The likelihood of a catastrophic release was calculated for each pipeline section.
6) These likelihoods were compared with the broadly acceptable frequency thresholds.

14.2.36 As previously noted in paragraph 14.2.4, CDOIF (2016) classifies MATTE in terms of severity and duration. A matrix approach is followed as shown in Illustration 14.1, with the determination of whether a risk is ‘broadly acceptable’ or not (equating to a non-significant effect or significant effect for the purposes of this major accidents assessment) being based on likelihood or frequency.

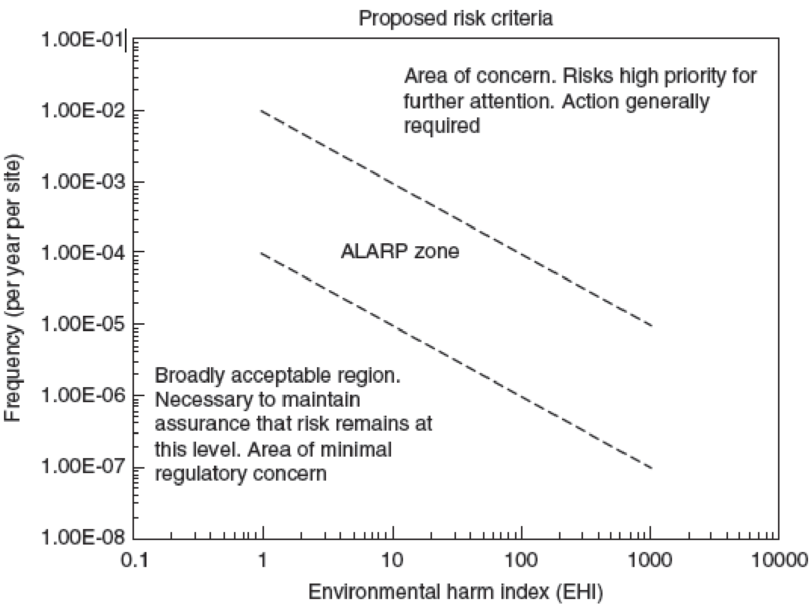
Illustration 14:1: Environmental Tolerability Risk Matrix (from CDOIF, 2016)

Severity of Harm				
4		C	D	D
3		B	C	D
2		A	B	C
1	*Sub-MATTE Harm*			
Harm Duration Category	1	2	3	4

Frequency at which the CDOIF consequence level is reached or exceeded	Frequency per receptor per establishment per year	
	Intolerable (greater than)	Broadly Acceptable (less than)
A	1.0 E-02	1.0 E-04
B	1.0 E-03	1.0 E-05
C	1.0 E-04	1.0 E-06
D	1.0 E-05	1.0 E-07

14.2.37 Illustration 14.2 sets out a matrix approach to environmental harm and frequency of incident, showing the ‘broadly acceptable’ and ‘Intolerable’ risk thresholds (the interval between this is where the risk is to be managed to be ‘As Low As Reasonably Practicable’; ALARP).

Illustration 14.2: Environmental Harm Index Plot (from IChemE, 2008)



14.2.38 From consideration of the relative impact of a given release, sensitivity factors are identified for different receptor types, as shown in Table 14.2. This table also shows the range of fuel spill quantities (in tonnes equivalent) that are identified as causing a CDOIF Category 2 severity of harm, for the CDOIF receptor types.

Table 14.2: Sensitivity and Severity by Receptor Type

Receptor Type	Sensitivity Factor	Severity 2 Range (Tonnes Equivalent, Te)
Widespread habitat	1	1,182–11,820
Site of Special Scientific Interest (SSSI)	20	59–590
Groundwater (including Source Protection Zone (SPZ))	10	118–1,180
Lake	10	118–1,180
River (low ecological class)	5	236–2,360
River (>low ecological class)	10	118–1,180
Marine	5	236–2,360
Estuary	5	236–2,360

14.3 Baseline Conditions

14.3.1 This section briefly summarises potential receptors, based on the corresponding environmental topic chapters of this ES. Context is then provided for natural hazards based on information regarding climate and ground conditions, and major accident installations (as identified by HSE) are also identified.

14.3.2 As explained in Chapter 3 Project Description, to aid design development and environmental assessment, the route was broken down into eight separate sections (Section A to Section H). Where appropriate, reference is made to these sections in the following baseline descriptions.

14.3.3 A brief summary of relevant legislation and guidance is also provided.

Potential Receptors

<u>Biodiversity</u>

14.3.4 Chapter 7 Biodiversity provides a detailed assessment of biodiversity within 1km of the Order Limits.

14.3.5 There are a large number of statutorily designated habitats along the route. Those within 1km of the Order Limits and of national importance and particular relevance to this assessment are:

- Thursley, Ash, Pirbright and Chobham Special Area of Conservation (SAC);
- Thames Basin Heaths Special Protection Area (SPA) and South West London Waterbodies SPA/Ramsar;
- Chobham Common NNR and Beacon Hill NNR; and
- nine SSSIs.

14.3.6 In addition, statutory designated sites beyond 1km of the Order Limits but with hydrological connectivity are Solent Maritime SAC, Solent and Southampton Water SPA, and Upper Hamble Estuary and Woods SSSI.

14.3.7 A number of non-statutorily designated sites such as local Sites of Importance for Nature Conservation (SINC), protected road verges, and areas of Ancient Woodland are also located within 1km of the Order Limits. These are listed in Chapter 7 Biodiversity.

14.3.8 The presence of protected species of nature conservation interest along the route is also reported in Chapter 7 Biodiversity:

- badgers;
- otters;
- water voles;
- bats (including common and soprano pipistrelle, Bechstein's and barbastelle);
- dormice;
- fish (including brown trout, brook lamprey, bullhead, European eel, stickleback);
- amphibians (notably Great Crested Newt); and
- reptiles (including sand lizard, adder, smooth snake, slow worm, common lizard).

Water

14.3.9 The water environment is described in Chapter 8 Water. Key water aspects that are considered under major accidents are Source Protection Zones (SPZs) and major river crossings.

14.3.10 SPZs that the pipeline is routed through have been identified:

- north of Bishop's Waltham (SPZ2 & 3, Section A) follows route of existing pipeline;
- southeast of New Alresford (SPZ2 & 3, Section B) follows route of existing pipeline;
- east of Ropley (SPZ2 & 3, Section B) follows route of existing pipeline;
- southwest of Ewshot (SPZ3, Section G) follows route of existing pipeline; and
- north of Addlestone (SPZ2 & 3, Section G) follows route of existing pipeline.

14.3.11 The route crosses 14 main rivers, of which one is the River Thames (in Section G).

Material Assets (Historic Environment)

14.3.12 Chapter 9 Historic Environment identifies historic buildings in the study area. The number of listed buildings (Grade I, II, or II*) within 100m bands up to 1km is shown in Table 14.3.

Table 14.3: Built Heritage (Listed Assets) within 1km

Range (m)	Listed Building Grade		
	Grade I	Grade II	Grade II*
0–100	-	32	-
101–200	2	33	1

Range (m)	Listed Building Grade		
	Grade I	Grade II	Grade II*
201–300	1	47	3
301–400	-	45	5
401–500	1	63	1
501–600	1	58	3
601–700	1	83	7
701–800	-	79	-
801–900	-	61	3
901–1,000	-	59	1

Land, Soils and Geology

14.3.13 Consideration of potential releases of methane as a result of the pathways crossing existing landfills was requested to be included in this assessment in the Planning Inspectorate's (2018) Scoping Opinion. Landfill sites are identified in Chapter 11 Soils and Geology at the following locations:

- south and west of Frimley (historic landfill, Section E);
- northeast of Addlestone (historic landfill, Section G), follows existing pipeline route;
- west of Shepperton (historic landfill, Section H);
- west of Shepperton (authorised landfill, Section H), follows existing pipeline route;
- west of Queen Mary Reservoir (historic landfill, Section H), follows existing pipeline route;
- west of Queen Mary Reservoir (authorised landfill, Section H), follows existing pipeline route;
- southeast of Staines Reservoir (historic landfill, Section H), follows existing pipeline route; and
- west of the Esso West London Terminal storage facility (historic landfill, Section H), follows existing pipeline route.

14.3.14 Current land use is described in Chapter 12 Land Use. Urban and non-agricultural areas comprise 6% and 11%, respectively, of the study area in Hampshire and 16% and 26% in Surrey. Of agricultural land, the majority (77% in Hampshire and 57% in Surrey) is of 'moderate' or lower agricultural quality.

Population and Human Health

14.3.15 Chapter 13 People and Communities provides a description of the population and communities in the vicinity of the project. In summary:

- Section A – Boorley Green to Bramdean: predominantly agricultural and/or rural. Passes through areas with rural residential properties, and within 500m of small villages and towns at Boorley Green and Newtown (Northbrook).

- Section B – Bramdean to South of Alton: predominantly rural area with low population density.
- Section C – South of Alton to Crondall (via Alton Pumping Station): predominately agricultural land with low population density. Passes close to the villages of Upper Froyle and Crondall, and approximately 2km from the large town of Alton.
- Section D – Crondall to Farnborough: compared to Sections A to C, passes closer to more urban landscapes and large residential areas, such as Church Crookham and Southwood, and within 500m of Farnborough Airport.
- Section E – Farnborough to Bisley and Pirbright Ranges: passes through large urban areas, including the towns of Farnborough and Frimley.
- Section F – Bisley and Pirbright Ranges to M25: predominately urban in nature, routed between a number of large residential areas including Heatherside, Lightwater and Chertsey South. Also passes through Chobham Common.
- Section G – M25 to M3: passes just south of Chertsey, a large urban area. Also passes though Chertsey Meads parkland and under the River Thames.
- Section H – M3 to West London Terminal storage facility: highly urbanised area, through the town of Ashford.

14.3.16 As described in Chapter 13 People and Communities, there are also various community facilities and recreational areas through each section, such as golf courses, churches, schools, and playing fields.

Climate and Natural Hazards

14.3.17 This section covers the baseline conditions in relation to potential disasters due to natural hazards, where scoped in to the assessment and not covered by the baseline conditions in the preceding paragraphs.

Flooding

14.3.18 Environment Agency flood zone definitions are set out in the National Planning Policy Guidance (2014), as follows:

- Flood Zone 1 – land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%);
- Flood Zone 2 – land assessed as having between a 1 in 100 and 1 in 1,000 year probability of river flooding (1% – 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%); and
- Flood Zone 3 – land assessed as having a 1 in 100 or greater annual probability of river flooding (≥1%), or a 1 in 200 or greater annual probability of flooding from the sea (≥0.5%).

14.3.19 The majority of the project passes through areas not designated as flood zone, although it does pass through areas identified as Flood Zones 2 and 3. These zones are associated with watercourses crossed by the route. The largest flood risk areas are associated with the River Thames, close to the northern extent of the project, where approximately 3.5km of the pipeline route is within Flood Zone 3 and a further

4km within Flood Zone 2. Other crossings of flood zones are typically over lengths of 50m to 200m around smaller watercourses.

14.3.20 Further information for each section of the route is provided in Section 5.3 of the Flood Risk Assessment (FRA) (**application document 7.3**), which supports the application for development consent for the project.

Land Instability

14.3.21 The project is located in an area with generally gentle to flat topography. Land instability for the purposes of this assessment was considered in terms of extensive ground movement due to natural hazards, principally an earthquake. Earthquakes severe enough to cause damage are rare in the UK.

14.3.22 The route passes through Hampshire and Surrey, areas considered to be of very low seismicity. The British Geological Survey (BGS, 2018) indicates that the pipeline passes through areas with a Peak Ground Acceleration (PGA, g) of 0.005 to 0.002 at its southern extent (approximating to Section A of the project) and 0.02 to 0.04 for the remainder of the route. These are the two lowest categories of the nine BGS seismicity categories for the UK.

Climate

14.3.23 The UK is not subject to extremes of hot or cold weather. The highest daily maximum temperature on record in the UK is 38.5°C, recorded in August 2003 in Kent. The lowest daily minimum temperature on record in the UK is -26.1°C, recorded in 1982 in Shropshire (UK Met Office data). Based on available data (1998–2010) from the UK Met Office climate station at Farnborough, close to the route of the replacement pipeline, average annual temperature data are as follows:

- max. temperature: 14.7°C;
- min. temperature: 6.1°C;
- max. temperature range between months: 14.6°C (Jan vs. Aug);
- min. temperature range between months: 11.4 °C (Feb vs. July); and
- days of air frost per year: 54.5.

14.3.24 Hampshire and Surrey have low rainfall in a UK context. Based on available data (1998–2010) from the UK Met Office climate station at Farnborough, rainfall data are as follows:

- total rainfall: 691mm;
- min. monthly rainfall: 7.9mm (June);
- max. monthly rainfall: 11.6mm (Jan and Nov); and
- days of rainfall >1mm: 115.4.

14.3.25 The occurrence of snow is linked closely with temperature, with falls rarely occurring if the temperature is higher than 4°C, and temperatures below this are generally required for snow to lie for any length of time. On average, the number of days with snow falling in the south of England is about 12–15 per year over lower lying areas (UK Met Office, 2019).

14.3.26 Southern England is one of the more sheltered parts of the UK. Based on available data (1998–2010) from the UK Met Office climate station at Farnborough, mean wind speed is 6.8 (knots, at 10m). Gales (a mean windspeed of 34 knots or more over any 10 consecutive minutes) only occur one to two days per year over most inland areas of southern England. Extreme storms are very rare – the most famous was the 'Great Storm' in October 1987, which is considered to be the most severe storm to affect the location of the project since November 1703. The Great Storm caused damage to buildings, woodland, power supplies and transport, and resulted in 18 storm-related deaths.

14.3.27 In a UK context, the southeast of England is relatively susceptible to the effects of droughts, which result in dry ground conditions. Water company supply areas in the UK are assessed in terms of 'water stress'. Hampshire and Surrey, within which the project is located, are both classified as areas of serious water stress (Environment Agency, 2013). However, due to the UK's temperate climate, the effects of drought are generally short term and do not pose significant environmental risk.

Wildfire

14.3.28 The UK has a temperate climate that is not usually associated with wildfire, however wildfires do occur annually. In 2018, there were several relatively large wildfires in the UK, following an extended period of hot and dry weather. Two of these were classified as major incidents (located in Greater Manchester and Lancashire). Whilst not classified as a major incident, a wildfire in Surrey (Witley Common, near Godalming) affected 100ha of land in August 2018. Wildfires generally start from human error, such as discarded cigarettes or barbeques, when ground conditions are dry after extended periods of hot, dry weather, and vegetation may have increased susceptibility to fire.

Nearby Major Accident Installations

14.3.29 The assessment considered the vulnerability of the project to a major accident at any nearby major accident installation. Through engagement with HSE, the following major accident installations were identified for inclusion in the assessment:

- Major Accident Hazard Sites (COMAH):
  - Site operated by Igas Energy plc incorporating Star Energy Ltd (HSE ref H4652);
  - Site operated by SCJ Eurafne Ltd (HSE ref H0417); and
  - Esso West London Terminal storage facility (HSE ref 0893).
- Major Accident Hazard Pipelines (MAHP):
  - Miltons Farm to Horsell Common (HSE ref 8025);
  - Staines Bypass to Laleham (HSE ref 8015); and
  - Lordswood/Purbrook P006 (HSE ref 80532).

14.3.30 The location of these installations is described in Table 14.5, in Section 14.5 Environmental Risk.

14.3.31 The assessment also considered the potential for the project to cause a major accident at a nearby installation. For such an event to occur, it is considered that a major fire would be required at an above ground installation or at an accidentally damaged/exposed section of buried pipeline. The HSE Land Use Planning website-based application (HSE, 2019) was used to review locations of hazardous installations near to the project. From the available mapping, no additional HSE listed installations to those listed in paragraph 14.3.29 were identified for more detailed assessment.

14.3.32 The existing pipeline runs parallel in adjoining easements with two other pipelines: a multifuel line carrying a range of liquid hydrocarbon products operated by Esso, and a natural gas pipeline operated by Southern Gas Networks (SGN) and Cadent Gas. Where the proposed pipeline route aligns with the existing pipeline it crosses these at a number of locations. In addition, it crosses two further SGN gas pipelines at Froyle. These pipelines were not notified as MAHPs by HSE during engagement, however, their protection of these and any other buried services would be achieved through similar controls. Further information on the protection of other buried pipelines and services is provided in Section 14.4 Design and Good Practice Measures.

Legislation and Regulatory Guidance

14.3.33 ES Chapter 2 Regulatory and Policy Context and its associated appendices set out the legislation and national policy relevant to this project. Appendix 2.2 includes a review of key local policy considerations. In addition, the following legislation and guidance has been reviewed as part of the development of this chapter.

Legislation

14.3.34 The Pipelines Safety Regulations (PSR) 1996 defines a ‘major accident hazard pipeline’ (MAHP) as one which ‘*conveys a dangerous fluid and which has the potential to cause a major accident’.* Under these regulations neither diesel nor aviation fuel is considered to be a dangerous fluid and the proposed pipeline does not classify as a MAHP.

Regulatory Guidance

14.3.35 The term ‘Major Accident To The Environment’ (MATTE) is used in the UK by the Competent Authorities (the HSE and Environment Agency) and industry to indicate when a major accident has caused or could cause serious harm to the environment.

14.3.36 Planning Inspectorate Advice Note 11 (2017) describes how the HSE supports the planning process with respect to major accidents. Annex G of the advice note recognises that these might arise either because the development introduces new major hazards, or because an accident at the new development might initiate an existing major hazard at a nearby installation.

14.3.37 Regulatory guidance for COMAH is provided by the HSE guidance note L111 (HSE, 2015b). Specific guidance on defining and assessing major accidents is provided by the HSE in the form of Safety Report Assessment Manuals, and these have been drawn on in the development of this chapter.

14.3.38 Whilst it is recognised that the project is a non-COMAH development, the CDOIF Guideline for Environmental Risk Tolerability for COMAH Establishments (CDOIF, 2016) was reviewed. This guideline implements the source-pathway-receptor approach to environmental risk assessment and considers the quantity of substance that could be released to a receptor. By considering how long the receptor is likely to take to recover, it can be determined if a MATTE would result from substance release. Any resulting MATTE is then risk assessed, examining unmitigated and mitigated likelihoods, to determine if the occurrence is considered tolerable.

14.3.39 The document 'Planning Advice for Developments near Hazardous Installations' (PADHI) (HSE, 2011) describes how the HSE makes assessments with regard to land use planning and MAHPs and sets safety zones around a development. As noted above, PSR 1996 confirms that neither diesel nor aviation fuel is considered to be a 'dangerous fluid'. Consequently, the PADHI guidance is referenced here for completeness only.

14.4 Design and Good Practice Measures

Health and Safety

14.4.1 Health and safety has been a key consideration on the project. This section details the standards and procedures that have been considered during the design development that are relevant to the construction and operation of the project.

14.4.2 The project would be constructed and operated in accordance with applicable health and safety legislation. All aspects of the work would comply with the provisions of the Health and Safety at Work etc. Act 1974 and all relevant subordinate legislation.

14.4.3 PSR 1996 provides for the design, construction, installation, operation, maintenance and decommissioning of pipelines covered by the regulations to be of a very high safety standard.

Summary of Design

14.4.4 Chapter 3 Project Description provides a full description of the project. In the context of both 'vulnerability to' and 'potential to cause' a major accident or disaster, it is noted that the project design complies with the PSR 1996, which requires the management of potential hazards to reduce accidents and disaster risk to an acceptable level.

14.4.5 The replacement pipeline would be buried underground for its entire length. The minimum depth from the top of the pipe to the ground surface would be 1.2m in open cut sections, and deeper for trenchless crossings. A slightly shallower depth may conceivably be necessary in exceptional circumstances, but all indications are that this would not be required. The pipeline would also be buried deeper, typically 1.5m from top of pipe to ground surface, in roads and streets to account for other existing infrastructure such as utility pipes, cables and sewers.

14.4.6 Above ground installations required as part of the project have been sited away from property and outside areas of flood risk where practicable, and are identified as:

- a new "pigging" station at Boorley Green to allow the entry and exit points for Pipeline Inspection Gauges (PIG) during inspections;
- installation of a replacement booster pump at Alton Pumping Station;
- 14 remotely operated valves along the pipeline to allow isolation for maintenance or to limit the impact of a potential leak;
- 6 above ground cathodic protection (CP) transformer rectifier cabinets to supply power to the existing CP system; and
- modifications to the PIG station at the West London Terminal storage facility including installation of a new 40cm PIG receiver for the 30cm diameter PIGs.

Design Measures

14.4.7 The project includes various measures embedded into the design specifically to reduce risk and effects on sensitive human and environmental receptors. These aspects are described in Chapter 3 Project Description. Of particular relevance are:

- remotely operated valves along the pipeline – these would enable sections of the pipeline to be quickly isolated in the event of a major accident, limiting the volume of aviation fuel that could be released;
- a 24/7 pipeline operation and monitoring regime, with continuous flow monitoring capable of detecting pressure and flow differentials in the pipeline. Changes in flow can be detected and identified to a specific section of the pipeline;
- the application of an anti-corrosion pipe coating and installation of an impressed current CP corrosion mitigation system, to protect the pipeline against corrosion, maintaining its integrity; and
- security fencing (approximately 3m) around the new pigging station at Boorley Green – this would prevent public access to this site.

Installation (Construction) Measures

14.4.8 The project team would prepare and maintain a health and safety policy and a detailed, site-specific health and safety plan. Methodologies, accompanied by safety risk assessments, would be produced to cover the construction activities.

Diesel Storage and Use

14.4.9 This chapter contains a number of project commitments to reduce impacts on the environment. These are indicated by a reference number like this (G23). Good practice measures are set out in the REAC and secured through DCO requirements such as the CoCP.

Table 14.4: Good Practice Commitments Relevant to Diesel Storage

Ref	Commitment Description
G8	The CEMP would include proactive actions and measures to control pollution risks. This could be either directly from the construction works or due to external factors such as extreme weather. Measures would include appropriate storage and handling of fuels and other substances hazardous to the environment.
G119	Potentially hazardous materials used during construction would be safely and securely stored including use of secondary containment where appropriate.
G121	All refuelling, oiling and greasing of construction plant and equipment, would take place above drip trays and also away from drains as far as is reasonably practicable. Vehicles and plant would not be left unattended during refuelling. Appropriate spill kits would be made easily accessible for these activities.

Methane Release

14.4.10 Installation of the pipeline may disturb waste and could lead to a potential release of landfill gas. This risk would be assessed through site investigations prior to and during the works. The primary mechanism for impact reduction would be working with Environmental Permit holders for the sites and the Environment Agency to seek appropriate modifications and consents for working on these permitted sites.

14.4.11 Good practice measures are provided in the REAC (Chapter 16) and will be secured through DCO requirements such as the CoCP, including measures relating to methane release from landfill. Those of particular relevance are measures G71 and G75. These are provided in full in Chapter 11 Soils and Geology, and summarised here:

- Working methods for the project in areas of contaminated land (including landfills) would be based on standard brownfield good practice. These would take into account qualitative risk assessment of known and expected contamination, and be used to develop risk assessments and methodologies. It is also noted that additional working methods may include gas monitoring.
- Contingency plans would be developed for dealing with various forms of expected or unexpected contamination. These procedures would clearly define methods for dealing with any areas of unexpected contamination to manage immediate risks, including prevention of any ground gas or airborne contaminants spreading from the affected area.
- Where the route passes through areas where there are active Environmental Permits (for example authorised landfill sites), the contractor(s) would work with the permit holder to comply with the permit requirements.

Other Pipelines and Services

14.4.12 The project design has taken account of existing buried pipelines in close proximity to the replacement pipeline route or crossed by it.

14.4.13 Standard industry measures and controls are already established to manage the risk of and to other pipeline assets from any nearby works or development. Two pipelines that would be crossed by the project are identified by HSE as MAHPs, and a number of other fuel pipelines would also be crossed. Esso is working with the owners/operators of these pipelines to confirm an appropriate safe working methodology which will also be covered by protective provisions forming part of the draft DCO.

14.4.14 Existing buried services pipelines would be covered by protective provisions with the relevant undertakers, which will form part of the draft DCO (i.e. a set of working requirements) during construction, with works taking into consideration HSE (2014) guidance '*Avoiding danger from underground services*'. This guidance outlines the potential risks of working near underground services and provides advice on how to reduce any direct risks to people's health and safety, as well as the indirect risks arising through damage to services.

Pipeline Commissioning

14.4.15 Measures would be taken to provide long term safety of the pipeline and associated infrastructure. During manufacture, the components would be subjected to rigorous testing before being certified as fit for use.

14.4.16 A range of tests would also be employed to check the integrity of the pipeline as part of the commissioning process. Typical safety measures that may be employed at the time of construction include:

- 100% inspection of all field welds using automatic ultrasonic inspection or radiographic (x-ray) testing. This includes tie-ins and valves; and
- hydrostatic pressure testing, where the pipeline length is filled with water and pressurised to a level greater than the maximum operating pressure of the installed pipe (initially for four hours and then for a period of 24 hours). This test further measures the integrity of the pipeline as a whole, with any deficiency or loss during the test leading to investigation, replacement and retest until a satisfactory test condition is achieved.

Operation and Maintenance

14.4.17 Pipelines are considered one of the safest modes of transport for conveying hazardous substances. The likelihood of failure in a fuel pipeline in the UK is extremely low. The pipeline would be operated in accordance with strict and comprehensive standard operating procedures (SOPs).

14.4.18 The design includes the following aspects:

- an easement strip extending 3m to either side of the pipeline – no building or below ground activity would be permitted within this area without prior approval, which would protect the pipeline from damage;
- industry standard pipeline marker posts at all road crossings and boundaries (plus additional markers along the route to enable aerial identification), minimising the risk of inadvertent disturbance of the buried pipeline.

14.4.19 Regular inspections of the pipeline and valves would also be undertaken:

- pipeline route patrols by vehicle/on foot in discrete areas, typically on a weekly basis;
- inspections of valves, typically on a monthly basis;

- pipeline route helicopter inspections, typically every other week;
- pipeline route walkover inspections, typically completed in the winter months every two years;
- testing and inspection of the cathodic protection system; and
- a programme of pipeline cleaning and inspection.

14.5 Environmental Risk

14.5.1 As explained in paragraph 14.2.3, this chapter differs from the other ES chapters which report potential impacts for each topic area, as it instead focusses on environmental risk. The section firstly considers potential vulnerability of the project to a major accident or disaster, and secondly the potential for the project to cause a major accident or disaster.

Vulnerability of Project to Effect

Project Vulnerability to Major Accidents

14.5.2 The following paragraphs review the potential vulnerability of the project to the major accidents types listed in paragraph 14.2.11.

Diesel Spills/Releases (Construction/Installation)

14.5.3 Diesel spills or releases are considered primarily as a potential effect of the project, considered under ‘Potential for Project to Cause Effect’ in the following section. The project itself would not be vulnerable to the effects of diesel spills or releases during construction/installation.

14.5.4 As described in Section 14.4, good practice measures in relation to diesel are set out in the REAC to protect construction site personnel and the environment.

Methane Release from Landfills (Construction/Installation)

14.5.5 Methane release from landfills is considered primarily as a potential effect of the project, considered under ‘Potential for Project to Cause Effect’ in the following section. The project itself would not be vulnerable to the effects of methane release during construction/installation.

14.5.6 As described in Section 14.4, good practice measures relevant to release of ground gas or atmospheric contaminants are set out in the REAC to protect construction site personnel and the environment.

Release of Aviation Fuel (Operation)

14.5.7 The project comprises a pipeline and associated installations which provide robust sealed containment of aviation fuel. The project itself is not vulnerable to a release of aviation fuel.

Fire (Operation)

14.5.8 It is not considered that the project would be susceptible to significant effects as a consequence of a nearby major fire. The pipeline is a minimum of 1.2m underground for its entire length and, as such, would be protected from fire.

14.5.9 Above ground installations forming part of the project are primarily the valves, CP transformer rectifier cabinets and the pigging station near Boorley Green. Valves would have a low risk to external effects of fire as they are fully enclosed, sealed and largely sub-surface. This limits the potential for fuel to be exposed to heat, air or ignition. These would operate under a semi-automated function (i.e. operations detect a loss of containment and actuate the valves) but could be manually shut down if required. CP transformer rectifier cabinets provide a long-term preventative maintenance function and their damage/loss due to fire would have no potential to cause a major accident. The pigging station (containing valves, a PIG receiver and a PIG launcher) is similarly of low vulnerability to the effects of fire.

14.5.10 The project also includes replacement facilities at the existing Alton Pumping Station. This is a more complex site and therefore has additional protection. Of relevance to the consideration of fire risk are closed-circuit television linked to a pipeline control centre and automated fire detectors that can shut down areas of risk.

Explosions (Operation)

14.5.11 As the pipeline is buried, the project is not considered to be vulnerable to the effects of a nearby explosion.

Smoke (Operation)

14.5.12 The project comprises a buried pipeline and remotely operated installations. It would not be vulnerable to the effects of smoke other than potentially requiring short term changes to visual inspections which would not constitute a risk to project operation or safety.

Major Accident Installation Sites (Operation)

14.5.13 Vulnerability of the project in terms of risk as a result of a major accident at identified MAHP or COMAH sites was considered. The review considered the potential of such sites to cause a major accident and the potential for any such incident to affect the project. These installations are presented in Table 14.5.

Table 14.5: Major Accident Installations – Project Vulnerability

Site	Category	Location	Review of Risk to the Project
Site operated by Igas Energy plc incorporating Star Energy Ltd (HSE ref H4652)	COMAH	Northeastern edge of COMAH site abuts the Order Limits, at Alton.	This is a crude oil storage facility. It is located immediately adjacent to Esso's Alton Pumping Station and existing pipeline. Order Limits abut site boundary, but pipeline would be clear of the main operating site, and operationally the pipeline would be as per the existing pipeline at this location.

Site	Category	Location	Review of Risk to the Project
Site operated by SCJ Eurafne Ltd (HSE ref H0417)	COMAH	Southern edge of COMAH site is immediately adjacent to Order Limits, at Frimley Green.	This site was previously a factory, but it has been confirmed by Esso in discussion with the operator that the site now only provides office accommodation. No risk to the project is identified.
Esso West London Terminal storage facility (HSE ref 0893)	COMAH	At the terminus of the project.	This is a fuel storage facility, owned and operated by Esso. It is located at the northern extent of the replacement pipeline, and the pigging station at this facility would be upgraded as part of the project. No increase of risk is identified.
Miltons Farm to Horsell Common (HSE ref 8025)	MAHP	Crossed by the project at Chobham Common	This is a high-pressure gas pipeline, owned by SGN. It would be unavoidably crossed by the project. Risk to be managed through design and installation methodology and the use of agreed protective provisions as set out in the draft DCO.
Staines Bypass to Laleham (HSE ref 8015)	MAHP	Crossed by the project at Fordbridge Park	This is a high-pressure gas pipeline, owned by Cadent Gas. It would be unavoidably crossed by the project. Risk to be managed through design and installation methodology and the use of agreed protective provisions as set out in the draft DCO.
Lordswood/Purbrook P006 (HSE ref 80532)	MAHP	South of Maddoxford Lane, Botley. Circa 500m from start of the project.	The project was initially anticipated to cross this pipeline (during statutory consultation with HSE), but the project design has been revised such that it now starts further north and does not cross the pipeline. No risk to the project is identified.

Project Vulnerability to Natural Disasters

14.5.14 The following paragraphs review the potential vulnerability of the project to natural disaster types as listed in paragraph 14.2.12. These are primarily applicable to the Operation phase of the project.

Flooding

14.5.15 The pipeline would be buried for its entire length and is not considered to be susceptible to the effects of flooding. Valves have been sited where possible to avoid areas of flood risk, and are also sealed and enclosed. The majority (13 of 14) of the valves are located beyond any identified flood zone, and none are located within the highest risk flood zone (Flood Zone 3). One is unavoidably located in Flood Zone 2, with an annual flood probability of between 1 in 100 and 1 in 1,000.

14.5.16 As noted previously, a FRA (**application document 7.3**) has been undertaken for the project, which considers effects both of the project and on the project. The FRA assesses flood likelihood and potential severity. The term ‘severity’ is of relevance to the major accidents assessment and is categorised in the FRA as being either ‘very low’, ‘low’, ‘moderate’ or ‘significant’. Of these, the only category that could potentially align with a significant effect in the context of a major accident or disaster would be the highest of these categories, the definition of which includes 'potential loss of life' and 'extensive areas affected'. The outcomes of the FRA (**application document 7.3**) confirm that no impacts of severity higher than 'low' or 'very low' are predicted, defined as 'inconvenience' or 'local disruption'.

Land Instability

14.5.17 Extensive ground movement due to land instability (such as an earthquake) could potentially damage a buried pipeline or above ground installations. The risk of pipeline leakage (which could occur due to land instability) is considered separately under major accidents.

14.5.18 As explained in paragraphs 14.3.22, the project is located in an area with generally gentle to flat topography and low seismicity. BGS (2019) estimates that a magnitude 4 earthquake happens somewhere in the UK approximately every two years and a magnitude 5 earthquake approximately every 10–20 years. A magnitude 5 earthquake would generally cause no damage or minimal damage to buildings. Research suggests that the largest possible earthquake anywhere in the UK is around 6.5, which could cause damage to buildings. However, this would generally not be sufficient to cause land instability that may present a risk to buried pipelines.

14.5.19 Whilst the risk of land instability having an effect on the project is considered minimal, the outcome of an improbable incident in a worst case could be a complete break to the pipeline and a consequent release of aviation fuel. This scenario is considered under 'Potential for Project to Cause Effect' in the following section.

Wildfire

14.5.20 There is not considered to be a risk of a significant environmental effect in terms of project vulnerability to wildfire. The effects of fire in terms of project vulnerability have been previously considered in paragraphs 14.5.8 to 14.5.10.

Storms

14.5.21 Thunderstorms may result in heavy rainfall, winds and lightning. Storms of sufficient severity to cause damage to infrastructure are very rare in the UK, and damage to underground installations such as buried pipelines are particularly unlikely. Lightning could potentially strike above ground installations. However, these have earthing protection against lightning strikes, and no fuel is stored at these locations (with the exception of the Esso West London Storage Terminal storage facility).

Drought

14.5.22 Extended dry (drought) conditions would not affect the pipeline or above ground installations directly. In the context of the project, secondary effects of drought could be creation of dry ground and reduced moisture content of vegetation, which can make them more flammable. This is considered separately under wildfire.

Dust, Smog, Haze, Fog

14.5.23 The project is not vulnerable to atmospheric pollutants (dust/smog/haze) or moisture in the air (fog).

Ice, Ice Accretion

14.5.24 The pipeline is buried and therefore not liable to ice/ice accretion. Above ground installations are not vulnerable to the effects of ice.

Wind Chill

14.5.25 Wind chill is the cooling effect of wind blowing on a surface. Neither the pipeline nor above ground installations are vulnerable to the effects of wind chill.

Reduced Groundwater Flow

14.5.26 The project comprises a pipeline and associated installations which provide robust sealed containment of aviation fuel. The project would not be vulnerable to reduced groundwater flow.

Water Quality

14.5.27 The operational project would not use water resources and is therefore not vulnerable to changes in water quality.

Potential for Project to Cause Effect

14.5.28 This section reviews the potential for the project to cause a major accident as listed in paragraph 14.2.11.

Potential to Cause a Major Accident

Diesel Spills/Releases (Construction/Installation)

14.5.29 During construction, diesel would be stored in relatively low volumes to fuel on-site plant and equipment. Release of diesel from temporary storage was identified as a possible hazard in the Planning Inspectorate’s Scoping Opinion for the project.

14.5.30 Towable fuel bowsers would be used to refuel the plant at the work faces and would typically have a 950-litre capacity (approximately 0.76 tonnes equivalent (Te), using 0.8 fuel gravity conversion rate). These would be refilled and stored at the working compounds along the route.

14.5.31 A static double containment fuel tank would be located at the working compound. These fuel tanks vary in capacity size, but the typical size that would be used would be 4,500 litres (approximately 3.6Te). This fuel tank would be filled from mobile road tankers as and when required.

14.5.32 Based on the Material Safety Data Sheet (MSDS) for diesel, as provided in Appendix 14.1, harm to humans would require either ingestion or repeated skin contact, neither of which would be expected to occur from release. Construction/installation personnel would wear appropriate personal protective equipment (PPE).

14.5.33 Whilst diesel can be toxic to aquatic organisms if it reaches watercourses, even the most sensitive class of receptors are identified in Table 14.2 as having a MATTE threshold of 59Te (approximately 73,000 litres), which is significantly higher than the maximum point source volumes predicted to be required in temporary storage for the project during construction.

14.5.34 Diesel would be managed on site in accordance with the CoCP for the project, which sets out good practice measures for the storage and use of diesel fuels.

14.5.35 Given the relatively low inventories held on site, no MATTE threat is identified.

Methane Release from Landfills (Construction/Installation)

14.5.36 The route crosses some sites that hold current Environmental Permits for landfill, as shown on Figure 11.8 supporting Chapter 11 Soils and Geology. The route would not cross areas of open landfill. In the absence of good practice measures, disturbance of covered areas of landfill can potentially lead to new migration paths for landfill gas, which in certain scenarios could accumulate at flammable concentrations.

14.5.37 There is a low likelihood of encountering major sources of methane-rich landfill gas, due to the age of the waste in sites underlying the proposed route and the superficial (near-surface) nature of the works. Waste that is near the surface is likely to decompose aerobically, which produces less methane than deeper-lying, anaerobic decomposition. Chapter 11 Soils and Geology, Table 11.7, provides a summary of the potential pollutant linkages which were found to be moderate/low and above, in which two landfills (site references 14, 25) were identified as being where potentially flammable gas could be encountered. However, these sites are 90m to 100m from the excavation work proposed for the project, with significant dilution and oxidation likely during any migration from the landfill to the excavation works, which would significantly reduce any flammability risk. Seven further sites are identified where methane gases have been recorded and for which the potential for exposure to accumulated landfill gas was assessed, with the likelihood of occurrence reported as follows:

- four sites: unlikely (site references 30, 36, 40 and 47);
- two sites: low likelihood (site references 30 and 48); and
- one site: likely (site reference 36).

14.5.38 Chapter 11 Soils and Geology confirms that the measures set out in the CoCP are appropriate to fully alleviate the risks (refer to good practice measures set out in Section 14.6), and that the primary mechanism for mitigation would be working with Environmental Permit holders and the Environment Agency.

14.5.39 It is therefore considered that the project would not affect methane release or accumulation to result in a major accident (i.e. serious damage to human populations or the environment as set out in paragraph 14.2.22). No MATTE threat is identified.

Release of Aviation Fuel (Operation)

14.5.40 Data on pipeline failures in both liquid and gas pipeline operations are provided by operators to industry organisations, regulatory bodies and others for analysis to improve understanding of pipeline hazards and operability and inform development in engineering and operational controls. Understandably, many of these datasets and analyses examine data on MAHP carrying natural gas at high pressures. The proposed pipeline is not an MAHP and therefore the following review of risk has drawn on the Concawe (2018) report 6/18, which is based on data from liquid hydrocarbon pipelines.

14.5.41 The Concawe data reflect the improvements in engineering design and operational controls over the full period of the work. Increased use of PIGs to characterise pipeline conditions and identify weaknesses, coupled with cathodic protection, allied with real time monitoring of pressure (as applied on the current line) address the risks from both third-party damage and other failure mechanisms. Over the full period of the study, approximately 60% of failures resulted from third-party activity with 37% from theft and 24% third-party damage. The majority of third-party incidents result in larger holes. Spillages not involving a hole in the lines normally relate to mechanical failures of fittings and other ancillary equipment (e.g. gaskets, pump seals, instrument connections), and as such use of these vulnerable features would be limited during the design process.

14.5.42 Valve locations have been chosen taking into account the sensitivity of the surrounding environment. The separation distance between valve locations is shown in Table 14.6, and is lower through areas where sensitive receptors are identified, to limit potential spill volumes from a complete fuel loss (‘catastrophic failure’). Severity of harm and duration are assessed for the maximum volume release from each section of pipeline, noting that complete loss is a particularly conservative approach.

14.5.43 To consider severity in accordance with Table 14.2, which uses mass quantities, a specific gravity for aviation fuel of 0.8 was applied, giving a corresponding worst-case tonnage releases in the event of a major accident for each section of the pipeline route between in-valve locations.

14.5.44 To consider likelihood, reference is made to the Concawe (2018) report which identifies the prevailing frequency of cold line spillages (excluding theft) as 0.2/yr per 1,000km. Theft is excluded as aviation fuel lines have not been shown to be an attractive theft target to date in the UK. It has relatively limited applicability to other uses (such as vehicle fuelling or domestic/industrial heating).

14.5.45 Concawe identifies average gross loss per incident (excluding theft) from 2012-2016 as 51m^3, with the average net loss of 11m^3. Of 35 incidents, only two were reported as being greater than 100m^3 (<6% of all spills); major spills arise with much lower frequencies. Catastrophic failure (i.e. a complete break/release) is therefore taken to be an order of magnitude less frequent than the total spill frequency, giving a catastrophic failure frequency of 0.02/yr per 1,000km.

14.5.46 Spills are much more likely to occur in commercial/industrial environments where impacts on sensitive receptors are in turn less likely due to the lower presence of residential receptors or sensitive habitats. The Concawe (2018) report states: ‘*it is clear that the number of spillages in commercial and industrial areas is higher than would be expected from consideration of installed length alone. Evidently, the vulnerability of the pipelines is significantly increased in such areas by a factor of possibly as much as ten compared to other areas’*.

14.5.47 On this basis, the overall catastrophic failure frequency in commercial/industrial areas for this assessment is nominally 0.16/yr per 1,000km, and the corresponding frequency outside these areas as 0.016/yr per 1,000km. An estimate of catastrophic failure was calculated for each length of pipeline between valves on the project, as presented in Table 14.6.

Table 14.6: Pipeline Catastrophic Failure Estimates

Valve	Chainage	Chainage Between Valves (km)	Release Frequency (per yr)	Catastrophic Failure (per yr)		Location Reference
				Industrial	Non-Industrial	
V1	14.8	n/a	n/a	n/a	n/a	Boorley Green
V2	19.3	4.5	0.00090	0.00072	0.00007	Cross Lane
V3	24.5	5.2	0.00104	0.00083	0.00008	Betty Mundy's Cottage access track
V4	34.55	10.05	0.00201	0.00161	0.00016	Uncle Bills/Wolfhanger Fm
V5	41.13	6.58	0.00132	0.00105	0.00011	Kitwood Lane
V6	48.35	7.23	0.00145	0.00116	0.00012	Selbourne Road
V7	54.55	6.2	0.00124	0.00099	0.00010	Alton Pumping Station
V8	67.98	13.43	0.00269	0.00215	0.00021	Tweseldown Racecourse
V9	71.6	3.63	0.00073	0.00058	0.00006	Ively Road
V10	78.25	6.65	0.00133	0.00106	0.00011	Frimley Green Road
V11	86.73	8.48	0.00170	0.00136	0.00014	Guildford Road (Lightwater)
V12	90.43	3.7	0.00074	0.00059	0.00006	Steep Hill
V13	98.7	8.28	0.00166	0.00132	0.00013	Pannels Farm
V14	106.28	7.58	0.00152	0.00121	0.00012	Ashford Road

Note: The Industrial frequencies identified conservatively assume that ALL of the pipeline section is in an industrial location (given choice of CDOIF Industrial or non-Industrial categories).

Fire (Operation)

14.5.48 No explosive or toxic hazards to humans are identified within the MSDS for aviation fuel, which is provided in Appendix 14.1. However, human population could potentially be vulnerable to fires (and, subsequently, the effects of smoke).

14.5.49 Aviation fuel is flammable but will not form a flammable vapour mixture in air under UK ambient conditions. The flash point for aviation fuel is 38°C and it has an auto-ignition temperature of 200°C. The Concawe (2018) report 6/18 on the performance of European cross-country oil pipelines records that there were no instances of fires reported from any aviation fuel cross-country pipelines and associated above ground installations across Europe. Apart from the previously noted above ground installations or exposure through third-party damage, the pipeline would be below ground, preventing any formation of other forms of flammable mixtures with air such as mists.

14.5.50 As stated in paragraph 14.2.28, jet fires can occur when a pressurised leak of flammable gas or liquid forms a burning jet. Aviation fuel requires particular conditions to ignite, and in the event of a pipeline release would be likely to require a naked flame or hot surface (e.g. direct contact with a vehicle engine). The hazard is associated with pressurised releases because these may carry the fluid momentum necessary to form a jet which then extends the flame length. It is more likely from a gas or gas-liquid mixture release rather than a liquid. The area affected by a jet fire is typically relatively small when compared with the potential extent of the hazard arising from a pool fire or flash fire. A pressurised release from a buried pipeline is highly unlikely to produce a surface jet unless there was associated excavation activity. Any resulting jet release would be predominantly towards the vertical, minimising the associated hazard range.

14.5.51 The predominant hazard arising from jet fires is not typically from the jet fire itself, but from the consequent effects of containment failure of vulnerable systems/vessels, leading to larger releases of flammable or toxic material (i.e. a scenario whereby jet flame affects nearby vessel/pipework and causes this to fail, resulting in further release. In the absence of surrounding vessels/pipework the hazard potential is lower). Jet fires typically carry more hazard potential in sites with high equipment density (such as offshore platforms) where there is more likely to be confinement or impingement. It should be noted that no such hazard is identified for the proposed pipeline.

14.5.52 A jet fire would be hazardous to anyone in the immediate vicinity of the jet, but given the low likelihood of ignition, there would likely be opportunity to evacuate to a safe distance. The jet fire would require line pressure, and as such would only be maintained until the pumped supply was cut off.

14.5.53 An aviation fuel release could also potentially lead to a pool of fuel that, if ignited, would give rise to a pool fire. It is difficult to identify the extent of any such pool fire because of the many variables, including the built environment, topography, soil characteristics, water table level, release location and orientation. As aviation fuel does not form a flammable atmosphere in UK ambient conditions, a spark would not ignite the fuel. For a fire to occur, a ‘hot-work’ source of ignition would have to be encountered, such as a naked flame. This makes a fire much less likely than would be the case with a fuel such as gasoline.

14.5.54 As indicative of typical hazard ranges, for worst-case release identified (i.e. the longest distance between two valves) and assuming a fuel release depth of 50mm, a circular pool would extend to a radius of approximately 57m.

14.5.55 From gasoline data (taken here as a conservative basis for evaluation of the risk associated with kerosene-based aviation fuel), the corresponding radius at which a thermal flux of 6.3kW/m^2 would arise is 97m. As per Table 14.7, this is the maximum heat intensity permissible in areas where emergency actions lasting up to one minute may be required by personnel without shielding but with appropriate clothing. It is generally considered that escape is possible from occupied buildings at this heat intensity.

14.5.56 Approximately double this intensity (12.6kW/m^2) would be necessary for there to be a risk to building timber (i.e. the minimum energy required for piloted ignition of wood; the condition under which wood gives off ignitable fumes). This is calculated to arise at approximately 62m radius (closer to the pool perimeter).

Table 14.7: Impact Criteria for Thermal Flux from Pool Fire

Impact Criteria	Description	Comment
6.3kW/m²	This is the maximum heat intensity permissible in area where emergency actions lasting up to one minute may be required by personnel without shielding but with appropriate clothing.	Generally considered that escape is possible from on-site occupied buildings. Impact criteria for on-site population.
12.5kW/m²	Extreme pain within 20 seconds and movement to shelter is instinctive. Limiting flux for secondary fires.	Minimum energy required for piloted ignition of wood, melting of plastic tubing.

14.5.57 The likelihood of aviation fuel igniting is low as explained in paragraph 14.5.49, and the potential for either a jet flame or pool fire to be such that escape/avoidance is prevented is also considered to be low.

Explosions (Operation)

14.5.58 The project would not create confined spaces suitable for creation of explosion risk, and aviation fuel has a flash point of 38°C (the temperature at which the liquid will generate sufficient vapour to support ignition) and therefore would not form an explosive atmosphere in UK ambient conditions.

Smoke (Operation)

14.5.59 The project does not create smoke, and in any unlikely incident where smoke was created (i.e. due to fire as listed above), this would be limited and not have the potential to cause a major accident.

Major Accident Installation Sites (Operation)

14.5.60 The major accident installations (COMAH and MAHP) previously considered in terms of vulnerability of the project (see Table 14.6) were also reviewed in terms of risk that the project could affect these facilities, as set out in Table 14.8.

Table 14.8: Major Accident Installations – Potential for Project to Cause Effect

Site	Category	Location	Potential for the Project to Cause Effect
Site operated by Igas Energy plc incorporating Star Energy Ltd (HSE ref H4652)	COMAH	Northeastern edge of COMAH site abuts the Order Limits, at Alton.	Order Limits abut site boundary, but pipeline would be clear of the main operating site, and operationally the pipeline would be as per the existing pipeline at this location. No additional risk identified.
Site operated by SCJ Eurafne Ltd (HSE ref H0417)	COMAH	Southern edge of COMAH site is immediately adjacent to Order Limits, at Frimley Green.	This site was previously a factory, but now only provides office accommodation. The replacement pipeline would be buried. Risk of a major accident is extremely low and, in terms of effects on human receptors, is limited to fire. This is assessed in paragraphs 14.5.48 to 14.5.57.
Esso West London Terminal storage facility (HSE ref 0893)	COMAH	At the terminus of the project.	This is a fuel storage facility, owned and operated by Esso. The pigging station at this facility would be upgraded as part of the project. No increase to risk is identified.

Site	Category	Location	Potential for the Project to Cause Effect
Miltons Farm to Horsell Common (HSE ref 8025)	MAHP	Crossed by the project at Chobham Common	This is a gas pipeline which would be crossed by the project. Risk to be managed through design and installation methodology and the use of agreed protective provisions as set out in the draft DCO.
Staines Bypass to Lalehan (HSE ref 8015)	MAHP	Crossed by the project at Fordbridge Park	This is a gas pipeline which would be crossed by the project. Risk to be managed through design and installation methodology and the use of agreed protective provisions as set out in the draft DCO.
Lordswood/Purbrook P006 (HSE ref 80532)	MAHP	South of Maddoxford Lane, Botley. Circa 500m from start of the project.	The project design has been developed such that it avoids this pipeline No risk is identified on this pipeline from the project.

Potential to Cause a Natural Disaster

14.5.61 By definition, natural disasters as listed in paragraph 14.2.12 (such as storms and drought) are caused by natural events, and therefore would not be caused by the project.

14.5.62 The exception to this could be wildfire, which could be initiated by a fire at an installation with any extensive spread thereafter being considered a natural disaster. However, the effects would be as per the fire assessment for major accidents, as reported in paragraphs 14.5.48 to 14.5.57.

Potential Effects on Receptors

14.5.63 Based on the review of potential major accidents and disaster risks, this section presents the assessment of environmental effects if a major accident or disaster were to occur. Based on the review presented in the preceding paragraphs, the assessment focuses on the risk of aviation fuel release and potential environmental consequences (including pollution and fire, including wildfire), as the occurrence of a major accident or disaster is not considered to be credible as a result of diesel spills/release; methane from landfills; explosions or smoke; or flooding.

14.5.64 The potential worst-case spills from each pipeline section (A-H) lie within the CDOIF Severity 2 ranges (or below in the case of widespread habitat) as set out in Table 14.2, giving a potential Class A MATTE, if the harm duration was Category 2. This corresponds to a ‘broadly acceptable’ frequency assigned to a Class A MATTE in the CDOIF (2016) guidance of 0.0001/year.

14.5.65 Exceptionally, if there is a receptor where the recovery period would be classified as having a Category 3 harm duration (long term), a MATTE may be classified as Class B. This would have a corresponding broadly acceptable frequency of 0.00001/year.

14.5.66 The calculations presented in Table 14.8 confirm that the catastrophic release frequencies in non-Industrial areas (such as might impact on sensitive habitats) are all close to the broadly acceptable frequency of 0.0001/yr for a class A MATTE. It should be noted that this analysis is highly conservative in that it is based on the likelihood of full release of fuel within a given section. The risk to any given receptor would depend on where it was situated in relation to the release point and, as such, may be significantly lower than estimate. Given this conservative approach, it is anticipated that even if a spill carried long term (Category 3) harm duration potential for a specific receptor, the specific risk to that receptor would remain close to the broadly acceptable threshold.

14.5.67 There are then further conditional modifiers that would reduce the risk for any individual receptor:

- the unlikelihood of a release having a pathway leading to the receptor (e.g. receptor is at higher elevation); and
- the unlikelihood of a release actually reaching the receptor even if there is a pathway, and the failure of intervention measures to recover any spill and prevent its propagation to sensitive receptors.

14.5.68 Accordingly, none of the failure frequencies referred to above would be considered a significant risk in the context of the assessment of environmental risk.

Population and Human Health

14.5.69 The Material Safety Data Sheet (MSDS) for aviation fuel (Appendix 14.1) does not identify any associated toxicity, and based on this information, no significant toxicity effects are predicted.

14.5.70 The design has incorporated the principles of inherently safe design and good practice. In addition, aviation fuel will not form an explosive atmosphere under UK ambient conditions, and historical data supports the conclusion that aviation fuel does not present a risk of major accident to population and human health.

Biodiversity

14.5.71 Experience of MATTE assessments indicates that, as protected species are mobile or live in metapopulations, the risk to the species overall is low and tolerable. Consequently, whilst no MATTE threat is predicted, if such an event were to occur close to areas where mobile fauna are present, they would not likely be significantly harmed.

Water

14.5.72 For all identified water habitats close to the pipeline (e.g. ponds, lakes, reservoirs, streams, rivers), a release of diesel or aviation fuel would have an impact on the environment. Both fuels are biodegradable and will degrade in groundwater given the right conditions, including access to oxygen. If a watercourse is reached, then dilution would occur, the extent of dilution being dependent on the size and flow of the watercourse.

14.5.73 No MATTE threat is predicted, and as such, no significant effect is identified in the context of this major accidents assessment. However, if such an event were to occur and dilution of a watercourse were to be limited, environmental effects could be significant. This is considered in the relevant chapter of this ES.

Material Assets (Historic Environment)

14.5.74 For material assets and cultural heritage to be impacted by a major accident there would need to be a major fire nearby.

14.5.75 The frequency of a release (all sizes) from a 2km straight length of line, conservatively assumed to be within 1km of a listed building, would be 0.2 x 2 / 1,000 = 0.0004/yr. (1 in 2,500 years).

14.5.76 There are then further conditional modifiers that would reduce the fire risk for any individual building:

- unlikelihood of the release being of a hazardous size (the above frequency being for all sizes);
- unlikelihood of a release having a pathway leading to potential impact on the building;
- unlikelihood of a release reaching the building and the failure of intervention measures to recover any spill and prevent its propagation towards buildings; and
- unlikelihood of ignition of the release.

14.5.77 Given the compounding of the factors listed above, the fire risk to an individual building from the line would be small compared with the total risk due to other sources (e.g. electrical faults, road vehicle accidents, discarded cigarettes, candles, heating system faults, arson).

Land, Soils and Geology

14.5.78 For land and soils in the vicinity of the pipeline, the recovery duration would vary depending on the land habitat. For example, agricultural land would generally recover more quickly that woodland or bog.

14.5.79 Aviation fuel is kerosene based, and as such, is not considered to be persistent or bioaccumulative, as it biodegrades naturally in the environment, even though it does not easily vaporize in UK ambient conditions as do some other petroleum-based products, such as gasoline.

Air and Climate

14.5.80 The release of aviation fuel to air following a MATTE would be negligible in quantity. It would also not impact global climate change issues such as global warming, changed rainfall, flooding or ozone.

14.6 Mitigation

14.6.1 There are no significant effects expected (i.e. no MATTE threat), and therefore no mitigation measures have been identified.

14.7 Summary

14.7.1 As explained in paragraph 14.2.3, the assessment of major accidents and disasters differs from other ES chapters as it focuses on identifying major risks in the context of potential for significant environmental effects. As such, this section does not identify any residual impacts, but considers any MATTE threat.

14.7.2 The assessment indicates that the majority of major accident sources or natural disasters have very limited potential to affect the project. If the pipeline were to be damaged, the volume of fuel release would be limited even in the worst-case scenario of a complete break, due to the inclusion of valves which would enable remote shut down of the pipeline to limit fuel loss. Aviation fuel is non-toxic, degrades/breaks down in the environment, is relatively difficult to ignite, and will not form an explosive atmosphere under UK ambient conditions. Additionally, historical data supports the conclusion that aviation fuel does not present a risk of major accident to population and human health.

14.7.3 Diesel fuel release from bowsers or tankers during construction and methane release from landfill were also considered. The volumes of diesel to be held on site would be significantly smaller than would be required for there to be threat of a MATTE, and the risk is comparable to the construction stage of many other projects. Similarly, methane release or accumulation would be limited, and no threat of MATTE is identified.

14.7.4 This assessment has considered the worst-case scenarios of a major accident or disaster causing complete fuel release (i.e. all aviation fuel between two valves, or all diesel from on-site containment). However, in the unlikely event of the integrity of the pipeline being compromised or diesel fuel released, the volumes of release are likely to be far lower than those on which this assessment has been based.

14.7.5 No MATTE threat has been identified, and no significant residual effects are therefore predicted within the scope of this assessment of environmental risk due to a major accident or natural disaster.

14.8 References

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