Mayaro and Guayaguayare Coastal Protection

Stakeholder Consultation

17th November 2015

MINISTRY OF Works & Transport

Coastal Protection Unit

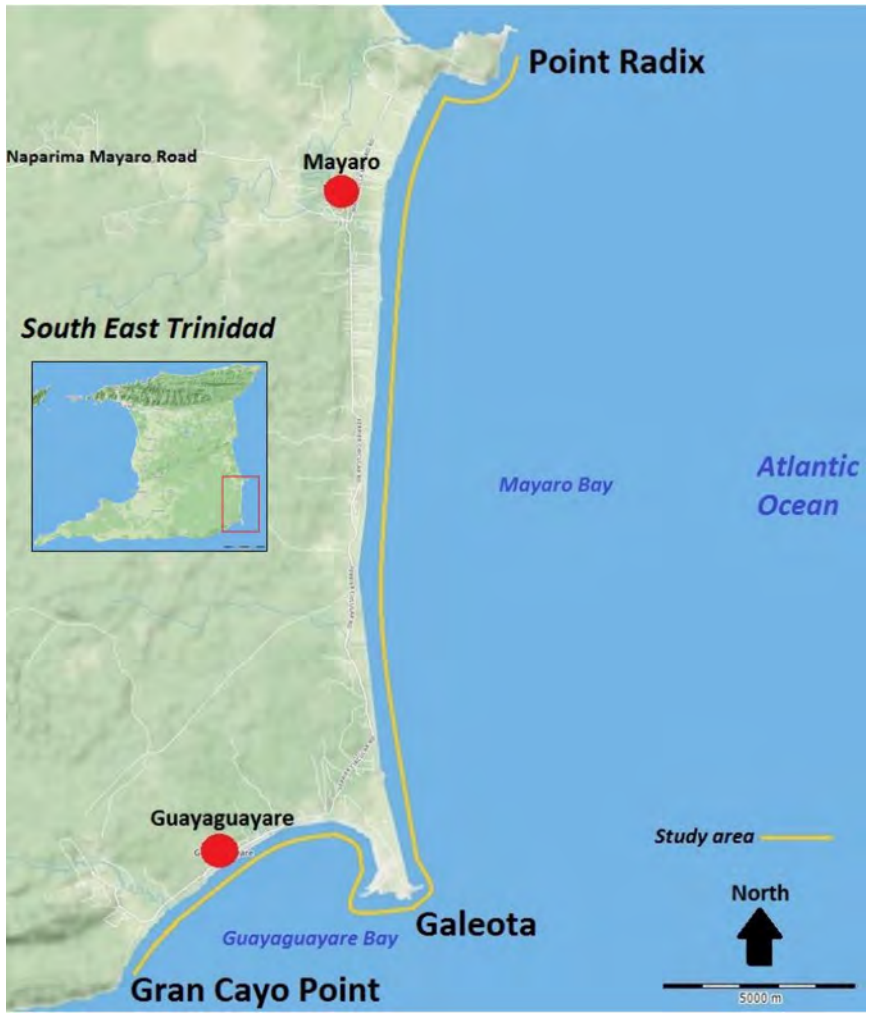
ch2m SM

Project Overview & Introductions

"Appraisal and design of <u>sustainable</u> coastal protection measures to address ongoing coastal erosion and coastal flooding problems at Mayaro and Guayaguayare"

or, WHERE AND HOW DO WE PROTECT THE COAST FROM EROSION AND FLOODING NOW AND INTO THE FUTURE

We invite your feedback on how we manage these risks



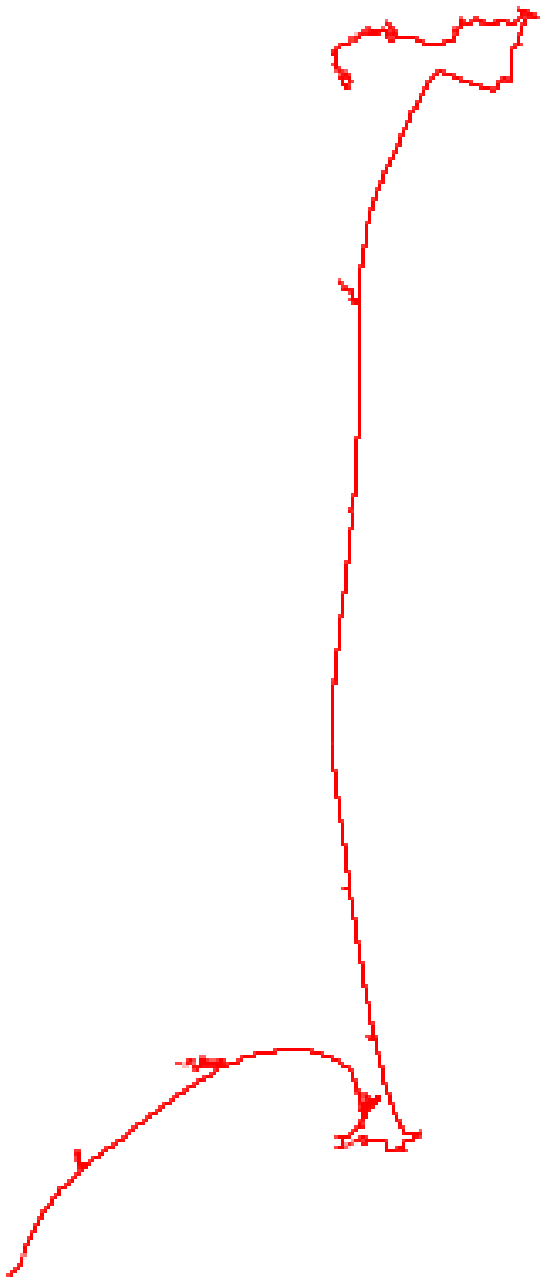
Agenda

- **Introduction (5 mins)**
- **What have we been doing and what comes next? (5 mins)**
- **What is “at risk” and where should we prioritise protection? (10 mins)**
- **What about your environment and livelihoods? (5 mins)**
- **What can we do to manage risk? (10 mins)**
- **Where should we be protecting? (25 mins)**
- **Questions on solutions? (50 mins)**

Introduction

What does the coastline face in the

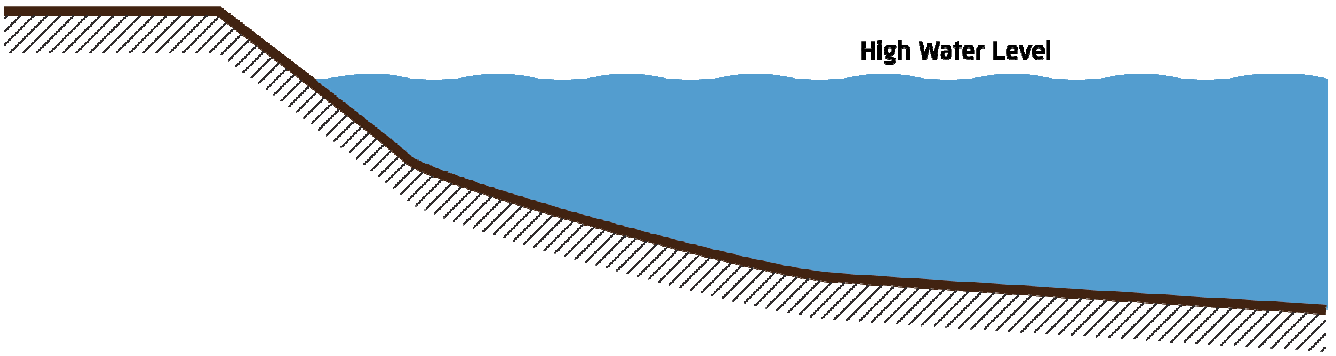
- Coastline has evolved
- This evolution will change in line with climate change
- We have tools to predict how the coastline will change
- We have methods to protect the coast, but at what cost?



What might Sea Level Rise mean for the coast?

Start with the present day situation

The shoreline moves as it always has done



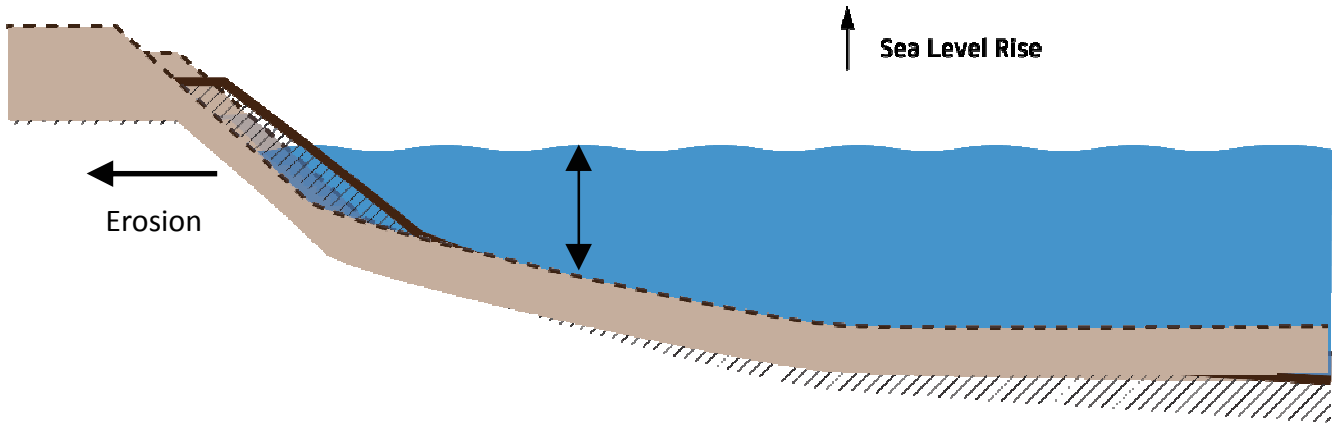
What might Sea Level Rise mean for the coast?

As sea level rises, so the beach responds

The beach retreats and rises in line with the SLR

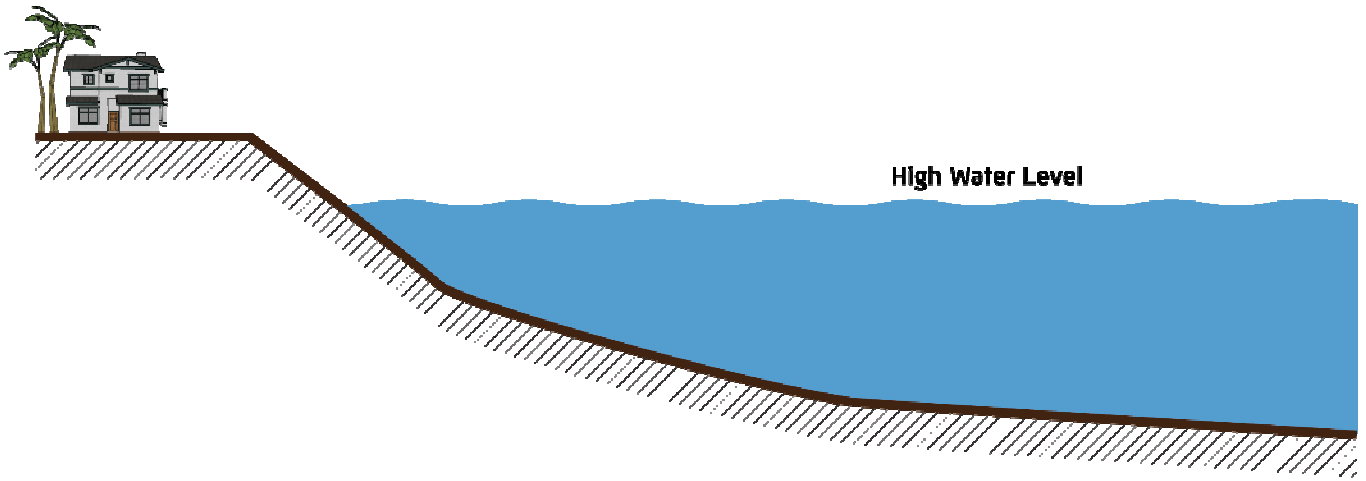
The retreat is seen as erosion.

The water depth near the shore remains the same



What might Sea Level Rise mean for the coast?

Where we have developments on the coast

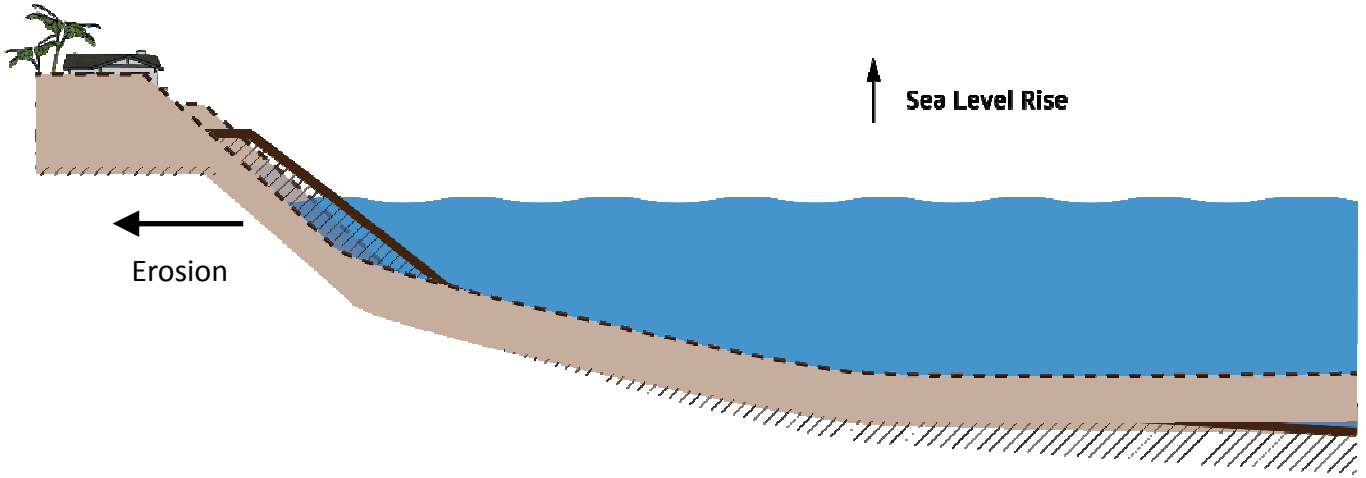


What might Sea Level Rise mean for the coast?

Where we have property on the coast

As sea level rises, and the beach responds

Erosion of the beach puts property at risk



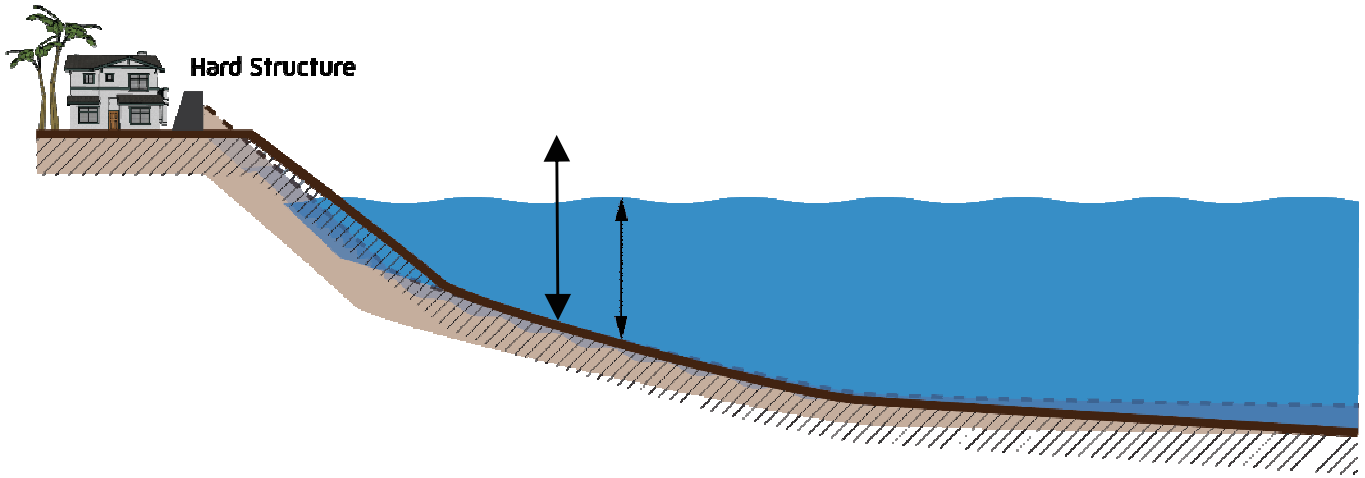
What will Sea Level Rise mean for the coast?

We can build engineering works

The beach and shore still respond to SLR

But the beach can not retreat or rise, and can be lost

The water near the shore becomes deeper increasing the wave heights at the coast



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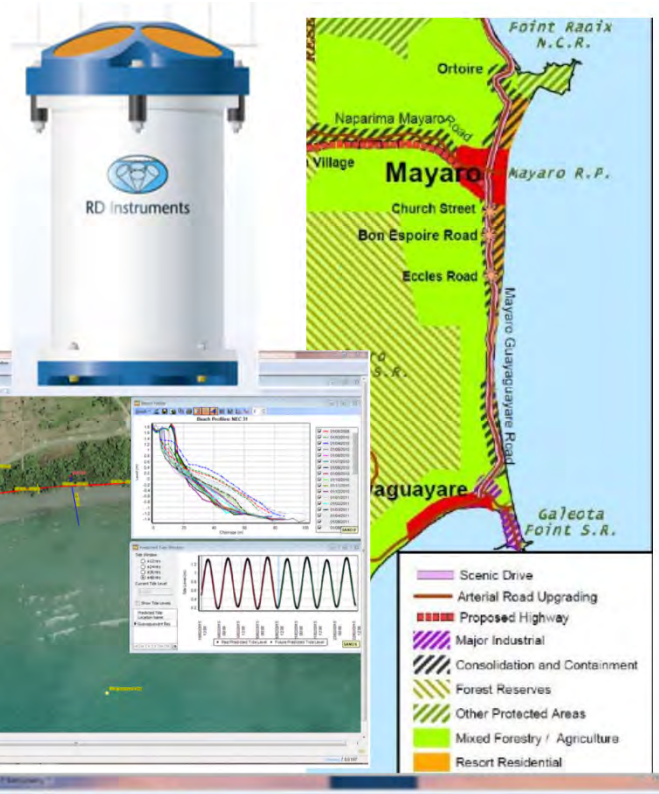
What happens if we harden the shoreline?

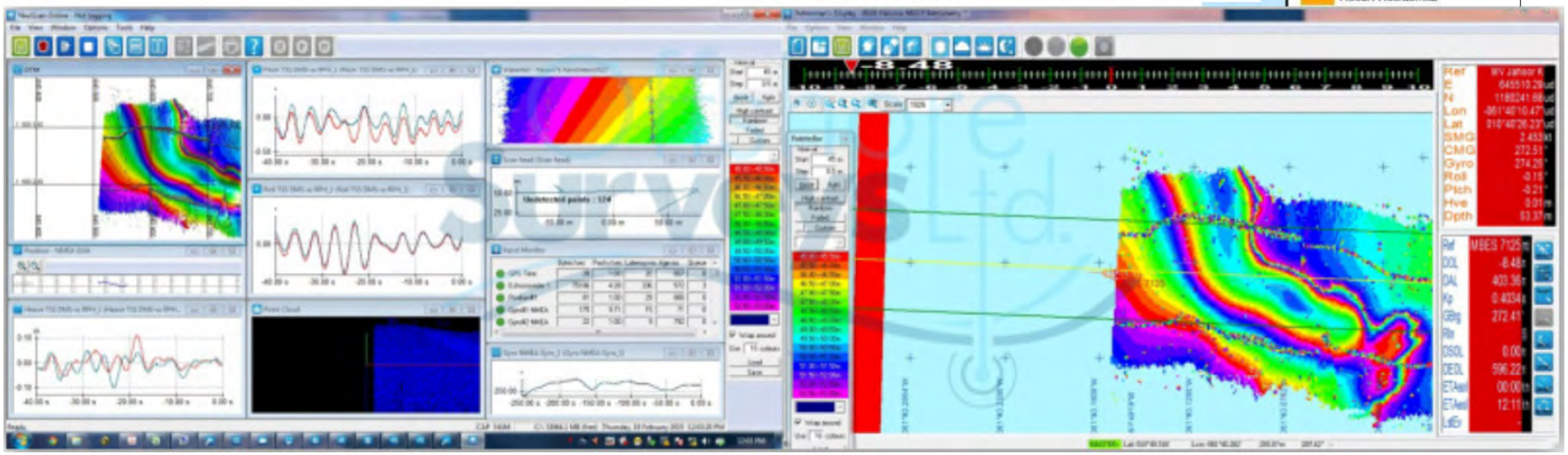
Loss of beaches and other coastal habitats…

What have we been doing and what comes next?

What have we been doing?

- Collecting existing data and field measurements
- Consulting with stakeholders
- Identifying the problems
- Mapping the hazards and identifying everything at risk



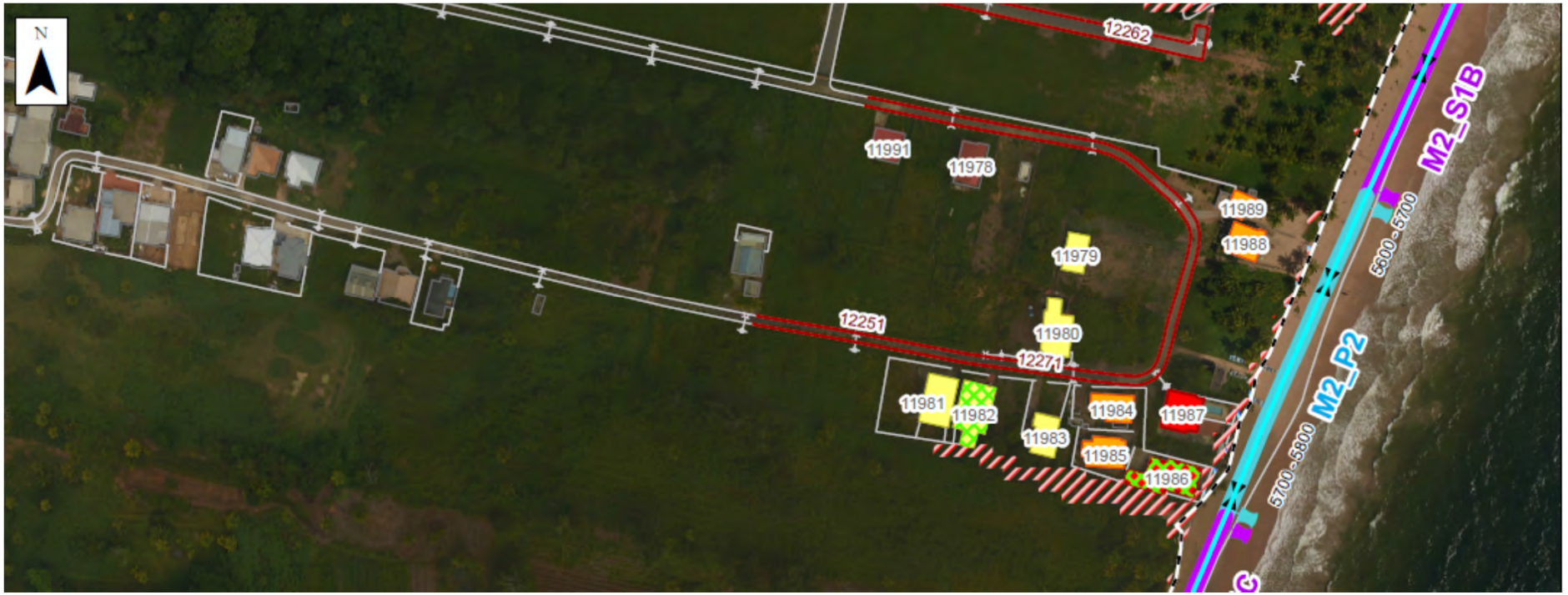


Where are we now and what comes next?

- Appraising how to manage the risks identified
- Identifying where appropriate to act through economic assessment
- Consideration of different solutions
- Technically appraising solutions
- Consulting with stakeholders
- Arriving at preferred solutions
- Detailing the required urgent schemes ready for construction

What is “at risk” and where should we prioritise protection?

What is out there?



Legend

- Back of Beach Contour
- Erosion 2035yr RCP4.5*
- Erosion 2065yr RCP4.5*
- Erosion 2115yr RCP4.5*
- Flood 2015 1 in 100yr
- Flood 2065 1 in 100yr
- Flood 2115 1 in 100yr
- Linear Assets at Flood and Erosion Risk
- Assets with Flood Risk 1in100yr event by 2065 (RCP4.5 CC)
- Assets with Flood Risk 1in100yr event by 2115 (RCP4.5 CC)
- Assets with Erosion Risk 2015 to 2035 (RCP4.5 CC)
- Assets with Erosion Risk 2035 to 2065 (RCP4.5 CC)
- Assets with Erosion Risk 2065 to 2115 (RCP4.5 CC)
- Assets with Wave Runup Flood Risk
- 137 Asset ID
- 100m Chainage Markers
- Cliff Frontage
- No Existing Coastal Defence Structure
- Continuous Existing Coastal Defence Structure
- Various Property Boundary Structures

* Erosion lines are indicative estimates for erosion potential and assume no defences in place. These show erosion tendency for long stretches and may not accurate for specific short stretches of frontage

Project :
Mayaro and Guayaguayare Coastal Protection Project

Drawing :
Site Maps

Drawn By :	JS	Date: 11/11/2015
Checked By :	JD	Date: 11/11/2015
Approved By :	AH	Date: 11/11/2015

Drawing No. : Map 11 of 60
Revision A
Drawing Scale : 1:2,500

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Halcrow Group (T&T) Ltd.
4 Rust Street
St Clair
Port of Spain
Trinidad & Tobago
www.ch2m.com

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Meters

Asset Database – a database of what is out there

- All “at risk” assets identified through mapping
- Asset type, size, condition identified
- Market value of assets
- Exposure to risk identified (year of loss for erosion, onset of property flooding)

Economics

- What is at stake if we “do nothing” to protect assets (what is the damage cost of “No Active Intervention”)
- Damage costs include business losses and costs of rebuilding/moving infrastructure.
- What is the value of “doing something” (identification of economic benefits of protecting frontages)
- What is the cost of protection (high level assessment of costs for “doing something”)
- Comparison of the two above to prioritise where to spend money (“Benefit-Cost Ratio”)

What about your environment and livelihoods?

Socio-economic and Environmental Factors

- Recreation (beach access, H&S, aesthetics)
- Employment
  - Tourism
  - Fishing
  - Oil & gas
- Communities
- Archaeological & cultural
- Turtle nesting & manatees
- Mangroves & native vegetation
- Bird habitat

What can we do to manage risk?

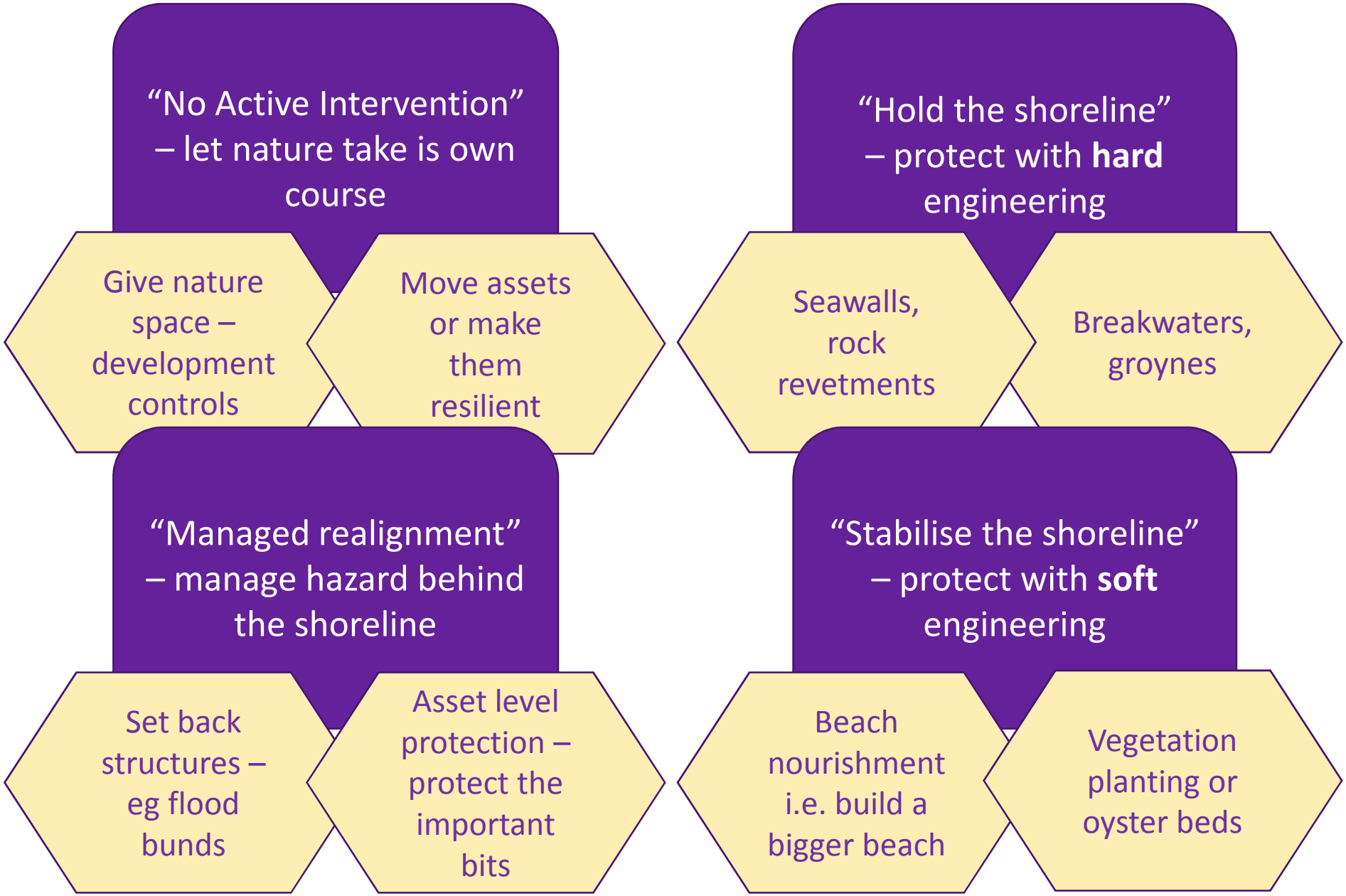
Recap

- Many areas are safe now, but this will change
- Erosion risk – present and future
- Coastal flood risk – present and future
- Which assets are affected and in what way
- Environmental and community impacts

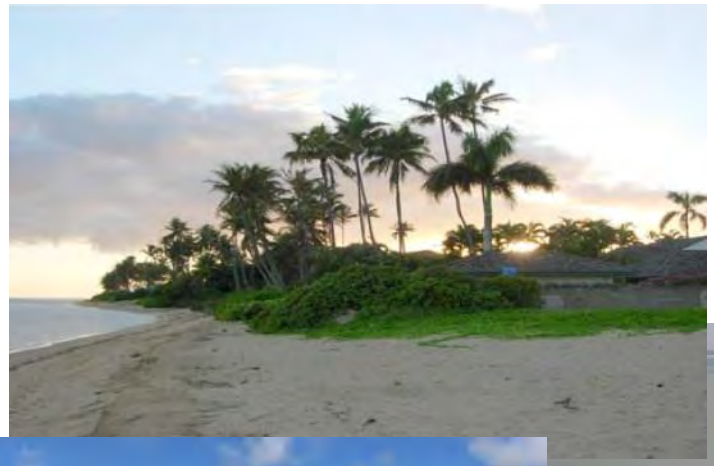
What are the solutions?

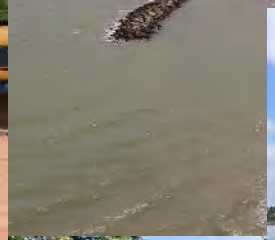
- Developed an understanding of the coastline
- Based on our experience we considered a range of suitable solutions to manage the risk
- Looked at pros and cons of various solutions
- Need to make the right choices

What can we do?



Examples





How do we chose the right solution?

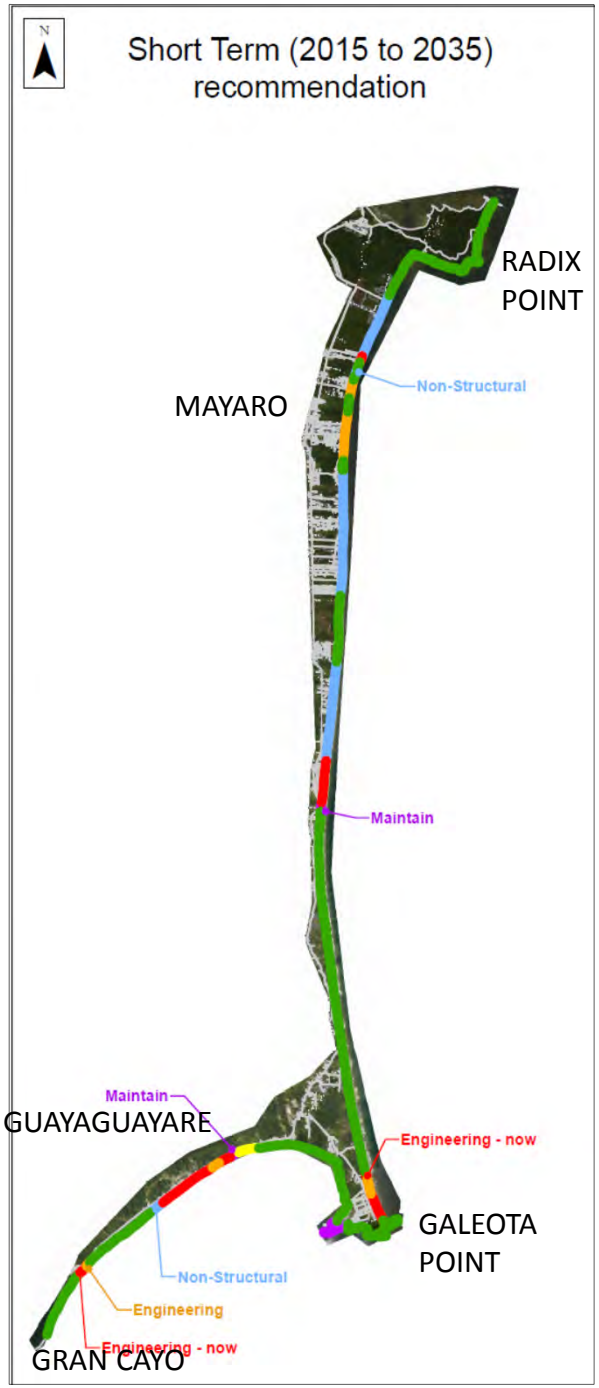
1. Understand the localised problems
2. Identify possible solutions
3. Do these solutions work? (technically, economically and environmentally)
4. Identify the right solution with stakeholders
5. When to act:
   - Short Term (2015 to 2035)?
   - Medium Term (2035 to 2065)?

Prioritising and Planning

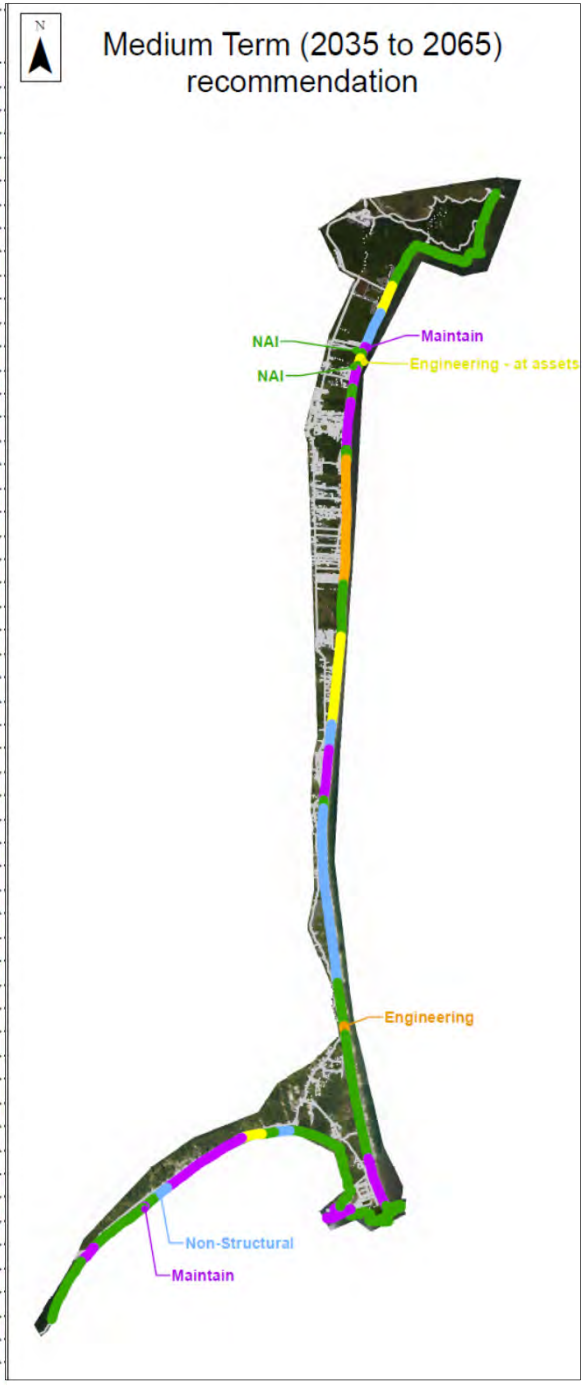
- Focus is on solutions recommended over the Short Term (within next 20-years)
- Prioritisation on protecting important assets that are at risk
- Long term considerations/context
- Identify who can deliver each scheme
- Provide a framework for how individuals can sensibly protect their assets

Do we need to protect the whole coastline?

Man. Unit ID	Short Term (2015 to 2035) recommendation
M1_S1	NAI
M2_S1A	NAI
M2_P1	Non-Structural
M2_S1B	Non-Structural
M2_P2	Engineering - now
M2_S1C	NAI
M2_P3	Non-Structural
M2_S1D	NAI
M3_S1A	Engineering
M3_S1B	NAI
M3_P1	Engineering
M3_S1C	NAI
M4_S1A	NAI
M4_S1B	Non-Structural
M4_S1C	NAI
M5_S1A	NAI
M5_S1B	NAI
M5_S1C	NAI
M5_S1D	Non-Structural
M6_S1	Non-Structural
M6_P1	Engineering - now
M7_P1	Maintain
M7_S1A	NAI
M7_P2	NAI
M7_S1B	NAI
M8_S1	NAI
M8_P1	NAI
M9_S1	NAI
M9_P1	Engineering - now
M10_P1	Engineering
M10_P2	Engineering
M10_P3	Engineering - now
M11_S1	NAI
G1_S1	Maintain
G2_S1	NAI
G3_S1A	NAI
G3_P1	Engineering - now
G3_S1B	NAI
G4_S1	Engineering - at assets
G5_S1	Maintain
G5_P1	Engineering - now
G5_P2	Engineering - now
G6_S1	Engineering
G6_P1	Engineering - now
G6_P2	Engineering - now
G6_P3	Engineering - now
G7_S1A	Non-Structural
G7_S1B	NAI
G7_P1	Engineering
G7_S1C	NAI
G8_S1A	NAI
G8_P1	Engineering
G8_P2	Engineering - now
G8_S1B	NAI
G9_P1	NAI
G9_S1	NAI



Man. Unit ID	Medium Term (2035 to 2065) recommendation
M1_S1	NAI
M2_S1A	NAI
M2_P1	Engineering - at assets
M2_S1B	Non-Structural
M2_P2	Maintain
M2_S1C	NAI
M2_P3	Engineering - at assets
M2_S1D	NAI
M3_S1A	Maintain
M3_S1B	NAI
M3_P1	Maintain
M3_S1C	NAI
M4_S1A	NAI
M4_S1B	Engineering
M4_S1C	NAI
M5_S1A	NAI
M5_S1B	NAI
M5_S1C	Engineering - at assets
M5_S1D	Engineering - at assets
M6_S1	Non-Structural
M6_P1	Maintain
M7_P1	Maintain
M7_S1A	NAI
M7_P2	Non-Structural
M7_S1B	Non-Structural
M8_S1	NAI
M8_P1	Engineering
M9_S1	NAI
M9_P1	Maintain
M10_P1	Maintain
M10_P2	Maintain
M10_P3	Maintain
M11_S1	NAI
G1_S1	Maintain
G2_S1	NAI
G3_S1A	NAI
G3_P1	Maintain
G3_S1B	NAI
G4_S1	Engineering - at assets
G5_S1	Maintain
G5_P1	Maintain
G5_P2	Maintain
G6_S1	Maintain
G6_P1	Maintain
G6_P2	Maintain
G6_P3	Maintain
G7_S1A	Non-Structural
G7_S1B	NAI
G7_P1	Maintain
G7_S1C	NAI
G8_S1A	NAI
G8_P1	Maintain
G8_P2	Maintain
G8_S1B	NAI
G9_P1	NAI
G9_S1	NAI



Which areas should we monitor and slow erosion?

Non-structural Solutions

Man. Unit ID	Short Term (2015 to 2035) recommendation
M1_S1	NAI
M2_S1A	NAI
M2_P1	Non-Structural
M2_S1B	Non-Structural
M2_P2	Engineering - now
M2_S1C	NAI
M2_P3	Non-Structural
M2_S1D	NAI
M3_S1A	Engineering
M3_S1B	NAI
M3_P1	Engineering
M3_S1C	NAI
M4_S1A	NAI
M4_S1B	Non-Structural
M4_S1C	NAI
M5_S1A	NAI
M5_S1B	NAI
M5_S1C	NAI
M5_S1D	Non-Structural
M6_S1	Non-Structural
M6_P1	Engineering - now
M7_P1	Maintain
M7_S1A	NAI
M7_P2	NAI
M7_S1B	NAI
M8_S1	NAI
M8_P1	NAI
M9_S1	NAI
M9_P1	Engineering - now
M10_P1	Engineering
M10_P2	Engineering
M10_P3	Engineering - now
M11_S1	NAI
G1_S1	Maintain
G2_S1	NAI
G3_S1A	NAI
G3_P1	Engineering - now
G3_S1B	NAI
G4_S1	Engineering - at assets
G5_S1	Maintain
G5_P1	Engineering - now
G5_P2	Engineering - now
G6_S1	Engineering
G6_P1	Engineering - now
G6_P2	Engineering - now
G6_P3	Engineering - now
G7_S1A	Non-Structural
G7_S1B	NAI
G7_P1	Engineering
G7_S1C	NAI
G8_S1A	NAI
G8_P1	Engineering
G8_P2	Engineering - now
G8_S1B	NAI
G9_P1	NAI
G9_S1	NAI

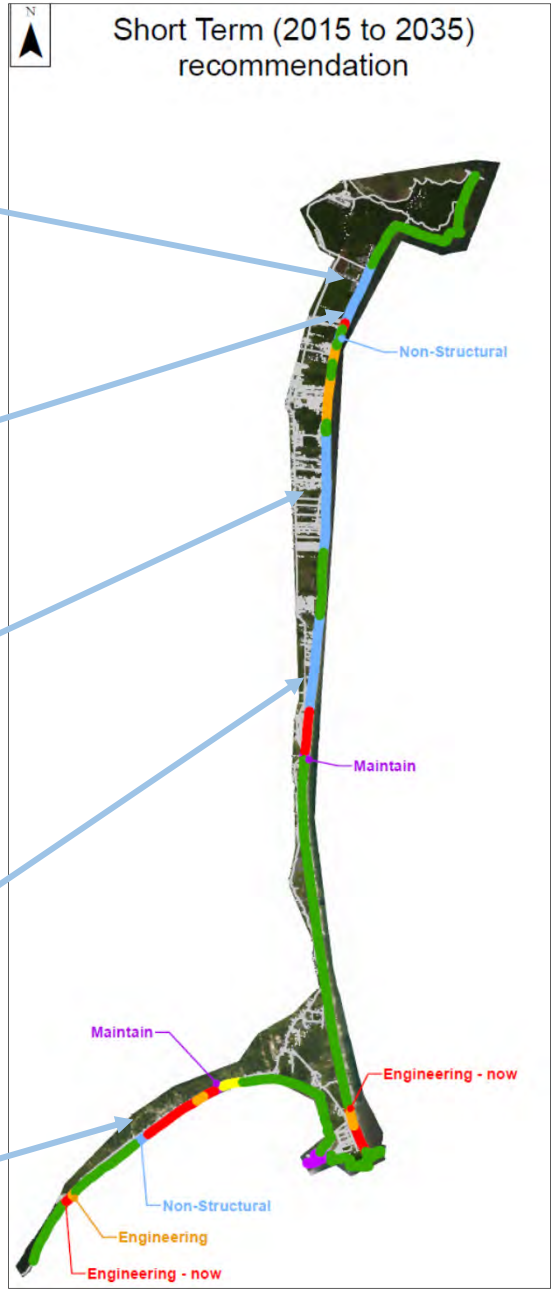
M2_P1 & M2_S1B – **St Joseph**
- Largely undeveloped/abandoned
- Some new development with asset level structural protection
- Slowing erosion using vegetation may be viable

M2_P3 – **Abandoned Property Cluster**
- Low density development, all derelict
- Slowing erosion using vegetation may be viable

M4_S1B – **Queens Beach**
- Beach currently stable, maintaining beach stability key in Short Term
- High value assets may justify future scheme

M5_S1D & M6_S1 – **South of Grand Lagon River/BP Compound**
- Beach currently stable, maintaining beach stability key in Short Term
- High value assets may justify future scheme

G7_S1A – **West Guayaguayare (sports field)**
- High value of assets may justify future scheme
- Slowing erosion using vegetation may be viable



Which areas may soon require an engineering solution, but not now?

Structural Solutions – At Assets

Man. Unit ID	Short Term (2015 to 2035) recommendation
M1_S1	NAI
M2_S1A	NAI
M2_P1	Non-Structural
M2_S1B	Non-Structural
M2_P2	Engineering - now
M2_S1C	NAI
M2_P3	Non-Structural
M2_S1D	NAI
M3_S1A	Engineering
M3_S1B	NAI
M3_P1	Engineering
M3_S1C	NAI
M4_S1A	NAI
M4_S1B	Non-Structural
M4_S1C	NAI
M5_S1A	NAI
M5_S1B	NAI
M5_S1C	NAI
M5_S1D	Non-Structural
M6_S1	Non-Structural
M6_P1	Engineering - now
M7_P1	Maintain
M7_S1A	NAI
M7_P2	NAI
M7_S1B	NAI
M8_S1	NAI
M8_P1	NAI
M9_S1	NAI
M9_P1	Engineering - now
M10_P1	Engineering
M10_P2	Engineering
M10_P3	Engineering - now
M11_S1	NAI
G1_S1	Maintain
G2_S1	NAI
G3_S1A	NAI
G3_P1	Engineering - now
G3_S1B	NAI
G4_S1	Engineering - at assets
G5_S1	Maintain
G5_P1	Engineering - now
G5_P2	Engineering - now
G6_S1	Engineering
G6_P1	Engineering - now
G6_P2	Engineering - now
G6_P3	Engineering - now
G7_S1A	Non-Structural
G7_S1B	NAI
G7_P1	Engineering
G7_S1C	NAI
G8_S1A	NAI
G8_P1	Engineering
G8_P2	Engineering - now
G8_S1B	NAI
G9_P1	NAI
G9_S1	NAI

G4_S1– **Fisherman's Beach**

- Beach currently stabilising around new fishing facility
- Monitor beach and intervene with structural solution as assets threatened (particularly the road)

Structural Solutions – Non Urgent

Man. Unit ID	Short Term (2015 to 2035) recommendation
M1_S1	NAI
M2_S1A	NAI
M2_P1	Non-Structural
M2_S1B	Non-Structural
M2_P2	Engineering - now
M2_S1C	NAI
M2_P3	Non-Structural
M2_S1D	NAI
M3_S1A	Engineering
M3_S1B	NAI
M3_P1	Engineering
M3_S1C	NAI
M4_S1A	NAI
M4_S1B	Non-Structural
M4_S1C	NAI
M5_S1A	NAI
M5_S1B	NAI
M5_S1C	NAI
M5_S1D	Non-Structural
M6_S1	Non-Structural
M6_P1	Engineering - now
M7_P1	Maintain
M7_S1A	NAI
M7_P2	NAI
M7_S1B	NAI
M8_S1	NAI
M8_P1	NAI
M9_S1	NAI
M9_P1	Engineering - now
M10_P1	Engineering
M10_P2	Engineering
M10_P3	Engineering - now
M11_S1	NAI
G1_S1	Maintain
G2_S1	NAI
G3_S1A	NAI
G3_P1	Engineering - now
G3_S1B	NAI
G4_S1	Engineering - at assets
G5_S1	Maintain
G5_P1	Engineering - now
G5_P2	Engineering - now
G6_S1	Engineering
G6_P1	Engineering - now
G6_P2	Engineering - now
G6_P3	Engineering - now
G7_S1A	Non-Structural
G7_S1B	NAI
G7_P1	Engineering
G7_S1C	NAI
G8_S1A	NAI
G8_P1	Engineering
G8_P2	Engineering - now
G8_S1B	NAI
G9_P1	NAI
G9_S1	NAI

M3_S1A & M3_P1 – **Mayaro/Plaisance**

- Increasing erosional pressure but beach currently stable (particularly to the south)
- Local wave overtopping risk
- Significant number of assets at risk in medium term (50+ by 2065) justify intervention when needed

M10_P1 & M10_P2 – **BP Offices**

- BP office is a significant single asset and economically justified to intervene when existing defence fails

G6_S1 – **East Guayaguayare**

- Undeveloped, road under increasing risk of erosion
- Monitor and intervene when required

G7_P1 – **Catholic Retreat**

- Single asset, protect locally when required

G8_P1 – **Road**

- Undeveloped, road under increasing risk of erosion
- Monitor and intervene when required

Which areas most urgently need an engineering solution?

M2_P2 – Property cluster

- Eroding shoreline
- Scheme currently viable at property cluster only
- *Recommendation*: Rock revetment/berm at top of beach (BCR>2)

M2_S1A	NAI
M2_P1	Non-Structural
M2_S1B	Non-Structural
M2_P2	Engineering - now
M2_S1C	NAI
M2_P3	Non-Structural
M2_S1D	NAI

M6_P1 – Indian Beach/Frontin Road

- Large number of high value assets at direct risk
- Narrow beach and property wall collapses, unstable ground
- *Recommendation*: Revetment or possibly beach nourishment and groynes (BCR>2)

M6_S1	Non-Structural
M6_P1	Engineering - now

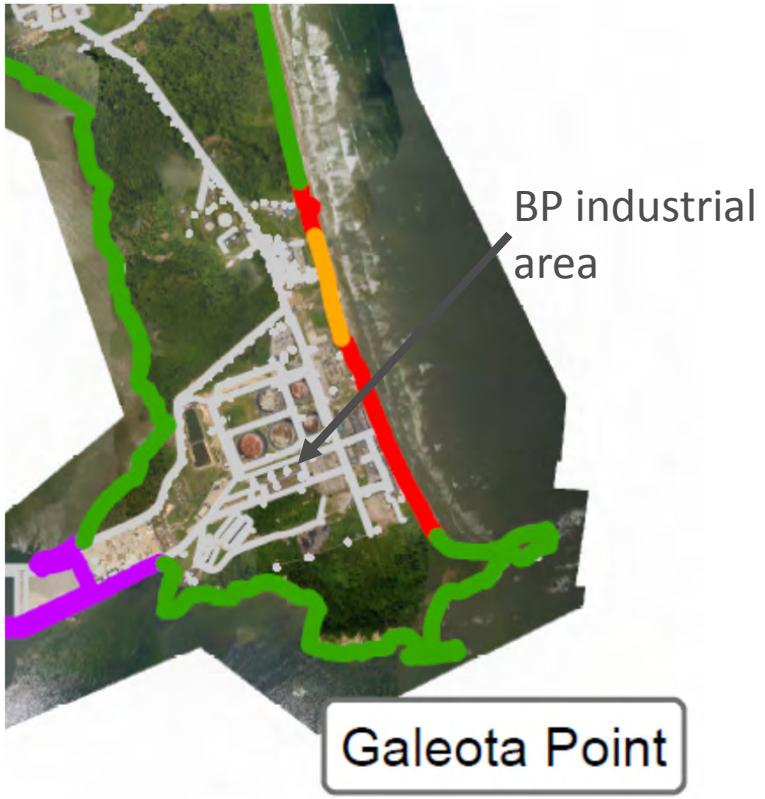
M9_P1 – Coastguard facility

- Pipeline and coastguard critical facility at risk
- Clearly eroding frontage
- *Recommendation*: Rock revetment (BCR>3)

M9_S1	NAI
M9_P1	Engineering - now

M10_P3 – BP Frontage

- High value private industrial frontage with existing failed wall
- High exposure, avoid reflective solution
- Little chance of holding beach
- Poor construction access
- *Recommendation*: Leave wall in place (replace sections where needed) and rock revetment in-front (BCR>4)



M10_P1	Engineering
M10_P2	Engineering
M10_P3	Engineering - now

G3_P1 – Calmapass

- Naturally eroding soft cliff
- Difficult economic justification for scheme but community affected
- *Recommendation*: Need to consider cost effective solutions to justify any scheme. If viable, likely to comprise low rock berm to manage retreat (BCR<1)

G3_S1A	NAI
G3_P1	Engineering - now
G3_S1B	NAI

G5_P1 – Seawall west of new fishing facility

- Seawall has failed and rock protection added as emergency measure
- Coast road and property at risk
- Option for improved amenity space
- *Recommendation*: Rock revetment with seawall to the east and rock toe protection to the west (BCR>10)

G5_S1	Maintain
G5_P1	Engineering - now
G5_P2	Engineering - now

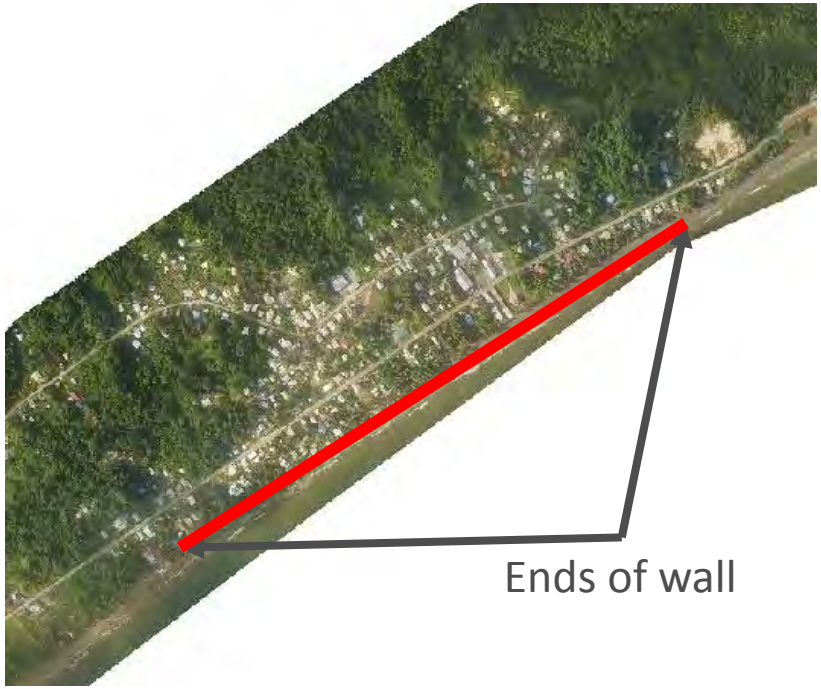
G5_P2 – Guayaguayare road

- Road is high value asset
- Eroding shoreline, close to road, threat to bridge.
- *Recommendation*: Revetment with seawall (BCR>15)

G5_S1	Maintain
G5_P1	Engineering - now
G5_P2	Engineering - now

G6_P2 – Guayaguayare seawall

- Wave overtopping and beach loss at this vertical wall
- Wall is not performing, but modifications could protect assets
- *Recommendation*: Modify wall by including set back wave wall and toe protection as required (BCR>2)



G6_S1	Engineering
G6_P1	Engineering - now
G6_P2	Engineering - now
G6_P3	Engineering - now

G6_P1 – East Guayaguayare

- Seawall stops short of property and road at risk
- *Recommendation*: Extend existing seawall with toe protection and wave wall (BCR>2)

End of existing seawall

G6_S1	Engineering
G6_P1	Engineering - now
G6_P2	Engineering - now
G6_P3	Engineering - now

G6_P3 – West Guayaguayare

- Seawall stops short of property at risk
- *Recommendation*: Extend existing seawall with wave wall and toe protection (BCR>2)

G6_S1	Engineering
G6_P1	Engineering - now
G6_P2	Engineering - now
G6_P3	Engineering - now

G8_P2 – Oil pipelines

- Headland is also protecting road
- High value asset and economically/environmentally justified to intervene when required
- *Recommendation*: Identification of risk only. Rock revetment may be appropriate. (BCR>20)

G8_S1A	NAI
G8_P1	Engineering
G8_P2	Engineering - now
G8_S1B	NAI


Questions?

Contact:

Kim.Ali@CH2M.com
Halcrow Group (T&T) Ltd., 4 Rust Street, St Clair