CIVILCORE
CONFERENCE ON RESEARCH IN ENGINEERING
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IMPACT OF CLIMATE CHANGE ON THE OPERATIONAL READINESS OF SINGAPORE-MALAYSIA HIGH SPEED RAIL

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Issues


Jakarta HSR, Jan 2020


KTMB Southern Line, Jan 2013


Kelantan ECL, Dec 2014


Scotland, Aug 2020

'Decisions made today–for example, in the creation of new infrastructure or other assets-need to occur in a way which ensures that the outcomes of those decisions are robust enough to cope with, or adapt to, changing climatic conditions in the future.' (Victorian Government, 2005) .

It has been widely recognized that there is a need to integrate consideration of climate change and its impacts in development policies and projects. (S., Kramer, G.Prudent-Richard, & M.Sainsbury, 2010).

RESEARCH PROBLEM

Despite climate change posing serious challenges to infrastructure projects, little research has been conducted in Malaysia into how vulnerable the proposed system will be, especially in terms of the HSR physical infrastructure and the planned operations on the network.

CENTRAL AIM (*MAIN OBJECTIVE*)

To assess the vulnerability of the planned infrastructure and the potential ramifications of this climate adaptation strategies.

KEY RESEARCH QUESTIONS

1. How to manage the weather and climated-related risks to the planned operations of the HSR system?
2. What are the potential impacts of climate change on future rail projects in the region?
3. What are the potential actions to mitigate climate-related risks?

SCOPE OF STUDIES

To determine the climated-related risks to the planned operations of the HSR systems.

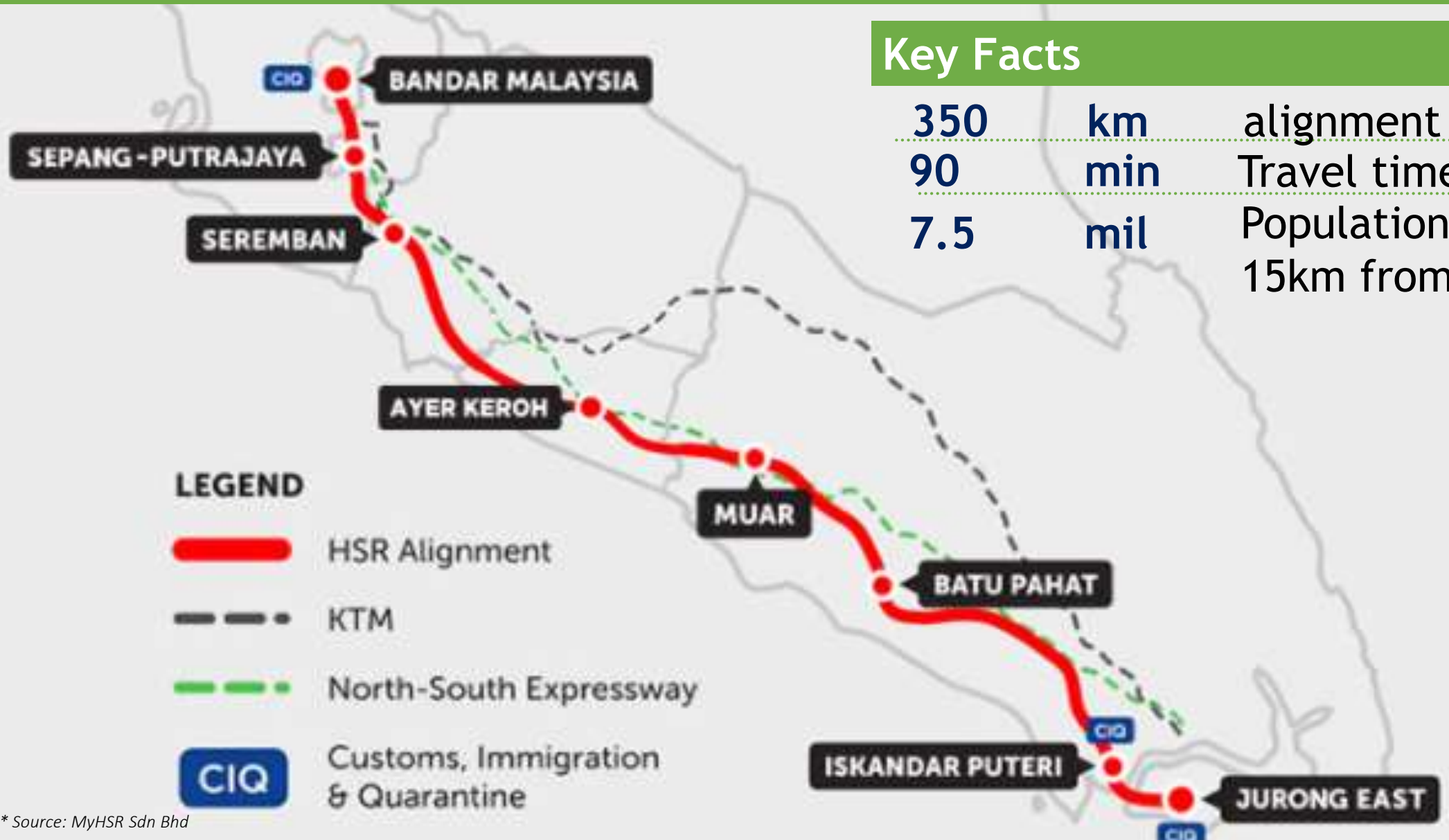
To determine the potential impacts of climate change on future rail projects in the region.

To establish the potential actions to mitigate climate-related risks.

Introduction on HSR KL-Singapore

PROJECT OVERVIEW

HSR KL-SPORE



Key Facts

350	km	alignment
90	min	Travel time from KL – SG
7.5	mil	Population catchment 15km from the station

** Source: MyHSR Sdn Bhd*

PROJECT OVERVIEW

HSR KL-SPORE

High Speed Rail

Express — 90 minutes — KL — SG

Transit — 7 cities served

*22 million passengers (for all travel routes)

*15 **minutes between trains for target service of 4 trains per hour**

* Source: MyHSR Sdn Bhd

Key Facts

Distance

- **System length of ~350km, from Bandar Malaysia to Jurong East**

Speed

- **Maximum design speed of 350 km/hour on proven high speed rail technologies**

Technology

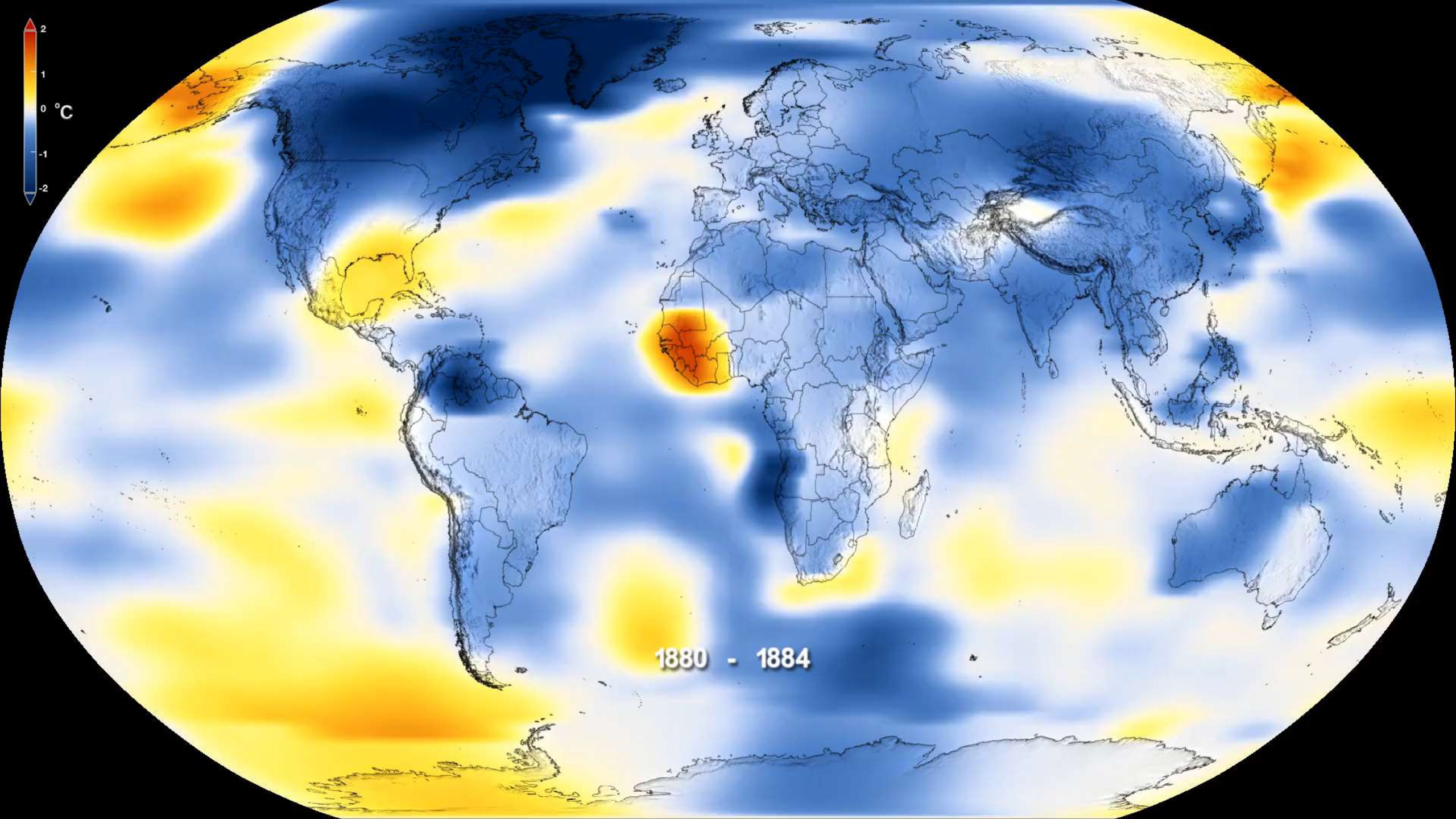
- **Double track on standard gauge**

Service

- **Dedicated passenger service**
- **City center to city center connectivity**

Introduction on Climate Change

The Greenhouse Effect


2
1
0 °C
-1
-2
1880 - 1884

Climate Change in M'sia

The obvious climate change that Southeast Asia experienced currently is increasing surface air temperature.

There were several studies that demonstrated tropical cyclones originating in the Pacific has increased given major impact to the Philippines and Vietnam (Malaysia Metereological Department, 2009) and including the Peninsular Malaysia southern bound massive flood happened in 2006 and 2007. (Badrul Hisham, Marzukhi, & Daud, 2009).

The increasing temperature and decreasing rainfall, both has significantly increased the intensity and spread the forest fires in Southeast Asia. Fires in peat lands in Indonesia during El Nino dry season are now common every year and had caused haze to almost ASEAN countries.

It is projected that in the next 50 years, Malaysia will experience higher temperatures, changing rainfall patterns, rising sea levels and more frequent extreme weather events including droughts and floods (Met, 2015).

The Climated-related Risks to the Planned Operations of the HSR Systems

Local Climate & Geography

The Government have identified a preferred coastal alignment from Kuala Lumpur to Singapore.

Malaysia rainfall distribution pattern is defined by both seasonal wind and local topographic. The west coast (HSR alignment) to be hindered from heavy drains due to the topographical features (far from SCS).

But due to Climate Change, severe and destructive floods in Johor occurred in two events back to back in Dec 2006 and Jan2007, which are known as Typhoon Utor.

Topographical&Geological

Topography: The proposed HSR route is along coastal esp at southern part i.e low lying area near to the sea.

Geological: The propose HSR route starting from KL, will pass through a carboniferous area, consist of limestone. The route then will cross granite geology in the Seremban area. In the southern part of the route, the HSR line from Melaka to Nusajaya lies on coastal area. Soil conditions are mostly in the form of clay, silt and peat.

According to Bakshipouri et al., approximately 40% (236.827km2) of the Kuala Lumpur area is underlain by limestone and karst, which are extensively developed and classified as extreme Karst class Kv.

Extreme Weather and Its Potential Impact on Railway Infrastructure

POTENTIAL IMPACTS

Flood

1. Earthworks Failures i.e settlements
2. Scour Of Bridges
3. Risk To Signalling Systems
4. Electronic Equipment And Track Circuit Failures

POTENTIAL IMPACTS

High Temperatures

1. Rail Buckling
2. Expansion of swing bridges
3. Overheating of electric equipment
4. Overhead line sag

POTENTIAL IMPACTS

High Wind

OLE damage from fallen trees, branches and objects

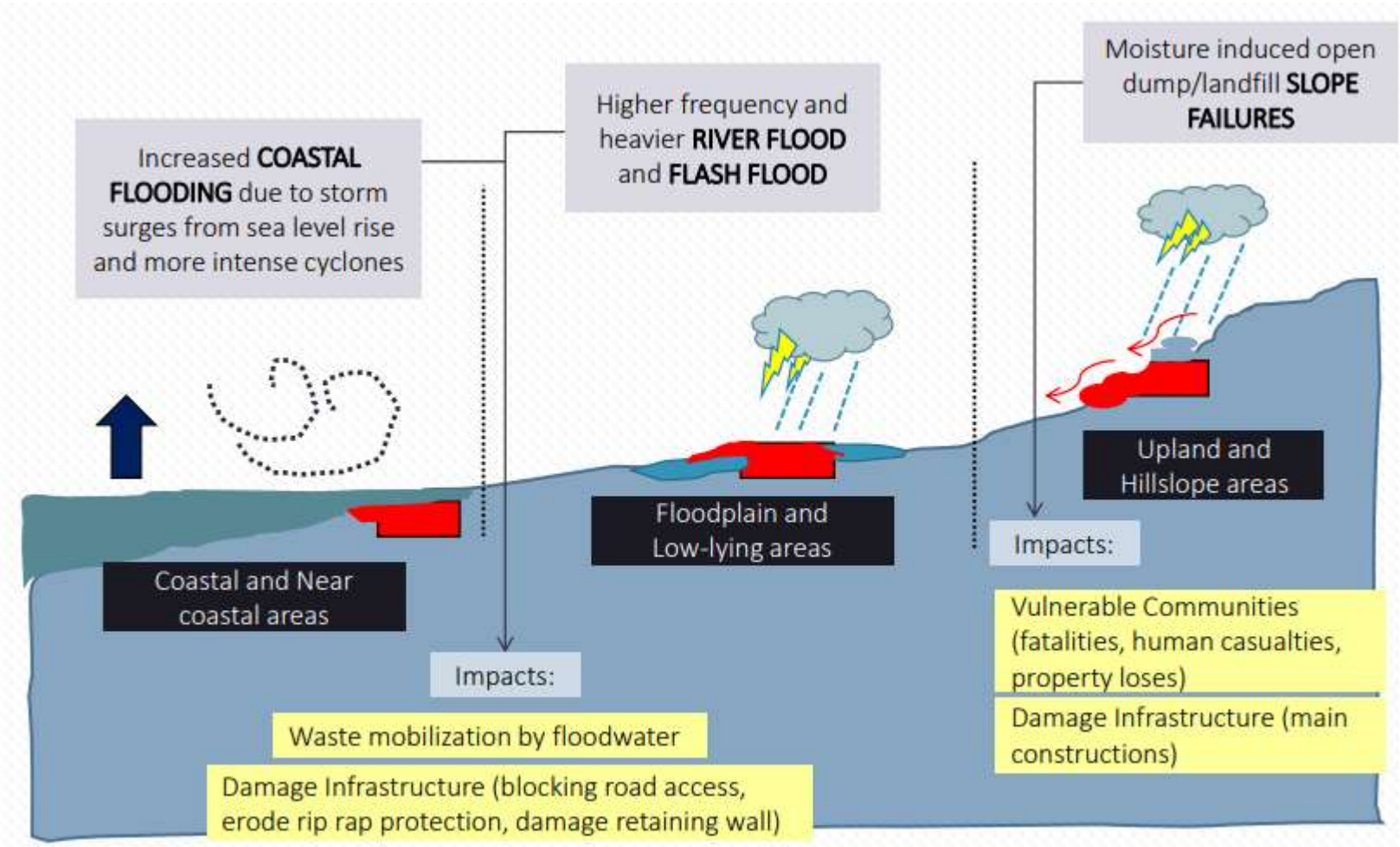
POTENTIAL IMPACTS

Landslides

Damage to the whole infrastructure and the rolling stocks

POTENTIAL IMPACTS

Sea Level Rise



Affect the 100 year return period flood level design for bridge platform level.

Overview Risks Of HSR Malaysia

Climate Impact Group	Risks	Safety Impact	Performance Impact	Likely Negative Impact from CC	Long or Short Term
Sea Level Rise	Increased flooding generally	Medium	High	High	Long
Increased Rainfall	Landslide	High	High	High	Long
Increased Rainfall	Settlement	High	High	Low	Long
Heat	Track buckling	High	High	High	Long

Infrastructure Design Requirements for Operational Readiness to Climate Change

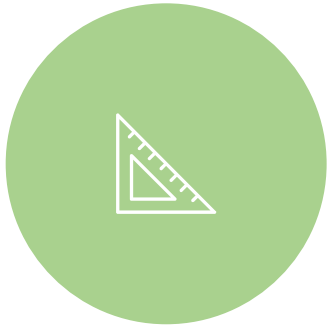
MITIGATION/ADAPTATION PROPOSAL ON DESIGN CRITERIA

BRIDGE

Design 1 in 200 years return period with 20% allowance for climate change

DRAINAGE

Open Drainage Return Period of 50 years and 100 years for culvert with a 20% of climate change

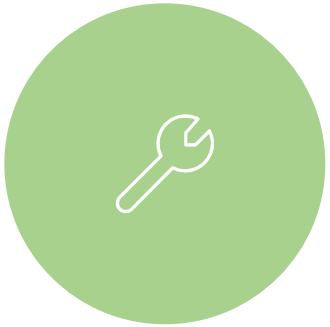


OLE

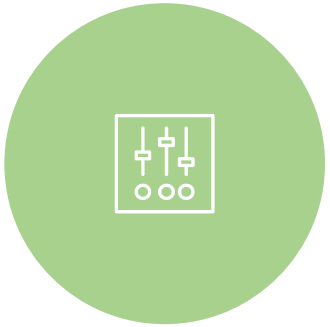
Design for temperature range 10^0 to 50^0

EARTHWORK

1. Reduce Slope Angles
2. Vegetation management
3. GIS based alert system



RAIL



Adapt more resistant specification by narrowing the temperature tolerances

CONCLUSION

The mitigation and adaptation measures to the risk of climate change are crucial in assuring:

- **Railway safety**
- **Reliability**
- **Capacity for the future**
- **Value for money**

Improve and embed the knowledge and understanding of climate change impacts to the policy makers/ central agencies/ infra owners

Establish baseline, and future, impacts operating costs and economics of adaptation, across a wide set of asset types.


THANK
YOU
GRACIAS
ARIGATO
SHUKURIA
DANKSCHEEN
BIYAN
SHUKRIA
TINGKI
YAQHANYELAY
TASHAKKUR ATU
SUKSAMA
EKHMET
GRAZIE
MEHRBANI
MAAKE
KOMAPSUMNIDA
GOZAIMASHITA
EFCHARISTO
JUSPAXAR
PALDIES
BOLZÏN
MERCI