JABATAN KERJA RAYA

SUB SURFACE INVESTIGATION

DATE : 17 MARCH 2020
VENUE : CReATE, JKR

PRESENTER : MUHAMMAD SYAFIQ BIN SAIDIN

SUB-SURFACE INVESTIGATION

- Excavation & Boreholes
  - Test Pits/ Trenching
  - Shallow Boring
    - Hand Augering
  - Deep Boring
    - Mechanical Augering
    - Percussion Drilling
    - Wash Boring
    - Rotary Drilling
- Sounding Tests
  - JKR/ Mackintosh Probe
  - Cone Penetration Test
- Geophysical Survey
  - Seismic
  - Resistivity

OBJECTIVES

1) To establish the general nature of the strata below at site
2) To obtain samples for laboratory testing
3) To allow in situ tests to be carried out

STAGES OF SOIL INVESTIGATION

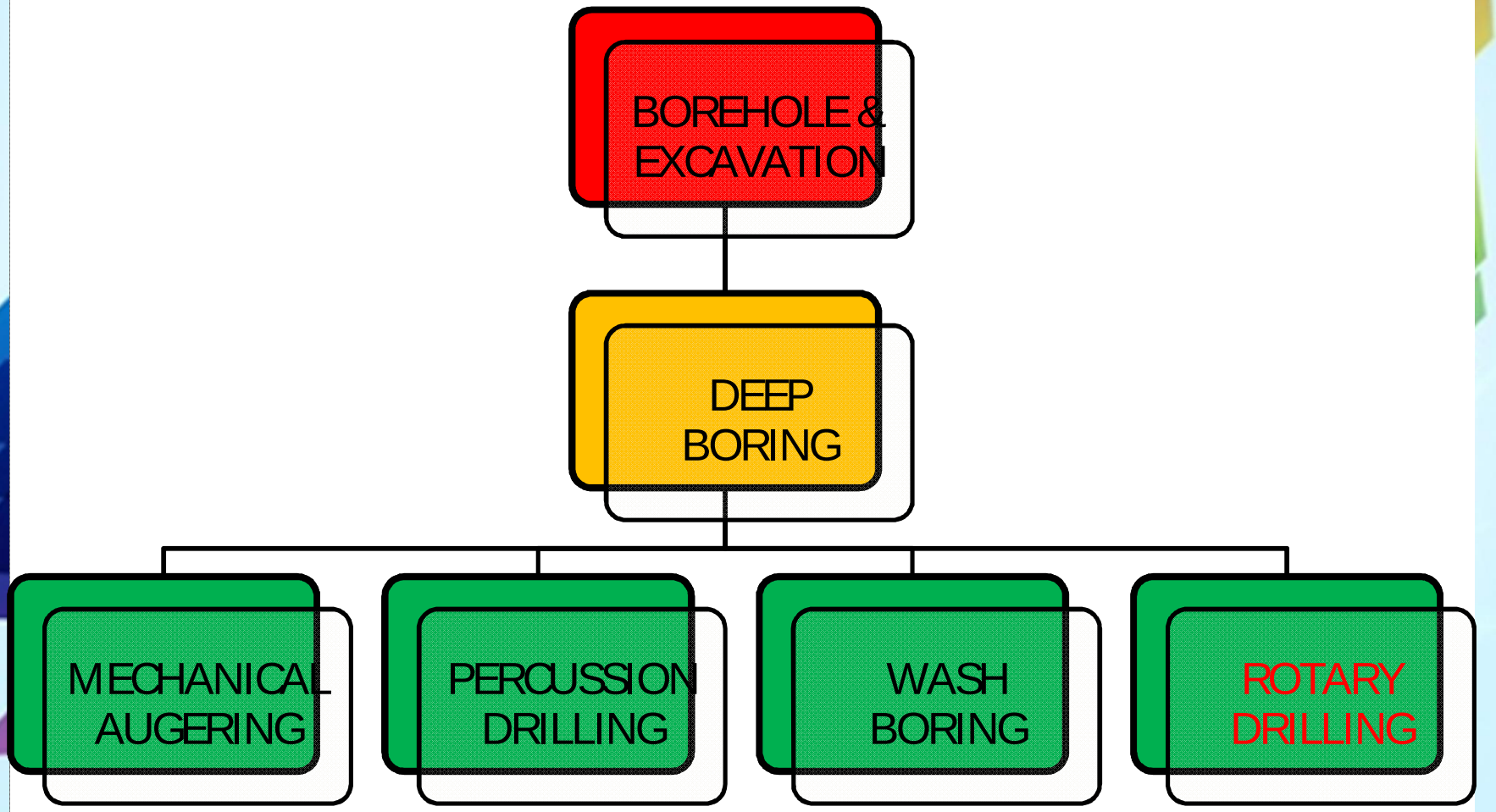
Stage 1: Preliminary S.I.

aims to achieve the following objectives :
- To obtain general subsoil profile for estimation of earthwork
- Preliminary or confirmation of layout and formation level
- Preliminary soil parameters and water level/table
- For conceptual designs and preliminary cost and time estimates

Stage 2 : Detailed S.I.

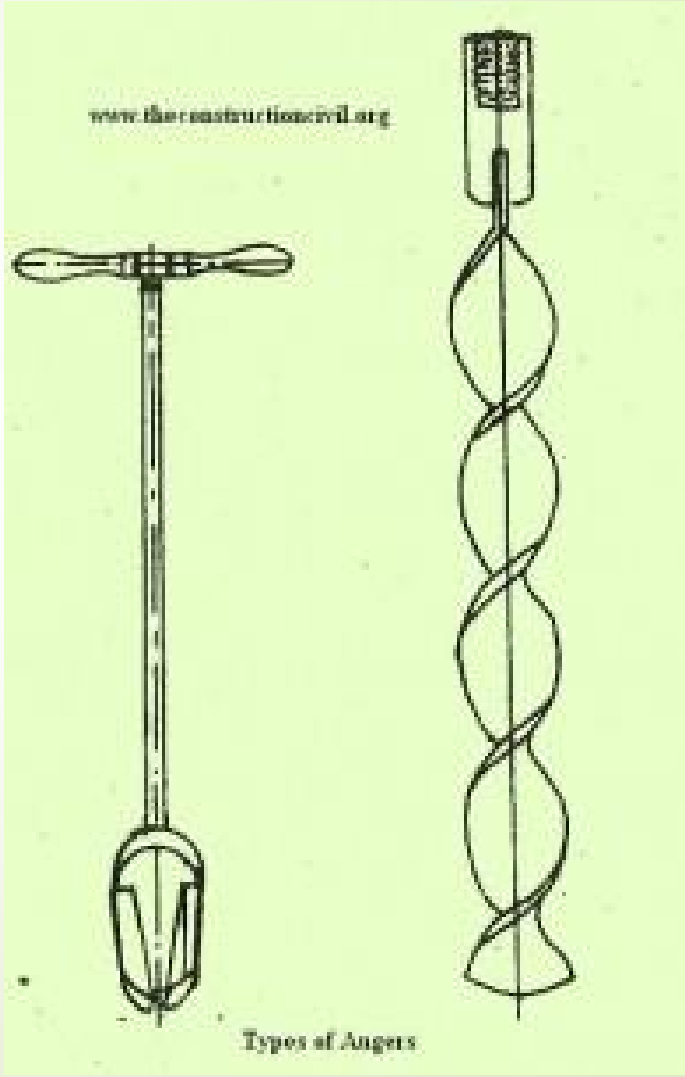
usually carry out after optimum layout has been selected and confirmed.
aims to achieve the following objectives :
- Plan for critical areas of concern
- Refine subsoil profile
- Obtain necessary soil parameters for detailed design of foundations
- At areas with difficult ground conditions (e.g. very soft soils, etc.)
- Major fill or cut areas that are more critical
- Locations with structures (e.g. retaining walls, areas with large loadings, etc.)

DEEP BORING


BOREHOLE & EXCAVATION
DEEP BORING
MECHANICAL AUGERING
PERCUSSION DRILLING
WASH BORING
ROTARY DRILLING

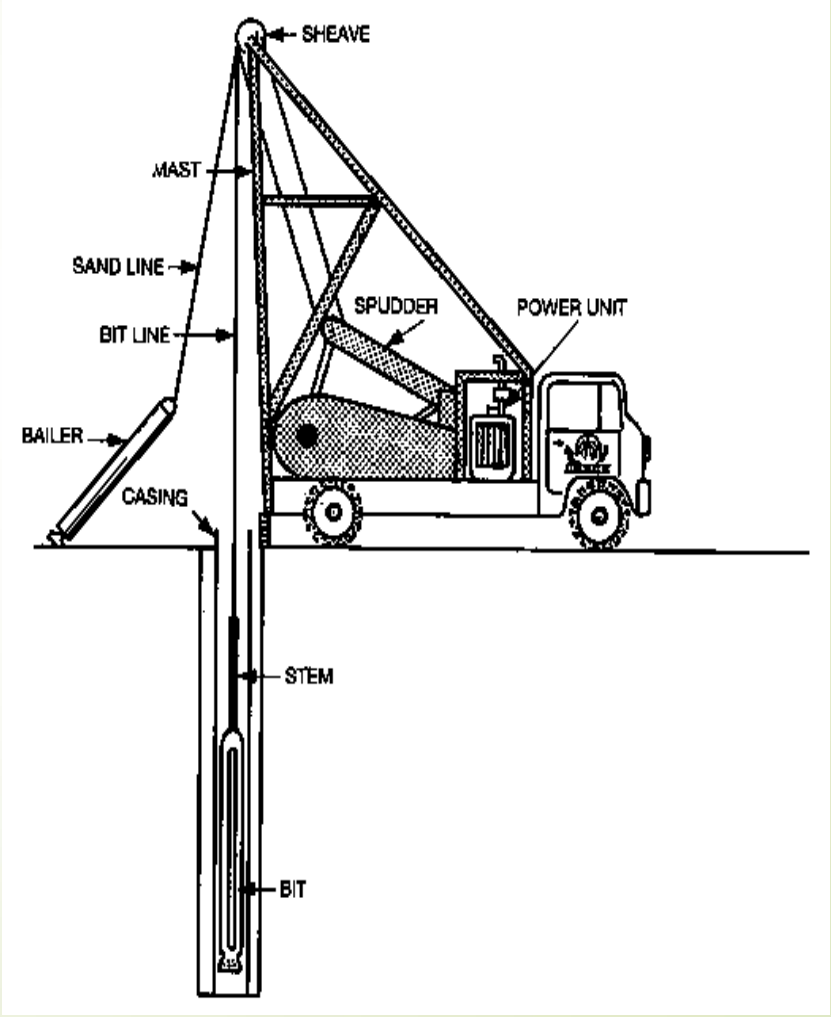
MECHANICAL AUGER

The auger is held vertically and is driven into the ground by rotating its handle by applying leverage. The auger is pressed down during the process of rotation. At every 30 cm of depth penetrated, the auger is taken out and the samples of the soils are collected separately for examination. This method can be conveniently used for soil penetration up to 15 m depth.



PERCUSSION BORING

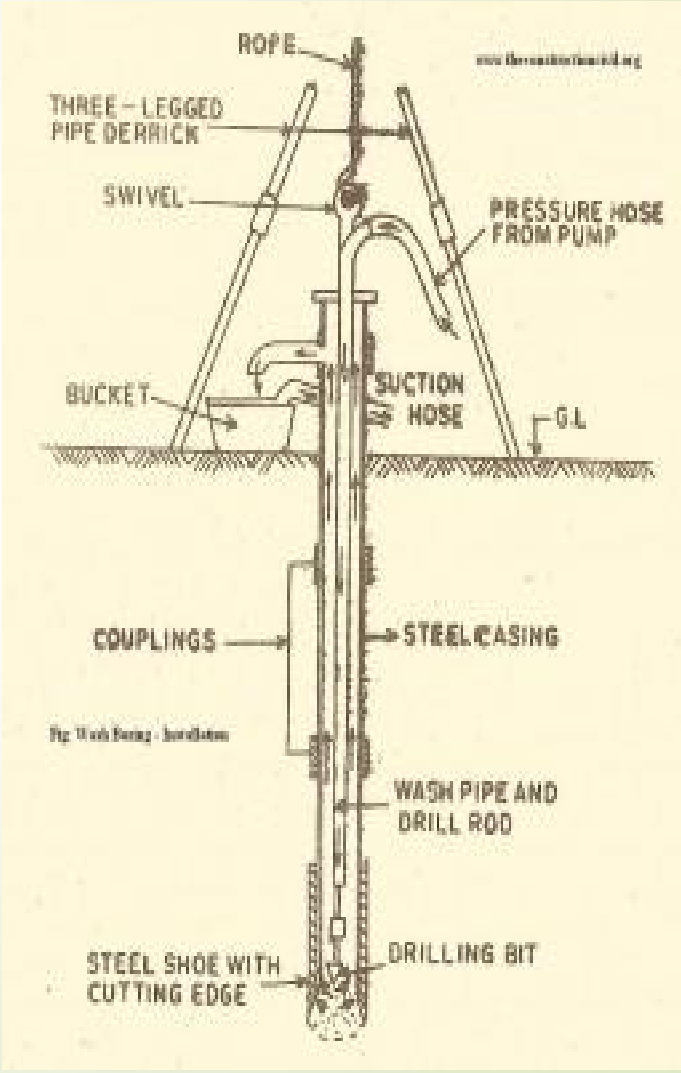
This method consists of breaking up of the sub-strata by repeated blows from a bit or chisel. The material thus pulverized is converted into slurry by pouring water in the bore. At intervals the slurry is bailed out of the hole and dried for examination. This method can be adopted in soil and rocks having boulders.



WASH BORING

Wash boring consists of simultaneous drilling and jetting action. A hole is bored through a casing by using a drilling bit.

Jetting action is accomplished by pumping water downward through the drilling bit to soften the soil. Samples taken using the wash boring method are disturbed samples.



ROTARY DRILLING

Rotary drilling is used to form a deep observation borehole or for obtaining representative samples of rock which could not be recovered using cable percussion. The drilling method involves a powered rotary cutting head on the end of a shaft, which is driven into the ground as it rotates. The system requires lubrication such as water to make the drilling pit easy to rotating into the ground and keep it cool.

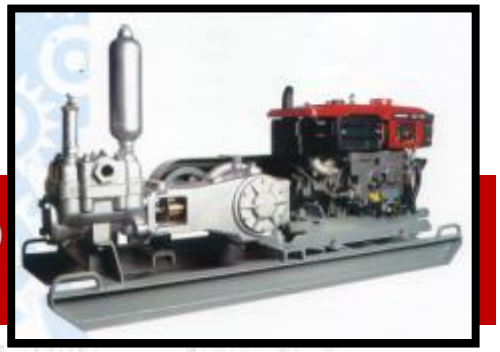
ROTARY DRILLING

OBJECTIVES

- To determine the sub-surface profile,
- To obtain SPT N value
- To obtain the soil & rock samples disturbed, undisturbed samples & rock coring

Advantages	Disadvantages
drilled	Requires capital expenditure in equipment.
formations	boulders.
below the water-table	maintenance.
40 meters	

ILLING EQUIP



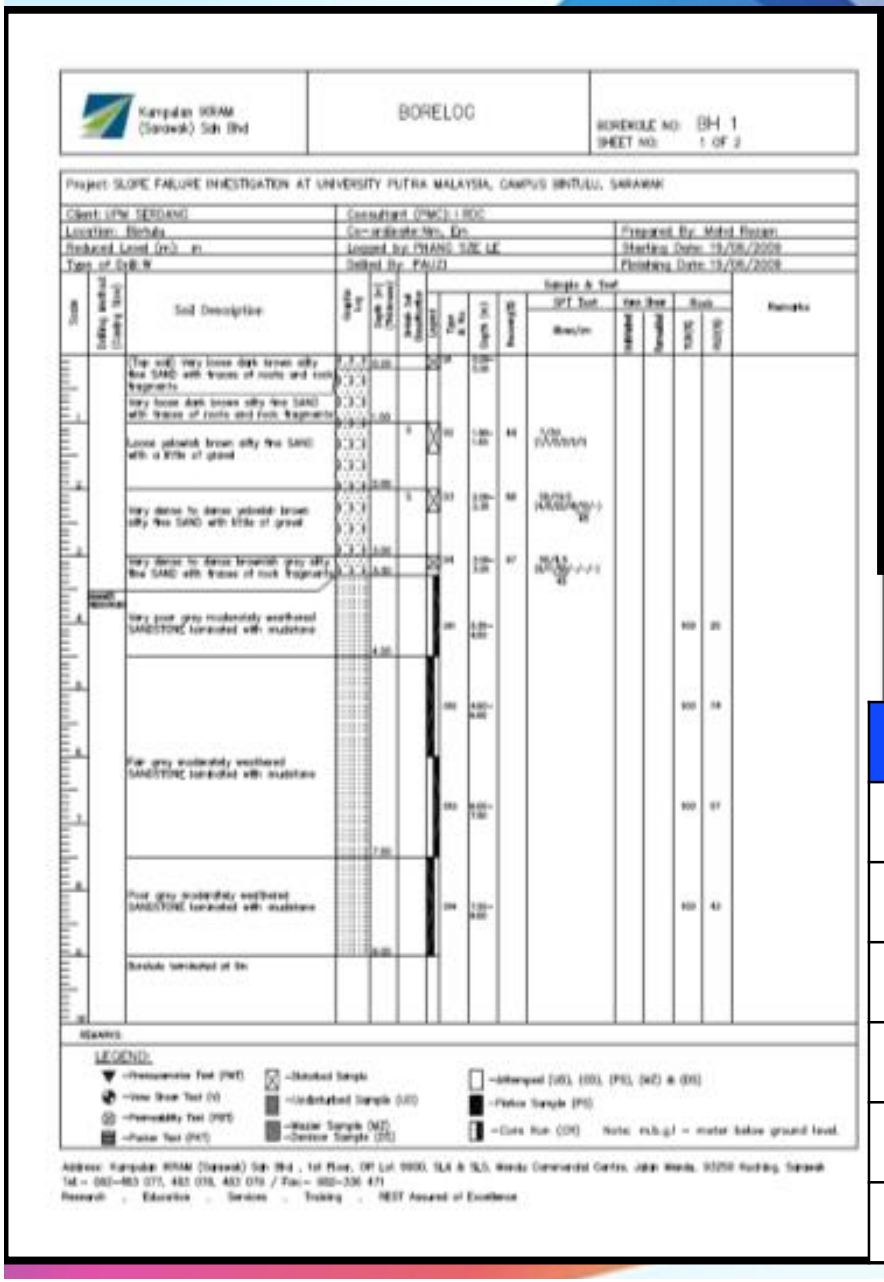
Information In Deep Boring Log

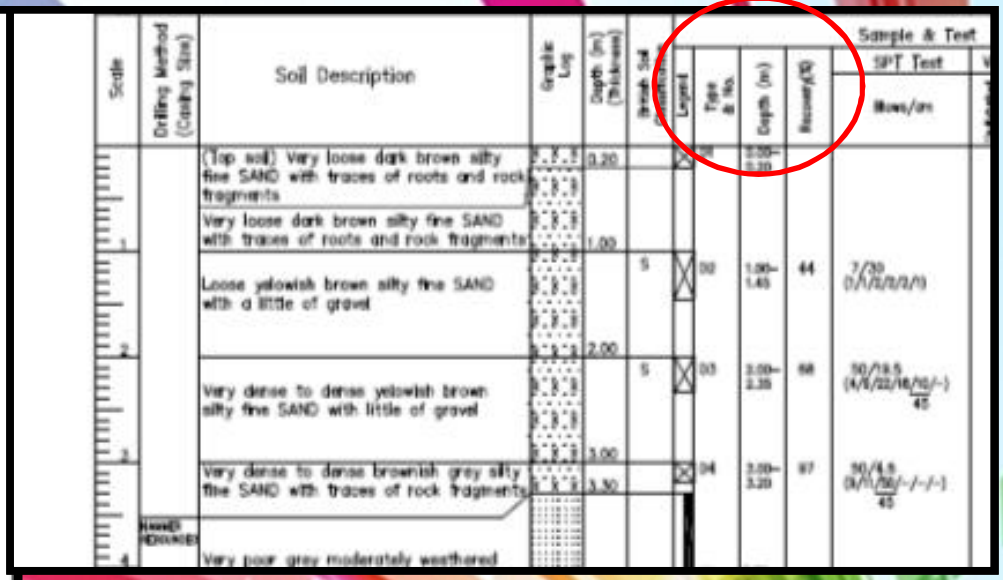
No.	Element	No.	Element
1	Project	19	Depth
2	Client	20	Number of Sample
3	Consultant	21	(SPT Test), Blows/cm
4	Reduced Level (Existing Ground Level)	22	Vane Shear Test (VS), Undisturbed/Remoulded
5	Borehole Number	23	Rock, %RQD/%TCR
6	Sheet Number	24	Remarks
7	Chainage	25	RQD(%) Calculation
8	Coordinate	26	Legend
9	Logged by	27	Undisturbed Sample (UD)
10	Drilled by	28	Disturbed Sample (D)
11	Starting Date	29	Mazier Sample (MS)
12	Finish Date	30	Core Sample (C)
13	Weather	31	Standard Penetration Test (N)
14	Type Of Drill	32	Pressuremeter Test (PMT)
15	Soil Description	33	Recovery Ratio (R/r)
16	Ground Water Level (G.W.L)	34	Signature (Certified by)
17	Graphic Log	35	SPT plot
18	Job No		

IMPORTANT ELEMENTS IN DEEP BORING

No.	Element	No.	Element
1	Reduced Level (Existing Ground Level)	8	Recovery Ratio (R/r)
2	Borehole Number	9	Rock, %RQD/%TCR
3	Weather	10	Undisturbed Sample (UD)
4	Number of Sample	11	Disturbed Sample (D)
5	Soil Description	12	Mazier Sample (MS)
6	Ground Water Level (G.W.L)	13	Core Sample (C)
7	Depth	14	Standard Penetration Test (N)

EXAMPLE OF BOREHOLE LOG

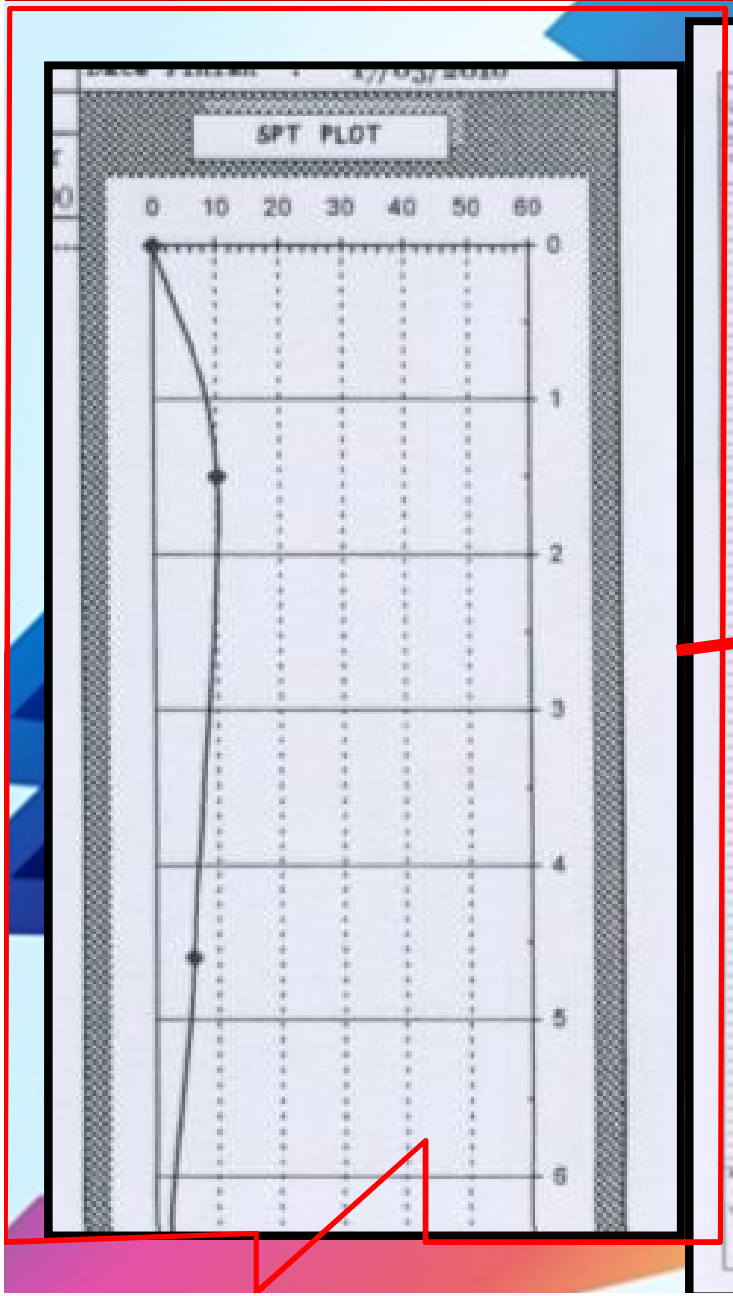


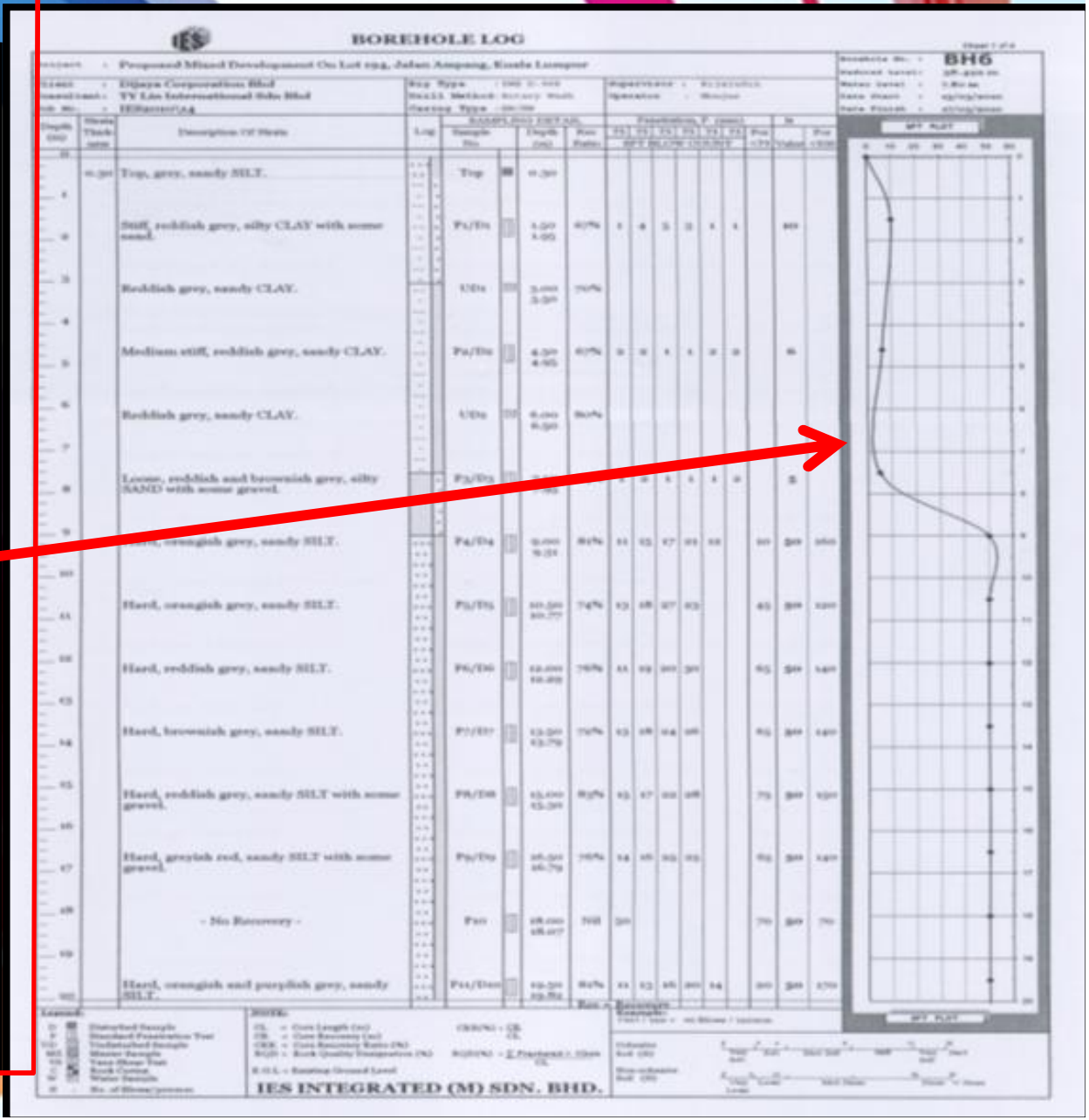


SPT N-Value

Cohesive soil	Non cohesive soil
0-2 Very soft	0-4 Very loose
2-4 Soft	4-10 Loose
4-8 Firm	10-30 Medium dense
8-15 Stiff	30-50 Dense
15-30 Very stiff	> Very dense
> 30 Hard	

SPT GRAPH OF BORELOG





Graphic Log Description

LEGEND

- Fill Material
- Boulder
- Gravel
- Sand
- Silt
- Clay
- Peat
- Shells
- Limestone
- Chert
- Sandstone
- Siltstone
- Claystone/Mudstone
- Shale
- Coal
- Volcanics
- Rhyolite
- Granite
- Schist
- Phyllite
- Quartz

- Bulk sample (BS)
- Mazier sample (MS)
- Undisturbed sample (UD)
- Undisturbed piston sample (UP)
- Disturbed sample (D)
- Core sample (C)
- Water sample
- Standard penetration test (P)
- Vane shear test (VST)
- Insitu field density test (FD)
- Piezometer

R = Recovery Ratio (mm/mm)

CL = Core Length (mm)

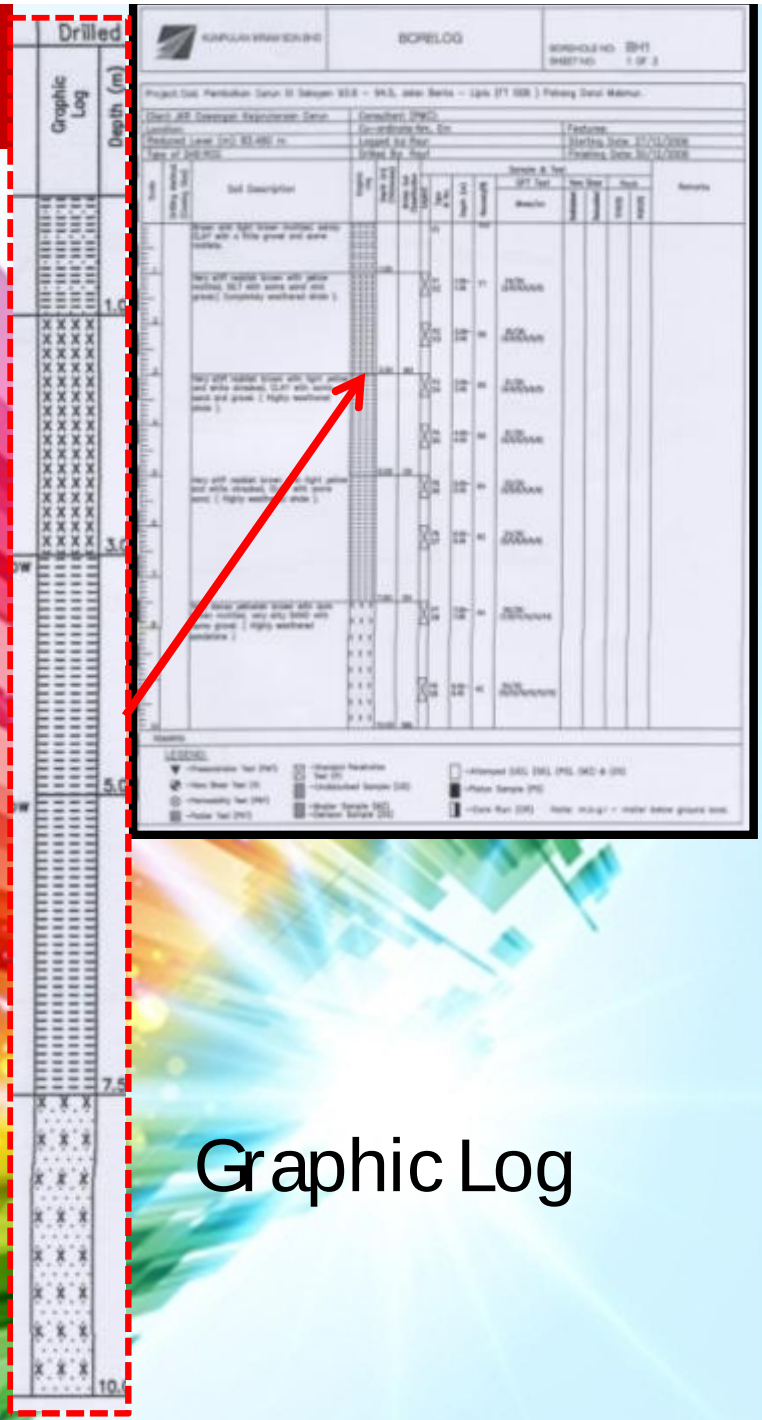
N = N value of SPT

SPT = Standard Penetration Test

NW = 3-inch inner dia. casing

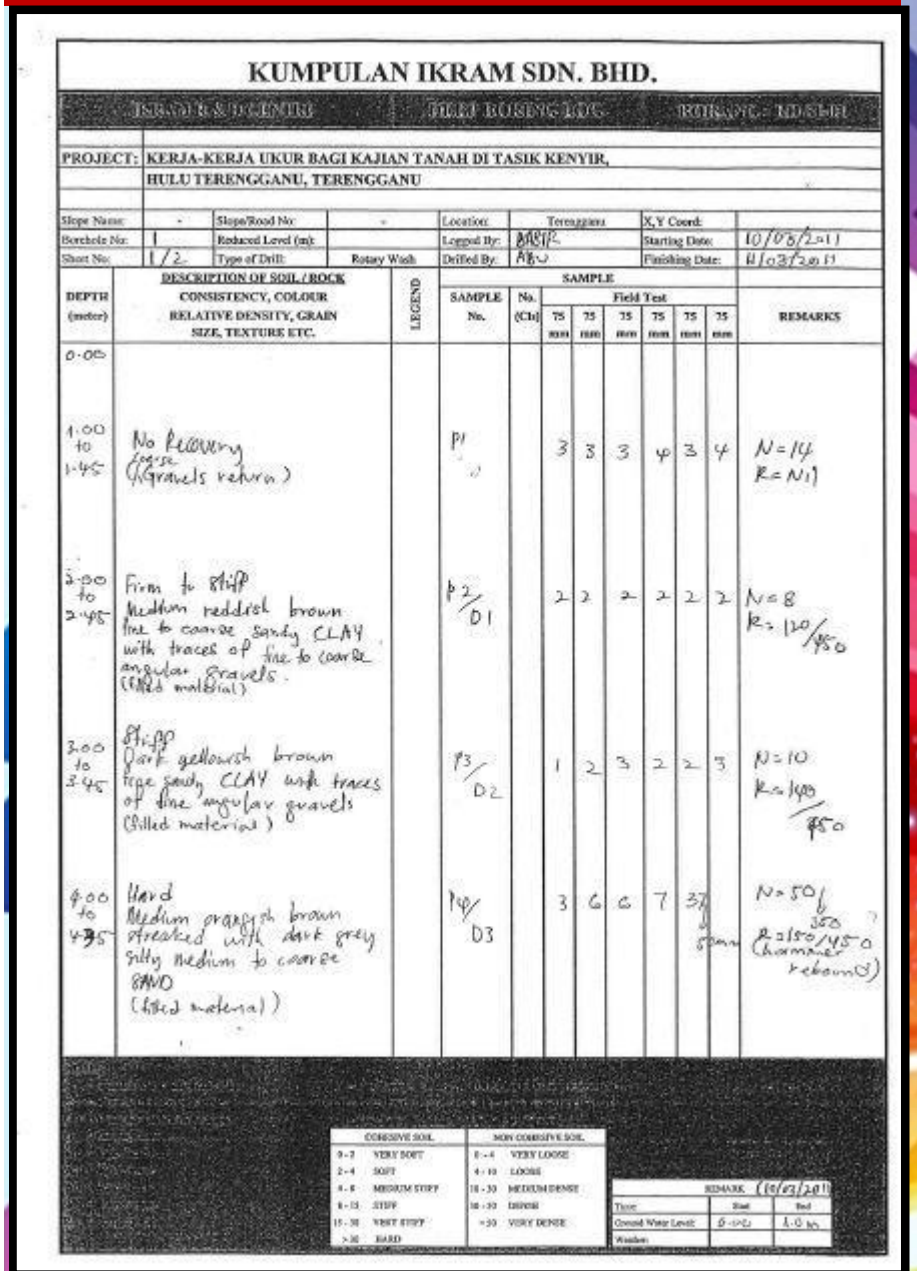
HW = 4-inch inner dia. casing

NMLC = 2.98-inch hole dia. core barrel



Graphic Log

Uncorrected Borehole Log



KUMPULAN IKRAM SDN. BHD.

IKRAM R & D CENTRE | DEEP BORING LOG | BORANG : RD/SI-01

PROJECT: KERJA-KERJA UKUR BAGI KAJIAN TANAH DI TASIK KENYIR, HULU TERENGGANU, TERENGGANU

Slope Name:	-	Slope/Road No:	-	Location:	Terengganu	X,Y Coord:	
Borehole No:	1	Reduced Level (m):		Logged By:	BASIP	Starting Date:	10/03/2011
Sheet No:	1/2	Type of Drill:	Rotary Wash	Drilled By:	ABU	Finishing Date:	11/03/2011

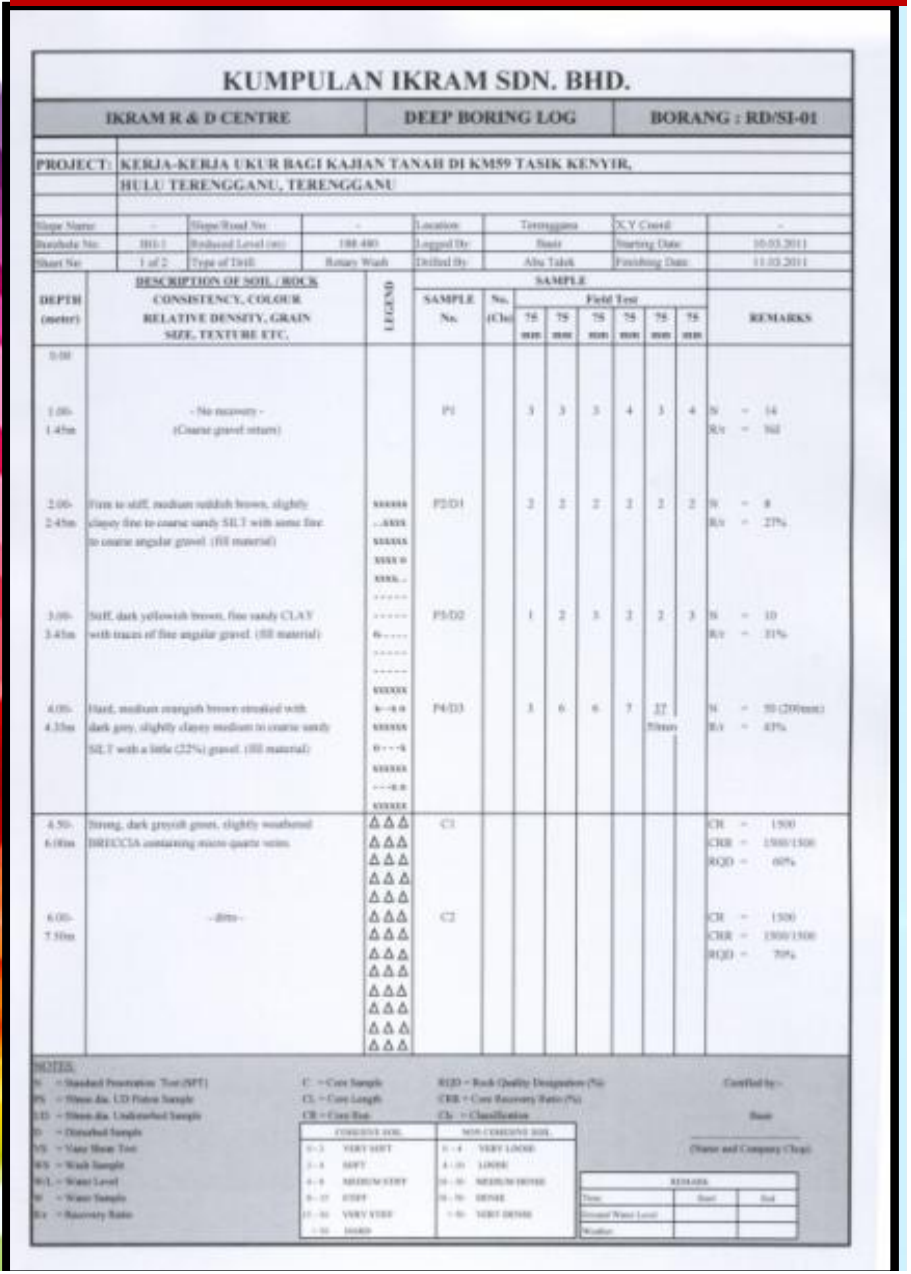
DEPTH (meter)	DESCRIPTION OF SOIL / ROCK CONSISTENCY, COLOUR RELATIVE DENSITY, GRAIN SIZE, TEXTURE ETC.	LEGEND	SAMPLE No.	No. (Cls)	Field Test 75 mm	75 mm	75 mm	75 mm	75 mm	75 mm	REMARKS
0.00											
1.00 to 1.45	No Recovery (Coarse Gravels return)		P1		3	3	3	4	3	4	N=14 R=N1)
2.00 to 2.45	Firm to Stiff Medium reddish brown fine to coarse sandy CLAY with traces of fine to coarse angular gravels. (Filled material)		P2/D1		2	2	2	2	2	2	N=8 R=120/450
3.00 to 3.45	Stiff Dark yellowish brown fine sandy CLAY with traces of fine angular gravels (Filled material)		P3/D2		1	2	3	2	2	3	N=10 R=140/450
4.00 to 4.35	Hard Medium grayish brown streaked with dark grey silty medium to coarse SAND (Filled material)		P4/D3		3	6	6	7	37 50mm		N>50/350 R=150/450 (hammer rebound)

CORESIVE SOIL		NON CORESIVE SOIL	
0 - 2	VERY SOFT	0 - 4	VERY LOOSE
2 - 4	SOFT	4 - 10	LOOSE
4 - 8	MEDIUM STIFF	10 - 30	MEDIUM DENSE
8 - 15	STIFF	30 - 50	DENSE
15 - 30	VERY STIFF	>50	VERY DENSE
>30	HARD		

REMARK (10/03/2011)

Time	Start	End
Ground Water Level:	0.00 m	1.0 m
Weather:		

Corrected Borehole Log



KUMPULAN IKRAM SDN. BHD.

IKRAM R & D CENTRE | DEEP BORING LOG | BORANG : RD/SI-01

PROJECT: KERJA-KERJA UKUR BAGI KAJIAN TANAH DI KM59 TASIK KENYIR, HULU TERENGGANU, TERENGGANU

Slope Name:	-	Slope/Road No:	-	Location:	Terengganu	X,Y Coord:	-
Borehole No:	HU-1	Reduced Level (m):	188.480	Logged By:	Basir	Starting Date:	10.03.2011
Sheet No:	1 of 2	Type of Drill:	Rotary Wash	Drilled By:	Abu Talek	Finishing Date:	11.03.2011

DEPTH (meter)	DESCRIPTION OF SOIL / ROCK CONSISTENCY, COLOUR RELATIVE DENSITY, GRAIN SIZE, TEXTURE ETC.	LEGEND	SAMPLE No.	No. (Cls)	Field Test 75 mm	75 mm	75 mm	75 mm	75 mm	75 mm	REMARKS
0.00											
1.00- 1.45m	- No recovery - (Coarse gravel return)		P1		3	3	3	4	3	4	N - 14 R/r - Nil
2.00- 2.45m	Firm to stiff, medium reddish brown, slightly clayey fine to coarse sandy SILT with some fine to coarse angular gravel. (fill material)		P2/D1		2	2	2	2	2	2	N - 8 R/r - 27%
3.00- 3.45m	Stiff, dark yellowish brown, fine sandy CLAY with traces of fine angular gravel. (fill material)		P3/D2		1	2	3	2	2	3	N - 10 R/r - 31%
4.00- 4.35m	Hard, medium orangish brown streaked with dark grey, slightly clayey medium to coarse sandy SILT with a little (22%) gravel. (fill material)		P4/D3		3	6	6	7	37 50mm		N - 50 (200mm) R/r - 43%
4.50- 6.00m	Strong, dark greyish green, slightly weathered BRECCIA containing micro quartz veins.		C1								CR - 100% CRR - 100/100 RQD - 60%
6.00- 7.50m	--do--		C2								CR - 100% CRR - 100/100 RQD - 70%

NOTES:

N = Standard Penetration Test (SPT)
PS = 50mm dia. UD Piston Sample
UD = 50mm dia. Undisturbed Sample
D = Disturbed Sample
VS = Vane Shear Test
WS = Wash Sample
W/L = Water Level
W = Water Sample
R/r = Recovery Ratio
C = Core Sample
CL = Core Length
CR = Core Run
RQD = Rock Quality Designation (%)
CRR = Core Recovery Ratio (%)
Cls = Classification

Certified by:-

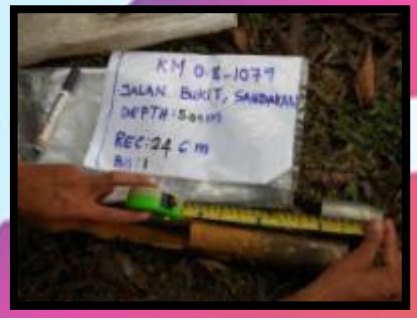
Basir

(Name and Company Chop)

CORESIVE SOIL		NON CORESIVE SOIL	
0 - 2	VERY SOFT	0 - 4	VERY LOOSE
2 - 4	SOFT	4 - 10	LOOSE
4 - 8	MEDIUM STIFF	10 - 30	MEDIUM DENSE
8 - 15	STIFF	30 - 50	DENSE
15 - 30	VERY STIFF	>50	VERY DENSE
>30	HARD		

REMARK		
Time	Start	End
Ground Water Level:		
Weather:		

Sample With Borehole Log



Kumpulan IKRAM (Sabah) Sdn Bhd
(Company No. 462019A)

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DEEP BORING LOG

Project:	Kerja-Kerja Pembaikan Cerun Di KM0.8 Di Jalan Bukit, Sandakan, Sabah		Chainage:
Hole No.:	BH-1 / Flat Ground	Reduced Level: (m) E.G.L.	Supervisor/Operator: Felius / Oklong
Sheet:	1 of 2	Drill: Y.W.E.7 D45	Date: 09.10.11 to 10.10.11
Project No:	1079	Coordinate N: 467,072.00 E: 622,101.00	Weather: Fine

Date / Time	(m)	DESCRIPTION OF SOIL Consistency, Colour, Relative Density, Grain Size, Texture, etc.	SAMPLE DEPTH (m)	No.	Field Test 75mm	75mm	75mm	75mm	75mm	75mm	REMARKS
09.10.11 2.00pm	0.00	Firm, yellowish brown sandy silty CLAY									
	1.00		1.00 - 1.50	UD 1							Rtr - 40cm
			1.50 - 1.95	D 1	1	0	1	1	1	1	N = 4 Rtr - 18cm
	2.00		2.00 - 2.45	D 2	1	1	2	2	2	2	N = 8 Rtr - 18cm
		2.70m									
	3.00	Stiff, mottled yellowish brown, sandy silty CLAY	3.00 - 3.50	UD 2							Rtr - 28cm
			3.50 - 3.95	D 0	1	1	1	2	2	3	N = 8 Rtr - 0
	4.00		4.00 - 4.45	D 3	1	1	2	2	2	2	N = 8 Rtr - 18cm
		4.60m									
	5.00	Medium dense to very dense, mottled light grey, fine SAND	5.00 - 5.45	D 4	1	1	3	5	7	7	N = 22 Rtr - 24cm
	6.00		6.00 - 6.29	D 5	3	5	13	37			N = >50 Rtr - 28cm
		6.60m									
09.10.11 5.35pm	7.00	Very dense, grey, SAND with weak weathered SANDSTONE									
10.10.11 8.00am			7.50 - 7.63	D 6	45	50					N = >50 Rtr - 10cm
	8.00										
	9.00		9.00 - 9.20	D 7	17	25	50				N = >50 Rtr - 20cm
	10.00										

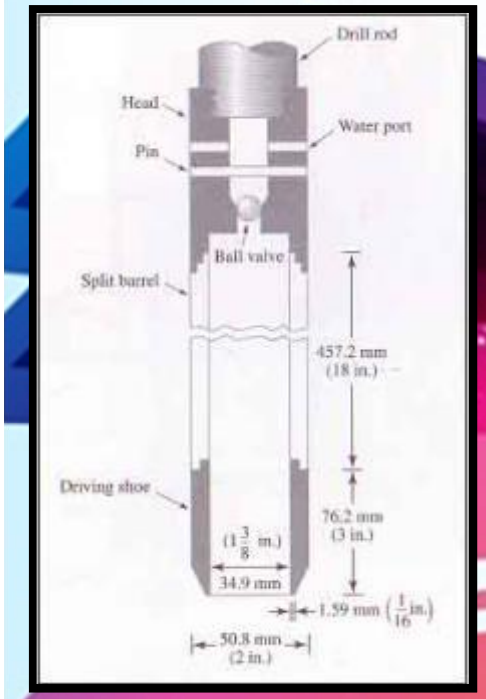
Note:

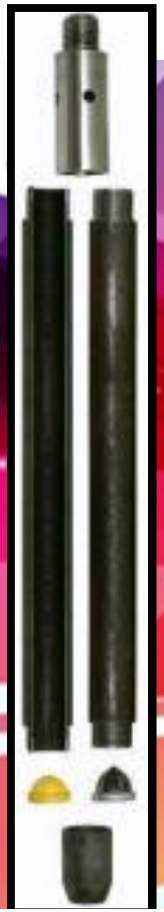
		Cohesive Soil[N]		Non-cohesive Soil[N]	
N	Standard Penetration Test [SPT]	0-2	Very Soft	0-4	Very Loose
P	50mm dia. Undisturbed piston sample	2-4	Soft	4-10	Loose
UD	50mm dia. Undisturbed sample	4-8	Firm	10-30	Medium Dense
D	Disturbed sample	8-15	Stiff	30-50	Dense
VS	Vane Shear Test	15-30	Very Stiff	>50	Very Dense
MS	Mazier Sample	>30	Hard		
C	Core sample				
RQD	Rock Quality Designation				
Rtr	Recovery ratio				
E.G.L	Existing Ground Level				
USS/R	Undisturbed /Remoulded Shear Strength				

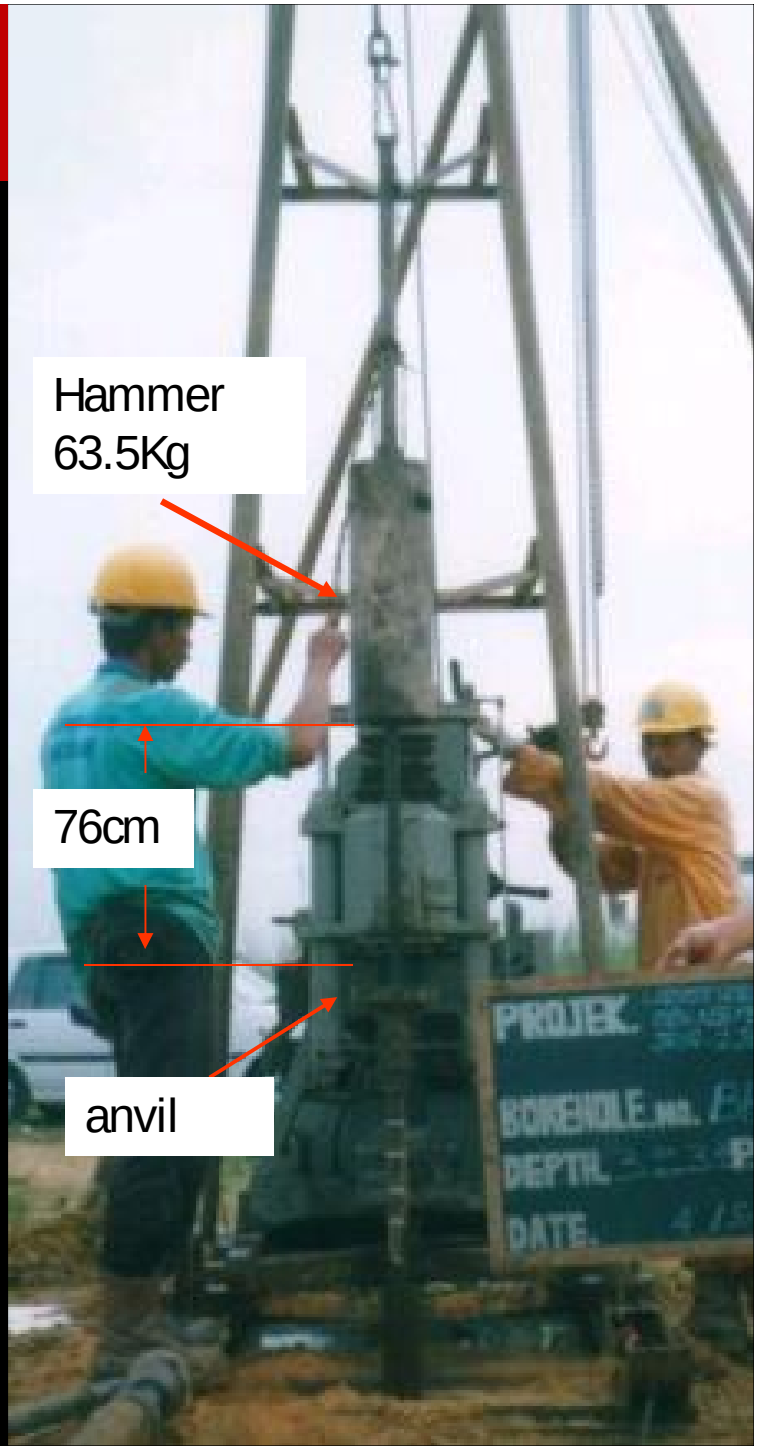
[Pegawai Penyiasatan Tapak]

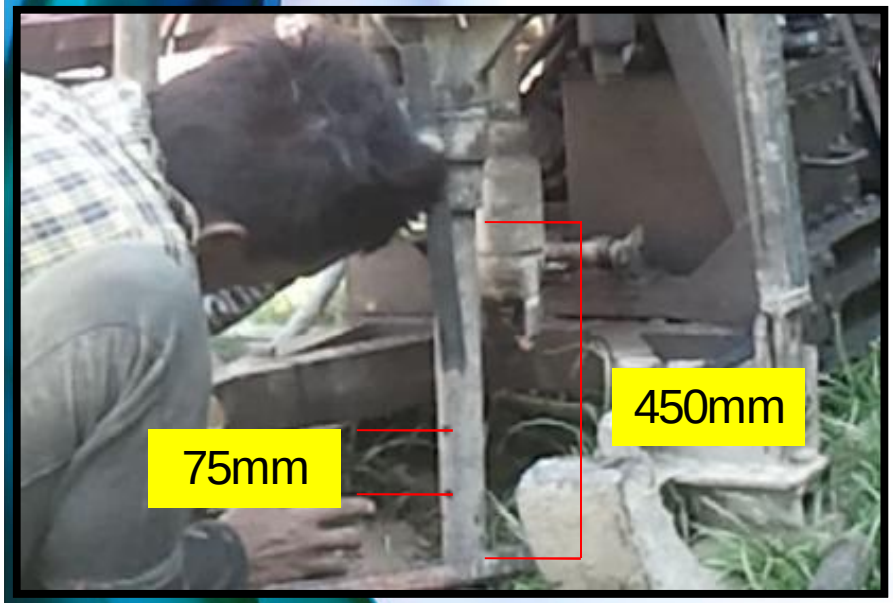
Standard Penetration Test (SPT)

- To determine the SPT N value
- To provide information on the geotechnical engineering properties of soil.
- To provide an indication of the relative density of granular deposits, such as sands and gravels
- The test procedure is described in the British Standard









Maximum depth of penetration is 450mm

The blows will be counted on every 75mm until it reach 450mm or 50 blows

The blows represent hardness of soil.

VIDEO OF SPT WORK

STANDARD PENETRATION TEST

Advantages	Disadvantages
-Relatively quick and simple to perform -Provides a representative soil sample -Provides useful index of relative strength and compressibility of the soil. -Able to penetrate dense layers, gravel, and fill	-The SPT does not typically provide continuous data (e.g. 5 ft. intervals), therefore important data such as weak seams may be missed - Limited applicability to gravels, cobbles boulders - Samples that are obtained from the SPT are disturbed

FACTOR AFFECTING 'N' VALUE

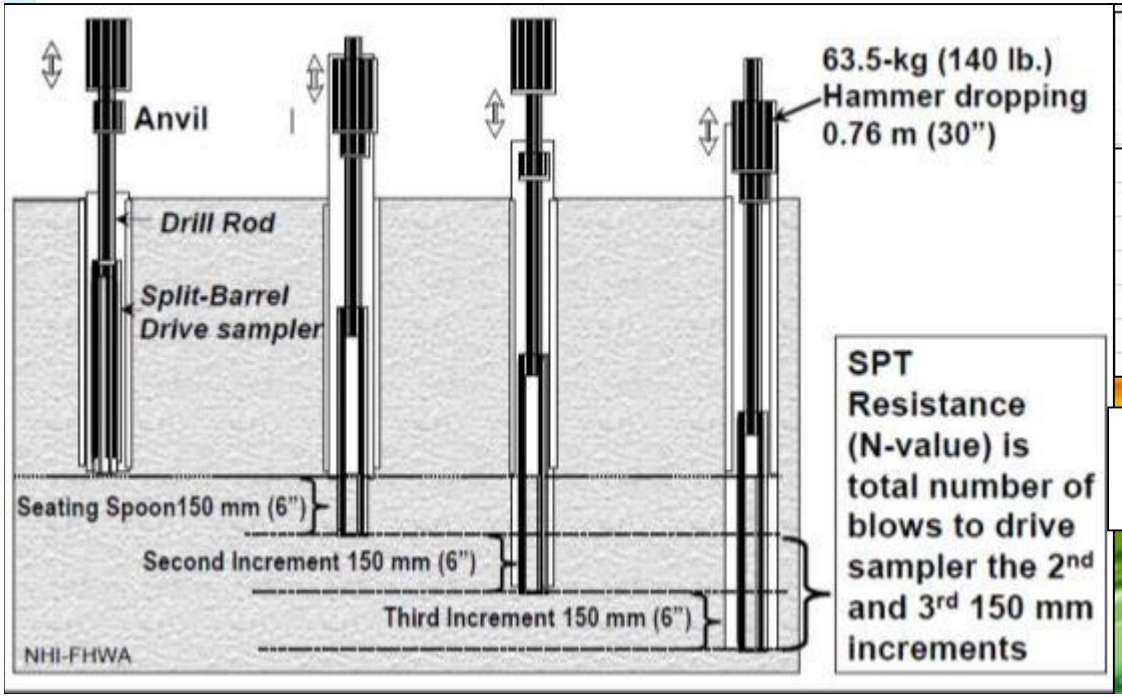
ERRORS	CONCEQUENCE
Inadequate cleaning of borehole	(X) N, sludge trapped in sampler
Casing driven bottom of the borehole	(↑) N in sand & (↓) N in clay
Damage tip of sampling spoons	(↑) N
Loose joints on connecting rods	(↑) N
Not using guide rod	(↑) N, eccentric blows
Water level in borehole below ground water level	(↓) N especially sand at bottom of borehole, piping effect

Note : Where N = SPT'N' values, (↓) = Giving misleading lower value.

(↑) = Giving misleading higher value, (X) = Wrong Results

STANDARD PENETRATION TEST CALCULATION

1) The number of hammer blows is counted.
2) The number required to drive the sampler three successive 150mm increments is recorded.
3) The first increment (0-150mm) is not included in the N value as it is assumed that the top of the test area has been disturbed by the drilling process.
4) The SPT N is the number of blows required to achieve penetration from 150-450mm.



LEGEND	SAMPLE								
	SAMPLE No.	No. (Cls)	Field Test 75 mm	75 mm	75 mm	75 mm	75 mm	75 mm	REMARKS
	P1		3	3	3	4	3	4	N = 14
									R/r = Nil

Penetration (mm)	75	75	75	75	75	75	N-value
Blow counts	1	3	5	7	7	9	28

Seating Drive

Test Drive

WHAT IS THE SPT "N" VALUE??

DEPTH (meter)	DESCRIPTION OF SOIL / ROCK CONSISTENCY, COLOUR RELATIVE DENSITY, GRAIN SIZE, TEXTURE ETC.	LEGEND	SAMPLE									
			SAMPLE No.	No. (Cls)	Field Test 75 mm	75 mm	75 mm	75 mm	75 mm	75 mm	REMARKS	
3.00-3.45m	Stiff, dark yellowish brown, fine sandy CLAY with traces of fine angular gravel. (fill material)	- - - - - o. . . . . - - - - - - - - - - xxxxxx	P3/D2		1	2	3	2	2	3	N =	
											R/r =	31%

SPT CORRELATION

$$N = \frac{50}{\text{Penetration Length}} \times 300\ \text{mm}$$

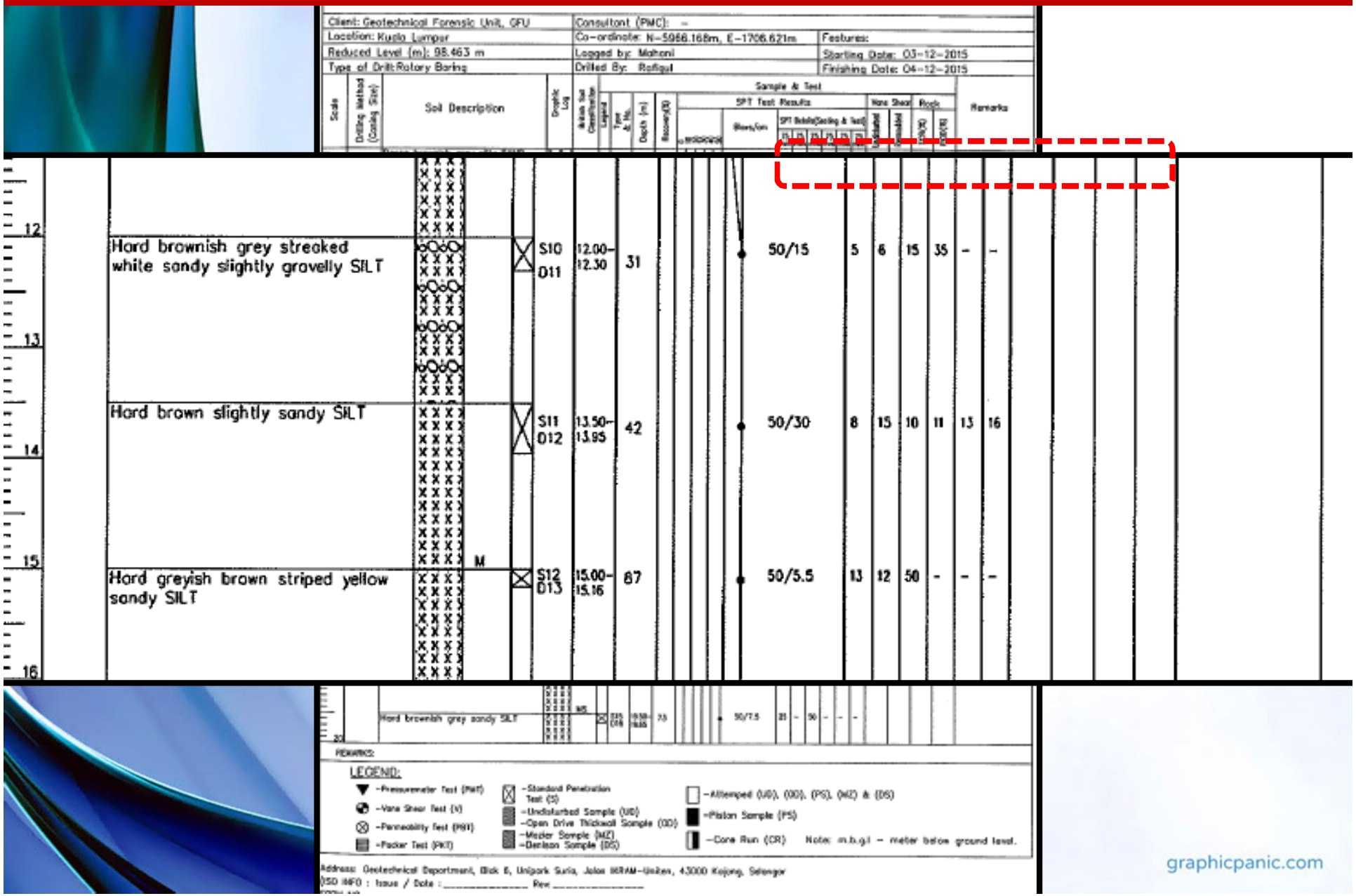
Example Calculation

5 - 10 - 30 - 20/30cm

Seating drive — Test drive

$$\text{SPT-N} = \frac{(30 + 20)}{(75 + 30)} \times 300 = 143$$

SPT CORRELATION



SAMPLING

How to Obtain ?

SAMPLE

Disturbed

- Split Spoon

Undisturbed

- Thin Wall
- Mazier

Coring

DISTURBED SAMPLE

Disturbed sample is taken when the SPT is carried out.

The sample is used for testing, such as Particle Size Distribution, Atterberg Limit, Density Test.

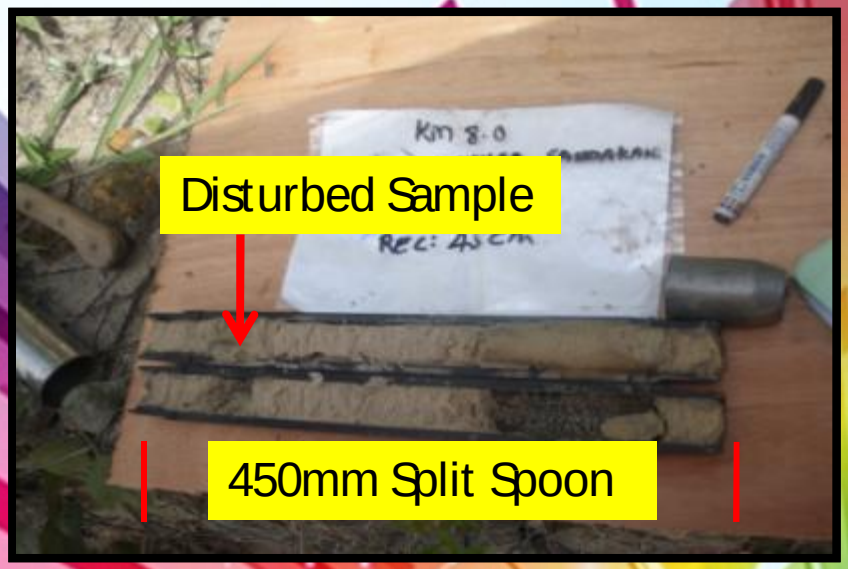
SPT is known as Standard Penetration Test. The value of SPT show the hardness of the soil. SPT reading start form 0 50 blows (very soft hard).

These value is obtained from the blows produced by a hammer pounding a rod to penetrate the soil layer.

The maximum depth of penetration is 450mm.

The termination of SPT is when it reached maximum depth 450mm or 50 blows.

Split Spoon



The SPT is taken using split spoon.

The length of split spoon in 450mm.

Inner diameter (35mm), outer diameter (50mm)

The sample inside split spoon known as disturbed sample.

DISTURBED SAMPLE VIDEO

UNDISTURBED SAMPLE

Undisturbed sample is taken based on engineer/site officer instruction. Usually it is taken when the hardness of soil is changing from one level to another level.

Type of test for undisturbed sample is

- One-Dimensional Test
- Consolidated Undrained Test
- Unconsolidated Undrained Test.

UNDISTURBED SAMPLE

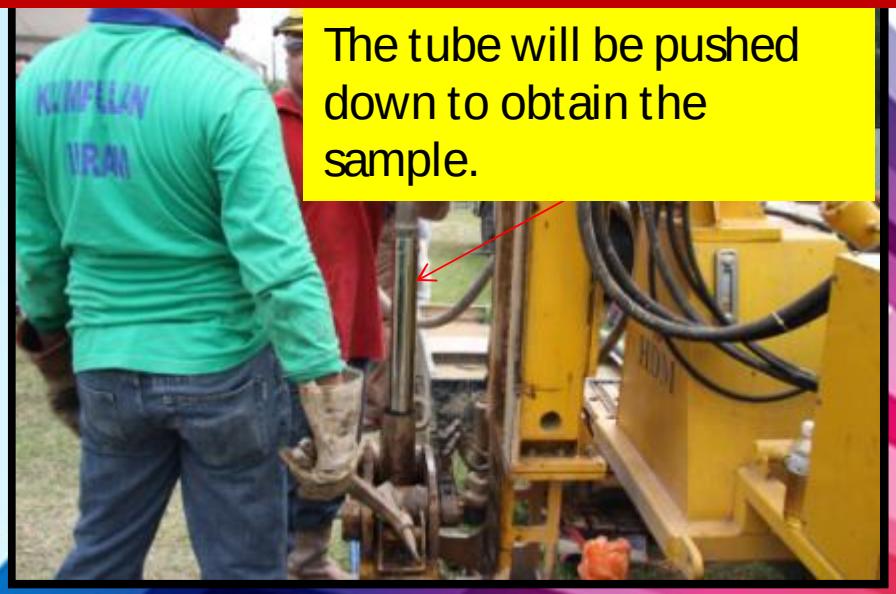
There are 2 types of sampling method for Undisturbed sample :-

- Thin-Wall Tube
- Mazier

Thin-Wall Tube

- Undisturbed sample is taken using stainless steel casing. There are 2 types of casing, U2(1meter length) and U3(500cm).
- These casing will be push inside the drilling hole using hydraulic or pounded with hammer to obtain a sample.
- After that, the sample will be sealed to prevent changes of soil properties.

THIN-WALL TUBE



UNDISTURBED SAMPLE

Mazier

This technology takes large diameter (101mm) core samples in 1,2m length pieces.

i) Using triple wall core barrel permits removal of the sample as it is taken from the ground, guaranteed the 'in situ condition of the core. Thats why these samples in addition good for large diameter geotechical laboratory tests beyond geological purposes.

ii) The third, inner tube made of plastic and continuously cover the sample.

iii) The Wire Line system allows that only the core barrel (second and third tubes) have pulled out to the surface after 1,2 m core drilling, while the outer tube (the first) works as a casing.

EXAMPLE OF MAZIER

CORING

Coring is done when SPT encounter the rock layer.

Length of coring is 1.5m. The technique is different from disturbed and undisturbed sample. It use a different casing.

The casing have its own bit to drill the rock.

From the obtained result, the quality of the rock can be determine, which is also known as RQD.

Extrusion of Coring Sample from Casing

Coring Bit

Coring Sample

Coring Sample

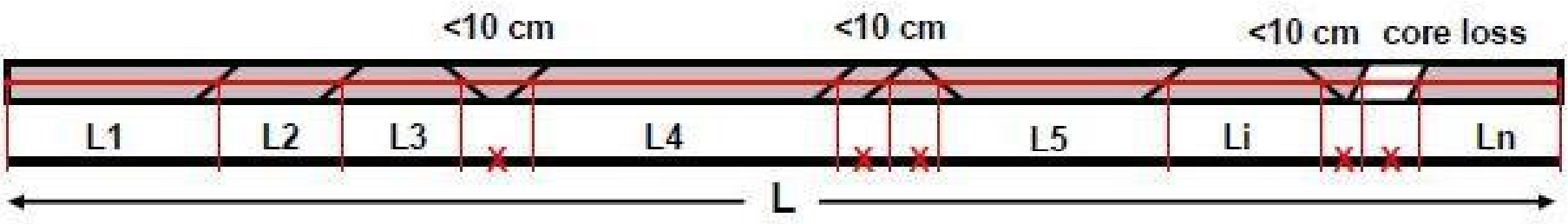
ROCK QUALITY DESIGN (RQD)

EXAMPLE CALCULATION

$$RQD = \left(\frac{l_{\text{sum of 100}}}{l_{\text{tot core run}}} \right) \times 100\,\%$$

$l_{\text{sum of 100}}$ = Sum of length of core sticks longer than 100 mm measured along the center line of the core

$l_{\text{tot core run}}$ = Total length of core run



RQD = (L1 + L2 + … + Ln) / L x 100%

ROCK QUALITY DESIGN (RQD) CLASSIFICATION TABLE

From the RQD index the rock mass can be classified as follows:

RQD	Rock mass quality
<25%	very poor
25-50%	poor
50-75%	fair
75-90%	good
90-100%	excellent

TOTAL CORE RECOVERY (TCR) CALCULATION

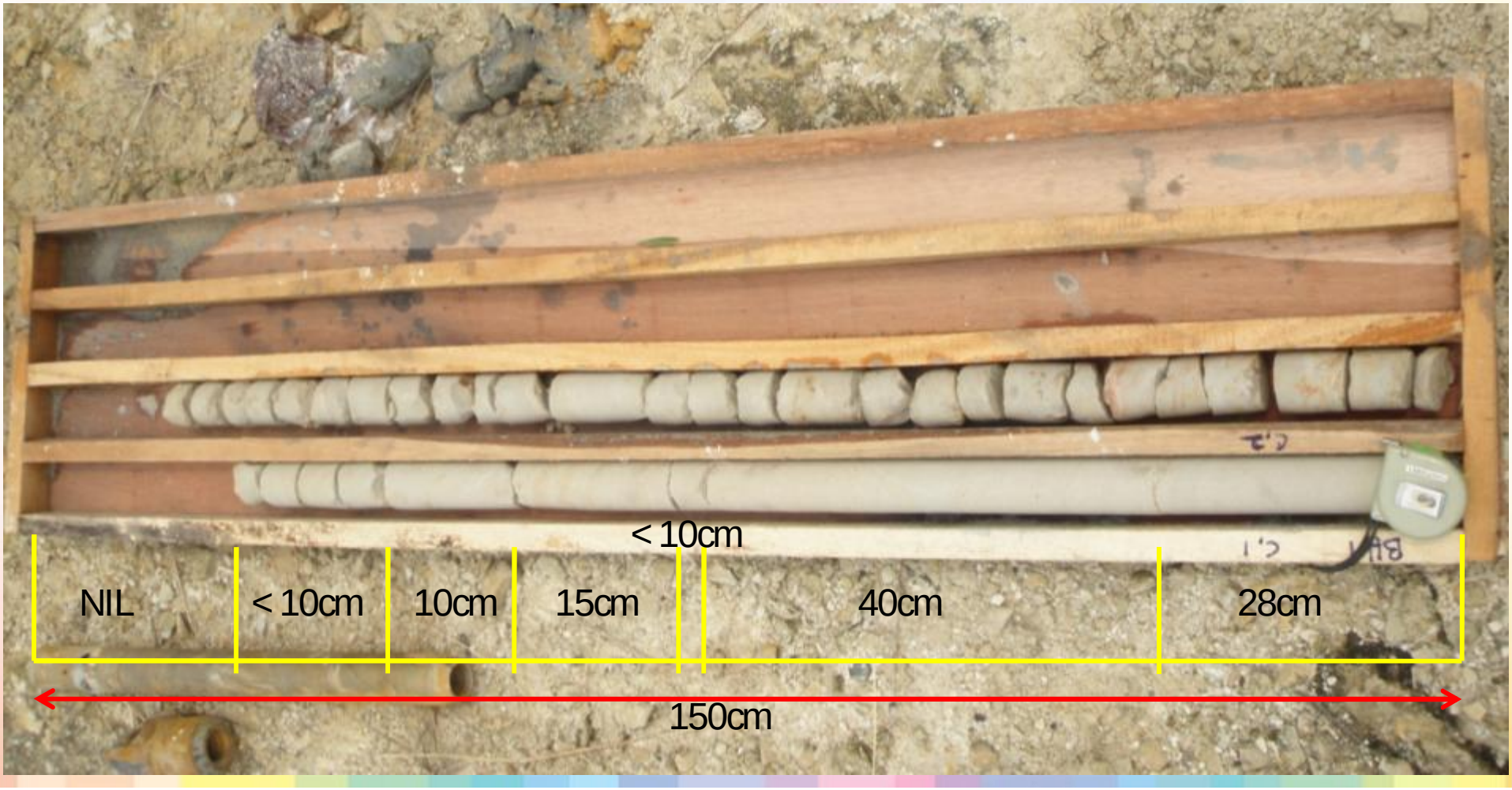
$$TCR = \left(\frac{l_{\text{sum of pieces}}}{l_{\text{tot core run}}} \right) \times 100\%$$

$l_{\text{sum of pieces}}$ = Sum of length of core pieces

$l_{\text{tot core run}}$ = Total length of core run

Try this

Calculate the RQD value of this sample?????



Answers

$$RQD = \left(\frac{l_{\text{sum of 100}}}{l_{\text{tot core run}}} \right) \times 100\,\%$$

$l_{\text{sum of 100}}$ = Sum of length of core sticks longer than 100 mm measured along the center line of the core

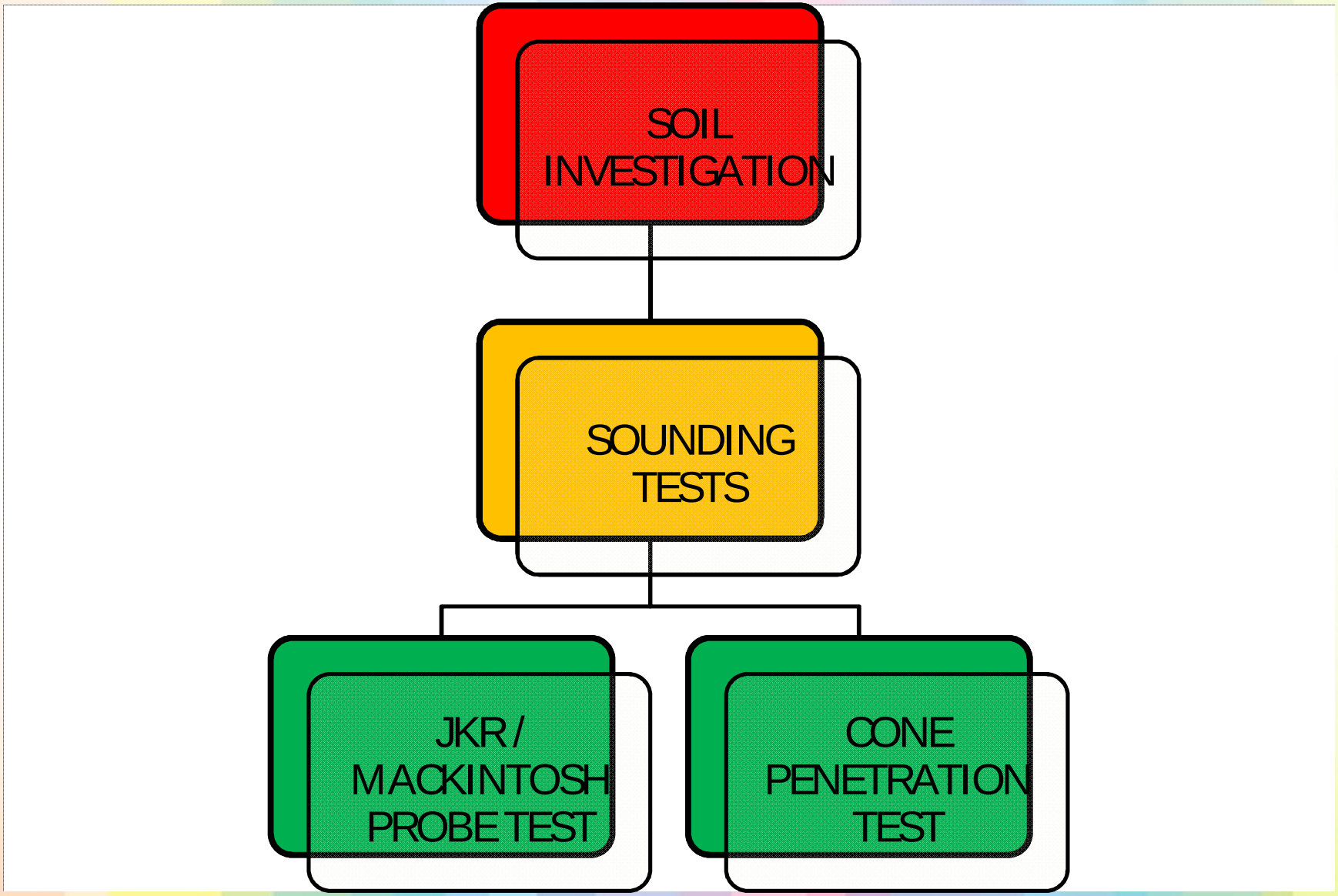
$l_{\text{tot core run}}$ = Total length of core run

RQD = $\frac{28+40+15+10}{150} \times 100$

= $\frac{93}{150} \times 100$

=62%, Rock mass quality = fair

JKR PROBE/ MACKINTOSH PROBE



OBJECTIVES OF JKR/MACKINTOSH PROBE

- Obtaining rough characteristics of surface conditions
- Preliminary tool to locate weak spots
- Can be used to determine the thickness of unsuitable material to be removed and also for preliminary design of embankments.
- Record no. of blows/ ft. then correlate to established chart to determine bearing capacity of soil.
- To check the consistency of the subsoil

JKR Probe

Hammer 5Kg

28cm

Rod 1.2m

Cone

WHAT ARE THE DIFFERENT BETWEEN JKR PROBE AND MACKINTOSH PROBE??

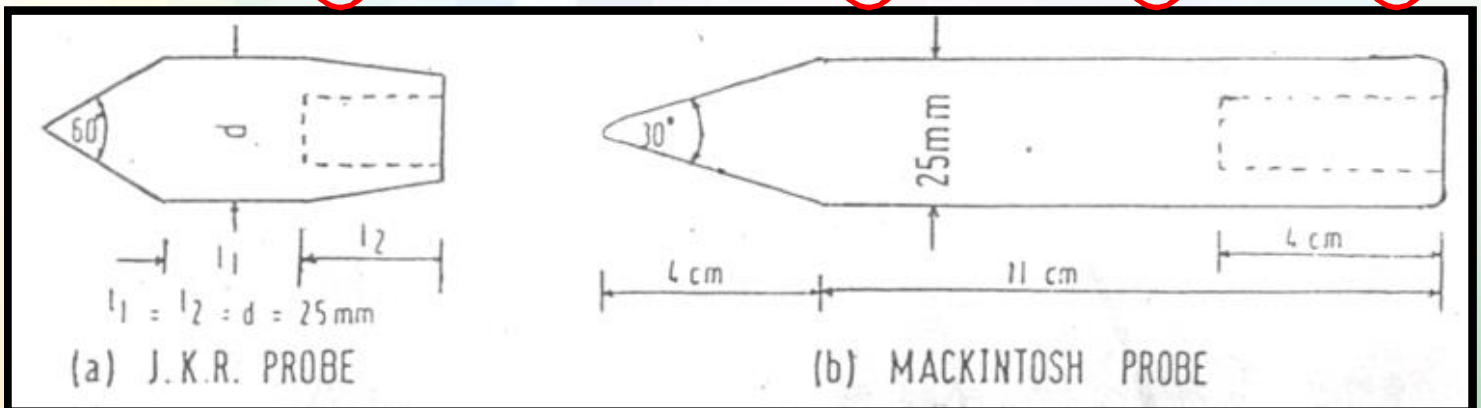
JKR PROBE VS MACKINTOSH PROBE

For practical application :

- ❖ Results of JKR Probe and Mackintosh Probe can be taken as equivalent.
- ❖ JKR Probe created as equivalent to Mackintosh Probe as Mackintosh Probe is patented in the early days.

Table compares the JKR and Mackintosh Probes

TYPE OF PENETROMETER	CONE		DIAMETER OF ROD (mm)	WEIGHT OF HAMMER (Kg)	HEIGHT OF FALL (cm)
	ANGLE	DIAMETER (mm)			
JKR	**60°**	**25**	**12**	**5**	**28**
MACKINTOSH	**30°**	**25**	**13**	**4.5**	**30**



Termination criteria

- Blows/ 300mm (maximum 400 blows/ 300mm)
- Recommended depth, 15 meters

Precautionary measures

- Free fall and consistent drop height
- Components and apparatus properly washed and oiled

Common Errors of JKR Probe / Mackintosh Probe

- Drop height less than 300mm resulting higher Blow counts
- Exerting force onto the hammer resulting in Lower blow count
- Penetration depth not marked correctly
- Wrong counting
- Driving bent rod giving more blow counts

Limitations of JKR Probe/ Mackintosh Probe

- Unable to penetrate hard layers and problems may arise when these hard layers are underlain by softer layers
- Unable to penetrate deeply into medium strength material and gravelly ground
- Not suitable to used in stony ground - pointer and rods would damaged
- Probing at great depth in the soft soil - wall may collapse; side friction on the rod is measured together with the resistance - results misleading

Example of JKR Probe Form

KUMPULAN IKRAM (SABAH) SDN. BHD.

Company No: 452918A

Slope Failure KM3.5 Jln Samunuh Kinoundusan, Ranau, Sabah (Jln Negari)

Penetration in meter	Position No. MP-4(L2)		Position No. MP-5(L2)			
	Date: 30/08/11	Remarks	Date: 30/08/11	Remarks		
	No of Blows		No of blows			
0.00	0		0			
0.00 - 0.30	55		49			
0.30 - 0.60	67		109			
0.60 - 0.90	70		139			
0.90 - 1.20	42		120			
1.20 - 1.50	59		291			
1.50 - 1.80	66		359			
1.80 - 2.10	95		480	10cm		
2.10 - 2.40	99					
2.40 - 2.70	187					
2.70 - 3.00	239					
3.00 - 3.30	369					
3.30 - 3.60	480	7cm				
3.60 - 3.90						
3.90 - 4.20						
4.20 - 4.50						
4.50 - 4.80						
4.80 - 5.10						
5.10 - 5.40						
5.40 - 5.70						
5.70 - 6.00						
6.00 - 6.30						

DRAFT

Supervisor : Albert Lee

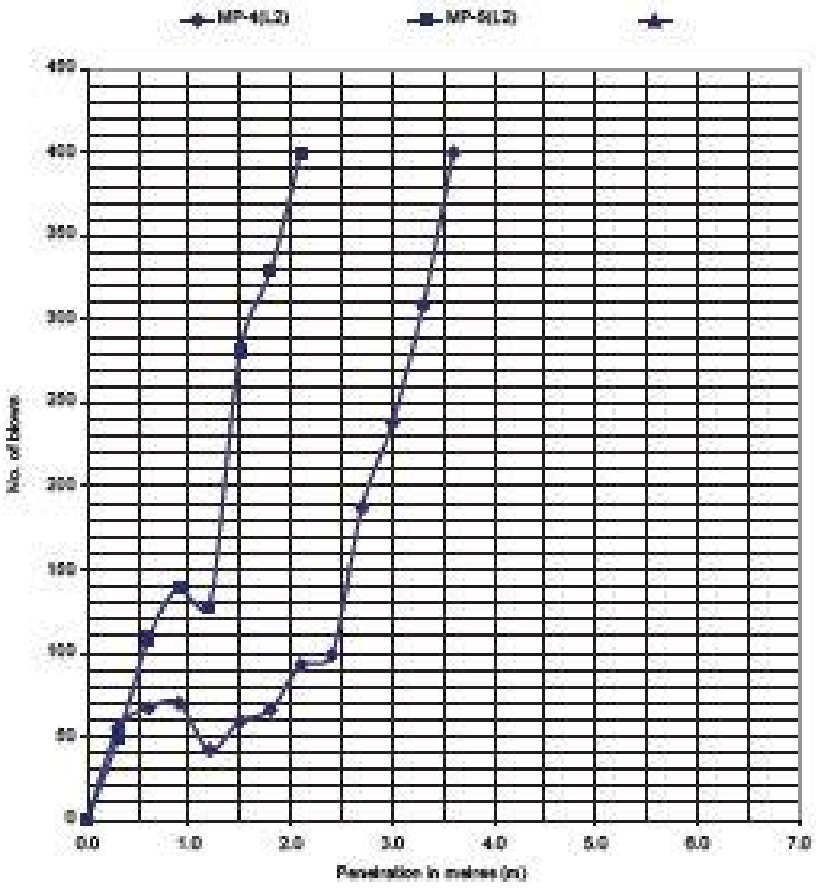


TABLE AND GRAPH CORELATION BETWEEN JKR PROBE & BEARING CAPACITY

BEARING CAPACITY AGAINST JKR PROBES

JKR Probes (Blows/Ft)	Soil Bearing Pressure TSF(Tons/Ft²)	PSF(Lbs/Ft²)	KPA(kN/m²)
0	0.004	9.986	0.48
2	0.048	106.973	5.12
4	0.093	207.888	9.95
6	0.139	311.807	14.93
8	0.187	417.922	20.01
10	0.235	525.539	25.16
12	0.283	634.069	30.36
14	0.332	743.028	35.58
16	0.380	852.031	40.80
18	0.429	960.786	46.00
20	0.477	1069.091	51.19
22	0.525	1176.832	56.35
24	0.573	1283.974	61.48
26	0.621	1390.559	66.58
28	0.668	1496.704	71.66
30	0.715	1602.592	76.73
32	0.763	1708.471	81.80
34	0.810	1814.647	86.89
36	0.858	1921.484	92.00
38	0.906	2029.393	97.17
40	0.955	2138.835	102.41
42	1.005	2250.311	107.74
44	1.056	2364.360	113.21
46	1.108	2481.555	118.82
48	1.162	2602.498	124.61
50	1.218	2727.814	130.61
52	1.276	2858.150	136.85
54	1.337	2994.168	143.36
56	1.400	3136.543	150.18
58	1.467	3285.954	157.33
60	1.537	3443.097	164.86
62	1.611	3608.022	172.75
64	1.689	3783.235	181.14
66	1.771	3967.594	189.97
68	1.858	4162.349	199.29
70	1.950	4368.431	209.16
72	2.047	4585.551	219.56
74	2.150	4815.788	230.58
76	2.258	5057.591	242.16
78	2.372	5313.373	254.40
80	2.492	5582.706	267.30
82	2.619	5866.514	280.89
84	2.752	6164.475	295.16
86	2.892	6477.512	310.14
88	3.038	6805.588	325.85
90	3.192	7149.506	342.32
92	3.352	7508.599	359.51
94	3.519	7882.531	377.42
96	3.693	8272.589	396.09
98	3.874	8678.480	415.53
100	4.062	9099.426	435.68

CORELATION BETWEEN JKR PROBE AND SPT N VALUE

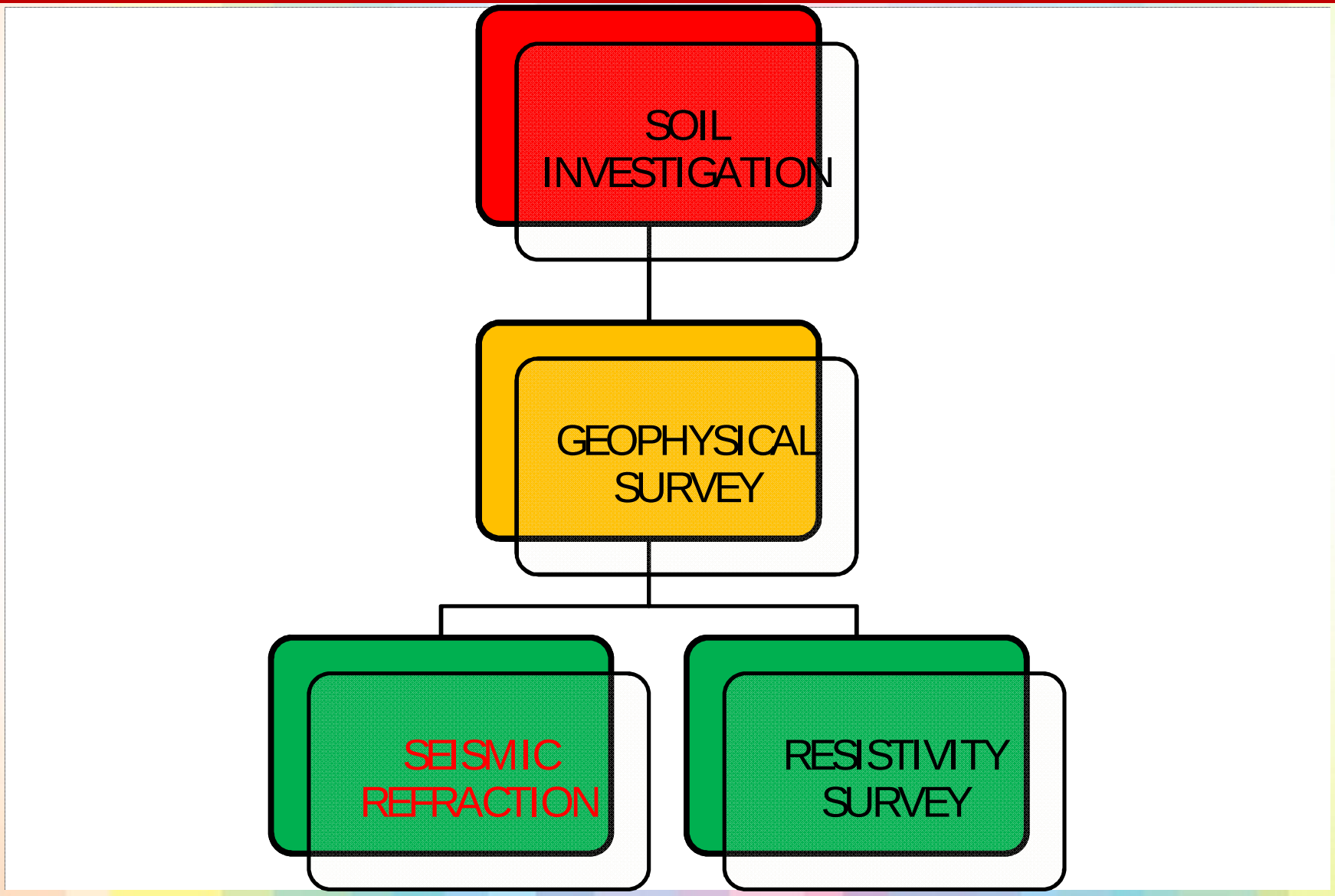
PROF. CHIN FUNG KEE

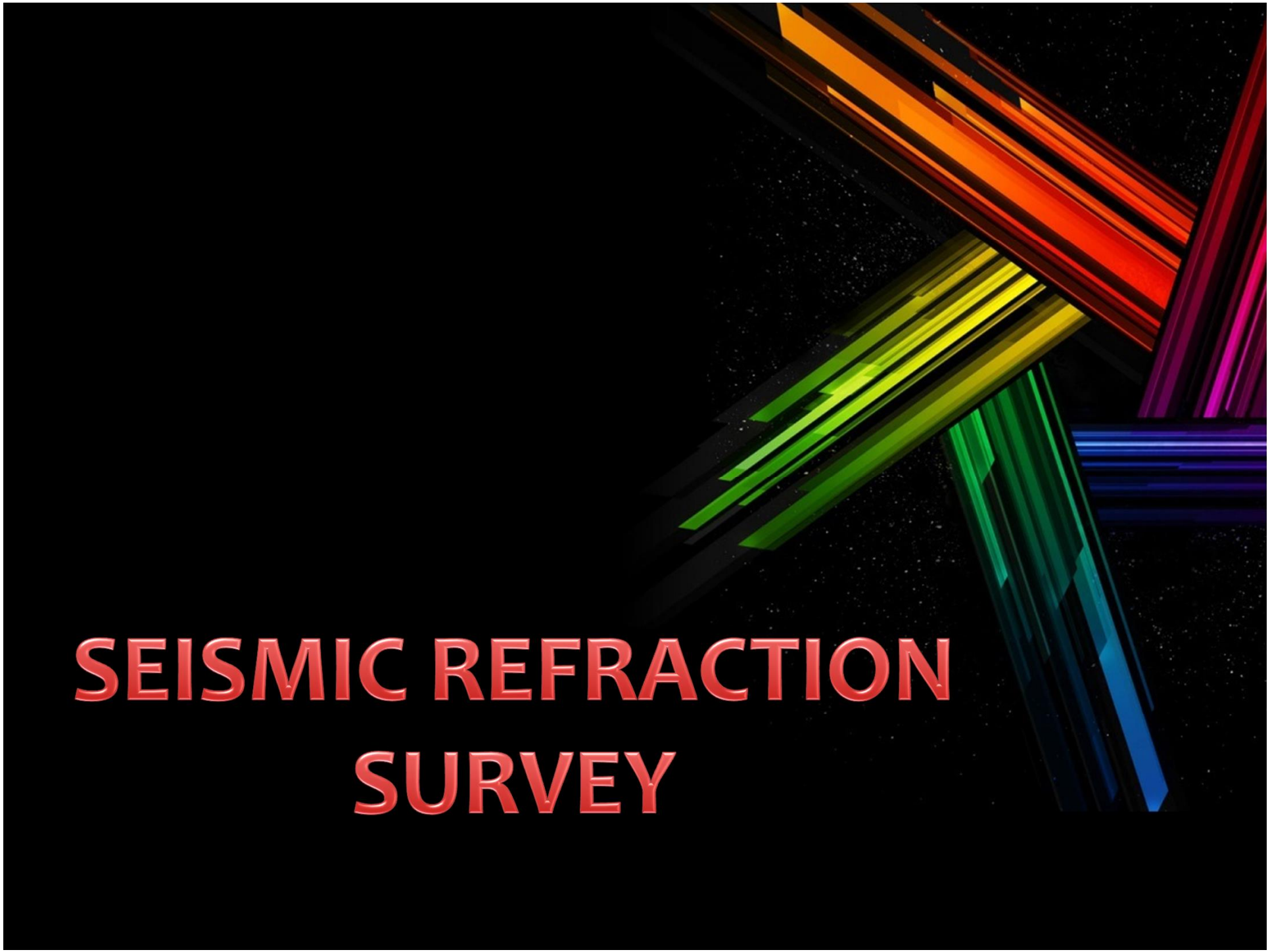
$$N = 0.091(M) + 1.8$$

N= SPT

M = MP BLOWS

SEISMIC REFRACTION SURVEY

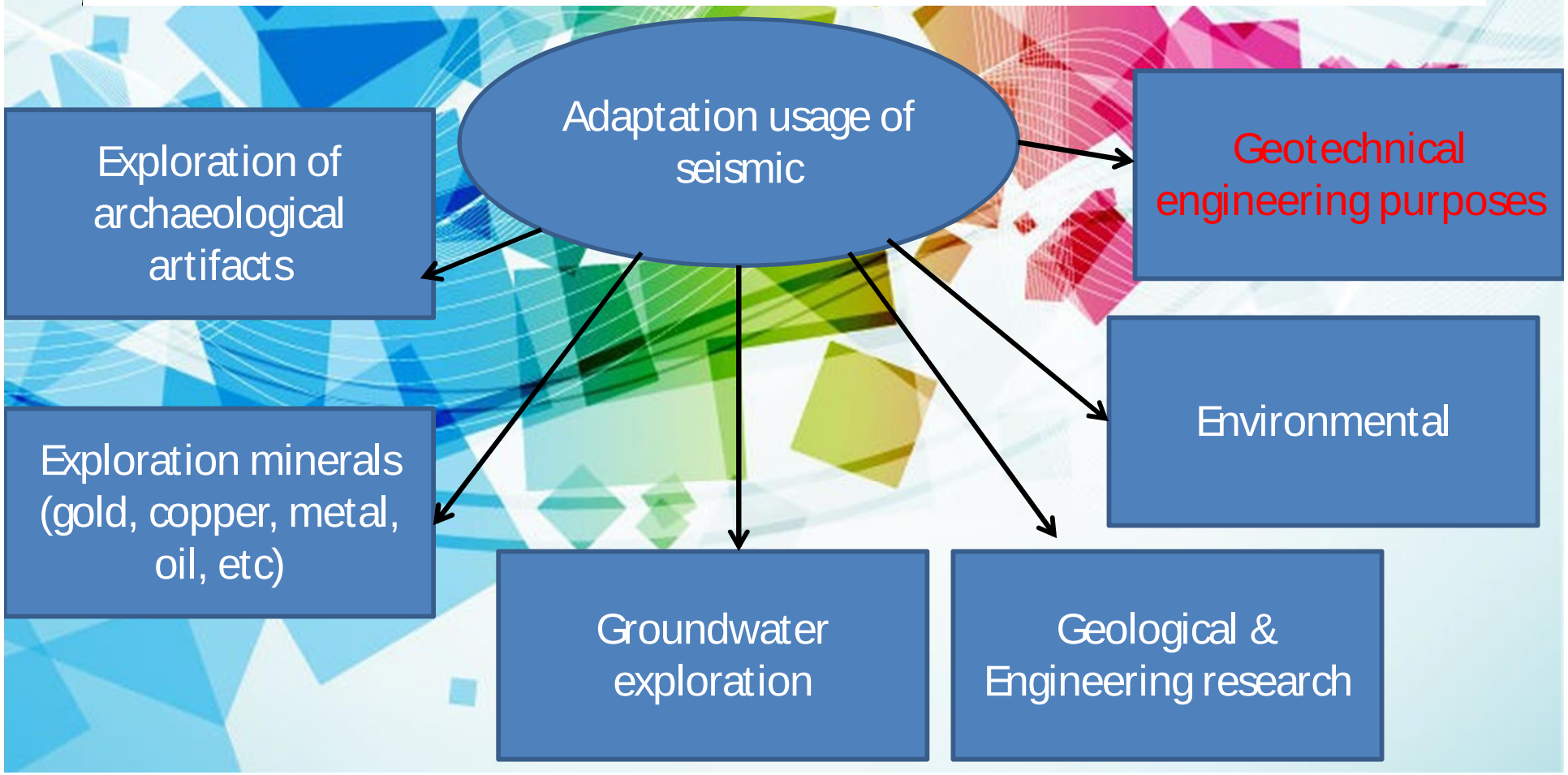



SEISMIC REFRACTION
SURVEY

INTRODUCTION

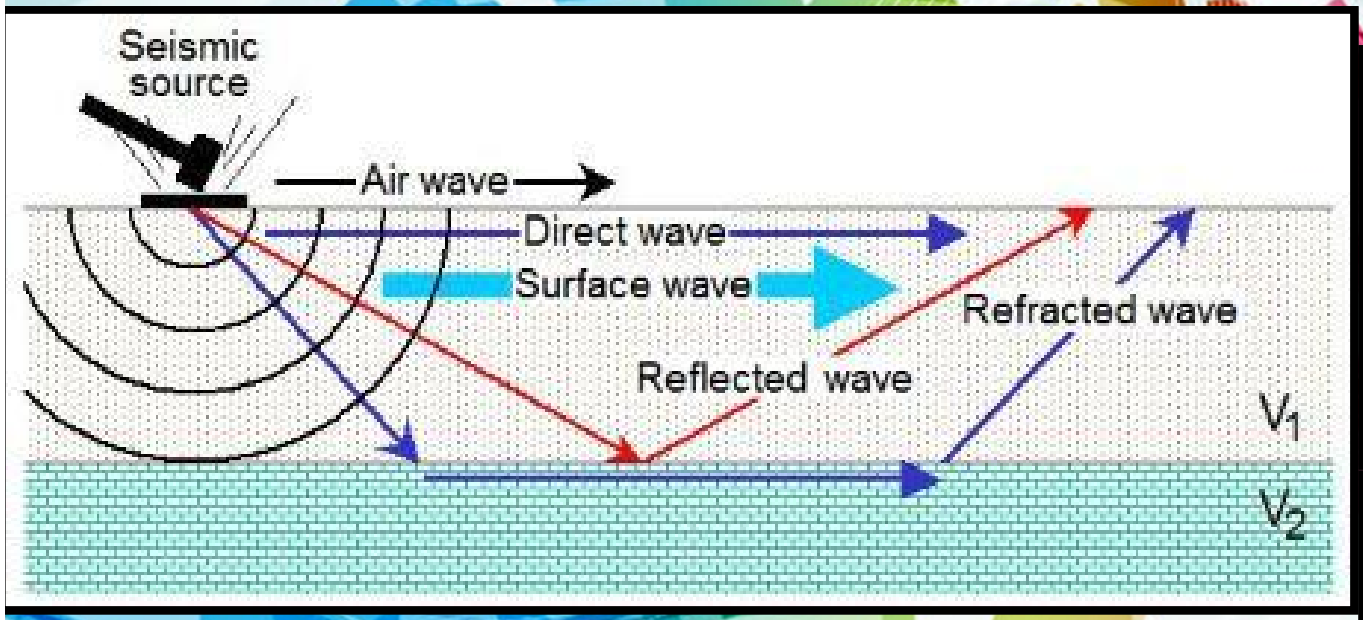
Seismic waves are waves of energy that through the earth, for example as a result of an earthquake, explosion or some other process that impacted ground.

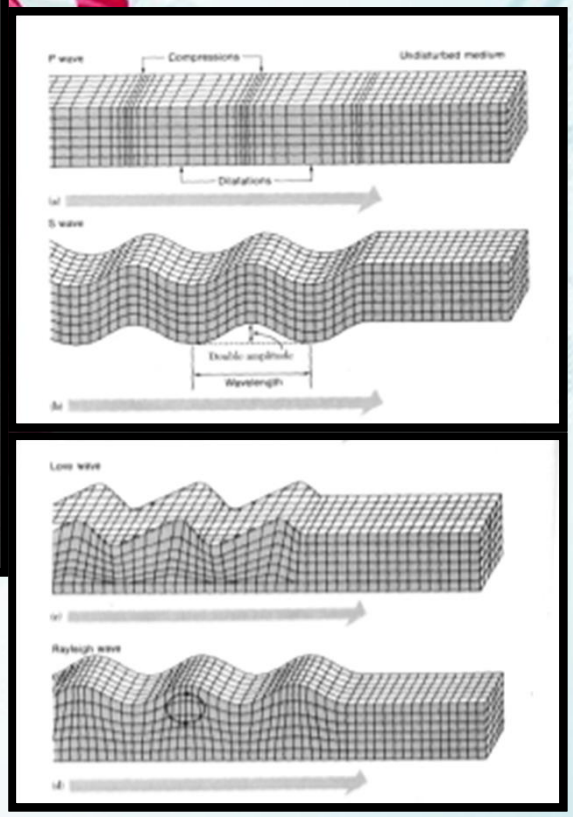
Waves that travel into the ground were reflected and refracted back to surface and in use for living adaptation.



Three type of seismic wave that travel into ground

1. Direct Wave
2. Reflected Wave
3. Refracted Wave





- In a seismic refraction study, refraction waves are to be use for interpretation.
- Seismic refraction provide clear differentiation of rock and soil boundary

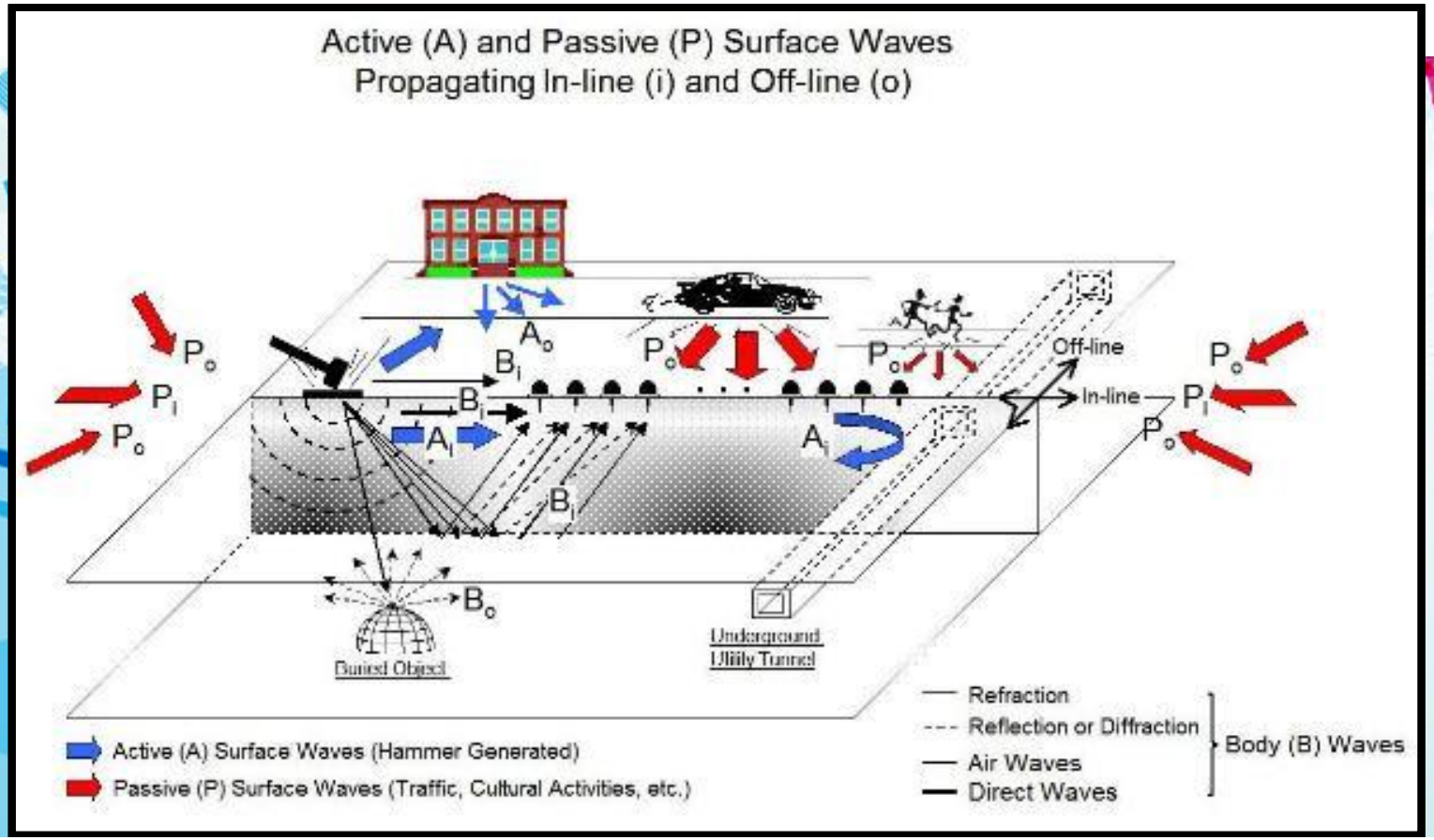
Waves that generated into ground

1. ACTIVE

   Waves that generated by source (Sledge Hammer, explosive, etc)

2. PASSIVE

   Waves that generated from surrounding environment



Seismic study consist of :

Survey

To determine and mark location of source and receiver

Source

Generate to released/produced energy(wave)

Examples: Hammer, vibroseis, explosive (dynamite)

Geophones

Detect seismic wave

Seismograph

Record and measure motions of the ground, including seismic wave.

Seismic Refraction Survey Method usually used in Geotechnical purposes

A seismic line consist of a series of 24 geophones with 12 on either side of geophones channel.

The geophones are laid down about 5m length to each others under sub-surface.

Shots will be performed about 7 times using sledgehammer which are divided into far shots for 2 times, end shots for 2 times ,intermediate shots for to 2 times and 1for middle shot.

Each of geophones will received signal/seismic wave that produced by sledgehammer(shot) and its recorded in the seismograph.

Layout of Geophones and Seismograph

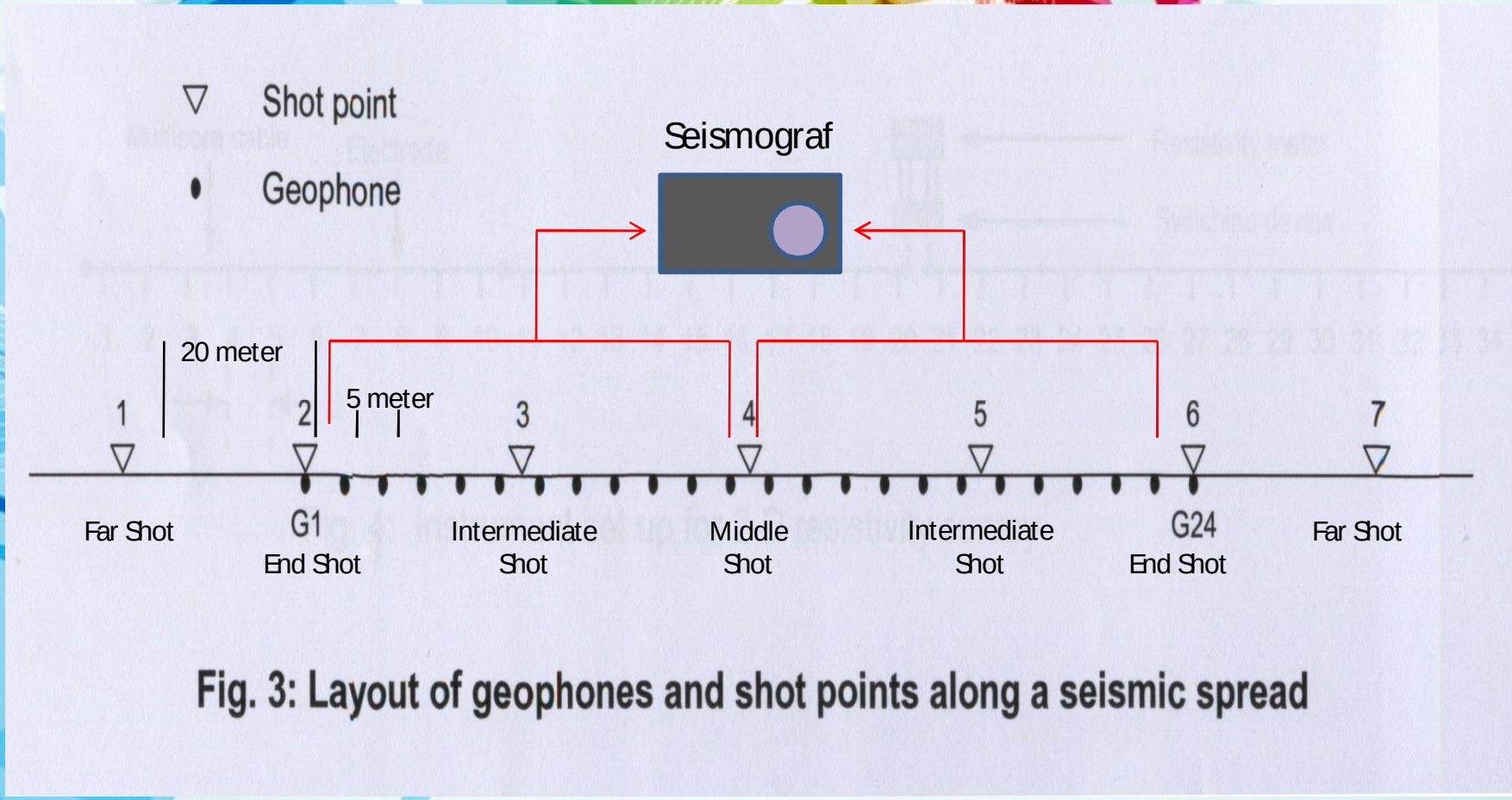
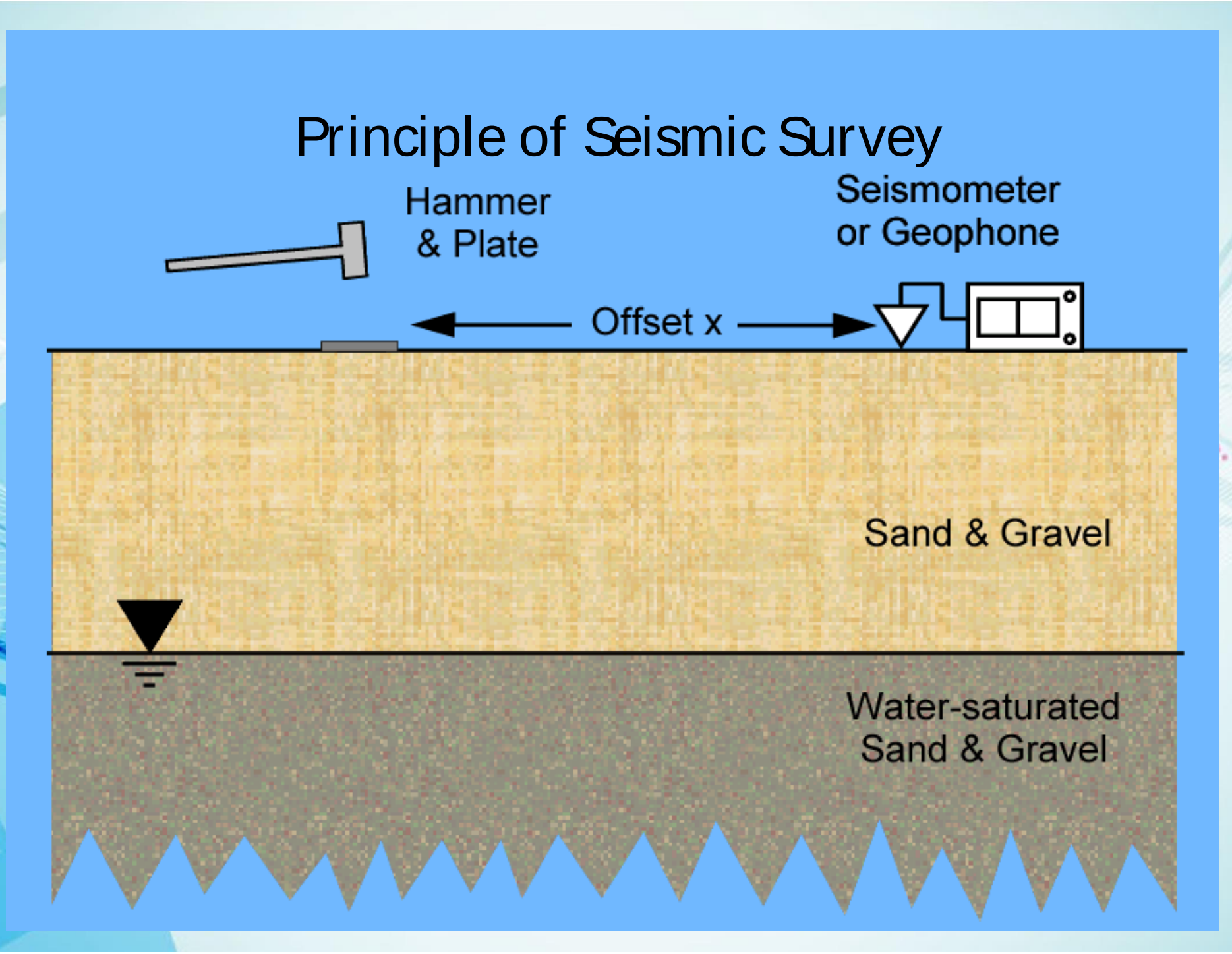
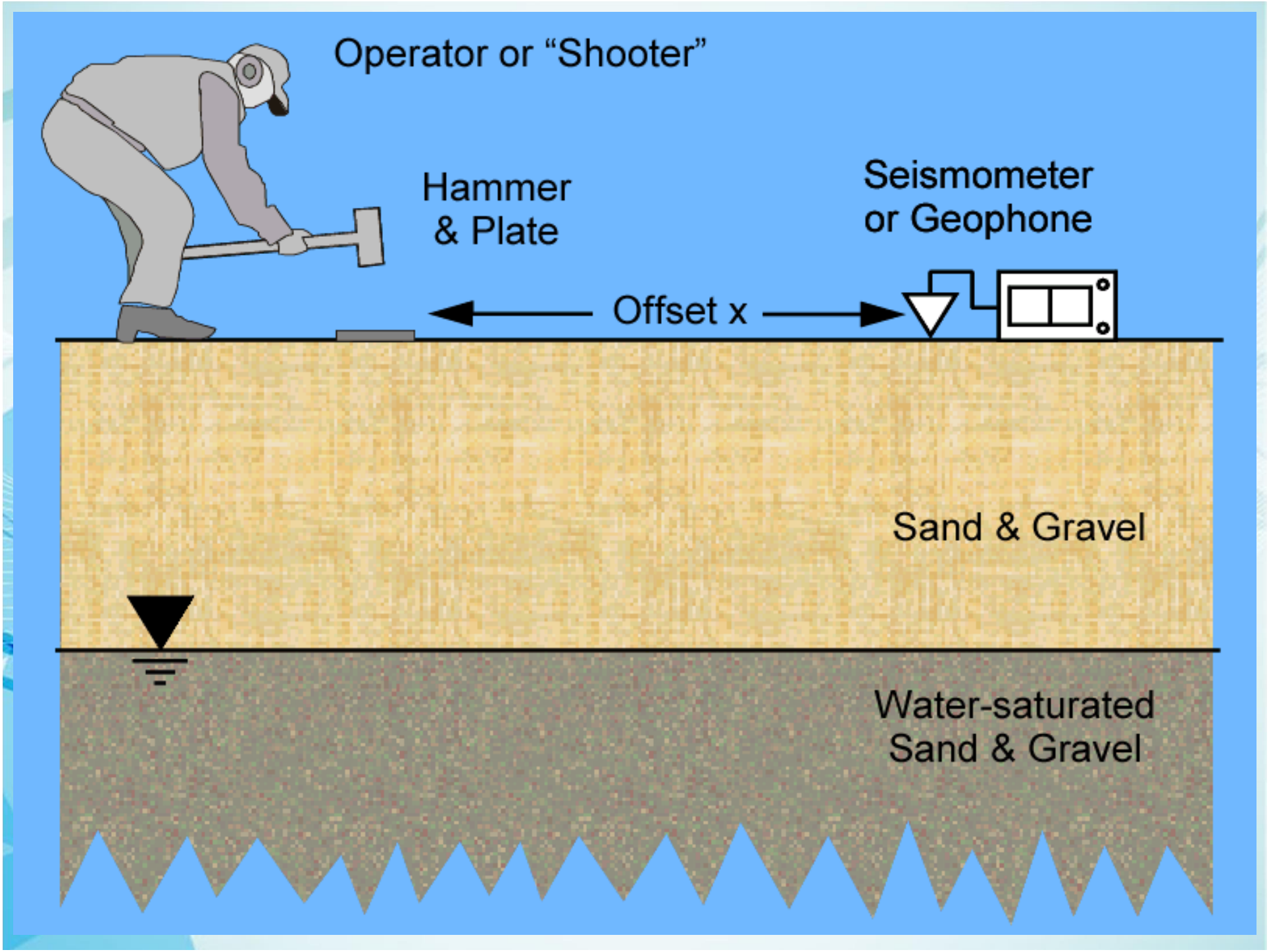
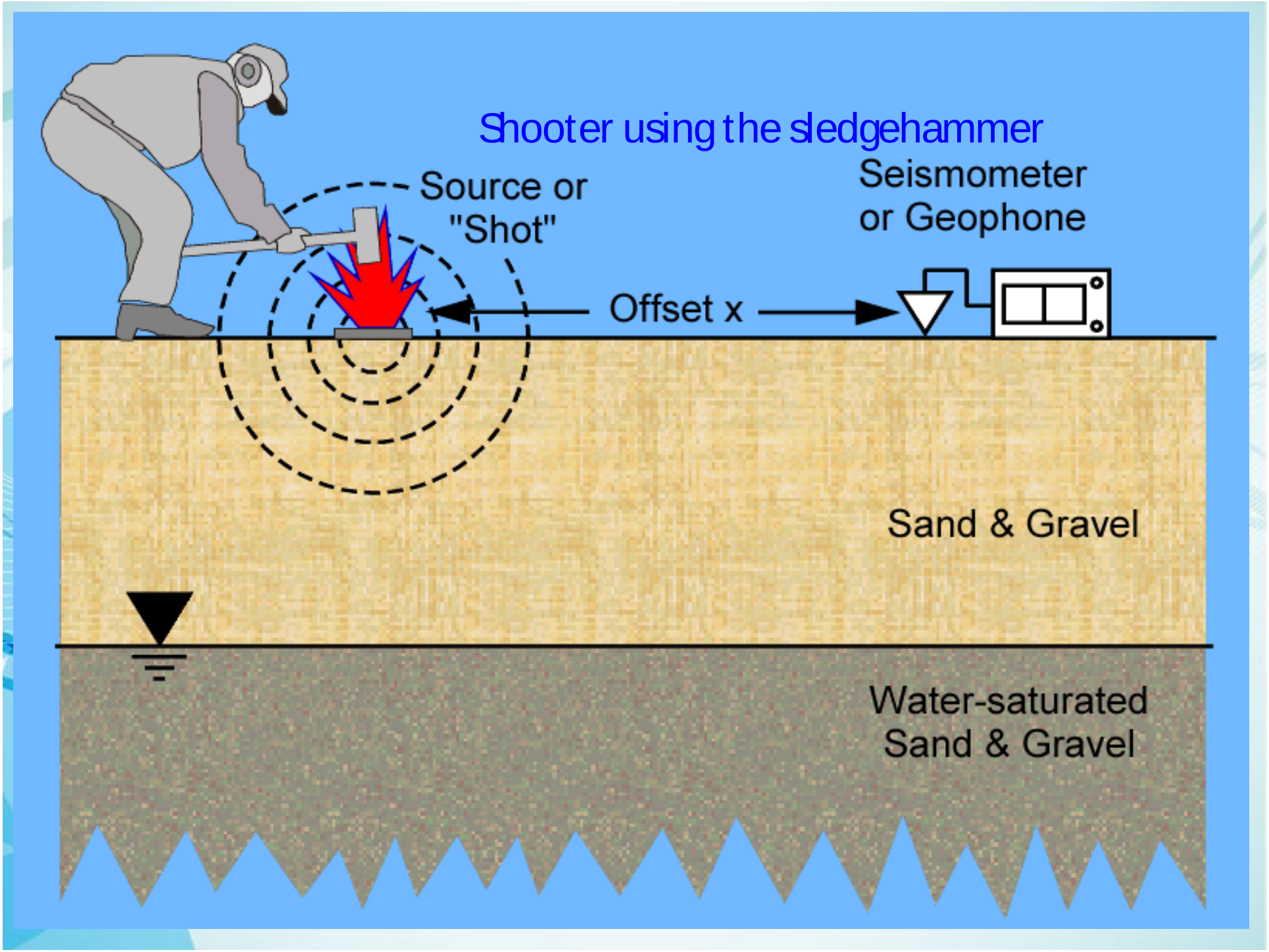
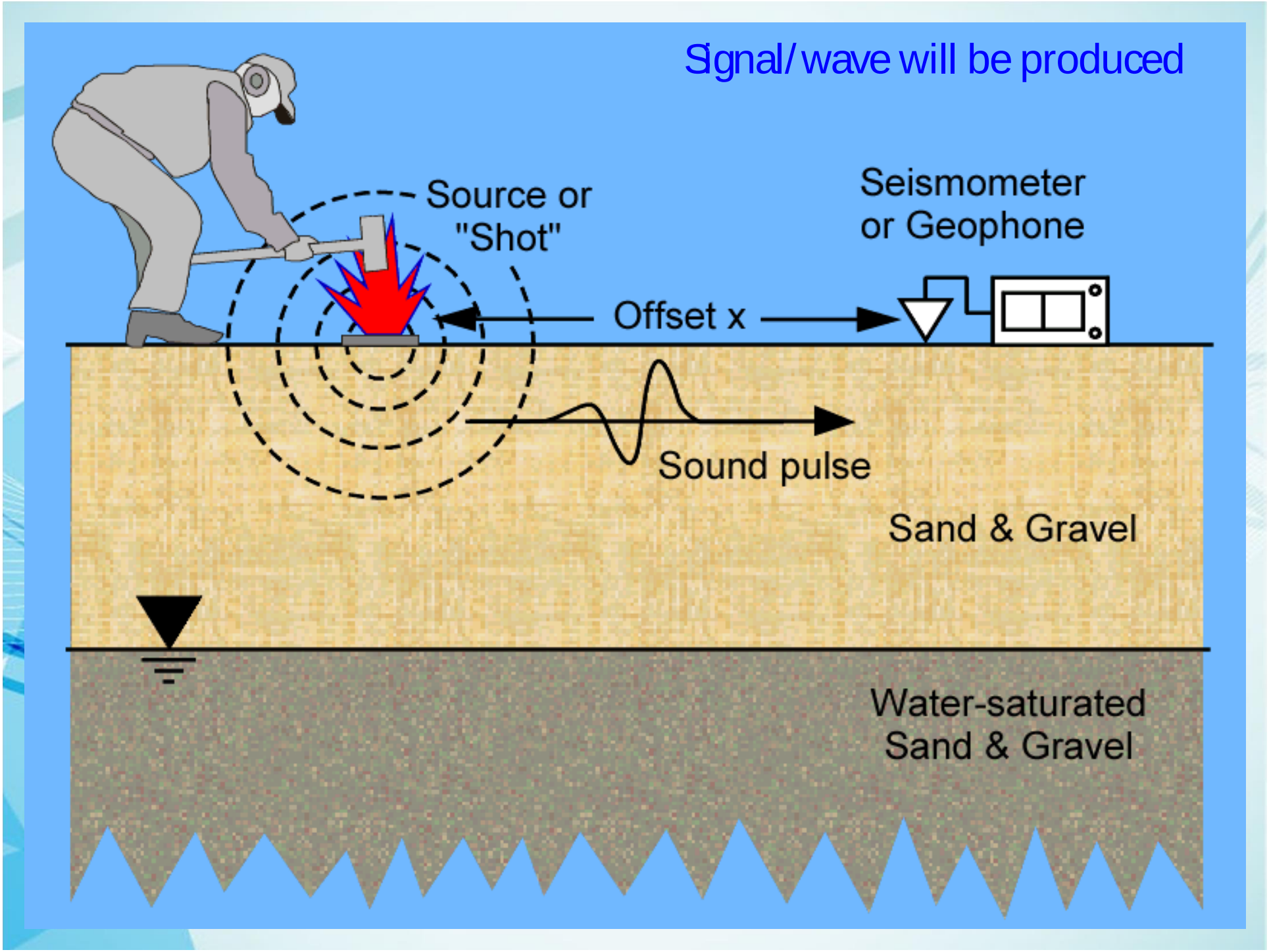


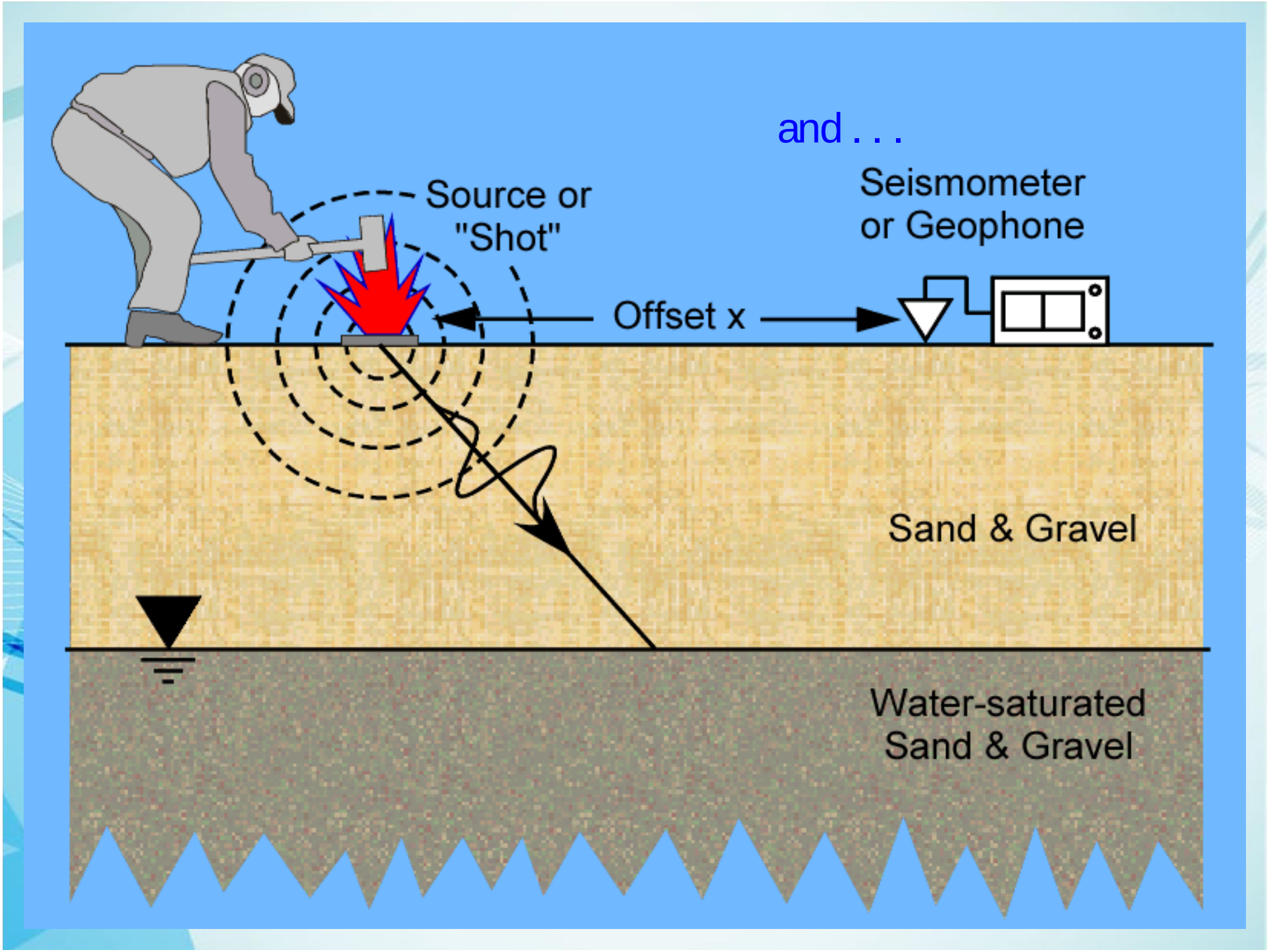
Fig. 3: Layout of geophones and shot points along a seismic spread

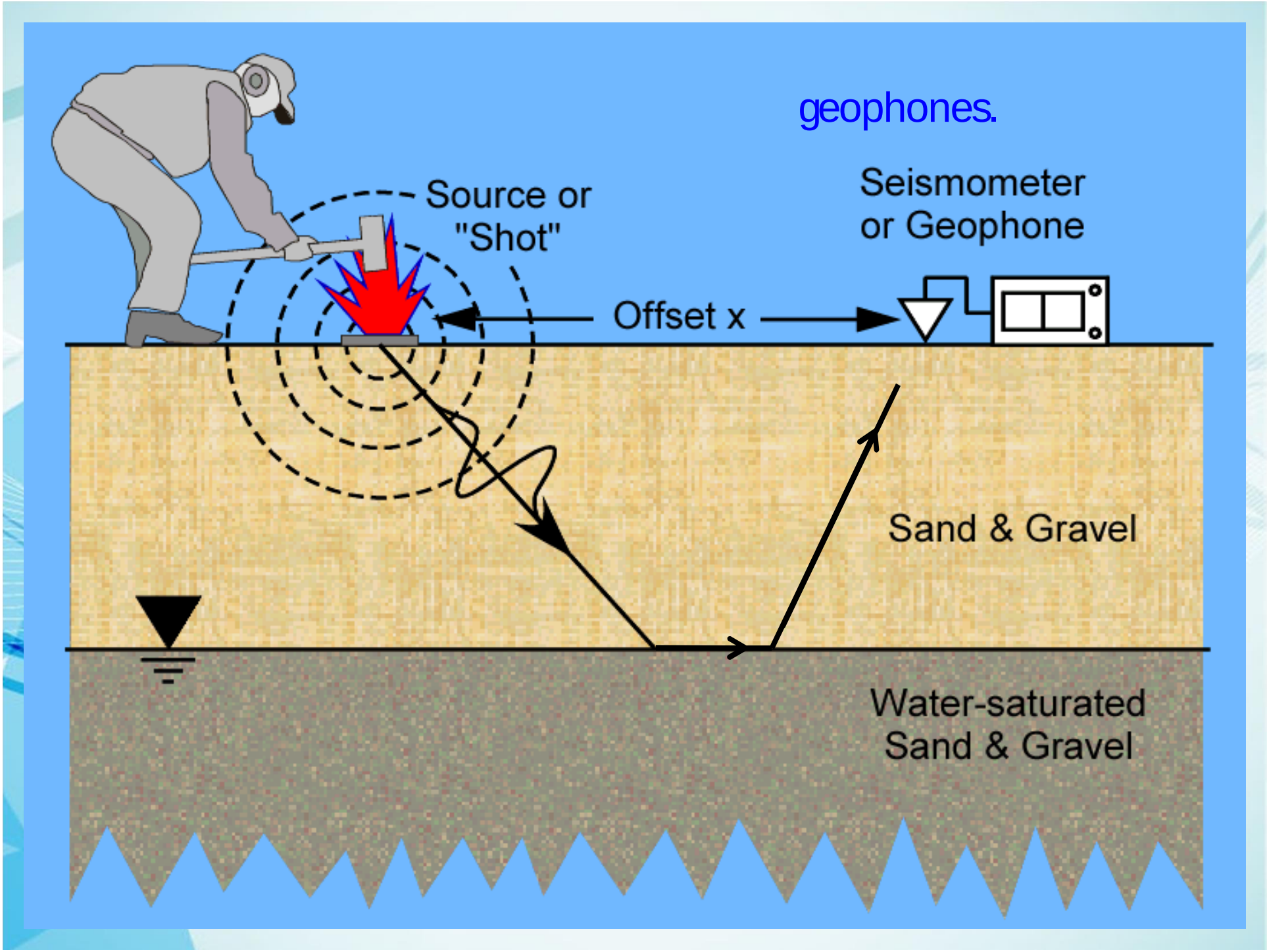

Principle of Seismic Survey
Hammer
& Plate
Seismometer
or Geophone
Offset x
Sand & Gravel
Water-saturated
Sand & Gravel

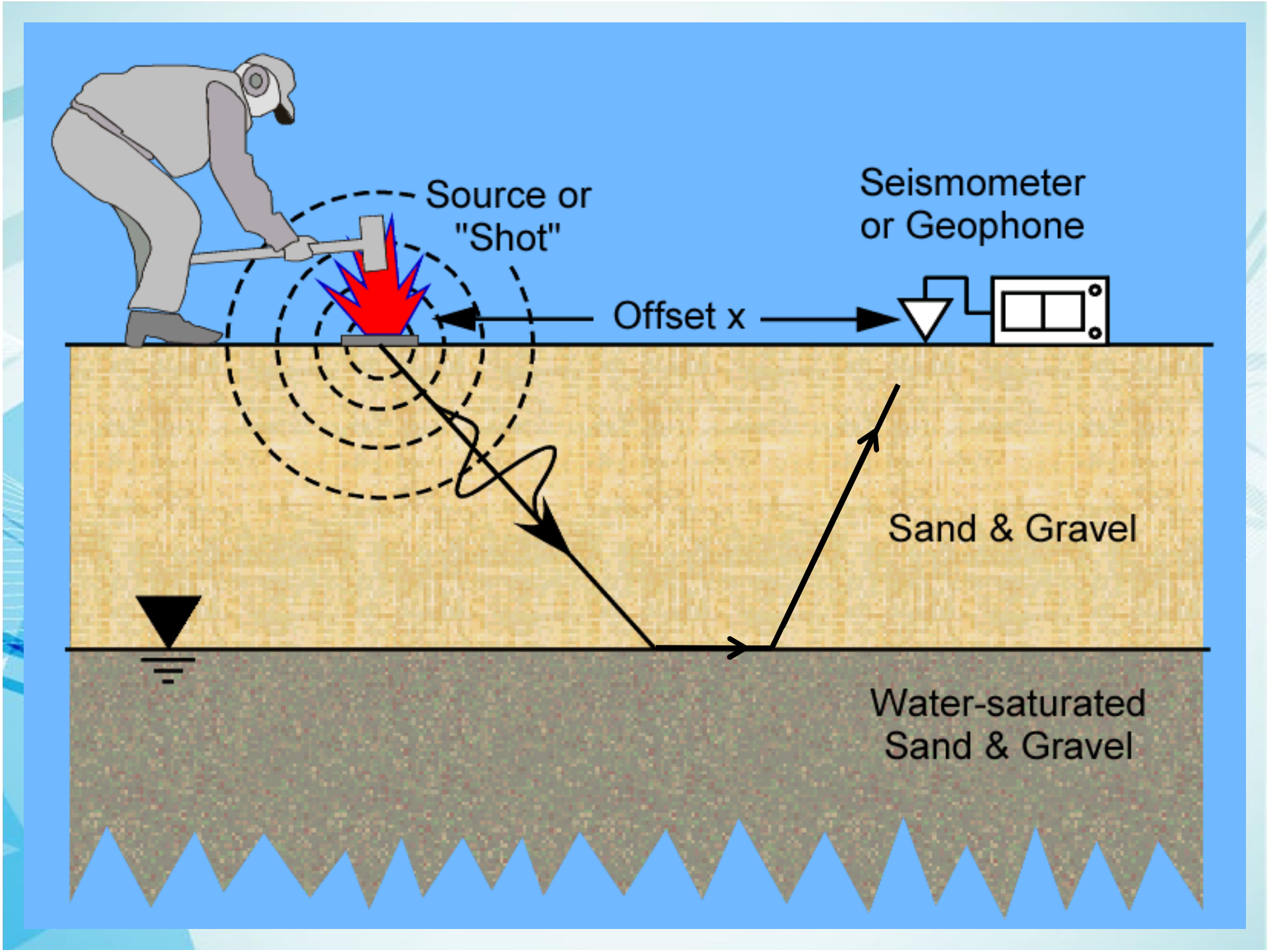

Operator or “Shooter”
Hammer
& Plate
Seismometer
or Geophone
Offset x
Sand & Gravel
Water-saturated
Sand & Gravel


Shooter using the sledgehammer
Source or
"Shot"
Seismometer
or Geophone
Offset x
Sand & Gravel
Water-saturated
Sand & Gravel

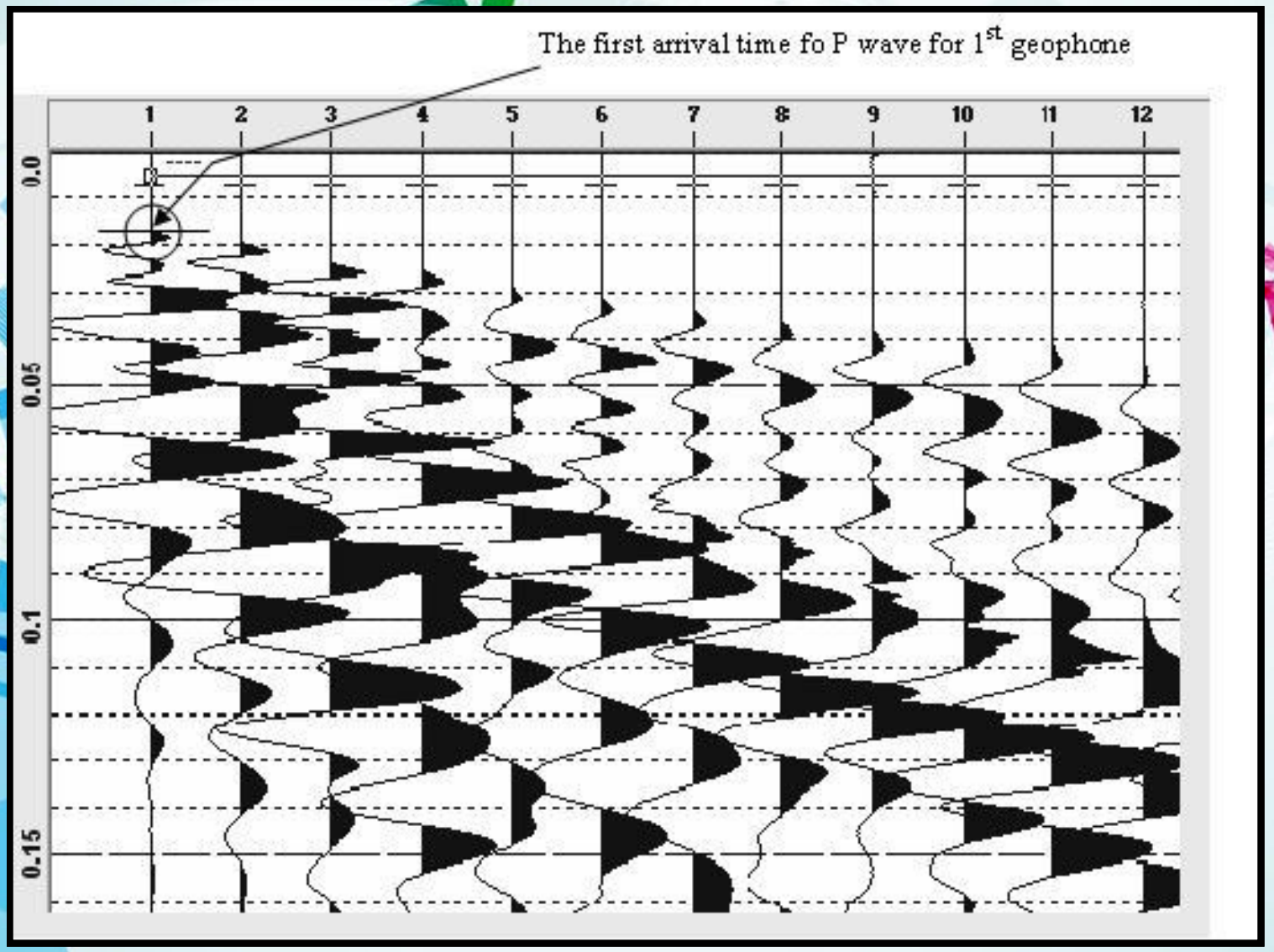

Signal/wave will be produced
Source or
"Shot"
Seismometer
or Geophone
Offset x
Sound pulse
Sand & Gravel
Water-saturated
Sand & Gravel


and . . .
Seismometer
or Geophone
Source or
"Shot"
Offset x
Sand & Gravel
Water-saturated
Sand & Gravel

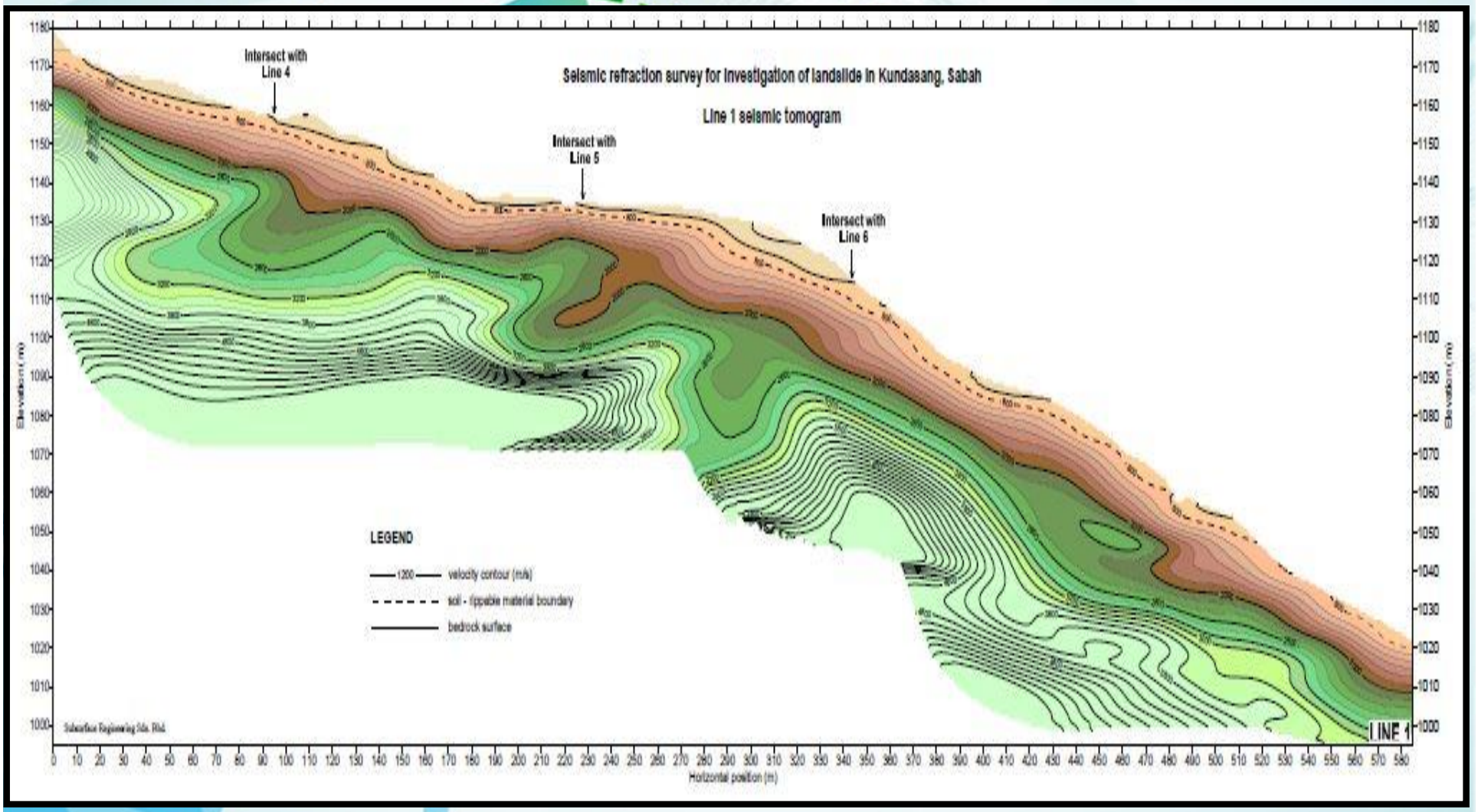

geophones.
Source or
"Shot"
Seismometer
or Geophone
Offset x
Sand & Gravel
Water-saturated
Sand & Gravel


Source or
"Shot"
Seismometer
or Geophone
Offset x
Sand & Gravel
Water-saturated
Sand & Gravel

Example of raw data:



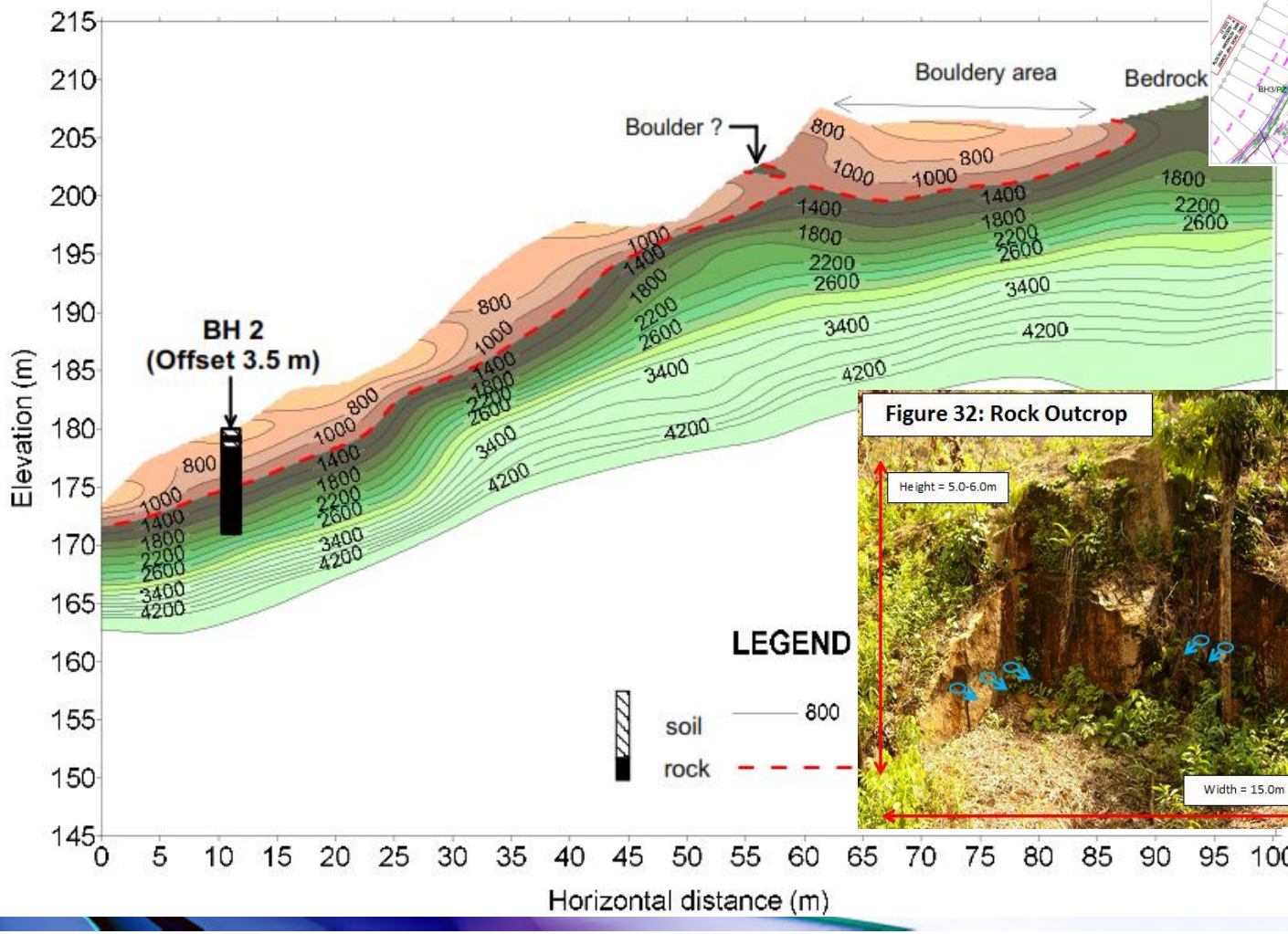
Example of interpreted data



Example of interpreted data

Seismic refraction survey di cerun runtuh di Taman Supreme, Kuala Lumpur

Line 3 seismic tomogram



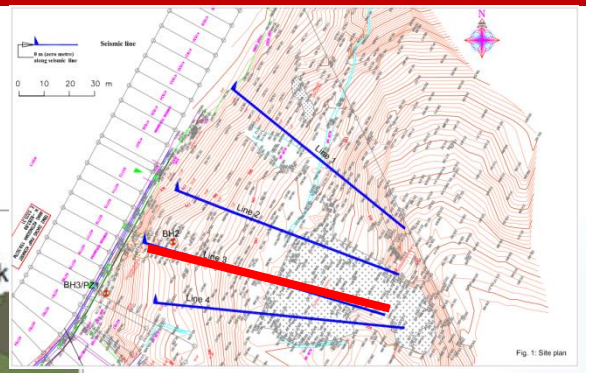


Figure 32: Rock Outcrop

Seismic Survey performed at site

What kind of equipment used in a seismic survey?

Seismograf

Geophone

sledgehammer

Table. Seismic Compressional Wave Velocities
(after Bonner and Schock, 1981) Velocity in m/s

Material	*Unsaturated*	*Water-saturated*
Sand	200-1000	900-2000
Sandy-gravel	400-600	900-1600
Clay	700-1200	1100-2500
Alluvium	400-900	1000-2000
Soil	320-450	1000-1800
Weathered bedrock	300-900	1200-1800
Granite	4200-5500	5000-6500
Basalt	5500-6200	
Sandstone	2500-5100	3000-5500
Limestone	3300-6200	
Metamorphic rocks	3000-6500	
Andesite	5000	
Shale	3700-5000	5300
Quartzite	3000-5400	

ADVANTAGES

Can detect both lateral and depth variations in a physically relevant parameter.

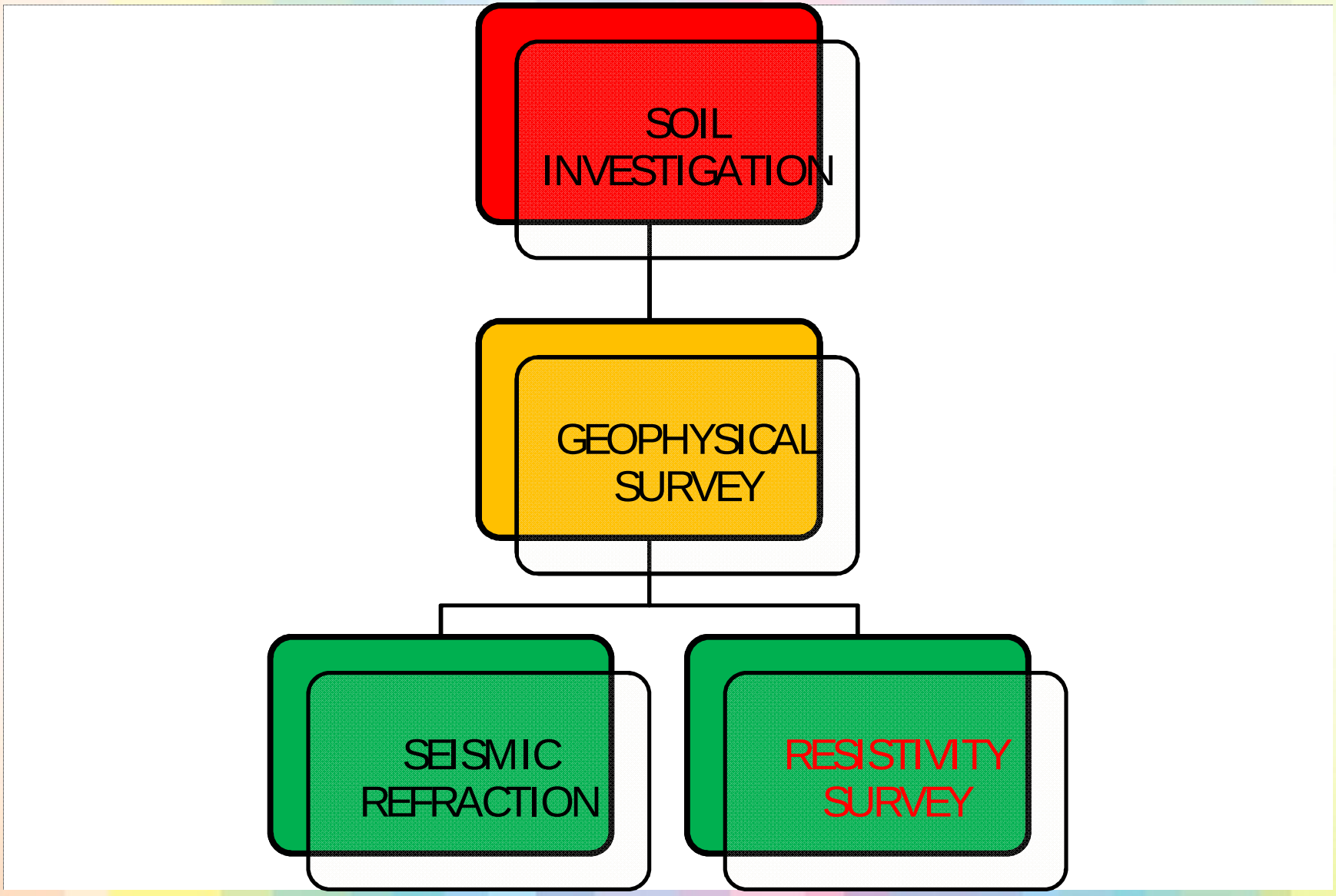
Can produce detail images of structural features present in the subsurface.

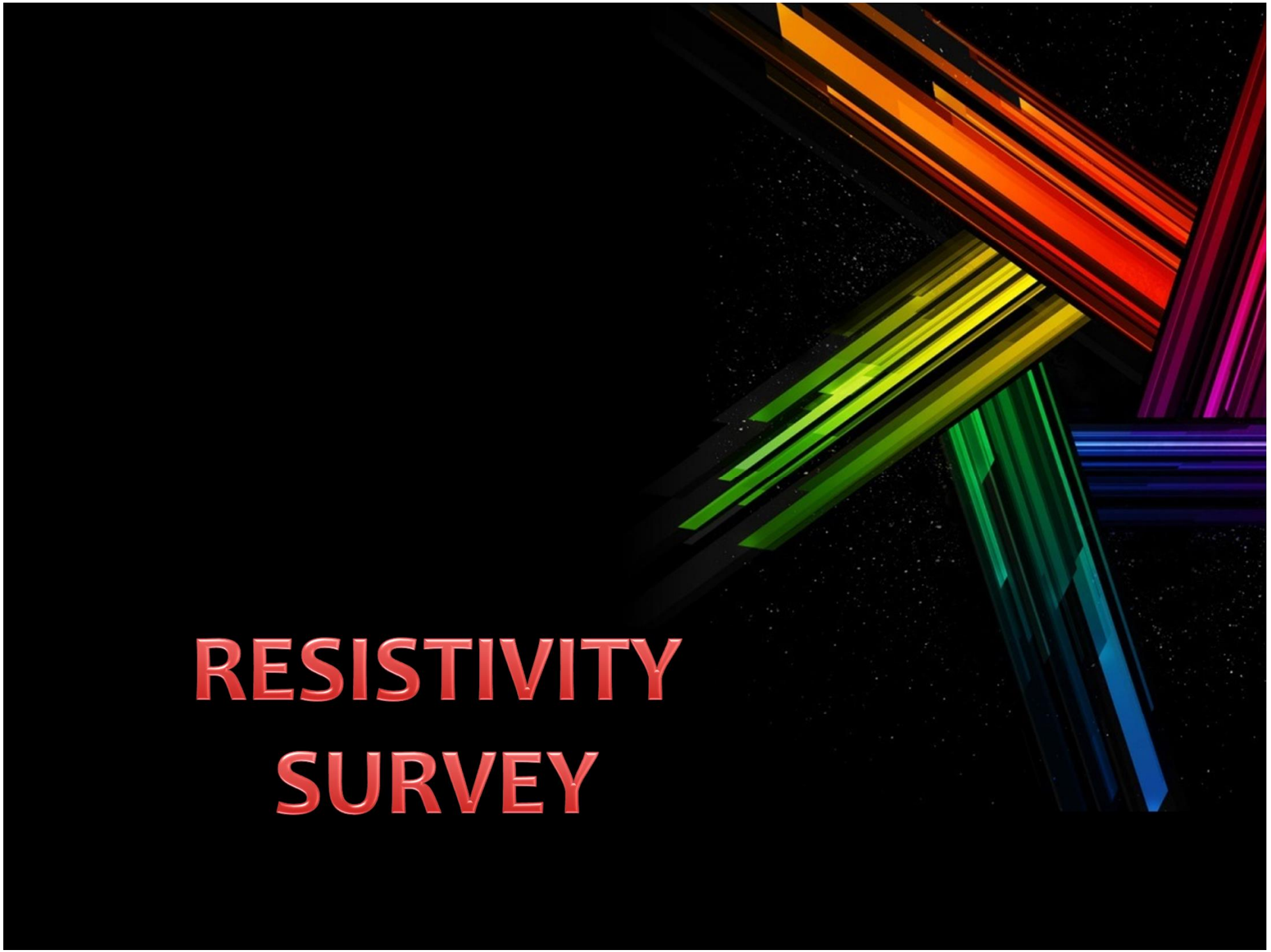
Can be use to delineate stratigraphic and depositional features.

DISADVANTAGES

- Amount of data collected in a survey can rapidly become overwhelming.
- Data is expensive to acquire and the logistics of data acquisition are more intense than other geophysical methods.
- Data reduction and processing can be time consuming, require sophisticated computer hardware, and demand considerable expertise.
- Direct detection of common contaminants present at levels commonly seen in hazardous waste spills is not possible.
- A low density layer underneath a high density layer could interfere the velocity value detected in a seismograph.

RESISTIVITY SURVEY




RESISTIVITY
SURVEY

INTRODUCTION

The purpose of resistivity survey is to determine the resistance rate underneath the earth surface.

The soil resistivity is related to numerous geological parameter such as amount of liquid and mineral content, porosity and degree of water saturation in the rock.

This survey have been used for many decades in hydrogeological, soil investigation and mining as well.

RESISTIVITY CONCEPT

The measurement of the resistance rate of subsurface is using the Wenner concept.

Basically, this concept is using 4 electrodes at the same time to get resistivity value.

The measurement of resistance are normally made by allowing the current flow through subsurface. The flowing current is then being measured. From the current and voltage value, resistivity can calculated.

RESISTIVITY CONCEPT

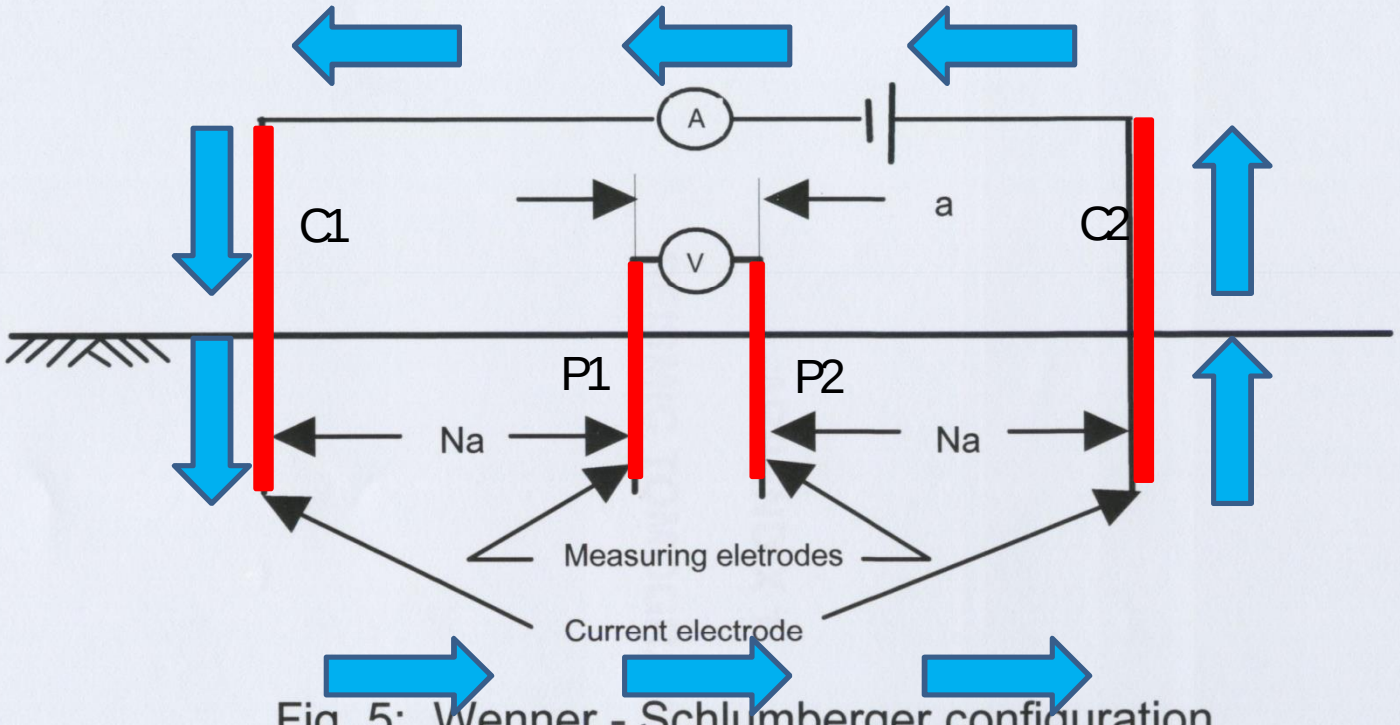


Fig. 5: Wenner - Schlumberger configuration

Electric Current

Electrodes

RESISTIVITY CONCEPT

FORMULA :

$$V = IR$$

Where V = Voltan (V)

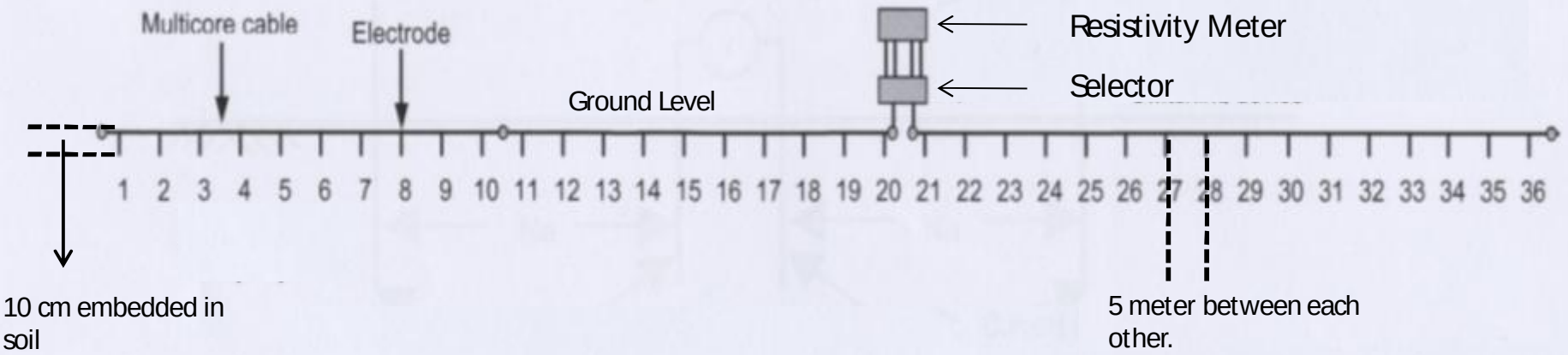
I = Current (A)

R = Resistance (Ohm)

PROCEDURE

1. The electrode embedded about 10cm in soil.
2. Each of electrode is located 5 meter each other and connected through cable to the selector. The selector is connected to resistivity meter.
3. The selector act as controller to these four electrode, known as C1, P1, P2, C2
4. Current will flow from C1 to C2.
5. The function of electrode P1 & P2 is to determine the resistance produce by the soil

2D RESISTIVITY SURVEY LAYOUT



CONCEPT OF RESISTIVITY

Resistance is inversely with current

The lower resistance value, the higher amount of current flow through it.

Water is a bad conductor, but, the underground water is the best electrical conductor.

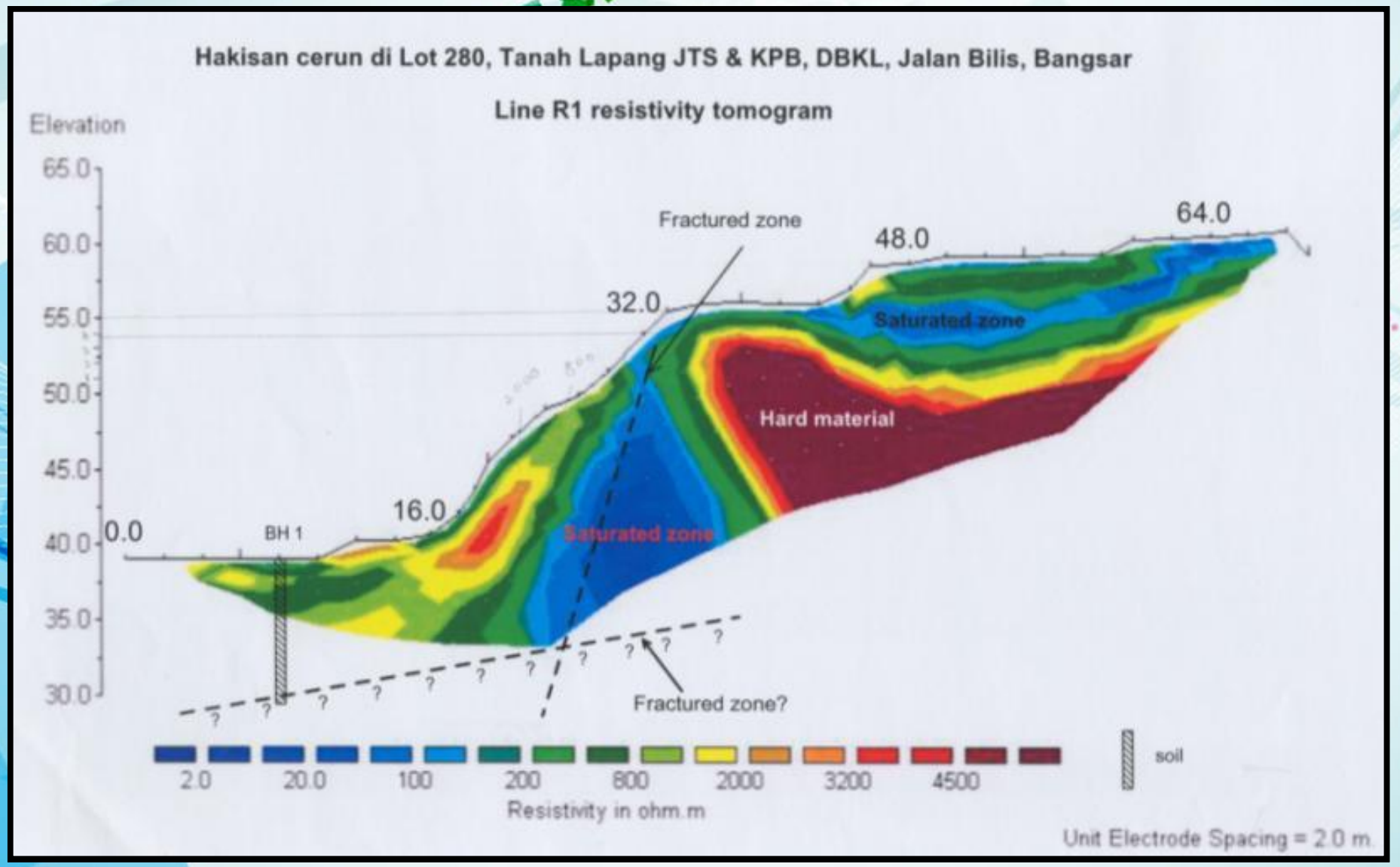
This is because the underground water contain dissolved minerals.

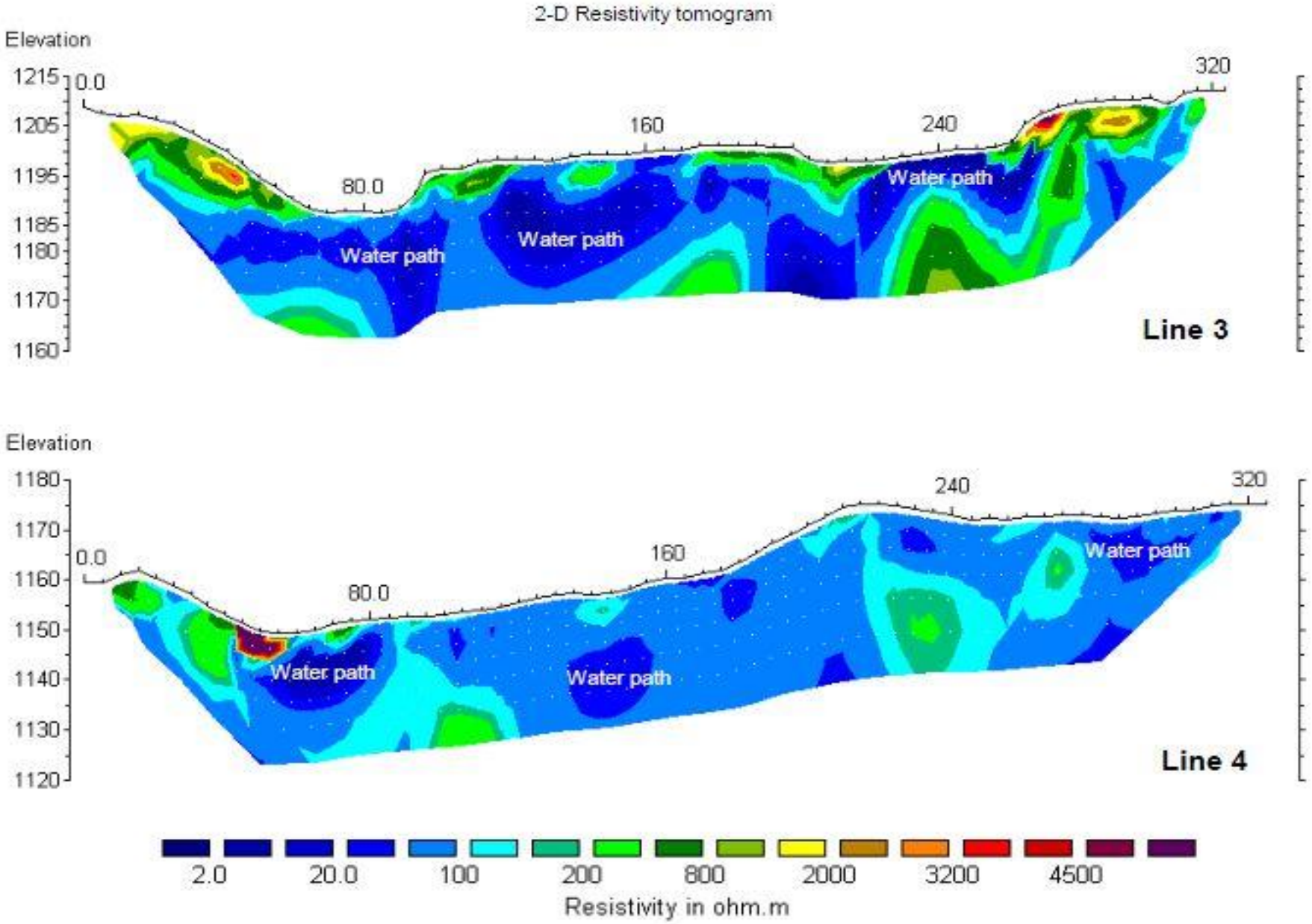
These mineral make underground water the best conductor.

The lower reading of resistance show that the area is saturated.

Meanwhile, a higher reading of resistance means the layer is dry and hard.

EXAMPLE OF RESISTIVITY RESULT

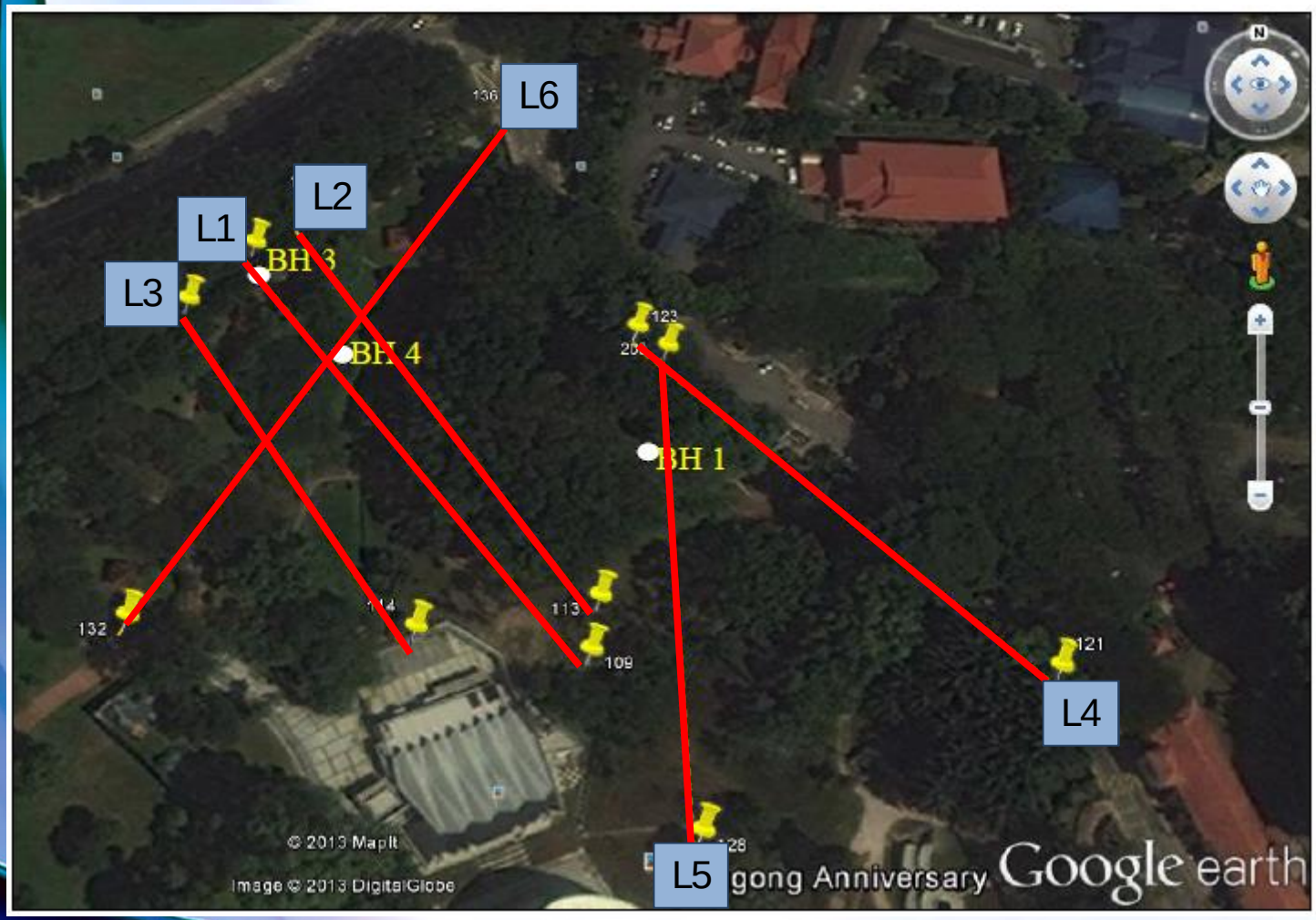



2-D Resistivity tomogram
Elevation
1215
1205
1195
1185
1180
1170
1160
0.0
80.0
160
240
320
Water path
Water path
Water path
Line 3
Elevation
1180
1170
1160
1150
1140
1130
1120
0.0
80.0
160
240
320
Water path
Water path
Water path
Line 4
2.0
20.0
100
200
800
2000
3200
4500
Resistivity in ohm.m

EXAMPLE OF 3D RESISTIVITY MODELING

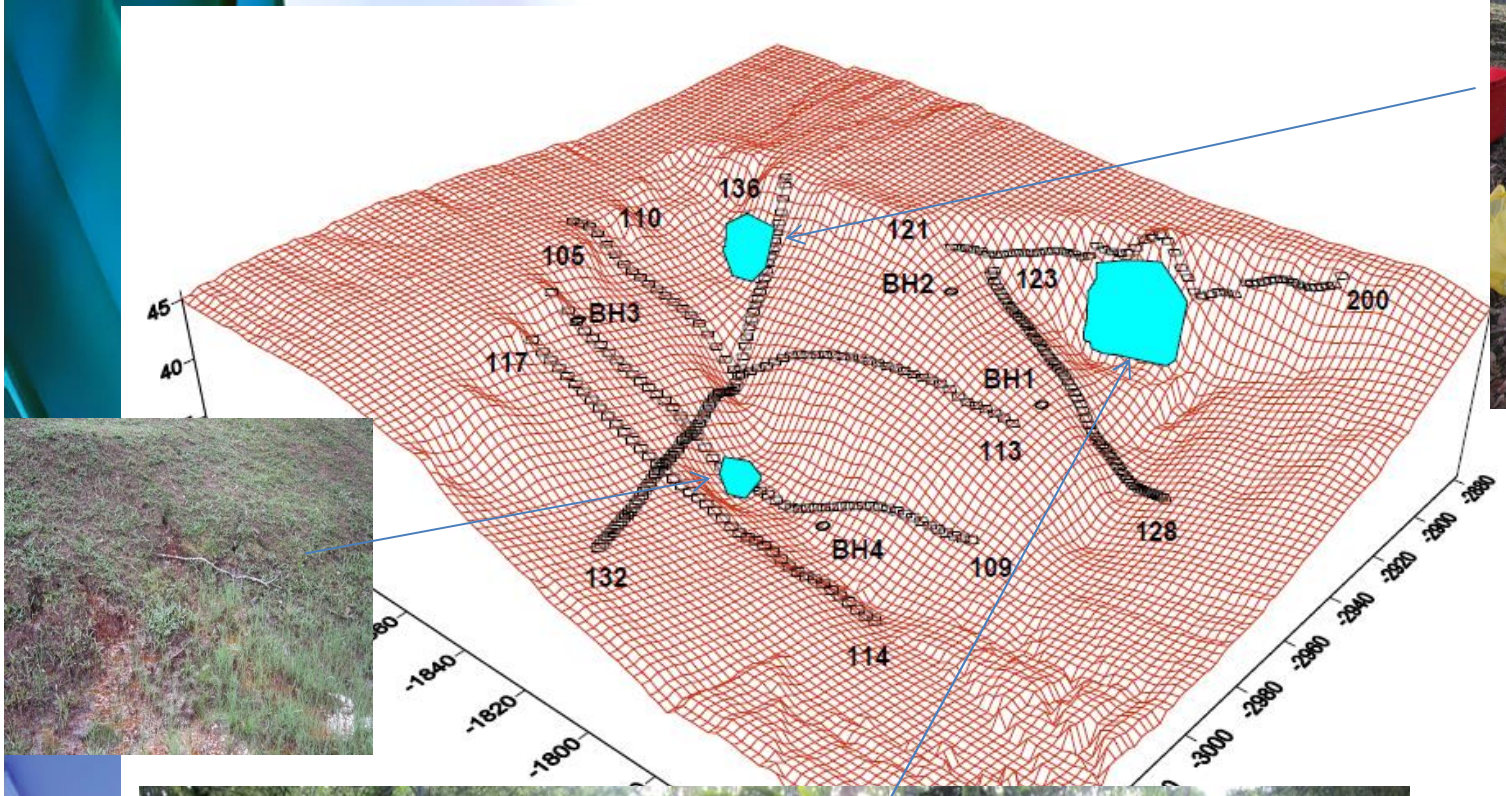
Resistivity Survey Lines,
3D Resistivity Modeling
Site Photos

Location of resistivity survey lines and boreholes

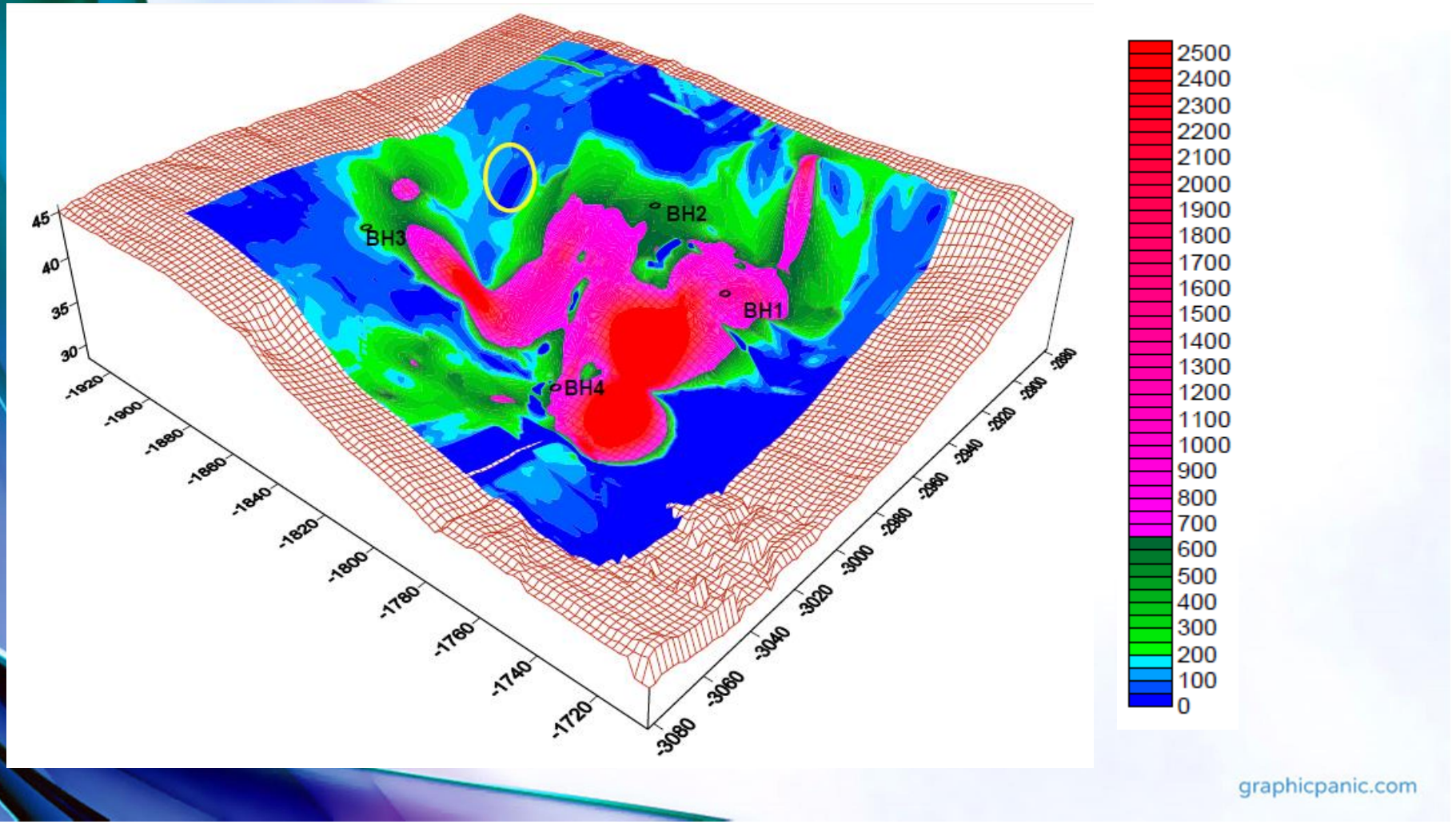


PHOTOS OF RESISTIVITY SURVEY WORKS

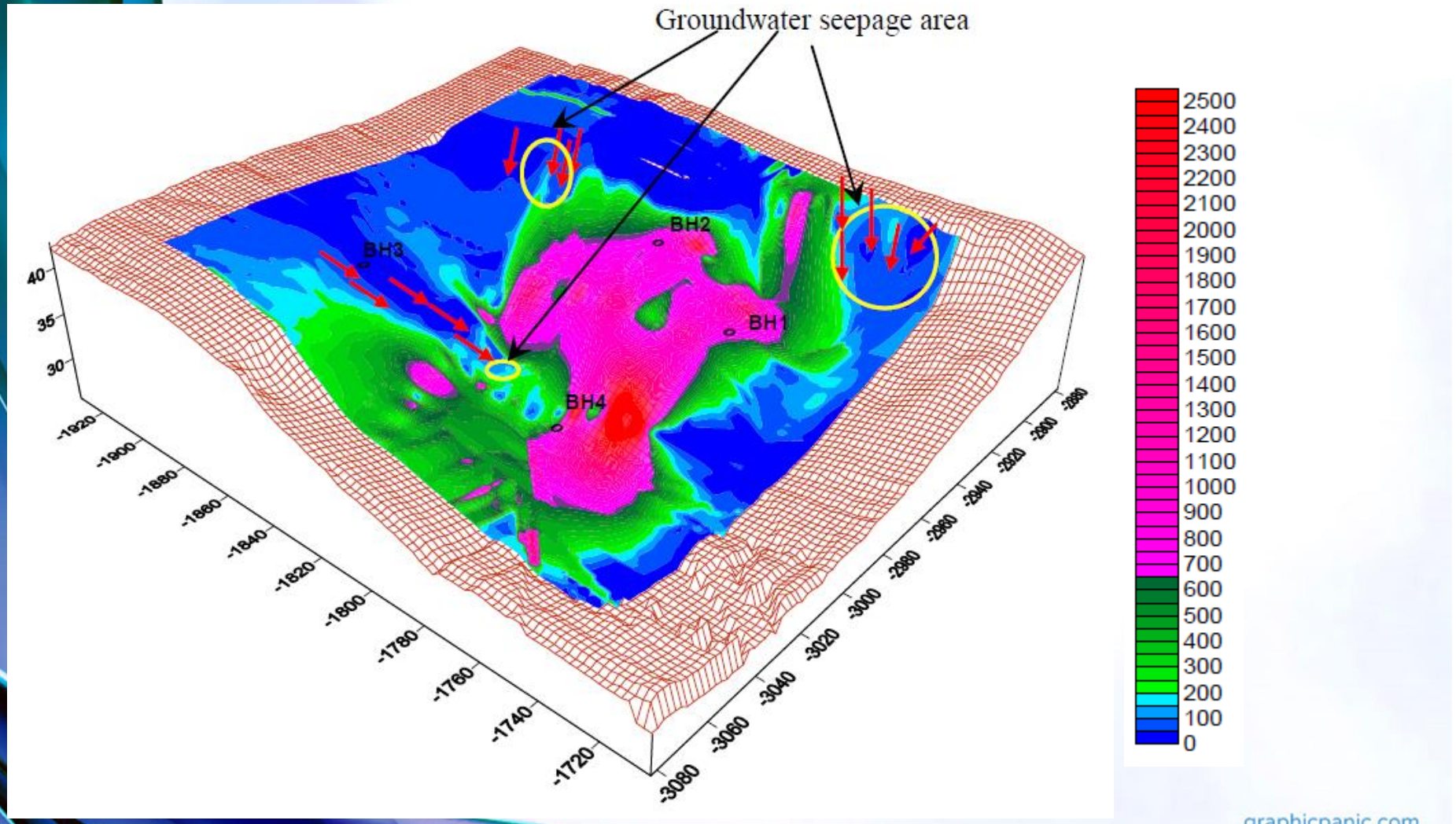
Topography, resistivity lines and groundwater occurrences in study area



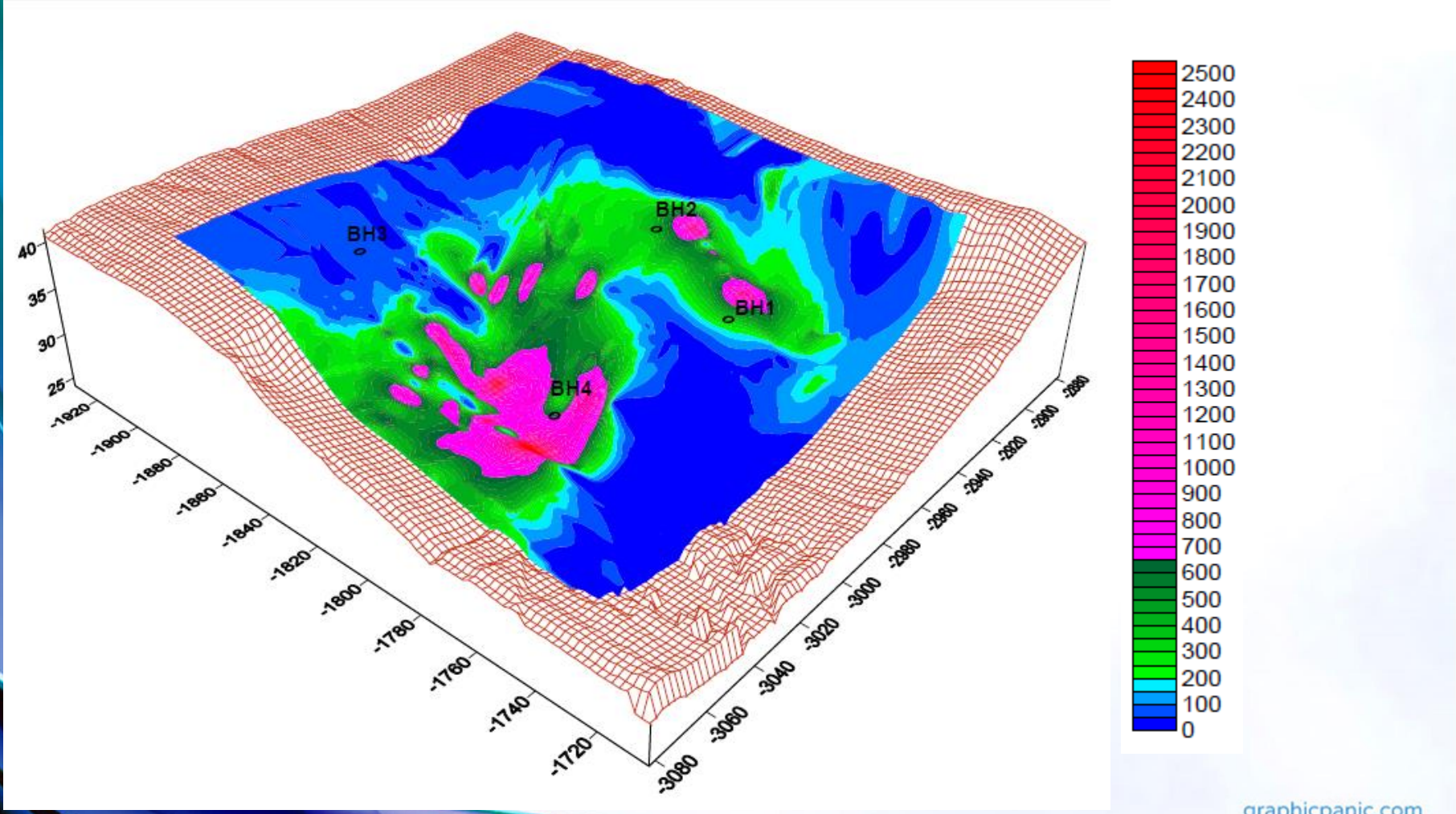
3-D resistivity distribution at depth 1 meter from ground surface



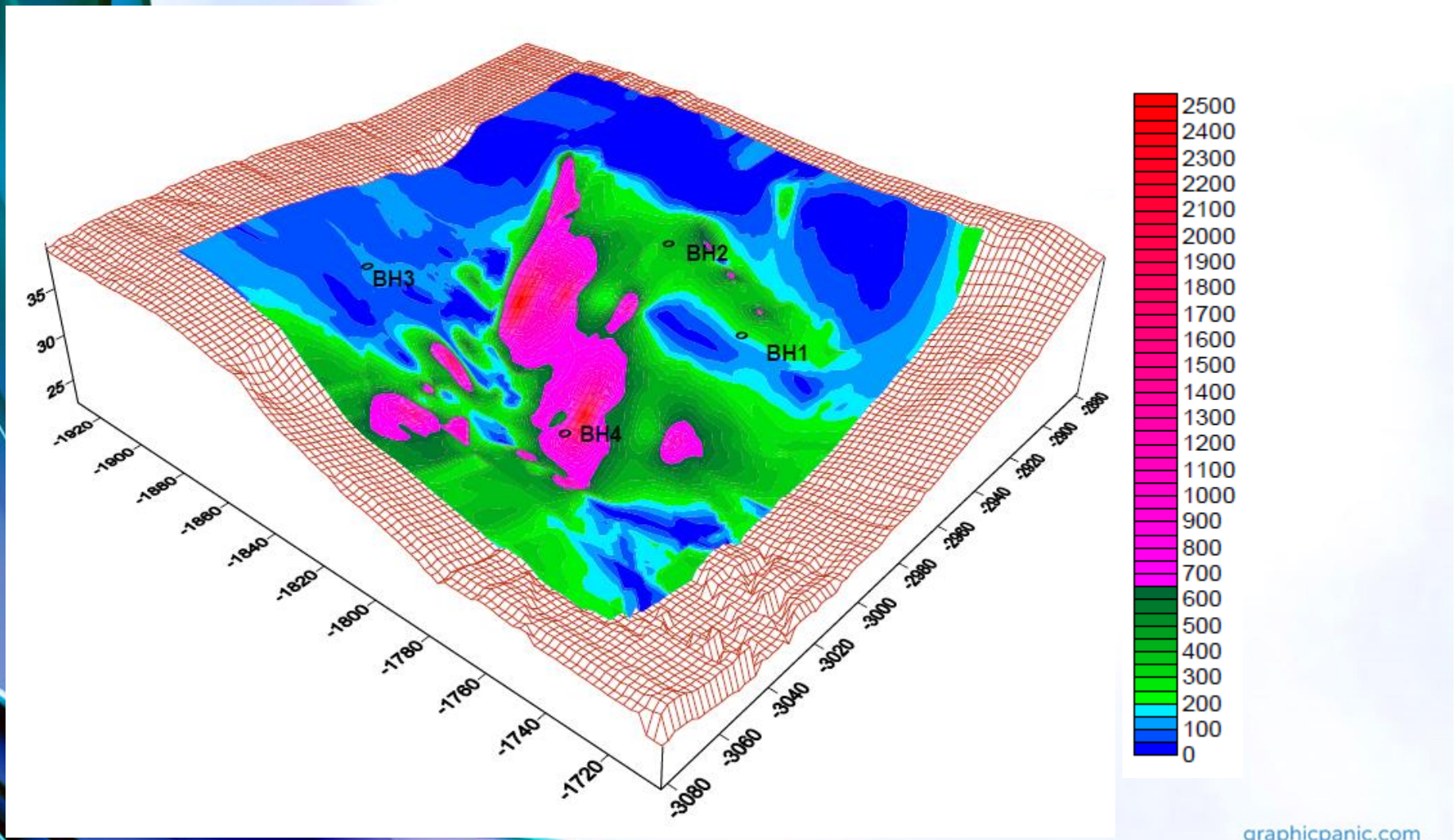
3-D resistivity distribution at depth 3 meter from ground surface



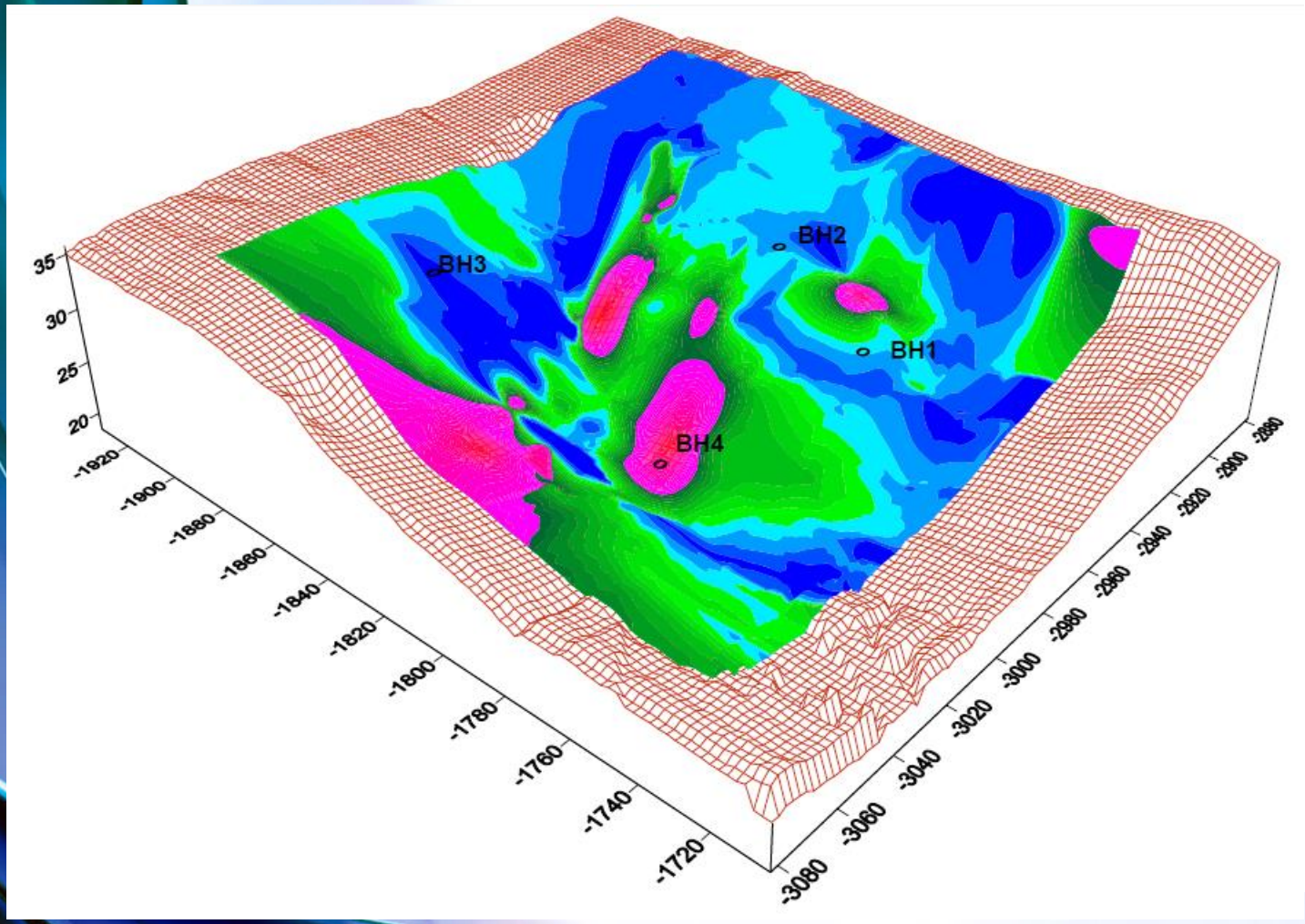
3-D resistivity distribution at depth 4 meter from ground surface



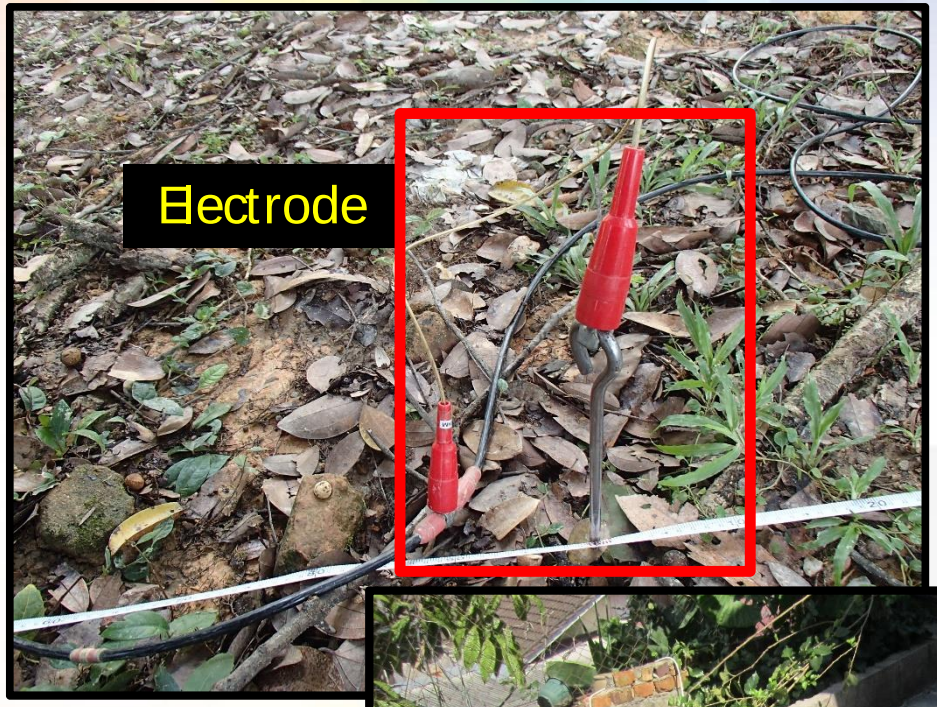
3-D resistivity distribution at depth 6 meter from ground surface

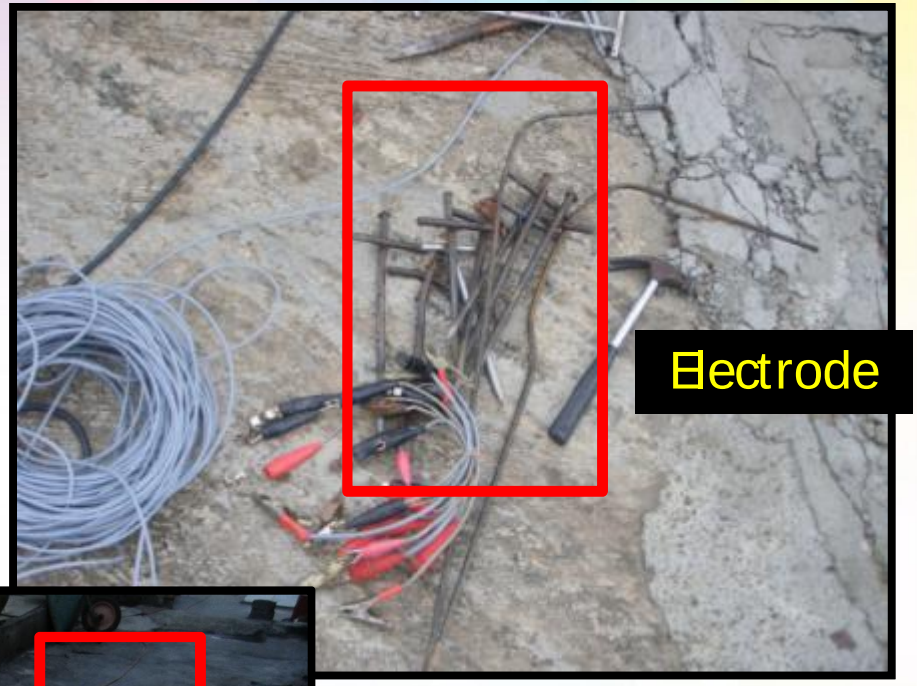


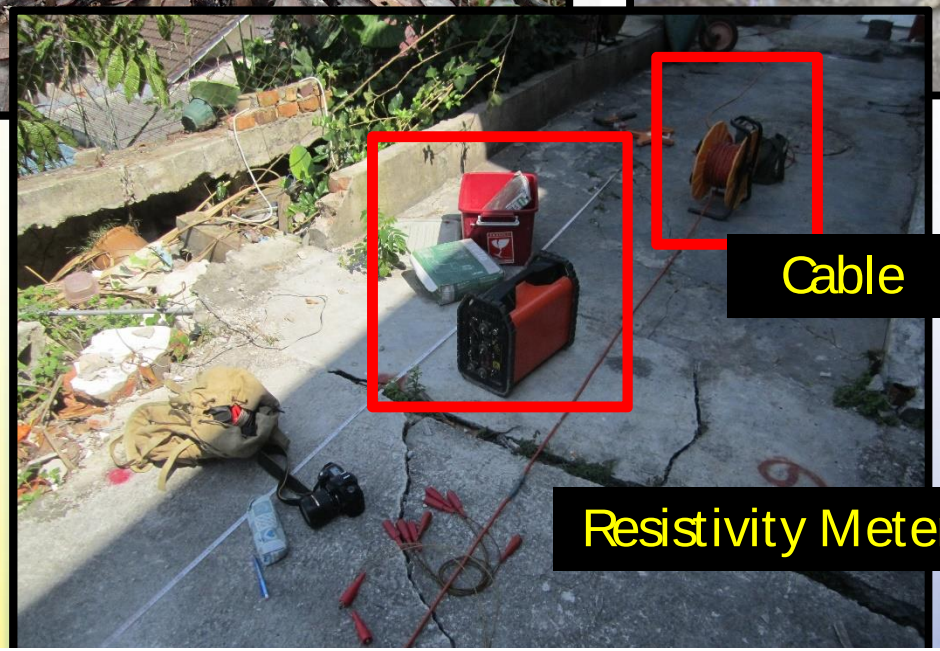
3-D resistivity distribution at depth 10 meter from ground surface



Apparatus For Resistivity Survey







ADVANTAGES OF RESISTIVITY

Non-destructive mapping technique

The greatest advantage is it doesn't disturbs the structure nor the function of the soil.

Temporal monitoring

This approach is advance for monitoring the physical changes in soil water distribution.

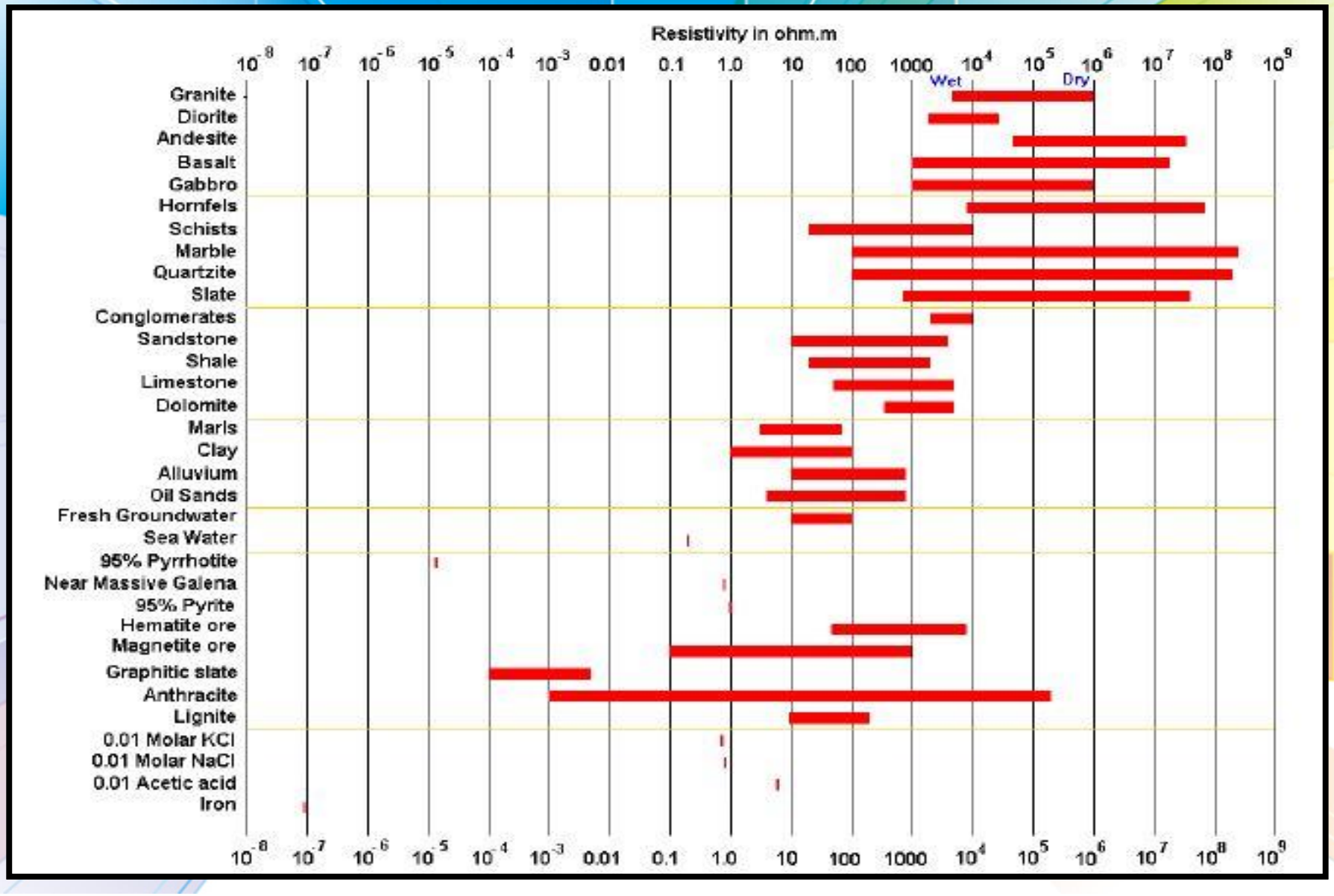
Data acquisition facilities

The improvement of computer controlled multi electrodes arrays has led to an important development of electrical imaging.

Large sensitivity of the measurement

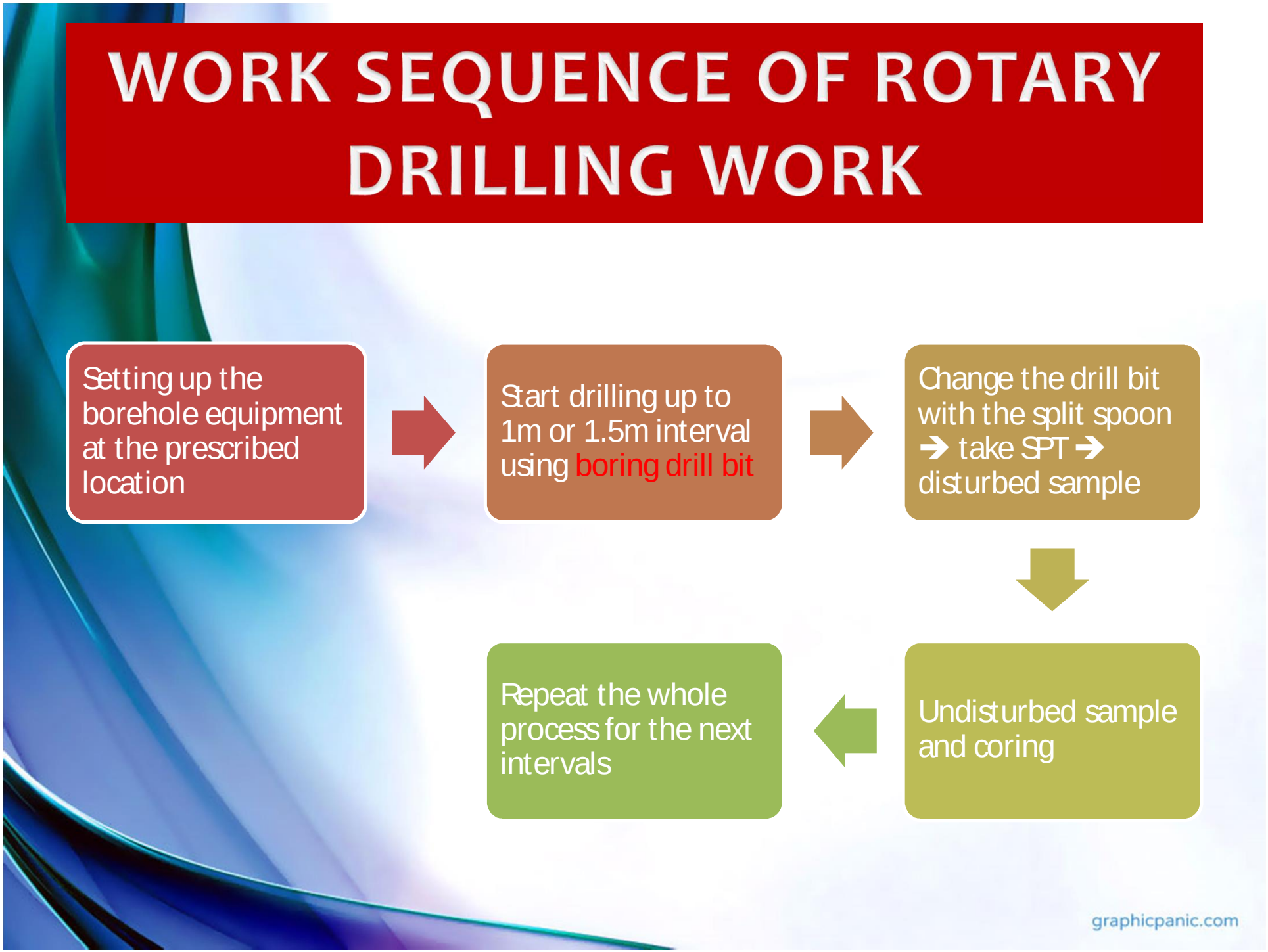
The sensitivity of the electrical resistivity measurement is spread over a wide range depending on the soil physical properties.

RESISTIVITY OF ROCKS, SOILS & MINERALS



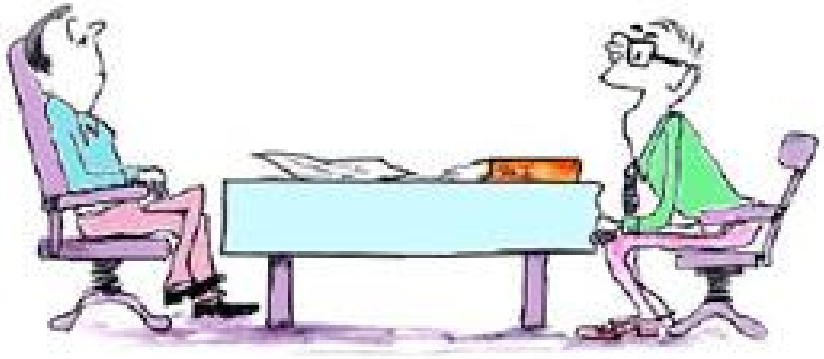

THANK YOU

WORK SEQUENCE OF ROTARY DRILLING WORK

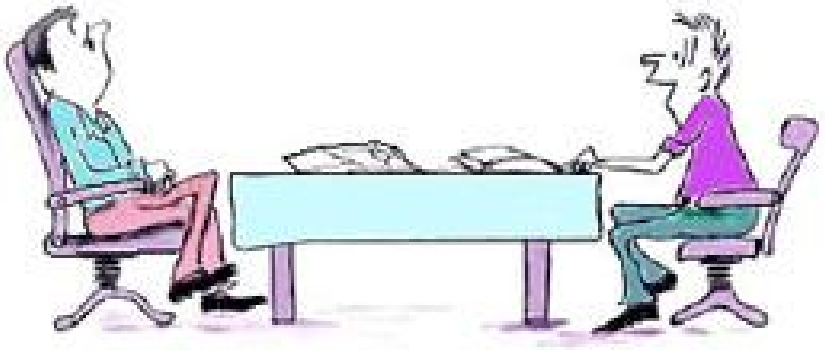


WHY WE HAVE TO PERFORM SI?

1 ONE BOREHOLE EVERY THREE DAYS....COMPLETE SI REPORT IN THREE MONTHS !!!

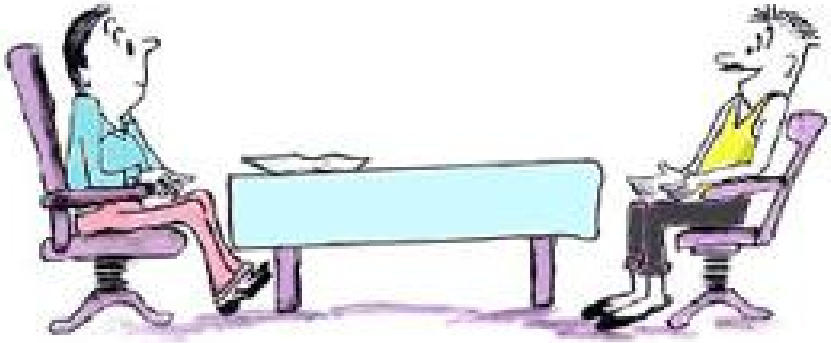


2 ONE BOREHOLE PER DAY.... COMPLETE SI REPORT.... ONE MONTH !!!



COMPLETE SI REPORT THREE DAYS.....

3 NOT EVEN NECESSARY TO VISIT THE SITE !!!



4 AGREED...!