

World Conference on Disaster Reduction

18-22 January 2005, Kobe, Japan

Thematic Session 1.5

Disaster Reduction Indicators: Safer Critical Facilities

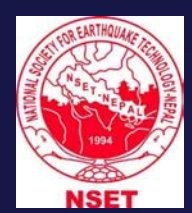
Seismic Risk of Water Supply System of Kathmandu Valley and Risk Reduction Measures



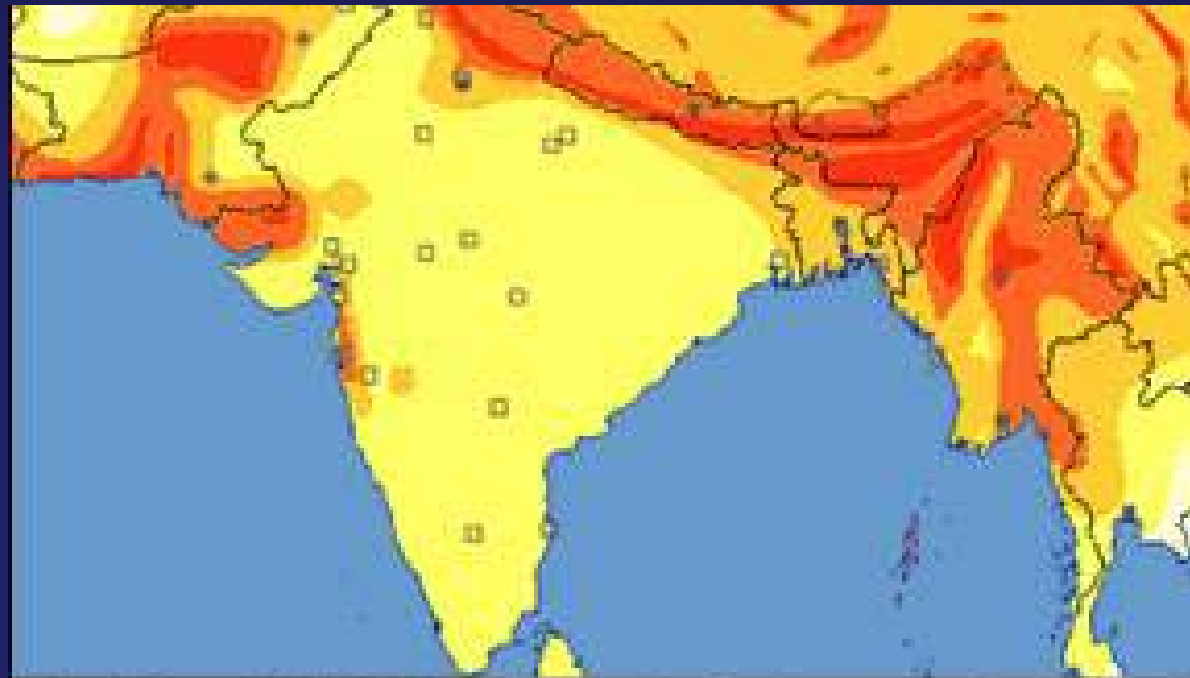
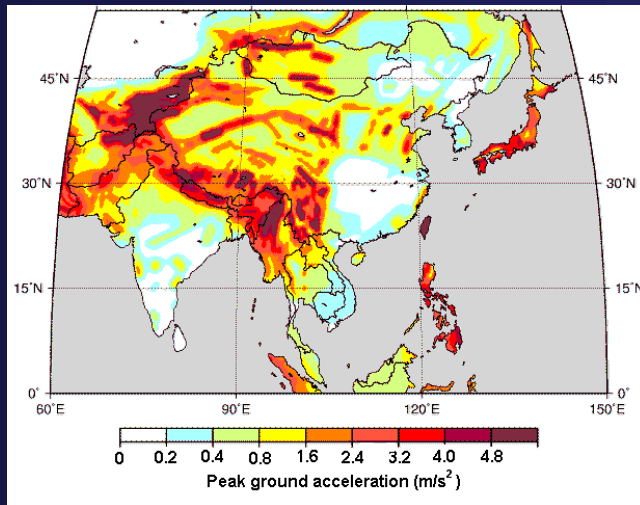
Surya Narayan Shrestha

National Society for Earthquake Technology-Nepal
(NSET)

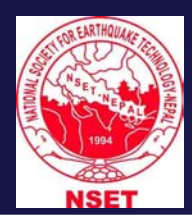
www.nset.org.np



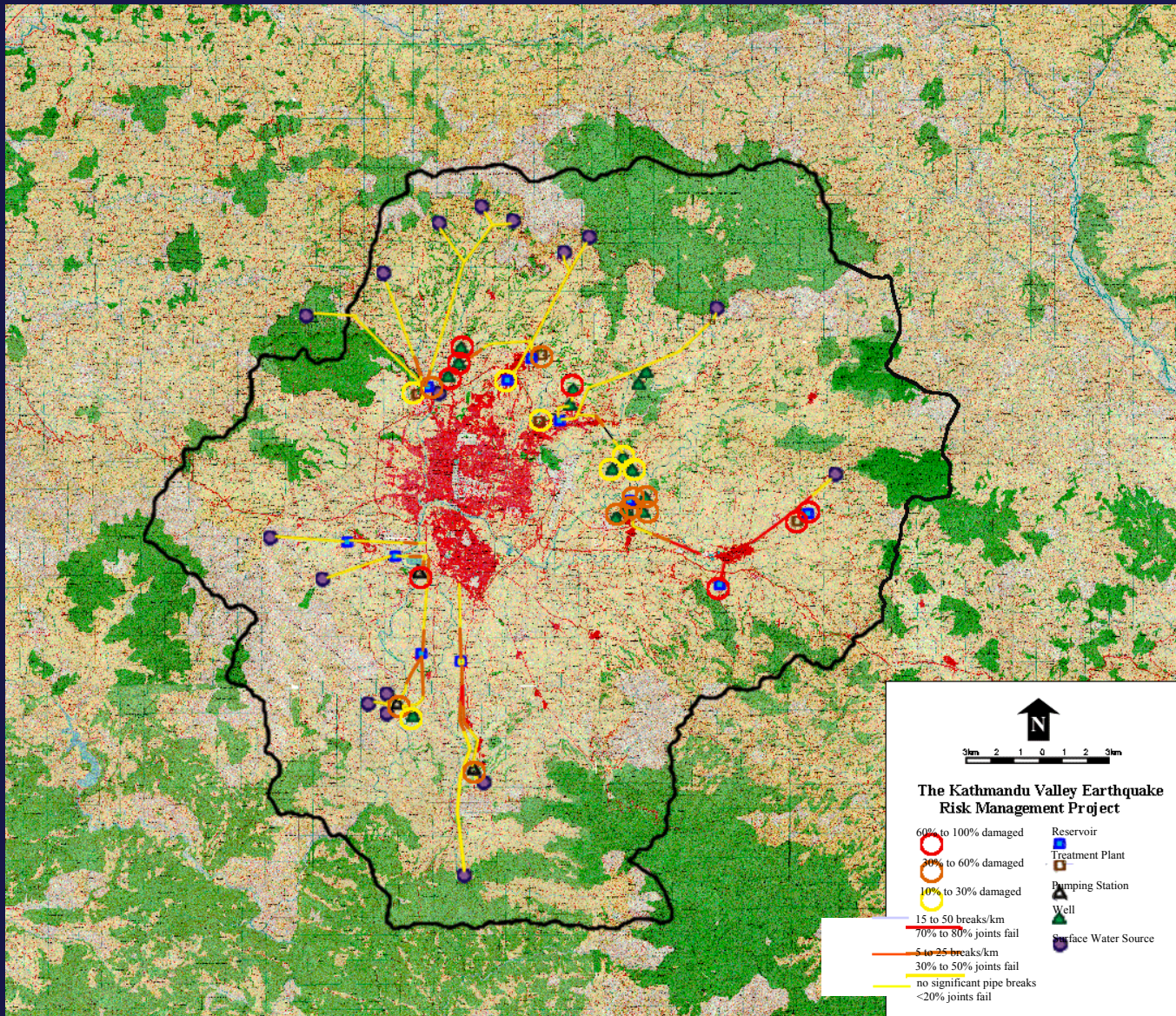
Seismic Hazard of Nepal



Seismic Zone	Modified Mercalli Intensity	Peak ground acceleration (%g)
Zone = 0	MMI = V	< 3
Zone = 1	MMI = VI	3 - 10
Zone = 2	MMI = VII	10 - 20
Zone = 3	MMI = VIII	20 - 35
Zone = 4	MMI = IX	> 35

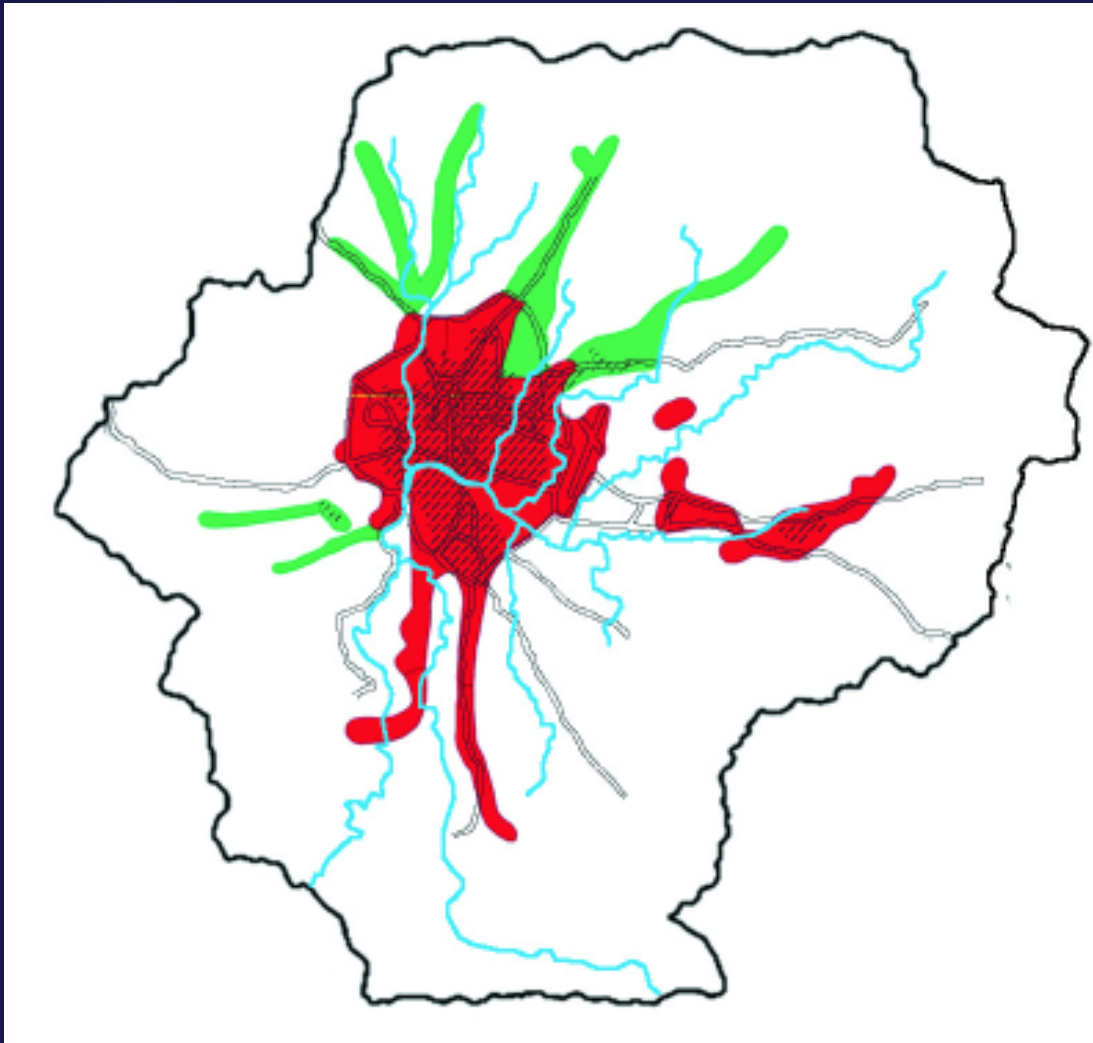


Water System Damage Map from KVERMP



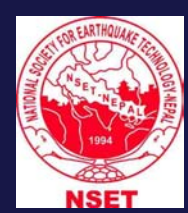
Larger portion of water supply system of Kathmandu Valley Could be damaged

Scenario One Week After



Main City Areas
could not get water
even after one week
of a large seismic
event

More detail study was felt necessary to assess the seismic
vulnerability of water supply system

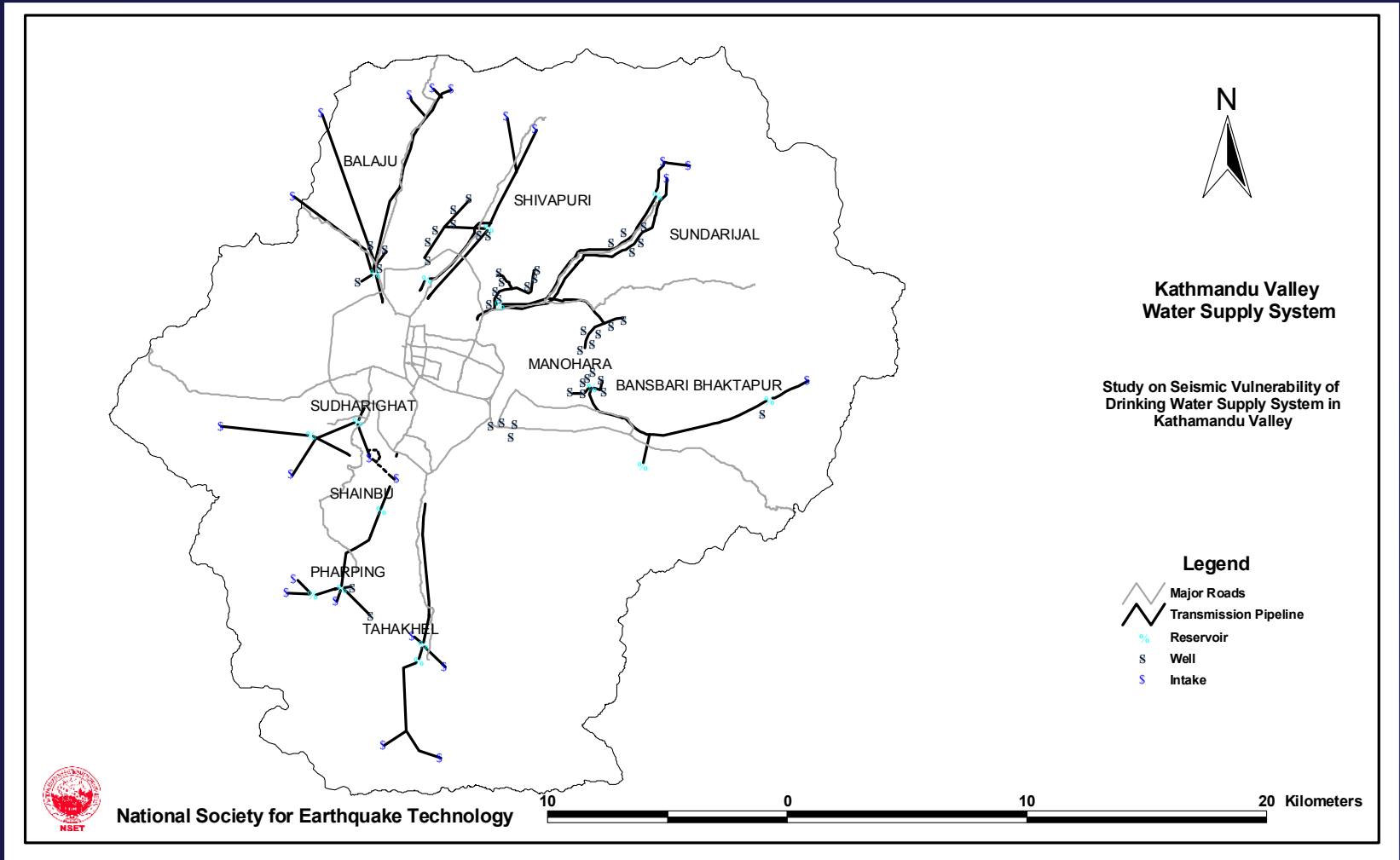


Recent Study

- **Recently a study on seismic vulnerability of Drinking Water Supply in Kathmandu Valley was conducted with the support from UNICEF Nepal**
- **The ATC-25-1 Methodology was used for the assessment of vulnerability with some adaptation to suit the local condition**
- **The study came up with recommendations for long term and short term mitigation measures**
- **Some of the recommendations for immediate action has been carried out**



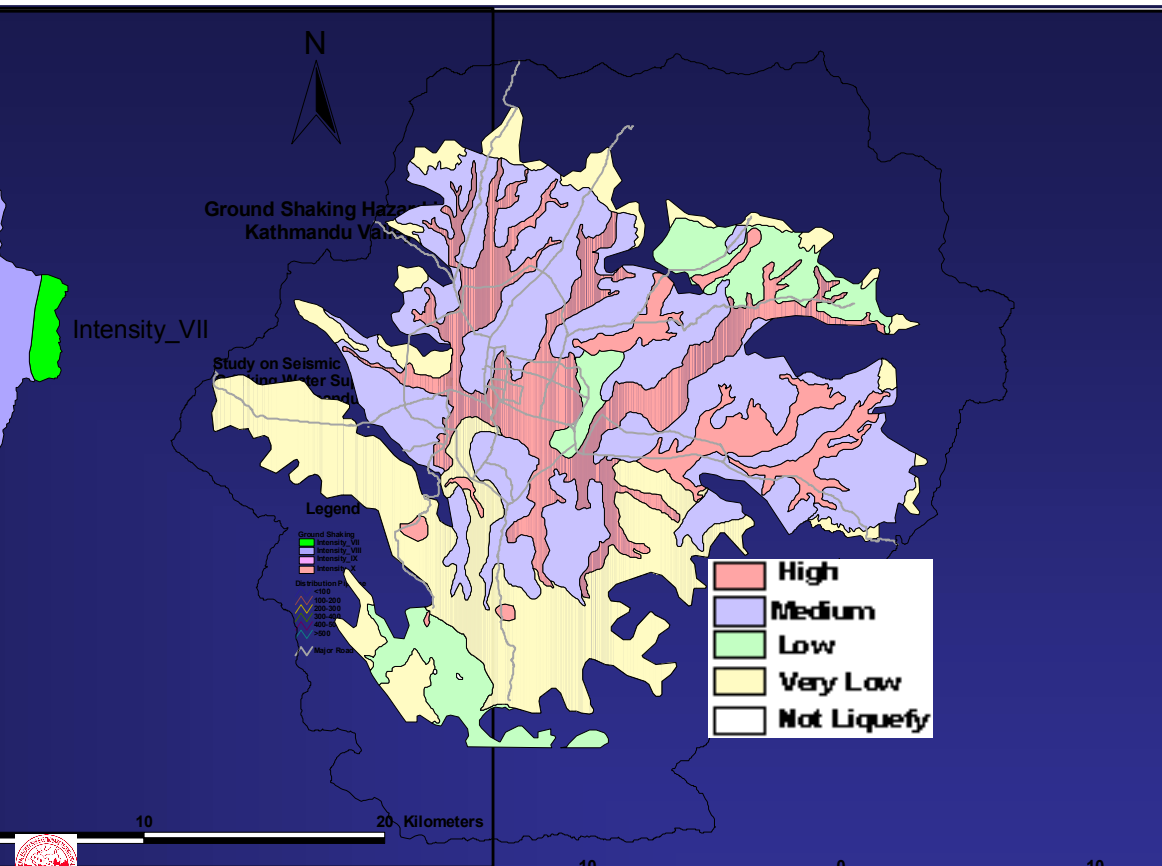
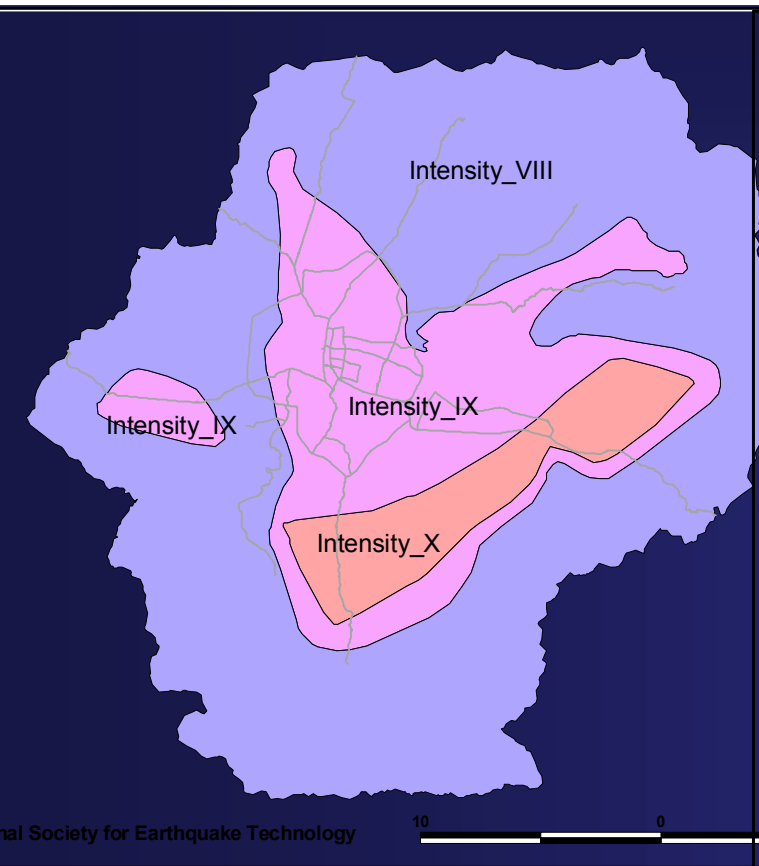
Kathmandu Valley Water Supply System



7 major supply networks – all very old and complex



Kathmandu Valley Seismic Hazard



Ground Shaking Hazard

Liquefaction Hazard

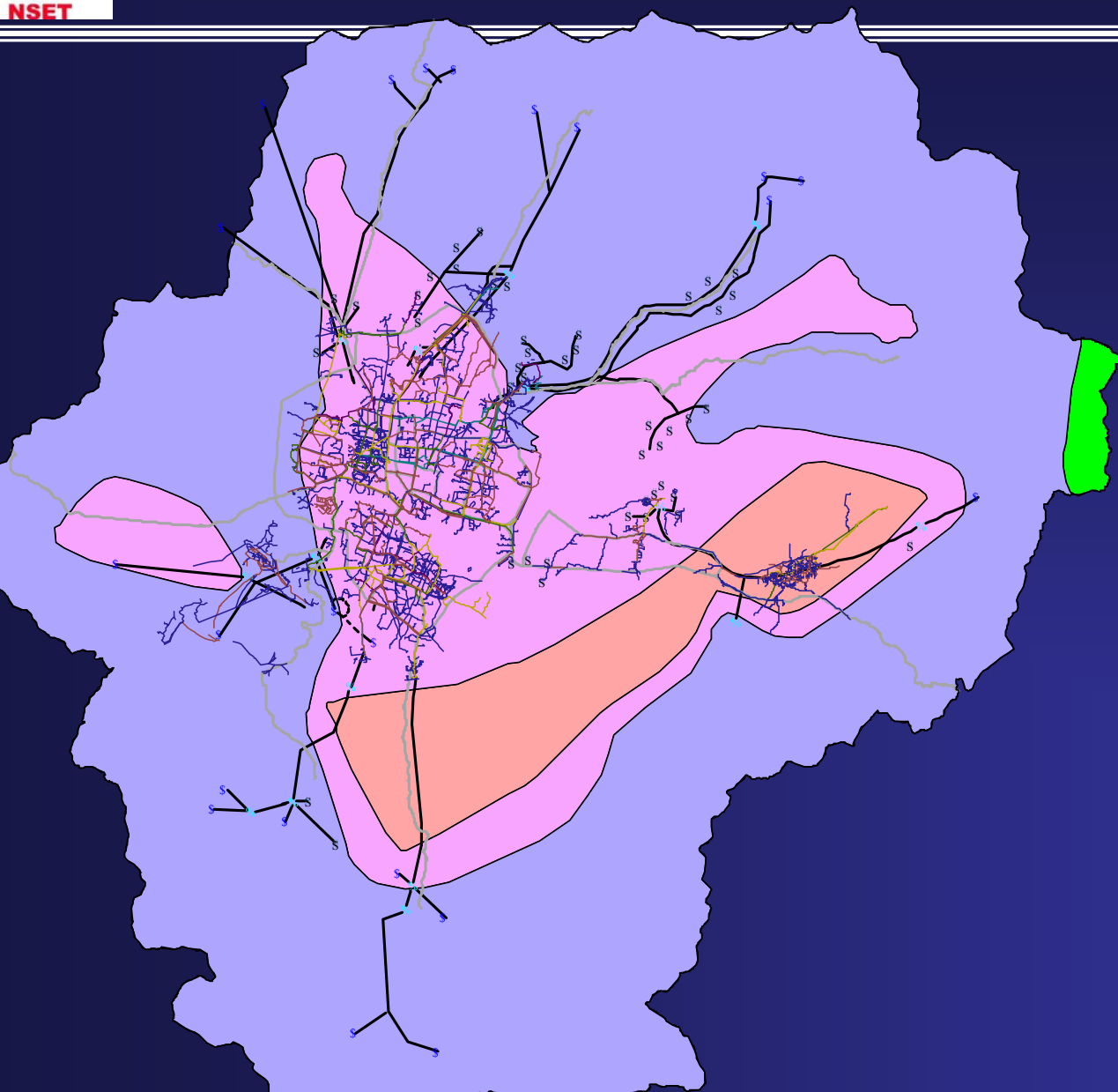


Damage due to Ground Shaking Hazard



Valley Water Supply System
Ground Shaking Hazard

Study on Seismic Vulnerability
Drinking Water Supply System
Kathmandu Valley



Legend

- Ground Shaking
 - Intensity_VII
 - Intensity_VIII
 - Intensity_IX
 - Intensity_X
- Distribution Pipeline
 - <100
 - 100-200
 - 200-300
 - 300-400
 - 400-500
 - >500
- Major Road
- Transmission Pipeline
- R Reservoir
- S Well
- I Intake

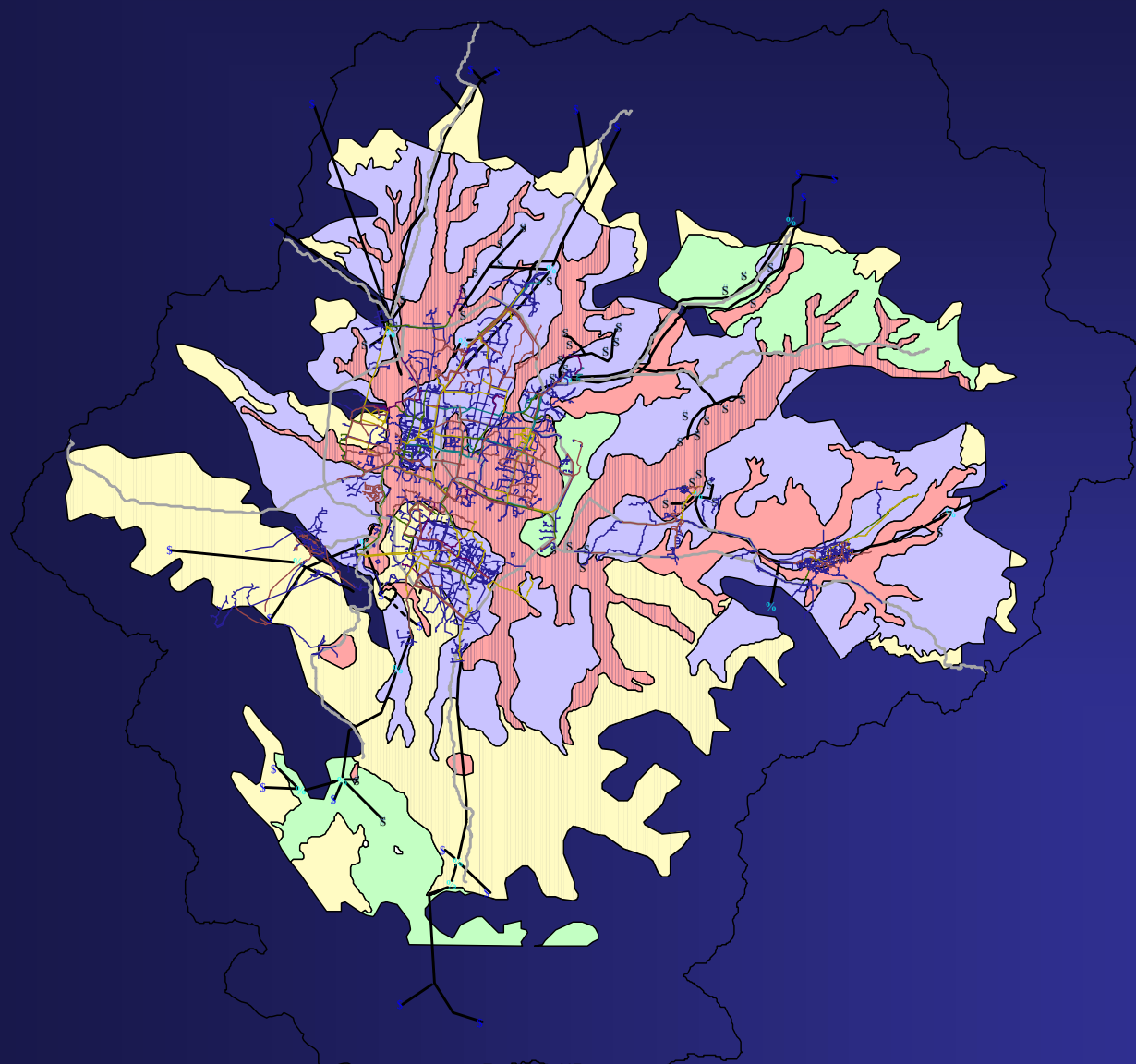


Damage due to Liquefaction Hazard



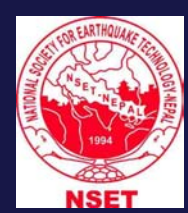
Valley Water Supply
Liquefaction Hazard

Study on Seismic Vulnerability of
Drinking Water Supply System
Kathmandu



- Liquefaction Hazard**
 - High
 - Medium
 - Low
 - Very Low
 - Not Liquefy
- Distribution Pipeline**
 - <100
 - 100-200
 - 200-300
 - 300-400
 - 400-500
 - >500
- Major Road
- Transmission Pipeline
- Reservoir
- Well
- Intake

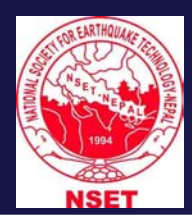




Total Damage and Direct Damage Cost

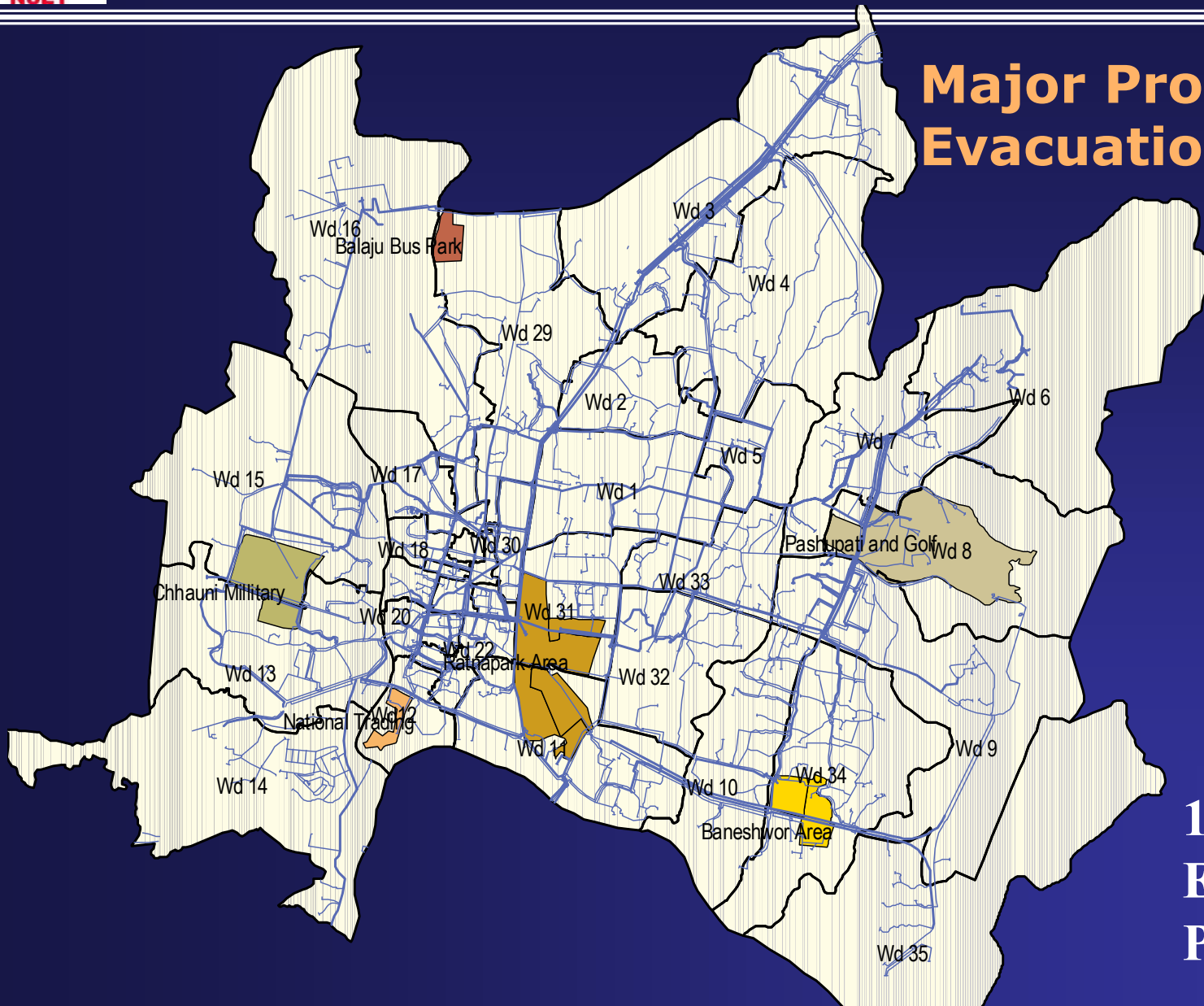
Diameter of Pipes (mm)	Damage (No. of Breaks)			Cost of Replacement per break (NRs)	Total Cost of Repair (NRs)
	Due to Liquefaction	Due to Ground Shaking	Total Damage		
<100	1666	2600	4267	5707.00	24,351,597.00
100-200	556	916	1471	22629.00	33,295,937.00
200-300	288	462	750	22480.00	16,869,025.00
300-400	165	267	431	48044.00	20,724,500.00
400-500	90	141	231	64283.00	14,872,225.00
>500	113	158	272	64283.00	17,462,316.00
Total	2879	4545	7423		127,575,602.00

Breaks in distribution pipes alone costs USD 1.75 million (Present Repair Rate)

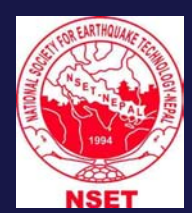


Water during Emergency

Major Probable Evacuation Points



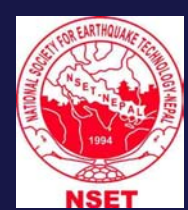
**17 Major
Evacuation
Points in KV**



Water during Emergency

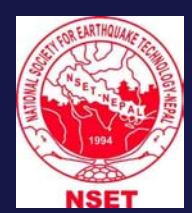
Evacuation Places	People holding capacity	Water (ltrs/day)	Reserve tanks for three days
Golf Course and Pashupati area	68,099	1,021,479	383
Birendra Intl. Conference Hall	14,286	214,286	80
Trally Park	8,893	133,393	50
Tudikhel (Khula Manch, Tudinkhel, Ratna park, Stadium, and Bhricuti Mandap area)	66,571	998,571	374
Exhibition Road area	4,957	74,350	28
Bhadrakali Military Camp area	10,809	162,141	61
Thapathali campus area	3,305	49,569	19
Chhauni Military area	28,055	420,822	158
National Trading Corporation	10,136	152,044	57
Balaju Buspark area	12,237	183,551	69
Total	227,347	3,410,205	1279

Tube wells in Evacuation Points require about a quarter million USD



Emergency Establishment of pipe system to serve Evacuation points

<u>Optimum Route for immediate recovery</u>	<u>Total breaks</u>	<u>Required Skill Manpower at hand</u>	<u>Cost (NRs '000)</u>
1. Shivapuri-Tudikhel	149	12	8737.00
2. Sundarijal-Pashupati	156	13	10,028.00
3. Manohara-Pashupati-Birendra Intl Conf. Hall	118	10	6485.00
4. Sundarighat-National Trading-Tundikhel	143	12	5864.00
5. Balaju- Chauni	135	12	4567.00
6. Takhel-Military-Khumaltar	115	10	2122.00

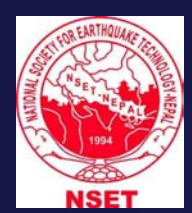


Emergency Establishment of pipe system to serve Evacuation points

<u>Optimum Route for immediate recovery</u>	<u>Total breaks</u>	<u>Required Skill Manpower at hand</u>	<u>Cost (NRs '000)</u>
7. Pharping- Pulchowk campus	88	7	5656.00
8. Sundarighat- Pulchowk campus	130	12	5136.00
9. Basbari- Industrial area-Military camp	158	13	4977.00
10. Manohara- Sallaghari- Military Camp	56	5	2690.00

Required money for restoration of optimum route = about a quarter million USD

time = about one month



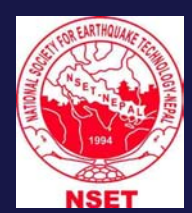
Institutional Capacity to respond disaster

Institutional Setup

- ◆ NO Mitigation, Emergency and Recovery plan
- ◆ Inter-intuitional coordination not explored

Operation & Maintenance

- ◆ Annual maintenance program for reservoir and treatment plan, not for conduits
- ◆ Very few trained personnel, just for small scale regular maintenance
- ◆ Equipments at centre, not enough to cope disaster



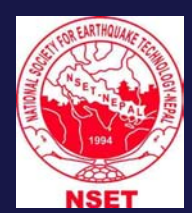
Institutional Capacity to respond disaster

Administrative support

- ✦ Centralized funding for repair
- ✦ Staff reassignment possible
- ✦ NO pre-contract with private companies for supply and service during emergency. No legal hurdle to do so.

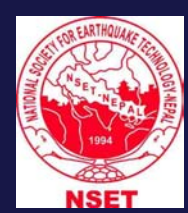
Hardware system

- ✦ Drawings with all key components not available
- ✦ Heavily interdependency with other infrastructure (electricity). Not all plants have backup generator
- ✦ One branch for tanker supply. Private tankers are also in operation



Institutional Capacity to respond disaster (Municipalities)

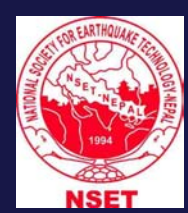
- ✦ NO plan for emergency case**
- ✦ NO responsibility assigned in regards to water service to citizen**
- ✦ NO dialogue with NWSC for coordination work required for emergency**
- ✦ Ready to provide institutional support to NWSC for disaster**



Recommended Actions

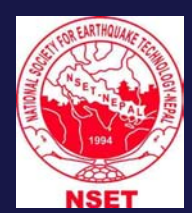
Specific for Emergency Response

- Maintain Accurate Facility maps
- Ensure Inter-institutional coordination for emergency response
- Maintain agreements with contractors, suppliers to provide service and material in case of disaster
- Maintain Redundancy in system operation. Back up generator, extra battery back at sites.
- **Maintain Pre-positioning of Drinking water at identified evacuation points. Perform Detail investigation for point source at evacuation sites**
- Maintain fund provision for for immediate recovery of water supply system to evacuation points



Achievements

- **Some of the immediate action are being implemented**
 - Some deep tube wells for supply during emergencies are established in some locations
- **Many emergency response institutions are concerned now**
- **Wide discussion about the mitigation process**



Thank You !