

# Coastal Erosion in a Highly Dynamic Shoreline Environment A CASE STUDY IN DUBAI, UAE

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# Introduction – Project Location & Background



2000



2016

# Introduction – Project Location & Background



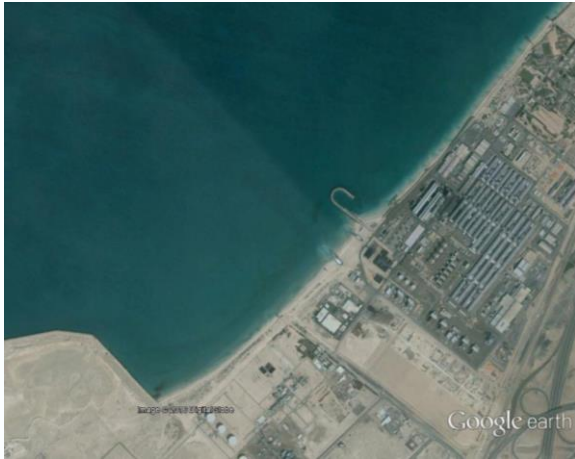
# Introduction – Presentation of the Problem



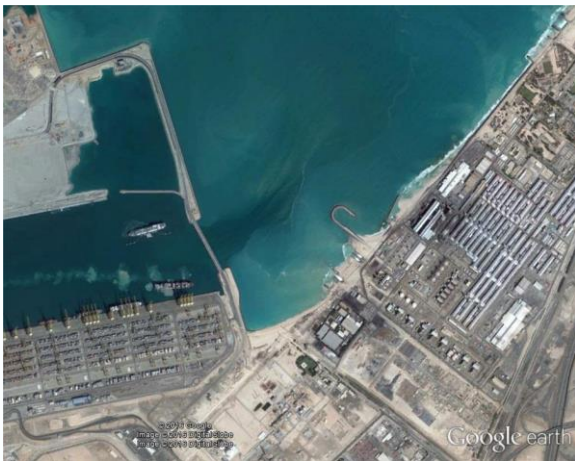
- Exposed gas and fuel pipelines and live 33 kV electrical cabling
- Emergency beach repair works already executed

March 2017

# Beach Stabilization – Shoreline Evolution Study



2005



2017

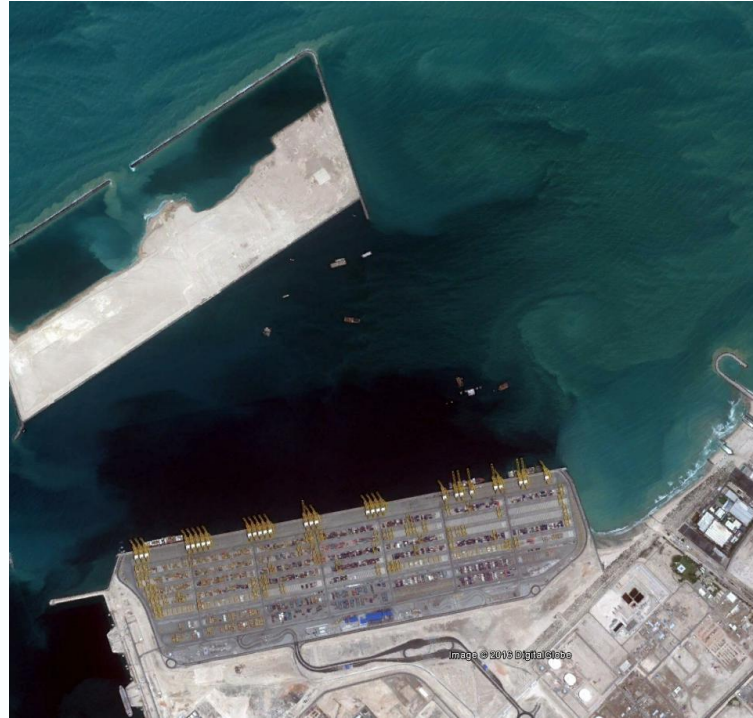


Shoreline receded ~50 m in 12 years

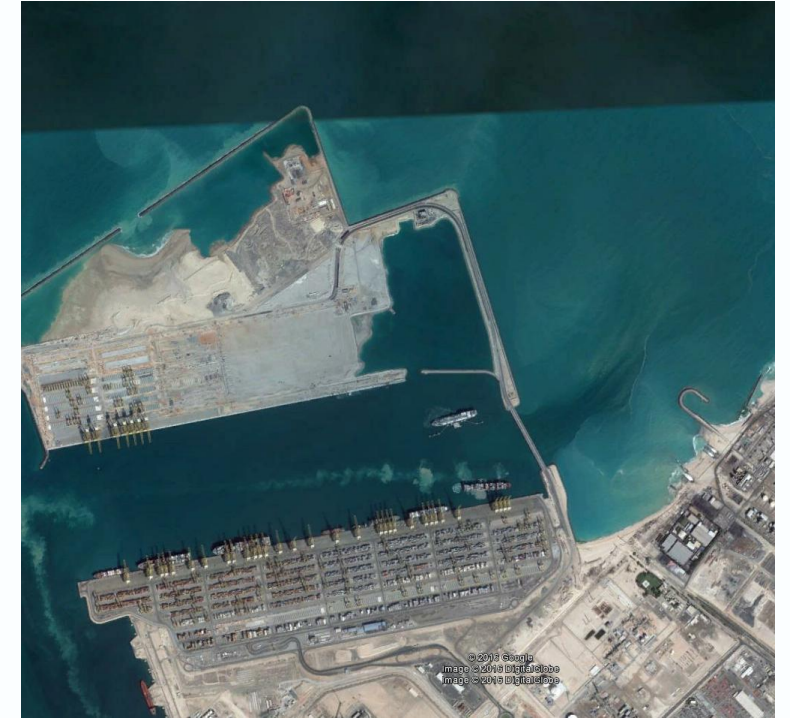
# Beach Stabilization – Shoreline Evolution Study



2005

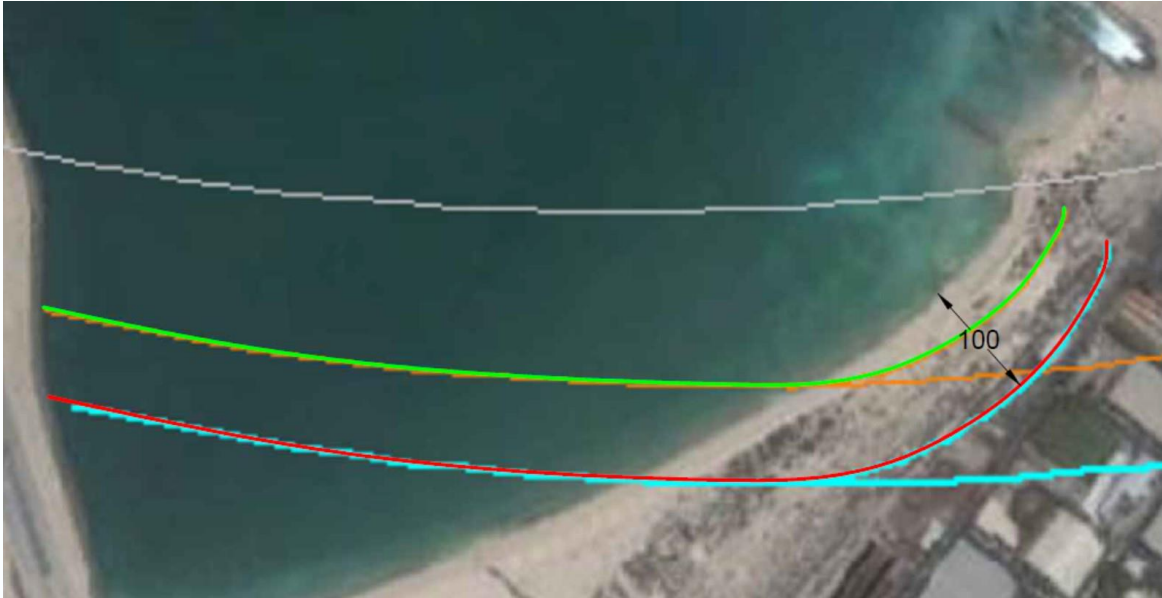


2010



2017

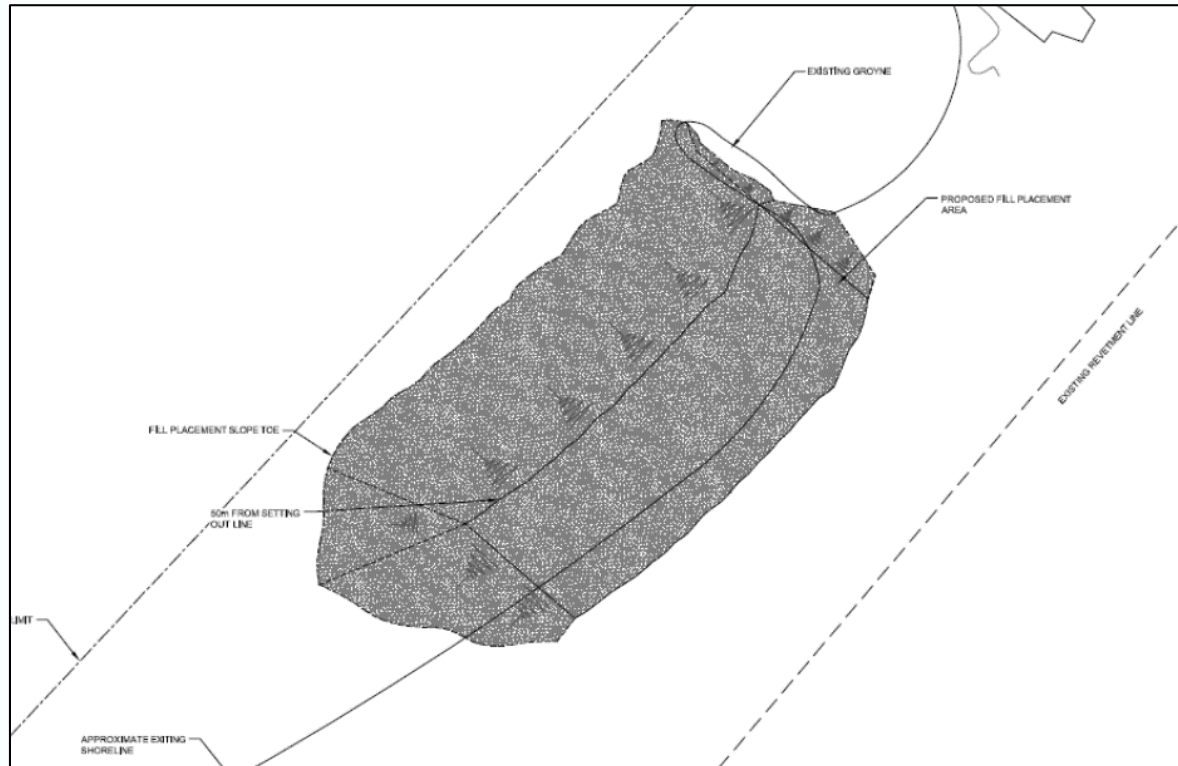
# Beach Stabilization – Shoreline Evolution Study



Final equilibrium shoreline

- Equilibrium shoreline shape formulation – Gonzalez & Medina (2001)
- Governing Parameters
  - Mean Wave Direction
  - Location of the point of diffraction
- Additional beach recession in case of no action –  $\sim 100\text{m}$

# Beach Stabilization – Temporary Solution



- 50,000 m<sup>3</sup> of sand material over 250 m of shoreline length



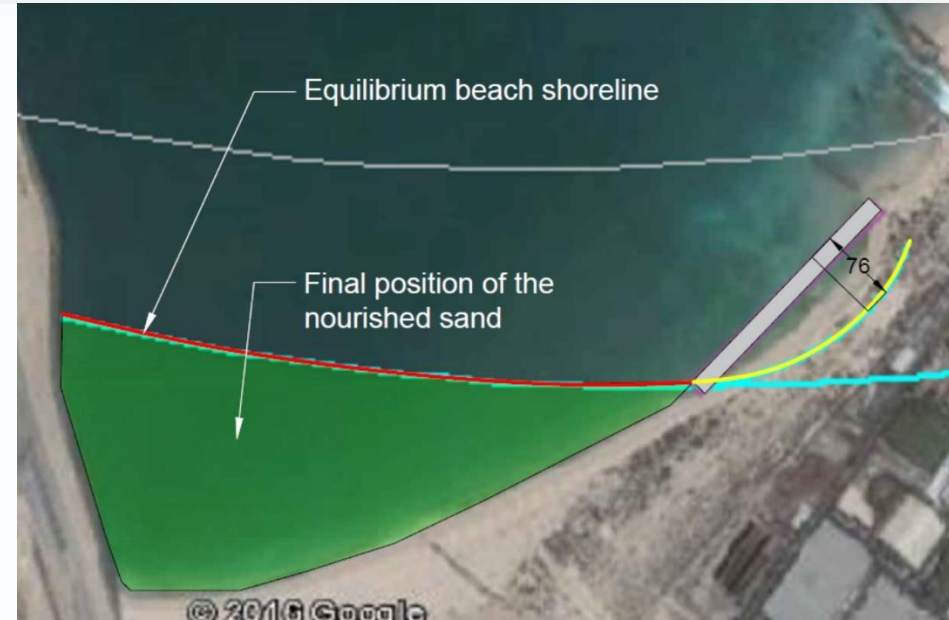


# Beach Stabilization – Solution Alternatives



Groynes Solution

- 15,000 m<sup>3</sup> of armour rock
- 11,000 m<sup>3</sup> of sand



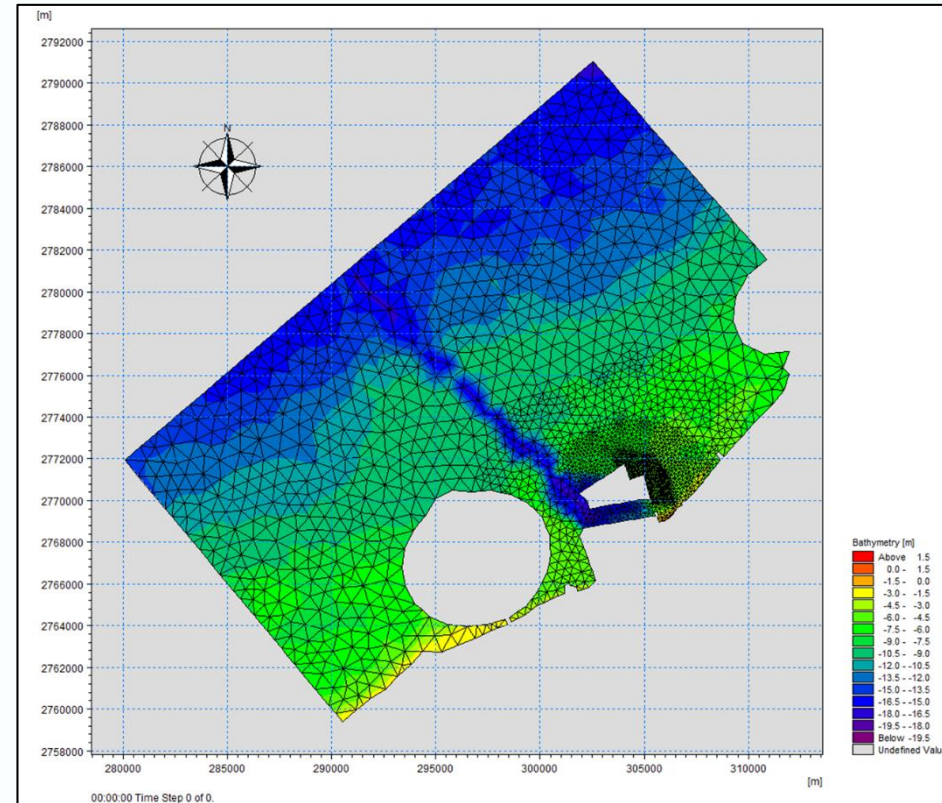
Rock Revetment Solution (~300 m long)

- 15,000 m<sup>3</sup> of armour rock
- 90,000 m<sup>3</sup> of sand
- 35,000 m<sup>3</sup> of backfilling material

# Beach Stabilization – Permanent Solution

## Wave Propagation

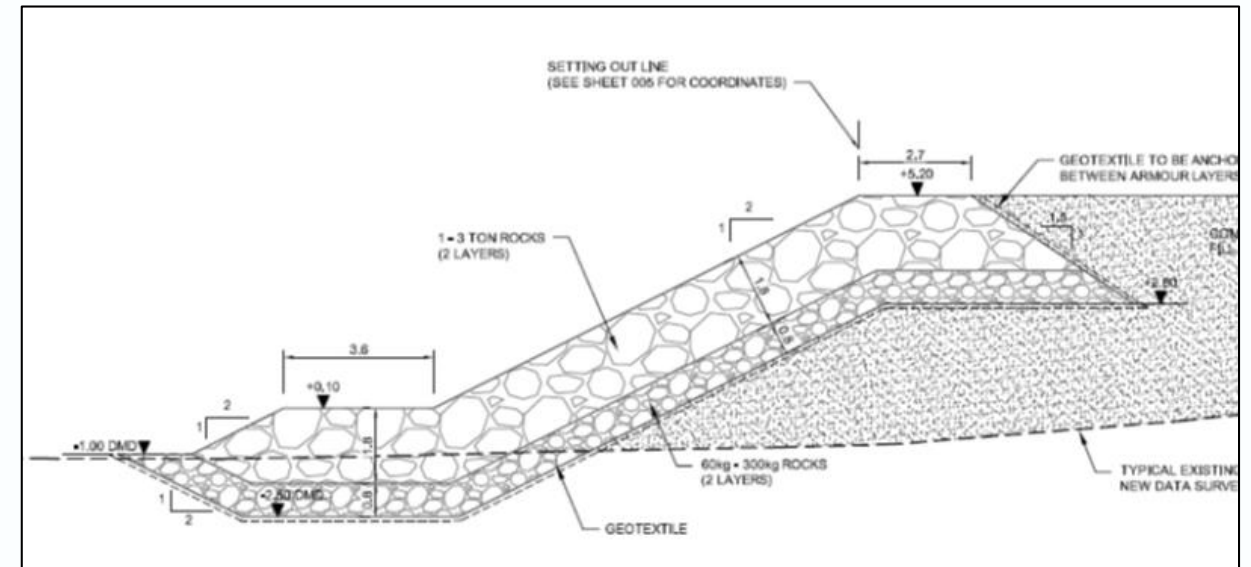
- 30+ years hindcast offshore metocean data
- Offshore/Inshore propagation model – MIKE21 SW
- Inshore/Toe of the structure propagation model – MIKE21 PMS



# Beach Stabilization – Permanent Solution

Design Parameters (Applicable code – CIRIA Rock Manual, 2007)

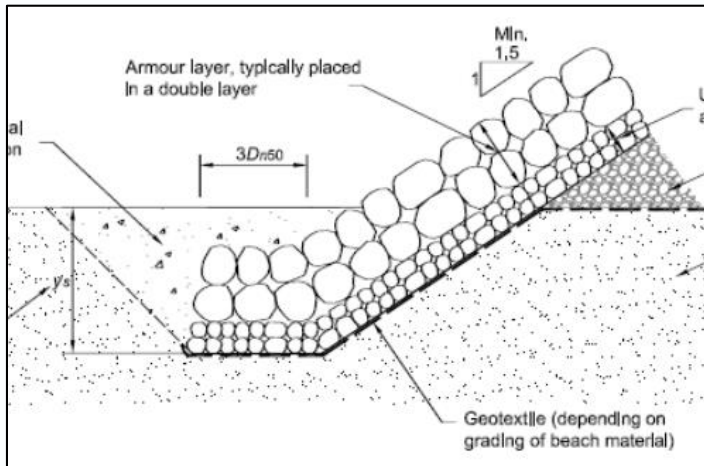
- Design life – 50 years
- ARI event – 100 years
- Design  $H_s$  – 2.14 m
- Design  $H_{2\%}$  – 2.28 m
- Cotg  $\alpha$  – 2
- Main armour rock W50 (VDM) – 1.27 t
- Main armour rock range – 1-3 t (applicable W50 – 2 t)
- Two main rock armour layers
- Underlayer rock range – 60-300 kg (applicable W50 – 180 kg)



# Beach Stabilization – Toe Scour Protection

## Toe Details

- Two layers
- W50 same as main armour rock (2 t)
- Toe width – 4 rock stones



CIRIA Rock Manual (2007)



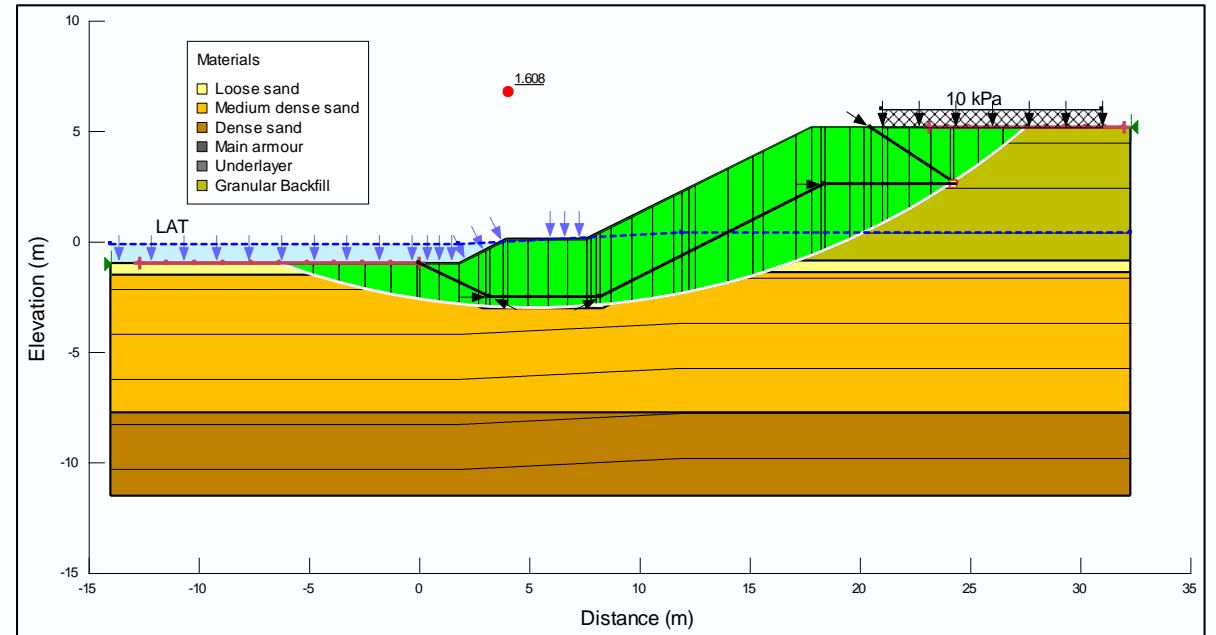
Toe trench excavation

# Beach Stabilization – Other Design Considerations

## Berm details

- Berm width – 3 rock stones
- Berm height – No structural damage (DWL = MHHW + SS + SLR)
- Wave overtopping – EurOtop manual

Static and dynamic slope stability analysis (SLOPE/W)



# Beach Stabilization – Completed Project



# Conclusions

## **Critical requirements during planning and design phases**

- Identify potential impacts outside project boundaries
- Assess the magnitude of these impacts (if any) and potential mitigation measures
- Implement Integrated Coastal Zone Strategies
- Evaluate remediation costs over total project costs. Significant overall benefit for the community compared to the additional costs (especially for large scale projects)
- Balance between permitting requirements and coastal development progress