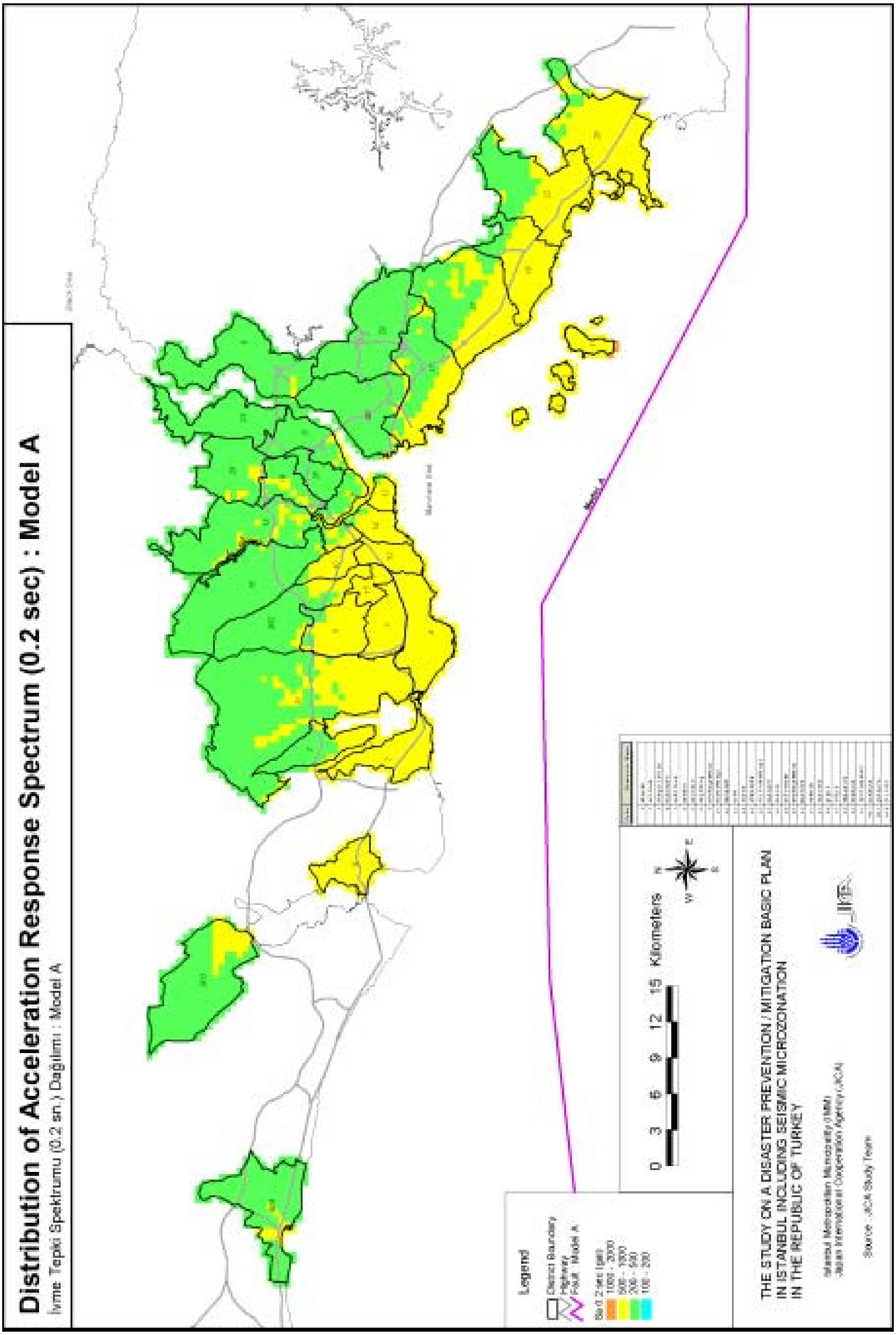

Figure 7.2.12 Distribution of Acceleration Response Spectrum (0.2 sec): Model A

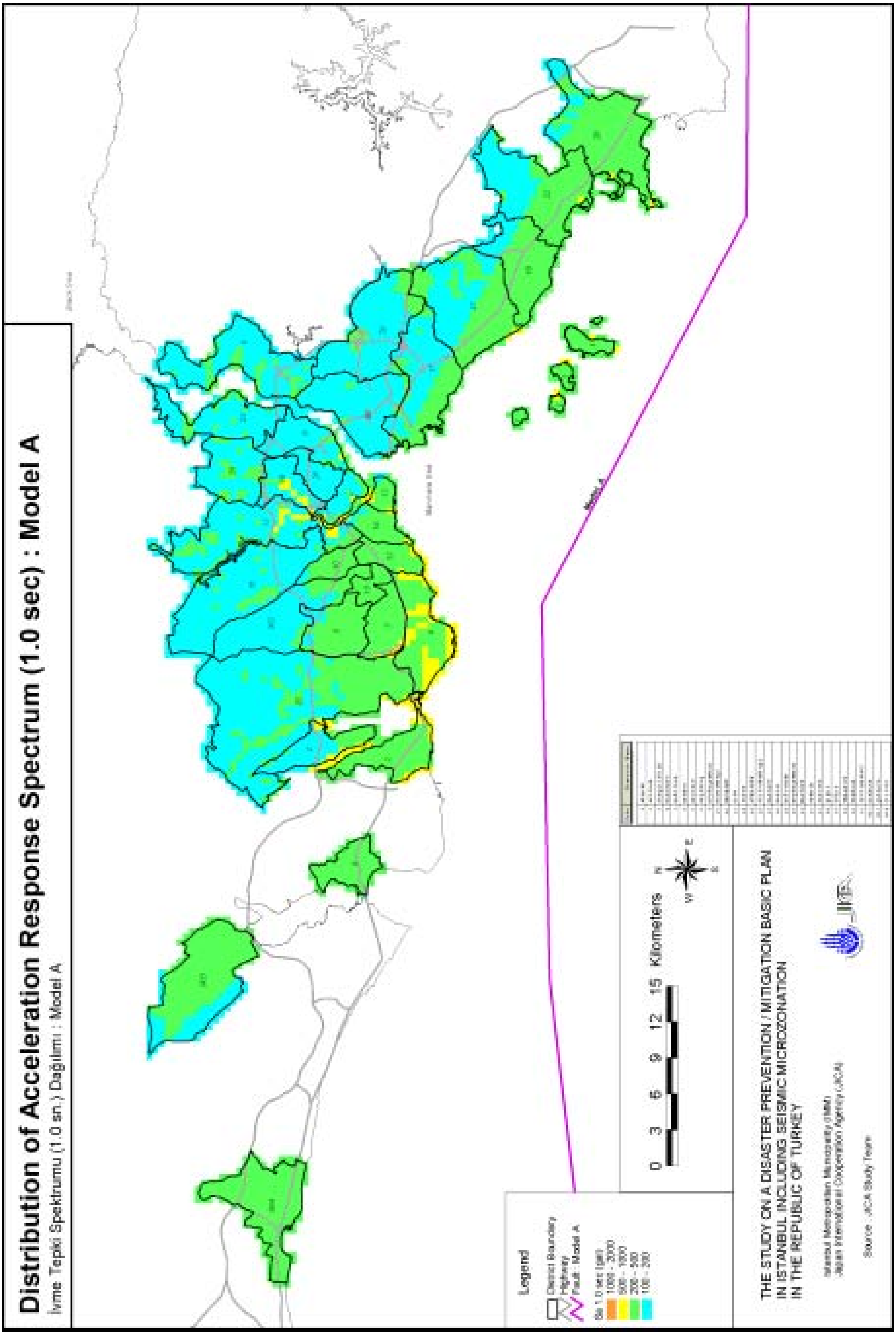

Figure 7.2.13 Distribution of Acceleration Response Spectrum (1.0 sec): Model A

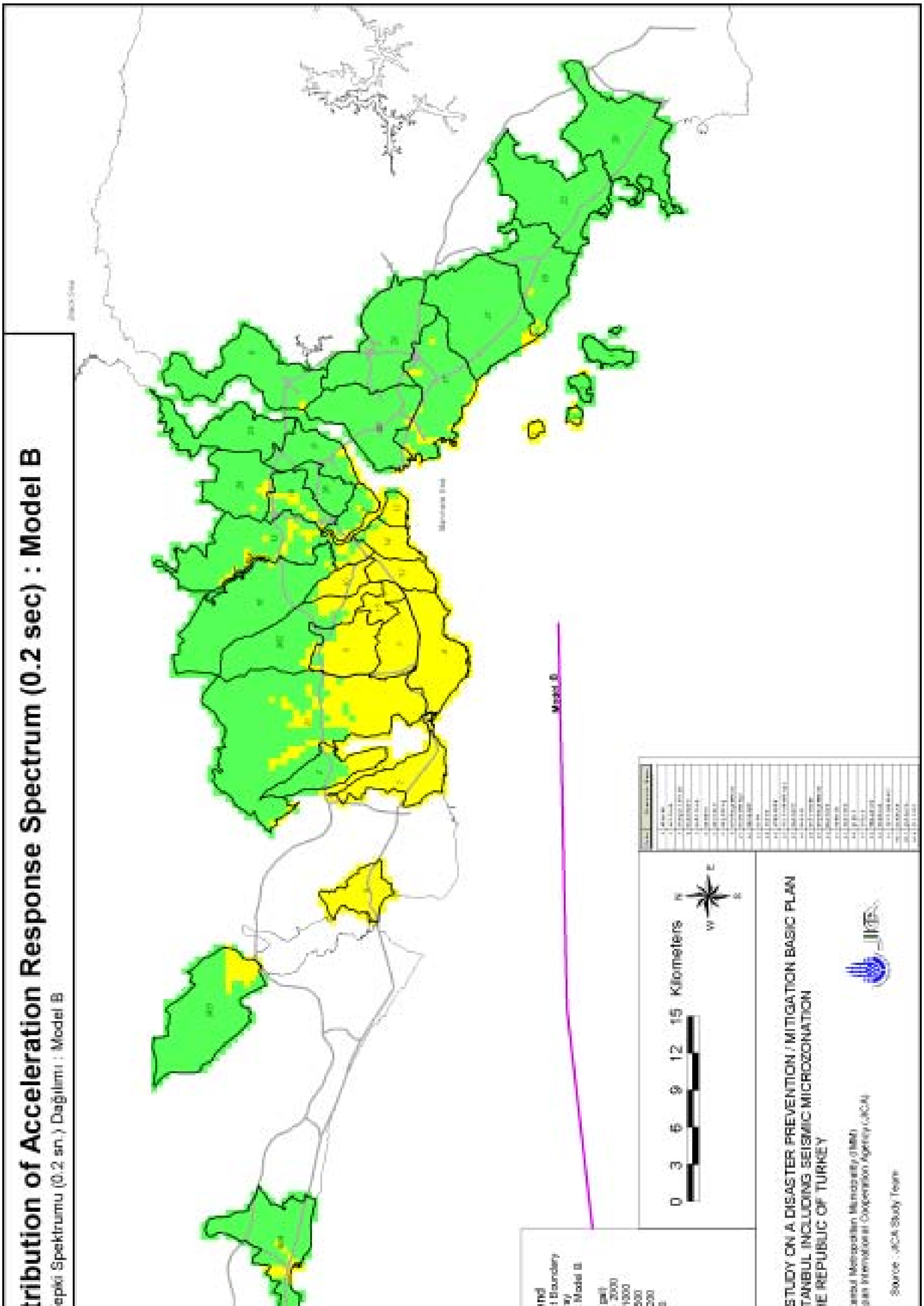

Figure 7.2.14 Distribution of Acceleration Response Spectrum (0.2 sec): Model B

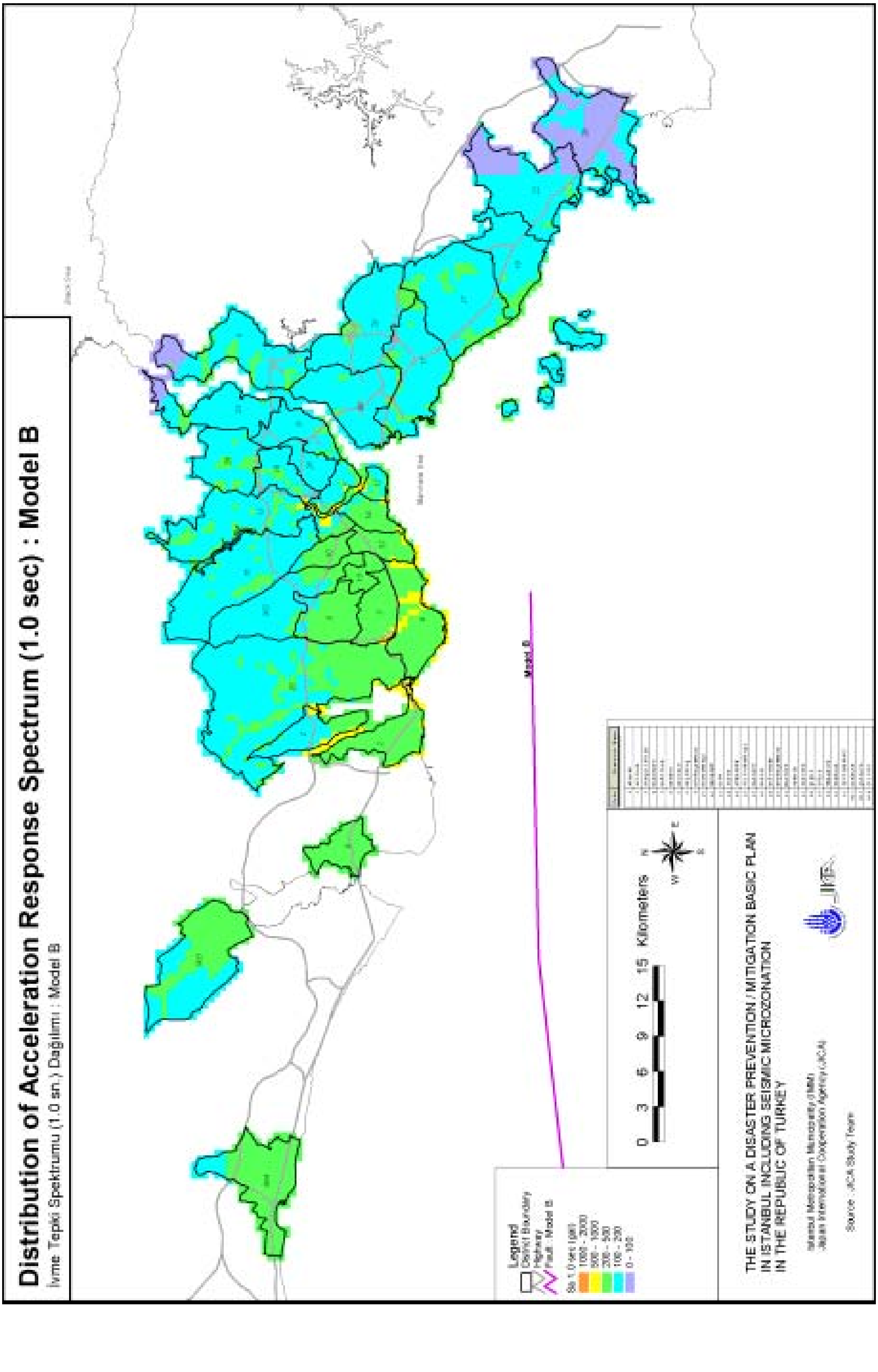

Figure 7.2.15 Distribution of Acceleration Response Spectrum (1.0 sec): Model B

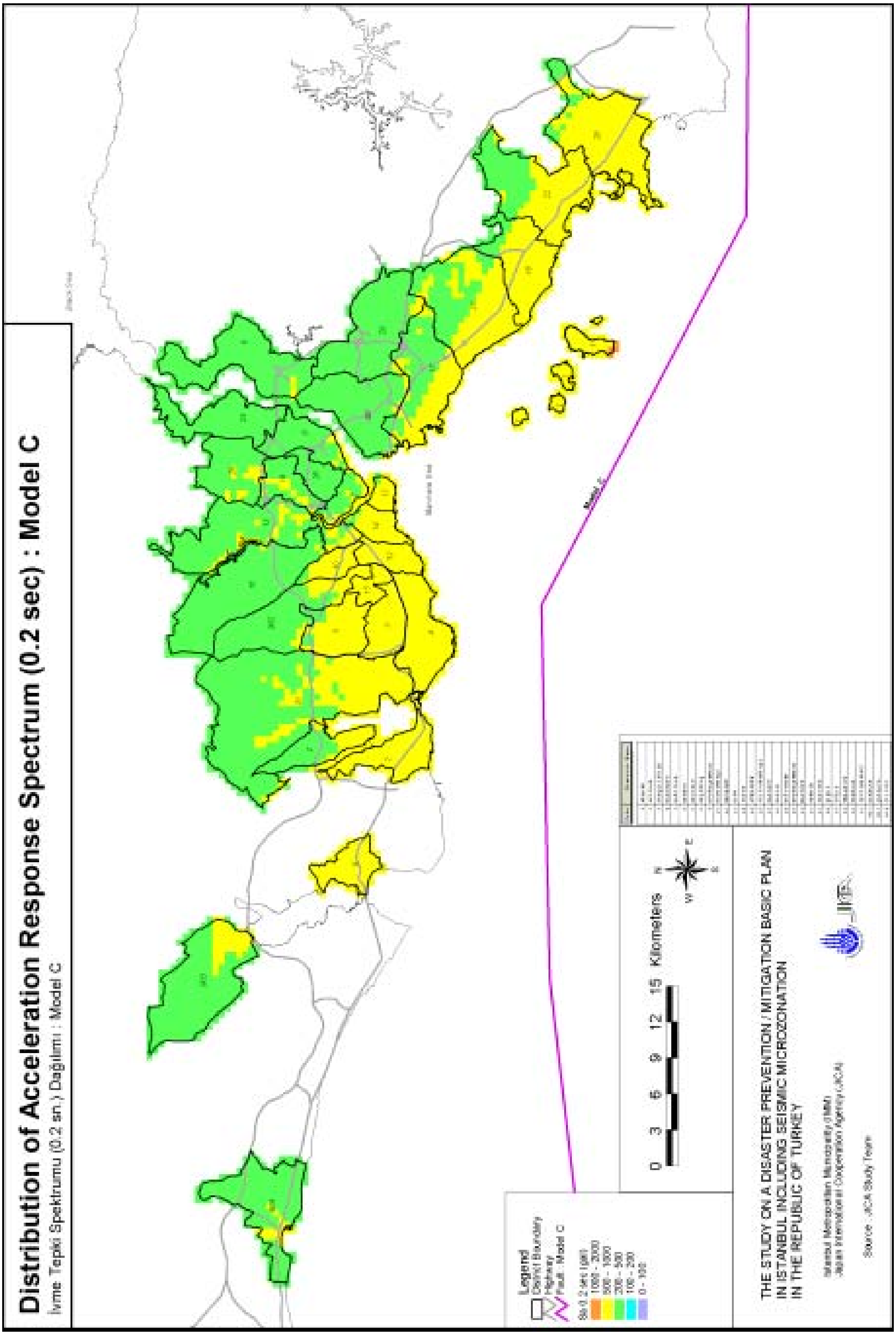

Figure 7.2.16 Distribution of Acceleration Response Spectrum (0.2 sec): Model C

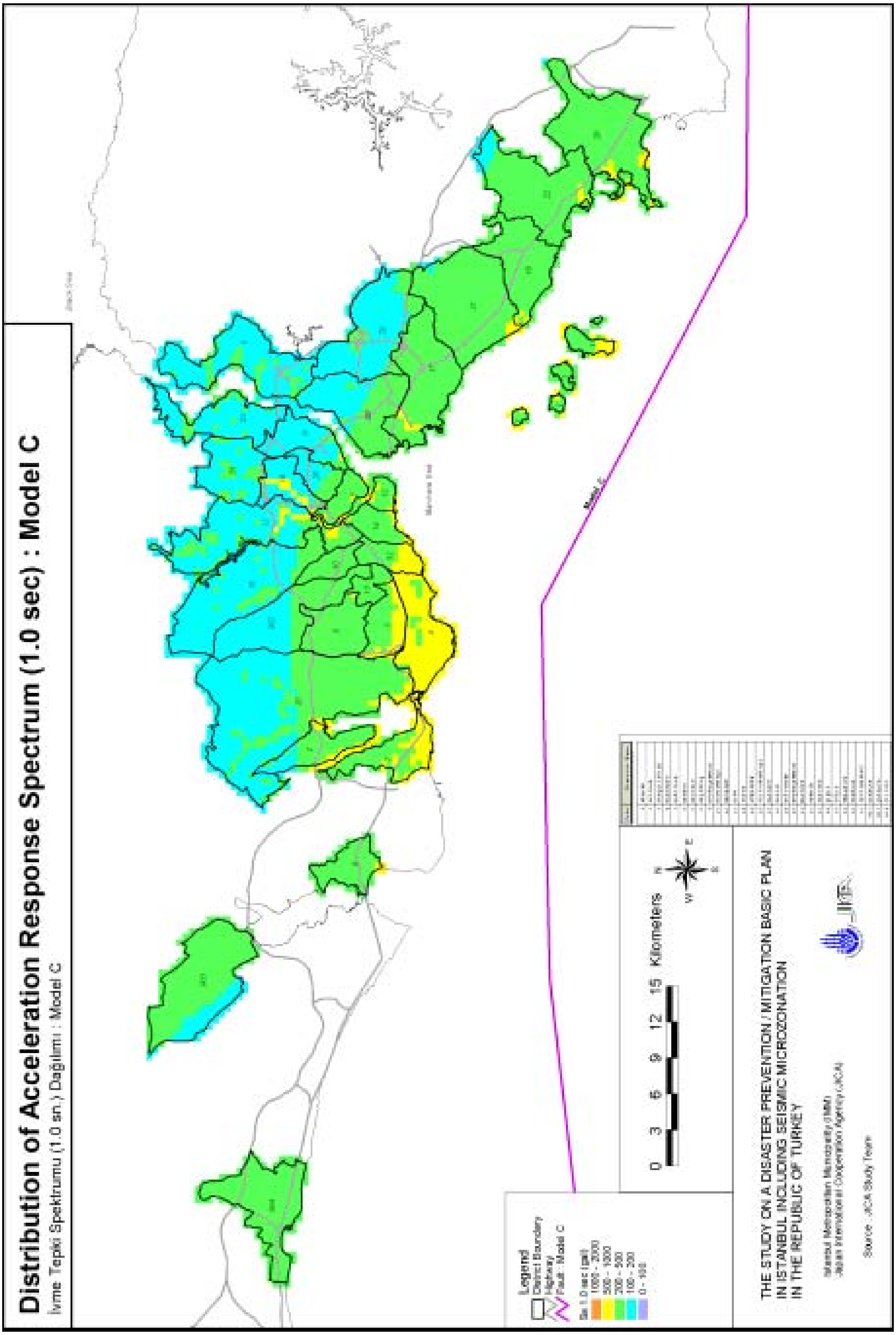

Figure 7.2.17 Distribution of Acceleration Response Spectrum (1.0 sec): Model C

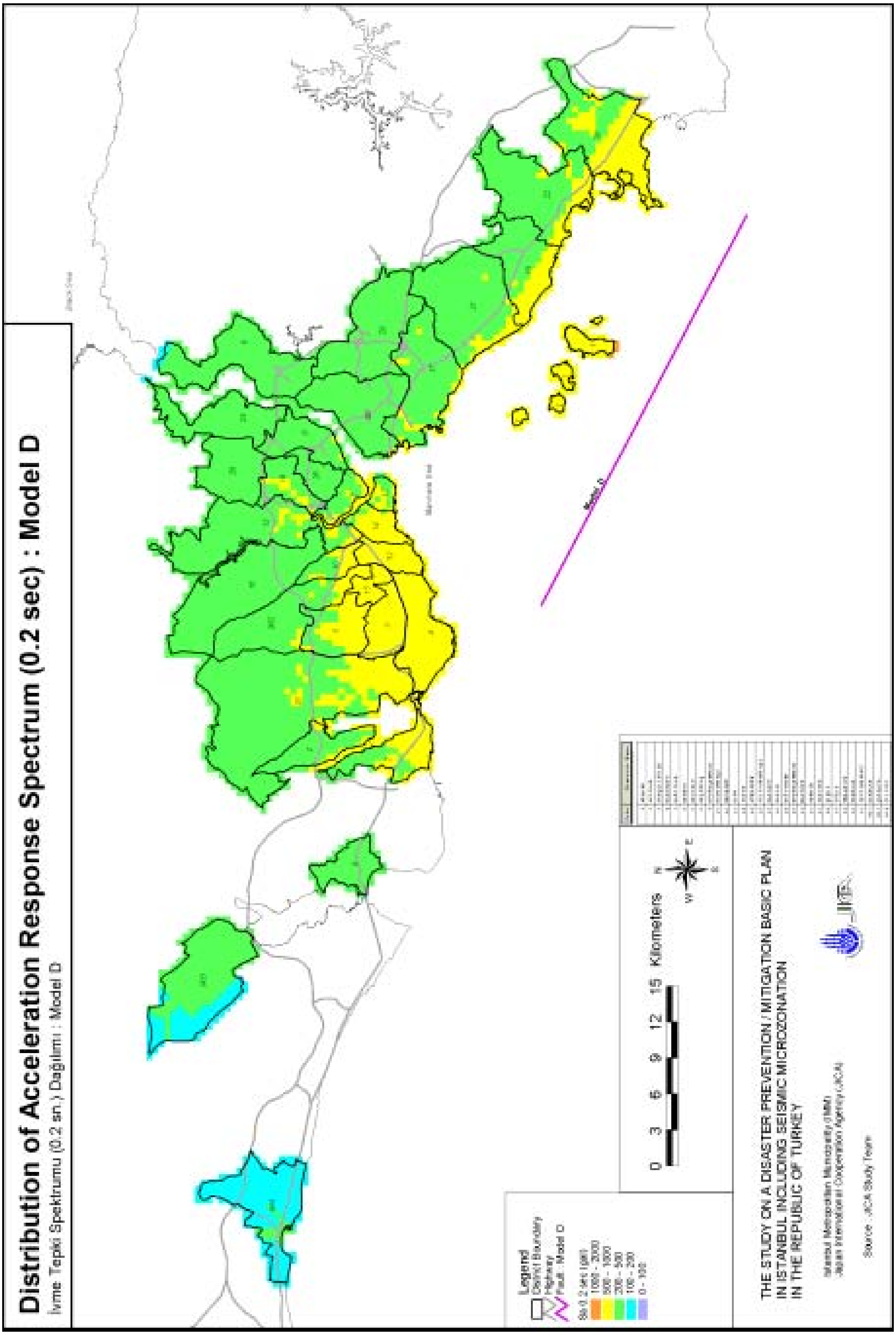

Figure 7.2.18 Distribution of Acceleration Response Spectrum (0.2 sec): Model D

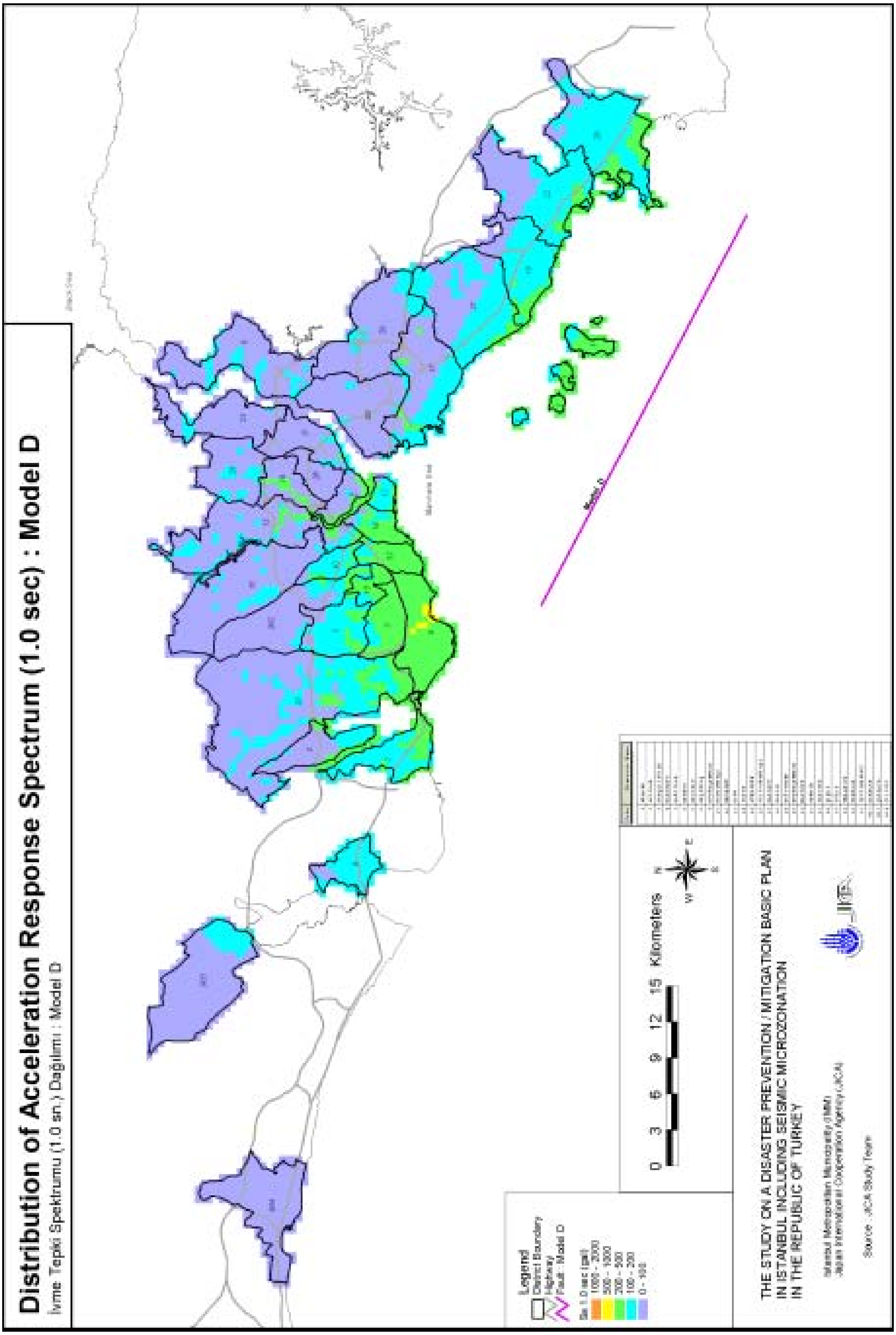

Figure 7.2.19 Distribution of Acceleration Response Spectrum (1.0 sec): Model D

Acknowledgements

The earthquake analysis in this chapter was conducted under close discussions with Prof. Dr. Mustafa Erdik and researchers in the Department of Earthquake Engineering, KOERI (NOTE: write out acronym for KOERI). This is especially true of the method of subsurface amplification calculation, which is based on their suggestions. The Study Team expresses special thanks for their collaboration on the Study.

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7.3. Evaluation of Liquefaction Potential

7.3.1. General

An evaluation of liquefaction potential is conducted in order to provide an overview of the distribution liquefaction potential over the area and its regional characteristics in the Study Area.

The following three grades are indicated as the liquefaction potential estimation in the "Manual for Zonation on Seismic Geotechnical Hazards" by TC4, ISSMFE (1993).

Method Grade 1: simple and synthetic analysis by using geological maps, topographical maps, and histories of disaster

Method Grade 2: a detailed analysis using site reconnaissance results, interviewing the local residents, etc.

Method Grade 3: a detailed analysis using geological investigation results and numerical analyses

It is considered that Method Grade 3 is appropriate in quality and content, compared to other estimation items of the Study. The main content of the evaluation of the liquefaction potential is the comparison of the soil strength with the seismic motion. Various procedures exist to determine these values. Soil properties are determined by simple physical property tests or detailed dynamic laboratory tests. Seismic motion is determined using only information on ground type of the area or an estimated waveform for target earthquakes. In the latter case, the waveform is used to obtain the maximum value of acceleration during an earthquake or time-dependent change of acceleration. The procedure should be determined considering the objective of the estimation. In cases where critical situations are estimated in designing important facilities, a point base analysis is to be used with detailed procedures. In this seismic microzoning study, soil strength and seismic motion are to be determined at the same levels of quality in the whole Study Area. Therefore, using some statistical method is appropriate.

The following information on soil properties and seismic motion was available in the Study:

- Borehole logs with results of Standard Penetration Tests (SPT)
- Physical soil properties
- Peak ground acceleration for scenario earthquakes

Considering the above, a combination of the F_L method and the P_L method was used in the Study. This method is commonly used in Japan for practical purposes.

Manmade ground and quaternary deposits are the objective of the evaluation. A 500 m grid system, which is used in the earthquake analysis, is prepared for modeling.

Figure 7.3.1 shows the flow chart for a liquefaction potential analysis.

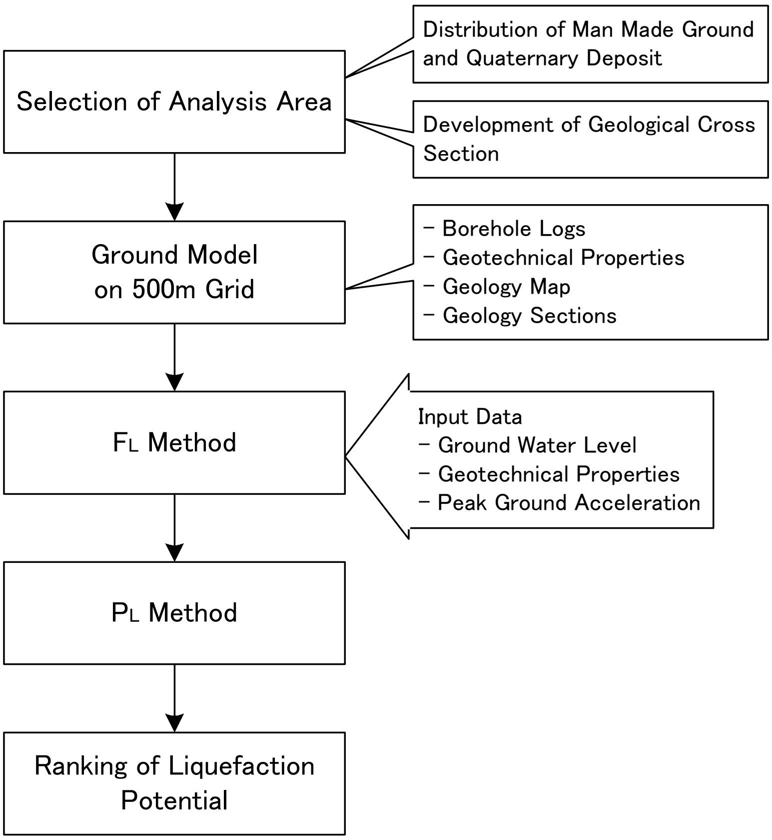


Figure 7.3.1 Flowchart of Liquefaction Analysis

7.3.2. Method of Calculation

The liquefaction potential for individual layers is analysed by the FL method. The whole liquefaction potential at the analysed point is evaluated by the PL method based upon the results of the FL method.

FL Method (Japanese Design Specification of Highway Bridge, revised 1996)

Ground condition to be evaluated:

Quaternary sandy soil from ground surface to depth of 20 m

Groundwater table less than 10 m from ground surface

$F_L = R/L$

F_L: liquefaction resistance factor

$F_L \leq 1.0$: Judged as liquefied

$F_L > 1.0$: Judged as not liquefied

R: cyclic shear strength at effective overburden pressure

$R = C_w \times R_L$

C_w: correlation coefficient for earthquake type

Type 1 earthquake (plate boundary type, large scale)

$C_w = 1.0$

Type 2 earthquake (inland type)

$C_w = 1.0 \quad (R_L \leq 1.0)$

$= 3.3R_L + 0.67 \quad (0.1 < R_L \leq 0.4)$

$= 2.0 \quad (0.4 < R_L)$

R_L: cyclic resistance ratio obtained by laboratory test

$R_L = 0.0882 \quad (Na/1.7)^{0.5} \quad (Na < 14)$

$= 0.0882 \quad (Na/1.7)^{0.5} + 1.6 \times 10^{-6} (Na-14)^{4.5} \quad (14 \leq Na)$

Sandy Soil

$Na = c_1 N + c_2$

$c_1 = 1 \quad (0\% \leq Fc < 10\%)$,

$= (Fc + 40)/50 \quad (10\% \leq Fc < 60\%)$

$= Fc/20 - 1 \quad (60\% \leq Fc)$

$c_2 = 0 \quad (0\% \leq Fc < 10\%)$

$= (F-10)/18 \quad (10\% \leq Fc)$

Fc : fine contents

Gravelly Soil

$Na = \{1-0.36\log_{10}(D_{50}/2.0)\}N_1$

N: SPT blow count

Na: N value correlated for grain size

N_1: $1.7N/(\sigma_v'+0.7)$

D_{50}: grain diameter of 50% passing (mm)

L: shear stress to the effective overburden pressure

$L = \alpha / g \times \sigma_v/\sigma_v' \times r_d$

r_d : stress reduction factor

$r_d = 1.0 - 0.015x$

x : depth in meters below the ground surface

α: peak ground acceleration (gal)

g: acceleration of gravity (= 980 gal)

σ_v: total overburden pressure

σ_v': effective overburden pressure

<u>P_L Method (Iwasaki et al. 1982)</u>

$$P_L = \int_0^{20} F \cdot w(z)dz$$

$15 < P_L$	Very high potential
$5 < P_L \leq 15$	Relatively high potential
$0 < P_L \leq 5$	Relatively low potential
$P_L = 0$	Very low potential

$F = 1-F_L \quad (F_L<1.0)$

$\;\; = 0 \quad (F_L \geq 1.0)$

$w(z) = 10 - 0.5z$

P_L: liquefaction potential index

F_L: liquefaction resistance factor

w(z): weight function for depth

z: depth in meters below the ground surface

7.3.3. Precondition for the Analysis

(1) Analyzed Area

In general, liquefaction takes place in loose Alluvial saturated sandy deposits. The Japanese Design Specifications for Highway Bridges describes the following conditions for soil stratum, which requires liquefaction potential evaluation:

> In principle, Alluvial saturated sandy deposits, which satisfy the following three (3) conditions at the same time, require liquefaction potential analysis:
>
> 1. Saturated sandy layer above the depth of 20 m from the present ground surface with ground water level within 10 m from the present ground surface.
> 2. Soil layer with fine contents (FC) less than 35%, or with plastic index less than 15% even with the FC more than 35%.
> 3. Soil layer with mean grain size (D50) less than 10 mm, and with grain size of 10 % passing less than 1 mm.
>
> Liquefaction potential evaluation is recommended for Diluvial deposits with a low N value or without diagenesis.

Areas of the evaluation are selected by the following steps:

1) Select area where sandy soil is mainly distributed or where sandy soil shows horizontal continuity.

From the particle size distribution shown in Figure 7.3.2, Yd, Qal, Ksf, Cf and Sbf are sandy soil or have sandy soil layer.

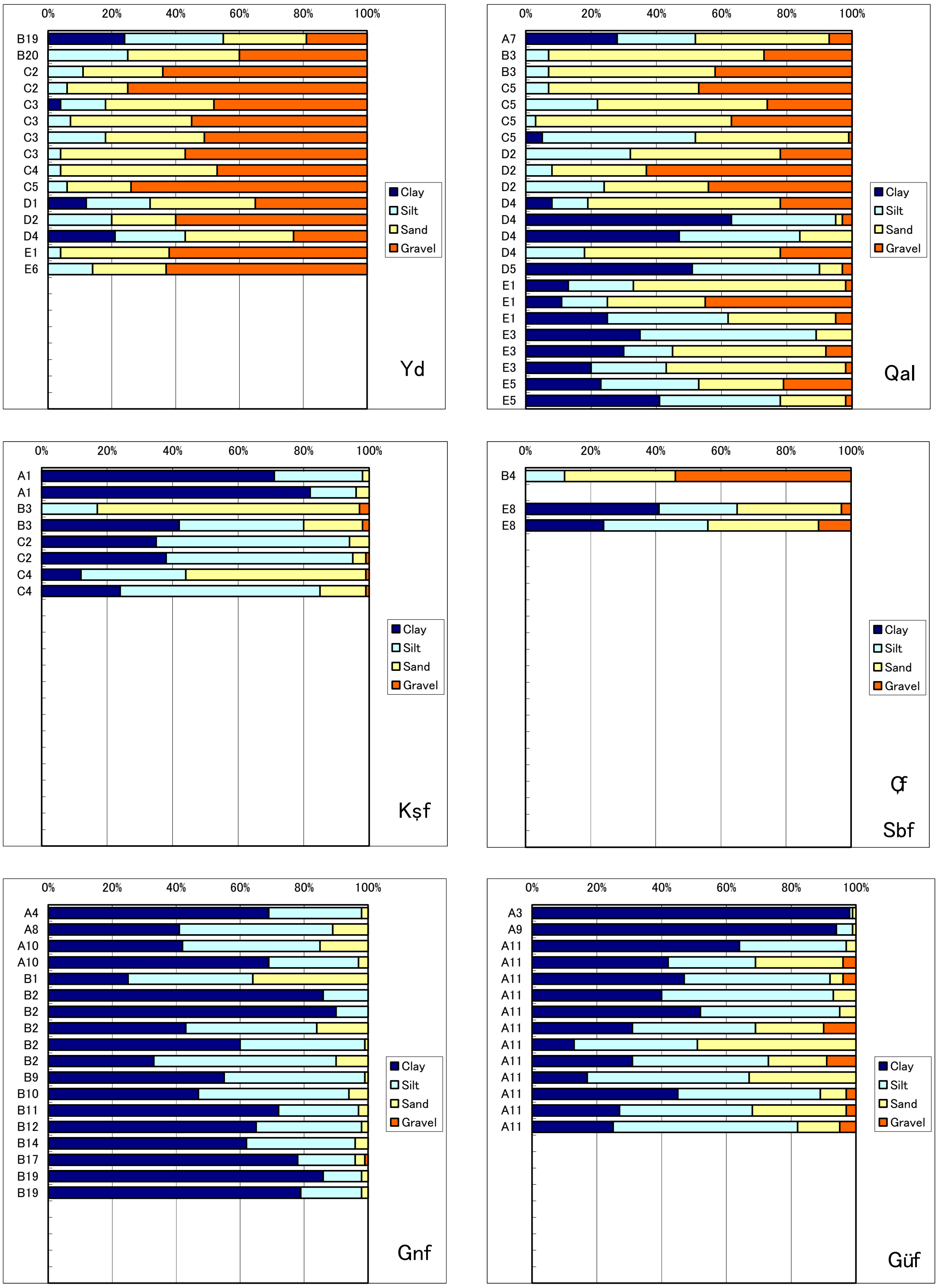


Figure 7.3.2 Particle Size Distribution

2) Select area where soft soil is prevailing

Çf and Sbf are not considered to have liquefaction potential because these layers are Tertiary deposits and their degree of cementation is relatively high due to diagenesis. Figure 7.3.3 shows the range of N-value of each soil stratum. Tertiary deposit (Çf, Sbf) obviously have a higher N-value than man made ground (Yd) and Quaternary deposit (Qal, Kşf).

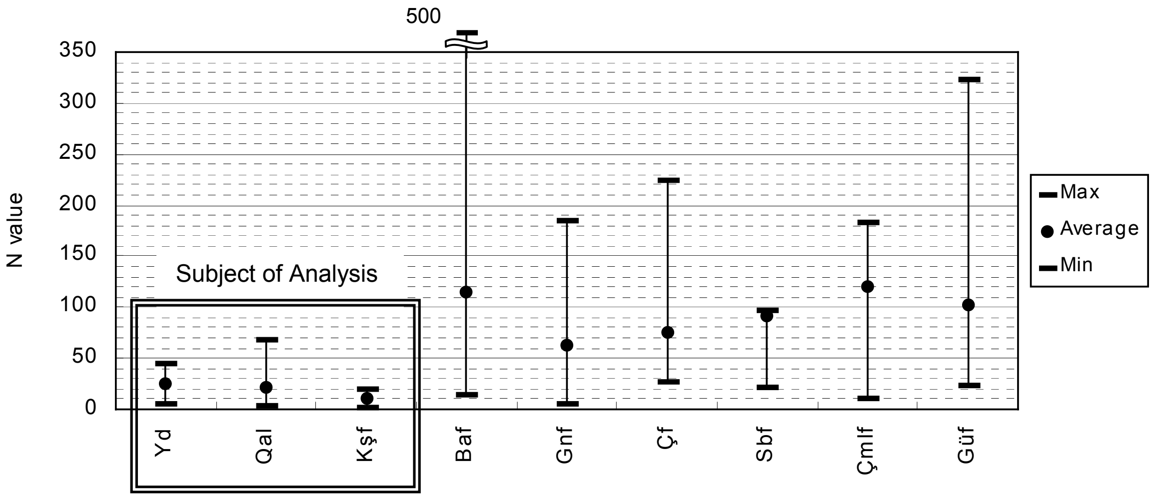


Figure 7.3.3 Range of N-value of Uncemented Soil Layers

Liquefaction is a phenomenon in which soil particles are re-arranged and soil ground is compressed by the cyclic vibration caused by an earthquake. By this reason, liquefaction potential is higher in looser soil, and softer in soil that has a smaller N-value. Therefore, the liquefaction potential study is conducted only in the area where man-made ground (Yd) and Quaternary deposits (Qal, Kşf) are present. Figure 7.3.4 shows the area of man made ground and Quaternary deposits.

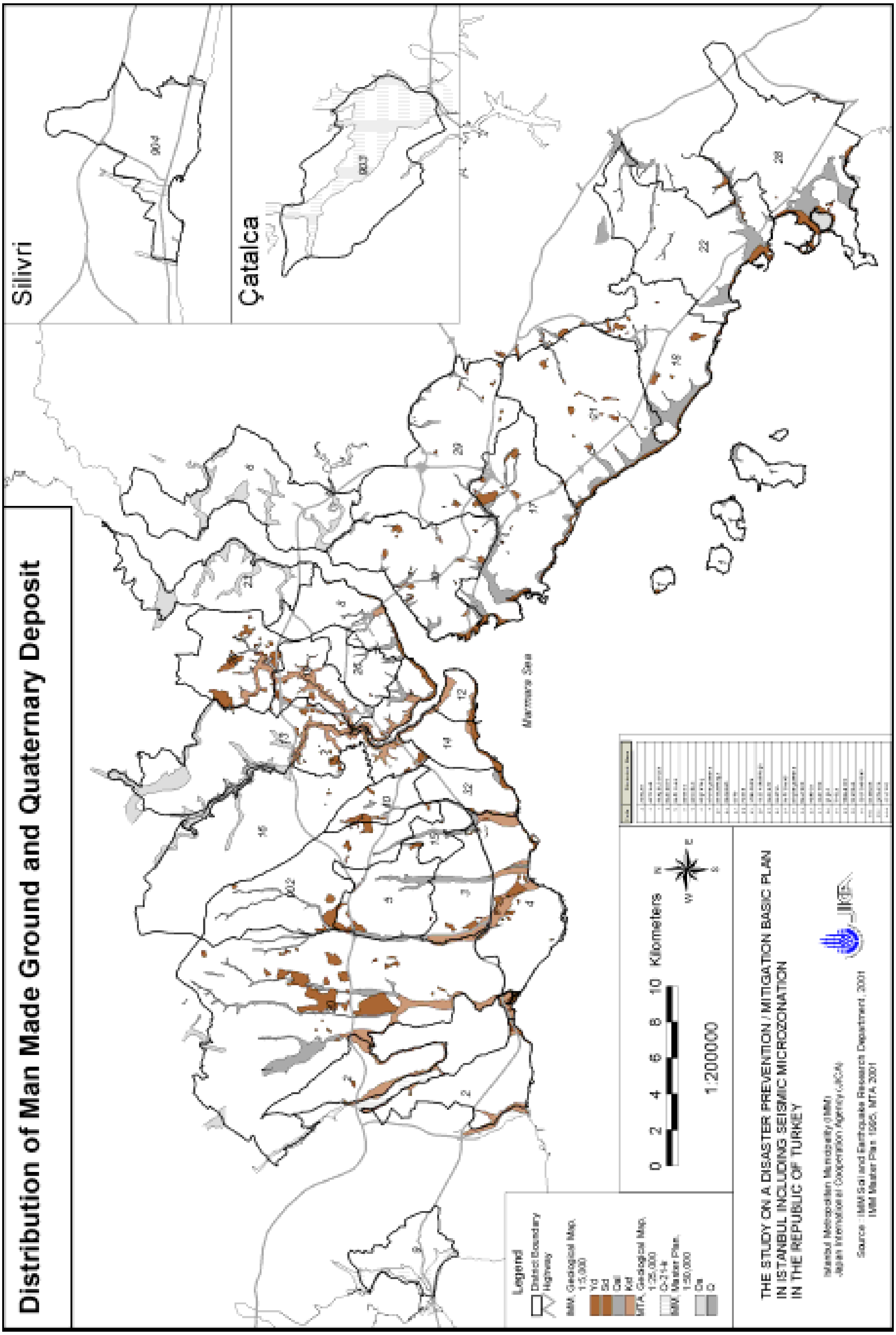


Figure 7.3.4 Distribution of Man-made Ground and Quaternary Deposits

Characteristics of each district from a viewpoint of distribution of man made ground and Quaternary deposits are as shown below:

Average ratios of the man made ground and Quaternary Deposits in each district are approximately 3% and 11%, respectively. In other words, the strata to be studied, regarding liquefaction, occupy approximately 14% in the Study Area (See Table 7.3.1 and Figure 7.3.5).

The district having the highest ratio is Çatalca (approx. 40%). On the other hand, the district having the lowest ratio is Gaziosmanpaşa (approx. 3%).

Table 7.3.1 Summary of Liquefaction Potential Soils Distribution by District

Code	District	Area (ha)								Ratio (%)		
		IMM				Master Plan	MTA	Others	Total	Man Made Ground	Quatenary Deposit	Others
		Man Made Ground		Quaternary Deposit								
		Yd	Sd	Qal	Ksf	Oa	Q-21-k					
1	ADALAR	10	0	73	0	0	0	1,016	1,100	0.9	6.7	92.4
2	AVCILAR	40	0	0	350	0	0	3,471	3,861	1.0	9.1	89.9
3	BAHÇELİ EVLER	42	0	125	154	0	0	1,340	1,661	2.5	16.8	80.7
4	BAKIRKÖY	131	0	80	350	0	0	2,390	2,951	4.4	14.6	81.0
5	BAĞCILAR	117	0	163	0	0	0	1,914	2,194	5.3	7.4	87.2
6	BEYKOZ	0	0	0	0	503	0	3,653	4,156	0.0	12.1	87.9
7	BEYOĞLU	74	0	59	143	0	0	614	889	8.3	22.7	69.0
8	BEŞİ KTAŞ	51	0	101	27	0	0	1,632	1,811	2.8	7.0	90.1
9	BÜYÜKÇEKMECE	0	0	0	0	0	321	1,153	1,474	0.0	21.8	78.2
10	BAYRAMPAŞA	67	0	27	0	0	0	865	958	7.0	2.8	90.3
12	EMİ NÖNÜ	32	0	0	102	0	0	374	508	6.4	20.0	73.6
13	EYÜP	156	0	9	297	529	0	4,059	5,050	3.1	16.5	80.4
14	FATİ H	81	0	1	55	0	0	909	1,045	7.8	5.3	86.9
15	GÜNGÖREN	1	0	68	0	0	0	649	718	0.2	9.5	90.3
16	GAZİ OSMANPAŞA	4	0	0	4	153	0	5,515	5,676	0.1	2.8	97.2
17	KADIKÖY	110	114	407	0	0	0	3,496	4,128	5.4	9.9	84.7
18	KARTAL	87	56	260	0	0	0	2,733	3,135	4.5	8.3	87.2
19	KAĞITHANE	35	0	2	247	0	0	1,158	1,443	2.5	17.3	80.2
20	KÜÇÜKÇKMECE	657	0	641	434	309	0	10,133	12,173	5.4	11.4	83.2
21	MALTEPE	76	78	309	0	0	0	5,066	5,530	2.8	5.6	91.6
22	PENDİ K	13	97	424	0	0	0	4,197	4,731	2.3	9.0	88.7
23	SARIYER	0	0	0	0	465	0	2,309	2,774	0.0	16.8	83.2
26	Şİ ŞLİ	244	0	79	128	0	0	3,092	3,543	6.9	5.9	87.3
28	TUZLA	12	164	384	0	0	0	4,437	4,998	3.5	7.7	88.8
29	ÜMRANİ YE	47	0	100	0	13	0	4,401	4,561	1.0	2.5	96.5
30	ÜSKÜDAR	98	42	150	0	29	0	3,463	3,783	3.7	4.7	91.5
32	ZEYTİ NBURUNU	39	0	29	29	0	0	1,052	1,149	3.4	5.0	91.6
902	ESENLER	154	0	121	0	0	0	3,616	3,890	4.0	3.1	92.9
903	ÇATALCA	0	0	0	0	0	2,127	3,137	5,263	0.0	40.4	59.6
904	Sİ Lİ VRİ	0	0	0	0	0	125	3,703	3,828	0.0	3.3	96.7
Total		13,435						85,546	98,981	13.6		86.4
Average		-						-	-	3.2	10.9	86.0

Source: The JICA Study Team

Note: A geological unit is counted using 50 m square grids. A count unit is the number of the 50 m grids in each geological unit.

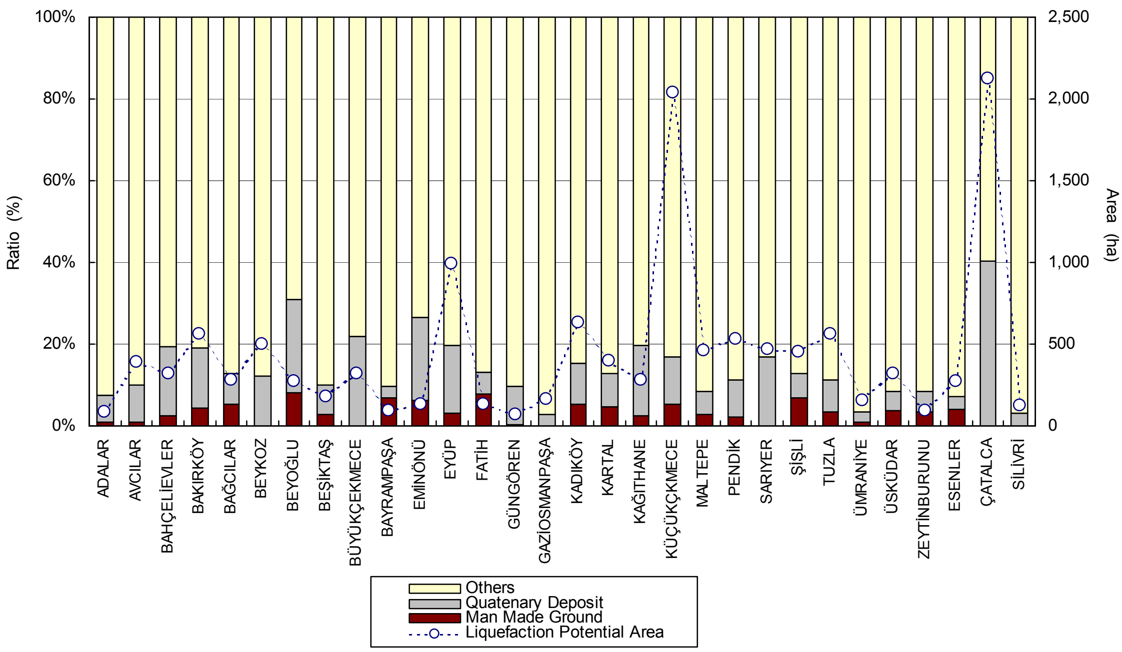


Figure 7.3.5 Liquefaction Potential Soils Distribution by District

(2) Setting up of the soil parameters

1) Gathering of soil condition information

The following data were used as information sources regarding soil conditions in the analyzed area:

- The boring logs based on boring conducted by the Study Team in the analyzed area (No. C1-C5, D1-D5 and E1-E5) and the results of laboratory tests (46 samples).
- The existing boring logs (for 480 holes) of the same area and the results of past laboratory tests (for 93 holes, 214 samples).

The number of the existing results of the past soil laboratory tests is much less than that of the existing boring logs. Most of the soil classification of the past boring logs was made depending on the engineers' empirical and qualitative judgment. Therefore, only the matrix information described in the section "Soil Description" has been used from the existing boring logs.

2) Classification of soil properties

In many cases, soil property distribution provides very complicated aspects. It is not difficult to imagine that the layer phases of the Quaternary Deposit, particularly distributed in the valleys of the Study Area, are complicated in both vertical and horizontal directions.

However, it is difficult to carry out the detailed study reflecting the complicated layer phases, since ground information is limited. Such being the situation, it was decided to study the land liquefaction covering as wide an area as possible, utilizing the limited information most effectively by simplifying the classification of the soil properties as shown below:

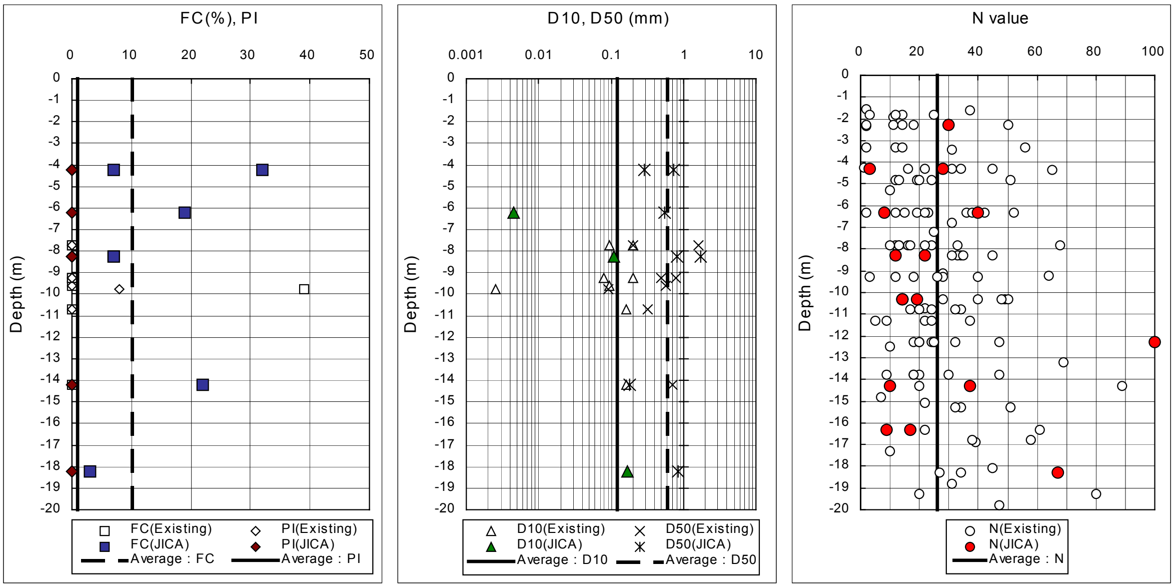
Man-made ground: It is estimated that various materials are used in artificially made grounds and it is too difficult to set up the constant for each ground. Therefore, it was decided to regard the man-made grounds as a single soil property section, considering all the man-made grounds have average soil properties.

Quaternary Deposit: In studying liquefaction, the soil properties are basically and necessarily classified as clayey soil, sandy soil, and gravely soil. Taking into consideration that effective data obtained from the existing boring logs are matrixes, it is reasonable to divide Qal and Kşf into 3 individual classes. Consequently, the quaternary deposit has been classified as Qal-Clay, Qal-Sand, Qal-Gravel, Kşf-Clay, Kşf-Sand, and Kşf-Gravel.

3) Setting up of the soil parameters

The soil parameters necessary for the study are *N value, Unit weight, Fine contents, Grain size of 10% passing, Grain size of 50% passing,* and *Plasticity index*. The individual parameters have been statistically processed and set up for the individual soil classifications. The data distribution used for setting up the constants for Qal-Sand and the constants consequently set up are shown in Figure 7.3.6 as an example.

Regarding the raw data and graphs of individual soil properties, please refer to Supporting Report.



(a) Fine Contents : FC
Plasticity Index : PI

(b) Grain Size of 50%
and 10% passing

(c) N value

Figure 7.3.6 Qal-Sand (Example)

Because the unit weight data for each of the 7 types of soils were not available, that data has been set up according to Table 7.3.2, which contains the approximate unit weight values for various types of soils (Japanese Design Specifications for Highway Bridges, 1990).

Table 7.3.2 Approximate Values of Unit weight, Average Grain Size and Fine Particle Contents of Various Types of Soils

Soil Type	Unit Weight below Ground Water γ_{t2} (tf/m^3)	Unit Weight above Ground Water γ_{t1} (tf/m^3)	Grain Size of 50% passing D_{50} (mm)	Fine Contents FC (%)	Geology Classification
Top Soil	1.7	1.5	0.02	80	-
Silt	1.75	1.55	0.025	75	-
Sandy Silt	1.8	1.6	0.04	65	Qal-Clay, Kşf-Clay
Silty Fine Sand	1.8	1.6	0.07	50	-
Very Fine Sand	1.85	1.65	0.1	40	-
Fine Sand	1.95	1.75	0.15	30	-
Medium Sand	2.0	1.8	0.35	10	-
Coarse Sand	2.0	1.8	0.6	0	Qal-Sand, Qal-Gravel Kşf-Sand
Gravelly Sand	2.1	1.9	2.0	0	Man Made Ground, Kşf-Gravel

Source: Japanese Design Specifications for Highway Bridges (partially modified)

Listed in Table 7.3.3 are the soil property constants used in the calculations.

Table 7.3.3 Summary of Soil Properties for Liquefaction Analysis

Geology Classification	FC (%)	PI	D_{10} (mm)	D_{50} (mm)	N	$_{t2}$ (tf/m^3)	$_{t1}$ (tf/m^3)
Man Made Ground	22	4	0.15	2.7	17	2.1	1.9
Qal-Clay	59	23	no data	0.036	21	1.8	1.6
Qal-Sand	10	1	0.12	0.58	26	2.0	1.8
Qal-Gravel	11	3	0.11	1.3	26	2.0	1.8
Kşf-Clay	67	43	0.006	0.037	12	1.8	1.6
Kşf-Sand	6	0	0.12	0.50	17	2.0	1.8
Kşf-Gravel	9	0	0.69	4.2	27	2.1	1.9

FC : Fine Contents
PI : Plasticity Index
D_{10} : Grain Size of 10% passing
D_{50} : Grain Size of 50% passing
N : N value
$_{t1}$: Unit Weight above Ground Water
$_{t2}$: Unit Weight below Ground Water

(3) Underground water level

Change of underground water level by seasons and tide levels is not known. The underground water level used in the calculation has been set as GL-1m. Taking in consideration the shallowest underground water level observed during boring work, by the Study Team and in the observation holes, this is a fairly safe estimate.

(4) Modeling of the ground

Though the study on liquefaction was planned to cover a comparatively wide area, the available ground information of the Study Area is limited and the classification of the soil properties has been simplified to 7 classes. Because the study aims to obtain a general view of the distribution of soils with liquefaction potential in order to identify the districts with high risk, it is necessary to make a judgment on liquefaction covering as wide an area as possible.

From this viewpoint, the ground models have been set up by the following procedures, taking the purpose of the study and the available ground information into consideration:

- Cross-sections of soil layers are prepared based on the 7 geological classes (Qal-Clay, Qal-Sand, Qal-Gravel, Ksf-Clay, Ksf-Sand and Ksf-Gravel) covering the man-made ground and Quaternary Deposits.
- Three dimensional soil layer constitutions are estimated based on the cross sections and configuration of the grounds.

- Model columns of the soil layers are prepared, using the 500 m grids, which are units for seismic motion calculation, and employing an average soil constitution in each grid (Ref. Figure 7.3.7).
- Models covering soil layers from ground surface to 20 m depth or less are set up.

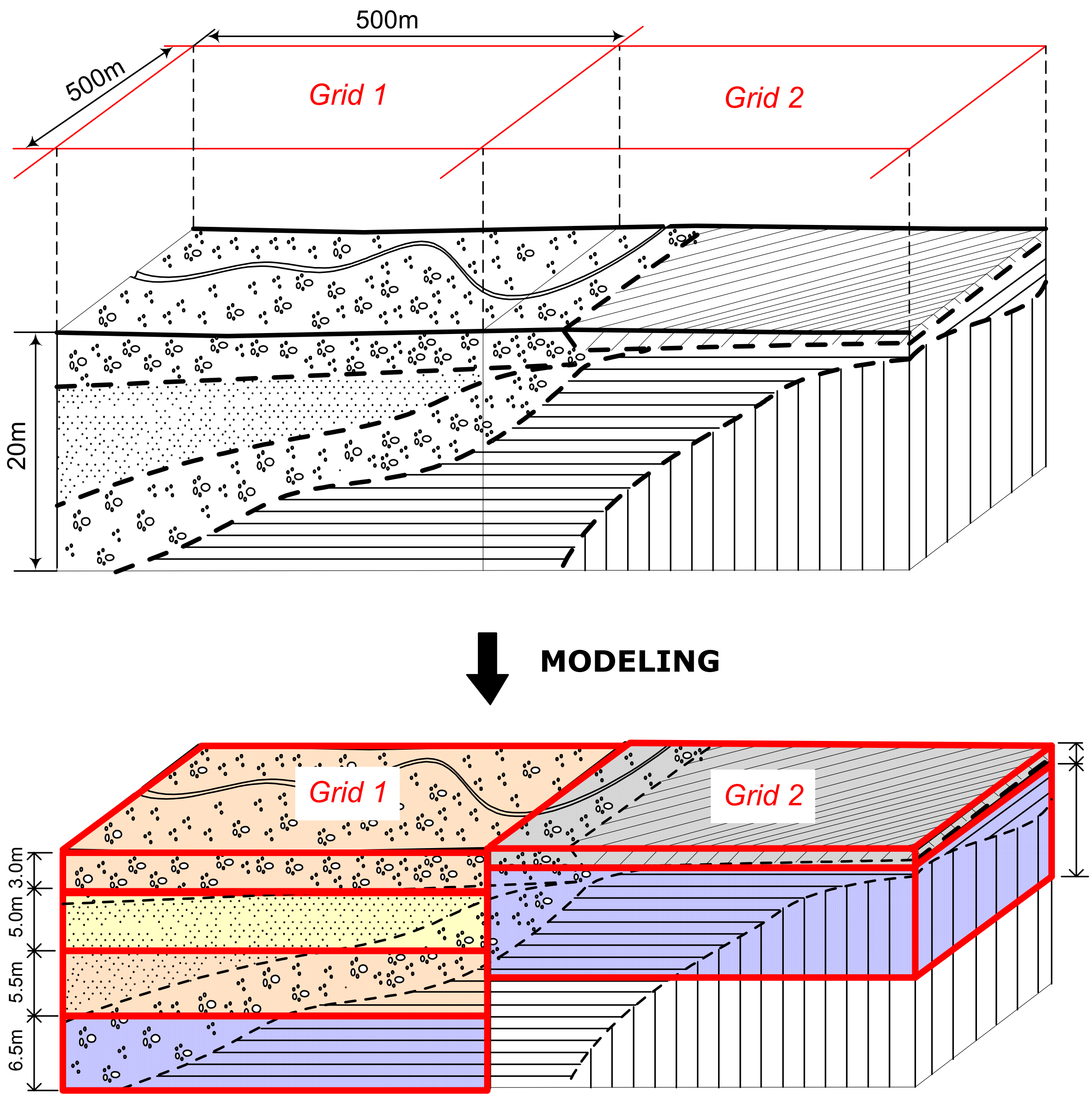
<example>

- When either of the man-mad ground or the Quaternary deposits are continuously distributed forming a 20 m or thicker layer, a soil layer from the surface down to 20 m in depth is modeled.
- When either of the man-made ground or the Quaternary Deposit are distributed in layers less than 20 m, the soil layer less than 20 m is modeled.

Figure 7.3.8 shows the 500 m grids in the area where the man-made ground and Quaternary Deposits prevail (1492 grids). Particularly, the specific places where the soil data are available and liquefaction study is carried out are framed with red lines (179 grids).

(5) Peak ground acceleration

The peak ground acceleration obtained from the result of the earthquake analysis is put into the calculation. The liquefaction studies are carried out for the two earthquake scenario cases, Model C and Model A.



Geology Model

Grid 1		Grid 2	
Soil	Thickness (m)	Soil	Thickness (m)
Qal Gravel	3.0	Man Made Ground	1.5
Qal Sand	5.0	Qal Clay	9.5
Qal Gravel	5.5	-	-
Qal Clay	6.5	-	-

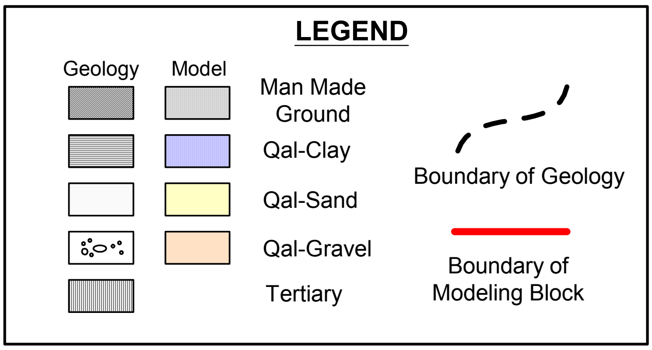


Figure 7.3.7 Schematic Chart of the Ground Model

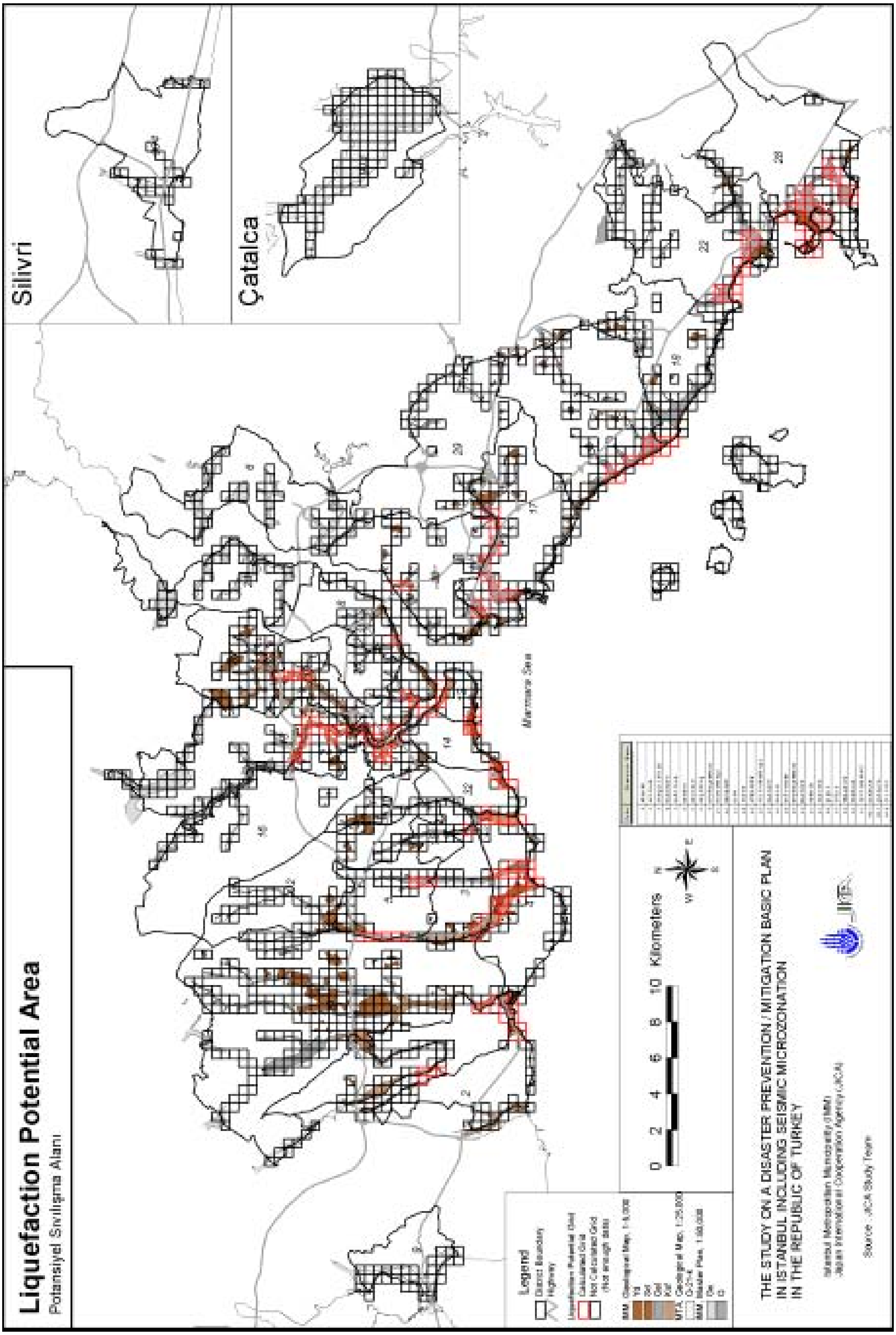


Figure 7.3.8 Liquefaction Potential Area

7.3.4. Liquefaction Potential

The results of the analysis for each grid are shown in the Supporting Report. These results are summarised in Table 7.3.4 and Figure 7.3.9 to Figure 7.3.10.

Table 7.3.4 Summary of the Liquefaction Analysis

Liquefaction Potential	Criterion	Explanation	No. of Grids	
			Model A	Model C
Very high	$15<P_L$	Ground improvement is indispensable	38	40
Relatively high	$5<P_L<15$	- Ground improvement is required - Investigation of important structures is indispensable	35	42
Relatively low	$0<P_L<5$	Investigation of important structures is required	36	28
Very low	$P_L=0$	No measure required	70	69
Unknown	-	No ground information exists	1,313	1,313

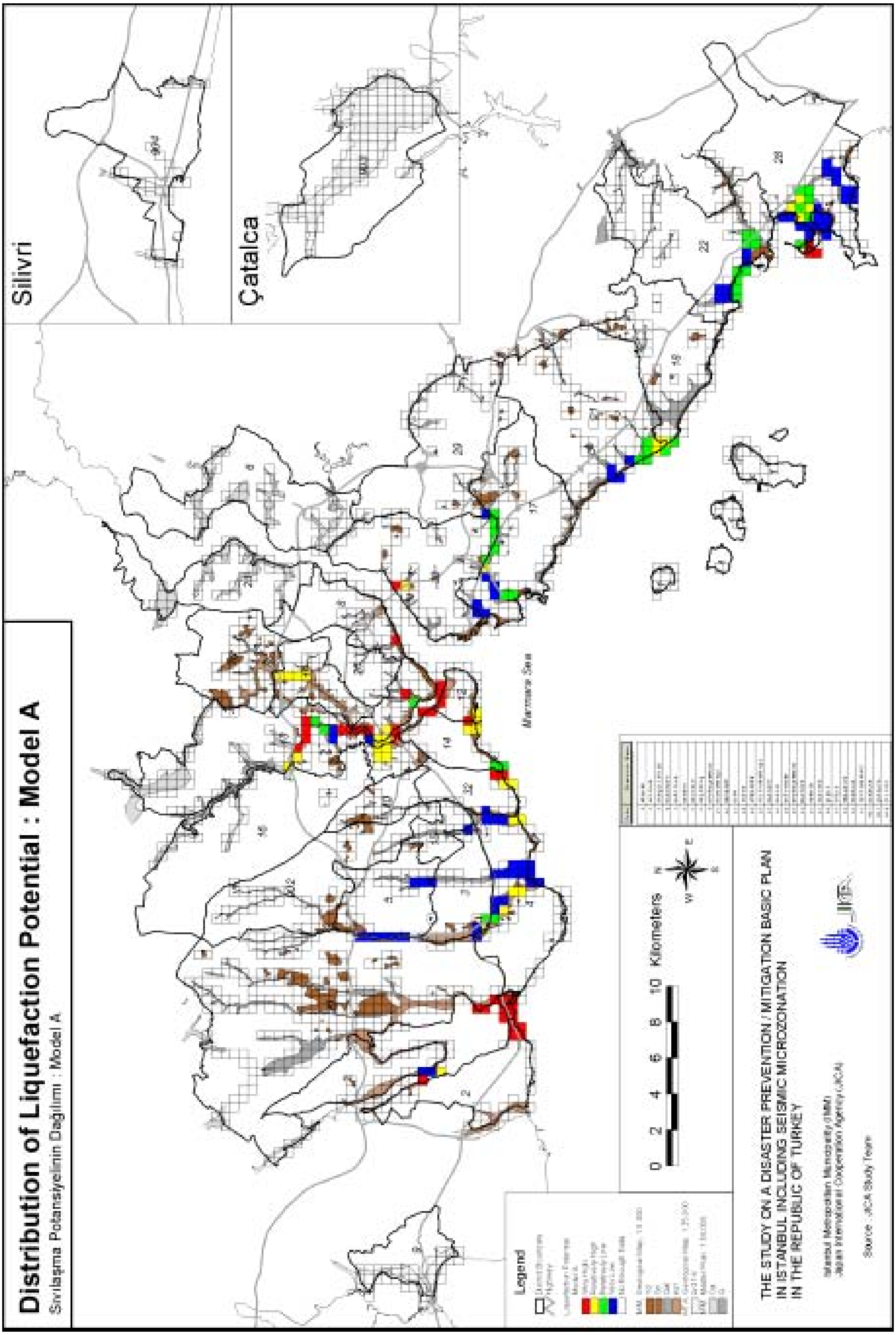


Figure 7.3.9 Distribution of Liquefaction Potential: Model A

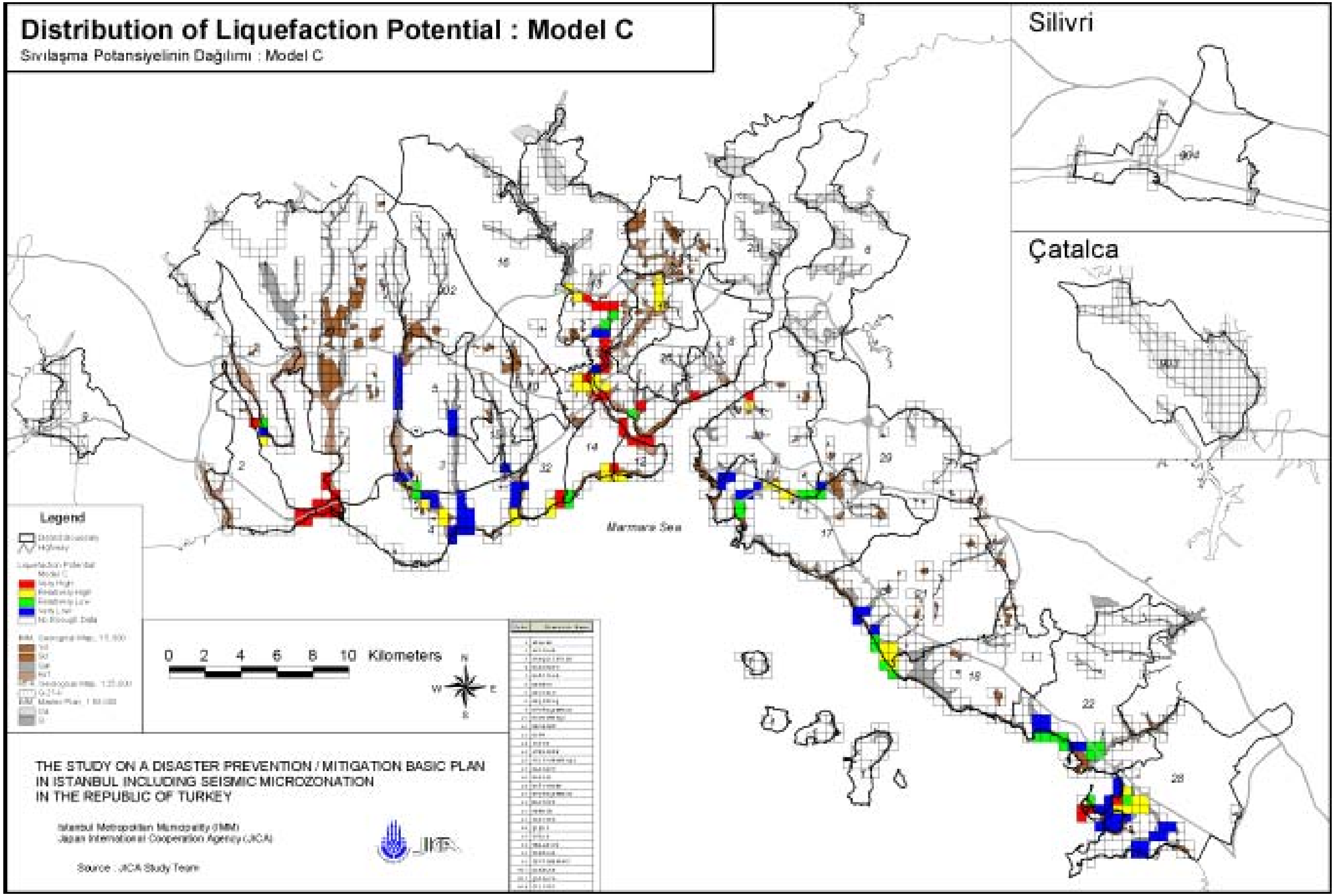


Figure 7.3.10 Distribution of Liquefaction Potential: Model C

The result for earthquake model C gives a little higher liquefaction potential than that of model A.

Liquefaction potential varies in different localities. Some areas have low liquefaction potential, while other areas have high liquefaction potential. These areas with high liquefaction potential are as follows:

(1) Area along swamp extending in NNE to SSW direction, in the west of Küçükçekmece Gölü

(2) Sandbar in the south of Küçükçekmece Gölü

(3) Coastal area close to the border between Zeytinburnu

(4) Coastal area close to the border between Fatih and Eminönü

(5) Coastal area of Haliç

(6) Swamp area in upstream of Haliç

(7) Area in the middle of swamp running down to Gazi Hasan Paşa Park in Beyoğlu

(8) Area around the Beşiktaş Harbor

(9) Area around coast in the north of Boğaziçi Bridge in Asian side

(10) Area close to the peninsula of Sakız Adası, Tuzla

Table 7.3.5 shows the general land-use in areas mentioned above.

Table 7.3.5 Land-use in Areas for High Liquefaction Potential

Area	General Characteristics of Land-Use
a	Swamp. No buildings exist.
b	Highway is running in the middle of sandbar. Low to middle storied commercial and residential buildings exist.
c	Mostly used as parks or open space. Few buildings. Located in urban planning zone.
d	Low to middle storied commercial and residential buildings exist densely.
e	Area along bay is used as harbor. Area between roads to harbor is used as park, and inland area is used mostly as commercial zone.
f	Lowland along river. Mostly used as park or green zone.
g	Mostly used as park or green zone. Many low storied residential buildings exist.
h	A harbor exists. Area between the roads to the sea is used as park, and inland area is used mostly as commercial zone.
i	Area is used as park and green zone.
j	Used as coastal industrial zone.

Source: The JICA Study Team

Table 7.3.6 and Figure 7.3.11 show liquefaction analysis results by districts. The area in the table was calculated reflecting the results by a 500 m grid in the shape of the geological ground.

- The ratio of the area examined in the liquefaction analysis for the liquefaction potential is 17%.
- The districts for which a liquefaction analysis was not conducted were Adaral, Büyükçekmece, Bayrampaşa, Saryer, Şişli, Esenler, Çatalca and Silivri.
- The districts whose area was evaluated "Very High" (Model C) and were greater than 40 ha were Küçükçekmece, Eyüp, Avcilar and Beyoğlu.

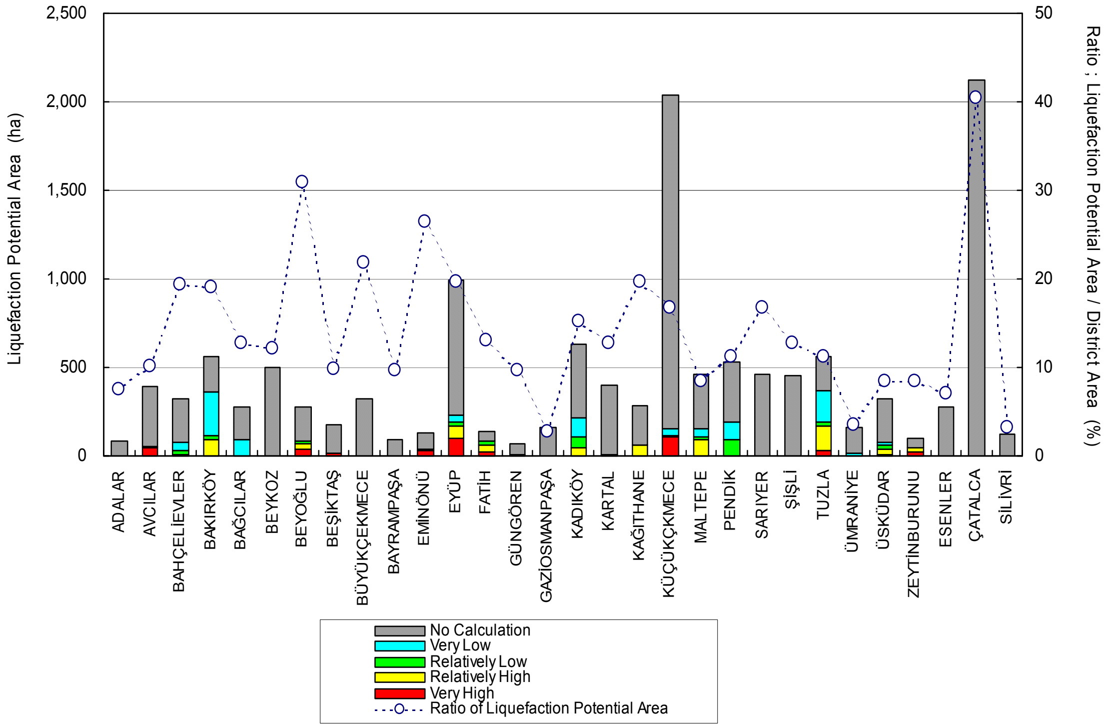


Figure 7.3.11 Liquefaction Analysis Results by Districts (Model C) and Ratio of Liquefaction Potential Area

The following are the necessary future efforts, derived from the results of the liquefaction evaluation:

- A detailed study should be carried out in order to perform a more precise evaluation for the areas with high liquefaction potential.
- Data collection and additional ground studies should be carried out to evaluate the area that is located on man-made land or on Alluvium ground, where an evaluation was not performed as part of this study.

- This study aims to identify areas with high liquefaction potential. Therefore, individual evaluations will be necessary for important facilities that are located on man-made land or on Alluvium ground.

Table 7.3.6 Liquefaction Analysis Results by Districts

Code	District	Man Made Ground and Quatenary Deposit (ha)	Liquefaction Potential Area (ha)										Calculation Area / Liquefaction Potential Area (%)
			Model A					Model C					
			Very High	Relatively High	Relatively Low	Very Low	No Calculation	Very High	Relatively High	Relatively Low	Very Low	No Calculation	
1	ADALAR	84	0	0	0	0	84	0	0	0	0	84	0
2	AVCILAR	390	45	0	0	11	334	45	0	7	4	334	14
3	BAHÇELİ EVLER	321	0	11	17	51	242	0	11	17	51	242	25
4	BAKIRKÖY	561	0	96	23	246	196	0	96	23	246	196	65
5	BAĞCILAR	280	0	0	0	91	189	0	0	0	91	189	32
6	BEYKOZ	503	0	0	0	0	503	0	0	0	0	503	0
7	BEYOĞLU	275	41	29	15	2	188	41	29	15	2	188	32
8	BEŞİ KTAŞ	179	18	0	0	0	160	18	0	0	0	160	10
9	BÜYÜKÇEKMECE	321	0	0	0	0	321	0	0	0	0	321	0
10	BAYRAMPAŞA	93	0	0	0	0	93	0	0	0	0	93	0
12	EMİ NÖNÜ	134	31	10	0	0	93	31	10	0	0	93	31
13	EYÜP	991	95	73	27	38	757	103	65	27	38	757	24
14	FATİ H	137	26	34	22	0	55	26	34	22	0	55	60
15	GÜNGÖREN	70	0	0	0	4	66	0	0	0	4	66	6
16	GAZİ OSMANPAŞA	161	0	3	0	0	158	0	3	0	0	158	2
17	KADIKÖY	631	0	15	95	104	418	0	48	62	104	418	34
18	KARTAL	402	0	4	3	0	395	0	4	3	0	395	2
19	KAĞITHANE	285	0	60	0	0	225	0	60	0	0	225	21
20	KÜÇÜKÇKMECE	2,041	108	7	0	39	1,886	108	7	0	39	1,886	8
21	MALTEPE	464	0	42	65	45	312	0	90	17	45	312	33
22	PENDİ K	534	0	0	94	98	341	0	0	94	98	341	36
23	SARIYER	465	0	0	0	0	465	0	0	0	0	465	0
26	Şİ ŞLİ	451	0	0	0	0	451	0	0	0	0	451	0
28	TUZLA	561	13	79	100	178	190	32	133	26	178	190	66
29	ÜMRANİ YE	160	0	0	1	11	148	0	0	1	11	148	7
30	ÜSKÜDAR	320	9	16	35	14	246	9	33	18	14	246	23
32	ZEYTİ NBURUNU	97	23	20	1	5	47	23	20	1	5	47	51
902	ESENLER	275	0	0	0	0	275	0	0	0	0	275	0
903	ÇATALCA	2,127	0	0	0	0	2,127	0	0	0	0	2,127	0
904	Sİ Lİ VRİ	125	0	0	0	0	125	0	0	0	0	125	0
Total		13,435	409	500	499	938	11,089	436	644	335	931	11,089	17