Appendix 14A: Climate Change Risk Assessment

RISK IDENTIFICATION															RISK ASSESSMENT							ADAPTATION
Risk ID	Climate variable	Risk statement	Direct or Indirect	Asset components impacted											Mitigation Measures/Planned Controls	Initial risk rating RCP8.5 (2010-2039)			Initial risk rating RCP8.5 (2040 - 2069)			Adaptation Measures
				Plant equipment e.g. PCC unit	Facilities e.g. CO_2 compression/oxygen removal unit	Mechanical services e.g. ducting	Electrical equipment & substation	Roads, pavements	Drainage	Water treatment	Water reuse	Construction assets, plant and equipment	Staff and visitors on site			Likelihood	Consequence	Risk Rating	Likelihood	Consequence	Risk Rating	
		Description of impacts													e.g. controls planned within the current design that mitigate the identified risk, or BAU contraction/operational management measures							Adaptation options are measures and actions that can be implemented to improve adaptation to climate change.
CONSTRUCTION																						
1	Extreme temperatures (heat)	Extreme temperature event causes overheating of construction equipment	Direct										•		The Contractors will monitor weather forecasts and plan works accordingly, protecting workers and resources from any extreme weather conditions.	Unlikely	Insignificant	Low	*N/A (construction risk)*			-Consider developing register of vulnerable construction assets. -Consider inspection of vulnerable construction assets after a hot day.
2	Extreme temperatures (heat)	Extreme temperature event causes increased heat stress/heat exhaustion for workers. Extreme temperatures also causes poor air quality.	Direct											•		Unlikely	Minor	Low	*N/A (construction risk)*			-Appropriate sun protection. -Measures and actions to combat extreme heat conditions (e.g. avoid working on hot summer days, welfare training for identifying heat illness, training for working in hot conditions, work in shaded areas, plan major activities for cooler parts of the day, wear loose fitting/breathable clothing)
3	Extreme rainfall	Extreme rainfall event causes surface water flooding of the construction site and local roads. This reduces staff productivity as a result of staff and equipment relocation.	Direct						•			•	•		- Suitable storage and bunding of pollutants to protect from high rainfall events. This will be further supported by the Site Emergency Response Plans. - Appropriate surface water drainage and attenuation will be provided for the construction phase to manage the risk of flooding.	Unlikely	Moderate	Medium	*N/A (construction risk)*			-Electrical equipment to be stored at higher ground levels. -Welfare areas to be assigned to higher ground levels. -For extreme rainfall forecasts, ensure construction plants are secure and stored at higher ground levels.
4	Sea level rise	Sea level rise results in coastal flooding causing inundation of the construction site and damage to assets, plants and equipment.	Direct									•	•		- The Contractors will monitor weather forecasts and receive Environment Agency flood alerts and plan works accordingly, protecting workers and resources from any extreme weather conditions such as storms, flooding.	Unlikely	Moderate	Medium	*N/A (construction risk)*			
5	Storms	Storm event results in damage to construction equipment resulting in repairs costs or reduced functionality, and/or safety risks.	Direct									•				Unlikely	Moderate	Medium	*N/A (construction risk)*			
OPERATION																						
6	Extreme temperatures (heat)	Extreme temperature events causes overheating of equipment causing damage to infrastructure components	Direct	•	•	•	•								- Some cabling will be buried underground, insulating against overheating in times of heatwaves. -All buildings will be designed to UK standards and specifications. Electrical equipment designed to operate in temperatures of up to 40º C. -The Humber Refinery and VPI Immingham CHP Plant are designed to operate over a large range of ambient conditions. -Maintenance inspections planned for operation.	Rare	Minor	Low	Rare	Minor	Low	No further adaptation required.
7	Extreme temperatures (heat)	Extreme temperature events lead to reduced efficiency of the carbon capture facility (air cooled exchangers) resulting in lower rates of carbon capture.	Direct	•	•	•	•								-The Proposed Developments will be designed to operate over a large range of ambient conditions. For example, the air cooled exchangers would not be adversely affected by increased average air temperature. - No embedded planned controls for extreme temperatures (e.g. 40+ degrees).	Unlikely	Minor	Low	Unlikely	Minor	Low	- Take extreme temperature events into account with minimum capture rates designed for the plant.
8	Extreme temperatures (heat)	Extreme temperature events cause an increase in ambient temperature of buildings, leading to higher air conditioning requirements and impacts on the thermal comfort of building users.	Direct	•										•	-Detailed design of air conditioning units for any proposed new office spaces will include an allowance for future rise in ambient temperature. -All buildings will be designed to UK standards and specifications. -Maintenance inspections planned for operation.	Unlikely	Minor	Low	Unlikely	Minor	Low	No further adaptation measures required.
9	Extreme temperature (cold)	Extreme cold temperatures results in freezing of instrumentation and lines	Direct	•	•										- Good plant design, heat tracing of any lines susceptible to freezing. - Winterisation of plant instruments (good instrument design).	Unlikely	Minor	Low	Unlikely	Minor	Low	Not further adaptation measures.
10	Extreme rainfall	Extreme rainfall events lead to surface water flooding and can cause damage to infrastructure, building surfaces and exposed utilities.	Direct	•	•		•	•	•						- Suitable storage and bunding of pollutants to protect from high rainfall events. Supported by a Site Emergency Response Plans. - Installation of a suitable sustainable surface water drainage network and management system (SuDS) to protect the proposed development from high rainfall events. - Flood Resistance and Resilience Measures will be implemented as required for each of the Proposed Developments, including: i. pipelines and storage tanks designed to withstand the water pressures associated with high return period event flooding;	Unlikely	Minor	Low	Moderate	Minor	Medium	No further adaptation measures required.

11	Sea level rise *VPI only*	Sea level rise results in coastal flooding causing inundation of the Development (or parts of the Development) causing damage to infrastructure.	Direct		•	•		•	•	•				ii. tanks securely tethered in such a way to ensure the infrastructure remains secure should flooding occur; iii. electrical supply entering the Proposed Development from height and down to required connections; iv. flood proofing including the use of water resistant coatings, use of galvanised and stainless steel fixings and raising electrical sockets and switches; v. suitable waterproofing measures to development located below ground i.e. tanking below ground storage areas etc. vi. make use of Environment Agency flood warnings and alerts; and vii. define emergency access and egress route. - The Flood Risk Assessment (FRA) has considered climate change within its assessment. It has assessed the Proposed Developments based on a 'high emissions' future scenarios including increases in extreme rainfall, flood flow and flash flood times. -A new, separate foul and surface water drainage system will be constructed for the Phillips 66 and VPI site. Further details on the design of the drainage system, including attenuation, restricted discharge to South Killingholme Drain and accounting for climate change (factor of 25%) is provided in the Drainage Strategy presented as Annex C in the FRA within Appendix 9A in ES Volume II. - All buildings will be designed to UK standards and specifications -Maintenance inspections planned for operation.	Unlikely	Moderate	Medium	Unlikely	Moderate	Medium	- Consider incorporating additional water defences
12	Storms (high wind and high rainfall)	Storm results in damage to structures/ equipment and resulting in repairs costs or reduced functionality, and/or unacceptable safety risks.	Direct		•					•				- Wind loadings will be considered within the detailed design of plant. - Quality control during construction and maintenance to secure at risk lagging. -The Flood Risk Assessment (FRA) considers climate change considerations of the 'high end' future scenarios including increases in extreme rainfall, flood flow and flash flood times. -Maintenance inspections planned for operation. - Procedures in place for extreme weather events (including wind) e.g. minimise maintenance during high wind events. - Lightning protections (rods) built into structures. Structures are also earthed.	Unlikely	Minor	Low	Unlikely	Minor	Low	Not further adaptation measures.
13	Storms (high wind and high rainfall)	Storm event or heat event results in local power outage (power outage of VPIs CHP Plant) causing disruption to carbon capture facility operations and reduced efficiency.	Indirect		•	•		•						- Redundancy in power supply from grid connection as back-up. - Further redundancy included in electrical expansion design. - In built protection measures to allow for safe shut-downs (fail-safe).	Unlikely	Minor	Low	Unlikely	Minor	Low	Not further adaptation measures.
14	Windstorms/Drought	Extreme drought increases dust in atmosphere affecting the cooling system and workers			•								•	- Dust control management measures will be employed if required across the Sites e.g. operators to wear higher level eye protection on windy days. - Housekeeping measures in place e.g. site washdown. - Routine air cooled exchanger cleaning program.	Unlikely	Minor	Low	Unlikely	Minor	Low	Not further adaptation measures.
15	Drought	Extreme drought events cause the drying of pavement structures and deterioration of structures/foundations due to decrease in soil moisture levels.	Direct		•				•	•				-Pavement design to allow for anticipated range of soil moisture levels. -Maintenance inspections planned for operation.	Unlikely	Insignificant	Low	Unlikely	Insignificant	Low	Not further adaptation measures.
16	Wildfires	Prolonged periods of extreme heat and dry conditions increase risk of fires on site which can cause damage to infrastructure assets and become a potential safety hazard.	Direct		•	•	•	•					•	- Vegetation cleared around the Sites. - Fire detection and protection built into the design of the Proposed Developments e.g. fire hydrants, ring main of water. - Site Emergency Response Plans & team to manage and control fire risk.	Rare	Moderate	Medium	Rare	Moderate	Medium	Not further adaptation measures.

MEASURES						
Responsibility	Residual risk rating RCP8.5 (2010-2039)			Residual risk rating RCP8.5 (2040 - 2069)		
	Likelihood	Consequence	Risk Rating	Likelihood	Consequence	Risk Rating
Contractor	Unlikely	Insignificant	Low	Unlikely	Insignificant	Low
Contractor	Unlikely	Minor	Low	Unlikely	Minor	Low
Contractor	Moderate	Minor	Medium	Unlikely	Moderate	Medium
	Moderate	Minor	Medium	Unlikely	Moderate	Medium
	Moderate	Minor	Medium	Unlikely	Moderate	Medium
Designer, Operator	Rare	Minor	Low	Rare	Minor	Low
Designer	Unlikely	Minor	Low	Unlikely	Minor	Low
Designer, Operator	Unlikely	Minor	Low	Unlikely	Minor	Low
Designer	Unlikely	Minor	Low	Unlikely	Minor	Low
Designer, Operator	Unlikely	Minor	Low	Moderate	Minor	Medium

	Designer, Operator		Designer, Operator		Designer, Operator
Rare	Unlikely	Unlikely	Unlikely	Unlikely	Unlikely
Moderate	Minor	Minor	Minor	Minor	Moderate
Medium	Low	Low	Low	Low	Medium
Rare	Unlikely	Unlikely	Unlikely	Unlikely	Unlikely
Moderate	Insignificant	Minor	Minor	Minor	Moderate
Medium	Low	Low	Low	Low	Medium