HKND Nicaragua
Technical Workshop Presentation

Nov 2014

THE MINING ADVANTAGE
WWW.MECMINING.COM.AU

Overview

- Canal Excavation Assumptions
  - Route Selection
  - Canal Floor
  - Geotechnical Assumptions
- Schedule Assumptions
- Excavation Strategy
  - Fleet Sizes
  - Allocation of Material
- Landform and Haulage Strategy
  - Material Placement Facilities
  - Rehabilitation and Final Land Use
- Water Management Strategy
  - Irrigation Control Facilities
  - Diversion Drains and Drop Structures
- Reconciliation to Previous Design
- Next Project Development Phases

About MEC

MEC Mining is a mining/earthworks consultancy specialising in mine evaluation, design, planning, onsite management and technical services solutions.

– Formed in 2005

– Offices in Brisbane – Australia and Santiago - Chile.

– Broad client base of majors, mid-tier mine owners and contractors.

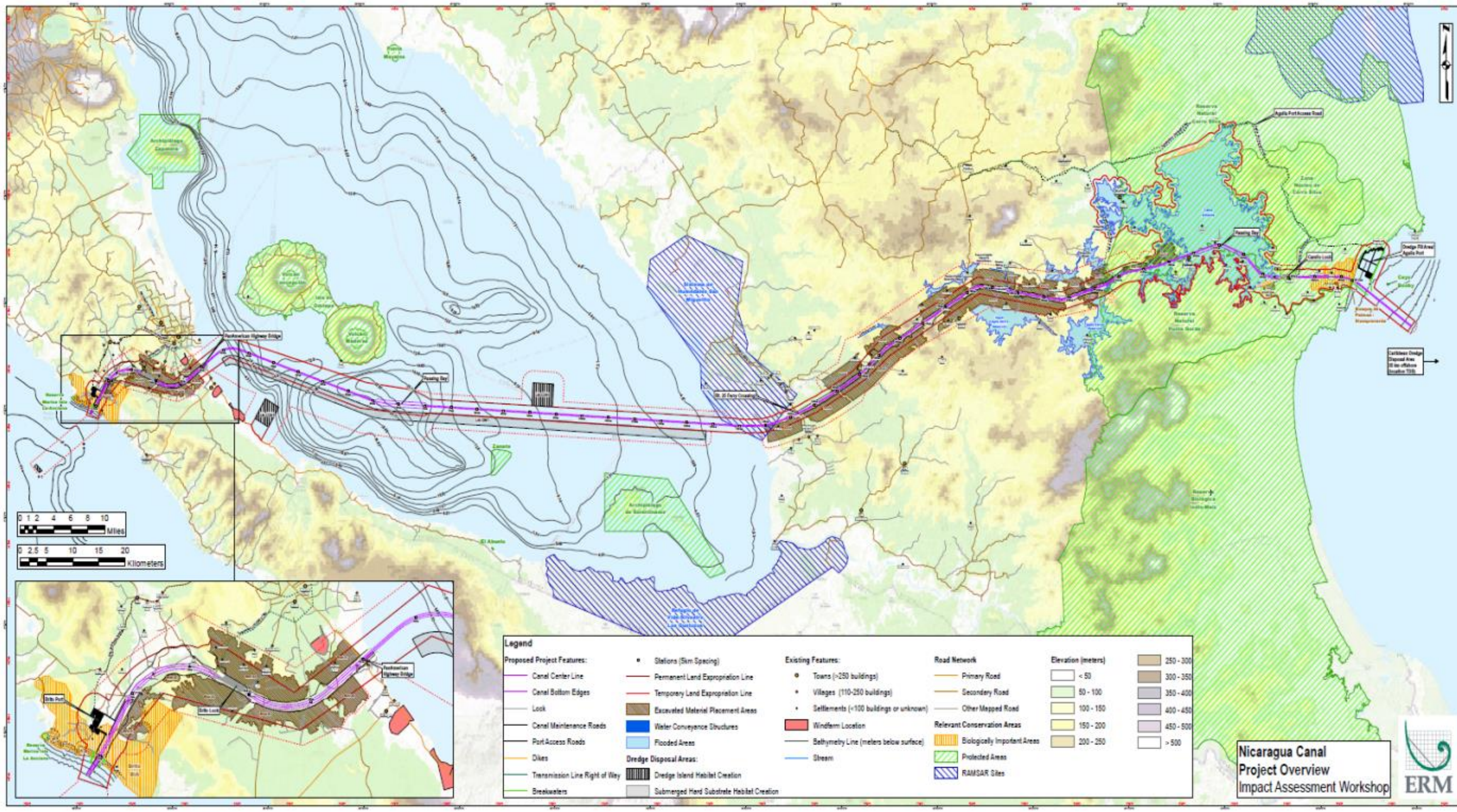
GLOBAL EXPERIENCE

Using Latest Design Technologies

MEC uses a range of software to deliver optimised earthworks solutions:

Software	Strengths	How We Use It
Vulcan	3D CAD package for design, volumetric calculations & sectional analysis.	Detailed 3D design combined with project design information (e.g. Topo, geotech) to deliver short, medium and long term plans. Accurate volume calculation for scheduling.
Deswik	3D scheduling, landform design and management and haulage simulation.	The design outputs above are imported to develop a visual excavation sequence, detailed dumping strategy and hauling unit numbers.
Talpac	Haulage profile analysis, cycle time and equipment productivity simulation.	Matching equipment selection to known operating equipment performance to deliver matched truck to excavator fleets. Return haulage times & haul road design optimisation.
Xpac / Xact	Detailed scheduling tool for long and short term / life of project.	The excavation sequence is scheduled in incremental blocks allowing for known material movement by periods. Outputs from the schedule are used to develop cost models based on material movements.
3D Dig	3D visualisation and spoil balancing tool.	Once an excavation sequence has been developed, this tool allows for detailed visualisation of the excavation and to understand issues with material balancing relative to surrounding topography etc.

Base Assumptions



CRCC base route design used (Sept 14)

280m Base Width, 30m Deep.

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Canal Design

- Primary alignment of the canal taken from CRCC design from September 2014
  - Alterations made based on advice from HKND include
    - Adjustment to East canal entrance into Lake Nicaragua further South from the San-Miguelito and Rio Tule.
    - Alteration to the placement of the CRCC designated passing lanes.
    - Relocation of the East Canal Lock to a more suitable location for constructability and environmental impact of the downstream section of the canal.
  - Geotechnical Recommendations
    - 15 Degree effective angle for Northern slope of West Canal section adjacent to locks – highlights need for further geotechnical site investigation.

Geotechnical Assumptions

GEOTECHNICAL UNIT		WEATHERING	CCRC SLOPE ANGLE(°)	PSM SLOPE ANGLE[1] (°)
SOILS[2]	silt	NA	7	18
	silty soil		10	18
	silty clay		27	18
	fine sand (underwater)		14 to 18	10
SEDIMENTARY	Sandstone, Argillaceous siltstone, shale	strong	42	38
		weak	53	42
		fresh	63	46
Volcanic - extrusives	Basalt, Andesite	complete	34	38
		strong	51	
		weak	63	42
		fresh	73	52
Volcanic - pyroclastics	volcanic breccia	complete	34	38
		strong	42	
		weak	53	42
		fresh	63	46
	Tuff	complete	34	38
		strong	38	
		weak	45	42
		fresh	53	48
	Ignimbrite	Not supplied	45	46
Intrusive rocks	Diabase	fresh	79	52

1 Slope angles refer to effective slope angle or IRA

2 All slope angles in soils should be subjected to a liquefaction assessment. The proposed slopes in soils may still collapse under earthquake loading.

- Australian consultants Pells Sullivan Meynik provided an assessment of the data supplied by HKND.
- A range of material types and rock strengths have been identified during the initial site investigations.
- Additional drilling and site investigation required along the whole route to full excavation depth.

Excavation Strategy

Vegetation & Site Clearing

Strip Topsoil

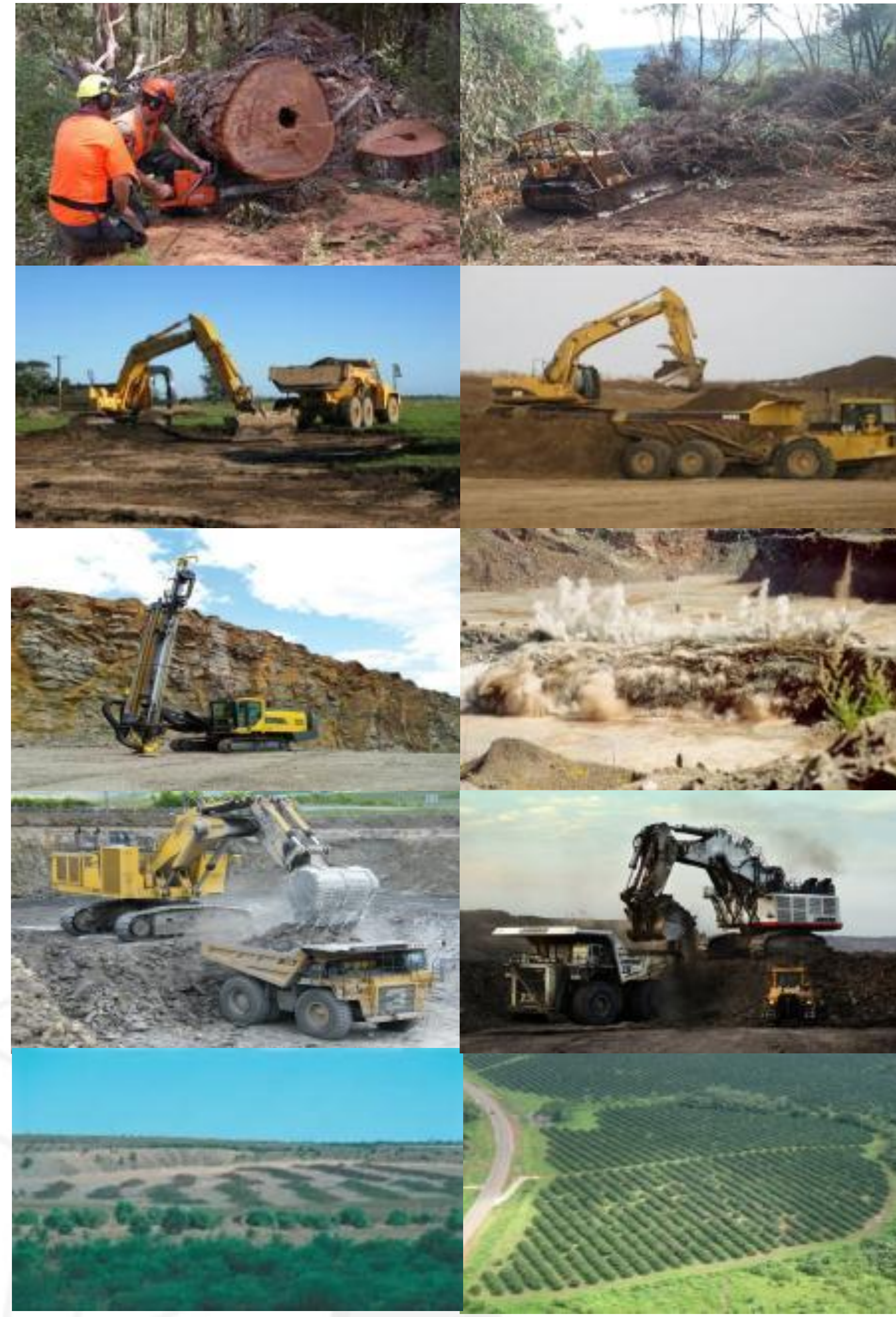
Free Dig

Drill & Blast

Load & Haul

Material Placement

Rehabilitation



Fleet Sizing

Matching the fleet size to material conditions.

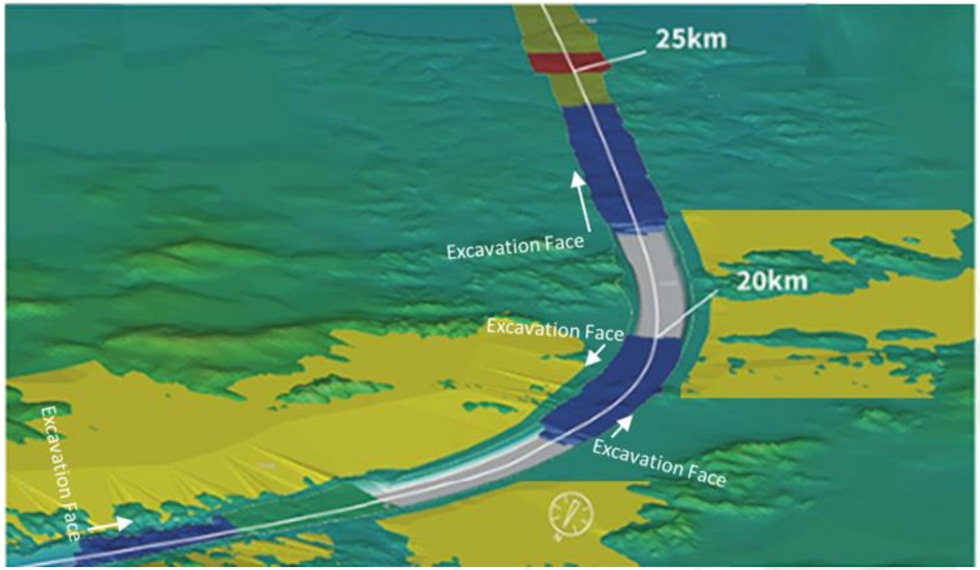
Appropriate blasting, operating benches and working bench sizes for each equipment type.

Excavation Strategy

- Small Scale truck and shovel excavators used for pioneering work and creating a running surface for large fleets.
- Pillars are used to control water flow as required
  - Phase 1 will be in-between the transverse river systems
    - Diversion drains dug as required to re-position river systems away from phase 1 excavation

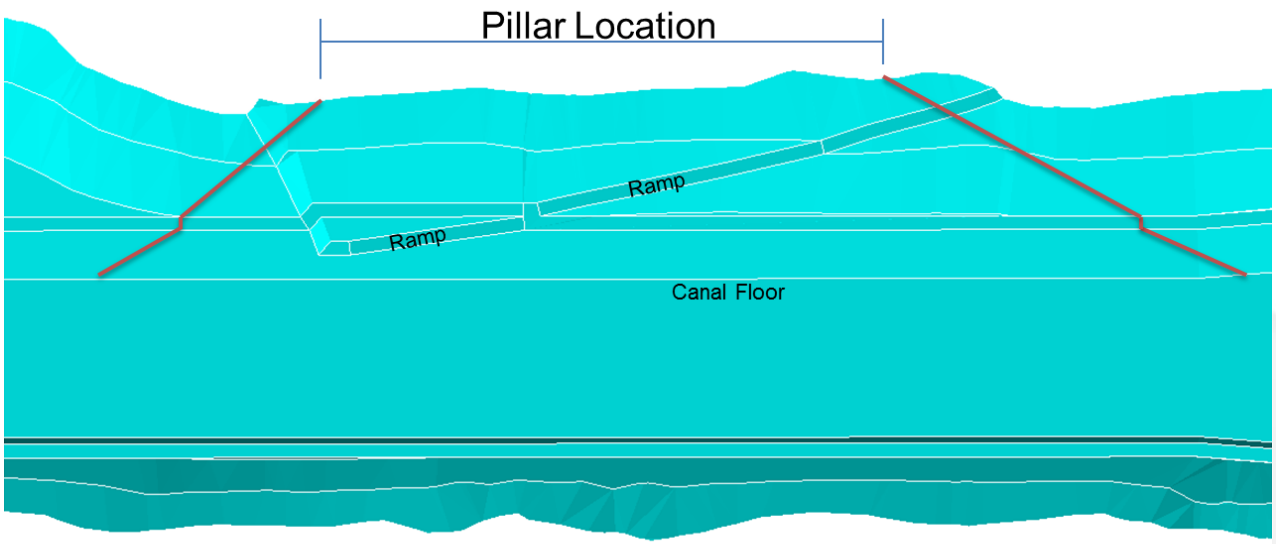
Excavation Strategy

- Design ramps perpendicular to the face advance where possible
  - Reduce haul lengths and supply multiple access points



Excavation Strategy

- Ramps used to excavate the pillars
  - These ramps will be installed inside the batter of the canal wall and will allow the final dirt to hauled to the surface



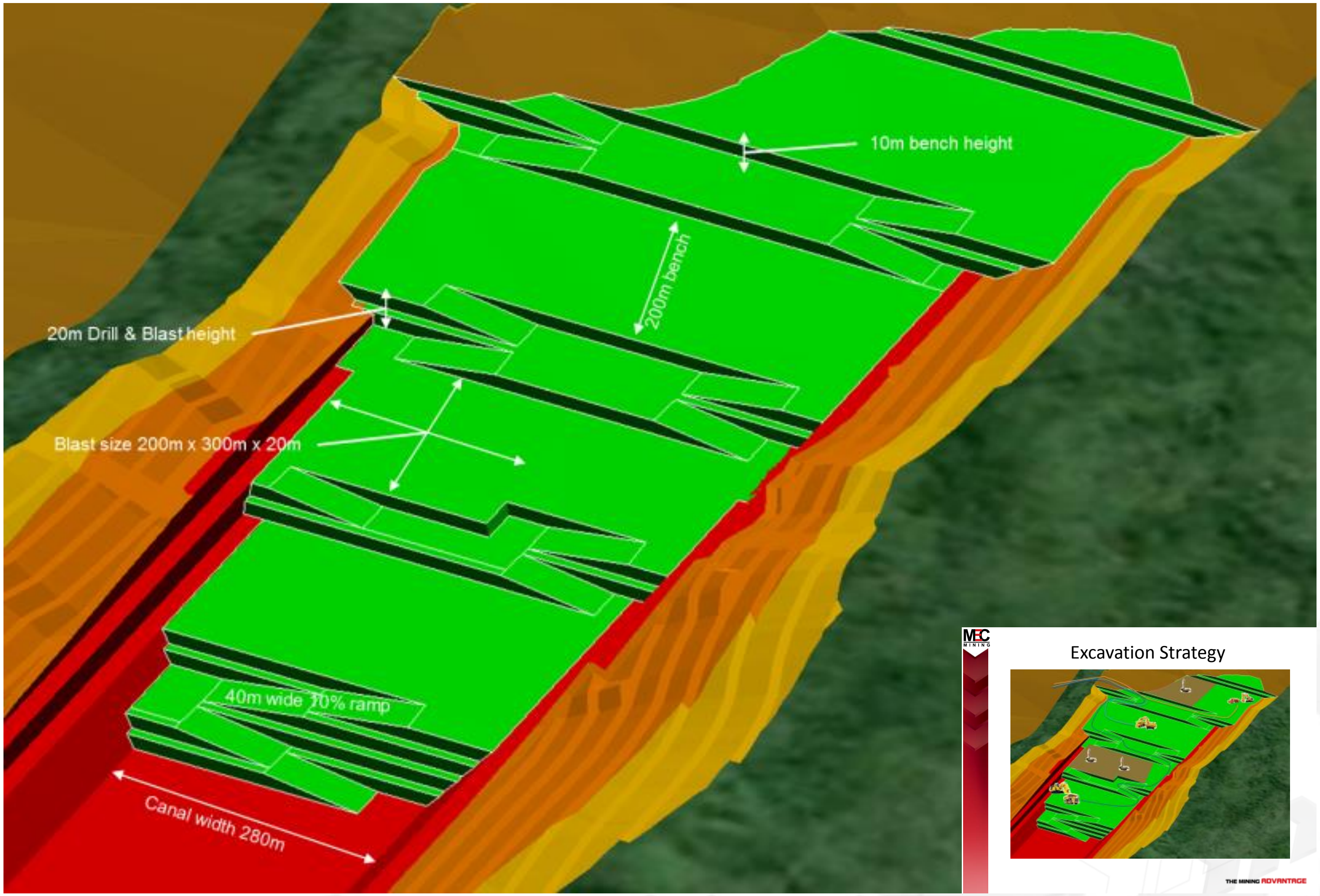
Excavation Strategy

- The ramps can be used to create drainage access points into the canal once the excavation is complete
  - The facing dump will be bermed and drained to ensure they lead to the nearest ramp for rain run-off to access the canal in the appropriate place and reduce erosion and sediment filling the canal unnecessarily

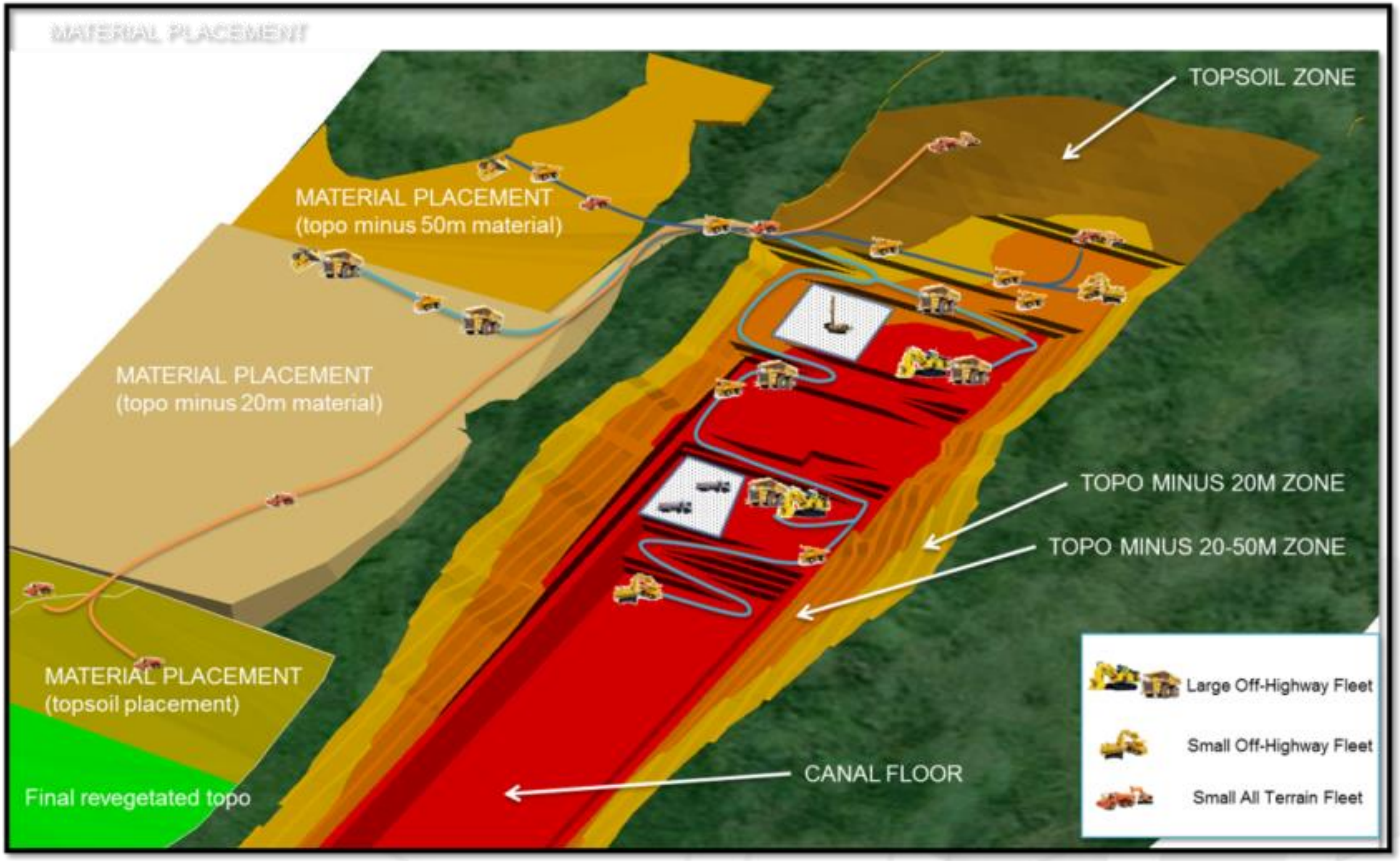
Excavation Strategy

- A terrace face advance system will be utilised for all advancing faces
- There will need to be at least 3 operational terrace faces to ensure all mining activities can occur in unison
- To excavate the complete canal in 5 years there will need to be a new excavation face every 1-2 km.

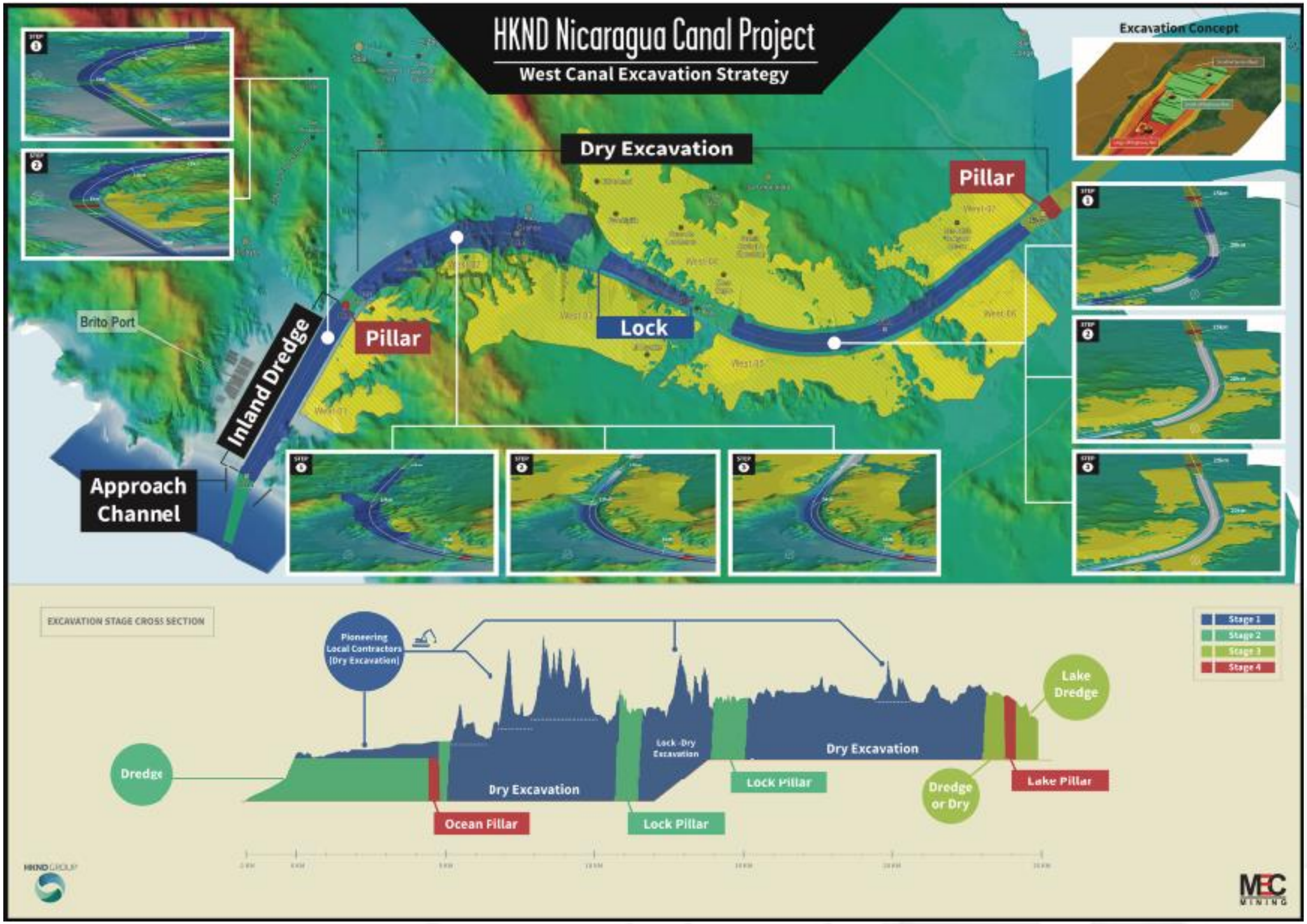
Excavation Strategy



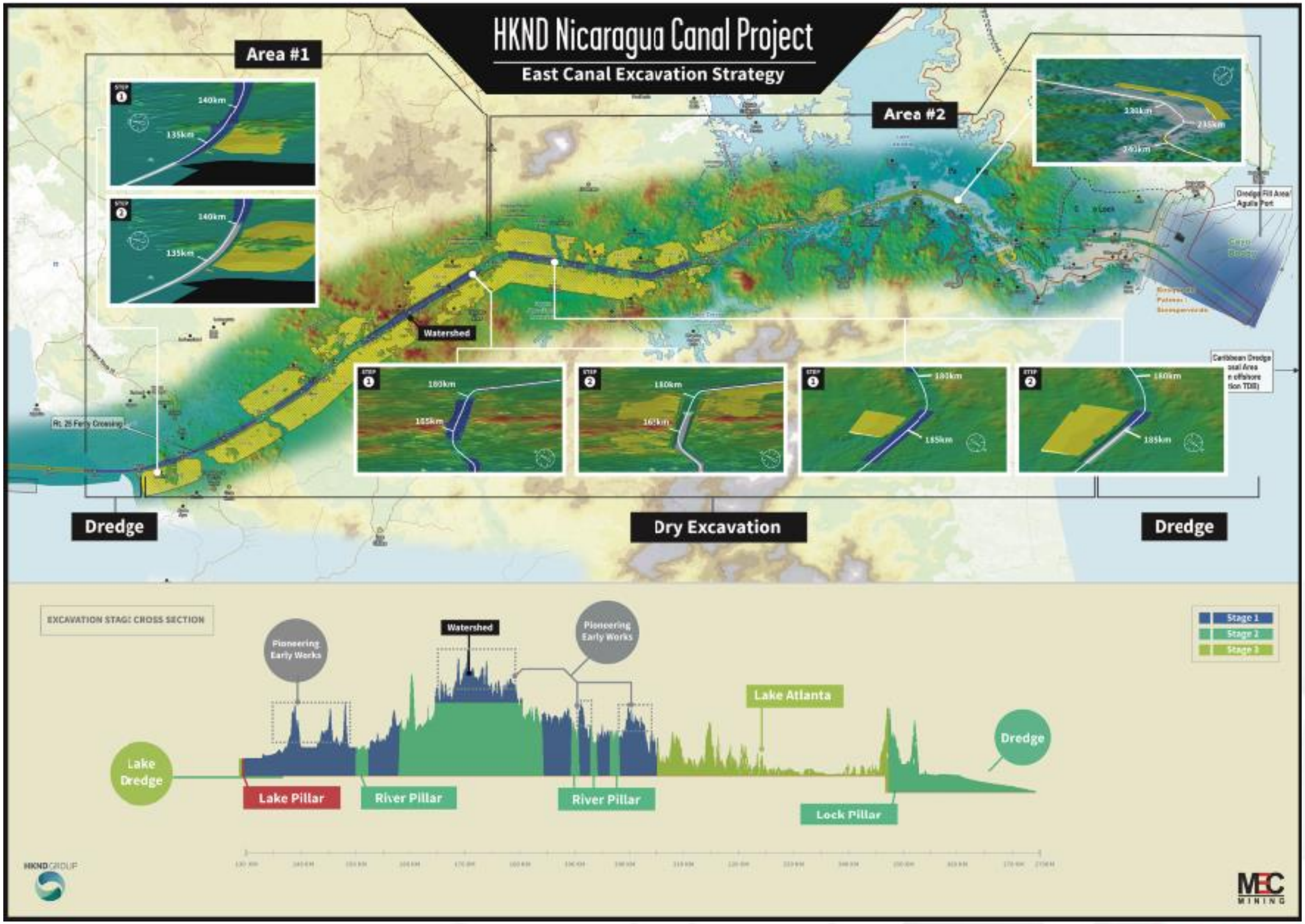
Excavation Strategy



West Canal Excavation Strategy



East Canal Excavation Strategy

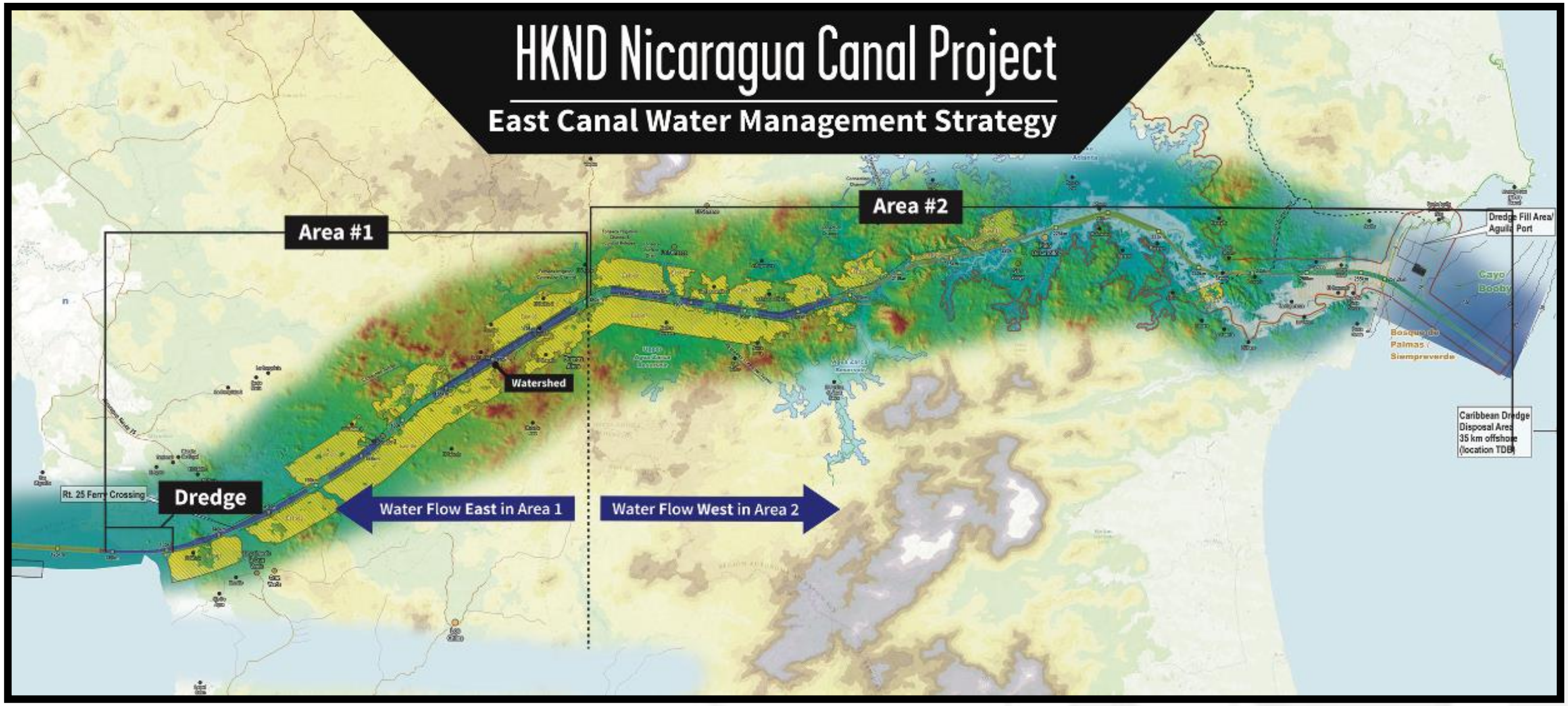


Water Management

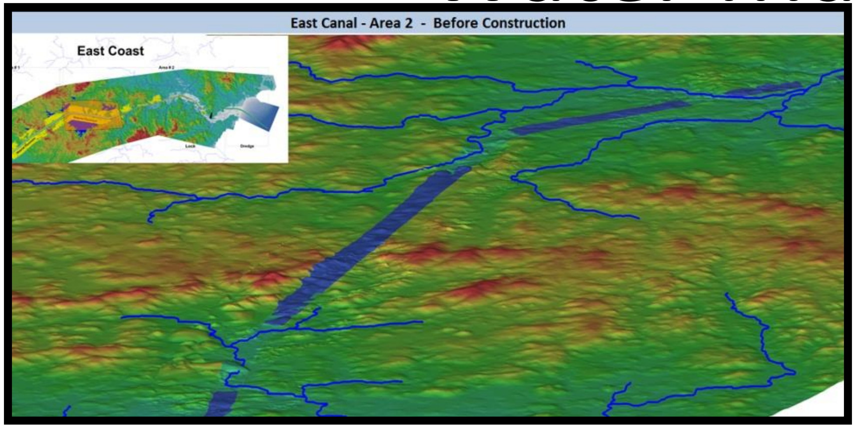
- The water management concept strategy is based around 2 key principals:
  - Minimising the impact of the existing water sheds during the construction of the canal.
  - Providing long term water management and storage during the operation of the canal for both use in the canal and by the proposed agricultural land created adjacent to the canal.

Water Management

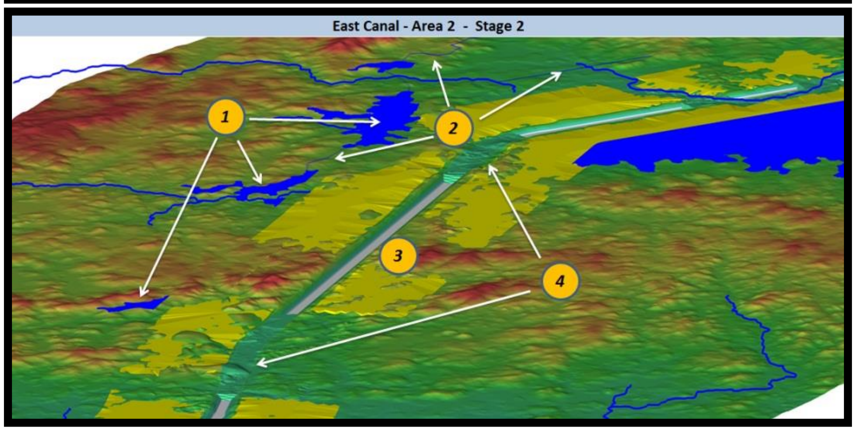
- East Canal Water management Stages



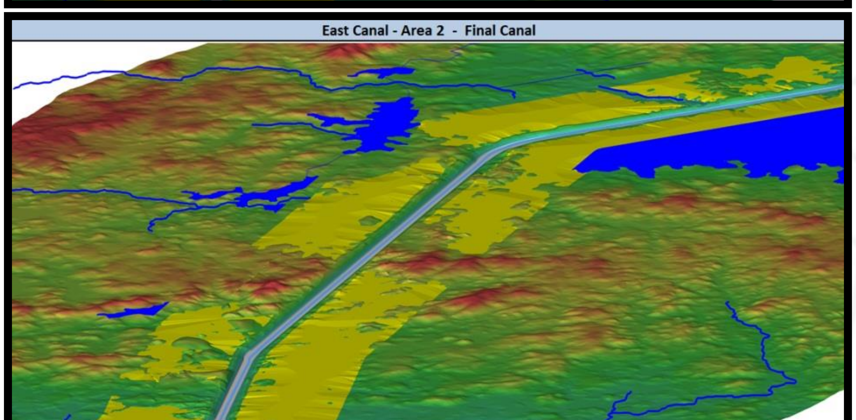
Water Management



Landform prior to excavation

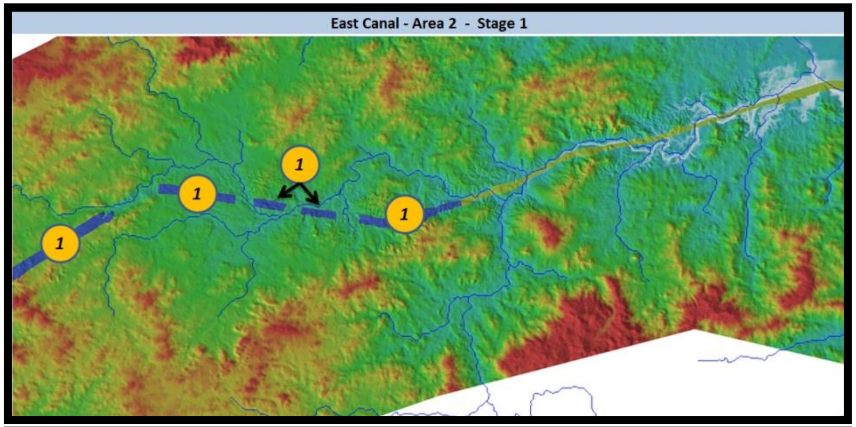


1. Construct water storage facilities and drains to prevent water entering the excavation.
2. Build diversion channels.
3. Dry excavation, allow river system to flow naturally while excavation takes place between pillars.
4. Strategically excavate pillars to final level.

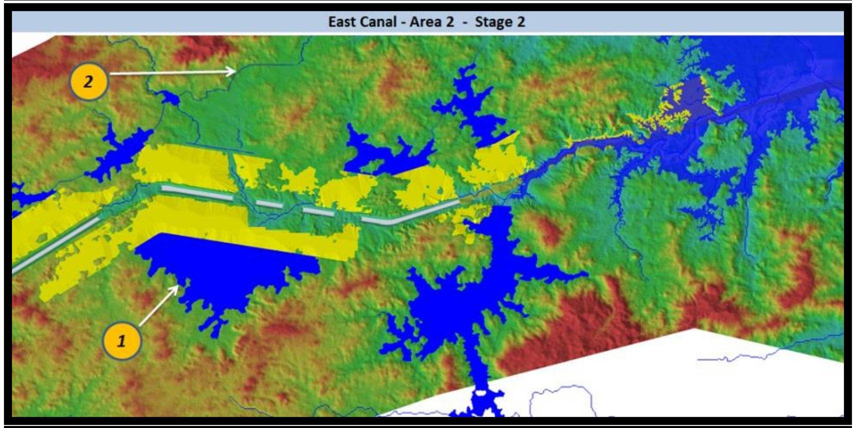


Landform after excavation

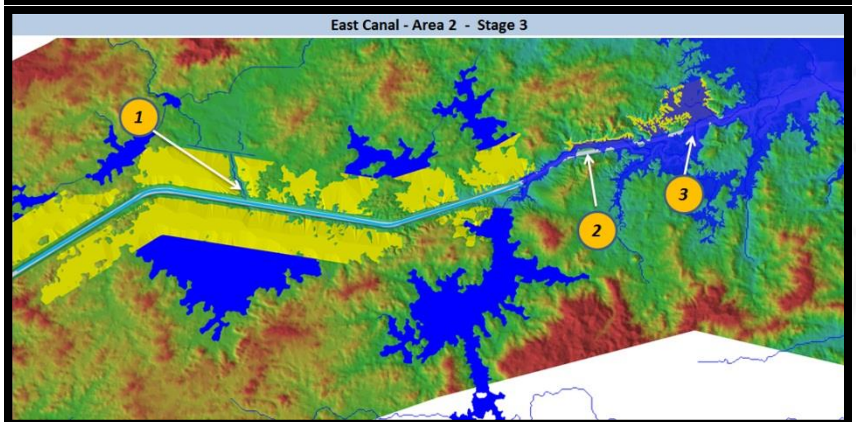
Water Management



1. Excavate between river systems without.
2. Begin material placement near dam locations to prevent water entering the excavation.



1. Construct water storage facilities and drains to prevent water entering the excavation.
2. Divert water around the town of Fonseca.



1. River flows permanently into the canal at the drop structure.
2. Excavate below Agua Zarco dam once the dam wall has been constructed.
3. Dredge the last part of the canal.

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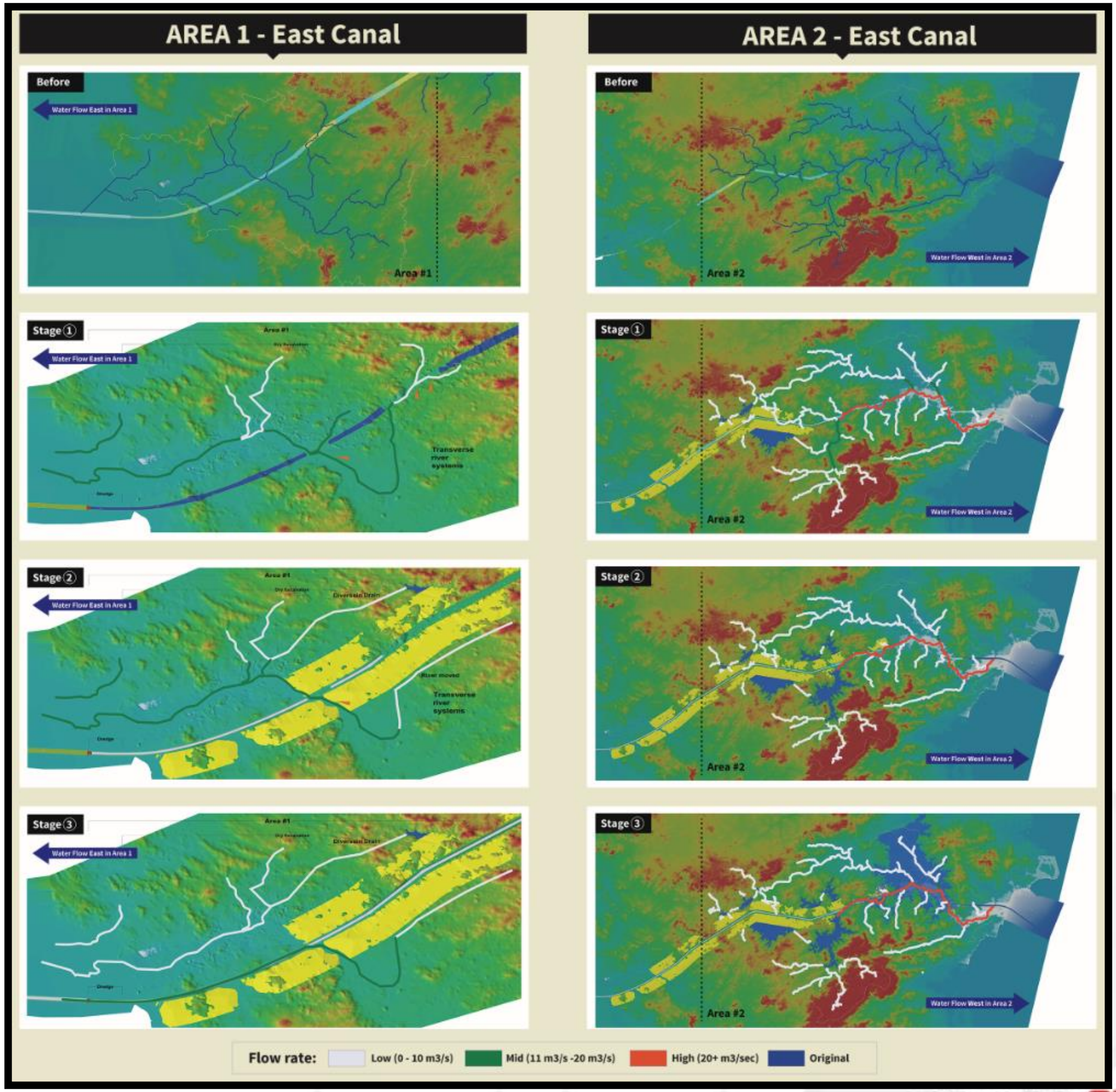
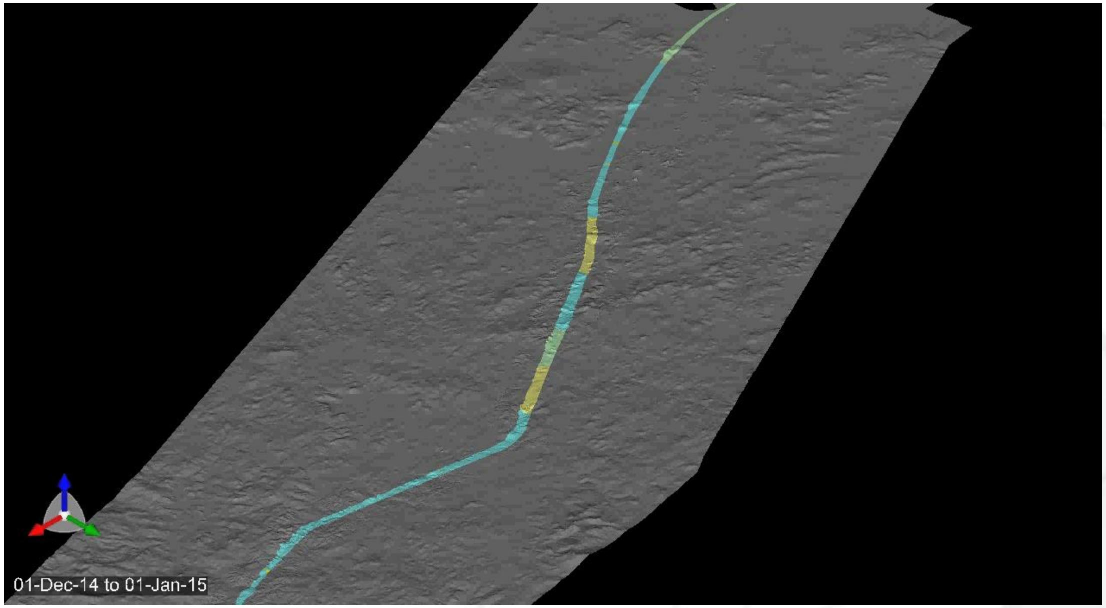
Water Management



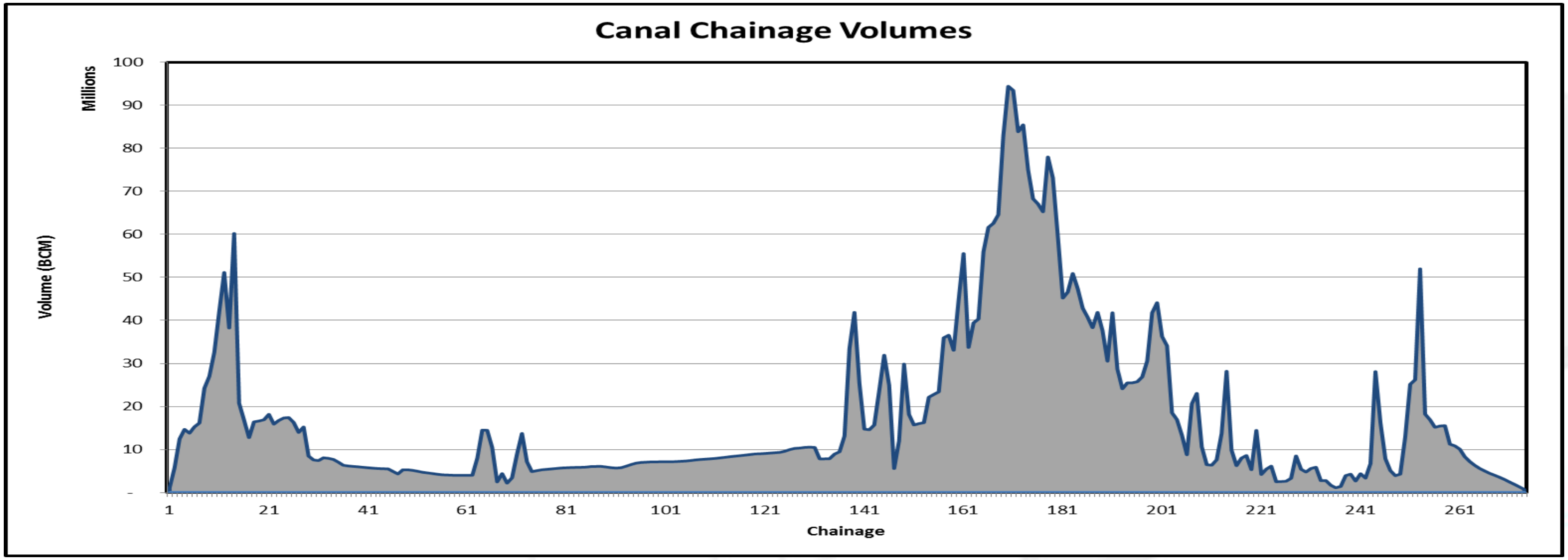
Landform Strategy

- Material Placement
- Deswik software used to simulate the haulage systems of the canal
- Minimum Cycle time algorithm used to run as a simulation methodology.



Volume Reconciliation

Canal Volume Summary				
Section	***Excavation (MBCM)***	***Locks (MBCM)***	***Ports (MBCM)***	***Total (MBCM)***
Pacific Ocean Dredge	*7*			*7*
Western Canal Saltwater Dredge	*72*		*30*	*102*
Western Canal Dry Excavation	*478*	*- 39*		*439*
Western Canal Fresh Water Dredge	*14*			*14*
Lake Nicaragua Dredging	*715*			*715*
Eastern Canal Fresh Water	*10*			*10*
Eastern Canal Dry Excavation	*3,297*	*- 67*		*3,230*
East Canal Saltwater Dredge	*78*			*78*
Atlantic Ocean Dredging	*54*			*54*
Total	4,725	- 106	30	4,649
Cost Plan Contingency				*351*
HKND Cost Plan Total Volume				**5,000**



Next Phases

- Further Detailed Site Investigation Required
  - Survey and Topography.
  - Geology and Geotechnical.
  - Hydrological – Surface and Sub-Surface

1. Completion of Conceptual Design Phase
2. Detailed Feasibility Design and Schedule
3. Construction Design and Schedule.