WJ GROUNDWATER LIMITED – QIT QATAR LLC

Groundwater control
Geotechnical instrumentation
Geothermal systems
Groundwater remediation
Pumping tests
Well drilling

Paul Turner –Overseas Director

Groundwater control for major infrastructure projects in the Middle East

4th December 2013

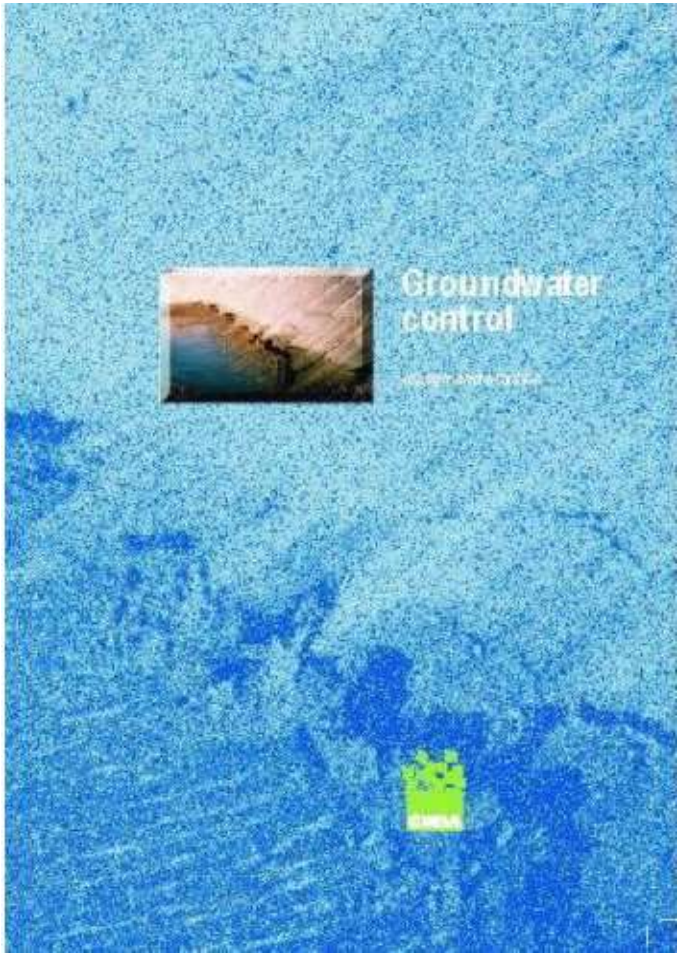
WJ GROUNDWATER LIMITED – QIT QATAR LLC

ESTABLISHED FOR 30 YEARS

- Construction Dewatering
- Pumping Tests, Analysis & Modelling
- Treatment & Remediation of Contaminated Groundwater
- Instrumentation / Automated Monitoring
- Geothermal Wells and TRT testing
- Water Supply Wells
- Qatar, Dubai, Abu Dhabi, KSA, Hong Kong, UK & Ireland

CIRIA
sharing knowledge
building best practice

WJ Groundwater are the authors of the industry best practice publication on groundwater control design and practice



CIRIA - C515 GROUNDWATER CONTROL - DESIGN AND PRACTICE

Outline of the Presentation

- Active pumping techniques in Qatar
  - Range of application of techniques
  - Trenching & sump pumping
  - Deepwells
- Cut-offs and dewatering
- Groundwater Control Case Studies in Qatar
  - Barwa Financial District
  - North East Car Park
  - NDIA Metro Station Box

Photo of the state of the practice

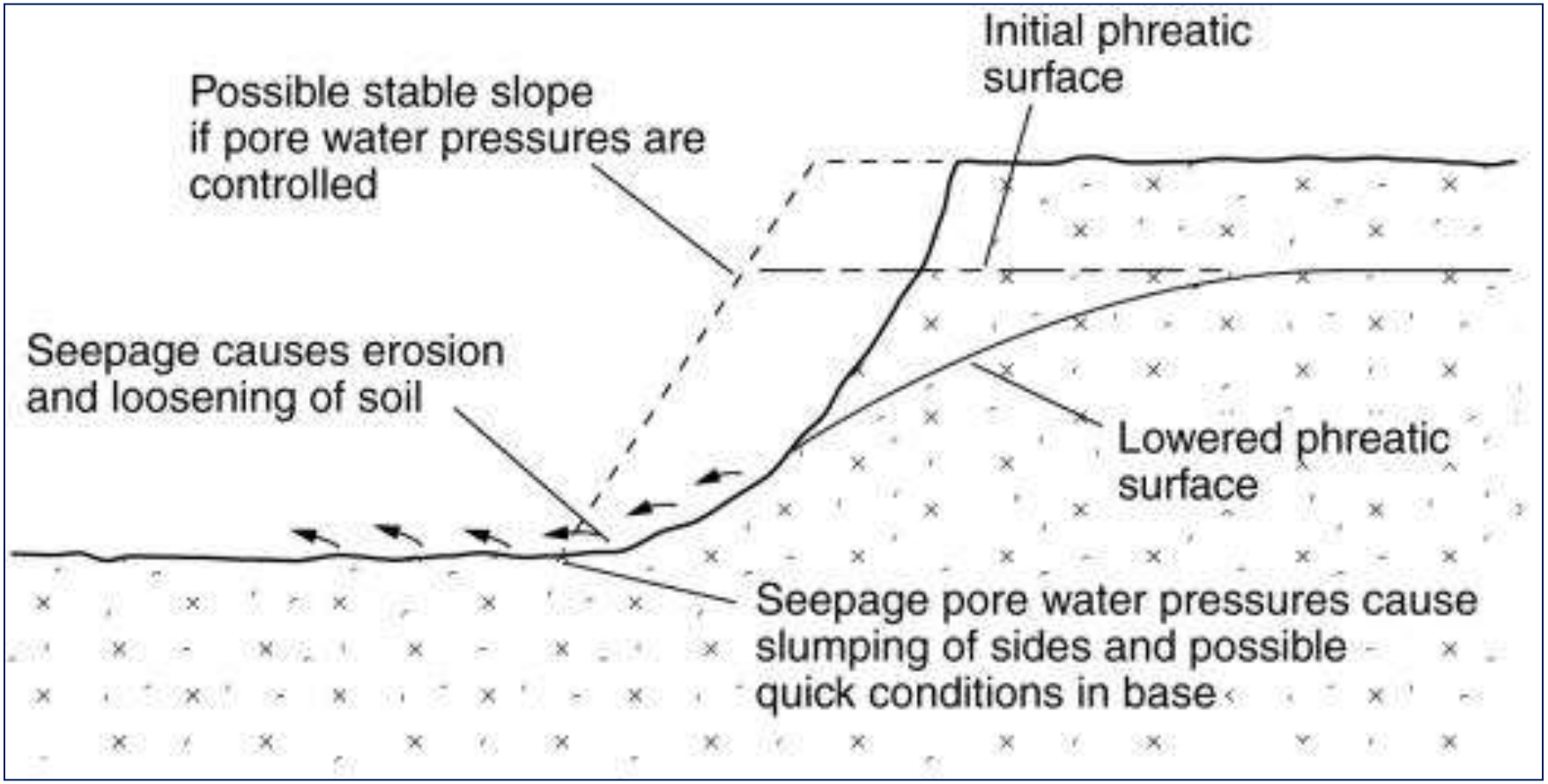


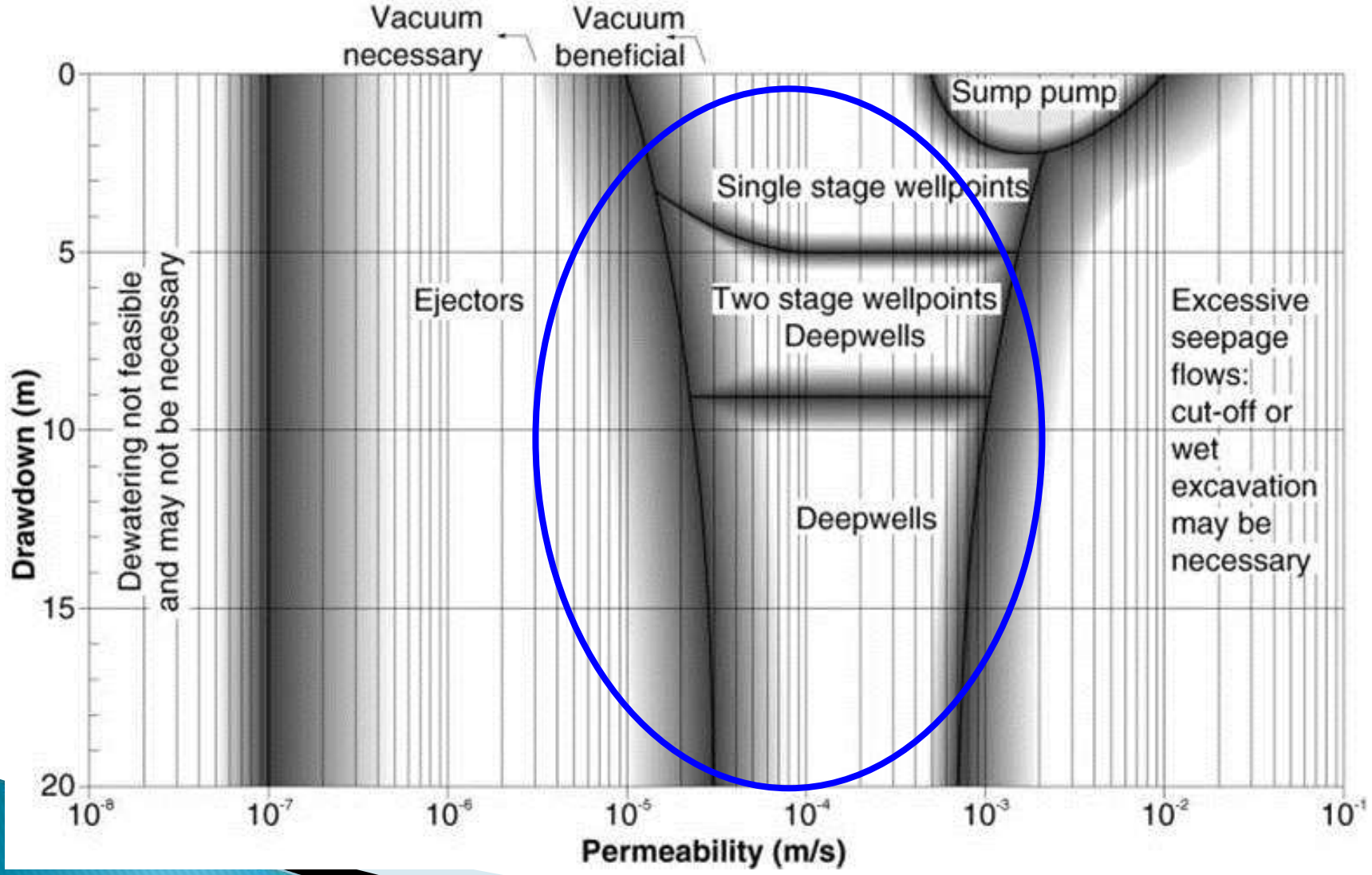
Diagram of the state of the theory

Diagram of the state of the practice in Qatar

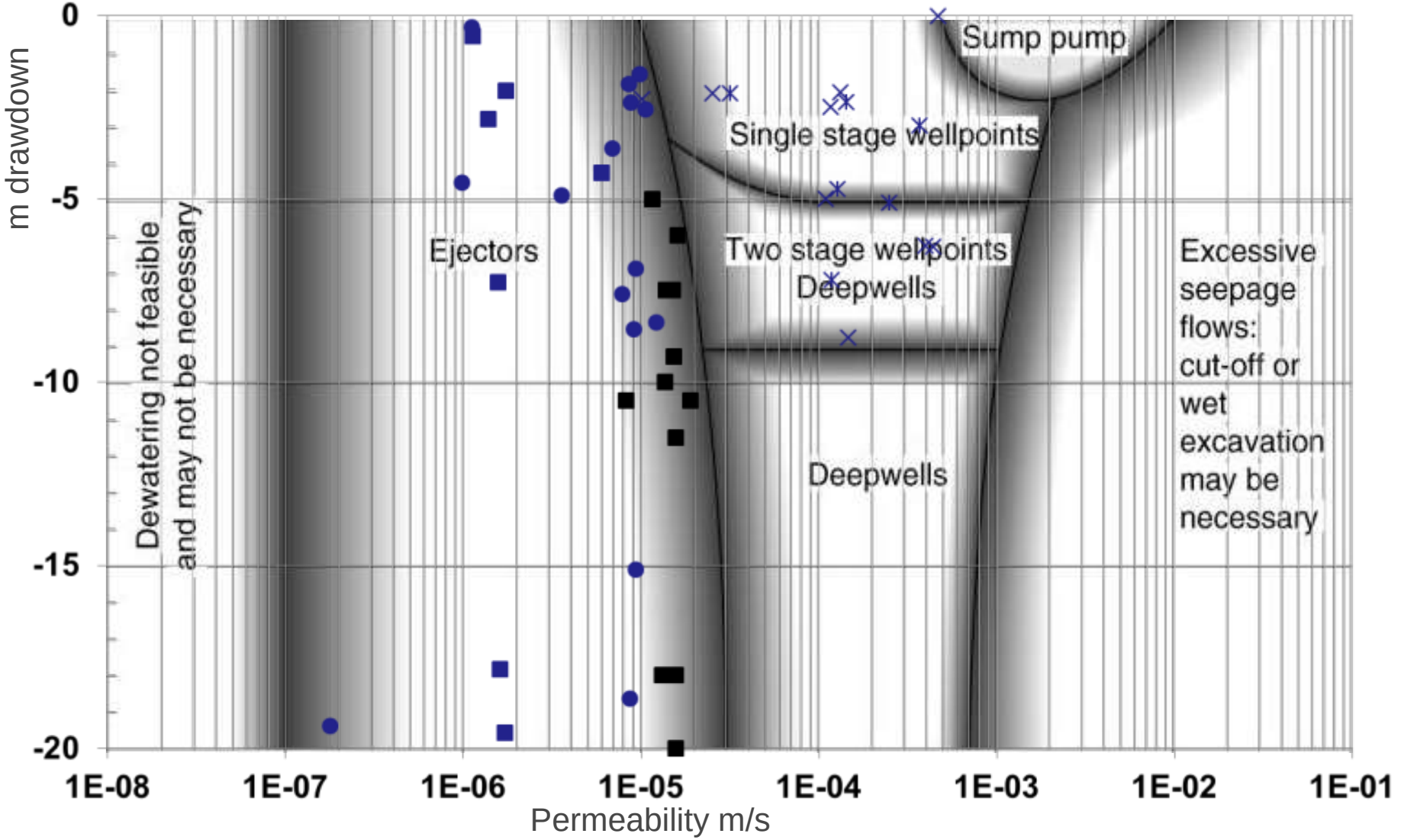
1. Rock

2. Cavities

Range of application of techniques



Example of permeability tests for ‘A’ project in Qatar



Summary of Permeability data + CIRIA C515 Fig 1.10

Trenching & sump Pumping

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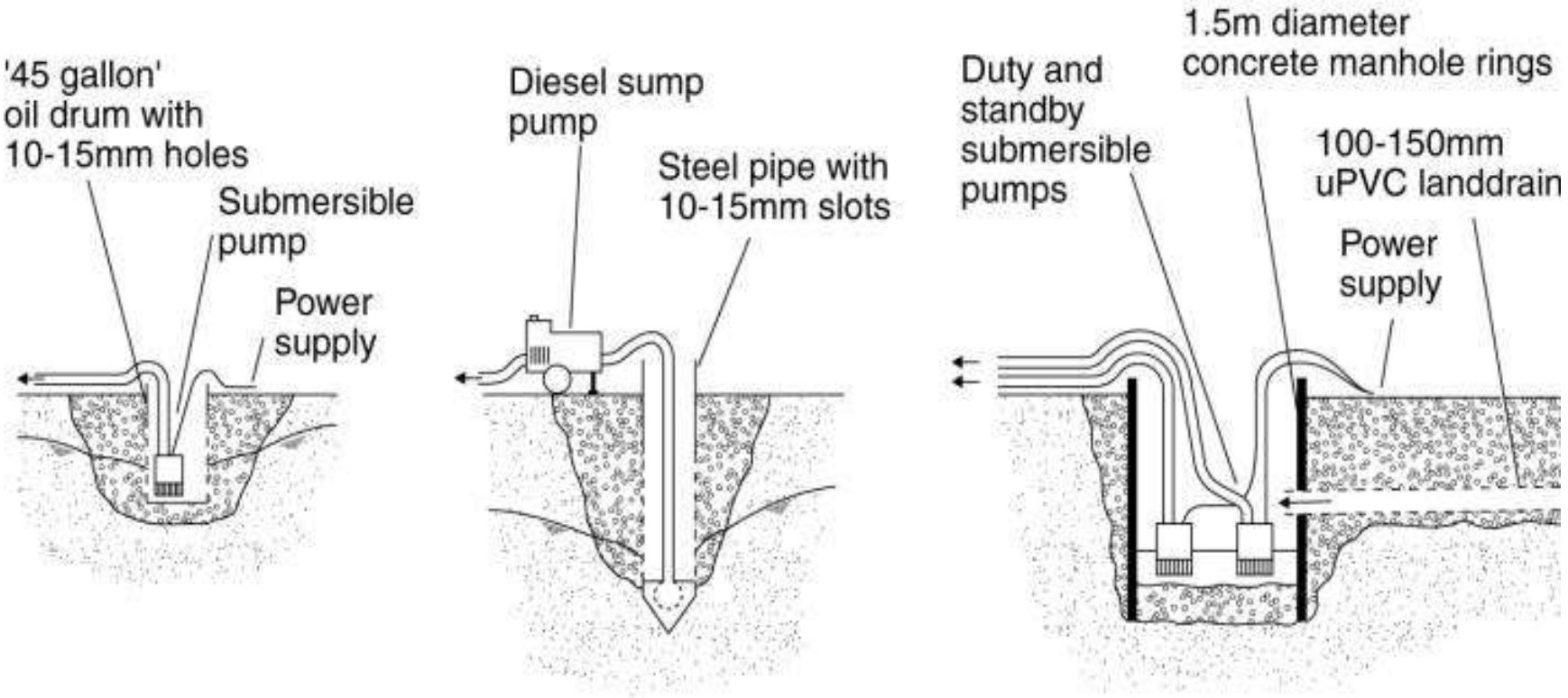
Trenches and sumps:

- Narrow
- Deep enough
- Free draining
- Sump / well

Typical sump pumping arrangements



a) Perforated oil drum

b) Perforated steel pipe with driving point

c) Concrete manhole rings fed by French drains

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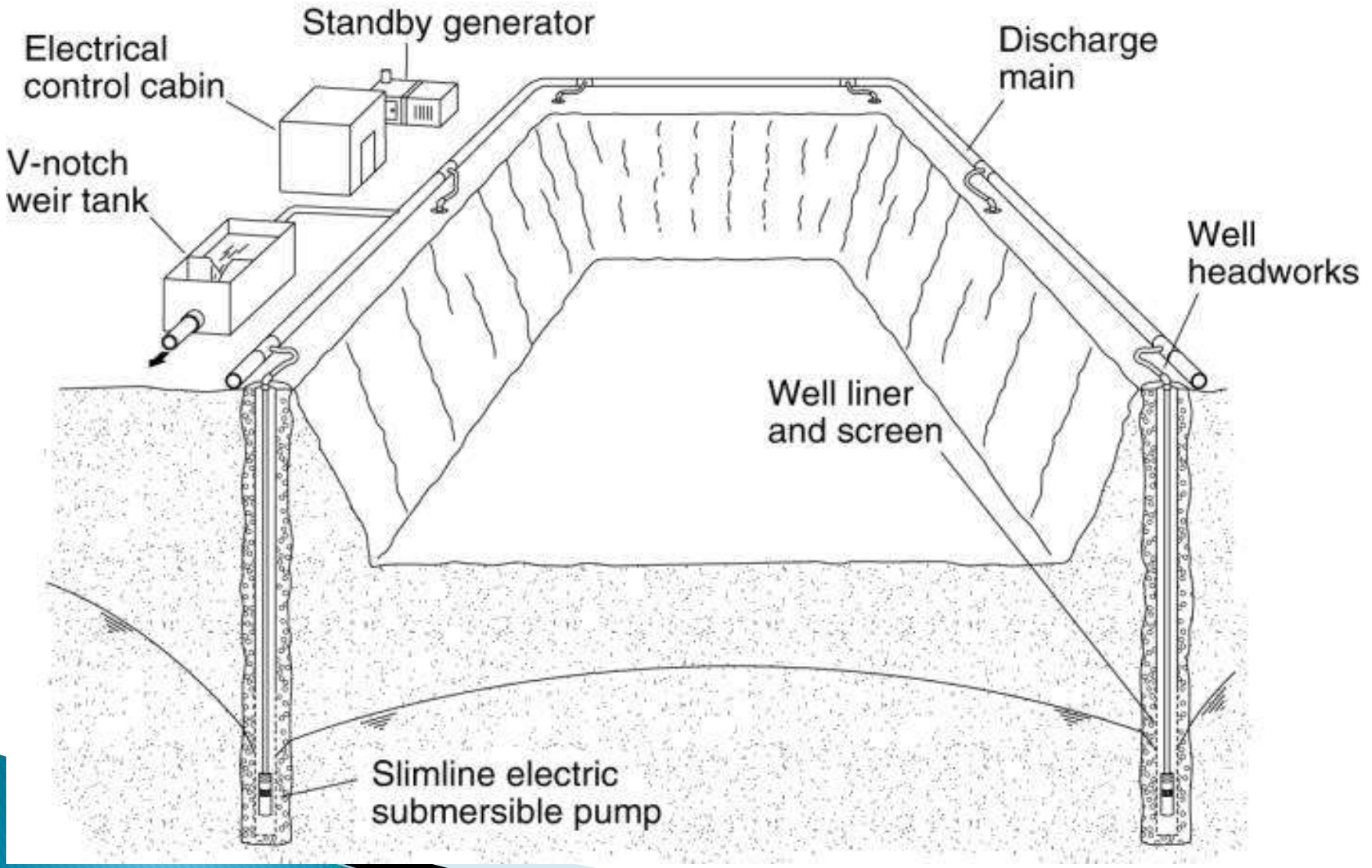
Same technique – Different out come

Deepwells


Standby generator
Electrical control cabin
Discharge main
V-notch weir tank
Well headworks
Well liner and screen
Slimline electric submersible pump

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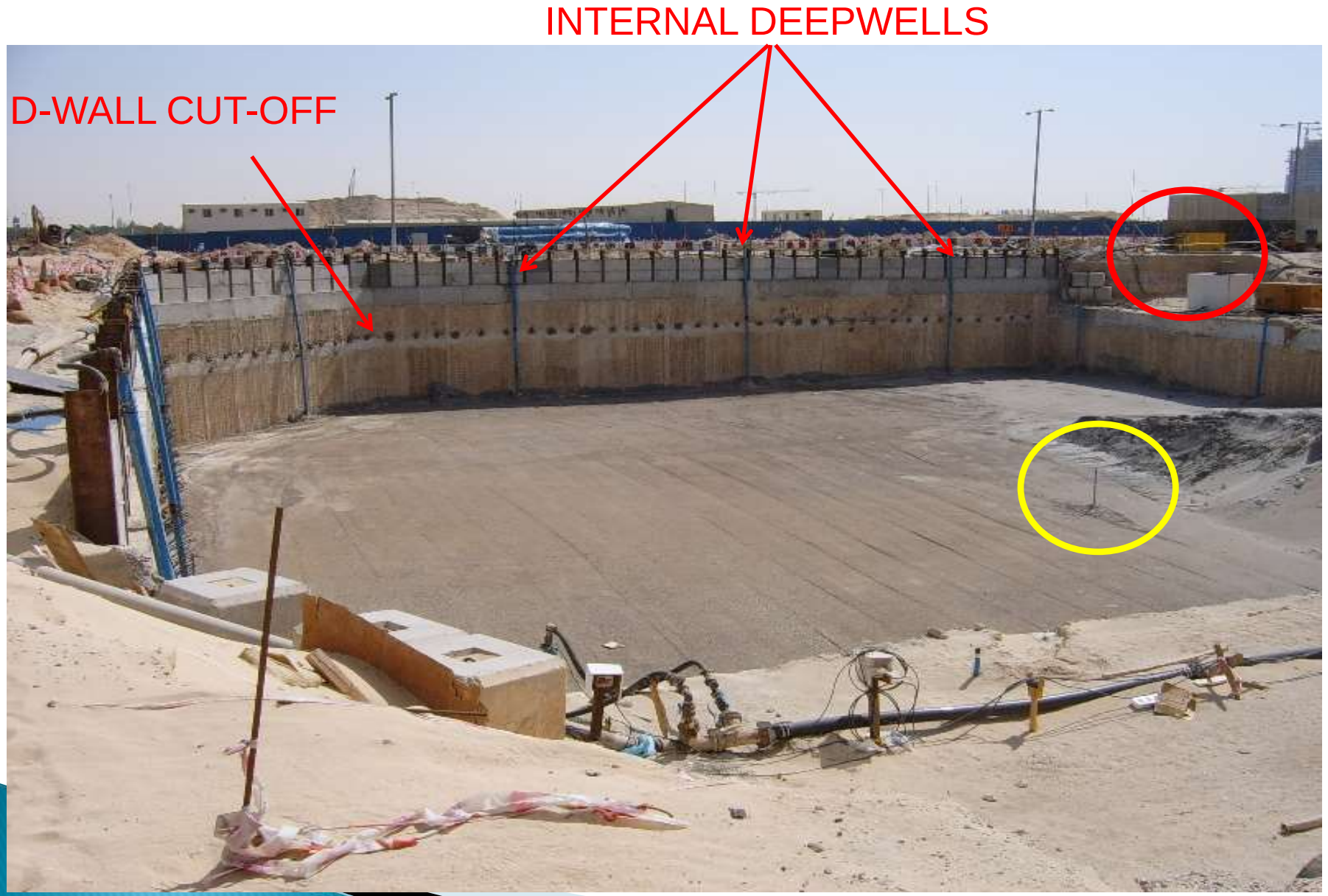

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Summary of techniques

	Sumping	Wellpoints	Deepwells
Depth m	Limited to excavator depth/stability	6 (per stage)	Unlimited
Flow l/s	1 to 50	1	1 to 50
Spacing m	10 to 100	1 to 3	10 to 100
Quality of discharge	Poor (initially)	Very good	Very good

Cut offs and dewatering

Why install a cut off?

- inflows would be excessive
- there is no suitable discharge point
- the groundwater is contaminated and treatment prohibitively costly
- external drawdown may cause unacceptable impact on adjacent structures

Not all earth retaining structures form a hydraulic barrier

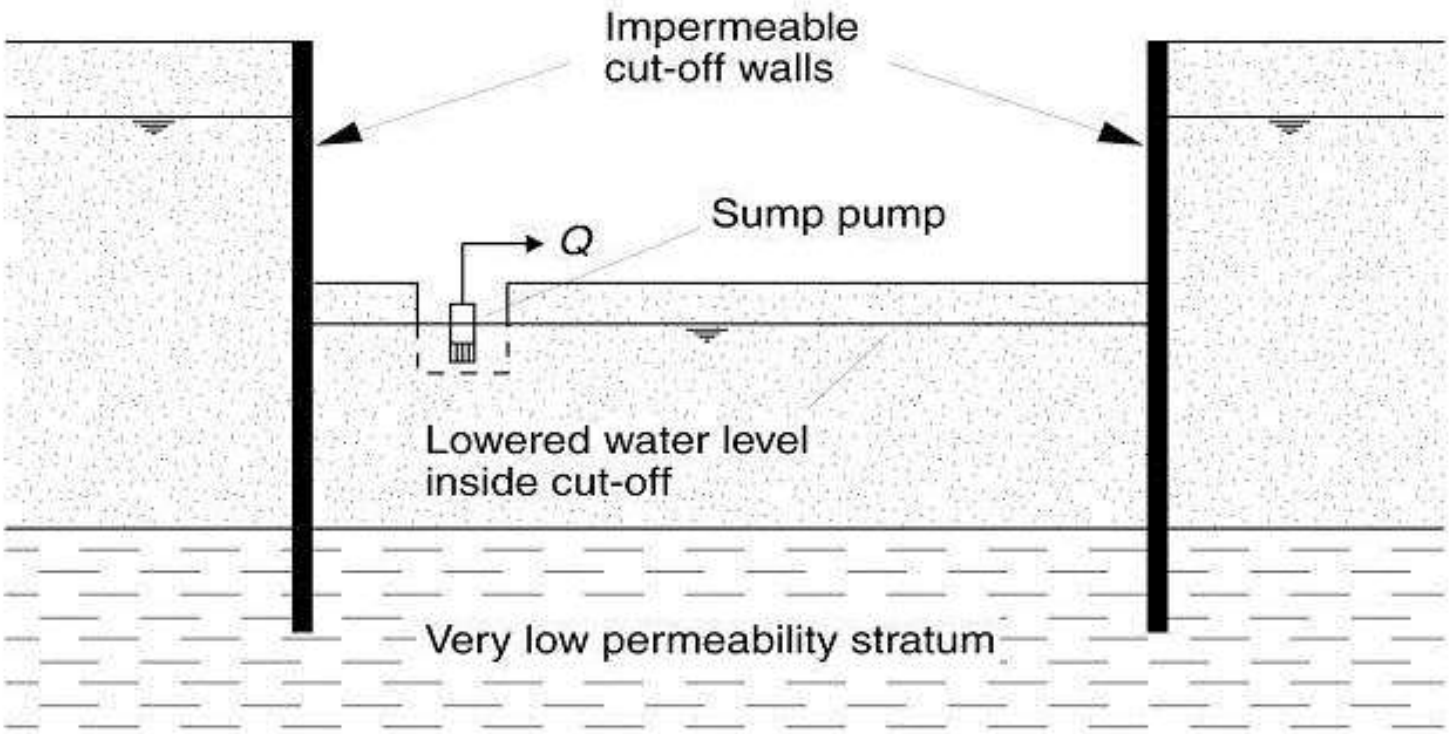
Hydraulic barrier

- Diaphragm Walls
- Secant Piles
- Sheet Piles

Non-hydraulic barrier

- Contiguous Piles
- Soldier Piles
- Battered Slopes

Groundwater control and physical cut-off wall toed into a low permeability strata



From CIRIA C515

Groundwater control and physical cut-off wall toed into strata with some isotropy

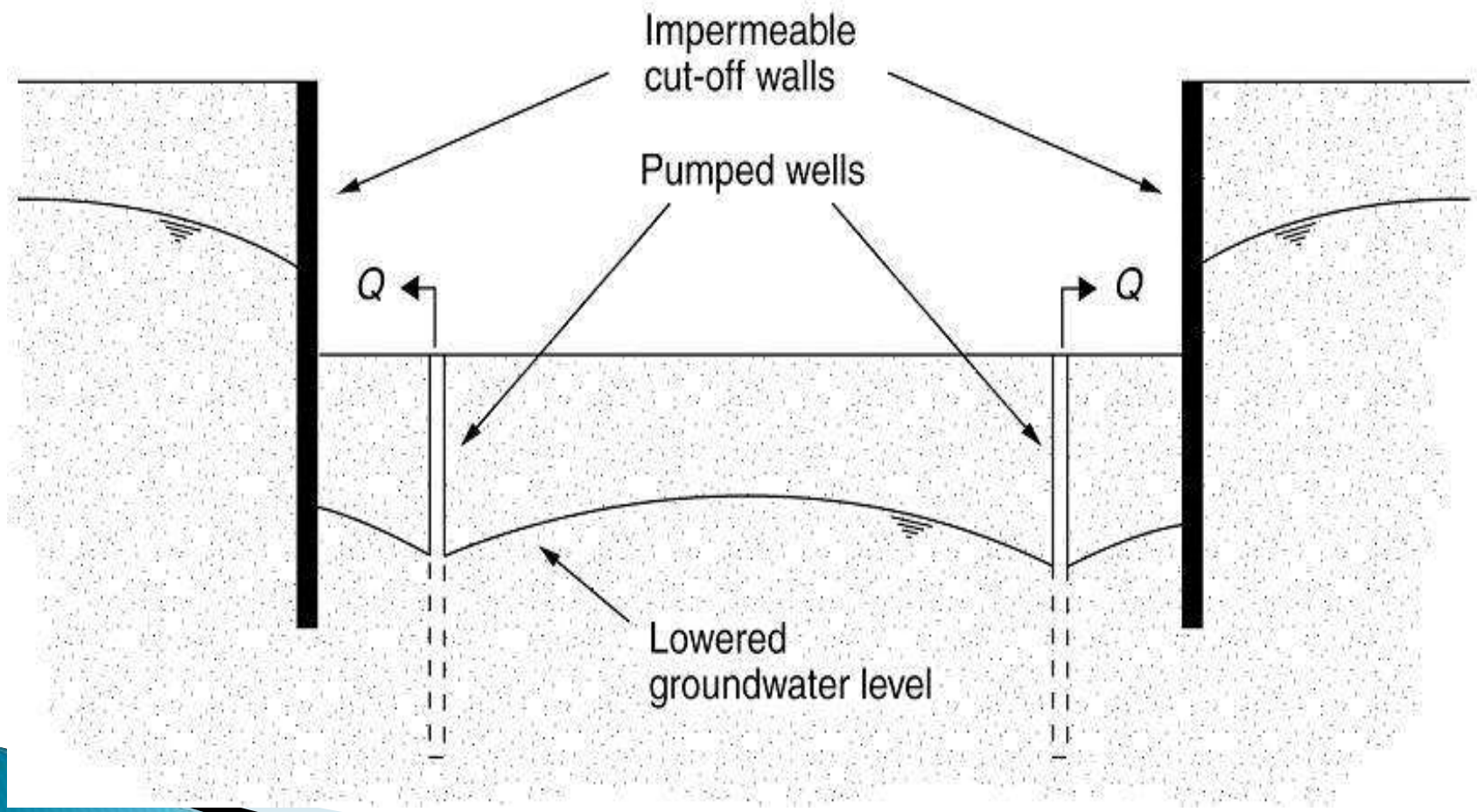


Diagram of the state of the theory

Barwa Financial District, Westbay, Qatar


Perimeter = 1,100 m
325 meters
200 meters
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Image © 2009 DigitalGlobe

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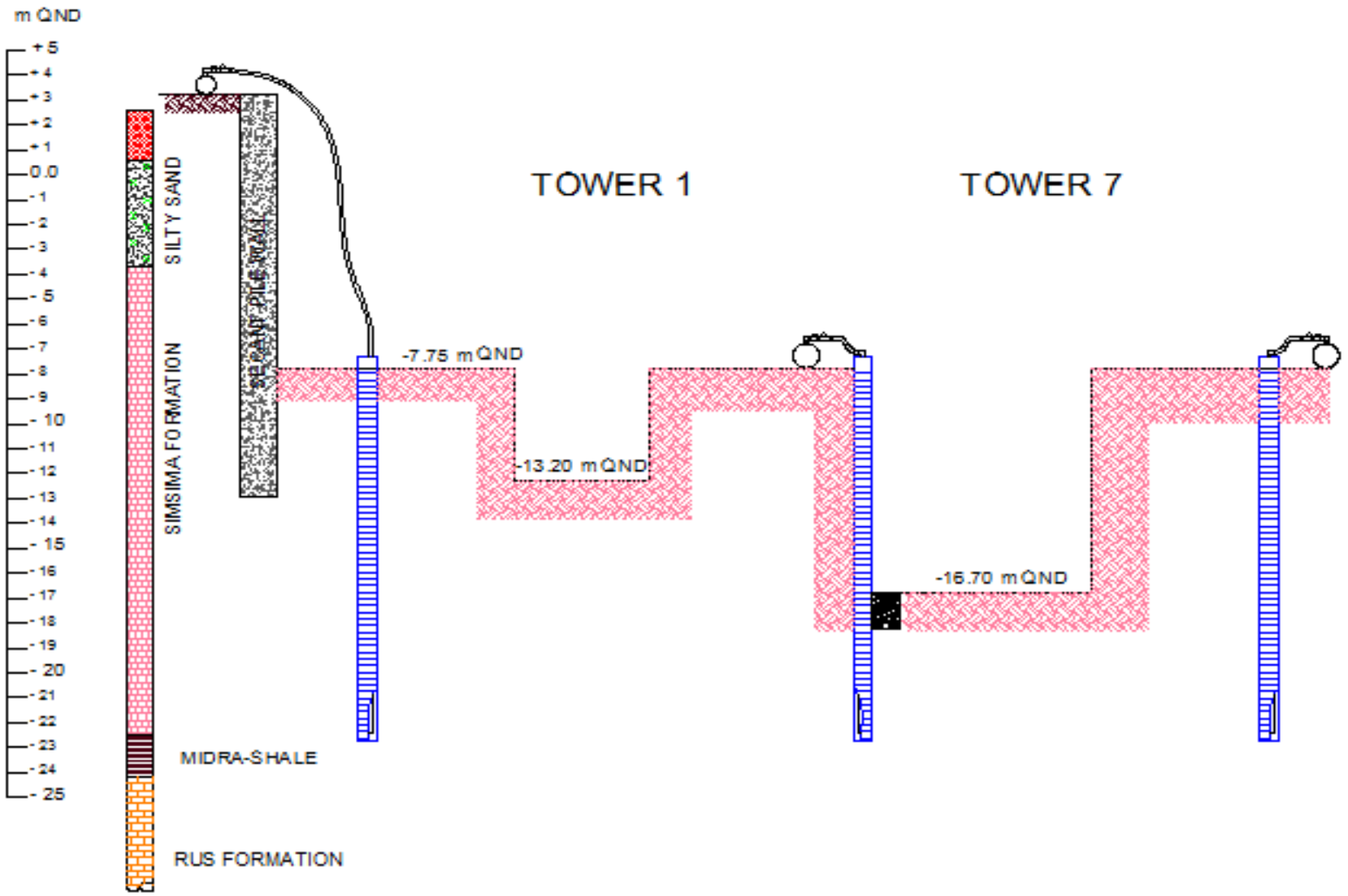


Perimeter internal wells
(could have been external?)

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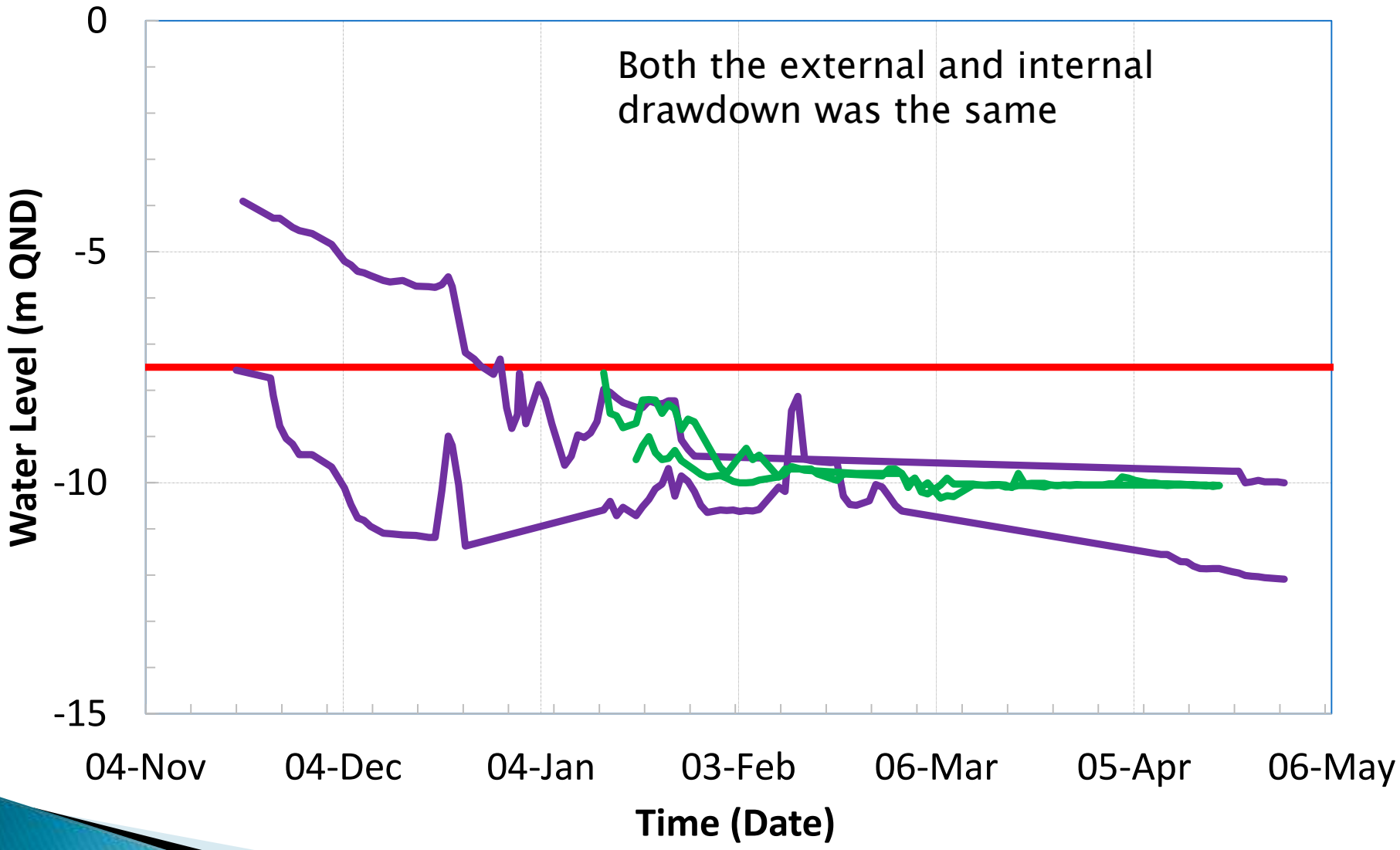

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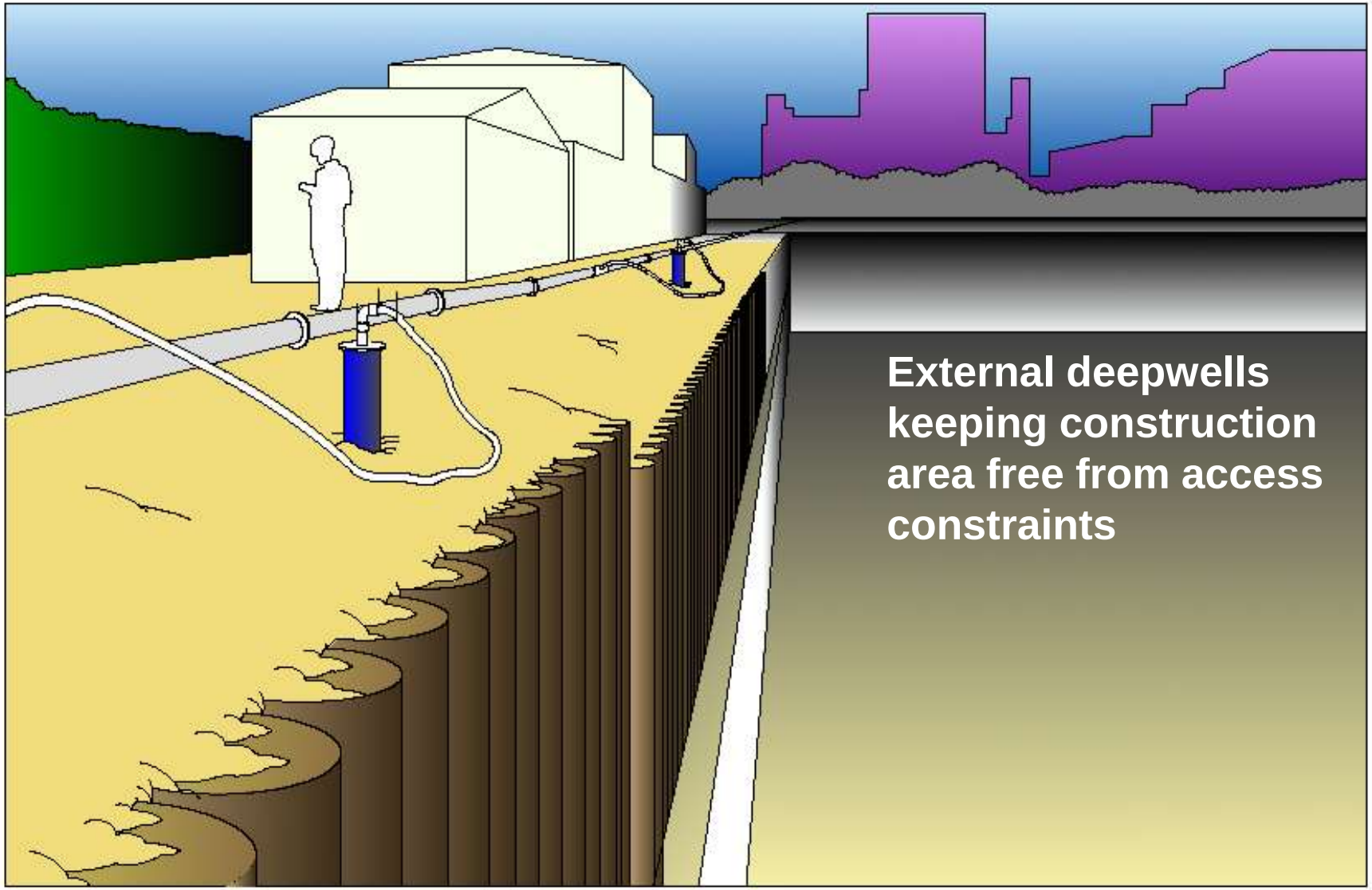

North East Car Park, Education City, Qatar

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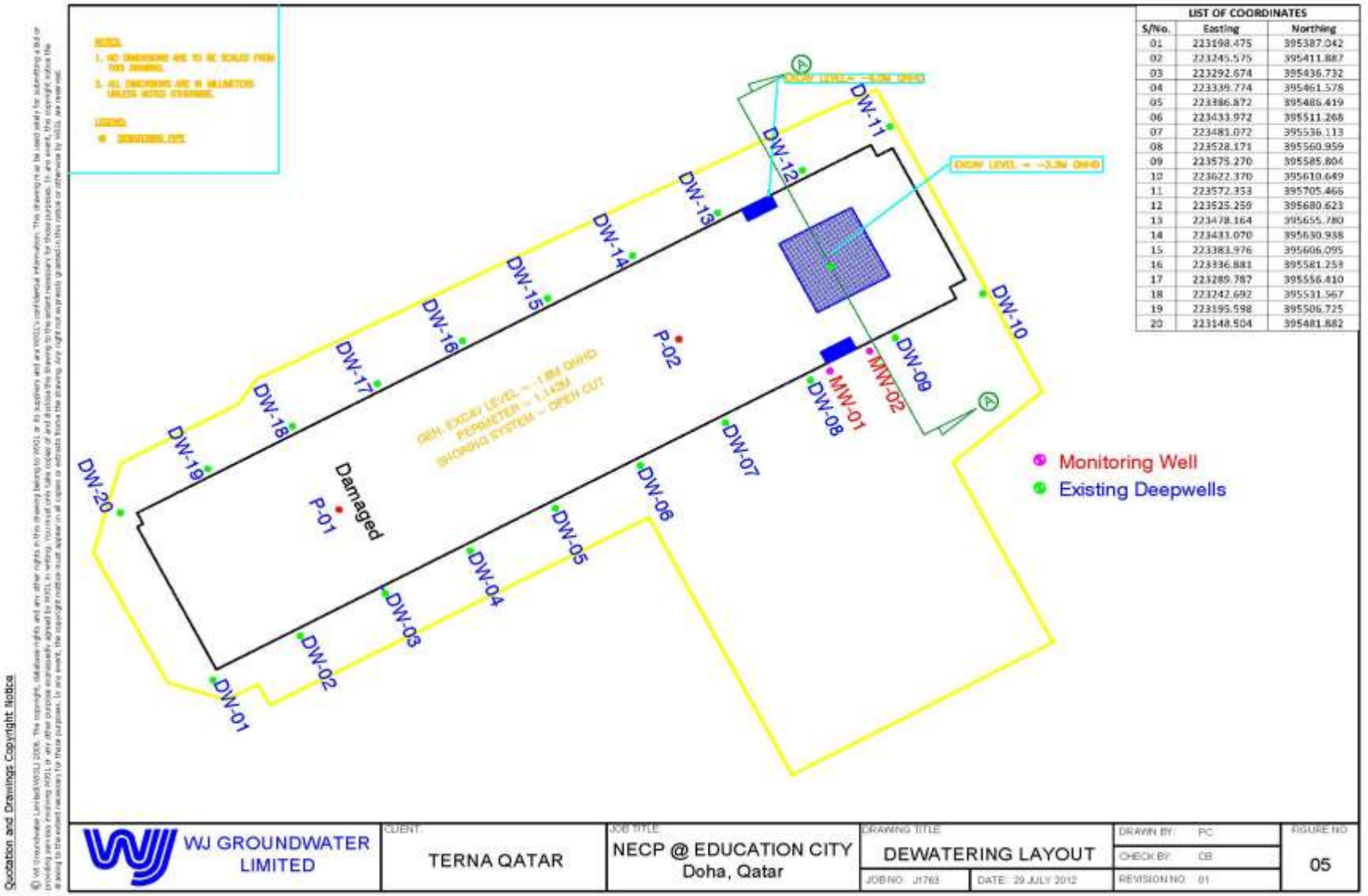

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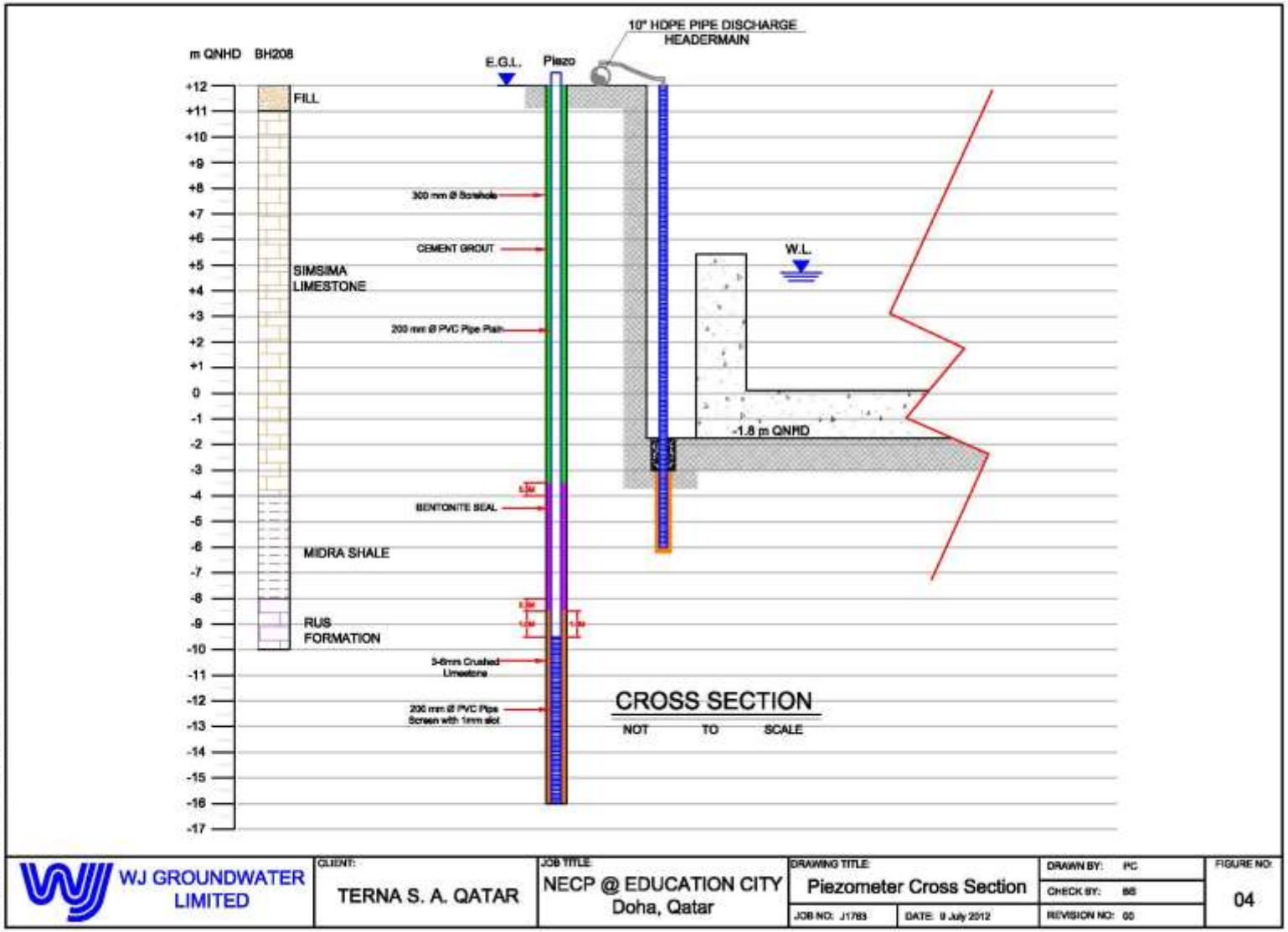

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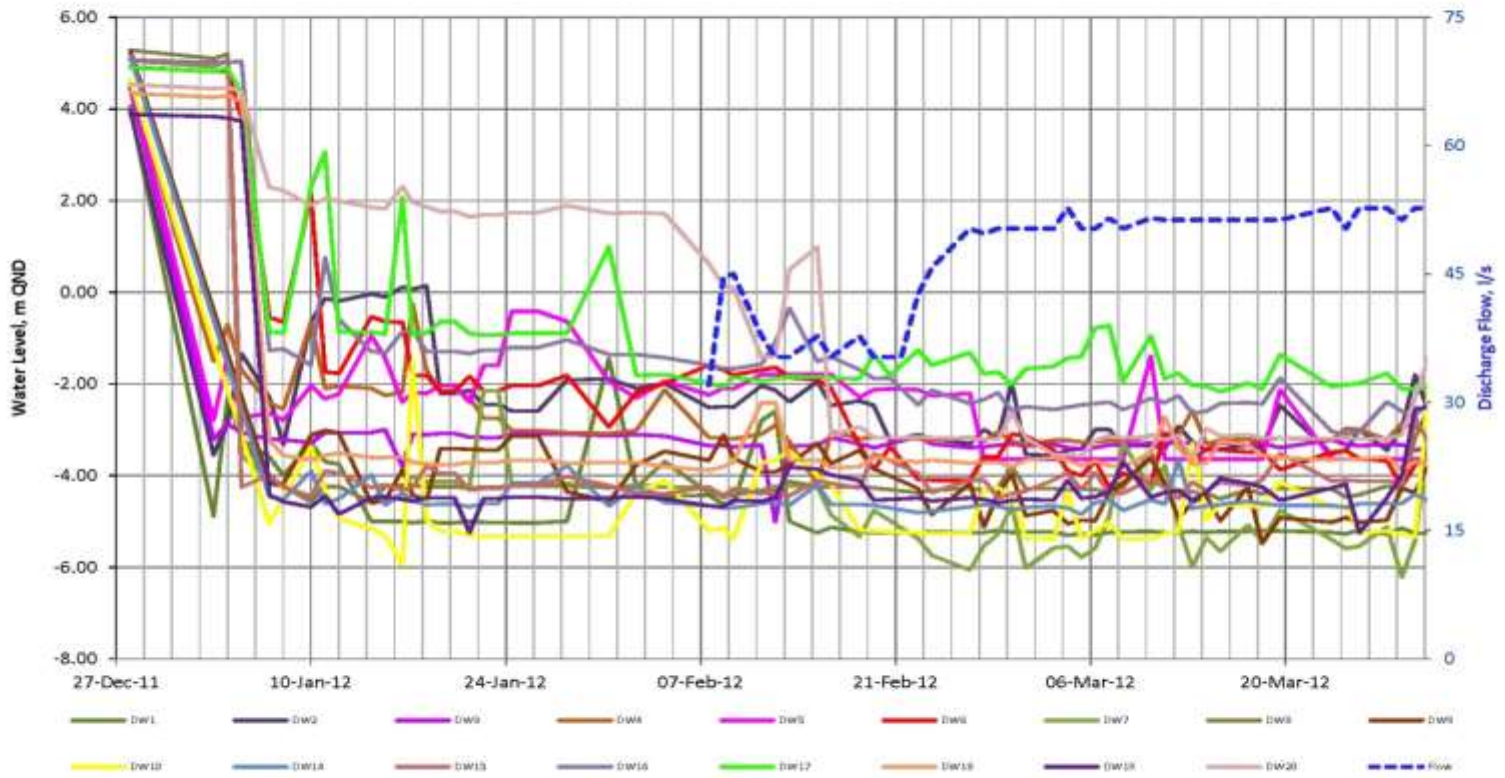
J1763 - Northeast Carpark Project,
Doha, Qatar - Dewatering

Reduced Dynamic Water Levels



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C:\Users\pablito.WJGLDUBAI\Desktop\J1763 Water Level Records.xls

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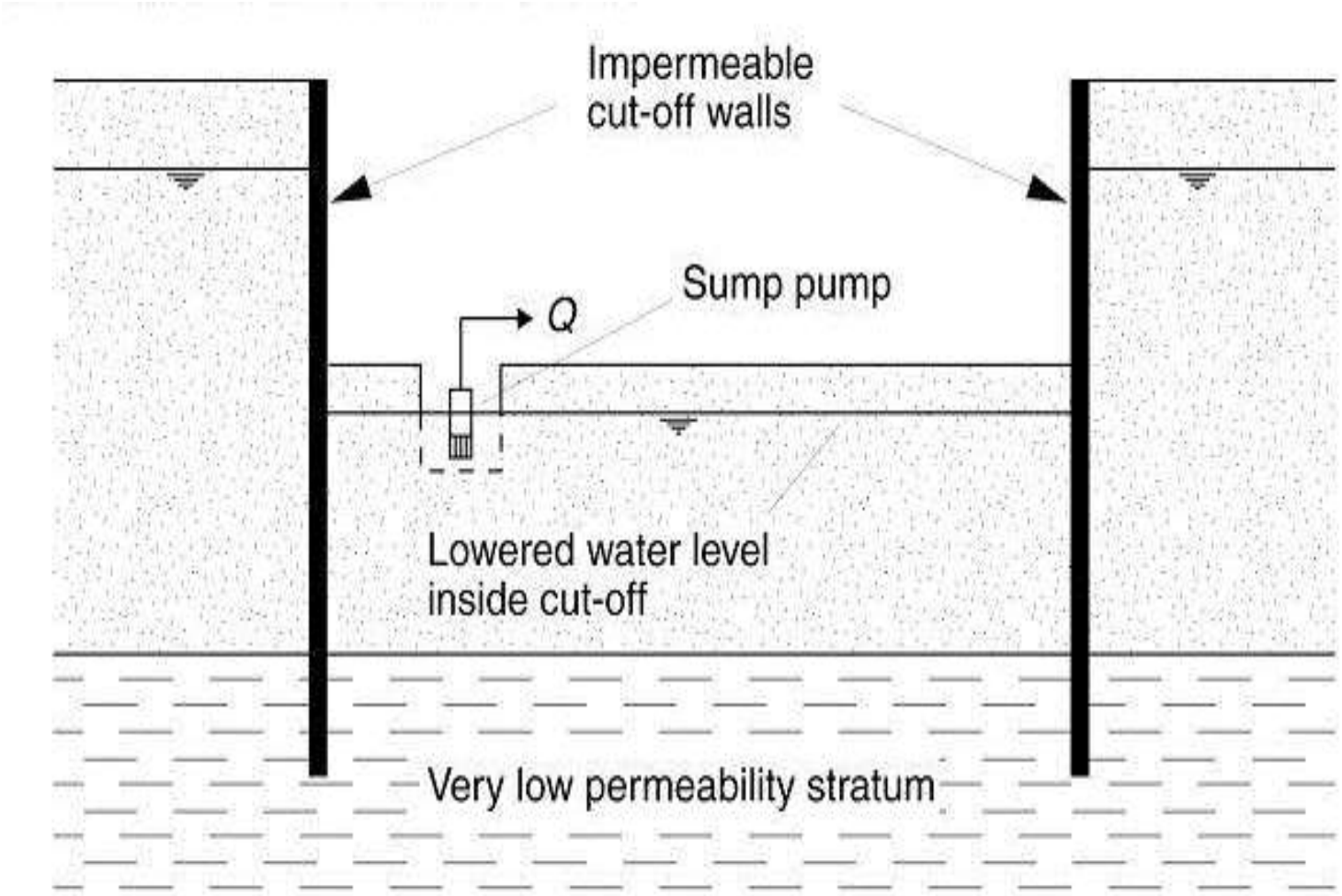
Metro Station Box, NDIA, Qatar



Cut-Off: State of the Theory

Cut-Off: State of the practice

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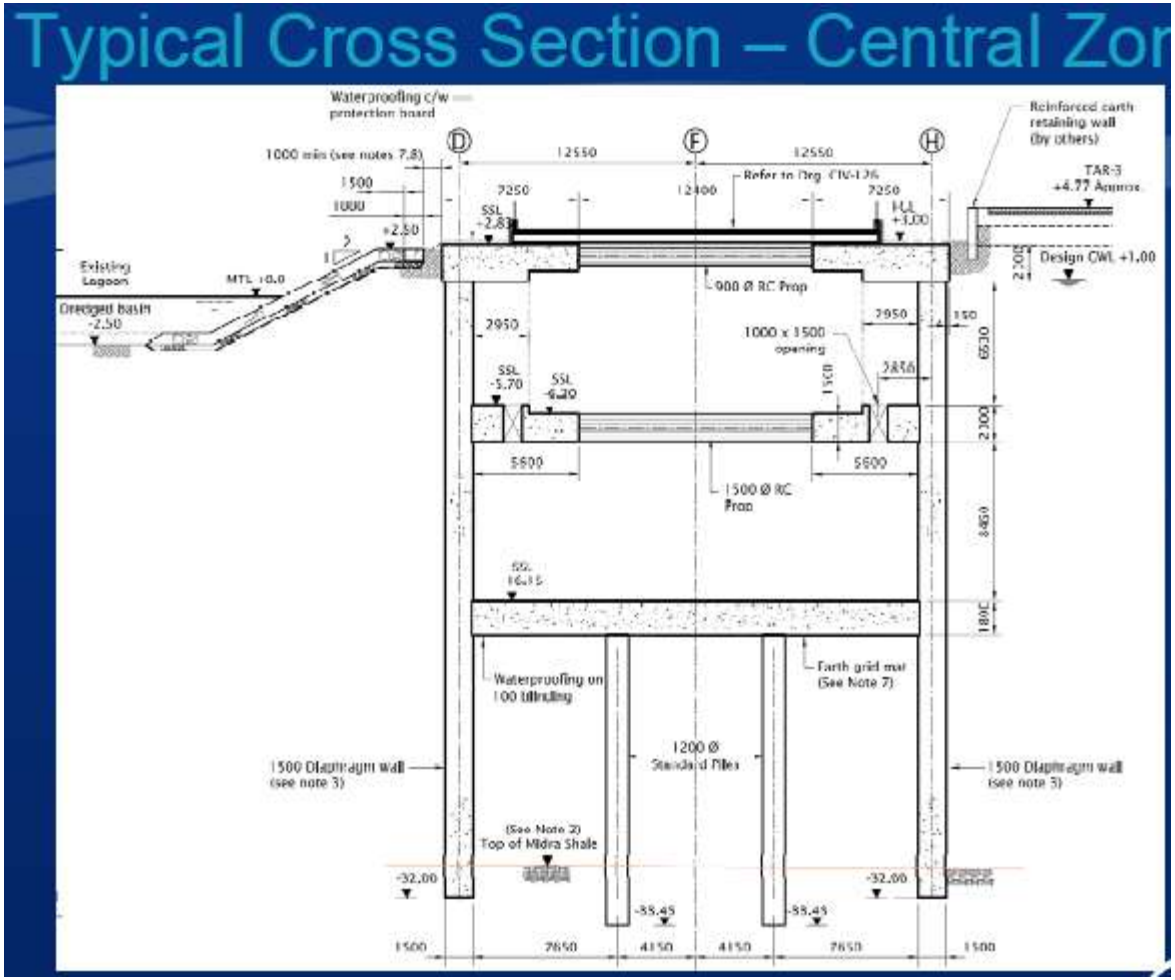

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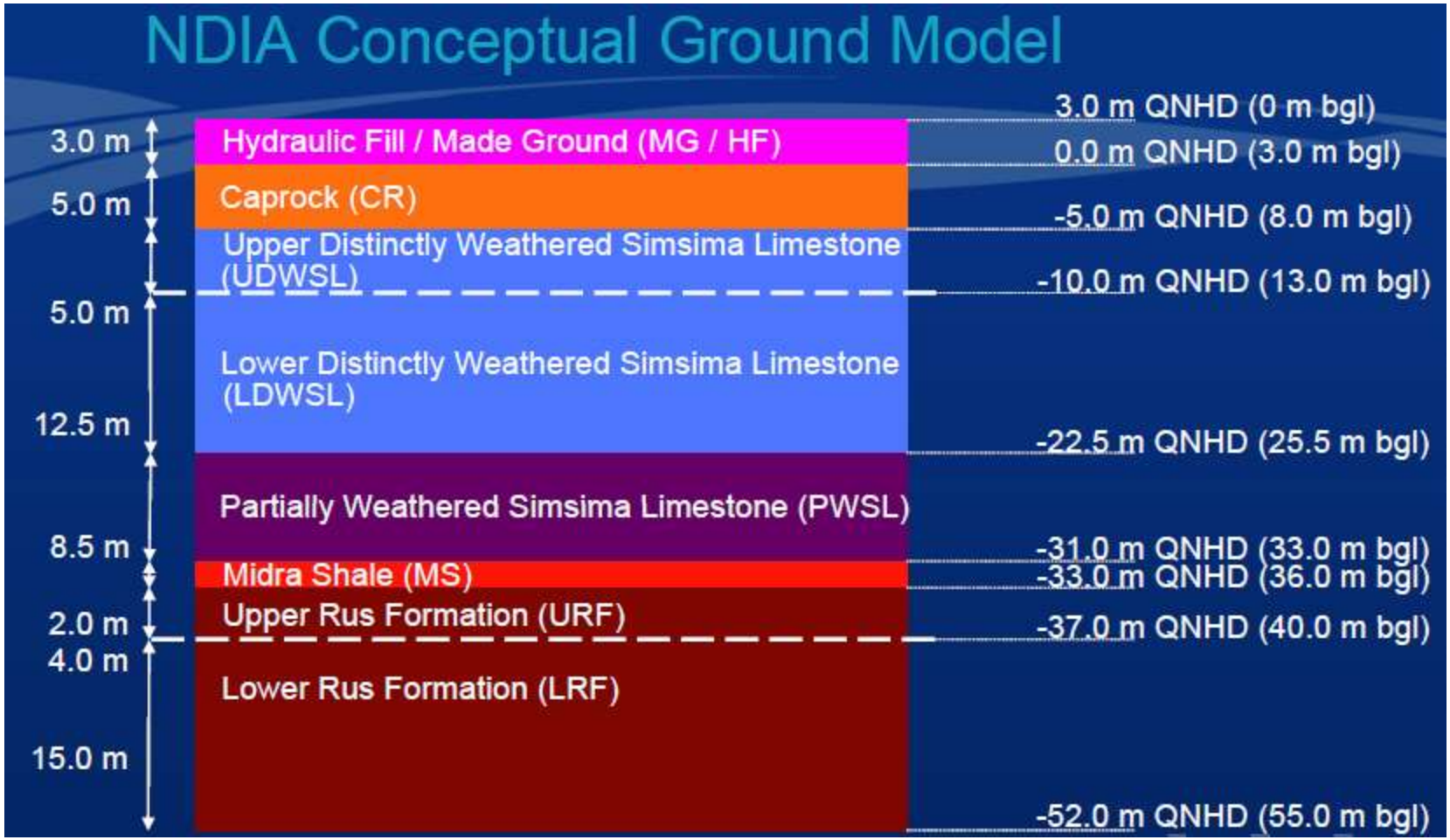

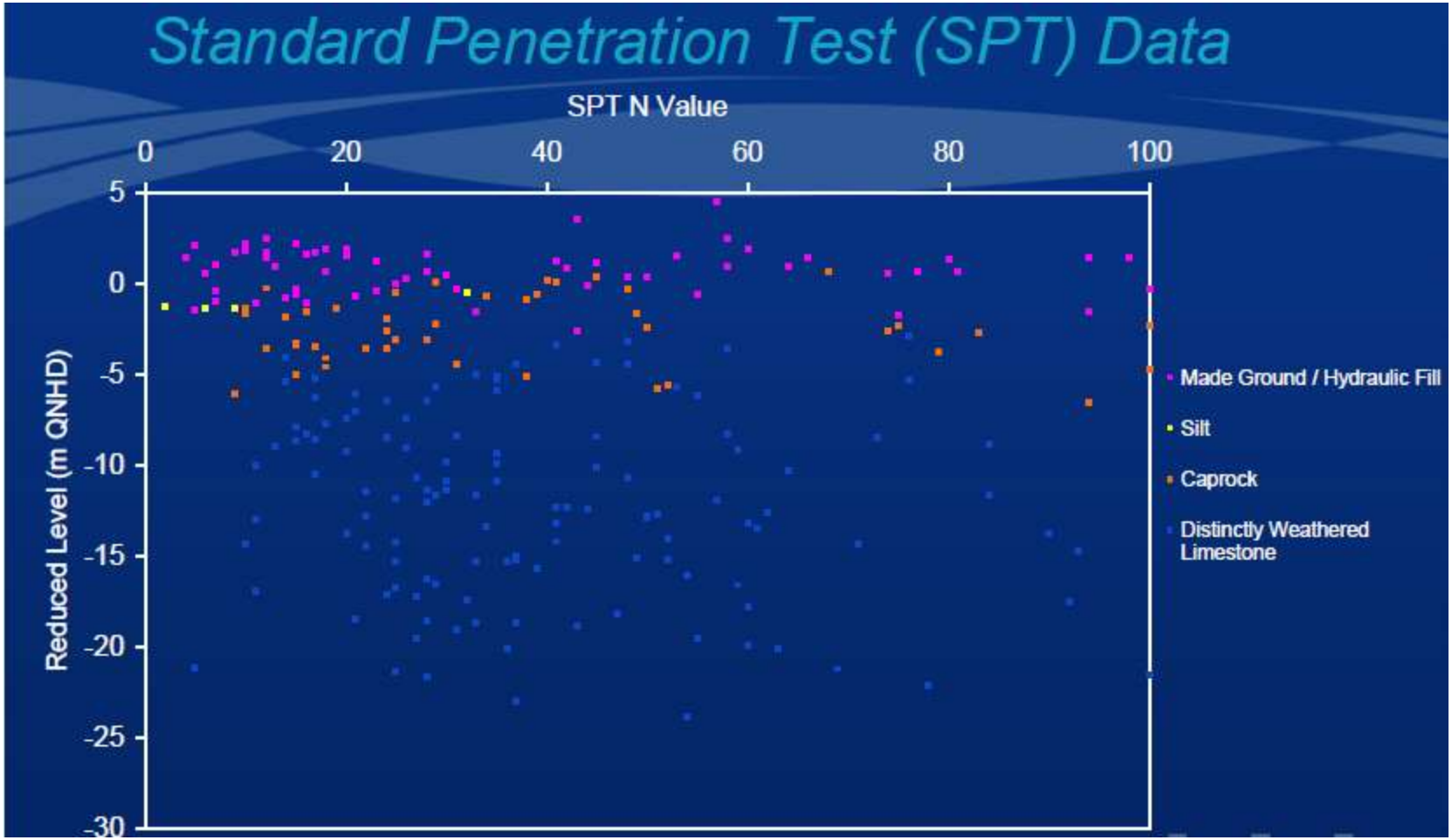
Standard Penetration Test (SPT) Data
SPT N Value
0
20
40
60
80
100
5
0
-5
-10
-15
-20
-25
-30
Reduced Level (m QNHD)
Made Ground / Hydraulic Fill
Silt
Caprock
Distinctly Weathered Limestone

The Current Hydrogeological thinking

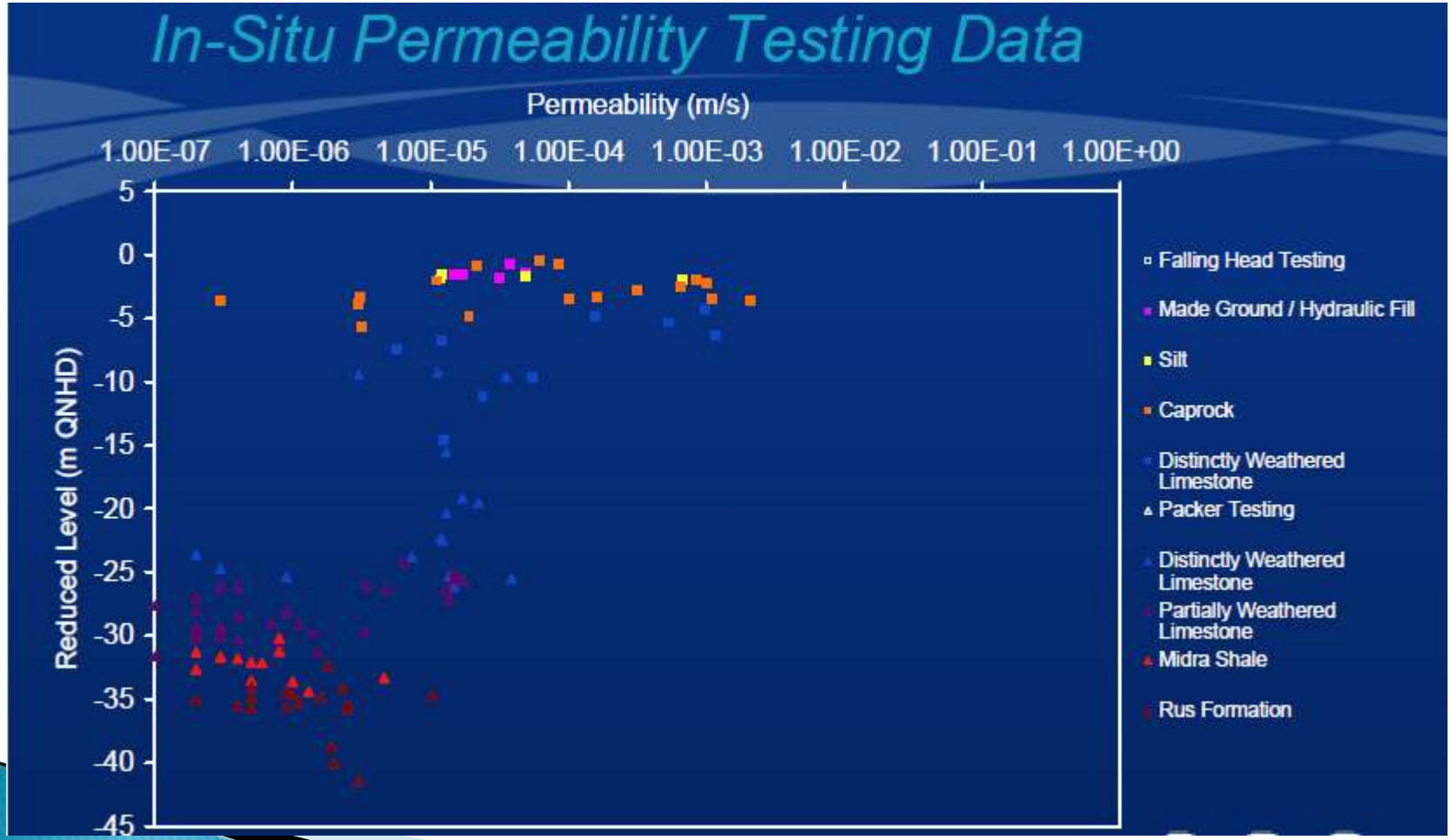

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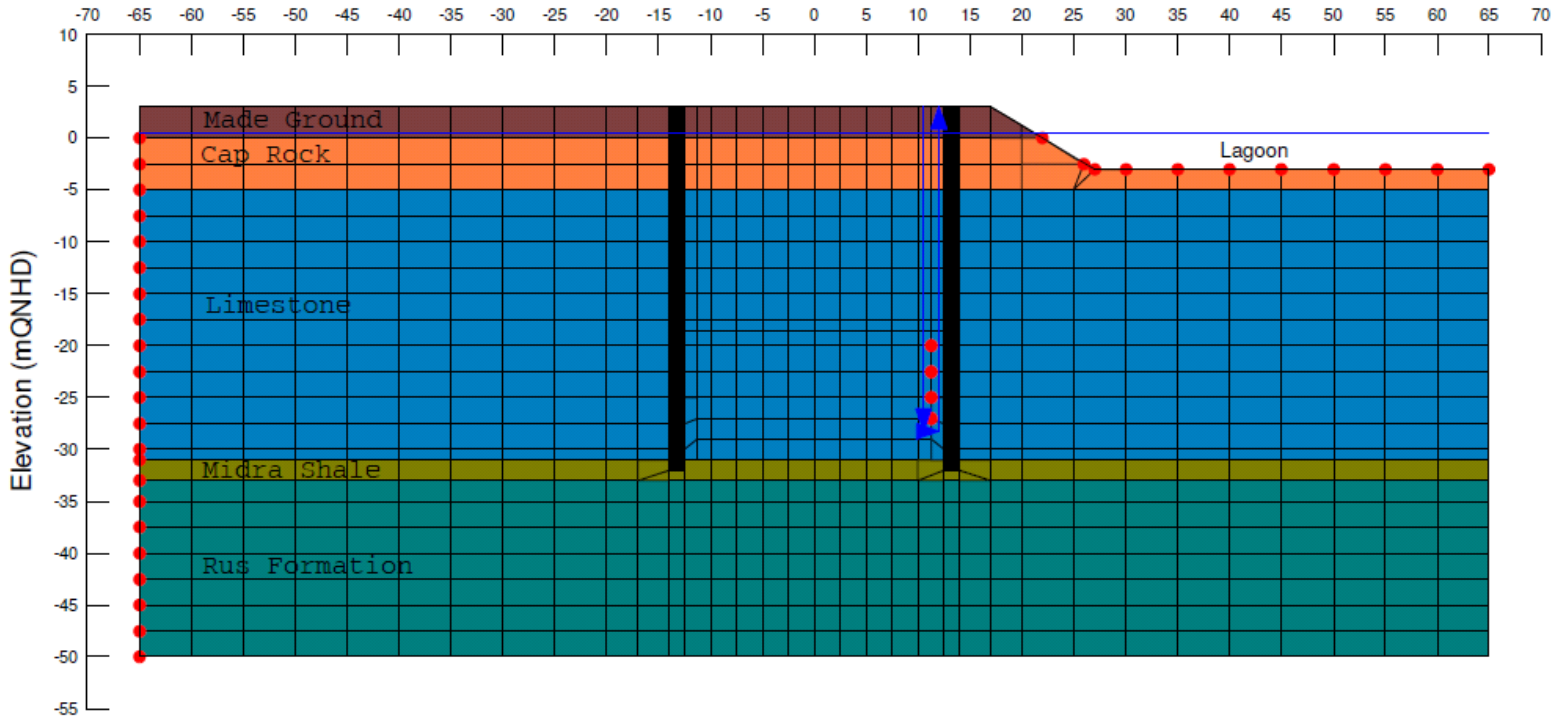
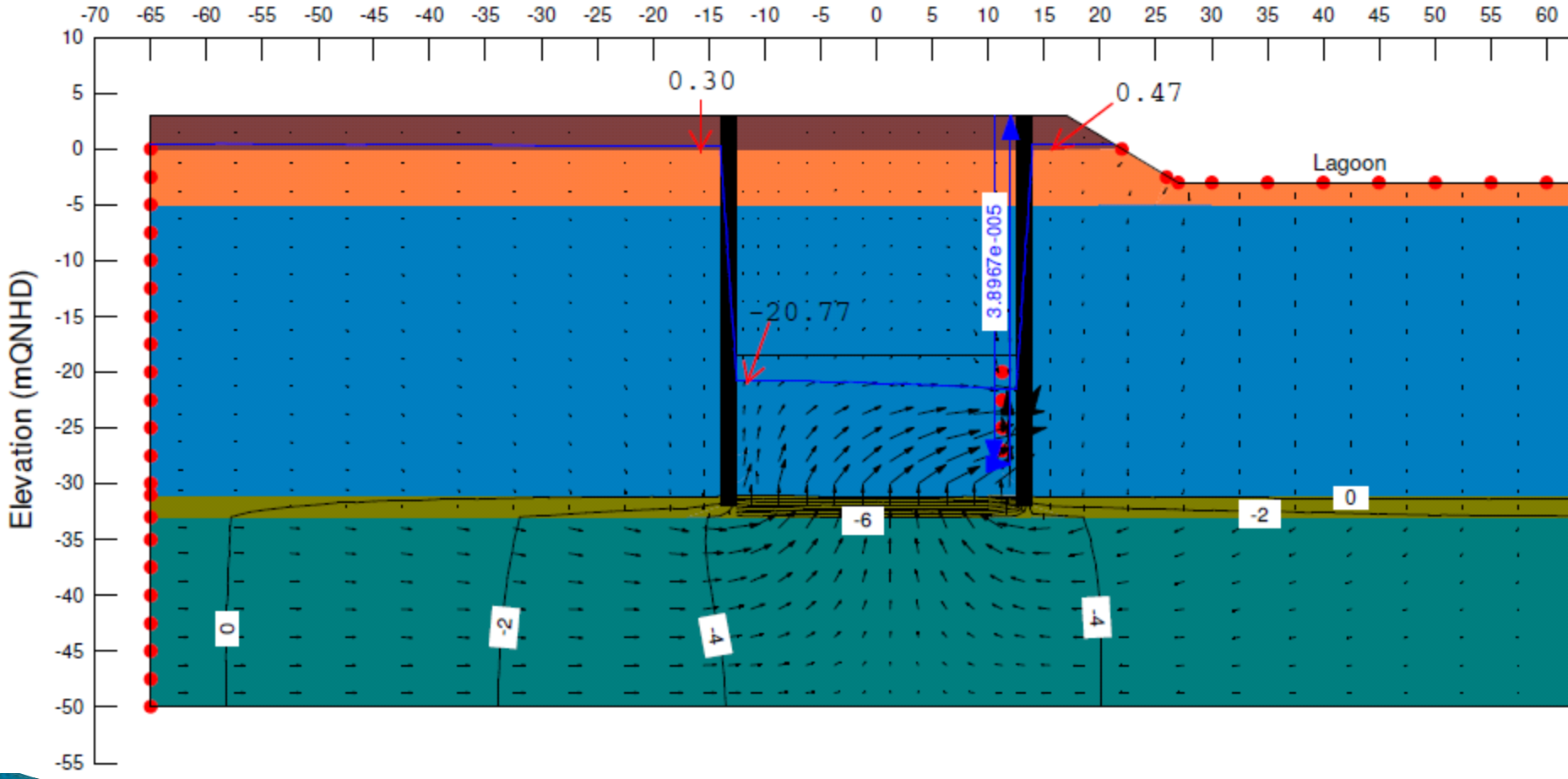
Figure 1: Groundwater Model

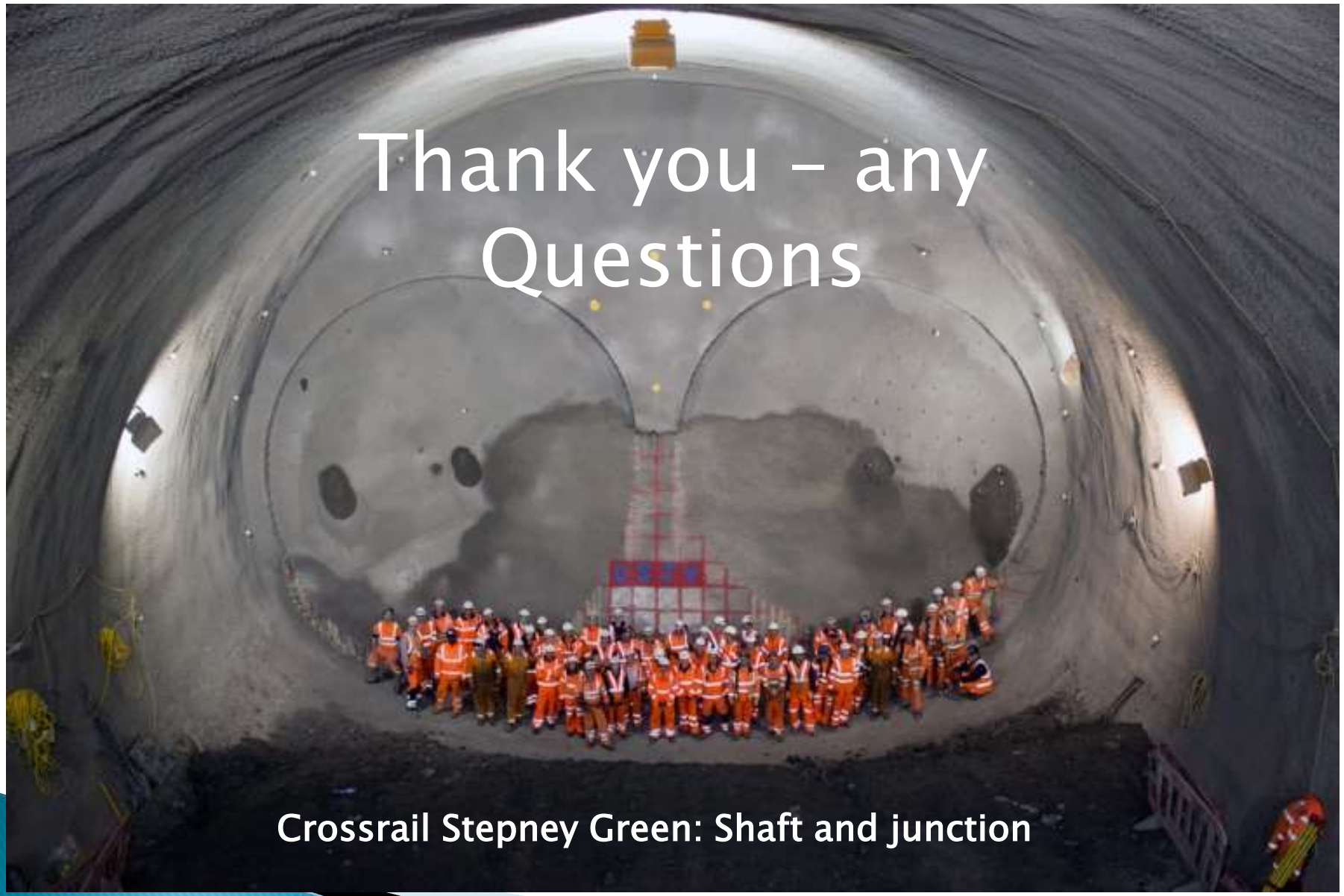


The following permeabilities have been assumed.

Strata	Permeability (m/s)	k_v/k_h
Made Ground	5×10^{-5}	1
Cap Rock	5×10^{-5}	1
Limestone	5×10^{-5}	14
Midra Shale	2×10^{-7}	1
Rus Formation	5×10^{-5}	1

Figure 2: Model Output




Thank you – any Questions
Crossrail Stepney Green: Shaft and junction