

A dark blue background featuring a light blue, pixelated world map. The map is centered and shows the outlines of continents. The text is overlaid on the map.

IMPLEMENTATION OF WEB BASED GIS APPLICATION FOR MAPPING OF HEALTH FACILITIES, SERVICES AND PROVIDERS IN MALAYSIA

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Ministry of Health Malaysia

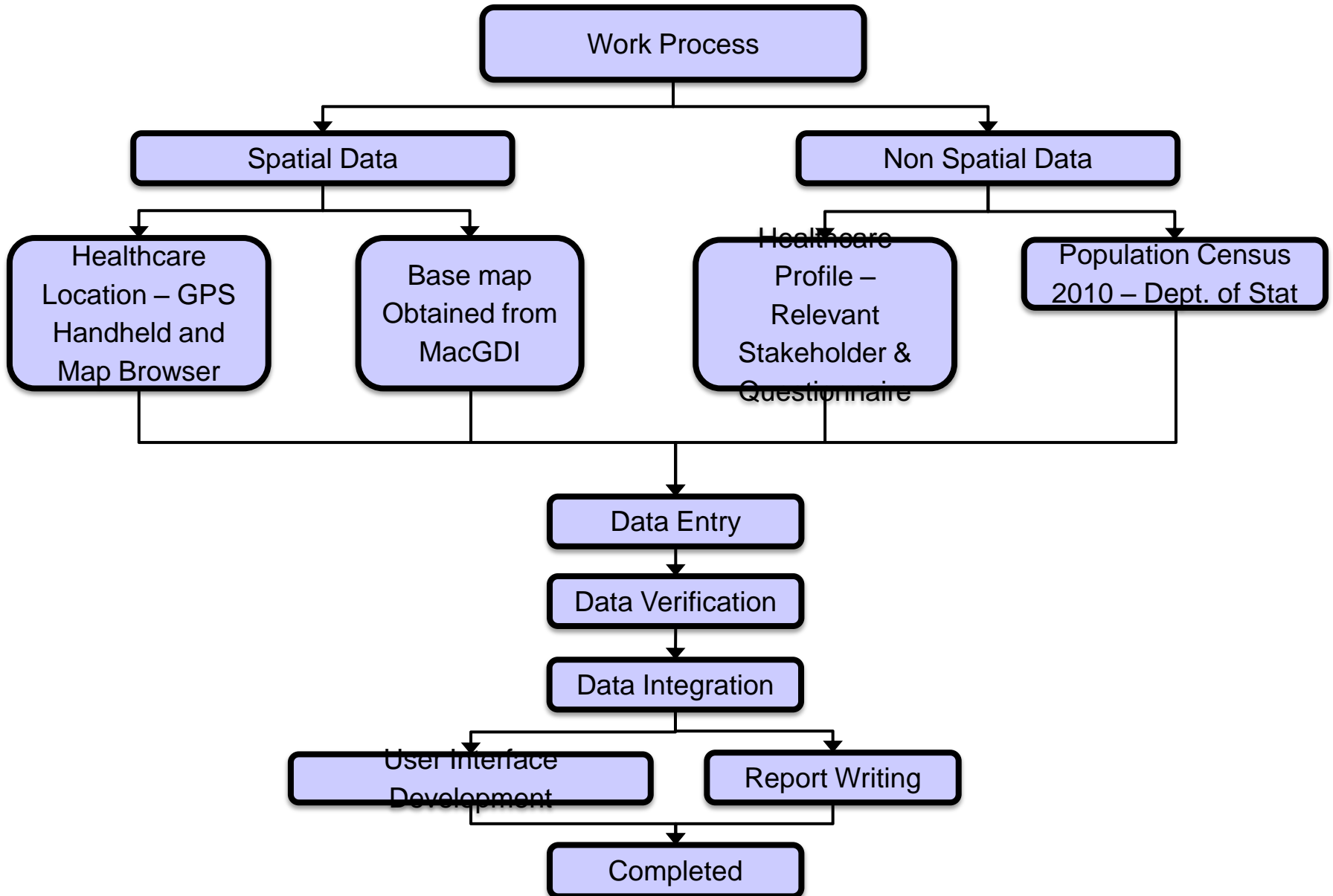
Introduction

- Interactive mapping or Internet GIS has developed rapidly over the past few years resulting in the migration of some GIS functionality.
- An interface system should be established to facilitate the users in terms of search, analysis and printout.
- This system enables users to use applications without the use of specialized GIS software.
- Users only need to use internet browsing application such as Internet Explorer, Mozilla Firefox to use the system.

Objective

- To establish a spatial database of healthcare facilities with profile of services and providers in Malaysia to support policy decision making.
- To design, develop, create, deploy, test and deliver web based GIS application of health facilities and services
- To develop manual and training modules for MOH

METHODOLOGY



Methodology

- The application is based on ArcGIS Server with ArcGIS Viewer for Flex.
- An ArcGIS Server is a server that serves GIS Services such as map service, geodata service and image service.
- ArcGIS Server software are required for building, managing and displaying GIS data on the Web to support desktop, mobile and web-based mapping applications.
- ArcGIS Viewer for Flex provides a smart, intuitive framework for looking at and interacting with maps.

Type of data in the GIS Database

	Type of data	Source
1	Coordinate of facilities	Located using GPS handheld and map browser
2	Base map	MacGDI (Malaysian Centre of Geospatial Database)
3	List and profile of health facilities	Centre for Health Information, MOH Medical Practice Division, MOH Medical Development Division, MOH, MOH Family Health Development Division Pharmaceutical Division, MOH Oral Health Division, MOH Traditional and Complementary Medicine Division, MOH Clinical Research Centre (CRC) Questionnaires
4	Population census 2010	Department of Statistics, Malaysia

Health Facilities	TOTAL					Data as of
	Total	Located	%	Profile	%	
Government (MOH) Hospital	134	132	98.5	105	78.4	Jan 2013
Other Gov. (Non MOH) Hospital	8	8	100.0	6	75.0	Okt 2013
Special Medical Institution	6	6	100.0	3	50.0	Jan 2013
Private Hospital	220	220	100.0	66	30.0	Okt 2013
Maternity Centre	86	86	100.0	29	33.7	Sept 2013
Government Health Clinic	879	879	100.0	465	52.9	Jan 2014
Government Dental Clinic (Standalone)	67	67	100.0	67	100.0	Okt 2013
MCH Clinic	105	105	100.0	66	62.9	Jan 2014
Rural Clinic (Klinik Desa)	1864	1864	100.0	995	53.4	Jan 2014
1Malaysia Clinic	128	128	100.0	49	38.3	Jan 2014
Private Clinic	6639	6386	96.2	2004	31.4	Okt 2013
Private Dental Clinic	1629	1446	86.8	517	35.8	Okt 2013
State Health Office	15	15	100.0	8	53.3	Jan 2014
District Health Office	167	167	100.0	85	58.6	Jan 2014
Hospital Day-care (Government)	58	58	100.0	21	36.2	Okt 2013
Ambulatory Care (Private)	28	28	100.0	0	0.0	Okt 2013
Pharmacy Centre (Private)	1740	1740	100.0	809	46.5	Apr 2013
Traditional & Complementary Medicine	337	337	100.0	70	20.8	Apr 2013
Dialysis Centre (Gov., Private & NGO)	387	387	100.0	226	58.7	Okt 2013
Radiology (Private)	26	26	100.0	8	30.8	Okt 2013
Nursing Home (Private)	16	16	100.0	13	81.25	Okt 2013
Medical Lab (Private)	143	143	100.0	39	27.3	Okt 2013
Rehabilitation Centre (Private)	24	24	100.0	5	20.8	Okt 2013

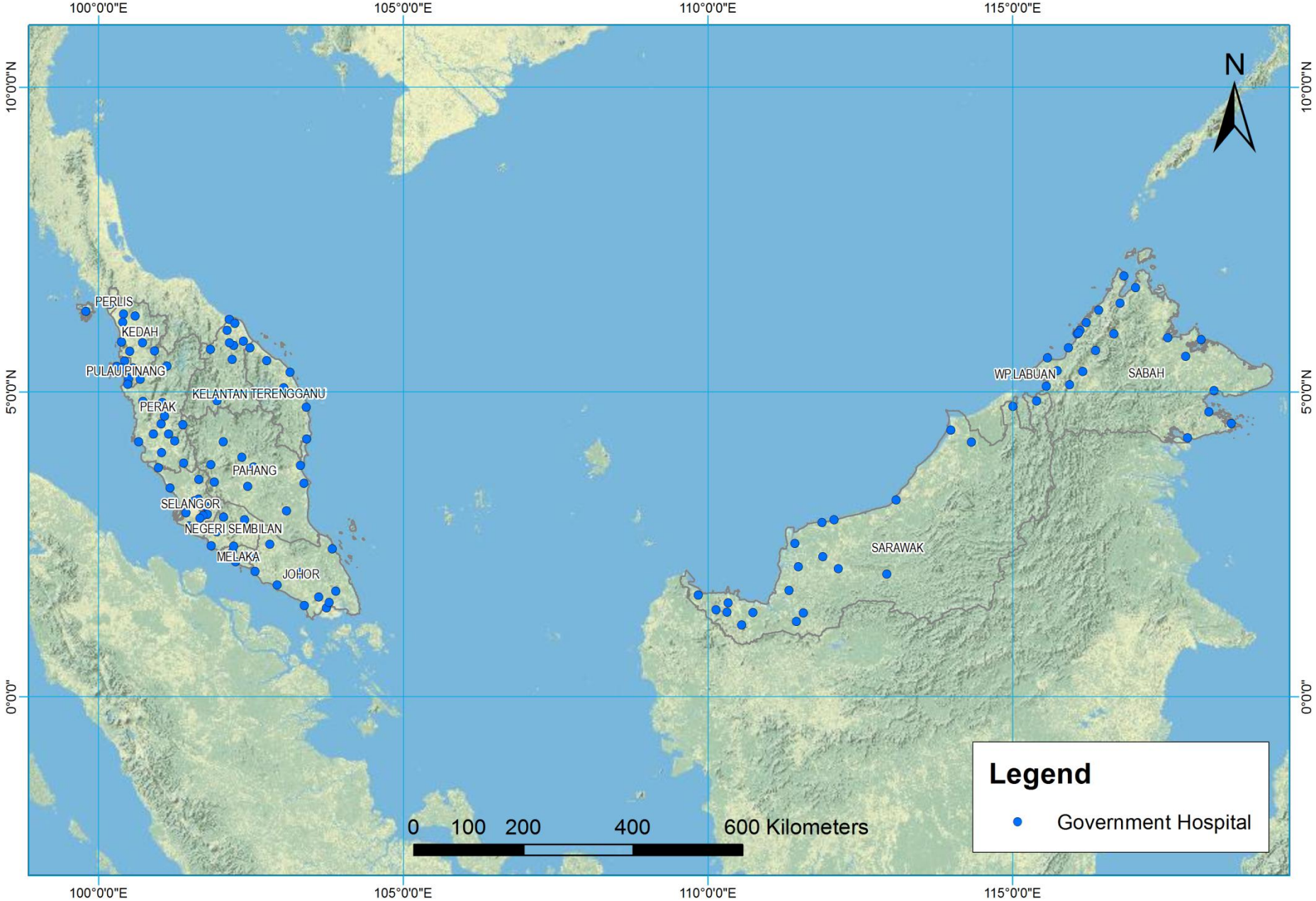
Web Based GIS Application

Available Modules for Web Based GIS Application

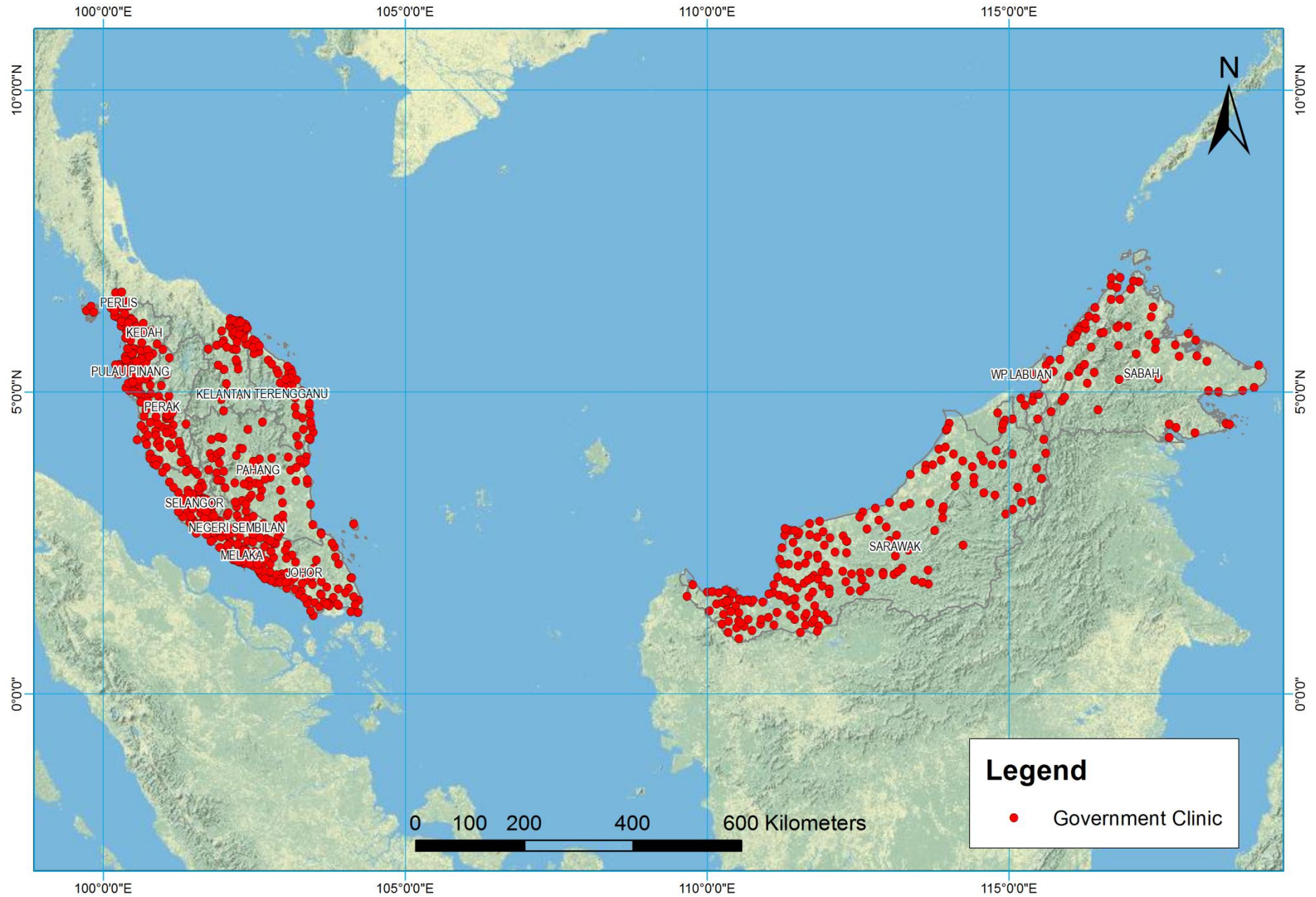
1. View
2. Query and search
3. Spatial and Network Analysis
4. Dissemination Tools

View

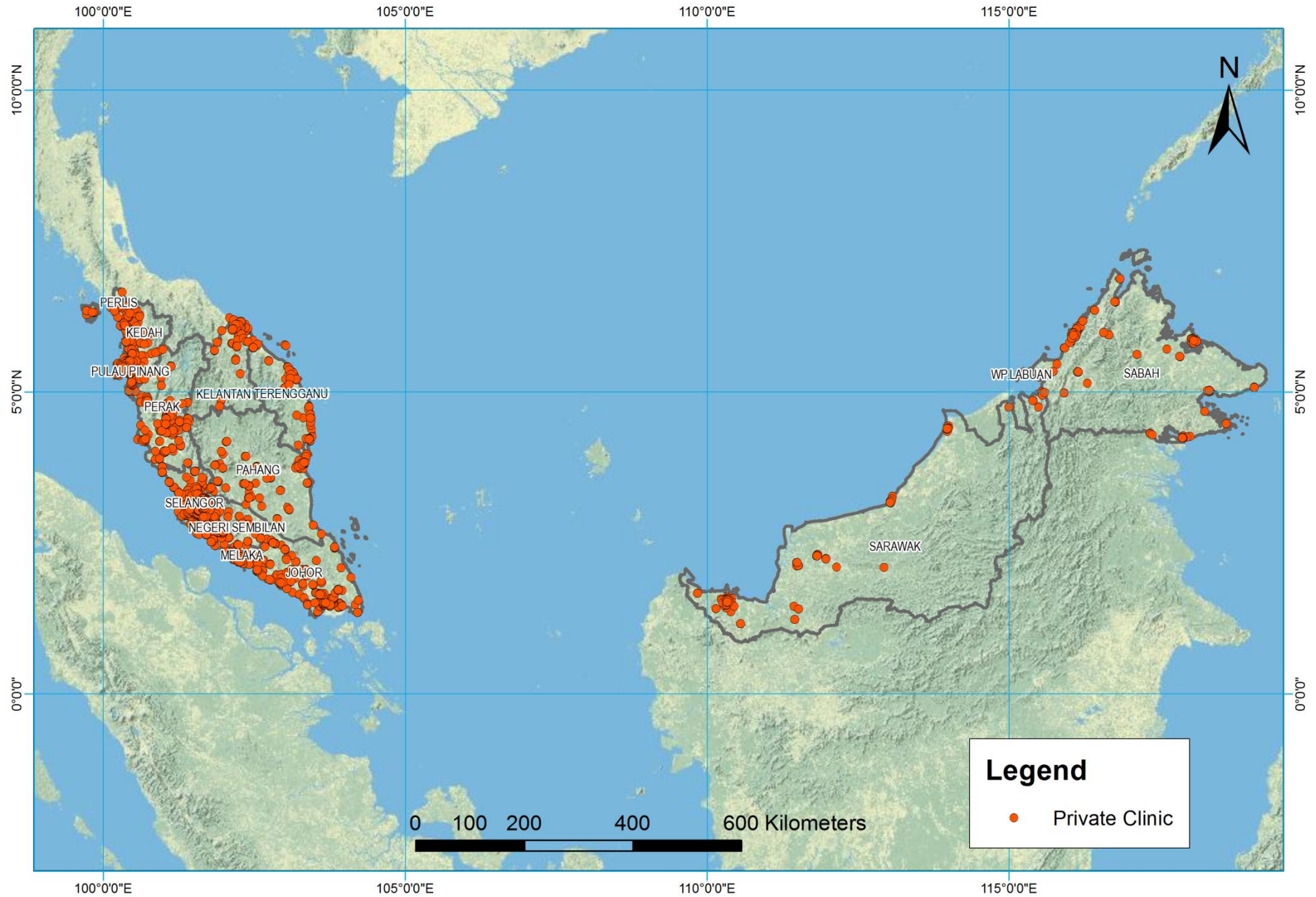
Distribution of Government (MOH) Hospitals



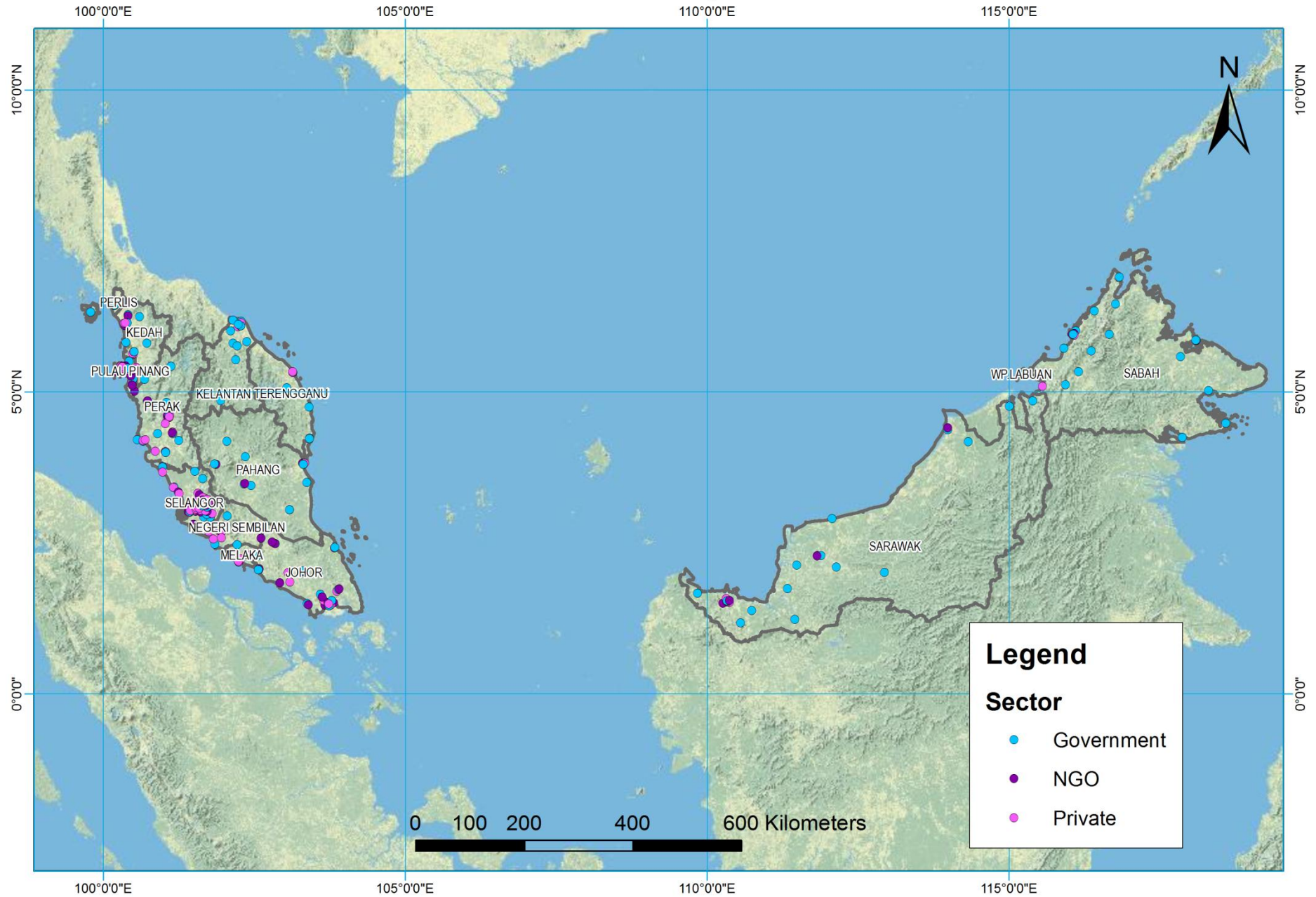
Distribution of Government Clinics



Distribution of Private Clinics

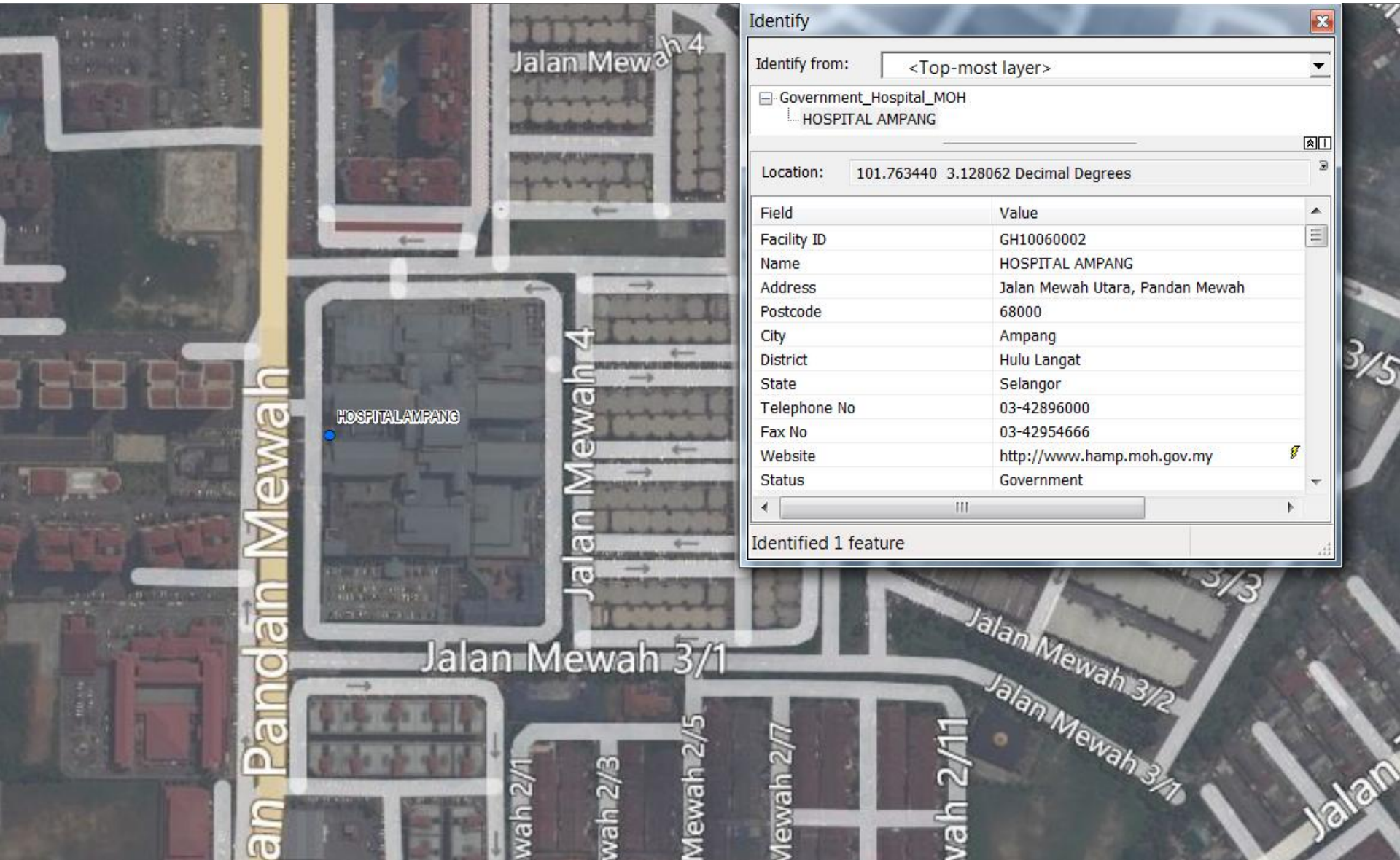


Distribution of Dialysis Centers

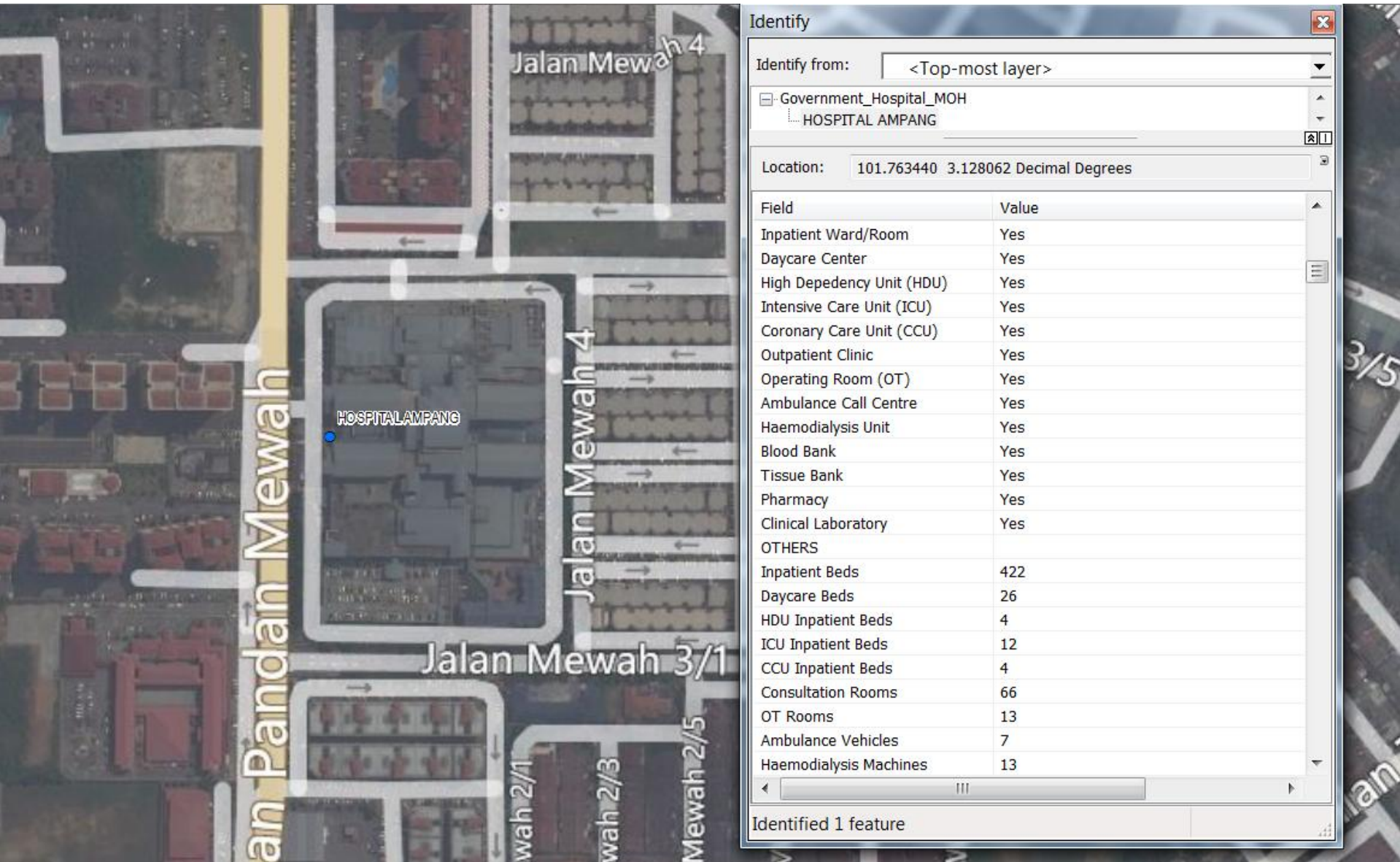


Further Information on Specific Facility

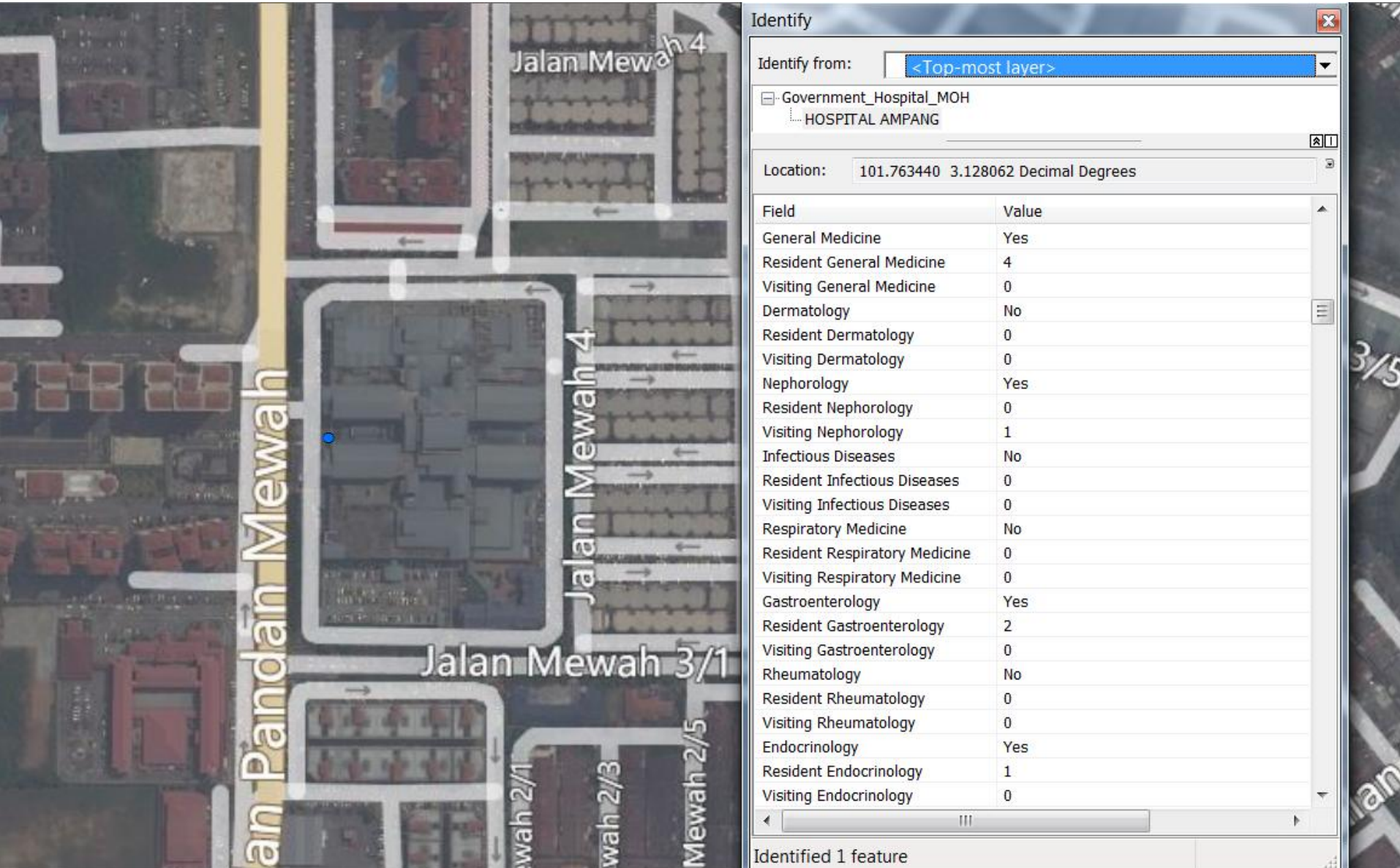
Basic Information



Facility



Clinical Specialty



The image shows an aerial view of Hospital Ampang with an 'Identify' window overlaid on the right. The map labels include 'Jalan Mewah 4', 'Jalan Mewah 3/1', 'Jalan Pandan Mewah', 'Jalan Mewah 2/1', 'Jalan Mewah 2/3', and 'Jalan Mewah 2/5'. A blue dot on the map indicates the location of the hospital. The 'Identify' window shows the following information:

Identify from:

Government_Hospital_MOH
 HOSPITAL AMPANG

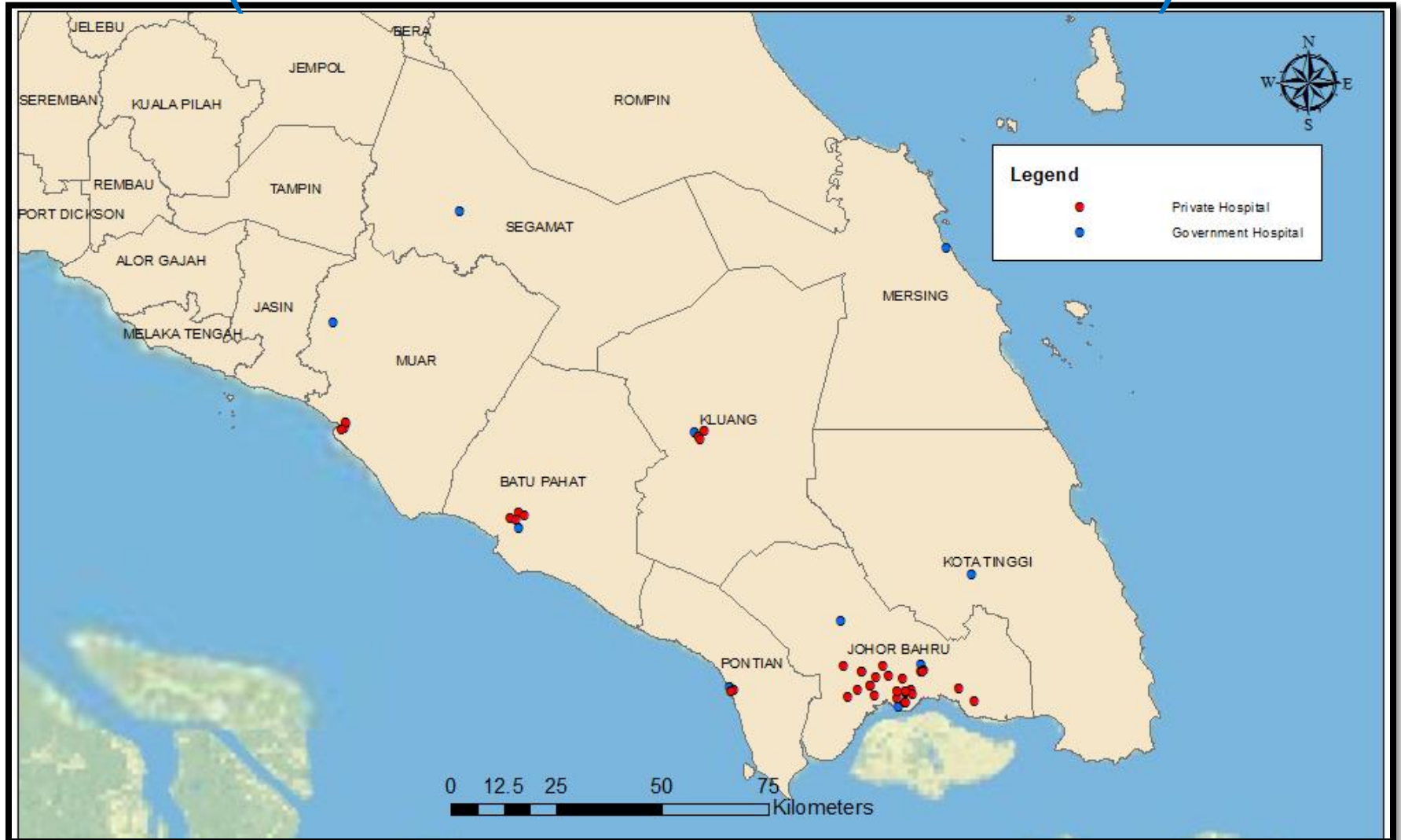
Location:

Field	Value
General Medicine	Yes
Resident General Medicine	4
Visiting General Medicine	0
Dermatology	No
Resident Dermatology	0
Visiting Dermatology	0
Nephrology	Yes
Resident Nephrology	0
Visiting Nephrology	1
Infectious Diseases	No
Resident Infectious Diseases	0
Visiting Infectious Diseases	0
Respiratory Medicine	No
Resident Respiratory Medicine	0
Visiting Respiratory Medicine	0
Gastroenterology	Yes
Resident Gastroenterology	2
Visiting Gastroenterology	0
Rheumatology	No
Resident Rheumatology	0
Visiting Rheumatology	0
Endocrinology	Yes
Resident Endocrinology	1
Visiting Endocrinology	0

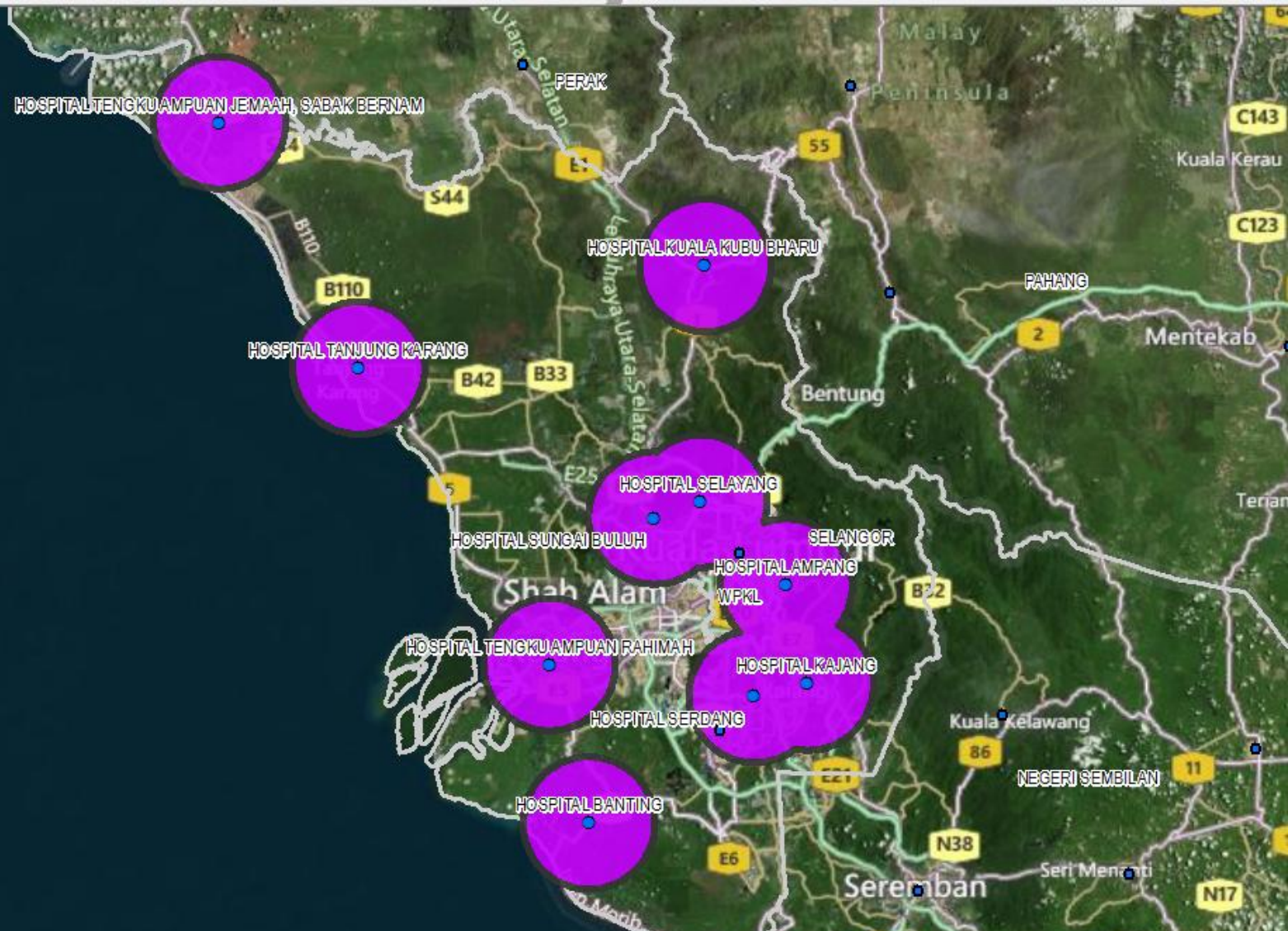
Identified 1 feature

Query and Search

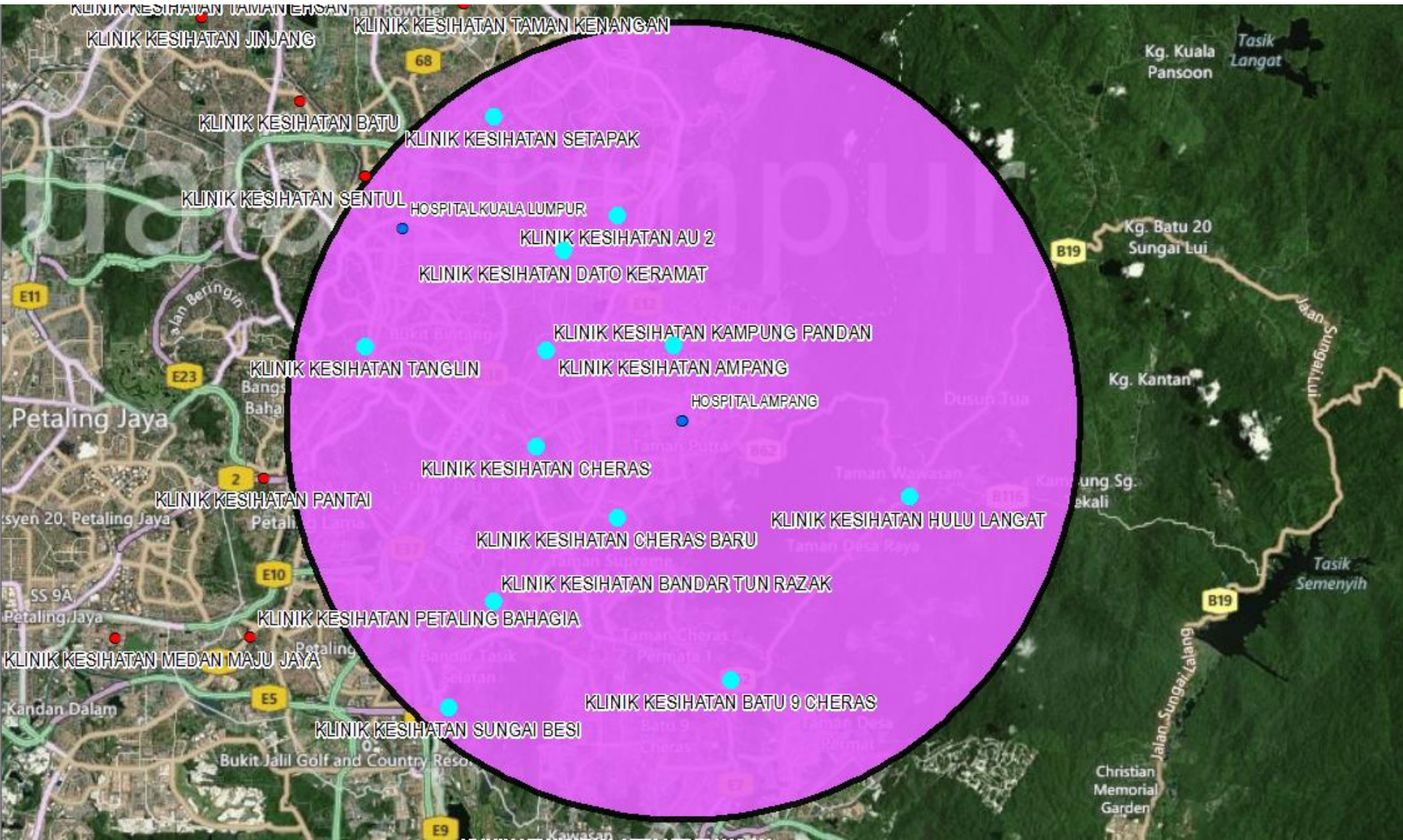
Distribution of Hospitals in Johor (Government and Private)



Area within 10km radius from Government Hospitals in Selangor

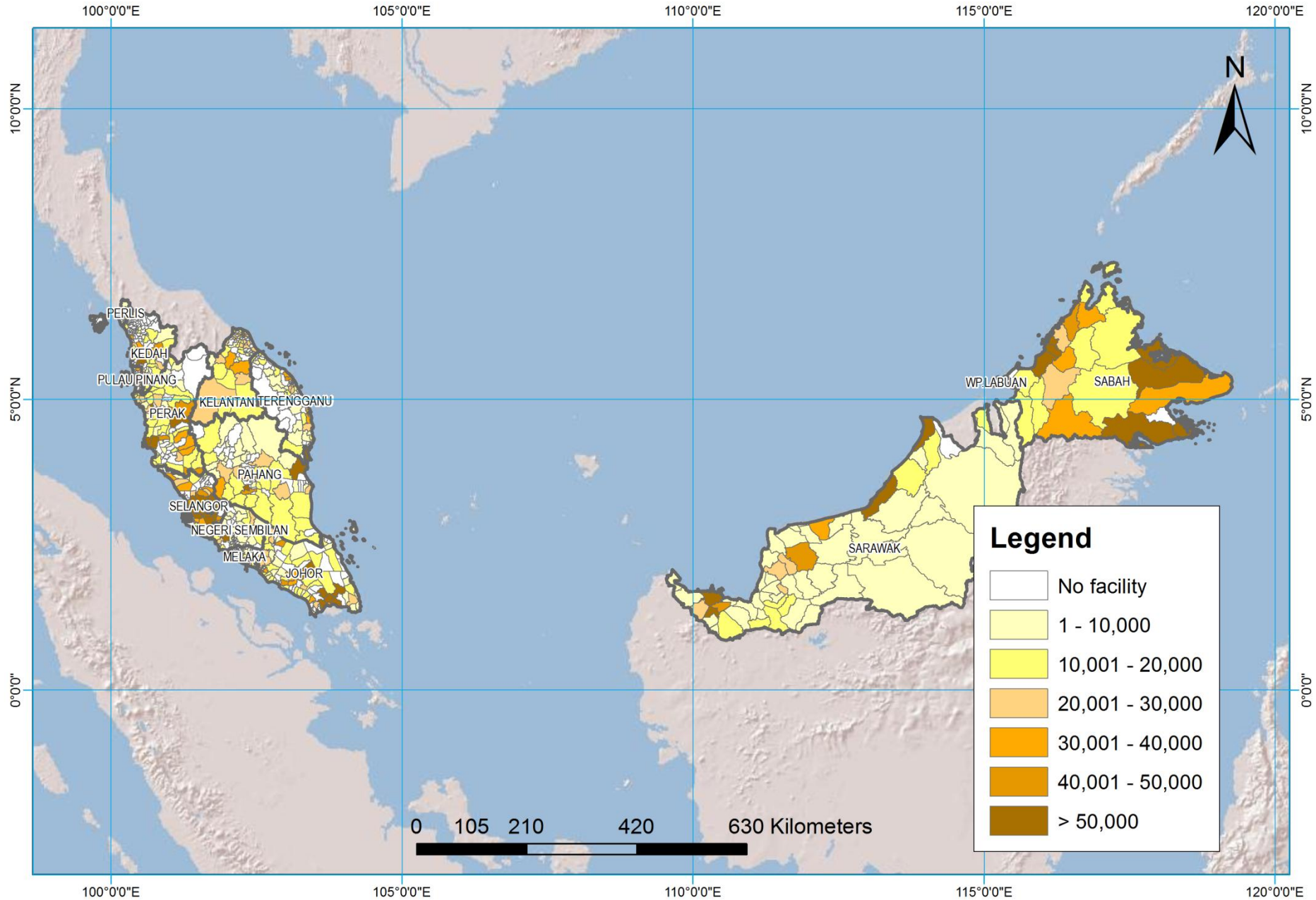


Government Clinic within 10km from Hospital Ampang

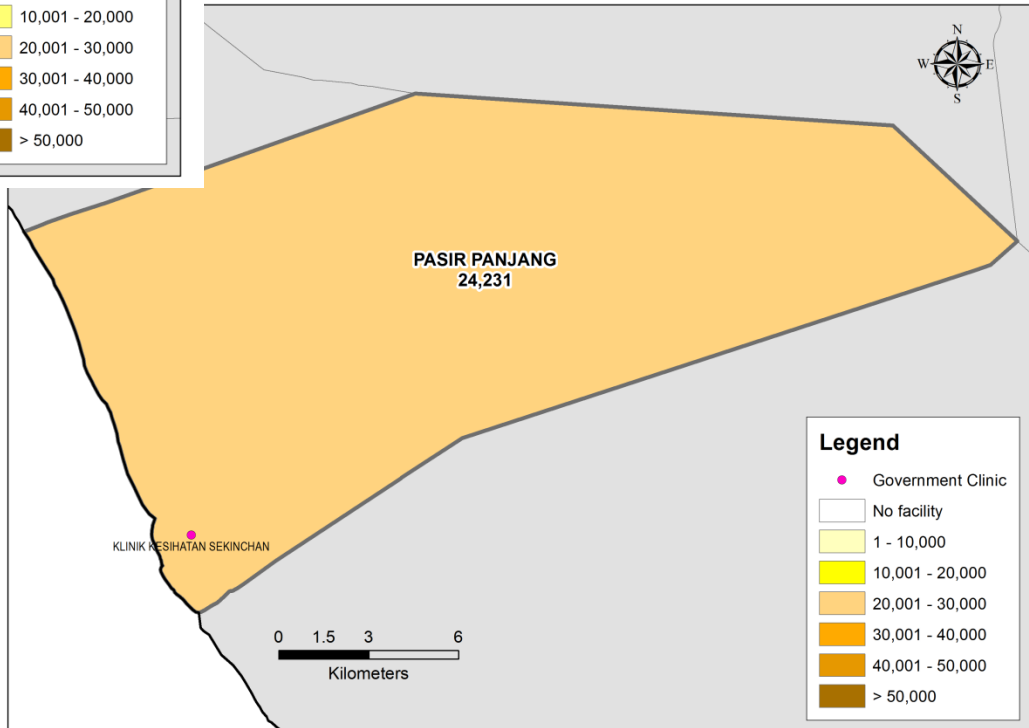
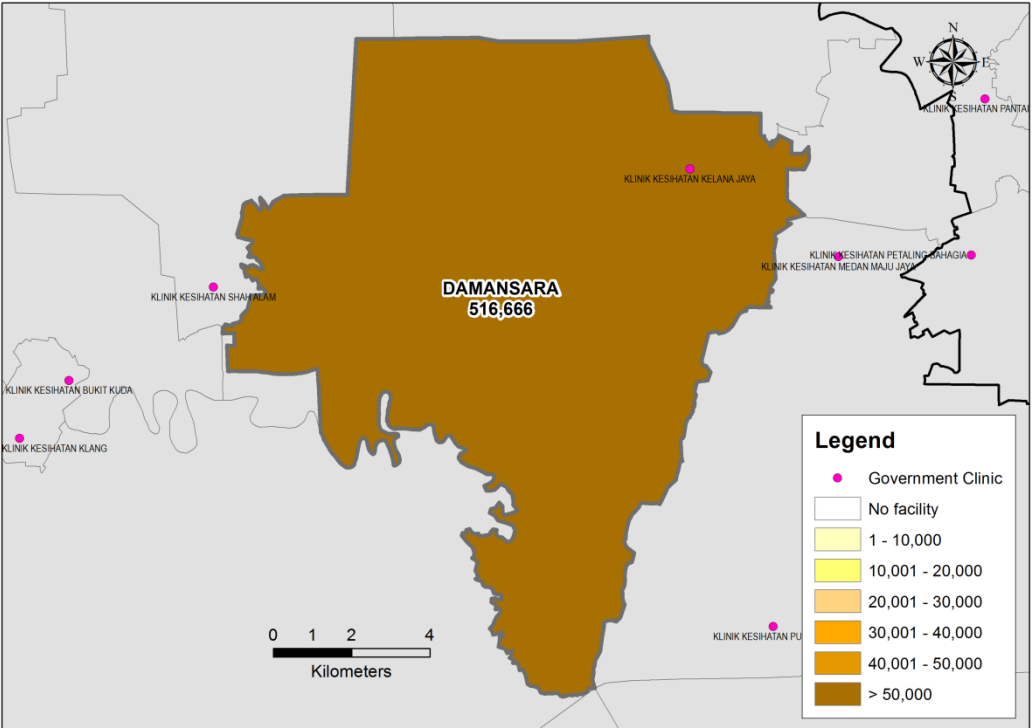


Spatial Analysis

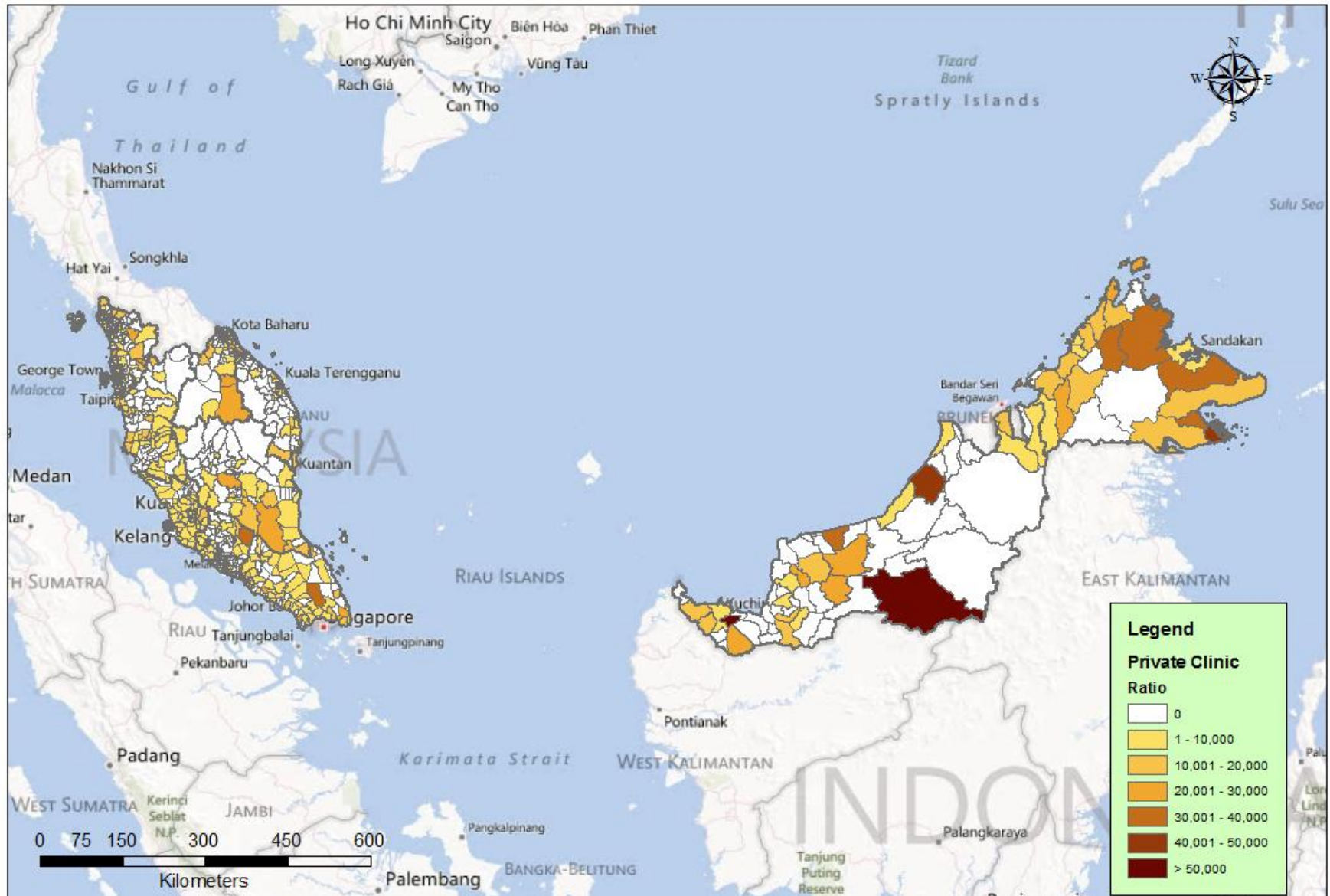
Population to Government Clinics Ratio by Sub-District



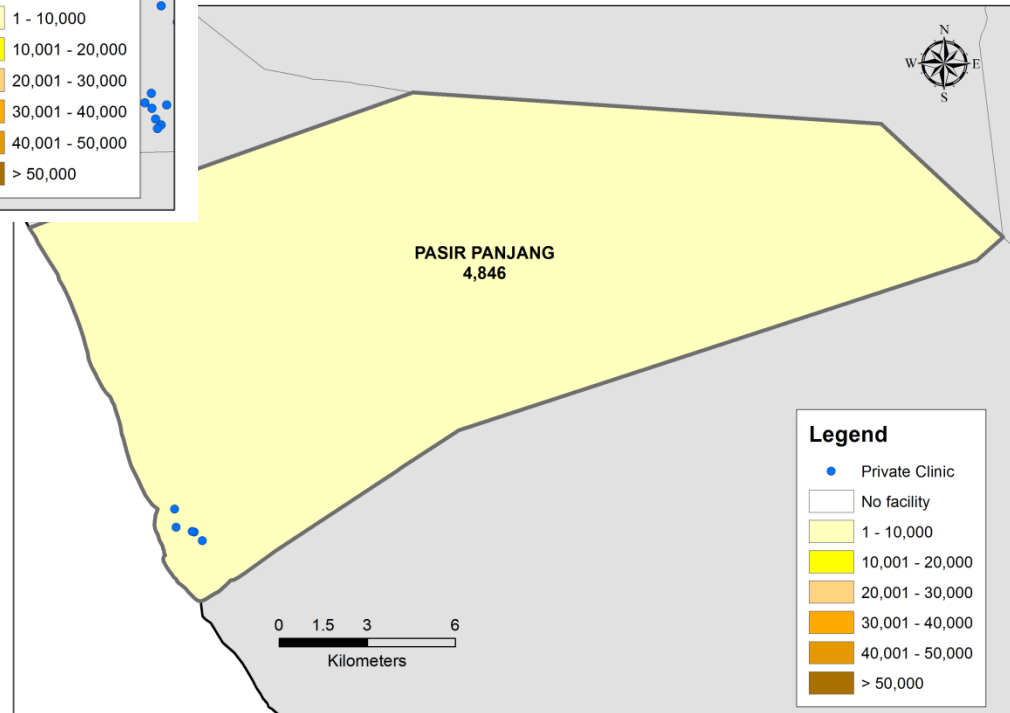
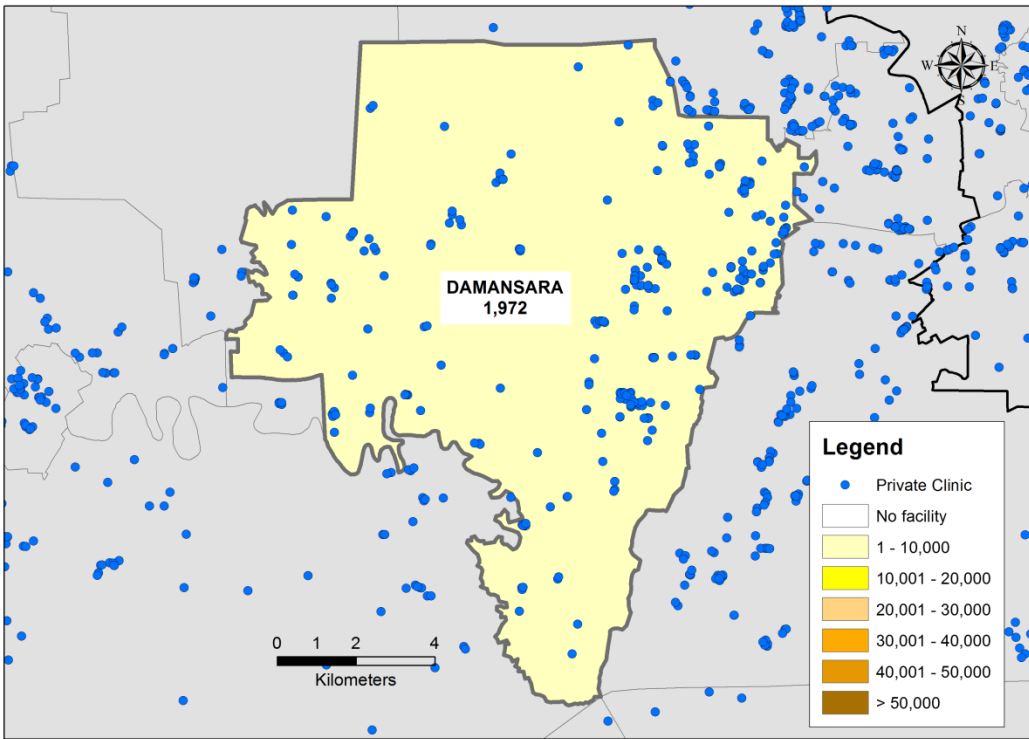
Population to Government Clinics Ratio by Sub-District



Population to Private Clinics Ratio by Sub-District

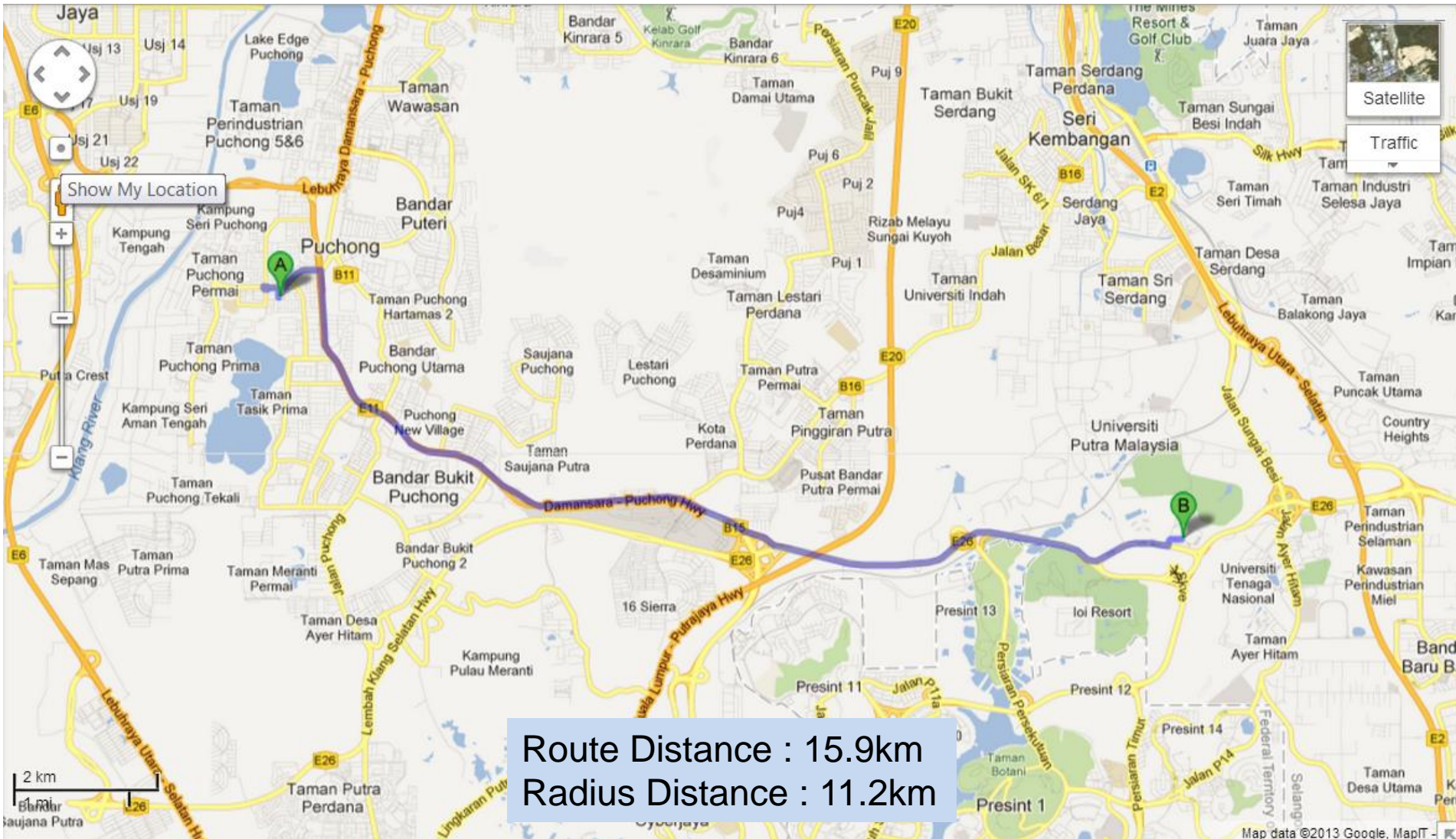


Population to Private Clinics Ratio by Sub-District



Network Analysis

From Klinik Kesihatan Puchong to Hospital Serdang



Spatial Temporal Analysis

Spatial Temporal Patterns Of Dengue In Seremban, Negeri Sembilan

Institute for Public Health

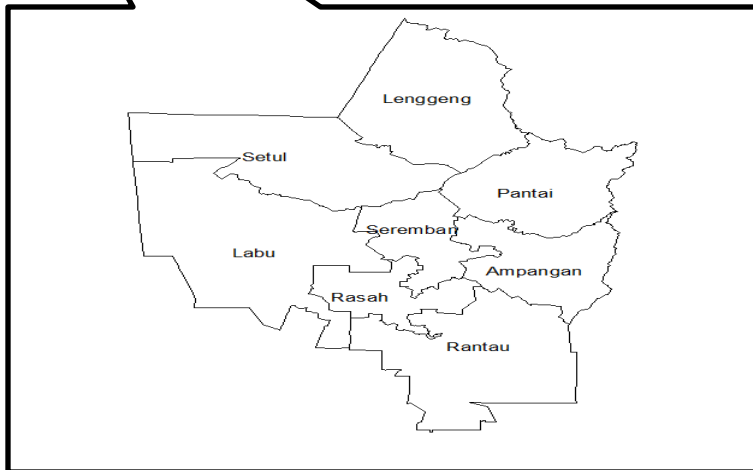
Main Objective

- To identify the vulnerability of Seremban district to dengue using spatial-temporal indices

Specific objective

- To identify spatial pattern in Seremban district using Moran's I, average nearest neighborhood and hotspot
- To determine dengue risk using spatial-temporal indices which are frequency index, duration index and intensity index.
- To assess the vulnerability of Seremban district using local indicator of spatial autocorrelation (LISA).

Study area



- Seremban, Negeri Sembilan: latitude $2^{\circ} 43'N$ dan longitude $101^{\circ} 57'E$
- Consist of 8 sub district: Ampangan, Setul, Lenggeng, Rasah, Pantai, Seremban, Labu and Rantau.
- Area: 95189.36 hektar
- 60 km from Kuala Lumpur

Method of collecting data

Dengue surveillance

- Data of dengue prevalence in Seremban district from 2003 to 2009 in VEKPRO Database, Seremban District Health Office

Data Analysis

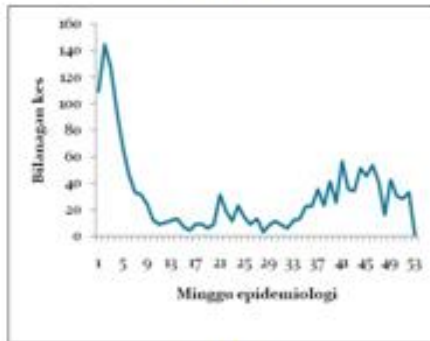
- Spatial
 - Moran's I , ANN (average nearest neighborhood) and Hotspot
- Spatial-temporal indices
 - frequency index, duration index and intensity index
- Dengue vulnerability
 - LISA (local indicator of spatial autocorrelation)

1. Socio-demographic of dengue cases

- 6076 cases have been reported in study duration 2003 -2009 in Seremban district.

Dengue distribution using epid week every year from 2003 - 2009

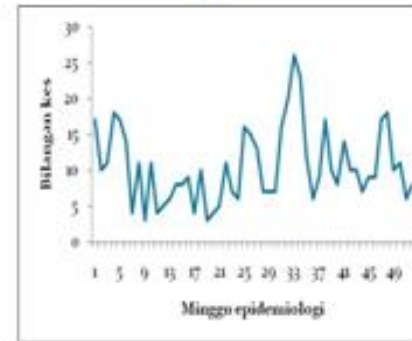
2003



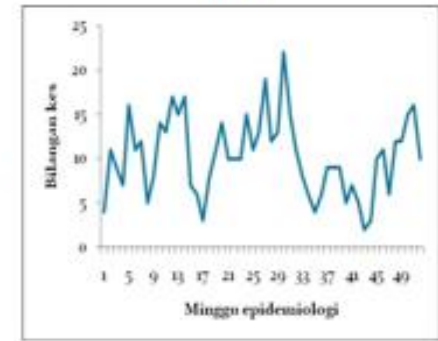
2004



2005



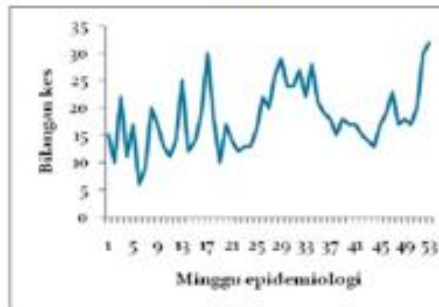
2006



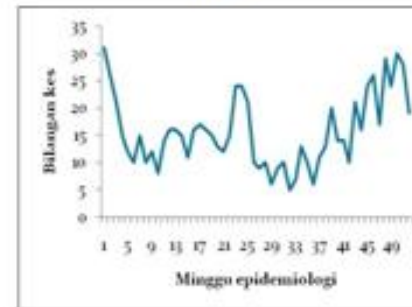
2007



2008



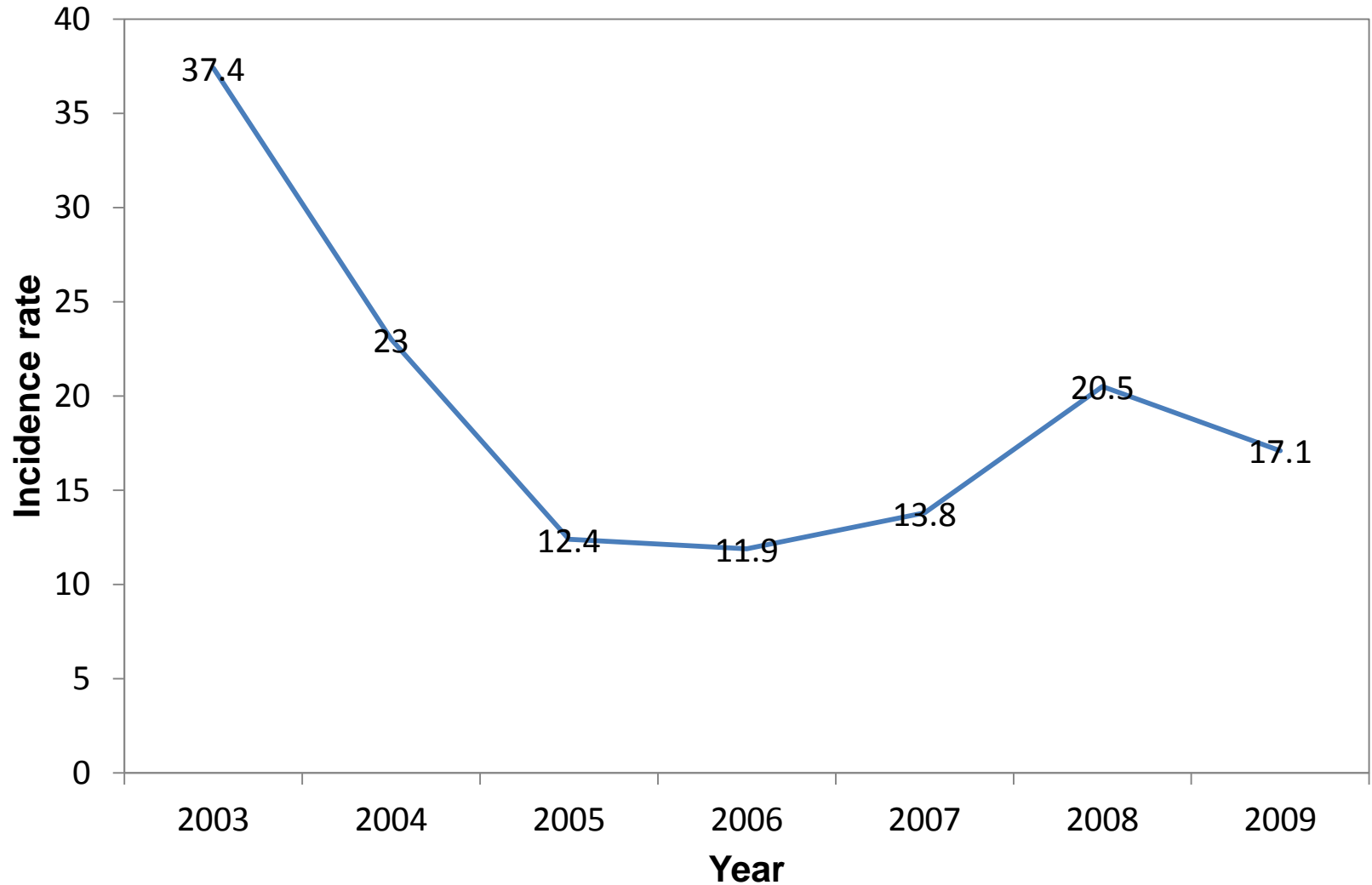
2009



Case and incidence rate of DF (DD) dan DHF (DDB) 2003-2009

<u>Tahun</u>	DD	%	DDB	%	<u>Jumlah</u>	%	<u>Kadar insiden</u>
2003	1496	94.2	92	5.8	1588	26.2	37.4
2004	972	97.4	26	2.6	998	16.4	23
2005	537	98.2	10	1.8	547	9	12.4
2006	519	97.2	15	2.8	534	8.8	11.9
2007	623	98.4	10	1.6	633	10.4	13.8
2008	929	96.8	31	3.2	960	15.8	20.5
2009	731	89.6	85	10.4	816	13.4	17.1
<u>Jumlah</u>	5807	95.6	269	4.4	6076	100	<u>Purata= 19.4</u>

Incidence rate of dengue in Seremban 2003-2009



2. Spatial patterns of dengue cases in Seremban

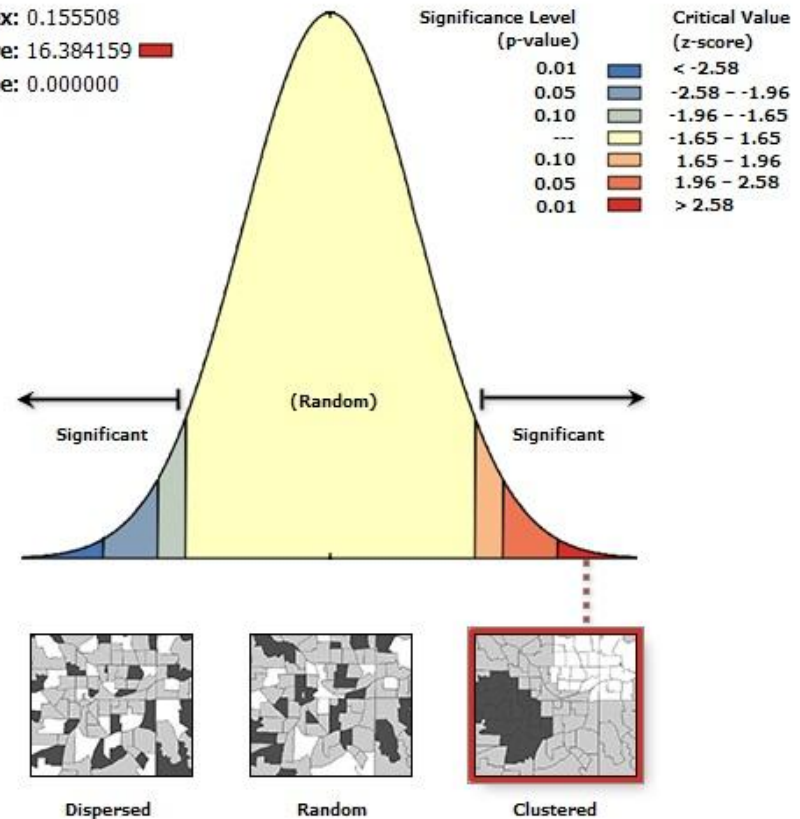
Moran's I

- used to test whether the dengue cases within Seremban District is spatially correlated or not.
- The value of Moran's I range from -1 for strong negative spatial autocorrelation to +1 for strong positive spatial autocorrelation.
- A value near 0 would indicate a spatially random pattern.

Moran's I

- Moran's Index: 0.16
- Z-score: 16.384
- $P < 0.05$
- Dengue cases are clustered in Seremban

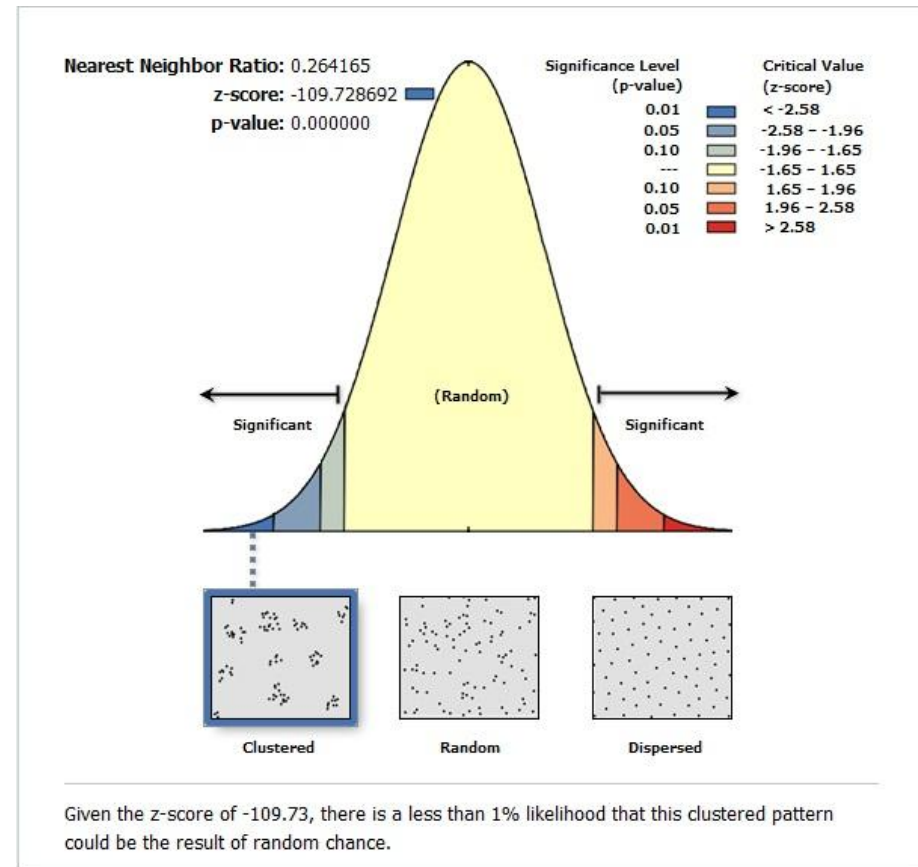
Moran's Index: 0.155508
z-score: 16.384159
p-value: 0.000000



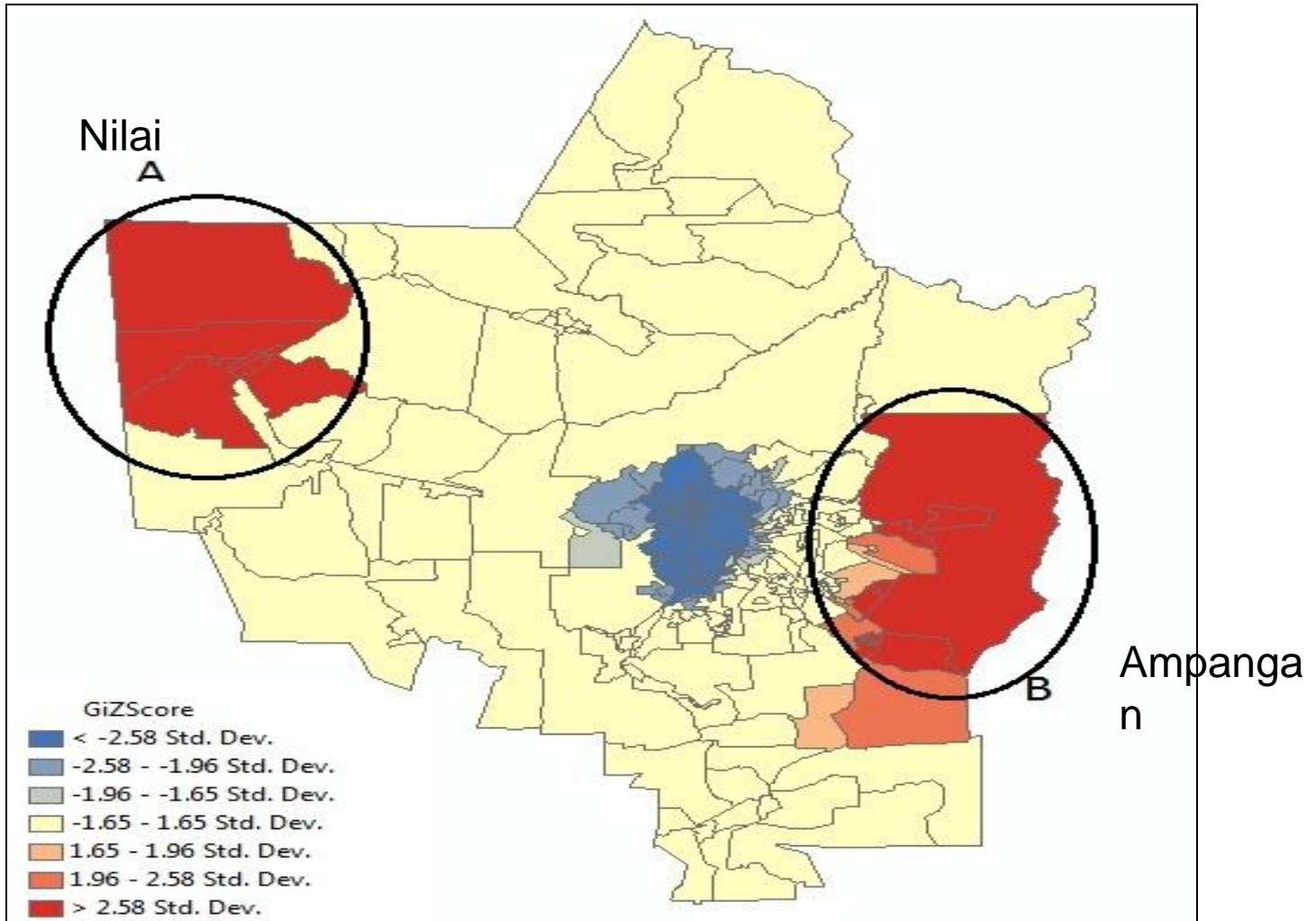
Given the z-score of 16.38, there is a less than 1% likelihood that this clustered pattern could be the result of random chance.

Average Nearest Neighbourhood (ANN)

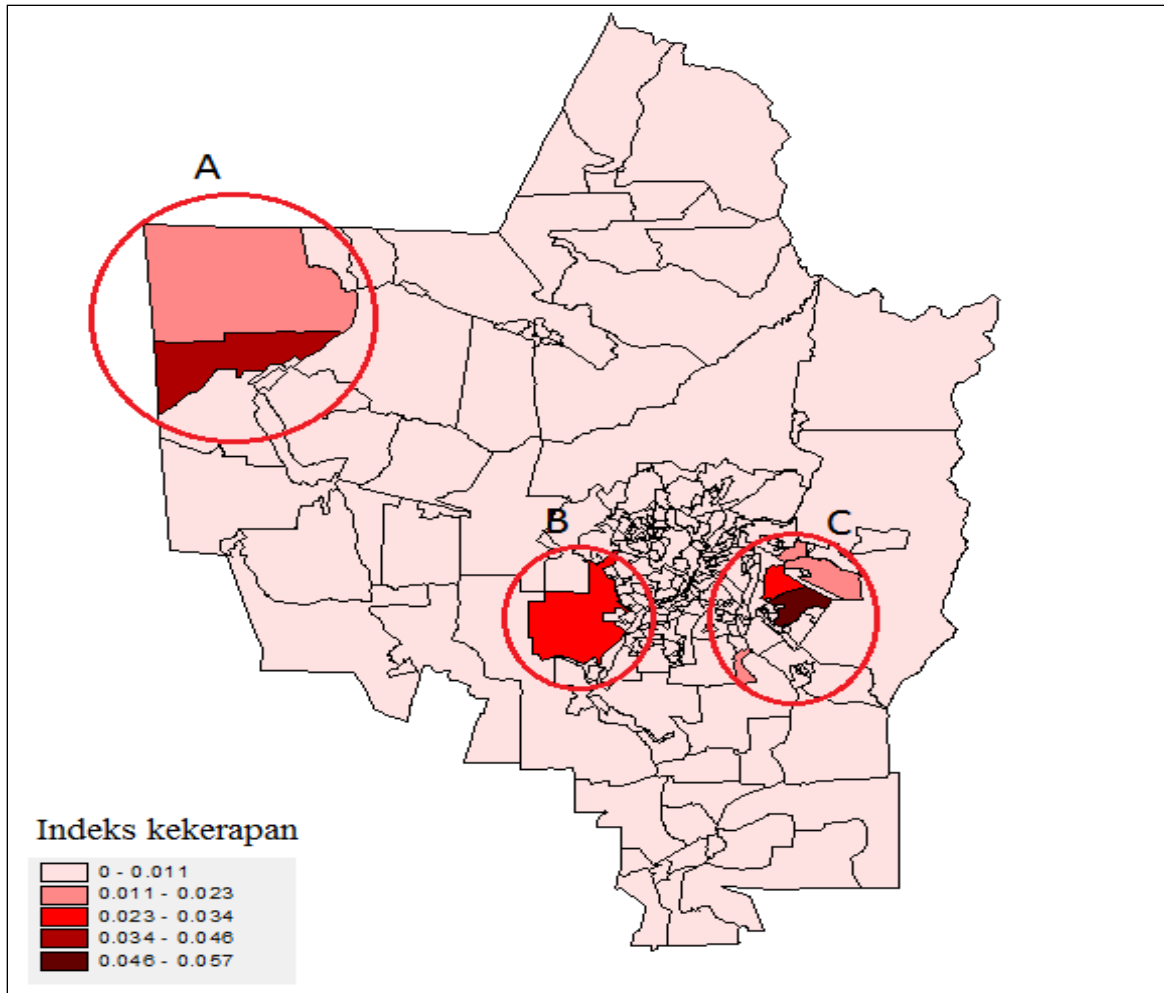
- Observed Mean Distance within dengue case: 55m
- z-score: -109.728692
- p-value < 0.05
- Clustered within dengue cases



Hotspots



Frequency index

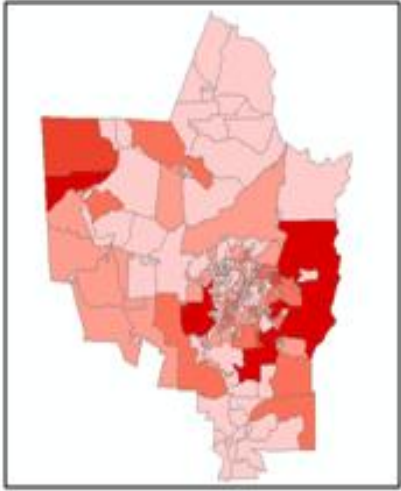


A = Nilai
B = Rasah
C = Ampangan

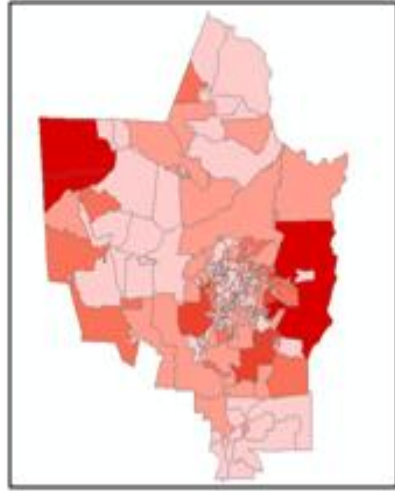
Risk area showed average of frequency index more than 0.023 until 0.057

Average of frequency index in Seremban

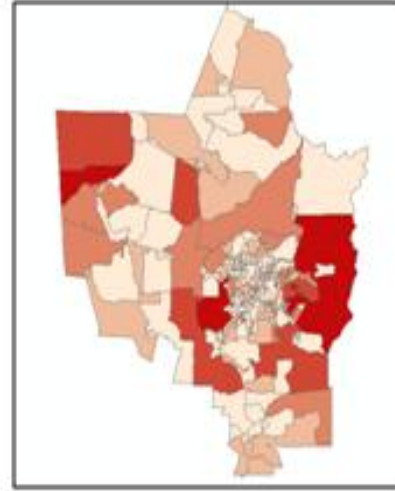
2003



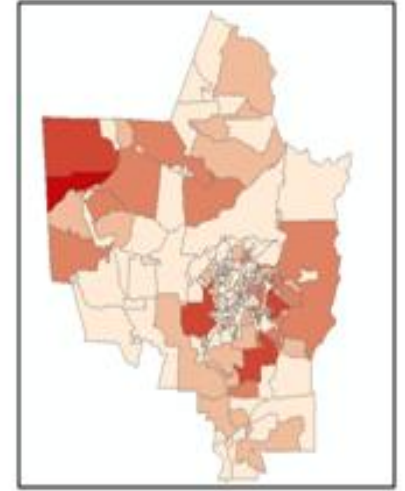
2004



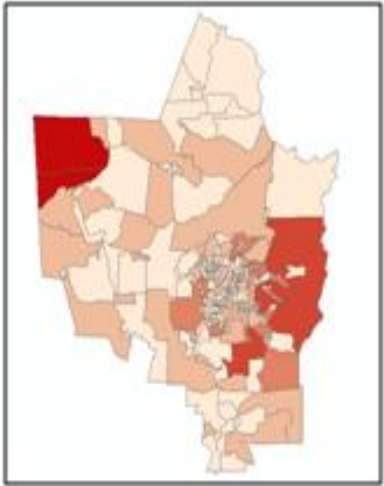
2005



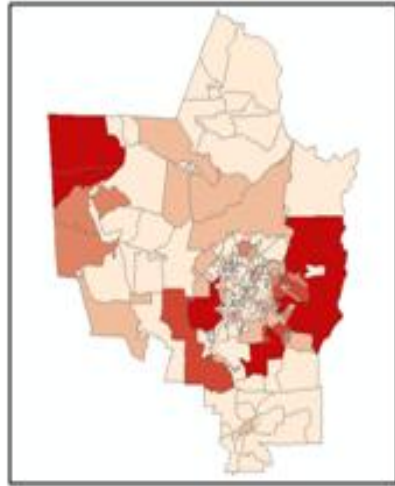
2006



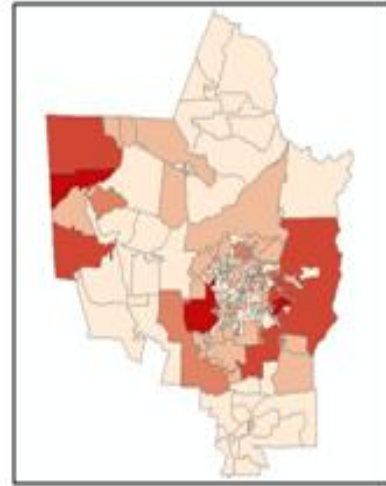
2007



2008

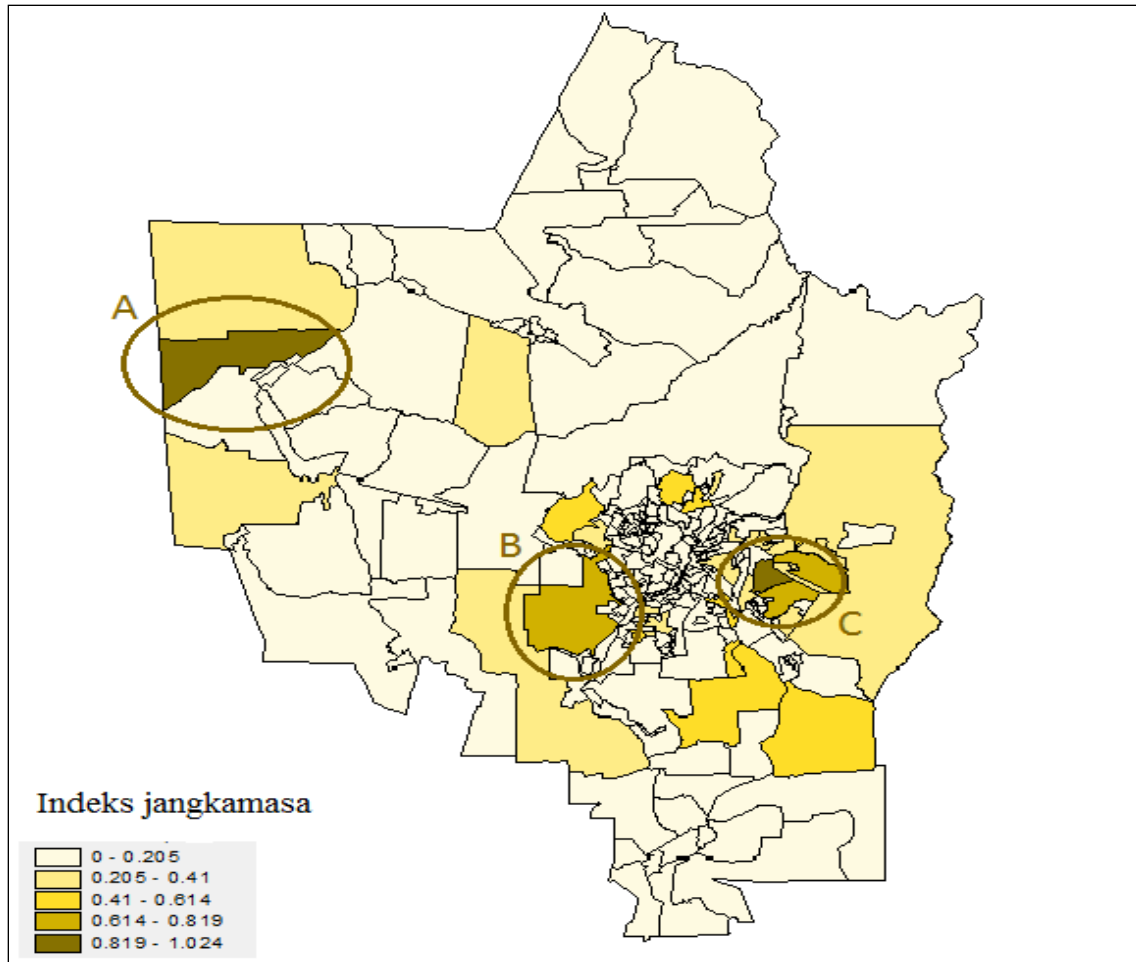


2009



Mapping of frequency index in Seremban, 2003-2009

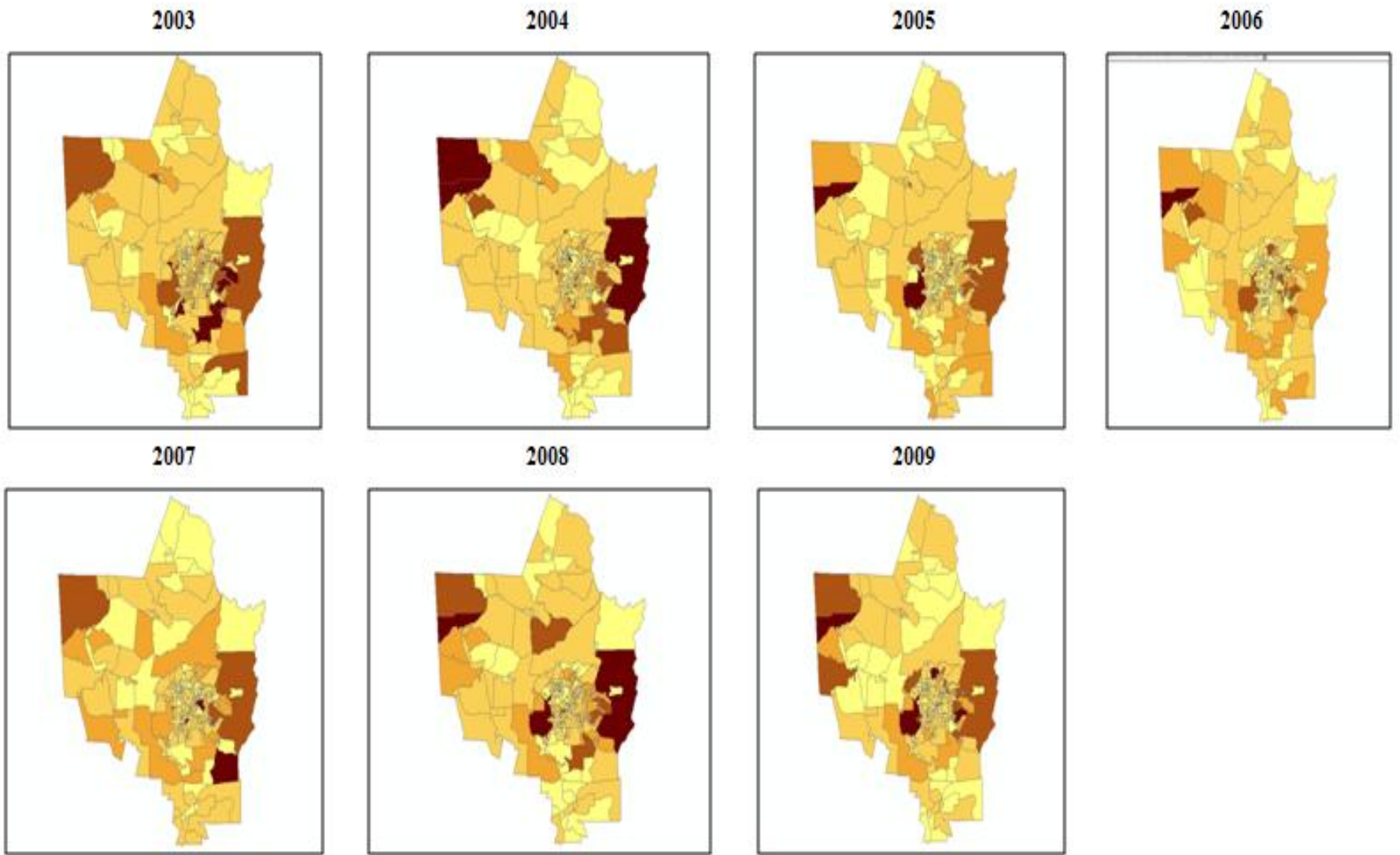
Duration index



A = Nilai
B = Rasah
C = Ampangan

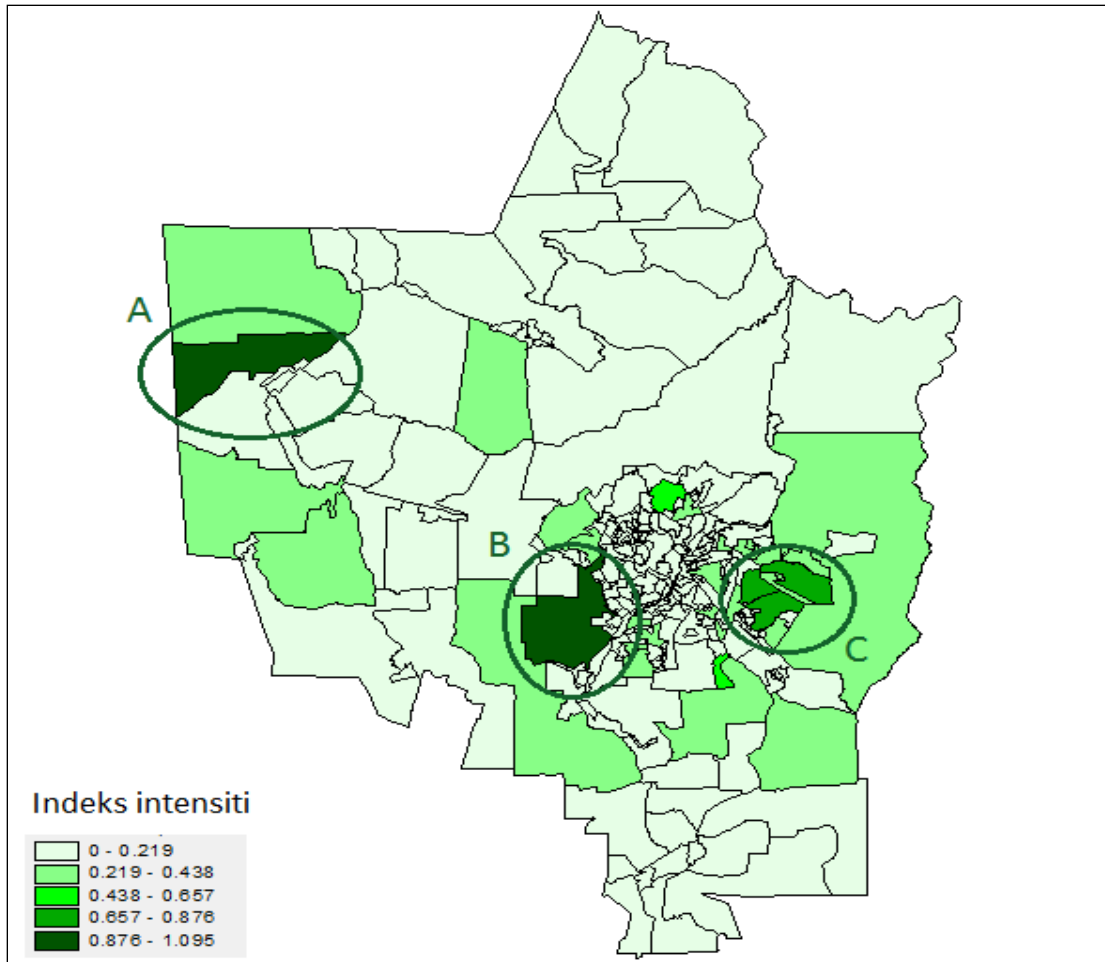
Risk area showed average of duration index more than 0.614 until 1.024

Average of duration index in Seremban



Mapping of duration index in Seremban, 2003-2009

Intensity index

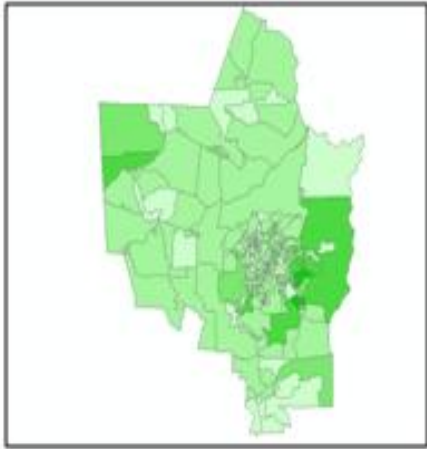


A = Nilai
B = Rasah
C = Ampangan

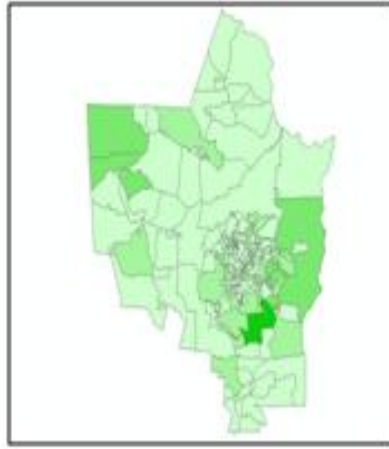
intensity index showed
average more than 0.657
until 1.095

Average of intensity index in Seremban

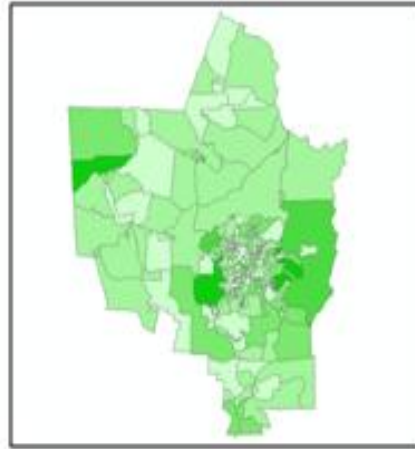
2003



2004



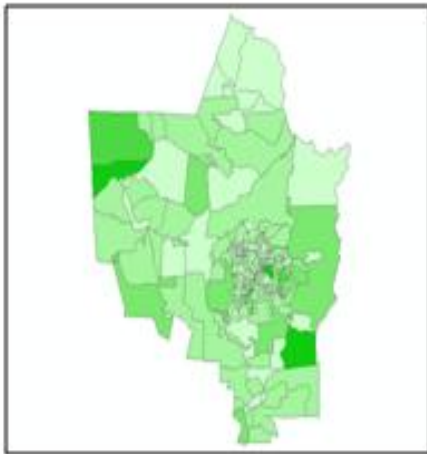
2005



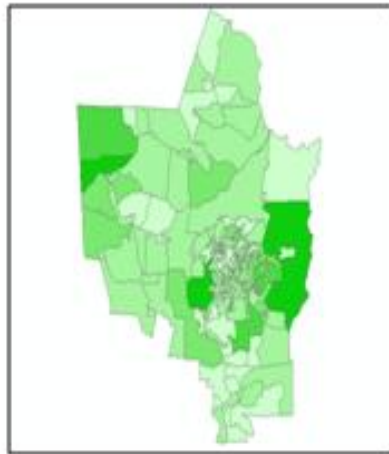
2006



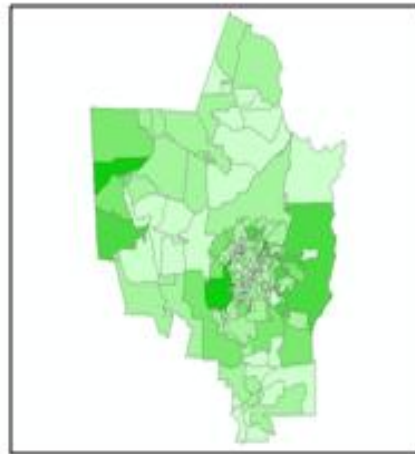
2007



2008



2009

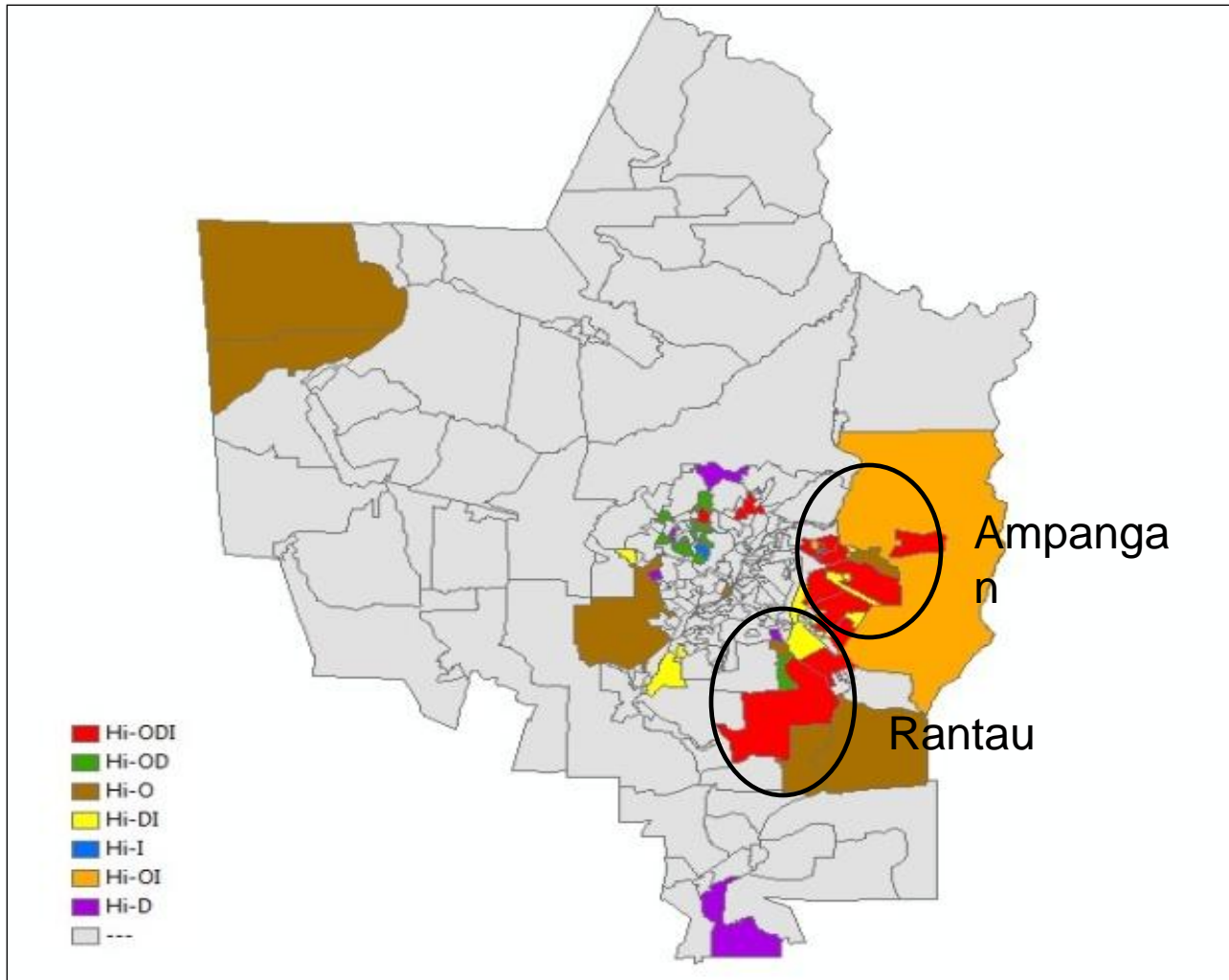


Mapping of intensity index in Seremban, 2003-2009

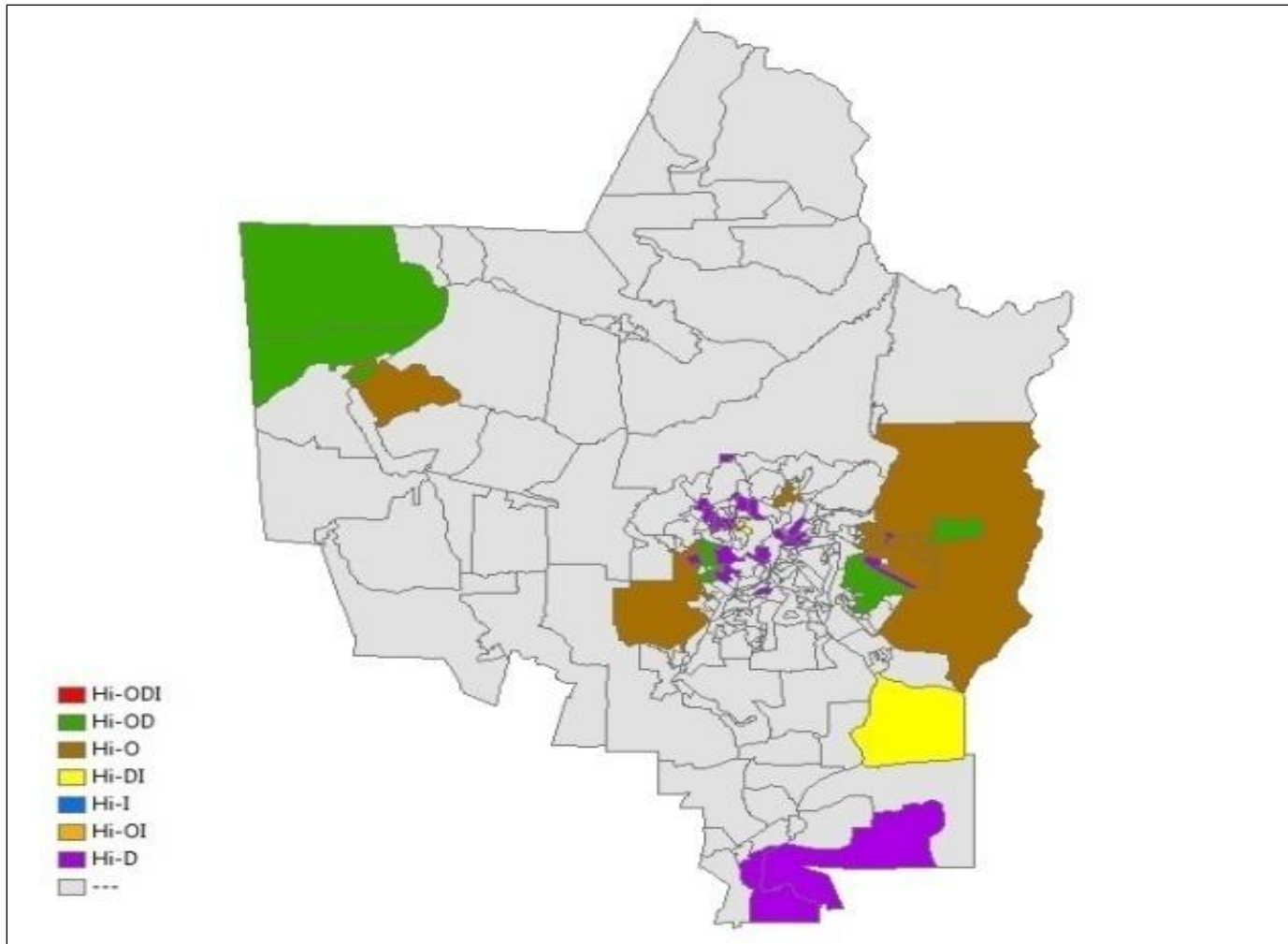
Vulnerability of Seremban using LISA

- Analysis:
 - determine the local indicator of spatial autocorrelation (LISA) of three spatial temporal indices.
 - to identify significant spatial patterns, including clustering and outliers
- The risk maps for these three spatial temporal indices (frequency index, duration index & intensity index) were overlaid together.

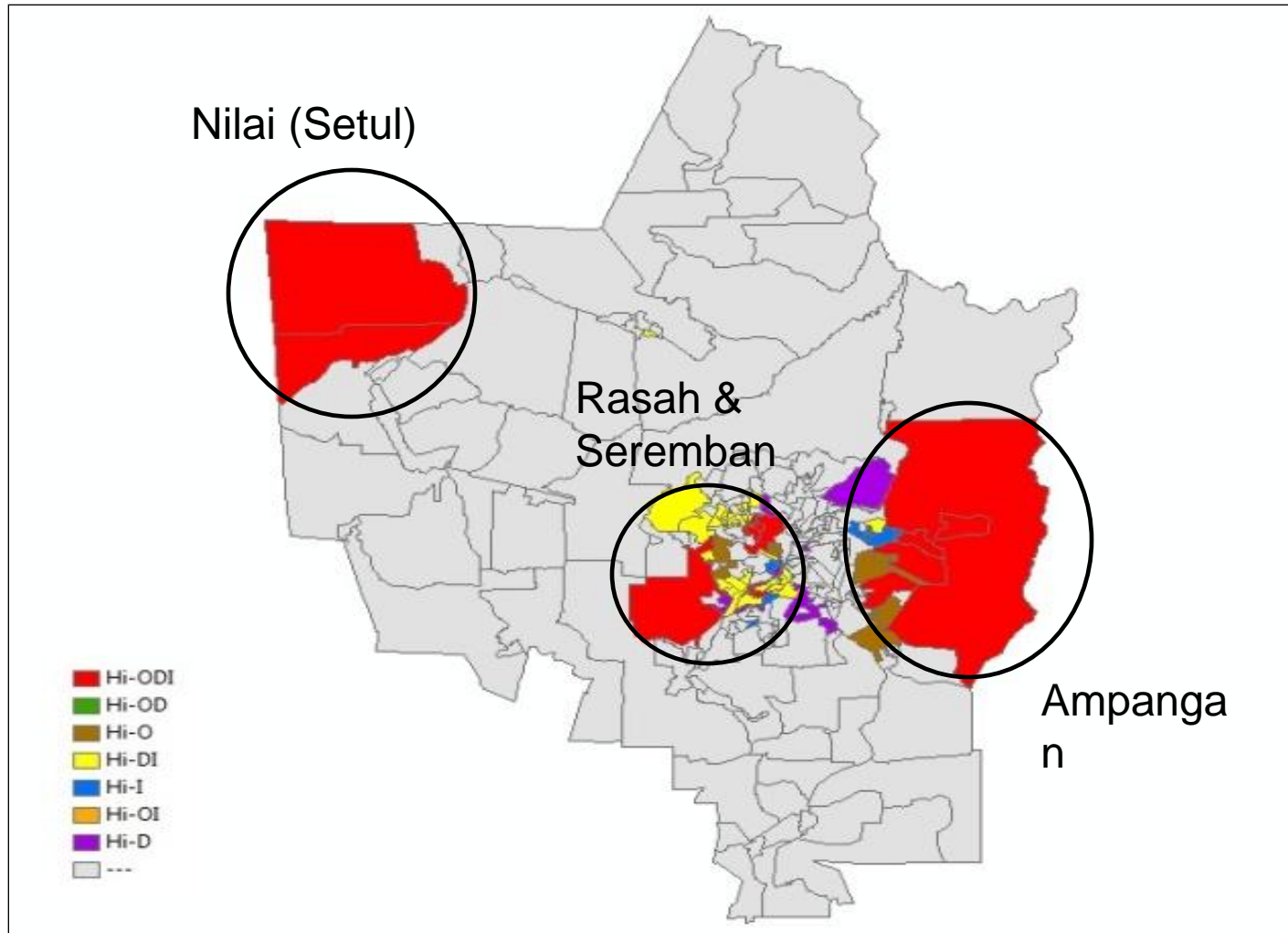
2003



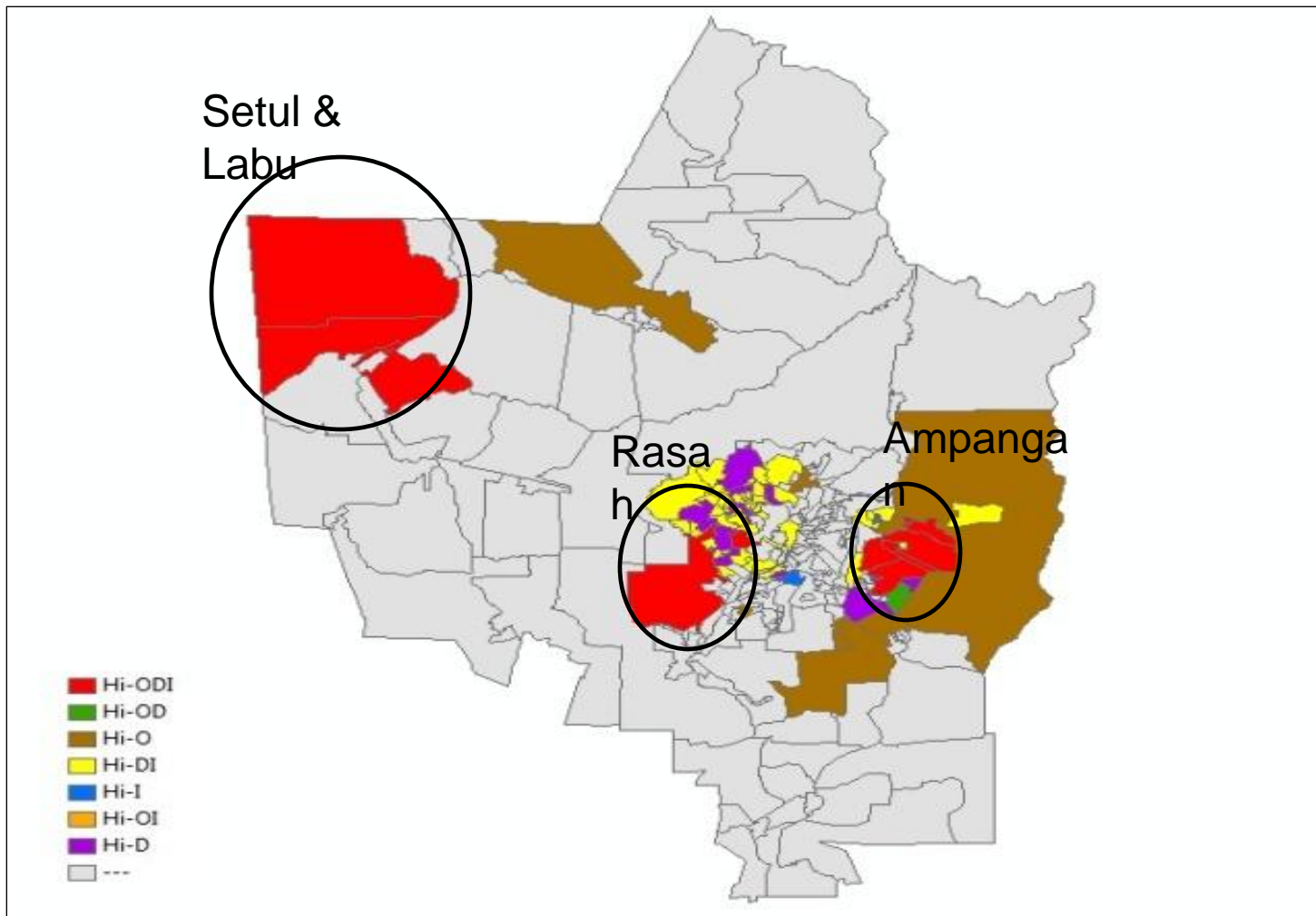
2004



2005



2006

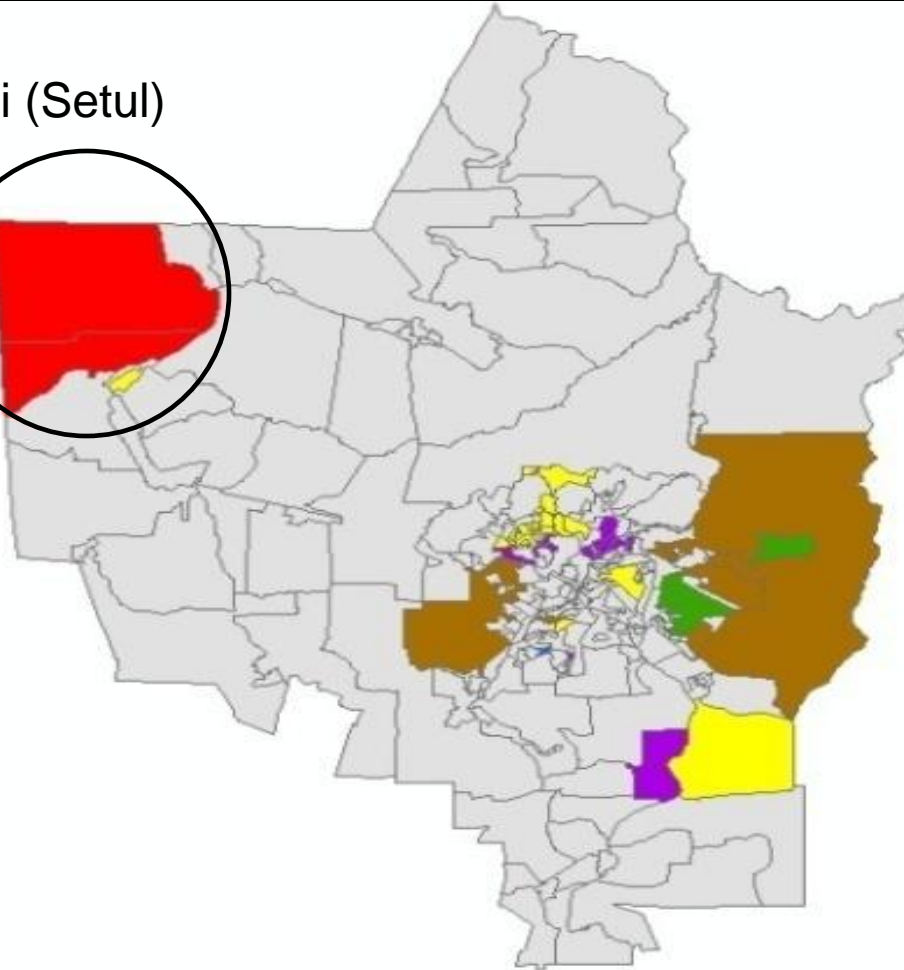


2007

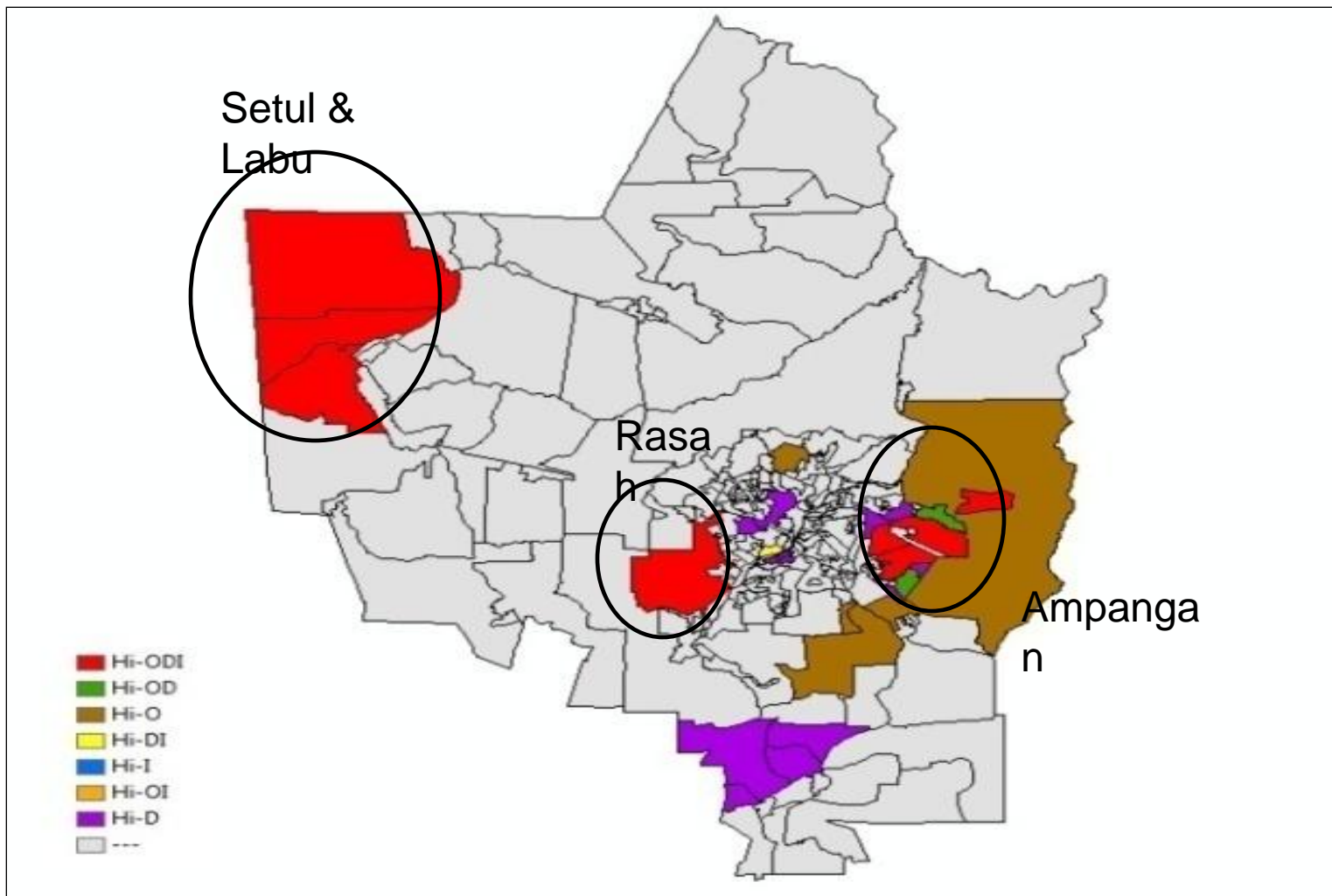
Nilai (Setul)



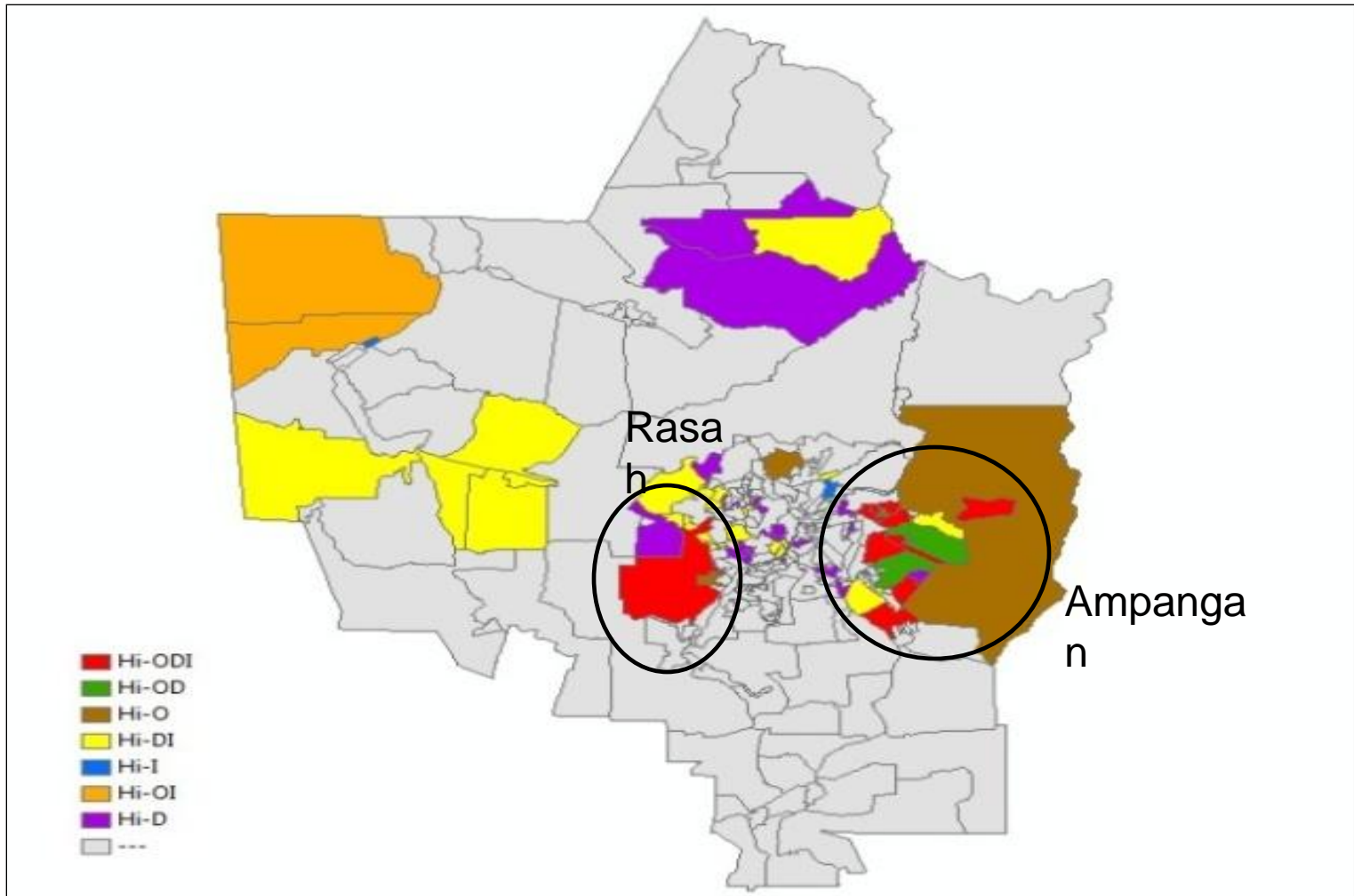
- Hi-ODI
- Hi-OD
- Hi-O
- Hi-DI
- Hi-I
- Hi-OI
- Hi-D
-



2008



2009

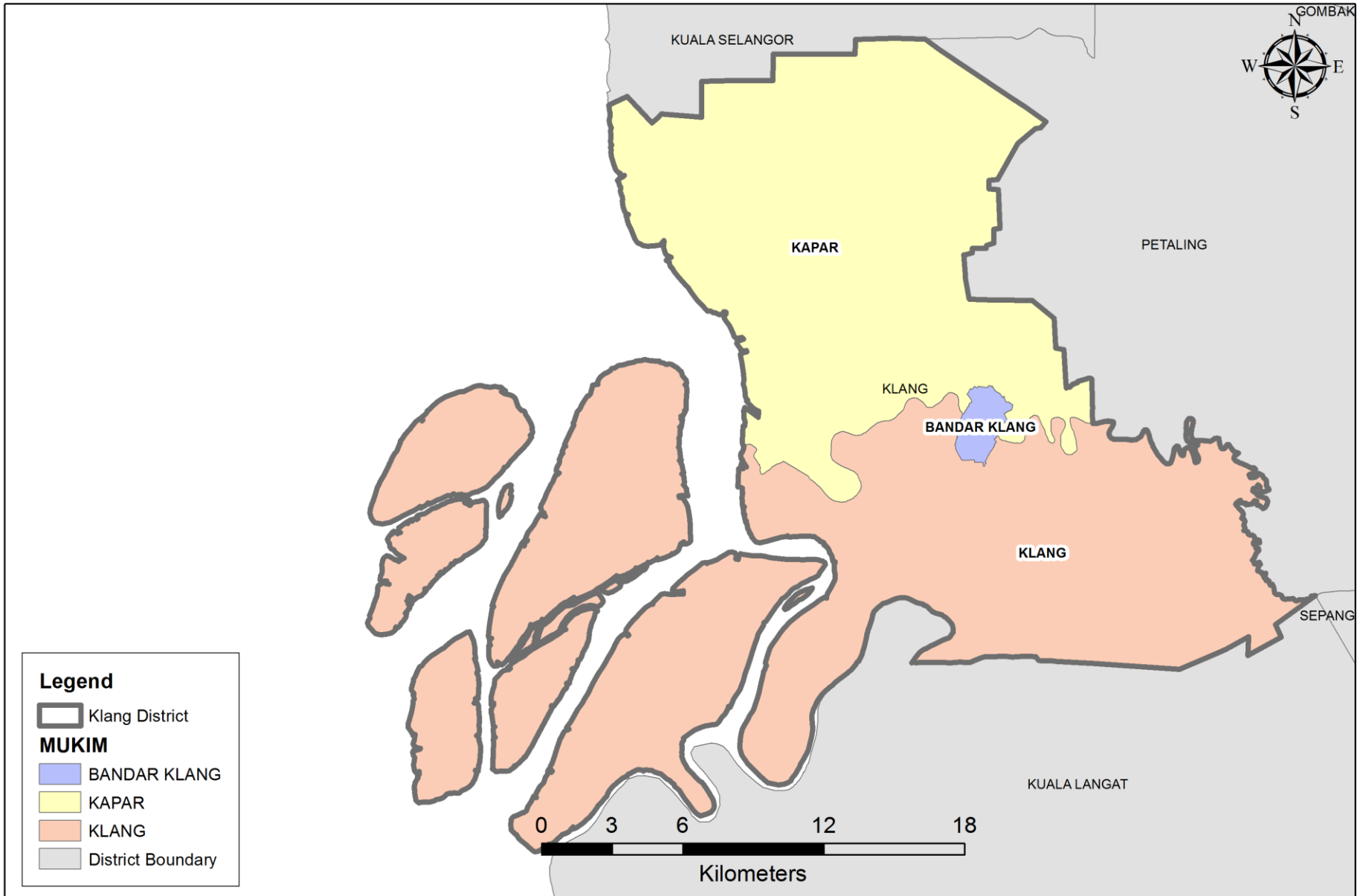


Development of Independent Public Lab and Radiological Centre at Klang District

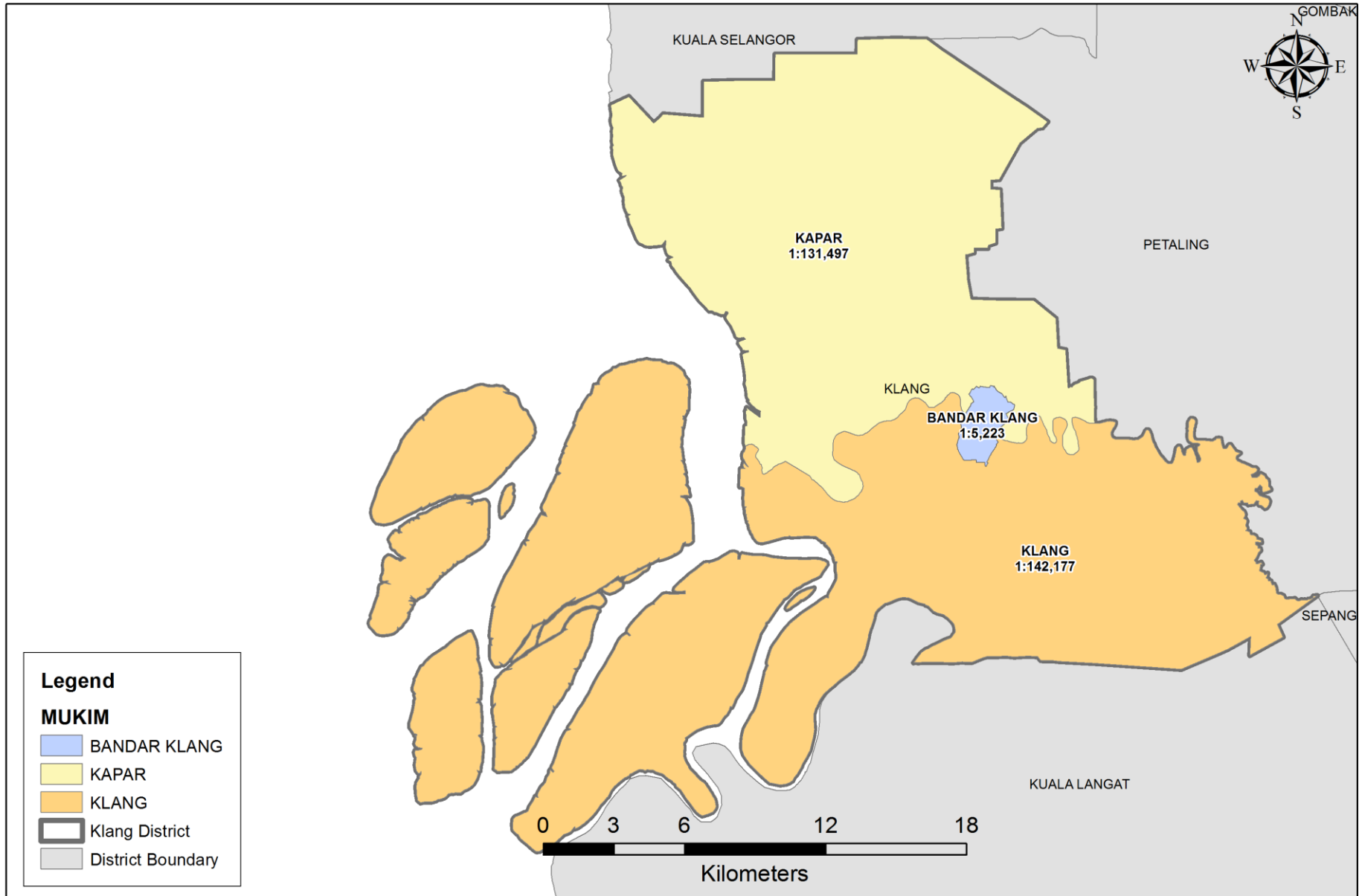
Objective

- To identify best location for development of a new independent public lab and radiological center.
- to study relationship between newly proposed site with existing healthcare facilities within certain kilometers area.

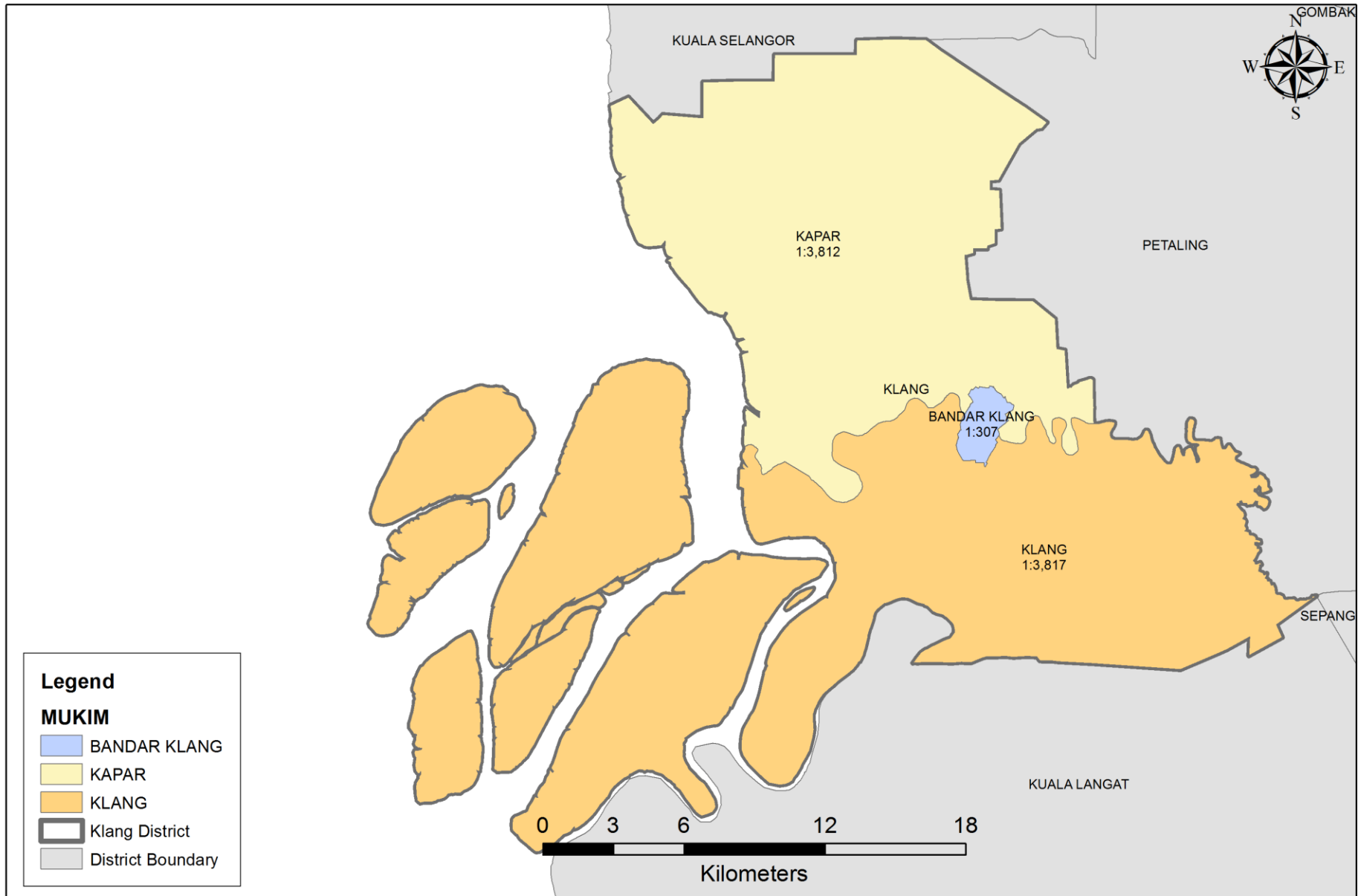
Klang District



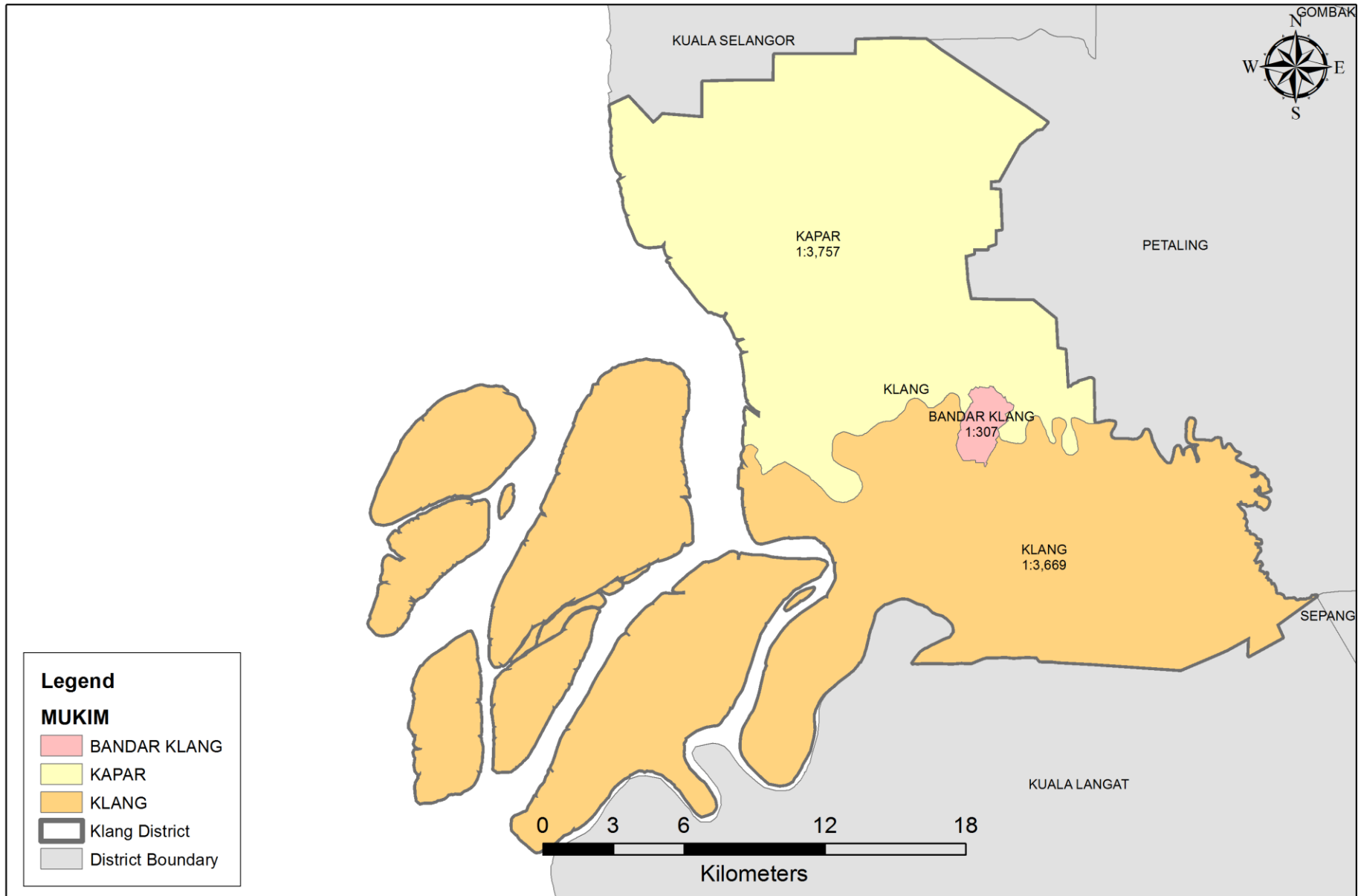
Government Health Clinic to Population Ratio



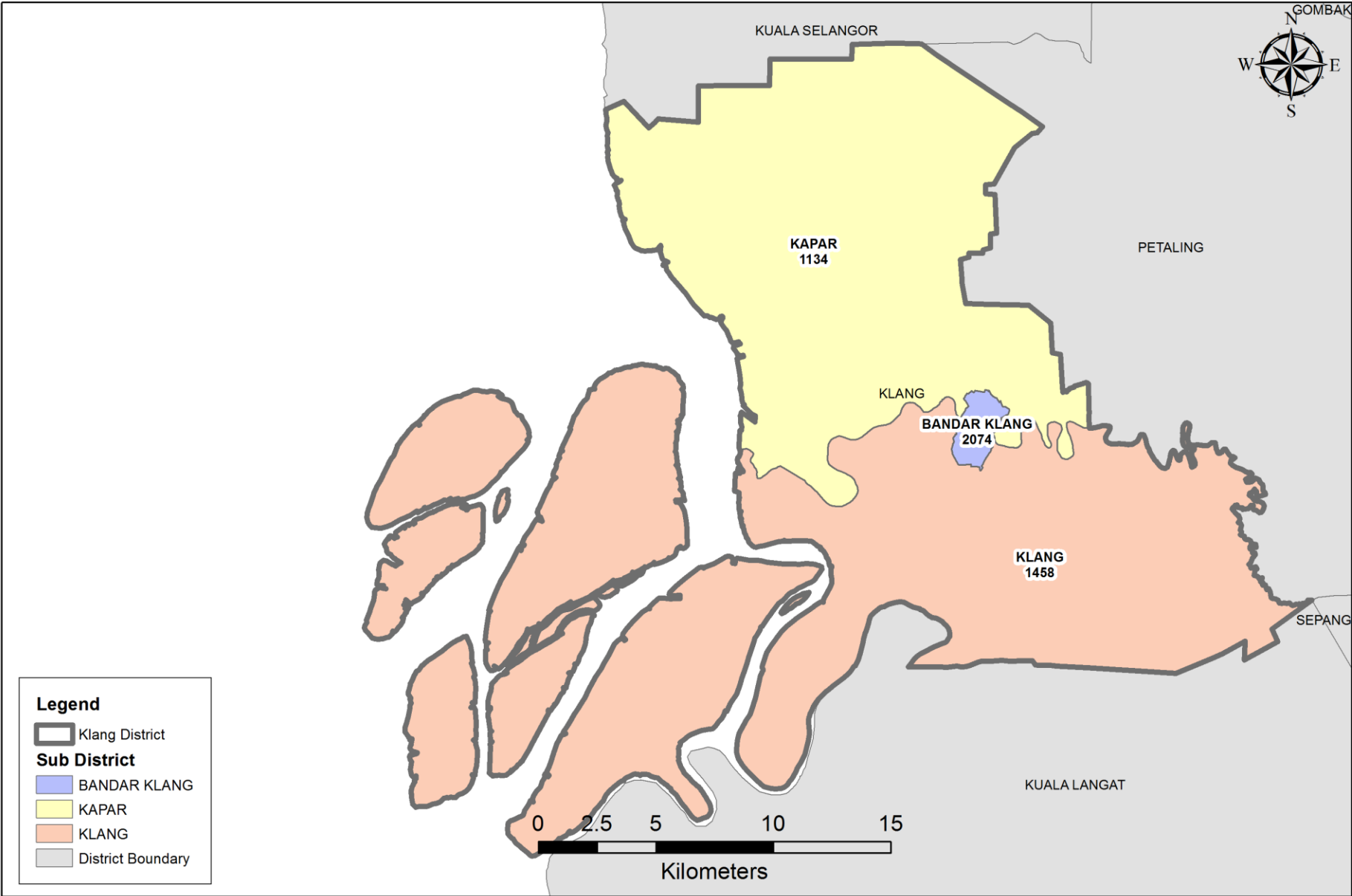
Private Clinic to Population Ratio



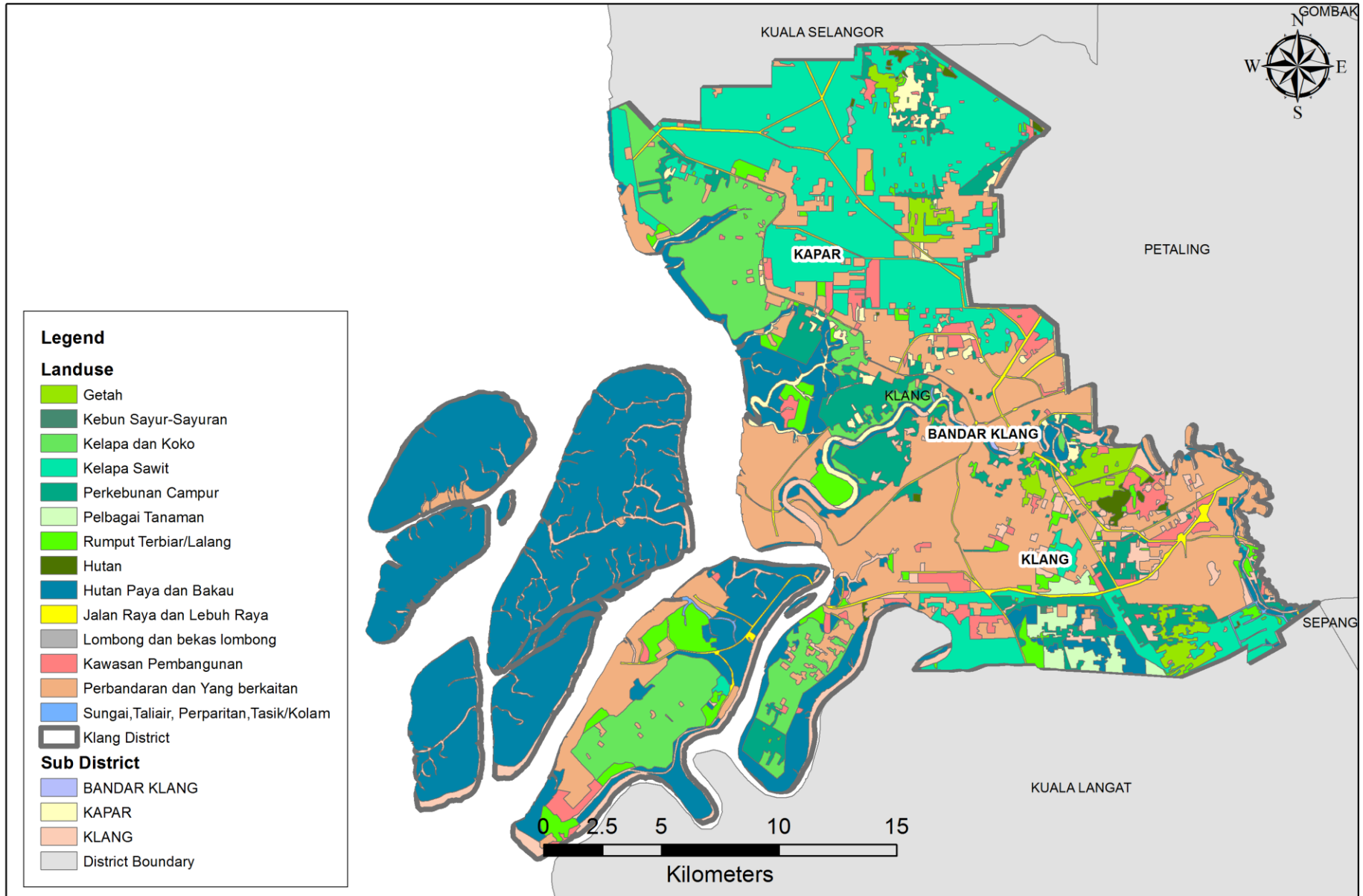
Government Clinic and Private Clinic to Population Ratio



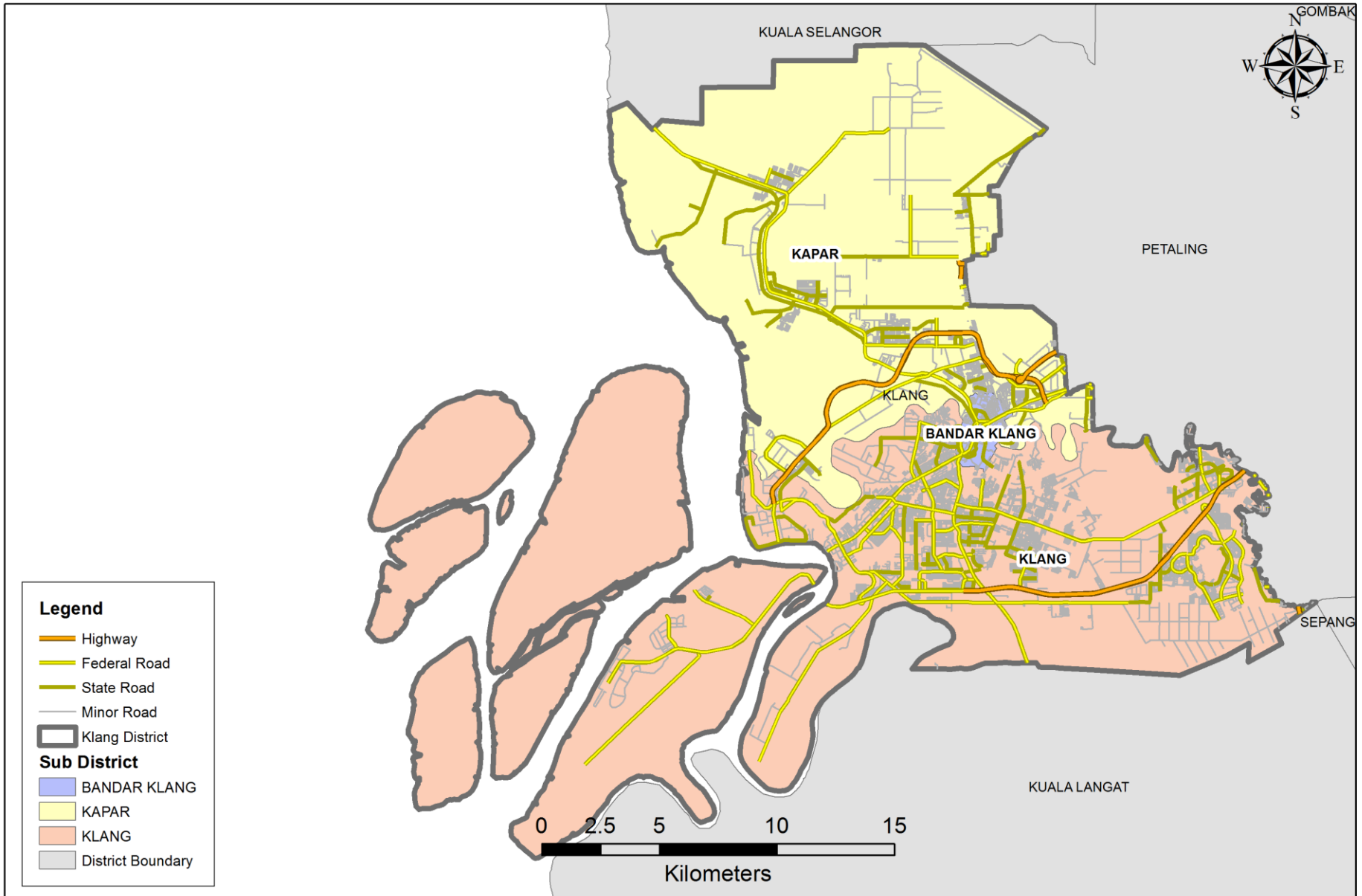
Density Population



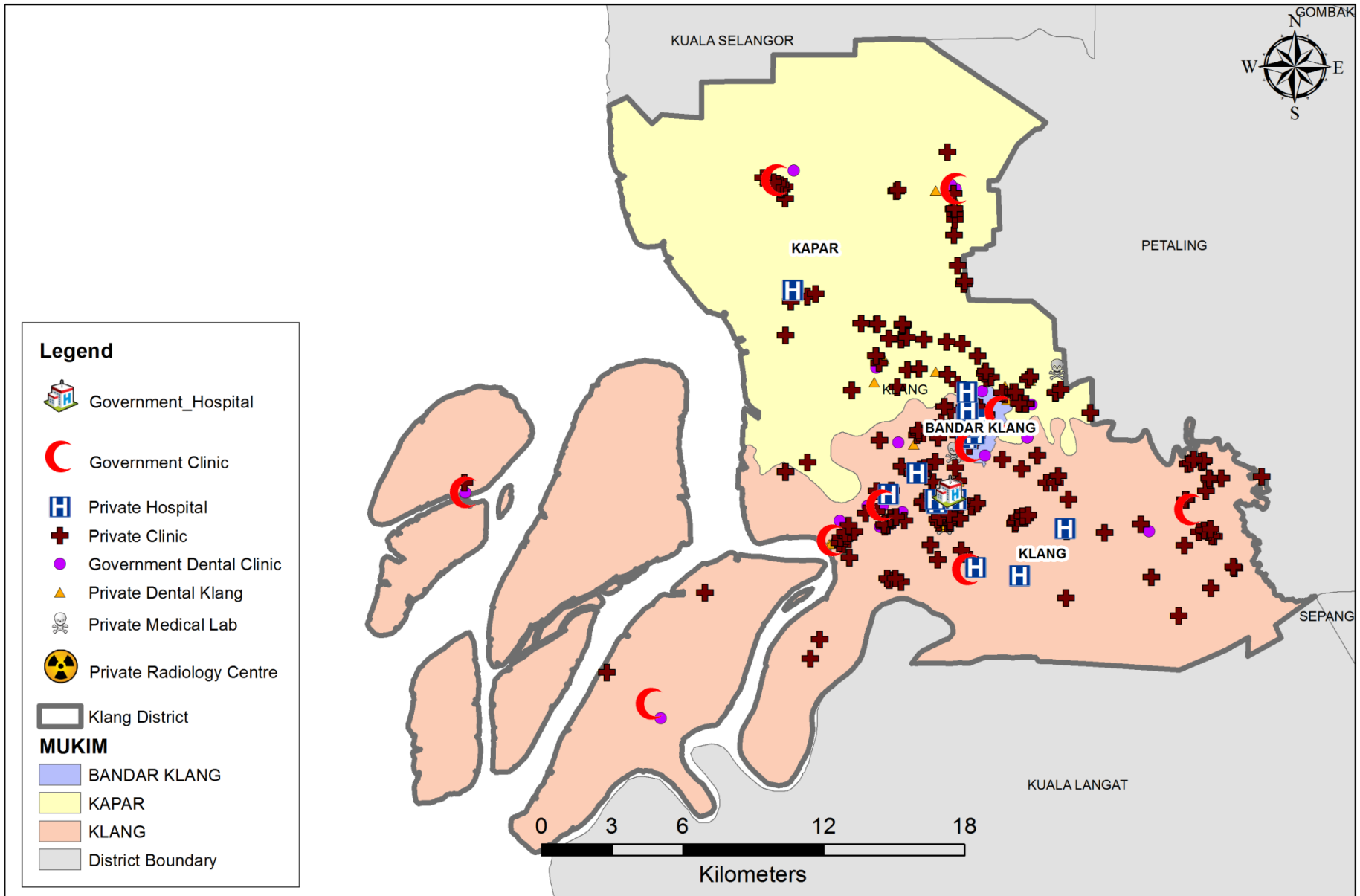
Landuse



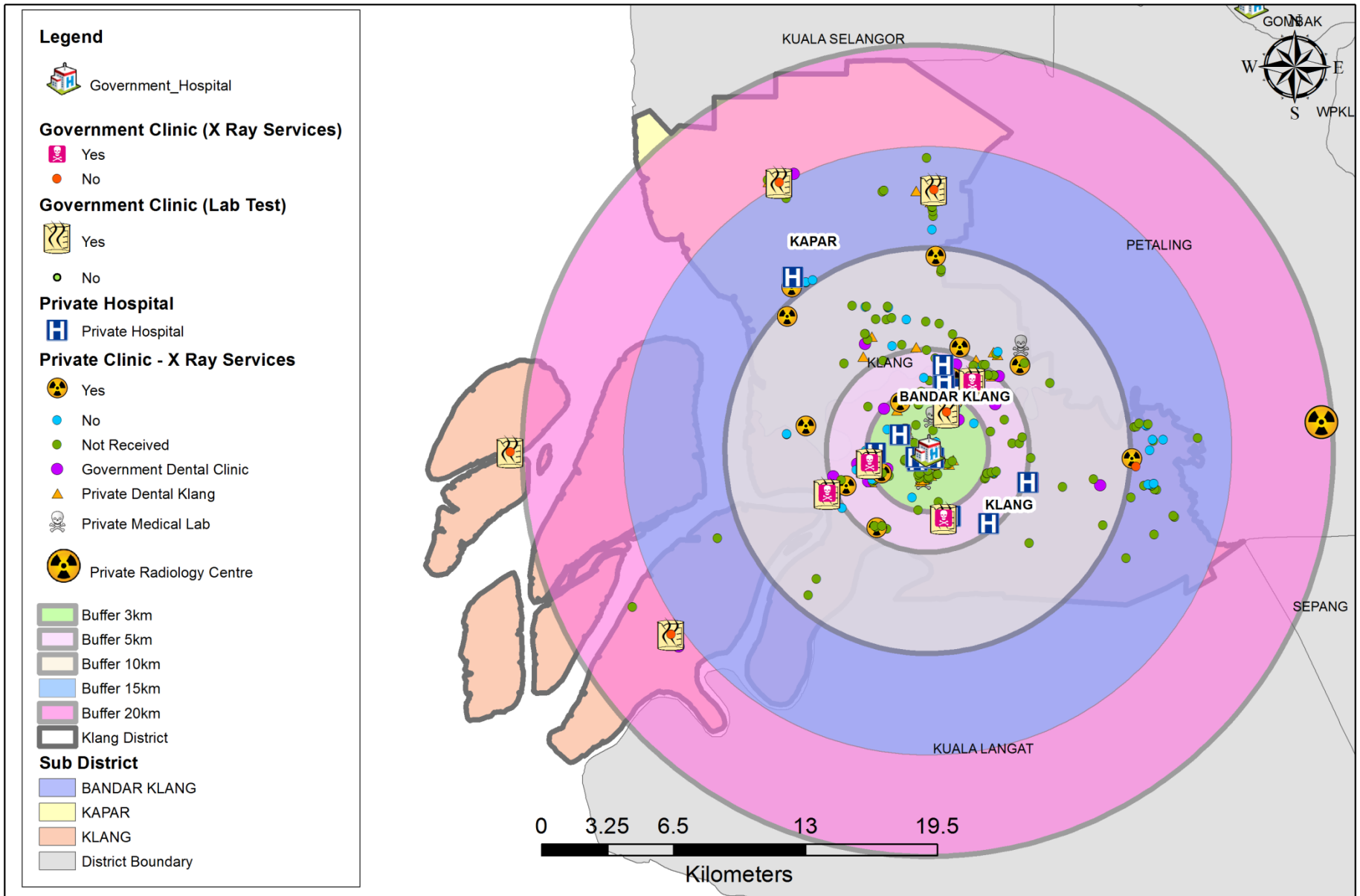
Road



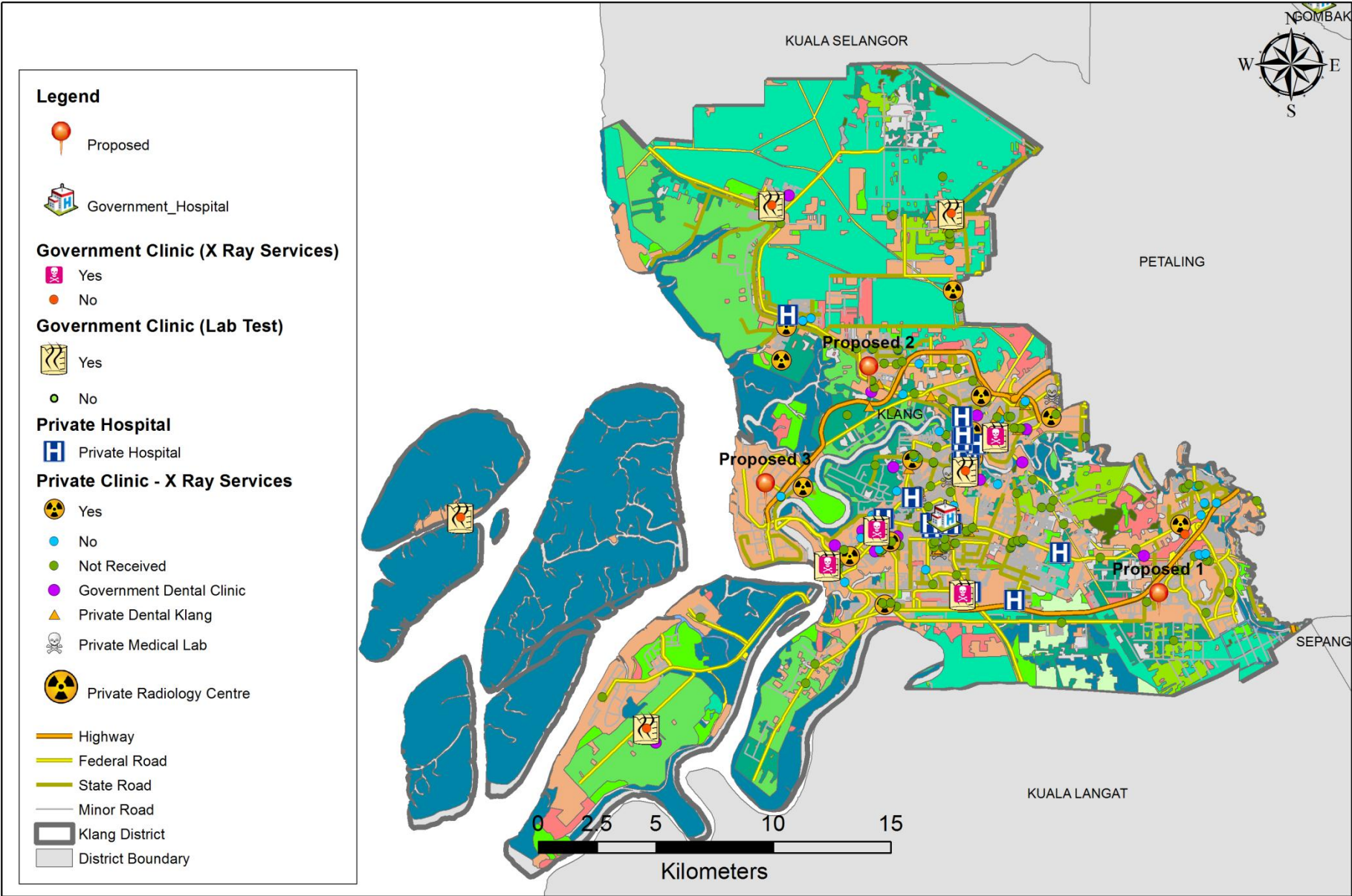
Distribution of Health Facilities in Klang District



Distribution of Health Facilities with X Ray Services in Klang District in Relation to Medical Lab and Radiology Centre within 3-20km

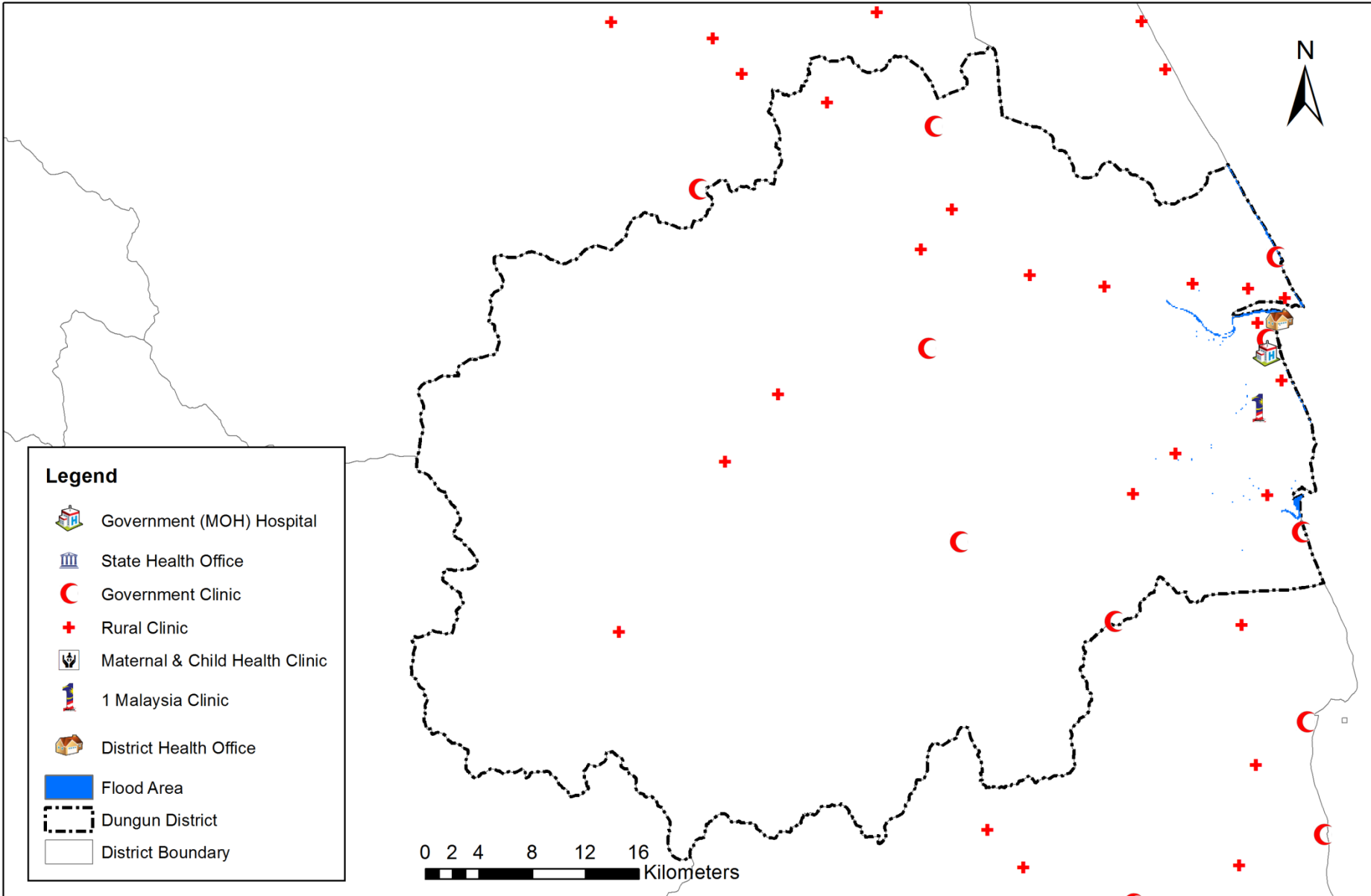


Proposed New Location of Radiology Centre

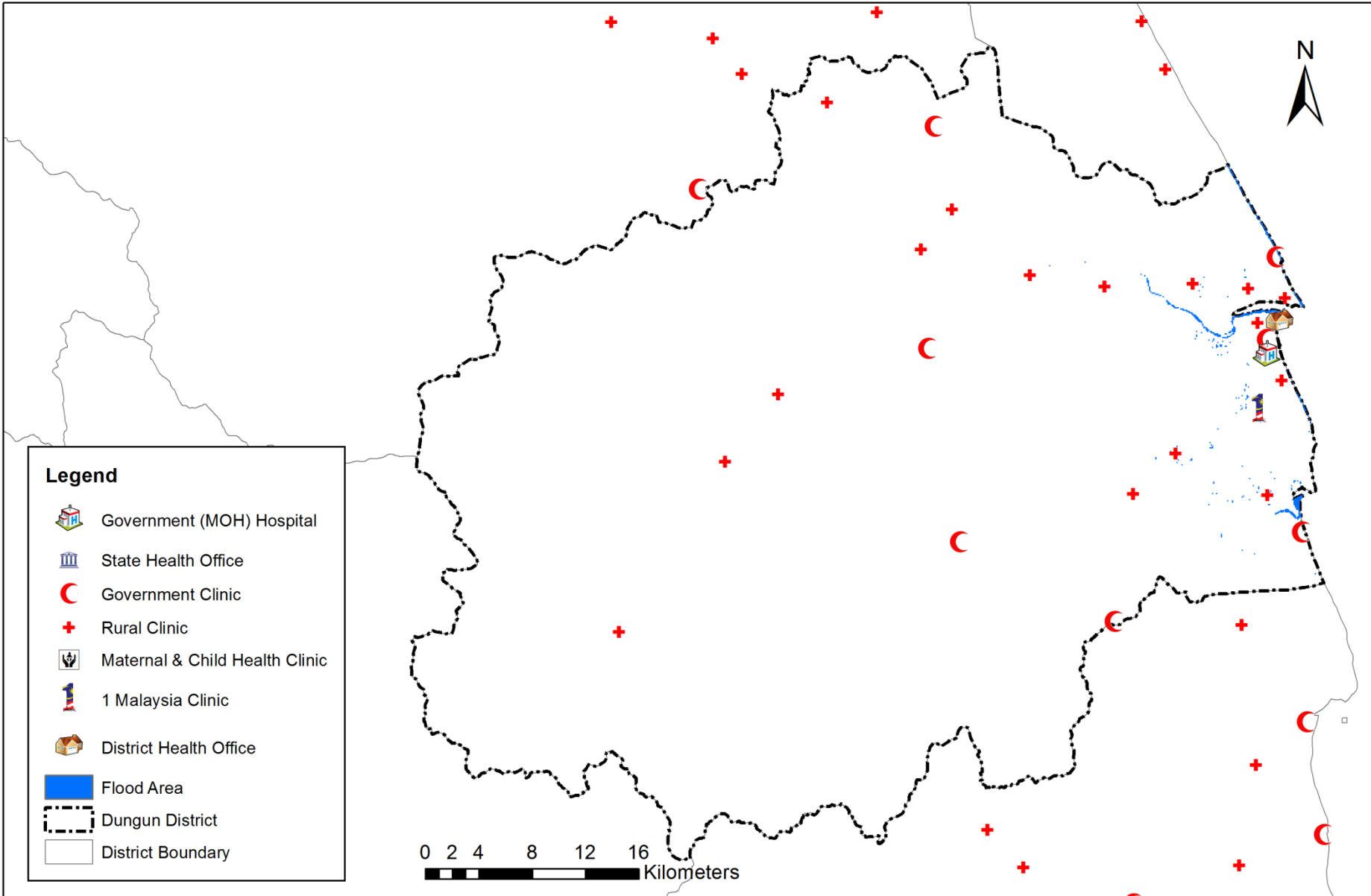


Health Facilities Affected by Flood Simulation In Dungun Terengganu

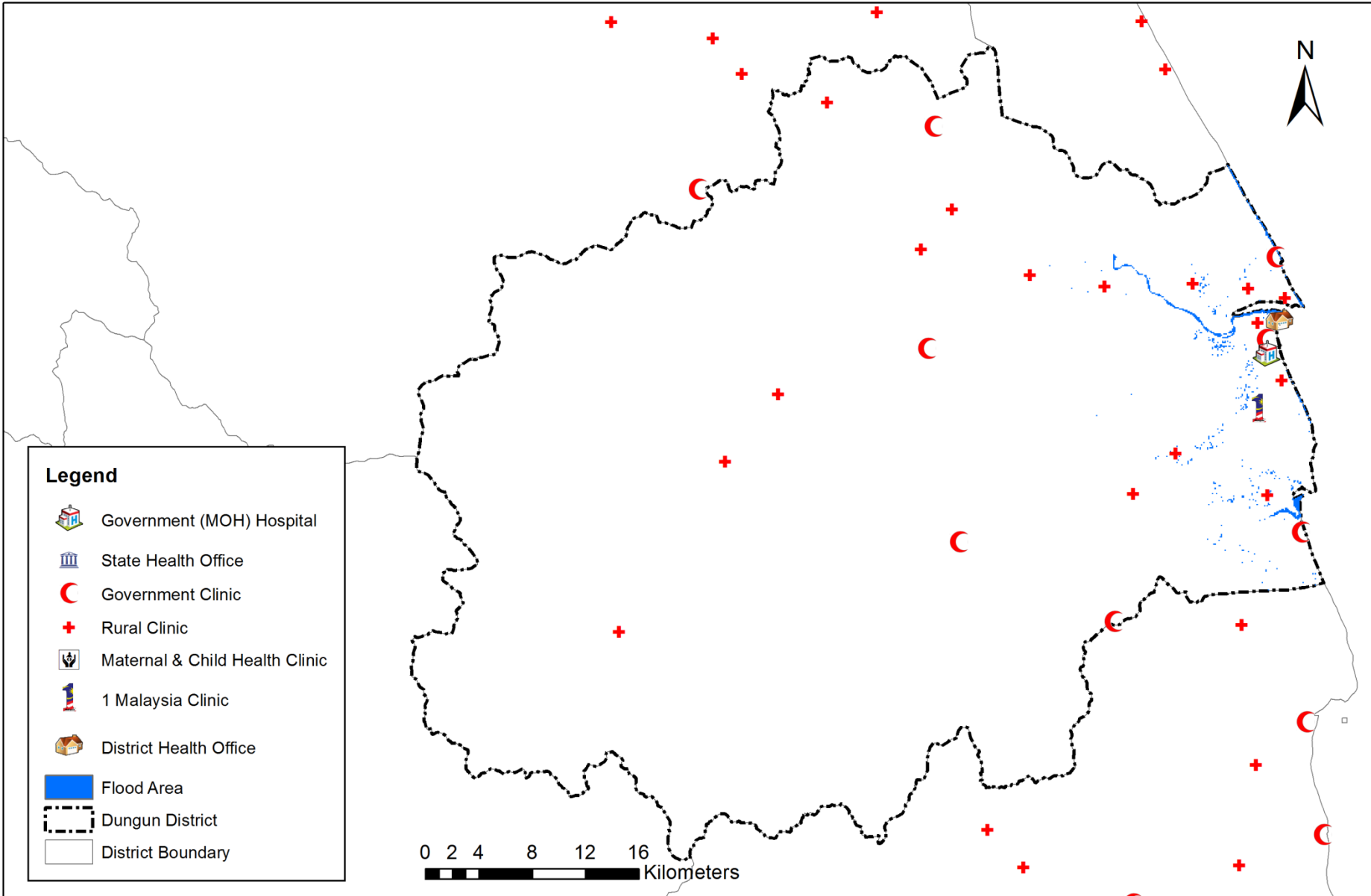
Water Level = 1 meters



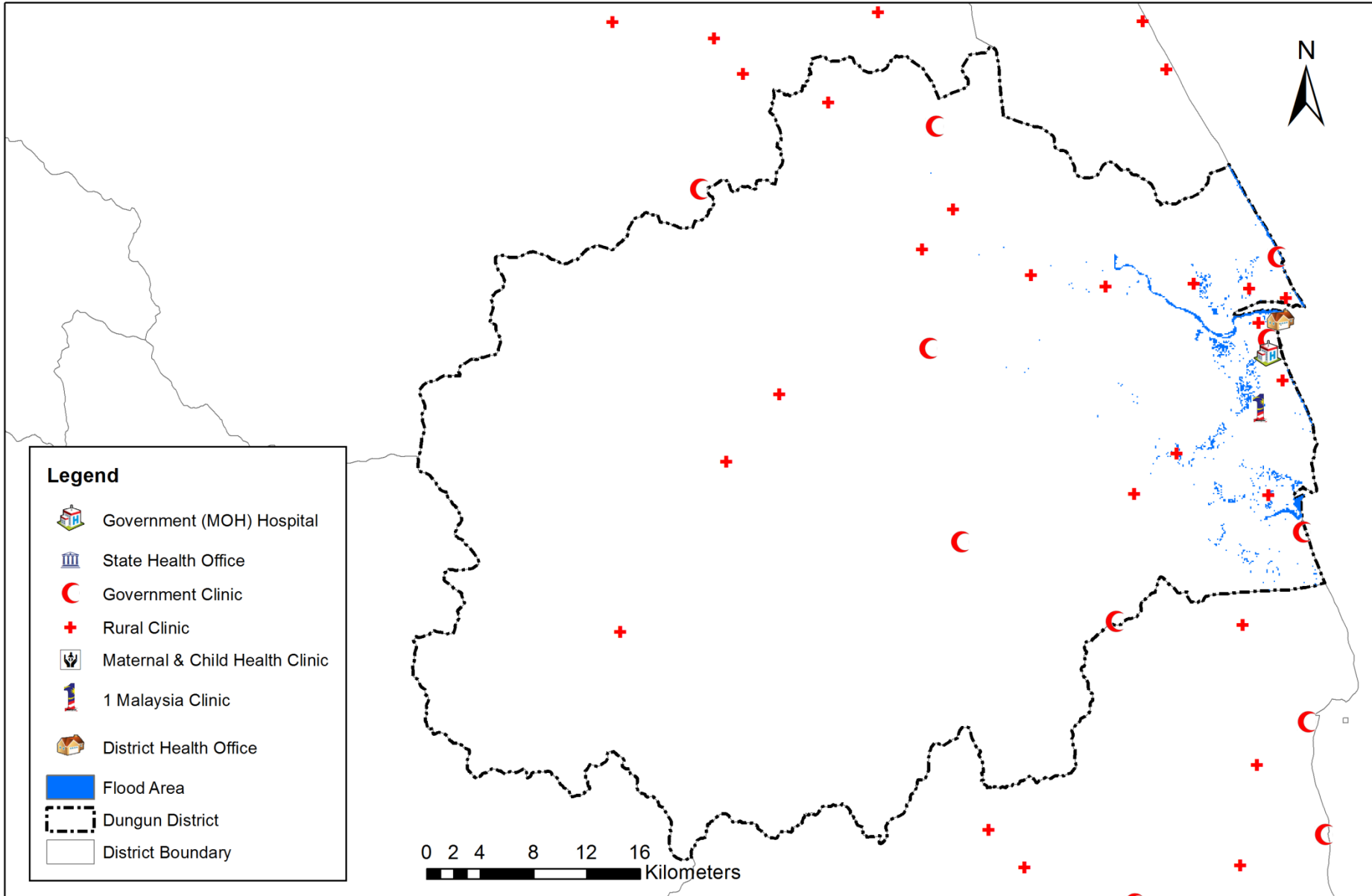
Water Level = 2 meters



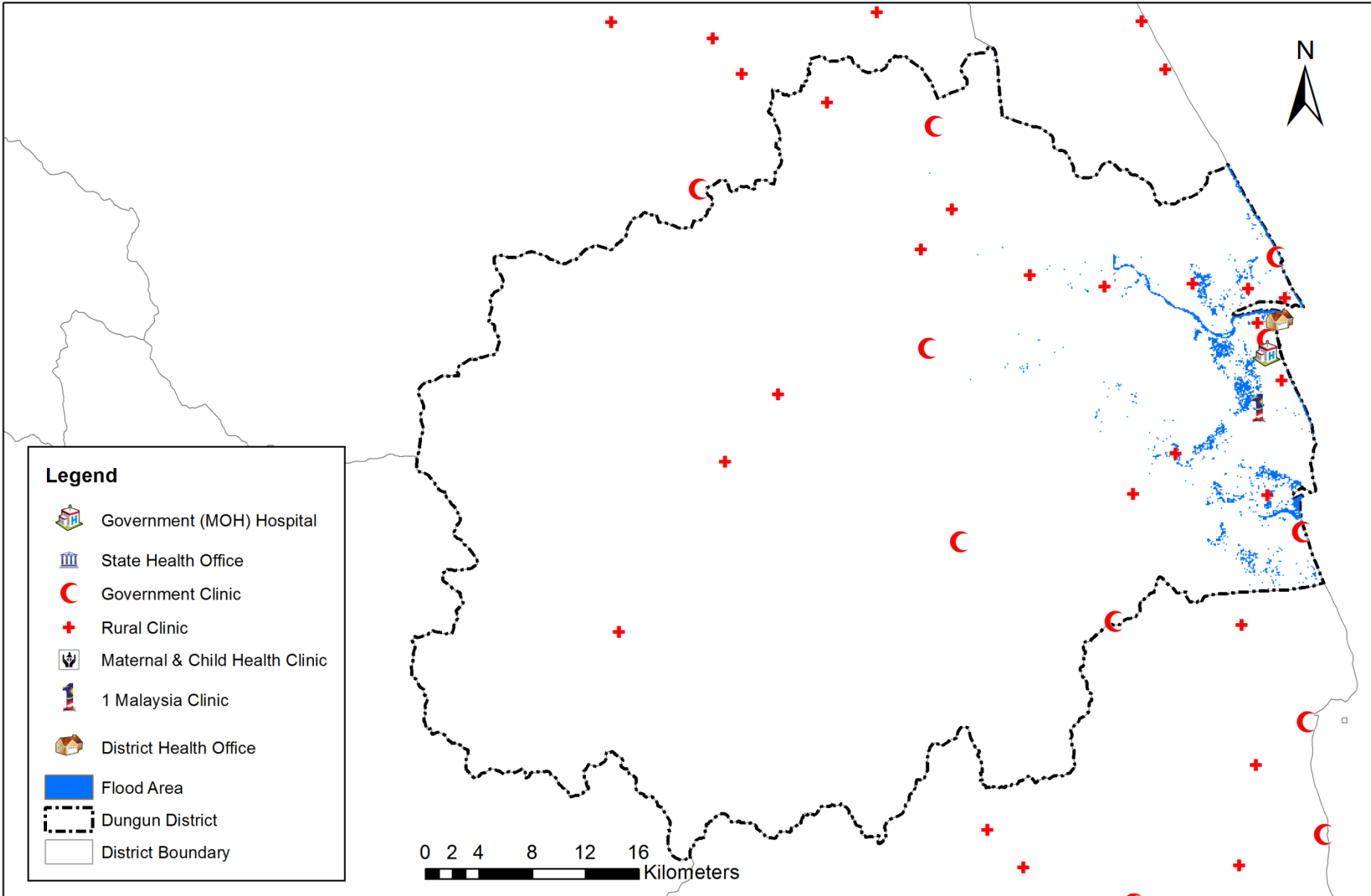
Water Level = 3 meters



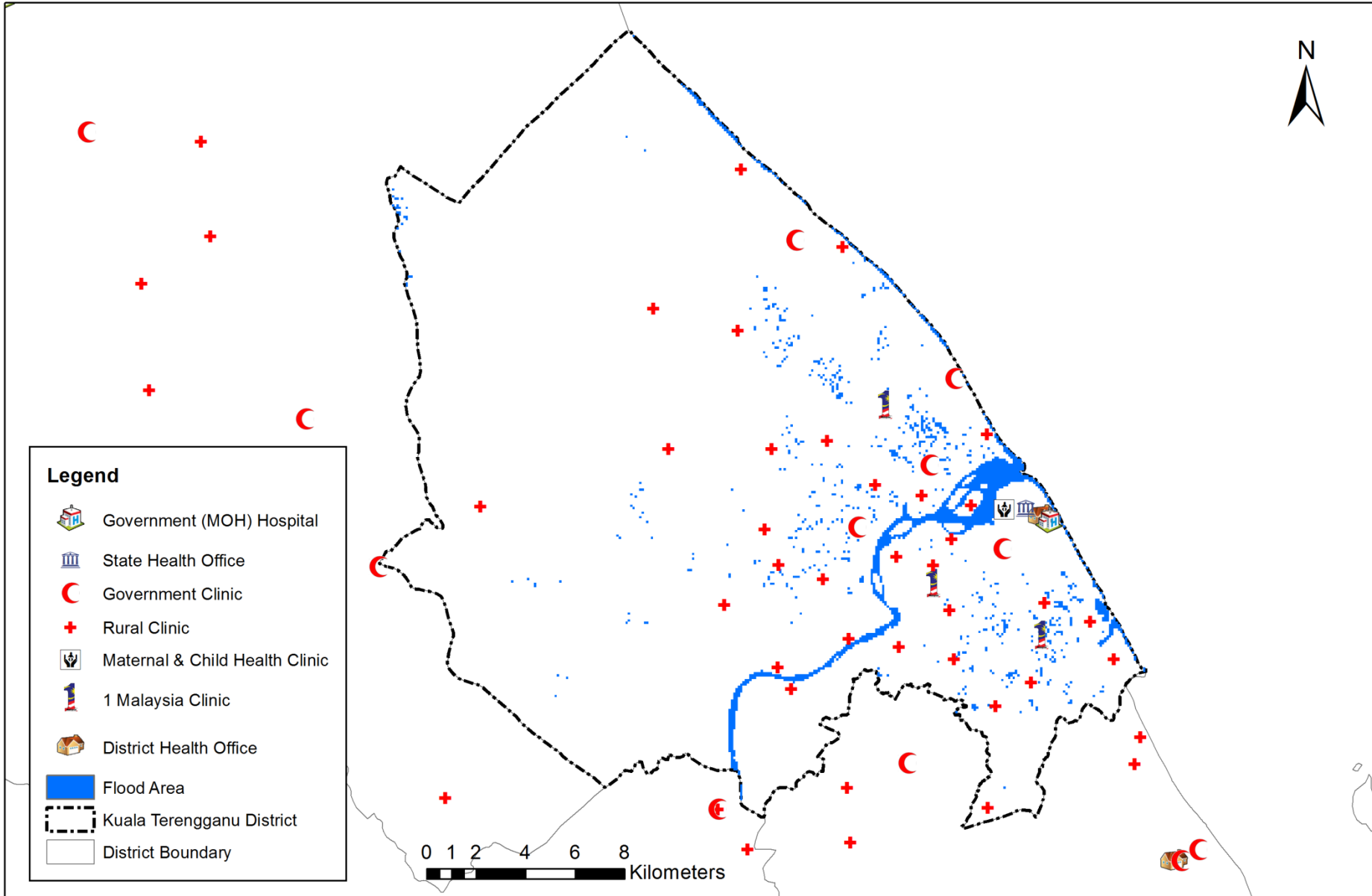
Water Level = 4 meters



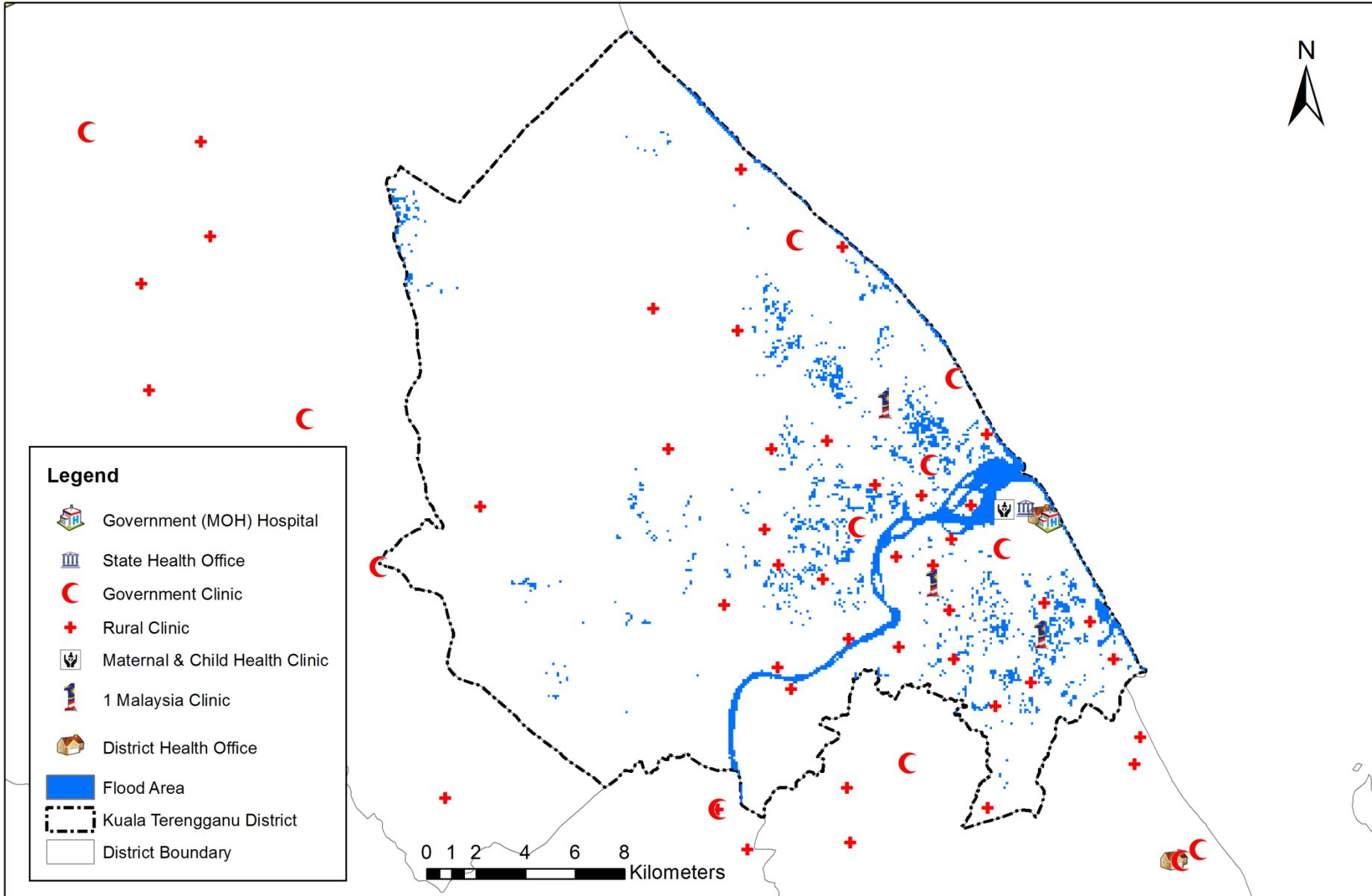
Water Level = 5 meters



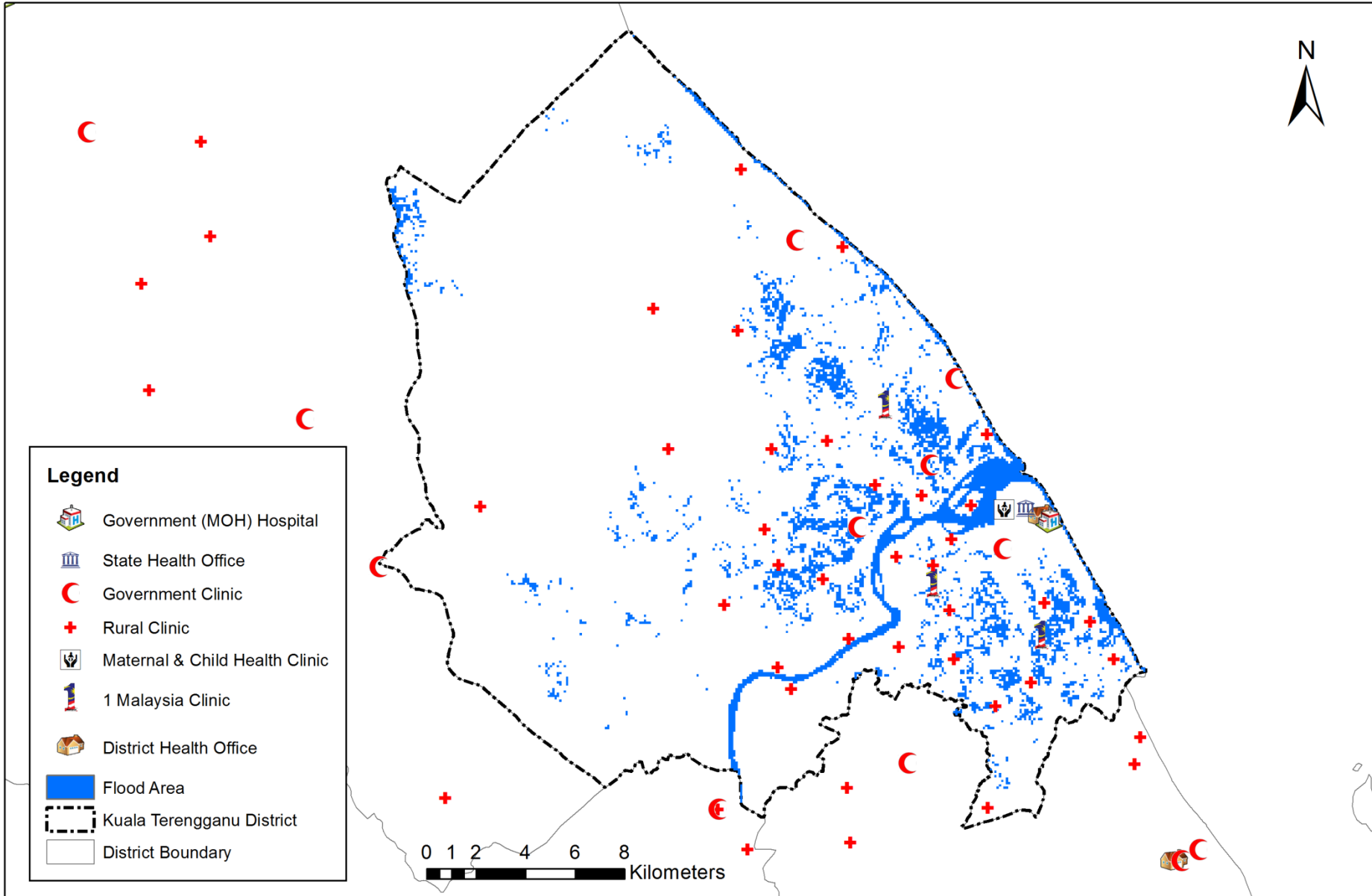
Water Level = 1 meters



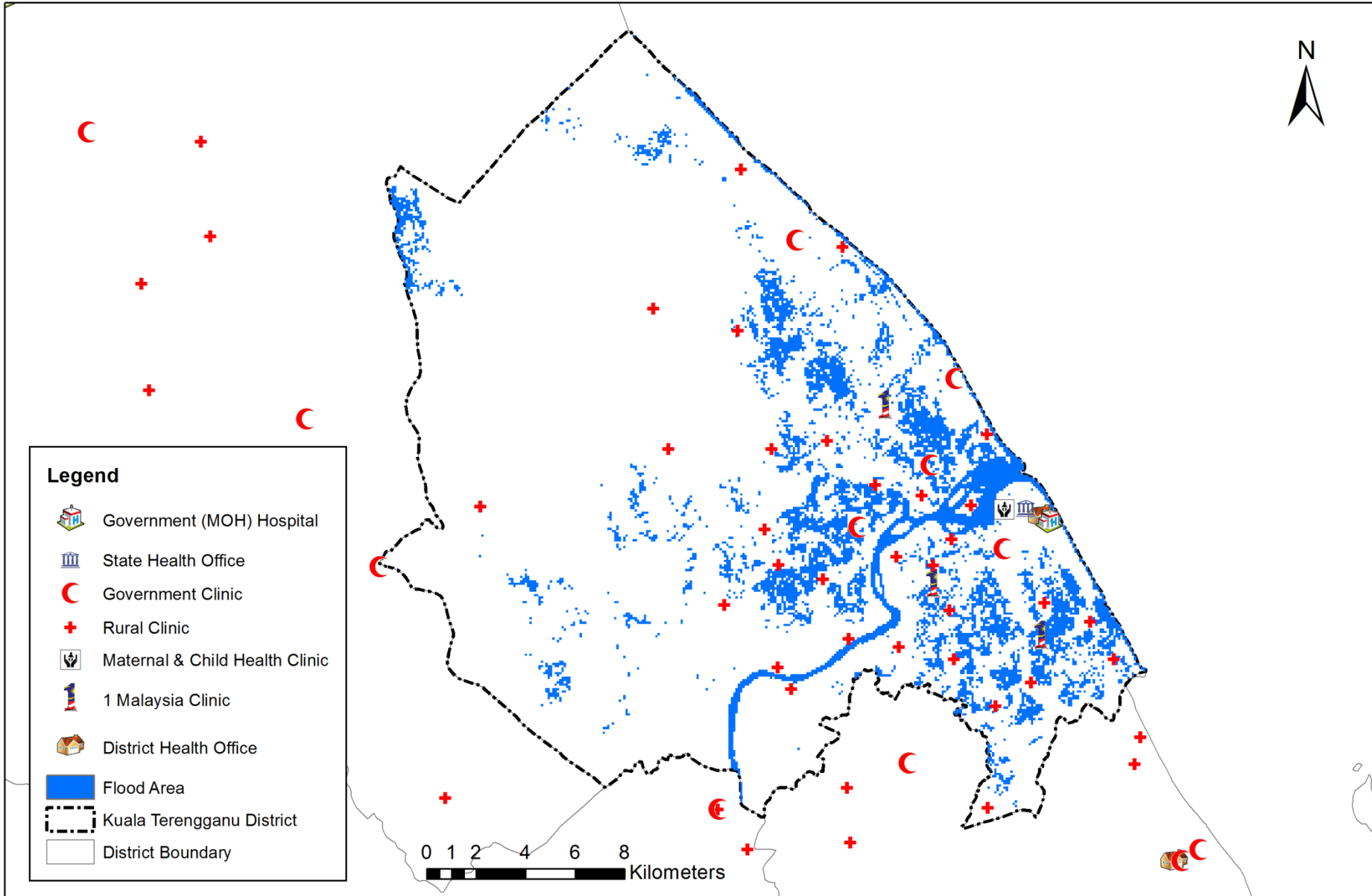
Water Level = 2 meters



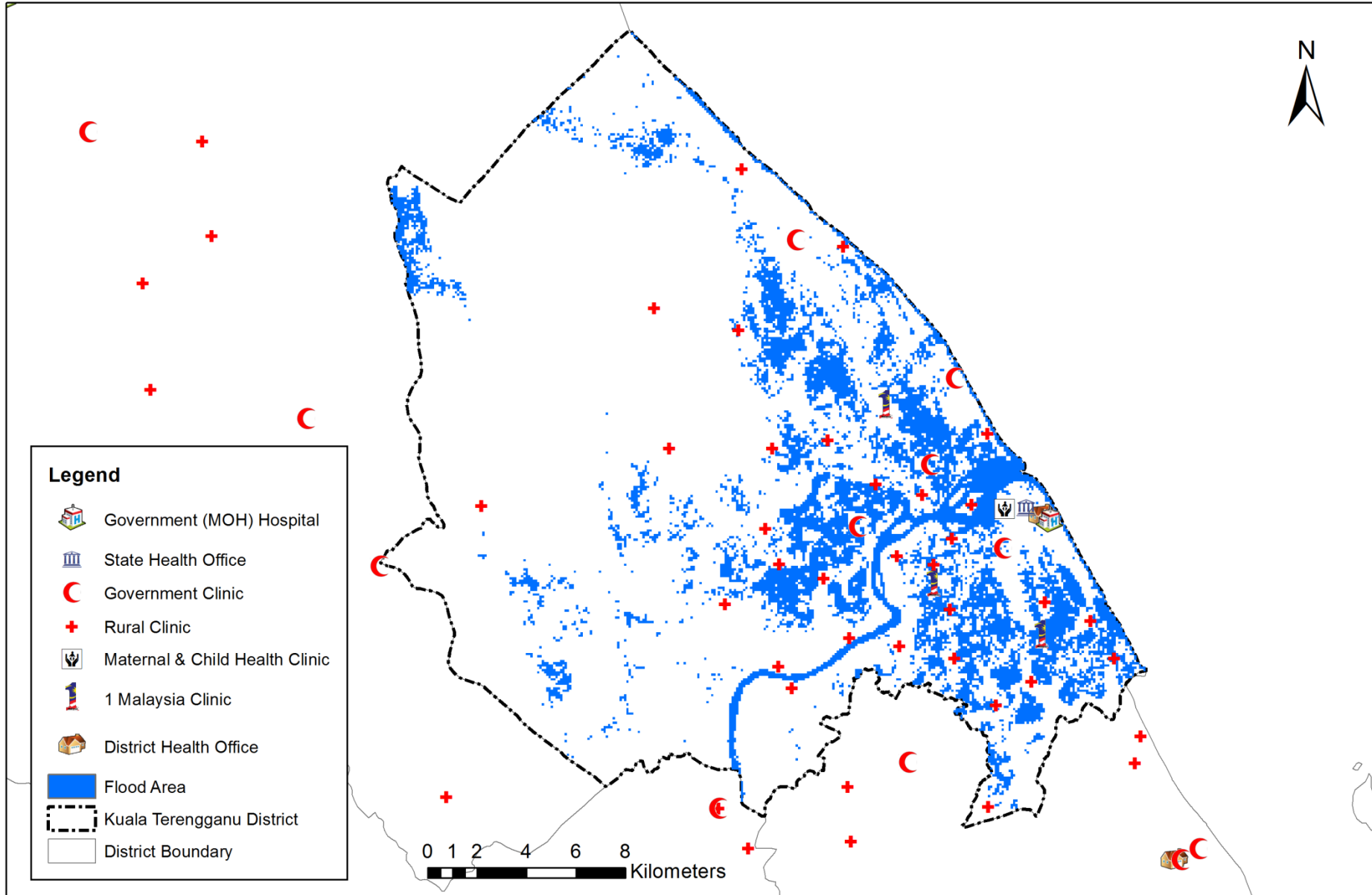
Water Level = 3 meters



Water Level = 4 meters



Water Level = 5 meters



Health Facilities Affected by Flood in Dungun

Health Facilities Affected	1m	2m	3m	4m	5m
Klinik 1Malaysia Taman Adis Indah	X	X	X	X	X
Klinik Desa Gelugor	X	X	X	X	X
Klinik Desa Gong Pauh		X	X	X	X
Klinik Kesihatan Bukit Tunggal			X	X	X
Klinik Desa Chendering				X	X
Klinik 1Malaysia KP Perdana				X	X
Klinik Desa Durian Burong				X	X
Klinik Desa Losong				X	X
Klinik Desa Menggabang Telipot				X	X
Klinik Desa Bukit Cempaka					X
Klinik Kesihatan Manir					X
Jabatan Kesihatan Negeri Terengganu					X
Pejabat Kesihatan Kuala Terengganu					X

Health Facilities Affected by Flood in Dungun

Health Facilities Affected	1m	2m	3m	4m	5m
Pejabat Kesihatan Dungun			X	X	X
Klinik Desa Kg Nyior				X	X
Klinik Desa Durian Mentangau				X	X
Klinik 1Malaysia Batu 6				X	X
Klinik Desa Tok Kah				X	X
Klinik Kesihatan Kuala Abang				X	X
Klinik Desa Seberang Pintasan					X
Klinik Desa Padang Jambu					X
Klinik Kesihatan Paka					X
Klinik Desa Sura					X

What Next

- Web editing through application.
- Allow user to support collaboration and editing within user organization.
- Volunteer geographic information (VGI) data collection and editing by general public.
- Apps for smartphone and tablets

Conclusion

- Web mapping application enables user to use the GIS database without having to have deep knowledge in the field of GIS or using GIS software.
- The system assist stakeholders in Ministry of Health in planning and developing facilities and services in Malaysia

THANK YOU