THE SOUTH AFRICAN NATIONAL ROADS AGENCY SOC LIMITED

CONTRACT NR: R573-

UPGRADING OF NATIONAL ROAD R573 SECTION 2: WORK PACKAGE E FROM KM (13.000) TO KM (24.700)

DESIGN RISK REVIEW REPORT

October 2022

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1 Introduction

The Design risk review forms part of the integrated risk management approach applied to the R573 SECTION 2: WORK PACKAGE E FROM KM (13.000) TO KM (24.700) project. Sound and effective EHS risk management early in the project lifecycle is the leading practice and a means of improving the performance objectives of the project going forward. Conducting a design risk review is a legal requirement in terms of the Occupational Health and Safety Act, 85 of 1993, Construction regulations, 2014. The results of the risk review are to be made available to the designers as well as to the potential contractors at the tender stage of the project.

2 Objective

The objectives of the design risk review were to:

- Identify, analyse and prioritize the health and safety hazards and Potential Unwanted Events (risks) associated with the project, introduced by the design to the construction phase as well as to the client and end user.
- Identify engineering type mitigation strategies early in the project lifecycle
- Provide information for improved costing associated with identified mitigation strategies
- Produce a prioritized profile of the Potential Unwanted Events associated with the design.
- Develop a risk allocation matrix that informs the design team, the contractor and the end user of the risks associated with the design and the requirements to ensure the implementation of mitigations are maintained by the end user.

3 Definitions

ALARP	As low as reasonably practicable. The concept of weighting the risk against the sacrifice needed to implement the measures necessary to avoid the risk. In health and safety it is assumed that the measures should be implemented unless it can be shown that the sacrifice is grossly disproportionate to the benefit.
Consequence	The outcome of an event or situation expressed qualitatively or quantitatively, whether a loss, injury, health or environment impact, or disadvantage, or a benefit, gain or advantage.
Control or Barrier	Control or barrier is defined as "anything used to control, prevent or impede energy flows or the loss of control of a hazard". Types of barriers include physical, equipment design, warning devices, procedures, work processes, knowledge and skills, and supervision. Controls impact on the risk of the event, whether it is an opportunity or threat. It is essential to consider controls or barriers in terms of their order of greatest effectiveness. This order is known as the 'Hierarchy of Control'.
Critical Controls	Those controls that significantly influence the likelihood and/or consequence of an event (if removed, they will significantly impact the risk rating).
Event	An incident or situation, which occurs in a particular place during a particular interval of time. Events involve releases or manifestations of, or exposures to the hazard. Events can be wanted (opportunity) or unwanted (threat).
Hazard	A source of potential harm to people, facilities, the environment or the community that, should it involve potential damage, will be an '**energy**' such as electricity, pressure, chemical, etc. The environmental term, "aspect", is synonymous with

	hazard. A hazard must be recognised and understood in order to manage the related risk. Understanding a hazard includes the nature, magnitude, and potential consequences as well as relevant "target" or impact characteristics, potential timeframes, pathways or mechanisms of its manifestation and residual harm. Also, understanding sources of harm to the community may require recognition of incentives.
Likelihood	The probability or chance that and event will occur.
Risk	A combination of the likelihood of an occurrence of a hazardous event or exposure and the severity of the impact (e.g. injury, illness, environmental impact) that may be caused by the event or exposure.
Risk Analysis	A systematic process to understand the nature of and deduce the level of risk.

4 Methodology

This Design risk review was carried out in accordance with leading practice for health and safety risk management and ISO 31000.

A qualitative risk methodology was followed utilizing a modified WRAC (Workplace Risk Assessment and Control) document as the risk assessment template.

Energy descriptors were used to classify/group/identify hazards, see Annexure A.

Risk scenarios describe the unwanted event.

A risk determination matrix was used for the evaluation of the risks.

The risk determination matrix was used to evaluate the inherent risk (without controls) considering the "maximum reasonable outcome".

The risks are allocated to the applicable party and comments from the design team are included.

5 Scope

The scope of the risk review is aligned to the scope for the R573 SECTION 2: WORK PACKAGE E FROM KM (13.000) TO KM (24.700) project. This includes all the construction activities associated with; surveying, site establishment, road construction, bridge construction, intersection upgrading and construction, storm water management and electrical infrastructure installations.

6 Facilitation and Attendance

The design risk review process followed a workshop format.

The workshop was facilitated by Fred Du Plessis via on the 3rd of October 2022. The following people were in attendance or gave inputs via draft review and comment submission:

U Ramnath	AECOM	**D Theron**	AECOM
R Malherbe	AECOM	**W Findley**	AECOM
F du Plessis	OXYGEN	**D Dippenaar**	AECOM

(Comment submission)

7 Design Risk Review Results

7.1 Total Risk Scenarios Identified

The detailed result of the design risk review process can be seen in Annexure 1. The focus of the review is to identify high and critical risks scenarios that can impact the construction phase as well as the end user. These identified scenarios allow the design team to engineer out or mitigate the risks during the design phase. During the workshop, 1 high and 21 critical unmitigated risk scenarios were identified.

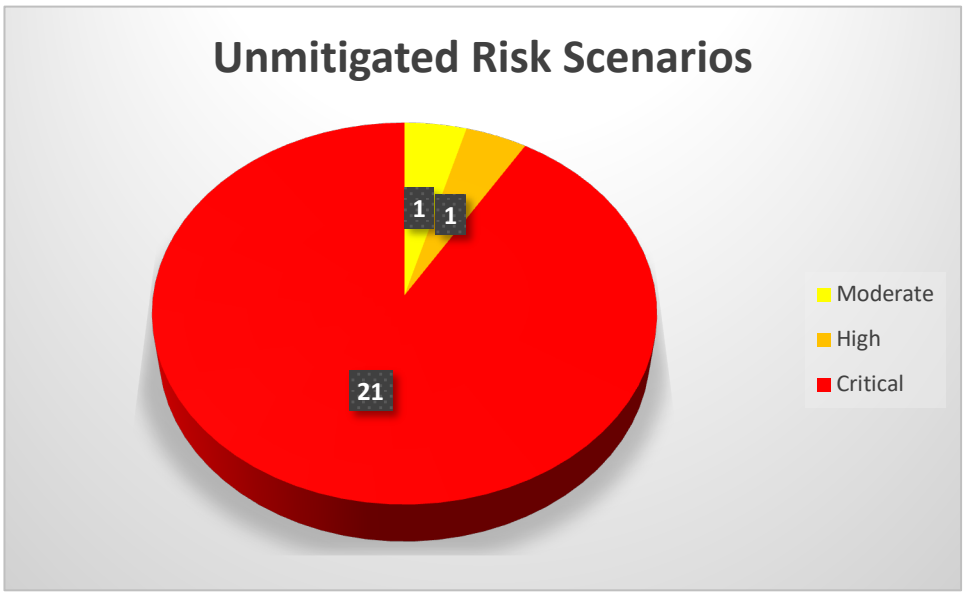

Chart 1, Total Risk Scenarios Identified

7.2 Risk Scenario by Energy Type

Chart number 2 below represents the number of risk scenarios identified by hazard / energy type. The energy types may be applicable to multiple design packages and the detailed analysis must be consulted by each of the design teams to ensure all the possible mitigation controls that can be applied in the design stage area effected.

The energy types that are applicable to the construction stage must be taken into account by the tenderer during the tender stage and must be addressed by the contractor during the execution of the project.

The client / end user must take note of the energy types identified with end user impact and ensure mitigation controls are implemented with consideration of the comments.

The detailed analysis of the risks are available in the actual risk assessment document in Appendix A.

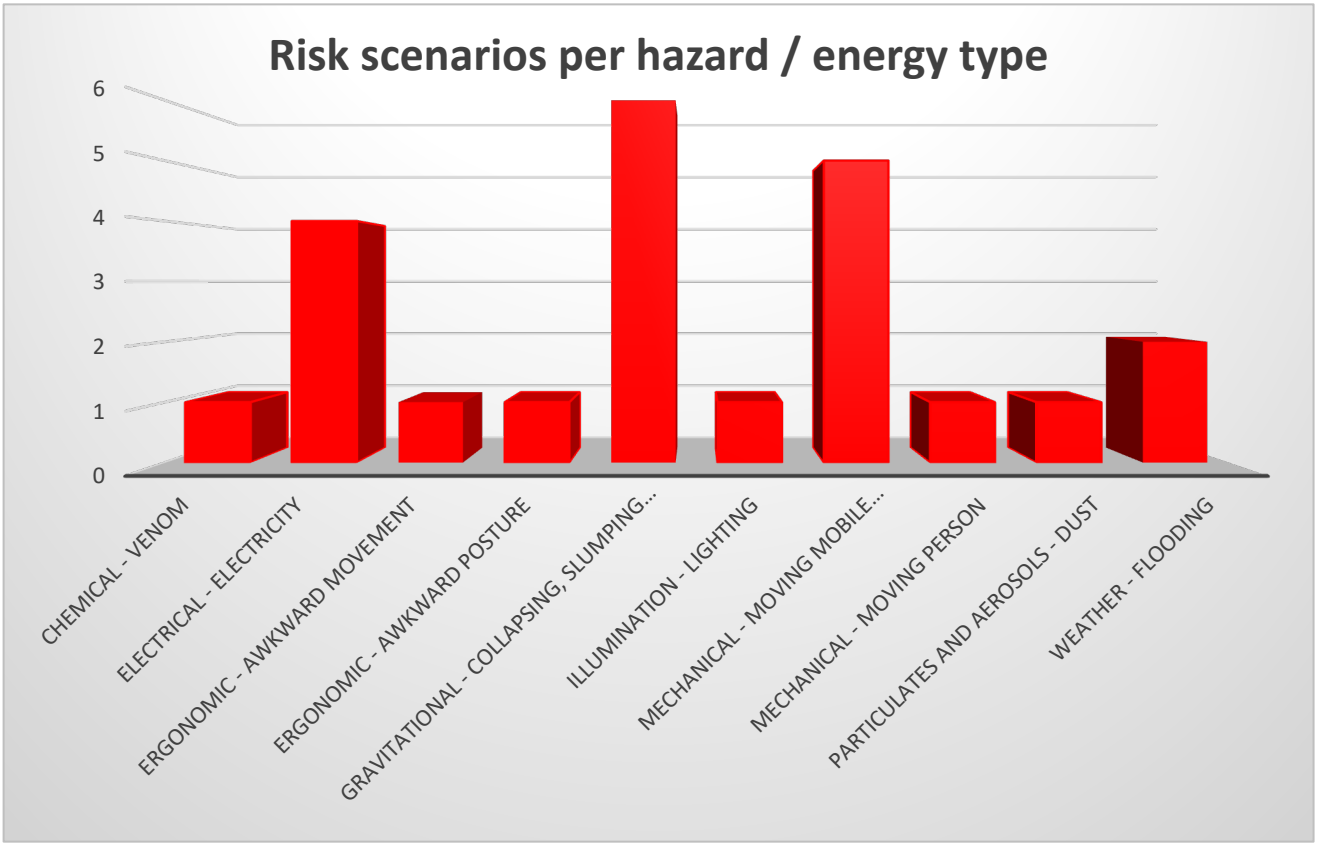

Chart 2, Risk Scenarios by Energy Type

7.3 Risk Allocation

Chart number 3 below represents the number of risks that was addressed in the design phase (20), the number of risks to be managed in the construction phase (15), and the number of risks that the end user have to be notified of (11), this also includes future mitigation actions to ensure the mitigation controls implemented during the design stage stays effective as they would require some level of maintenance. The detailed list of allocations is available in the actual risk assessment document in Appendix A.

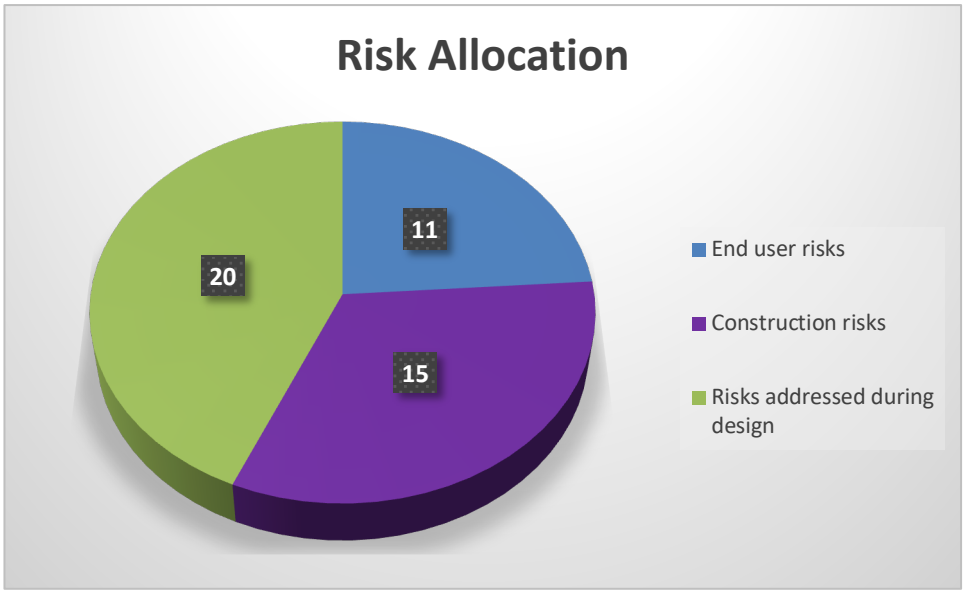

Chart 3, Risk allocation chart

7.4 Conclusion and Future Actions

The design risk review reflects the critical occupational health and safety hazards and risk scenarios identified by the design team, associated with the scope of activities as described in section 5 above.

The project team is confident that the identified hazards will be effectively mitigated during the design to ensure OHS risks are mitigated to acceptable levels.

Immediate future actions include;

- Communication of allocated risks to all applicable parties in the design stage.
- Inclusion of the design risk review in the tender documentation.

Appendix A

Hazard (Energy)	Description of Risk Scenario (Unwanted Event)	Initial Risk Rating			Risk allocation			
		Likelihood	Consequence	Risk Rating	Adressed during design	Construction risk	End user risk	Comment
Chemical - Venom	Snakes nesting in culverts and subsurface structures	Possible	Major	Critical			X	End user to take note of this risk. Pre work inspection of areas are critical for all culvert and subsurface work
Electrical - Electricity	Electrocution / Electrocution hazard to community.	Possible	Major	Critical	X		X	Risk eliminated due to placing of lighting infrastructure on median barrier.
Electrical - Electricity	Electrocution / Electrocution hazard during construction, electrical infrastructure in works area.	Possible	Major	Critical	X		X	Contractor to ensure electrical infrastructure is removed / relocated before work starts in area
Electrical - Electricity	Electrocution / Electrocution hazard during construction, electrical infrastructure crossing road infrastructure.	Possible	Major	Critical	X		X	Contractor to ensure electrical infrastructure is removed / relocated before work starts in area
Electrical - Electricity	Electrocution / Electrocution hazard during construction, electrical infrastructure proximity to pedestrian bridge.	Possible	Major	Critical	X	X	X	Design team to verify the required clearances and proximity to current overhead electrical infrastructure and adjust design accordingly. Contractor to ensure electrical infrastructure is removed / relocated before work starts in area

Hazard (Energy)	Description of Risk Scenario (Unwanted Event)	Initial Risk Rating			Risk allocation			
		Likelihood	Consequence	Risk Rating	Adressed during design	Construction risk	End user risk	Comment
Ergonomic - Awkward Movement	Incorrect intersection design leading to unergonomic movement requirements of road users.	Possible	Serious	High	X			Risk eliminated during design phase
Ergonomic - Awkward Posture	Restricted work space for maintenance teams cleaning culverts and open channels	Almost Certain	Serious	Critical			X	Culvert sizes specified to ensure ease of entry for maintenance. End user to take note of this risk.
Gravitational - Collapsing, Slumping or Flowing Material or Substance	Collapse of excavation/trench	Possible	Major	Critical	X	X		Geo tech survey conducted and taken into account during design phase. Contractor to ensure recommendations from survey results are implemented during construction. All prescribed inspections to be conducted by a competent person.
Gravitational - Collapsing, Slumping or Flowing Material or Substance	Toppling of crane while lifting	Possible	Major	Critical	X	X		Geo tech survey conducted and taken into account during design phase. Contractor to ensure recommendations from survey results are implemented during construction. All prescribed inspections to be conducted by a competent person.

Hazard (Energy)	Description of Risk Scenario (Unwanted Event)	Initial Risk Rating			Risk allocation			
		Likelihood	Consequence	Risk Rating	Adressed during design	Construction risk	End user risk	Comment
Gravitational - Collapsing, Slumping or Flowing Material or Substance	Side walls of excavation collapsing due to ground conditions.	Possible	Major	Critical	X	X		Geo tech survey conducted and taken into account during design phase. Contractor to ensure recommendations from survey results are implemented during construction. All prescribed inspections to be conducted by a competent person.
Gravitational - Collapsing, Slumping or Flowing Material or Substance	Form work or support work collapsing due to ground conditions.	Possible	Major	Critical	X	X		Geo tech survey conducted and taken into account during design phase. Contractor to ensure recommendations from survey results are implemented during construction. Regular inspections to be conducted of temporary works by a competent person as prescribed by legislation.
Gravitational - Collapsing, Slumping or Flowing Material or Substance	Form work or support work collapsing due to incorrect load bearing capacity	Possible	Major	Critical	X	X		Temporary works to be designed by a competent person, design to be verified by engineering team prior to being issued for construction. Regular inspections to be conducted of temporary works by a competent person as prescribed by legislation.

Hazard (Energy)	Description of Risk Scenario (Unwanted Event)	Initial Risk Rating			Risk allocation			
		Likelihood	Consequence	Risk Rating	Adressed during design	Construction risk	End user risk	Comment
Gravitational - Collapsing, Slumping or Flowing Material or Substance	Form work or support work collapsing due to substandard erection practices	Possible	Major	Critical	X	X		Temporary works designer and site engineer to verify compliance to design, during erection as well as prior to allowing structure to be used or placed under loadbearing conditions.
Illumination - Lighting	Intersection and road area very dark during night.	Possible	Major	Critical	X	X	X	Rerouting of traffic during times when excavations are crossing the road included in design. Contractor to ensure concrete jersey barriers are in place with correct visibility regime for night visibility for road users.
Mechanical - Moving Mobile Equipment or Light Vehicle	Walk way brought next to road at major culvert.	Possible	Major	Critical	X	X		Handrails and Gaurdrail included in design
Mechanical - Moving Mobile Equipment or Light Vehicle	Vehicles driving into median when travelling east bound	Possible	Major	Critical	X	X		Crash cussion to be included in design at the start of concrete median

Hazard (Energy)	Description of Risk Scenario (Unwanted Event)	Initial Risk Rating			Risk allocation			
		Likelihood	Consequence	Risk Rating	Adressed during design	Construction risk	End user risk	Comment
Mechanical - Moving Mobile Equipment or Light Vehicle	Vehicles entering construction areas at high speed	Possible	Major	Critical	X	X		Traffic accomodation plan detailing traffic calming measures to be done and included in tender packages. Inspection of traffic accomodation by Traffic Safety Officer and engineering staff. Road users and workers to be seperated by Barrier.
Mechanical - Moving Mobile Equipment or Light Vehicle	Current road users driving into construction area next to road.	Possible	Major	Critical		X		Contractor to take note of the risk and ensure that mitigation controls are developed prior to construction activity taking place. Road users and workers to be seperated by Barrier.
Mechanical - Moving Mobile Equipment or Light Vehicle	Vehicles performing illegal movements and road crossings resulting in accidents	Possible	Major	Critical	X	X	X	Design methodology including median to prevent illegal movments and crossings.

Hazard (Energy)	Description of Risk Scenario (Unwanted Event)	Initial Risk Rating			Risk allocation			
		Likelihood	Consequence	Risk Rating	Adressed during design	Construction risk	End user risk	Comment
Mechanical - Moving Person	Public and live stock crossing road intermittendly at various places	Possible	Major	Critical	X	X	X	Fencing included in the design to restrict crossing areas. Median included in design. Traffic calming measures included in design to ensure dedicated crossings are safe for pedestrians. Universal access included in design methodology. Agricultural underpass included at 17 700. Pedestrian bridge included in design.
Particulates and Aerosols - Dust	Excessive dust to end user on gravel road.	Possible	Medium	Moderate	X		X	Control measures included in design to ensure correct type of material is specified to minimise dust for end users. End user to ensure maintenance regime is implemented and road is maintained in serviceable condition

Hazard (Energy)	Description of Risk Scenario (Unwanted Event)	Initial Risk Rating			Risk allocation			
		Likelihood	Consequence	Risk Rating	Adressed during design	Construction risk	End user risk	Comment
Weather - Flooding	Flooding of stormwater system creates a drowning hazard for the local community.	Possible	Major	Critical	X		X	Stormwater and wetland flooding control measures have been included in the design. The end user will have to ensure that the required maintenance is performed to ensure the designed mitigations are kept effective. Construction methodology for stormwater infrastructure to start from downstream to upstream. End user and municipality to ensure downstream water management is maintained. Municipality to prevent any development within the 1 in 50 year flood line. Guardrail fitted onto embankment.
Weather - Flooding	Scaffold footings flooded in river bed eroding away formwork base support.	Possible	Catastrophic	Critical	X	X		Bridge deck to be constructed during the dry season to minimize the risk of erosion under formwork supports in the river bed. Contractor to ensure formwork support and ground conditions are included in inspection protocol. Contractor to ensure temporary works designer include mitigation controls in design.