Castle Cement Limited

Climate Change Adaption Plan

Padeswood CCS Environmental Permit

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Foreword

Castle Cement is committed to fulfilling their role in meeting the UK government's ambitions, signing the Business Ambition for 1.5° Commitment and joining the UN's Race to Zero campaign. An unprecedented increase in the emissions and quantities of Greenhouse Gases (GHG's) in our atmosphere has been identified worldwide as the primary cause of increasing temperatures and global climate change.

At their heart are the parent company Heidelberg Materials' six sustainability commitments:

- Business and product innovation
- Health, safety and wellbeing
- Environmental responsibility
- Resource use and the circular economy
- Being a good neighbour
- Fairness, inclusion and respect

Castle Cement have a roadmap in place, which includes several important areas that will help them achieve net zero. These include:

- Increased use of alternative raw materials and alternative fuels
- Carbon capture and storage
- Fuel switching to hydrogen
- Use of reduced CO_2 products
- Improvements in plant efficiency and processes across their operations.

The Heidelberg Materials Sustainability report (2023) reinforces their commitment to fulfilling our share of the responsibility to keep the global temperature rise below 1.5° Celsius and will continue to reduce their impact on air, land, and water.

This adaption plan identifies the climate risks Castle Cement face at Padeswood Cement Carbon Capture Storage and aims to drive change for the future that will enable them to meet the goals outlined above.

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1 INTRODUCTION

A current and thorough analysis of the UK climate and the effects of climate change is presented in the UK Climate Projections, 2018 (UKCP18). These projections include an analysis tool which uses the most up-to-date scientific assessment for projecting the UK climate into the future. The UKCP is supported by both the Department for Environment, Food and Rural Affairs (DEFRA) and the Department for Business, Energy and Industrial Strategy (BEIS). The UKCP18 highlights that the UK can expect "warmer, wetter winters along with hotter, drier summers."

Climate change is identified as not only an environmental issue but an issue affecting the health and wellbeing of individuals. This plan has been devised to consider strategies to adapt to climate change as an essential component of local planning and decision-making. Taking a stance towards adaptation regarding climate change will increase the ability of Castle Cement to support local communities.

The plan sets out the climate change risks facing Castle Cement, its neighbours, and workforce, and looks at how these risks can be mitigated moving forward in a changing climate. The plan includes a template Climate Change Risk Assessment that may be implemented at Padeswood.

1.1 Climate Change and the Cement Industry

Cement production is a significant contributor to CO_2 emissions, with the chemical reactions involved generating additional carbon dioxide as a by-product.

Cement manufacturing consumes large amounts of energy. A significant amount thermal energy from fossil fuels has been replaced using waste fuels with biomass in recent years; however, large volumes of CO_2 are still emitted The following strategies are employed to reduce the CO_2 emissions:

- Energy efficiency improvements
- Use of recycled and waste materials
- Deployment of low carbon fuels
- Reducing clinker-to-cement radio
- Processing of cement at lower temperatures; and
- Carbon Capture, Utilisation and Storage (CCUS) techniques.

The UK Government's direction is influenced by the independent Climate Change Committee (CCC) in its capacity as adviser to the UK and devolved administration emissions targets. The CCC's Sixth Carbon Burdge supports the utilisation of bioenergy with carbon dioxide capture as a significant contributor to the greenhouse gas removals sector.

Aligned to this policy intent, Castle Cement is seeking a variation to its environmental permit for Padeswood Cement Works to operate post-combustion carbon dioxide capture as an activity on the cement kiln. This would enable the capture of over approximately 80,000 tonnes of carbon dioxide per annum, the largest carbon capture project twithin the industry in the UK. Castle Cement is planning to transport and store carbon dioxide captured by the post-combustion carbon dioxide capture (PCC) system within disused oil well in Liverpool Bay.

1.2 Environmental responsibility

Castle Cement are committed to fulfilling their share of the responsibility to keep the global temperature rise below 1.5 ° Celsius and will continue to reduce their impact on air, land and water. They:

- Have stringent targets to reduce emissions to air from all our operations.
- Will transition our operational fleets from traditional combustion engines to alternative forms of energy and, through collaboration with suppliers, our fleets will be more efficient through new technology.
- Set science-based targets to reduce carbon emissions and energy consumption, reduce the use of fossil fuel through efficiency improvements and the use of alternative and renewable sources.
- Seek to apply the principles of environmental stewardship throughout our operations. by managing and restoring our sites to ensure land remains of value; implementing biodiversity net gain and safeguarding geodiversity where appropriate.
- Use water efficiently, recycle where possible and protect water quality.

According to the UK Climate Change Risk Assessment, the UK is projected to see an increase in the frequency and intensity of weather-related hazards, including heat waves and flooding. Adaptation is therefore needed from Castle Cement for a variety of climate-related scenarios.

Current decisions regarding the commissioning and designing of assets and infrastructure are due to have an impact in the future upon the resilience of organisations to climate change.

1.3 Climate Change Adaption and Castle Cement

Castle Cement completed a Climate Change 2022 assessment, which has been included in this report:

1. Identify climate hazards that are likely to affect your assets
2. Identify assets that could be affected by the hazards now or in the future
3. Probability of the climate hazard occurring
4. Severity of the consequence for specific assets if the hazard were to occur
5. Risk assessment is a product of the event probability multiplied by the severity of its consequences
6. Adaptation planning

The Adaptation Strategy and subsequent risk assessment template (Appendix I) detailed within this report follows these steps to help deliver a climate change response which appropriately safeguards the wellbeing of individuals and the sustainability of Padeswood Cement Works for its future longevity.

2 WHAT IS CLIMATE CHANGE?

The UK MET Office describes climate change as a large-scale, long-term shift in the planet's weather patterns or average temperatures.

There is overwhelming scientific evidence that the warming effect is due to increases in levels of greenhouse gases (carbon dioxide, methane, nitrous oxide, chlorofluorocarbons, and ozone) released as a result of human activity.

The impacts of a changing climate are already beginning to be felt in the UK. The physical impact of climate change on our natural environment is forecast to include extreme heat and cold, increased ground level ozone, more flooding and storms, increased freshwater pathogens, and increased sunlight (ultra violet (UV) light levels), all of which will impact Castle Cement in one way or another.

2.1 Flooding and Storms

The UK Adaptation Sub Committee (2014) reports that increased flood risk is the greatest threat to the UK from climate change, with historical emissions and global warming likely to have already increased the potential for flooding in England.

Within its discussion of the effects of climate change, the Met Office highlights that it is possible that climate change will cause an increase in both the frequency and severity of storms in the UK. More detailed Met Office discussion of wind storms highlights that modelling the factors which influence storms is complex – there is not yet scientific consensus on future trends, though UKCP18 projected a modest increase in near-surface wind speeds over the UK for the second half of the 21st century, occurring in the winter season when more significant impacts of wind are experienced. However, while there remain uncertainties and research needs, the Climate Change Committee has recently highlighted, when discussing climate risks to infrastructure, that the possibility of changes in the strength and frequency of storms makes prudent planning today vital. Indeed, in 2022, the UK saw three named storms in one week for the first time, and one of these set the highest gust speed ever recorded at a low-level site in England. Storms can bring multiple simultaneous threats (intense rainfall, strong winds, and lightning) in combination, and often with cascading impacts, which can affect natural and human systems.

2.2 Draught and surface water

The UK faces an increased demand for water in a changing climate. Analysis commissioned for CCRA3 indicates that water resource regions in England and parts of Wales are projected to be in deficit under a central population scenario and a +4°C at 2100 scenario without additional adaptation and that while adaptation efforts in the sector are well advanced, assisted by five yearly Water Resource Management Plans, more action is needed in addition to current adaptation approaches.

2.3 Heat (increased summer temperatures and heat wave events)

Rising temperatures associated with a changing climate are already impacting the UK. Recent evidence suggests that the average UK land temperature was 0.9°C higher during the period 2005-2014 compared to 1961-1990.

Summers could become over 6°C warmer and winters over 3°C warmer by 2100. Also, as explained by the Met Office, extreme heatwaves could become almost 100 times more likely by the end of the century than at present. Hot weather can impact buildings, assets and people's health – both the health of staff and those affected by the decisions made need to be considered.

Examples of impacts included increased wildfires and amplification of the impacts from the ongoing drought, power outages, significant disruption to transport and technology sectors, restrictions on school hours and significant pressures on emergency services, with several Fire and Rescue Services declaring major incidents. Industrial impacts that occurred affected multiple businesses with fires and other infrastructure or equipment failures.

2.4 Cold (extreme weather events)

Extreme cold weather events are likely to be less severe as the changing climate takes effect, with cold spells occurring less frequently, and lasting for a shorter period of time than was historically the case.

Low temperatures can affect the speed of chemical reactions that occur in the curing process and may also make the concrete vulnerable to the effects of freezing. Ultimately, cold weather concreting needs careful planning and common sense.

2.5 Ground Level Ozone

Ground level ozone is a respiratory irritant strongly affected by climate and background levels of ozone have been found to be increasing across much of Europe (Public Health England, 2012).

Ground-level ozone is a colour-less gas which forms just above the earth's surface and is a secondary pollutant created when two primary pollutants react in sunlight and stagnant air.

Ground level ozone has significant impacts on human morbidity and mortality, mostly related to effects on the respiratory system.

3 RISK IMPLICATIONS TO PADESWOOD CEMENT PLANT

Identifying climate vulnerabilities across the cement production industry establishes the following categories of risk on the Padeswood Cement Plant infrastructure.

3.1.1 Extreme Weather Events

3.1.1.1 Flooding

Flooding could have several detrimental impacts on Padeswood, affecting its operations, infrastructure, and overall sustainability. With expansive facilities that include storage units, warehouses, and administrative buildings, the plant is vulnerable to severe damage when floodwaters strike. Transportation networks leading to and from the plant can be washed out or damaged, complicating logistics and supply chains.

The inundation of the plant's facilities poses immediate risks, affecting machinery, electrical systems, and production equipment. The potential for short-circuits in electrical systems not only causes outages but also puts expensive equipment at risk. Moreover, the structural integrity of buildings is compromised, with foundations eroding and buildings becoming unstable.

Utilities critical to plant operations, such as electricity, gas, and water supply, are often disrupted by flooding. Repairing waterlogged electrical systems is a priority before resuming operations safely. The resulting downtime not only impacts production schedules but also escalates recovery costs.

Production can be brought to a standstill or significantly curtailed as machinery and production lines require shutdowns for cleaning, repairs, or replacement of damaged components. Delays in the drying process of concrete further compound issues, leading to potential quality concerns with the final product.

The safety and accessibility of plant workers are compromised as floodwaters restrict entry to certain areas, hindering crucial operations and maintenance tasks.

The impact of flooding extends to the raw materials used in cement production. Contamination of these materials can compromise quality and handling, potentially impacting the strength of the product. As a result, additional testing and treatment may become necessary to maintain production standards.

The environmental consequences of flooding are substantial. Stored materials, chemicals, and fuels on-site may be washed away, polluting nearby water bodies. Spills of hazardous substances can have enduring ecological repercussions, necessitating extensive cleanup efforts and regulatory compliance.

3.1.1.2 Droughts

Concrete production currently accounts for almost 10% of global industrial water use. It's estimated that in 2050, 75% of the water demand for concrete production will likely occur in regions expected to experience water stress. Droughts could impact Padeswood in several ways, primarily due to their effects on water availability and the plant's operations.

Droughts often lead to a significant decrease in available water sources. Cement production requires substantial amounts of water for various processes, including cooling machinery, dust control, and mixing concrete. Reduced water availability could hinder the plant's ability to operate at full capacity or maintain normal production levels.

Cement production involves high-temperature processes, such as kiln operations. These operations require cooling systems to regulate the temperature of equipment and materials. During droughts, water scarcity could make it challenging to adequately cool machinery, potentially leading to overheating and equipment failures.

Dust suppression is crucial at Padeswood for permit compliance. Water is used to dampen dust particles on roadways and open yards in various areas of the plant. Droughts reduce the availability of water for dust control, which can result in increased airborne particles and compliance issues with environmental regulations.

Padeswood collects surface runoff water within the site lagoon for reuse in the process. During droughts, limited water collection would result in increased borehole water extraction.

Extended droughts can have lasting effects on the local water ecosystem. Overdrawing water during droughts can harm local wildlife, vegetation, and communities that depend on the same water sources.

3.1.2 Temperature Extremes

3.1.2.1 Heat Waves

Heat waves could have several significant effects on Padeswood, impacting its operations, equipment, and workforce.

Cement production involves high-temperature processes, and extended heatwaves can lead to elevated ambient temperatures, causing equipment to operate at higher than normal temperatures. This can result in equipment overheating, reducing efficiency and increasing the risk of breakdowns or malfunctions.

Heat waves often coincide with increased energy demand for cooling systems. Padeswood may require additional energy to maintain the temperature of machinery and facilities, particularly in areas such as kilns and grinding mills. Higher energy demand can lead to increased operational costs and strain on the plant's power supply.

Cooling systems in cement plants play a crucial role in maintaining equipment and process temperatures. During heat waves, cooling systems may struggle to effectively dissipate heat, leading to reduced cooling efficiency. Inefficient cooling can impact the performance and longevity of machinery, affecting production output and quality.

High temperatures pose health and safety risks to workers in the plant. Heat stress and heat-related illnesses become more prevalent during heat waves, affecting employee well-being and productivity. Adequate measures, such as providing cooling stations, scheduling breaks in shaded areas, and enforcing hydration protocols, are essential to protect workers.

High temperatures can make material handling more challenging. Raw materials such as aggregates and PFA may be prone to moisture loss, affecting their handling characteristics and increasing fugitive dust emissions. Stable moisture content is crucial for achieving desired quality properties, and heat waves can disrupt this balance.

Dry and hot conditions increase the risk of fires. Combustible materials, such as coal and fuel used in kilns, pose a heightened fire risk during heat waves. Enhanced fire prevention measures and monitoring systems are necessary to mitigate this risk.

3.1.2.2 Freezing Conditions:

Aggregates and other materials used in cement production can freeze, leading to handling difficulties. Frozen materials can clump together, making it challenging to achieve proper mix proportions and consistency.

Machinery and equipment at Padeswood could be vulnerable to freezing temperatures. Water in pipelines, pumps, and cooling systems can freeze, leading to blockages and damage. Frozen lubricants and oils can impair the operation of machinery, causing increased friction and potential breakdowns. Water pipes, conduits, and other infrastructure within the plant can be susceptible to freezing. Frozen pipes can burst or crack, leading to water leaks and damage to the plant's structure. Repairing and replacing frozen or damaged pipes can be time-consuming and costly.

Freezing temperatures can lead to water sources, such as reservoirs or ponds, freezing over. This can result in challenges in accessing water for production, affecting plant operations and efficiency.

Working in freezing conditions poses risks to the health and safety of plant workers. Exposure to extreme cold can lead to frostbite, hypothermia, and other cold-related illnesses. Slippery surfaces due to ice formation increase the risk of accidents and injuries.

Padeswood may need to increase heating to prevent freezing of equipment and materials. Higher energy demand for heating systems during freezing conditions can lead to increased operational costs. Efficient heating of facilities and equipment is essential to maintain production schedules and prevent downtime.

3.1.3 Ground Ozone Level

Padeswood is subject to air quality regulations that limit emissions of pollutants, including ozone precursors such as volatile organic compounds (VOCs) and nitrogen oxides (NO_X). Ground-level ozone is formed when VOCs and NOx react in the presence of sunlight and heat. Padeswood must monitor and control its emissions to comply with regulatory limits, which may require the installation of emission control technologies.

Ground-level ozone is a harmful air pollutant that can cause respiratory problems, aggravate asthma, and lead to other respiratory illnesses. Workers at Padeswood and surrounding residents may be exposed to elevated levels of ozone and other pollutants, affecting their health and well-being. Employee safety measures and air quality monitoring are important for minimising health risks.

Ozone can contribute to the corrosion of metal surfaces, including equipment and infrastructure at cement plants. Corrosion can lead to the deterioration of equipment, pipelines, and structures, requiring costly repairs and maintenance.

Ground-level ozone can damage vegetation, including crops and natural vegetation surrounding the cement plant. Reduced crop yields, forest damage, and ecosystem disruption can result from prolonged exposure to elevated ozone levels.

Ozone and its associated pollutants can contribute to poor visibility and haze in the surrounding area. Aesthetic impacts such as reduced scenic views and smoggy conditions can affect the local community's quality of life.

Cement plants with high emissions of ozone precursors may face increased regulatory scrutiny and requirements for emission reduction. Public perception of the plant's environmental impact, including ozone pollution, can influence community relations and regulatory decisions. Proactive measures to reduce ozone precursor emissions can improve the plant's environmental image and relationships with stakeholders.

4 OUR APPROACH TO CLIMATE CHANGE ADAPTION

4.1.1 Mitigation strategies for flooding

To mitigate the impacts of flooding at Padeswood, a comprehensive set of strategies can be implemented. This includes conducting thorough flood risk assessments and developing detailed response plans tailored to the specific vulnerabilities of the plant. Infrastructure resilience emerges as a critical factor, necessitating the design of buildings, storage facilities, and equipment to withstand potential flood events effectively.

The construction of flood barriers and the elevation of critical infrastructure further fortify the plant against flood damage, providing a tangible line of defence. Installing backup power systems and redundant utilities ensures that essential operations can continue without interruption during unforeseen outages. Equally important is the training of employees in emergency procedures and safety protocols, enhancing the overall preparedness of the workforce.

Prioritising adequate insurance coverage for property damage, business interruption, and potential environmental liabilities is essential. This ensures financial protection and the ability to swiftly recover and resume operations post-flooding. Supply chain diversification strategies, such as establishing multiple sourcing options for raw materials, bolster the plant's resilience by mitigating disruptions in production.

Collaborating with local authorities and communities through active community engagement efforts is paramount. This collaborative approach not only improves flood preparedness but also strengthens the plant's response capabilities. By working closely with stakeholders, the cement plant can develop a comprehensive and effective flood risk management framework that safeguards operations and contributes to the overall resilience of the Padeswood facility.

4.1.2 Mitigation strategies for drought

To enhance water management practices at Padeswood, a comprehensive approach can be adopted. This includes the implementation of water recycling and reuse systems within the plant, allowing for the efficient utilisation of water for various processes. Investing in water-efficient equipment and technologies is essential to minimise overall water consumption and improve sustainability. Exploring alternative water sources such as rainwater harvesting, groundwater recharge, or desalination can provide additional supply options, reducing reliance on conventional sources.

In preparation for water scarcity events, developing drought contingency plans is crucial. These plans should outline strategies to manage operations during shortages, including adjusting production schedules and prioritising critical processes. Additionally, collaborating with local communities through community engagement is beneficial. Collaboration ensures responsible water use practices are adopted, minimising the impact on shared water resources and fostering a sustainable approach to water management.

Proactive measures to meet and exceed regulatory standards for water usage and discharge are beneficial. This not only ensures compliance with environmental regulations but also demonstrates a commitment to long-term sustainability. By integrating these strategies, the cement plant can optimise water usage, mitigate risks associated with water scarcity, and contribute to the preservation of water resources for future generations.

4.1.3 Mitigation strategies for heatwaves

To ensure operational efficiency during heatwaves, several practical strategies can be implemented at Padeswood. This includes regular equipment maintenance to uphold efficiency and durability, especially in higher temperatures. Upgrading cooling systems and adopting efficient heat dissipation technologies are vital steps to manage equipment temperatures effectively.

Worker safety measures, including adequate training, provision of protective gear, and access to cooling stations, are essential to mitigate heat-related health risks. Transitioning to alternative fuels or renewable energy sources helps reduce reliance on fossil fuels, promoting sustainability during heatwaves. Water management practices, such as implementing recycling and conservation measures, mitigate the impact of water scarcity on production.

Investment in dust suppression technologies is crucial to maintain air quality and mitigate dust-related hazards, ensuring a safe working environment. Developing emergency response plans with clear protocols for equipment failures, worker emergencies, or fire incidents during heatwaves enhances overall preparedness and response capabilities. These practical measures collectively contribute to the plant's resilience and sustainability in the face of challenging heatwave conditions.

4.1.4 Mitigation for freezing temperatures

Padeswood could face unique challenges during cold weather, necessitating specific practices to ensure efficient operations. Insulation and heating systems play a crucial role in preventing the freezing of vulnerable equipment and pipes. Implementing efficient heating systems ensures continued functionality during cold spells. Thawing measures, such as using portable heaters or warm water, can prevent operational delays for frozen materials and equipment.

Routine equipment maintenance is essential to prepare the plant for winter conditions, ensuring equipment remains operational. Emergency response plans should be developed with clear protocols for handling frozen pipes, equipment failures, or cold-related emergencies. Employee training should emphasise cold weather safety, appropriate clothing, and recognising symptoms of cold-related illnesses. These practical steps collectively bolster the plant's resilience and ensure smooth operations during cold weather challenges.

4.1.5 Mitigation Strategies for Ground Level Ozone

Efforts to control emissions at Padeswood involve a range of technologies and operational practices. This includes the installation and upgrading of emission control systems such as selective catalytic reduction (SCR) for NOx reduction and volatile organic compound (VOC) abatement systems. By implementing these technologies, plants can effectively reduce the release of ozone precursors into the atmosphere.

Focusing on best practices and process improvements to minimise the emissions of ozone precursors during cement manufacturing is crucial. Utilising alternative fuels and raw materials with lower VOC and NOx content is a sustainable approach to further reduce emissions from the production process.

Regular monitoring of air emissions and reporting activities is essential to ensure compliance with regulatory limits. This includes implementing robust emission monitoring systems to track pollutant levels and report data accurately.

Employee safety measures should include the provision of proper personal protective equipment (PPE) and the implementation of air quality monitoring in work areas. This ensures a safe working environment for all plant personnel.

Engaging with the local community to address concerns, provide information on emission reduction efforts, and promote transparency is also important. By fostering communication and collaboration, plants can build trust and understanding with the community.

APPENDIX 1 CLIMATE CHANGE ADAPTION RISK ASSESSMENT

Risk Assessment Rating System

LIKELIHOOD	Likelihood of the aspect causing a positive or negative impact on the environment
5	Continuously
4	Monthly
3	Annually
2	Once every 10 years
1	Once every 50 years

SEVERITY	How severe is the impact
5	Major long-term impact
4	Major short-term impact
3	Minor long-term impact
2	Minor short-term impact
1	Negligible impact

LIKELIHOOD					
	5	10	15	20	25
	4	8	12	16	20
	3	6	9	12	15
	2	2	6	8	10
	1	2	3	4	5
	SEVERITY				

SIGNIFICANCE	
(red)	High - Immediate Adaption Plans Required
(amber)	Medium - Short Term Adaption Plans Required
(green)	Low - Long term Adaption Plans Required
(blue)	Negligible – No Adaption Plans Required

Climate Change Adaption Risk Assessment

Climate Hazard	Potential Impact or Damage	Likelihood	Severity	Risk	Current Controls	Adaption Planning
Drought (Current)	• Reduced water availability could directly hinder Padeswood's ability to operate at full capacity or maintain normal production levels. • During droughts, water scarcity can make it challenging to adequately cool machinery, potentially leading to heating and equipment failures. • Drought reduce the availability of water for dust control, which can result in increased airbourne particulates and compliance issues with environmental regulations.	1	4	4	• Rainwater harvesting. • (CCS) Cooling of the combustion gases produced water condensate that gets used in the process instead of abstracted water. • Monitoring for leaks.	• Rainwater harvested volume is greater than the demand.
Droughts (2050)		3	4	12		• Increase use of borehole water to meet requirements.
Drought (2100)		5	4	20		• Find alternative methods of cooling that require less water usage e.g. air cooling where water cooling is currently used. • Use of wetting agents for dust control.
Flooding (Current)	• Damage to Equipment and Machinery including electrical systems short-circuiting and outages which could potentially damage expensive equipment • Machinery and production lines may need to be shut down for cleaning or repairs. • Floods pose safety risk to plant workers. • Floods may contaminate raw materials. • Floods may wash away stored hazardous materials, chemicals or fuels leading to pollution of nearby water bodies. • Flooding can disrupt utilities such as electricity, gas and water supply. Extensive repairs may be required before operations can resume safely. • Flooding may overwhelm drainage system. • Flood can destroy inventory such as storage of raw materials and packed products. • Risk to rail dispatch of cement in extreme conditions.	2	4	8	• Drainage system. • Drain inspections and cleaning. • (CSS) drainage system has been designed for an above 1 in 100 year flooding event. Based on highest precipitation in the past 20 years in a single day. • Recently installed sensitive equipment constructed at ground level or above.	• Review and upgrade current drainage system.
Flooding (2050)		3	4	12		• Move sensitive equipment to above ground level. • Review pump sizing for bund emptying/cleaning. • Create more covered storage for raw materials and packed products. • Automation of pumping under weighbridges. • Discuss alternatives with Local Authorities to adapt local highways.
Flooding (2100)		4	4	16		• See above.
Extreme weather – heatwaves (Current)	• Extended heat waves can lead to elevated ambient temperatures, causing equipment to overheat reducing efficiency and increasing the risk of breakdowns or malfunctions.	3	2	6	• A/C built into substations as required. • All electrical equipment rooms have A/C in place and alarmed back to the control room. • Sweeper and bowser used daily.	• Fire suppression systems. • Increase use of sweeper and bowser.

Climate Hazard	Potential Impact or Damage	Likelihood	Severity	Risk	Current Controls	Adaption Planning
Extreme weather – heatwaves (2050)	• Heat waves may increase energy demand for cooling systems and could lead to a strain on the plants power supply. • Cooling systems may struggle to effectively dissipate heat, leading to reduced cooling efficiency. • High temperatures can create heat stress and heat-related illnesses affecting employee well-being and productivity. • Dry and hot conditions can increase dust levels, posing challenges for dust suppression efforts. • Combustible materials such as coal and fuel used in kilns pose a heightened fire risk during heat waves. • Potential for spikes in humidity which can impact the cooling system. • Risk to rail dispatch of cement in extreme conditions.	4	2	8	• (CCS) Designed for the 98th percentile average temperature for the last 20 years, and added a 1.6 correction factor for the temperature.	• A/C capacity will need to be increased. • Review working hours and change to either earlier or later shifts to avoid the hottest part of the day. • Review cooling system design for motors and drives to run at a higher ambient temperature. • Reduce fuel inventory stored. • Switch from coal to natural gas. • In extreme events where rail is unavailable, dispatch of cement would switch to road.
Extreme weather – heatwaves (2100)		5	2	10		• See above.
Extreme weather – freezing conditions (Current)	• Aggregates and other materials used in cement production can freeze, leading to handling difficulties. • Machinery and equipment can be vulnerable to freezing temperatures. • Water in pipelines, pumps and cooling systems can freeze, leading to blockages and damage. • More viscous lubricants and oils can impair the operation of machinery, causing increased friction and potential breakdowns.	1	4	4	• Drain the lines during shut-down period to reduce risk of freezing. • (CCS) designed for -15ºc ambient temperature. • (CCS) Winterisation philosophy included in place.	• Bigger lines to reduce risk of freezing during site close down period. • Trace heating on critical equipment where water freezes.

Climate Hazard	Potential Impact or Damage	Likelihood	Severity	Risk	Current Controls	Adaption Planning
Extreme weather – freezing conditions (2050)	• Freezing temperatures can lead to water sources, such as reservoirs or ponds freezing over. • Frozen pipes can bust or crack leading to water leaks and damage to the plant's structure. • Working in freezing conditions can lead to frostbite, hypothermia or other cold related illnesses. • Slippery surfaces due to ice formation increases the risk of accidents. • Plant may need to increase heating to prevent freezing of equipment and materials leading to increased operational costs and a higher demand for energy. • Risk to rail dispatch of cement in extreme conditions.	2	4	8		• See above.
Extreme weather – freezing conditions (2100)		3	4	12		• See above.
Ground Level Ozone (Current)	• Ground-level ozone can cause respiratory problems, aggravate asthma. Workers may be exposed to elevated levels of ozone and other pollutants affecting their health and well-being. • Ozone can contribute to the corrosion of metal surfaces, including equipment and infrastructure which can lead to the deterioration of equipment, pipelines and structures. • Ozone can damage vegetation, including crops and natural vegetation and can disrupt ecosystems. • Ozone and associated pollutants can contribute to poor visibility and haze in the surrounding areas. • Risk to rail dispatch of cement in extreme conditions.	1	1	1	• Padeswood is located in a rural area, ambient ozone is already at a very low level, shown no clear long-term trend of increase since 1987. Nox emissions from the cement plant are low and will reduce further.	• N/A
Ground Level Ozone (2050)		1	1	1		• N/A
Ground Level Ozone (2100)		1	1	1		• N/A