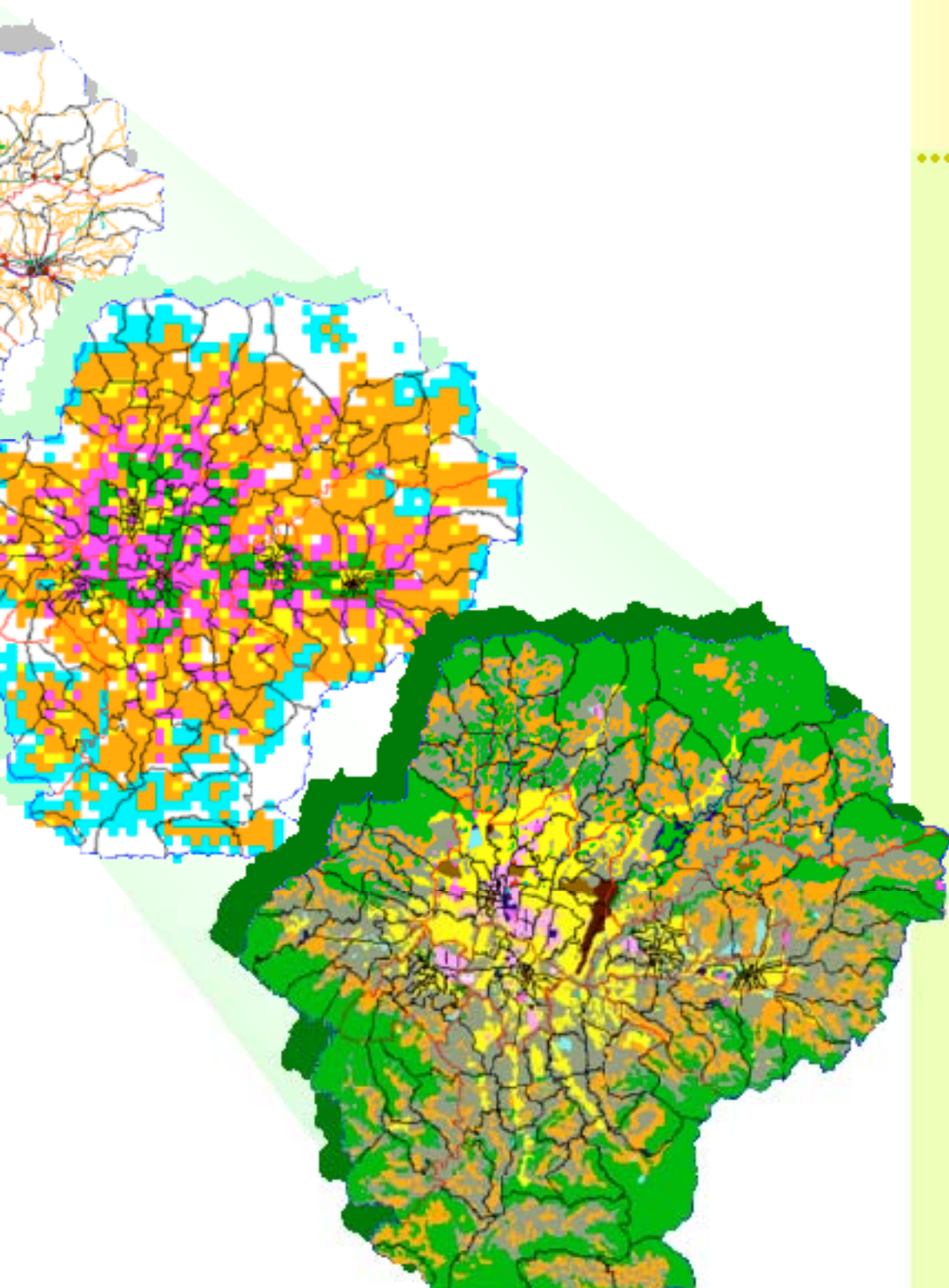


JICA Japan International Cooperation Agency (JICA)



Ministry of Home Affairs, HMG of Nepal



No.



The Study on Earthquake Disaster Mitigation

In the Kathmandu Valley
Kingdom of Nepal

Final Report

Vol. I II III IV V

MAIN REPORT (I)

**Blueprint for
Kathmandu Valley
Earthquake Disaster
Mitigation**

March, 2002

Nippon Koei Co., LTD.
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JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
MINISTRY OF HOME AFFAIRS, HIS MAJESTY'S GOVERNMENT OF NEPAL

**THE STUDY
ON
EARTHQUAKE DISASTER MITIGATION
IN
THE KATHMANDU VALLEY, KINGDOM OF NEPAL**

FINAL REPORT

VOLUME II

MAIN REPORT (1/2)

**BLUEPRINT
FOR
KATHMANDU VALLEY EARTHQUAKE DISASTER MITIGATION**

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Abbreviation

ACCL	Apla Consultant Co., Ltd.
AD	Adobe Structure
ADB	Asian Development Bank
AIGP	Additional Inspector General of Police
ATC	Applied Technology Council
BC	Brick with cement mortar
BDS	Bulk Distribution System
BJPY	Billion Japanese Yen
BM	Brick with mud mortar
BNRs	Billion Nepal Rupees
BOT	Build Operate and Transfer
BPC	Butwal Power Company
CBD	Central Business District
CBO	Community Based Organisation
CDOs	Chief District Officers
CDR	City Diagnostic Report
C(N)DRC	Central (Natural) Disaster Relief Committee
CNPS	Central Nepal Power System
D(N)DRC	District (Natural) Disaster Relief Committee
DHM	Department of Hydrology and Meteorology
DIG	Disaster Imagination Games
DMC	Disaster Management Committee
DMG	Department of Mines and Geology
DMO	Directorate of Military Operations
DNCMD	Department of Narcotics Control and Disaster Management
DOAD	Department of Agricultural Development
DOI	Department of Irrigation
DOL	Department of Labour
DOR	Department of Roads
DOSCE	Department of Soil Conservation
DPTC	Water Induced Disaster Prevention Technical Centre
DR	District Roads
DRCS	Digital Radio Concentrating System
DWIDP	Department of Water Induced Disaster Prevention
EC	European Community
ECB	Emergency Control Board
EMT	Emergency Medical Technician
EOC	Emergency Operation Center
FINNIDA	Finnish International Development Agency
FM	Frequency Modulation
FNCCI	Federation of Nepal Chamber of Commerce and Industry
FR	Feeder Roads
gal	(Earth Gravity: cm/sec/sec)
GDP	Gross Domestic Products
GIS	Geographic Information System
HF	High Frequency
HMG	His Majesty's Government
ICIMOD	International Centre for Integrated Mountain Development
IDA	International Development Association
IDNDR	International Decade for Natural Disaster Reduction
INGO	International Non-Government Organisation
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
KERMIT	Kathmandu Valley Earthquake Risk Mitigation Tool
KMC	Katmandu Metropolitan City
KUDP	Kathmandu Valley Urban Development Project

KV	Katmandu Valley
KVDMC	Katmandu Valley Disaster Management Council
KVMP	Katmandu Valley Mapping Plan
KVTDC	Katmandu Valley Town Development Council
LDC	Load Dispatching Centre
LDC	Least Developed Countries
L(N)DRC	Local (Natural) Disaster Relief Committee
LPS	Land Pooling Scheme
LSI	Large Scale Integrated Circuit
MARTS	Multiple Access Radio Transmission System
MCA	Multi-Channel Access
MHPP	Ministry of Agriculture
MHz	Mega Hertz
MJPY	Million Japanese Yen
MLD	Million Litre per Day
MMI	Modified Mercalli Intensity
MNRs	Million Nepal Rupees
MOA	Ministry of Agriculture
MOEC	Ministry of Education and Culture
MOF	Ministry of Finance
MOFA	Ministry of Foreign Affairs
MOFSC	Ministry of Forest and Soil Conservation
MOHA	Ministry of Home Affairs
MOHe	Ministry of Health
MOI	Ministry of Industry
MOIC	Ministry of Information and Communication
MOLD	Ministry of Local Development
MOLJ	Ministry of Law and Justice
MOPE	Ministry of Population & Environment
MOWR	Ministry of Water Resources
MPPW	Ministry of Physical Planning and Works
MWSDB	Melamchi Water Supply Development Board
NARL	Nepal Amateur Radio League
NASC	Nepal Administrative Staff College
NBC	National Building Code of Nepal
NCC	National Cadet Corps
NDF	Nonproliferation and Disarmament Fund
NDMC	National Disaster Management Council
NEA	Nepal Electricity Authority
NEA	Nepal Engineering Association
NEPECON	Nepal Engineering Consultancy Services Center Ltd.
NFC	Nepal Food Corporation
NGO	Non-Government Organisation
NGS	Nepal Geological Society
NH	National Highway
NORAD	North American Air Defence Command
NPC	National Planning Commission
NRCS	Nepal Red Cross Society
NSC	National Seismological Centre
NSET	National Society for Earthquake Technology
NTC	Nepal Telecommunication Cooperation
NWSC	Nepal Water Supply Corporation
ODA	Official Development Assistance
OPEC	Organization of Petroleum Exporting Countries
PGA	Peak Ground Acceleration
PIP	Priority Investment Plan
PSTN	Public Subscriber Telephone Network
RC	Reinforced Concrete

R(N)DRC	Regional (Natural) Disaster Relief Committee
RNA	Royal Nepal Army
RTSC	Relief and Treatment Sub-Committee
SDH	Synchronous Digital Hierarchy
SOP	Standard Operation Procedure
SSRSC	Supply, Shelter and Rehabilitation Sub-Committee
ST	Stone Structure
SWC	Social Welfare Council
TESU	Traffic Engineering and Safety Unit
TIA	Trivuban International Airport
TU	Tribhuvan University
UHF	Ultra High Frequency
UN	United Nations
UNDP	United Nations Development Program
UR	Urban Roads
USA	United States of America
USAID/OFDA	U.S. Assistance for International Development/Office of Foreign Disaster Assistance
UTM	Universal Transverse Mercator
VDC	Village Development Committees
VHF	Very High Frequency
V-SAT	Very Small Aperture Terminal
WECS	Water and Energy Commission Secretariat
WHO	World Health Organization
WIL	Wireless Loop

Conversion Factors

Length (1)

m	cm	yard	ft	inch
1	100	1.09361	3.28084	39.370
0.01	1	0.010936	0.032803	0.39370
0.91440	91.4400	1	3	36
0.30480	30.480	0.33333	1	12
0.02540	2.54000	0.02778	0.08333	1

Length (2)

km	nautical mile (nm)	yard	mile
1	0.5400	1093.61	0.62137
1.852	1	2026.67	1.1515
0.000914	-	1	-
1.60934	0.869	1760	1

Area (1)

m ²	cm ²	ft ²	in ²
1	10000	10.764	1550
0.09290	929.0	1	144.0
0.0001	1	0.001076	0.1550
0.0006452	6.4516	0.006944	1

Area (2)

ha	km ²	acre	mile ²
1	0.0100	2.471	0.00386
100	1	247.10	0.3861
0.4047	0.004047	1	0.001563
259	2.590	640	1

Volume

in ³	U.S. gallon	Imperial gallon	ft ³	m ³	acre-ft
1	0.00433	0.00361	5.79 x 10 ⁻⁴	1.64 x 10 ⁻⁵	1.33 x 10 ⁻⁸
231	1	0.833	0.134	0.00379	3.07 x 10 ⁻⁶
277	1.20	1	0.161	0.00455	3.68 x 10 ⁻⁶
1728	7.48	6.23	1	0.0283	2.30 x 10 ⁻⁵
61,000	264	220	35.3	1	8.11 x 10 ⁻⁴
7.53 x 10 ⁷	3.26 x 10 ⁵	2.71 x 10 ⁵	43,560	1230	1

Discharge

U.S. gallon/day (gpd)	ft ³ /day	U.S. gal/min	Imperial gpm	acre-ft/day	ft ³ /sec (cfs)	m ³ /sec
1	0.134	6.94 x 10 ⁻⁴	5.78 x 10 ⁻⁴	3.07 x 10 ⁻⁶	1.55 x 10 ⁻⁶	4.38 x 10 ⁻⁸
7.48	1	5.19 x 10 ⁻³	4.33 x 10 ⁻³	2.30 x 10 ⁻⁵	1.16 x 10 ⁻⁵	3.28 x 10 ⁻⁷
1440	193	1	0.833	4.42 x 10 ⁻³	2.23 x 10 ⁻³	6.31 x 10 ⁻⁵
1728	231	1.20	1	5.31 x 10 ⁻³	2.67 x 10 ⁻³	7.57 x 10 ⁻⁵
3.26 x 10 ⁵	43,560	226	188	1	0.504	0.0143
6.46 x 10 ⁵	86,400	449	374	1.98	1	0.0283
2.28 x 10 ⁷	3.05 x 10 ⁶	15,800	13,200	70.0	35.3	1

Weight

kg	t	oz	lb	short ton	long ton
1	0.001	35.27	2.2046	0.00110	9.8420×10^{-4}
1000	1	3.527×10^4	2204.6	1.1023	0.984
0.02835	2.835×10^{-5}	1	0.06250	3.125×10^{-5}	2.790×10^{-5}
0.4536	4.536×10^{-3}	16	1	0.0005	4.464×10^{-4}
907.2	0.9072	32.000×10^3	2.000×10^3	1	0.8529
1016	1.016	3.584×10^4	2.240×10^3	1.12	1

Velocity

m/sec	km/hr	ft/sec	mile/hr	kn
1	3.600	3.2808	2.237	1.9438
0.2778	1	0.9113	0.6214	0.5400
0.3048	1.0973	1	0.6818	0.5925
0.4470	1.6093	1.4667	1	0.8690
0.5144	1.8520	1.6878	1.1508	1

Density (c.g.s. Unit)

gr/cc	kg/m ³ =(gr/l)	gr/m ³	lb/ft ³	oz/ft ³
1	1×10^3	1×10^6	62.43	998.8
0.001	1	1×10^3	0.06243	0.9988
1×10^{-6}	1×10^{-3}	1	6.243×10^{-5}	9.988×10^{-4}
0.016018	16.018	1.6018×10^4	1	16
0.0010012	1.0012	1.0012×10^3	0.0625	1

Pressure

MPa =(N/mm ²)	Pa =(N/m ²)	bar	kgf/cm ²	atm	mmH ₂ O	mmHg
1	1×10^6	10	10.197	9.8692	1.0197×10^5	7500.617
1×10^{-6}	1	1×10^{-5}	1.0197×10^{-5}	9.8692×10^{-6}	0.1019716	7.5006×10^{-3}
0.1	1×10^5	1	1.019716	0.9869233	1.0197×10^4	750.0617
0.0980665	98066.5	0.980665	1	0.9678411	1×10^4	735.5593
0.101325	101325	1.01325	1.03323	1	1.0332×10^4	760
9.8067×10^{-6}	9.80665	9.806×10^{-5}	1×10^{-4}	9.6784×10^{-5}	1	7.3555×10^{-2}
1.3332×10^{-4}	133.3224	1.3332×10^{-3}	1.3595×10^{-3}	1.3158×10^{-3}	13.59510	1