

**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**

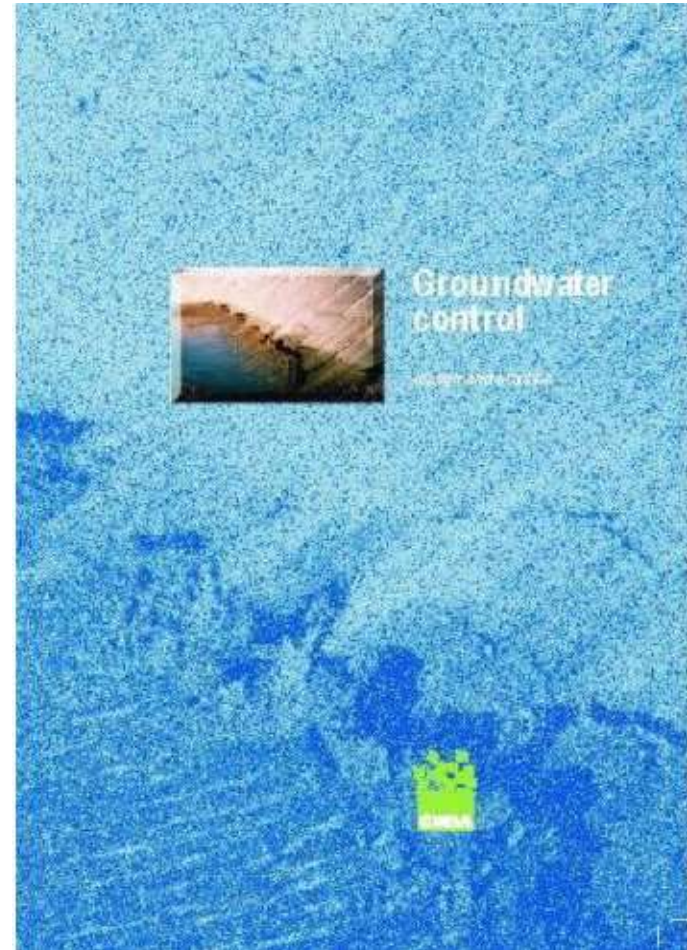
4th December 2013

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



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

Construction Dewatering:
Temporary lowering of groundwater levels by pumping from wells or sumps to provide stable conditions for excavations below the groundwater level



Photo of the state of the practice

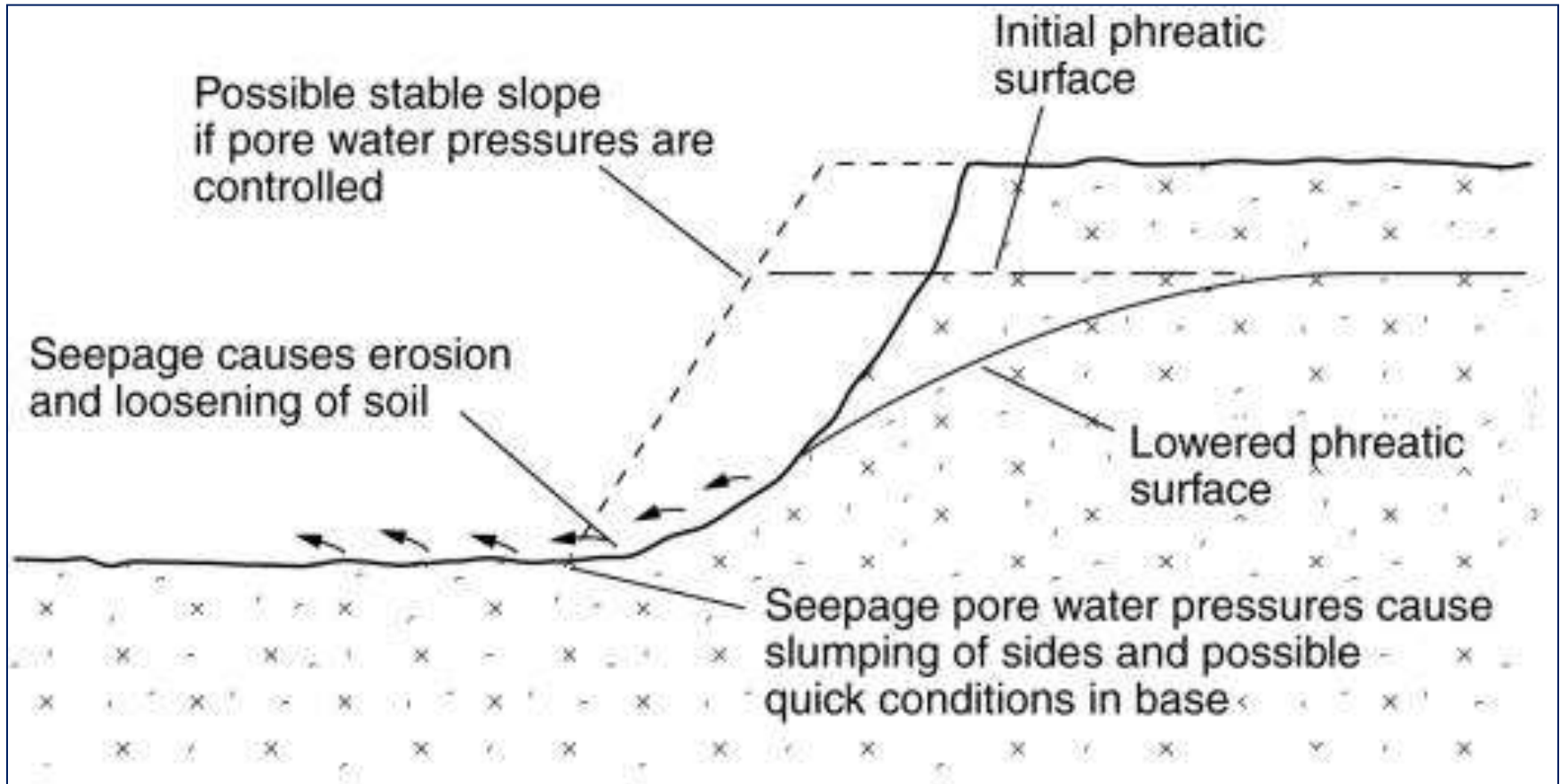


Diagram of the state of the theory

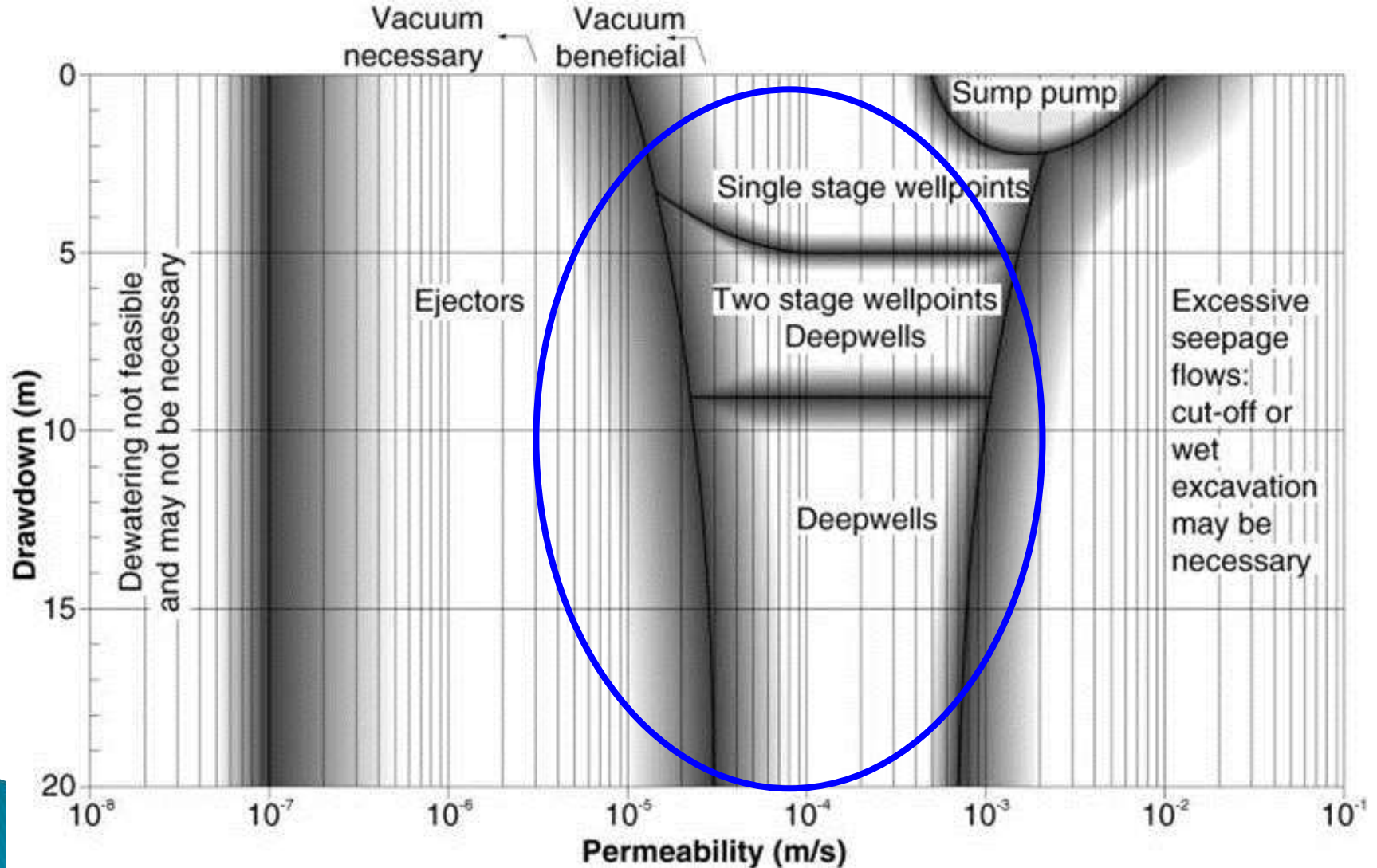


Diagram of the state of the practice in Qatar

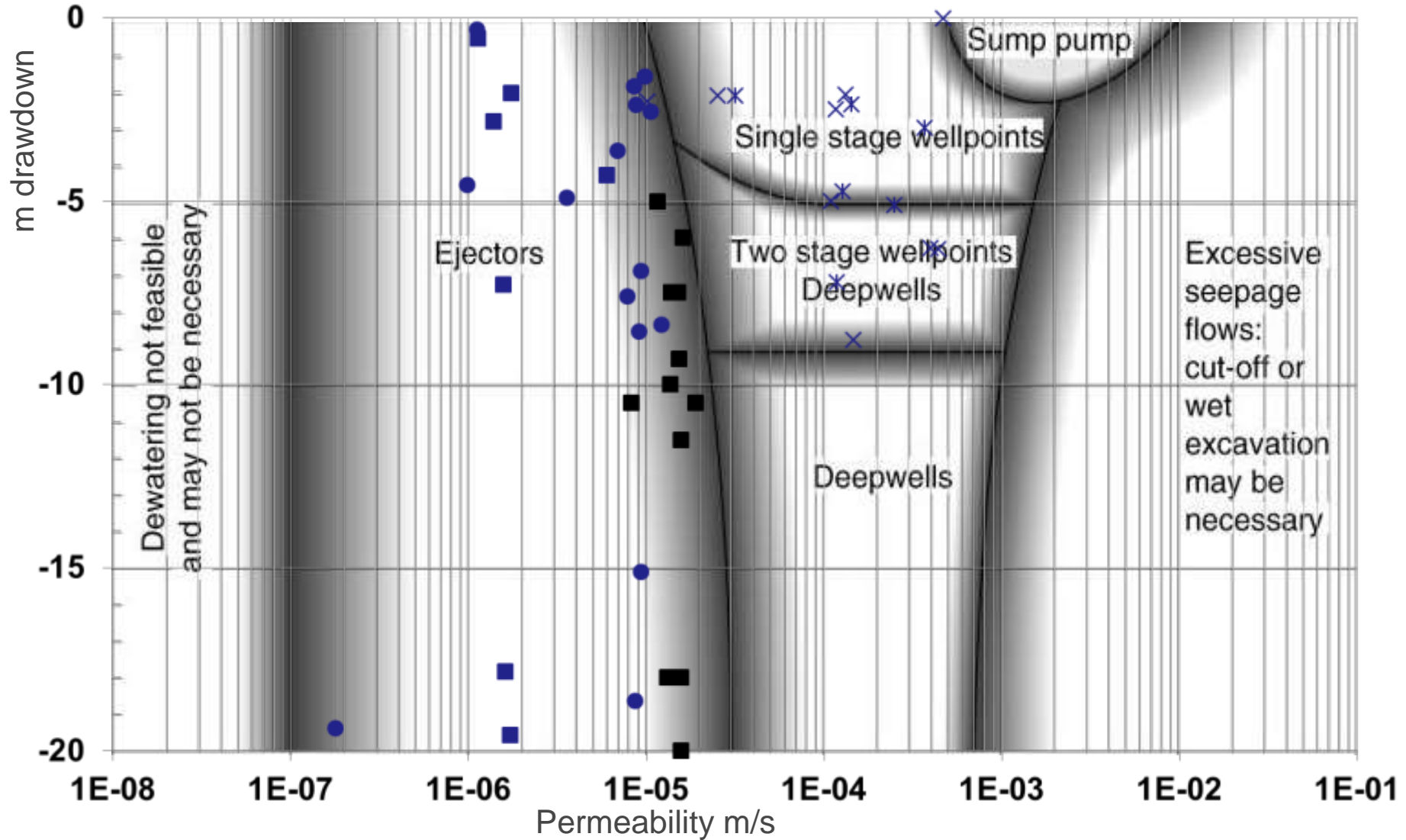
1. Rock

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

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Trenching & sump Pumping



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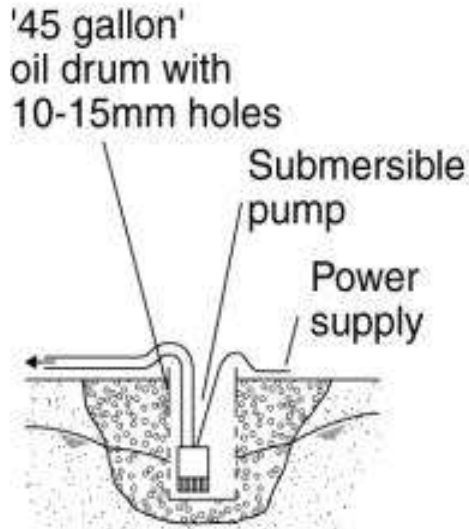




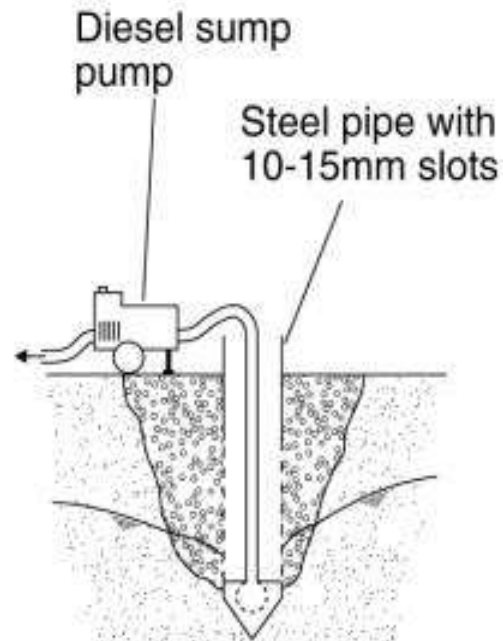
Trenches and sumps:

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

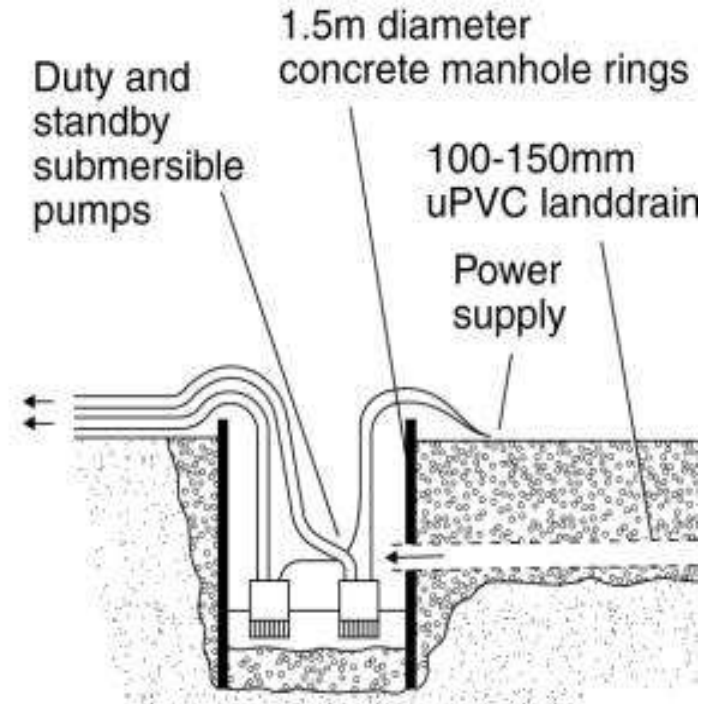
Typical sump pumping arrangements



a) Perforated oil drum



b) Perforated steel pipe with driving point



c) Concrete manhole rings fed by French drains

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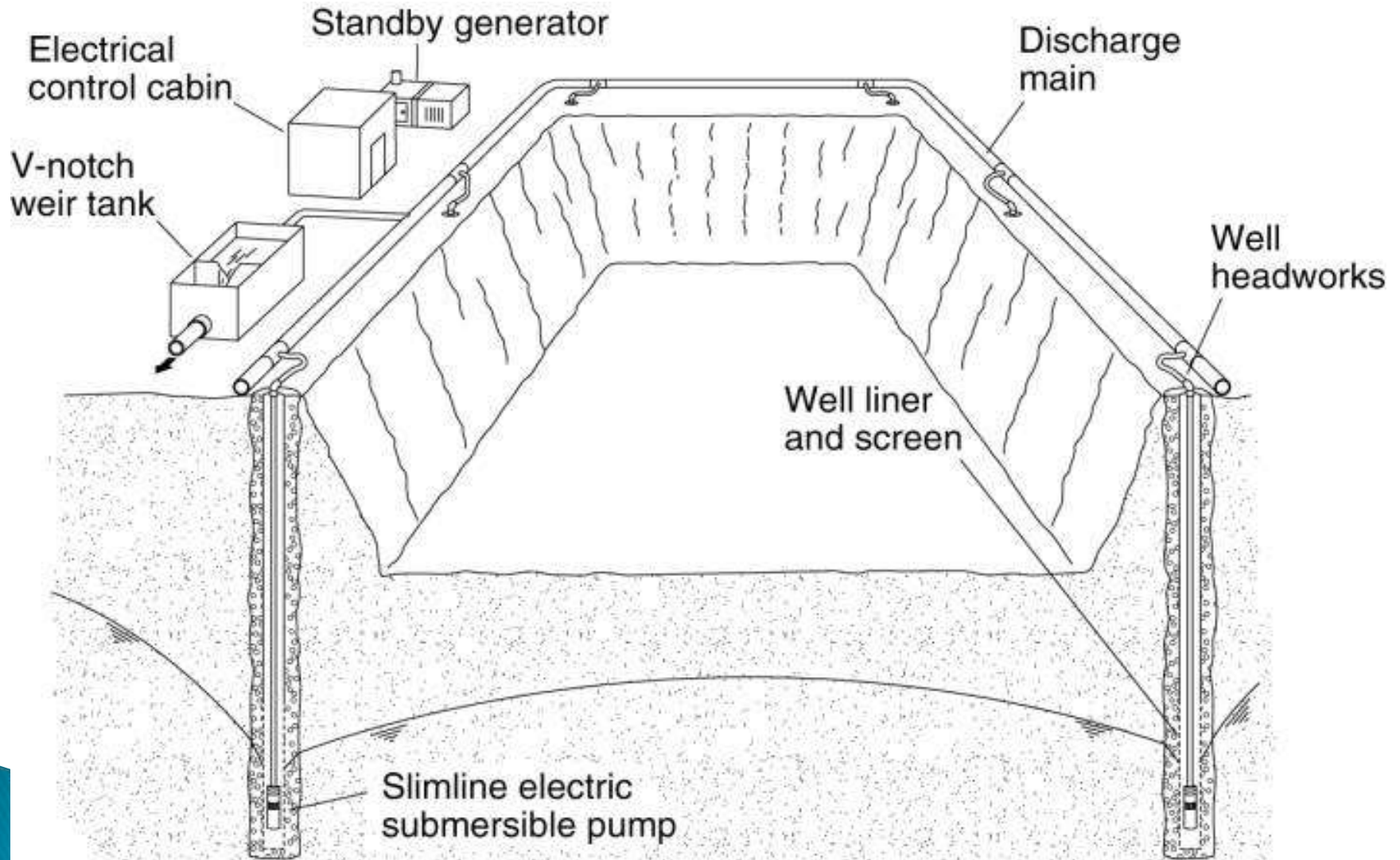
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Same technique – Different out come



Deepwells



INTERNAL DEEPWELLS

D-WALL CUT-OFF



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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

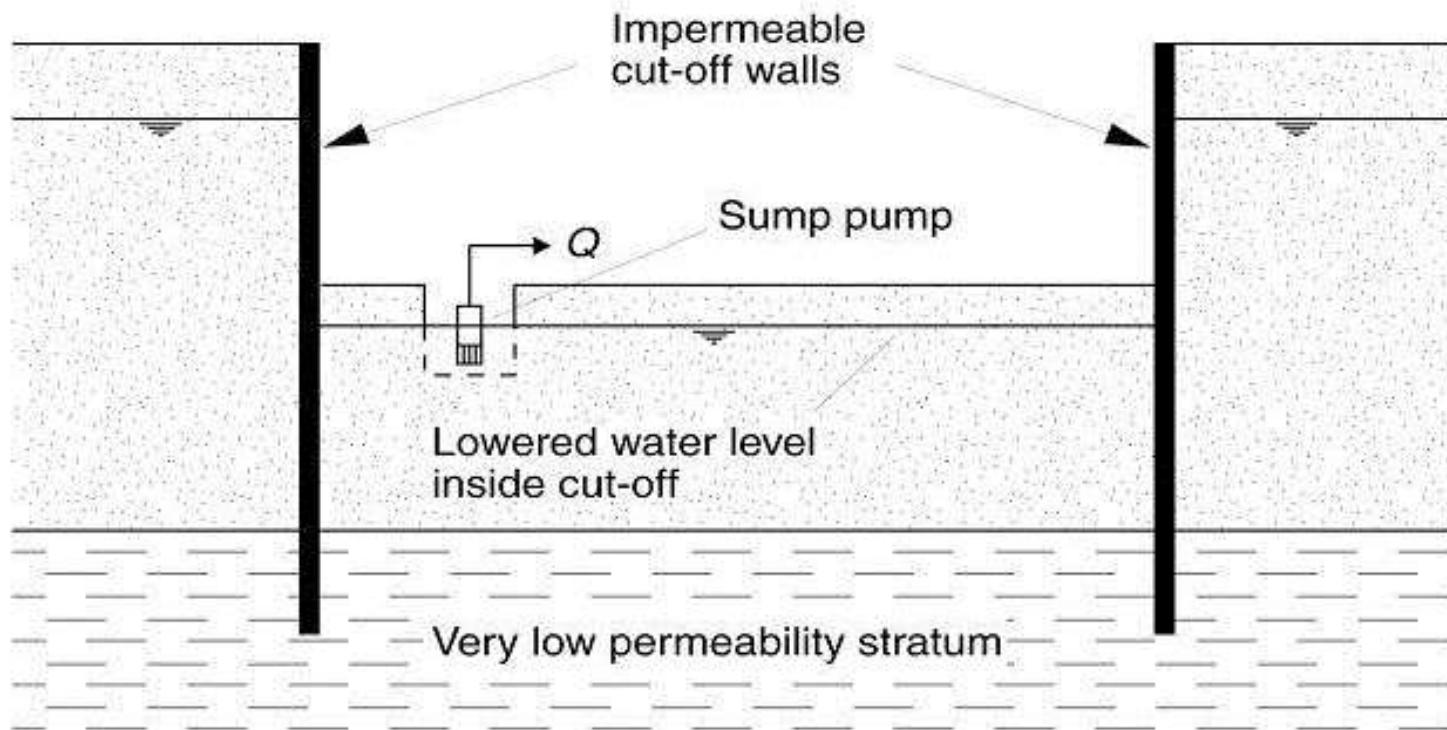
Hydraulic barrier

- 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



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

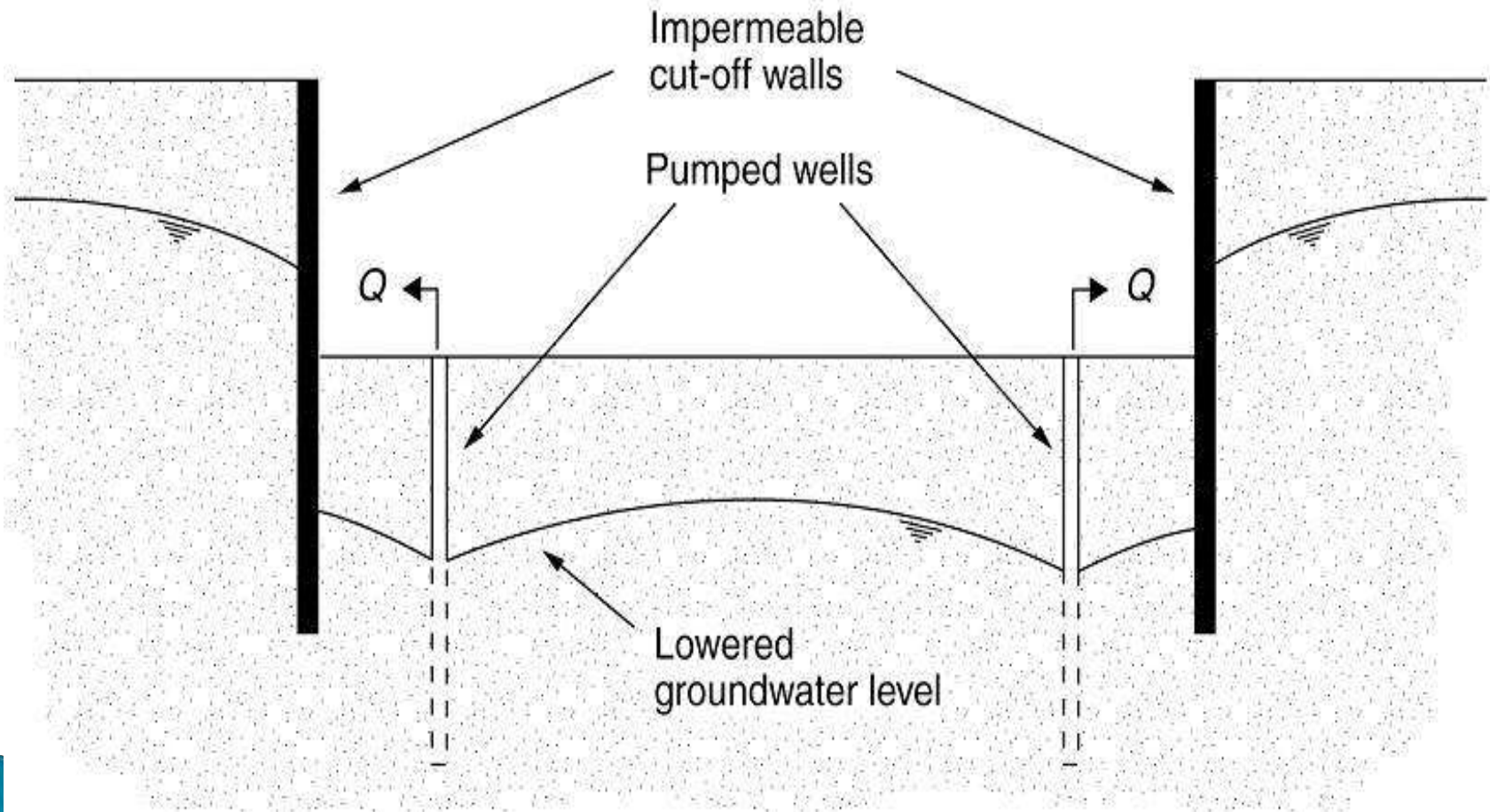


Diagram of the state of the theory

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Barwa Financial District, Westbay, Qatar



Perimeter = 1,100 m





Perimeter ring main

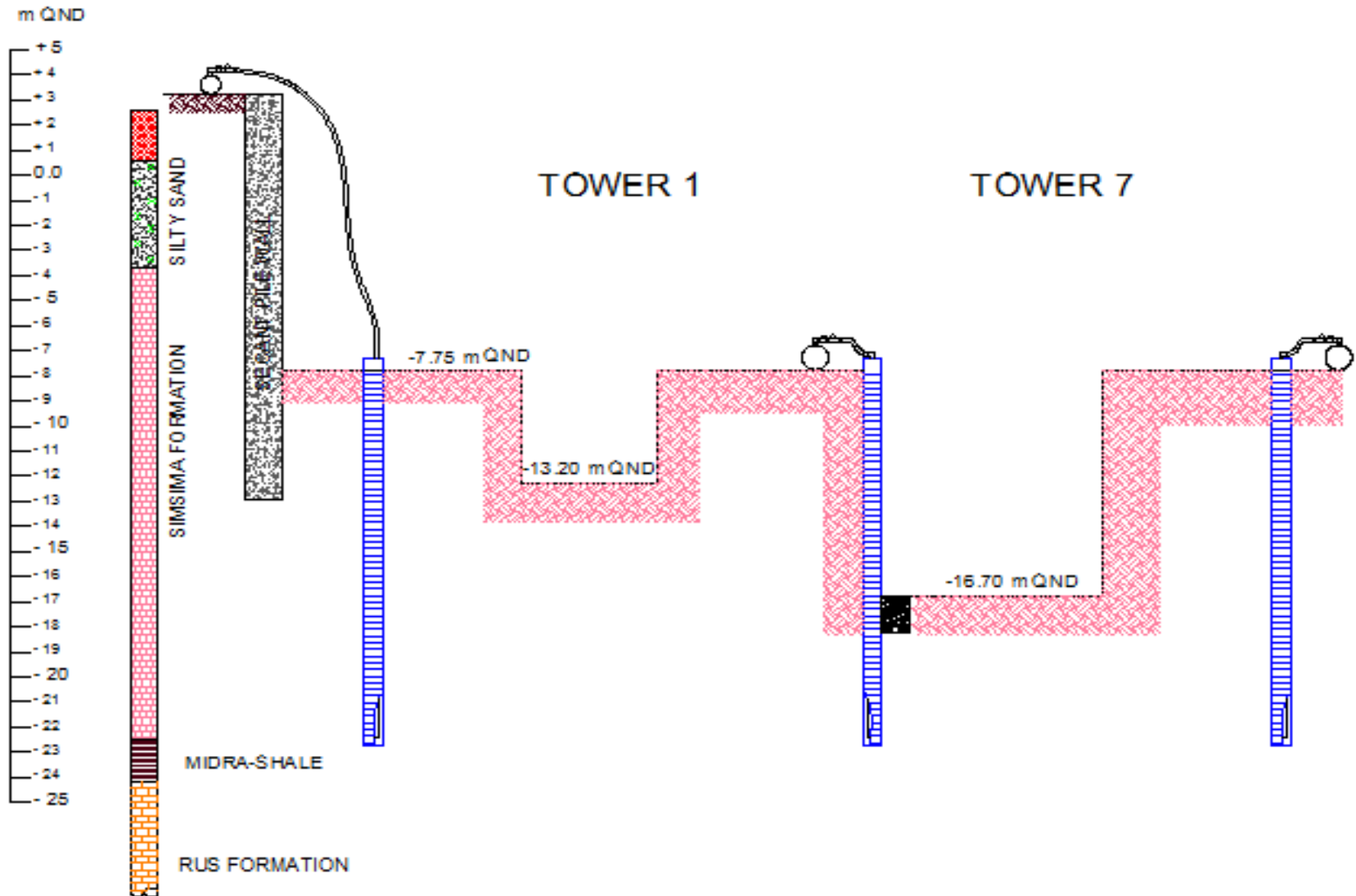
Non return valves

**Cables and ring main
protected**

**Control cabin with duty
and standby power
supply**



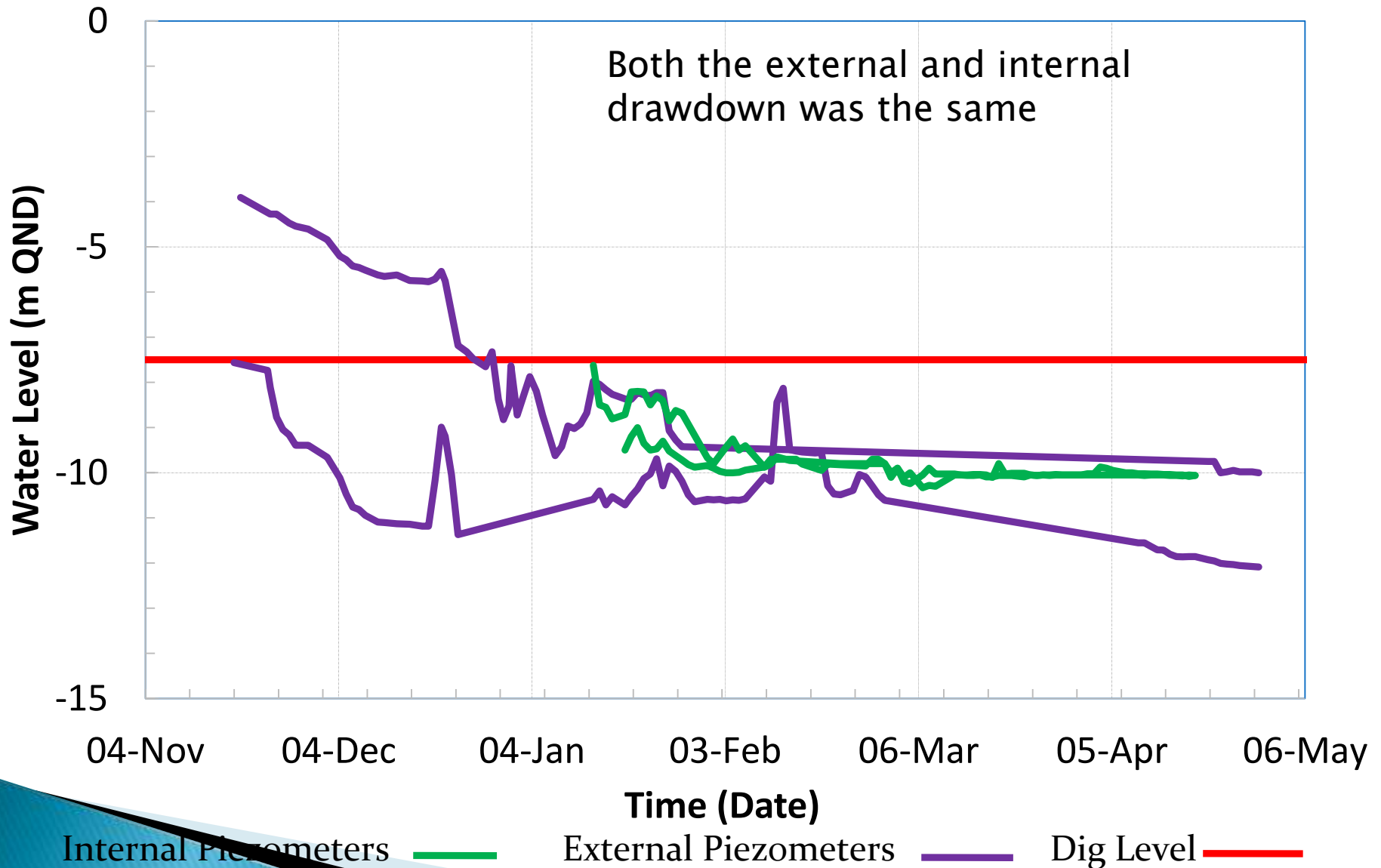
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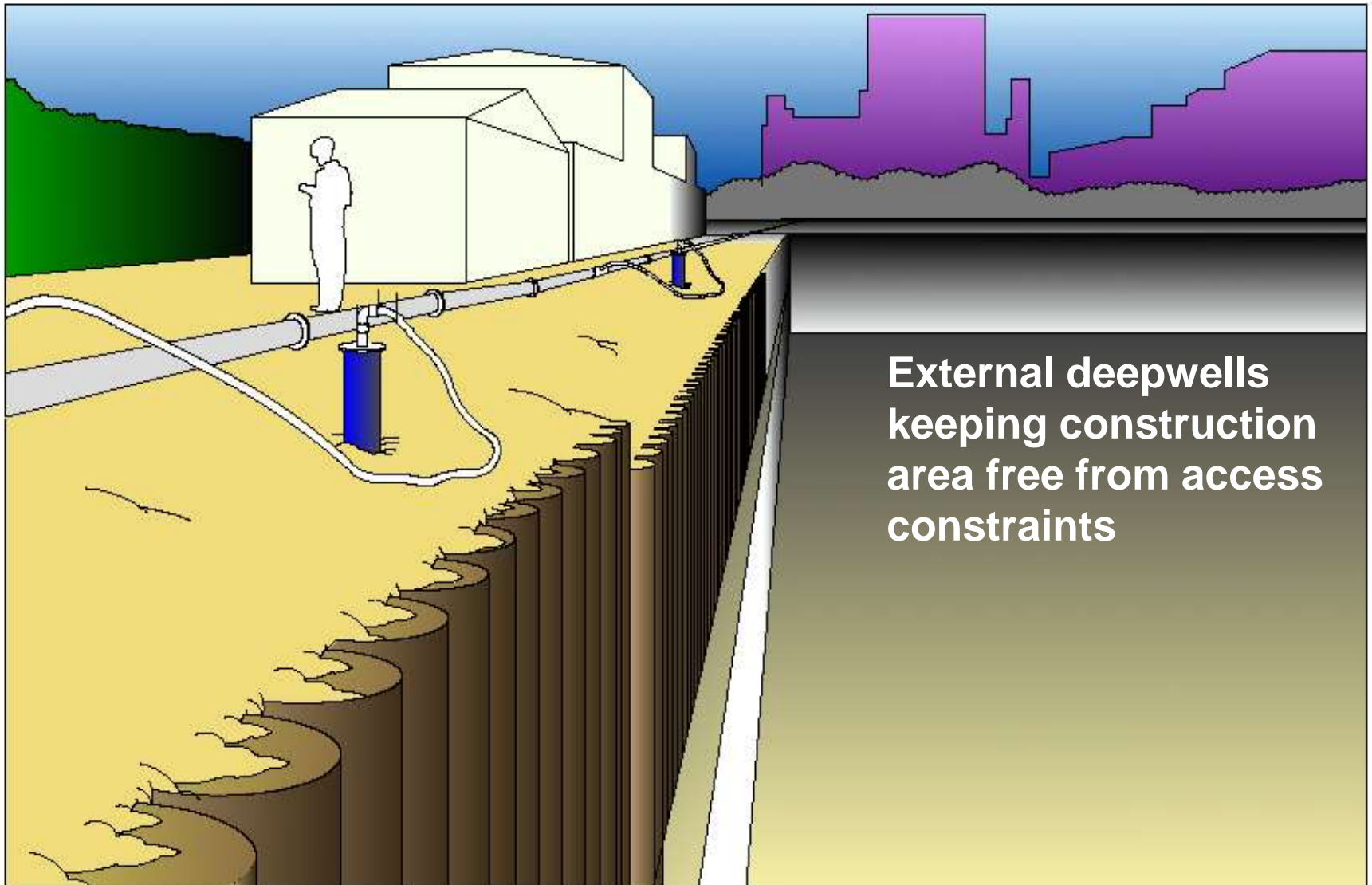




**Perimeter internal wells
(could have been external?)**

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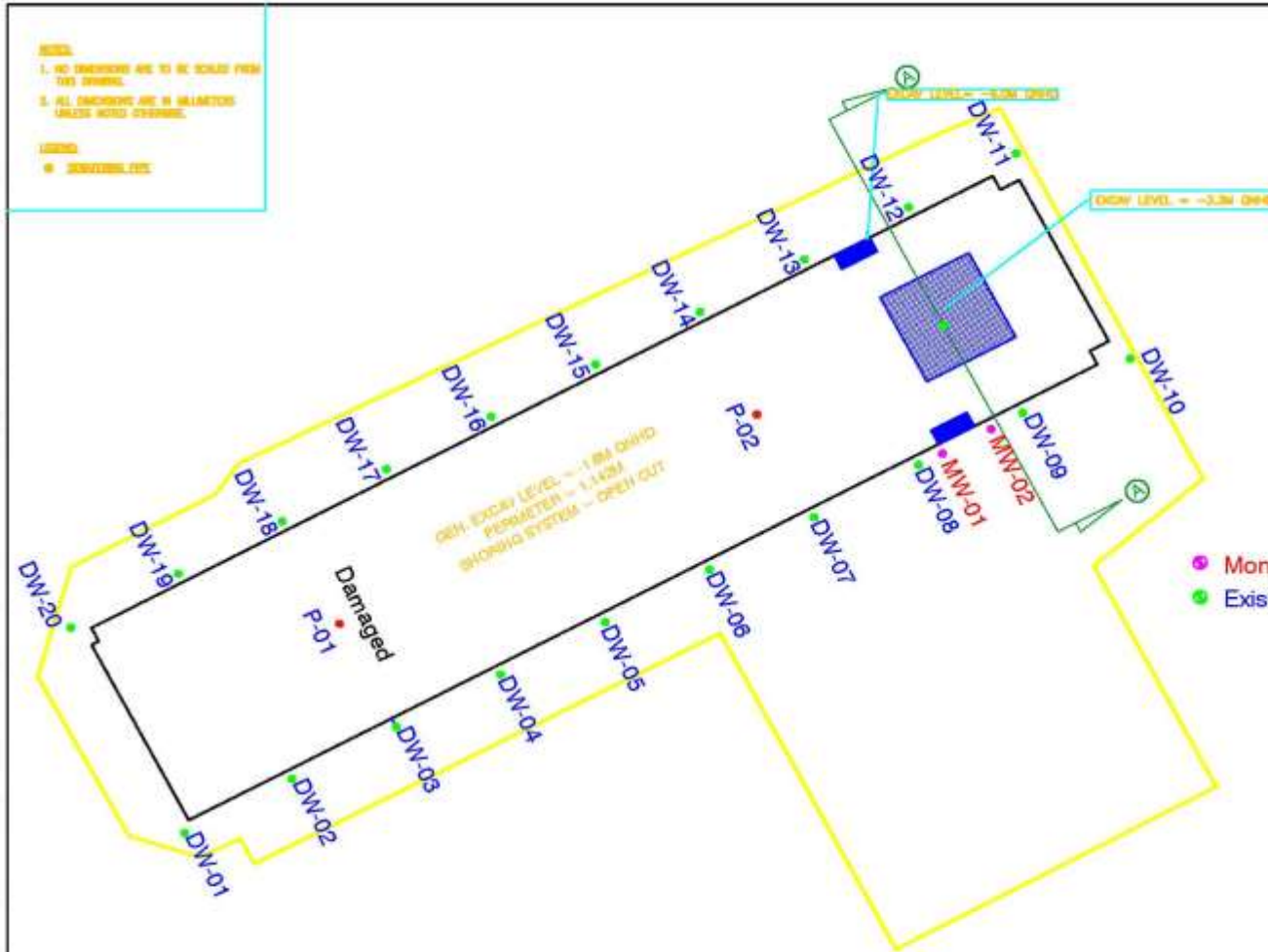


North East Car Park, Education City, Qatar



10/05/2012 17:08

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LIST OF COORDINATES		
S/No.	Easting	Northing
01	223198.475	395387.042
02	223245.575	395411.887
03	223292.674	395436.732
04	223339.774	395461.578
05	223386.872	395486.424
06	223433.972	395511.268
07	223481.072	395536.113
08	223528.171	395560.959
09	223575.270	395585.804
10	223622.370	395610.649
11	223672.353	395705.466
12	223525.250	395680.623
13	223478.164	395655.780
14	223431.070	395630.938
15	223383.976	395606.095
16	223336.881	395581.252
17	223289.787	395556.410
18	223242.692	395531.567
19	223195.598	395506.725
20	223148.504	395481.882

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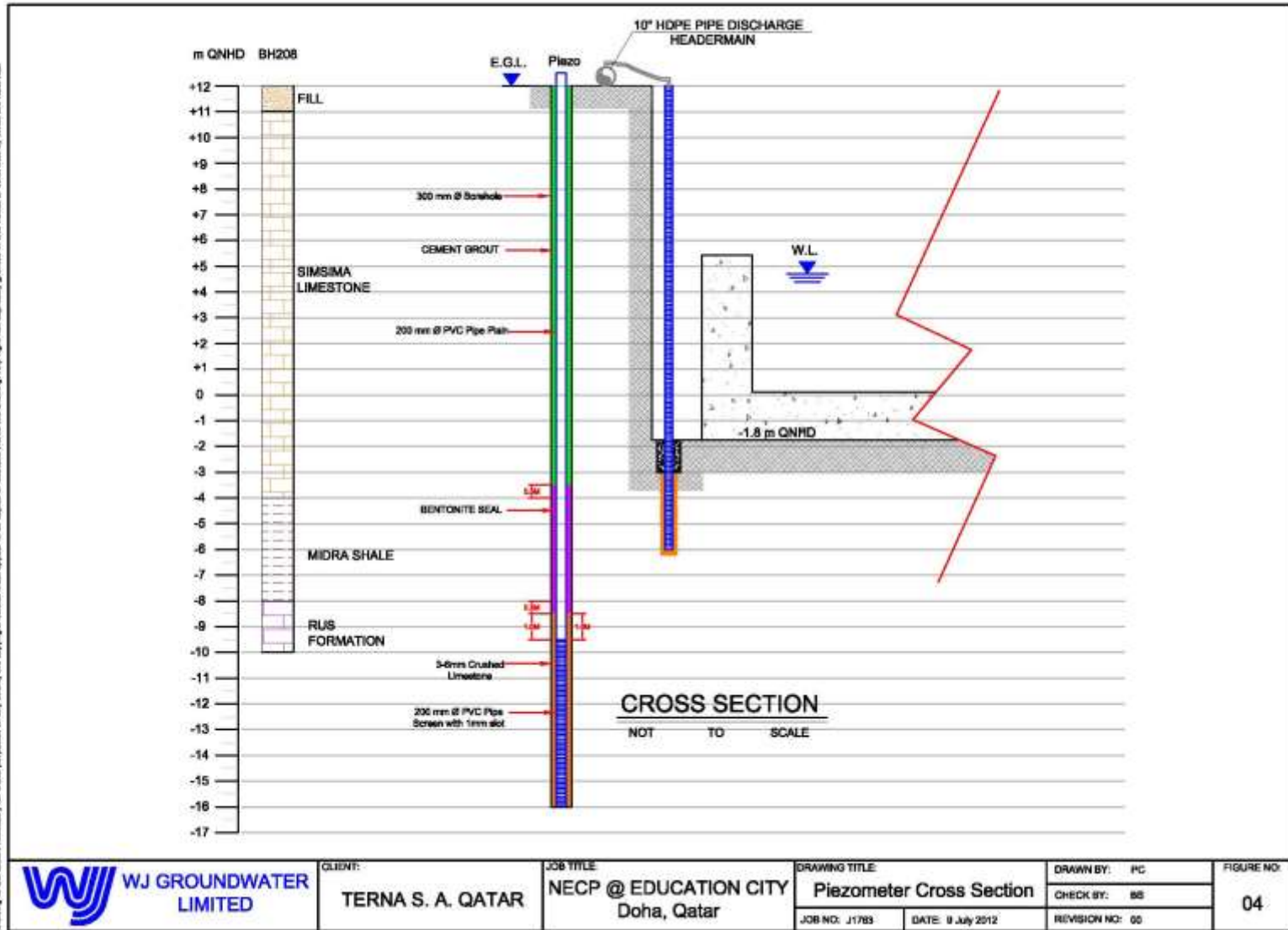
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WJ GROUNDWATER LIMITED	CLIENT: TERNA QATAR	JOB TITLE: NECP @ EDUCATION CITY Doha, Qatar	DRAWING TITLE: DEWATERING LAYOUT		DRAWN BY: PC	FIGURE NO: 05
			JOB NO: J1763	DATE: 29 JULY 2012	CHECK BY: CB	

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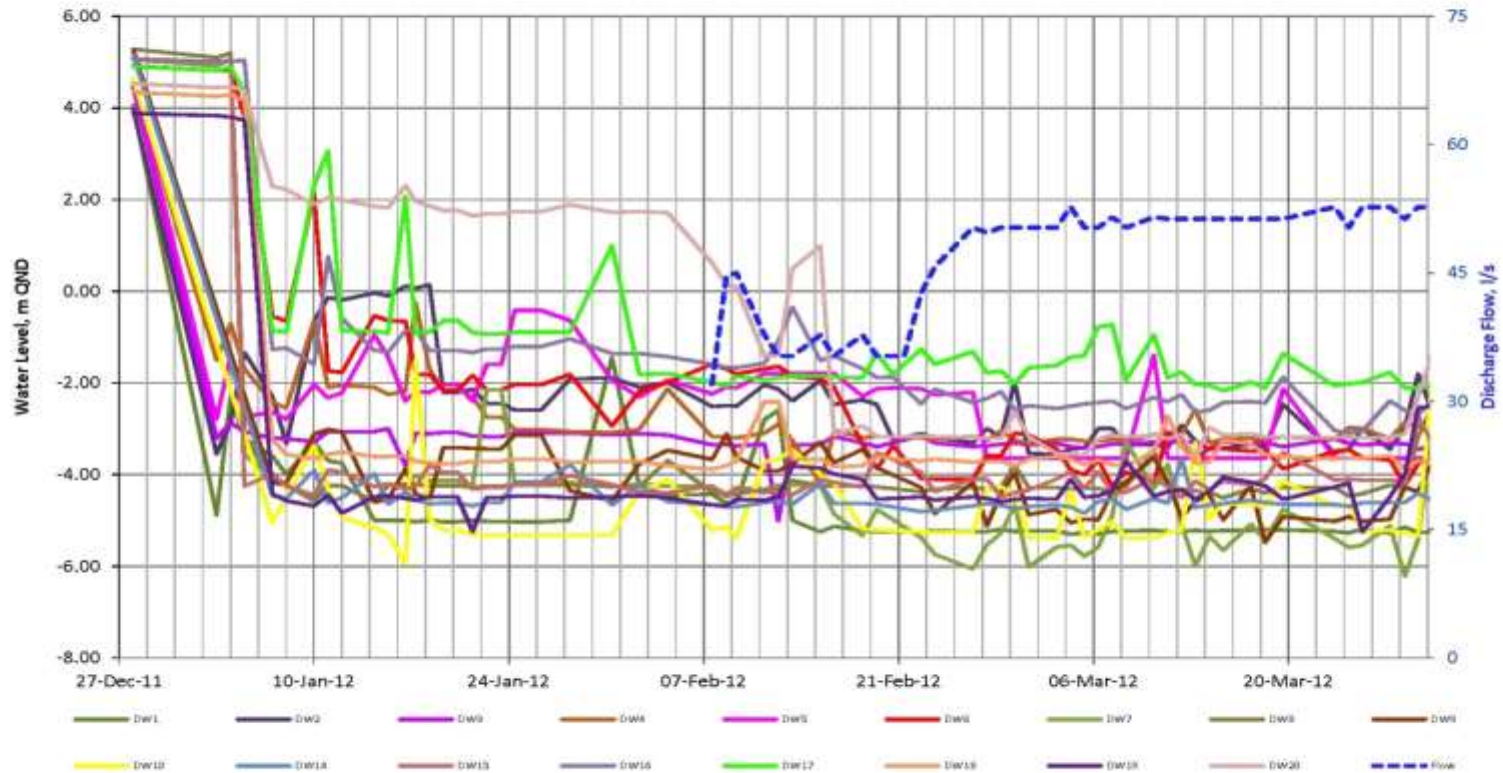


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J1763 - Northeast Carpark Project,
Doha, Qatar - Dewatering



Reduced Dynamic Water Levels



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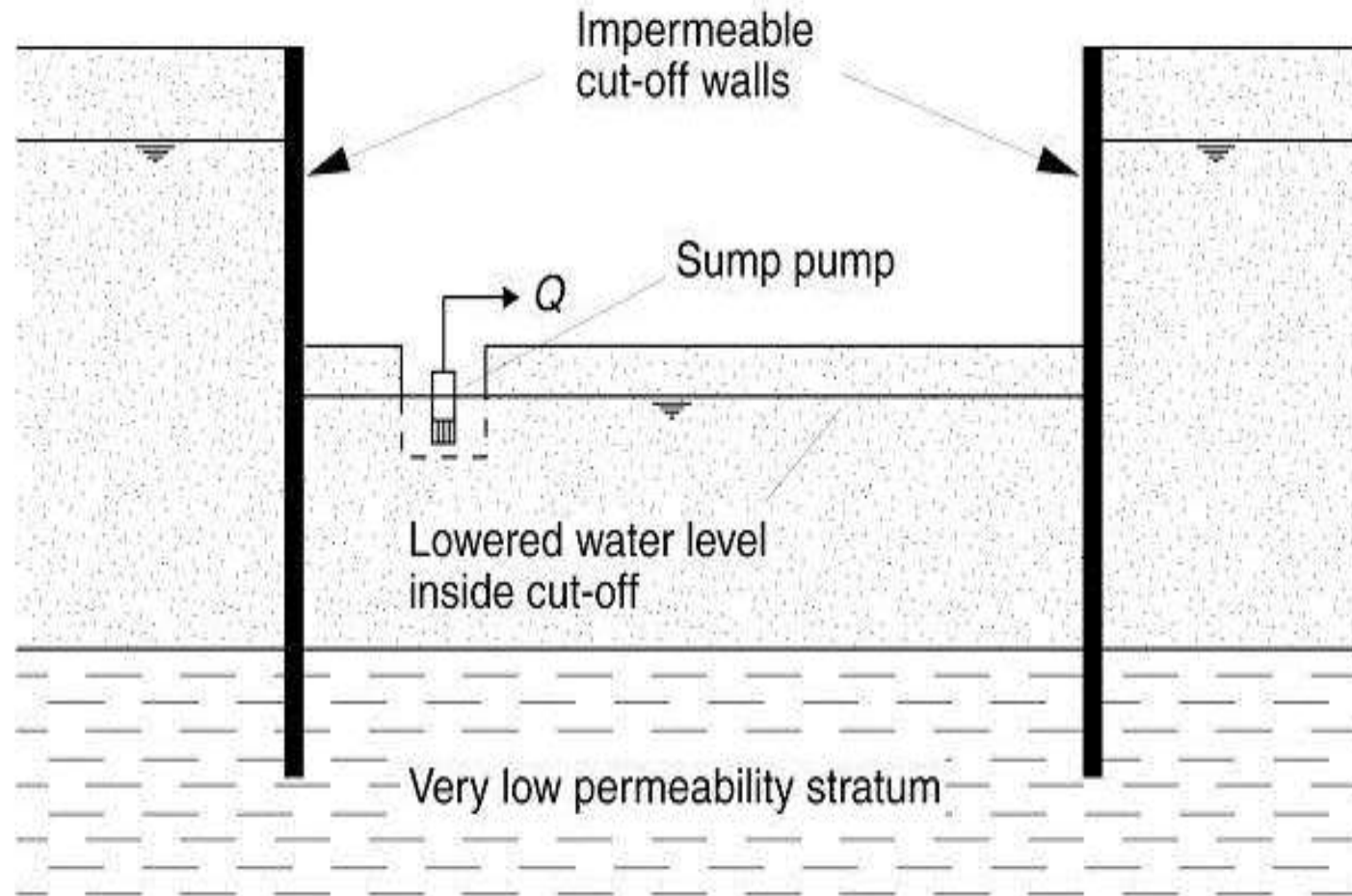


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Metro Station Box, NDIA, Qatar

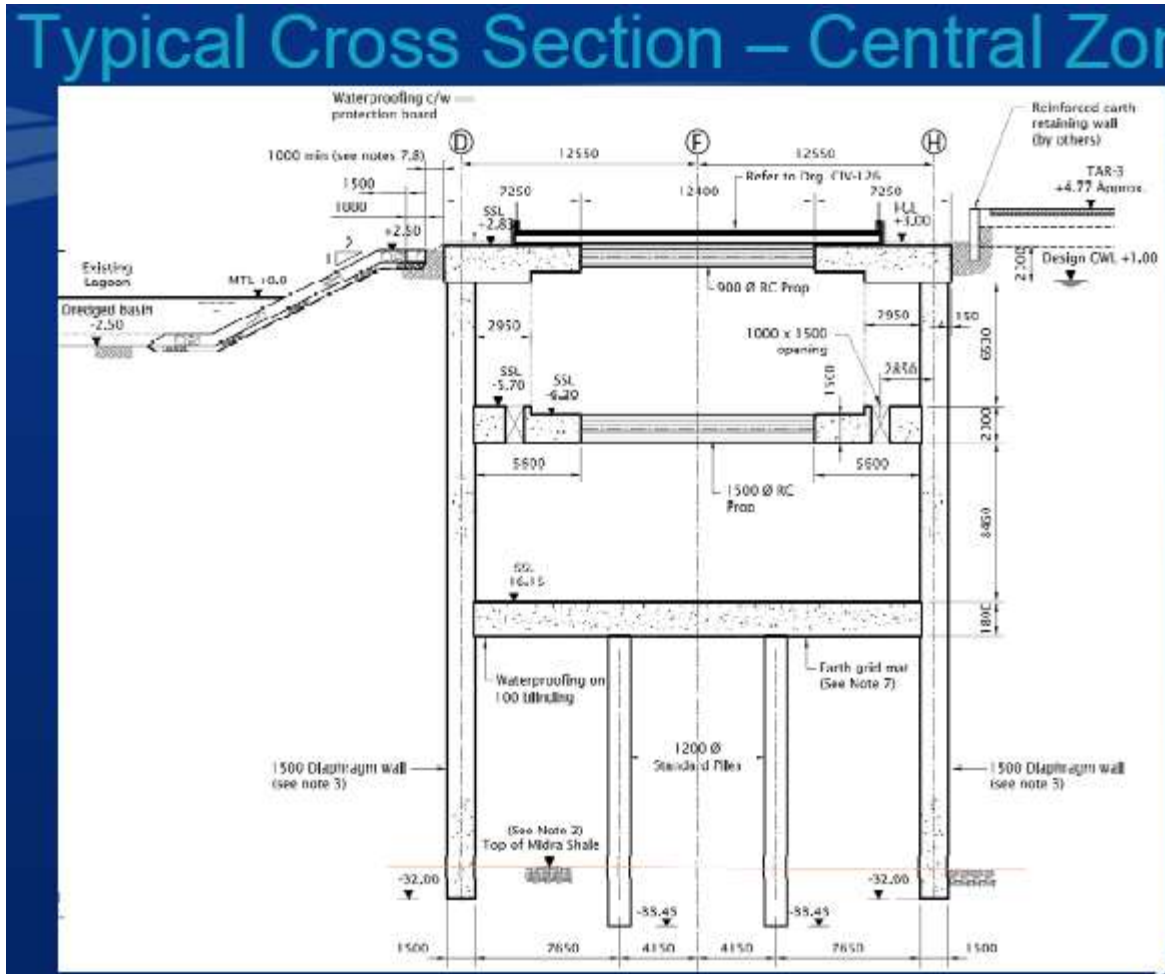




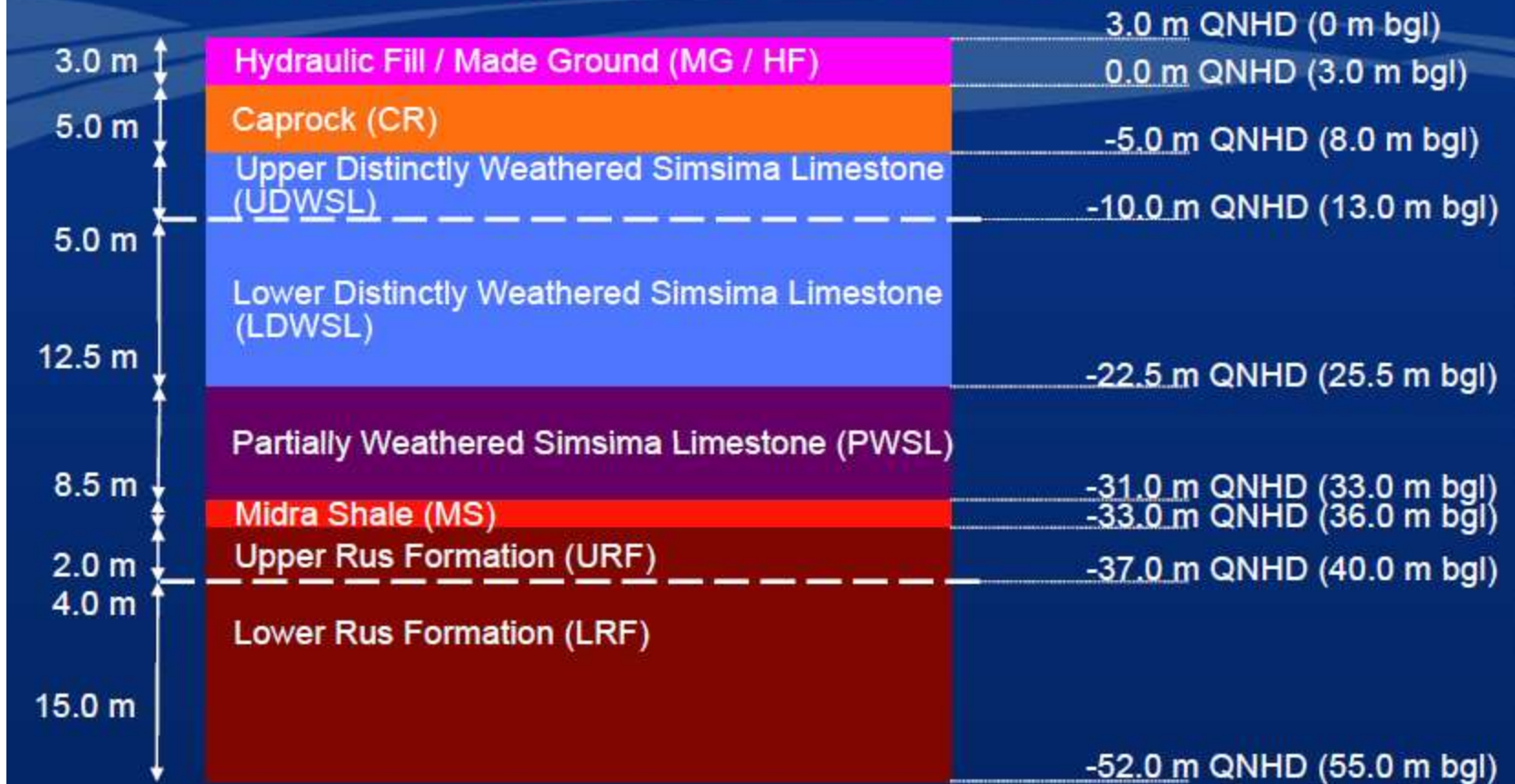
Cut-Off: State of the Theory



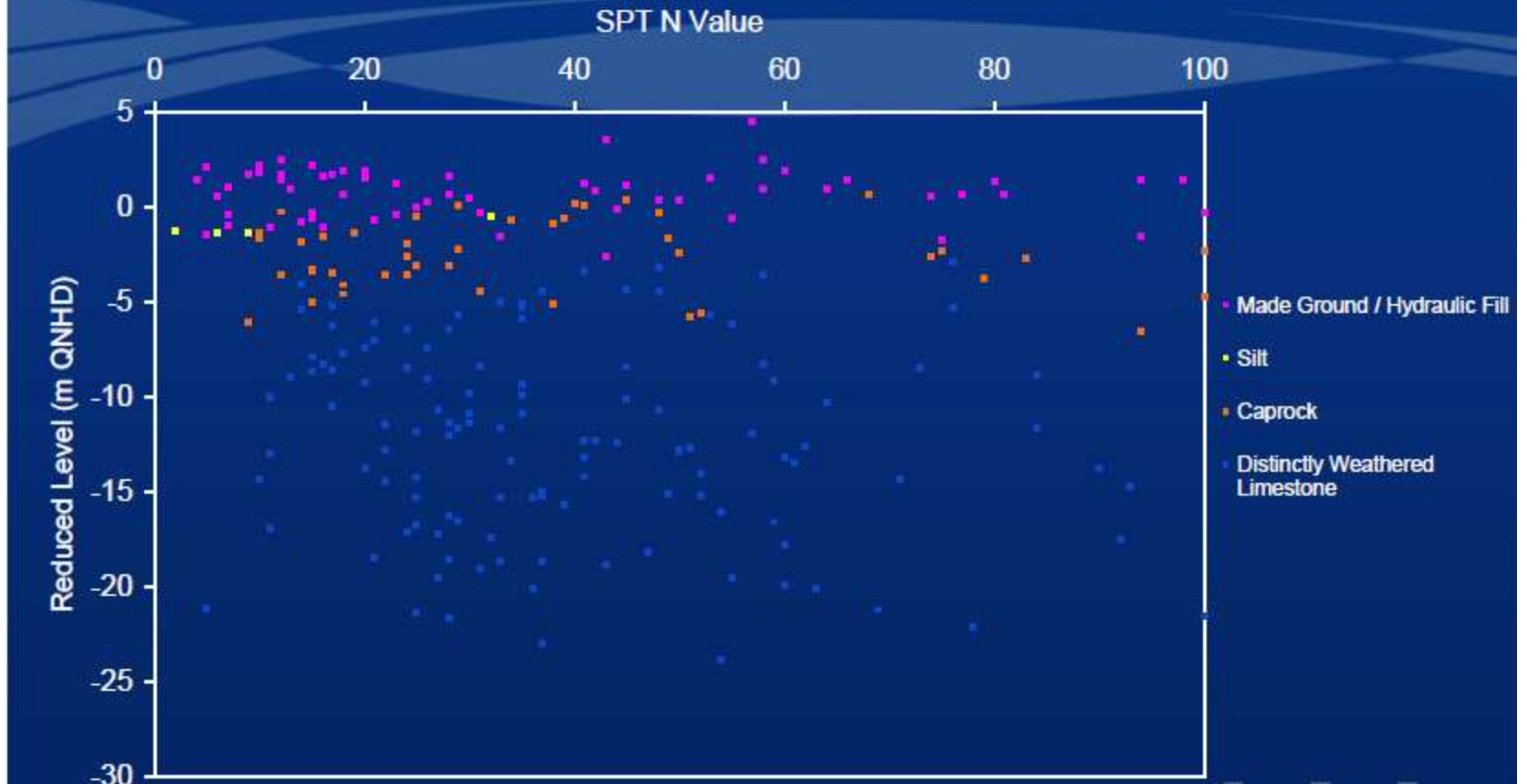
Cut-Off: State of the practice



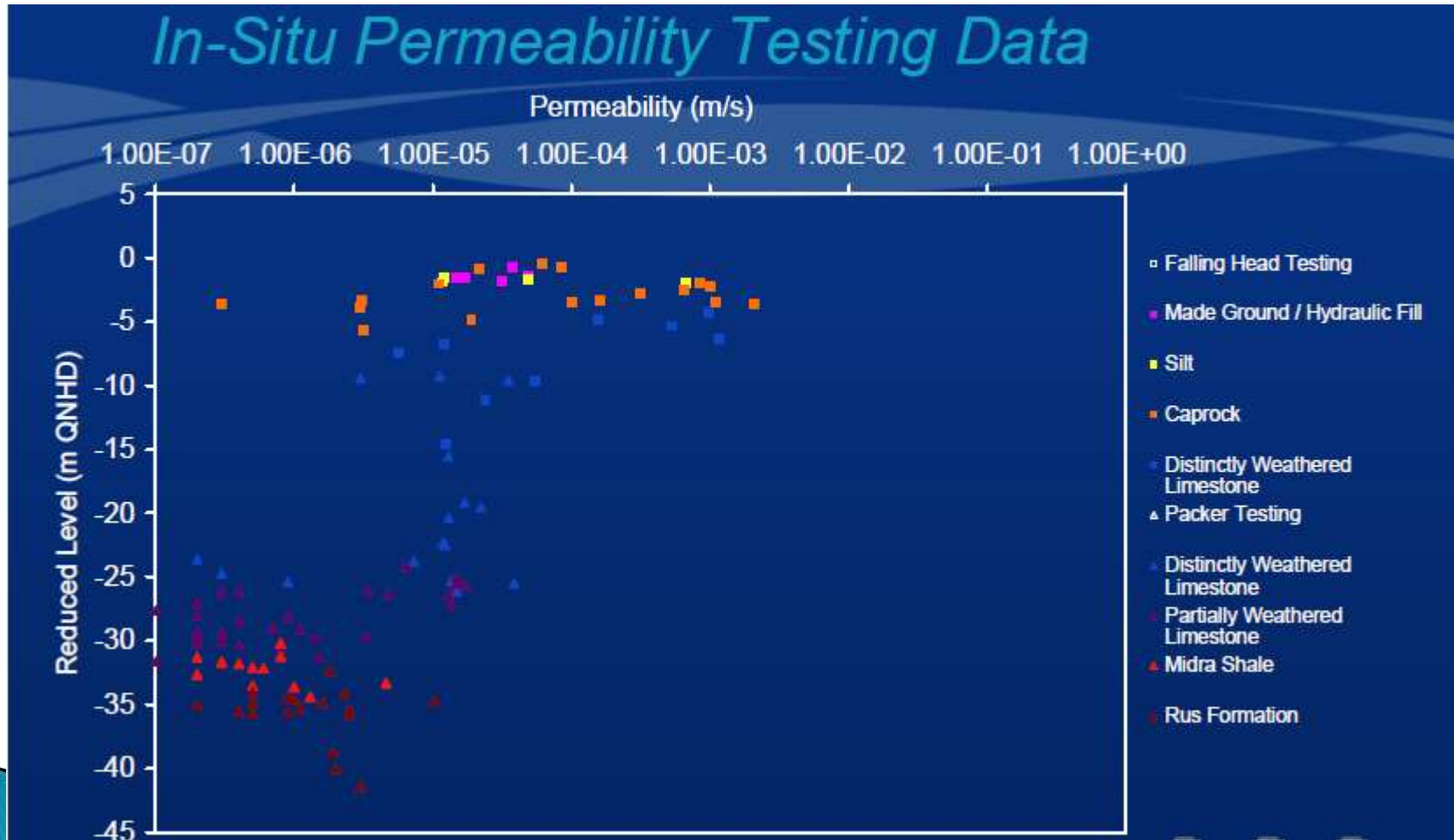
NDIA Conceptual Ground Model



Standard Penetration Test (SPT) Data

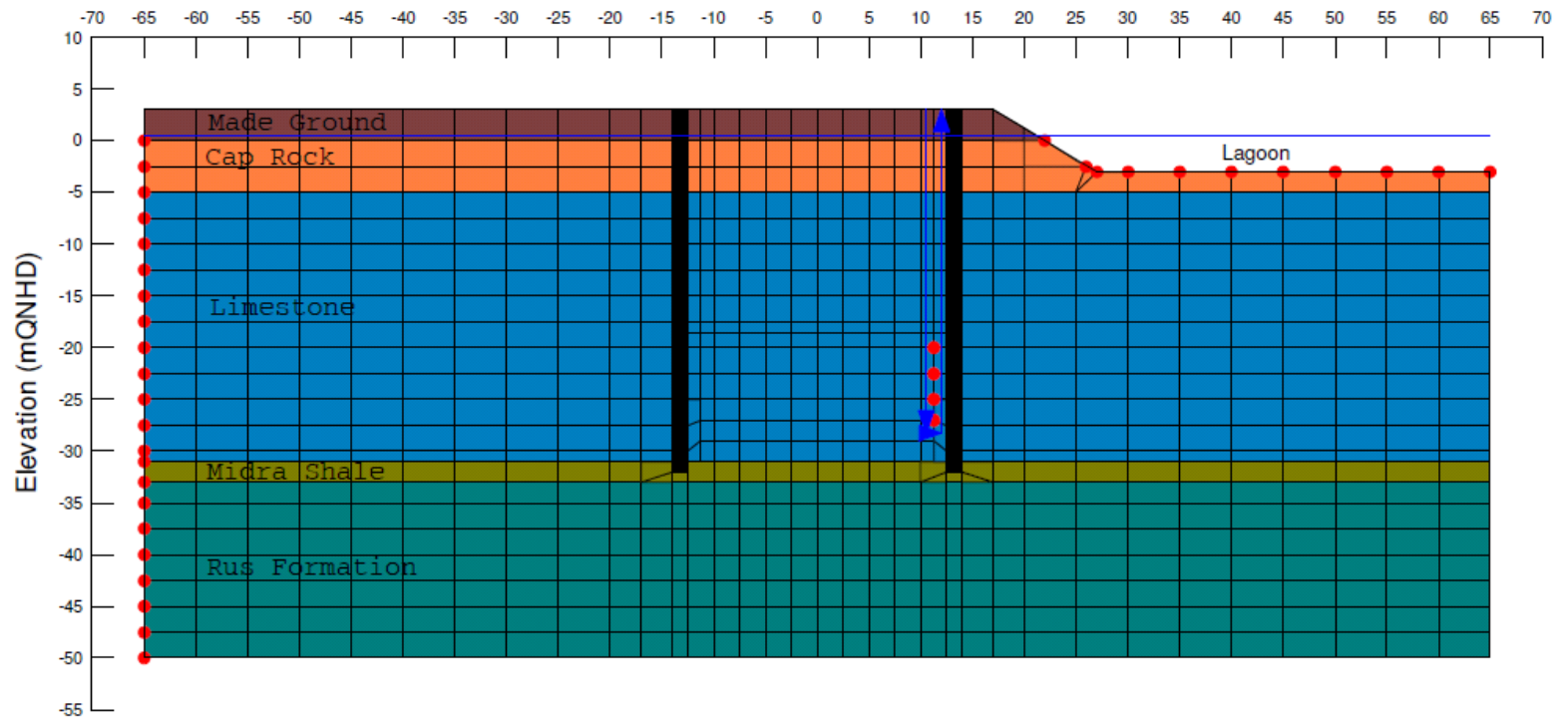


The Current Hydrogeological thinking



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Figure 1: Groundwater Model

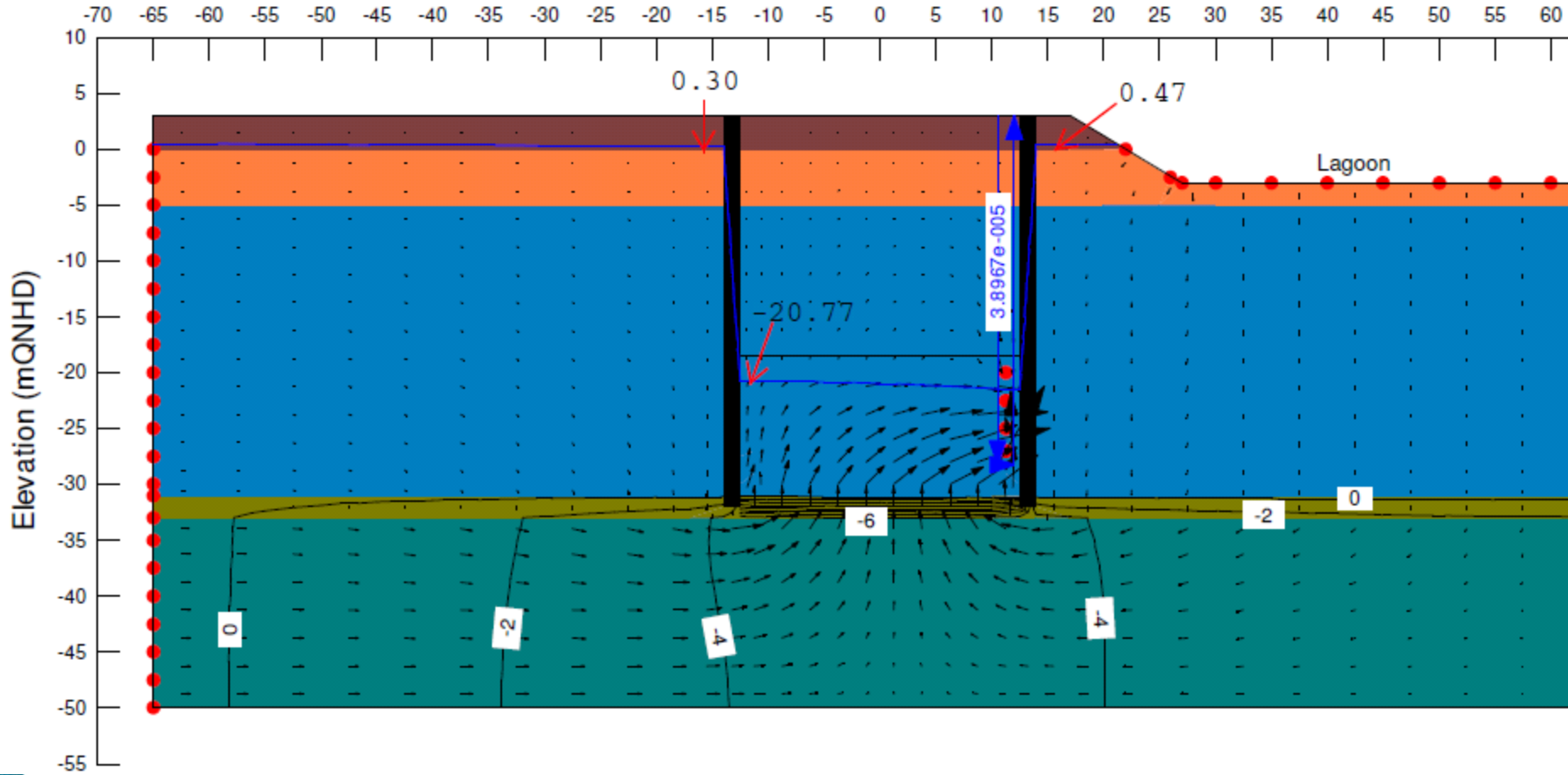


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The following permeabilities have been assumed.

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

