JABATAN MINERAL DAN GEOSAINS MALAYSIA
KEMENTERIAN SUMBER ASLI, ALAM SEKITAR DAN PERUBAHAN IKLIM

APLIKASI TEKNOLOGI GEOSPATIAL DALAM PENGURUSAN BENCANA GEOLOGI TANAH RUNTUH NEGARA

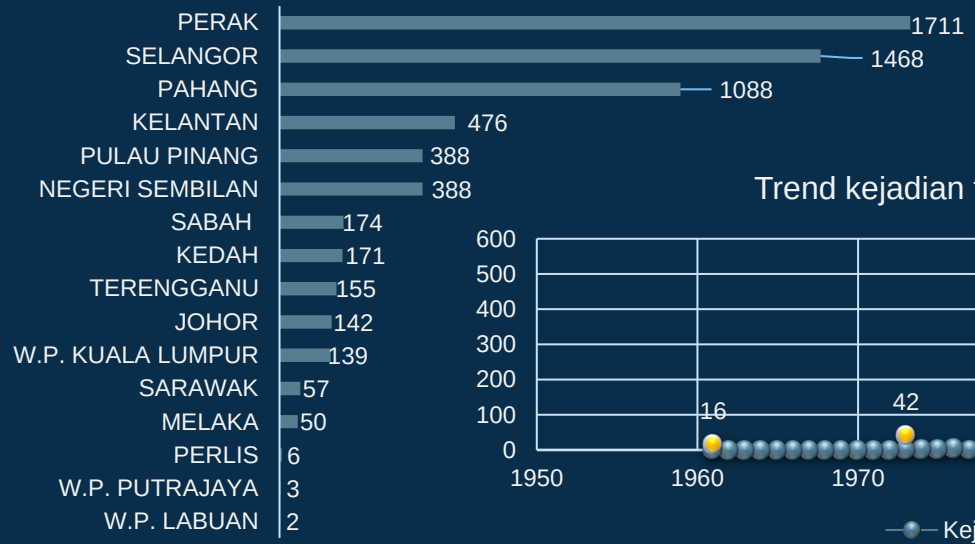
MOHD FARID BIN ABDUL KADIR, P.Geol

SIMPOSIUM MAKLUMAT GEOSPATIAL KEBANGSAAN (NGIS) 9
18 OKTOBER 2023
PICC, PUTRAJAYA

TANAH RUNTUH!

Tanah runtuh merupakan salah satu jenis bencana yang sering berlaku di Malaysia dan telah meragut banyak nyawa dan kerosakan harta benda.

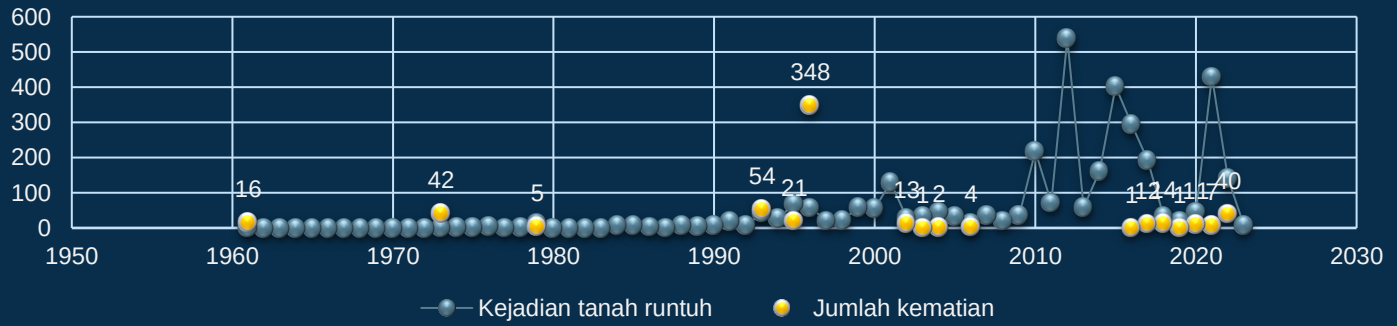
Rekod tanah runtuh mengikut negeri



6418	592
rekod tanah	kematian

Rekod tanah runtuh dari tahun 1961 hingga 2023

Trend kejadian tanah runtuh dan kematian mengikut tahun



Highland Tower (1993) — **48 kematian**

Keningau, Sabah (1996) — **302 kematian**

Taman Hillview (2002) — **8 kematian**

Batang Kali (2022) — **31 kematian**

SUMBER: Sistem Maklumat Geospatial Terain dan Cerun Negara (NaTSIS) JMG

PERANAN JMG DALAM PENGURUSAN BENCANA GEOLOGI TANAH RUNTUH

1. Memetakan kawasan bencana geologi tanah runtuh dan mengenal pasti zon bahaya dan risiko
2. Pembangunan pangkalan data geospatial bencana geologi tanah runtuh
3. Mengenal pasti dan menyediakan input Pembangunan Sistem Amaran Awal Tanah Runtuh
4. Kerjasama pintar dalam pemulihan dan konsep mitigasi
5. Memperkasa komuniti rentan serta melahirkan jaguh setempat (*local champion*) di peringkat komuniti

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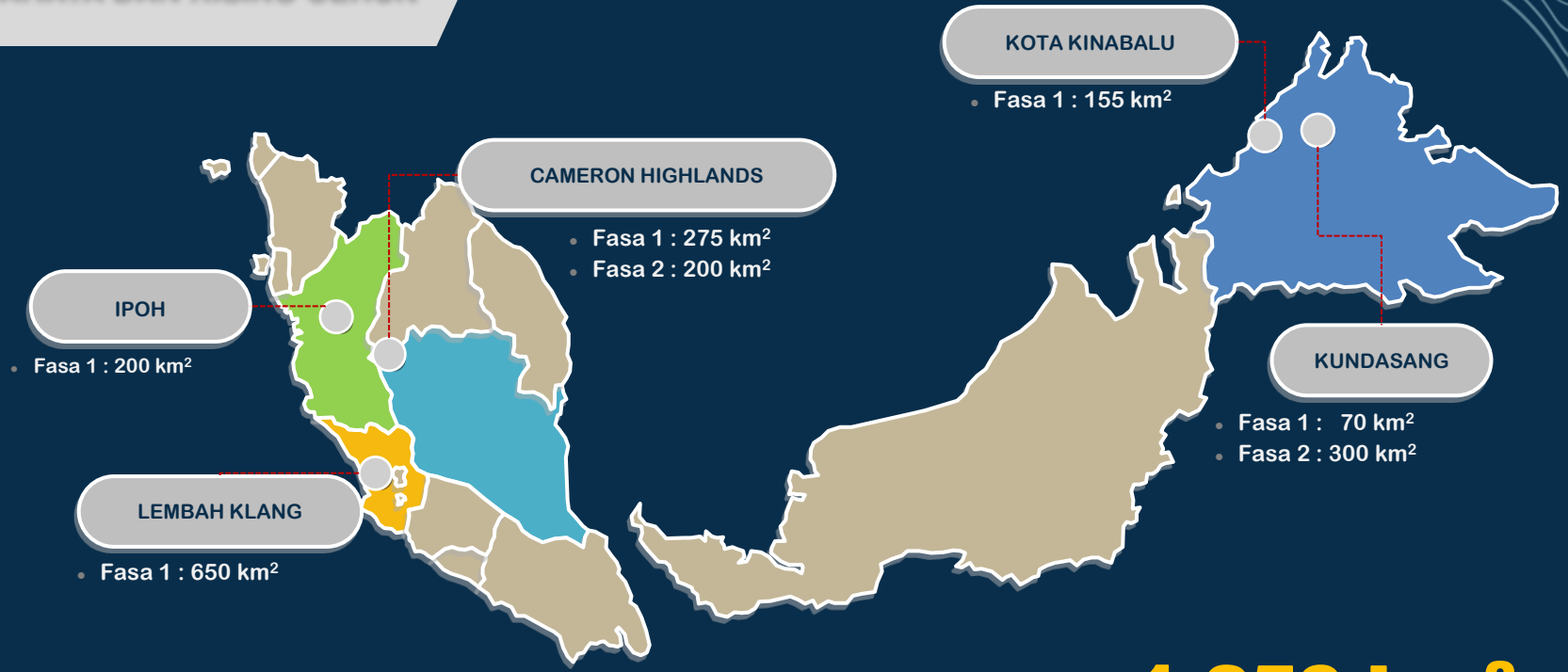
01

Memetakan kawasan bencana geologi tanah runtuh dan mengenal pasti zon bahaya dan risiko

PBRC
PETA BAHAYA DAN RISIKO CERUN

PBRC

PETA BAHAYA DAN RISIKO CERUN



1,850 km²

JABATAN MINERAL DAN GEOSAINS MALAYSIA

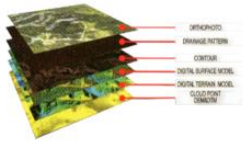
RANGKA KERJA PEMETAAN BAHAYA DAN RISIKO CERUN

3 GPS Survey

4 Mobile GNSS-GIS Field Mapping

5 LiDAR-GIS Data Processing

6 LiDAR-derivatives & parameterisation

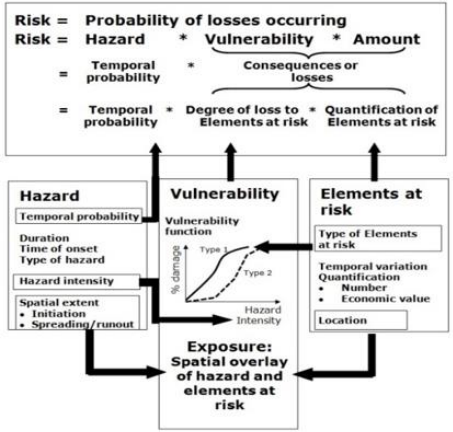


7 Landslide Inventory Mapping

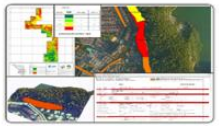
2 Terrestrial LIDAR data captured

1 Airborne LIDAR data captured

IMPLEMENTATION FRAMEWORK – SLOPE HAZARD AND RISK MAPPING

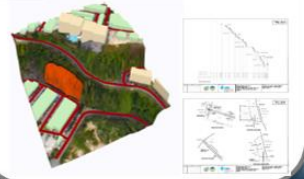


8 Landslide Susceptibility Analysis

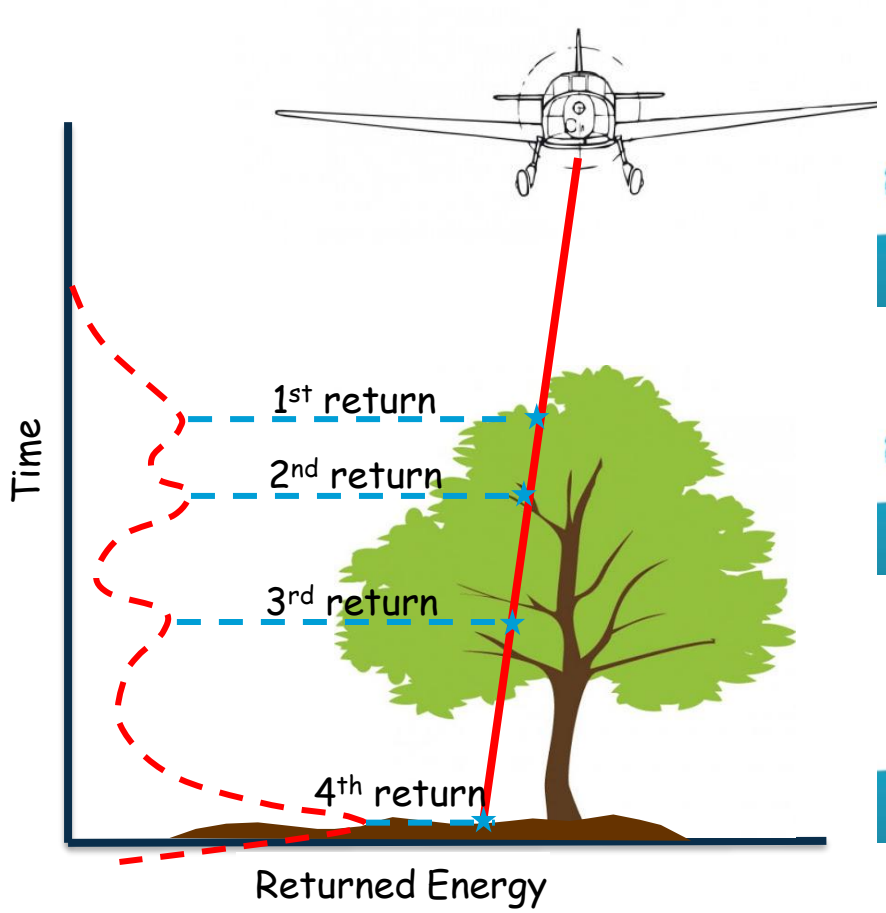


9 Landslide hazard & risk Assessment

10 Geotechnical Risk Assessment



LIGHT DETECTION AND RANGING (LiDAR)



Digital Surface Model (DSM)

Digital Terrain Model (DTM)

PBRC

PETA BAHAYA DAN RISIKO CERUN

Airborne Laser Scanning (ALS)

Terrestrial Laser Scanning (TLS)

SPESIFIKASI KHAS ALS

KEPADATAN POINT CLOUD

Sekurang-kurangnya 8 titik/m^2 bagi setiap tile 1 km^2.

MISI PENERBANGAN

Tinggi penerbangan : < 800 m AGL
Laju penerbangan: < 600 knot

ORTOFOTO

Resolusi 0.25 m atau lebih baik

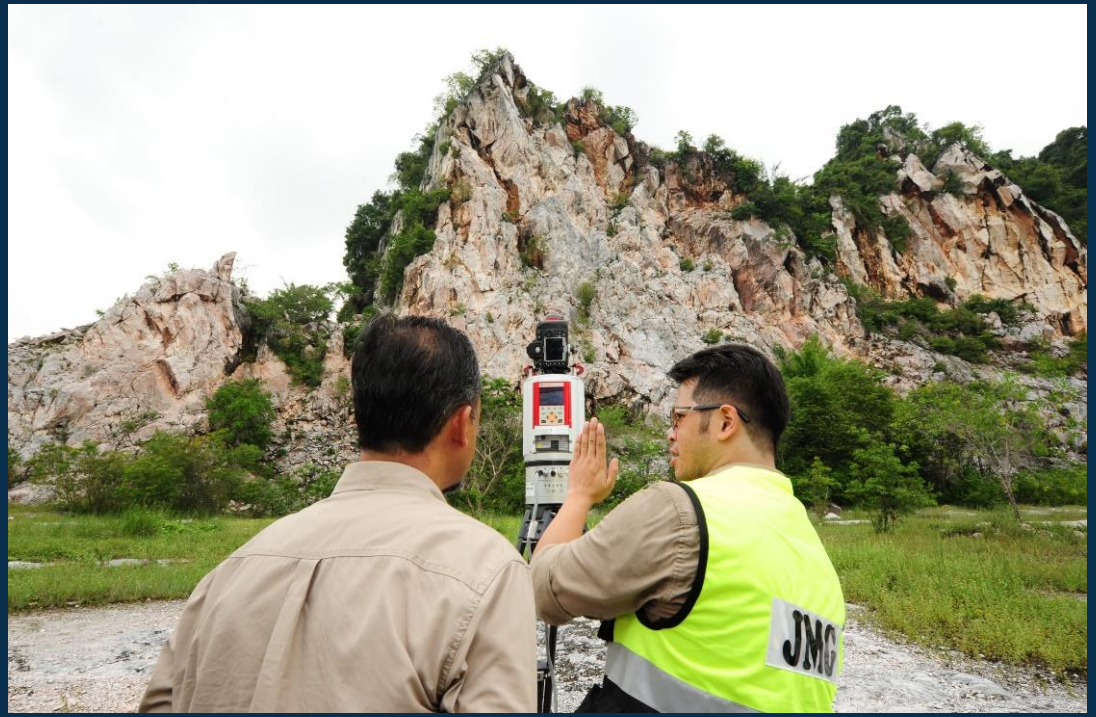
FULL-WAVEFORM LiDAR

Sensor LiDAR perlu mempunyai keupayaan bagi menawan full-waveform LiDAR data

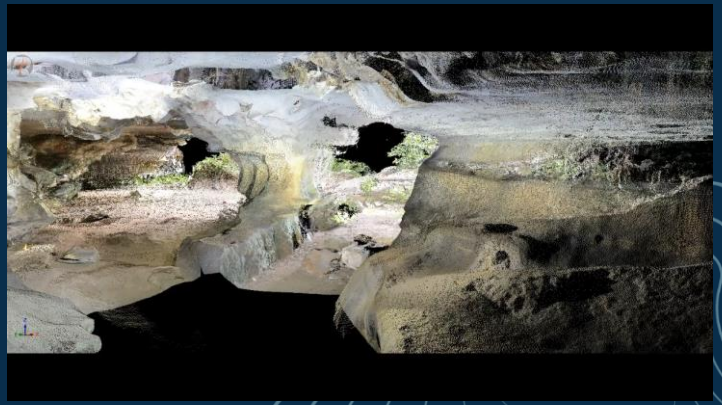
DTM

Resolusi 0.25 m atau lebih baik

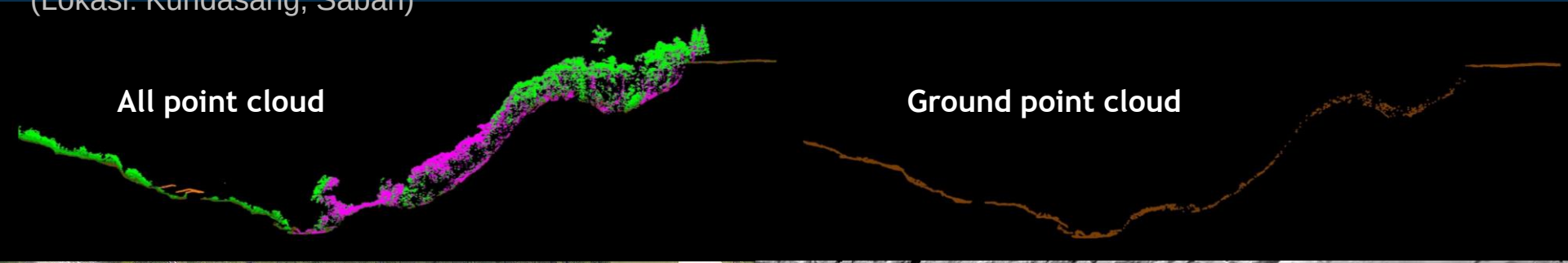
TERRESTRIAL LASER SCANNING (TLS)

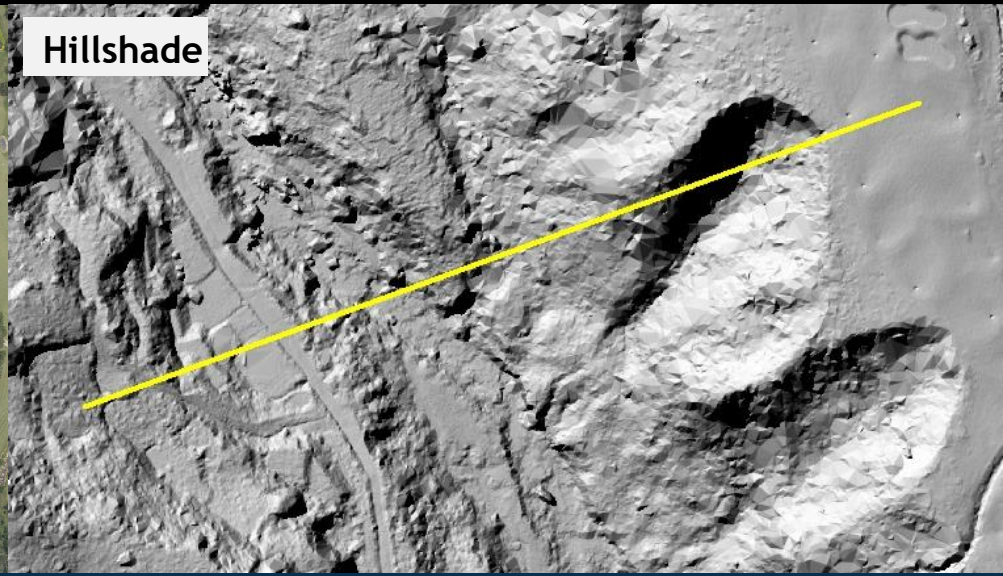


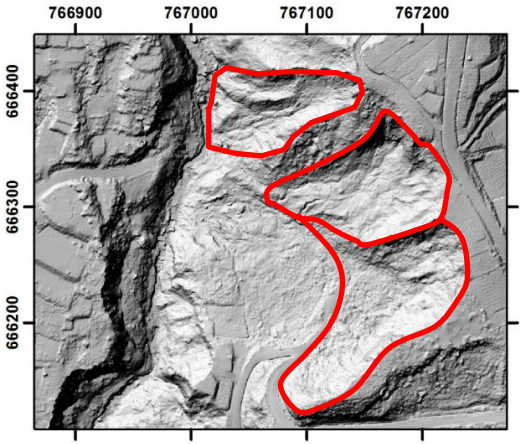
Reigl VZ400



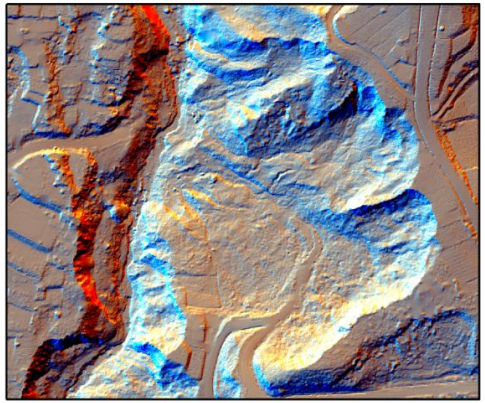
Teknologi LiDAR membantu dalam mengenalpasti parut tanah runtuh yang telah dilitupi oleh pokok-pokok. (Lokasi: Kundasang, Sabah)



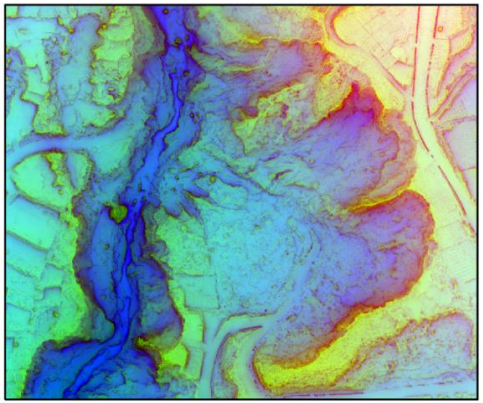




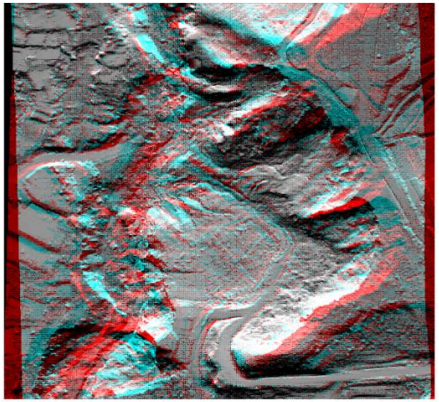
Hillshade (ArcGIS)



Color Composite (ILWIS)



Topographic Openess (SAGA)



3D Anaglyph (ILWIS)

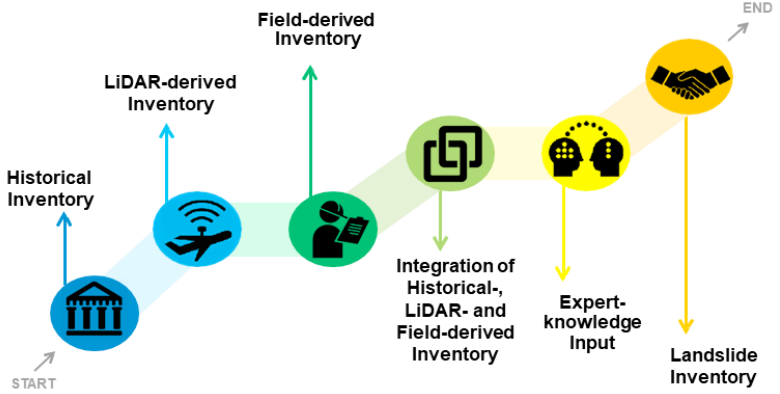
200 100 0 200 Meters

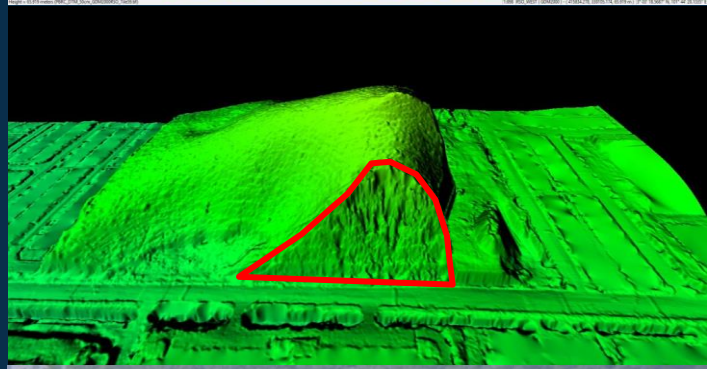
Scale 1:5,000

Penggunaan pelbagai jenis data raster bagi proses pendigitan tafsiran poligon tanah runtuh.

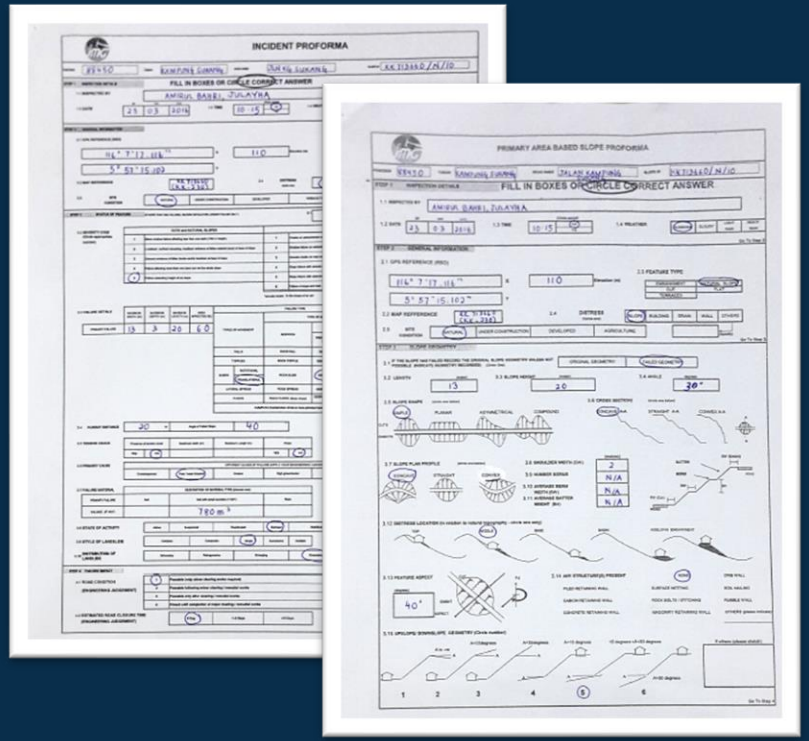
Location: Kampung Mesilau, Kundasang

INVENTORI TANAH RUNTUH

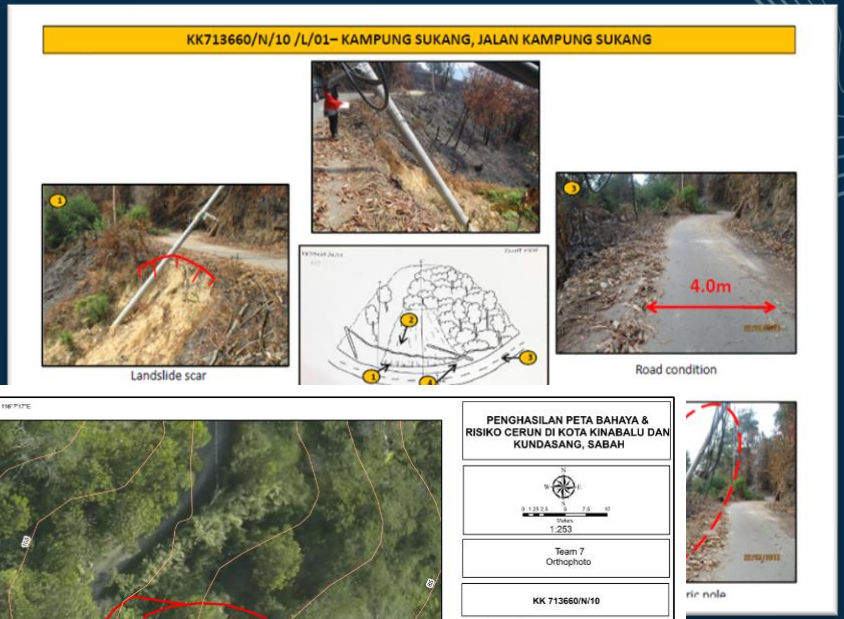


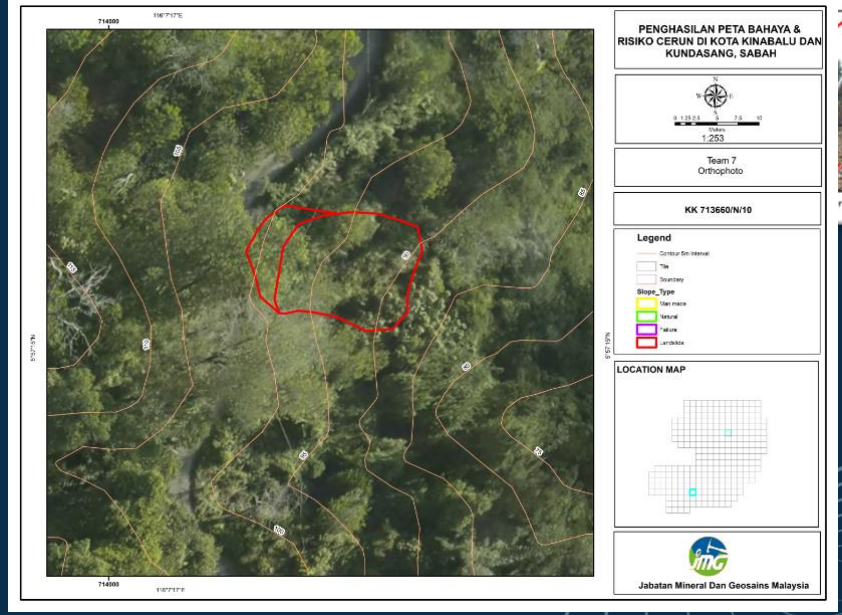


VERIFIKASI LAPANGAN



Field proforma





PANGKALAN DATA GEOSPATIAL

Table

NATSIS.DBO.Tanah_Runtuh_Semenanjung

OBJECTID *	tanah_runtuh_id	Kod_Negeri	Kod_Daerah	Kod_Mukim	Kod_PBT	UNIQUE_ID	tahun	guna_tanah	status	Shape *	Date
1	AP3413_M_01_SF_01	Negeri Sembilan	Seremban	Pekan Rantau	Majlis Perbandaran Nilai	20230105113938	2022	PERUMAHAN	1	Point	<Null>
2	AU1202_N_01_L_01	Negeri Sembilan	Seremban	Bandar Seremban	Majlis Perbandaran Seremban	20230105120713	2022	<Null>	1	Point	<Null>
3	FC4415_M_02_SF_01	Pulau Pinang	Seberang Perai Tengah	17	Majlis Perbandaran Seberang Perai	<Null>	1999	<Null>	<Null>	Point	<Null>
4	AP4108_N_01_L_01	Melaka	Alor Gajah	Sungei Petai	Majlis Perbandaran Alor Gajah	20230105105648	2022	PERUMAHAN	1	Point	<Null>
5	AU1202_M_06_SF_01	Negeri Sembilan	Seremban	Pekan Setul	Majlis Perbandaran Seremban	20230105112010	2022	PERUMAHAN	1	Point	<Null>
6	BLD3320_M_01_SF_01	Negeri Sembilan	Jempol	Pekan Rompin	Majlis Perbandaran Jempol	20230105115350	2022	PERUMAHAN	1	Point	<Null>
7	AP4205_M_01_SF_01	Melaka	Alor Gajah	Durian Tunggal	Majlis Perbandaran Alor Gajah	20230105121452	2022	PERUMAHAN	1	Point	<Null>
8	AP3409_M_01_SF_01	Negeri Sembilan	Rembau	Pedas	Majlis Perbandaran Rembau	20230105102432	2022	PERUMAHAN	1	Point	<Null>
9	FD1408_N_01_L_01	Perak	Kuala Kangsar	Sungai Siput	Majlis Perbandaran Kuala Kangsar	20230108102322	2022	PERUMAHAN	1	Point	<Null>
10	FD1408_N_02_L_02	Perak	Kuala Kangsar	Sungai Siput	Majlis Perbandaran Kuala Kangsar	20230108104642	2022	PERUMAHAN	1	Point	<Null>
11	FD2100_N_01_L_01	Perak	Kinta	Sungai Raya	Majlis Daerah Kampar	20230106110148	2022	PERUMAHAN	1	Point	<Null>

SQLQuery12.sql - GEO-DB-SVR.NATSIS (JMG (54))* - Microsoft SQL Server Management Studio

```
SELECT TOP 8000 [NamaKgTmn]
      ,[Nama1nSg]
      ,[RSO_X]
      ,[RSO_Y]
      ,[NamaPemilik]
      ,[InsidenTaHh]
      ,[InsidenMasaOld]
      ,[Jenis_tanahRuntuh]
      ,[JenisKedalaman_tanahRuntuh]
      ,[Punca_tanahRuntuh]
      ,[Geologi]
      ,[Lebar]
      ,[Panjang]
      ,[Kedalaman]
      ,[Isipadu]
      ,[Jenis_kerosakan]
      ,[Kos_kerosakan]
      ,[Bil_kematian]
      ,[Bil_kecederaan]
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      ,[Catatan]
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```
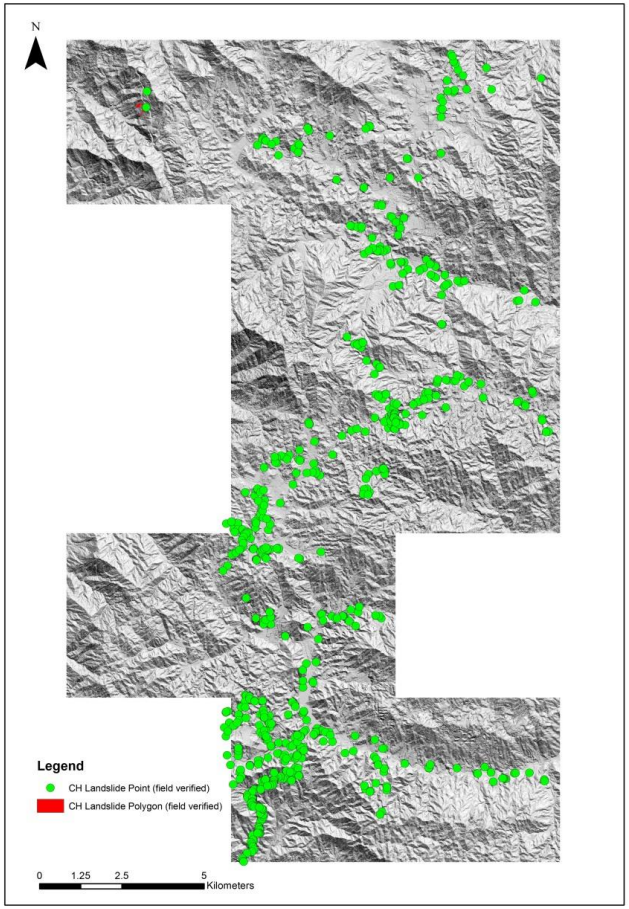

Query executed successfully.



ANALISIS GEOSPATIAL

- Slope Map
- Curvature Map
- Geomorphological Map
- Aspect Map
- Terrain Roughness Index
- Terrain Surface Classification
- Terrain Surface Texture
- Terrain Surface Convexity
- Vector Ruggedness Measure

- LULC
- Road Cut
- Disrupted Drainage
- Distance to Road
- Distance to River

Geological Factors

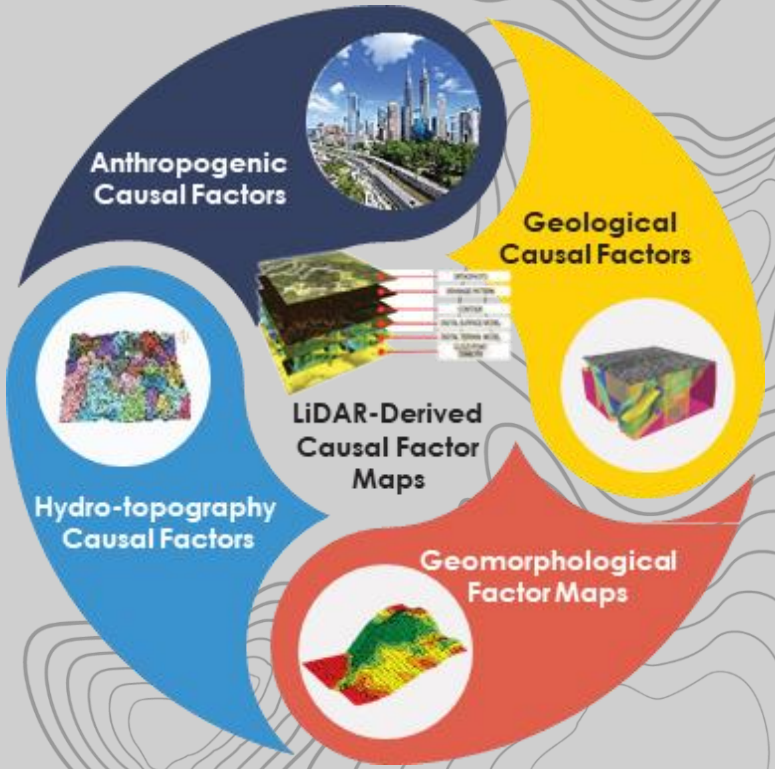
- Lithology
- Soil
- Lineament
- Faults
- Distance to Lineament
- Distance to Fault
- Distance to Earthquake Epicenter

Geomorphological Factors

Hydro-topographical Factors

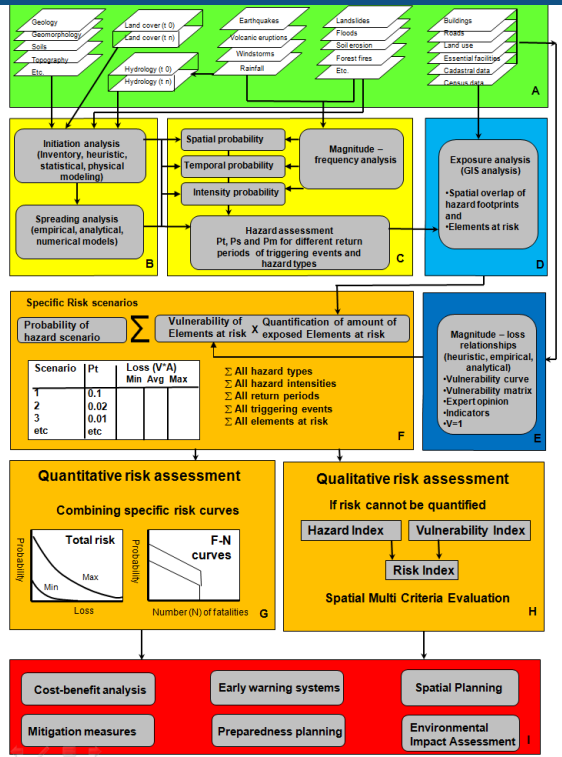
- Flow Direction
- Watershed
- Flow Accumulation
- Channel
- Stream Network
- Topographic Wetness Index

Anthropogenic Factors



ANALISIS GEOSPATIAL

HAZARD AND RISK ASSESSMENT FRAMEWORK



A: Input data

B: Susceptibility assessment

C: Hazard assessment

D: Exposure analysis

E: Vulnerability assessment

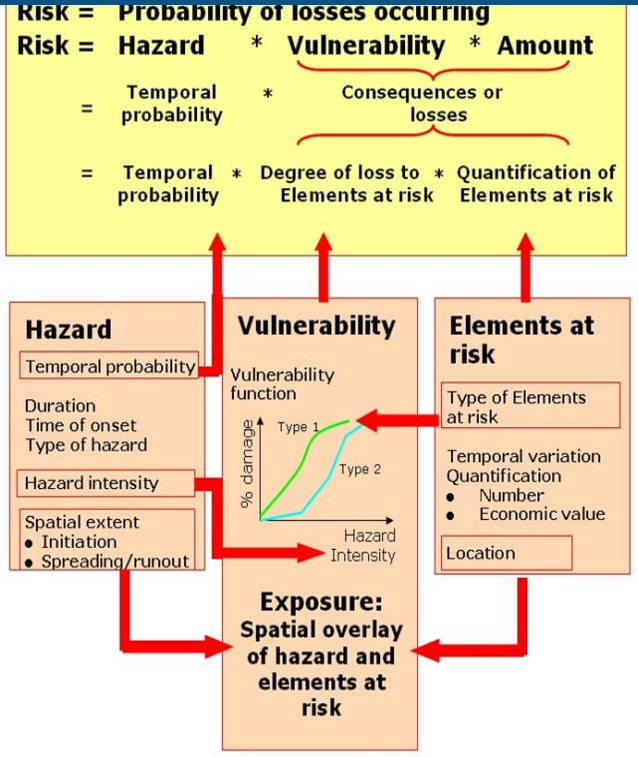
F: Risk assessment

G: Quantitative risk

H: Qualitative risk

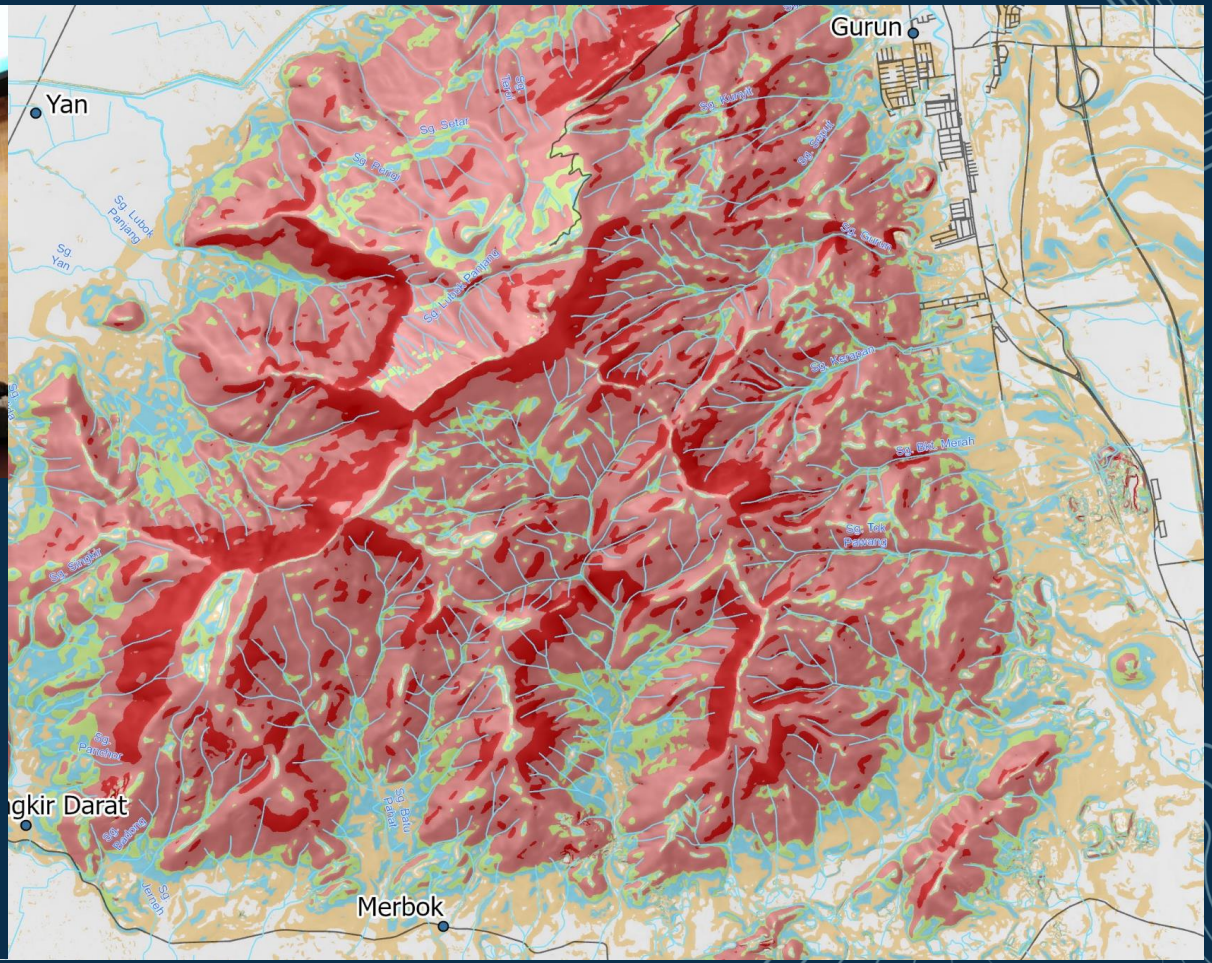
I: Risk reduction measures

LANDSLIDE RISK ASSESSMENT FRAMEWORK

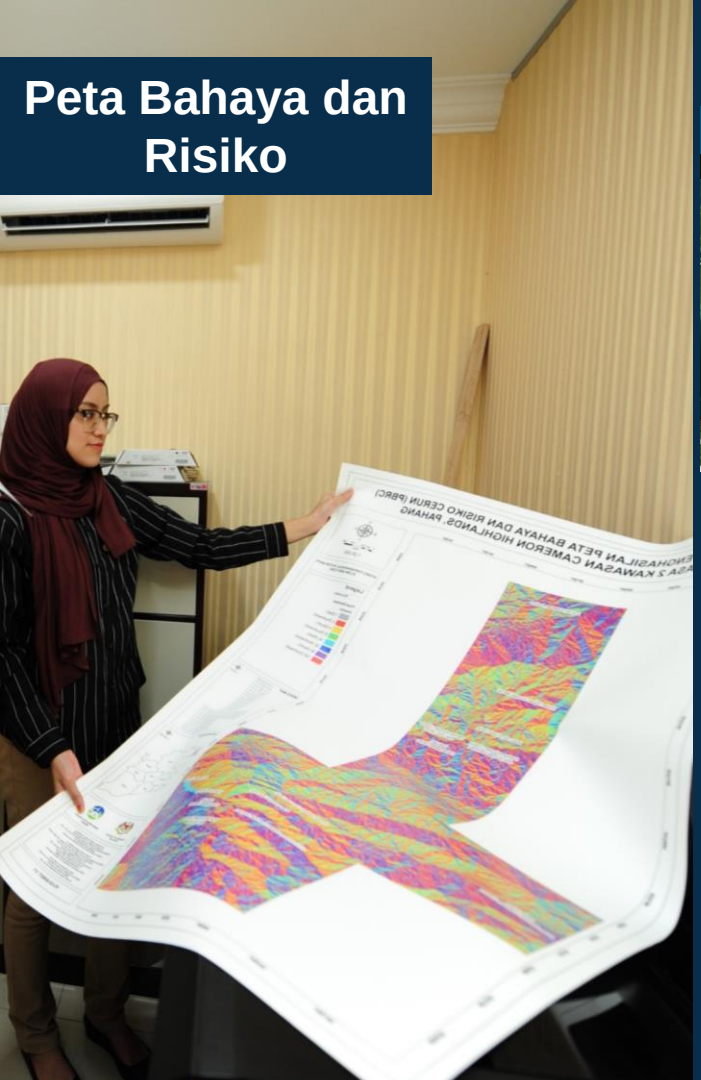


Van Westen et al. (2005)

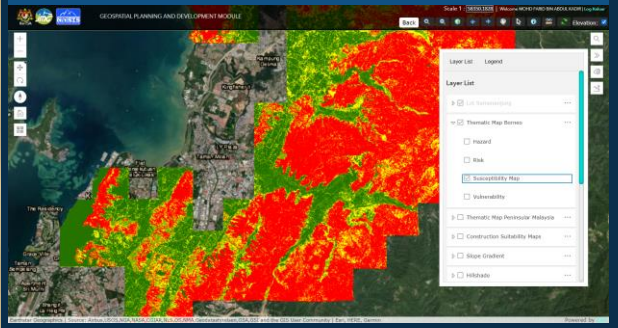
Penghasilan Peta



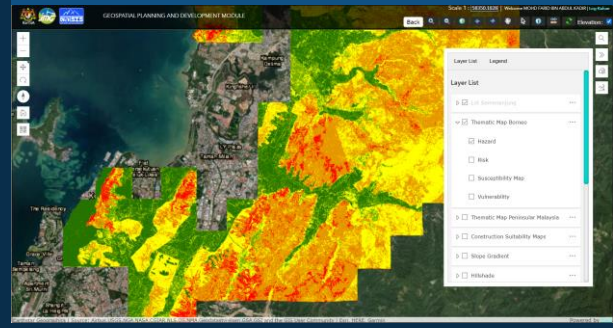
Peta Bahaya dan Risiko



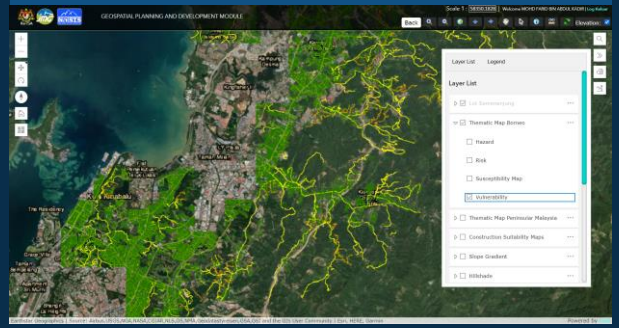
Peta Kerentanan



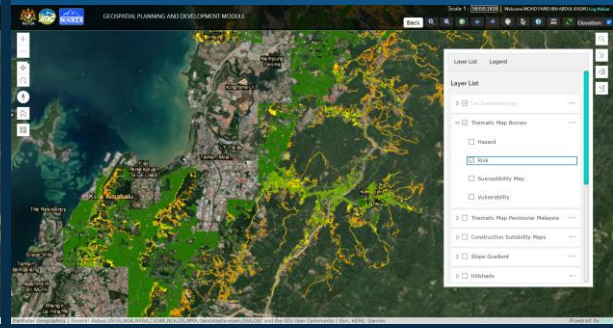
Peta Bahaya

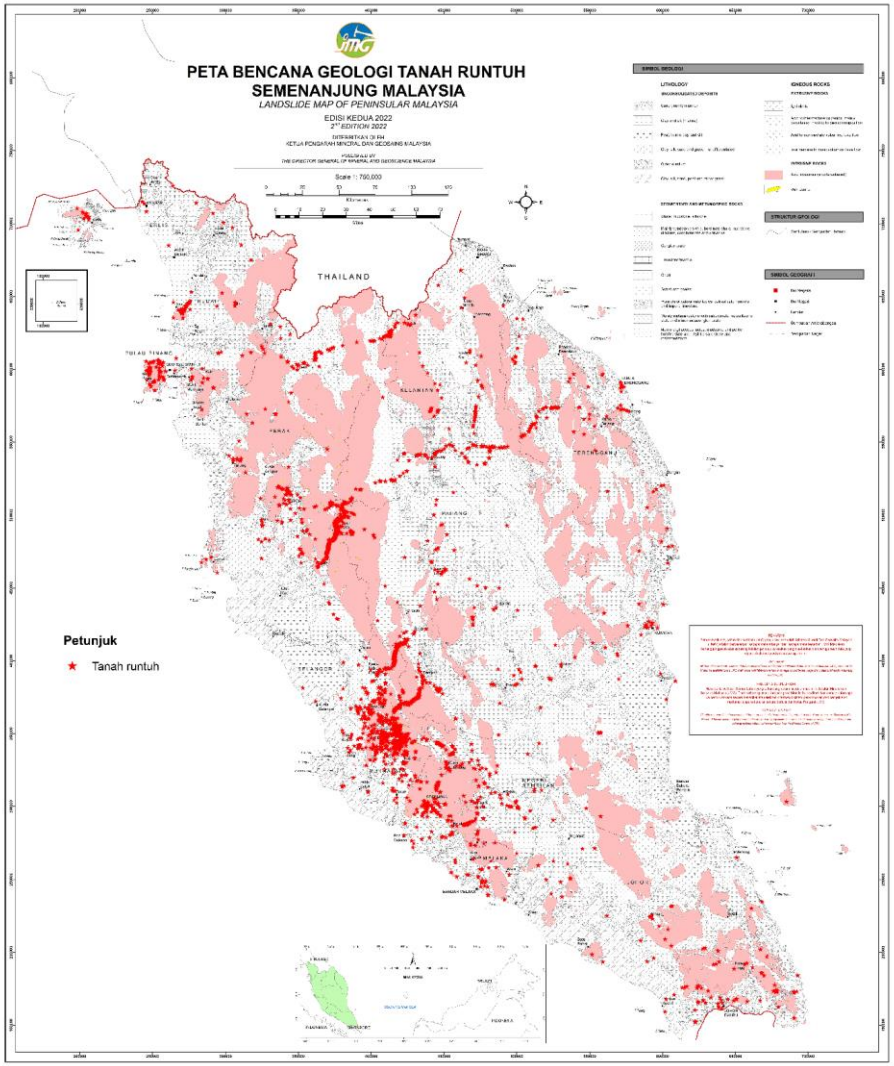


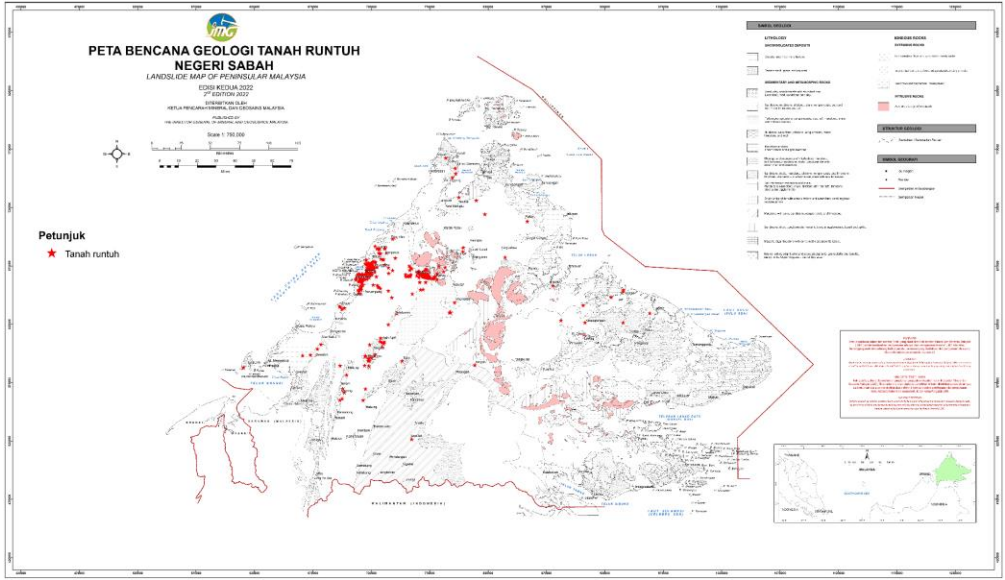
Peta Keterancaman

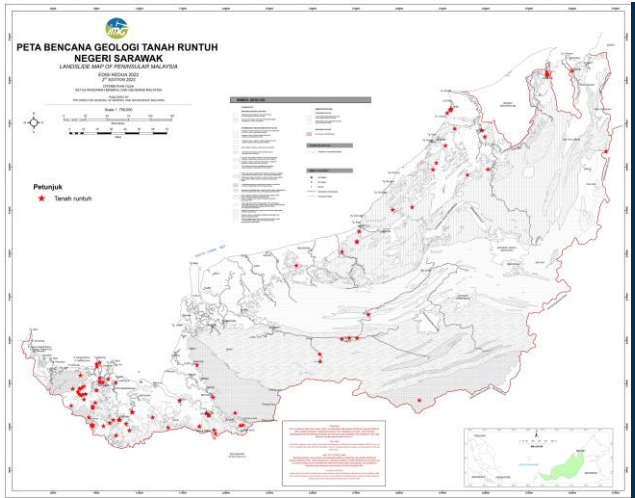


Peta Risiko





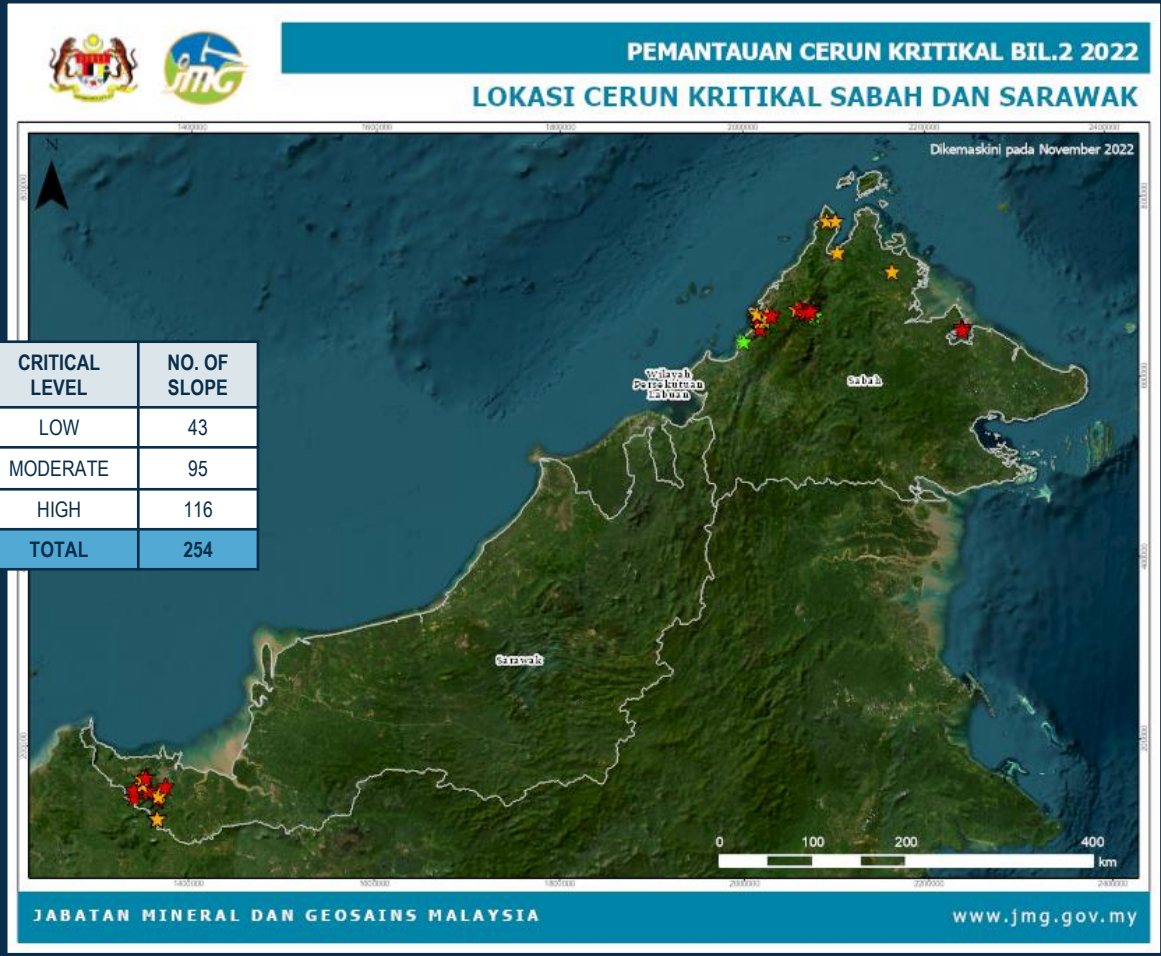




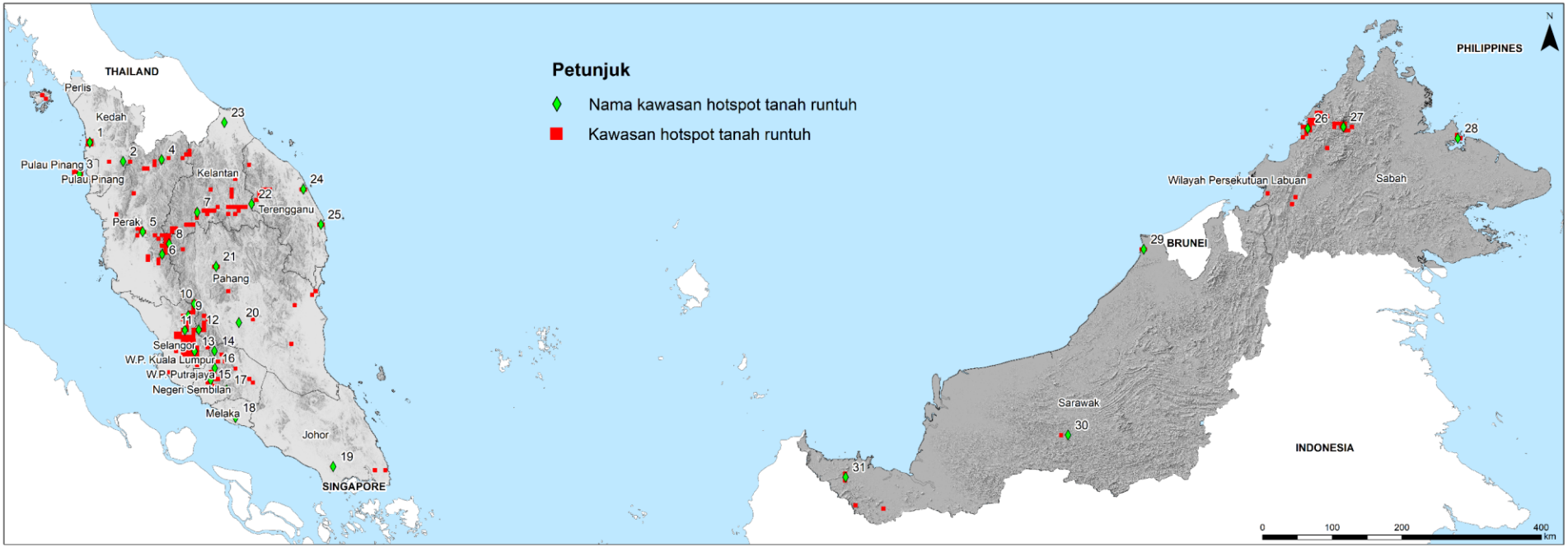
PENERBITAN PETA BENCANA GEOLOGI TANAH RUNTUH SETIAP TAHUN

LOKASI CERUN KRITIKAL

CRITICAL LEVEL	NO. OF SLOPE
LOW	43
MODERATE	95
HIGH	116
TOTAL	254



KAWASAN HOTSPOT TANAH RUNTUH



31

KAWASAN

5,900

KM PERSEGI

NATIONAL GEOSPASTIAL TERRAIN AND SLOPE INFORMATION SYSTEM

02

Pembangunan pangkalan data geospatial bencana geologi tanah runtuh

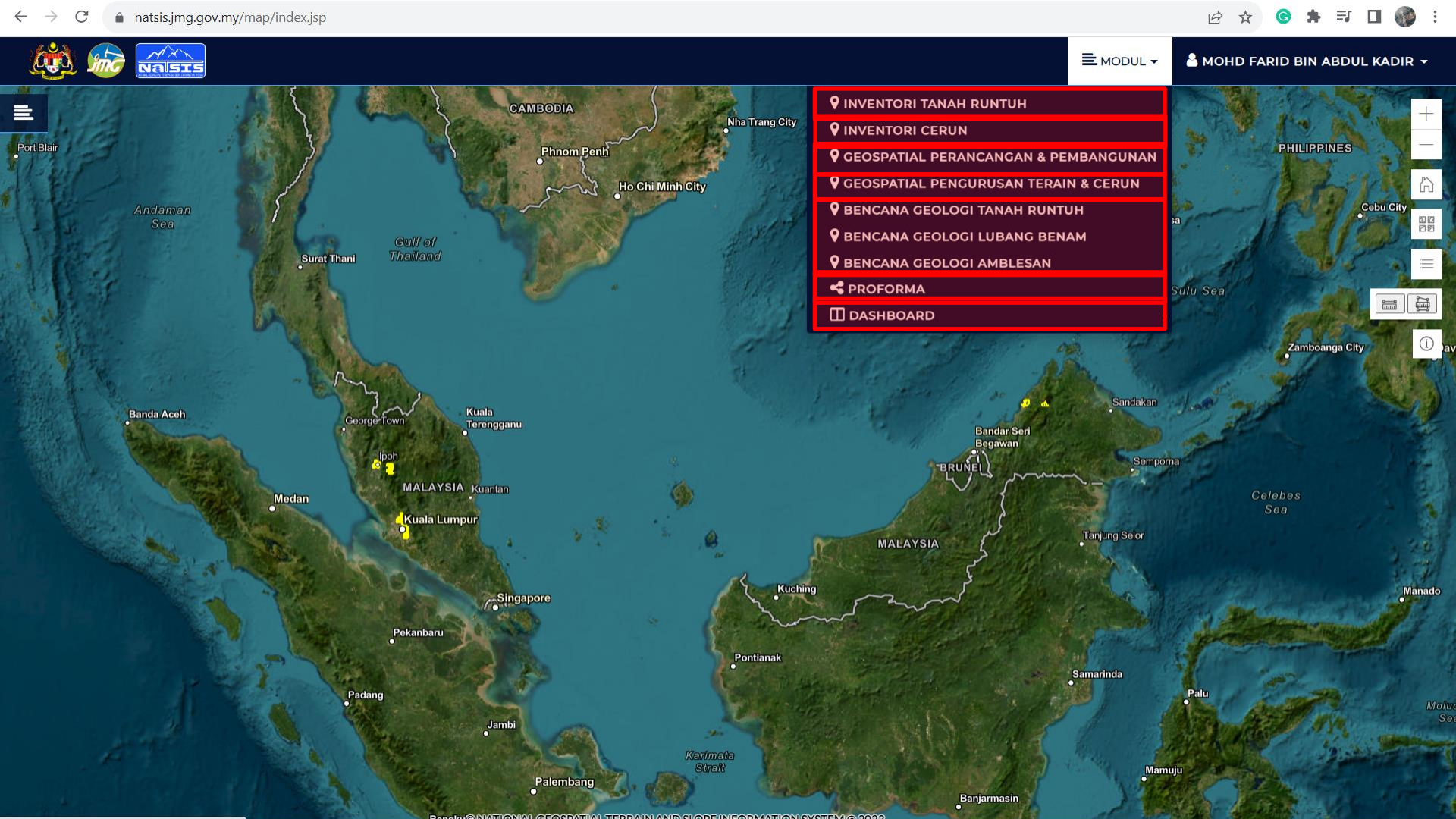
www.natsis.jmg.gov.my/v1

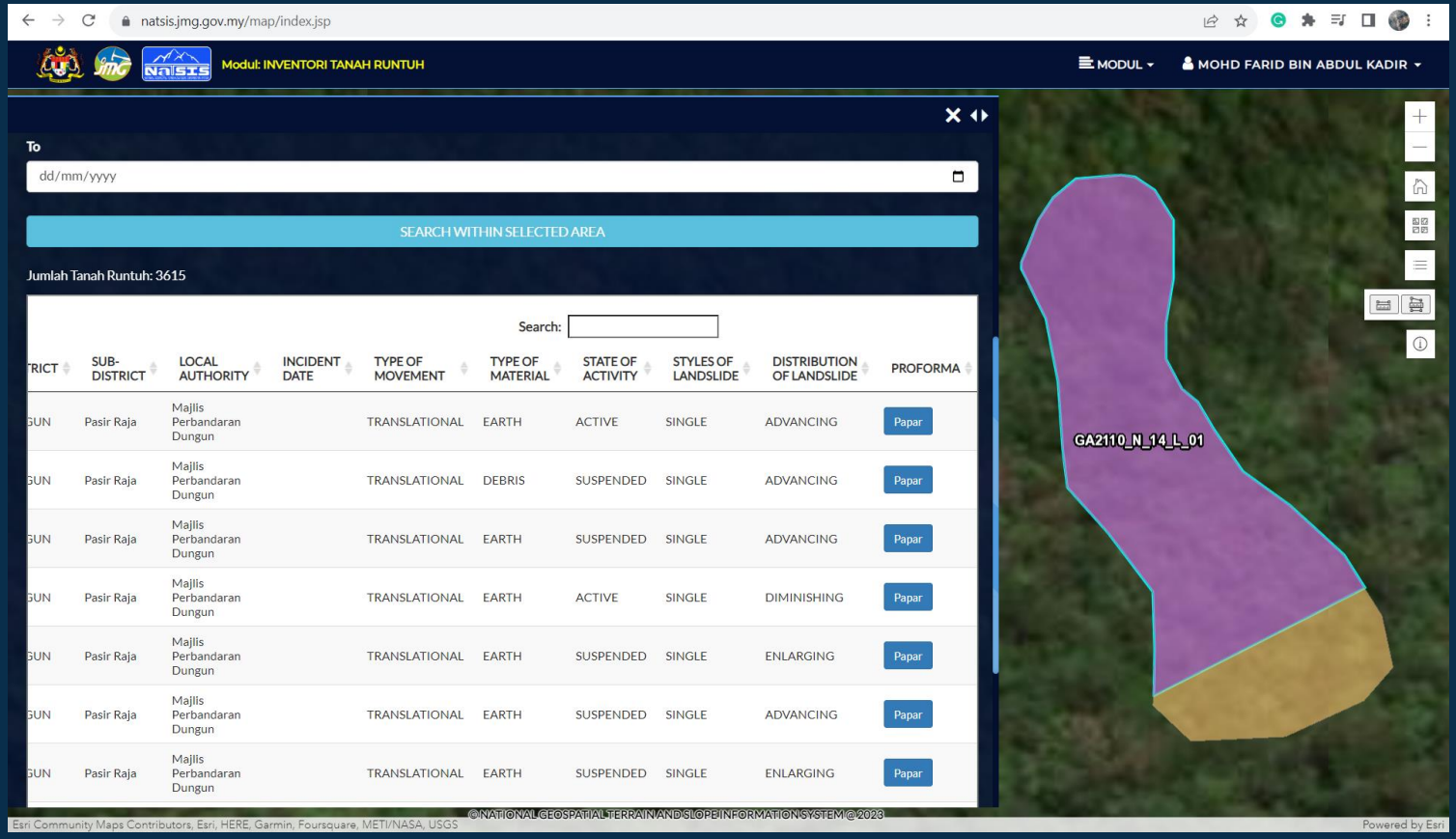
MATLAMAT

NaTSIS dibangunkan khusus untuk membantu pihak berkuasa tempatan dan Agensi Berkepentingan bagi proses pengurusan maklumat tanah runtuh dan cerun dalam aspek pembangunan fizikal dan pengurusan bencana geologi tanah runtuh.

7 MODUL

1. Inventori Tanah Runtuh
2. Inventori Cerun
3. Geospatial Perancangan dan Pembangunan
4. Geospatial Pengurusan Terain dan Cerun
5. Bencana Geologi
6. Proforma
7. Dashboard


natsis.jmg.gov.my/map/index.jsp
NATSIS
MODUL
MOHD FARID BIN ABDUL KADIR
INVENTORI TANAH RUNTUH
INVENTORI CERUN
GEOSPATIAL PERANCANGAN & PEMBANGUNAN
GEOSPATIAL PENGURUSAN TERAIN & CERUN
BENCANA GEOLOGI TANAH RUNTUH
BENCANA GEOLOGI LUBANG BENAM
BENCANA GEOLOGI AMBLESAN
PROFORMA
DASHBOARD
CAMBODIA
Nha Trang City
Phnom Penh
Ho Chi Minh City
Port Blair
Andaman Sea
Gulf of Thailand
Surat Thani
PHILIPPINES
Cebu City
Sulu Sea
Zamboanga City
Banda Aceh
George Town
Kuala Terengganu
Ipoh
MALAYSIA
Kuantan
Medan
Kuala Lumpur
Singapore
Pekanbaru
Padang
Jambi
Palembang
Karimata Strait
Sandakan
Bandar Seri Begawan
BRUNEI
Semporna
Celebes Sea
Tanjung Selor
MALAYSIA
Kuching
Pontianak
Samarinda
Palu
Manado
Mamuju
Banjarmasin


natsis.jmg.gov.my/map/index.jsp
Modul: INVENTORI TANAH RUNTUH
MODUL
MOHD FARID BIN ABDUL KADIR
To
dd/mm/yyyy
SEARCH WITHIN SELECTED AREA
Jumlah Tanah Runtuh: 3615
Search:
TRICT | SUB-DISTRICT | LOCAL AUTHORITY | INCIDENT DATE | TYPE OF MOVEMENT | TYPE OF MATERIAL | STATE OF ACTIVITY | STYLES OF LANDSLIDE | DISTRIBUTION OF LANDSLIDE | PROFORMA
GUN | Pasir Raja | Majlis Perbandaran Dungun | | TRANSLATIONAL | EARTH | ACTIVE | SINGLE | ADVANCING | Papar
GUN | Pasir Raja | Majlis Perbandaran Dungun | | TRANSLATIONAL | DEBRIS | SUSPENDED | SINGLE | ADVANCING | Papar
GUN | Pasir Raja | Majlis Perbandaran Dungun | | TRANSLATIONAL | EARTH | SUSPENDED | SINGLE | ADVANCING | Papar
GUN | Pasir Raja | Majlis Perbandaran Dungun | | TRANSLATIONAL | EARTH | ACTIVE | SINGLE | DIMINISHING | Papar
GUN | Pasir Raja | Majlis Perbandaran Dungun | | TRANSLATIONAL | EARTH | SUSPENDED | SINGLE | ENLARGING | Papar
GUN | Pasir Raja | Majlis Perbandaran Dungun | | TRANSLATIONAL | EARTH | SUSPENDED | SINGLE | ADVANCING | Papar
GUN | Pasir Raja | Majlis Perbandaran Dungun | | TRANSLATIONAL | EARTH | SUSPENDED | SINGLE | ENLARGING | Papar
GA2110_N_14_L_01
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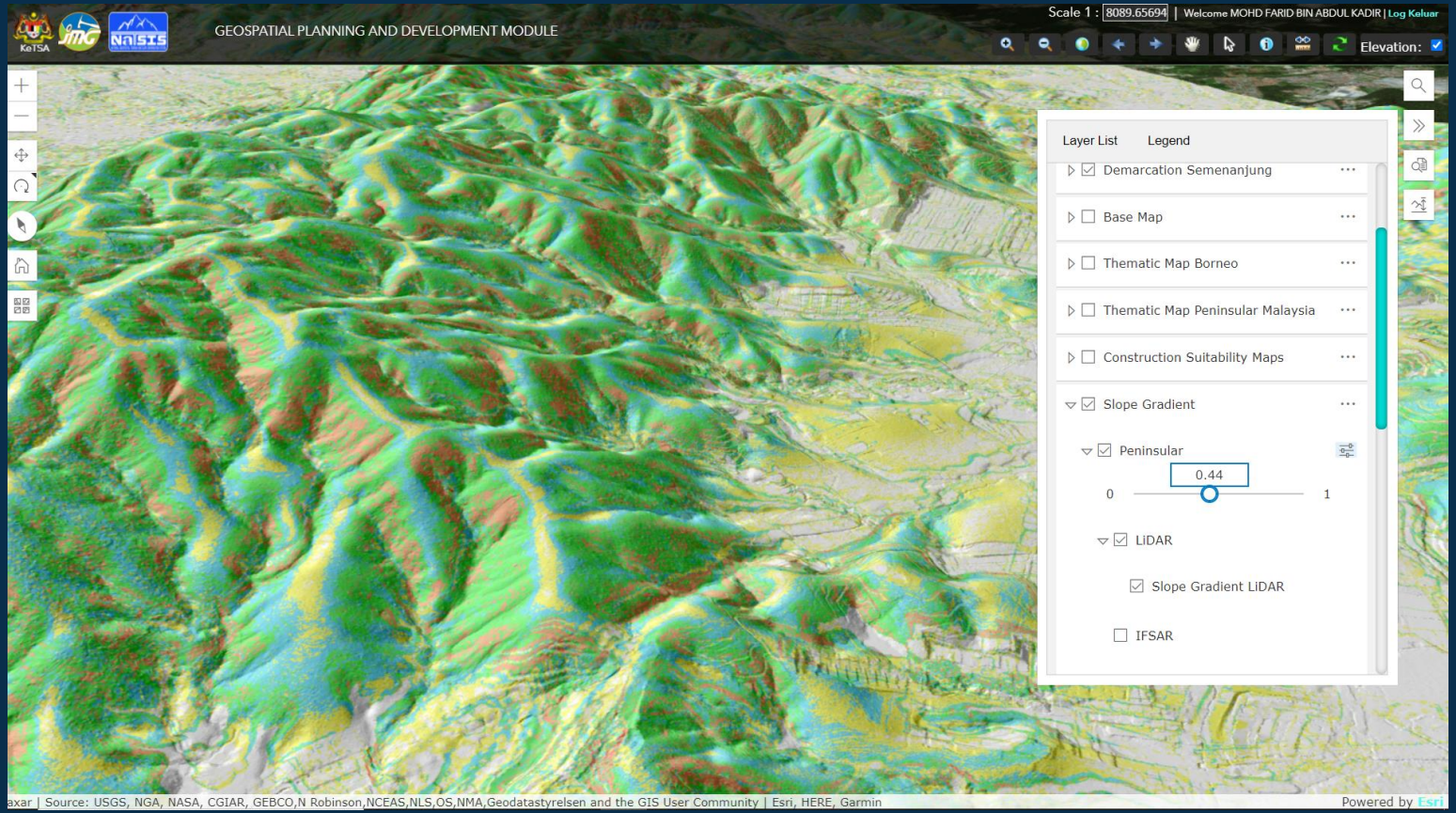
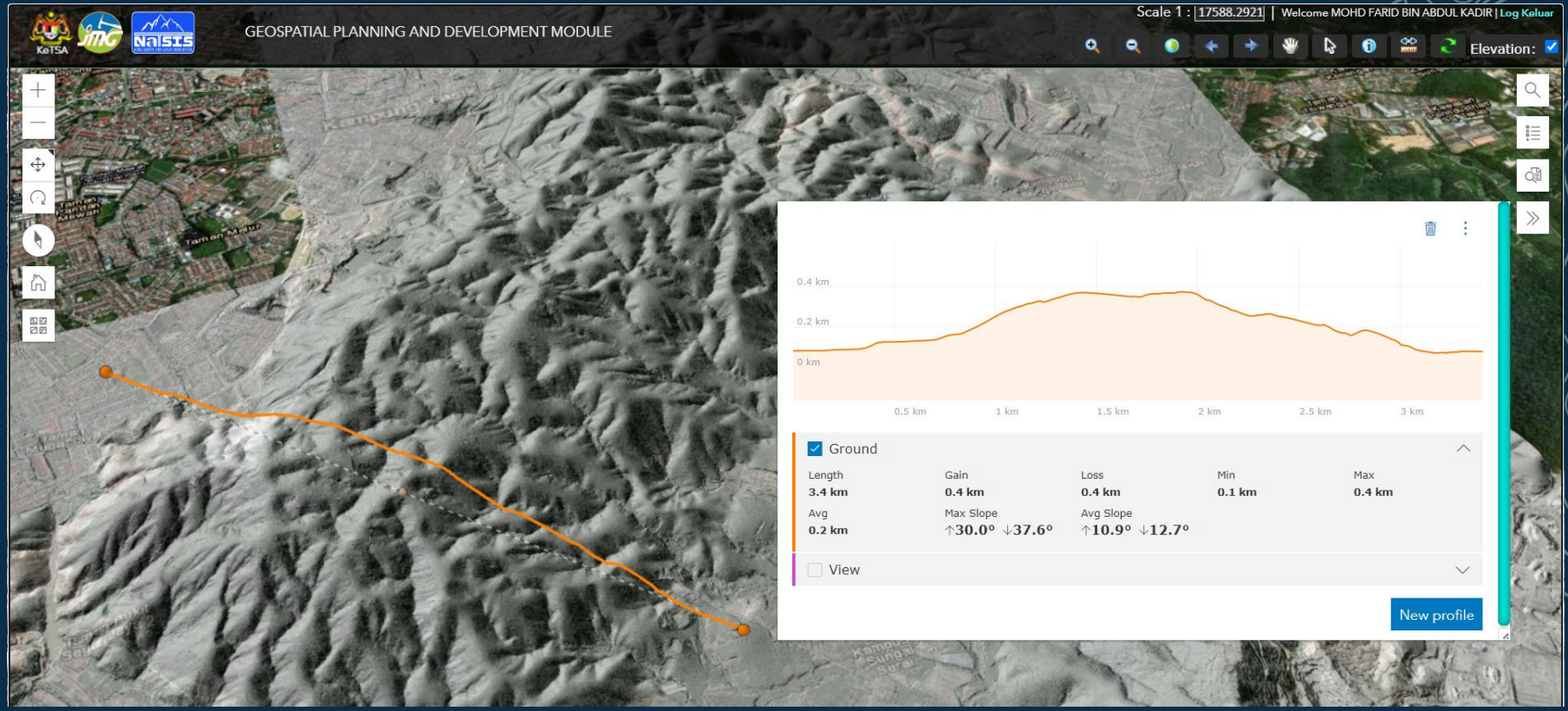
Esri Community Maps Contributors, Esri, HERE, Garmin, Foursquare, METI/NASA, USGS
Powered by Esri


GEOSPATIAL PLANNING AND DEVELOPMENT MODULE
Scale 1 : 8089.65694 | Welcome MOHD FARID BIN ABDUL KADIR | Log Keluar
Elevation:
Layer List
Legend
Demarcation Semenanjung
Base Map
Thematic Map Borneo
Thematic Map Peninsular Malaysia
Construction Suitability Maps
Slope Gradient
Peninsular
0.44
0
1
LiDAR
Slope Gradient LiDAR
IFSAR
axar | Source: USGS, NGA, NASA, CGIAR, GEBCO,N Robinson,NCEAS,NLS,OS,NMA,Geodatastyrelsen and the GIS User Community | Esri, HERE, Garmin
Powered by Esri


KeTSA
NaSIS
GEOSPATIAL PLANNING AND DEVELOPMENT MODULE
Scale 1 : 17588.2921 | Welcome MOHD FARID BIN ABDUL KADIR | Log Keluar
Elevation:
0.4 km
0.2 km
0 km
0.5 km
1 km
1.5 km
2 km
2.5 km
3 km
Ground
Length
3.4 km
Gain
0.4 km
Loss
0.4 km
Min
0.1 km
Max
0.4 km
Avg
0.2 km
Max Slope
↑30.0° ↓37.6°
Avg Slope
↑10.9° ↓12.7°
View
New profile

83

Lapisan data geospatial

3,736

GB data

281

Pengguna berdaftar

SISTEM YANG BERKAITAN

MyGEMS
Malaysia Geospatial Mineral and Geoscience Information System

BIG DATA ANALYTIC (BDA) KES BISNES PENGURUSAN BENCANA GEOLOGI TANAH RUNTUH

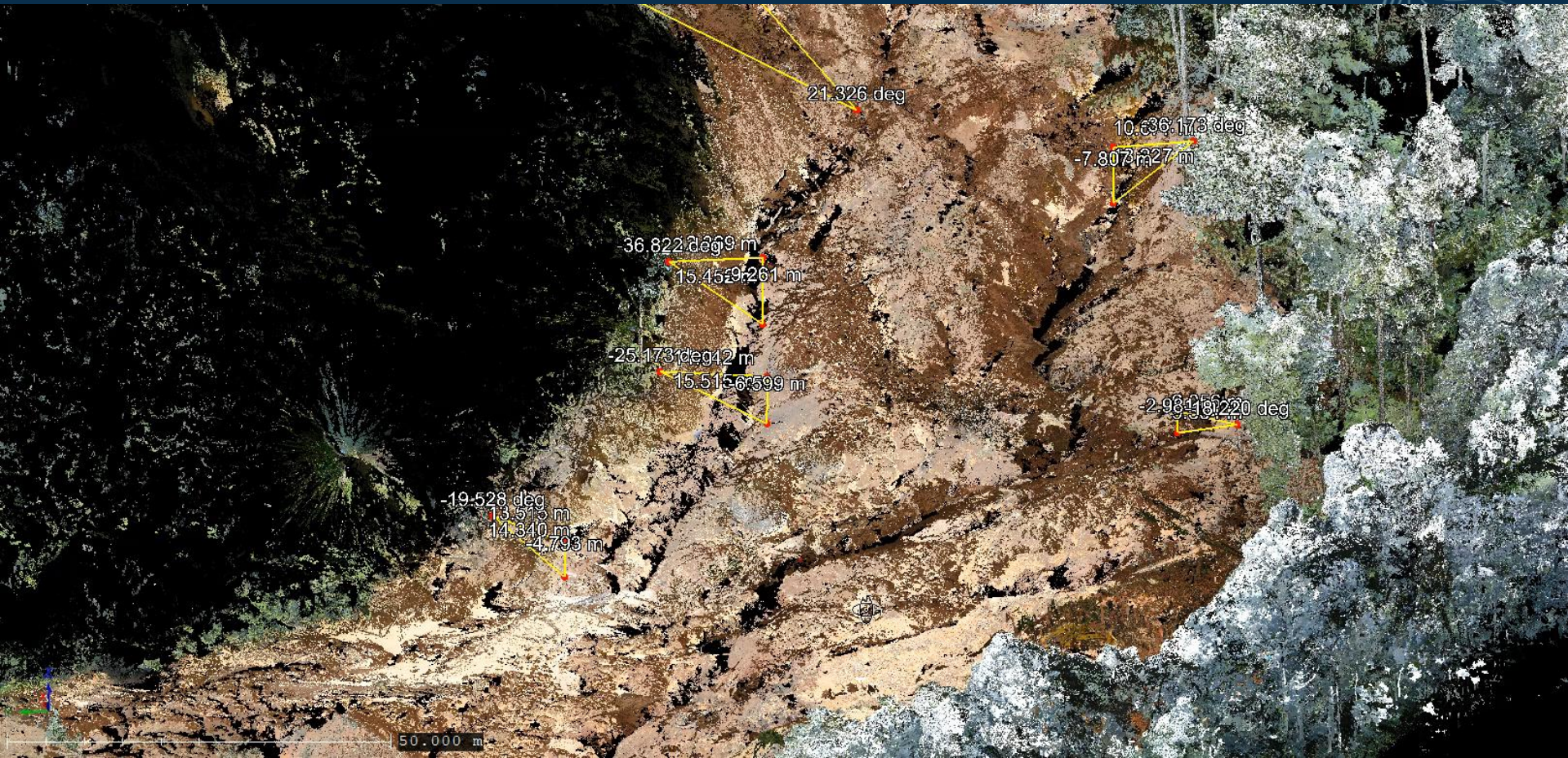
JABATAN MINERAL DAN GEOSAINS MALAYSIA
KEMENTERIAN SUMBER ASLI, ALAM SEKITAR DAN PERUBAHAN IKLIM

TINDAK BALAS BENCANA

Menjalankan pemetaan lapangan di tapak tanah runtuh bagi membantu proses Mencari dan Menyelamat (SAR) dan mengenalpasti punca kejadian

Lokasi: Farther’s Organic Farm, Batang Kali

Penggunaan aplikasi geospatial memudahkan dan mempercepat proses penilaian di tapak tanah runtuh.



KESIMPULAN

Penawanan data
Penilaian bahaya & risiko
Penghasilan peta
GEOSPATIAL
dalam pengurusan bencana geologi tanah runtuh
Penyampaian maklumat digital
Tindak balas bencana

TERIMA KASIH