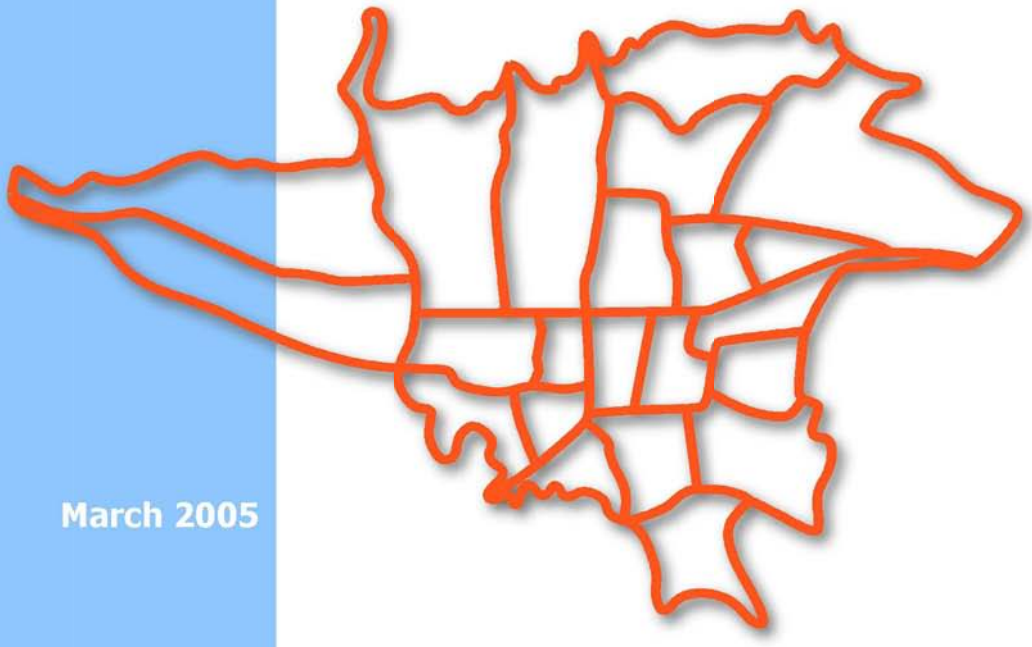
No.

The Comprehensive Master Plan Study on Urban Seismic Disaster Prevention and Management for the Greater Tehran Area in the Islamic Republic of Iran

Japan International Cooperation Agency (JICA)
Tehran Disaster Mitigation and Management Center (TDMMC)

District-Based Assessment of Vulnerability to Earthquake Disaster



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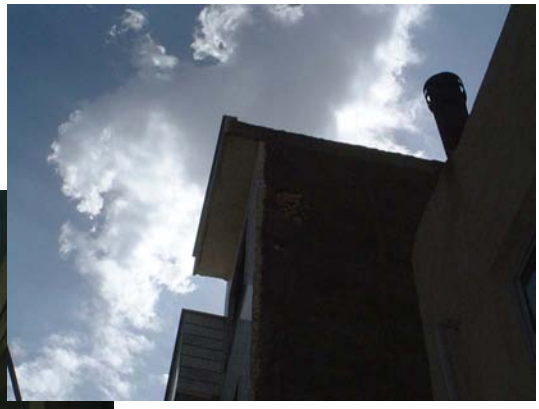


Introduction

INTRODUCTION

In response to the official request of the Government of Islamic Republic of Iran, the Government of Japan conducted "The Study on Seismic Microzoning of the Greater Tehran Area" with Center for Earthquake and Environmental Studies of Tehran (CEST) in 1999-2000 and "The Comprehensive Master Plan Study on Urban Seismic Disaster Prevention and Management for the Greater Tehran Area" with Tehran Disaster Mitigation and Management Center (TDMMC) in 2002-2004. JICA Study Team publishes the results of the two surveys of District-based Vulnerability conducted throughout from 1999 to 2004.

BACKGROUND

Tehran City is located at the foot slope of the Alborz Mountain Ranges that form part of the Alpide-Himalayan Orogenic Zone, which is a high potential earthquake zone having many peculiar active faults. According to the historical seismic data, Tehran has suffered from strong earthquakes at 150-year return period; Manjil City, which is located 200 km northwest from Tehran, was hit by a strong earthquake in 1990. Seismologists predict a strong earthquake will hit Tehran in the near future, because the City has not experienced any disastrous earthquake since 1830.

GOAL

The lives and properties of the citizens of Tehran are being made safer from potentially devastating earthquake by formulation and implementation of a comprehensive disaster management master plan. Urban development has been rapidly progressing in Tehran without the development of a proper disaster prevention system against potential earthquakes. It is clear that Tehran has to be prepared for earthquake disaster.

To Establish a Safe and Secure Urban Environment against a Potential Earthquake

PURPOSE OF THE BROCHURE

While these governmental efforts must be intensively continued, it should be primarily stressed that individual citizen must properly understand the dangers of disasters in his/her neighborhood and prepare for emergency and take appropriate actions even in the daily life. This brochure would facilitate the understanding of current condition in their living area.

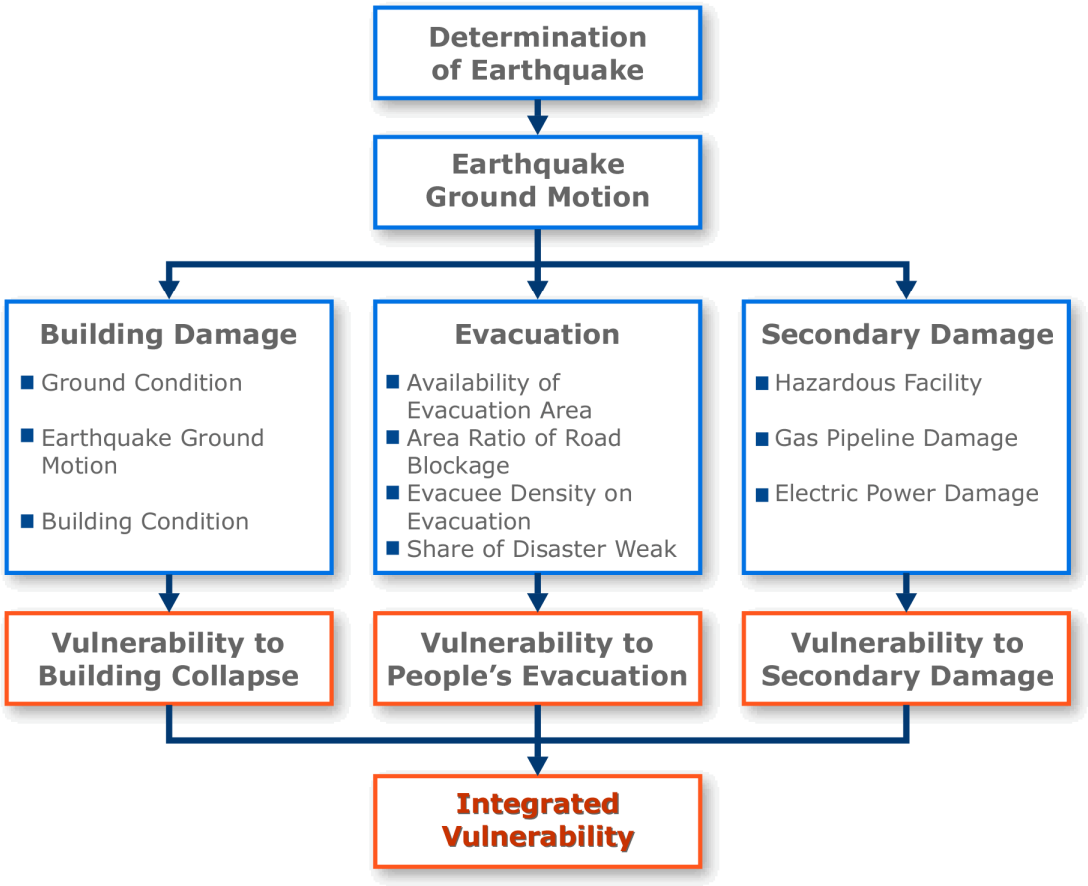
District-Based Vulnerability

Damage may depend on such earthquake-related factors as the energy related, the epicenter, and the time of occurrence combined with hazardous characteristics of the district.

Seismic damage is classified into physical and human parts. The physical damage implies building collapse caused by ground shaking and secondary damage. Human damage can mainly be caused by hazardous obstacles on way to evacuation site during escape.

In the Master Plan survey, vulnerabilities to earthquake disaster were classified into three types; Vulnerability to Building Collapse, Vulnerability to Evacuation, and Vulnerability to Secondary Disaster, and each district is relatively related on a scale of 1 to 5. These three types of vulnerability were merged into "Integrated Vulnerability" to assess the comprehensive danger of each district.

Study Flow to Measure Area Danger Levels



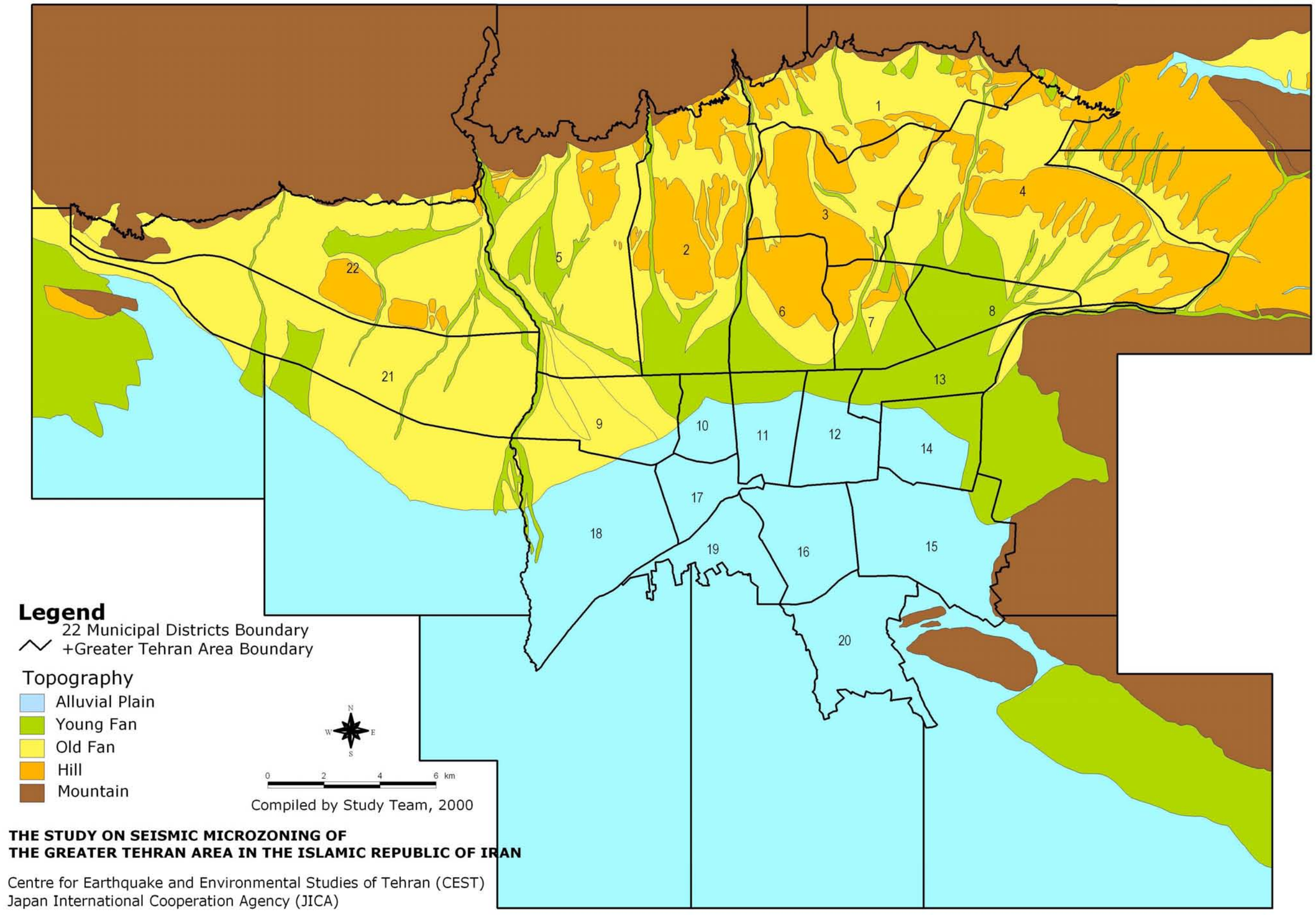
Ground Structure in Tehran

GROUND STRUCTURE CHARACTERISTICS

Tehran is located at the foot of the southern slopes of the Alborz Mountain Range. The ground structure in Tehran can be simplify classified into 5 topographic units: (1) mountains, (2) hills, (3) old Alluvial fans, (4) young alluvial fans, and (5) alluvial plains. Each characteristic is explained in following table.

Mountains	The Alborz Mountain range is located in the northern part of Tehran. The highest point of the study area is approximately 1800m above sea level and its average angle of the slope is 30 to 50 degrees. However, these areas are not in residential area.
Hills	Many hills are situated at the foot of the Alborz Mountain. Water erosion formed this topographical unit. The highest point in the study area is approximately 1500m above sea level. The average angle of slope is 20 to 30 degrees at the top and 30 to 40 degrees at the edge of the hills. The analysis concluded that there is not high slope-failure risk in the residential and commercial area generally prevailing in hill, terrace and fan areas. Many small-scale slope-failures and stone falls would occur at cut slopes during an earthquake.
Old Alluvial Fans	Old alluvial fans are widely spread at the foot of the Aldorz Mountain Range. The elevation of the old alluvial fan area varies from 1100 to 1500m. This topographical unit can be distinguished from a hill and a young alluvial fan by the smooth gradient slopes measuring 5 to 10 degrees and relatively deep valleys formed in the fan.
Young Alluvial Fans	Young alluvial fans are widely spread at the bottom and mouth of the valley in the old alluvial fan. The elevation of the young alluvial fan area varies from 1100 to 1400m. This topographical unit can be distinguished from old alluvial fans and alluvial plains by its less steep slopes and its less eroded surfaces. No remarkable valley can be seen in this topographical unit.
Alluvial Plains	Alluvial plains spread widely beyond the young and old alluvial fans. The elevation of the alluvial plain area varies from 1000 to 1100m. The surface of this unit is mostly flat but slightly inclined to the south. No remarkable valley can be seen in this topographical unit, but there exists a topographical discontinuity zone in the southern area. This discontinuity zone is thought to originate from an anticline of pre-tertiary sediments, but it may also be the result of water erosion.

Ground Structure Classification



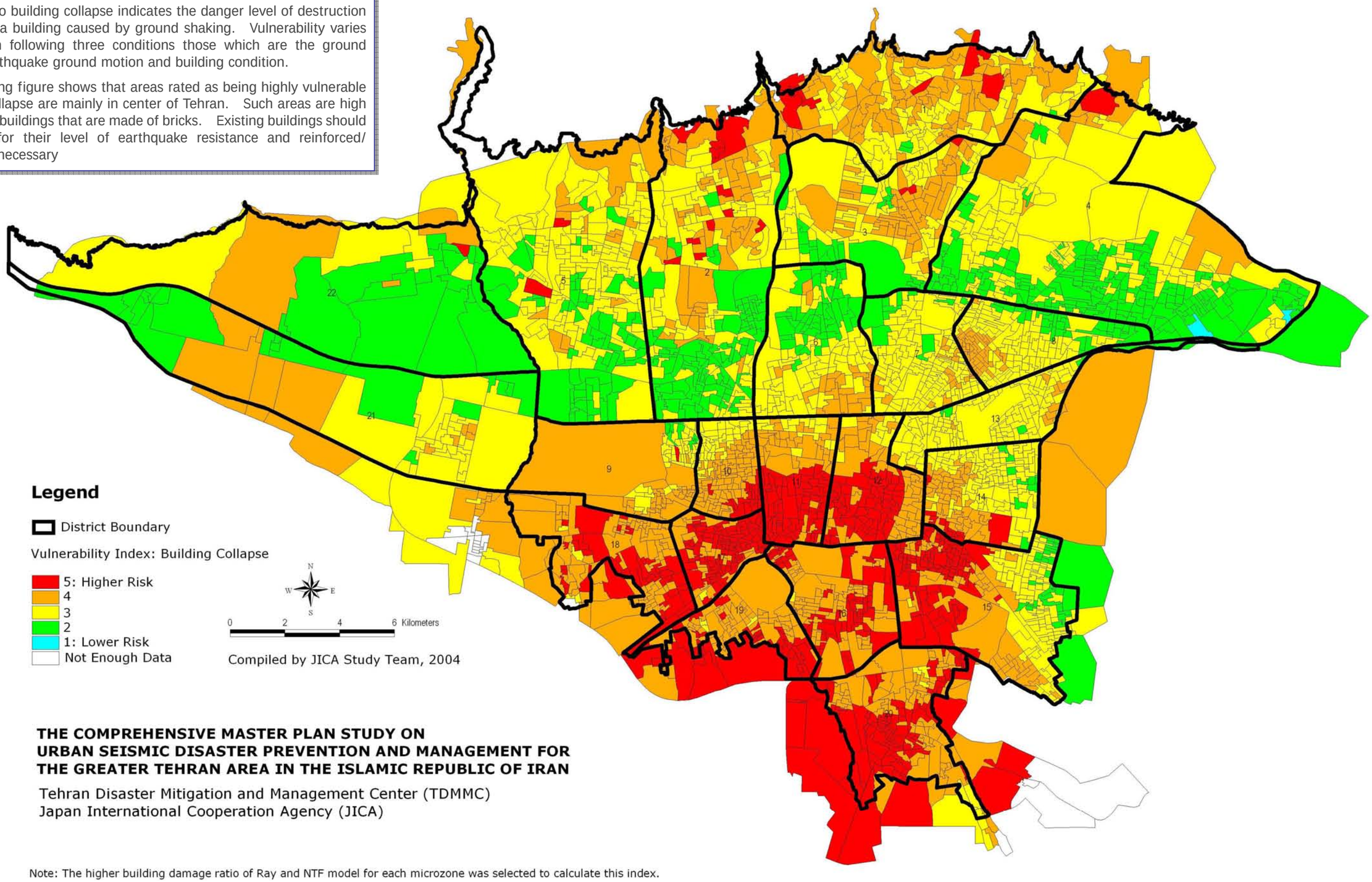
THE STUDY ON SEISMIC MICROZONING OF
THE GREATER TEHRAN AREA IN THE ISLAMIC REPUBLIC OF IRAN

Centre for Earthquake and Environmental Studies of Tehran (CEST)
Japan International Cooperation Agency (JICA)

Vulnerability to Building Collapse

Vulnerability to building collapse indicates the danger level of destruction or leaning of a building caused by ground shaking. Vulnerability varies depending on following three conditions those which are the ground condition, earthquake ground motion and building condition.

As the following figure shows that areas rated as being highly vulnerable to building collapse are mainly in center of Tehran. Such areas are high density of old buildings that are made of bricks. Existing buildings should be checked for their level of earthquake resistance and reinforced/ strengthen if necessary



THE COMPREHENSIVE MASTER PLAN STUDY ON URBAN SEISMIC DISASTER PREVENTION AND MANAGEMENT FOR THE GREATER TEHRAN AREA IN THE ISLAMIC REPUBLIC OF IRAN

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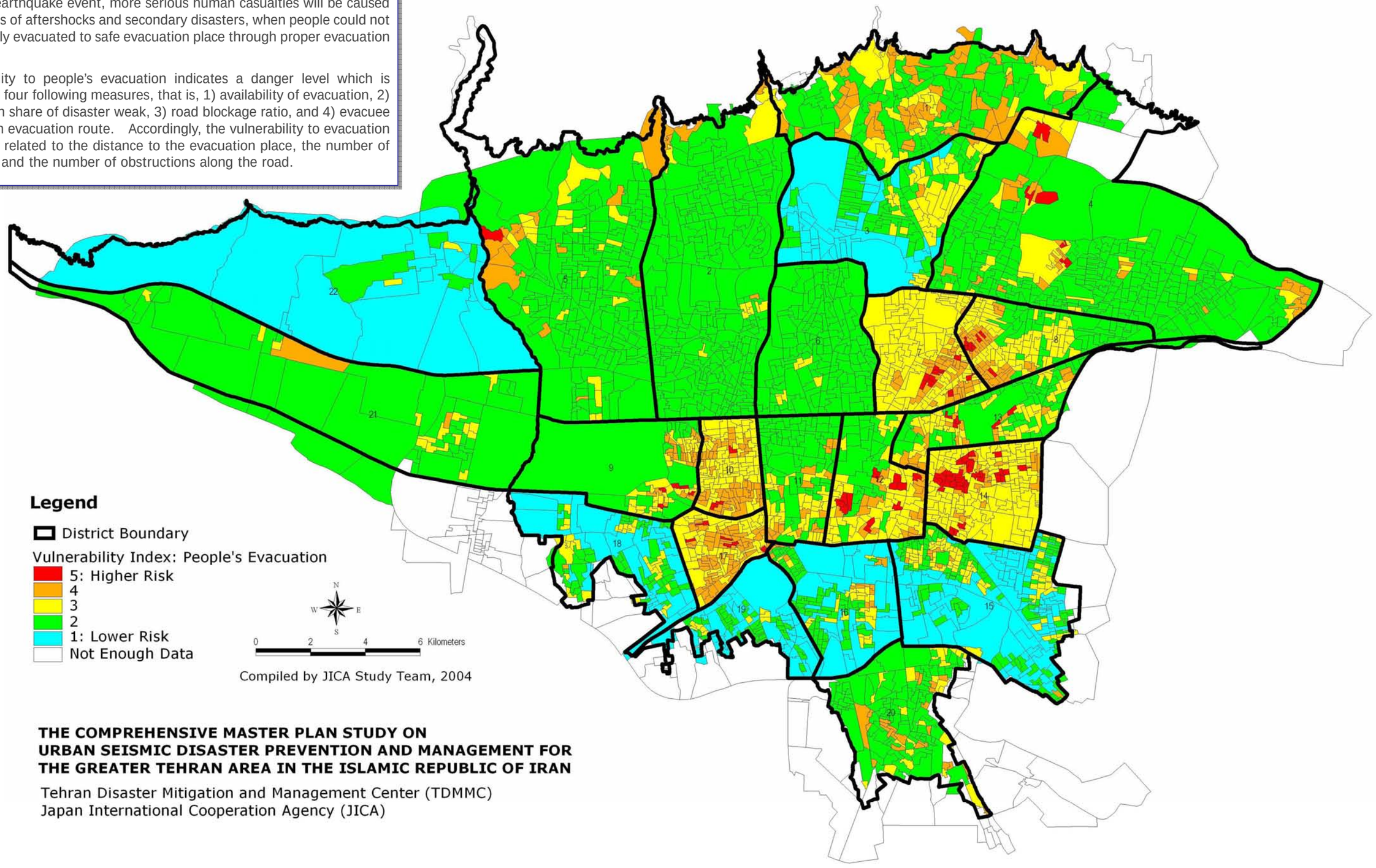
Note: The higher building damage ratio of Ray and NTF model for each microzone was selected to calculate this index.

Vulnerability to People's Evacuation

After an earthquake event, more serious human casualties will be caused by hazards of aftershocks and secondary disasters, when people could not be properly evacuated to safe evacuation place through proper evacuation route.

Vulnerability to people's evacuation indicates a danger level which is combined four following measures, that is, 1) availability of evacuation, 2) population share of disaster weak, 3) road blockage ratio, and 4) evacuee density on evacuation route. Accordingly, the vulnerability to evacuation is directly related to the distance to the evacuation place, the number of evacuees and the number of obstructions along the road.



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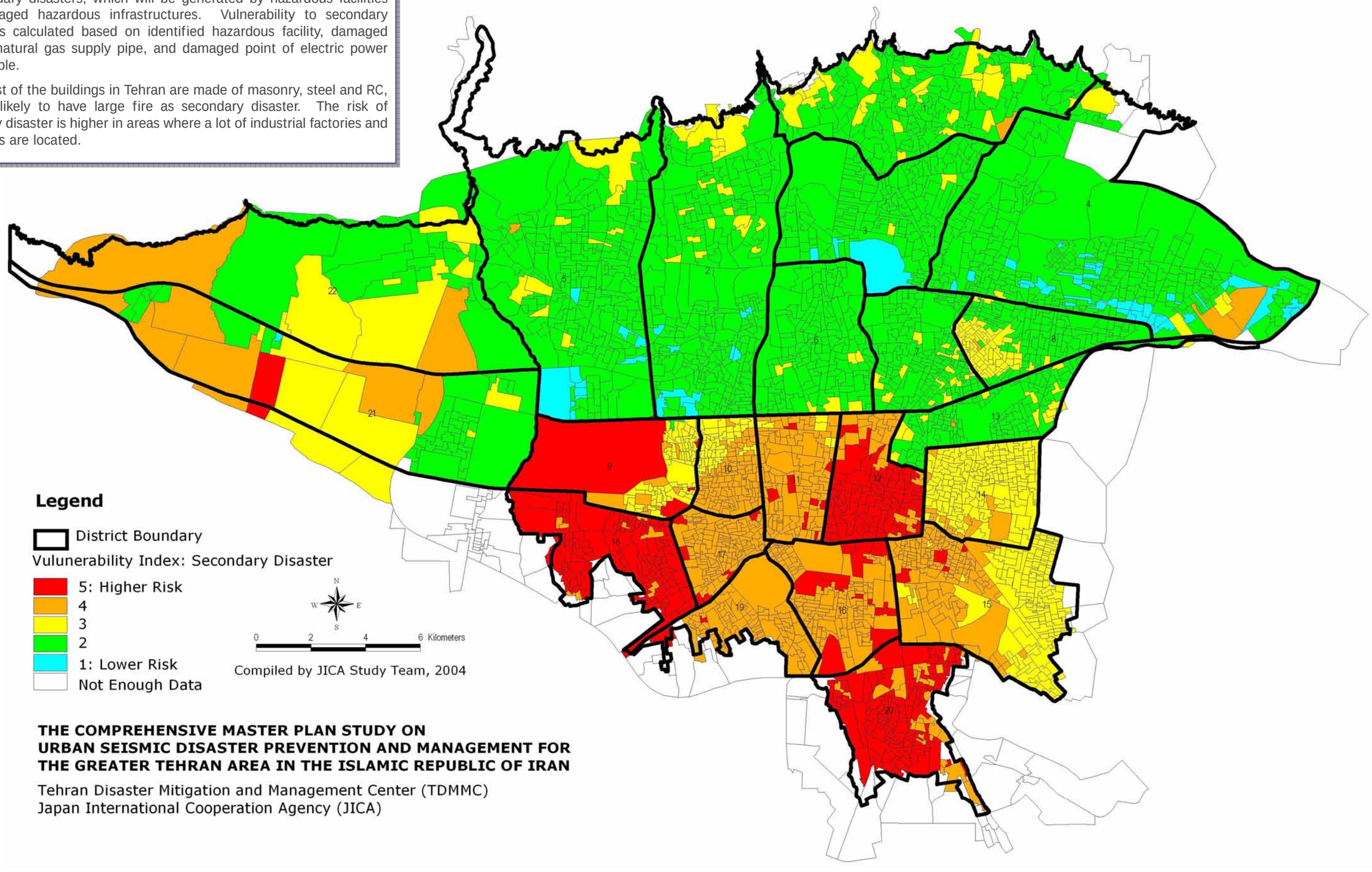
Vulnerability to Secondary Damage

After an earthquake event, more serious human casualties will be caused by secondary disasters, which will be generated by hazardous facilities and damaged hazardous infrastructures. Vulnerability to secondary damage is calculated based on identified hazardous facility, damaged point of natural gas supply pipe, and damaged point of electric power supply cable.

Since most of the buildings in Tehran are made of masonry, steel and RC, it is not likely to have large fire as secondary disaster. The risk of secondary disaster is higher in areas where a lot of industrial factories and workshops are located.



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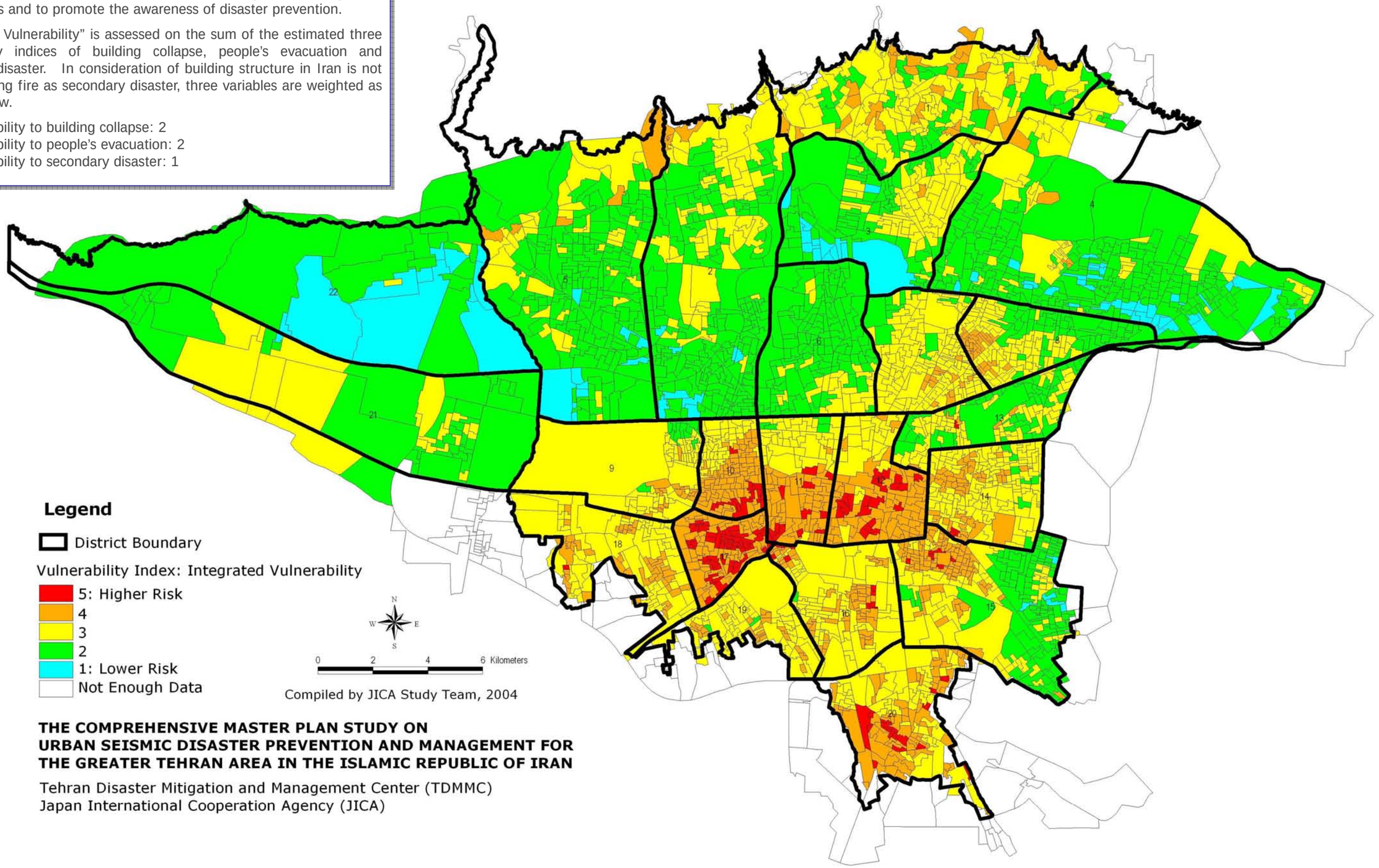
Integrated Vulnerability

The survey of district-based vulnerability is carried out for district officer and residents of Tehran to facilitate understanding of the dangers of earthquakes and to promote the awareness of disaster prevention.

"Integrated Vulnerability" is assessed on the sum of the estimated three vulnerability indices of building collapse, people's evacuation and secondary disaster. In consideration of building structure in Iran is not likely to bring fire as secondary disaster, three variables are weighted as shown below.

- Vulnerability to building collapse: 2
- Vulnerability to people's evacuation: 2
- Vulnerability to secondary disaster: 1



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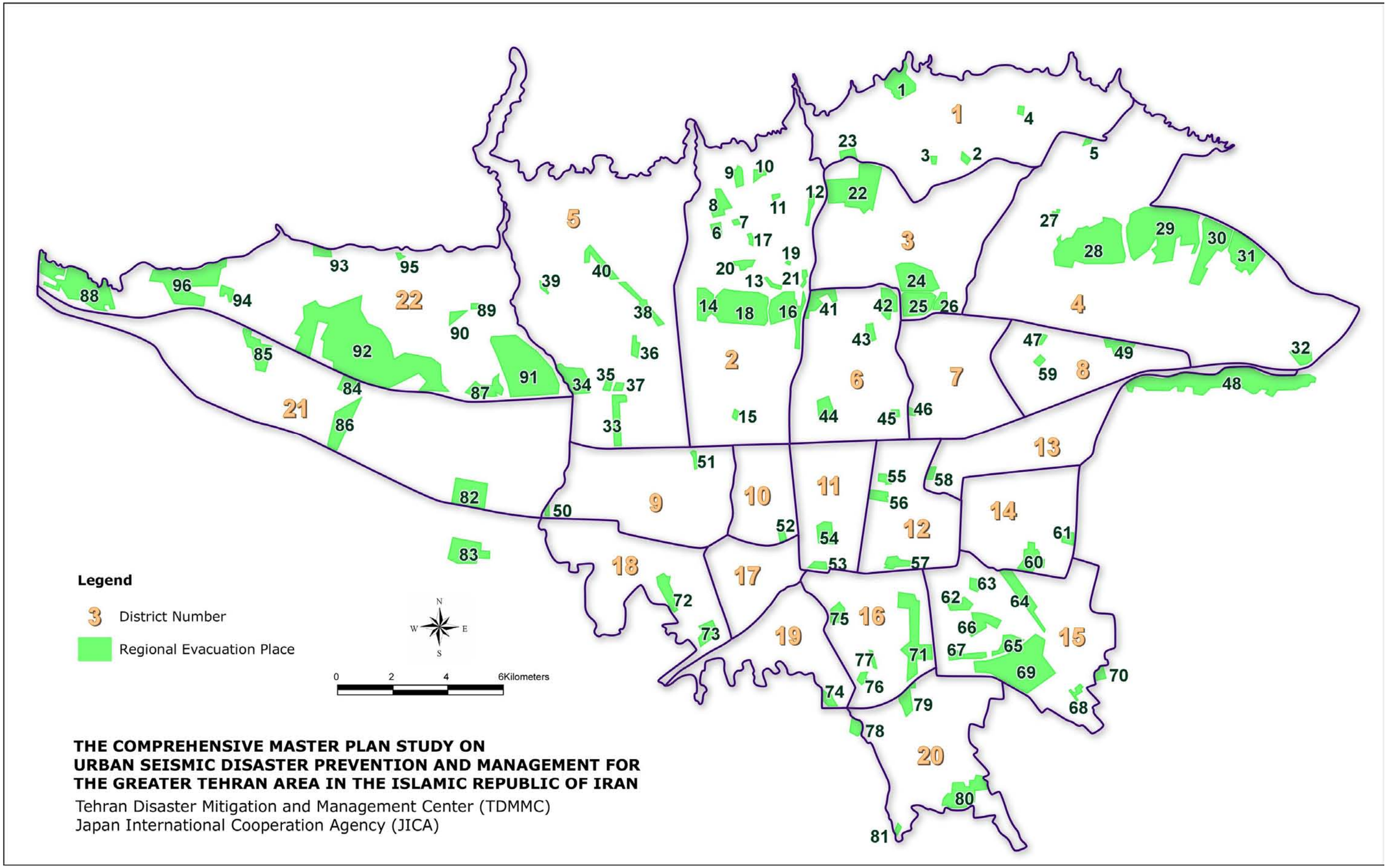
Regional Evacuation Place in Tehran



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List of Regional Evacuation Place

District	Regional Evacuation Place		
	Code	Name of Place	Area (ha)
1	1	Saad Abad Garden	84.2
	2	Qeytarieh Park	9.9
	3	Green Space, Next to Qeytarieh Sub Station, TREC	7.5
	4	Niavaran Park	6.1
	23	National Parlement, Islamic Conference Place, North of Chamran Highway	16.8
	Total		**124.6**
2	6	Surrounding of water reserviour, in Farahzad	16.4
	7	Vacant for Food Science Faculty, in Farahzad	4.2
	8	Forest in Farahzad	38.4
	9	Parvaz Park, Farahzad	21.9
	10	Vacant, North of Saadat Abad	14.2
	11	Water Reserviour, Kaj Square	4.1
	12	Vacant along Darake River	15.1
	13	Vacant belong to Azad University, Shahrak Ghods	8.8
	14	Western Part of Pardisan Park	52.1
	15	Vacant, Water Company in Tarasht Area	4.9
	16	Nasr Park and Sorrounding area	134.2
	17	Kanoon Parvaresh Fekri, Shahrak Ghods	8.7
	18	Main Part of Pardisan Park	219.1
	19	Vacant, by the Hormozan St.	1.8
	20	Civil Workshop in Shahrak Ghods	17.2
	21	Forest Park along Chamran Highway, Surrounding Mollasadra St.	7.6
	Total		**568.6**
3	22	Surroundings of I. R. I. B. Headquarters	225.9
	24	Northern Part of Abbas Abad land	136.6
	25	Northern Part of Abbas Abad land	104.2
	26	Jahan Kodak Park (National Library in Plan)	25.5
	Total		**492.1**
4	5	Park, South Eastern Part of Lashgarak St. and Ozgol St. Intersection	5.8
	27	Javaherian Garden (related to Municipality), Lavizan Area	6.5
	28	Lavizan Park	334.2
	29	Narvan Park, Babaiee Highway	431.8
	30	Pardis Green Land Park	188.5
	31	National Forest Park, Babaiee Highway	135.3
	32	Park, Vacant belongs to Municipality, South of Hakimiye	32.0
	Total		**1134.0**
5	33	Ekbatan Rehabilitation and Renovation Co.	51.8
	34	Eram Park	79.6
	35	Ekbatan Rehabilitation and Renovation Co.	11.3
	36	Green Space, Nour Sq.	14.0
	37	Green Space, East of South Nour Blvd.	10.7
	38	South Part of Vacant under Power Cable, Shahrak Gharb	44.6
	39	Kan Garden	5.9
	40	North Part of Vacant under Power Cable, Shahrak Gharb	54.8
	Total		**272.7**
6	41	Atomic Energy Organization, Chamran and Hemat Highway Intersection	51.9
	42	Abbas Abad Land, West of Modarres Higway	51.1
	43	Saiee Park	16.5
	44	Laleh Park	43.4
	45	Tehran Garden (Cultural House)	6.5
	Total		**169.5**
7	46	Shiroudi Sport Land	8.5
	Total		**8.5**
8	47	Buildings belong to Municipality (Technical Workshop, Storages)	11.7
	49	Tehran Metro Company and related storage and Technical Office, Between Dardasht and Bagheri St.	47.1
	59	Sport Land, Storage belong to MOE and Polt National Company	8.0
	Total		**66.8**
9	50	Workers Sport Complex	5.6
	51	Almahdi Park, Daily bazar along Mehrabad Airport Zone	6.4
	Total		**11.9**
10	52	22 Bahman Park, North of Ghazvin St., West of Arab St.	8.9
	Total		**8.9**
11	53	Shahid Haji Zadeh Educational Complex, N. I. O. P. D. C.	16.8
	54	Razi Park, Behind Razi and Farabi Hospital	42.3
	Total		**59.1**
12	55	Open Space, between Hafez and Ferdosi St., along Sakhaiee St.	11.7
	56	Parke Shahr	24.2
	57	Boostan and Sport Complex under plan, West of Shoosh Square	31.2
	Total		**67.0**
13	58	New place for National Parlement, Mojahedin Eslam Intersection	16.9
	48	Sorkhe Hesar	396.8
	Total		**413.7**
14	60	Cultivation, Between Nabard and Ahang Highway	57.1
	61	Basij Park, between Basij and Mahalati Highway	12.4
	Total		**69.5**
15	62	Daily Bazar, Sport Complex, North of Besat Highway	39.3
	63	Valiasr Park, Attarbashi St.	16.3
	64	Cultural House, Green Space along Khavaran St.	69.7
	65	Northern part of Tooska Forest park	31.5
	66	Forest Park, South of Besat Highway	57.3
	67	North west part of Tooska Forest park	21.8
	68	Mesgar Abad old Cemetry	8.0
	69	Main Part of Tooska Forest Park	318.1
	70	Vacant, East of Moshiriye Square	24.6
	Total		**586.5**
16	71	Besat Poweplant and Surrounding area	159.2
	75	22 Bahaman Boostan, Bahman Cultural House, Old Koshtargah	36.3
	76	Shariati Educational Complex, ETKA Factory, South of Barbary Square	11.1
	77	Shahid Rajaiee Park, long Rajaiee Highway, East of Barbari Square	6.9
	Total		**213.5**
17	--	--	0.0
	Total		**0.0**
18	72	Ghaem Boostan	51.4
	73	Sepide Park, Sport Land, North of Saeedi Highway	37.0
	Total		**88.4**
19	74	Cultivation, Intersection of Besat and Beheshte Zahra Highway	17.6
	Total		**17.6**
20	78	Vacant, West of Shahrake 13 Aban	31.6
	79	Green Space, Sport Land, South of Azadegan Highway	37.9
	80	Vacant in ghaleh Gabri Area	97.8
	81	Green Space along Anbare Naft St.	5.3
	Total		**172.6**
21	82	Vacant belongs to Properties Org.	104.2
	83	Norouz Abad Riding Club	99.4
	84	Vacant belongs to Valiasr Cultural Complex	27.2
	85	Vacant along Shahrak Cinemaie Ghazali	73.9
	86	Shahrak Daneshgah Cooperation Company	91.4
	Total		**396.1**
22	87	Khargoosh Darreh Forest	55.7
	88	Western Part of Chitgar Park	232.1
	89	Forest between Shahrak Cheshme and Nabovat Garrison	5.6
	90	Forest between Nabovat Garrison and Shahrak Rahahan	13.8
	91	Azadi Stadiuum	359.1
	92	Chitgar Park	741.1
	93	Vacant, North of Shahid Namjoo Garrison	19.0
	94	Forest, North of Vardavard Metro Station	16.8
	95	Green Space, West of Shahrak Rah Ahan	4.7
	96	Vardavard Forest Park	52.5
	Total		**1,500.4**

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