Model of water leakage beneath reservoir and above diversion water tunnel; Mae Prachum reservoir area, Mae Taeng District, Chiang Mai Province

[1st]Noppadol Poomvises, Anchalee Kongsuk,
Benjamas Sawasdipong, and Tanapon Suklim

Bureau of Engineering Topographical and Geotechnical Survey

Royal Irrigation Department, Samsen rd., Bangkok, Thailand

Climate change → Solving drought problem

- Drought : Mae Kuang
- 2015
- Water-rich → Water-lack
- Diversion tunnel
  - 47 km, convey 160 MCU of water
  - Mae Taeng – Ma Ngad – Mae Kuang reservoir

Cr. Bureau of large scale water resources development 1 (LSC1)

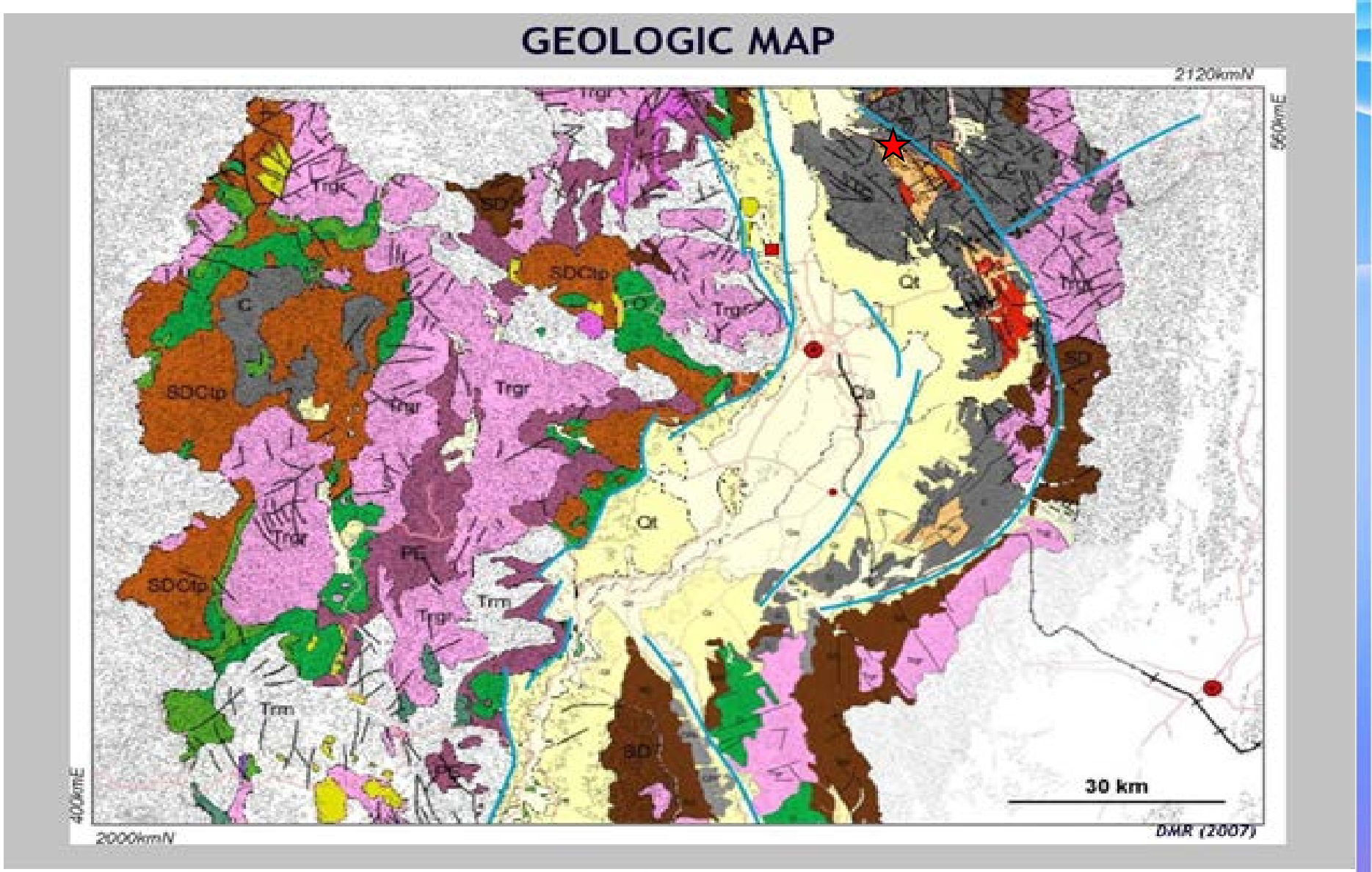
2018 - 2019

- Construction beneath a small-scale reservoir, Huai Mae Prachum, Mae Taeng, Chiang Mai
- Storage water level in the reservoir rapidly drew down
- Srisuthum, C. and team 2020, walk-thru survey
- A large amount of water in reservoir flew into the tunnel conduit, in the meantime of construction.
- Detail geophysical and geological survey for improvement
- 2021 Run geophysics

GEOLOGIC MAP

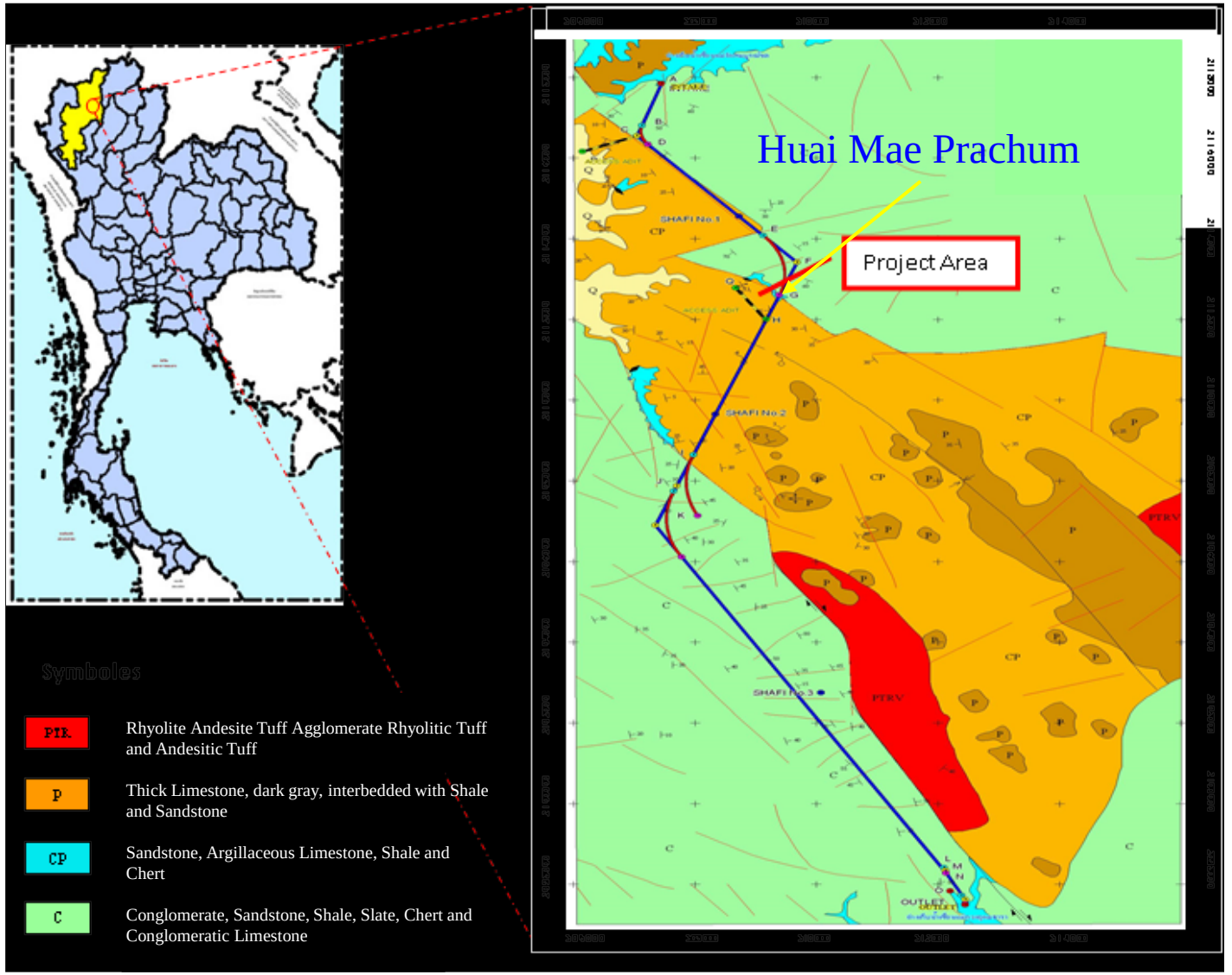
Huai Mae Prachum

Faults



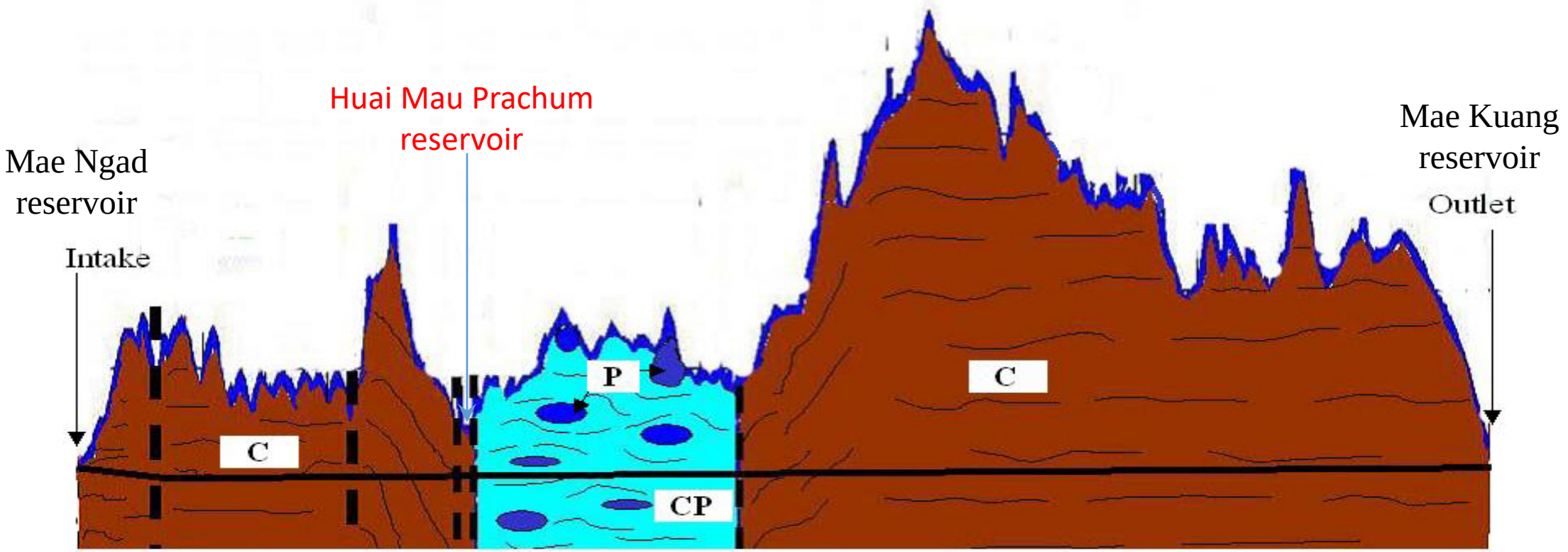
Cr. Singdaeng (2015)

GEOLOGICAL MAP



Cr. Singdaeng (2015)

Geological profile along main tunnel from Mae Ngad to Mae Kuang reservoir



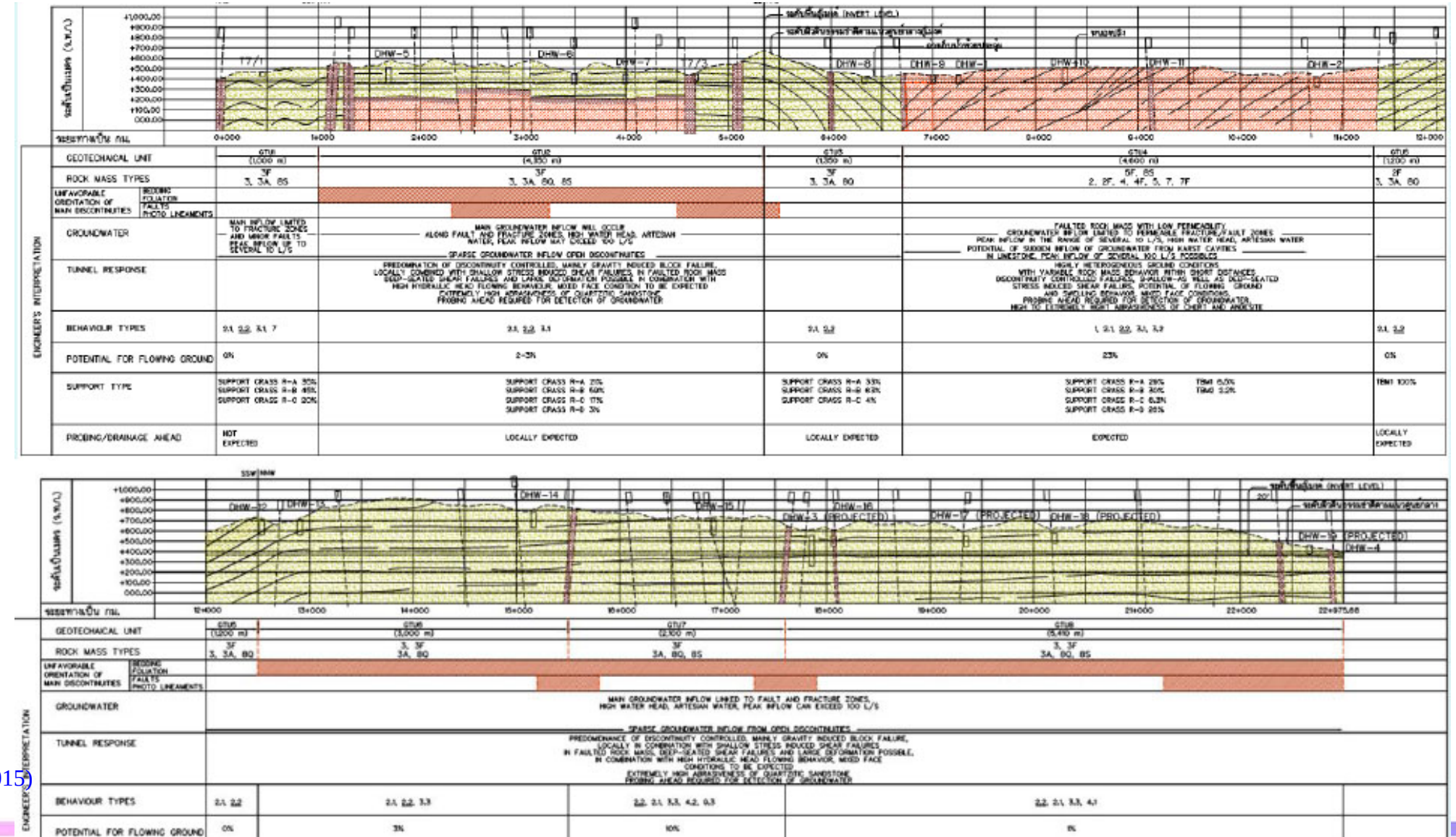
Cr. Singdaeng (2015)

Thrust fault, downstream area of Mae Prachum

Geological prediction of main tunnel

Mae Ngad reservoir

Mae Kuang reservoir

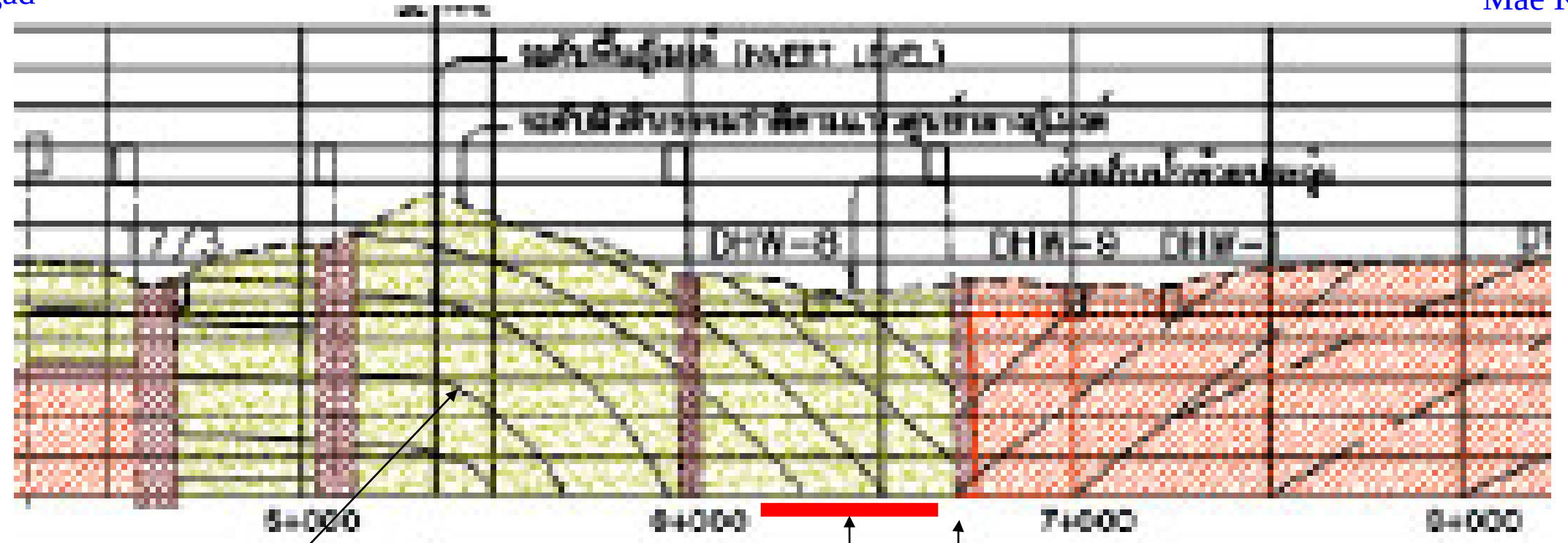


Cr. Singdaeng (2015)

Geological prediction of foundation of Mae Prachum reservoir

Mae Ngad

Mae Kuang



C **CP** **C**

Low-angle Thrust fault

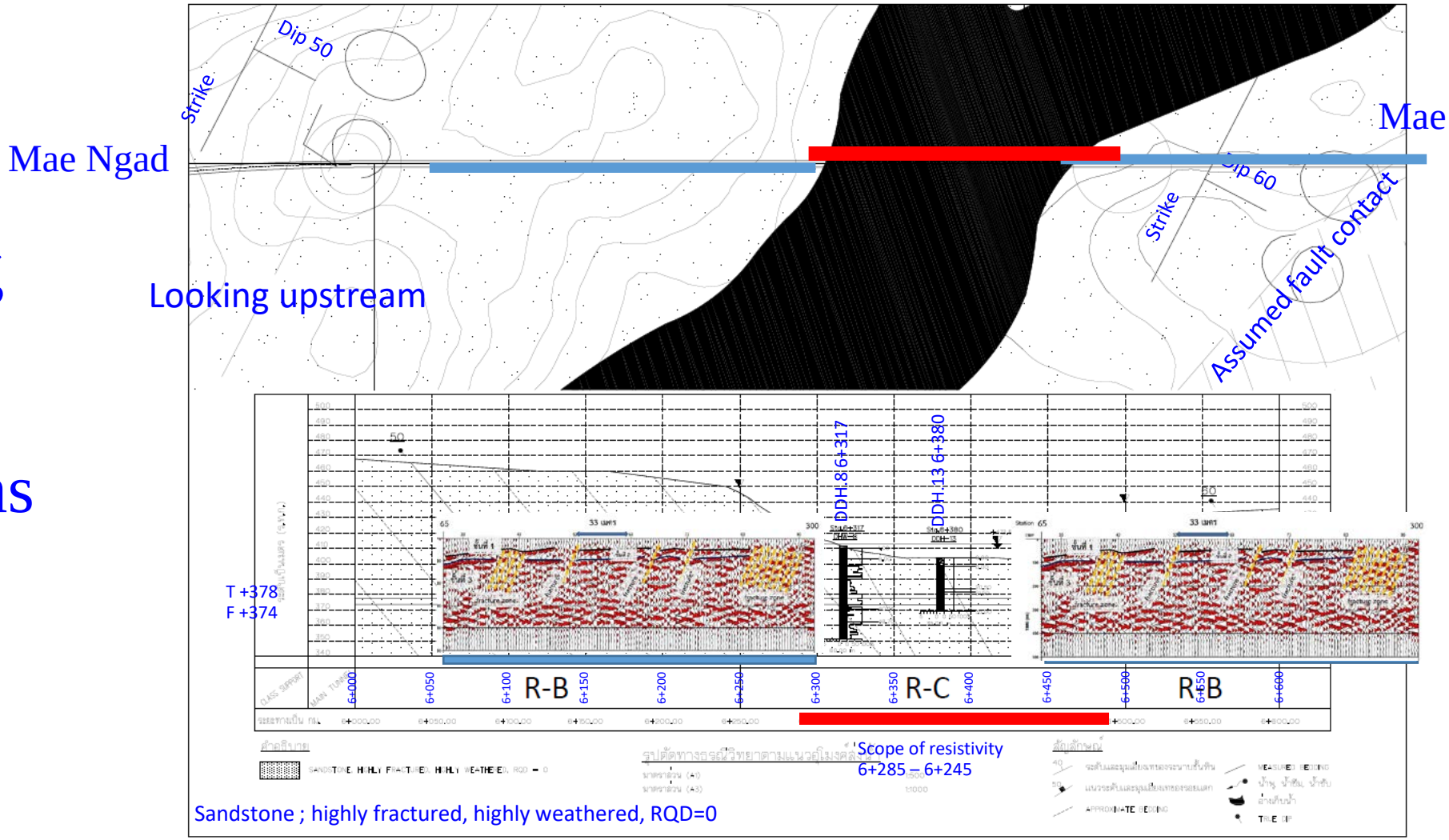
Fracture / Fault / Sheared zone

Mae Prachum

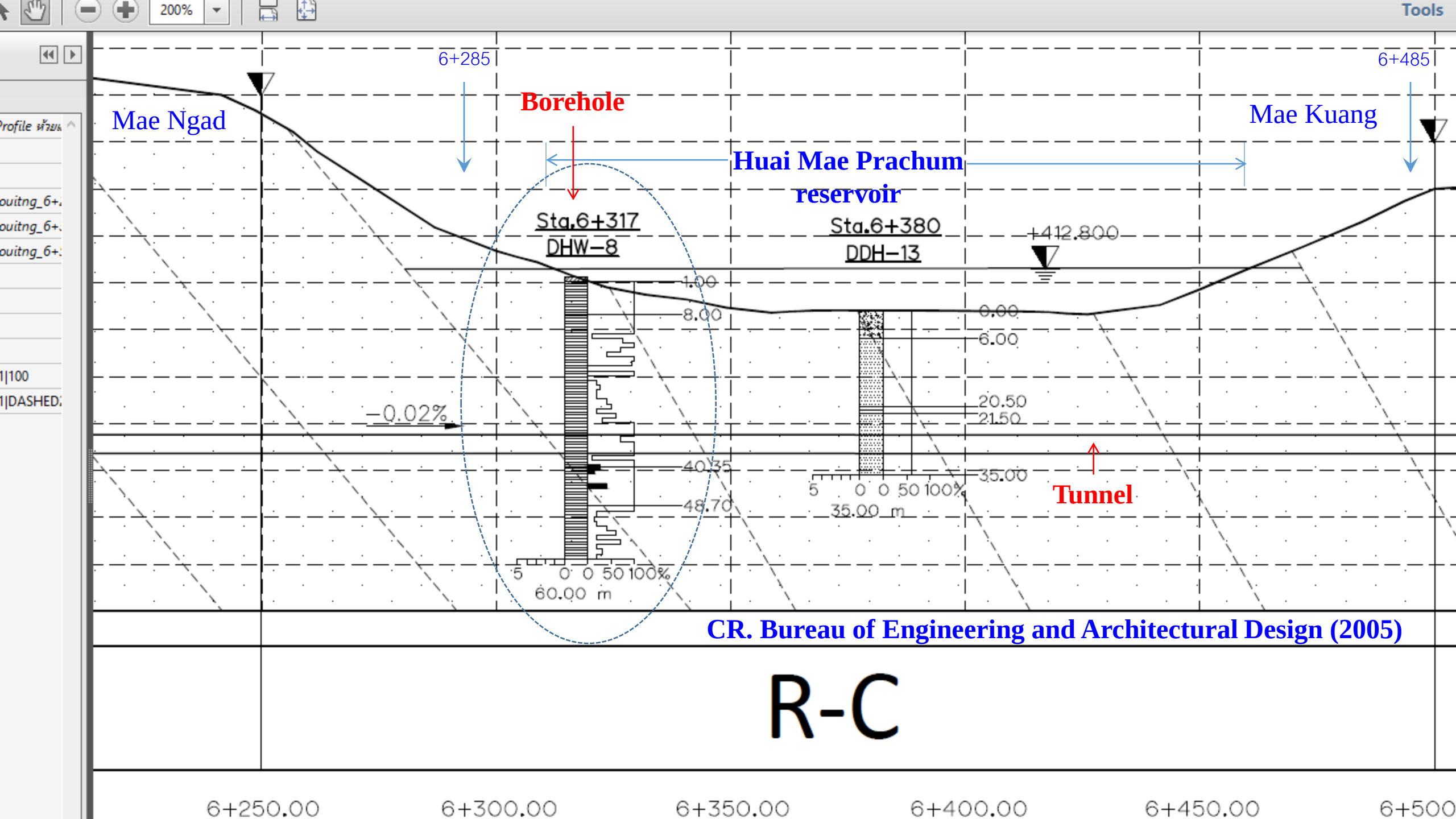
Fracture / Fault / Sheared zone / Rock unit

Cr. Singdaeng (2015)

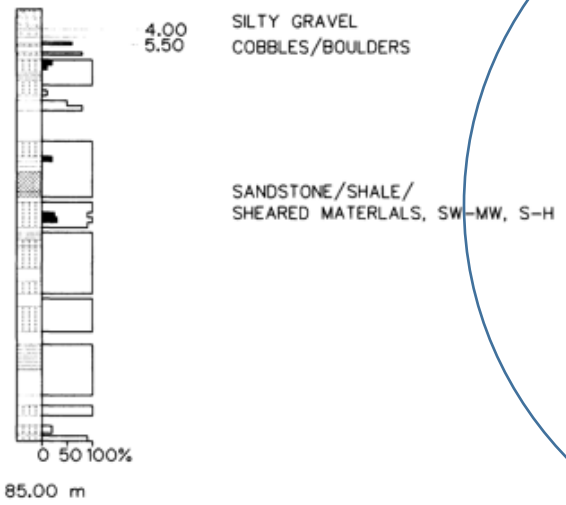
Seismic reflection profile along tunnel and touch two reservoir rims



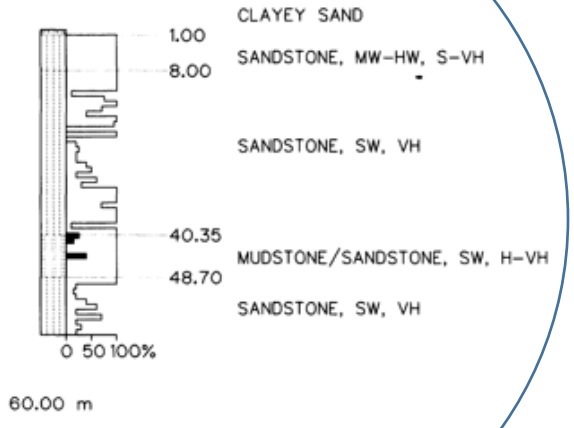
Cr. Youngmee (2015)


6+285
6+485
Borehole
Mae Ngad
Mae Kuang
Huai Mae Prachum reservoir
Sta.6+317
DHW-8
Sta.6+380
DDH-13
+412.800
1.00
8.00
0.00
6.00
20.50
21.50
35.00
40.35
48.70
-0.02%
5 0 0 50 100%
60.00 m
5 0 0 50 100%
35.00 m
Tunnel
CR. Bureau of Engineering and Architectural Design (2005)
R-C
6+250.00
6+300.00
6+350.00
6+400.00
6+450.00
6+500

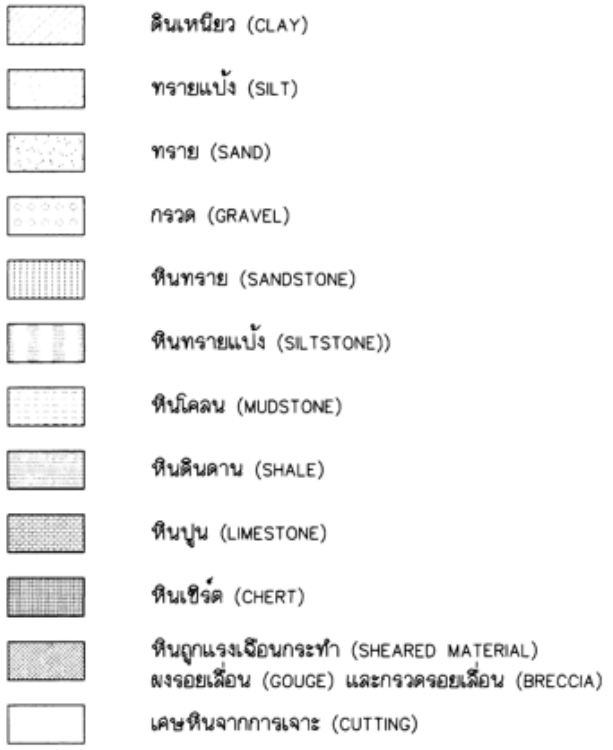
DHW-6 (+499.987)



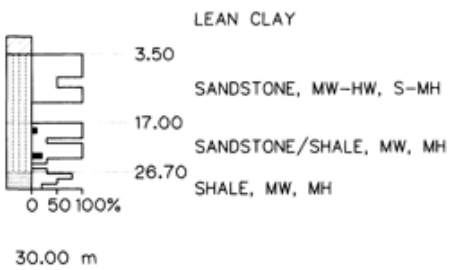
DHW-8 (+415.056)



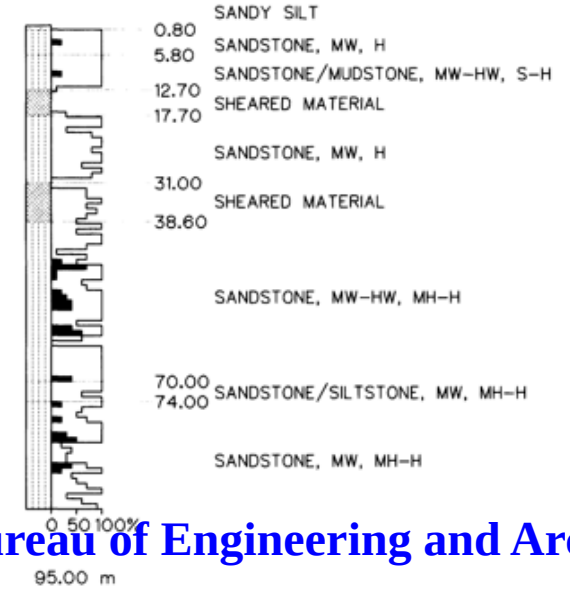
สัญลักษณ์ดินและหิน



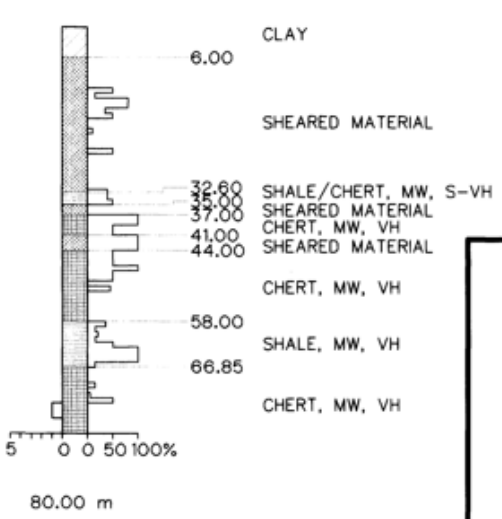
HW-4 (+393.533)



DHW-7 (+447.661)



DHW-9 (+431 .868)



อัตราการผุพังสลายตัว

FR = หินสด
SW = ผุพังสลายตัวน้อย
MW = ผุพังสลายตัวปานกลาง
HW = ผุพังสลายตัวสูง
CW = ผุพังสลายตัวสมบูรณ์

กรมชลประทาน

โครงการอุโมงค์ส่งน้ำแม่งัด-แม่กวง

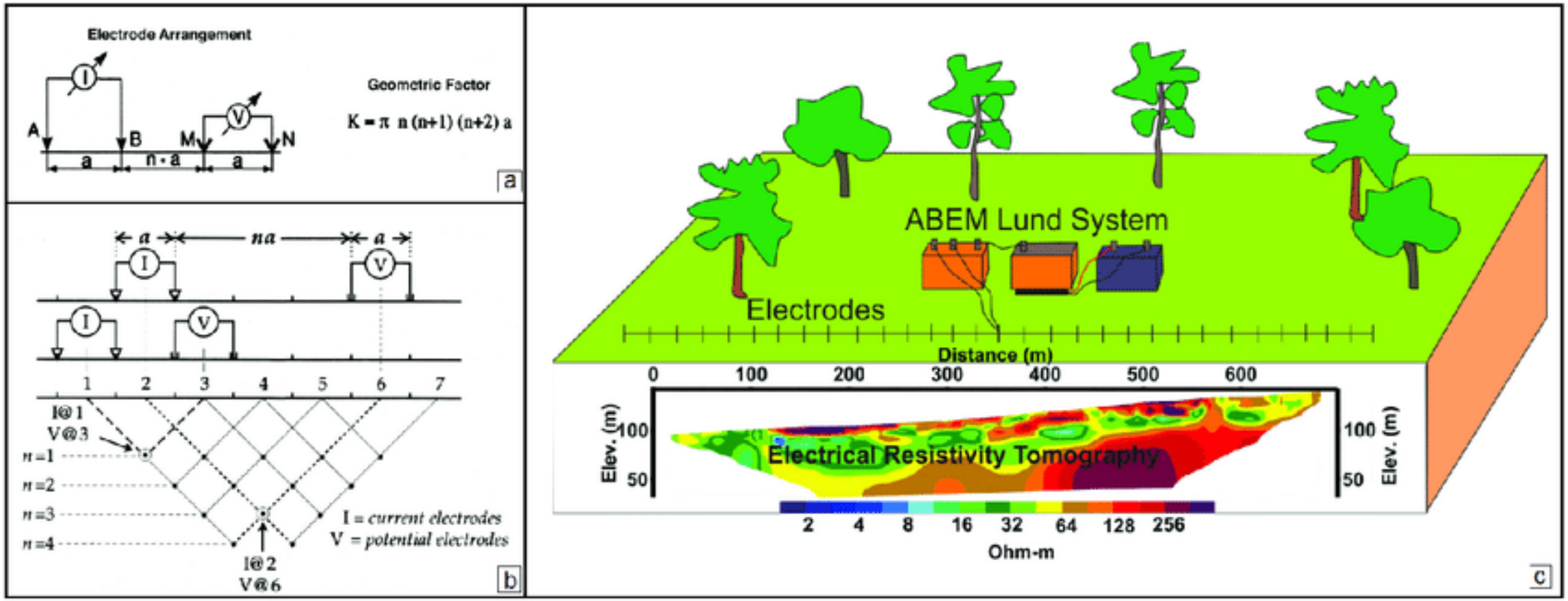
จังหวัดเชียงใหม่

การสำรวจทางธรณีวิทยาฐานราก

รายละเอียดข้อมูลหลุมเจาะธรณีวิทยาฐานราก (แผ่นที่ 1/3)

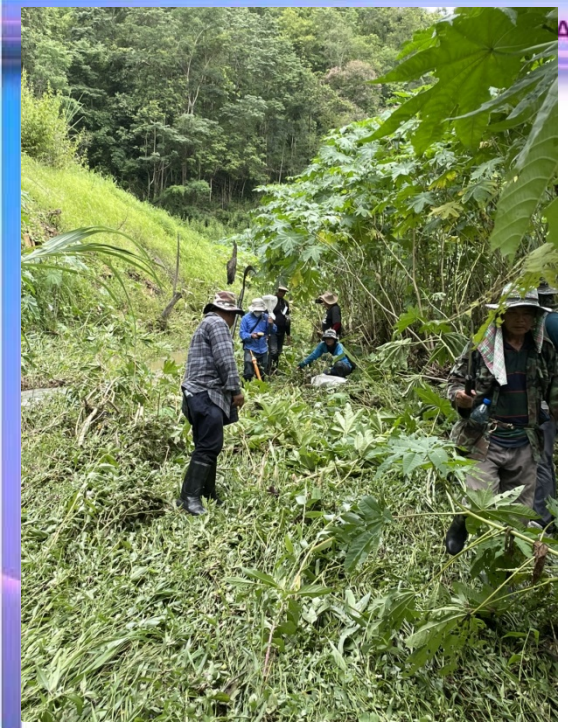
CR. Bureau of Engineering and Architectural Design (2005)

Geophysics ; 2-D electrical resistivity survey

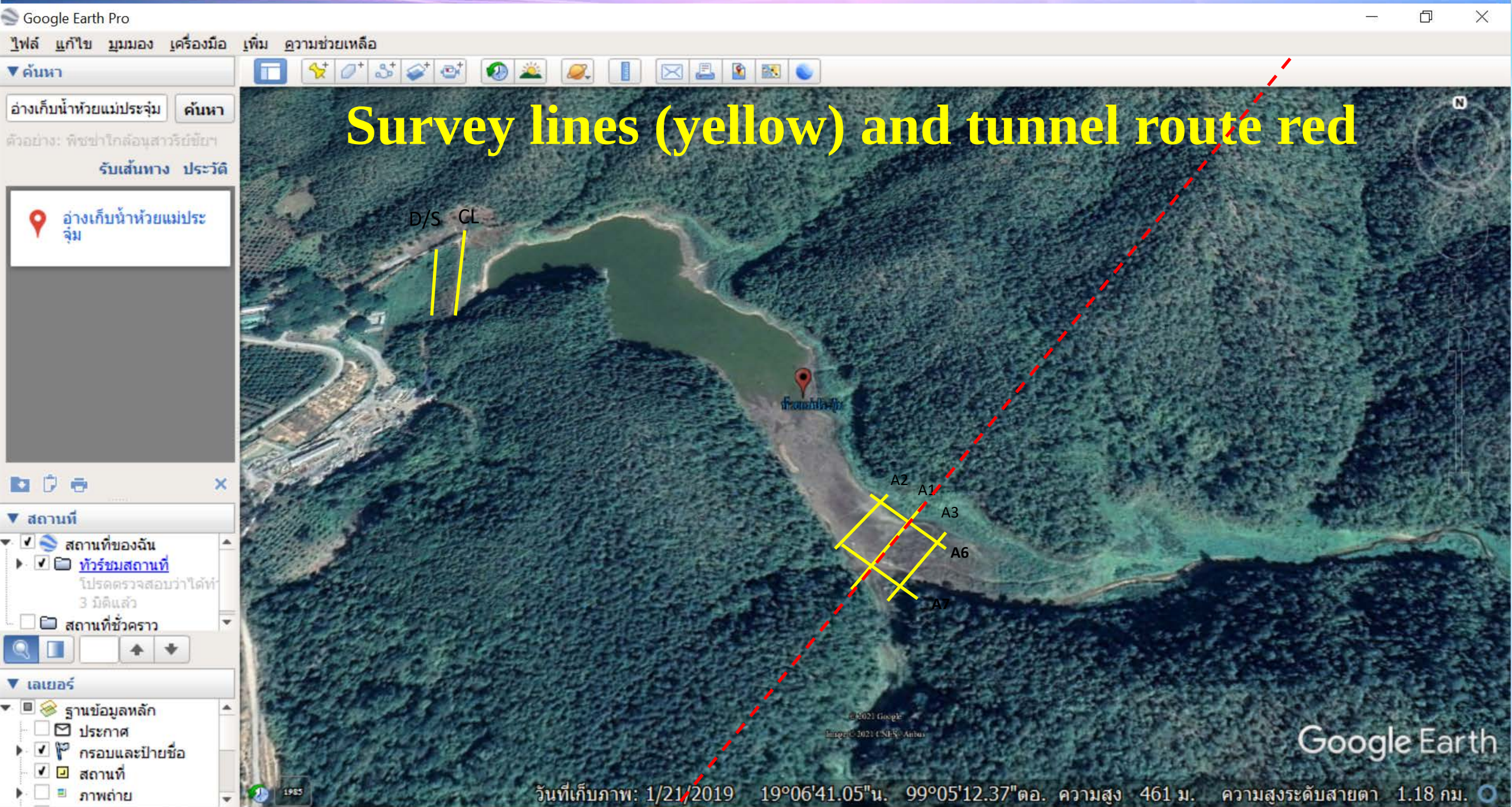


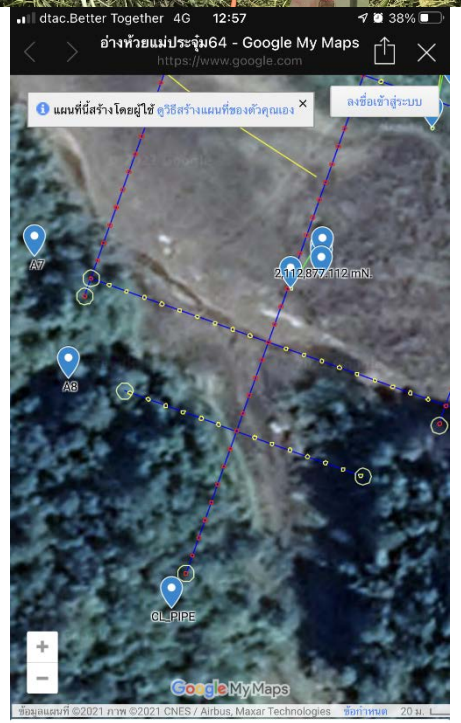
Cr. https://www.researchgate.net/publication/338472345/figure/fig3/

Ground survey, RTK-GNSS, in rainy days



Resistivity in cloudy days


Google Earth Pro
ไฟล์ แก้ไข มุมมอง เครื่องมือ เพิ่ม ความช่วยเหลือ
ค้นหา
อ่างเก็บน้ำห้วยแม่ประจุ่ม
ค้นหา
รับเส้นทาง ประวัติ
อ่างเก็บน้ำห้วยแม่ประจุ่ม
สถานที่
สถานที่ของฉัน
ทัวร์ชมสถานที่
สถานที่ชั่วคราว
เลเยอร์
ฐานข้อมูลหลัก
ประกาศ
กรอบและป้ายชื่อ
สถานที่
ภาพถ่าย
Survey lines (yellow) and tunnel route red
D/S
CL
A2
A1
A3
A6
A7
N
Google Earth
วันที่เก็บภาพ: 1/21/2019 19°06'41.05"น. 99°05'12.37"ตอ. ความสูง 461 ม. ความสูงระดับสายตา 1.18 กม.



อ่างห้วยแม่ประจุ่ม64

Resistivity survey

Walk-thru survey

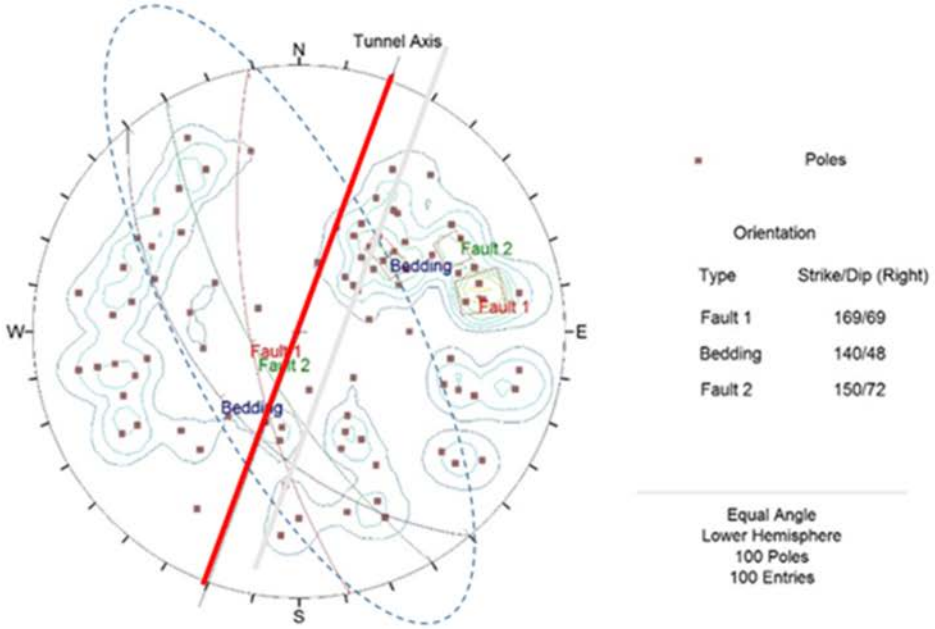
Fracture (white dot)

Opened fracture (white ellipse)

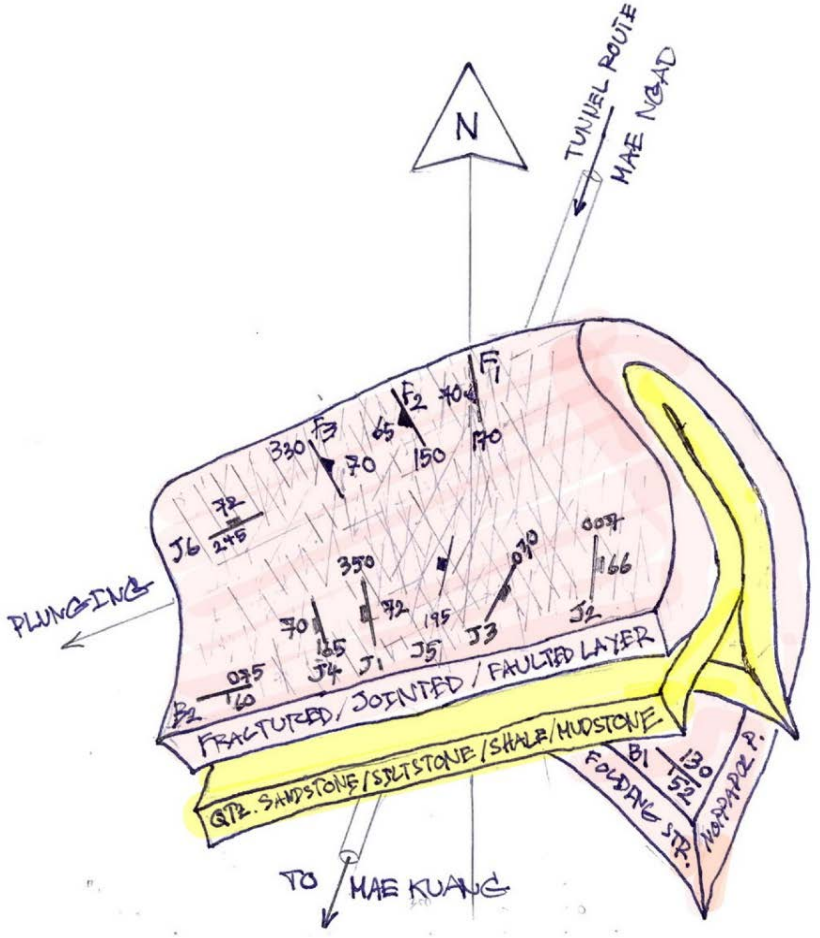
Fig.·1.·Rock·exposures·at·Huai·Khun·Mi,·showing·opened·joint,·fracture,·and·cavity·(white),·associated·with·fold·structure·(red)·as·channels·that·water·outflowing·from·reservoir.¶

Structure controled; Fracture and Fold associated Fault

Discontinuities
Avr. N27°W 63°SW



Stereo plot of discontinuities

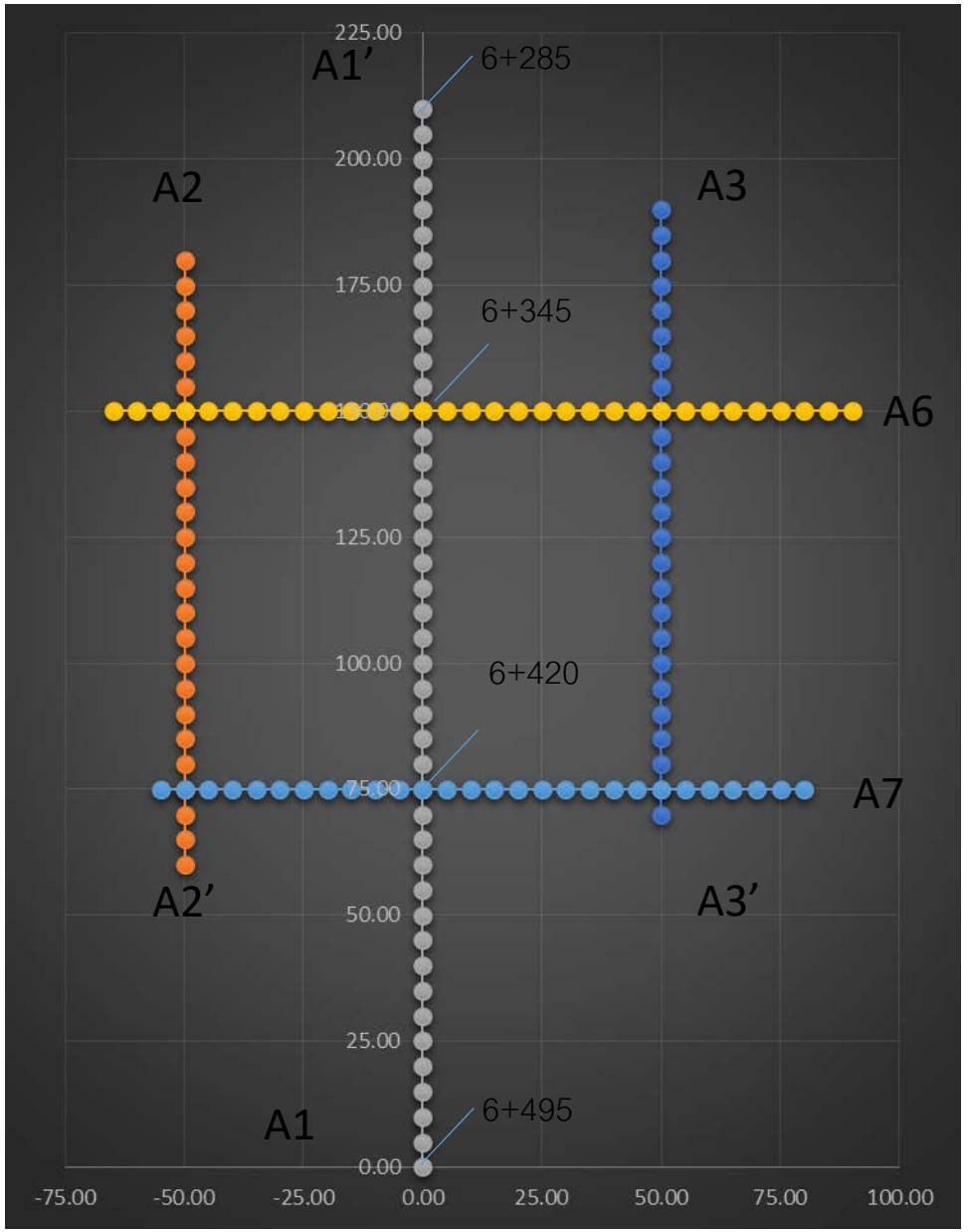


Structural model of foundation

2-D Electrical survey lines

จุดตัดแนวสำรวจ		E*	N*	X	Y
A2	A6	509005.31	2112950.34	-50	150
A1	A6	509052.36	2112933.55	0	150
A3	A6	509099.50	2112916.73	50	150
A2	A7	508980.11	2112879.70	-50	75
A1	A7	509027.19	2112862.90	0	75
A3	A7	509074.33	2112846.09	50	75

Note * พิกัด UTM Zone 47 Q

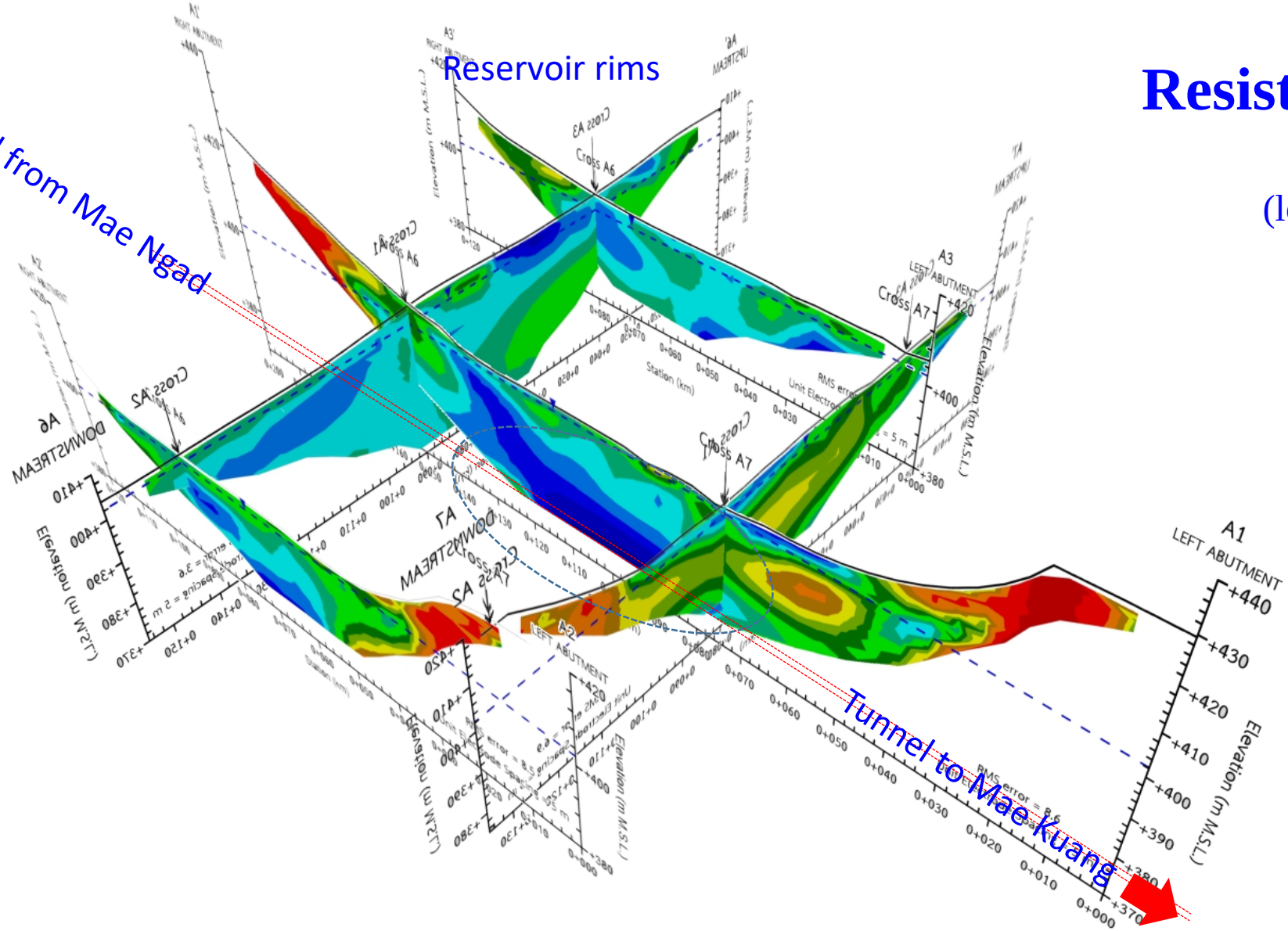


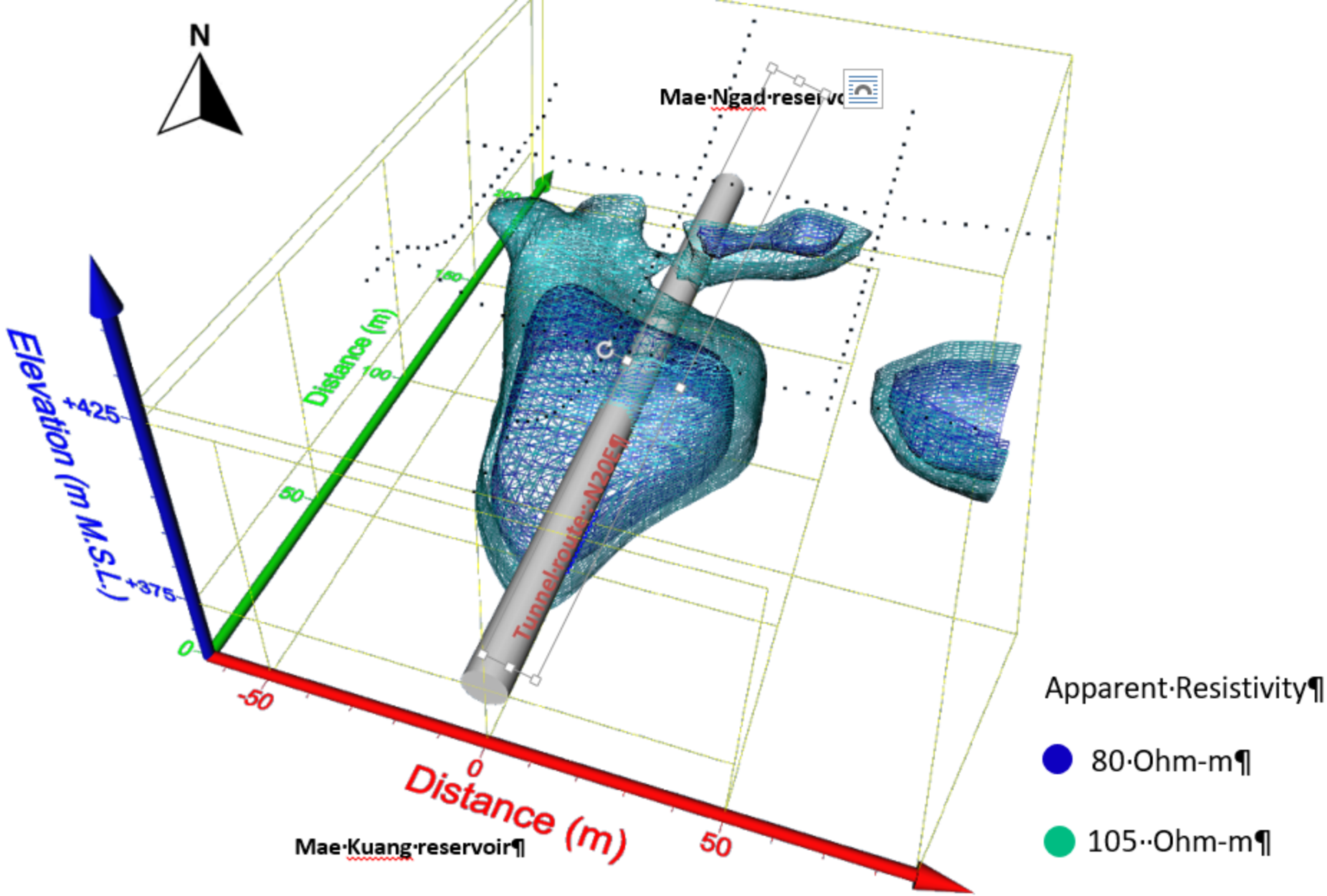
Resistivity model

(looking NE)

North

South



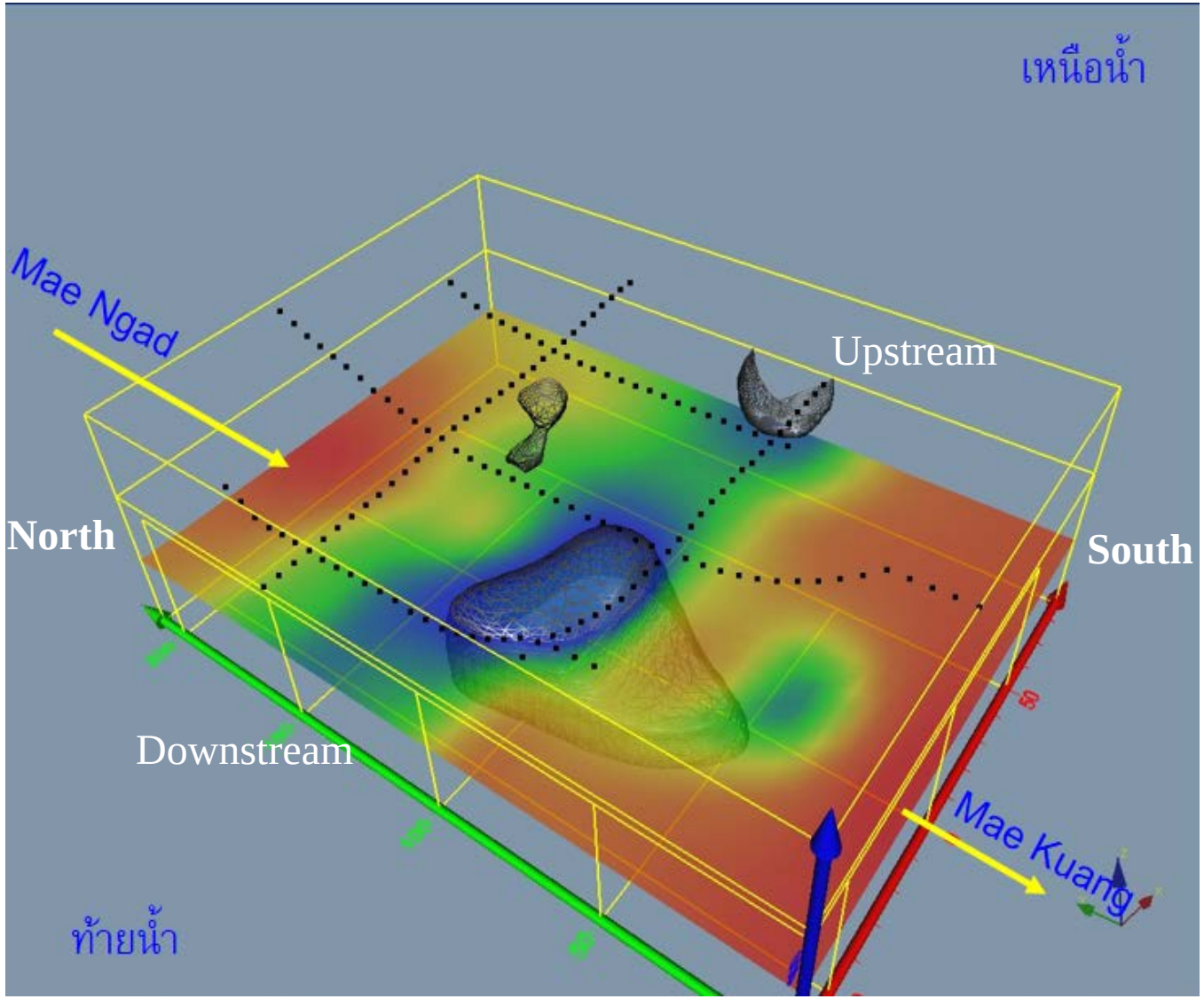


¶

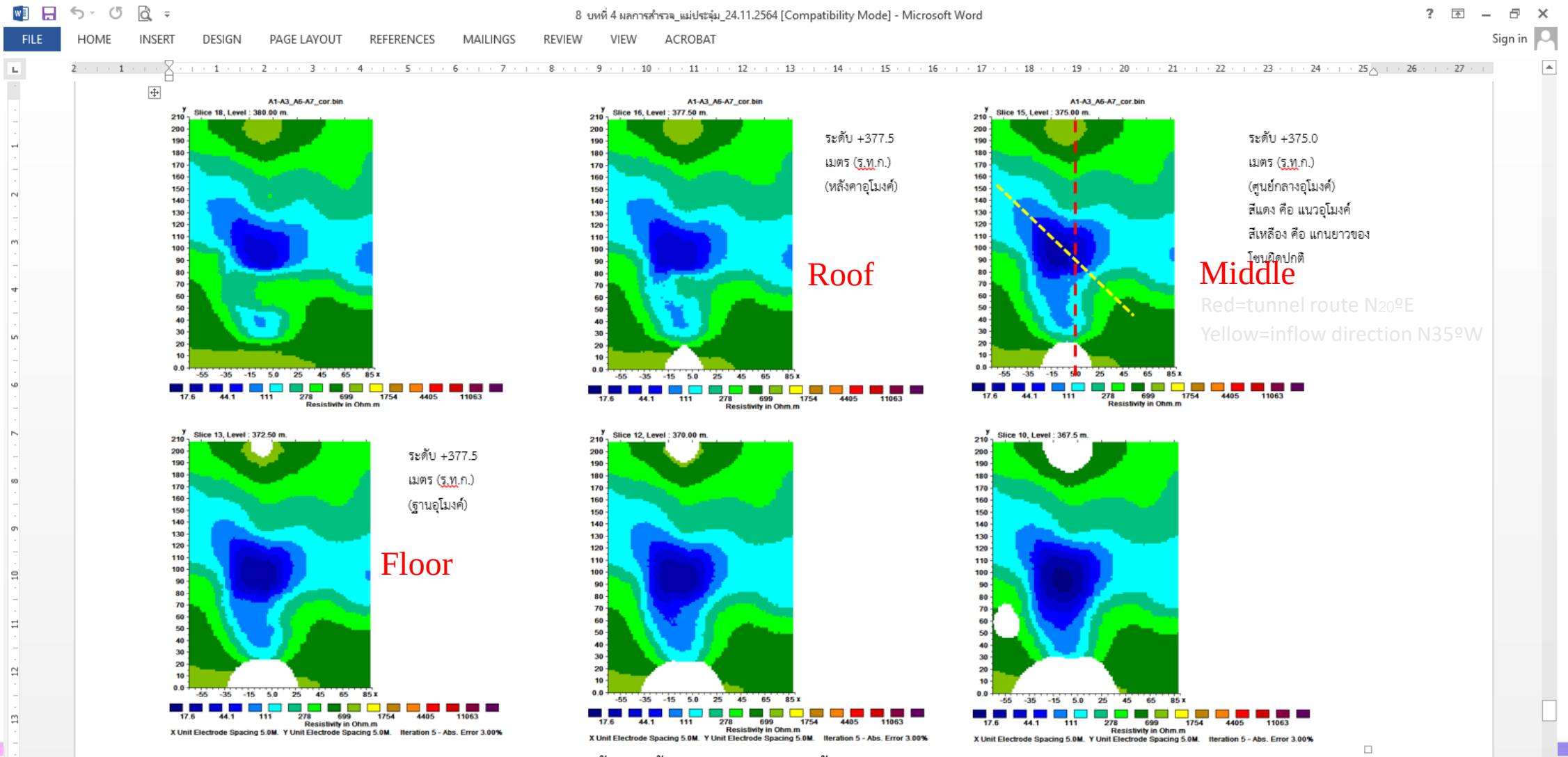
Fig.·2.·Model·of·water·leakage·by·using·electrical·resistivity·imaging·data.·¶

Note·:·Tunnel·direction·=·N20°E,·scale·X:Y:Z·=·1:1:1¶

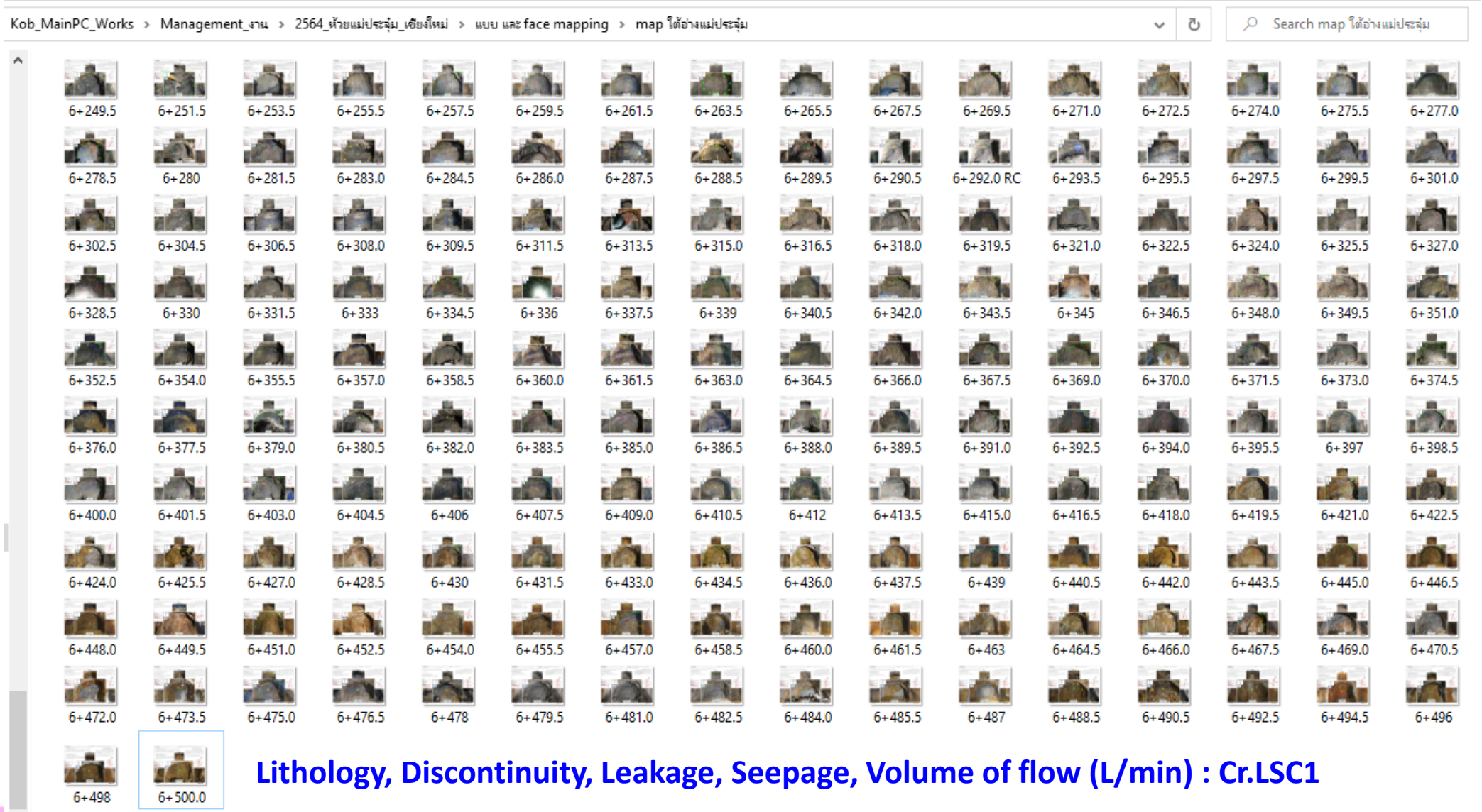
Area of seepage and leakage at surface



Depth slices of resistivity anomaly at roof, middle and floor of tunnel from 6+285 to 6+495, area 210x160 m, slice interval of 2.5 m



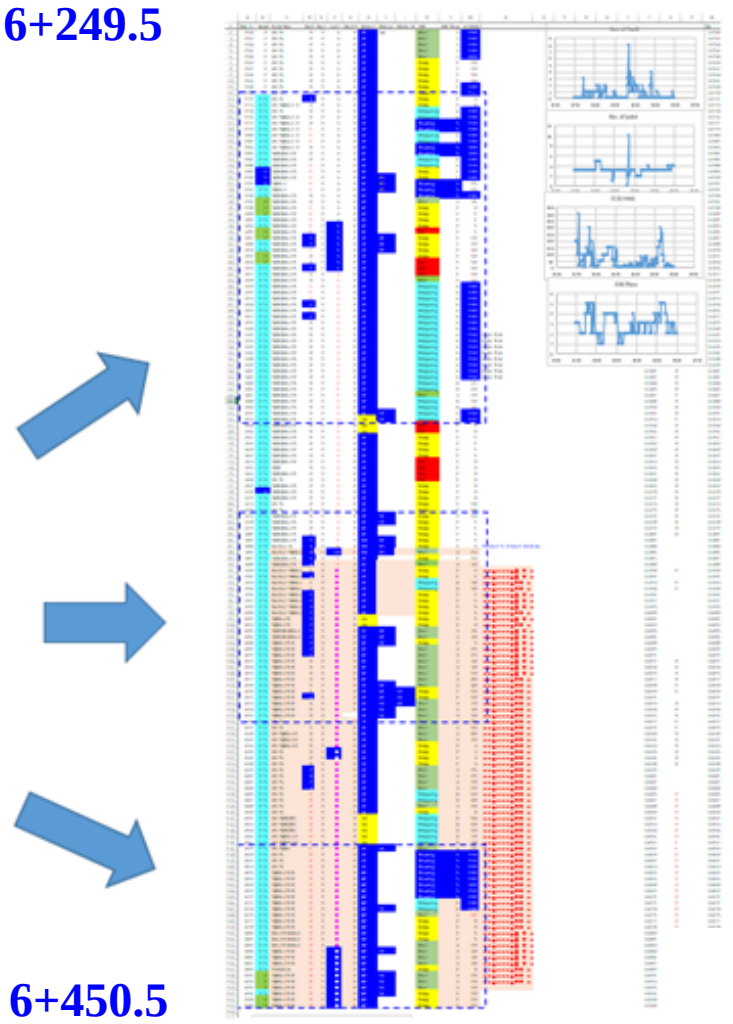
162 tunnel faces ; km 6+249.5 – 6+500.5



Lithology, Discontinuity, Leakage, Seepage, Volume of flow (L/min) : Cr.LSC1

Interpreted arriving station of water flow-in along tunnel conduit, km 6+249.5 – 6+500.5, beneath reservoir

1) 6+269.5 – 6+352.5
2) 6+376.0 – 6+425.5
3) 6+458.5 – 6+500.5



Combination

- Geological observation (surface)
  - Discontinuity analysis by stereo plot
  - Rock exposure study
- Geophysics (in between)
  - Resistivity profile
  - Resistivity modeling
  - Depth slides
- Tunnel faces analysis (sub-surface)

Summary

- Geology, geophysics, and analysis of discontinuity system point out the model of water leakage
- Water leaks out from Huai Mae Prachum reservoir and flows down to tunnel conduit beneath
- Inflow from opened cracks at outcrops and reservoir floor, flows down through fracture zones, and arrives tunnel,
  - Station 6+248 – 6+500 km, (3 zones)
  - Elevation +372 – +377 m MSL.,
  - Direction of North 27º to West and dipping angle of 63º to South-west

To the present day

- The treatment of tunnel has been preliminary conducted for awhile.
- Reservoir floor will be the next step to be treated
- Finish designing work
- Waiting for budget for reservoir improving and safety

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- http://www.google.co.th/map
- **https://www.researchgate.net/publication/338472345/figure/fig3/**

Thanks very much
Q & A