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TOWARDS A RESILIENT TRANSPORTATION INFRASTRUCTURE

A MULTI-CRITERIA APPROACH FOR FLOOD RISK ASSESSMENT OF HIGH SPEED RAILWAY DESIGN IN TÜRKİYE

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Content



- FLOOD RISK RESOLUTION
- FLOOD RISK IN CONSTRUCTION
- FLOOD RISK IN RAILWAYS CONSTRUCTION
- THE EXISTING ACTS AND INVESTIGATIONS
- OUR PROPOSAL FOR UNDER-CONSTRUCTION RAILWAYS IN TÜRKİYE
- CASE STUDY
- CONCLUSION



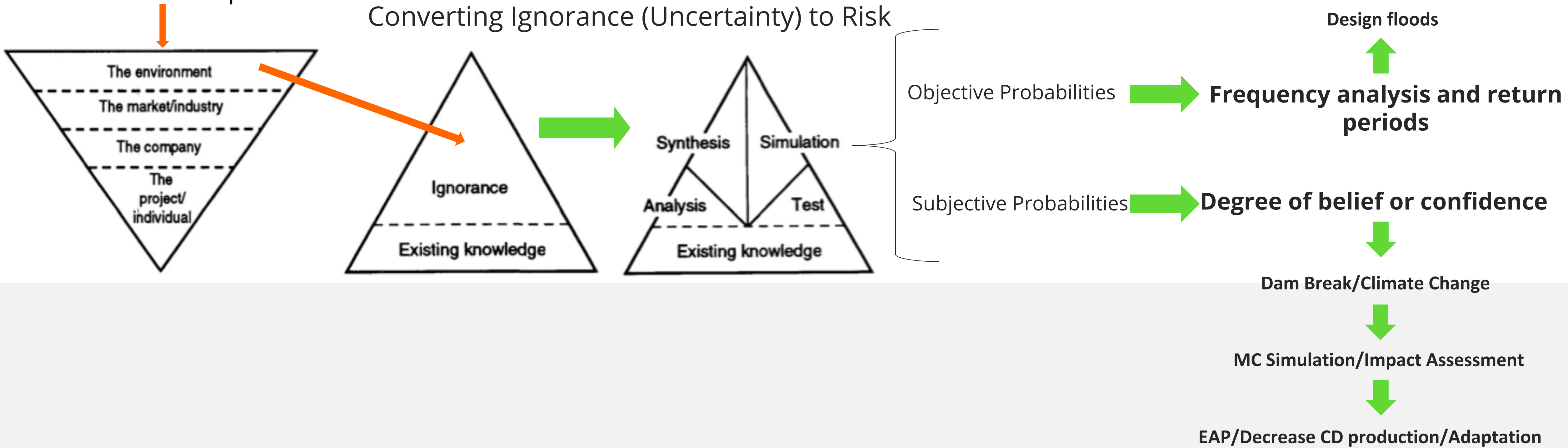

AUSTÜRKİYE
ITS TÜRKiYE

SUMMITS 2-3-4
MAYIS
Uluslararası AUS Zirvesi '24
Emniyetli | Güvenli | Yeşil | Entegre | Dayanıklı

FLOOD RISK RESOLUTION (General Methods)

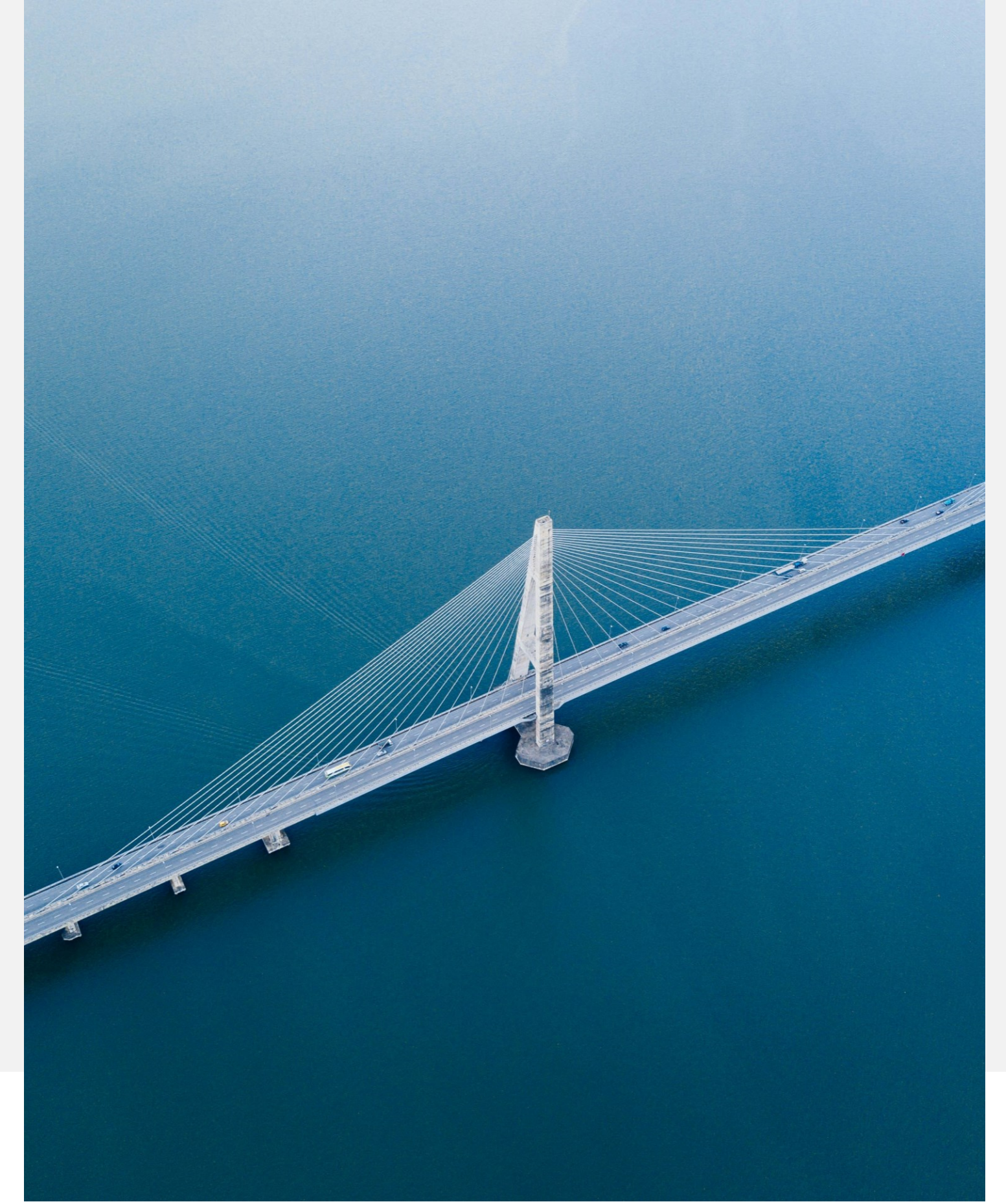
Flood is a natural uncontrollable

Environmental disaster with Significant Risk on urban and infrastructures but is a Blessing for food production and water balance in floodplains



FLOOD RISK IN CONSTRUCTION

Flood risk in construction refers to the potential for flooding to affect construction sites or completed structures. This risk can vary based on location, climate, topography, and other factors.



Temporary Risks

- Inundation of Construction Sites
 - Temporary Structure Damage
- Work Delays and Project Overruns
- Water Damage to Building Materials
 - Sedimentation and Debris Accumulation
- Erosion and Foundation Instability

Permanent Risks

- Backwater in Upstream
- Change River Morphology and Bed Level
 - Scouring in transverse or longitudinal Structures
- Increase potential of Direct and Indirect Damages
 - Climate Change Effects

Some Examples



River diversion during dam construction and its failure consequence



Canalization of urban rivers and increase flood risk by change in land use and climate

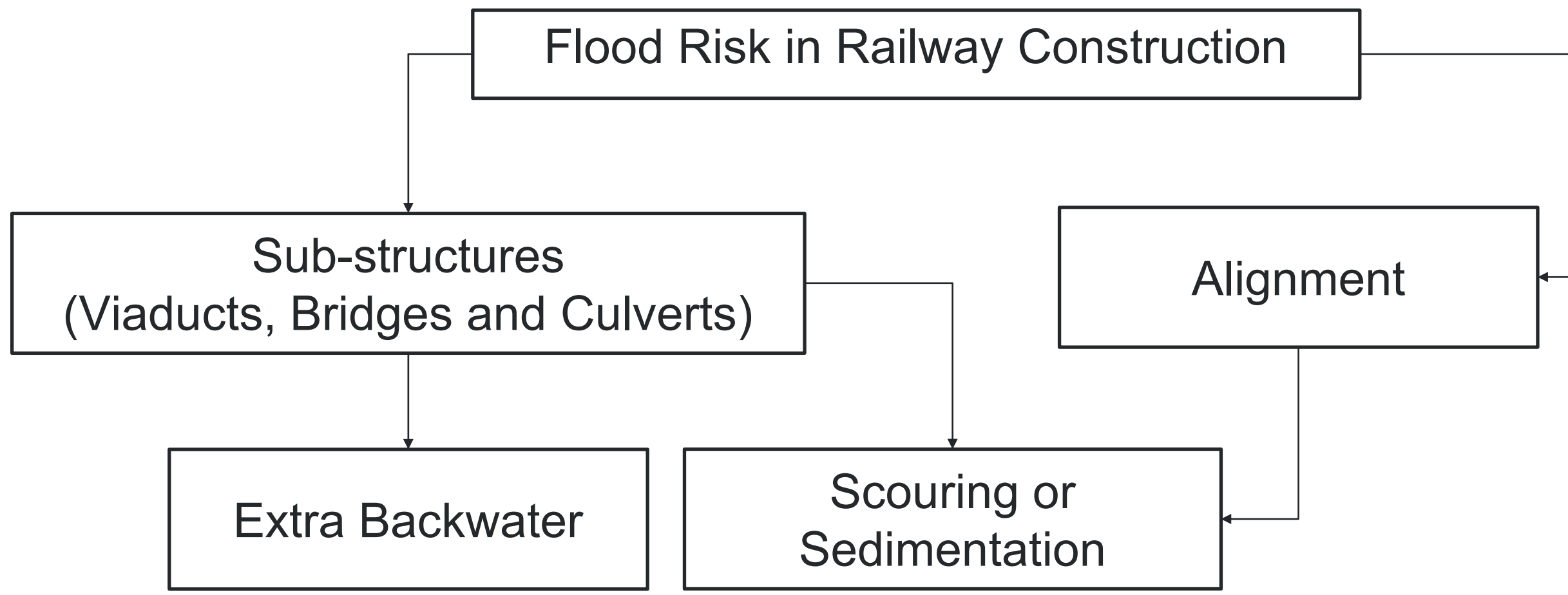


Construction of transportation infrastructures and socio-economic change around alignment

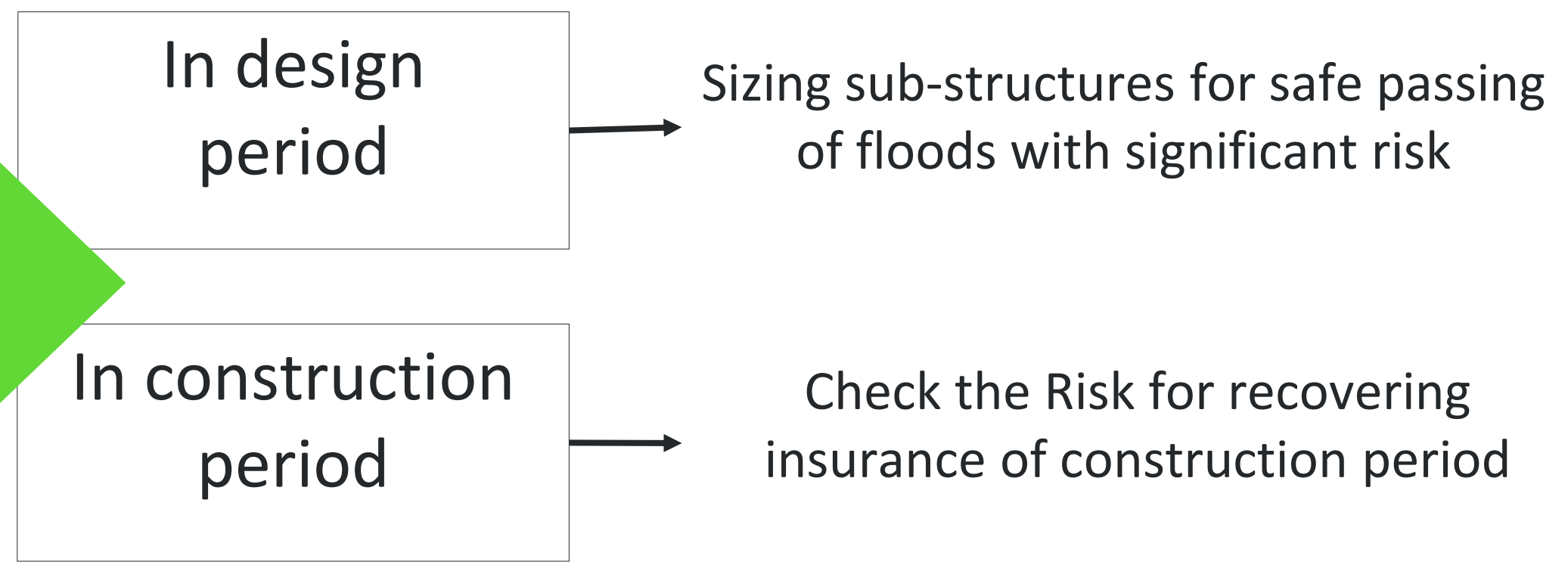
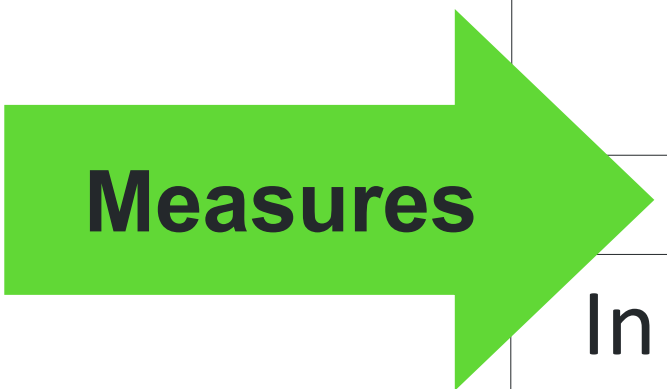
FLOOD RISK ANALYSIS IN RAILWAYS CONSTRUCTION



Railways as a large-scale infrastructure project provides safe, efficient and economic transportation of goods and passengers internal and external of cities.



For ensuring the safety, resilience, and functionality of the railway infrastructure, especially in flood-prone areas.



- ❑ Increasing risk for socio-economic in upstream area from extra backwaters
- ❑ River restriction consequences around alignment on river morphology

FLOOD RISK ANALYSIS IN RAILWAYS CONSTRUCTION



EXISTING ACTS AND GUIDLINES

Preparation of Flood Management Plans (Ministry of Agriculture and Forestry, Türkiye, 12 May 2016)

River Basin Characteristics
Preliminary Flood Risk Assessment
Floods Hazard and Risk Maps
Objectives and Measures
Coordination with River Basin
Management Plans

Highway Design Handbook
(General Directorate of Highways,
Türkiye, December 2016)
CHAPTER 6 : Drainage Design

FLOOD AND SEDIMENT CONTROL REGULATION (STATE HYDRAULIC WORKS, TÜRKİYE, 3 MAY 2019)

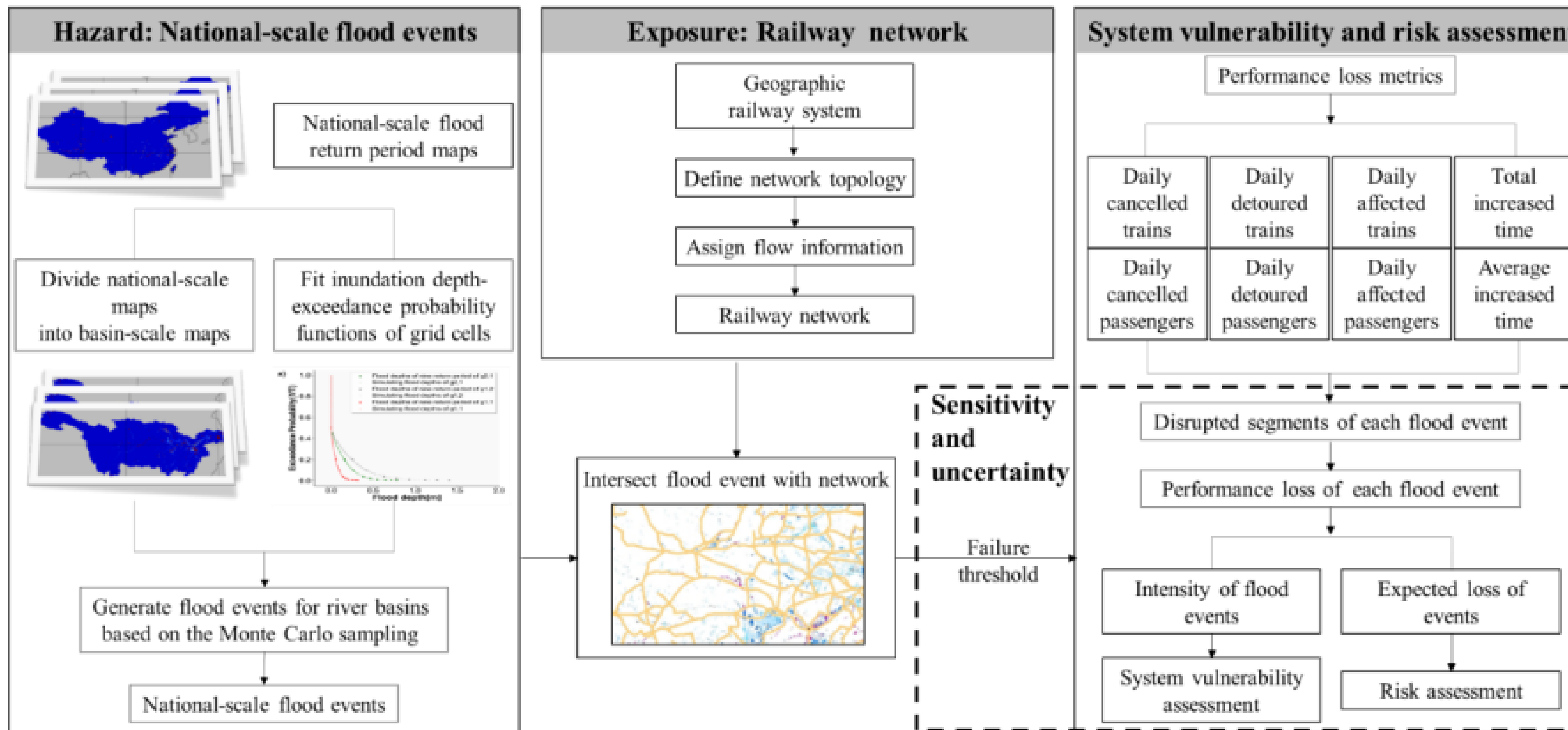
Including criteria in design of flood and sediment for crossing structures, hydraulic section approval, removing sand and gravel from stream beds

FD(2007/60/ EC, Updating every 6 years)

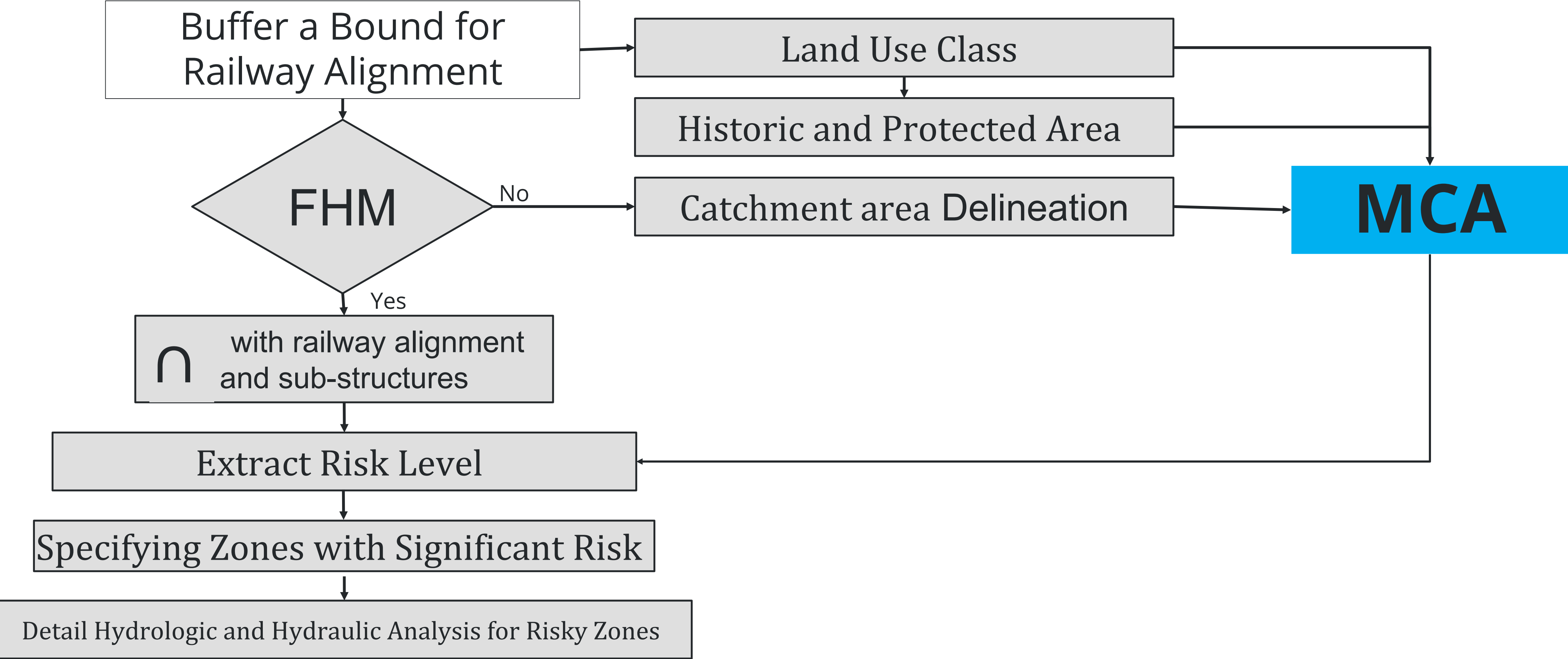
Preliminary Flood Risk Assessment
Floods Hazard and Risk Maps
Flood Risk Management Plans
Climate Change Adaptation
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FLOOD RISK ANALYSIS IN RAILWAYS CONSTRUCTION

System vulnerability and risk assessment of railway systems to flooding (Weihua et al 2021)



OUR PROPOSAL FOR RAILWAY DESIGN IN TÜRKİYE

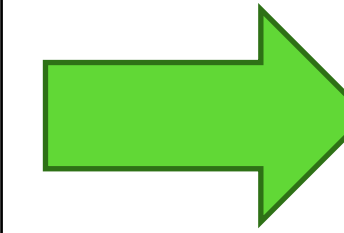


OUR PROPOSAL FOR UNDER-CONSTRUCTION RAILWAYS IN TÜRKİYE

Multi-Criteria Analysis (MCA)



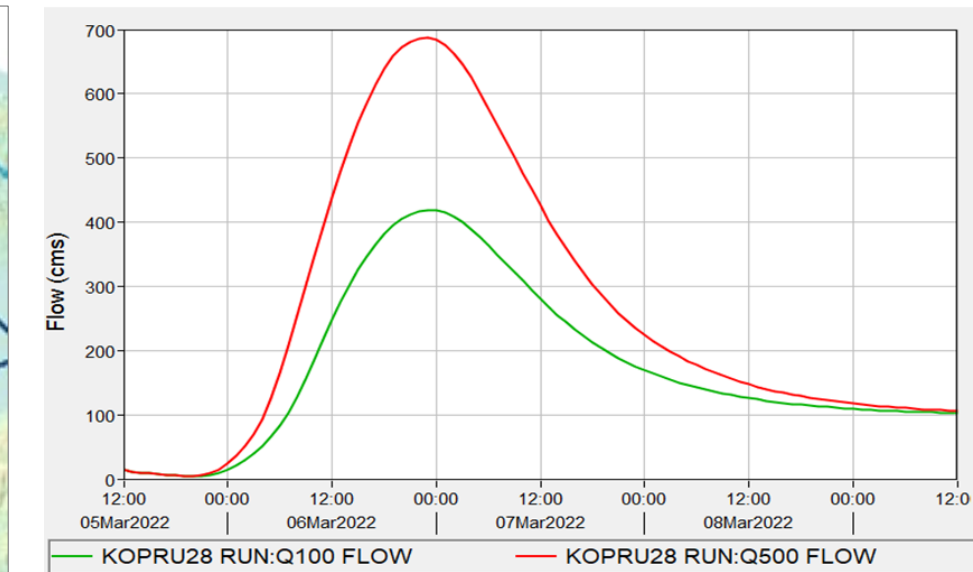
Criteria (Weight)	High (100)	Medium (50)	Low (0)
Population and Urban Area (0.5)	Residential and commercial	Park, roads, orchards, and Agriculture	zero populated area
Economic facilities (0.25)	Residential and commercial public infrastructures	Orchards and Agriculture	Forest and non-agriculture area
Protected areas and historical monuments (0.10)	Completely influenced by floods	Partially influenced by floods	No impact
Catchment Area (0.15)	>10 km ²	1-10 km ²	<1 km ²



Normalized Index	Significance
0-0.25	Not significant
0.25-0.5	Moderately significant
0.50-0.75	Significant
> 0.75	Very significant

CASE STUDY

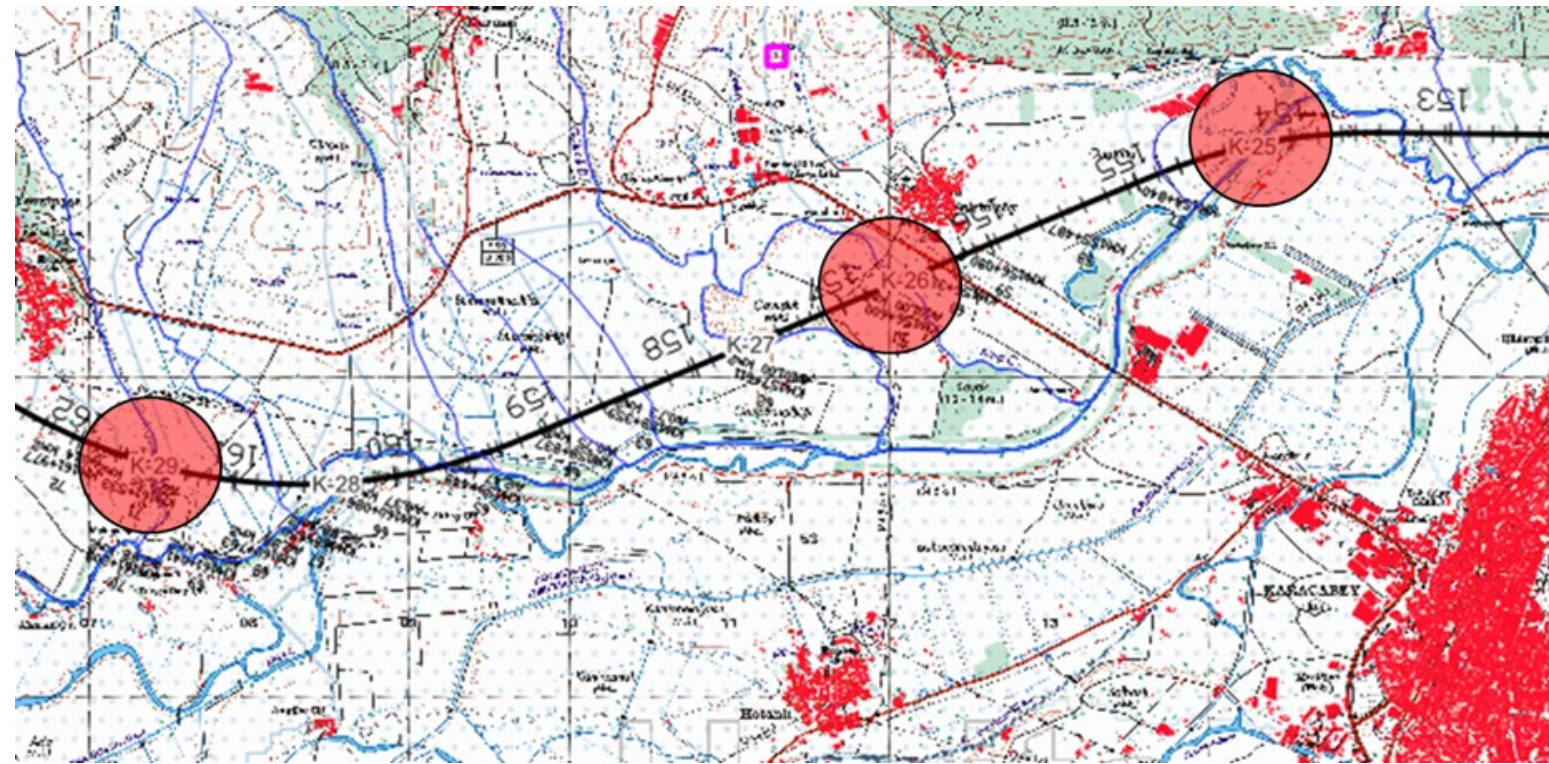
Zone	Substructure Name	Kilometers	Size (m)	Catchment Area (km ²)	Domain Land Use	Risk Level
1	K-25	154+000	500.000	4165.20	Rural and Agriculture Area	Significant
	K-26	156+600	60	101.00	Rural and Agriculture Area	Significant
	K-29	161+533	150	23.35	Rural and Agriculture Area	Significant
2	K-37	171+940	45	47.48	Rural and Agriculture Area	Significant
3	CU-94	179+430	2.5×2	0.56	Rural and Industrial Area	Significant
	CU-95	180+000	2×2	0.12	Rural and Industrial Area	Significant
	CU-96	180+628	2.5×2	0.57	Rural and Industrial Area	Significant
	V-15	181+200	600	195.03	Rural and Industrial Area	Significant
	CU-97	181+942	2.5×2.5	1.36	Rural and Industrial Area	Significant
	CU-98	182+396	5×5	14.94	Rural and Industrial Area	Significant
	CU-99	182+817	2*4×4	25.32	Rural and Industrial Area	Significant
	CU-100	184+788	5×4	12.45	Rural and Industrial Area	Significant
	CU-101	185+441	3×3	4.85	Rural and Industrial Area	Significant
	CU-102	186+209	2.5×2.5	2.72	Urban Area	Very significant
	CU-103	187+505	2×2	0.03	Urban Area	Very significant
	CU-104	187+667	2×2	1.10	Urban Area	Very significant
CU-105	188+587	2.5×2.5	1.82	Urban Area	Very significant	



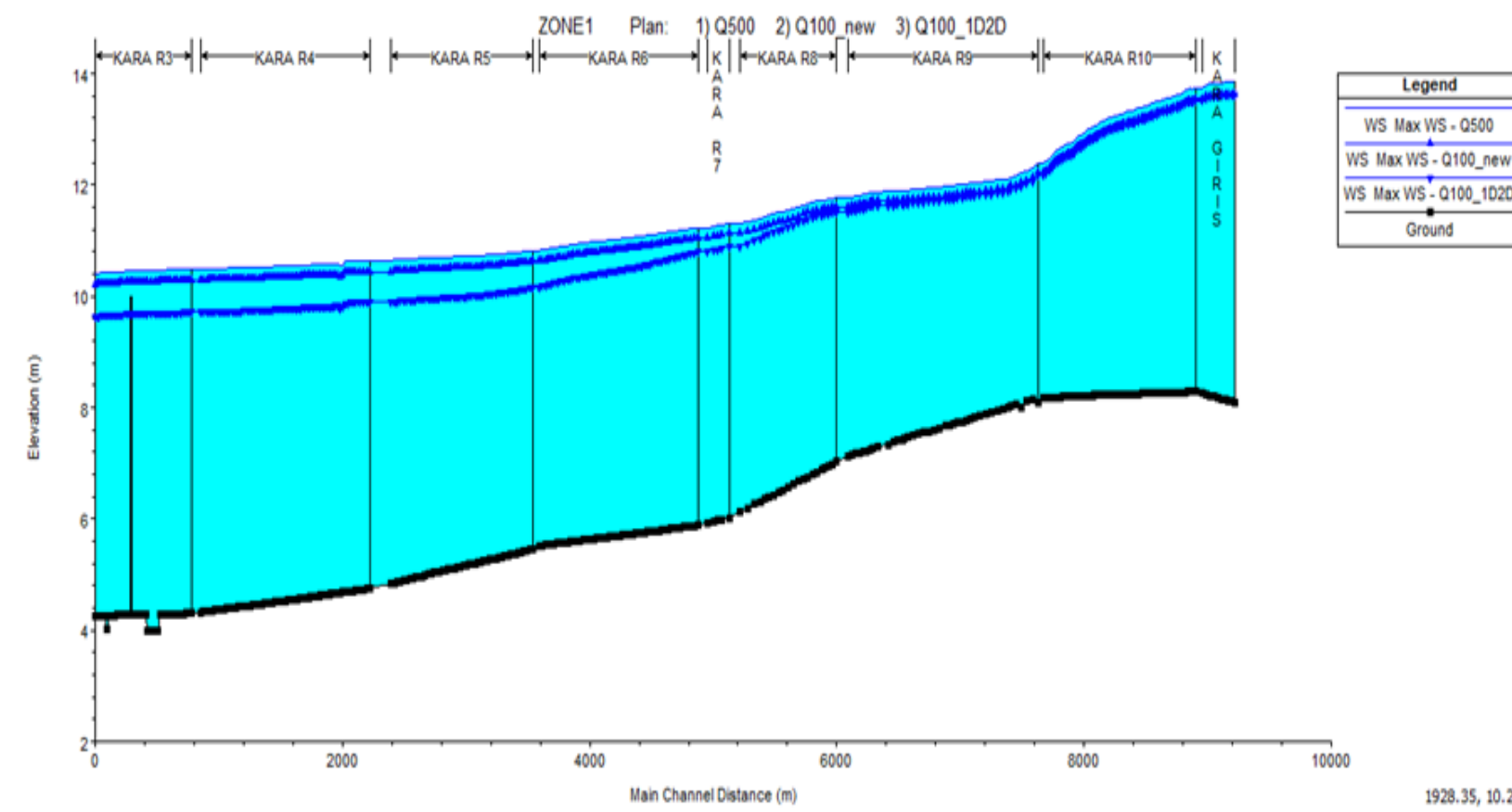
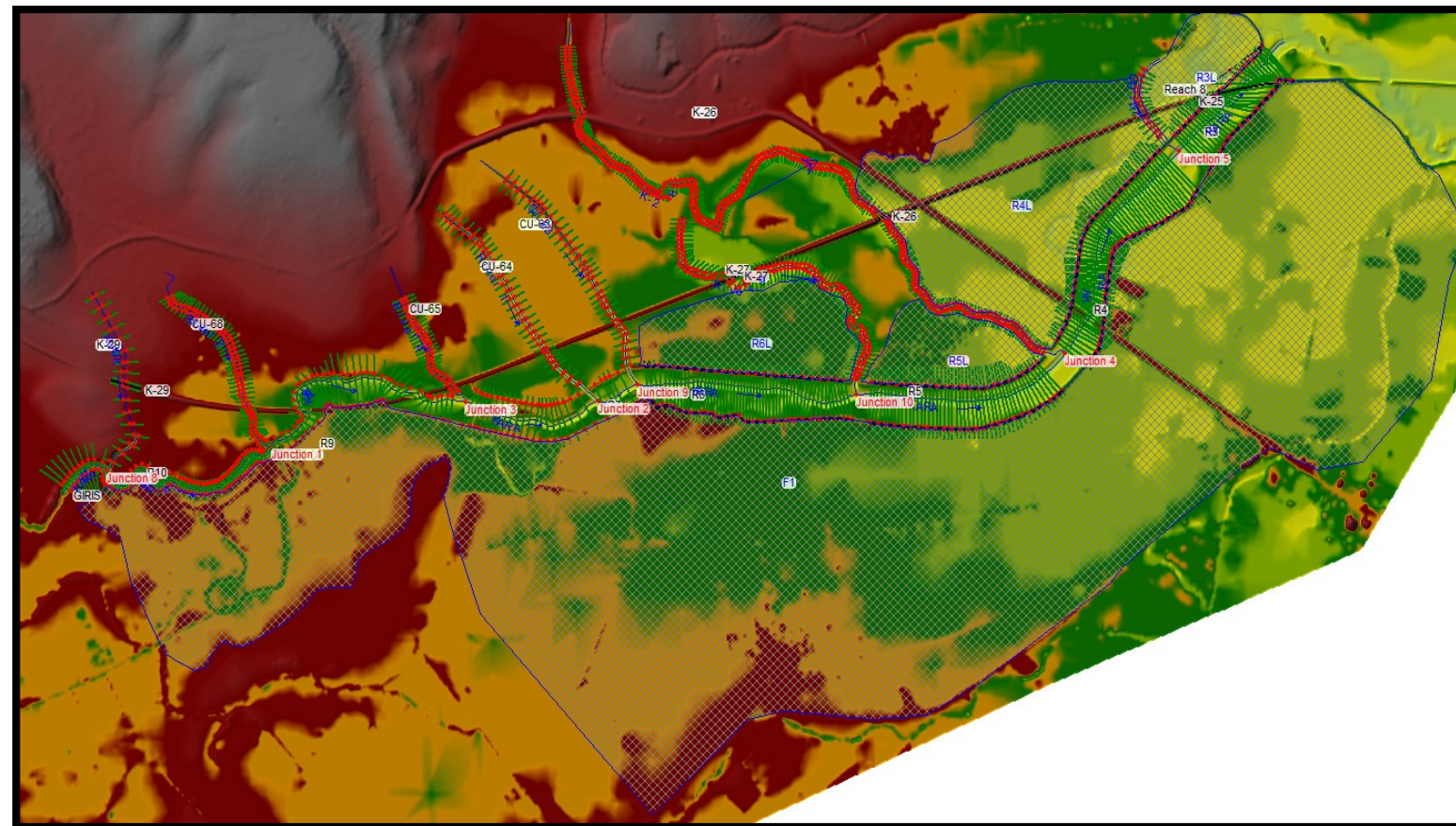
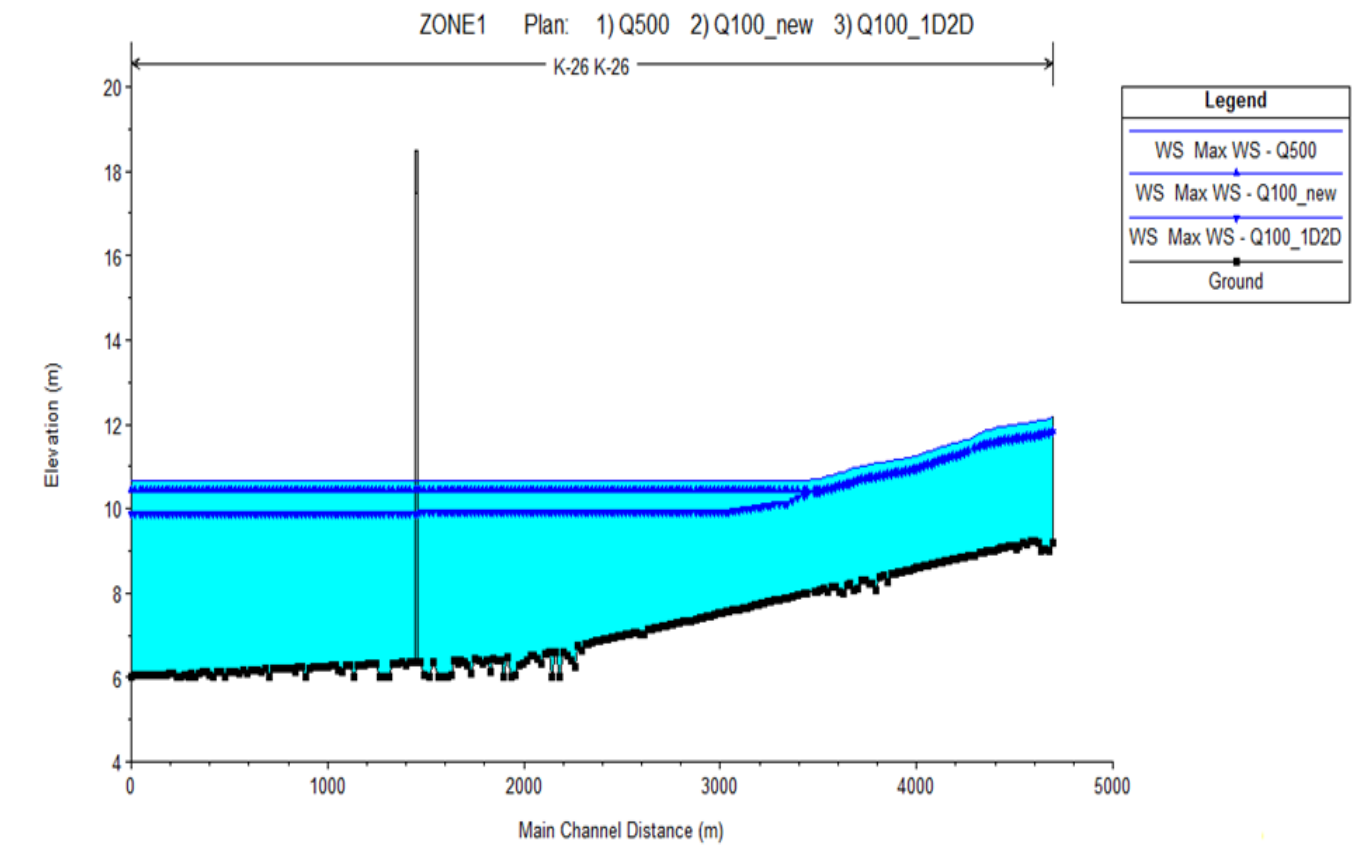
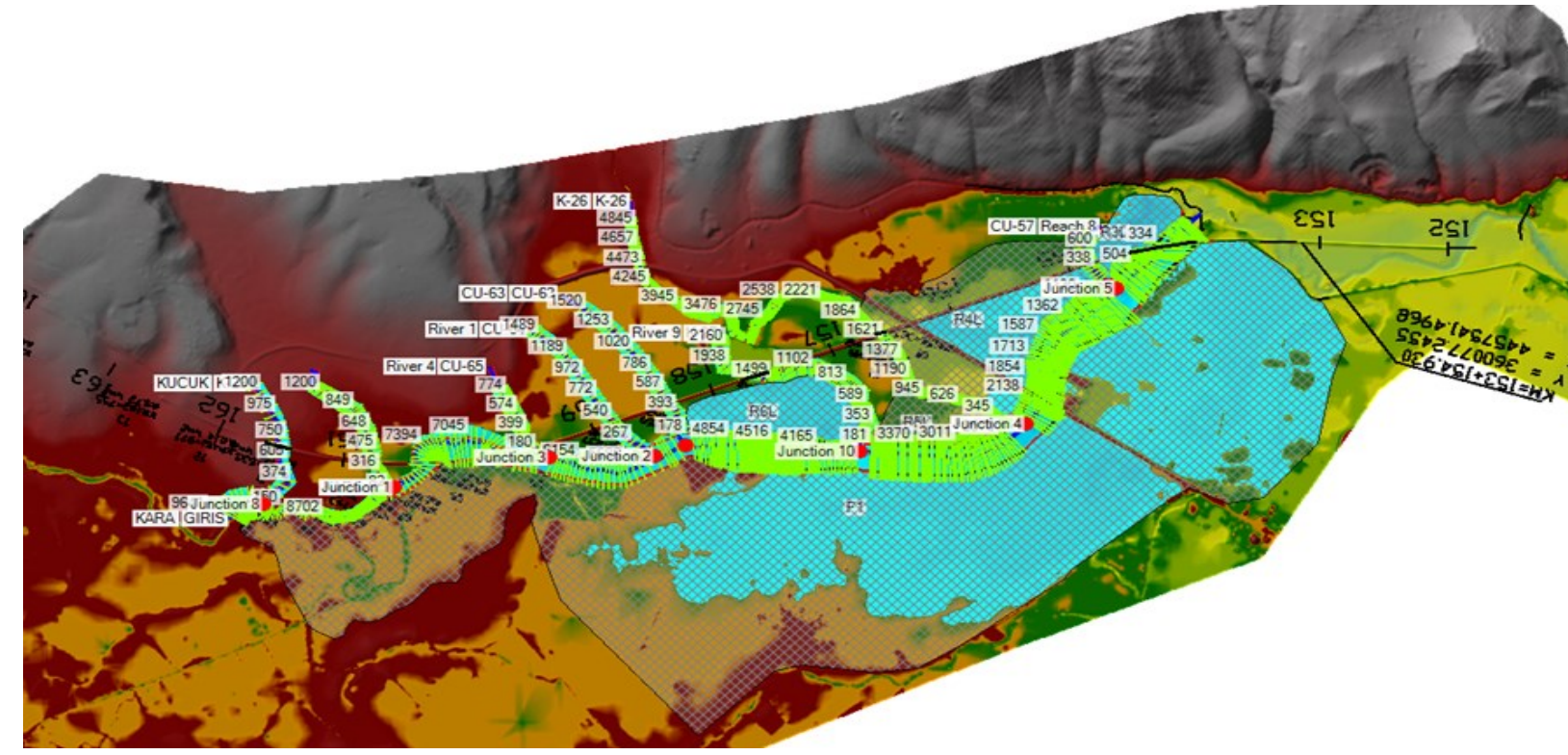
K-25 Floods Hydrographs

Hydrologic Modeling of Bridge K-25

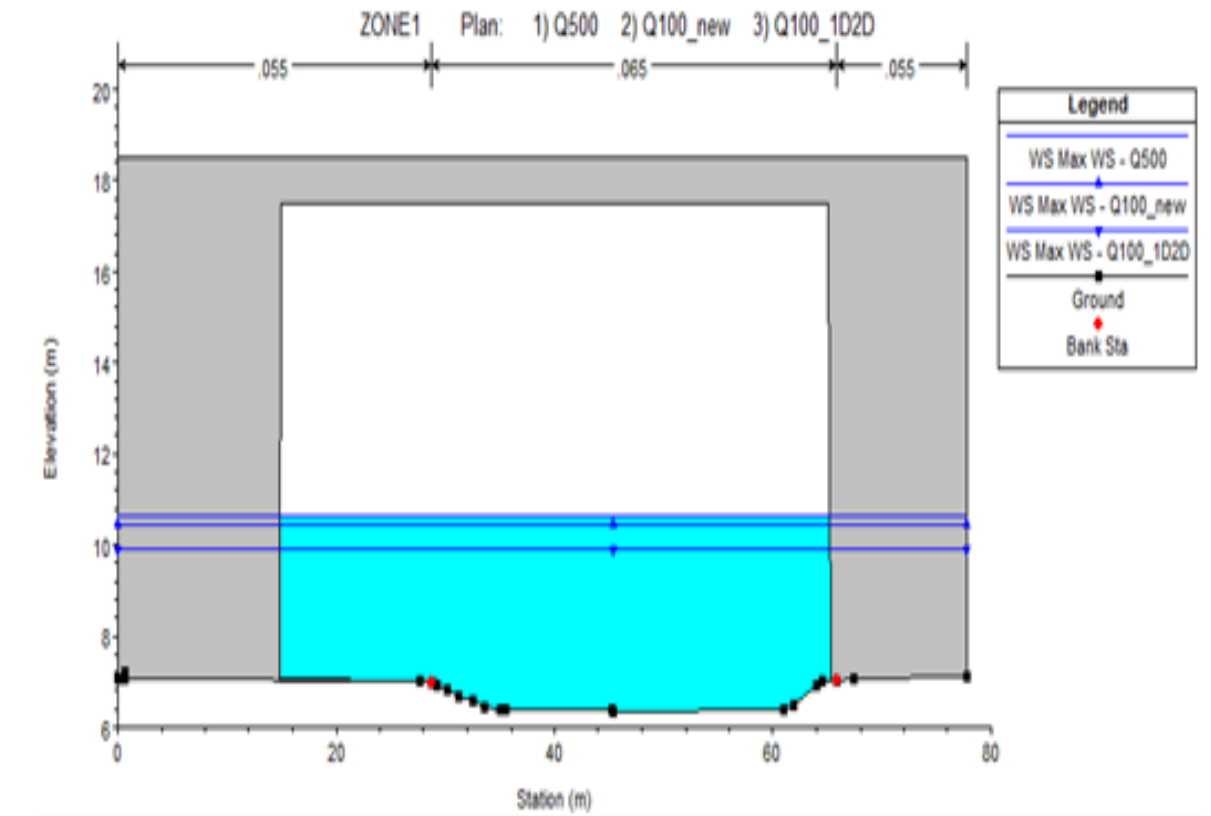
CASE STUDY



ZONE-1 Crossing Risky Bridges



ZONE-1 Hydraulic Simulation Results



K-26 Hydraulic Simulation Results

ZONE-1 Hydraulic Model

CONCLUSION AND THE KEY FINDINGS



- ❑ Türkiye is developing its high-speed railway line and needs a systematic method to analyze the risk of natural disasters such as floods for reduction socio-economic consequences.
- ❑ The proposed systematic flood risk assessment can be used for the existing railways floods risk evaluation as well as the railway in design and construction stage.
- ❑ The proposed approach helps benchmarking risky zones and investment to mitigation of existing railways floods damages
- ❑ Climate Change criteria must be added to the MCA for area with significant change in observed recodes.

- ❑ The proposed approach can standardize the procedure needs to flood risk assessment in the existing and in the under-construction railways.



Teşekkürler

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