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Transport Infrastructure Ireland

TII Publications

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Climate Assessment of Proposed National Roads - Standard

PE-ENV-01105
December 2022

PE Planning & Evaluation

Standards

About TII

Transport Infrastructure Ireland (TII) is responsible for managing and improving the country's national road and light rail networks.

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TII Publications

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Glossary of Terms

Key Term	Definition
Active Travel	All types of pedestrian and cycle facilities which improve conditions for people walking, wheeling, and cycling.
Baseline Scenario	The current state of environmental characteristics – including any evident trends in its status (EPA, 2022).
Carbon Dioxide Equivalent (CO_2e)	The unit for comparing the radiative forcing of a greenhouse gas to carbon dioxide.
Construction Environmental Management Plan (CEMP)	A working document that describes how a construction project will be managed and carried out to minimise impacts on the environment. The CEMP addresses all relevant environmental aspects of the management of the construction works and sets out the mitigation and monitoring requirements to be implemented.
Climate	The prevailing weather conditions of a region, as temperature, air pressure, humidity, precipitation, sunshine, cloudiness, and winds, throughout the year, averaged over a series of years.
Climate Assessment	For the purpose of this Standard, climate assessment is a catch all term for the assessments required for planning and evaluation – which incorporates the greenhouse gas assessment as well as climate change risk assessment.
Climate Change Adaptation	The process that a receptor or project has to go through to ensure it maintains its resilience to climate change. In the case of a development project, adaptation can be embedded in the design to account for future climate conditions, or the project can introduce measures to ensure it retains it resilience (i.e. the project adapts) to future climate conditions. Environmental receptors will adapt to climate change in varying degrees depending on how vulnerable they are to climate.
Climate Change	The United Nations Framework on Climate Change (UNFCCC, 1992) defines climate change as a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.
Climate Change Mitigation	The Intergovernmental Panel on Climate Change (IPCC, 2018) defines mitigation of climate change as: *'a human intervention to reduce emissions or enhance the sinks of greenhouse gases. Note that this encompasses carbon dioxide removal (CDR) options.'* Mitigation measures include technologies, processes or practices that contribute to mitigation.
Climate Change Risk (CCR) Assessment	For the purpose of this Standard, the CCR identifies the impact of a changing climate on a project. The assessment considers a project's vulnerability to climate change and identifies adaptation measures to accommodate climate change impacts.
Climate Practitioner	The climate expert undertaking the climate assessment meeting the qualification and competency defined in Section 1.6.
Competent Authority	The term 'competent authority' means the Minister or public authority to which an EIAR is required to be submitted, i.e., the authority charged with examining an EIAR with a view to issuing a consent to develop or operate (EPA, 2022).
Cumulative Impacts	Cumulative Impact Assessment falls into two strands, the first being to ensure that the effects of the project are considered cumulatively alongside those of other proposed projects in geographic proximity to the project, and then secondly, to ensure that cumulative effects are considered for a single receptor (i.e. people, wildlife or the physical environment) where multiple impacts (i.e. noise, air quality, traffic and visual impacts) are predicted to arise from the project.
Cycleway	An offline public road reserved for the exclusive use of people cycling or people walking, wheeling, and cycling (see also definitions of 'Greenway').

Key Term	Definition
	All mechanically propelled vehicles, other than mechanically propelled wheelchairs and electric bikes, are prohibited from entering except for the purpose of maintenance and access.
Designer/Design Team	The group of experts, including internal (e.g. NRO/PO) designers and/or external engineering, environmental, valuation and legal advisors, who are responsible for all aspects of the project design, up to and including the award of the Main Construction Contract (and for employer design projects for Project design after the awarding of construction contract).
Do Minimum Scenario	Likely future receiving environment without the proposed project in place. Further details of the Do something scenario in the context of TII schemes can be found in Project Appraisal Guidelines for National Roads Unit 4.0 – Consideration of Alternatives and Options Section 4.2.
Do Something Scenario	Likely future receiving environment with the proposed project in place. Further details of the Do something scenario in the context of TII schemes can be found in Project Appraisal Guidelines for National Roads Unit 4.0 – Consideration of Alternatives and Options Section 4.2.
Effect/Impact	A change resulting from the implementation of a project (EPA, 2022).
Environmental Impact Assessment (EIA)	The process of examining the anticipated environmental effects of a proposed project – from consideration of environmental aspects at design stage, through consultation and preparation of an EIAR, evaluation of the EIAR by a competent authority, and the subsequent decision as to whether the project should be permitted to proceed, encompassing public response to that decision (EPA, 2022).
Environmental Impact Assessment Report (EIAR)	A report or statement of the effects, if any, that the proposed project, if carried out, would have on the environment (EPA, 2022).
Embodied Carbon	GHG emissions emitted in producing materials, includes emissions caused by extraction, manufacture/processing, transportation and assembly of materials and products.
Emissions	Emissions in the context of this Standard, refer to the release of greenhouse gases and/or their precursors into the atmosphere over a specified area and period of time (EPA, 1992).
Exposure Analysis	In the context of a climate change risk assessment, the aim of an exposure analysis is to identify which climate hazards are relevant to the planned project location, irrespective of the project type.
Greenhouse Gases	Gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere, and clouds (BSI, 2016).
Greenhouse Gas (GHG) Assessment	For the purpose of this Standard, the greenhouse gas assessment identifies the greenhouse gas impact of a project on the climate over the life of a project.
Greenway	A cycleway that caters for people walking, wheeling, and cycling in a mainly recreational environment.
Mitigation Measures	Measures designed during the planning and evaluation process to avoid, prevent, or reduce impacts. These measures can mitigate impacts: • By avoidance - When no impact is caused (often through consideration of alternatives).

Key Term	Definition
	• By prevention - When a potential impact is prevented by a measure to avoid the possibility of the impact occurring. • By reduction - When an impact is lessened (EPA, 2022).
Monitoring	The observation, measurement and evaluation of environmental data to follow changes over a period of time, to assess the efficiency of control measures and to record any unforeseen effects in order to be able to undertake appropriate remedial action. This is typically a repetitive and continued process carried out during construction, operation or decommissioning of a project.
Operational Environmental Management Plan (OEMP)	A working document that describes how a project will be managed and implemented, to minimise environmental impacts during the operational phase of the project.
Overarching Technical Document (OTD)	The purpose of TII's OTDs are to provide consistent theory and methodology (with the accompanying theory) of a subject matter e.g. climate change, to enable the assessment of National Roads and related infrastructure.
Project Manager	The role and responsibility of the Project Manager in this Standard is to ensure that a project is delivered on time, to budget and to the required standards and specifications, for more detail on duties please refer to PE-PMG-02041.
Representative Concentration Pathways (RCPs)	To model and predict future climate it is necessary to make assumptions about the economic, social and physical changes to our environment that will influence climate change. Representative Concentration Pathways (RCPs) are a method for capturing those assumptions within a set of scenarios. The conditions of each scenario are used in the process of modelling possible future climate evolution. RCPs specify concentrations of greenhouse gases that will result in total radiative forcing, increasing by a target amount by 2100, relative to pre-industrial levels. Total radiative forcing is the difference between the incoming and outgoing radiation at the top of the atmosphere. Radiative forcing targets for 2100 have been set at 2.6, 4.5, 6.0 and 8.5 watts per square metre (W m-2) to span a wide range of plausible future emissions scenarios and these targets are incorporated into the names of the RCPs; RCP2.6, RCP4.5, RCP6.0 and RCP8.5. Each pathway results in a different range of global mean temperature increases over the 21st century.
Scope and Boundary	The scope is the identification of which receptors/effectors (e.g. climate, GHG emissions, environment, project element) should and should not be included within an assessment. The boundary is the remit of where (spatial) and when (temporal) the receptors/effectors should be looked at.
Sensitivity Analysis	Sensitivity analysis is a method for testing uncertainty in different outcomes of a situation based on different scenarios and/or variables.
Significance	Details evidence of practice, associated with assessing and reporting on the extent of impact associated with the climate related assessments undertaken as part of the preparation of planning deliverables.
Standards Document (SD)	Provides the standard approach to the analysis and production of assessments and outputs/documents being prepared for use in National Roads and related infrastructure.
Thresholds	Thresholds, which may relate to the characteristics and location of a project or to the type and characteristic of the potential impact, are often laid down in relevant legislation. Where a project meets or exceeds these thresholds, EIA is mandatorily or automatically required. The thresholds in respect of roads are set down in Section 50(1)(a) of the Roads Act 1993, as amended, and Article 8 of the Roads Regulations 1994. In respect of light rail, regard should be had to the requirements of the Transport (Railway Infrastructure) Act 2001, as amended.

Key Term	Definition
Vulnerability Assessment	The vulnerability assessment combines the outcomes of the analysis of sensitivity and exposure and aims to identify potential significant climate hazards to the project.

Abbreviations and Acronyms

Acronym	Name
BaU	Business as Usual
BSI	British Standards Institution
CAP	Climate Action Plan
CBA	Cost Benefit Analysis
CO_2e	Carbon Dioxide Equivalent
CCR	Climate Change Risk
CDR	Carbon Dioxide Removal
CEMP	Construction Environmental Management Plan
DoT	Department of Transport
DM	Do Minimum
DS	Do Something
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EPA	Environmental Protection Agency
EPD	Environmental Product Declarations
ES	Environmental Statement
ESR	Effort Sharing Regulation
EU	European Union
EV	Electric Vehicle
GHG	Greenhouse Gas
IEMA	The Institute of Environmental Management and Assessment
IPCC	Intergovernmental Panel on Climate Change
kWh	Kilowatt Hour
LCA	Life Cycle Assessment
MCA	Multi-Criteria Analysis
NAF	National Adaptation Framework
NDP	National Development Plan
NIFTI	National Investment Framework for Transport in Ireland
NRN	National Road Network
NRO/PO	National Road Office/Project Office
NTA	National Transport Authority
OEMP	Operational Environmental Management Plan

Acronym	Name
OTD	Overarching Technical Document
PABS	Project Appraisal Balance Sheet
PAG	Project Appraisal Guidelines
PAS	Publicly Available Specification
PB	Project Brief
PMG	Project Management Guidelines
RCMs	Regional Climate Models
RCPs	Representative Concentration Pathways
SD	Standards Document
SLR	Sea Level Rise
TII	Transport Infrastructure Ireland
UKCP	United Kingdom Climate Projections
UNFCCC	United Nations Framework Convention on Climate Change
WBCSD	World Business Council for Sustainable Development
WRI	World Resources Institute

1. Introduction

Transport Infrastructure Ireland (TII) produces and manages a wide range of standards and technical documentation related to its areas of responsibility. These, and other publications, are available to users through the TII Publications system website: www.tiipublications.ie

1.1 Purpose of this Standard

Climate change is currently assessed as part of Environmental Impact Assessment (EIA) requirements and should be considered as one of the environmental factors assessed as part of TII's planning and development of national roads, including motorway service areas.

Climate change is being caused by an anthropogenic increase in Greenhouse Gas (GHG) emissions. This change in climate is being seen in global temperatures, and an increase in the frequency and severity of extreme weather events. To combat this, there is a parallel need to reduce GHG emissions via mitigation and increase our resilience to climate change through adaptation.

This Standard Document (SD) PE-ENV-01105 sets out the required approach for Climate Practitioners to identify significant climate effects; in terms of both Greenhouse Gas (GHG) emissions and climate resilience, associated with all stages of proposed national road developments: the design, construction, and operation of national roads in accordance with TII's project planning and national planning requirements.

1.2 Terms and Definitions

The following verbal forms are used:

- "shall" or "will" indicates a requirement.
- "should" indicates a recommendation.
- "may" indicates a permission.
- "can" indicates a possibility or a capability.

Information marked as "Note" is for guidance in understanding or clarifying the associated requirement. Other key definitions are included in the Glossary of Terms.

1.3 Using this Standard

This SD is to be used by Climate Practitioners on proposed national road developments to assess and report the project's impact on GHG emissions and the project's risk and resilience to climate change through a climate assessment. It sets out the climate assessment step-by-step methodology for the analysis and the production of documents and deliverables as they relate to national roads and associated infrastructure, in terms of:

- Greenhouse Gas Emissions (GHG) assessment: the assessment of GHG emissions identifies the impact of GHGs arising from a proposed national road development during its lifetime and addresses how the project will affect the ability of the Government to meet its carbon reduction targets.
- Climate Change Risk (CCR) Assessment: The CCR assessment identifies the vulnerability of a proposed national road development to climate change and considers adaptation measures to increase the resilience of the project.

The methodology outlined in this SD and the theory of climate assessment are presented in an "Overarching Technical Document" (OTD) **PE-ENV-01104.** The OTD should be read in conjunction with this SD. The OTD provides best practice methodology and processes for climate assessment for proposed national road developments, as well as light railway and rural cycleways (offline & greenways) projects.

The documents are intended for use by a suitably qualified practitioner with appropriate climate assessment skills carrying out climate assessment of proposed national road developments in Ireland, including new construction, road improvements, and maintenance projects. Appropriate competencies are defined in Section 1.6 of this document. The documents will also be used by Project Managers, environmental co-ordinators, designers, and contractors that may support climate assessments.

This SD expands on the advice set out in the TII Project Management Guidelines (PMGs) and Project Manager's Manual (PMM), which should be read in conjunction with this SD.

1.4 Background and Legislative Framework

1.4.1 Background

Climate change poses significant challenges. Ireland has already experienced an unprecedented level of damage to infrastructure and disruption to services caused by multiple extreme weather events such as the floods of winter 2015/2016, and storms Ophelia and Emma in 2017 and 2018 respectively. As Figure 1.1 shows, both carbon mitigation, and climate change adaptation of Ireland's infrastructure projects will enable the development of a net zero, resilient future that is aligned with Ireland's national ambitions. The transition to a net zero and resilient infrastructure system may also bring with it wider benefits through health, environmental and quality of life such as improved air quality and increased levels of physical activity.

The approach of TII as part of its Sustainability Implementation Plan (2021) is to lead in the delivery and operation of sustainable transport. Addressing and mitigating against the GHG impacts of a project early in the planning stage will support TII's 'Transition to net zero' principle. Designing projects so that they are resilient to a changing climate will help deliver safe and resilient networks and services.

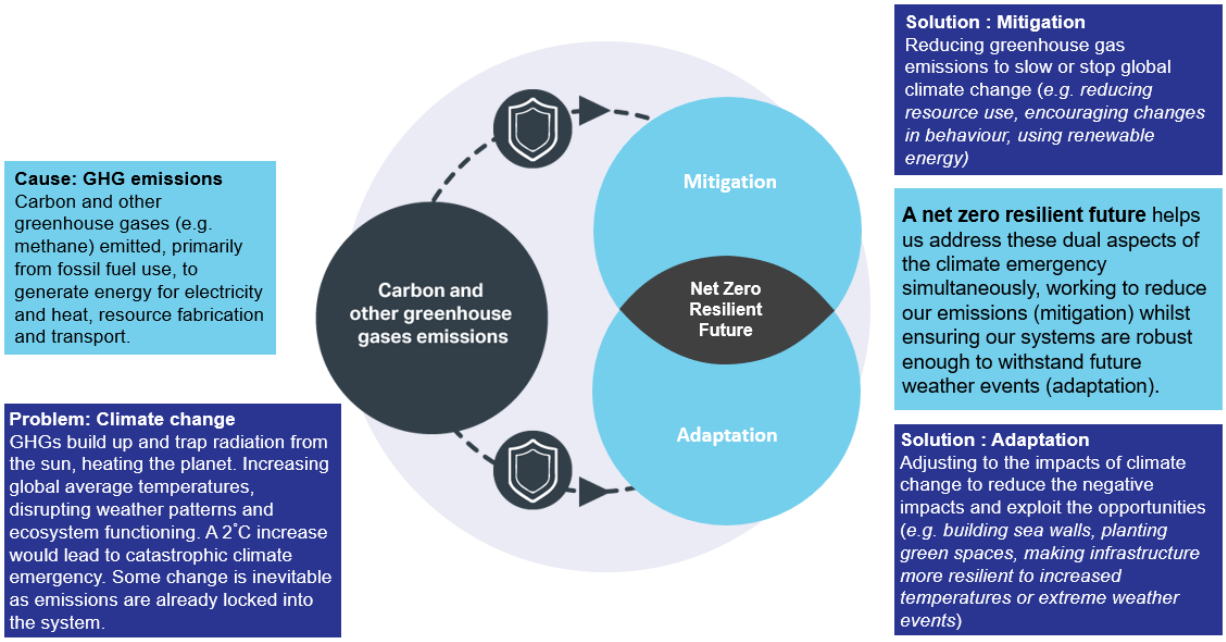


Figure 1.1 Transition to a net zero resilient future

1.4.2 Legislation

The relevant legislative and statutory guidance and key influencing documents relevant to climate assessment is summarised in Figure 1.2.

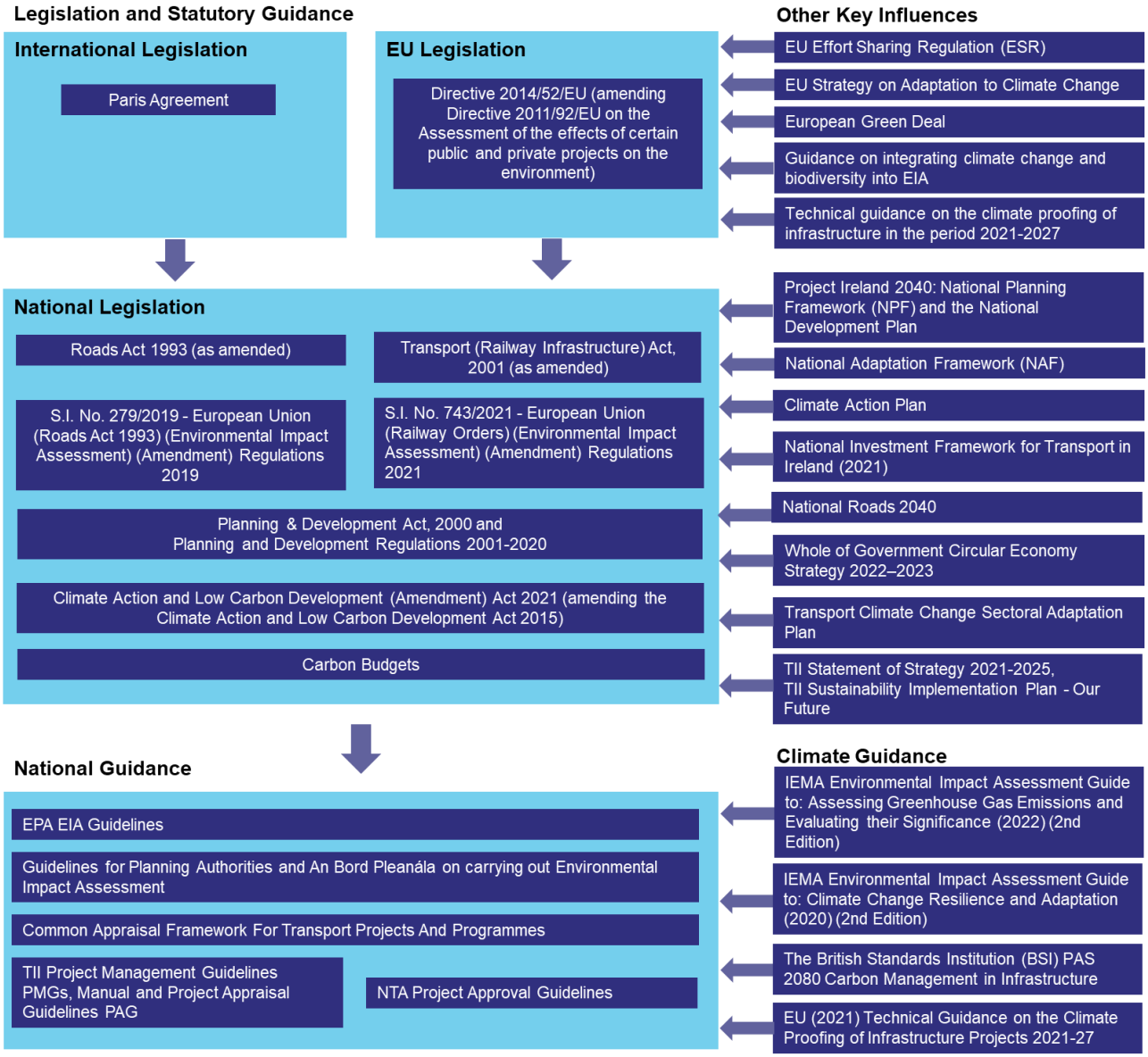


Figure 1.2 Legislation, Statutory Guidance and other key influences on Climate Change and GHG for National Roads, Light Rail and Rural Cycleways projects

Ireland is a party to the United Nations Framework Convention on Climate Change (UNFCCC), and the Paris Agreement signed in 2015, which together provides the international legal framework for addressing climate change (UNFCCC, 2015). It requires all signatories to strengthen their climate change mitigation efforts to keep global warming to well below 2°C this century and to pursue efforts to limit global warming to 1.5°C. Since 2015, Ireland has brought into effect its Climate Action and Low Carbon Development (Amendment) Act (Goverment of Ireland, 2021)) and introduced Carbon Budgets which set legally binding caps on the amount of GHG emissions Ireland can emit.

Note: *For further discussion on Ireland's regulatory/policy framework refer to Chapter 2 of the OTD.*

1.5 Implementation of this Standard

Mitigating risk is about anticipating and responding appropriately to potentially significant effects. This is a component of good planning and design and helps avoid unnecessary delay in delivering projects. The routing and development of projects can be a complex process which has effects on the climate. It requires a balance between a number of issues including ensuring a functional, safe, and direct road network; adapting to physical and land use constraints; consideration of environmental protection; meeting compliance with engineering and other technical requirements; and working within expected costs.

This SD shall be used in the planning, design and construction of national road developments that:

- Require approval under Section 51 of the Roads Act, 1993, as amended (proposed national road development subject to Environmental Impact Assessment);
- Require approval under Section 177AE of the Planning and Development Act, 2000, as amended (certain local authority development subject to Appropriate Assessment); or
- Are subject to the procedure established under Section 179 of the Planning and Development Act, 2000, as amended, and Part 8 of the Planning and Development Regulations, 2001, as amended (known as the 'Part 8' procedure).

Where projects requiring approval under Section 51, Section 177AE or Part 8 have at the date of publication of this SD, commenced planning and design, and in particular, where technical advisor contracts have been executed, this SD should also be:

- Treated as advice and guidance.
- Employed to the greatest extent reasonably practicable; and,
- Applied in a proportionate manner, having regard to the characteristics and location of the project/maintenance works and the type and characteristics of potential impacts.

This also applies to the planning, design and construction of all other national road developments, and the maintenance of these national roads.

The procedures followed by TII and local authorities in the planning, design, implementation, and management of proposed national road developments are specified in:

- Roads Act, 1993, as amended 2019;
- TII's PMGs (TII);
- TII's PMM for Major National Roads (TII);
- TII's Project Appraisal Guidelines (PAGs) (TII); and,
- As referred to in other standards and guidelines.

Climate assessment will be carried out:

- Formally, as part of the preparation of an Environmental Impact Assessment Report (EIAR) for developments above a certain threshold, or sub-threshold/minor projects if deemed necessary during the screening process, where the potential impact of the project on the climate or the impact of the climate on the project are determined by the consenting authority likely to be significant.
- Informally, as a contribution to the assessment of development proposals and consent applications (e.g. Part 8 projects).

Climate assessment will be carried out on sub-threshold/minor projects where the Project Manager deems it prudent or is required by local policy.

Each national road development must be assessed in terms of possible effects. When a proposed national road development, which is not considered an EIA development, but which has the potential to have significant effects on the climate, a climate assessment shall be carried out. This will need to be screened by the project developer with personnel who have competency as defined in Section 1.6.

When undertaking such an assessment climate professionals shall follow this SD. The format of such an appraisal may not need to satisfy the formal requirements of an EIA, however, it shall as a minimum set out any effects of the project on the climate or effects of the climate on the project, as well as proposed mitigation or adaption in a rational and proportional way so that this can be fully considered through the planning, design and construction processes.

1.5.1 Environmental Impact Assessment Report (EIAR)

General guidance on the scope and detail of an environmental impact assessment report, including climate impact assessment, is available in Guidelines on the information to be contained in Environmental Impact Assessment Reports (EPA, 2022). TII also prepared an Environmental Impact Assessment of National Road Schemes – A Practical Guide, which helps to interpret earlier EIA guidance in the context of proposed national road developments (TII). For further details on the requirements of the EIAR, refer to Section 2.4 of the OTD.

Overlaps and Interactions with Other Disciplines

Figure 1.3 presents the typical team members who will need to be engaged when undertaking a climate assessment, whether to collect primary data or to understand the impact of the climate on the project and how this can be mitigated.

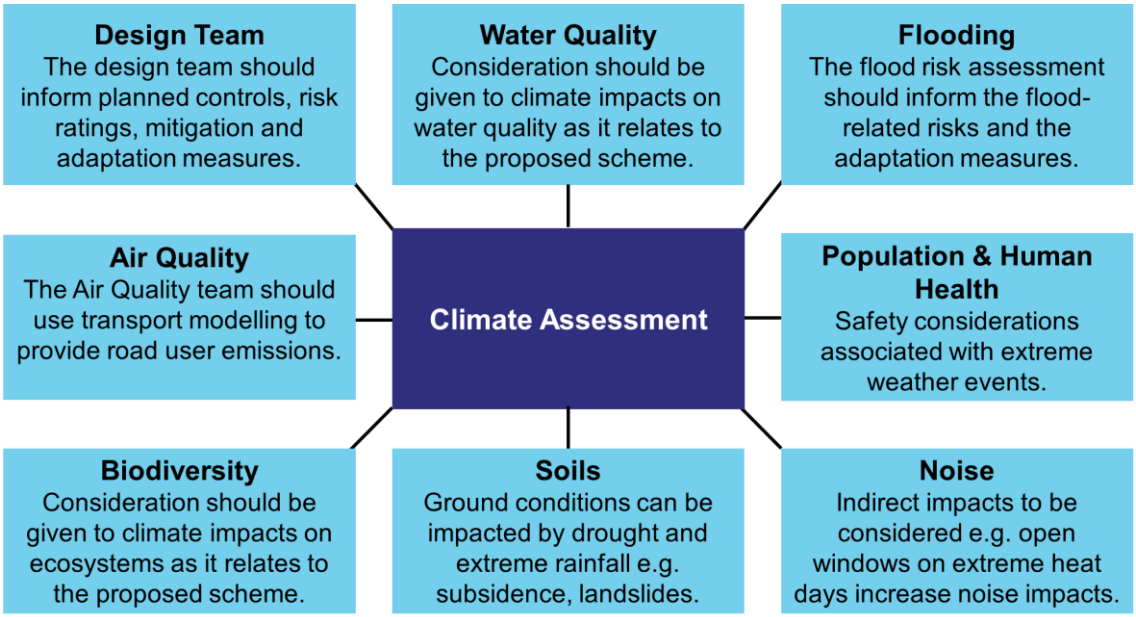


Figure 1.3 Climate interactions and overlap with other disciplines

1.6 Requirements for an EIA / Climate Practitioner

Undertaking a climate assessment as part of the preparation of the planning process deliverables requires expertise, independence, and objectivity.

Directive 2011/92/EU, as amended by Directive 2014/52/EU, stipulates that the Environmental Impact Assessment Report (EIAR) and assessments must be carried out by competent practitioners. Where required for national road developments, the climate assessment will be carried out by a suitably qualified and competent Climate Practitioner who has previous experience in this field.

The Climate Assessment Practitioner undertaking the climate assessment is referred to as the 'Climate Practitioner' in this document. It is recommended that the Climate Practitioner(s) involved in the preparation of the EIAR and/or carrying out of the climate assessment in respect of TII projects have the following qualifications, as a minimum:

- An honours degree in environmental science, climate change (or equivalent discipline); and/or a master's degree in environmental science, climate change (or equivalent discipline).

It is also recommended that:

- The Climate Practitioner undertaking the GHG Assessment should be experienced in GHG management, including GHG Assessment aligned with PAS 2080 Carbon Management in Infrastructure (BSI, 2016). The Climate Practitioner should also have experience utilising the TII Carbon Assessment Tool.
- The Climate Practitioner undertaking the CCR Assessment should be experienced in CCR Assessments including the interpretation and application of climate change data (historic and projections) and have experience managing climate change impacts on transport projects.
- The Climate Practitioner should hold membership of the relevant/appropriate professional body.

In general, it is recommended that the Climate Practitioners have five years' relevant post-graduate experience in GHG management and climate change. The minimum number of years' relevant post-graduate experience may change (upwards or downwards) depending on the size, nature, complexity etc., of the project in question. In addition, it is essential to carefully lay down further criteria defining what post-graduate experience is considered relevant in the context of the project at hand.

The Climate Practitioner should have experience with the EIA process (or other planning processes as applicable) and requirements, be capable of characterising the existing environment and assessing how the proposed project will impact upon it. The Climate Practitioner should have technical knowledge of, and be up to date with:

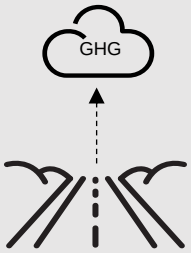
- The relevant legislation, policy and standards that apply.
- The relevant EIA, planning and climate change guidance.
- The criteria for evaluation and classification of the significance of impacts.

The person(s) responsible for the submission of the climate assessment, must document compliance with the criteria above to ensure that the Climate Practitioners, who carry out climate assessments on TII projects (which require an EIA), are qualified, competent, and expert.

2. Overview of Climate Assessment Process

Proposed national road developments can have effects on the climate, and conversely the climate can have significant effects on proposed national road developments. GHG assessment and CCR assessment are key approaches in understanding, assessing and mitigating these effects. While there are strong links between GHG assessment and CCR assessment, they require separate methods of assessment. In brief they are defined as follows:

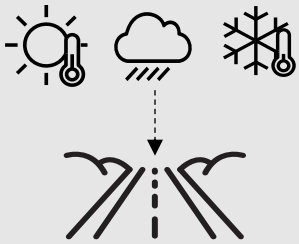
1. Greenhouse Gas Emissions (GHG) Assessment



Impact of the project on the climate

Quantifies GHG emissions from a project during its lifetime and contextualises the magnitude of the impact of these emissions against relevant carbon budgets, targets and policy.

2. Climate Change Risk (CCR) Assessment



Impact of a changing climate on the project

Identifies the impact of a changing climate on a project and receiving environment. The assessment considers a project's vulnerability to climate change and identifies adaptation measures to accommodate climate change impacts.

Figure 2.1 GHG assessment and CCR assessment summary

Objectives of the GHG assessment/CCR assessment process are to:

- Avoid or reduce the adverse impacts of GHG emissions from a national road development on the climate, allowing a project to make a positive contribution to Ireland's net zero trajectory.
- Reduce or manage the adverse impacts of climate change on the proposed project and develop a project resilient to climate change.

The climate assessment will assess the impact of GHGs arising from a proposed national road development during its lifetime, and address how the project will affect the ability of the Government to meet its carbon reduction targets. It will identify the vulnerability of the proposed national road development to climate change and consider adaptation measures to increase the project's resilience to climate change impacts. Regardless of the size of the project, the methodology for climate assessment will be the same. The climate assessment will be proportionate to the size and scale of the project, and sensitivity of the receiving environment.

Refer to the Overarching Technical Document PE-ENV-01104 for further detail on the application of GHG assessment and CCR assessment.

2.1 Key Principles and Deliverables of the Climate Assessment Process

Key principles which should be followed throughout the assessment process are:

- The assessment should be proportionate to the nature, scale, and characteristics of the project as it relates to the potential for significant GHG and climate risk effects.
- The methodology used in the climate assessment including the citing of key references and sources should be described. Explain the facts, assumptions, limitations and basis of the assessment in order to ensure a transparent process and provide a rationale for conclusions and decisions.
- It should be collaborative and provide input to the Design Team as part of the iterative process during options selection, design development and preparation of contract requirements.
- It should be carried out by the Climate Practitioner with competence and relevant experience as outlined in Section 1.6.

2.2 Common Effects

Impacts from climate change are observed in increased severity and frequency of extreme weather events, such as floods as well as in longer-term shifts in climate patterns, such as sustained higher temperatures. Possible effects of climate change impacts on the project are captured in Section 3.6.2 of this SD.

2.3 Mitigation and Adaptation Measures

When impacts on the climate, and climate impacts on the proposed project, are unavoidable, a variety of mitigation and adaptation measures can be introduced to avoid, reduce, or manage these impacts.

Mitigation and adaptation measures should be considered from the start of the TII PMG process and reviewed in all PMG Project Stages. Climate Practitioners shall demonstrate that sufficient measures are in place to mitigate GHG effects, and adequate adaptation measures are in place to avoid significant climate change risks.

3. Application of Climate Assessment to TII Guidelines

TII projects are classified as either Minor or Major Projects by project threshold value. Projects are assessed and delivered through various phases (see PE-PAG-02009 Unit 1.0). This chapter outlines the Project Thresholds, PMG and PAG process and deliverables, and the climate assessment outputs required for each as part of this SD.

3.1 Project Thresholds

In general, the full extent of this SD does not apply to TII Projects of less than €5 million. Similarly, there are other road pavement and safety schemes which are not considered under TII PMGs, and this SD will not apply. A climate assessment will only need to be carried out where there may be the potential to have significant effects on the climate (or climate on the project). This will need to be screened by the project developer with personnel who have a competency in considering climate issues related to national road developments, this process shall be documented.

The level of assessment required will generally be proportionate to the size and value of a project. The complexity of projects between €5 and €20 million can vary considerably. The upgrading of a section of a national road will most likely not require the same level of climate assessment as a new bypass of a town or a new urban relief road. Therefore, the level of climate assessment should be proportionate to the potential for significant effects to occur.

TII projects are classified into three main categories, each requiring a different and proportionate level of appraisal, as defined in PAG Unit 1.0, and are summarised in Table 3.1.

Table 3.1 TII Project Threshold and Standard Document Applicability

Project Threshold	TII Project Classification	Description	Standard Document Guidance to be applied
€0.5 to €5 million	Minor Projects[1]	Less complex in nature, typically involve an upgrade to an existing section of sub-standard road less than 2km in length, or a specific road safety improvement scheme.	No (Unless EIA is required, or where there may be potential for likely significant climate effects.)
€5 to €20 million		Less complex in nature and typically involve lengths of improvement to the national road network, junction/bridge improvements, or combination of road and junction improvements.	Yes
Greater than €20 million	Major Projects	Improvements to significant lengths of the national road network be they online or offline upgrades, large scale junction improvements, structures/bridges or tunnels.	Yes

[1] It should be noted that projects between 0.5 to 5 million will generally follow the Design Phase Procedure for Road Safety Improvement Schemes, Urban Renewal Schemes and Local Improvement Schemes DN-GEO-03030

3.2 PMG Process and PAG Deliverables

TII have set out its project phases and stated specific appraisal requirements at each phase through its PMG and PAG. It is important that these guidelines are considered by the Climate Practitioner as they identify the level of environment assessment required. This Section explains how climate change should be assessed in accordance with TII's guidelines and national planning requirements.

TII's PMG and PAG are applicable to all projects which are funded through TII and/or TII as the Approving Authority and are used by Project Managers and others responsible for project delivery.

- The PMG provides a framework for a consistent, structured, and standardised phased approach to the management of the development and delivery of National Road and Public Transport Capital Projects.
- The TII PAG translates the requirements of the CAF in relation to national road developments and programmes and provides detailed guidance on aspects of appraisal including cost benefit analysis, transport modelling and parameter values.

Table 3.2 illustrates the requirements of this SD across the project phases, together with the PAG and PMG deliverables the SD informs. The focus of this SD is on the Planning and Design (PMG Phases 0 to 4). This SD does not provide detailed guidance for Climate Practitioners to TII project Phases 5 to 7, which relate to procurement, construction and implementation and closeout & review. However, Phases 5 to 7 may require support from Climate Practitioners to help review climate mitigation, adaptation, and monitoring measures where these are required. Phases 0 to 4 are discussed in the following sections.

Table 3.2 Identifying when Climate Assessment is required

Phase	Standard Document requirements	PAG* and PMG deliverables/outputs this Phase informs
Phase 0: Scope and Pre-Appraisal	N/A	• Strategic Assessment Report* • Phase 0 Gate Review Statement
Phase 1: Concept & Feasibility	Phase 1 Climate Assessment should be incorporated into the Constraints Report.	• Project Execution Plan • Phase 1 Gate Review Statement • Constraints Report
Phase 2: Option Selection	Completed MCA for Environment (including GHG assessment and CCR assessment)	• Project Appraisal Balance Sheet (PABS)* • Options Appraisal Report (OAR)* • Phase 2 Gate Review Statement • Options Selection Report
Phase 3: Design and Environmental Evaluation	Climate Chapter (as part of EIAR) / Standalone Climate Report/Project specific environmental report	• Preliminary Business Case (PBC)* • EIAR • Phase 3 Gate Review Statement • Design Report
Phase 4: Statutory Processes	Update climate deliverables, respond to third party submissions where pertinent/required and participate in oral hearing(s) as required by the statutory processes	Reported outputs shared with Project Manager so that mitigation and adaptation measures are taken forward for Phases 5 to 7 deliverables

3.3 Phase 0: Scope and Pre-Appraisal

Phase 0 is the scope and pre-appraisal phase; its aim is to ensure project alignment with current TII strategic programmes and plans. At Phase 0 as set out in the PMG and PMM these initial phases are carried out by the Project Manager to:

- Allow for the project to be aligned with the current consenting authority strategic programmes and plans.
- Develop and investigate in further detail the feasibility of the project and to implement the project management structure.

Table 3.3 provides the details of the climate assessment associated with Phase 0.

Table 3.3 Phase 0 Climate Assessment

Phase 0 Climate-specific Objectives	Phase 0 will allow for GHG emissions and climate change risk to be considered from project inception, so that the project scope and its objectives are aligned with key national policies (including the National Investment Framework for Transport in Ireland (NIFTI) investment priority of decarbonisation), local and national climate policy and the overarching goal of decarbonising the transport sector.
Assessment type	Qualitative
Person(s) responsible	Project Manager. This will not require the input of a Climate Practitioner.
SD Deliverable for this Phase	N/A
Informs	The findings shall be inputted into the Strategic Assessment Report and Phase 0 Gate Review Statement.

3.3.1 Climate Assessment Process

To deliver the outputs for Phase 0 the steps in Table 3.4 shall be followed.

Table 3.4 Phase 0 Step by Step Instructions

Phase 0 GHG assessment and CCR assessment Instructions
Align with local and national policy in relation to climate change
At Phase 0 there will be no project-specific data available to perform a quantitative climate assessment. The Project Manager shall examine local and national policy in relation to climate change and identify whether the project scope is in keeping with policy in relation to GHG emissions and climate risk.
Evaluate against NIFTI's investment priority of decarbonisation
The project scope must be evaluated against NIFTI's investment priority of decarbonisation. The Project Manager shall assess the need for infrastructure a prioritisation of sustainable modes of travel must take place, via pragmatic application of the NIFTI intervention and modal hierarchies.
Note: *For more information on national climate change policy including the NIFTI framework please refer to Chapter 2 of the OTD. Guidance of how to apply the NIFTI intervention and modal hierarchies is provided in Section 4.3 of National Investment Framework for Transport in Ireland (Department of Transport, 2021).*

3.4 Phase 1: Concept and Feasibility

The aim of Phase 1 is to further develop and investigate the feasibility of the project and Project Management structure. Phase 1 will establish whether a sufficient case exists to consider the proposal in more depth and will consider a range of transport modes/project options proposed to solve the identified problem.

Table 3.5 provides the details of the climate assessment tasks associated with Phase 1.

Table 3.5 Phase 1 Climate Assessment

Phase 1 Climate-specific Objectives	Phase 1 will allow for a concept and feasibility evaluation including a consideration of GHG effects and climate change risk to the project.
Assessment type	Qualitative (to understand the magnitude of a potential project's impact.)
Person(s) responsible	This will require the input of a Climate Practitioner.
SD Deliverables for this Phase	The processes followed for this phase will be incorporated into the Constraints Report.
Other Project deliverables this Phase informs	• Project Execution Plan • Phase 1 Gate Review Statement • Constraints Report

Note: *To distinguish between the remainder of the phases, the process for* ***GHG assessment*** *is colour coded in* ***Green****, and* ***CCR assessment*** *is in* ***Orange****.*

3.4.1 GHG Assessment Process

To deliver the outputs for Phase 1 the steps in Table 3.6 shall be followed.

Table 3.6 Phase 1 GHG Assessment Instructions

Phase 1 GHG Assessment Instructions
Define the purpose and scope
The Climate Practitioner shall refine the scope of the assessment in line with the project needs: • Purpose to understand the potential magnitude and scale of GHG emissions from the proposed reasonable alternatives and to inform concept and feasibility evaluation. • Scope – will include each reasonable alternative. It will include GHG emission generating activities associated with the project (see below).
Describe the potential GHG impacts of the project on the climate
At Phase 1, specific GHG data for each proposed reasonable alternative is unlikely to be available. Differences in reasonable alternatives may have a bearing on the GHG emissions impact and shall be described by the Climate Practitioner. The Climate Practitioner shall consider relevant distinguishing features. which may include: • *Length of infrastructure* – a longer or more complex route will likely require more materials, increasing the embodied carbon. Additionally, this would likely result in greater emissions from construction activities. NIFTI investment hierarchy to be considered at this stage. • *Land use types* – a route traversing peatland or forested areas will have a more significant carbon impact than a route that impacts agricultural land. • *Type(s) of infrastructure* – range of multi modal options being considered.
Note: Indicative carbon values of land and road types are provided in Appendix A.
Discuss mitigation principles with Design Team
Using the mitigation hierarchy, the Climate Practitioner shall engage with the Design Team to identify and capture GHG mitigation principles and initial opportunities in the Phase 1 Project Feasibility Report.
Report results into Phase 1 Climate Assessment Report
The Climate Practitioner must report the results of the actions into the output deliverable – the Phase 1 Project Feasibility Report.
***Note:** For further background on Ireland's net zero target, please refer to section 2.3 of the OTD. An overview of the mitigation hierarchy is shown in Figure 3.1.*

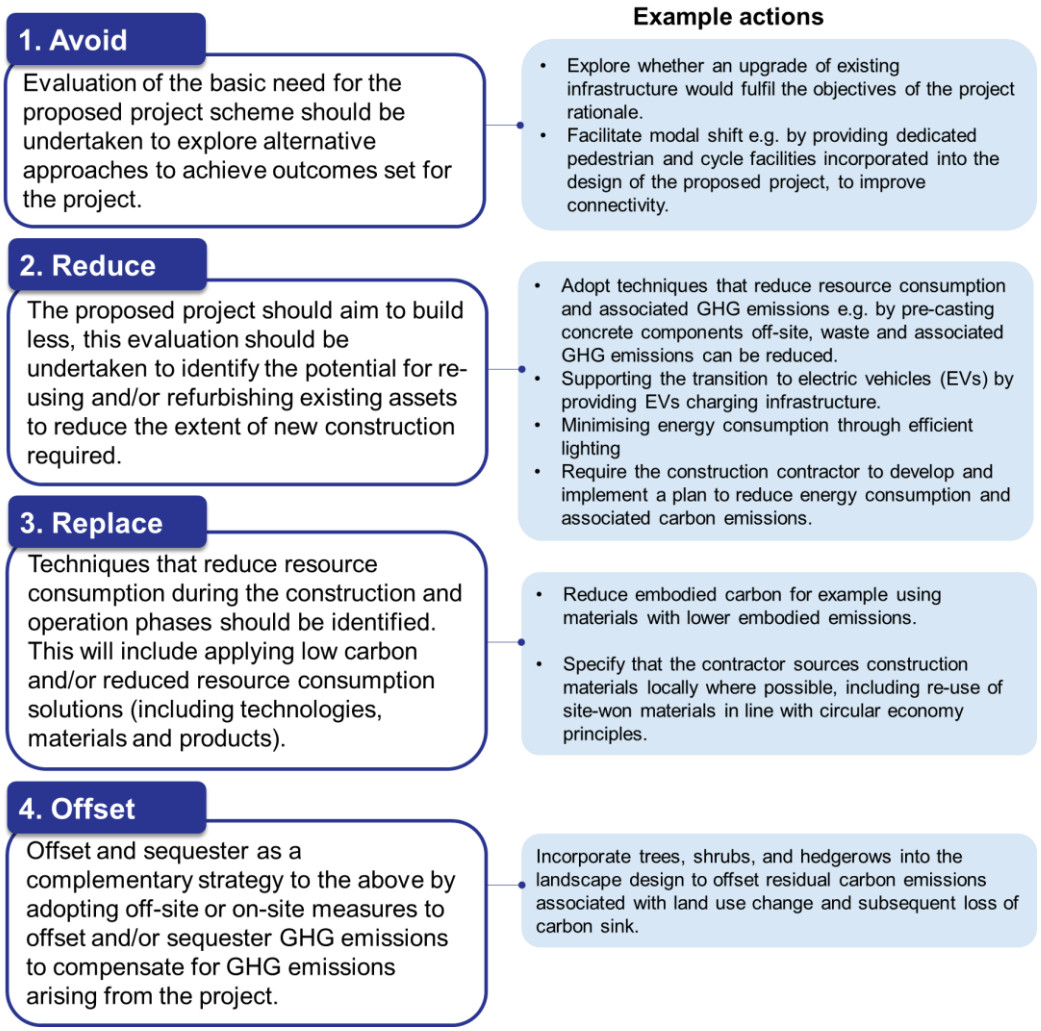


Figure 3.1 GHG Mitigation Hierarchy (This can be undertaken in parallel with NIFTI intervention hierarchy)

3.4.2 CCR Assessment Process

To deliver the outputs for Phase 1 the steps in Table 3.7 shall be followed and recorded in the constraints report.

Table 3.7 Phase 1 CCR Assessment Instructions

Phase 1 CCR Assessment Instructions
Define the purpose and scope
The Climate Practitioner shall refine the scope of the assessment in line with the project needs: • Purpose – to understand the exposure of the proposed reasonable alternatives to climate change risk, taking into consideration the geographic area and any distinguishable features of each reasonable alternative. This should inform concept and feasibility evaluation. • Scope - will include each proposed mode/reasonable alternative, the existing local conditions and historic climate events (see below).
Describe the historic climate events
The project modes/reasonable alternative will be proposed for a defined geographical area. The historic climate events for that geographical area should be described by the Climate Practitioner in order to identify possible climate vulnerabilities that may impact the project. Example sources and types of historic climate data that should be gathered at this stage include: • Climate Ireland's (2022) 'Climate Data Explorer' tool. This tool allows for the collection of observed climate data over a set baseline period (1981 to 2010) and provides information on average temperature, average precipitation, maximum temperature and minimum temperature. • The Global Facility for Disaster Reduction and Recovery's (GFDRR) (2020) 'Think Hazard' tool which provides a high-level understanding of the hazards present within a select location. Think Hazard provides information on flooding (including coastal, pluvial and fluvial), extreme heat, drought, wildfires and landslides. The Climate Practitioner should enter their project location and the tool will indicate if the user requires a high, medium or low awareness of the hazard. • Met Éireann's (Met Éireann, Major Weather Events, n.d) 'Major Weather Events' database, which provides a list of major weather events in Ireland including storms, heatwaves, droughts, windstorms, flood events. • A high-level and simplistic online search of different hazards in the project location should also be undertaken to provide additional climatic context at this stage of the project.
Summarise climate data
The above research will likely result in a mix of qualitative and quantitative climate data that should be presented by the Climate Practitioner in an easy-to-understand table as demonstrated in Appendix B.
Report results into Phase 1 Climate Assessment Report
The results of the actions above shall be reported by the Climate Practitioner into the output deliverable – the Phase 1 Climate Assessment Report.

3.4.3 Deliverables/Outputs

Table 3.8 Phase 1 Deliverables and Outputs

SD Deliverable for this Phase	Phase 1 Constraints Report
Other Project Deliverables this Phase Informs	• Project Execution Plan • Phase 1 Gate Review Statement • Constraints Report

The results of the Phase 1 climate assessment process should be reported into the Constraints Report. The Constraints Report must include:

- A description of likely GHG differences between proposed reasonable alternatives as identified through their likely distinguishable design features.
- A record of the GHG mitigation principles agreed between the Climate Practitioner and Design team.
- A record of the project location's climate vulnerabilities.

3.5 Phase 2: Options Selection

3.5.1 Objective:

Phase 2 is the Options Selection phase which aims to identify a Preferred Option through a structured, comparative appraisal of alternative options, or 'narrowing of options', to provide a best fit with the environment and other criteria. The process is split into three distinct stages within the PMG, each requiring a greater level of assessment and appraisal.

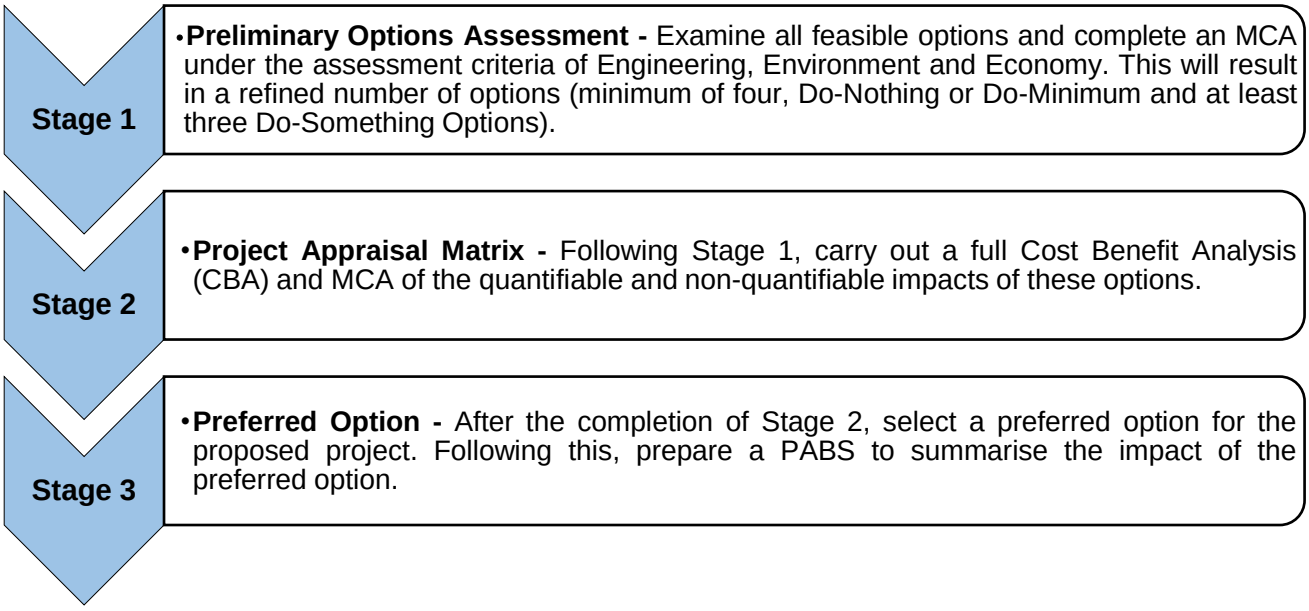


Figure 3.2 Stepped Approach detailed in the PAG

The MCA is an appraisal tool used during the Phase 2 Options Selection process to evaluate and rank project options against a set of criteria on the basis of a scoring procedure.

The following sub-sections provide further guidance on the climate work required for Phase 2 Options Selection Stages 1 to 3 whilst Table 3.9 provides the details of the climate assessment tasks associated with this phase.

Table 3.9 Phase 2 Climate Assessment details

Phase 2 Climate-specific Objectives	The Climate Practitioner will demonstrate that GHG effects and climate risk for each option are assessed as part of 'Environment' in the MCA
Assessment type	Qualitative (Stage 1), qualitative and quantitative (Stage 2 and 3)
Person(s) responsible	Climate Practitioner.
SD Deliverables for this Phase	Completed MCA for Climate (including GHG assessment and CCR assessment) as part of 'Environment' MCA
Other Deliverables this Phase informs	Options Appraisal Report Phase 2 Gate Review Statement Options Selection Report

3.6 Phase 2, Stage 1: Preliminary Options Assessment

The Stage 1 Preliminary Options Assessment in the Option Selection process is used to identify the nature and extent of significant constraints within a defined study area. These constraints will be documented and mapped so that feasible options can be designed to avoid such constraints, where possible. Data collection shall be based on desk-based research studies. This section describes the GHG assessment process, including providing a guide to scoring the effects and the deliverables that will result from this Stage 1. The purpose of the assessment will be to evaluate the climate impact of each option to inform the MCA.

3.6.1 Greenhouse Gas Assessment Process

Table 3.10 Phase 2, Stage 1 GHG Assessment Instructions

Phase 2, Stage 1 GHG Assessment Instructions
Define the study area and zone of influence
The Climate Practitioner shall define the study area and zone of influence for GHG Assessment: • Study area – is each design option and their associated GHG activities. • Zone of influence - Ireland's carbon budget (and relevant sectoral budget if applicable).
Note: For more background on Ireland's carbon budgets please refer to section 2.3 of the OTD.
Define the purpose and scope of the assessment
The Climate Practitioner shall define the purpose and scope of the assessment. • Purpose - to evaluate the amount of GHG emissions produced (as an estimate) by each option to inform the MCA. • Scope - will include each proposed option. It will include the GHG emission generating activities in Table 3.6, as well as additional activities described below.
Qualitatively identify GHG hot spots
At Phase 2, Stage 1 definitive quantitative route specific carbon data will not be available.

Phase 2, Stage 1 GHG Assessment Instructions
The Climate Practitioner's aim shall be to determine the key differences in carbon emissions for the Do Something scenarios, by identifying GHG 'hot spots' of the infrastructure's design, construction and operation activities qualitatively, these are described in the next step.
Update information and assess emissions
The Climate Practitioner shall review information from Phase 1. Using professional judgement, the following variables should also be assessed qualitatively by the Climate Practitioner for each route option: • Current road user emissions – This should be obtained from the project's Air Quality Practitioner. • Design attributes/features – The Climate Practitioner shall obtain this information from the project's team. Distinguishable design attributes that will have a bearing on GHG emissions include: o Number of junctions o Number of roundabouts o Bridges, overpasses, underpasses etc., o Embankments o Cut and fill balance - earthworks may have a significant impact. A project that is built on level ground (at grade) will require fewer embankments/cuttings. o Culverts o Number of ancillary requirements e.g. services/tolls
Describe potential GHG impacts and identify differences
Using their professional judgement, the Climate Practitioner shall describe the potential GHG impacts of the options and identify any differences between the options. The Climate Practitioner can use for example a Red Amber Green (RAG) rating to assist with this.
Describe applicable mitigation measures
Using Figure 3.1, and by working with the Design Team, the Climate Practitioner shall describe applicable mitigation measures for each option based on available data and professional judgement.
Complete the Stage 1 MCA
The Climate Practitioner shall use the PMG Unit 7.0 Seven Point Scoring Scale to score each option and measure it in terms of its impact. The potential GHG impact of an option is used to determine whether it will result in a positive, neutral or negative outcome. Table 3.11 should be followed to assign a score to each option. Complete the Stage 1 MCA for each option with the assigned score and qualitative comments added.
Note: Appendix C includes an example of how to present this information when undertaking the scoring process.

Identifying the impact at Phase 2, Stage 1 - PMG Unit 7.0 Seven Point Scoring Scale
For the MCA, the PAG Unit 7.0 document sets out a seven-point scale to rate each option. A score of 1 or 7 would signify that the potential effects from an option would be significant. A score of 7 would indicate a positive outcome, while a score of 1 would indicate a negative outcome. If a score of 1 is assigned to an option, then it would be considered problematic and further work to consider whether the potential effects could be mitigated should be undertaken. Whether each option meets the project objectives should also be considered.

Table 3.11 Greenhouse Gas Assessment Scoring Guide

Seven Point Scale	Phase 2, Stage 1: GHG impact (qualitative)
7 – Major or highly positive	Based on professional judgement the option would result in a potentially significantly positive improvement, providing a GHG reduction overall and positively contributing to Ireland's net zero trajectory. Mitigation measures are in place well beyond policy requirements.
6 – Moderately positive	Based on professional judgement it is anticipated that the option would not result in a potentially significant positive improvement. However, the option has the potential to provide a moderate GHG reduction and will align with Ireland's net zero trajectory. Some mitigation measures are in place.
5 – Minor or slightly positive	Based on professional judgement it is anticipated that the option would not result in a potentially significant positive improvement. However, the option has the potential to provide a small GHG reduction and will align with Ireland's net zero trajectory. Some mitigation measures are in place.
4 – Not significant or neutral	Based on professional judgement it is anticipated that the option will align with Ireland's net zero trajectory. No mitigation measures are in place.
3 – Minor or slightly negative	Based on professional judgement it is anticipated that the option has mitigation measures in place way beyond policy requirements, but it is likely that the project will produce some carbon emissions and fall short of Ireland's net zero trajectory.
2 – Moderately negative	Based on professional judgement it is anticipated that the option has some mitigation measures in place, but it is likely that the project will produce carbon emissions and fall short of Ireland's net zero trajectory.
1 – Major or highly negative	Based on professional judgement it is anticipated that the option has no mitigation measures in place, and it is likely that the project will produce carbon emissions and fall short of Ireland's net zero trajectory. Mitigation would be required for an option to progress.

3.6.2 Climate Change Risk Assessment Process

It anticipated that options are unlikely to differ significantly in terms of location, and so a proportionate approach should be taken to identify options where there are key differences in climatic conditions and receptors.

This Section provides instructions for the tasks to be undertaken at this stage for the CCR Assessment, providing examples of sensitivity testing, exposure and vulnerability testing, using a standardised scoring system. The process for Stage 1 is as follows:

Table 3.12 Phase 2, Stage 1, Climate Change Risk Assessment Instructions

Phase 2, Stage 1 CCR Assessment Instructions
Define the study area and zone of influence
The Climate Practitioner shall define the study area and zone of influence for the project. Using their professional judgement this will include the climate impacts on the proposed project and, through liaison with other environmental disciplines, the in-combination impacts as defined by the relevant discipline.
Define the purpose and scope
The Climate Practitioner shall define the purpose and scope of the assessment: • Purpose - to assess the vulnerability of each option to climate to inform the MCA. • Scope - will include each proposed option and the surrounding environment including any land or water bodies they traverse.

Undertake the Climate Screening

Using the historic data gathered under Phase 1 the Climate Practitioner shall undertake the climate screening. This involves an analysis of sensitivity and exposure of the project to climate which together provide a measure of vulnerability.

Undertake the Sensitivity Analysis

In undertake a sensitivity analysis the Climate Practitioner shall confirm the asset categories and climate hazards to be considered in the climate screening. The list of asset categories and climate hazards that shall be used for TII projects include:

- *Asset categories* - Pavements; drainage; structures; utilities; landscaping; signs, light posts, associated auxiliary buildings, and fences.
- *Climate hazards* - Flooding (coastal); flooding (pluvial); flooding (fluvial); extreme heat; extreme cold; wildfire; drought; extreme wind; lightning and hail; fog. Discretion should be left to the Climate Practitioner as to if any additional climate hazards are to be considered.

The Climate Practitioner shall determine the sensitivity (low, medium, or high) of each asset category to each of the climate hazards by assigning a sensitivity score of 1 to 3. Table 3.13 provides the definitions and scoring that should be used when assessing sensitivity whilst Table 3.14 provides a worked example of the sensitivity analysis.

Table 3.13 Sensitivity definition and scoring

Sensitivity level	Definition	Scoring
High sensitivity:	The climate hazard will or is likely to have a major impact on the asset category.	3
Medium sensitivity:	It is possible or likely the climate hazard will have a moderate impact on the asset category.	2
Low sensitivity:	It is possible the climate hazard will have a low or negligible impact on the asset category.	1

Table 3.14 Example Sensitivity Analysis

Example Climate Hazards	Flooding (coastal)	Flooding (pluvial)	Flooding (fluvial)	Extreme heat	Extreme cold	Wildfire	Drought	Extreme wind	Lightning & hail	Landslides	Fog
Pavements	2	2	2	2	2	2	1	1	1	1	1
Utilities	3	3	3	3	2	3	1	2	2	1	1

Undertake the Exposure Analysis

Using the climate data collected during Phase 1, the Climate Practitioner shall assess the level of exposure for each climate hazard at the project location. Table 3.15 provides the definitions and scoring that should be used when assessing exposure whilst Table 3.16 provides a worked example of the exposure analysis.

Table 3.15 Exposure definition and scoring

Sensitivity level	Definition	Scoring
High exposure:	It is almost certain or likely this climate hazard will occur at the project location i.e. might arise once to several times per year.	3
Medium exposure:	It is possible this climate hazard will occur at the project location i.e. might arise a number of times in a decade.	2
Low exposure:	It is unlikely or rare this climate hazard will occur at the project location i.e. might arise a number of times in a generation or in a lifetime.	1

Table 3.16 Example Exposure Analysis

Climate Hazard	Flooding (coastal)	Flooding (pluvial)	Flooding (fluvial)	Extreme heat	Extreme cold	Wildfire	Drought	Extreme wind	Lightning & hail	Landslides	Fog
Exposure at project location	3	3	2	2	2	2	1	2	2	1	2

Assess the vulnerability
To undertake the vulnerability assessment, the Climate Practitioner shall take the product of sensitivity and exposure, for each climate hazard and each asset category identified. Table 3.17 provides an example of the vulnerability matrix whilst Table 3.18 provides an example of the vulnerability assessment using the example sensitivity and exposure analyses in Table 3.14 and Table 3.16 above.

Table 3.17 Vulnerability matrix

		Exposure		
		Low (1)	**Medium (2)**	**High (3)**
Sensitivity	**Low (1)**	1	2	3
	Medium (2)	2	4	6
	High (3)	3	6	9

Vulnerability key

	Low
	Medium
	High

Table 3.18 Example Vulnerability Analysis

Climate Hazard	Flooding (coastal)		Flooding (pluvial)		Flooding (fluvial)		Extreme heat		Extreme cold		Wildfire		Drought		Extreme wind		Lightning & hail		Landslides		Fog	
	Sensitivity	Exposure	Sensitivity	Exposure	Sensitivity	Exposure	Sensitivity	Exposure	Sensitivity	Exposure	Sensitivity	Exposure	Sensitivity	Exposure	Sensitivity	Exposure	Sensitivity	Exposure	Sensitivity	Exposure	Sensitivity	Exposure
Pavements	2	3	2	3	2	2	2	2	2	2	2	2	1	1	1	2	1	2	1	1	1	2
Vulnerability	6		6		4		4		4		4		1		2		2		1		2	
Utilities	3	3	3	3	3	2	3	2	2	2	3	2	1	1	2	2	2	2	1	1	1	2
Vulnerability	9		9		6		6		4		6		1		4		4		1		2	
Asset category																						
Vulnerability																						

Complete the Stage 1 MCA
The Climate Practitioner must use the PMG Unit 7.0 Seven Point Scoring Scale to score each option and measure it in terms of its impact. The potential GHG impact of an option is used to determine whether it will result in a positive, neutral or negative outcome. Table 3.19 should be followed to assign a score to each option. Complete the Stage 1 MCA for each option with the assigned score and qualitative comments added.
Note: *Appendix D includes an example of how to present this information when undertaking the scoring process.*

Table 3.19 CCR Assessment Seven Point Scoring

Seven Point Scale	
7 – Major or highly positive	Based on the vulnerability assessment undertaken for the project, the option has only low vulnerabilities to climate change risk across all climate hazards.
6 – Moderately positive	Based on the vulnerability assessment undertaken for the project, the option has primarily low vulnerability to climate change risk, with medium vulnerability for one climate hazard.
5 – Minor or slightly positive	Based on the vulnerability assessment undertaken for the project, the option has primarily low vulnerability to climate change risk, with medium vulnerability across up to three climate hazards.
4 – Not significant or neutral	Based on the vulnerability assessment undertaken for the project, the option has only low and medium vulnerabilities to climate change risk across all hazards.
3 – Minor or slightly negative	Based on the vulnerability assessment undertaken for the project, the option has high vulnerability to climate change risk for one climate hazard.
2 – Moderately negative	Based on the vulnerability assessment undertaken for the project, the option has high vulnerability to climate change risk across more than one climate hazard.
1 – Major or highly negative	Based on the vulnerability assessment undertaken for the project, the option has high vulnerability to climate change risk across three or more climate hazards.

3.6.3 Phase 2, Stage 1 Deliverables/Outputs:

From Phase 2 onwards, the climate assessment outputs must be acknowledged by the Project Manager and receipt of this recorded by the Climate Practitioner, these are shown in Table 3.20.

Table 3.20 Phase 2, Stage 1 Deliverables and Outputs

SD Deliverable for this Phase	N/A
Other Deliverables this Phase Informs	Whilst not formal deliverables, the outputs of this stage are as follows: • Climate screening, including an assessment of climate sensitivity, exposure and vulnerability. • A qualitative analysis of GHG emitting 'hot spot' activities across design, construction and operation, for each option. The results of the GHG assessment and CCR assessment process for Stage 1 will be used to inform the Stage 1 comparative ranking (MCA) and PAG and PMG deliverables at Stage 2 and 3.

3.7 Phase 2, Stage 2: Project Appraisal Matrix

Following an examination of the Stage 1 Preliminary Options Assessment of the Option Selection process, option selection continues. The Design Team develops feasible options which will be assessed in accordance with the Project Appraisal Matrix.

Phase 2, Stage 2 is a more detailed or refined options selection process, based on a reduced number of selected options. This may include options from Stage 1 but may also include amended or new options as a result of design refinement during the Stage 2 process.

This section sets out instructions for the Greenhouse Gas Assessment and the Climate Change risk assessment at Stage 2.

To provide a consistent approach to GHG assessment TII have developed two carbon accounting tools. **Please note that in order to get access to the REM and Carbon Tools, prospective users should email climatetools@tii.ie to be set up as an authorised user on the TII Web Application Portal.**

The Climate Practitioner shall use the TII Carbon Tool for the calculation of emissions arising from the construction and maintenance of a proposed project.

The Carbon Tool aligns with TII's project phases as well as (PAS) 2080 Carbon Management in Construction (BSI, 2016). The tool includes an emission factors library using factors developed by relevant industry bodies including:

- Institution of Civil Engineers (2013), CESMM4 Carbon & Price Book 2013
- Sustainable Energy Authority of Ireland (2017), Conversion Factors
- European Commission (2010) Guidelines for the calculation of land carbon stocks
- Environment Agency, Carbon Calculator for Construction Activities (Version 3.6)
- UK Government (2021), Greenhouse Gas Reporting Conversion Factors

The outputs from the tool allow Climate Practitioners to compare and evaluate the lifecycle carbon impacts of multiple design options for any given national road project.

Data from the TII REM Tool should be obtained from an Air Quality Practitioner to inform road user emissions during operation. The TII REM Tool is a scalable and user-editable emissions calculation tool. The tool focuses on road emissions and, in particular, the National Road Network (NRN).

It also considers how emissions may change over time on the NRN due to anticipated traffic growth and national policies and provide analysis how interventions on the NRN (e.g. speed limit changes) will affect emissions. The tool uses a link-by-link based emission calculation approach and detailed fleet predictions for age, fuel technology, engine size and weight it also enables the user to gain additional insights to inform on possible interventions for different scenarios. The carbon emissions data calculated from the TII REM Tool are output using common nomenclature (i.e. tCO_2e), and so ensures compatibility with associated industry tools. Importantly, data from the TII REM Tool can be inputted into the TII Carbon Assessment Tool.

The combined outputs from the two tools provide the lifecycle emissions for a project.

3.7.1 Greenhouse Gas Assessment Process

Table 3.21 Phase 2, Stage 2 GHG Assessment Instructions

Phase 2, Stage 2 Greenhouse Gas Assessment Instructions
Quantify available GHG data
There is likely to be limited quantitative data for each of the route options at Phase 2, Stage 2. - Where possible, available quantitative variables must be inputted into the TII Carbon Assessment Tool by the Climate Practitioner. The Climate Practitioner shall include major sources of GHGs (in addition to those identified in earlier phases) including but not limited to: Cut and fill balance. Main materials for construction – these include pavement, earthworks, concrete, and steel. Road user emissions – data for road user emissions for the proposed options should be obtained from the Air Quality Practitioner.
Note: Transport Infrastructure Ireland Carbon Tool for Road and Light Rail Projects: Guidance provides step by step instructions on how to use the Carbon Tool.
Qualitative assessment (where quantitative data not available)
Where data is not available, a qualitative assessment shall be provided by the Climate Practitioner. The key sources of emissions should be described by the Climate Practitioner, with reference to where key emissions sources appear on similar projects.
Discuss/update mitigation measures
The Climate Practitioner shall discuss/update mitigation measures with the Design Team based on available data. To enable alignment with Ireland's net zero trajectory, mitigation measures should be considered in line with the mitigation hierarchy with reduction impacts quantified where possible (refer to Figure 3.1, section 3.4.1).
Rank options
The options shall be ranked from lowest to highest carbon impact in terms of tCO_2e and split via lifecycle stage, with any GHG emissions unable to be quantified, ranked via Red Amber Green (RAG) rating.
Update MCA GHG assessment scoring
Based on the steps followed, re-score each option using the MCA criteria in Table 3.11.
Note: For more background on the GHG lifecycle stages, please refer to Section 6.2 of the OTD. Appendix D includes an example of how to present this information.

3.7.2 Climate Change Risk Assessment Process

Table 3.22 Phase 2, Stage 2, CCR Assessment instructions

Phase 2, Stage 2 CCR Assessment Instructions
Update climate screening
The Climate Practitioner shall update the climate screening using the methodology in Section 3.6.2 based on any additional data available e.g. refinements in location or key features of route alignment.
Update MCA CCR Assessment scoring
The scoring of each option shall be updated by the Climate Practitioner using the MCA criteria in Table 3.19.

3.7.3 Phase 2, Stage 2 Climate Assessment Deliverables and Outputs:

The climate assessment Phase 2, Stage 2 deliverables/outputs are shown in Table 3.23 below:

Table 3.23 Phase 2, Stage 2 Deliverables and outputs

SD Deliverable for this Phase, Stage 2	N/A
Other Deliverables this Phase Informs	The results of the GHG assessment and CCR assessment process will be used to update the Stage 2 comparative ranking (MCA) and PAG and PMG deliverables at Stage 3.

3.8 Phase 2, Stage 3: Selection of Preferred Option

The purpose of Stage 3 is to select the preferred option and to outline the likely environmental effects, including climate effects. After the completion of Stage 2 (Project Appraisal Matrix), a preferred option for the project will emerge and be selected based on the MCA.

Further project detail may or may not be available for the preferred option. Where new information is available, the assessment shall be updated, and any additional detail should be reflected in the Stage 3 report. Stage 3 will provide a summary climate assessment of the Preferred Option for inclusion as a chapter in the Options Assessment Report. Table 3.24 provides the details of the climate assessment deliverables associated with Phase 2, Stage 3.

3.8.1 Phase 2, Stage 3 Climate Assessment Deliverables:

Table 3.24 Phase 2, Stage 3 Deliverables and Outputs

SD Deliverable for this Phase	Completed MCA for Climate as part of the wider 'Environment' MCA (including GHG assessment and CCR assessment).
Other Deliverables this Phase Informs	Options Appraisal Report. Phase 2 Gate Review Statement.

3.9 Phase 3 – Design and Environmental Evaluation

At Phase 3, a single project option will be developed in more detail. This phase of project delivery allows for the iterative design and environmental assessment of the project.

Significant detail will emerge through this iterative design and assessment phase of the project, and it is critical that the Climate Practitioner is kept abreast of design evolution by closely working with the Project Manager, Design Team and other environmental disciplines. This detail will address construction and operation stages as well as the detailed design of all aspects of the project. Phasing of construction may also be a relevant consideration.

As the design and environmental assessments progress, the detail of proposed mitigation measures for all environmental factors assessed, will also evolve. All of this detail must be reflected and assessed in the climate assessment where it is relevant to the determination of likely significant effects.

Table 3.25 provides the details of the climate assessment tasks associated with Phase 3.

Table 3.25 Phase 3 Climate Assessment details

Phase 3 Climate-specific Objectives	To produce a climate assessment that can be submitted as evidence as part of a project's planning application in adherence with EIA requirements.
Assessment type	Quantitative.
Person(s) responsible	Climate Practitioner.
Standard Document Deliverables for this Phase	Climate Chapter (as part of EIAR) / Standalone Climate Report / Project specific environmental report.
Other Deliverables this Phase Informs	The Climate Practitioner shall consult with the Project Manager and share the reported outputs so that the necessary mitigation and adaptation measures are taken forward for deliverables in Phases 5 to 7.

3.9.1 Greenhouse Gas Assessment Process

The GHG process for Phase 3 is summarised in Table 3.26, including investigating GHG reduction opportunities, clearly defining the scope and boundary of the assessment and the collection of necessary data to complete this Phase 3 assessment.

Table 3.26 Phase 3 Greenhouse Gas instructions

Phase 3 Greenhouse Gas Assessment Instructions
Investigate GHG reduction opportunities
Opportunities to reduce GHG emissions shall be investigated. Engagement shall take place between the Climate Practitioner, Project Manager, Design Team and environmental disciplines at the start of the phase and throughout the design development. This engagement activity will include the application of the mitigation hierarchy (Figure 3.1) to the project with discussion and identification of mitigation measures for the project.
Define the scope and boundary of the assessment
The Climate Practitioner shall define the scope and boundary of the GHG assessment based on the Publicly Available Statement (PAS) 2080 Carbon Management in Infrastructure approach. Define the temporal boundary - this should be based on the anticipated construction period and operational design life of the project being assessed; the Climate Practitioner should provide justification for its duration. A national road development typically has a 60-year design life.

Phase 3 Greenhouse Gas Assessment Instructions

Collect project data

The Climate Practitioner shall collect data for the assessment by liaising with the Project Manager, contractor and Design Team. The types of data that should be collected at project Phase 3 are shown in Table 3.27. A review of the data quality should take place and the Climate Practitioner shall discuss any data gaps or limitations with the Project Manager and relevant discipline/team. Any assumptions, uncertainties and limitations of the data should be described in the assessment.

Table 3.27 Data Types for Assessment of GHG Emissions

Lifecycle Stage	Type of data	Likely sources
Before Use / Construction	Information that defines and describes the size, magnitude, and physical nature of the proposed project. Project value for construction phase.	Project description
	Land use change – size of the area, existing and future by type of land use.	Biodiversity / Ecology consultant
	Construction material quantities.	Bill of Quantities
	Construction works techniques/technologies, volume of fuel/ electricity consumed during advanced works and construction.	Contractor/Design Team
	Transportation distances and modes for construction workers and construction materials. Number of construction workers and their mode of transport to site.	Contractor / Design Team
	Waste generation during construction and - quantity of waste and disposal method, distance to the waste facility.	Contractor/ Design Team
	Energy and water demand during construction.	Contractor / Design Team
Use	Road user emissions.	Air Quality Practitioner via the TII REM Tool.
	Maintenance activities.	Design Team
	Energy demand.	Design Team

Establish the Baseline and Do Minimum Scenarios

The Climate Practitioner shall establish the current (baseline) and future ('Do Minimum' (DM)) emissions scenario(s). The Climate Practitioner must use the TII Carbon Tool to calculate all emissions for construction, operation and maintenance. The Air Quality Practitioners should use the REM tool for road user emissions. Using their professional judgement, the Climate Practitioner should refer to national policy in relation to future grid emissions decarbonisation. Where it is not reasonably possible to calculate emissions from an existing site then a zero emissions baseline shall be assumed as a worst case for construction emissions. Climate Practitioners should calculate emissions using the method shown in Table 3.28, which separates emissions into current and future categories.

As a minimum, the following DM vs 'Do Something' (DS) (see below) scenarios should be presented for road user carbon:

- Year of opening – the year which the project opens;
- Design year – 15 years after opening; and
- 2050 Horizon.

Note: *For further background on Baseline, DM and DS scenarios please refer to the Section 6.4 of the Climate OTD.*

Table 3.28 Current and Future Emissions

Emissions	Description
Current (Baseline)	Represents the existing GHG emissions from within the boundary of the proposed study area, this may include calculating emissions from existing structures (e.g., energy consumption from a building which is scheduled for refurbishment, demolition or replacement) and existing infrastructure.
Future (DM)	Is developed using the current baseline and projections of the future situation without the proposed project. The future baseline should reflect changes as a result of other factors and projects in proximity to the project area, subject to what is included in the TII REM Tool e.g., increased efficiency in vehicles, grid decarbonisation due to the increase in energy generated from renewable sources.

Update baseline (where data available)
Where data is available, the Climate Practitioner should reflect changes in the DM scenario as a result of known policy changes e.g. grid decarbonisation.
Calculate the GHG emissions from the proposed project
A 'Do-Something' (DS) emissions scenario i.e. where the project is built and operated, shall be calculated by the Climate Practitioner, the TII Carbon Tool must be used to calculate emissions from construction and operation, and the TII REM Tool should be used by an Air Quality Practitioner to calculate emissions from road users. The combined outputs provide the lifecycle GHG emissions. The Climate Practitioner should present outputs from the TII Carbon Tool and TII REM Tool in accordance with the PAS2080 lifecycle modules.
Identify mitigation measures
The Climate Practitioner shall work with the Design Team, Project Manager, and environmental disciplines to review and identify mitigation measures across the project lifecycle. Within the assessment report, the Climate Practitioner shall describe where implementation of mitigation measures will take place and how they will be secured. The DS emissions scenario should be updated by the Climate Practitioner to include embedded mitigation measures where they are quantifiable.
Include mitigation measures in the EIAR
The Climate Practitioner shall include agreed mitigation measures and any associated securing mechanisms such as a CEMP) within the GHG assessment and referenced within the EIAR. Where data is not available, a qualitative description of the potential impact of mitigation measures shall be provided by the Climate Practitioner.
Assess the significance
The Climate Practitioner shall assess the extent to which GHG emissions over the life of the project aligns with Ireland's GHG trajectory to net zero by 2050. This shall be done by considering the estimated emissions of the life of the project against Ireland's trajectory to net zero. An example of this is shown in Figure 3.2.

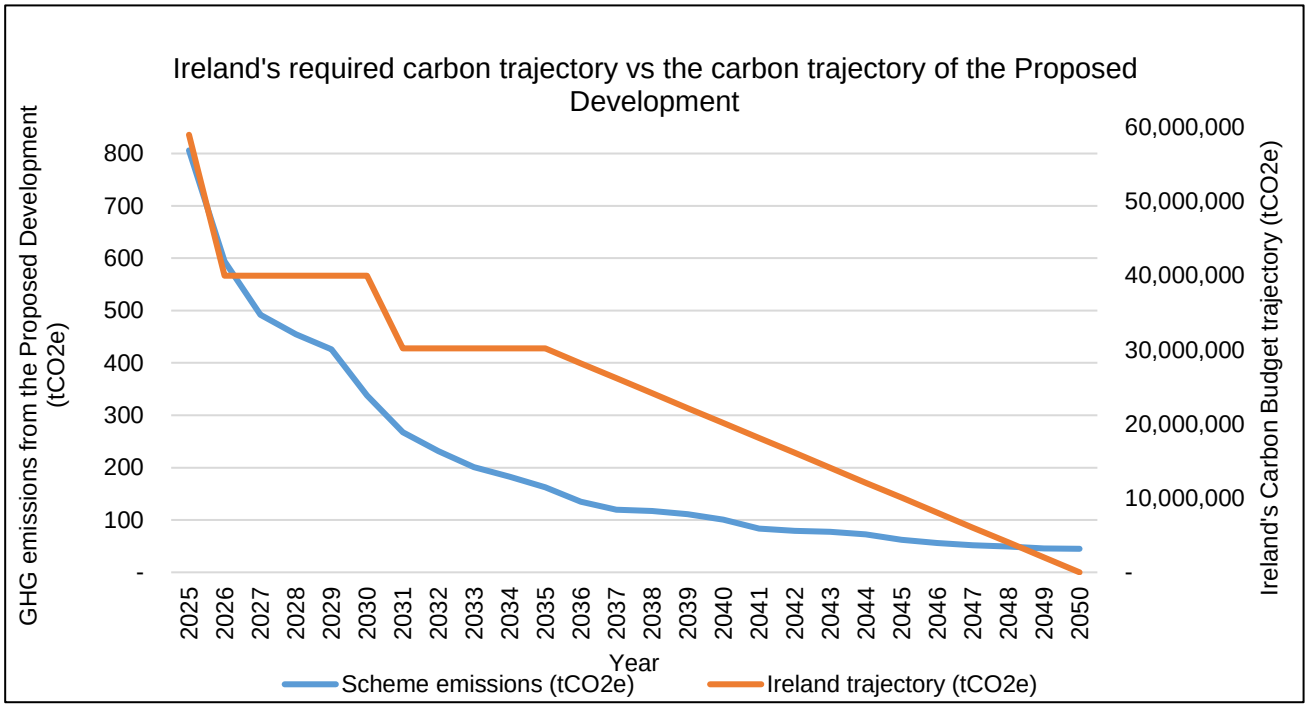


Figure 3.3 Projected Carbon Emissions

Assess the Significance
The project's GHG emission trajectory and the extent to which it aligns with Ireland's net zero trajectory should be described by the Climate Practitioner within the assessment, any dependencies (e.g. grid decarbonisation) on the Project's trajectory should also be described, as should the level of mitigation taking place in terms of both the mitigation measures taking place and the quantifiable impact of said measures where practicable.
Alignment to Ireland's carbon budget trajectory and level of mitigation
Based on the project's alignment to Ireland's carbon budget trajectory and level of mitigation taking place, the Climate Practitioner will use the matrix shown in Table 3.29 to assess the significance of GHG emissions arising as a result of the project, a minimum of one bullet must be met in order to justify the level of significance for the proposed project.

Table 3.29 Significance Matrix

Effects	Significance level	Description
Significant adverse	Major adverse	• The project's GHG impacts are not mitigated; • The project has not complied with do-minimum standards set through regulation, nor provide reductions required by local or national policies; and • No meaningful absolute contribution to Ireland's trajectory towards net zero.
	Moderate adverse	• The project's GHG impacts are partially mitigated; • The project has partially complied with do-minimum standards set through regulation, and have not fully complied with local or national policies; and • Falls short of full contribution to Ireland's trajectory towards net zero.
Not significant	Minor adverse	• The project's GHG impacts are mitigated through 'good practice' measures;

Effects	Significance level	Description
		• The project has complied with existing and emerging policy requirements; and • Fully in line to achieve Ireland's trajectory towards net zero.
	Negligible	• The project's GHG impacts are mitigated beyond design standards; • The project has gone well beyond existing and emerging policy requirements; and • Well 'ahead of the curve' for Ireland's trajectory towards net zero.
Beneficial	Beneficial	• The project's net GHG impacts are below zero and it causes a reduction in atmosphere GHG concentration; • The project has gone well beyond existing and emerging policy requirements; and • Well 'ahead of the curve' for Ireland's trajectory towards net zero, provides a positive climate impact.

Contextualise the magnitude

Depending on the year in which the Project's emissions are expected to occur, Ireland's carbon budgets can also be used to contextualise the magnitude of GHG emissions from the project, an example of how to present this is shown in Table 3.30**.**

Table 3.30 This Project in the Context of Ireland's Carbon Budget

Carbon budget period	Lifecycle Stage	Carbon budget (tCO_2e)	Proposed Development GHG emissions (tCO_2e)	Percentage of carbon budget emissions
1st Carbon Budget (2021 to 2025)	Construction & Operation	295,000,000	10,000	0.0274%
2nd Carbon Budget (2026 to 2030)	Operation	200,000,000	3,000	0.0012%
3rd Carbon Budget (2031 to 2035)	Operation	151,000,000	1,500	0.0007%

Assess the Cumulative Impact

As GHG emissions are inherently cumulative, the Climate Practitioner shall demonstrate the cumulative impact for the assessment via the project's alignment to any sectoral carbon budgets and Ireland's 2050 net zero target. The Climate Practitioner shall present this information in an easy-to-read visual format and provide written explanation of the results.

Note: *For further background on the cumulative impact of GHG emissions, please refer to section 6.8 of the Climate OTD.*

3.9.2 Climate Change Risk Assessment Process

Table 3.31 Phase 3 CCR Assessment instructions

Phase 3 CCR Assessment Instructions
Establish scope and boundaries
The Climate Practitioner shall define the scope and boundary of the assessment. In the context of the CCR assessment, this includes: The Climate • Spatial boundary - this will include the project boundary and the surrounding environmental boundaries as defined by the relevant discipline e.g. The impact boundary associated with noise may differ to the groundwater discipline's impact boundary. • Temporal boundary - the project lifespan (including the design life of its components). In the context of TII projects, the temporal lifespan of a project is considered to be 60 years. Both the construction and operation phases of the project should be considered in the assessment. • Climate hazard -the climate screening undertaken as a part of Phase 2 shall inform the climate hazards considered in the detailed CCR assessment. That is, any climate hazards with vulnerabilities marked as medium and high should be included in this detailed climate change risk assessment. The hazards deemed relevant for this assessment, shall inform the climate variables for which data should be collected (refer 0 for a long list of climate variables). For example, if the asset was assessed as having high or medium vulnerability to extreme temperatures then according to 0, data should be collected for the following climate variables: o Mean annual maximum daily temperature (°C) o Mean annual minimum daily temperature (°C) o Mean summer maximum daily temperature (°C) o Mean winter minimum daily temperature (°C) o Average temperature during the warmest month (°C) o Average temperature during the coolest month (°C) o Days per annum under 0 (°C) (days) o Heatwaves (no.) • Project receptors: The asset categories considered in the climate screening shall form the key project receptors in this assessment as well as any critical connecting infrastructure and significant parts of the surrounding environment as defined by the relevant environmental discipline e.g. water bodies that should be considered as a part of the indirect, cumulative and in-combination impact assessment. For more detail on indirect and cumulative impacts refer to the instructions below on 'Identify indirect and cumulative risks'. *Note: Section 7.2 of the OTD provides further guidance on what should inform the scope and boundary of the assessment.*
Gather climate data
Having defined the scope and boundary of the assessment, the next step for the Climate Practitioner is to gather the climate data. This includes defining the climate baseline using historic climate conditions and gathering climate change projection data to understand future climate conditions.
Define the climate baseline
The climate baseline is based on historic climate data collected for a selection of climate variables across a specified time period. This period should encompass the baseline period upon which the selected climate change projections are based. To establish an accurate and consistent baseline, the Climate Practitioner shall:

Phase 3 CCR Assessment Instructions

- Collect historical climate data from Met Éireann for the chosen baseline period (Met Éireann, Historical Data, n.d). In most cases, the climate change projections available for Ireland will be from Climate Ireland's database, which use 1981 to 2000 as their baseline period. Data should be collected from the closest weather station with the largest availability of data. It is acknowledged that for some locations data is unavailable; in such cases, any proxy data used should be identified and justified.
- Identify historic extreme climate events that have occurred at or nearby the project location to provide insight on past vulnerability. This is important, as it is not uncommon to describe the existing baseline using historical climatic trends which may not properly account for extreme events. Examples of such events include cold snaps, storms, drought, wildfires and floods. Useful sources in the identification of past extreme events include Office of Public Works – Flood Maps (Office of Public Works, n.d)[2], Met Éireann website – Major Weather Events (Met Éireann, n.d.) and reports from Local Authorities.

Gather climate change projection data

The following steps should be followed by the Climate Practitioner when selecting climate change projections:

- Define the GHG Scenario: Given the inherent uncertainty surrounding climate change projections, a moderate and high emissions scenario shall be adopted. This provides decision-makers with a more holistic understanding of the range of potential climate futures possible, which is essential when understanding risk and developing appropriate adaptation measures. Climate Ireland provides data for Representative Concentration Pathways (RCP) scenarios 4.5 (moderate) and 8.5 (high), which are appropriate to adopt for this assessment.[3]
- Define the Time frame: It is preferable to consider several time frames to inform the change in risk over time. The Practitioner should use their professional judgement, to consider a range of time slices to reflect the varying design life and maintenance cycles of individual assets which make up the infrastructure project. Currently, Climate Ireland's data explorer tool only provides one time period of 2041 – 2060, multiple time frames should be selected if later versions of the tool enable this.
- Selection of Climate data: The climate change data should be current, authoritative, and credible to enable a robust and accurate estimation of risk. As climate change projections are updated when new climate change information becomes available, the data sources should be reviewed on a regular basis to ensure the most up-to-date sources are used. The data used and the justification for determining its relevance should be noted in the assessment. An example of a credible data source in Ireland is Climate Ireland (Climate Ireland, Climate Data Explorer, 2022) which provides readily available climate change projections for a wide range of climate variables across multiple GHG emission scenarios.[4]
- Scenario Probability: The probability levels of climate projections should also be determined for the CCR Assessment. Where available, the 50% probability scenario should be presented alongside the 10th and 90th percentiles to demonstrate the range in projections.

[2] The Office of Public Works' national flood information portal provides access to historical and projected maps of flood extents and plans for Ireland. This map and plan viewer website is an important resource, to support planning, emergency response planning, and to empower people and communities to respond to flood risk.
[3] The Intergovernmental Panel on Climate Change's (IPCC) Fifth Assessment Report developed Representative Concentration Pathways (RCPs) to describe different 21st century pathways of GHG emissions depending on the level of climate mitigation action undertaken. Refer glossary for more detail.
[4] Climate Practitioners should be aware of the Met Éireann research project 'TRANSLATE', which is aimed at standardising national climate projections for Ireland and is due to finish in early 2023.

Phase 3 CCR Assessment Instructions

Identify climate change risks

Develop climate risk statements

The climate data gathered by the Climate Practitioner should be used to identify climate-related risks to the project. The aim of this step is to generate a comprehensive list of risks based on the climate change hazards that have been deemed relevant to the project type and location.

Risks should be associated with a specified climate variable and the project receptors for each risk should be stated by the Climate Practitioner. Risk statements should link a climate-related cause to a project-related effect. For each risk, existing or planned controls should be noted by the Climate Practitioner. In this instance, existing or planned controls represent business-as-usual measures that are typically included in the design and operation of a TII project that work to mitigate the climate risk.

Generate a risk register

The Climate Practitioner shall generate a risk register to document the risk assessment process. Table 3.32 provides an example risk register to document the outcomes of the risk identification process. For a complete climate change risk register template refer to Appendix G.

Table 3.32 Example Risk Register

Risk ID	Climate variable	Risk statement	Project receptors	Existing/ planned controls
1	Extreme rainfall	Extreme rainfall results in the overflow of drainage systems causing flooding of the road.	Drainage system, pavements.	Drainage infrastructure designed to account for 1% AEP flood event.
2	Extreme heat	Extreme heat affects pavement durability, causing cracking or damage resulting in reduced reliability and design life.	Pavements.	Pavement design inherently allows for extreme temperatures.

Identify indirect, in-combination and cumulative risks

In addition to direct physical risks to the infrastructure asset, consideration should also be given to indirect, in-combination and cumulative risks. Examples of these risks are listed below:

- *Indirect risk example:* flooding of connected transport routes impacts the operation of the asset in question in that it can cause increased travel time and inconveniences for road users.
- *Cumulative risk example:* If other transport infrastructure is being constructed nearby and operation is interrupted by a climate impact, this could have a knock-on impact on the proposed national road scheme.
- *In-Combination risk example:* climate change exacerbates the noise impacts of the project as extreme heat days may force occupants of nearby households to open their windows

Validate risks

The Climate Practitioner must validate the outputs of this stage with the subject matter experts e.g. the Design Team and environmental specialists so that the risks are realistic to the project. More detail is provided below on consultation throughout the risk assessment process.

Assess climate change risks

For each climate change risk identified, a risk assessment should be undertaken by the Climate Practitioner. This involves an assessment of likelihood and consequence, which results in a risk rating and an evaluation of significance. The risk assessment process should include an **initial** and **residual** risk rating. The initial risk rating takes into consideration the existing or planned controls, whilst the residual risk rating takes into consideration the proposed adaptation measures.

Select a risk framework
In order to undertake the risk assessment, the Climate Practitioner must adopt an appropriate risk framework. If available, to enable consistency, a project or client specific risk framework should be used for the assessment of climate risk, if the climate practitioner deems this appropriate. If there isn't an appropriate risk framework, the Climate Practitioner must use the EU Technical Guidance (2021) framework, the likelihood and consequence descriptors and the risk matrix associated with this are presented in Appendix F.
Determine the likelihood
Using the risk framework adopted and the climate change data collected, the Climate Practitioner shall determine the likelihood of each risk identified for each climate scenario considered. Likelihood refers to how likely the identified climate risk is to occur within a given timescale. The likelihood associated with the initial risk rating should take into account, the existing or planned controls, whilst the likelihood associated with the residual risk rating should also take into consideration the adaptation measures identified.
Determine the consequence
Using the risk framework adopted and the climate change data collected, the Climate Practitioner shall determine the consequence of each risk identified for each climate scenario considered. Consequence refers to the severity or magnitude of the impact associated with the climate risk, should it eventuate. As with likelihood, it should be determined for each of the climate change scenarios considered for both the initial and residual risk rating. The consequence associated with the initial risk rating should take into account the existing or planned controls, whilst the consequence associated with the residual risk rating should also take into consideration the adaptation measures identified. The Climate Practitioner should consider multiple categories of consequence including (but not limited to): asset damage / engineering / operational, safety and health, environmental, social, financial, reputation and cultural heritage. The analysis should reflect the geographical extent of the effect, the number of receptors affected (e.g., scale), the complexity of the effect, the degree of harm to those affected and the duration, frequency, and reversibility of effect.
Assess the initial risk
Using a combination of the selected likelihood and consequence levels, and the risk framework selected, the Climate Practitioner shall determine the initial risk rating for each climate change risk taking into consideration the existing or planned controls. The Climate Practitioner should provide detailed explanations to substantiate the assessment conclusions, with each risk categorisation defendable and justifiable.
Assess the initial significance
The risk framework and the risk ratings allocated can be used to determine significance of each risk identified. Significance determines the priority given to that risk in the next step of the assessment. Using the risk framework adopted for the assessment, the Climate Practitioner should assign each risk rating levels e.g., 'Low', 'Medium', 'High', 'Extreme' as either 'Significant' or 'Not Significant'. Each risk is then allocated a significance rating depending on its highest initial risk rating. Table 3.33 provide an example significance matrix.

Table 3.33 Assessing Significance using the Risk Matrix

	Magnitude of consequence				
Likelihood	**Insignificant**	**Minor**	**Moderate**	**Major**	**Catastrophic**
Rare	Not significant	Not significant	Not significant	Significant	Significant
Unlikely	Not significant	Not significant	Not significant	Significant	Significant
Moderate	Not significant	Not significant	Significant	Significant	Significant
Likely	Not significant	Significant	Significant	Significant	Significant
Almost certain	Significant	Significant	Significant	Significant	Significant

Legend	Low	Medium	High	Extreme

Communication and Consultation

Communication and consultation are key elements of a climate change risk assessment due to the uncertainty and complexity surrounding the process. The Climate Practitioner shall engage with TII and other relevant stakeholders, including members of the Design Team and other disciplines involved in the EIA process to determine the consequence, likelihood and significance of each risk identified.

A recommended approach for effective consultation is the facilitation of a **risk assessment workshop** which brings in the relevant internal and external stakeholders to validate the risks identified and assist in the assessment of likelihood, consequence and significance as well as in the identification of adaptation measures.

Identify adaptation measures

If the risk assessment concludes that there are significant climate risks to the project, to the greatest extent practicable, these must be managed and reduced to an acceptable level through the identification and implementation of adaptation measures. Adaptation measures are actions that can be implemented to improve resilience to climate change. In line with Ireland's National Adaptation Framework (Department of the Environment, Climate and Communications, 2018), and the terminology used in both the Local Authority Strategies and the Sectoral Plans, the Climate Practitioner shall describe adaptation actions as either Grey, Green or Soft:

- **Grey Actions** involve technical or engineering oriented responses to climate impacts, for example the consideration of climate change projections in the design of drainage structures.
- **Green Actions** seek to use nature-based solutions to enhance the resilience of human and natural systems, for example the addition of green spaces to linear infrastructure projects to counteract urban heat island effect.
- **Soft Actions** involve the alterations in behaviour, regulation, or systems of management such as increased monitoring of climate change impacts during operation, or the consideration of climate risk in asset management plans. They are generally relatively flexible and inexpensive to implement.

For each adaptation measure identified, the Climate Practitioner shall identify an implementation timeframe and a responsible party to provide direction during later stages of the project and enable accountability.

Note: Appendix H provides example adaptation measures linked to example risks

Reassess climate change risks

Assess residual risk

Using the adaptation measures identified, the Climate Practitioner shall undertake an assessment of residual risk for each risk using the same risk framework as for the initial risk rating. This assessment is conducted assuming the adaptation measures identified have been implemented (whether they are design, construction or operation related) and accordingly will often result in a lower risk rating. The residual risk assessment should be undertaken in consultation with TII and other relevant stakeholders with the appropriate specialists confirming how and if the adaptation measures change the likelihood and consequence of an identified risk.

Assess residual significance:

The final step in the climate change risk assessment process is to reassess the number of significant risks following the implementation of adaptation measures. The Climate Practitioner should use the same criteria when assessing initial significance with the intention that the number of 'Significant' risks would have reduced due to the increased resilience of the asset.

3.9.3 Phase 3, Climate Assessment Outputs:

At Phase 3, the Climate Practitioner should consult with the Project Manager and share the reported outputs so that the necessary mitigation and adaptation measures are taken forward for deliverables in Phases 5 to 7. The outputs for this Phase 3 are shown in Table 3.34.

Table 3.34 Phase 3 Deliverables and outputs

SD Deliverables for this Phase	Climate Chapter (as part of EIAR) / Standalone Climate Report / Project specific environmental report
Other Deliverables this Phase Informs	Preliminary Business Case (PBC) Phase 3 Gate Review Statement

3.10 Phase 4 – Statutory Processes

Phase 4 is the consenting process whereby the statutory and non-statutory stakeholders can provide submission/observations/objections to the proposed road development. These perspectives need to be considered by the consenting authority (An Bord Pleanála or Planning Authority, as appropriate). This is applicable for EIA and non-EIA projects.

3.10.1 Approach and Process

During the statutory process, the Climate Practitioner will respond to third party submissions where pertinent/required and participate in oral hearing(s) as required by the statutory processes, so the proposed Project is developed in accordance with planning and environmental legislation. Climate-related inputs in Phase 4 are likely to include:

- Compile documentation and participating in oral hearing(s) as required by the statutory processes to ensure that the proposed Project is developed in accordance with planning and environmental legislation.
- Participation in oral hearing preparation meetings and drafting a Climate Statement of Evidence, where a public oral hearing is to be held and responses to submissions.
- Presenting the Climate Statement of Evidence at the public oral hearing and responding to questions direct from the public, other bodies, or the inspector for the consenting authority.
- Review and drafting, responding where warranted, to climate issues raised in submissions to the consenting process, and in requests for further information from the consenting authority.
- Reviewing and drafting responses to any climate requests for further information issued by the consenting authority.
- Reviewing and updating, if necessary, any aspect of the climate assessment and documenting same.
- Finalising the Climate Statement of Evidence.
- Review and report on any climate aspects addressed in the decision of the consenting authority (and planning inspector’s report).

3.11 Phase 5: Enabling and Procurement

- During Phase 5 it may be necessary to update the climate assessment undertaken during Phases 1 to 4, for example if there was a significant time lag between Phases or due to changes brought about during the statutory procedures. If the assessment requires updating, then the methodology outlined above should be followed.

- During Phase 5 a review of the consenting authority's decision, and any conditions and schedule of commitments may be necessary to further develop climate mitigation and adaptation.

3.12 Phase 6: Construction and Implementation

- The objective of Phase 6 is the administration and execution of the Main Contract in accordance with the design, specification, relevant standards, and legislation. This will include ensuring that the works will be carried out to the intended design, specification, schedule of commitments and planning conditions, as well as relevant best practice standards and legislation.
- Similarly to Phase 5, it may be necessary to update the climate assessment undertaken during Phases 1 to 4, for example if there was a significant time lag between Phases or due to changes brought about during the statutory procedures.
- Implementation of mitigation measures and monitoring to ensure the measures are effective should be outlined in the EIAR (Phase 3), with further details provided in a Construction Environmental Management Plan (CEMP) or similar document and implemented during Phases 5 to 7. It may be necessary for the Climate Practitioner to review the mitigation and/or monitoring being implemented to ensure it is consistent with the CEMP.

3.13 Phase 7: Closeout and Review

- At the completion of any major project, it is a requirement of the TII PMG that a Post Project Review be carried out.
- This will include 'Lessons learned' for the climate assessment aspects, for example;
  - Did the climate adaptation measures deliver the required outcomes set out in the EIAR.
  - Are there conclusions or lessons learned that can be drawn and applicable to other projects, to the ongoing assessments of climate or to associated TII policies and guidelines.

References

BSI. (2016). Publicly Available Specification PAS 2080:2016 Carbon Management in Infrastructure. Retrieved from https://shop.bsigroup.com/ProductDetail?pid=000000000030323493

Climate Ireland. (2022). *Climate Data Explorer*. Retrieved from Climate Ireland: https://www.climateireland.ie/#!/tools/climateDataExplorer

Climate Ireland. (2022). *Climate Data Explorer*. Retrieved from Climate Ireland: https://www.climateireland.ie/#!/tools/climateDataExplorer

Department of Housing, P. a. (2018). *Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment.*

Department of the Environment, Climate and Communications. (2018). National Adaptation Framework (NAF): Planning for a Climate Resilient Ireland. Retrieved July 8, 2021, from https://www.gov.ie/en/publication/fbe331-national-adaptation-framework/#

Department of Transport. (2021). National Investment Framework for Transport in Ireland (NIFTI). Retrieved March 10, 2022, from https://www.gov.ie/en/publication/cfae6-national-investment-framework-for-transport-in-ireland-nifti/

Department of Transport, Tourism and Sport. (2019). *Transport Climate Change Sectoral Adaptation Plan.* Retrieved July 8, 2021, from https://www.gov.ie/en/publication/a2444e-sectoral-adaptation-plan-for-transport-infrastructure/

Environmental Protection Agency. (2022). *Guidelines on the information to be contained in Environmental Impact Assessment Reports.* Retrieved June 1, 2022, from https://www.epa.ie/publications/monitoring--assessment/assessment/EIAR_Guidelines_2022_Web.pdf

EPA. (1992). *The Environmental Protection Agency Act.*

EPA. (2022). *Guidelines on the information to be contained in Environmental Impact Assessment Reports.* Retrieved June 1, 2022, from https://www.epa.ie/publications/monitoring--assessment/assessment/EIAR_Guidelines_2022_Web.pdf

European Commission. (2021). *Technical guidance on the climate proofing of infrastructure in the period 2021-2027.* Retrieved August 24, 2021, from https://ec.europa.eu/clima/sites/default/files/adaptation/what/docs/climate_proofing_guidance_en.pdf

Global Facility for Disaster Reduction & Recovery. (2020). *ThinkHazard!* Retrieved from ThinkHazard!: https://thinkhazard.org/en/

Goverment of Ireland. (2021). *Climate Action and Low Carbon Development (Amendment) Bill 2021.* Retrieved from https://www.gov.ie/en/publication/984d2-climate-action-and-low-carbon-development-amendment-bill-2020/

IPCC. (2018). *Annex I: Glossary [Matthews, J.B.R. (ed.)]. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways.*

Met Éireann. (n.d). *Historical Data*. Retrieved from Met Eireann - The Irish Meteorological Service: https://www.met.ie/climate/available-data/historical-data

Met Éireann. (n.d). *Major Weather Events*. Retrieved from Met Éireann: https://www.met.ie/climate/major-weather-events

Met Éireann. (n.d.). *Major Weather Events*. Retrieved from Met Éireann - The Irish Meteorological Service: https://www.met.ie/climate/major-weather-events

Office of Public Works. (n.d). *Floodinfo*. Retrieved from Floodinfo.ie: https://www.floodinfo.ie/

TII. (2021). PE-PAG-02009 Project Appraisal Guidelines for National Roads Unit 1.0 - Introduction .

UNFCCC. (1992). *United Nations Framework Convention on Climate Chnage.*

UNFCCC. (2015). Paris Agreement. Retrieved September 2021, 2021, from https://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf

Appendix A:

Table A1 Examples of Carbon Sink Value by Land Type

Vegetation Type	Quantity	Unit	Carbon Sink tCO_2e (removed)
Mixed forest	1	ha	99
Natural grassland	1	ha	24.93
Transitional woodland scrub	1	ha	27.13
Land principally occupied by agriculture	1	ha	0.00
Peat bogs	1	ha	403.33

Table A2 Carbon Impact by Road Type

Type of Road[5]	Assumed carbon impact (per road)
Type 3 Single (6.0m) Carriageway (National Secondary Roads Only)	Lowest carbon impact
Type 2 Single (7.0m) Carriageway	
Type 1 Single (7.3m) Carriageway	
Type 3 Dual, (7.0m + 3.5m) Divided 2+1 lanes Primarily for retro fit projects	
Type 2 Dual, Divided 2 +2 Lanes (2x7.0m) Carriageways	
Type 1 Dual Divided 2+2 Lanes (2x7.0m) Carriageways	
Motorway Divided 2 +2 Lane (2X7.0m)	Highest carbon impact

[5] Source of Road Type is from TII (2017) Rural Road Link Design DN-GEO-03031

Appendix B:

Climate Data Template

Table B1 Presentation of Project Climate Vulnerabilities

Observed climate data (based on Climate Ireland's 'Climate Data Explorer' tool	
Climate variable	Observed climate at project location
Average temperature	
Average precipitation	
Maximum temperature	
Minimum temperature	
Hazard Level (based on the GFDRR's 'ThinkHazard!' tool	
Hazard type	Hazard level
Coastal flood	
Pluvial flood	
Fluvial flood	
Extreme heat	
Wildfire	
Landslide	
Past extreme events	
• Climate Practitioner to include past extreme weather events that occurred in the project location.	

Appendix C:

Presenting GHG Assessment
MCA Scoring at Phase 2, Stage 1

Table C1 MCA GHG Impacts

Option	Features					Possible mitigation measures	Qualitative commentary on GHG impact	MCA Scoring
	Land use types traversed	Infrastructure type (s)	Length	Current road user emissions	Design features			
1	*Forest*	*Dual carriage way* *cycle lanes*	*14km*	*30tCO_2e/annum*	*Possible bridge*	*Explore option for steel bridge over concrete*	*Cycle lanes may reduce overall operational emissions through modal shift*	*5*
2								
3								
4								
[…] 20								

Appendix D:

Presenting CCRA Assessment
MCA Scoring at Phase 2, Stage 1

Table D1 MCA CCR Impacts

Option	Asset Category Vulnerability score									Qualitative commentary	MCA Score
	Pavements	Drainage	Structures	Utilities	Landscaping	Signs	Light posts	Fencing	Auxiliary Buildings		
1	*9*	*6*	*1*	*4*	*1*	*1*	*1*	*4*	*1*	*Has only one climate hazard with high vulnerability*	*3*
2											
3											
4											
[…]20											

Appendix E:

Greenhouse Gas Assessment Multi Criteria Analysis Scoring at Phase 2, Stage 2

Table E1 MCA GHG Impacts

Option	Land use types traversed	Infrastructure type (s)	Length	Design features	Before Use (A1-A3) (tCO_2e)					Use (B1-B9) (tCO_2e)		Possible Mitigation measures	Updated MCA Scoring
					Cut and fill balance	Earthworks	Pavement	Concrete	Steel	Current road user emissions	Proposed road user emissions		
1	*Forest*	*Dual carriage way cycle lanes*	*14km*	*Bridge* *2 x roundabouts*	*Unknown*	*30*	*150*	*350*	*26*	*30*	*25*	*Reuse aggregate from local plant* *Engineering solution for lighter-weight bridge*	
2													
3													
4													
5													
[6….10]													

Appendix F:

Climate Variables

Table F1 Potential climate variables to be considered in the assessment

Climate theme	Potential climate parameters
Temperature 	Mean annual maximum daily temperature (°C) Mean annual minimum daily temperature (°C) Mean summer maximum daily temperature (°C) Mean winter minimum daily temperature (°C) Average temperature during the warmest month (°C) Average temperature during the coolest month (°C) Days per annum under 0 (°C) (days) Heatwaves (no.)
Rainfall 	Mean annual rainfall levels (mm) Mean summer rainfall (mm) Mean winter rainfall (mm) Wettest month on average & mean rainfall during month (mm) Driest month on average & mean rainfall during month (mm) Wet days (>20 mm) (no.) Very wet days (>30mm) (no.) Summer dry days (5 consecutive days where daily rain <1 mm) Highest daily rainfall (mm) for baseline period
Other 	Mean wind speed (knot) Highest gust (knot) Snowfall Storms (frequency and severity) Lightning Sea level rise (m) Potential Evapotranspiration (mm)

Appendix G:

Example Risk Framework

A risk framework with which to assess climate risks must be selected in consultation with TII. The risk framework provided as an example in this guidance is based on the framework detailed in the EU Technical Guidance on climate proofing (2021). The risk matrix, likelihood analysis and consequence analysis are provided in Table G1, Table G2 and Table G3, respectively.

Table G1 Impact Criteria to establish Significance

Likelihood	Magnitude of consequence				
	Insignificant	**Minor**	**Moderate**	**Major**	**Catastrophic**
Rare	Low	Low	Medium	High	Extreme
Unlikely	Low	Low	Medium	High	Extreme
Moderate	Low	Medium	High	Extreme	Extreme
Likely	Medium	High	High	Extreme	Extreme
Almost certain	High	High	Extreme	Extreme	Extreme

Table G2 Assessment of Likelihood

Likelihood term	Qualitative	Quantitative
Rare	Highly unlikely to occur	5%
Unlikely	Unlikely to occur	20%
Moderate	As likely to occur as not	50%
Likely	Likely to occur	80%
Almost certain	Very likely to occur	95%

Table G3 Assessment of Consequence

Risk areas	Magnitude of consequence				
	Insignificant	**Minor**	**Moderate**	**Major**	**Catastrophic**
Asset damage, engineering, operational	Impact can be absorbed through normal activity	Adverse event that can be absorbed by taking business continuity actions	A serious event that requires additional emergency business continuity actions	A critical event that requires extraordinary/emergency business continuity action	Disaster with the potential to lead to shut down or collapse or loss of the asset/network
Health and safety	First aid case	Minor injury, medical treatment	Serious injury or lost work	Major or multiple injuries, permanent injury or disability	Single or multiple fatalities
Environment	No impact on baseline environment/localised in the source area	Localised within site boundaries.	Moderate harm with possible wider effect	Significant harm with local effect	Significant harm with widespread effect/

Risk areas	Magnitude of consequence				
	Insignificant	**Minor**	**Moderate**	**Major**	**Catastrophic**
	No recovery required	Recovery measurable within one month of impact	Recovery in one year	Recovery longer than one year Failure to comply with environmental regulations/ consent	Recovery longer than one year/limited prospect of full recovery
Social	No negative social impact	Localised, temporary social impacts	Localised, long-term social impacts	Failure to protect poor or vulnerable groups91/ national, long-term social impacts	Loss of social licence to operate/community protests
Financial	x % IRR < 2% of turnover	x % IRR 2-10% of turnover	x % IRR 10-25% of turnover	x % IRR 25-50% of turnover	x % IRR > 50% of turnover
Reputational	Localised, temporary impact on public opinion	Localised, short-term impact on public opinion	Local, long-term impact on public opinion with adverse local media coverage	National, short-term impact on public opinion/negative national media coverage	National, long-term impact with potential to affect the stability of the government
Cultural Heritage and cultural premises	Insignificant impact	Short term Impact/possible recovery or repair	Serious damage with wider impact to tourism industry	Significant damage with national and international impact	Permanent loss with resulting impact on society

Appendix H:

Climate Change Risk Register Template

Table H1 Climate change risk register template

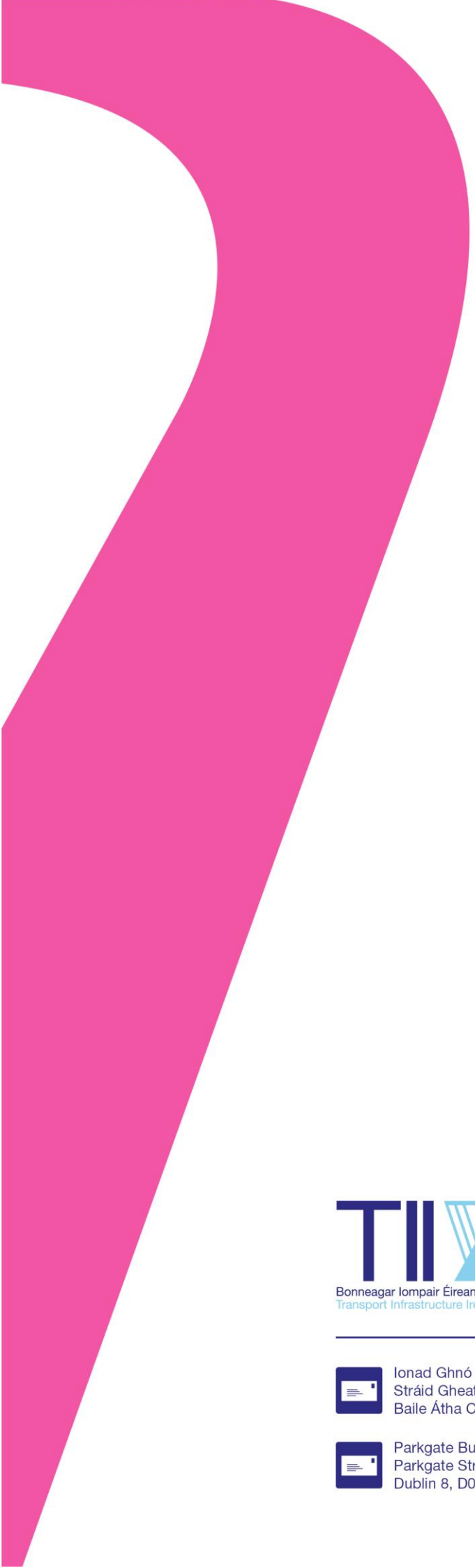
Risk Identification					Risk Assessment							Adaptation Measures							Significance
Risk ID	Climate variable	Risk statement	Project receptors	Impact type	Planned controls	Initial risk rating						Adaptation Measures	Timing & Responsibility	Residual Risk Rating					Significance
						RCP4.5 (2041-2060)			RCP8.5 (2041-2060)					RCP4.5 (2041-2060)			RCP8.5 (2041-2060)		
						Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating			Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating	
1	*e.g. Extreme rainfall*	*Description of impact associated with climate variable.*	*Asset components impacted e.g. pavements, drainage, landscaping, utilities, etc.*	*Nature of the impact, often associated with consequence category e.g. asset damage, safety and health, environmental, social, financial etc*	*Description of controls planned within the current design or business-as-usual operational measures that mitigate the identified risk.*	*e.g. Rare*	*e.g. Moderate*	*e.g. Medium*	*e.g. Unlikely*	*e.g. Moderate*	*e.g. Medium*	*Additional measures to be implemented during design, construction or operation with the intention of addressing and mitigating the identified risk.*	*Timing and responsible party for the implementation of adaptation measures e.g. Construction, Constructor.*	*e.g. Rare*	*e.g. Minor*	*e.g. Low*	*e.g. Unlikely*	*e.g. Minor*	*e.g. Low*	*e.g. Not significant*
2																			
3																			
4																			
5																			
6																			
7																			

Appendix I:

Climate Change Risk and Adaptation Examples

Table I1 Example Climate Change Hazards and Potential Associated Impacts

Climate change hazard	Key questions to consider	Example risk statements	Example adaptation measures
Construction			
Extreme weather events (e.g. storms)	Can construction works continue during extreme weather conditions?	Extreme weather events result in an inaccessible construction site or health and safety risk to workers, causing restricted working hours and a delay in operations.	Contractors' Environmental Management System (EMS) should consider all measures deemed necessary to manage extreme weather events and should as a minimum, cover training of personnel and, prevention and monitoring arrangements. Construction method statements should also consider extreme weather events where risks have been identified. Emergency preparedness and contingency procedures in place for an extreme weather event on the construction site or within the supply chain.
	Can storms have an impact on the construction's stability?	Extreme weather events cause damage to construction materials, plant, and equipment.	
Extreme temperatures	Can the materials used during construction withstand higher temperatures (or will they experience material fatigue or surface degradation)?	Extreme heat impacts concrete curing process resulting in damaged infrastructure components and rework.	Contractor to schedule concrete curing to avoid peak temperatures.
	Are the construction activities likely to generate dust which could be exacerbated in hot and dry conditions?	Warm and dry conditions exacerbate dust generation and dispersion, health risks to construction workers.	Contractor to consider increased dust suppression measures in hot and dry conditions. Contractor to have health and safety plan in place that takes into consideration dust-related air quality concerns.
Extreme rainfall	Will the construction activities and workers be at risk because the site is located in a flood zone?	Extreme rainfall event results in flooding onsite causing soil erosion during early works or damage to partially constructed infrastructure, resulting in programme delays and/or increased costs.	Use short to medium range weather forecasting to inform short to medium term programme management, environmental control and impact adaptation measures. Contractor to register with the flood warning service in areas of flood risk.
Operation			
Extreme weather events (e.g. storms)	Can ice affect the functioning/operation of the proposed project?	Cold weather conditions result in ice or 'black ice' on road surface presenting safety hazard for road users including car accidents which could result in injury or fatality.	Road signage to include ice warnings. Consider inclusion of variable message signs or variable speed limit signs to provide up-to-date messaging on weather warnings and to decrease speed limit in dangerous conditions.
	Is the proposed project's connectivity to energy and ICT networks ensured during extreme weather events such as storms?	Extreme weather event such as a storm results in loss of power to infrastructure including street lighting and traffic lights resulting in reduced functionality of infrastructure and causing potential safety hazard.	Consider including redundancy in design in the event of loss of power to the asset.
Extreme rainfall	Is the site located in a flood zone?	Infrastructure drainage system is unable to cope with extreme rainfall event leading to flooding of road surface which has implications on road safety and the operation of the asset.	Drainage design to consider flood alleviation measures to improve the resilience of the project to potential flooding events. For example, Sustainable Drainage Systems (SuDs) to be implemented where appropriate and runoff to be conveyed via filter drains and attenuation ponds.
Extreme wind	Will the proposed project be at risk because of storms and strong winds?	Strong wind gusts result in damage from wind borne debris including fallen trees on carriageway presenting safety hazards to road users.	Design to include minimum clearing distance between road edge and landscaping to ensure fallen trees do not impact road users. Establish maintenance and inspection program for landscaping.
Extreme heat	Are extreme heat conditions expected in the project location?	Extreme heat affects pavement/material durability, causing cracking and damage, resulting in reduced reliability and design life.	Consider designing for expected temperature extremes under future climate change scenarios e.g., consider using modified binders in surfacing to reduce susceptibility of asphalt to deformation. Implement regular maintenance regime to detect deterioration and damage.
Wildfire	Is the proposed project located in an area vulnerable to wildfires?	Wildfire reaches infrastructure site causing road closures and presenting safety hazard to road users.	Standard operating procedures to be developed for use in the event of necessary road closure and/ or traffic diversion.
Sea level rise / storm surge	Is the proposed project located in an area that may be affected by rising sea levels and/or storm surge?	Sea level rise or storm surge event results in flooding of roadway, which has implications on road safety and the operation of the asset.	Drainage design to account for expected sea level rise over the lifetime of the asset and increased severity of storm surge event. Design to incorporate flood alleviation measures.



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