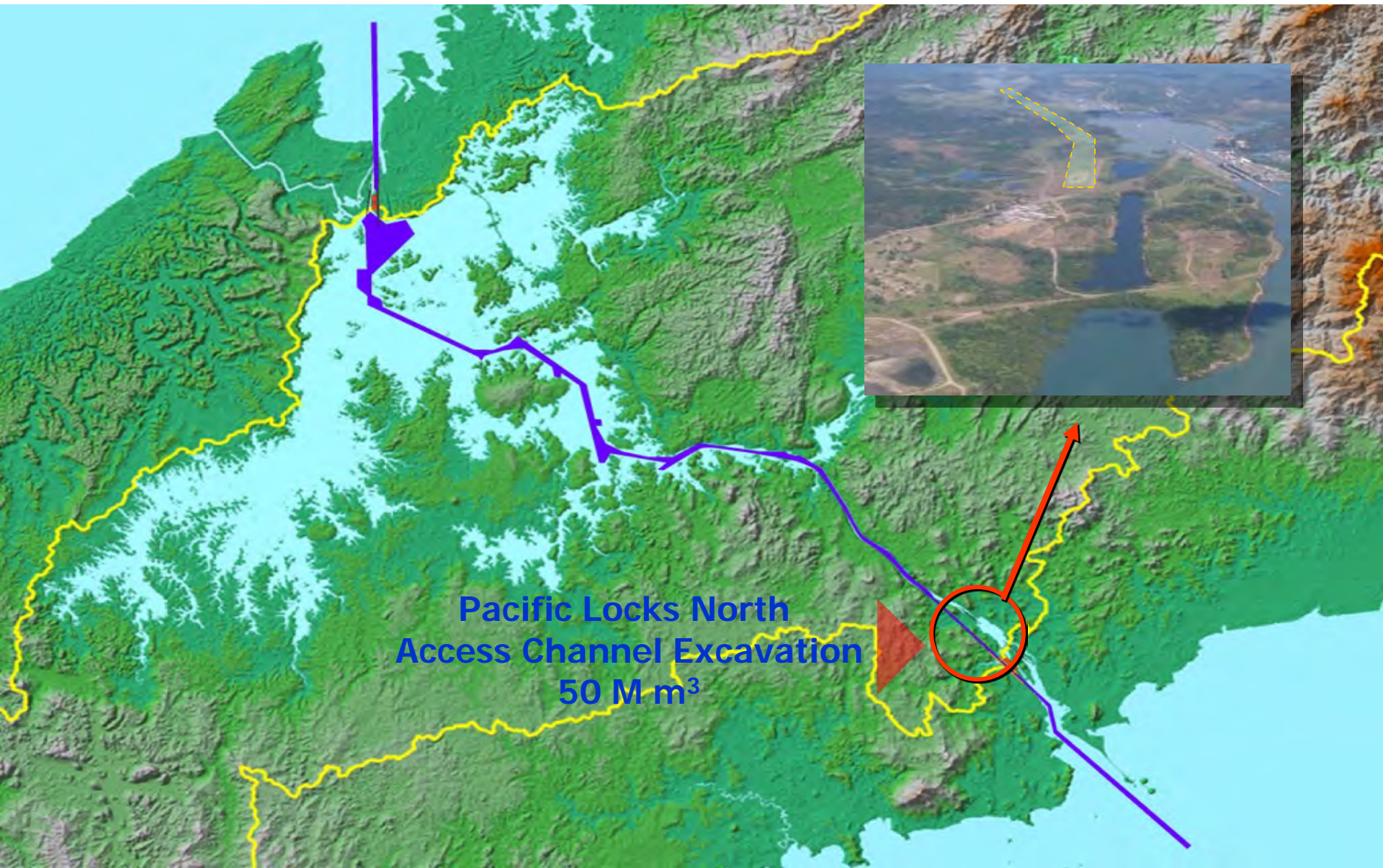


PACIFIC ACCES CHANNEL (PAC): Construction Challenges

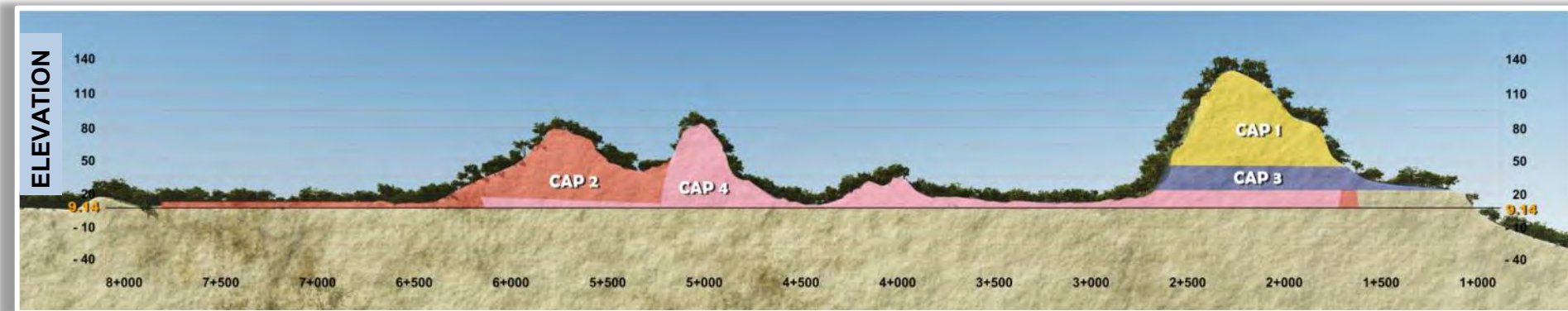
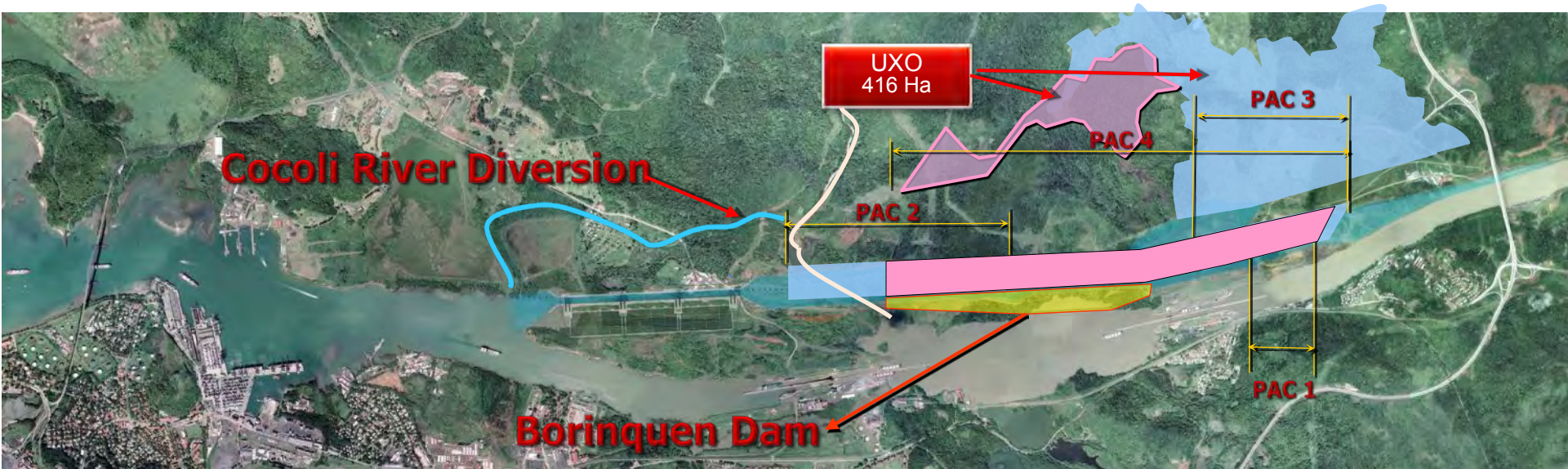
Jorge A. Fernandez A.
PANAMA CANAL AUTHORITY

Pacific Access Channel



Pacific Access Channel

50 M m³ dry excavation



Excavation and dredging at the northern entrance of the access channel to the new locks

Oct 2012



UXO Removal



Cocoli River Diversion



**Inicio de Trabajos de Dragado en
El Río Cocolí (Est. 0K+000 @ 0K+200)**



**Vista aérea de los trabajos del Canal de Desvío
(Est. 2K+800 @ 3K+500)**



**Vista aérea de los trabajos del Canal de
Desvío
(Est. 1K+160 @ 1K+440)**



**Trabajo de estructuras de protección
entre las estaciones 1K+222 y 1K+428**



**Vista aérea de los trabajos del Canal de Desvío
(Est. 0K+220 @ 1K+160)**

Cocoli River Diversion



October 26, 2009

Heavy Equipment

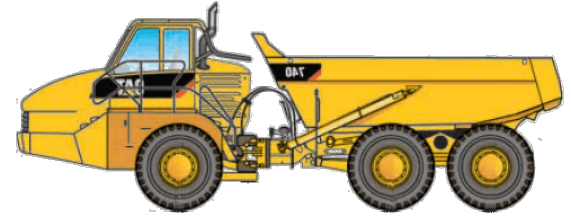


Equipment used for dry excavation

740

Tons
43.5
Tons

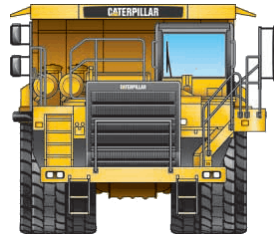
Cubic Yards
31.4
Cubic yards



773

60
Tons

46.5
Cubic yards

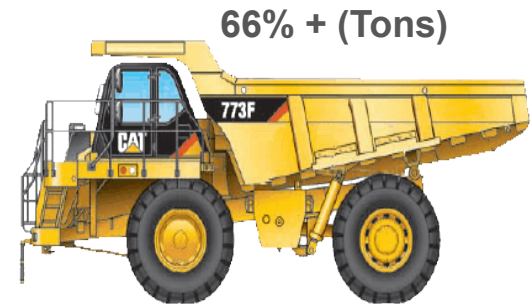
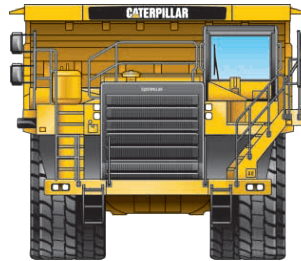


777

100
Tons

PAC 1

78.8
Cubic yards



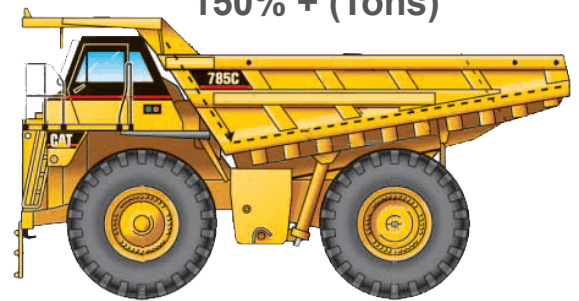
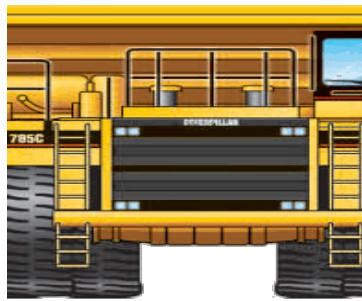
66% + (Tons)

785

150
Tons

PAC 2

102.0
Cubic yards



150% + (Tons)

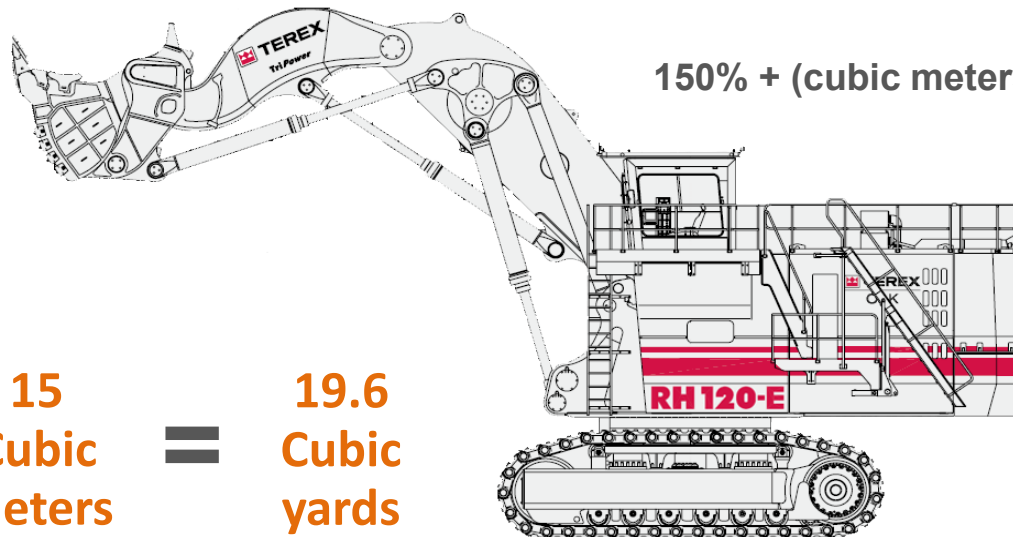
Equipment used for dry excavation

6.0
Cubic
meters = 8.0
Cubic
yards

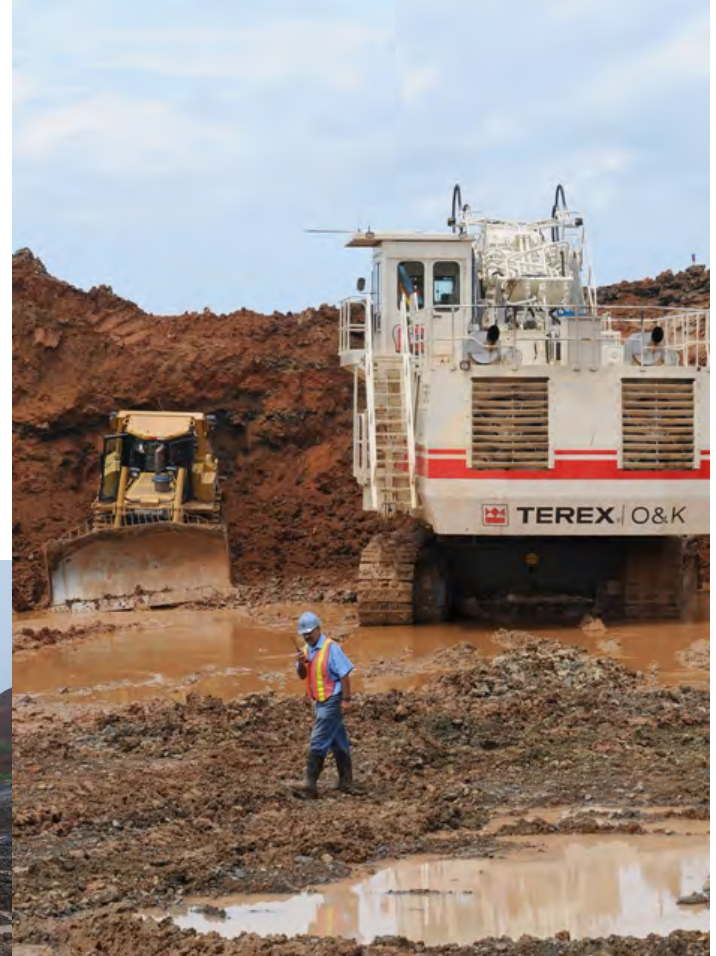


150% + (cubic meters)

15
Cubic
meters = 19.6
Cubic
yards



Equipment used for dry excavation



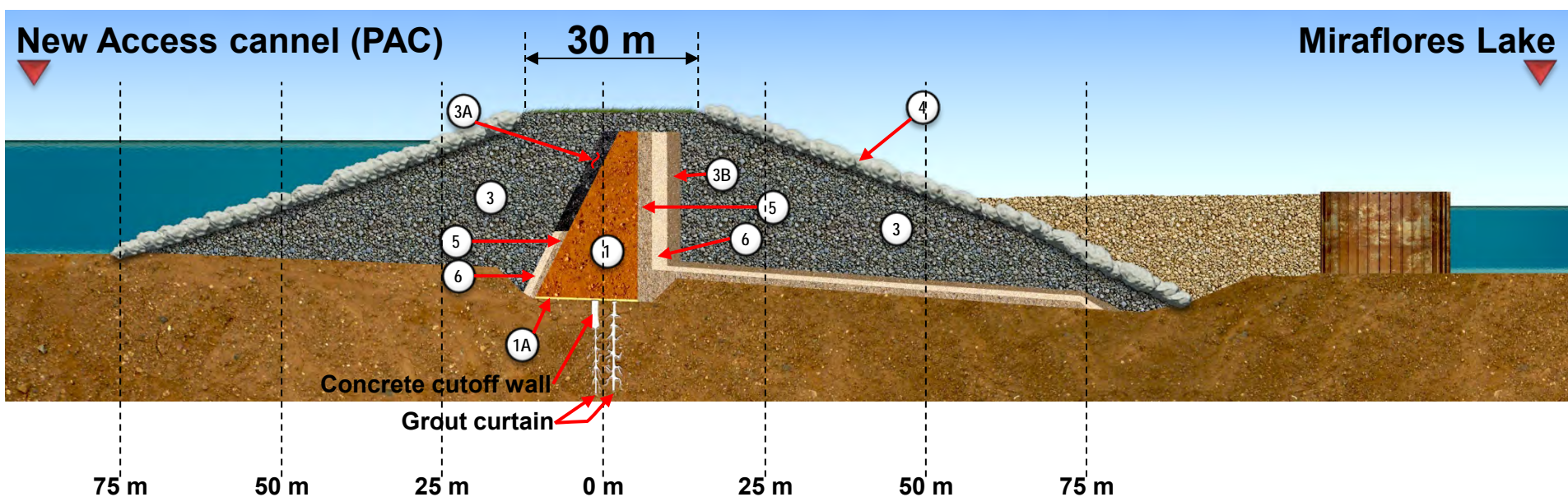
Cellular Cofferdam – Phase 4



Dewatering of Access Channel and Dam footprint



Borinquen Dam cross section

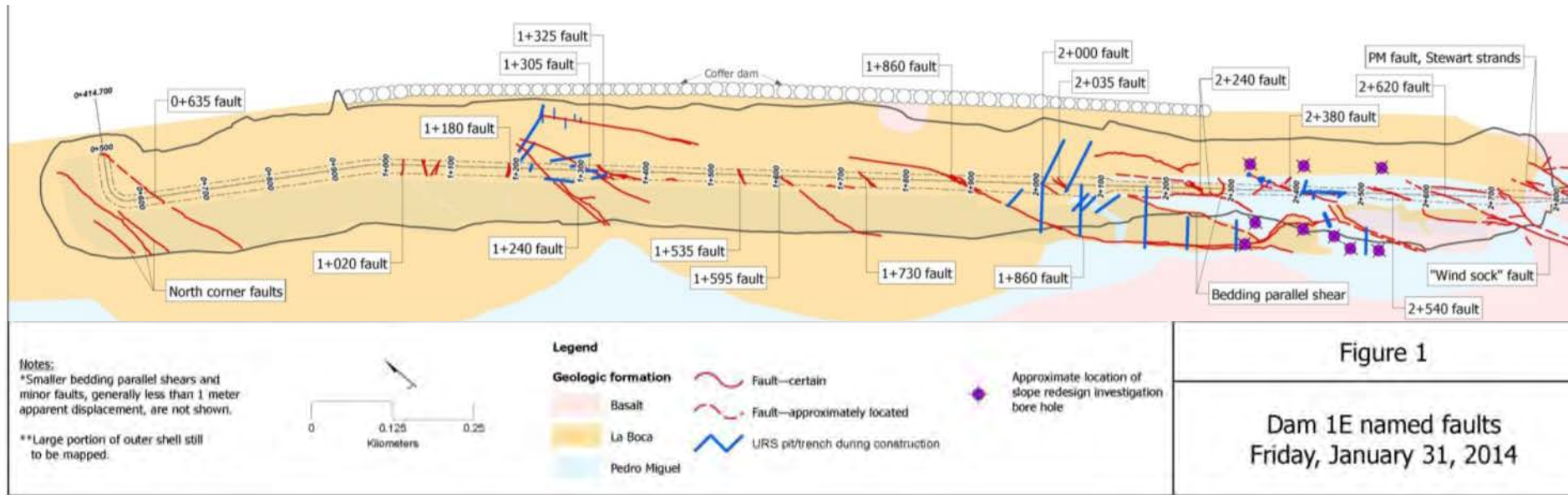


Zona 1/1A - Core - 460,000 m ³	Zona 4 - Riprap - 210,000 m ³
Zona 3 - Rockfill Shell - 3,350,000 m ³	Zona 5 - Filter - 315,000 m ³
Zona 3A - Filter - 100,000 m ³	Zona 6 - Drain - 260,000 m ³
Zona 3B - Transition - 235,000 m ³	Backfill - 340,000 m ³

Borinquen Dam



Complex Geological Conditions



Open fractures on Dam Foundation

Foundation - Borinquen Dam

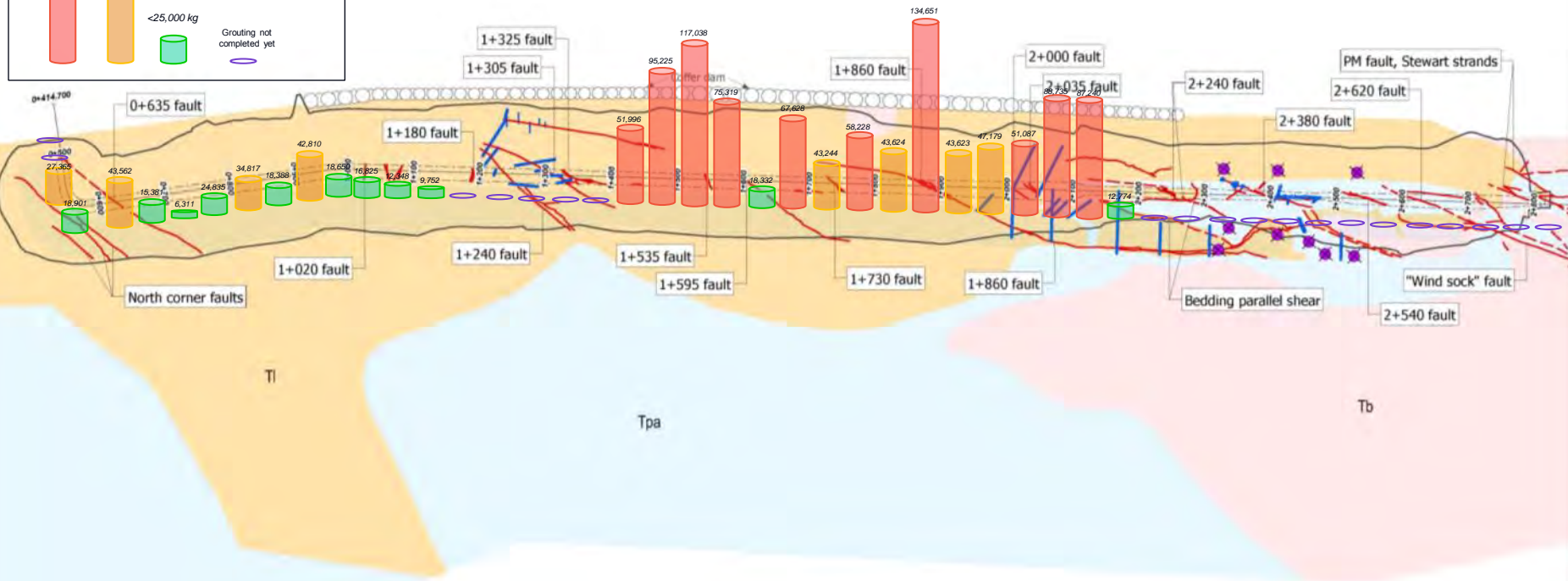
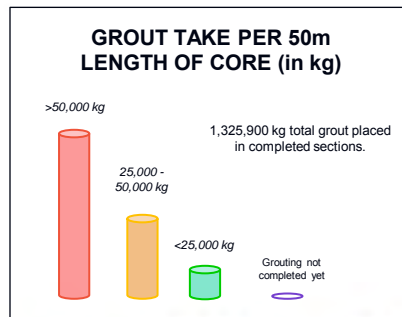


Weak Foundation

Pedro Miguel formation was found to be less extensive than previously considered and, where exposed in the foundation, generally weak, fractured rock (not strong agglomerate). The Concrete Cutoff Wall length was increased from 1,742m to 2,287m

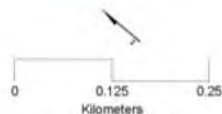


Higher Grouting Takes Associated with Faults



Notes:
 *Smaller bedding parallel shears and minor faults, generally less than 1 meter apparent displacement, are not shown.

**Large portion of outer shell still to be mapped.



Legend

Geologic formation

Basalt
 La Boca
 Pedro Miguel

Fault—certain

Fault—approximately located

URS pit/trench during construction

Approximate location of slope redesign investigation bore hole

Figure 1

Dam 1E named faults
 Friday, January 31, 2014

Foundation - Borinquen Dam



Grout Filled Fractures – Cored Recovery Verification Holes



Core Materials Stockpiles - Borinquen Dam

Clay



Filters

Zone 1 Sourcing (Clay Core)

- Potential Sources Evaluation
- Clearance on UXO zones
- Exploration through Testpits
- Sampling and Lab Testing of Material



Zone 1 Selection, Excavation, Stockpiling

- Quality Control of materials during Excavation by qualified geologists
- Material treatment during Stockpiling Process. (Moisture conditioning and oversizes removal)



Zone 1 Test Fills

- Evaluation of excavated material's behavior with equipment and installation methodology proposed by Contractor.
- Materials from different sources behave differently under same equipment and installation method.



Clay – Borinquen Dam



Clay stockpile – Borinquen Dam



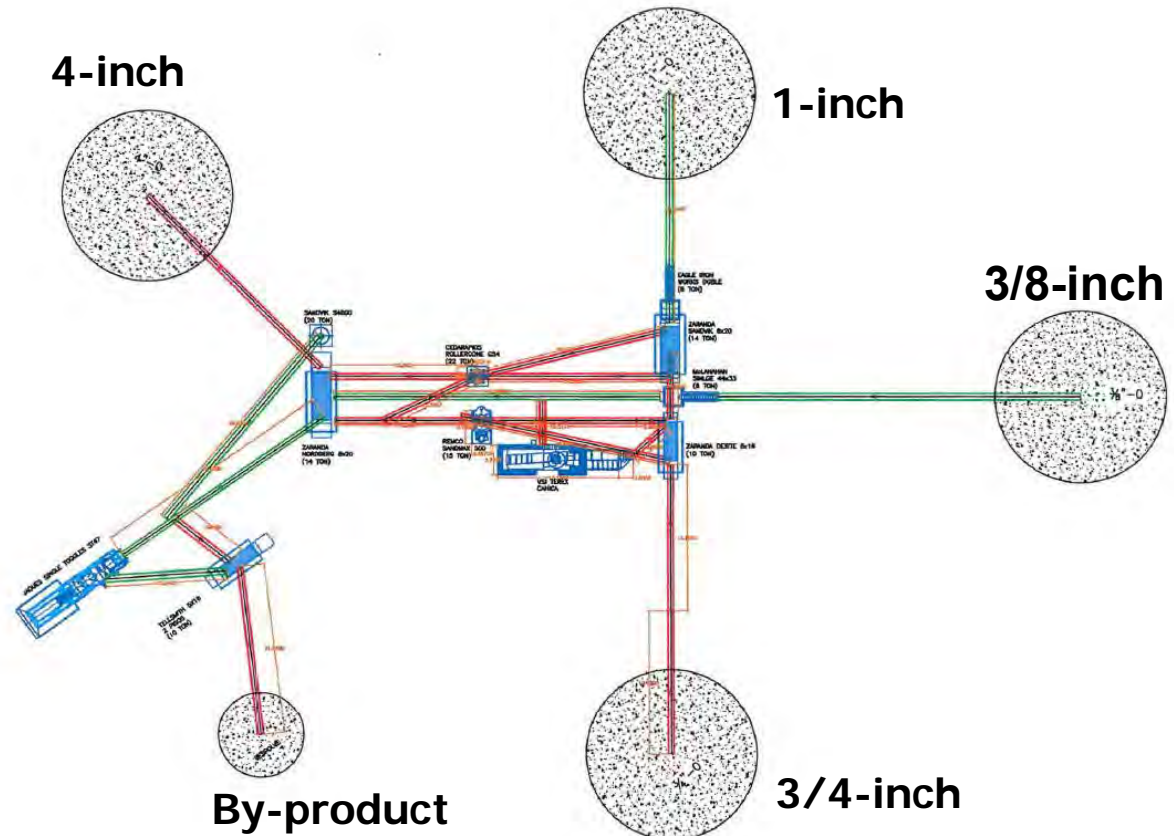
Aggregate Filter Supply

Initial Approach:

- All-inclusive plant producing filters and other required aggregates
- Planned filter output of 18,000 m³/month

Problems Encountered:

- Fines content very close to upper limit
- Output \approx 3,000 m³/month



Crushing Plants



Aggregate Filter Supply



Actions taken:

- Engaged crushing experts to improve overall process and equipment selection.
- Acquired four additional on-site dedicated plants with specialized equipment such as HP4 cone crushers and hydrocyclones for sand washing,
- Imported coarse sand crushed from fresh rock for on-site processing,
- Engaged filter import from off-site commercial source

Results:

- Fines content averaging 3% (upper limit: 5%)
- Output: 30,000 m³/month

Crushing Plants



Pacific Access Channel – Phase 4



Material Placement against Dam Foundation



Borinquen Dam – Clay Core – North Section



Filter Placement Rates



Materials Placement



PAC Filling and Plug Removal



14 de septiembre de 2015



Pacific Access Channel



GRACIAS