Government of the People's Republic of Bangladesh

CONTINGENCY PLAN FOR EARTHQUAKE HAZARD
for Dhaka Water Supply & Sewerage Authority

Dhaka Water Supply & Sewerage Authority

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Contingency Plan for Earthquake Hazard

Under Comprehensive Disaster Management Programme (CDMP)
Ministry of Food and Disaster Management
Earthquake and Tsunami Preparedness
CDMP/EC/4a/PC-1

UNDP Bangladesh

DFID Department for International Development

CDMP Comprehensive Disaster Management Programme

Executive Summary

This Contingency Plan is developed by Dhaka Water Supply and Sewerage Authority (DWASA). Technical support for its preparation was provided by Asian Disaster preparedness Centre (ADPC) and National Society for Earthquake Technology-Nepal (NSET) as a part of **"Contingency planning with regards to Earthquake Hazards"** sub-component of Earthquake and Tsunami Preparedness Component of Comprehensive Disaster Management Programme (CDMP) under implementation by the Ministry of Food and Disaster Management (MoFDM), the Government of Bangladesh (GoB) with the support from the United Nations Development Programme (UNDP), UK Department for International Development – Bangladesh (DFID-B) and the European Commission (EC).

This plan is an outcome of a series of interactions, workshops and meetings conducted among the staff of DWASA as well as interagency workshops and meeting conducted during the process. It is risk based contingency plan based on the earthquake loss estimation recently conducted. Once the loss maps and the targeted scenario is changed, some modifications in terms of human resources, materials and cost needs modification accordingly.

Two main objectives of this Contingency Plan are to:

- Provide emergency water and sanitation facilities to the evacuated people in immediate shelter area and
- Quick restoration of potable water supply and waste water system after an earthquake

The specific objectives are:

- To identify the scope of immediate response and early recovery of different facilities in potable water and sewerage system
- Identify required capacity of the organization to meet the demand
- Priorities different facilities for earthquake risk reduction considering their importance and cost effectiveness
- Priorities different facilities for early recovery
- Prepare Operating Procedure Guideline
- Prepare Readiness Checklist for better preparedness

The total number of displaced population needing shelter has been estimated at around 870,000 within the Dhaka city during scenario earthquake. This is estimated as 50% of the displaced people need immediate shelter after the earthquake and the remaining 50% will manage their shelter in their relatives and other places. Open spaces within the city corporation area that are more than 2500 square meters (Area with capacity for sheltering 500 families or more) are mapped and their shelter capacities are calculated. The total open spaces within the Dhaka city have only about ¼ capacity of the total population needing shelter.

The population evacuated in immediate shelter requires about 3800 cubic meters of emergency water with the rate of 15 liters per capita per day. Total population needing Evacuation Shelter is about 870,000 so the immediate shelter needing population exceeded the open space capacity within Dhaka City Corporation area is 616822 and need to be provided with immediate shelter in the shelter camps near to City Corporation. The population who are taken outside require about 9,250 cubic meters of water per day. So the total emergency water needed in the emergency shelters is about 13,000 cubic meters per day.

Pre-positioning of this amount of the water at the above planned spaces is before earthquake is the most appropriate way to provide immediate emergency water.

To manage toilets in the immediate shelters spaces is the main challenge related to sanitation. Sphere standard demand one toilet for each 20 people in the emergency shelter. The calculation shows that about 12,700 toilets are needed in the open spaces within Dhaka City and additional 30,700 toilets need to plan for the people of Dhaka who need immediate shelter outside Dhaka city.

The total number of skilled/trained workers required for repairing the Potable water and Waste water system within Dhaka city corporation area after an earthquake is about 1800 people per day to repair the system within 7 days. If it is planned to repair in 14 days, it require about 900 skilled workers per day and require about 420 people working per day to repair the system in 30 days time.

Skilled workers required to repair overhead water tank and waste water treatment plant is not calculated here, as it require thousands of skilled workers if planned to repair within a month, which is practically not possible even if planned. It requires 3-6 months to repair the overhead tanks and treatment plant, even if the required manpower is available. The total estimated cost require for repairs is about 27 Million US Dollars. It is assumed that the repair cost for the waste water treatment plant, probability of which to be functional after the earthquake is 40-50% has been assumed that 25% of the replacement cost. Priorities for recovery of different components within the system are also made in this plan.

Legal provisions and organizational set up, functional response roles and responsibilities assigned for the agency, operating procedures guideline and readiness checklists are also outlined in this plan.

List of Abbreviations

ADB	Asian Development Bank
AFD	Armed Forces Division
AMI	Anjumane Mofidul Islam Bangladesh
Ansar & VDP	Bangladesh Ansar and Village Defence Party
BA	Biman Airlines
BDR	Bangladesh Rifles
BCAA	Bangladesh Civil Aviation Authority
BCG	Bangladesh Coast Guard
BDRCS	Bangladesh Red Crescent Society
BFRI	Bangladesh Forest Research Institute
BGSL	Bakhrabad Gas Systems Limited
BGMEA	Bangladesh Garment Manufacturers and Exporters Association
BIP	Bangladesh Institute of Planners
BIWTA	Bangladesh Inland Water Transport Authority
BKMEA	Bangladesh Knitwear Manufacturer and Exporters Association
BLRI	Bangladesh Livestock Research Institute
BMA	Bangladesh Medical Association
BMD	Bangladesh Meteorological Department
BP	Bangladesh Police
BPDB	Bangladesh Power Development Board
BR	Bangladesh Railway
BRTA	Bangladesh Road and Transport Authority
BRTC	Bangladesh Road and Transport Corporation
BSS	Bangladesh Sangbad Sangstha
BTMEA	Bangladesh Textile Mills Association
BTCL	Bangladesh Telecommunication Company
BTRC	Bangladesh Telecommunication Regulatory Commission
BTV	Bangladesh Television
BUET	Bangladesh University of Engineering & Technology
BWDB	Bangladesh Water Development Board
CAAB	Civil Aviation Authority Bangladesh
CBOs	Community-Based Organizations
CC	City Corporations
CCP	Bangladesh Centre for Communication Programs
CDA	Chittagong Development Authority
CDC	Communicable disease Control
CME	Centre for Medical Education
CMMU	Construction, Maintenance and Management Unit
CPA	Chittagong Port Authority
CPP	Cyclone Preparedness Programme
CWASA	Chittagong Water Supply and Sewerage Authority
DCC	Dhaka City Corporation
DESA	Dhaka Electricity Supply Authority
DESCO	Dhaka Electric Supply Company Ltd.
DFP	Department of Films and Publications
DG Fisheries	Directorate of Fisheries
DGoF	Directorate General of Food
DG Livestock	Directorate of Livestock
DGHS	Directorate General of Health Services
DMB	Disaster Management Bureau

DMC	Department of Mass Communication
DOA	Department of Architecture
DPHE	Bangladesh Department of Public Health Engineering
DRR	Directorate of Relief and Rehabilitation
DWASA	Dhaka Water Supply and Sewerage Authority
EMS	Earthquake Magnitude Scale
FAO	Food and Agricultural Organization
FBCCI	Federation of Bangladesh Chambers of Commerce
FSCD	Bangladesh Fire Service & Civil Defence
IAB	Institute of Architects Bangladesh
IFRC	International Federation of Red Cross and Red Crescent Societies
IOM	International Organization for Migration
IRC	International Rescue Committee
JICA	Japan International Cooperation Agency
GSB	Geological Survey of Bangladesh
HBRI	Housing & Building Research Institute
IAB	Institute of Architects Bangladesh
IEB	Institute of Engineers Bangladesh
IFRC	International Federation of Red Cross and Red Crescent
INGOs	International Non-Government Organizations
JGTDSL	Jalalabad Gas Transmission & Distribution Co. Limited
LGA	Local Government Agencies
LGD	Local Government Division
LGED	Local Government Engineering Department
LGRD	Local Government and Rural Development
LGRDC	Local Government Rural Development and Cooperatives
MinCom	Ministry of Commerce
MoC	Ministry of Communications
MoCAT	Ministry of Civil Aviation and Tourism
MoF	Ministry of Finance
MoFDM	Ministry of Food and Disaster Management
MoFL	Ministry of Fisheries and Livestock
MoHA	Ministry of Home Affairs
MoHFW	Ministry of Health and Family Welfare
MoHPW	Ministry of Housing and Public Works
MoI	Ministry of Information
MoL	Ministry of Land
NGOs	Non-Government Organizations
NHA	National Housing Authority
NIPSOM	National Institute of Preventive and Social Medicine
OHCHR	Office of the High Commissioner for Human Rights
PDB	Power Development Board
PetroBangla	It is a successor of Bangladesh Mineral Oil and Gas Corporation
PGCL	Power Grid Company of Bangladesh Ltd
PIB	Press Institute of Bangladesh
PID	Press Information Department
PSTN	Public switched telephone Network
PWD	Public Works Department
R&H	Roads and Highways
RAB	Rapid Action Battalion
REB	Rural Electrification Board
RAJUK	Rajdhani Unnyan Kortipakha
REHAB	Real Estate & Housing Association of Bangladesh
RHD	Roads and Highways Department

TGTDCL	Titas Gas Transmission and Distribution Co. Ltd
SoB	Survey of Bangladesh
UNDP	United Nations Development Programme
UN HABITAT	United Nations agency for human settlements
UNHCR	UN High Commissioner for Refugees
UNICEF	United Nations Children's Fund
UNRC	Resident Coordinator of United Nations
UNOCHA	United Nations Office for the Coordination of Humanitarian Affairs
VDP	Village Defence Party
WFP	World Food Programme
WHO (DERG)	World Health Organization (Disaster Emergency Response Group)

Introduction

1.1 Creation of the Plan

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1.2 Objectives of the Plan

Two main objectives of this contingency plan are to:

- Provide emergency water and sanitation facilities to the evacuated people in immediate shelter area and
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The specific objectives are:

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- Prepare Operating Procedure Guideline
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1.3 Planning Assumptions

This contingency plan has been developed with following assumptions in the background:

- The existing water and sanitation system of the Dhaka city will be partially functional

- DWASA offices and staff will start working for providing services to the people just after the earthquake
- Capacity of the systems after the earthquake will not be sufficient after the earthquake and need extra preparations beforehand
- Large numbers of persons (hundreds of thousands) will be in need of water and sanitation including other facilities
- Access will be severely restricted due to debris, landslides, collapsed bridges etc.

1.4 Intended Users of the Plan

The direct users of this Earthquake contingency plan will be the management personnel of Dhaka Water Supply & Sewerage Authority in order to provide water and sanitation to the people of Dhaka city during immediate response and early recovery phase after an earthquake. The plan also covers the preparedness actions before earthquake for effective response afterwards.

In addition to DWASA, the others such as line Ministries, Departments, City Authorities, NGOs/ INGOs, electronic and paper Media, Community based Organizations (CBOs), Civil Society Organizations (CSOs), Academia; Development Partners will be the passive users of the plan as they will be providing support services for plan implementation with regard to emergency services. The ultimate beneficiaries would be the communities at risk to bring normalcy within a fastest possible time.

1.5 Plan Implementation Strategies by the Agency

The following strategies are to be adopted in plan implementation:

- Setting up a strong organizational framework to identify and assess earthquake hazards, analyze vulnerability , assess risk and loss estimation with regards to water supply & Sewerage;
- Plan & development of institutional capabilities to translate earthquake risk reduction into Preparedness and Response Plans;
- Establish a consistent, participatory approach to the management of earthquake emergency responses;
- Undertake training and education programs on all phases of Disaster Management for all levels to build the capacity of professionals;
- Develop a mechanism to improve the relationships with non-government organizations to address mitigation, preparedness, response and recovery phase effectively;
- Transfer knowledge and state of the art of technologies necessary to support institutional operations and implement operation plans;

1.6 Plan Limitations

Following limitations are noted when this plan is drafted:

- This plan do not address all aspects of earthquake risk management (e.g. long-term recovery plans)
- The Plan assumes that the line agencies will have Mandatory provisions and national capacity to deal with assigned tasks. Mandatory provisions for line agencies, ministries, and local governments. District authorities can be granted through a gazette notification but Lines of authority need to be finalized and communicated to all levels.
- DWASA may need additional resources in terms of qualified manpower, technical as well as financial resources to undertake assigned tasks under the Earthquake Contingency Plan.
- The Earthquake Contingency Management process will take some time to become fully functional as an integrated system.
- The plan is based on earthquake loss estimation results obtained during the preparation of this plan and need verification when the final scenario is prepared
- The seismic assessment of the different components of the system are done as a part of the city risk assessment and require detail assessment for earthquake risk reduction planning

Earthquake Hazard, Vulnerability and Risk Assessment of Water and Sanitation System for Contingency planning

Earthquake risk assessment of the water and sanitation system was carried out under earthquake hazard, vulnerability and risk assessment component of CDMP project is taken as the base for the Contingency planning purpose. The loss estimation depends on the vulnerability assessment of the system as well as the expected hazards. As the study on hazard and vulnerability studies are still in the phase of revisions, the loss estimation team may arrive to new conclusions on total loss estimations.

This plan has used the loss estimation results that were available when the plan was created and subjects to revision when the new loss estimation is available.

The vulnerability and loss estimation results on water and sanitation system available from the earthquake hazard, vulnerability and risk assessment component for the Contingency planning is given in Section 2.1 and Section 2.2 of this chapter.

2.1 Earthquakes Hazard Assessment

2.1.1 Earthquakes Hazard in Bangladesh

The combination of high disaster events as well as increasing human vulnerability resulting from demographic pressure, poverty, social inequality and coupled with the apprehended climate change indicate that Bangladesh is, currently, at high risk to large scale disasters with consequent impact on shelter, food, health and survival. Bangladesh is also susceptible to damaging earthquakes. It is a fact that during the recent past no major earthquake has occurred in Bangladesh or within its neighborhood but records indicates that during the past few hundred years there have been several significant earthquakes recorded within Bangladesh. Reliable historical data for seismic activity affecting Bangladesh is available only for the last 450 years (Gupta et. al. 1986).

Recently developed earthquake catalogue for Bangladesh and surrounding areas (Sharfuddin, 2001) shows 1200 earthquakes with a magnitude (Ms) of 4.0 have occurred between 1885 and 1995, within a 200 km radius of Bangladesh.

Site dependent seismic motion and damage, caused by specific soil conditions and other characteristics is an important characteristic in seismic hazard assessment. It can provide inputs to Micro-zonation studies as well as to determine the overall seismic risk in the built environment. This facilitates the preparation of the earthquake emergency plans and also to improve the preparedness and mitigation of earthquake and tsunami risk with a view to strengthen the capacity of the city dwellers of major cities to face, manage the emergencies and reduce the impact and economic losses through better preparedness measures undertaken as a long term measure.

The earthquake risk of the urban centre grows with every passing moment because of the unabated growth of human settlement and industrial and other economic activities. Disastrous effects of earthquakes in high density areas even far from the epicentral tracts can be quantified now through scenario based studies, and it opens up the opportunity to create knowledge products for large urban areas like Dhaka, Chittagong and other urban centre.

Figure 2.1 gives the main fault system in and around Bangladesh that can have severe in Bangladesh.

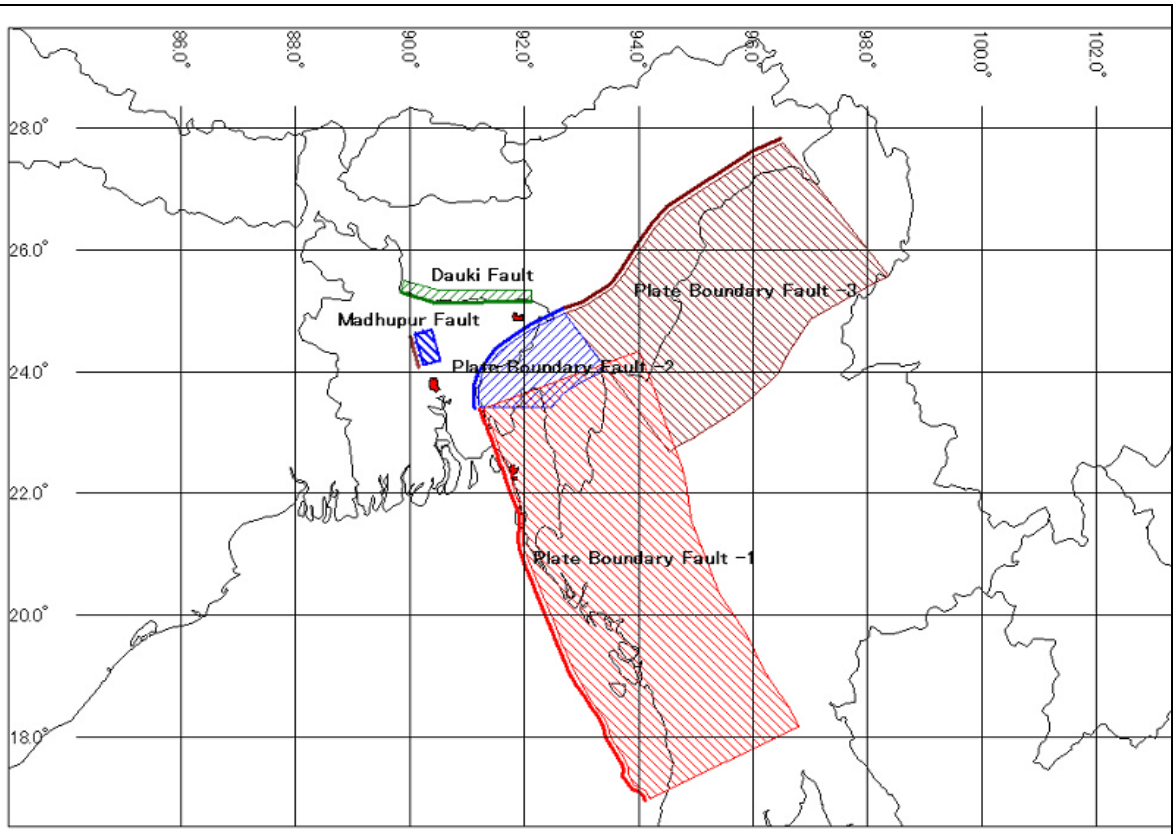


Figure 1: *Earthquake Fault Zones in and around Bangladesh*

Different parameters of the fault systems are given in Table 2-1.

Table 2.1 Fault Parameters for Empirical Attenuation Analysis

Fault	***Mw***	***Depth to top of fault (km)***	***Dip (degree)***	***Down-dip rupture width (km)***	***Fault Type***
Madhupur Fault (MF)	7.5	10	45	42	Reverse
Dauki Fault (DF)	8.0	3	60	43	Reverse
Plate Boundary Fault -1 (PBF-1)	8.5	3	20/30	337	Reverse
Plate Boundary Fault -2 (PBF-2)	8.0	3	20	137	Reverse
Plate Boundary Fault -3 (PBF-3)	8.3	3	20/30	337	Reverse

2.1.2 Earthquake Hazard in Dhaka City

The ADPC and partners hazard assessment team under the CDMP project studied the seismic hazard of three cities, Dhaka, Chittagong and Sylhet. In case of Dhaka, the PGA, PGV and Sa (h=5%, T=0.3 and 1.0 sec) at ground surface were calculated for five scenario earthquakes. In this analysis, the effects of non linearity of soils were considered.

The most important earthquake is Madhipur Fault and the PGA in Dhaka is 220 to 410 gal. Figure 2-2 shows the PGA distribution map and Figure 2-3 gives the Liquefaction susceptibility map.

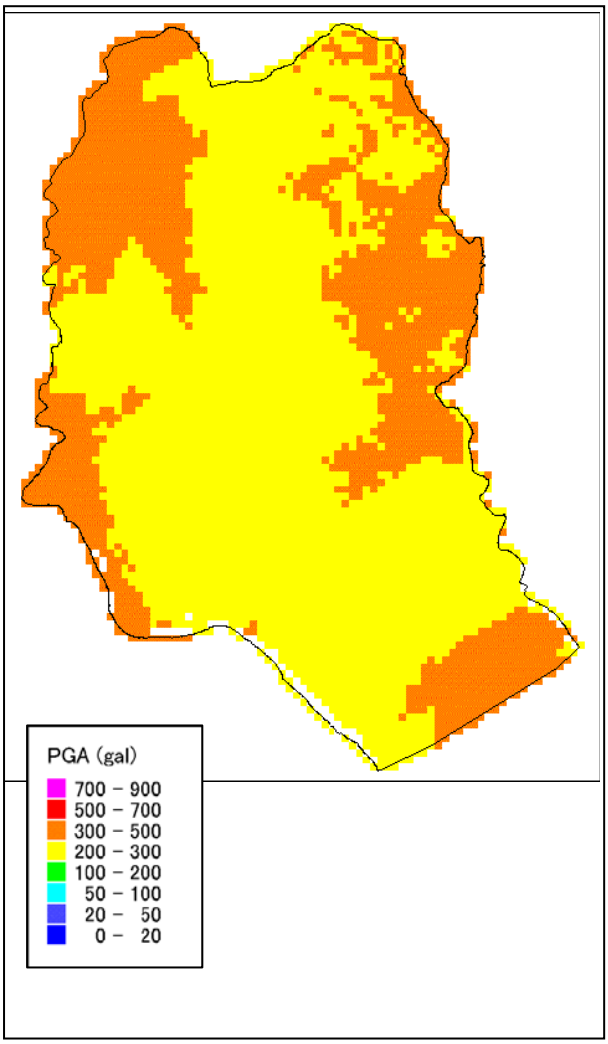


Figure 2.2 PGA map of Dhaka city

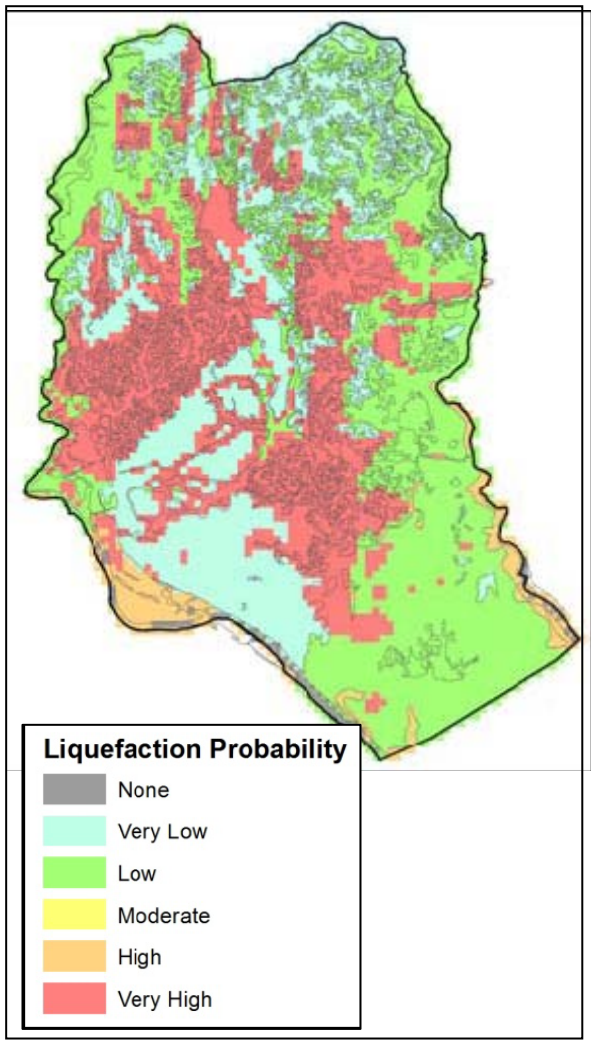


Figure 2.3 Liquefaction Susceptibility Map of Dhaka City

2.2 Vulnerability Assessment of Water and Sanitation system

2.2.1 Vulnerability Assessment of Potable Water System

Vulnerability is assessed from the characteristics of potable water pipeline and distribution facilities that make them susceptible to the damaging effect of an earthquake. In potable water system, vulnerability is identified from the pipe ductility type, distribution facility type, and soil liquefaction susceptibility on which the pipe and facility lie on. From the field survey, it is found that most of distribution facilities are not prepared with the seismic design, proper anchorage, and backup power system. Based on material type, the pipe is classified into brittle (PWP1) and ductile (PWP2). Brittle pipe material includes asbestos cement (AC), cast iron (CI), and reinforced concrete (RCC), while ductile pipe material includes galvanized iron (GI), ductile iron (DI), mild steel (MS), PVC, and steel. Brittle pipe is more vulnerable than ductile one. Potable water facility include well, pumping plant, above ground tank, and water treatment plant. Pipeline as well as distribution facilities located on higher liquefaction susceptibility soil is more vulnerable than those on lower or none liquefaction susceptibility. The following tables shows the pipeline length and number of facilities in different liquefaction susceptibility soils, as well as spatial distribution of potable water system components in every ward of Dhaka City corporation areas.

Table 2.1Potable Water Pipe Length and Number of Facilities on Soil Liquefaction Susceptibility in Dhaka City Corporation Area

Component	Liquefaction Susceptibility (length in km or number of facility)						Total
	None	Very Low	Low	Moderate	High	Very High	
Pipeline							
Brittle Pipe	*0.00*	*10.80*	*0.00*	*0.39*	*0.00*	*6.61*	*17.80*
Ductile Pipe	*0.00*	*629.43*	*4.95*	*96.35*	*9.05*	*807.52*	*1547.30*
Total Length	*0.00*	*640.24*	*4.95*	*96.74*	*9.05*	*814.13*	*1565.10*
Facility							
Well	*0*	*154*	*0*	*21*	*3*	*190*	*368*
Pumping Plant	*0*	*137*	*0*	*21*	*3*	*181*	*342*
Above Ground Tank	*0*	*24*	*2*	*0*	*0*	*10*	*36*
Water Treatment Plant	*0*	*0*	*0*	*0*	*1*	*1*	*1*
Total Number	*0*	*315*	*2*	*42*	*7*	*382*	*748*

Table 2.2 Spatial Distribution of Potable Water System Components in Each Ward of Dhaka City Corporation Area

City Corporation Ward	Pipeline			Distribution Facilities				
	Brittle Pipe (km)	Ductile Pipe (km)	Total Length (km)	Well	Above Ground Tank	Pumping Plant	Water Treatment Plant	Total (number)
1	*3.422*	*62.88*	*66.302*	*9*		*3*		*12*
2		*36.413*	*36.413*	*6*	*2*	*6*		*14*
3		*29.456*	*29.456*	*8*	*1*	*8*		*17*
4		*10.528*	*10.528*	*1*		*1*		*2*

City Corporation Ward	Pipeline			Distribution Facilities				
	Brittle Pipe (km)	Ductile Pipe (km)	Total Length (km)	Well	Above Ground Tank	Pumping Plant	Water Treatment Plant	Total (number)
5		31.371	31.371	5		5		10
6	1.147	56.695	57.842	11	2	11		24
7		23.19	23.19	5		5		10
8		18.446	18.446	5		5		10
9		7.977	7.977	2		2		4
10	0.282	19.603	19.885	2		2		4
11		12.608	12.608	3	1	3		7
12		16.406	16.406	1		1		2
13		39.91	39.91	11		12		23
14		24.911	24.911	8		8		16
15		17.382	17.382	6	1	5		12
16		22.501	22.501	5		5		10
17		42.531	42.531	8		8		16
18		21.46	21.46	3		3		6
19		65.737	65.737	8	3	8		19
20		24.199	24.199	4	3	4		11
21		27.694	27.694	2		2		4
22		24.115	24.115	4		4		8
23		13.309	13.309	4		4		8
24		20.202	20.202	3		3		6
25		22.935	22.935	4		4		8
26		18.091	18.091	2		2		4
27		16.988	16.988	5		4		9
28		13.103	13.103	3		3		6
29		12.68	12.68	3		3		6
30		9.64	9.64	1		1		2
31		8.902	8.902	1	1			2
32		17.429	17.429	9	1	7		17
33		4.339	4.339	2		2		4
34		12.767	12.767	3	1	3		7
35		8.085	8.085	1		1		2
36		22.732	22.732	6	2	5		13
37		31.344	31.344	9	2	9		20
38		14.309	14.309	5		4		9
39	0.897	17.73	18.627	5		5		10
40	4.915	29.511	34.426	8		8		16
41		6.23	6.23	2		2		4
42	0.674	17.986	18.66	5		5		10
43	0.582	21.02	21.602	6		6		12
44	0.81	19.403	20.213	5	1	4		10
45	1.067	24.299	25.366	6		6		12
46	0.725	23.263	23.988	5		5		10
47	0.03	11.299	11.329	5		5		10
48		18.591	18.591	5		4		9
49	2.085	41.585	43.67	7		7		14
50	0.62	17.197	17.817	4		4		8
51	0.277	14.177	14.454	5	2	4		11

City Corporation Ward	Pipeline			Distribution Facilities				
	Brittle Pipe (km)	Ductile Pipe (km)	Total Length (km)	Well	Above Ground Tank	Pumping Plant	Water Treatment Plant	Total (number)
52	0.266	16.473	16.739	6		6		12
53		30.238	30.238	12	1	11		24
54		14.33	14.33	5		5		10
55		9.579	9.579	5		5		10
56		19.362	19.362	6	1	6		13
57		8.577	8.577	2	5	1		8
58		9.942	9.942	3	1	3		7
59		8.816	8.816	3		3		6
60		6.921	6.921	1		1		2
61		6.617	6.617	1	1	1		3
62		15.634	15.634	2		2		4
63		7.696	7.696	4		2		6
64		5.116	5.116	1				1
65		9.126	9.126	5		4		9
66		7.913	7.913	4		4		8
67		5.187	5.187	3		3		6
68		6.179	6.179	2		1		3
69		5.704	5.704	2		2		4
70		3.914	3.914	2	1	2		5
71		6.901	6.901	1		1		2
72		4.489	4.489	1		1		2
73		6.539	6.539	2		1		3
74		11.416	11.416	2		2		4
75		14.112	14.112	1		1		2
76		9.753	9.753	4		4		8
77		7.917	7.917	2				2
78		8.386	8.386	2	1	2		5
79		9.929	9.929	3		3		6
80		1.229	1.229					
81		7.154	7.154	7	2	6		15
82		7.128	7.128	1		1		2
83		5.871	5.871	3		3		6
84		15.621	15.621	5		5		10
85		12.945	12.945	4		4	1	9
86		11.136	11.136	3		2		5
87		10.691	10.691	2		2		4
88		6.052	6.052	1		1		2
89		9.819	9.819	2		2		4
90		4.167	4.167	1		1		2
91		23.167	23.167	6		7		13
Total	17.799	1,536.905	1,554.704	368	36	342	1	747

2.2.2 Vulnerability Assessment of Waste Water System

Waste Water System only exists in some parts of Dhaka City Corporation area. Vulnerability is assessed from the characteristics of waste water pipeline and waste water facilities that make them susceptible to the damaging effect of an earthquake.

In waste water system, vulnerability is identified from the pipe ductility, facility type, and soil liquefaction susceptibility on which the pipes and facilities lie on. At the moment of data acquisition (in DWASA), there is no information on pipe material type. From the field survey, it can be identified that almost all pipeline are brittle. Waste water system facilities comprise waste water treatment plant (WWTP) and lift station. In Dhaka, WWTP is located outside the city corporation area, while existing lift station is considered to be small lift station (WLSS).

Pipeline and facilities located on higher liquefaction susceptibility soil is more vulnerable than those on lower or none liquefaction susceptibility. The following tables show the pipeline length and number of facilities in different liquefaction susceptibility soils and spatial distribution of waste water components in Dhaka City Corporation Area.

Table 2.3 Waste Water Pipe Length and Number of Facilities on Soil Liquefaction susceptibility in Dhaka Corporation Area

Component	Liquefaction Susceptibility (length in km or number of facility)						Total
	None	Very Low	Low	Moderate	High	Very High	
Pipeline							
Brittle Pipe	*0.00*	*214.99*	*2.50*	*10.83*	*0.27*	*172.74*	*401.33*
Total	*0.00*	*214.99*	*2.50*	*10.83*	*0.27*	*172.74*	*401.33*
Facility							
Lift Station	*0*	*4*	*1*	*0*	*0*	*8*	*13*
Total	*0*	*4*	*1*	*0*	*0*	*8*	*13*

Table 2.4 Spatial Distribution of Waste Water System Components in Different Wards of Dhaka City Corporation Area

Ward	Ductile Pipe (km)	Sewer Lift Station
2	*31.31*	*1*
3		*1*
16	*1.07*	
18	*0.22*	
19	*58.98*	
22	*9.04*	
23	*7.86*	
24	*14.32*	
25	*7.49*	*1*
26	*0.87*	
27	*6.75*	*2*
28	*2.71*	
32		*1*
45		*1*
55		*1*
58		*1*
76		*1*
80		*1*
82		*1*
84		*1*

Total	*140.60*	*13*

2.2 Earthquake Risk Assessment of Water Supply and Sanitation System

Table 2-5 and Table 2-6 provide information on the damage to three major utility lifeline systems. The estimated damage to the pipelines shows that there will be about 350 leaks and breakages to the potable water pipeline system and about 470 breaks for waste water lines. Most of the overhead tanks for potable water supply and lift stations of the waste water system may undergo out of function. Among 36 overhead tanks, 21 have the chances of less than 40% to be functional after the earthquake and remaining 15 has the chance of 40-60% being functional. Similarly, out of 13 lift stations in the waste water system, 10 have less than 40% of chance being functional.

Table 2.5 Calculated Potable Water Supply Pipeline Damage in Dhaka City Corporation Area

Component	**Total Length (km)**	**Total Losses (thou $)**	**Total leaks and breakages requiring Repairs**	**Remark**
Pipeline	1120	1,612	350	

Table 2-6 Calculated Waste Water Pipeline Damage in Dhaka City Corporation Area

Component	**Total Length (km)**	**Total Losses (thou $)**	**Total leaks and breakages requiring Repairs**	**Remark**
Pipeline	396	3,175	466	

Table 2.7 Calculated Potable Water System Facility Damage in Dhaka City Corporation Area

Component	**Total Number**	**Functionality Probability at Day 1**			**Total Losses (thou $)**	**Remark**
		More than 60%	**40%-60%**	**Less than 40%**		
Over Head Tank	36	0	15	21	846	
Pump	342	2	334	6	8154	
Well	368	239	129	0	3651	

Table 2.8 Calculated Waste Water System Facility Damage in Dhaka City Corporation Area

Component	***Total Number***	***Functionality Probability at Day 1***			***Total Losses (thou $)***	***Remark***
		More than 60%	**40%-60%**	**Less than 40%**		
Lift Station	13	0	3	10	95	
Treatment Plant	1	0	1	0	5235	

Potential repairs required for potable water supply system, repairs required for waste water system, potable water supply system facilities functionality, and waste water system functionality maps are given in different maps of the **Annex II** of this plan.

2.3 Overall Earthquake Damage Scenario of the City

Three different loss scenarios are studied by the risk assessment team for Dhaka city. The scenario 1, the loss due to Madhupur fault, is taken as the worst case scenario for the water and sanitation system Contingency planning. The risk analysis was conducted in HAZUS, risk assessment computer software.

HAZUS estimates that about 166,570 buildings will be at least moderately damaged. This is over 51.00 % of the total number of buildings in the region. There are an estimated 75,218 buildings that will be damaged beyond repair.

Table 2.5 Expected Building Damage by Occupancy Class in Dhaka City Corporation Area: Scenario case 1

Dhaka : Case 1										
	None		***Slight***		***Moderate***		***Extensive***		***Complete***	
	Count	***(%)***	***Count***	***(%)***	***Count***	***(%)***	***Count***	***(%)***	***Count***	***(%)***
Agriculture	*526*	*0.45*	*273*	*0.65*	*325*	*0.60*	*193*	*0.52*	*327*	*0.44*
Commercial	*16,271*	*13.80*	*5,028*	*11.88*	*7,738*	*14.26*	*6,198*	*16.71*	*11,533*	*15.33*
Education	*1,388*	*1.18*	*384*	*0.91*	*432*	*0.80*	*349*	*0.94*	*610*	*0.81*
Government	*330*	*0.28*	*117*	*0.28*	*168*	*0.31*	*129*	*0.35*	*170*	*0.23*
Industrial	*2,294*	*1.95*	*562*	*1.33*	*917*	*1.69*	*1,033*	*2.79*	*1,572*	*2.09*
Other Residential	*94,994*	*80.56*	*34,924*	*82.50*	*42,882*	*79.03*	*27,821*	*75.01*	*58,739*	*78.09*
Religion	*781*	*0.66*	*271*	*0.64*	*307*	*0.57*	*297*	*0.80*	*523*	*0.70*
Single Family	*1,340*	*1.14*	*770*	*1.82*	*1,491*	*2.75*	*1,072*	*2.89*	*1,744*	*2.32*
Total	*117,924*		*42,330*		*54,261*		*37,091*		*75,219*	

HAZUS estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- *Severity Level 1:* Injuries will require medical attention but hospitalization is not needed.
- *Severity Level 2:* Injuries will require hospitalization but are not considered life-threatening
- *Severity Level 3:* Injuries will require hospitalization and can become life threatening if not promptly treated.
- *Severity Level 4:* Victims are killed by the earthquake.

The casualty estimates are provided for two times of day: 2:00 AM and 2:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum and the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum.

Table 2.6 Summary of the casualties estimated for earthquake in Dhaka City Corporation Area : Scenario Case 1

Dhaka : Case 1					
		Level 1	**Level 2**	**Level 3**	**Level 4**
2 AM	Commercial	635	209	37	73
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	72	24	4	8
	Industrial	101	33	6	11
	Other-Residential	150,938	50,463	8,952	17,733
	Single Family	561	177	30	59
	Total	152,307	50,905	9,028	17,884
2 PM	Commercial	81,688	27,043	4,789	9,401
	Commuting	2	2	4	1
	Educational	3,590	1,176	208	405
	Hotels	14	5	1	2
	Industrial	744	244	43	84
	Other-Residential	51,351	17,279	3,166	5,979
	Single Family	194	62	11	20
	Total	137,582	45,810	8,221	15,892

Immediate Shelter Need:

The estimated displaced population will be about 1,700,000 and about half of them i.e. 870,000 need immediate shelter. So, all the relief materials like water, food, clothes etc. are needed for 870,000 of the people within Dhaka city.

2.4 Interrelationship with other Lifelines and Utilities

Transportation and lifeline infrastructure include road network, bridge, gas (natural gas) network, electric network, telephone network, water supply network, and sewerage network. Typically such lifeline systems are extended spatially over large areas and consist of numerous structures; they are related to urban lives and functions and are vulnerable to earthquake. In Dhaka, gas and water-sewerage connections still use either galvanized iron (GI) or concrete pipes. During an earthquake these are likely to breakdown very easily. Electrical service is also likely to collapse during and after an earthquake.

The major causes of post-earthquake fires include gas leaks due to failure of pipes or gas appliances; problems in the electrical distribution system; flammable materials; overturning of candles, lamps, cooking ovens, etc. Narrow roads in old town, garments and other manufacturing industries in dense residential areas of Dhaka are likely to create additional problems in the event of an earthquake.

Natural gas leaks and explosions are responsible for a significant number of fires following disasters. Electrical sparks in broken buildings and infrastructure have the potential of igniting the gas leaks from the ruptured pipeline. Fires break out initially and then spread to the surroundings depending on building construction, building density, wind, etc.

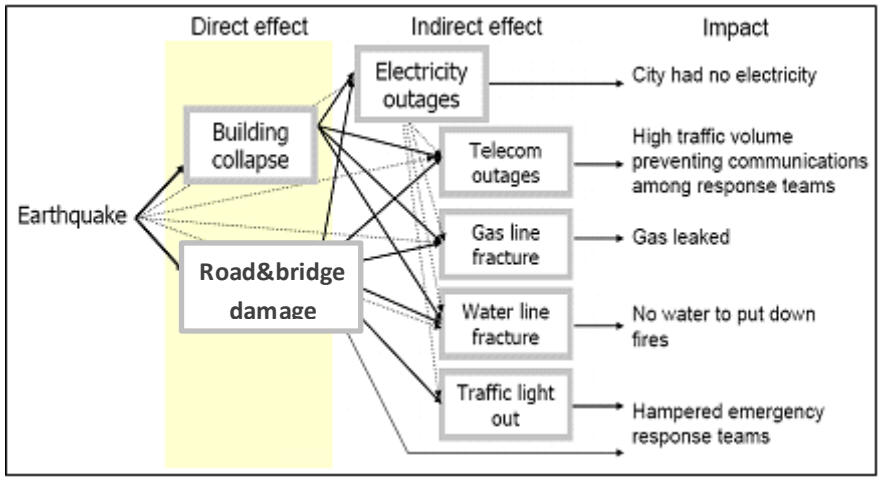


Figure 2.4 Effect and Impact of Earthquake toward infrastructure and lifeline

Effect and impact of an earthquake towards the transportation and lifeline infrastructure can be seen in (Figure 2.1). In emergency situation, management of those infrastructures form a complex relationships among various critical facilities and infrastructure elements, and result in infrastructure interdependencies as shown in

Plan for Immediate Response and Early Recovery

3.1 Key Activities of the Water and Sanitation Sector for Immediate Response and Early Recovery

The main objective of the water and sanitation cluster according to the national level contingency plan is **"Quick restoration of water supply for provision of safe drinking water and sanitation management during earthquake disaster". Table 3-1** gives the details on water supply, sanitation and Hygiene sector objectives, main tasks and activities, lead agencies and supporting agencies.

The main tasks assigned are:

1) Damage assessment of Water supply & drainage, waste management systems
2) Restoration of Water supply & drainage
3) Observe Sanitation norms during emergencies
4) Restoration of Waste disposal and
5) Epidemic control and Immunization

Table 3-1: Details on Water Supply, Sanitation and Hygiene sector in National Contingency Plan

Cluster 6 - Water Supply, Sanitation and Hygiene				
Objectives: Quick restoration of water supply for provision of safe drinking water and sanitation management during earthquake disaster.				
Cluster Lead: Local Government Bodies (City Corporations, Pourashavas)				
Responsible Ministry: Ministry of Local Government and Rural Development (Local Government Division)				
	Activities	***Lead Agency/ Institution***	***Support Agencies/Institutions***	***Global Cluster Partner (Proposed)/Other associate agencies***
Pre-disaster Phase	Develop procedure for vulnerability assessment of water supply system, infrastructure facilities & buildings, sewerage & drainage systems by respective managers	Local Government Bodies	DWASA, CWASA, , DPHE	Global cluster partners - UNICEF, World Bank ADP GOJ
	Develop Contingency Plans for water and sanitation sector, waste management systems at all levels covering earthquake prone local government agencies by respective managers	Local Government Bodies	DWASA, CWASA, DPHE	
	Pre-positioning of water supply deep wells to be used during emergencies	WASA/DPHE	Local Government Bodies, DPHE	
	Develop minimum standards for drinking water supply and issue guidelines to public, NGOs, INGOs and	Local Government Bodies	DWASA, CWASA, DPHE	

	other civil society agencies			
	Develop guidelines for close surveillance in epidemic outbreak and conduct of preparedness measures such as Immunization programs , awareness programs to prevent epidemic outbreaks	DGHS	Office of Civil Surgeon, AFD, Centre for Medical Education (CME), Local Government Bodies	Others – NGO, INGO, BDRCS
	Develop guidelines with water and sanitation group for minimum sanitation levels to be maintained in temporary shelter set up for IDPs	Local Government Bodies	DWASA, CWASA, DPHE, DGHS	
	Facilitate alternate systems for emergency water supplies such as transportation by container trucks, bowsers etc.	Local Government Bodies	DWASA, CWASA, DPHE, DGHS, FSCD	
	Promote household level long term water conservation methods such as rain water harvesting, water softening & SODIS techniques for water purification	Local Government Bodies	DWASA, CWASA, DPHE	
Emergency Response Phase	Activate the Contingency Plans for water and sanitation sector at all levels covering earthquake affected areas	Local government Bodies/WASA	DMB, AFD, DPHE	Global cluster partners - UNICEF, World Bank, ADP, GOJ
	Observe the emergency water supply needs and communicate to relevant stakeholders	Local government Bodies/WASA	DMB, AFD, DPHE,	
	Close surveillance in epidemic outbreak in affected areas due to problems connected with water and sanitation and make remedial actions	DGHS, , Office of Civil Surgeon	AFD, Local govt. Bodies, DRR	
	Rapid damage assessment of water supply, sewerage & drainage system and initiate actions for restoration Assist authorities to maintain water supply & sanitation facilities within welfare camps set up for victims	Local government Bodies	AFD, WASA, DPHE, DRR,	Others – NGO, INGO, BDRCS
	Implement temporary shelter sanitation management system in the temporary shelter for the benefit of victims in affected areas	Local Govt. Bodies	AFD, DMB, DRR, DPHE	
	Arrangements for quality check of water sources, bottled water and	Local government	DGHS, DMB, AFD, DPHE	

	disposable water containers	Bodies		
Early Recovery Phase	Carry out performance evaluation of response actions under cluster Water Supply, Sanitation and Hygiene and introduce suitable modifications to Contingency Plan to improve the performance	Local Government Bodies, WASA	DGHS, DMB, DRR, DPHE	Global cluster partners - UNICEF, World Bank ADP, GOJ Others – NGO, INGO, BDRCS
	Observe and facilitate the emergency water supply needs and communicate to relevant stakeholders	Local Government Bodies	DMB,WASA, DPHE, District Administrations	
	Close surveillance in epidemic outbreak in affected areas due to problems connected with water and sanitation and make remedial actions	Local Government Bodies	DGHS,DMB, WASA, DPHE	
	Conduct Damage Assessment survey for Water supply facilities and develop Plans to restore and rehabilitate water and sanitation sector facilities at all levels covering earthquake affected areas	Local Government Bodies, WASA	DMB, DPHE	
	Conduct periodic quality check of water sources, portable water containers and disposal of waste	WASA, Local Govt. Bodies	DMB, DOE, DPHE	

3.2 Immediate Response Plan

The total number of displaced population needing shelter has been estimated at around 870,000 within the Dhaka city during scenario earthquake. This is estimated as 50% of the displaced people need immediate shelter after the earthquake and the remaining 50% will manage their shelter in their relatives and other places. Open spaces within the city corporation area that are more than 2500 square meters (Area with capacity for sheltering 500 families or more) are mapped and their shelter capacities are calculated. Area of different evacuation spaces, population holding capacities and the emergency water needed in different evacuation spaces are given in **Table 3-2** below. The total open spaces within the Dhaka city have only about ¼ capacity of the total population needing shelter.

Table 3-2: Requirement of Emergency Water in Different Evacuation Spaces

Evacuation Space	Area (m^2)	Population Holding Capacity	Emergency Water (m^3)
1	64157	7129	107
2	59836	6648	100
3	81509	9057	136
4	677244	75249	1129
5	60265	6696	100

Evacuation Space	Area (m^2)	Population Holding Capacity	Emergency Water (m^3)
6	128245	14249	214
7	119715	13302	200
8	809639	89960	1349
9	31132	3459	52
10	25125	2792	42
11	145079	16120	242
12	32601	3622	54
13	44054	4895	73
Total Population Evacuated in Open Spaces Inside Dhaka City Corporation Area and the Needed Emergency Water		***253178***	***3798***

The population evacuated in immediate shelter requires about 3800 cubic meters of emergency water with the rate of 15 liters per capita per day. Total Population needing Evacuation Shelter is about 870,000 so the immediate shelter needing population exceeded the open space capacity within Dhaka city corporation area is 616822 and need to be provided with immediate shelter in the shelter camps near to City Corporation. The population who are taken outside require about 9,250 cubic meters of water per day. So the total emergency water needed in the emergency shelters is about 13,000 cubic meters per day.

Pre-positioning of this amount of the water at the above planned spaces is before earthquake is the most appropriate way to provide immediate emergency water. Calculated amount of required pre-positioned water is given in **Map 3** of **Annex II**.

To manage toilets in the immediate shelters spaces is the main challenge related to sanitation. Sphere standard demand one toilet for each 20 people in the emergency shelter. The calculation shows that about 12,700 toilets are needed in the open spaces within Dhaka City and additional 30,700 toilets need to plan for the people of Dhaka who need immediate shelter outside Dhaka city.

The numbers of toilets required in different open spaces are given in **Table 3-3** below and in **Map 7** of **Annex II**.

Table 3-3: Requirement of Number of Toilet

Evacuation Space	Area_m2	Population Holding Capacity	Required number of Toilets
1	64157	7129	356
2	59836	6648	332
3	81509	9057	453
4	677244	75249	3762
5	60265	6696	335
6	128245	14249	712
7	119715	13302	665
8	809639	89960	4498

Evacuation Space	Area_m2	Population Holding Capacity	Required number of Toilets
9	31132	3459	173
10	25125	2792	140
11	145079	16120	806
12	32601	3622	181
13	44054	4895	245
Total Population Evacuated in Open Spaces Inside Dhaka City Corporation Area		***253178***	**12659**
Total Population needing Evacuation Shelter		870000	
Shelter needing population exceeded the open space capacity withn city corporation area		**616822**	**30841**

3.3 Early Recovery Plan

3.3.1 Human Resources, Materials and Cost Planning

Assumptions:

Human resources required for repair of Potable Water and Waste water Pipeline:

12"and 10" diameter pipes: 4 persons for 24 hours

6" and 8" diameter pipes: 4 persons for 8 hour

In average 16 hours (2 days) for 4 person crew to repair one break.

Human resources required for repair and construction of the other facilities depends on the size of the facilities. A group of about 10-20 skilled masons are required from a week to 6 months for repair and reconstruction of the facilities.

In average, 15 persons for 3 days to repair a well, 15 persons for 3 days to repair a pump and 15 persons for 3 Months to repair an overhead tank has been assumed to calculate human resources required. **Table 3-2** gives the required human resources and the repair cost.

Table 2-5 Human Resources, Cost and Materials Required for Repairing Potable Water Supply Pipeline

Component	*Total Length (km)*	*Total Losses (thou $)*	*Total Repairs*	*Required Number of Skilled People to Repair the Damage in Specified Time*			*Repair Unit Cost (thou $)*	*Repair Cost (thou $)*	*Materials Required*
				7 Days	14 Days	30 days			
Pipeline	1120	1,612	350	400	200	93	0.70	245	To repair 350 Breaks

Table 2-5 Human Resources, Cost and Materials Required for Repairing Waste Water Pipeline

Component	Total Length (km)	Total Losses (thou $)	Total Repairs	Required Number of Skilled People to Repair the Damage in Specified Time			Repair Unit Cost (thou $)	Repair Cost (thou $)	Materials Required
				7 Days	14 Days	30 days			
Pipeline	396	3,175	466	533	266	124	0.70	326	To repair 466 Breaks

Table 2-6 Human Resources, Cost and Materials Required for Repairing Potable Water Supply System Facilities

Component	Total Number	Total Number of Facilities Requiring Repairs	Functionality Probability at Day 1			Repair Unit Cost (thou $)	Repair Cost (thou $)
			7 days	14 Days	30 days		
Over Head Tank	36	25	4773	2387	1114	160	3960
Pump	342	90	575	288	134	150	13425
Well	368	32	207	104	48	63	2027

Table 2-7 Human Resources, Cost and Materials Required for Repairing Waste Water System Facilities

Component	Total Number	Total Number of Facilities Requiring Repairs	Functionality Probability at Day 1			Repair Unit Cost (thou $)	Repair Cost (thou $)
			7 days	14 Days	30 days		
Lift Station	13	11	71	35	17	160	1760
Treatment Plant	1	0.25				60000	15000

The total number of skilled/trained workers required for repairing the Potable water and Waste water system within Dhaka city corporation area after an earthquake is about 1800 people per day to repair the system within 7 days. If it is planned to repair in 14 days, it require about 900 skilled workers per day and require about 420 people working per day to repair the system in 30 days time.

Skilled workers required to repair overhead water tank and waste water treatment plant is not calculated here, as it require thousands of skilled workers if planned to repair within a month, which is practically not possible even if planned. It requires 3-6 months to repair the overhead tanks and treatment plant, even if the required manpower is available.

The total estimated cost require for repairs is about 27 Million US Dollars. It is assumed that the repair cost for the waste water treatment plant, probability of

which to be functional after the earthquake is 40-60% has been assumed that 25% of the replacement cost.

The equipment and materials are not detailed and requires further detailing during plan revision.

3.3.2 Priorities for Early Recovery

The first priority after the immediate response is to start the recovery of the critical elements within the system. Following are the proposed priorities actions for effective recovery:

Potable Water Supply System:

Priority 1: Repair Wells

Priority 2: Repair Pumps

Priority 3: Repair Main Pipelines

Priority 4: Repair Pipelines

Priority 5: Repair Overhead Tanks

Priority 6: Repair other components

Waste Water System:

Priority 1: Repair Treatment Plant

Priority 2: Repair Lift Stations

Priority 3: Repair Pipeline

Legal Provisions and Organizational Setup

4.1 Legal Provisions, Authority and national level DM Functions of the Agency

Organizational setup of the Dhaka Water Supply & Sewerage Authority: The Managing Director, DWASA is responsible for Implementation of all Water Supply & Sewerage related programs & to provide technical guidance to the Ministry. Four Deputy Managing Directors are assigned to work under the Managing Director, DWASA.

With regard to Disaster Management, the Dhaka Water Supply & Sewerage Authority is to provide efficient water supply to all levels of victims.

4.2 The Major roles assigned to the agency in relation to National Earthquake Contingency Plan

The agency level responsibility of DWASA with regards to Earthquake Risk Management is to ensure management of situation of mass casualties and treatment of victims as a result of Earthquakes and major aftershocks and as a result of co-lateral hazards. The main roles assigned to DWASA in relation to National Earthquake Contingency Plan are to ensure:

- Water supply & drainage
- Sewerage
- Waste disposal
- Epidemic control
- Immunization

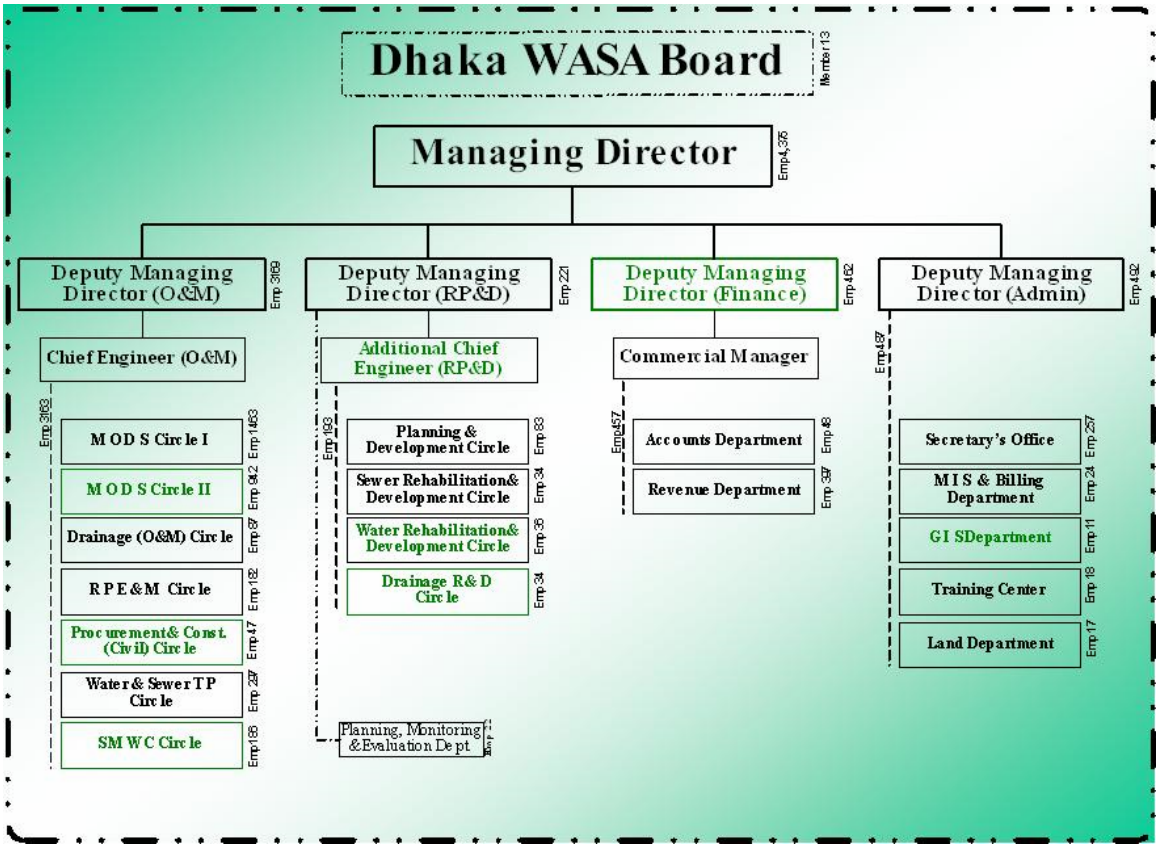
4.3 The support roles assigned to agency under National Earthquake Contingency Management Plan

A strong National Earthquake Contingency Plan is considered to be a one that is built on a foundation for DRM that promotes

- Preventing outbreak of epidemics
- Appropriate command and control mechanism
- Efficient, effective collaboration & coordination
- Trust, mutual respect and understanding among all stakeholders
- Arrangements for sharing of resources and experience that will result in a highest level of safety and security of citizens of Bangladesh from Earthquakes at all times

4.4 Agency level structure for Command, control and coordination within the organization and with outside agencies

The Organogram of the Dhaka Water Supply & Sewerage Authority is given as follows:



Source: DWASA, 2008

Command, control and coordination mechanism for DWASA with regard to Disaster Management are as follows:
Overall Supervision: Managing Director, Dhaka Water Supply & Sewerage Authority
Focal Point: Deputy Managing Director (O&M), DWASA
Management support: Deputy Managing Director (RP&D), Deputy Managing Director (Finance), Deputy Managing Director (Admin)
Monitoring: Chief Engineer (O&M), Additional Chief Engineer (RP&D)

The Response Action of DWASA can be expressed as under:
Initial Action: Managing Director calls Officials of DWASA and other concern Agencies
Continuing Action:

- Situation Assessment
- Activate & deploy of Water and Sanitation Response Team
- Coordination of Requests for Potable Water and Sanitation at the City level

Functional Response Roles and Responsibilities Assigned for the Agency

5.1 Emergency Response Tasks under Respective Functional Groups- Preparedness and Mitigation Phase (normal time activities)

To ensure this Contingency planning as a forward planning process, it is obvious to agree upon specific scenarios and objectives. An effective Potential Response System has to be put in place in order to prevent, or better respond to, an emergency or critical situation. In this regard, DWASA needs to accomplish the following activities well-before the earthquake event.

Activities related to Contingency planning

- Develop and regularly update contingency plan
- Conduct necessary training and capacity building for plan update
- Carry out periodic reporting to authorities on readiness of the sector for responding to earthquake events

Activities related to Water Supply & Sewerage

- Develop Contingency Plans for earthquake risk
- Conduct necessary training and capacity building for Plan update
- Carry out periodic reporting to authorities on readiness of the (WASA) for responding to earthquake events

Activities related to Just-after Recovery Phase

- Develop procedures and guidelines for recovery projects in water supply and Sewerage facilities to reduce future damages
- Develop procedures for integrating seismic safety in recovery programs in water supply & Sewerage sector
- Develop capacity building programs for professionals to integrate seismic safety and improve preparedness

5.2 Emergency Response Tasks under Respective Functional Groups – Response phase (activities during and soon after the disaster events)

Activities related to Contingency planning

- Compliance with plan arrangements and reporting on the health sector involvement in providing health care to victims

Activities related to Water Supply & Sewerage

- Compliance with Plan arrangements and reporting on the (WASA)involvement in Contingency Plan implementation
- Activate the alert system
- Mobilize trained Triage teams to affected urban areas and control Points.
- Set up temporary health care centers for victims who do not need urgent Medicare

- Mobilize ambulance services in critical urban areas to transport sick and injured
- Resource deployment for aid to injured and disposal of dead
- Close surveillance in epidemic outbreak
- Arrangements for quality check of water sources and disposal of waste
- Take action to restore and rehabilitate water and Sewerage sector facilities at all levels covering earthquake affected areas
- Rehabilitation of water supply, sewerage & drainage system within the city
- Close surveillance in epidemic outbreak
- Conduct periodic quality check of water sources and disposal of waste

5.3 Emergency Response Tasks Under Respective Functional Groups – Recovery phase (activities following a disaster event)

Activities related to Contingency planning

- Compliance with the plan arrangements and reporting on water supply sector involvement in providing emergency water supply to victims

Activities related to Water Supply & Sewerage

- Organize project teams to conduct Detail damage assessment of all water supply & Sewerage infrastructure and prepare for recovery program implementation
- Develop guidelines for water supply, sewerage & drainage systems for build better taking the impact of potential earthquakes

Activities related to Just-after Recovery Phase

- Conduct detail damage assessments and prepare estimates for recovery of health sector buildings & facilities
- Undertake initiatives for integrating seismic safety in recovery programs for health sector buildings & facilities
- Report results of rapid damage assessment of water supply, sewerage & drainage systems

Operating Procedure Guidelines

6.1 Planning assumptions

- The agency level responsibility of Utilities and Service agencies (water supply, gas, electricity supply and telecommunications) with regards to Earthquake Risk Management is to ensure quick restoration of services and facilities and extent assistance in evacuation, Search & Rescue operations, transportation of relief & welfare items as well to help in Medical First Response to all levels of victims of earthquake disaster. Agreed actions listed in the National level Plan during normal times should be covered comprehensively during Agency level planning by the concerned utilities and service agencies. The level of preparedness at any given time determines the level of response capacity of the utilities and service agencies during any Earthquake disaster situation. The maintenance of standards of services and redness during normal times can be demonstrated through verification of effectiveness through simulations and conduct of regular stock taking and regular reporting. This ensures the response capacity of the utilities and service agencies to any disaster situation.

- For effective preparedness, the utilities and service agencies must have a clearly defined Earthquake Contingency Plan, in order to avoid confusion and, improve efficiency in cost and time

- Operating procedures for mobilizing staff, manpower, and material during various stages of earthquake emergency response should be identified by the respective agencies in the Agency level Earthquake Contingency Plan. All utilities and service agencies are required to study the National Earthquake Contingency Plan and adopt appropriate measures to ensure the uninterrupted services by respective agency during post earthquake period.

- Also the agencies should ensure the utilities and service agencies have taken maximum effort to control the occurrence or out break and any kind of spread of collateral hazard events such as fire outbreaks

- Orientation and training for implementation of the Earthquake Contingency Plan and procedures accompanied by simulated exercises will keep the utilities and service agencies prepared for meeting the needs to act in Earthquake events. Special skills required during earthquake emergency response operations need to be imparted to the officials and the staff of utilities and service agencies. Selected personnel can be deputed for training'

- A designated officer from each organization listed under utilities and service agencies at national level should take the role of as "NODAL OFFICER –Water Supply & Drainage". In the similar way the officers should be designated as

"Officer-in-charge – Water supply & Drainage" at the city level to take charge of Earthquake Contingency Plan related functions.

- Measures should be undertaken to enhance the capacity of utilities and service agencies regularly in terms of man-power, equipment, material etc to respond to an Earthquake disaster.

6.2 Normal time activities

- Assess preparedness level and report the same as per the reporting formats to National Emergency Operation Centre (EOC) every six months
- Conduct training and capacity building programs to provide necessary skills and knowledge on handling utilities and service agencies issues during Earthquake emergency
- Obtain maps of all supply routes, operational areas of utilities and services by respective agencies and store them carefully so that it can be made available to authorities with short notice after Earthquake emergency. Keep and maintain Earthquake Contingency plans with spatial databases so that in case of severe damage to utilities and services a quick assessment could be undertaken by the respective authorities to establish most essential services within the shortest time period.
- Maintain a list of Earthquake Disaster prone areas in the city level and conduct simulations to verify the preparedness level to respond to earthquake events (especially involve the Emergency repair and maintenance teams in simulations)
- Appoint and designate the Emergency Repair teams and develop database of such officers with contact numbers. Develop a coordination mechanism between utilities and service agencies and response agencies. Develop and maintain database of heavy machinery(specify the number, location, etc)belong to the respective Institution that can be used during emergencies
- Conduct verification of stocks of spare parts and material necessary for restoration of utilities and services by respective agencies.
- Conduct vulnerability assessment of buildings and make arrangements to ensure critical facilities and buildings will be under safe conditions during Earthquake emergencies.

6.3 Activities on receipt of notice of Activation if National Earthquake Contingency Plan

- All personnel from Utilities & lifelines services required for Earthquake Emergency response should work under the overall supervision and guidance of Response Commander of the respective area. Within the affected area all available personnel from Utilities & lifelines services will be made available to the Response Commander of the respective area. If more personnel are required, then out of station or those on leave may be recalled.

- Establish radio communications between Utilities & lifelines services and Emergency operations centre and other relevant officials to provide necessary assistance by establishing uninterrupted services to affected areas. The switching off of supply to designated areas should be taken care of in order to avoid fire out breaks.

- All relevant department vehicles should be fueled and parked in the protected arrears so that they can be used for emergency response duties.

- Maintenance and repairmen should be instructed to assemble and check repair equipment and ready to be dispatched to affected areas for restoration of Utilities & lifelines services. Plans should be developed for sending auxiliary staff and repairmen into the affected areas to assist local staff in restoration of Utilities & lifelines services when required. Every work gang should have tools which will be needed in an emergency.

- The special service personal with responsibilities for cut of services, switching off supply lines etc should be given special training and they should liaise with relevant officials from Fire service and civil defense and other emergency response agencies in case of fire out break in order to bring the events under control without spreading it to other areas.

- Contingency plans should be established for providing food and emergency shelter for local staff, and for auxiliary staff being sent into the affected area for restoration of supply lines, repairs, switching off the supply lines etc.

- Arrangements have to be made to assist the increased volume of traffic for telecommunication services. If necessary dedicated lines should be assigned and operated for the use by emergency response personal from first responder agencies. Mobile phone operators have restrictions to reduce the inflow of calls and to serve the emergency service personal.

- A rapid assessment of the number and location of landslides, damage power connections, water lines, telephone connections, gas supply lines, areas affected

by liquefaction, subsidence and places covered with debris should be carried out, to ensure at least a minimum level of utilities and services during an emergency situation. Public announcements should be provided through media at regular intervals to inform the public about the disruption of services. Personal involved in operation of underground water supply schemes, power supply schemes etc should be given strict advises for avoiding flooding of equipment.

- Emergency instructions for services and utilities should be developed. All staff should be well trained to implement the emergency supply systems of utilities and life line services.

- Within the emergency operating framework, emergency procedures should be developed to provide the utilities and life line services with authority, to dispatch or Holt services and take other emergency decisions in a disaster threatening situation to provide temporary services to hospitals, schools and evacuation centers, police, AFD, FS&CD etc. If halting or termination of utilities and services is intended for certain areas, arrangements for alternate means of supply to critical facilities, VIPs etc must be ensured.

- Polythene or other material should be acquired for the protection of very essential valuable equipments such as transformers, controlling stations, pumps, storage tanks etc. All perishable and breakable items should be loaded in to lorries, transported, stored and padlocked in safer areas

- Reserve stocks of fuel should be checked. Additional stand by generators, pumping stations etc should be transported and placed to ensure supply to critical facilities such as hospitals, cams for displaced, police etc. Where necessary attempts should be made to pre-positioned generators, water supply wells, tanks, transportation vehicles, etc.

- Inspection of all supply lines, by appropriate specialists and engineers shall be carried out to ascertain the damage levels. A full check on all concrete and steelworks should be included, and any repairs needed should be promptly carried out.

- Emergency repairs of service lines and utilities if affected, must be carried out

Readiness Checklist

7.1 Readiness Checklist and Reporting Formats

Preparedness Check List for DWASA

Preparedness measures taken	***Details/Remarks***
All staff of DWASA are familiar with this plan as well as city level contingency plan	
Orientation and training for implementation of Earthquake Contingency plan and procedures undertaken at different level	
Special skills required during emergency operations imparted to the designated officials and the staff	
Prepositioning of the emergency water at different evacuation spaces is carried out	
Equipment and cost require for early recovery of water and sewer system are planned	
Overhead tanks, lift stations and sewer treatment plant are assessed in detail and the facilities are retrofitted accordingly	
Reviewed and updated - Precautionary measures and procedures for coordination between different utility and lifeline service agencies during earthquake emergencies - A list of special emergency restoration teams, the data base on heavy equipment, spare parts needed for quick restoration of utilities and lifeline services under relevant agency - Training and capacity building programs, Plans to conduct routine simulations - the precautions to be taken to avoid fire out breaks, floods inside buildings etc - the precautions to be taken to protect equipment during earthquake emergencies - procedure for assessment of damages to buildings and granting permission to use them after inspection - The post-disaster procedures to be followed.	

Reported By:
Designation:
Signature:
Date:

Agency Level Actions for Training & Capacity Building of Staff, Awareness Creation, Reporting, Pre-positioning of Emergency Facilities, Resource Mobilization for Purchase of Equipments

8.1 Assessment of Existing Capacity (Man power, equipment and material)

DWASA was created in 1963 as a public utility under the Ministry of Local Government, Rural Development and Co-operative, in charge of providing water supply and sewerage services in the Metropolitan area of Dhaka. In 1996 the WASA Act was amended in order to grant more autonomy to DWASA by reconstituting and strengthening the Board, introducing commercial regulations and reducing government role. The Act clearly defines the mandate of the Board and Managing Director of DWASA, their competencies and responsibilities in the matters related to procurement, budget approval, recruitment, staff promotion and definition of salaries and benefits.

8.2 Gap Analysis (Man power, equipment and material)

Followings are the key elements identified to enhance the emergency preparedness for a sustainable response.

Type of gap	Description	Remarks
General	• Difficulties for compliance to the Standard Operation Procedure (SOP) of DWASA since Earthquake aspect is not covered adequately. • There is no job description for all levels of Disaster Management Personnel inside the DWASA.	• Needs specific job descriptions are needed to incorporate into the SOP. • Need to prepare earthquake & tsunami response plan separately.
Training & Capacity Building	• Limited training programs are conducted by the DWASA	• Training Institute needs to be established w DWASA.
Coordination among stakeholders	• There have minimum coordination all stakeholders (DMB, CDMP, LGRD/Civil Admin./Fire Service & Civil Defense/ Army/NGOs/CBOs and other relevant ministries) • No regular coordination at all level with GO, NGO Donors for Disaster management	• An effective internal & external Coordination Mechanism needs to be developed.
Public awareness	• There are very few training activities on capacity building and regular Mock drill for preparedness for any impending disasters and post-disaster Water Supply & Sewage management.	• Needs to conduct trainings & Mock drills regularly for emergency disaster preparedness.
Equipments	• There are scarcity of medical equipments such as transports,	• Needs assessment has to be conducted based on the

Type of gap	Description	Remarks
	medicine, mobile hospitals, emergency medicines, trained manpower etc.	possible worst-case scenarios and then required resources has to be mobilized.

8.3 Process for addressing the gaps

Enhanced capability of the Water Supply and Sewage sector to effectively address the risks to emergencies through:

- Development of an integrated emergency Water Supply management mechanism that covers areas of risk assessment, capacity building, public awareness as well as effective emergency response capability;
- Using "Water Supply & Sewage mapping" as a useful operational tool for the risk assessment of the hazard prone areas;
- Development of technical guidelines, and surveillance standards in order to promote best Water Supply practice during humanitarian crisis situation;
- Capacity building for rapid needs assessment following any emergency in order to ensure that the most vulnerable population benefit from the humanitarian relief Programme.

8.4 Action Plan for Enhancement of Capacity

- Establishment of core group at periphery level including all stakeholders (DMB, CDMP, LGRD/Civil Admin./Fire Service & Civil Defense/Army/NGOs/CBOs and other relevant ministries)
- Enhanced the national capacity of disaster mitigation in respect of planning and responding to disasters, like Earthquakes and Tsunamis by preparing Earthquake/Tsunami Response Plan
- Conduct and assess field based survey to find out vulnerability of the area for their capacity building by table-talk & simulation exercise.
- Provide more training – capacity building and regular Mock drill for preparedness for any impending disasters and post-disaster Water Supply management.
- Strengthening epidemiological surveillance as well as increase laboratory capacity.
- Ensuring adequate supply of logistics like life-jacket, rain-coat, umbrella, gum boot, and others essential materials during response activities.

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Glossary of Terms

Building Codes Ordinances and regulations controlling the design, construction, materials, alteration and occupancy of any structure to insure human safety and welfare. Building codes include both technical and functional standards.

Capacity A combination of all the strengths and resources available within a community, society or organization that can reduce the level of risk, or the effects of a disaster.

Capacity may include physical, institutional, social or economic means as well as skilled personal or collective attributes such as leadership and management. Capacity may also be described as capability.

Capacity Building Efforts aimed to develop human skills or societal infrastructures within a community or organization needed to reduce the level of risk.

In extended understanding, capacity building also includes development of institutional, financial, political and other resources, such as technology at different levels and sectors of the society.

Cluster A "cluster" is essentially a "sectoral group" and there should be no differentiation between the two in terms of their objectives and activities; the aim of filling gaps and ensuring adequate preparedness and response should be the same. (IASC Guidance Note on Using the Cluster Approach Nov 2006)

Cluster Approach The Cluster Approach aims to strengthen humanitarian response capacity and effectiveness in five key ways: i) ensuring sufficient global capacity is built up and maintained in key gap sectors/areas of response; ii) identifying predictable leadership in the gap sectors/areas of response; iii) facilitating partnerships and improved inter-agency complementarity by maximizing resources; iv) strengthening accountability; and 5) improving strategic field-level coordination and prioritization in specific sectors/areas of response by placing responsibility for leadership and coordination of these issues with the competent operational agency. (IASC Guidance Note on Using the Cluster Approach Nov 2006)

Cluster Leads A "cluster lead" is an agency/organization that formally commits to take on a leadership role within the international humanitarian community in a particular sector/area of activity, to ensure adequate response and high standards of predictability, accountability & partnership. (IASC Guidance Note on Using the Cluster Approach Nov 2006)

Disaster A serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses which exceed the ability of the affected community or society to cope using its own resources.

A disaster is a function of the risk process. It results from the combination of hazards, conditions of vulnerability and insufficient

	capacity or measures to reduce the potential negative consequences of risk.
Disaster Risk Management	The systematic process of using administrative decisions, organization, operational skills and capacities to implement policies, strategies and coping capacities of the society and communities to lessen the impacts of natural hazards and related environmental and technological disasters. This comprises all forms of activities, including structural and non-structural measures to avoid (prevention) or to limit (mitigation and preparedness) adverse effects of hazards.
Disaster Risk Reduction (disaster reduction)	The conceptual framework of elements considered with the possibilities to minimize vulnerabilities and disaster risks throughout a society, to avoid (prevention) or to limit (mitigation and preparedness) the adverse impacts of hazards, within the broad context of sustainable development. *The disaster risk reduction framework is composed of the following fields of action, as described in ISDR's publication 2002 "Living with Risk: a global review of disaster reduction initiatives", page 23:* • *Risk awareness and assessment including hazard analysis and vulnerability/capacity analysis;* • *Knowledge development including education, training, research and information;* • *Public commitment and institutional frameworks, including organisational, policy, legislation and community action;* • *Application of measures including environmental management, land-use and urban planning, protection of critical facilities, application of science and technology, partnership and networking, and financial instruments;* • *Early warning systems including forecasting, dissemination of warnings, preparedness measures and reaction capacities.*
Earthquake	An earthquake is a series of vibrations on the earth's surface caused by the generation of elastic (seismic) waves due to sudden rupture within the earth during release of accumulated strain energy.
Emergency Management	The organization and management of resources and responsibilities for dealing with all aspects of emergencies, in particularly preparedness, response and rehabilitation. *Emergency management involves plans, structures and arrangements established to engage the normal endeavours of government, voluntary and private agencies in a comprehensive and coordinated way to respond to the whole spectrum of emergency needs. This is also known as disaster management.*
Emergency	Consists of all activities taken in anticipation of a crisis to expedite effective emergency response. This includes contingency planning,

Preparedness	but is not limited to it: it also covers stockpiling, the creation and management of standby capacities and training staff and partners in emergency response. (Source: ODIHPN Contingency Planning Review Paper 2007)
First Responder	The term 'first responder' refers to those agencies/ individuals who in the early stages of an incident are responsible for the protection and preservation of life, property, evidence, and the environment, including emergency response providers as well as emergency management, public health, clinical care, public works, and other skilled support personnel (such as equipment operators) that provide immediate support services during prevention, response, and recovery operations. *Source: Homeland Security Act of 2002 (6 U.S.C. 101, Washington, U.S.A.)*
Geographic information systems (GIS)	Analysis that combine relational databases with spatial interpretation and outputs often in form of maps. A more elaborate definition is that of computer programmes for capturing, storing, checking, integrating, analysing and displaying data about the earth that is spatially referenced. *Geographical information systems are increasingly being utilised for hazard and vulnerability mapping and analysis, as well as for the application of disaster risk management measures.*
Hazard	A potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. *Hazards can include latent conditions that may represent future threats and can have different origins: natural (geological, hydrometeorological and biological) or induced by human processes (environmental degradation and technological hazards). Hazards can be single, sequential or combined in their origin and effects. Each hazard is characterised by its location, intensity, frequency and probability.*
Hazard Analysis	Identification, studies and monitoring of any hazard to determine its potential, origin, characteristics and behaviour.
Land-use Planning	Branch of physical and socio-economic planning that determines the means and assesses the values or limitations of various options in which land is to be utilized, with the corresponding effects on different segments of the population or interests of a community taken into account in resulting decisions. *Land-use planning involves studies and mapping, analysis of environmental and hazard data, formulation of alternative land-use decisions and design of a long-range plan for different geographical and administrative scales.* *Land-use planning can help to mitigate disasters and reduce risks by discouraging high-density settlements and construction of key*

	installations in hazard-prone areas, control of population density and expansion, and in the siting of service routes for transport, power, water, sewage and other critical facilities.
Mitigation	Structural and non-structural measures undertaken to limit the adverse impact of natural hazards, environmental degradation and technological hazards.
Natural Hazards	Natural processes or phenomena occurring in the biosphere that may constitute a damaging event. *Natural hazards can be classified by origin namely: geological, hydrometeorological or biological. Hazardous events can vary in magnitude or intensity, frequency, duration, area of extent, speed of onset, spatial dispersion and temporal spacing.*
Planning Assumptions	The key elements of a scenario that form the basis for developing a contingency plan (for example, projected caseloads) (Source: IASC Contingency Planning Guidelines 2001)
Preparedness	Activities and measures taken in advance to ensure effective response to the impact of hazards, including the issuance of timely and effective early warnings and the temporary evacuation of people and property from threatened locations.
Prevention	Activities to provide outright avoidance of the adverse impact of hazards and means to minimize related environmental, technological and biological disasters. *Depending on social and technical feasibility and cost/benefit considerations, investing in preventive measures is justified in areas frequently affected by disasters. In the context of public awareness and education, related to disaster risk reduction changing attitudes and behaviour contribute to promoting a "culture of prevention".*
Recovery	Decisions and actions taken after a disaster with a view to restoring or improving the pre-disaster living conditions of the stricken community, while encouraging and facilitating necessary adjustments to reduce disaster risk. *Recovery (rehabilitation and reconstruction) affords an opportunity to develop and apply disaster risk reduction measures.*
Relief / Response	The provision of assistance or intervention during or immediately after a disaster to meet the life preservation and basic subsistence needs of those people affected. It can be of an immediate, short-term, or protracted duration.
Resilience / Resilient	The capacity of a system, community or society potentially exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure. This is determined by the degree to which the social system is capable of organizing itself to increase its capacity for learning from past disasters for better future protection and to improve risk reduction measures.

Retrofitting (or upgrading)	Reinforcement of structures to become more resistant and resilient to the forces of natural hazards. *Retrofitting involves consideration of changes in the mass, stiffness, damping, load path and ductility of materials, as well as radical changes such as the introduction of energy absorbing dampers and base isolation systems. Examples of retrofitting includes the consideration of wind loading to strengthen and minimize the wind force, or in earthquake prone areas, the strengthening of structures.*
Risk	The probability of harmful consequences, or expected losses (deaths, injuries, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between natural or human-induced hazards and vulnerable conditions. *Conventionally risk is expressed by the notation Risk = Hazards x Vulnerability. Some disciplines also include the concept of exposure to refer particularly to the physical aspects of vulnerability.* *Beyond expressing a possibility of physical harm, it is crucial to recognize that risks are inherent or can be created or exist within social systems. It is important to consider the social contexts in which risks occur and that people therefore do not necessarily share the same perceptions of risk and their underlying causes. (Source: ISDR)*
Risk Assessment/Analysis	A methodology to determine the nature and extent of risk by analysing potential hazards and evaluating existing conditions of vulnerability that could pose a potential threat or harm to people, property, livelihoods and the environment on which they depend. *The process of conducting a risk assessment is based on a review of both the technical features of hazards such as their location, intensity, frequency and probability; and also the analysis of the physical, social, economic and environmental dimensions of vulnerability and exposure, while taking particular account of the coping capabilities pertinent to the risk scenarios.*
Scenario	An account or synopsis of a possible course of events that could occur, which forms the basis for planning assumptions (for example, a river floods, covering a nearby town and wiping out the local population's crop) (Source: IASC Contingency Planning Guidelines 2001)
Scenario-building	The process of developing hypothetical scenarios in the context of a contingency planning exercise. (Source: IASC Contingency Planning Guidelines 2001)
Seismic Hazard	Seismic hazard in the context of engineering design is defined as the predicted level of ground acceleration which would be exceeded with 10% probability at the site under construction due to occurrence of earthquake anywhere in the region, in the next 50 years.
Sustainable	Development that meets the needs of the present without

development compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of "needs", in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and the future needs. (Brundtland Commission, 1987).

Sustainable development is based on socio-cultural development, political stability and decorum, economic growth and ecosystem protection, which all relate to disaster risk reduction.

Vulnerability The conditions determined by physical, social, economic, and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards.

For positive factors, which increase the ability of people to cope with hazards, see definition of capacity.