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KATHMANDU DISTRICT VULNERABILITY ASSESSMENT REPORT: URBAN SETTLEMENTS AND INFRASTRUCTURE (USAI) SECTOR

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Version B

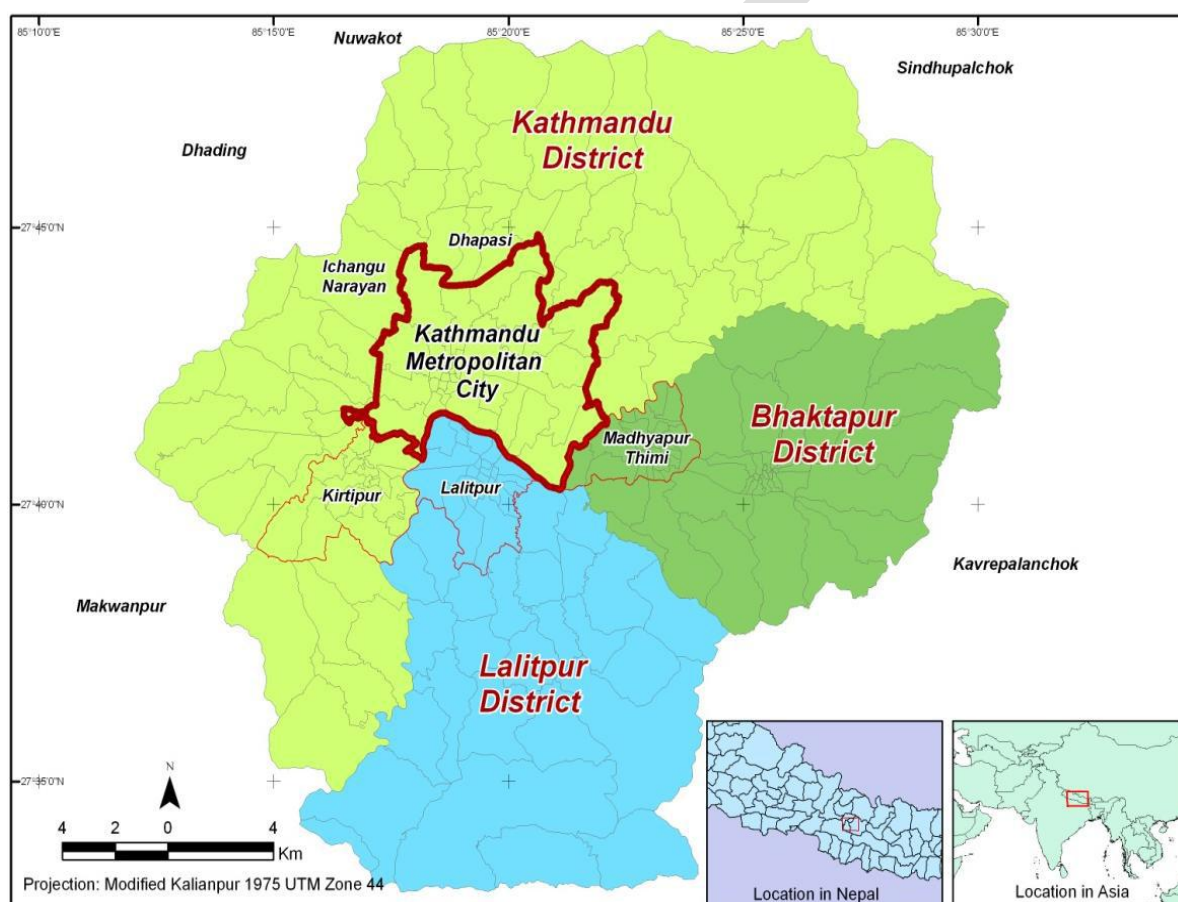
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1 DISTRICT ASSETS/SYSTEM PRIORITIES

1.1 Urban Settlements and Infrastructure (USAI) in Kathmandu District

Strategic infrastructure in the urban sector in Kathmandu district, has been planned according to the district's settlement pattern and trends and by the district sector master plan. Urban development components consist of buildings, housing, and infrastructure – urban roads and bridges, water supply and sanitation, storm drainage, solid waste disposal, rain water harvesting, and water retention schemes. A map of Kathmandu district is shown in Figure 1.1.



Kathmandu Valley Location Map

Source: Kathmandu Metropolitan City Government

Map and projection modified by EMI-GIS, 2010

Figure 1.1: Kathmandu District

The assets identified in the USAI sector are created through the annual programs of the Kathmandu Division of DUDBC and the Office of the Kathmandu District Commissioner, Kathmandu Valley Development Authority (KVDA). These programs are limited to government buildings, land development, public land conservation, urban amenities like park development, urban infrastructure developments such as roads and drains, and infrastructure development in the rural settlements. Apart from those two agencies, there are also other agencies under the Ministry of Urban Development (MUD) created to look

after special projects and programs related to urban environment conservation and development. These agencies include the High Powered Committee for Integrated Development of the Bagmati Civilization (HPCIDBC), and the UN Park Development Committee (UNPDC).

The emerging slums and squatter settlements which are disaster prone due to their locations in the vulnerable areas of the district also provide another dimension in the priority listing of the assets/system from climate change perspectives. Out of 51 informal settlements reported in the urban areas of the valley, 11 are along the Bagmati River with a squatter population of 7,040.

From climate change perspectives, the assets/systems in the urban sector within the district are very much influenced by the following factors:

- The characteristic geographic features of the district encompassing a large portion of the relatively flat topography of Kathmandu Valley as well as some hilly areas of Mahabharat mountain range;
- The major river system of the district consists of Bagmati and its principal tributaries - Vishnumati, Manohara, and Dhobi Khola rivers along with the numerous smaller rivers and rivulets, and Hanumante and Nakhu Kholas flowing through Bhaktapur and Lalitpur districts. (Figure 1.2).

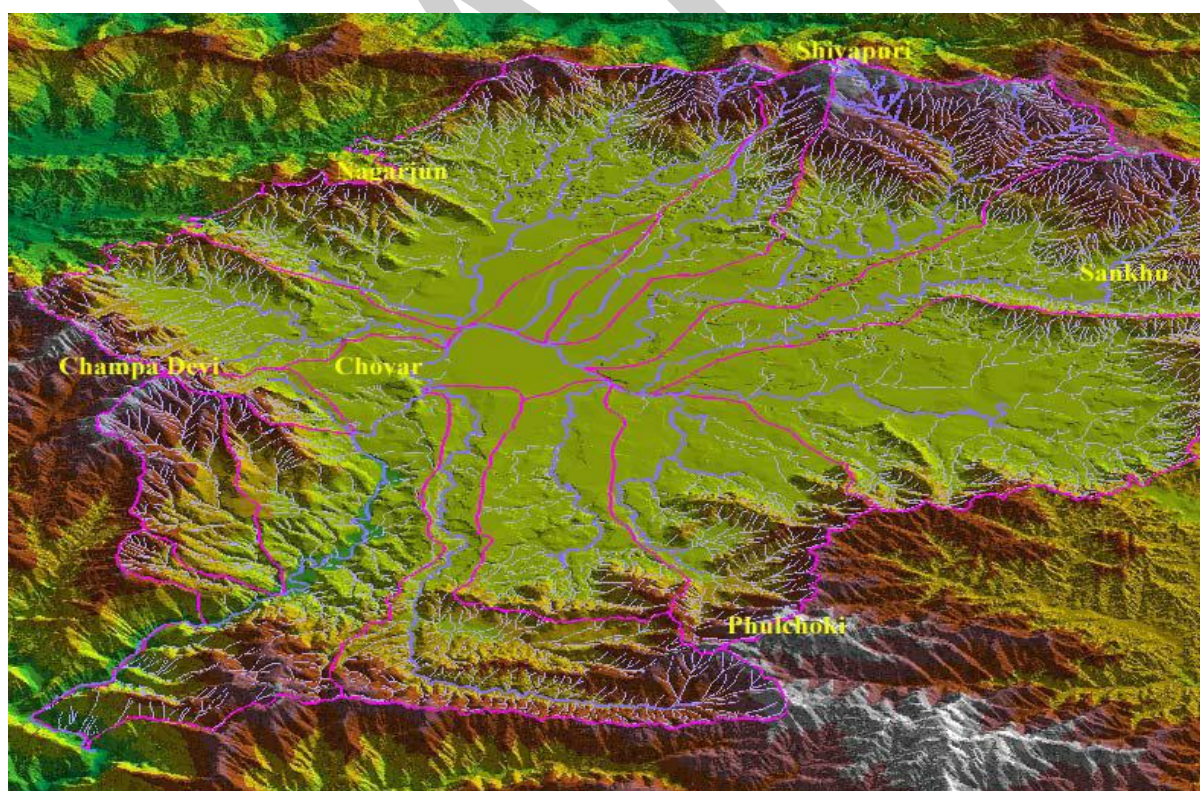


Figure 1.2: Watershed of Bagmati River and Tributaries.

1.2 Identifying the Priority Assets for Vulnerability Assessment

1.2.1 Criteria for selecting priority assets

Identification of the priority assets was carried out through field investigations and discussions with concerned government officials, local citizens and other stakeholders.

The key criteria for the assets prioritization were:

- Infrastructure of national strategic importance
- Infrastructure of district strategic importance
- Infrastructure that has been impacted by past extreme events
- Infrastructure located in areas prone to past extreme events.

On the basis of the above criteria the assets mentioned in Table 1 were short-listed.

ID	Name	Infrastructure type	Reason/s for inclusion
	Kathmandu Metropolitan City (KMC) Area		
1	The United Nations Park	Multi-dimensional Park (planned system/asset)	National Strategic Importance / cultural heritage sites
2	Dhobi Khola Growth Corridor	The urban expansion area along the Dhobi Khola river (planned system/asset)	District Strategic importance
3	Pathivara Informal Settlements	Spontaneously developed slum area along the river	Prone to past extreme events, particularly flood
4	Khadipakha Informal Settlements	Spontaneously developed slum area along the sloppy land	Infrastructure that has been impacted by the past extreme event - landslides
	Kirtipur Municipality		
5	Kirtipur Housing Project Area	Planned housing area for urban poor	Successful rainwater harvesting / infrastructure of district importance (resettlement site)

Table 1: List of priority infrastructure in Kathmandu district

Two urban assets out of the 5 short-listed assets were selected as priority assets for vulnerability assessments and adaptation planning in Kathmandu District. The priority assets include the United Nations Park and the Pathivara Informal Settlements (PIS). The priority assets selection is highly influence by the vulnerability of the settlements and built-up areas along the valley river systems. A brief discussion on these two assets and related components are in the following sub-sections.

1.2.2 Bagmati United Nations Park

Established to commemorate the 50th anniversary of the UN, the UN Park is aligned along a 3.5 km strip of Bagmati River extending from Sankhamul to Teku Dovan, linking both Kathmandu and Lalitpur districts. The park covers 82.95 hectares and is located in the historic core of Kathmandu Metropolitan City. Figure 1.3 shows the Bagmati River and its principal tributaries - Vishnumati, Manohara, and Dhobi Khola rivers along with the numerous smaller rivers and rivulets. These rivers form the watershed of the UN Park, and cover a 666 sq km area of the Kathmandu Valley. The UNPDC brochure states, 'growing population, increasing vehicular traffic, problems of waste management and the loss of bio-diversity characterize the capital city.

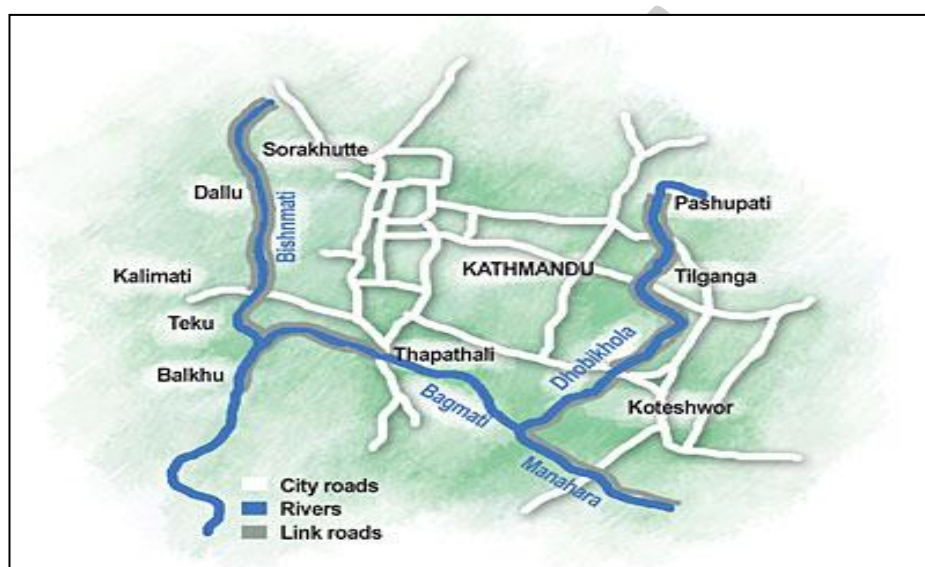


Figure 1.3 UN Park Location

The Master Plan prepared by UNPDC outlines several programs that are grouped into four categories: i) park development, ii) river training, iii) sewerage disposal and iv) conservation of historical, cultural, religious sites and monuments. The 3 park includes 6 Zones as follows:

- Zone I (UN Memorial Pillar),
- Zone II (walking and exercise activities),
- Zone III (elements of donor attraction),
- Zone IV (recreational activities),
- Zone V (conservation of historical, cultural & religious sites/monuments), and
- Zone VI (the Bagmati river).

Figure 1.4 shows the types of religious and cultural sites in Zone V.



Figure 1.4 Cultural and Religious Sites near UN Park

The planning and design concept for the project area is elaborated in 'the Guidelines for UN Park Master Plan. However, the guidelines require more elaboration in terms of the following: planning and design concept; detailed design of the individual zones; and the landscape and architectural components contained within each zone.

Illegal encroachment into certain sections of the Park has created social, political, environmental and security problems undermining the activities of the project. A need is also being felt for the positive intervention measures in the certain sections of the asset to improve their image and status in keeping with the project's vision, goals and objectives.

The residents along the Bagmati River have experienced flood problems in the past, and damages occurred to houses, agriculture land and other properties. As the adaptation response, the construction of river training structures at flood hazard locations along the river bank did provide some measure of safety from the possible damage. The disaster resilience of the asset in terms of climate change needs to be strengthened.

Basically from climate change perspective the Bagmati UN Park can be considered in terms of the following components:

- 1) Cultural/religious heritage sites and monuments component.
- 2) Urban green and recreational areas component.
- 3) The urban built-up areas (including mixed residential/institutional buildings, civil structures- bridges) component.
- 4) Informal settlements spread along the Bagmati river.

1.2.3 Pathivara Informal Settlements (PIS)

The squatter settlement of Pathivara is located 700 meters north of Chabahil Chowk along Dhobi Khola Corridor in Ward no 3 of Kathmandu Metropolitan City (Figure 1.5). The settlement consists of 165 households in cluster along Dhobi Khola Corridor. People started

to squat in Pathivara from 1993 till 2007. The field data indicates that out of 165 houses, only 34 houses (20%) are fairly in good conditions, and the rest being constructed with the inferior materials e.g. mud, bamboo, tin/metal sheet roofing, and plastic sheet roofing.

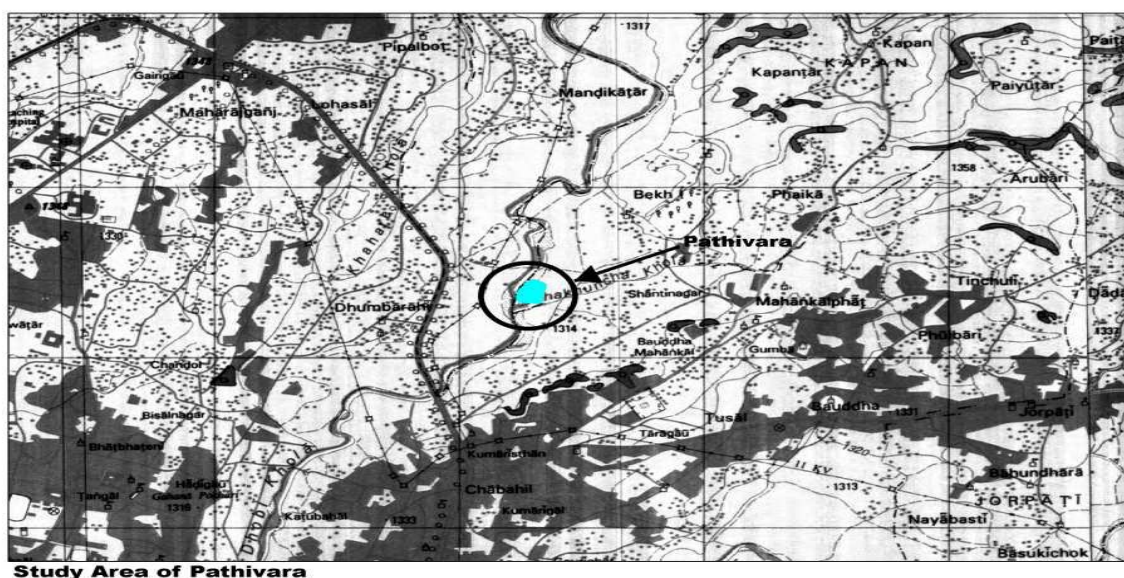


Figure 1.5 Location of Pathivara Informal Settlement.

Figure 1.6 provides an overall view of the Pathivara settlement along the river.



Figure 1.6: Pathivara Informal Settlement (PIS).

The upstream section of the Dhobi Khola passes through a ground water recharge zone, flood plain, rural agricultural areas and a peri-urban zone which defines the watershed situation of the asset. Kapan – the urbanising VDC - falls within the peri-urban zone and is located towards the west of the Dhobi Khola. The upper reaches of Dhobi Khola, where the asset is located, has experienced problems of bank cutting and inundation.

Heavy flooding was reported in Kathmandu district in July 13, 2010. However, it could not be ascertained how much damages to the life and property was caused within the asset area. Some area improvement program, launched by the local community did include provision of water supply and sanitation, paving of the walk ways, and other general infrastructure improvement schemes. However, the whole area appears very much prone to

the flooding. Since a majority of the buildings are in a poor condition, there is a need for special safety precaution for the existing structures from the possible future extreme events which might occur from increased and more intense precipitation events due to climate change. Further area upgrading measures need to be initiated to improve the living conditions of the residents. Tenure security would be a precondition for the genuine settlers in the area for positive impacts on the lives of the people living there in terms of secure living environment.

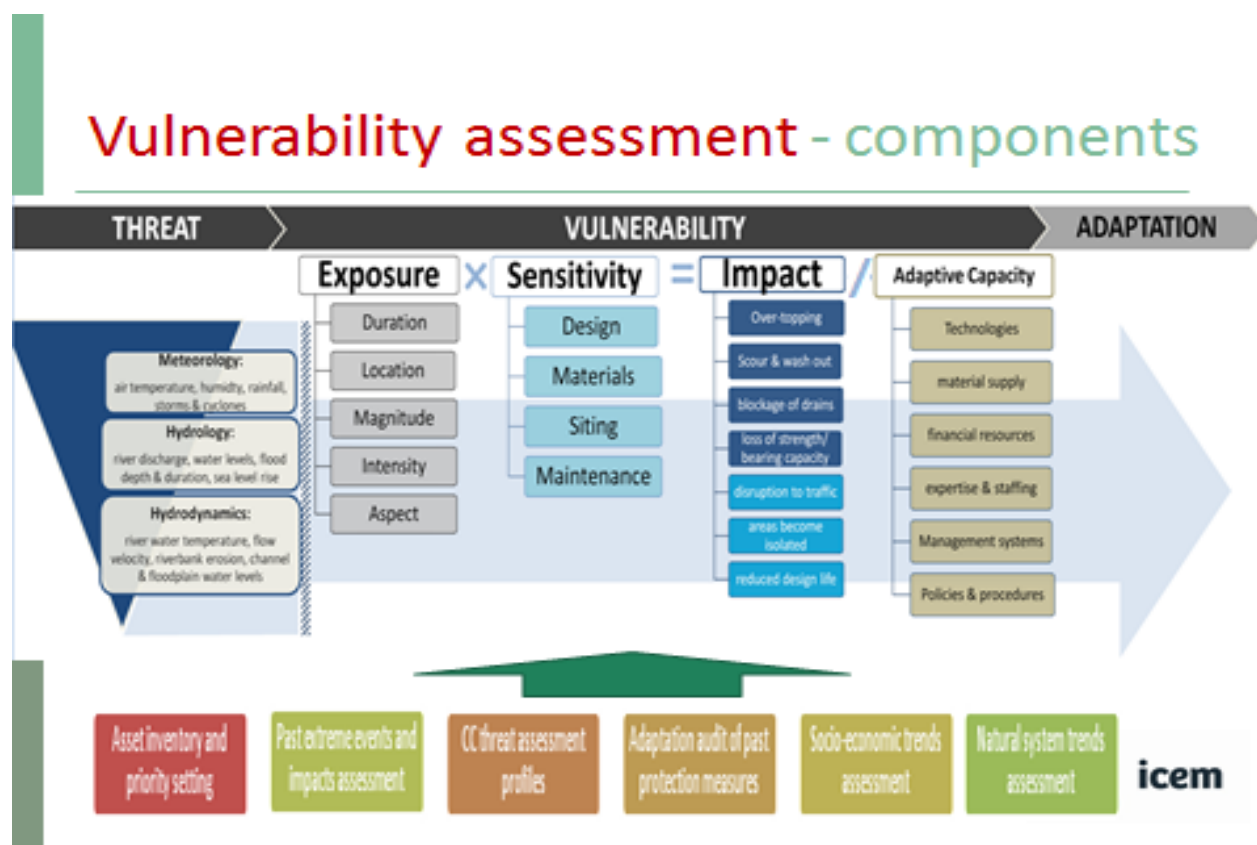
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2 VULNERABILITY ASSESSMENT METHOD

2.1 VA Method

The overall VA method used to assess the vulnerability of urban settlements and infrastructure (USAI) assets is outlined in Figure 2-1. Information for conducting the VA was obtained from the Dolakha District Baseline Report. The components of the baseline report as shown in the bottom part of Figure 2-1.

Figure 2-1: VA Process



For each of the high priority urban infrastructure assets identified in Dolakha, the projected district climate change threats were analyzed with regards to how each asset would be **exposed** to the climate threat as well as the **sensitivity** of the asset to the threat. After an assessment of the exposure and sensitivity of each asset to the projected climate change threats, a relative ranking of **impact** was determined through a standard evaluation matrix based on selected criteria for exposure and sensitivity. The two high priority infrastructure assets were selected because of their high impact rankings. To arrive at an assessment of the vulnerability of each asset to climate change threats, the **adaptive capacity** of each asset was evaluated in order to determine the degree of **vulnerability** to climate change. Again vulnerabilities of the assets were ranked according to an evaluation system matrix with specified criteria for adaptive capacity.

The criteria used for determining impacts and vulnerability for the assets are further explained in the next section.

2.2 Criteria of VA Method Applied to Urban Sector

The criteria used for determining risk and vulnerability for the high priority urban assets are (1) Exposure, (2) Sensitivity, and (3) Adaptive Capacity. These criteria are further explained in Kathmandu District context as follows.

Exposure with regards to climate change projections and threats is described by the following criteria:

- Duration of climate change event in terms of hours or days,
- Location with respect to the climate change threat,
- Intensity and volume of the climate change event, and
- Orientation of the asset with respect to a climate change event.

In Kathmandu District, the priority urban infrastructure assets – UN Park and the Pathivara Informal Settlement -- are mainly exposed to climate change events through location since both assets are situated near major rivers that are vulnerable to flooding and flash flooding.

Sensitivity criteria for the assets with regards to climate change threats consist of the following:

- Quality of construction materials and construction technology,
- Levels of asset maintenance,
- Availability of protection systems, and
- Design.

The UN Park and the cultural heritage sites associated with the park were sensitive to climate change threats because there are few protective systems constructed to protect various parts of the park. An embankment has been constructed at the upper river end of the park but the embankment is inadequate for protecting most areas of the park including the informal settlements and the religious cultural heritage sites near the Bagmati river. In Pathivara, poor housing design, quality of materials and construction techniques contribute to the asset's sensitivity to climate change. In most instances, National Building Code has not followed or monitored. Also in Pathivara, protective systems such as dykes or gabion walls have not been constructed.

Adaptive Capacity refers to the ability of Kathmandu institutions and communities to cope with climate change threats and natural disaster events. Adaptive Capacity criteria are listed as follows:

- Cross cutting factors such as availability of financial resources; availability of skills, knowledge and management systems to respond to climate change; and political commitment
- Availability of construction and repair resources, and access to adaptation technologies
- Social factors such as community networks, knowledge and skills to adapt to climate change and access to insurance
- Availability and diversity of natural eco-systems to cope with and help alleviate climate change events.

The Adaptive Capacity of UN Park is considered medium since there is a park development Master Plan in place with park development being managed by a Development Committee

with legal, administrative and resource mobilization power. However, some informal settlements and the cultural heritage temple management groups have very limited resources.

The Adaptation Capacity of the Pathivara Informal Settlement is rated as low since there is limited institutional capacity and financial resources in place to adequately respond to climate change.

2.3 Climate Change Threat Profiles

- 1) The climate change threat profiles for Kathmandu District were prepared by a hydrological climate modelling team. The year 1980-2000 was taken as the base year, and the climate change threats were projected to the year 2050.

The climate change threat profiles for Kathmandu were studied and their relevance to the USAI sector is described as follows.

2.3.1 Increase/decrease in precipitation

From downscaling of climate change projections, the following conclusions can be drawn:

- Duration of extreme rainfall events with high intensity will occur more often than before. For example, 40mm/hr rainfall intensity has duration of 10 minutes; in future 100mm/hr rainfall intensity will fall for the same duration.
- Increase in precipitation frequency and volume can be foreseen in future, this may trigger more flooding. The projected data for precipitation versus annual recurrence interval indicates increased precipitation events will occur more frequently. For example in the past 250 mm of precipitation used to occur at every 100 years but in future it can be seen at every 30 years.
- On an average the rainfall intensities will increase by 76%.

2.3.2 Increase in temperature

Regarding rising temperature projections, the following conclusions can be drawn:

- Increase in average maximum temperature of up to 1.85⁰C.
- The projected data indicates a temperature of 25⁰ C, which is currently exceeded by 60% of days in one year, would increase to 73% by the year 2050. The corresponding figures for 30⁰ C would be 10% and 30%, respectively, implying that a higher temperature would persist during the wet season triggering a longer summer period by the year 2050.

2.3.3 Increase in flows

The projected climate change threats to river flows in Kathmandu reveals the following:

- Increase in wet season flow in Bagmati – peak monthly average flow in wet season will increase up to 68%.
- Extreme river flows that historically used to occur every 20 or 30 years will occur almost every year by year 2050
- Increase in flood water levels in Bagmati and Dhobi Khola rivers could have a significant negative impact on the informal settlements and cultural heritage sites along the rivers.

3 VULNERABILITY ASSESSMENT RESULTS

The detailed results of the vulnerability assessment are outlined in matrix format in Annex 1 of this report. However, a brief vulnerability assessment of two assets within Kathmandu District is outlined below:

3.1 Vulnerability Assessment of UN Park

The following sub-section outlines the decisions undertaken in setting the levels of threat, exposure, sensitivity and adaptive capacity for the UN Park.

Threat: Increased Intensity of Rainfall caused Riverine Flooding

The following threats have been identified as likely to impact on the water supply system:

- As per the projected climate change threat profile, average rainfall intensities will increase by 10%.
- Rainfall events occur more frequently than before, 5 year events now occur at every 2 years.
- 10 year flow event will increase by 80%.
- Peak monthly average flow in wet season will increase by up to 68%.
- 40% increase in peak flow which will occur earlier, mid-July.

Exposure: VERY HIGH

The exposure was ranked as very high for the following reasons:

- Asset components are located on both sides of 3.5 km stretch of Bagmati river in flood plain area. Eastern area of park is flooded regularly, every 1-2 years. Extreme flood events occurred in 1993 and 2002 when water levels reached lower level of temple Ghats.

Sensitivity: HIGH

The sensitivity was ranked as high for the following reasons:

- Informal settlements located in flood plain, and historic temples adjacent to flood plain. Some river training in place in park area. Roads and bridges built to relatively high standards. City drainage system blocked at some locations in park.

Impact: VERY HIGH

From the guiding matrix shown in Figure 3.1, it can be seen that the impact is VERY HIGH as well. The justification for high impact is given below:

- High velocity flows could undermine Bagmati bridges and cause structural damage disrupting transportation.
- Destruction of historic temples, Ghats, school, informal settlements and police barracks.
- UNICEF constructed ground water supply and treatment system could be severely damaged and rendered non functional.
- Damage to park greenery, bio-diversity and agricultural areas.
- Indirect impacts – Possible high loss of life, property damage and extreme disruption in peoples' livelihood. Contamination of UNICEF water treatment system.

- Loss of vegetable crops.

Adaptive Capacity: MEDIUM

The adaptive capacity was ranked as medium for the following reasons:

- Park development Master Plan in place with park development being managed by a Development Committee with legal, administrative and resource mobilization power. Informal settlements and temple management groups have very limited resources.

Vulnerability Scoring: VERY HIGH

As per the guiding matrix, the vulnerability for the UN Park is VERY HIGH.

Figure 3.1: Vulnerability Matrix for Bagmati UN Park

		Impact				
		Very Low Inconvenience (days)	Low Short disruption to system function (weeks)	Medium Medium term disruption to system function (months)	High Long term damage to system property or function (years)	Very High Loss of life, livelihood or system integrity
Adaptive Capacity	Very Low Very limited institutional capacity and no access to technical or financial resources	Medium	Medium	High	Very High	Very High
	Low Limited institutional capacity and limited access to technical and financial resources	Low	Medium	Medium	High	Very High
	Medium Growing institutional capacity and access to technical or financial resources	Low	Medium	Medium	High	Very High
	High Sound institutional capacity and good access to technical and financial resources	Low	Low	Medium	Medium	High
	Very High Exceptional institutional capacity and abundant access to technical and financial resources	Very Low	Low	Low	Medium	High

3.2 Vulnerability Assessment of Pathivara Informal Settlements

The following sub-section outlines the decisions undertaken in setting the levels of threat, exposure, sensitivity and adaptive capacity for the Pathivara informal settlements.

Threat: Increased Intensity of Rainfall caused Riverine Flooding

The following threats have been identified as likely to impact on the water supply system:

- As per the threat profile, on average rainfall intensities will increase by 10%.

- Rainfall events occur more frequently than before, 5 year events now occur at every 2 years.
- 10 year flow event will increase by 80%.
- Peak monthly average flow in wet season will increase by up to 68%.
- 40% increase in peak flow which will occur earlier, mid-July.

Exposure: VERY HIGH

The exposure was ranked as very high for the following reasons:

A majority of the poor quality construction dwelling units being located at the edge of the stream are highly exposed to riverine flooding.

Sensitivity: HIGH

The sensitivity was ranked as high for the following reasons:

- High population density (1000 persons per ha) resulting in poor environmental living conditions, and
- Poor quality of housing construction.

Impact: VERY HIGH

From the guiding matrix (Figure 3.2), it can be seen that the impact is VERY HIGH as well. The justification for high impact is given below:

- High velocity flows could enter into the settlements along the banks of the kholas and rivers.
- Destruction of 80% houses constructed with the inferior materials e.g., mud, bamboo, tin/metal sheet roofing, plastic sheet roofing and in some cases loss of human life.
- Indirect impacts – possible high loss of life, property damage and extreme disruption in peoples' livelihood.
- Secondary impacts would result into the prevalence of diseases as a result of environmental deterioration.

Adaptive Capacity: LOW

The adaptive capacity was ranked as medium for the following reasons:

- The informal settlement groups have very limited resources to prepare themselves for any emergency management procedures and evacuation.

Vulnerability Scoring: VERY HIGH

As per the following guiding matrix, the vulnerability for the Pathivara Informal Settlement is VERY HIGH.

Figure 3.2 Vulnerability Matrix for Pathivara Informal Settlements

	<i>Impact</i>					
		<i>Very Low</i> <i>Inconvenience</i> <i>(days)</i>	<i>Low</i> <i>Short</i> <i>disruption to</i> <i>system</i> <i>function</i> <i>(weeks)</i>	<i>Medium</i> <i>Medium term</i> <i>disruption to</i> <i>system</i> <i>function</i> <i>(months)</i>	<i>High</i> <i>Long term</i> <i>damage to</i> <i>system property</i> <i>or function</i> <i>(years)</i>	<i>Very High</i> <i>Loss of life,</i> <i>livelihood or</i> <i>system integrity</i>
<i>Adaptive Capacity</i>	<i>Very Low</i> <i>Very limited institutional capacity</i> <i>and no access to technical or</i> <i>financial resources</i>	<i>Medium</i>	<i>Medium</i>	<i>High</i>	<i>Very High</i>	<i>Very High</i>
	<i>Low</i> <i>Limited institutional capacity and</i> <i>limited access to technical and</i> <i>financial resources</i>	<i>Low</i>	<i>Medium</i>	<i>Medium</i>	<i>High</i>	<i>Very High</i>
	<i>Medium</i> <i>Growing institutional capacity and</i> <i>access to technical or financial</i> <i>resources</i>	<i>Low</i>	<i>Medium</i>	<i>Medium</i>	<i>High</i>	<i>Very High</i>
	<i>High</i> <i>Sound institutional capacity and</i> <i>good access to technical and</i> <i>financial resources</i>	<i>Low</i>	<i>Low</i>	<i>Medium</i>	<i>Medium</i>	<i>High</i>
	<i>Very High</i> <i>Exceptional institutional capacity</i> <i>and abundant access to technical</i> <i>and financial resources</i>	<i>Very Low</i>	<i>Low</i>	<i>Low</i>	<i>Medium</i>	<i>High</i>

4 KATHMANDU DISTRICT VULNERABILITY SUMMARY

4.1 Summary of VA Results

4.1.1 Bagmati UN Park

The table below summarises the vulnerability assessment of the UN Park settlements.

UNITED NATIONS PARK					
THREAT	EXPOSURE	SENSITIVITY	IMPACT	ADAPTATION CAPACITY	VULNERABILITY
INCREASED RAINFALL CAUSED RIVERINE FLOODING	VERY HIGH	HIGH	VERY HIGH	MEDIUM	VERY HIGH

4.1.2 Pathivara Informal Settlements

The table below summarises the vulnerability assessment of the Pathivara Informal Settlements.

PATHIVARA INFORMAL SETTLEMENTS					
THREAT	EXPOSURE	SENSITIVITY	IMPACT	ADAPTATION CAPACITY	VULNERABILITY
INCREASED RAINFALL CAUSED RIVERINE FLOODING	VERY HIGH	HIGH	VERY HIGH	LOW	VERY HIGH

4.2 Most Vulnerable Assets and its Components

Based on the VA performed within Kathmandu District, the following conclusions can be made on the assets and components.

Bagmati UN Park

THREAT	DESCRIPTION	IMPACT and WHY IT IS VULNERABLE
Increased Flow due to increased rainfall	Increased flow events occur more frequently and in large volumes	<ul style="list-style-type: none"> High velocity flows could undermine Bagmati bridges and cause structural damage disrupting transportation. Destruction of historic temples, Ghats, school, informal settlements and police barracks. UNICEF constructed ground water supply and treatment system could be severely damaged and rendered non-functional. Damage to park greenery, bio-diversity and agricultural areas. Indirect impacts – Possible high loss of life, property damage and extreme disruption in peoples' livelihood. Contamination of UNICEF water treatment system. Loss of vegetable crops.

Pathivara Informal Settlements

THREAT	DESCRIPTION	IMPACT and WHY IT IS VULNERABLE
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Increased Flow due to increased rainfall	Increased flow events occur more frequently and in large volumes	<ul style="list-style-type: none"> • High velocity flows could enter into the settlements along the banks of the kholas and rivers. • Destruction of houses and in some cases loss of human life. • Indirect impacts – Possible high loss of life, property damage and extreme disruption in peoples' livelihood. Contamination of water treatment system. • Secondary impacts would result into the prevalence of diseases as a result of environmental deterioration.
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4.3 Lessons and Application to Other Assets

- The two prioritized short-listed assets – Bagmati UN Park and Pathivara Informal Settlement - represent the vulnerable assets in the urban settings within Kathmandu district. Since similar types of assets can be seen across the district, this means that the VA for these two assets can be applicable to other areas in Kathmandu District.
- The Bagmati UN Park is only 3.5 km stretch of the total length of Bagmati river (28.75 km) extending from Sundarijal within Shivapuri watershed in the north up to Chovar - the narrow gorge in the southern edge of the valley. This long stretch contributing to Bagmati civilisation within the Kathmandu Valley consists of innumerable settlements along with historical, cultural and religious elements. They are experiencing similar sort of exposure, sensitivity towards the climate change threats, and high vulnerability levels implying that UN Park adaptation interventions can be applied within the wider context represented by the Sundarijal - Chovar stretch and the major river system of the district. The Kathmandu Valley river system consists of Bagmati and its principal tributaries such as the Vishnumati, Manohara, and Dhobi Khola rivers, along with the numerous smaller rivers and rivulets including the Hanumante and Nakhu Kholas flowing through Bhaktapur and Lalitpur districts.
- Pathivara Informal Settlement (PIS) is one of the 51 informal settlements in the urban areas of the Kathmandu valley, and out of which 11 are along the Bagmati River and confined within Kathmandu District with a squatter population of 7,040. Hence, the climate vulnerability arising out of climate threats and the VA for the PIS could have wider applications for the similar assets within the district affecting a large number of squatter populations.
- The VA of the two selected urban assets highlight a need for linking with other sectors – particularly, road and bridge, water supply and sanitation, and drainage sectors, to achieve an integrated urban development strategy for climate resiliency.

ANNEXES

VA MATRIX

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Threat	Interpretation of threat	Exposure	Sensitivity	Impact Level	Impact Summary	Adaptive capacity	Vulnerability
Change and shift in regular climate	written description of how the threat relates to the asset	refer to table			written explanation of what the impact is, and why it was scored (high, med, low)	refer to table	refer to table
Increased Intensity of Rainfall caused Riverine Flooding	<ul style="list-style-type: none"> As per the threat profile (see Annexure 1), on an average rainfall intensities will increase by 10% Rainfall events occur more frequently than before. Rainfall events occur more frequently than before, 5 year events now occur at 	VERY HIGH¹	HIGH²	VERY HIGH	<ul style="list-style-type: none"> High velocity flows could undermine Bagmati bridges and cause structural damage disrupting transportation. Destruction of historic temples, Ghats, school and police barracks. UNICEF constructed ground water supply and treatment system could be severely damaged and rendered non functional. Damage to park greenery, bio-diversity and agricultural areas. Indirect impacts – Possible high loss of life, property damage and extreme disruption in peoples' livelihood. 	MEDIUM³	VERY HIGH

¹ Located on both sides of 3.5 km stretch of Bagmati river in flood plain area. Eastern area of park flooded regularly, every 1-2 years. Extreme flood events occurred in 1993 and 2002 where water levels reached lower level of temple Ghats..

² Informal settlements located in flood plain, and historic temples adjacent to flood plain. Some river training in place in park area. Roads and bridges built to relatively high standards. City drainage system blocked as some locations in park.

³ Park development Master Plan in place with park development being managed by a Development Committee with legal, administrative and resource mobilization power. Informal settlements and temple management groups have very limited resources.

	<ul style="list-style-type: none"> every 2 years 10 year flow event will increase by 80% Peak monthly average flow in wet season will increase by up to 68% 40% increase in peak flow which will occur earlier, mid-July 				<ul style="list-style-type: none"> Contamination of UNICEF water treatment system. Loss of vegetable crops. 		
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Threat	Interpretation of threat	Exposure	Sensitivity	Impact Level	Impact Summary	Adaptive capacity	Vulnerability
Change and shift in regular climate	<i>written description of how the threat relates to the asset</i>	<i>refer to table</i>			<i>written explanation of what the impact is, and why it was scored (high, med, low)</i>	<i>refer to table</i>	<i>refer to table</i>
Increased Intensity of rainfall caused riverine flooding	<ul style="list-style-type: none"> Average rainfall intensities will increase by 10% Rainfall events occur more frequently than before. Rainfall events occur more frequently than before, 5 year events now occur at every 2 years 10 year flow event will increase by 80% Peak monthly average flow in wet season will increase by up to 68% 	VERY HIGH⁴	HIGH⁵	VERY HIGH	<ul style="list-style-type: none"> High velocity flows could enter into the settlements along the banks of the kholas and rivers. Destruction of houses and in some cases loss of human life. Indirect impacts – Possible high loss of life, property damage and extreme disruption in peoples' livelihood.. Secondary impacts would result into the prevalence of diseases as a result of contamination of water treatment system and environmental deterioration. 	LOW⁶	VERY HIGH

⁴ A majority of the dwelling units being located at the edge of the stream are highly exposed to riverine flooding.

⁵ High population density (1000 pph), poor quality of construction, very poor environmental conditions of the Pathivara informal settlement in terms of extreme congestion.

⁶ The informal settlement groups have very limited resources to prepare themselves for any emergency management procedures and evacuation.

	<ul style="list-style-type: none">40% increase in peak flow which will occur earlier, mid-July							
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