SEEING SURAKARTA BASED ON ~~CIVIL~~ GEOTECHNICAL ENGINEERING PERSPECTIVE

Challenges and Opportunities

By:

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International Conference
In Rehabilitation and Maintenance in Civil Engineering

Best Western Hotel
Surakarta, July 11th - 12th 2018

ORGANIZATION

- INTRODUCTION
- POTENTIALS THREATS FACE BY SURAKARTA
- WHAT NEED BY SURAKARTA
- GEOTECHNICAL PERSPECTIVE
- UNIVERSITY CONTRIBUTION
- CONCLUSION

INTRODUCTION

WHERE IS SURAKARTA

JOGLOSEMAR TRIANGLE

SURAKARTA

HERITAGE CITY
CULTURAL CITY

WHY HERITAGE?

- Keraton Surakarta
- Pura Mangkunegaran
- Beteng Vastenburg
- Alun-alun and Gapuro (Park and Gate)
- Masjid Agung (Great mosque)
- Pasar Gede
- Kampoeng Batik (Batik Village)

All of those are protected by Law

WHY CULTURAL?

Preserve

- Traditional clothing : batik, blangkon, Javanese kebaya
- Traditional food (cullinary)
- Traditional buliding structure (especially roof, gate)
- Traditional art (song, dancing, music instrument)
- Traditional commemoration: Suro

BRIEF HISTORICY OF SURAKARTA

- Found : 17 Feb 1745
- Founder : Pakubuwana II
- Ruler : 1st ruler, Pakubuwana II (1745- 1749),
  now: Pakubuwana XIII (since 2004)

Pakubuwana II (1745- 1749)

THE RULERS OF SURAKARTA (PAKUBUWANA SINCE 1745)

PB II
1745 -1749

PB III
1749 -1788

PB IV
1788 -1820

PB V
1820 - 1823

PB VI
1823 -1830

PB VII
1830 -1858

PB VIII
1858 -1861

PB IX
1861 -1893

PB X
1893 -1939

PB XI
1939 -1945

PB XII
1945 -2004

PB XIII
2004 -

HERITAGE SURAKARTA

Keraton Palace

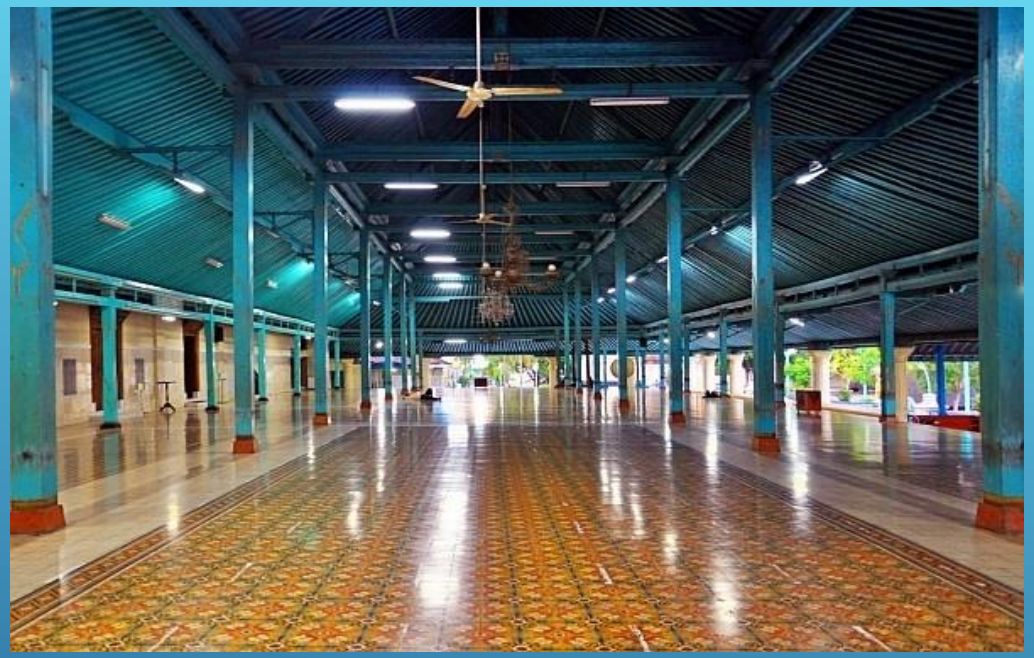
Mangkunegaran Palace

HERITAGE

GREAT MOSQUE

SURAKARTA

Built by PB III, 1763



HERITAGE SURAKARTA

Pasar Gede, built 1930

Historical Vastenburg 1775

Klewer Batik Market

HERITAGE TRADITION

Traditional music instrumen

Traditional batik

Traditional food

HERITAGE FESTIVAL

Sekaten Festival

Jumenengan Festival

TYPICAL ARCHITECTURE

TYPICAL TRADITIONAL GATE

Eastern Gate (Jurug)

Western Gate (Kleco)

Norhtern Gate (Mojosongo)

Southern Gate (Grogol)

SURAKARTA

The Surakarta is committed to preserve its heritage,culture, and tradition

- Heritage city
- Cultural city
- Traditional city

TOURIST CITY

SURAKARTA

- The other name: Solo, Sala
- Heritage city, cultural city
- Area: 46 km^2
- Population: 562.260
- Economic growth: 5.32 % (Statistic BPS, 2017)

VISION

SURAKARTA as a cultural, self relience, flourishing, and prosperous city

Some Surakartan claim that:

SOLO is “THE SPIRIT OF JAVA”


SOLO
the spirit of java

GROWING AND GROWING

1 floor

14 floors

23 floors

27 floors

Under Construction

30 floors, 124 m

(Perda 8/2009)

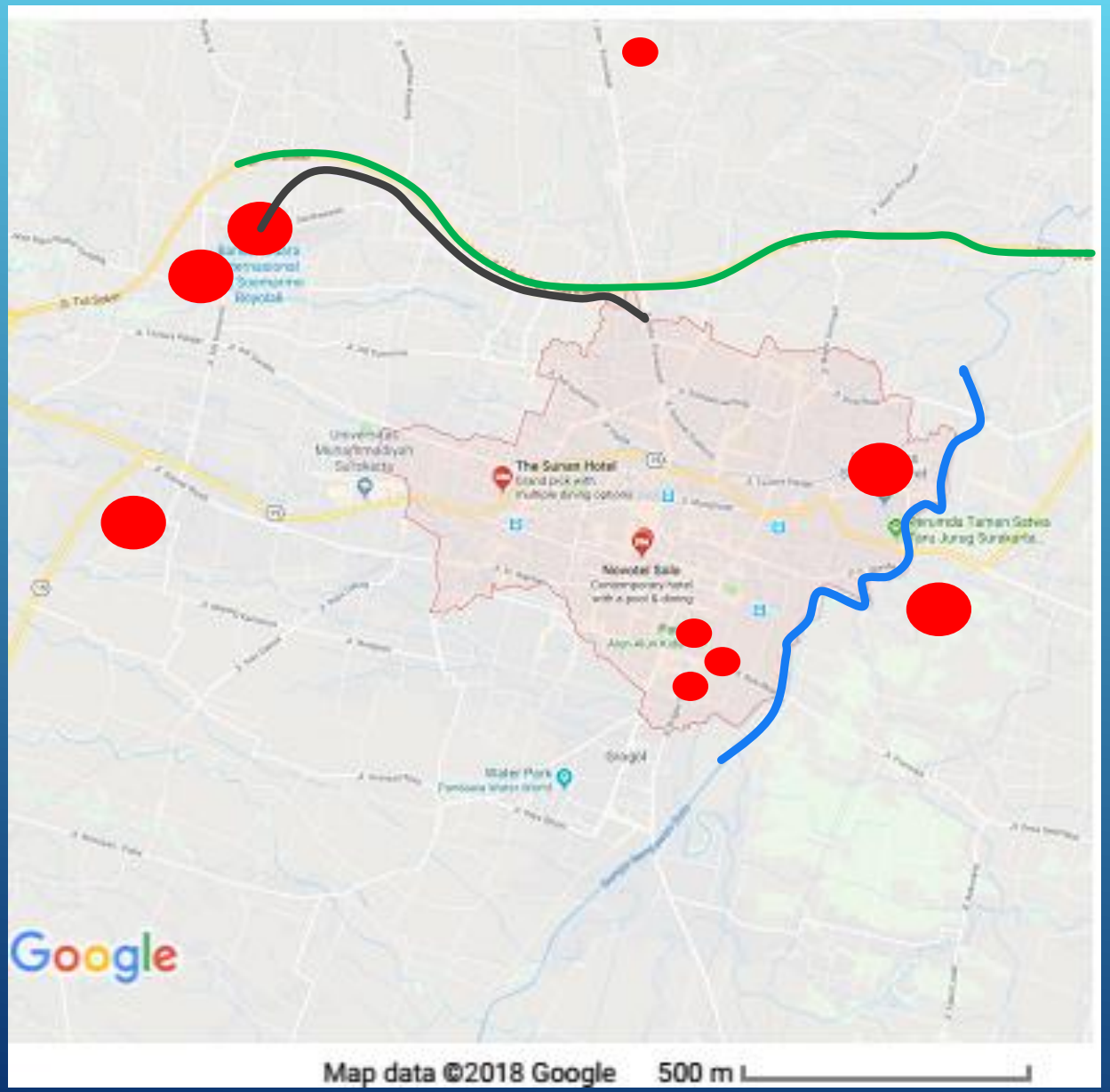
TOP INDONESIAN LIVABLE CITIES, 2017*

No	City	Livability index	Note
1	Surakarta	66.9	The best
2	Palembang	66.6	
3	Balikpapan	65.8	
4	Denpasar	65.5	
5	South Tangerang	65.4	
6	Banjarmasin	65.1	

- *Survey based on: food, facilities, water, education, health facilities
- *Source: Ikatan Ahli Perencanaan Indonesia (IAPI, 2017)

STRATEGIC NATIONAL ASSET IN AND NEAR SURAKARTA

No	Asset	Name	Note
1	Int'l airport	Adi Sumarmo	
2	Air Base	Adi Sumarmo	
3	Spacial Force	Kopassus, Kostrad	
4	University	UNS	> 36.000 students
5	River	Bengawan Solo	Longest river in Java (548 km)
6	Historical buliding/ tourist destintion	Keraton, Mangkunegaran, Batik village, Klewer, Beteng, Great mosque,	Attract tourists coming to Surakarta
7	Prehistory site	Sangiran	Recognised by UNESCO



CURRENT INFRASTRUCTURE PROJECT SURROUNDING SURAKARTA

- On going toll road project
- On going airport train project
- Bengawan Solo Parapet wall project Solo
-
- Strategic assets

JOGLOSEMAR TRIANGLE

SURAKARTA

HERITAGE CITY
CULTURAL CITY
STRATEGIC CITY

HOWEVER

POTENTIAL THREATS

FACES BY SURAKARTA

MAJOR POTENTIAL THREATS FOR SURAKARTA

- Volcanoes : Mt. Lawu (last eruption: 28/11/1885)
  Mt. Merapi (most active volcano in Indonesia),
  Mt. Merbabu (last eruption: 1797)
- Flooding : Lowland elev. →Flooding from River Bengawan Solo (main flood: 1915, 1966, 2016), yearly inundation
- Earthquake : Java Subduction, Opak Fault (5 mm/yr), Merapi-Merbabu Fault (1 mm/yr), Kendeng Fault

Opak Fault caused major earthquake in Jogjakarta 27 may 2006 (very close to Surakarta)

VOLCANOES

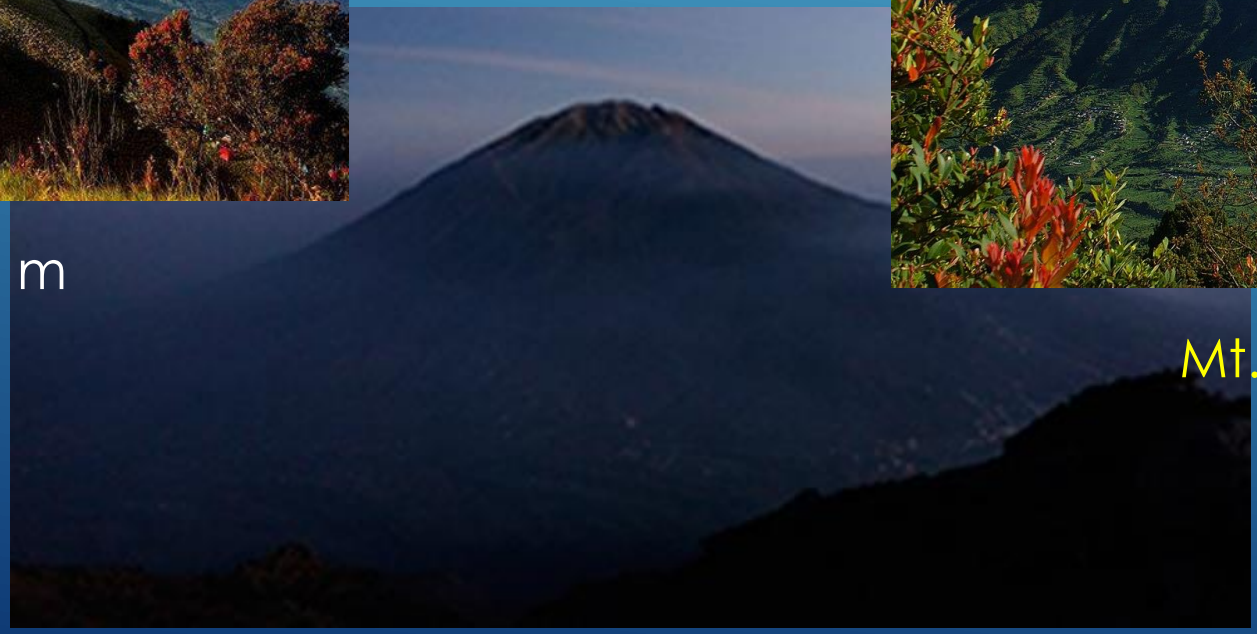

Jepara
Cirebon
Semarang
CENTRAL JAVA
Surabaya
Tasikmalaya
Purwokerto
40 km
20 km
Sidoarjo
EAST JAVA
Cilacap
Kediri
SPECIAL REGION
OF YOGYAKARTA
Malang
Jember
BALI
Denpasar
Pulau Lombok
Google
©2018 Data SIO, NOAA, U.S. Navy, NGA, GEBCO, Landsat / Copernicus, Map data ©2018 Google
50 km

BEAUTIFUL SCENARY OF MOUNTS

NEAR SURAKARTA

Mt. Lawu, 3.265 m

Mt. Merbabu, 3.145 m



Mt. Merapi, 2.930 m

VOLCANOES

Mt. Lawu (last eruption: 28/11/1885)

Mt. Merapi (most active volcano in Indonesia),

Mt. Merbabu (last eruption: 1797)

ERUPTION OF MERAPI

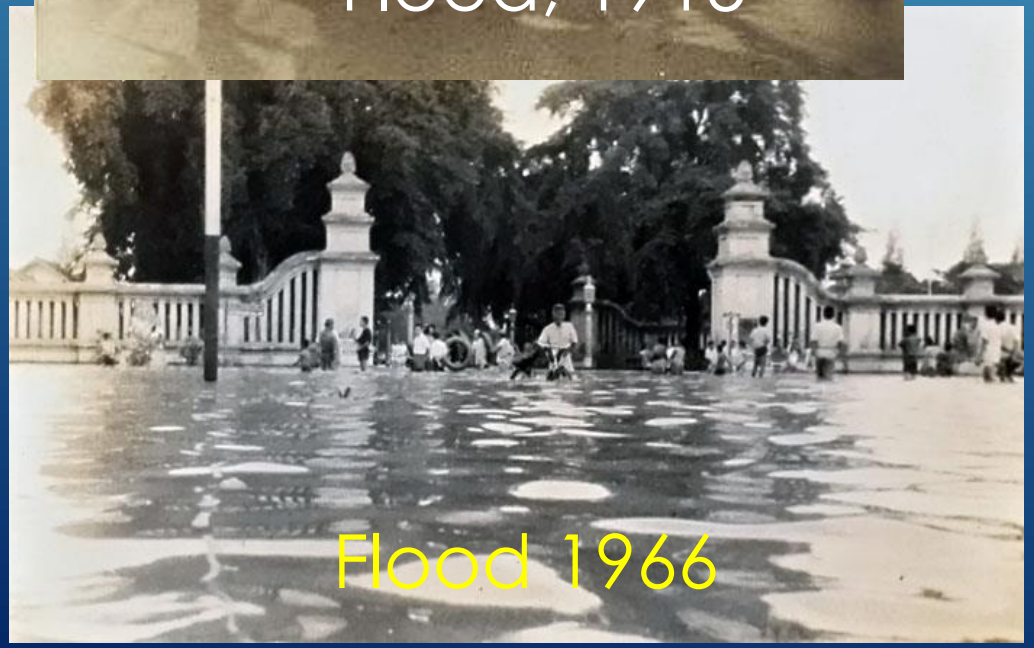
Source:
http://www.kemendagri.go.id/news/2016/11/23

Source:
http://jateng.tribunnews.com/2015/12/02/

FLOOD

MAIN FLOOD IN SOLO

Flood, 1915

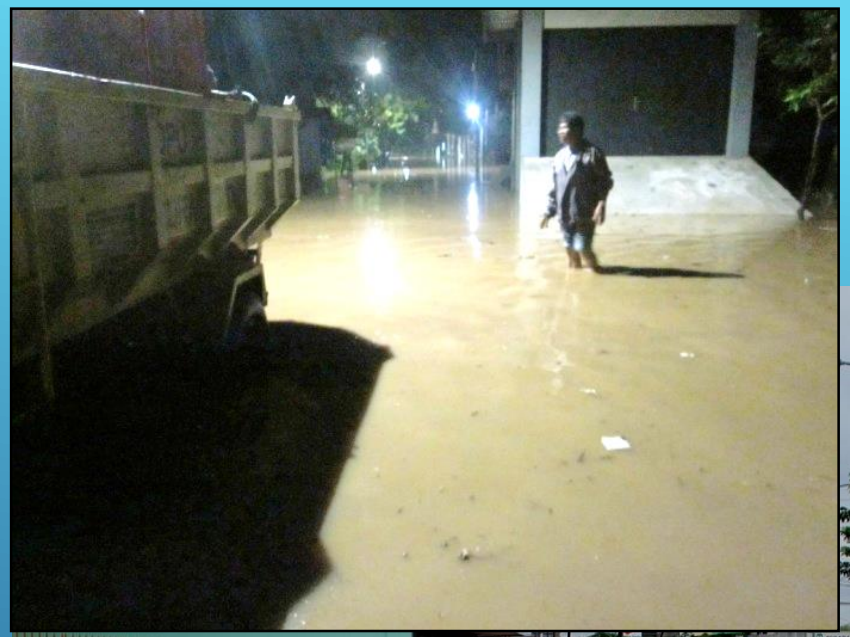


Flood 1966

Flood, 2016

Frequent Flood*

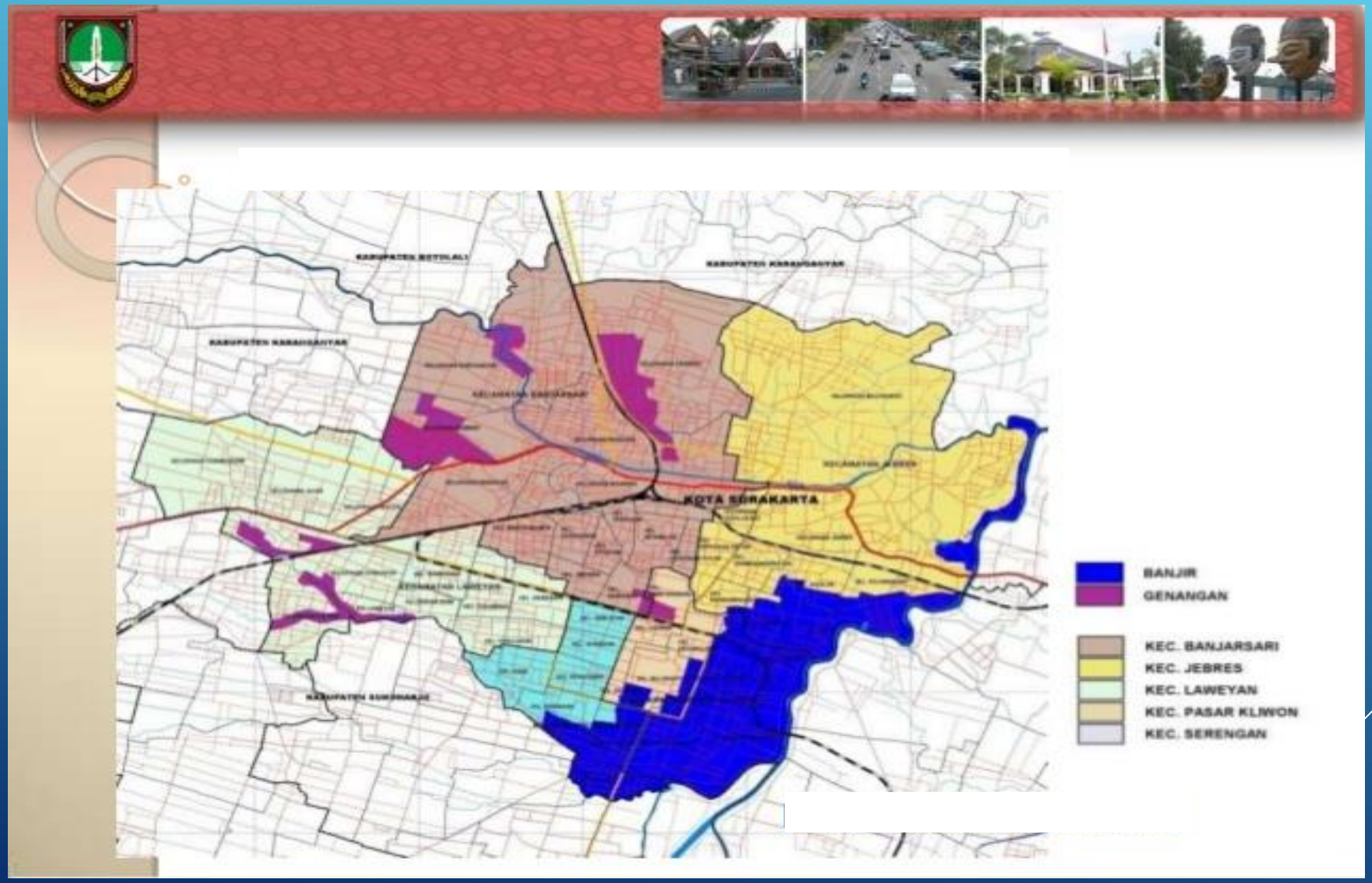
*PUPR Surakarta, anonymous



Yearly Inundation*

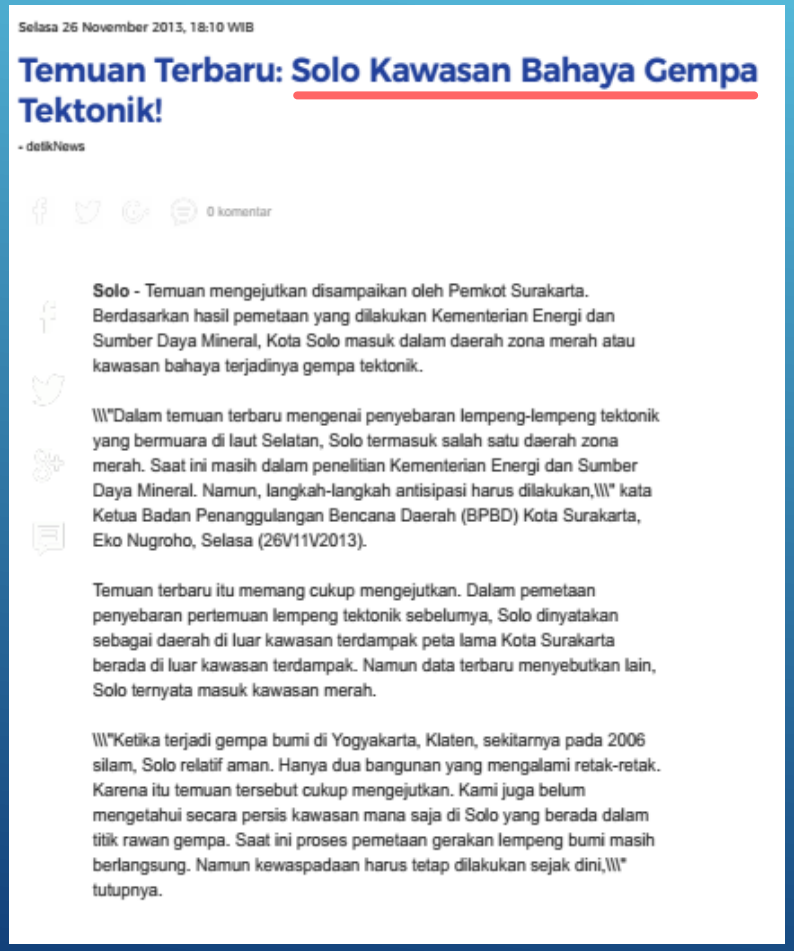
*PUPR Surakarta, anonymous

INUNDATION AND FLOOD PRONE AREA



EARTHQUAKE

EARTHQUAKE



Selasa 26 November 2013, 18:10 WIB

Temuan Terbaru: Solo Kawasan Bahaya Gempa Tektonik!

- detikNews

0 komentar

Solo - Temuan mengejutkan disampaikan oleh Pemkot Surakarta. Berdasarkan hasil pemetaan yang dilakukan Kementerian Energi dan Sumber Daya Mineral, Kota Solo masuk dalam daerah zona merah atau kawasan bahaya terjadinya gempa tektonik.

\\\"Dalam temuan terbaru mengenai penyebaran lempeng-lempeng tektonik yang bermuara di laut Selatan, Solo termasuk salah satu daerah zona merah. Saat ini masih dalam penelitian Kementerian Energi dan Sumber Daya Mineral. Namun, langkah-langkah antisipasi harus dilakukan,\\\" kata Ketua Badan Penanggulangan Bencana Daerah (BPBD) Kota Surakarta, Eko Nugroho, Selasa (26V11V2013).

Temuan terbaru itu memang cukup mengejutkan. Dalam pemetaan penyebaran pertemuan lempeng tektonik sebelumya, Solo dinyatakan sebagai daerah di luar kawasan terdampak peta lama Kota Surakarta berada di luar kawasan terdampak. Namun data terbaru menyebutkan lain, Solo ternyata masuk kawasan merah.

\\\"Ketika terjadi gempa bumi di Yogyakarta, Klaten, sekitarnya pada 2006 silam, Solo relatif aman. Hanya dua bangunan yang mengalami retak-retak. Karena itu temuan tersebut cukup mengejutkan. Kami juga belum mengetahui secara persis kawasan mana saja di Solo yang berada dalam titik rawan gempa. Saat ini proses pemetaan gerakan lempeng bumi masih berlangsung. Namun kewaspadaan harus tetap dilakukan sejak dini,\\\" tutupnya.

Kota Solo Masuk Zona Merah dalam Peta Gempa

14 Desember, 2013 - 06:23
NASIONAL (/NASIONAL)

SOLO, (PRLM).- Wilayah Surakarta, khususnya Kota Solo yang selama ini tidak termasuk dalam peta gempa tektonik. Namun berdasarkan laporan terakhir hasil penelitian tim ahli kegempaan Kementerian Energi dan Sumber Daya Mineral (ESDM) menunjukkan wilayah itu masuk dalam "zona merah".

Dalam peta kegempaan yang baru-baru ini dirilis Kementerian (ESDM), ada "titik merah" yang mengindikasikan potensi gempa tektonik yang perlu diwaspadai.

Kepala Badan Penanggulangan Bencana Daerah (BPBD) Kota Solo, Eko Nugroho mengungkapkan hal itu kepada "PRLM" di kantornya, Jumat (13/12/2013).

Dia menjelaskan potensi bencana di Kota Solo selain bencana banjir tahunan akibat luapan Sungai Bengawan Solo.

"Titik merah pada peta kegempaan yang muncul pada area Kota Solo dan terpantau dalam penelitian Kementerian ESDM masih terus dikaji. Hal itu disampaikan ke BPBD Kota Solo supaya dapat mengambil langkah antisipasi, sehingga jika kelak benar-benar terjadi gempa tektonik dapat meminimalkan dampak negatifnya," ujar Eko Nugroho.

Mengutip penjelasan tim ahli Kemen EDSDM, Eko menyebutkan, temuan baru berupa munculnya titik merah di Kota Solo sebagai indikasi daerah zona merah dalam peta kegempaan, ada kaitan dengan penyebaran lempeng-lempeng tektonik yang bermuara di laut Selatan.

Dia mengakui, temuan baru itu memang mengejutkan, karena dalam peta penyebaran pertemuan lempeng-lempeng tektonik sebelumnya posisi Kota Solo berada di luar kawasan terdampak.

Ketika wilayah Yogyakarta dan Surakarta sisi barat daya terlanda gempa tektonik dengan kekuatan 5,6 skala richter yang menimbulkan kerusakan hebat dan memakan banyak korban jiwa pada 2006, Kota Solo termasuk relatif aman. Berdasarkan laporan yang diterima Pemerintah Kota Solo kala itu, hanya tercatat dua bangunan yang mengalami retak-retak.

"Sampai saat ini kami belum tahu secara persis kawasan mana saja di Kota Solo yang masuk dalam titik rawan gempa. Sebab Kemen ESDM masih terus memantau dan memetakan gerakan lempeng. Tapi, dengan adanya temuan baru tersebut diharapkan warga Kota Solo dapat memahami potensi bencana yang mungkin terjadi," jelasnya. (Tok Suwarto/A_88)***

National newpaper, 2013

NEED DETAILED INFO

1. Volcanoes : How dangerous of volcanoes to Suarakarta
2. Floods : How extent flood threats Surakarta
3. Earthquakes : What is the level of the earthquake risk faces by Surakarta.

UNIVERSITY AS A RESEARCH INSTITUTON

MUST RESPOND

BY CHANGING THE CHALLENGES TO **OPPORTUNITIES**

~~CHALLENGES~~/OPPORTUNITY

For collecting the information it needs at least:

1) Volcanologist
2) Seismologist
3) Geologist
4) Hydrologist
5) Geotechnical engineering

Usually available in Campus

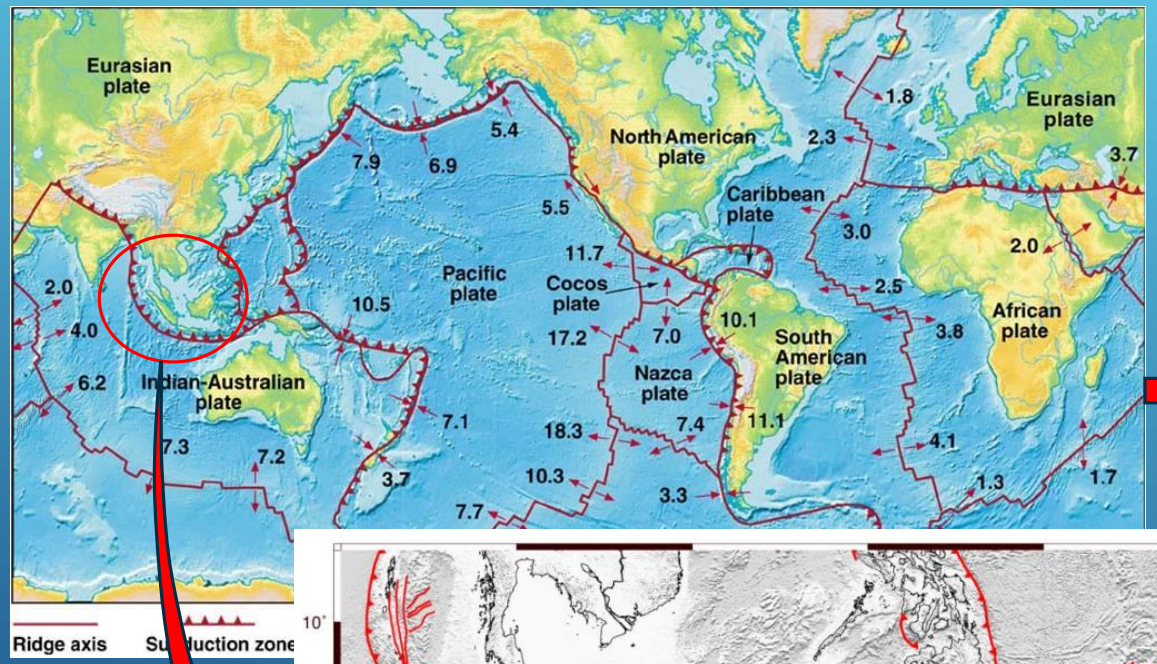
THIS PRESENTATION

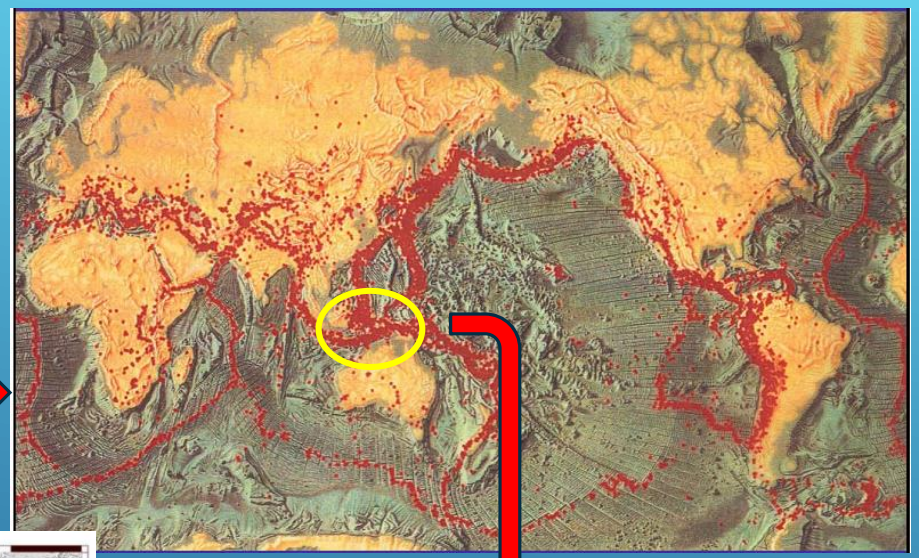
IS FOCUSING ON **GEOTECHNICAL ENGINEERING**

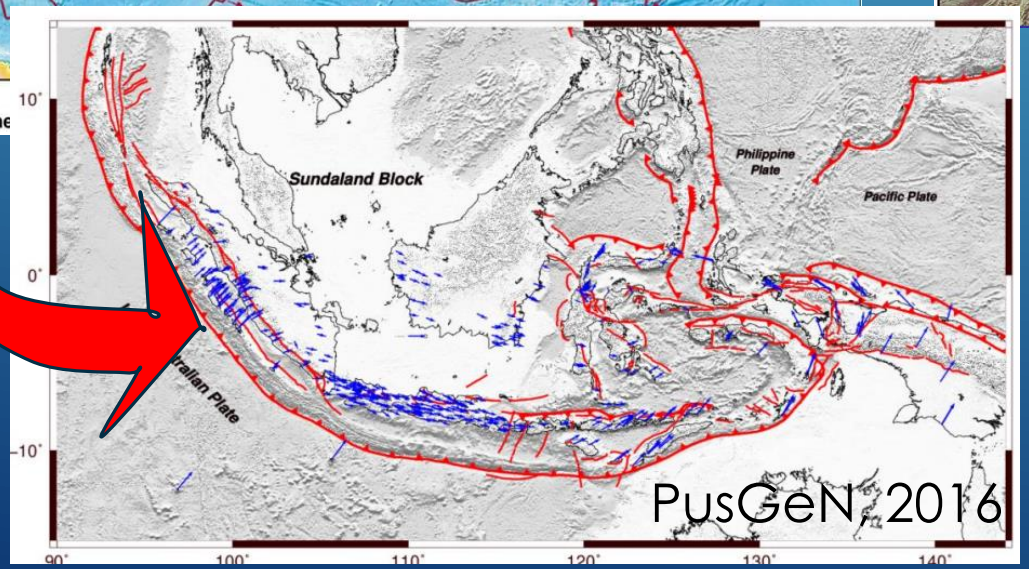
APPROACH

THE GEOTECHNICAL PERSPECTIVE

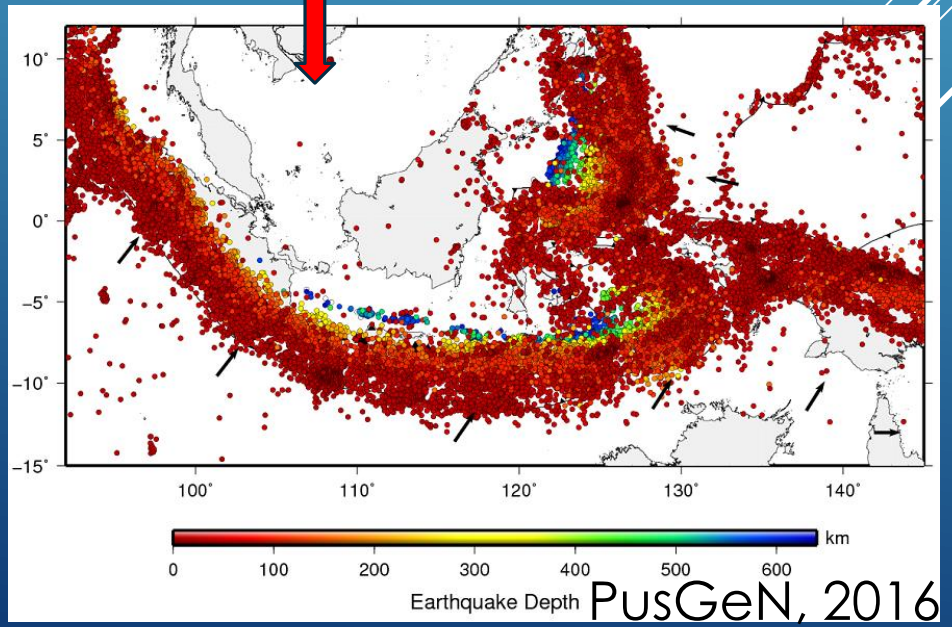
TECTONIC PLATE MOVEMENT





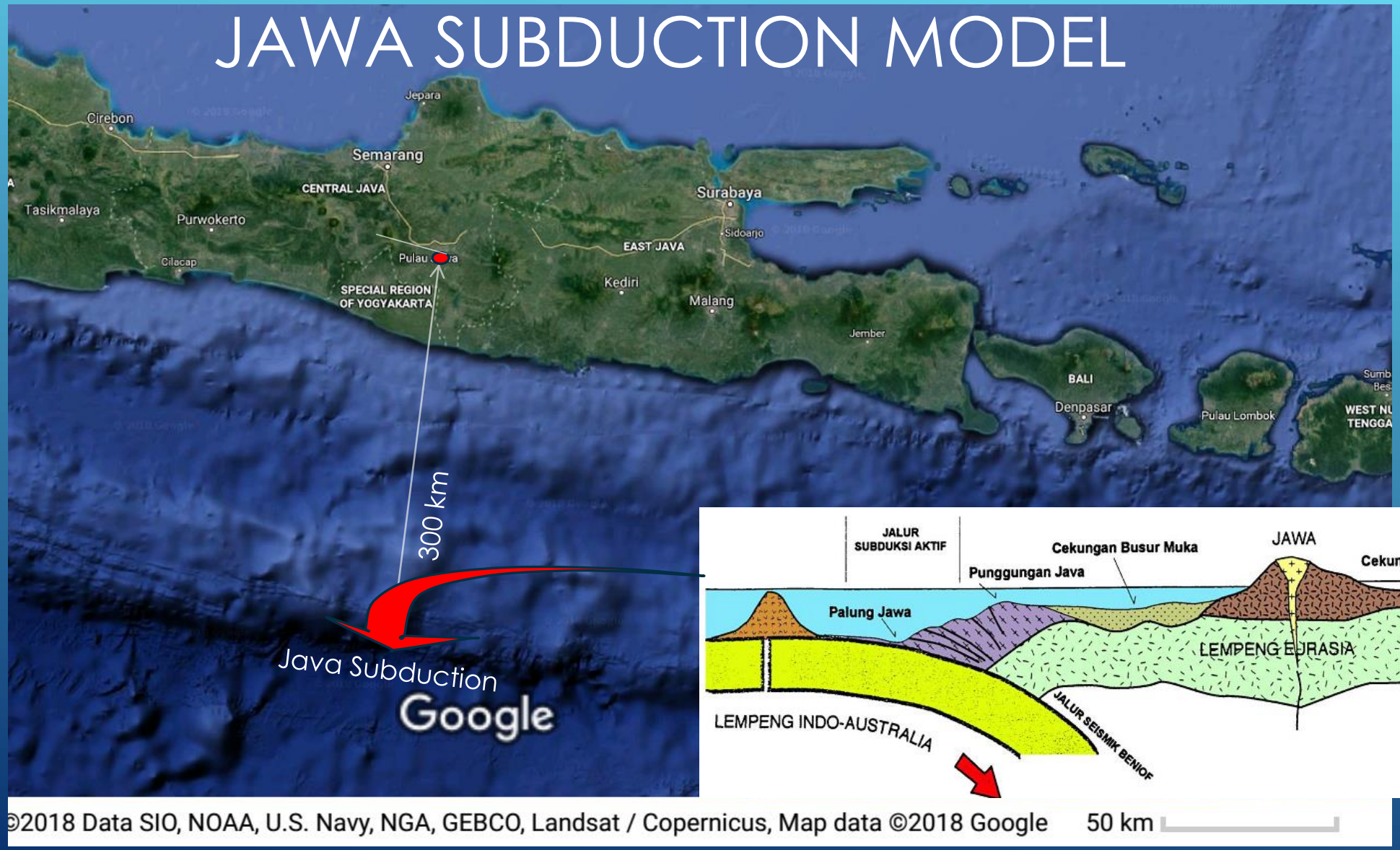


PusGeN, 2016



PusGeN, 2016

JAWA SUBDUCTION MODEL



(SOME) ACTIVE FAULTS NEAR SURAKARTA

Opak Fault (5 mm/yr),

Merapi- Merbabu Fault (1 mm/yr),

Kendeng Fault

UNIVERSITY CONTRIBUTION
FOR
SURAKARTA

GEOTECHNICAL POINT VIEW

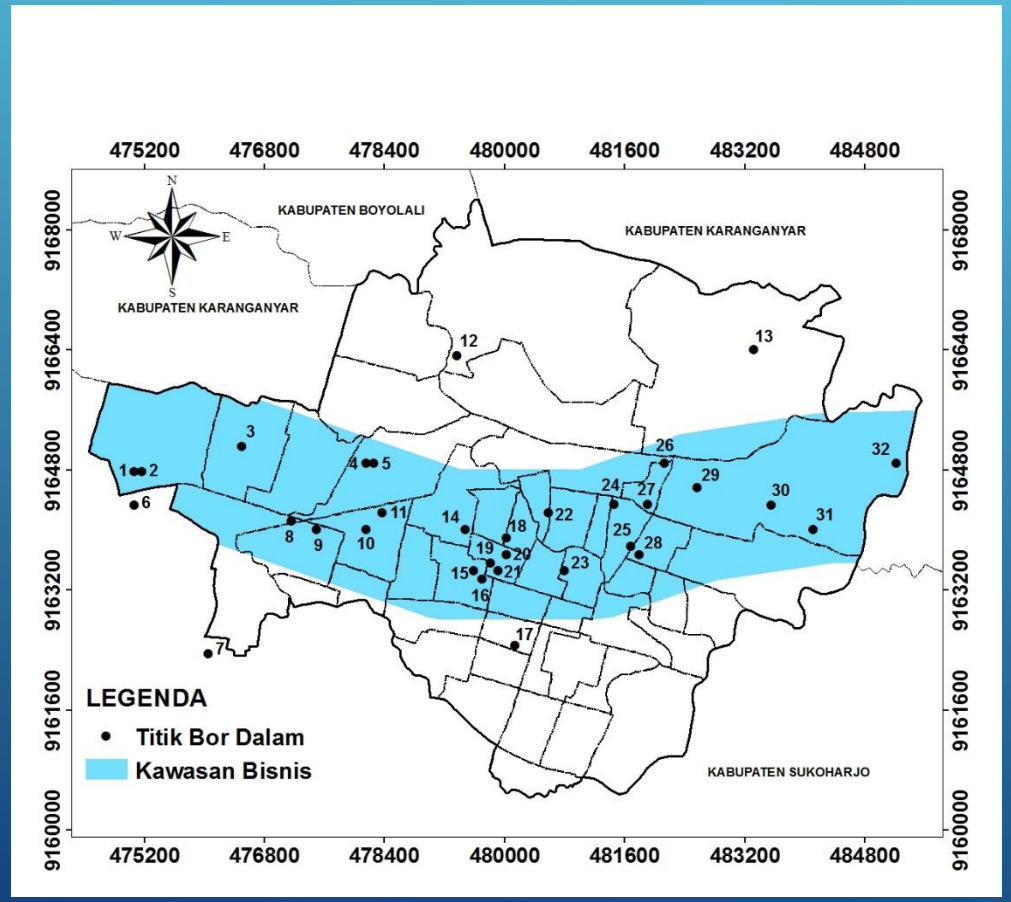
FINDING AND RESULT

BASED ON BORE HOLE DATA AND GEOPHICICS (5 YEARS AGO)

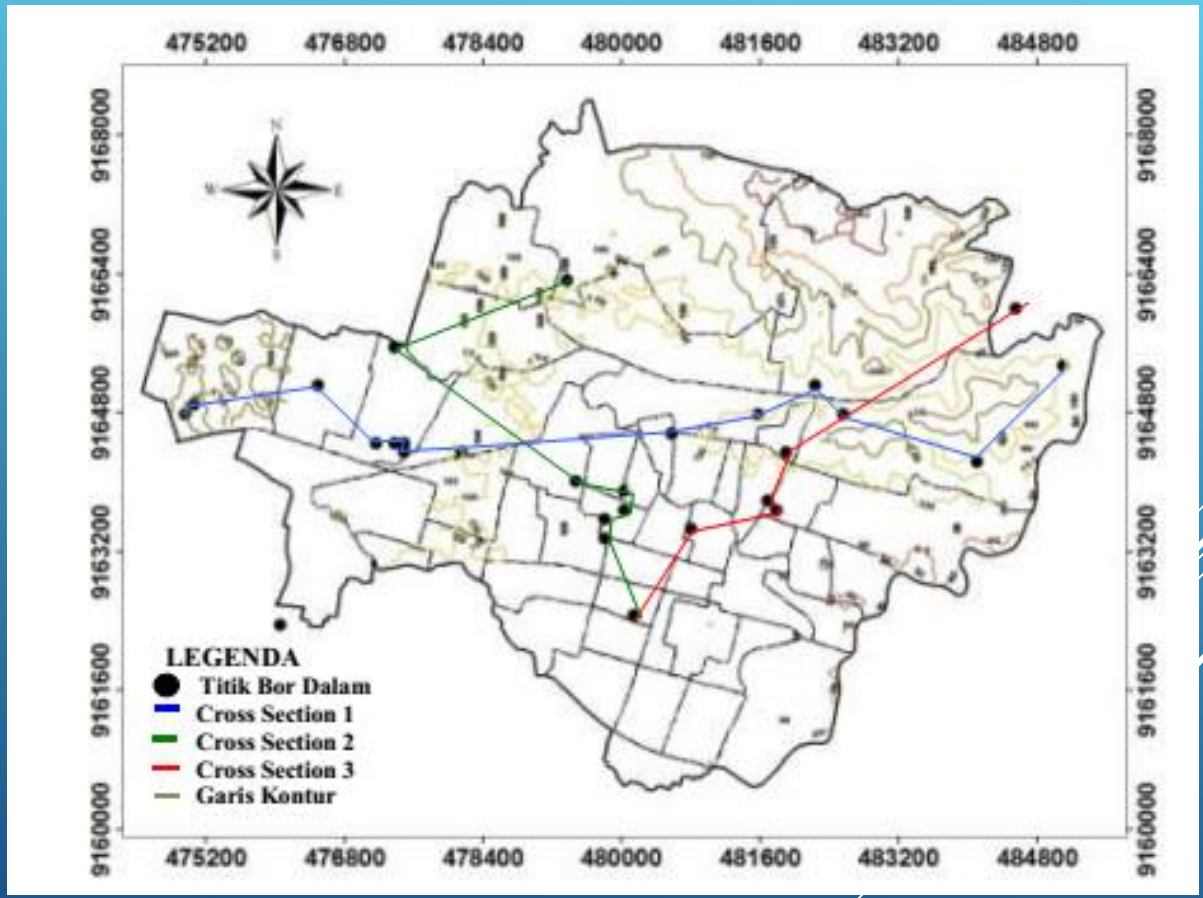
- Hard soil surface of Surakarta and surrounding area
- Seismic hazard of Surakarta
- Location of bedrock
- Amplification factors and domain periods

BORE HOLES POINTS OF SURAKARTA

(LAST UPDATED 2013)

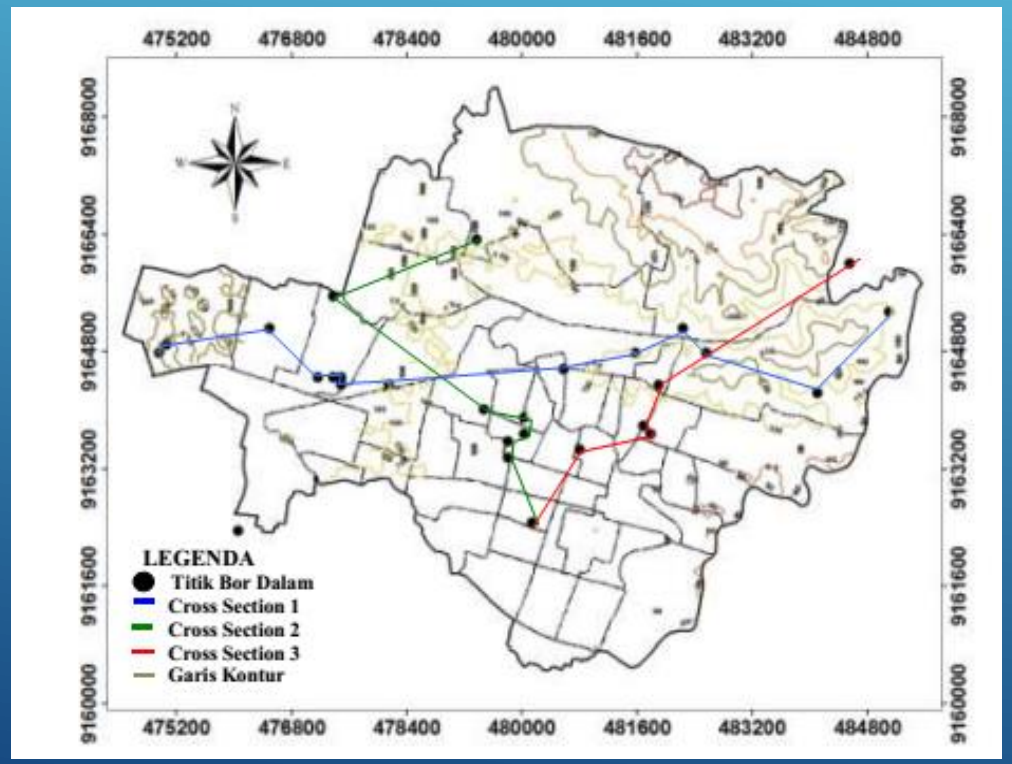


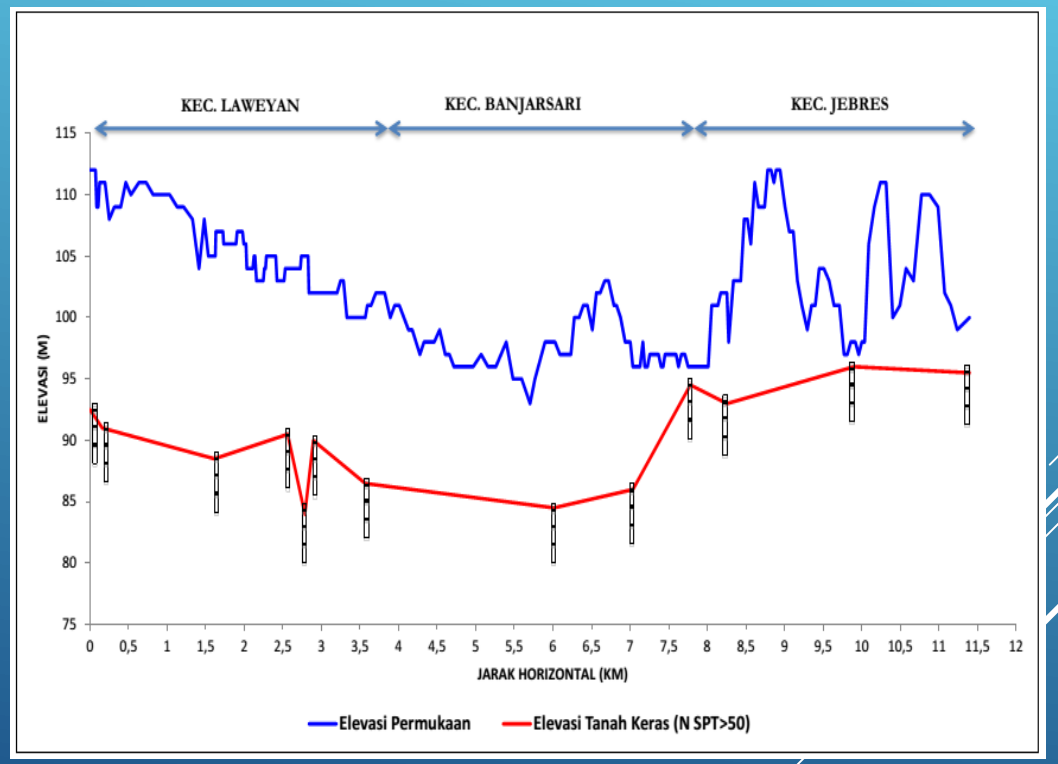
The scatter of bore holes



Cross sections

THE DEPTH OF HARD SOIL SURFACE OF SURKARTA



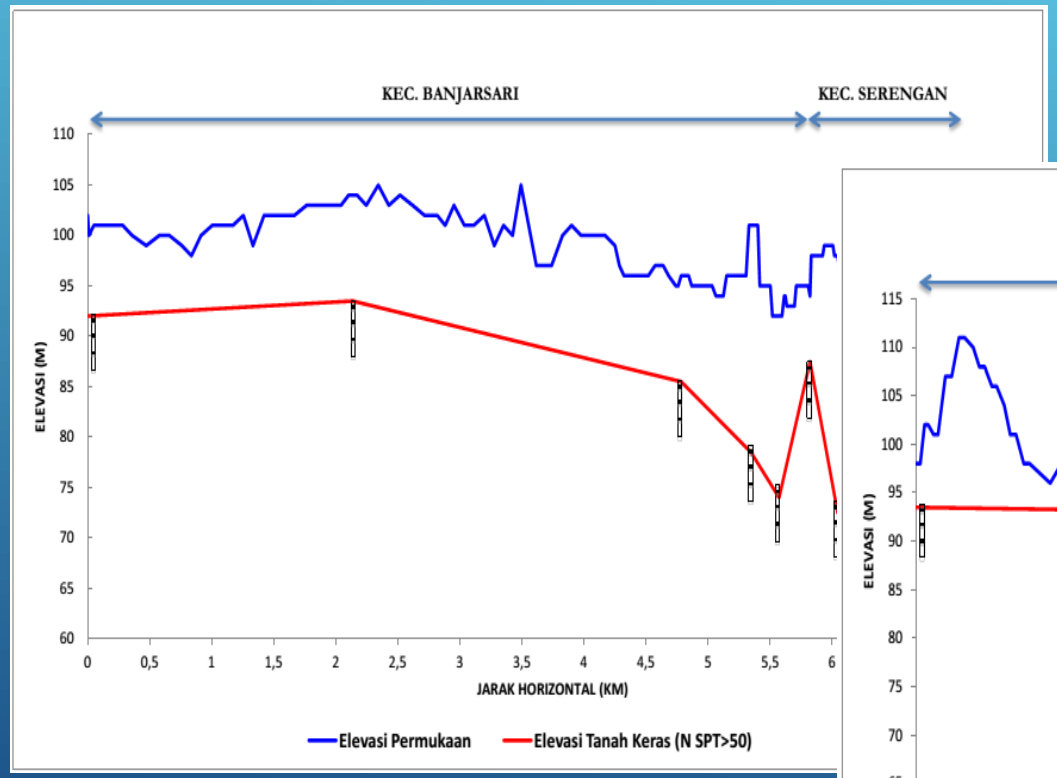


The scatter of bore hole

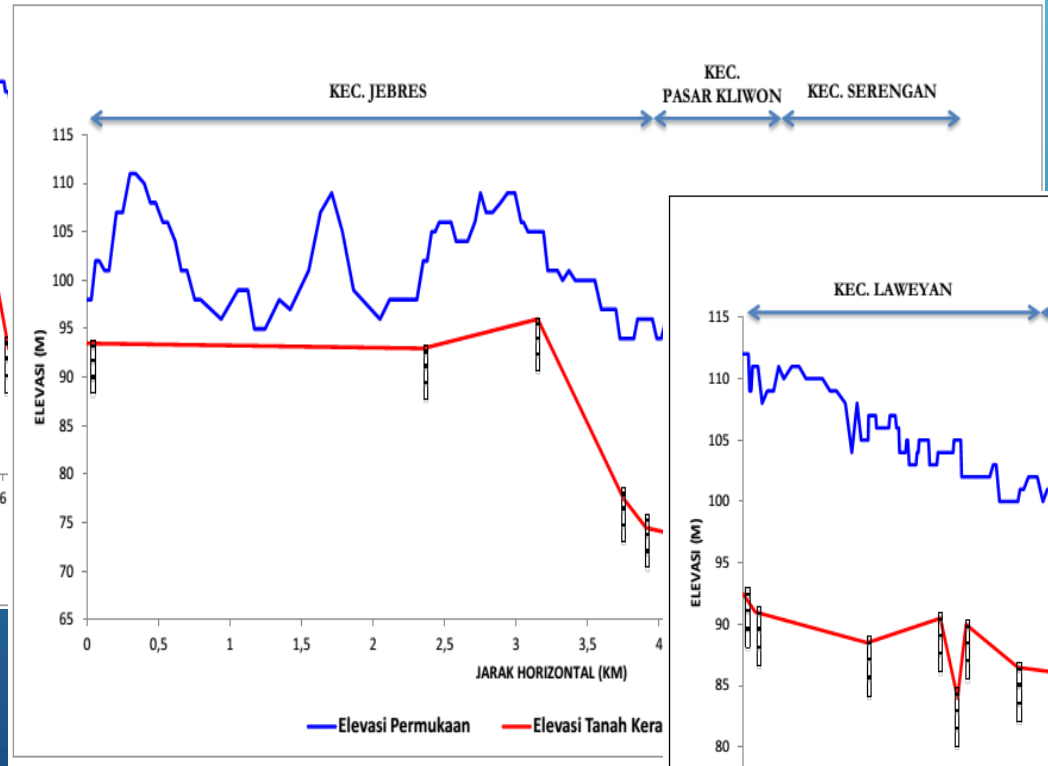
Cross sections: west-east

THE DEPTH OF HARD SOIL SURFACE OF SURKARTA

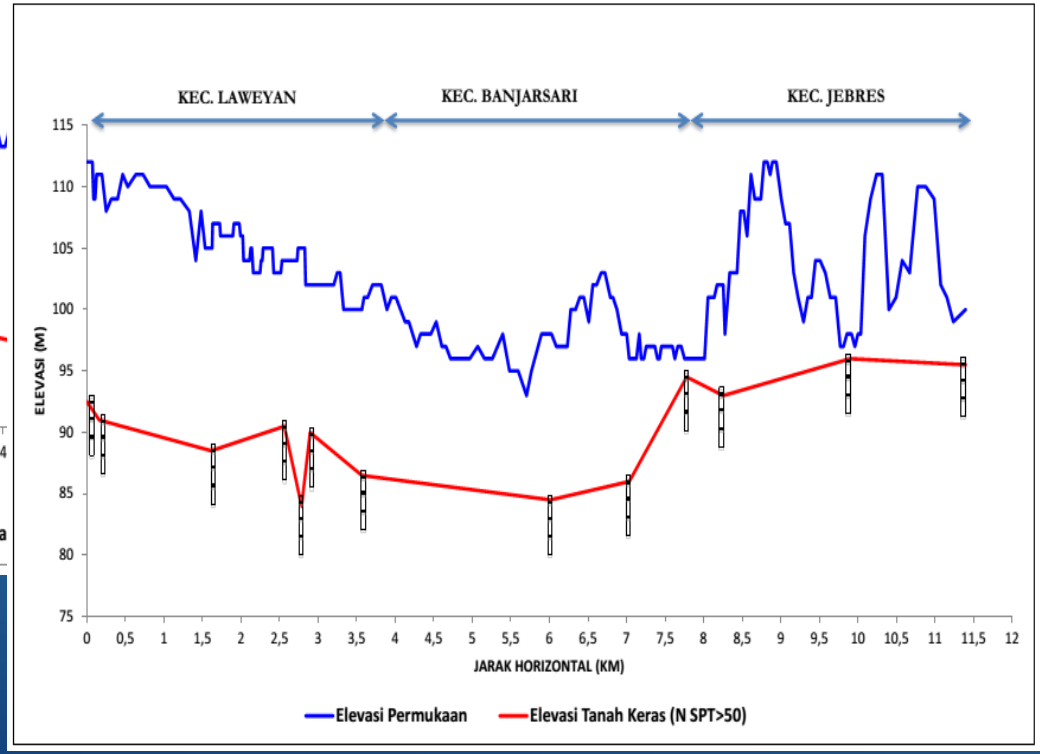
BASED ON BORE HOLE DATA



south-north



south-northeast



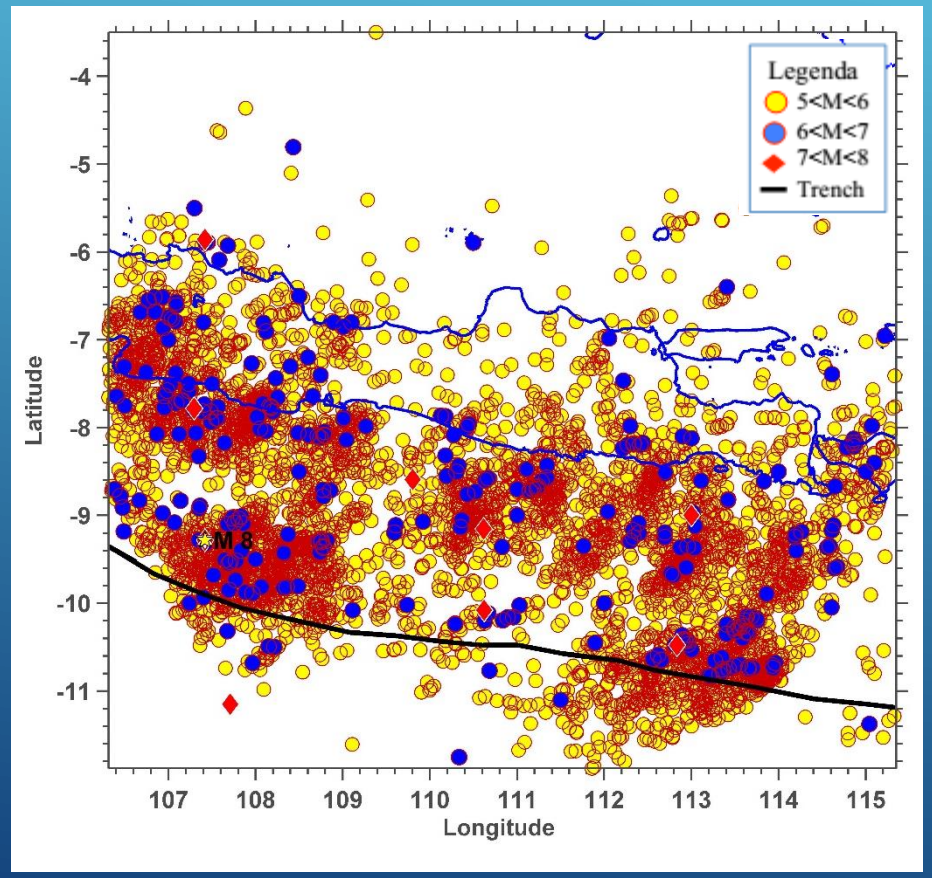
west-east

SEISMICITY OF SURAKARTA

Have been presented and published in:

1. 19th Annual Scientific Meeting, Indonesian Society for Geotechnical Egineering, Jakarta, 2015
2. 20th Annual Scientific Meeting, Indonesian Society for Geotechnical Egineering, Jakarta, 2016
3. National Conference for Geotechnic, Indonesian Society for Geotechnical Egineering, Chapter Yogyakarta, 2016

SEISMICITY STUDY FOR SURAKARTA



Epicenter data for Surakarta

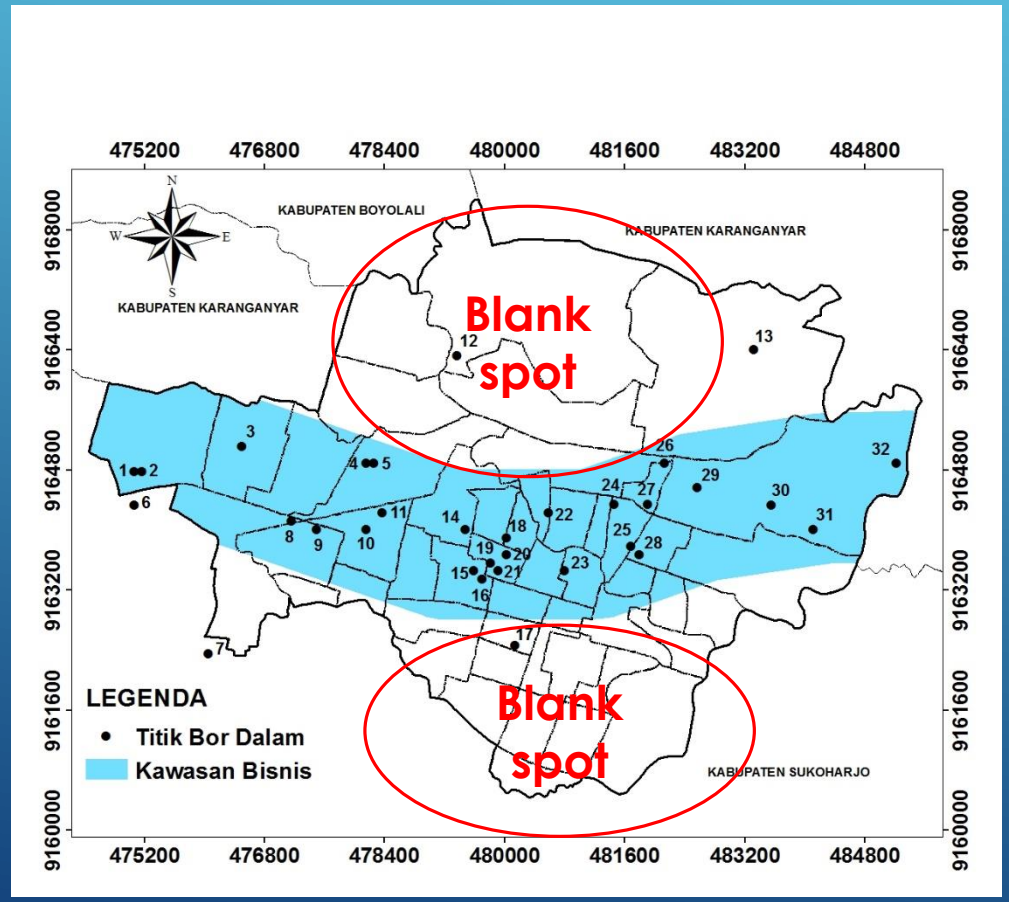
1916 - 2015

- Surakarta has the intensity of MMI VII for 500 year return period and VIII for 2500 years return period.
- Surakarta is categorized as the city with medium risk (level II) for 500 years return period and high risk (level III) for 2500 return period.

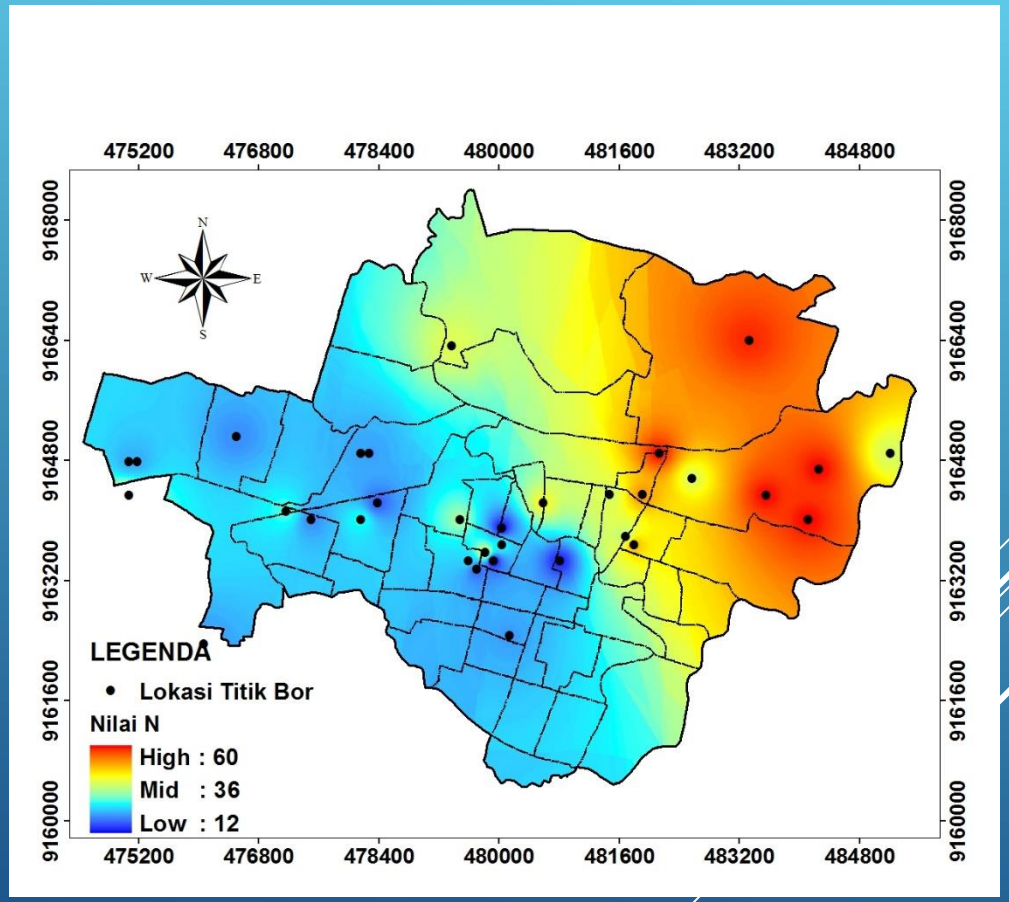
SEISMIC RISK LEVEL OF SURAKARTA

No	Return periods	PGA (g)	MMI Scale	Risk potension	Descripion
1	500 year	0.24 – 0.25	VII	Medium	• **Negligible damage for good design structure** • Slight to moderate damage in well built ordinary structures, • **Considerable damage in poorly built structures**
2	2500 year	0.41 – 0.43	VIII	High	• **Slight damage in specially design structure** • Considerble damage in ordinary buliding. • **Great damage in poorly bulilt structure**

BORE HOLES POINT OF SURAKARTA



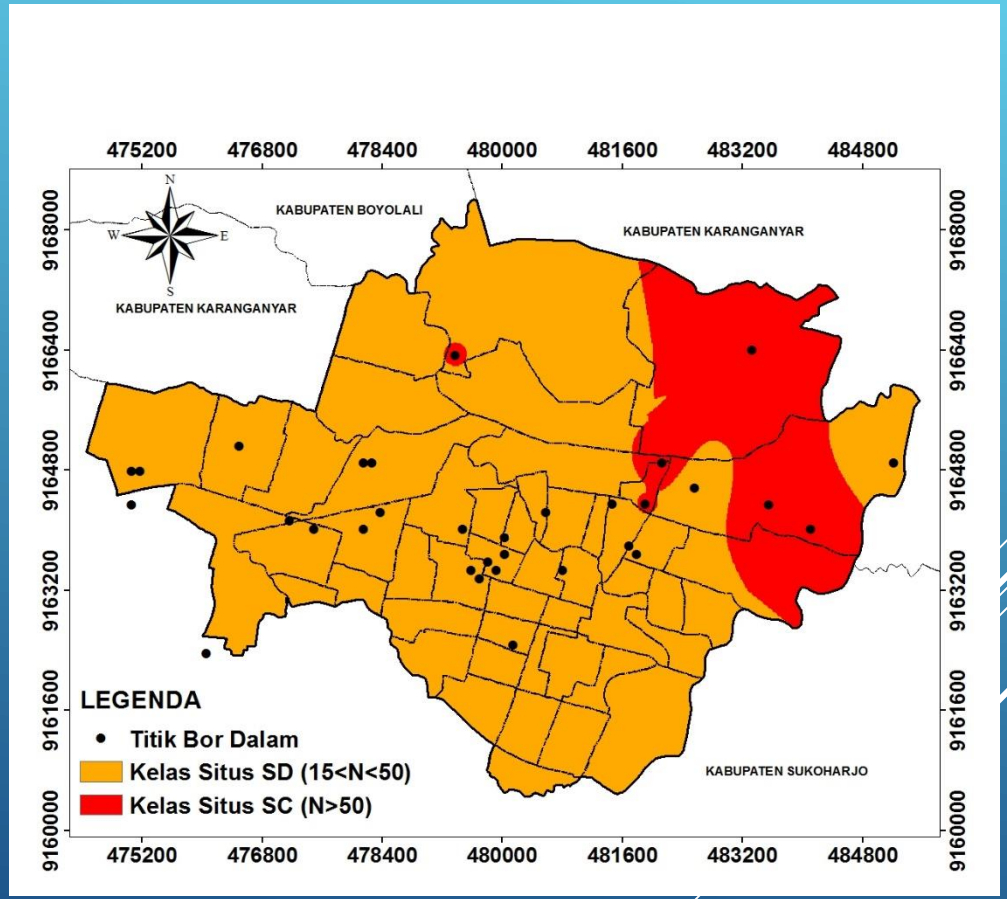
The scatter of bore hole



The variation of N SPT

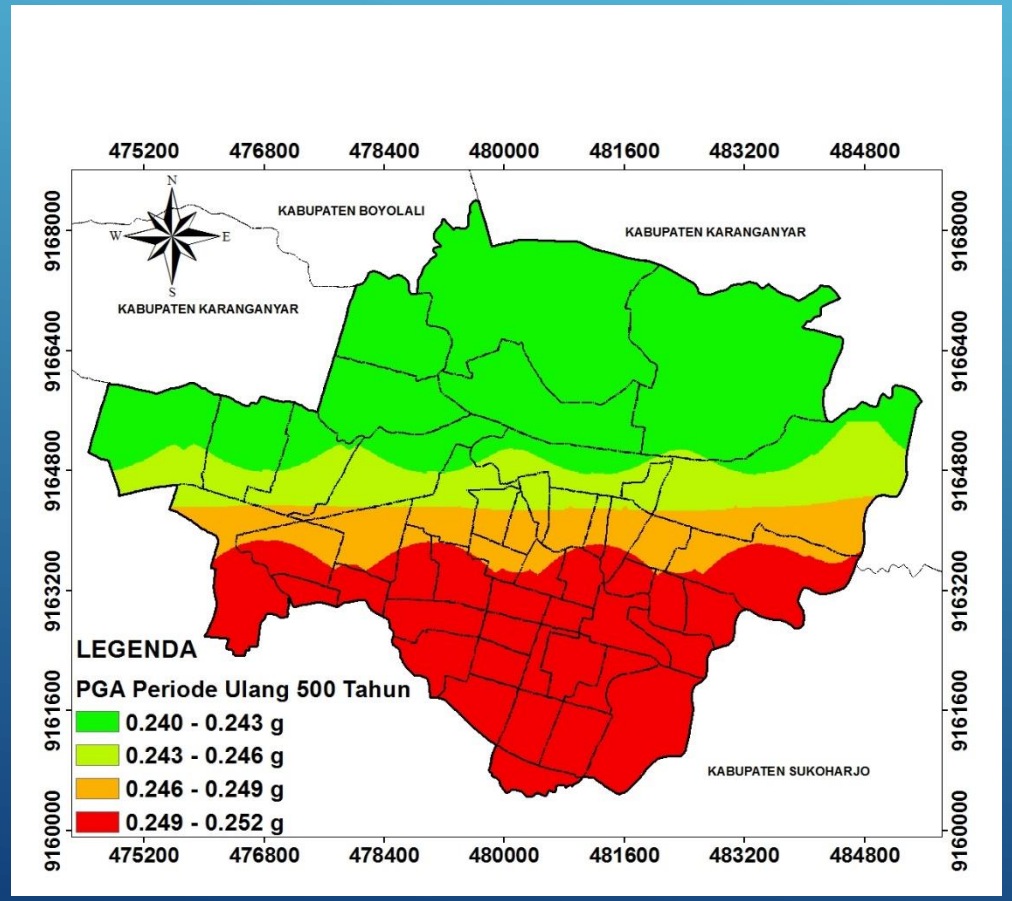
MICROZONATION MAP OF SURAKARTA

No	N SPT	Site class
1	N/A	SA (hard rock)
2	N/A	SB (rock)
3	> 50	SC (hard soil, soft rock)
4	15 - 50	SD (medium soil)
5	< 15	SE (soft soil)
6		SF (special soil)

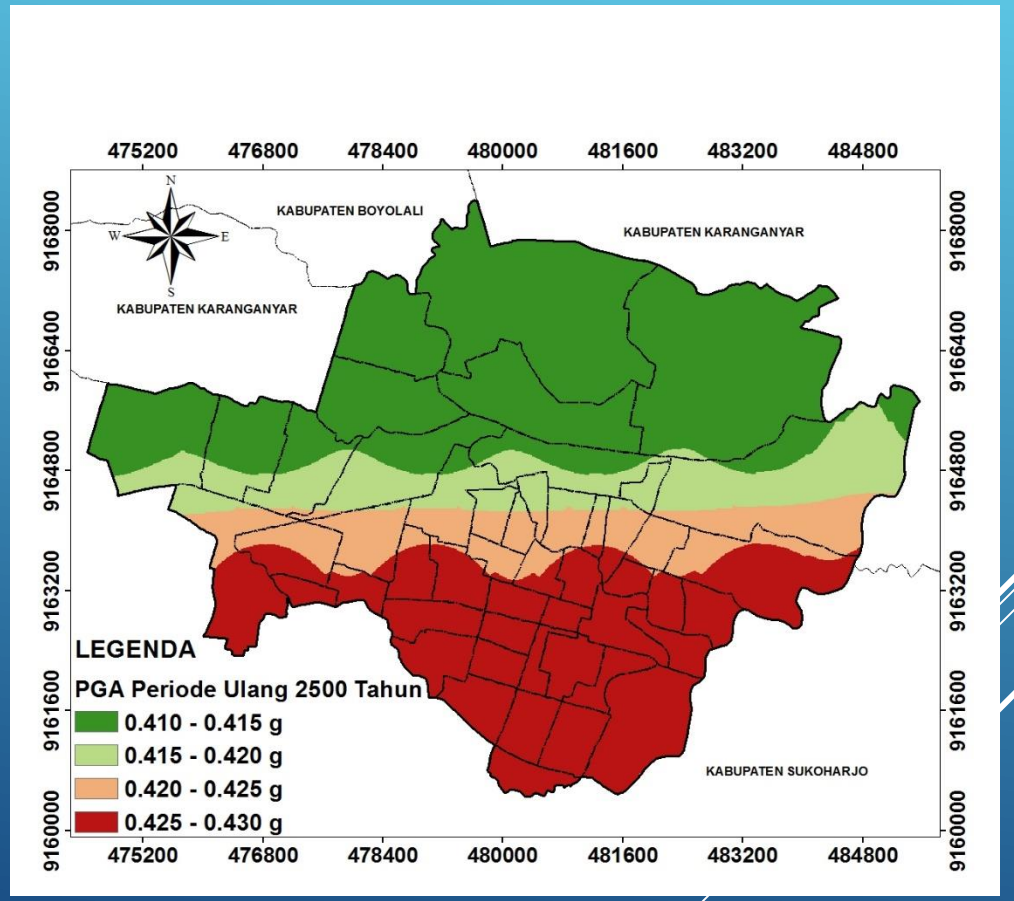


Site class map

SEISMIC HAZARD MAP OF SURAKARTA



500 year return period



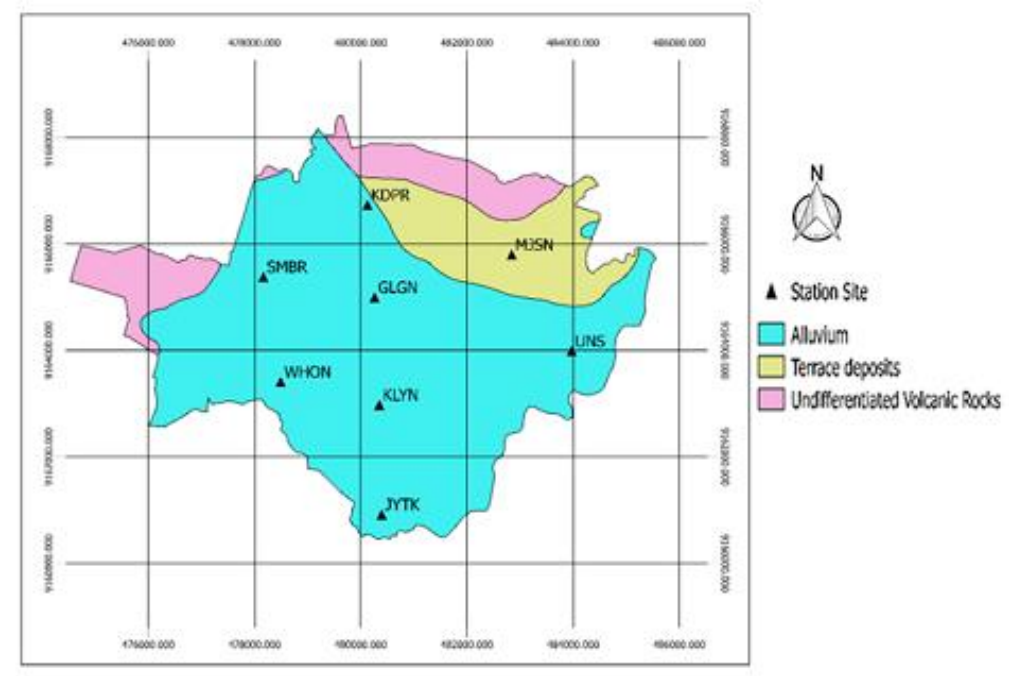
2500 year return period

GEOPHYSISCS SURVEY

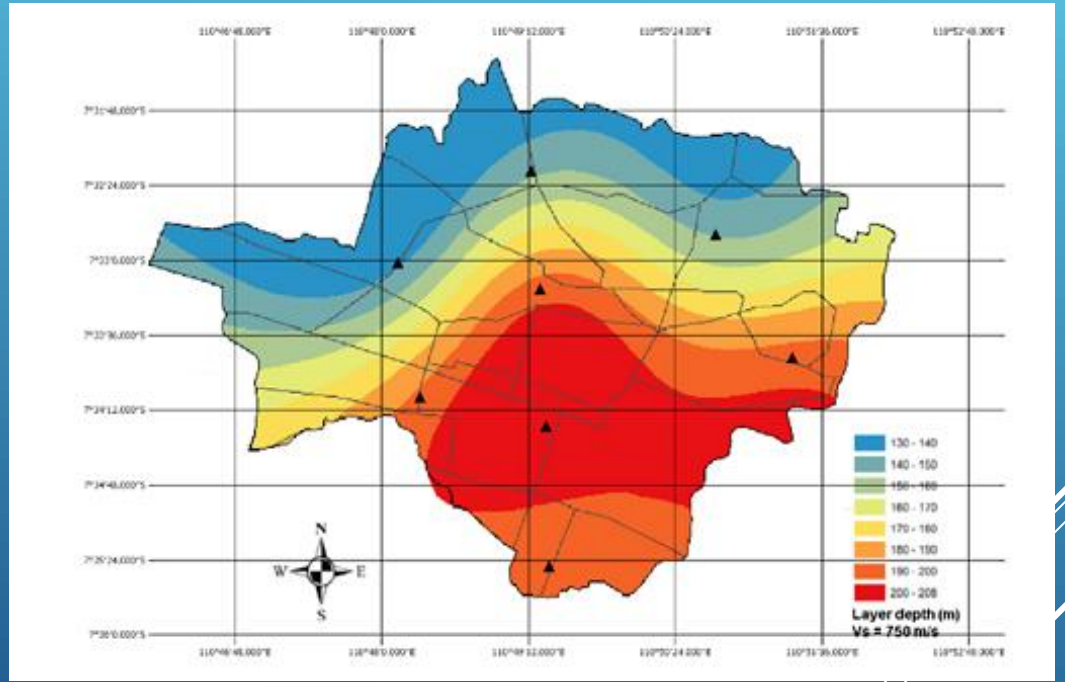
Microtremor survey team, 2014

Microtremor data recorder

GEOPHYSISCS SURVEY



Microtremor survey site



Contour of bedrock depth

DEPTH OF SURAKARTA BEDROCK

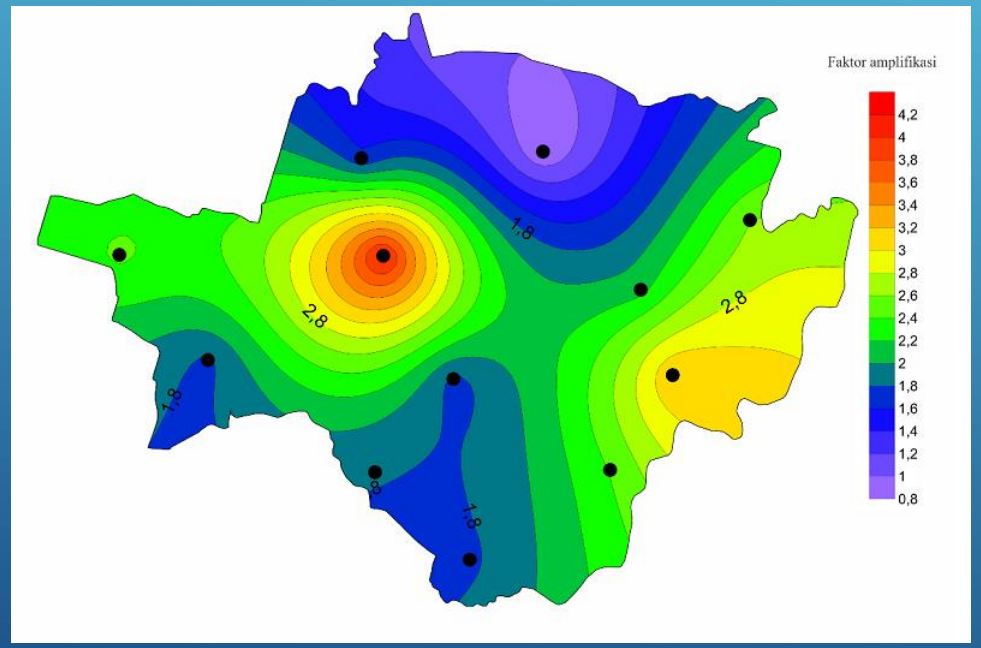
Table 2 Depths of engineering bedrock for Vs > 750 m/sec.

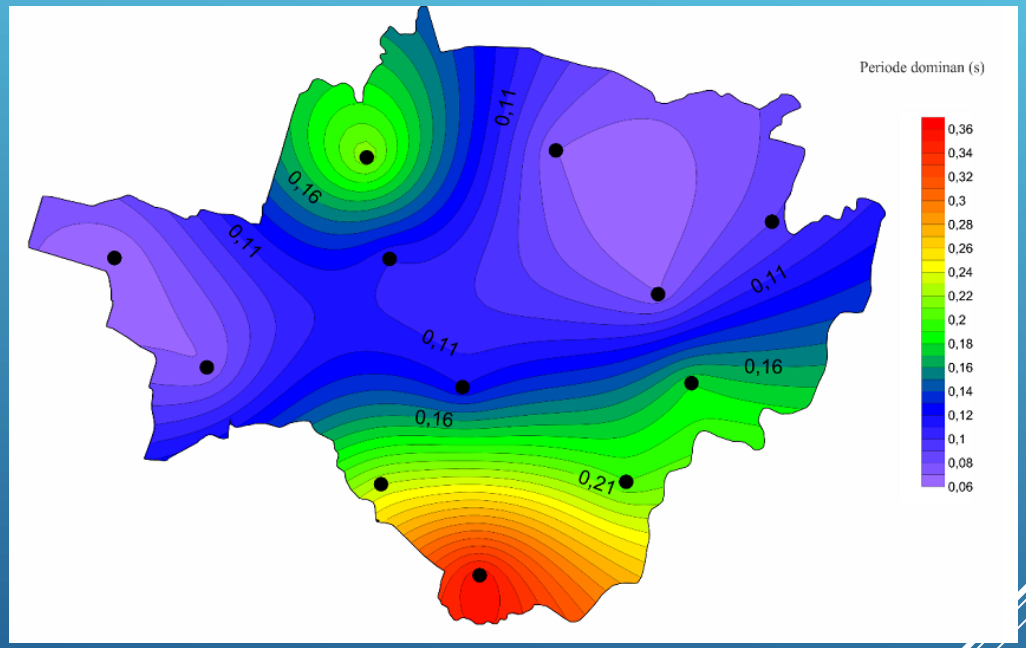
No	Station (code)	Long (deg)	Lat (deg)	Engineering Bedrock	
				Vs (m/sec)	Depth (m)
1	Sumber (SMBR)	110.803	– 7.550	782	139
2	Wahidin (WHDN)	110.806	– 7.568	771	193
3	Kadipiro (KDPR)	110.821	– 7.538	778	148
4	Gilingan (GLGN)	110.822	– 7.554	839	195
5	Kemlayan (KLYN)	110.823	– 7.572	814	208
6	Joyotakan (JYTK)	110.823	– 7.591	753	195
7	Mojosongo (MJSN)	110.846	– 7.546	800	149
8	UNS (UNS)	110.856	– 7.563	783	194

Sorja et. al (2017)

MICROTREMOR RESULT*

*PRATIWI AT AL, 2017





Zonation of Amp. Factor

Dominant periods (s)

CONCLUSION

1. Surakarta is a growing city located in strategic area togather with other two neighbour competing cities of Semarang and Yogyakarta
2. In Indonesia, Surakarta is a most liveable city with its distinctive attributes as a heritage and cultural city.
3. According to civil engineering perspective, Surakarta may have some potential threats; volcanic hazard, flood, and earthquake.
4. Based on geophisic study, the soil layer of Surakarta is classified as hard and medium soil layer with the location of bedrock is around 150m – 200 m.
5. Seismic risk level of Surakarta is level II (medium) and III (high) equivalent to MMI VII and VIII, so it is important to consider that modarate and considerable damages may occur on building due to earthquake in this region.
6. The information about engineering data of Surakarta is still very lacking. Reasearch institution such as university must be responsible for collecting more information about the city.

THANK YOU