

Integrating Natural Hazards in the Planning Process
Risk Control Planning Workbook

Linda Noson

for the

Sri Lanka Urban Multi-Hazard
Disaster Mitigation Project

January 2000



Asian Disaster Preparedness Center

Bangkok, Thailand

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The **Sri Lanka Urban Multi-hazard Disaster Mitigation Project** was launched in September 1997 under the Asian Urban Disaster Mitigation Program. The objective of the Sri Lanka national demonstration project is to reduce the vulnerability of the Ratnapura municipality. The project, implemented by the Centre for Housing, Planning and Building in partnership with the National Building Research Organisation and the Urban Development Authority, demonstrated a methodology for identifying hazards and for selecting appropriate strategies to avoid or reduce hazard related losses. The project assisted municipal officials to develop improved tools and skills in development planning and risk management. Activities under the demonstration phase of the project included hazard and vulnerability mapping, risk analysis, strategic planning, policy and procedural changes, training and professional development, and networking.



This paper is published under the Asian Urban Disaster Mitigation Program for sharing knowledge and experiences from national demonstration projects on disaster mitigation in target countries of Asia. It is made available by the Asian Disaster Preparedness Center, Bangkok, Thailand, with minimal editing. The opinions expressed herein are those of the author and do not necessarily reflect the views of Asian Disaster Preparedness Center or the U.S. Agency for International Development. Publication of this paper was made possible through support provided by the Office of Foreign Disaster Assistance, United States Agency for International Development, under the terms of Cooperative Agreement No. 386-A-00-00-00068.

The contents of this paper may be freely quoted with credit given to the implementing institution, Asian Disaster Preparedness Center and to the Office of Foreign Disaster Assistance of the U.S. Agency for International Development.

Working Paper #1

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Acknowledgements

It is with pleasure that ADPC presents the first of a series of papers to be published by the Asian Urban Disaster Mitigation Program (AUDMP), one of the regional programs managed by the ADPC. The AUDMP being implemented in Bangladesh, Cambodia, Laos, India, Indonesia, Nepal, Philippines, Sri Lanka, has demonstrated successful methodologies and approaches in mitigating the impact of the disasters in the region. During implementation of the national demonstration projects, there has been continuous building of knowledge and experience emanating from the country projects. The national demonstration projects have produced wealth of knowledge in the form of hazard maps, reports, proceedings, review of policies, documentation of various events and activities, etc.

The purpose of making the papers available in the present form is to share the knowledge and experiences with those promoting mitigation in their respective constituencies at community, city and national levels and to help them learn from the experiences of the national demonstration projects.

The present paper was originally produced by Ms. Linda Noson of Linda Noson Associates, USA who was hired as ADPC consultant on the request of the Centre for Housing, Planning and Building, the implementing institution of Sri Lanka Multi-hazard Disaster Mitigation Project, to develop and finalize this Risk Based Mitigation Planning Workbook.

ADPC congratulates the Centre for Housing, Planning and Building and its partner institutions, including National Building Research Organisation and Urban Development Authority for successfully implementing the demonstration project and wish them success during the replication phase of the project to further continue their efforts in reducing loss of lives and damage of properties from devastating disasters.

I also take this opportunity to thank Ms. Linda Noson for contributing to the workshop organized for planners from the UDA and for developing this Workbook.

We hope that you will find this paper useful and we look forward to receiving your comments on this new initiative.

Dr. Suvit Yodmani
Executive Director
Asian Disaster Preparedness Center
Bangkok, Thailand

January 2000

Preface

The Risk Control Planning Workbook supported the delivery of a workshop held on 21 & 22 January 1999 for planners of the Urban Development Authority (UDA) of Sri Lanka. The workshop was held at the Centre for Housing, Planning and Building (CHPB) of the Ministry of Urban Development, Housing and Construction of Sri Lanka. The workshop was organized by the Sri Lanka Urban Multi-hazard Disaster Mitigation Project (SLUMDMP), which is a collaboration of the Urban Development Authority (UDA), National Building Research Organisation (NBRO) and Centre for Housing, Planning and Building (CHPB). The workshop was attended by over 70 planners from the UDA, NBRO and local authorities. The UDA is the central agency in Sri Lanka providing the planning assistance to local authorities. The workshop provided an opportunity for planners to learn about the impacts of natural hazards on communities, share information on local efforts to incorporate natural hazards into the planning process and to learn new approaches.

I wish to extend my gratitude to the ADPC for providing a consultant, viz. Ms. Linda Noson of AGRA Earth & Environmental, for preparing this workbook.

Ms. Noson initially designed the methodology for Risk Based Mitigation Planning Approach, which was finalized at an earlier workshop held in July 1998 at the CHPB for a similar target group and was published by the SLUMDMP.

I am grateful to Ms. Noson for preparing the Risk Control Planning Workbook for the use of planners in integrating natural hazards into the planning process.

I wish to take this opportunity to thank the project partners UDA, NBRO, CHPB and staff involved in the project activities for their contribution, continued support and encouragement.

Publication of the Risk Control Planning Workbook is yet another achievement of the SLUMDMP, which welcomes any constructive suggestions and comments for further improvements if necessary.

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Project Director
Sri Lanka Multi-hazard Disaster Mitigation Project

January 2000

Introductory Note

There are three dimensions to risk discussed in this workbook: (1) elements exposed to harm (exposure inventory), (2) the nature of the hazard having potential to cause harm, and (3) the vulnerability of the exposure inventory to hazard impacts. Together these three elements define the risk problem. Developing countries are particularly vulnerable to the impacts of natural hazards. According to the United Nations Human Development Report (UNDP, 1994), “in the 45 least developed countries, 46% of the population lacked access to health services, 55% lacked safe drinking water, the average daily calorie supply per capita was 91% of requirements, and 64% lived in absolute poverty”. Hazard impacts on these chronically vulnerable communities can be disproportionately harmful as compared to impacts on more resilient communities. Even modest hazard impacts on countries with marginal food production and health care capabilities can overwhelm the capacity of the country to cope.

The devastating impacts of natural hazard events can prevent communities from achieving the most basic of human goals, human survival. Flooding, landslides, and cyclones are among some of the natural hazards that have impacted Sri Lanka communities over the past 15 years (Table 1). The selected events shown on Table 1 have killed more than 400 individuals, displaced over one-half million people, destroyed thousands of homes, damaged roads, water supplies, agricultural production, and fostered disease. The events in Table 1 do not show the substantial losses that also result from the accumulation of impacts of smaller events over a long time period. Together sudden on-set hazards like landslides and slowly emerging hazards like global warming interfere with the capability of community members to achieve the essential goals and objectives that embody the vision of what they want the future to be.

Table 1: Selected Hazard Events in Sri Lanka (from UNDR0 web page)

Hazard	Date	Location	Fatalities Missing	Displaced Persons	Impacts
Floods Monsoon	Jul 1984	Ratnapura, Kegalle, Gampaka, Colombo	3	14,000 homeless	1500 houses destroyed
Floods Landslides	Jan. 1986	Floods in eastern area; Landslides in Central provinces	43 dead 12,897 families affected	3,030 homes destroyed	
Irrigation Dam Burst	Apr. 1986	Kantalai Reservoir 138 mi. NE of Colombo	14 dead; 25 missing	9500	Housing reconstruction RS 5.4 million (400 new homes; 450 homes repaired) Polluted wells; Disease; Agriculture Dozens of villages flooded
Floods and Landslides	June 1989	SouthWest; Bulathkohupitiya in Kegalle District worst affected	300 dead	300,000 homeless	Homes (Columbo 900; Matara 250) Roads Bridges Culverts Sanitation; water supply;
Floods And Landslides	Jan 1990	Ampara Badulla, Kandy, Kurunegala, Matale, Monaragala, Nuwara, Eliya, Polonnaruwa, Trincomalee	33 dead	37,653 400,000 affected	16,000 homes

Hazard	Date	Location	Fatalities Missing	Displaced Persons	Impacts
Cyclone	Nov. 1992	Eastern Coast, moving west; Ratnapura; Badulla; Nuwara; Eliya Districts	3 dead		housing Heavy rainfall Communications; Railway; Roads
Floods Monsoons	Jun 1993	South; Colombo, Kalutara; Galle; Matara; Ratnapura	8	28,000 families effected	
Floods	Dec. 1993	North Central North Eastern 7 Districts		150,000 people effected	Property damage; plantations, farms, infrastructure extensively damaged; irrigation tank overflows
Floods – NE Monsoon	Nov. 1994	Batticaloa Trincomalee		95,680 families homeless	Roads, railways badly damaged; major water reservoirs & tanks full
Floods	May 1995	Western, Northwestern Sabragamuwa & southern provinces	1	10,000 families displaced	Road traffic, electrical supply, telecommunications interrupted
Floods	Oct. 1995	Ratnapura; Kegalle	4 dead (landslides)	20,000 people affected	Two minor landslides

Risk control planning focuses on identifying those risk control measures necessary to achieve defined measures of community success. The risks to be addressed by the implementation of risk control measures depend on the significance of the risks to the community, the community's risk tolerance and acceptance of loss, and the availability of resources to control risk. Differences in goals, objectives, and capabilities among communities will result in the identification of different risk control priorities.

The growing need worldwide by developing countries for assistance to cope with (1) chronic vulnerability, (2) impacts related to natural hazards, and (3) impacts related to internal conflicts has resulted in increased competition for internal and external resources. It is imperative that communities identify essential risk control measures necessary to lessen the need for assistance and to more effectively direct and use relief that is received. Risk control planning is a central element in achieving a community's goals and objectives.

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INTRODUCTION TO THE RISK CONTROL PLANNING WORKBOOK

Purpose

The Risk Control Planning Workbook guides policy makers, planners, emergency managers, scientists, and others through the process of identifying risk control measures to improve community sustainability in a world in which potential damage and injury from natural hazard impacts should be considered a certainty. The goal of risk control planning is not to eliminate hazard impacts, but to identify opportunities to reduce risks induced by these impacts in a manner that is consistent with community defined goals, performance objectives, and capabilities. The risk control planning methodology presented in this workbook provides a structured framework for deciding what to do about risk.

Methodology

The methodology is divided into two parts: an administrative process and a planning process. The workbook will focus on the risk control planning process shown on Table 2. However, it is important to note that the following administrative process needs to be applied to each step shown on Table 2:

1. Planning what work needs to be done
2. Organizing the resources needed to complete that work
3. Motivating participants to do the work
4. Controlling work schedules and budgets

Different departments, agencies, or ministries will generally be responsible for completing different steps in the risk control planning process. Each organizational unit involved will need an administrative process to manage the planning activities in each step.

The Risk Control Planning Process focuses on the identification of risk control measures to reduce the frequency, severity, or unpredictability of hazard impacts. The Risk Control Planning Process includes five steps (Table 2):

- | | |
|----------|--|
| (Step 1) | Establish guiding principles for the risk control program: |
| (Step 2) | Evaluate the performance of community exposures to likely hazard impacts according to the guiding principles established in Step 1, |
| (Step 3) | Identify risk control options and formulating risk control policies to improve performance capability according to the guiding principles established in Step 1 and based on the evaluation of the community's capabilities in Step 2; |
| (Step 4) | Evaluate the effectiveness of implemented risk control measures, |
| (Step 5) | Communicate risk control information to community stakeholders |

Application

The workbook methodology may be applied to any type of organization. However, the effectiveness of selected risk control measures must be evaluated from the perspective of a specific organization, such as a community department, community government, public-private stakeholders task force, or country. Similarly, the effectiveness of risk control measures must be evaluated with respect to the reduction of a specific risk to the implementing organization. The implementation of a risk control measure to reduce a risk to one organization may not address or may even increase the risk to another organization. The workbook adopts the perspective of a local community when discussing the development of guiding principles, identification of risk control goals and objectives, the selection of potential risk control measures, and the evaluation of the effectiveness of implemented risk control measures.

Planning Guides

Table 4 lists planning guides that are included in the workbook to help users complete the risk control planning process for steps one through four.

Workbook Format

The workbook is organized into five sections. Each section covers one step in the Risk Control Planning Process:

- **Section One – Guiding Principles.** The first step for community planners is to establish a context for risk control planning. The Risk Control Status Report defines the community's planning framework by: describing the community, identifying the community's planning goals, reviewing existing policies, programs, and plans for achieving those goals, and by establishing pre- and post-hazard impact performance objectives to guide the evaluation of the community's risk and to guide the selection of risk control measures to reduce that risk to acceptable levels.
- **Section Two – Performance Evaluation.** The second step in the planning process is to evaluate the potential natural hazard impacts on the capability of the community to achieve the community planning goals according to the Guiding Principles defined in Step One. This step defines the community's risk problem.
- **Section Three – Performance Improvement.** Identification, evaluation, and implementation of risk control measures to improve the performance capability of the community according to the Guiding Principles define in Step One.
- **Section Four – Performance Tracking.** Development of mechanisms to track the effectiveness of implemented risk control measures. Collection of data on the impacts of natural hazards over time can help identify the need for additional risk control measures or the revision of existing measures.
- **Section Five – Risk Communication.** Effective risk management requires the recognition that risk control is everyone's business. People need to understand what risks threatened the community, who and what they impact, how, why specific risk control measures are being implemented, and what their role is in that implementation.

Table 2: Steps in the Risk Control Planning Process

Part Two – Risk Control Planning Process				
Step One	Step Two	Step Three	Step Four	Step Five
Guiding Principles	Performance Evaluation	Performance Improvement	Performance Tracking	Risk Communication
Review Mission	Identify critical exposures	Evaluate feasibility of risk control options	Reporting requirements	Training and education
Review Policies	Identify potential hazards	Adopt risk control measures	Simulation tests	Internal and external communications
Review Programs and Plans	Assess risk	Implement risk control programs	Post-hazard impact reports	
Participants				
<ul style="list-style-type: none"> • Senior Executives • Community Leaders • Stakeholders in the risk control process 	<ul style="list-style-type: none"> • Risk Managers • Line Managers • Researchers • Analysts 	<ul style="list-style-type: none"> • Risk Control Planning Team • Line Managers • Engineers • Contractors 	<ul style="list-style-type: none"> • Risk Managers • Line Managers • Employees 	<ul style="list-style-type: none"> Risk Managers Line Managers Public Relations Corporate Communications
Planning Outputs				
<ul style="list-style-type: none"> • Community goals • Pre-hazard impact performance objectives • Post-hazard impact performance objectives 	<ul style="list-style-type: none"> • Exposure inventory • Exposure ranking • Hazard Identification • Exposure vulnerability ranking • Risk Matrix 	<ul style="list-style-type: none"> • Risk control policy • Risk control plans 	<ul style="list-style-type: none"> • Planning Scenarios • Database Formats • Loss data base 	<ul style="list-style-type: none"> • Newsletters • Press Releases • Customer inserts

Table 3: Planning Guides for Implementing the Risk Control Methodology

Step 1 Guiding Principles	Step 2 Performance Evaluation	Step 3 Performance Improvement	Step 4 Performance Tracking
<p>(G1) Definition of risk area boundaries</p> <p>(G2) Collection of information to identify community goals and objectives</p> <p>(G3) Definition of performance objectives</p>	<p>(E1) Exposure checklist (E2) Exposure inventory (E3) Exposure Indicators (E5) Exposure Ranking</p> <p>(H1) Hazard Checklist (H2) Hazard Identification (H3) Hazard Indicators (H4) Hazard Ranking</p> <p>(V1) Assessment Checklist (V2) Vulnerability identification (V3) Vulnerability Indicators (V4) Vulnerability Ranking</p> <p>(R1) Risk Matrix</p>	<p>(I2) Impact Checklist</p> <p>(I3) Effectiveness Checklist</p>	<p>(T1) Planning Scenario(s) (T2) Data base format issues</p>

Definitions

The terms used to define hazard, risk, vulnerability, exposure and other key risk control planning concepts have been used interchangeably for different applications and have been defined differently for similar applications. This blurring of meanings makes it necessary to provide working definitions for key terms and concepts as they will be used in this workbook.

Consequences: the damages, injuries, and losses of life, property, environment, or business described in quantitative terms, such as size of economic impact, percentage of functional loss, etc. Links the probability that a hazard will occur to the vulnerability of the types of values exposed to produce an estimate of the potential loss associated with the impact of a specific hazard.

Exposure: The types of values at risk, including (1) property, (2) personnel, (3) net income (economy), and (4) liability (duty to others). Liability includes legal obligations to comply with worker safety regulations, provide employee benefits, comply with environmental regulations, and other legal requirements. Liability as used in the workbook refers to the organization's duty to others as established by policy, law, custom, community values, or other real or perceived duties owed to the community.

Hazard: A natural, human or economic event that has the potential to cause harm or loss: *falling rock is a hazard in steep, mountain areas.*

Hazard identification: The process of defining and describing potential community hazards. Hazard identification includes defining and describing the hazard's physical characteristics, causative factors, probability and frequency of occurrence, magnitude and severity, and locations likely to be affected.

Mitigation: Actions taken to eliminate, prevent, or strengthen community exposures to the impacts of natural hazard events. The hazard event triggers a test of the effectiveness of implemented mitigation measures to perform as desired.

Peril: the exposure to potential injury, loss, or destruction: *they faced the peril of falling rocks*; Peril is generally used by insurance companies to describe exposures to hazards covered by the policy.

Preparedness: Actions taken to reduce potential loss by improving the community's emergency response and recovery capabilities. A hazard event triggers the activation of emergency response and recovery plans prepared to rapidly stabilize and control hazard impacts. Mitigation and preparedness actions are complementary approaches to reducing loss. The most rapid and effective response will not undo the immediate losses triggered by the hazard on-set. The focus of preparedness actions is on executing effective rescue, containment, salvage and recovery.

Probability: The chance that an event can be expected to occur. Probabilistic methods follow the "law of large numbers", which requires stability and independence of events over time. A probability forecast requires a large amount of data on past events so that a reliable pattern of occurrence can be established. In addition, the conditions that established that pattern must remain stable. The historic record may not be long enough to establish a reliable pattern of occurrence for many natural hazards. If the mechanisms causing the hazard are well enough understood, then probability can be calculated using analytical means rather than observations of real events. Probabilities can be very helpful in forecasting future events, but the dependence on the stability of the environment, the completeness of the data, the consistency of the data, and the independence of each event needs to be taken into consideration when evaluating the accuracy of results.

Risk: the exposure to the chance of injury or loss; risk may be expressed mathematically as the product of the probability that a loss will occur times the value at risk (exposure). Three interrelated factors combine to describe risk:

- Values at risk of potential hazard impacts (Exposure Inventory)
- Likelihood that a hazard will occur,
- Vulnerability of exposed values to the likelihood of injury, loss, or destruction.

Risk Assessment: The risk assessment defines the risk problem through the identification of potential risks and the analysis of the significance of those risks to the community. Risk identification includes an assessment of community exposures, hazards, and vulnerability. Risk analysis estimates the significance of identified risks on the community's capability to achieve its defined goals and objectives. Gaps in understanding the nature of the hazard and uncertainties in expected hazard impacts lead to less accurate risk assessments.

Risk Evaluation: A process or method for evaluating the feasibility of possible risk control measures. Integrates risk assessment results with risk control planning goals and objectives to identify a range of risk control options.

Stakeholders: Those individuals and organizations that literally have a stake in the outcome of the risk control planning process. They may be directly responsible for some part of the community's risk problem. They may be directly affected by community risks and/or the measures selected to control them. They may have information important to completing the risk control planning process.

Vulnerability: The specific circumstances or hazardous conditions that increase the chance that a loss will occur. In this workbook, "hazard" will designate the event with the potential to cause harm. "Vulnerability" or "hazard factors" will be used to indicate adverse conditions or circumstances that increase the chance that a loss will occur.

SECTION ONE – ESTABLISH GUIDING PRINCIPLES

Overview

Purpose

The first step for community planners is to establish a context for making risk control decisions. What community values are the risk control decisions expected to support? What essential resources are necessary to carry out the fundamental objectives the community has specified for achieving those values? What regulatory, financial, and operational criteria must be met before and after a hazard impact? What tolerance does the community have for uncertainty and potential loss? Answering these questions helps define the guiding principles for the identification and implementation of risk control measures that support the community's vision for existing and future development.

Information collected to establish a context for risk control planning forms the basis of the Risk Control Status Report. This initial report provides a "blue print" for risk control planning by outlining what the community hopes to accomplish, what resources are available, and what is in place to protect those resources.

General Risk Control Planning Information Sources

The community's mission or vision statement provides a starting point for understanding the importance and relative priority of community goals and objectives. These community goals and objectives form the basis for identifying essential community functions and for establishing specific performance objectives for the facilities and operations needed to carry out those functions. Each community will have a different perspective on what the future should look like and what resources will be needed to achieve that vision. Some communities may want to support and expand existing industries. Other communities may want to encourage new types of businesses and industries. Others may want to focus efforts on improving the availability of affordable housing. Risk control planning needs to address the specific interests of the community.

The community may have prepared a Comprehensive Plan or General Plan that states the official long-term policy for future community development, including the consideration of economic, political, social and physical impacts on growth and change. Functional plans describe the personnel, facilities and operations needed to implement each community function identified in documents like the General Plan. Community functions might include transportation, water service, public safety, building safety, etc. The policies and programs adopted by a community to implement the Comprehensive Plan and associated functional plans provide key information for the formation of the guiding principles to be used in risk control planning. These principles guide the selection of appropriate risk control measures that support the implementation of the community vision, the Comprehensive Plan and functional plans. These plans also specify who has the authority to implement plan objectives, what regulations must be addressed, and what coordination with other governmental and non-governmental entities is required. This information helps formulate pre-hazard and post-hazard risk control planning objectives.

Sri Lanka Risk Control Planning Information Sources

Presently all disaster matters are handled by the Central Government of Sri Lanka with the assistance of District and Divisional Secretaries. The Districts and Divisional Secretaries operate under the Central Government to carry out civil administration. The link between the District and Divisional Secretaries and local authorities was not well defined at the time this workbook was prepared (1999). Implementation of a proposed Draft Disaster Counter-Measures Act will strengthen the integration of disaster planning activities between the Central Government and local authorities. This proposed Act defines Central Government activities pertaining to natural and other hazards in Sri Lanka. Enactment of the Act will establish (1) the National Council for Disaster Management (chaired by the Prime Minister) and (2) the National Disaster Management Center. The

National Council will be responsible for directing and formulating policies on which the National Disaster Management Plan and National Emergency Operations Plan for natural disasters will be based (Mattingly, UNDP Consultancy Report, 1998). Enactment of the Disaster Counter-Measures Act will direct the National Disaster Management Center to prepare or coordinate the preparation of plans based on policies and programs of the National Council and with assistance from a Technical Advisory Group.

The Urban Development Authority (UDA) is the chief planning entity for Sri Lanka. UDA responsibilities are set-forth in the following documents:

- The UDA Act of 1978 with subsequent amendments
- UDA declarations and circulars
- Planning and Building Regulations – Gazette No. 386/2 1986
- Town and Country Planning Ordinance of 1949
- Central Environmental Authority Law of 1983
- Coast Conservation ACT
- Gazetted Development Plans
- Draft Development Plans
- Housing and Town Improvement Ordinance
- Municipal and Urban Council Ordinances

The UDA operates in most urban areas of Sri Lanka. The primary UDA responsibilities include: (1) providing planning assistance to local authorities to develop plans that integrate the physical (buildings, infrastructure, environment), social, and economic aspects of the community to achieve the welfare, security, and safety of local inhabitants; (2) regulating development, planning and building, and (3) preparing regional plans. In regional planning, the UDA structures the plan and helps define the role of cities in the regional plan. The UDA prepared the Urban Sector Policy Action Plan (USPAP), the Sabarabamuwa Regional Structure Plan, and environmental workbooks for Bandarawela and Hambantota. UDA completed a Divisional land use plan that addresses natural hazard and urban environment problems. UDA also completed a plan for mapping landslide-prone areas.

The National Building Research Organization (NBRO) prepared a manual, called “Site Selection, Development Planning and Construction in the Hilly Regions of Sri Lanka.” This manual forms the basis for the development of guidelines to incorporate potential landslides into planning activities.

There are 9 provinces in Sri Lanka. Each province has a Provincial Council with several local government units, including municipal Urban Councils like the Ratnapura Municipal Council and Village level councils like the Pradeshiya Sabha. The Municipal Councils prepare and fund local operations plans and budget for routine community needs.

These organizations have information that local community' will need to incorporate into local risks control planning activities.

Examples of Sri Lanka Institutions Involved in Government Coordination of Sri Lanka Planning Activities Related to Natural Hazards

The Housing Secretary for the Ministry of Housing, Construction, & Public Utilities (M/HC&PU) chairs the Secretarial Committee on Urban Sector Policy that facilitates inter-ministerial coordination and networking among a number of government agencies. These agencies include the Ministry of Health, Highways, & Social Services (the new Disaster Management Centre), the Ministry of Cooperatives, Provincial Councils, and other organizations within the ministry.

Three organizations under the M/HC&PU have been selected to assist in implementing the Ratnapura Demonstration Project initiated by the Asia Disaster Preparedness Center under the Asia Urban Disaster Mitigation Project (AUDMP). These organizations include the Centre for Housing Planning and Building (CHPB), the Urban Development Authority (UDA), and the National Building Research Organization (NBRO). A CHPB project coordinator will be appointed to prepare, plan, coordinate, and control AUDMP project activities, including establishing links with all agencies, organizations, and individuals involved. The CHPB and the Sri Lanka Institute of Development Administration provide training on natural disaster management.

Risk Control Planning Activities

Task 1. Define Risk Area Boundaries

The first step in the risk control planning process is to define the boundaries of the risk area(s) within which risk control measures will be implemented (Planning Guide G1). Defining the risk area helps to identify the stakeholders that should be involved in the development of risk control measures. Each of the three factors used in this workbook to describe community risk – exposure, vulnerability, and hazard – vary geographically. Geographic variations in hazard impact zones, in concentrations of exposures, and in degree of vulnerability within a defined risk area enable variations in risk to be identified. The risk area may be the boundaries of a neighborhood, a community, a country, or other type of administrative unit. The risk area may be subdivided into smaller risk sites to evaluate variations in risk within the risk area.

Consistently defined risk areas also help identify and foster implementation of risk control measures that best meet the implementing organization's risk control planning goals and objectives. For example,

- An international risk control program might define risk areas based on the boundaries of countries, of greater metropolitan areas, or the location of essential world industries (like food production resources). Such programs generally address the reduction of risks capable of causing significant global consequences. The exposure inventory to be collected in the defined risk areas will also reflect the goals and objectives of the international program. Humanitarian organizations like the Red Cross and Red Crescent might focus their inventory collection on population demographics and health care resources.
- A national risk control program might define risk areas based on national political divisions, such as states, provinces, districts or use the boundaries of greater metropolitan areas. National programs generally address the reduction of risks capable of causing significant national consequences. Thus, there may be noteworthy local risks that are not addressed in national programs.
- A state or provincial control programs may define risk areas based on subunits like counties, urban areas, or other administrative unit
- A community risk control program might define risk areas based on the boundaries of the community or of the metropolitan area. The risk area might be subdivided into risk sites defined by internal community boundaries, such as zipcodes, neighborhoods, wards, precincts, or other community administrative units. The variations in risk (exposure, hazard, and vulnerability) among the risk sites within the community risk area will help identify locally relevant risk control measures. Community risk sites help identify the type and amount of assistance needed to reduce risks within selected parts of the community.
- A private entity, such as an insurance company or a bank, needs to define risk areas that best identify the risk to the organization from an individual policy holders or property owners. Geographic information systems capable of identifying exposure, vulnerability, and hazard in small geographic units have become increasingly important to organizations needing to assess the impact of each new policy or property purchase on the corporate book of business. These tools also help look at risks aggregated over the risk areas defined by local, national, and international organizations.

Overlapping risk control areas defined by different levels of government may result in a community being responsible for the implementation of risk control measures reflecting the program concerns of local, regional, and national authorities. This overlapping of jurisdiction responsibilities is one of the reasons that effective risk control programs requires participation from each stakeholder group.

Task 2. Collect Information

Use Planning Guide G2 to help identify information needed to prepare the Risk Control Status report. This report describes the community and helps establish a framework for the planning process.

Task 3. Define Risk Control Planning Objectives

Use Planning Guide G3 to guide the development of risk control planning objectives. These objectives need to take into account community needs before and after a hazard event impacts the community. Risk control planning objectives should support the capability of the community to achieve its essential community goals.

Planning Guide G1 Definition of Risk Area Boundaries

Purpose

The purpose of defining the risk area boundary is to establish the geographic region in which risks will be identified and analyzed. The risk area must be consistently defined in order to complete a meaningful risk assessment. Each element of risk – exposure, hazard, and vulnerability – must be identified within a consistently defined risk area boundary. Selection of the risk area boundary will depend upon the goals and objectives of the risk control program. The risk area may be subdivided into smaller risk sites to better identify variations of risk within the risk area. Site boundaries should also be clearly defined.

Identify Community Risk Area Boundaries

A community risk control program might use a legal description of the boundaries of the municipal council to define the community risk area. Smaller risk sites within the community might be defined by the boundaries of community administrative units, such as neighborhoods. For example, the Ratnapura Municipal Council (RMC) is divided into 15 municipal wards (Table 4). The geographic boundaries of the RMC can be used to define the risk area. The boundaries of each ward can be used to define community risk sites. The Sri Lanka Urban Multi-Hazard Disaster Mitigation Project prepared a Map Work Book (June 1998) that describes the RMC and provides a map of the municipal wards.

A national risk control program might use the boundaries of larger administrative units to define risk areas. Sri Lanka is divided administratively into 9 provinces and 25 districts. The provincial councils include several local government units, such as municipal councils and village councils. Subdivisions of the provincial council risk area could be defined as risk sites. Thus, the RMC located in the Ratnapura District could be a risk site for a provincial risk area defined by the boundaries of the Sabaragamuwa Province of Sri Lanka. It is the only municipal council in the province. A national program that focuses on urban areas might use municipal council boundaries to define risk sites. Or, a larger administrative boundary such as a province or district might be selected. The definition of the risk sites for a national program should foster the comparison of risks throughout the country and help identify the organizations that will be involved in implementing risk control measures within the risk sites. If implementation will be through local municipal councils, then municipal council boundaries may be appropriate to define national risk sites. If implementation will be through provincial councils, then risk sites coinciding with provincial boundaries may be most convenient.

Table 4: Definition of risk area boundaries

Identification of the risk area	Risk Sites	Identification of risk sites within the risk area	Stakeholders in the RMC risk control planning process
<i>Example: Risk area boundary is defined as the geographic region that encompasses the Ratnapura Municipal Council (RMC).</i>	<i>The risk area is subdivided into risk sites using the boundaries of the RMC Wards</i>	(1) Hudellana (2) Kospelwailla (3) Weralupe (4) Pompakele (5) Godigamuwa (6) Angamma (7) Tirivanakettiya (8) Batugedara (9) Warakatota (10) Kadaweediya (11) Kotuwa (12) Pulungupitiya (13) Dewalegawa (14) Muwagama (15) Mudduwa	RMC Local authorities Homeowners Business owners Gem Associations Plantation owners Workers Central Government UDA NBRO CHPB AUDMP

Collection of information to identify community goals and objectives

Purpose

A community's goals and objectives form the basis for the development of community policies and programs. Community plans and legislation specify how these policies and programs will be implemented in order to achieve those community goals and objectives. Collection of information on existing plans involving the community, therefore, provides a starting point for identifying the goals and objectives that will need to be addressed in the risk control planning process. Community plans also provide a source of information on the type of resources that will be needed to implement policies and programs. These resource lists help define essential community exposures.

Identify Community Planning Information and Information Sources

Table 5 lists information necessary to generally describe the community physically and organizationally. Table 6 provides space to index existing plans that may be used to help identify community planning requirements, goals, objectives, and implementation resources. The information collected in Tables 5 and 6 provides the context for the development of the risk control planning framework. If information is not available, enter NA (not available) into the location column and make a note in the Comments column concerning how that information could be obtained.

Planning Coordination

What external organizations should be involved in the identification and implementation of risk control measures to manage the impact of natural hazards on the community? It is common for the goals and objectives of different communities, community organizations, and the national government to differ, reflecting different priorities, resources, and authorities. Planning coordination to resolve basic differences in priorities and concerns will help identify risk control measures that are consistent with a broad range of objectives and facilitate implementation. The proposed Disaster Counter Measures Act provides a mechanism for coordinating Sri Lanka disaster planning activities.

Table 5: Identification of information that describes the community physically and organizationally.

Information that describes the risk area	Enter information below	What documents provide this information?	Where are documents located?	Comments
Risk Area Name Location Risk Area Size Boundaries Population Administrative units Primary businesses Industries				
Community vision or mission statement				
Community internal organizational relationships (attach copy of organization chart)				
Community external organizational relationships (attach flowchart showing relationships)				

Table 6: Index of plans developed to implement local, regional, and national policies and programs in the Risk Area. Use to identify community planning goals and objectives

Plan Name	Plan Developer Plan Purpose	Implementing Organization(s) (Ministry, Agency, Community Dept.)	Required or voluntary	Plan location and contact information
Community Comprehensive or General Plan				
Urban Sector Policy Action Plan	Urban Development Authority			
Sabarabamuwa Regional Structure Plan				
Site Selection, Development Planning & Construction in Hilly Regions of Sri Lanka	NBRO Guidelines to incorporate potential landslides into planning activities			
National Disaster Management Plan				
National Emergency Operations Plan				
National Irrigation Plan				
Public Health and Safety Plan				
Local water supply plan				
Local transportation plan				

Planning Guide G3 Definition of Risk Control Planning Objectives

Purpose

Risk control planning objectives help to identify the community's essential exposure inventory, define how that inventory should perform under conditions of risk, and define the characteristics that risk control measures must have to help the community achieve the goals identified in the documents collected using Planning Guide G2. Planning Guide G3 helps identify constraints and priorities that will be imposed on the selection of risk control measures in order to be compatible with overall community needs. Enter additional guidelines as desired.

Pre-Hazard Objectives – Risk Control Planning objectives that should be met whether or not a hazard event has occurred.

The following are examples of common pre-hazard objectives that risk control measures should address. These are objectives that must be met whether or not a hazard impacts the community. These objectives will be used to help identify the facilities and operations necessary to meet community goals during times of normal operations. These objectives will also help identify selection criteria to be used to identify risk control measures. Risk control measures that do not meet pre-hazard impact objectives are unlikely to be successfully implemented. Table 7 provides space to identify pre-hazard community goals and objectives, who is responsible for defining them, and who is responsible for implementing them. Typical pre-hazard risk control planning objectives include:

- Maximize use of existing resources by operating economically, efficiently, and equitably. Benefits gained through the identification and implementation of risk control measures should be appropriate to the costs required. Who pays the costs and who receives the potential benefits should be carefully considered.
- Comply with legal mandates, including worker safety, environmental regulations, contracts etc. Legal requirements may indicate specific risks that must be addressed by the risk control program and identify risk control measures that must be implemented. For example, environmental laws may indicate levels of contamination that can not be exceeded within the risk area and specify how hazardous material must be handled to reduce the risk that levels might be exceeded.
- Provide a tolerable working environment by providing risk control measures to support worker safety and enhance worker confidence and productivity.
- Address issues related to operational, social, political, or cultural concerns. Identification and implementation of risk control measures must take into account issues that would facilitate or prevent successful implementation.

Table 7. Identification of Pre-Hazard impact planning objectives

Identify Planning objective	What <u>pre-hazard</u> objectives have been defined by the community?	What organizational unit is responsible for defining these objective?	What stakeholders are involved in carrying out these objective?	Where is information needed to define this objective located?
Economic – risk control planning budget				
Economic – business development				
Legal – worker safety requirements				
Legal – environmental requirements				
Legal – planning and building regulations				
Social – community housing				
Social – medical				
Social – beautification				

Post-Hazard Objectives - Risk Control Planning objectives that should be met after the hazard event has occurred.

Risk control measures should meet the following objectives in the event that a natural hazard impacts the community. Note that human survival is considered the baseline objective for risk control measures. Implementing risk control measures to achieve Community Sustainability or Growth will generally require more resources than to achieve the baseline objective of human survival. Check those post-hazard objectives to be included in your risk control planning process. Enter additional objectives as desired. This checklist may also be used to outline a schedule of planning activities. For example, the initial planning period might focus primarily on issues related to life safety. Table 8 provides space to enter proposed post-hazard objectives.

- **Human Survival.** The fundamental objective of risk control planning is to protect life.
 - Level 1. Protection of life safety. Minimum performance standards for building construction are generally set to this level. It is important to note that buildings designed to a life safety standard may be a total economic and functional loss following the impact of a natural hazard event.
 - Level 2. Continuity of facilities, operations, and level of operation needed to save lives. A higher performance standard is needed if a building or operation must be capable of operating following a natural hazard event. The highest standard is required for facilities, such as nuclear power plants, that must operate without interruption. Delivery of water to suppress fires versus potable water for drinking purposes may be addressed by setting specific performance objectives for the community's water supply and distribution system following different types and severity of hazard impacts. The evaluation and construction costs to achieve this level are substantially higher than those required to achieve a basic life safety standard.
- **Community Sustainability.** While human survival is the fundamental goal of risk control planning, survival of the individual is necessary but not sufficient to ensure survival of the community.
 - ◆ Restoration of community facilities and operations essential to community survival
 - ◆ Protection and reconstruction of property
 - ◆ Protection of community revenue sources
 - ◆ Restoration of normal operations
- **Community Growth and Redevelopment.** A devastating natural hazard can also provide opportunities for new growth and redevelopment. Obsolete facilities or equipment may be replaced. Structures designed to inadequate building standards may be strengthened. Addressing these issues in the risk planning process provides an opportunity to prepare recovery and reconstruction plans during a less stressful planning environment.
 - ◆ Seek new income
 - ◆ Development opportunities

Table 8. Post-hazard impact risk control planning objectives

Identify Planning objective	What <u>pre-hazard</u> objectives have been defined by the community?	What organizational unit is responsible for defining these objective?	What stakeholders are involved in carrying out these objective?	Where is information needed to define this objective located?
Life Safety – housing				
Life safety – business and industrial facilities				
Life safety- fire suppression system				
Life safety – police protection				
Life safety – emergency medical system				
Life safety – drinking water				
Community survival – economic needs				
Community survival- social needs				

SECTION TWO – PERFORMANCE EVALUATION

Overview

Purpose

The purpose of the performance evaluation is to define the community's risk problem. The performance evaluation involves the completion of a Risk Assessment to identify and analyze the likelihood and consequences of community risk. The Risk Assessment includes the identification of the three elements of risk: (a) community exposures necessary to carry out essential community functions; (b) hazards likely to impact essential community exposures; and (c) the vulnerability of essential community exposures to potential hazard impacts. The risk analysis applies quantitative and/or qualitative methods to systematically estimate and rank risks according to their probabilities and consequences.

The methodology presented in this workbook stresses the usefulness of an initial qualitative risk control planning process to develop an understanding of risks capable of impeding a community's highest priority goals. This initial risk assessment helps focus attention on key risk problems, assign priorities to the selection and implementation of risk control measures and provides information on risks that require more detailed methods of analysis. Increasingly complex qualitative and quantitative risk assessments should be completed for high priority risks identified in the initial screening process as requiring more complex methods of assessment in order to determine appropriate risk control actions.

Information Sources

Exposure Inventory. Exposures are generally classified by risk managers into four groups: property, net income, legal, and personnel exposures. Tables 9-12 list types of exposures in each of these four groups. Selected exposure indicators for each exposure group are identified. These tables also list information sources for obtaining information needed to assign a value to these exposure indicators. The exposure indicators that can be used to characterize the community's exposure in the Risk Assessment. Focusing on exposure indicators representing community resources necessary to achieve high priority community goals helps narrow the focus of the exposure inventory. The information collected in Step One identifying the community goals and risk control planning objectives helps in the identification of appropriate exposure indicators for the Risk Assessment. Selecting a set of essential exposure indicators limits the cost and time needed to complete the exposure inventory.

Community exposures include those owned by the local government (public sector) and those owned by individuals and corporations (private sector). Information on public sector exposures may be obtained from local government agencies, such as facilities, real estate, finance, and human resources departments. Some general community exposure information may also be available through local or national government agencies, such as population data, information on the community's gross national product, and values of imports and exports.

Private sector exposures may be more difficult to obtain. Data collection methods that extrapolate or estimate private sector exposures from information that is more readily available may be needed. The HAZUS loss estimation program funded by the US Federal Emergency Management Agency and developed by Risk Management Solutions provides a methodology for estimating exposures using nationally available databases that can be adjusted by local communities. In the HAZUS methodology, land use maps are used to identify the type of building occupancies within a risk site defined by the boundaries of a zipcode. Databases linking building occupancies to specific types of buildings and an estimated average size per building provides an estimate of the number and type of buildings in the risk site. Building type tables are prepared for ranges of time to help track changes in building type over time. For example, if adobe construction is

commonly used for building homes, then those areas of the land use map marked single family, residential dwellings can be assumed to primarily consist of adobe homes. If the average home size is also known, then an estimate can be made of the number of homes in that area as well. The HAZUS loss estimation software uses this type of map data linked to building types method to estimate property exposures within areas included by zip code boundaries. The methodology is described in detail in the technical manuals that accompany the software.

Inventories of specific types of exposures may be necessary to collect some types of exposure data. Data collection can be a costly and time consuming activity, which is why it is important to select exposure indicators that are most needed to achieve community goals.

Table 9 - Property Exposures

Exposure Types	Exposure Factors	Property Exposure Indicators	Information Sources
Real Property	<ul style="list-style-type: none"> • Land • Buildings • Permanent Structures • Utilities • Transportation 	<ul style="list-style-type: none"> <input type="checkbox"/> City Hall <input type="checkbox"/> Police precincts <input type="checkbox"/> School buildings <input type="checkbox"/> Hospitals and clinics <input type="checkbox"/> Housing units <input type="checkbox"/> Commercial buildings <input type="checkbox"/> Light industry <input type="checkbox"/> Heavy industry <input type="checkbox"/> Agricultural land <input type="checkbox"/> Water system <input type="checkbox"/> Power system <input type="checkbox"/> Transportation system 	<ul style="list-style-type: none"> <input type="checkbox"/> Land use maps <input type="checkbox"/> Housing database <input type="checkbox"/> Tax assessor database <input type="checkbox"/> Property database <input type="checkbox"/> Real estate division <input type="checkbox"/> Building inventories
Tangible Personal Property	<ul style="list-style-type: none"> • Furniture, equipment, & supplies • Money & Securities • Records of money due • Machinery • Data processing hardware, software, & media • Papers, documents • Mobile property 	<ul style="list-style-type: none"> <input type="checkbox"/> Fire suppression equipment <input type="checkbox"/> Agricultural machinery <input type="checkbox"/> Value of building contents estimate for each occupancy type <input type="checkbox"/> Bank Statements <input type="checkbox"/> Accounting records <input type="checkbox"/> Insurance records 	<ul style="list-style-type: none"> <input type="checkbox"/> Public records and archives <input type="checkbox"/> Private records and archives <input type="checkbox"/> Inventories
Intangible Personal Property	<ul style="list-style-type: none"> • Community goodwill • Right to collect fees and taxes • Licenses • Leases & leasehold interest • Patents 	<ul style="list-style-type: none"> <input type="checkbox"/> Gem mining licenses <input type="checkbox"/> Business licenses 	<ul style="list-style-type: none"> <input type="checkbox"/> Accounting records <input type="checkbox"/> Legislation

Table 10 - Net Income Exposures

Exposure Types	Exposure Factors	Exposure Indicators			
		Community	Central Govt	Commercial	Information Sources
Revenues	<ul style="list-style-type: none"> • Taxes • Fees • Budgets 	<input type="checkbox"/> Permit Fees <input type="checkbox"/> Service Fees <input type="checkbox"/> Taxes Earned <input type="checkbox"/> Central Gov't Allocations	<input type="checkbox"/> GDP \$69.7 billion (1996 estimate) <input type="checkbox"/> Per Capita GDP \$3,760 (1996 estimate) <input type="checkbox"/> Total Foreign Trade <input type="checkbox"/> National Revenues \$3 billion	<input type="checkbox"/> Gross Domestic Product by sector: agriculture (23.8%), industry (24.7%), services 51.5% (1994)	<input type="checkbox"/> Trade data <input type="checkbox"/> Economic data <input type="checkbox"/> International Monetary Fund <input type="checkbox"/> World Bank
Expenses	<ul style="list-style-type: none"> • Salaries & Benefits • Expense History 	<input type="checkbox"/> Total Salary and Benefits <input type="checkbox"/> Operating Expenses <input type="checkbox"/> Emergency Expense History	<input type="checkbox"/> National Expenses \$4.2 billion <input type="checkbox"/> Budget Targets <input type="checkbox"/> Emergency Expense History	<input type="checkbox"/> Accounting Records	<input type="checkbox"/> Budget allocations <input type="checkbox"/> Accounting records

Table 11 - Legal Exposures (Duty or Responsibility Owed)

Exposure Types	Exposure Factors	Exposure Indicators	Information Sources
Legal	<ul style="list-style-type: none"> • Employees 	<input type="checkbox"/> Work force	<input type="checkbox"/> Human resource database
Social	<ul style="list-style-type: none"> • Legislation environmental worker safety 	<input type="checkbox"/> Number of residents <input type="checkbox"/> Safety regulations	<input type="checkbox"/> Legislation <input type="checkbox"/> Ordinances
Political	<ul style="list-style-type: none"> • Population exposure 	<input type="checkbox"/> Number of employees <input type="checkbox"/> Land Management Requirements	<input type="checkbox"/> Policies

Table 12 – Skilled Worker and Leadership Exposures

Exposure types	Exposure Factors	Personnel Exposure Indicators	
		Community	Information Sources
Individuals whose loss would be a special hardship to the community	<ul style="list-style-type: none"> • Elected officials • Skilled Workers 	<ul style="list-style-type: none"> <input type="checkbox"/> Type and number of skilled workers <input type="checkbox"/> Type and number of government workers 	<ul style="list-style-type: none"> <input type="checkbox"/> Human resources <input type="checkbox"/> Job database <input type="checkbox"/> Accident data
Retirement, Death Disability, Resignation	<ul style="list-style-type: none"> • Business leaders 	<ul style="list-style-type: none"> <input type="checkbox"/> Type and number of business leaders 	

Hazard Information. Information on the impacts of past hazards on the community is often available in local private and public sector archives, newspapers, legends, and in the memories of long-term residents. This type of information can provide useful insights into the types of hazards that have caused loss of life and damage to parts of the community in the past. Since human records and memory are often short in comparison to the repeat times of many natural hazards, care should be given in the evaluation of historical hazard information. Also, some areas of the community may not have reports of past hazard impacts only because no one lived or worked there in the past. Historic data is often helpful in convincing a community that a problem exists.

National and local organizations that study specific hazards – geology, meteorology, environmental – are good sources of information. Private consulting firms may provide information or complete studies under contract for local communities.

Vulnerability Information. Information on the vulnerability of the community's essential exposures to potential hazard impacts may be obtained from a variety of sources. Historic records might provide information on how community exposures performed under past hazardous conditions. Particular locations in the community may have experienced repeated landslides or flooding. Particular types of buildings may have experienced greater or lesser damage during floods, strong winds, or other hazard impacts that may damage a building structurally. This information needs to be evaluated carefully because the vulnerability of exposures may change over time. For example, older buildings may perform more poorly today than they did when first constructed. Newer site preparation techniques may improve the performance of some locations.

Engineering studies on the performance of land and buildings (Real Property Exposures) during different types of hazard impacts provide useful vulnerability information. Research on the vulnerability of different age groups to injury and death provide information on differences in vulnerability among different portions of the population.

Sri Lanka Risk Exposure, Hazard, and Vulnerability Information Sources

The following organizations are sources of exposure, hazard, and vulnerability information to needed to complete a risk assessment for a Sri Lanka community. Many of these organizations have also completed functional plans related to their area of responsibility. Some of these plans have been noted in Step One.

CHPB provides training, information services and carries out research related to housing, construction management and human settlements.

National Disaster Management Centre
 Central Environment Authority

Department of Meteorology
Department of Irrigation
Land Commissioner's Department
Ministry of Health
Geological Survey Department
Coast Conservation Department
Engineering Faculty, University of Peradeniya
Institute of Fundamental Studies
Telecommunication Regulation Commission

Risk Assessment Methods

The Risk Assessment helps define the community's risk problem by forecasting future hazard impacts on essential community exposures. Past patterns of hazard impacts combined with an understanding of the causes of natural hazards and of the causes of hazard-induced damage are used to estimate future impacts. The Risk Assessment provides a systematic process for identifying, estimating, and ranking community risks.

Data to be used to determine potential patterns of hazard impacts must meet the following requirements:

- data must be complete; for example, when analyzing the frequency and severity of a natural hazard in a community, one must determine the completeness of available data. For example, a low population in the impact area may result in under-reporting of even sizeable events. Similarly, high population may result in detailed reporting of even very small events. When estimating future events from the occurrence of past events, it is important to determine if the data is complete for the sizes of events being considered. The evaluation of incomplete data may distort forecasts of future events and complicate the understanding of past events;
- data must be collected on a consistent basis to enable meaningful comparisons (same type, source, technique, and valuation methods should be used)
- data should be relevant to the risk control objectives defined in Step One; if the risk control objective is to improve the reliability of electrical service following the impact of a natural hazard, then collecting information on dollar losses to the community from the disruption of the electrical system would not provide the necessary information (though such losses may be useful in determining the benefits of implementing a selected risk control measure)
- data should be organized to reveal potential risks; for example organizing data on past hazard impacts according to time of occurrence (chronological order) may obscure important information related to the size of dollar losses or outages times sustained

Quantitative and qualitative Risk Assessment methods may be used depending upon the type and amount and quality of data needed, assessment costs, accuracy, and the application of the results.

Quantitative and qualitative methods may be used to estimate the severity and frequency of:

- natural hazards in the community
- damage and injury related to the impacts of natural hazard events (vulnerability of the community's essential exposures)
- economic or functional losses sustained by the community as a result of natural hazard impacts

Quantitative Methods

Quantitative methods include probabilistic and analytic approaches to understanding the severity and consequences of events. "Probability is the relative frequency with which an event can be expected to occur in the long run in a stable environment (Essentials of

Risk Management)”. Probabilistic methods assumes that the event being studied is governed by an unchanging probability distribution over time and meet the “law of large numbers” requirements for stability and independence. For stability, events must have occurred in the past under substantially identical conditions and have resulted from unchanging, basic causal forces and future events can be expected to occur under the same conditions. For independence, past events and future events will be independent of each other. The occurrence, for example, of a flood this year is independent of the occurrence of a flood last year.

Analytical methods require sufficient understanding of the event being studied to make appropriate assumptions and define functions appropriately.

Qualitative Methods

Deterministic methods may be used to identify potential community risks. Selected past hazard events can be used to evaluate the impacts on the community. These “scenario” events help people visualize the potential damage. However, they may be misleading to those who misinterpret them to represent all possibilities. They are most useful to support emergency response planning.

Ranking risks using qualitative values for exposure, hazard, and vulnerability indicators provides an informal method to systematically assess potential risks. To facilitate comparisons of risks in the community, indicator data must be collected within the defined risk area or areas.

Planning Activities

Task 1. Risk Assessment: Risk Identification and Risk Analysis

The planning activities in this step focus on the assessment of potential natural hazard impacts on the vulnerability of the community's exposure inventory. The results are used to help community planners to define the community's risk problem. The Risk Assessment task consists of two primary activities, Risk Identification and Risk Analysis. Risk Identification focuses on an assessment of the community's exposure, potential hazards, and the vulnerability of community exposures to potential hazard impacts. Specific risk indicators should be selected for each of these three elements of risk to provide a consistent basis for the risk assessment.

Risk Analysis uses quantitative or qualitative analytical methods to estimate the relative importance of each selected risk indicator. Risk indicators are ranked based on the consequences to the community's capability to perform essential functions. These relative risks form the basis for the risk control planning process.

In Step Three, a Risk Evaluation process is presented for evaluating the feasibility of risk control measures that will improve the community's performance capability by addressing risks with a significant impact on the community.

Task 2. Risk Identification – Exposure Assessment

The Exposure Assessment Checklist (Planning Guide E1) lists the steps to be taken to assess the community's exposure. Planning Guide E2, Exposure Identification, provides a classification scheme for identifying exposures. Exposure data may be collected by (1) using questionnaire results to define critical community functions (Planning Guide E3), which helps identify the facilities, equipment and personnel needed for implementation of critical functions, (2) reviewing community property inventory records, (3) interviewing and meeting with community employees and community stakeholders, and (4) inspecting community facilities. Planning Guide E4 helps users select exposure indicators to characterize specific community exposures. The exposure indicators help identify the specific type of information that will need to be collected to assess the type of exposure. Planning Guide E5 provides a method to subjectively rank the importance of identified community exposures based on the user defined exposure indicators.

Task 3. Risk Identification – Hazard Assessment

The Hazard Assessment Checklist (Planning Guide H1) lists the steps to be taken to assess the hazards likely to impact the community. Hazard Identification Checklists (Planning Guide H2) provide a classification scheme to help identify the types of hazard events that a community is likely to experience. Hazard data may be collected by (1) reviewing research results from organizations like the Geological Survey that investigate specific types of hazard, (2) using questionnaires to identify past community hazard experience, (3) field inspections, and (4) contracting for hazard specific studies. Planning Guide H3 helps the user select specific hazard indicators to help identify the specific type of information that will need to be collected to assess the types of hazards likely to impact the community. Planning Guide H4 provides a method to subjectively rank the importance of identified community hazard impacts based on user defined hazard indicators.

Task 4. Vulnerability Assessment

The Vulnerability Assessment Checklist (Planning Guide V1) lists the steps to be taken to assess the vulnerability of community exposures. The Vulnerability Identification

Checklist (Planning Guide V2) provides a vulnerability classification scheme to help identify the types of vulnerability's (adverse conditions) that the community's exposure inventory is likely to experience. Vulnerability data may be collected by (1) reviewing past damage and loss histories that report the impacts of comparable hazard impacts on comparable exposures, (2) reviewing research results of empirical or theoretical investigations of potential hazard impacts on comparable exposures, and (3) conducting laboratory studies. Planning Guide V3 helps the user identify specific vulnerability indicators for selected potential hazards. Planning Guide V4 provides a method to subjectively rank the importance of identified vulnerabilities based on user defined vulnerability indicators. These vulnerability characteristics represent adverse conditions that increase the likelihood that a hazard will cause damage or harm. The hazard trigger, such as high rainfall, acts on these vulnerabilities, resulting in damage and loss to the community.

Task 5. Risk Analysis

Combine the results of the exposure, hazard, and vulnerability assessments using the qualitative rankings to rate each of these elements of risk for each risk site within the risk area. Therefore, for Ratnapura, each ward would have the selected exposures, hazards, and vulnerabilities ranked. These rankings would be plotted on the risk matrix. The hazard frequency data would be plotted on the vertical axis and the consequences would be plotted on the horizontal axis. The consequences represent the average exposures for the risk site versus the average vulnerability for those exposures within the risk site. Therefore, a risk site with a number of high priority exposures would have a high average priority (priority of 1 to 3 with 1 being the highest priority). An average vulnerability of those exposures within the risk site would also be averaged. So, vulnerability of the specified exposures to multiple hazards within the risk site would also have a high average priority. This combination of exposure and vulnerability represented the consequences of the hazard impacts on essential community exposures.

Planning Guide E1 - Exposure Assessment Checklist

- The first step in identifying exposures is to identify the risk control program goals and objectives (Step One). The type of exposure information to be collected will include exposure indicators like those listed on Tables 9-12 that are needed to identify the potential risk to the capability of achieving the defined program goals and objectives. For example, if the program goals include the reduction of loss of life caused by the impact of landslides, then exposure indicators might include: community population distribution data, identification of areas of unstable land, equipment designed to provide warnings to potential victims, equipment needed to prevent additional ground failure, etc. If the goals and objectives are defined to reduce the operational risks to a community department, then the resources needed by that department to carry out critical functions needs to be identified. Planning Guide 2 helps identify the resources needed to implement a community function, such as public health and safety. The exposure indicators would again be selected to support the goals and objectives of a risk control program designed to support that function. The type of risk control measures to be selected and the evaluation of their effectiveness can only be done with respect to their ability to help the implementing organization achieve its risk control program goals and objectives. A community risk control program may be established by a stakeholders groups of public and private sector participants or it may be established by a specific community department.
- Define community exposure indicators to be used in the risk assessment (Planning Guide E3). Refer to Tables 9-12 for examples of exposure indicators. It is important to specify particular exposure indicators to enable exposure data to be collected consistently. Also, vulnerability data will be collected for the specific exposures identified in this step.
- Assign qualitative values to exposure indicators to assess their relative level of importance to the community in each risk site within the risk area (Planning guide E4).

Planning Guide E2 – Essential Community Function Profile

Complete the following function profile for the three most important functions in each community department. Essential functions are those considered essential for the implementation of plans and programs developed to carry out community goals and objectives included in the Risk Control Status Report.

- Name of community function _____
- Name of community department: _____
- Location of function. Identify the name and location of building(s) needed to perform this function. If more than one building, assign a number in order of priority..

- Area serviced by function (community, ward, district, province, etc.)

- Peak demand time period (seasonal peaks related to weather, seasonal peaks related to festivals, holidays, daily peaks related to normal operational schedules, etc.)

- What type of revenue would be lost to the community if this function could not be carried out, such as property taxes, license fees, etc. Provide a general estimate of the value of the revenue exposed to potential loss using L (low), M (medium), H (High).

_____.
- Backup capability or contractor available to perform function : yes no
- Name/Address of backup capability (department or equipment) or name of contractor:

- Liability to community by duration if function unavailable (what legal responsibility does the community have to provide this function):

- Impact on community by duration if function unavailable:

Planning guide E3 – Exposure Indicators

For each exposure category selected to provide an understanding of the community's vulnerability to natural hazard impacts, enter the exposure indicators that you will use in your Exposure Assessment. The selection of exposure indicators will depend upon what data is available to you at the time of the assessment and what resources would be needed to collect new data. Exposure Indicators provide a measurable value that can be defined by the user to assess the level of exposure. For each exposure indicator you select, note where you can obtain the exposure indicator information. If the information is not available, how can it be obtained, and how expensive would acquiring it be (low, medium, high).

Table E1 – Property Exposures

Table E2 – Net Income Exposures

Table E3 – Legal Exposures

Table E4 – Personnel Exposures

Planning Guide E4 – Assign relative priorities to each exposure factor

These tables provide a method for qualitatively ranking exposures by assigning an exposure level to each of the exposure indicators identified using Planning Guide E3. The range of values defined will need to be adjusted to fit local conditions and concerns. For example, the values used to rate population exposures were developed after evaluating the information from the Ratnapura Demonstration Project Map Book. Values were selected to compare the relative exposures among the municipal wards. A larger or smaller community may need to adjust these values to better reveal where there are concentrations of people or property. A national organization may need to set levels for consistent application across the country to best show relative values of exposures among different communities. The goal of the workbook is provide an internally consistent, systematic method to evaluate the relative importance of community exposures.

Tables 9-12 identifies types of exposures included in each exposure class and suggests possible exposure indicators that can be used to estimate the value of those exposures. Planning Guide E2 provided a questionnaire to help identify specific exposures important to the implementation of essential community functions. Functions should be selected that contribute to the achievement of the community goals and objectives identified in Step One.

Property Exposure Ranking - Land Use (PE-LU)		
Defined using land use maps as the exposure indicator for real property		
Priority	Exposure Ranking	Exposure Indicator Description
1	High	Urban Centers
2	Medium	Urban Settlements
3	Low	Agricultural Estates

Property Exposure Rating – Essential Facilities (PE-CF)		
Higher priority for community facilities needed to carry out essential functions		
Function: Public Health & Safety – Emergency Management		
Priority	Exposure Level	Description
1	High	Needed to implement emergency response actions

2	Medium	Needed to implement recovery actions
3	Low	Needed for normalization of community activities

Net Income Exposure Rating - Municipal Council (NI-MC) Higher priority for income sources that provide the greatest municipal revenue		
Priority	Exposure Level	Description
1	High	Range of revenue income considered high
2	Medium	Range of revenue income considered medium
3	Low	Range of revenue income considered low

Liability Exposure Rating - Population (LE-P) Higher priority for concentrations of people		
Priority	Exposure Level	Description (based on RMC population)
1	High	Population over 4000
2	Medium	Population density 2000-4000
3	Low	Population density less than 2000

Skill Exposure Rating - Age (S-A) Higher priority for concentrations of people		
Priority	Exposure Level	Description
1	High	More than 75% of skilled workers or leaders over 50
2	Medium	50-75% of skilled workers or leaders over 50
3	Low	Less than 25% of skilled workers or leaders over 50

Risk Identification - Hazard Assessment

Planning Guide H1 – Hazard Assessment Checklist

- Identify potential community hazards (types of hazards) (Planning Guide H2). Sources of information include local newspapers, oral history, and research studies.
- Complete a Hazard Information Checklist like the one shown in Planning Guide H3 and H4 to identify types and applications of information to characterize each hazard.
- Define hazard indicators to be used to characterize the hazards to be included in the assessment (Planning Guide H4).
- Assign qualitative values to the hazard indicators to determine the relative frequency and severity of each hazard type (Planning Guide H5). Use to rank the hazard in each risk site within the risk area.

Planning Guide H2 – Types of Hazard Events

Natural Hazards	Human Hazards			Economic Hazards
	Operational	Environmental	Security	

<input type="checkbox"/> Avalanche <input type="checkbox"/> Coastal Erosion <input type="checkbox"/> Cyclones <input type="checkbox"/> Disease <input type="checkbox"/> Drought <input type="checkbox"/> Earthquakes <input type="checkbox"/> Erosion <input type="checkbox"/> Flooding <input type="checkbox"/> Lightning <input type="checkbox"/> Landslides <input type="checkbox"/> Molds <input type="checkbox"/> Subsidence <input type="checkbox"/> Tropical Storms <input type="checkbox"/> Volcanic Activity <input type="checkbox"/> Wildland Fires	<input type="checkbox"/> Hazardous Materials Spills <input type="checkbox"/> Construction and Development Accidents <input type="checkbox"/> Structural Fires <input type="checkbox"/> Production Accidents <input type="checkbox"/> Mechanical Failures (HVAC) <input type="checkbox"/> Air Plane Crashes <input type="checkbox"/> Traffic Accidents <input type="checkbox"/> Water Outage <input type="checkbox"/> Communications Outage <input type="checkbox"/> Power Outage <input type="checkbox"/> Transportation Closures	<input type="checkbox"/> Pollution <input type="checkbox"/> Chemical leakage <input type="checkbox"/> Industrial contam.	<input type="checkbox"/> Theft <input type="checkbox"/> Forgery <input type="checkbox"/> Fraud <input type="checkbox"/> Vandalism <input type="checkbox"/> Sabotogage <input type="checkbox"/> Embezzlement	<input type="checkbox"/> Currency fluctuations <input type="checkbox"/> Depression <input type="checkbox"/> Inflation <input type="checkbox"/> Strikes <input type="checkbox"/> War
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Planning Guide H3 - Hazard Information Checklist

Type of Hazard Event: Natural,	Geographic Data Uses: Define	Geologic Data Uses: Identify	Special Studies	Incident Reports Uses:
--	--	--	------------------------	----------------------------------

Human, Economic	spatial distribution of hazard	type, distribution, and relative strength of rock types	Uses: Identify detailed hazard characteristics	establish past history
Natural Hazards				
<p>FLOODS Riverine: periodic overbank flow of rivers and streams. Flash: quickly rising small streams after heavy rain; Urban: overflow of storm sewer systems usually due to poor drainage following heavy rain Coastal – flooding along coastal areas associated with severe storms, hurricanes, or other events</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Topographic Maps – trace the land contour at regular intervals; help define variations in elevation <input type="checkbox"/> Arial Photos (stereographic high-altitude or landsat low altitude) <input type="checkbox"/> Slope Maps divide an area into cells based on the percent slope; <input type="checkbox"/> Precipitation Contour Maps <input type="checkbox"/> Flood-prone area maps <input type="checkbox"/> Flood-hazard maps 	<ul style="list-style-type: none"> <input type="checkbox"/> Bedrock or surficial geology maps- location of recent water deposits (alluvium – sand, gravels) <input type="checkbox"/> Relative characteristics of geologic data – e.g. rock strength 	<ul style="list-style-type: none"> <input type="checkbox"/> Flood inundation maps show elevation of flood waters for specified times <input type="checkbox"/> Dam inundation zones show impact of dam failures <input type="checkbox"/> Flood-plain information reports <input type="checkbox"/> Flood-insurance studies <input type="checkbox"/> Hydrographic studies: stream length, bifurcation ratio, relative relief, basin area, basin length 	<ul style="list-style-type: none"> <input type="checkbox"/> Photographs <input type="checkbox"/> Flood reports <input type="checkbox"/> Loss data <input type="checkbox"/> Damage assessments
Sources of Flood Information:				
Type of Information Needed:				
<p>Map Scale: Regional City/Country Wide Site-Specific</p>				

Planning Guide H4 – Types and Applications of Information

Type of Hazard	Scale of Hazard Information
----------------	-----------------------------

	Regional Mapping 1:64,000- 1:250,000	Town/District 1:10,000- 1:24,000	Site-Specific Study
	Uses: Formulation of broad policies to guide future development. Regional assessment	Uses: Land use planning (Zoning ordinances, etc.).	Uses: Structural design, economic studies, land-use regulation.
Drought	<ul style="list-style-type: none"> Spatial variation in mean stream flow Global climate change 	<ul style="list-style-type: none"> Precipitation data 	<ul style="list-style-type: none"> Water quality, reservoir levels and contents, groundwater levels
Flooding	<ul style="list-style-type: none"> Regional map of flood prone areas Regional maps of drainage system Climate and precipitation maps 	<ul style="list-style-type: none"> Flood prone area maps showing potential areas of flooding based on location near rivers, streams, lakes, ocean or other water body. Hydrologic and hydraulic studies showing peak stage and peak discharge Topographic maps Airphoto mosaics 	<ul style="list-style-type: none"> Flood hazard maps showing potential extent of inundation based on detailed technical study of flooding in a given locality Land surface elevations and depth relationships
Landsliding	<ul style="list-style-type: none"> Regional map of past landslides Evaluation of soils data and surficial geologic maps Reconnaissance slope maps Terrain analysis 	<ul style="list-style-type: none"> Landslide inventory using time series air photos and field investigations Slope stability map 	<ul style="list-style-type: none"> Site maps based on field investigations and/or laboratory tests of soil samples showing slope categories, depth of overburden, depth of groundwater
Sea Erosion	<ul style="list-style-type: none"> Regional maps showing areas in close proximity to oceans or bays Coastal geomorphology and topography Storm data 	<ul style="list-style-type: none"> Topographic maps Airphoto mosaics Elevation of coastal dunes and bluffs 	<ul style="list-style-type: none"> Tidal elevation studies Current studies
Subsidence	<ul style="list-style-type: none"> Evaluation of soils data and surficial geologic maps. 	<ul style="list-style-type: none"> Mine inventory Geologic studies 	<ul style="list-style-type: none"> Site maps showing active and abandoned tunnels Engineering studies
Tropical Cyclone	<ul style="list-style-type: none"> Historical storm pathways 	<ul style="list-style-type: none"> Wind and precipitation 	<ul style="list-style-type: none"> Local wind and rain data

Planning Guide H5

Ranking potential hazard impacts. For each risk site estimate the frequency of hazard impacts likely to occur for each hazard. Generally more frequency events will be less severe than unusually events.						
Risk Sites: Wards of Ratnapura Municipal Council						
Level	Frequency	Natural Hazards				
		Flooding	Landslides	Tropical Storm	Cyclone	Drought
1	Likely to occur several times in a year	Substantial rain, excessive run off;				
2	Likely to occur several times in a lifetime	Significant, temporary flooding of low lying areas				
3	Likely to occur in a lifetime	Inundation of major portion of RMC	Landslides causing fatalities and destruction of property			
4	Possibly will occur in a lifetime					
5	Unlikely to occur in a lifetime, but possible					

Risk Identification - Vulnerability Assessment

Planning Guide V1 – Vulnerability Assessment Checklist

- Use this planning guide (Planning Guide V1) as a checklist for completing the Vulnerability Assessment.
- Use Planning Guide V2 to help identify the elements of vulnerability and vulnerability indicators for community exposures identified using Planning Guide E2 and noted on Planning Guide E3.
- Assign relative weighting factors to vulnerability indicators.
- Use weighted vulnerability indicators to assess the relative vulnerabilities of the exposure inventory located in each risk site within the risk area.

Planning Guide V2

Real Property Vulnerability - RPV					
Vulnerability	Factors	Real Property Vulnerability Indicators			
		Building	Location	Site Conditions	Development
Adverse conditions increase the potential for exposures to sustain loss Triggers, such as rainfall, act on adverse conditions to produce loss	Building Features Location Site Conditions Development Activities on Site	<input type="checkbox"/> Age of construction <input type="checkbox"/> Type of construction <input type="checkbox"/> Foundation <input type="checkbox"/> Building Code <input type="checkbox"/> Life Safety Systems	<input type="checkbox"/> Hazard zone <input type="checkbox"/> Population Density <input type="checkbox"/> Proximity of emerg. Services	<input type="checkbox"/> Slope <input type="checkbox"/> Drainage <input type="checkbox"/> Vegetation <input type="checkbox"/> Geologic materials	<input type="checkbox"/> Site Construction, digging, grading <input type="checkbox"/> Mechanical Failure <input type="checkbox"/> Land use
Personal Property Vulnerability - PPV					
Vulnerability	Factors	Personal Property Vulnerability Indicators - Tangible (TPV)			
		Installation Characteristics	Building Characteristics	Back-up Provisions	Location
Adverse conditions that increase the potential for damage or loss of life Triggers, such as fire, act on adverse conditions to produce loss	Installation Building Backup Location	<input type="checkbox"/> Hazards specific installation requirements	<input type="checkbox"/> Emergency systems to protect from damage <input type="checkbox"/> Alarm systems	<input type="checkbox"/> Copies of records and documents <input type="checkbox"/> Duplicate supplies & equipment <input type="checkbox"/> Manual procedures	<input type="checkbox"/> Hazard specific location requirements
Personnel Vulnerability – Skilled Workers and Leaders					
Vulnerability	Factors	Personnel Vulnerability Indicators			
				Information Source	
Individuals whose loss due to retirement, death, disability or resignation would be a hardship on the community	Elected officials Skilled employees Business leaders	<input type="checkbox"/> Age <input type="checkbox"/> Job risk <input type="checkbox"/> Employment rate		<input type="checkbox"/> Human resource records <input type="checkbox"/> Accident reports <input type="checkbox"/> Economic data	

Risk Analysis

Planning Guide R1 – Risk Analysis Checklist

- The Risk Analysis Matrix in Planning Guide R1 enables the results of the Exposure Assessment, Hazard Assessment, and Vulnerability Assessment to be plotted to graphically show relative risks. Evaluation of the significance of these risks to the capability of the community to achieve its goals and objectives focuses attention on areas where risk control measures are needed.
- Risks shown on the risk matrix are based on subjectively defined and weighted risk indicators. Meaningful representation of risk requires careful selection of the indicators to be plotted. Risk should be plotted relative to a specific function, area, or hazard. The Risk Matrix can be used to illustrate the spatial distribution of risk from natural hazards for each geographic area in the community. To be meaningful, the same exposure and vulnerability indicators will need to be assessed relative to the frequency and severity of a specific hazard.
- When looking at general risks to the community of selected hazards, exposure indicators that best express community values should be selected. For example, population density, number of housing units, per capita gross domestic product, etc.
- When examining risks of selected hazards on specific community functions, exposure indicators related to elements of the community needed to perform that function should be assessed. For example, the relative risk to the community's capability to carry out emergency response actions requires the assessment of exposure and vulnerability indicators for community elements essential for each functional activity. Risk Matrices may be prepared to show the risk to community property needed to implement response actions (critical facilities) for each of several natural hazards.

RISK MATRIX

Community Name:

Risk Area Boundary:

Name of Hazards:

Past Hazard History:

EXPOSURE

List Exposure Indicators for each type of exposure to be addressed in the risk assessment. Indicators should be consistent with the goals and objectives of the risk control program. For example, property indicators for a public safety program might include hospitals, fire stations, police stations, and schools. The type of measurement used to assign a value to each indicator provides a method for identifying the importance of the exposure. Values that might be selected to measure the level of property exposure could include: number of buildings, building replacement costs, importance to support emergency response actions, etc. Exposure priority levels can then be assigned to ranges of exposure values based upon local conditions and needs.

Property Exposure Indicators: *hospitals - number*

Net Income Exposures: *tax- income*

Liability (Responsibility): *population- size*

Personnel Exposures (Skilled Workers/Leaders): *doctors- number*

HAZARD

Describe the hazard impacts likely to occur for each potential hazard according to the level of frequency shown on the table below. For example, significant flooding capable of covering the first floor of homes and businesses is likely to occur in the RMC risk area several times in a lifetime (H=F2). To better identify variations within the risk area, describe the hazard impact likely for each risk site within the risk area. Not all risk sites in the RMC risk area would be exposed to potential flooding hazards. Only a few risk sites would be exposed to potential landslide hazards.

Frequency of Hazard Event in Risk Area:

- Very High (F1) 50 % in 1 year; likely to experience one or more times a year
- High (F2) 50% in 10 year; likely to several times in a lifetime
- Moderate (F3) 50% in 50 years; likely to experience in a lifetime
- Low (F4) 10% in 50 years; possible to experience in a lifetime
- Very Low (F5) 50% in 500 years; unlikely to experience in a lifetime, but might

F	Flood	Risk Sites	Landslide	Risk Sites	Subsidence	Risk Sites
VH(1)	<i>Minor flooding</i>				<i>Minor to moderate subsidence</i>	
H(2)	<i>Moderate to Major flooding – temporary resettlement</i>		<i>Minor landsliding – no fatalities; repairable property damage</i>		<i>Major subsidence</i>	
M(3)	<i>Catastrophic Flooding – prolonged resettlement</i>	<i>Muwagama Weralupe</i>	<i>Major landsliding – fatalities; property destroyed</i>	<i>Helauda Angamma</i>		
L(4)						
VL(5)						

VULNERABILITY

List Vulnerability Indicators for each exposure and type of hazard likely to occur. Indicators should relate to the potential for the specific hazard to cause damage or harm to the selected type of exposure.

Property (*buildings –type and age of construction, number of stories; land – slope, location, geology*)

Flood vulnerability indicators:

Land – (High) proximity to coastline or river systems; in flood plain; (Moderate) in floodway;

Low (higher elevations)

Buildings – (High) single story, on-grade construction; (Moderate) two-story, on-grade construction; (Low) two-story, elevated foundation

Net Income (*taxes – diversity of revenue sources*)

Liability (Responsibility) (*population – density, age*)

Population – (High) high density, over 65/under 5; fast moving water

Personnel (Skilled Workers/Leaders) (*doctors-distance to replacements*)

Risk

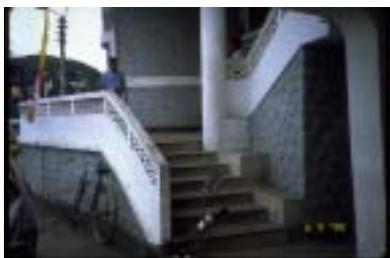
For each Risk Area and/or Risk Site combine and average the exposure rankings to obtain a value for all exposures of interest. Combine and average the vulnerability ranking for each hazard impact on the exposures in the risk area. Plot the combined exposure/vulnerability ranking for the risk area or risk sites in the risk area on the Risk Matrix opposite the frequency of the hazard selected. Describe the severity of the hazard in the Risk Matrix Cell.

Planning Guide R1

Frequency	RISK MATRIX				
	Very High (1) 50% in 1 year			Subsidence in areas of gem mining	
High (2) 50% in 10 year					Severe flooding in Weralupe
Moderate (3) 50% in 50 years				Landslides in Heulada area	
Low (4) 10% in 50 years (Eng.Design)					
Very Low (5) 50% in 500 years					
	3E/3V	2E/3V-3E/2V	E2/V2	E1/V2-E2/V1	E1/V1
	Slight		Significant		Extreme
INCREASING CONSEQUENCES ^					

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LOCATION INFORMATION

Building Name _____
 Street Address _____
 City _____
 Ward _____
 District _____
 Province _____

BUILDING PERFORMANCE OBJECTIVE

_____ (1) Risk Reduction _____ (3) Immediate Occupancy
 _____ (2) Life Safety _____ (4) Continual Occupancy

BUILDING CONTACT INFORMATION

Building Contact Name/Telephone number: _____
 Building Management Name/Telephone number: _____
 Emergency Contact Name/Telephone number _____

HAZARDS

General Site Information

Soil report reviewed: _____ yes _____ no _____ not available
 Soil type _____ Depth to competent layer _____
 Percent of site w/soft soil _____
 Slope: _____ Flat < 6 deg. _____ Moderate 6-15 deg _____ Steep >15 deg.
 Percent of site with Steep slope _____
 Site in flood plain or flood prone area _____ yes _____ no
 Vegetation: _____ Low (grasses, flowers) _____ Moderate (shrubs) _____ High (trees)
 Vegetation Hazard: _____ none _____ L _____ M _____ H
 Site Drainage: _____ good _____ fair _____ poor
 Construction on site? _____ yes _____ no Comment: _____

Site-Specific Hazards – Landslides

Past history of landslides on site _____ yes _____ no Date(s) _____
 Susceptibility: _____ none _____ L _____ M _____ H
 Access potentially blocked by landslide : _____ yes _____ no

Site-Specific Hazards – Flooding

Past history of flooding on site: _____ yes _____ no Date(s) _____
 Flood susceptibility _____ none _____ L _____ M _____ H
 Access potentially blocked by flooding? _____ yes _____ no

Site-Specific Hazards - Tropical Storm

Past history of storm damage to site: _____ yes _____ no Date(s) _____
 Susceptibility _____ none _____ L _____ M _____ H
 Access potentially blocked by storm damage (e.g. fallen trees, flooding)? _____ yes _____ no

Site-Specific Hazards – Subsidence

Past history of subsidence on site? _____ yes _____ no Date(s) _____
 Mining activity under or near site? _____ yes _____ no
 Comment: _____
 Undermining by water at site _____ yes _____ no Comment: _____
 Access potentially blocked by subsidence? _____ yes _____ no

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VULNERABILITY***Structural System***

Structural drawings reviewed _____ yes _____ no _____ not available
 Designed according to local or national building code standards: _____ yes _____ no
 Name and year of Building Code _____
 Year built _____ Basic Structural Type: _____
 Number of stories above grade _____ Number of below grade levels _____
 Total height _____ Plan dimensions (foot print) _____
 Roof type _____ Roof conditions _____ poor _____ good _____ excellent
 Foundation type: _____ Foundation elevated _____ no _____ yes _____ feet
 Foundation conditions: _____ poor _____ good _____ excellent
 Exterior walls made of _____ wood _____ masonry _____ concrete _____ steel _____ other
 Plan irregularity _____ L _____ M _____ H Vertical irregularity _____ L _____ M _____ H
 Adjacent building hazard: Falling Hazard _____ L _____ M _____ H Other: _____
 General condition: _____ good _____ fair _____ poor

Architectural System

Cladding _____ yes _____ no Cladding Weight: _____ heavy _____ medium _____ light
 Windows: safety glass _____ yes _____ no Window size: _____ small _____ moderate _____ large
 Elevator: _____ yes _____ no;
 Elevator lobby-recall (fire safety system) _____ yes _____ no

Mechanical/Electrical Systems

Sprinkler system _____ yes _____ no Building fully sprinkled _____ yes _____ no _____
 Location(s) of sprinklers _____
 Type of sprinkler system(s) _____ wet _____ dry _____ halon _____ other
 Fire extinguishers _____ yes _____ no; Fire alarm system _____ yes _____ no
 Fire Alarm System Monitoring _____ yes _____ no
 Name of fire alarm monitoring company _____
 Internal Security system _____ yes _____ no
 Security Monitoring Company _____
 Exterior security system: video cameras _____ yes _____ no
 Exterior boundary fencing _____ yes _____ no; If yes, full boundary with gates? _____ yes _____ no
 Security Patrols _____ yes _____ no
 If yes, name-number of firm _____
 Temperature Alarms _____ yes _____ no

Furniture/Equipment Vulnerability

Critical emergency response equipment on site _____ yes _____ no Protected _____ yes _____ no _____
 Critical operations equipment on site _____ yes _____ no Protected _____ yes _____ no _____
 Comments:

Electrical System

Electrical Company Name/Number: _____
 Electrical distribution system _____ underground _____ above ground
 Emergency back-up system (Generator) _____ yes _____ no; Protected _____ yes _____ no
 Generator fuel type _____ Days supply of fuel on site _____
 Uninterrupted Power System _____ yes _____ no Duration _____ minutes
 Emergency lighting _____ yes _____ no Where? _____
 Exterior lighting: _____ fluorescent _____ incandescent _____ emergency
 _____ metal halide _____ mercury vapor _____ high pressure sodium
 Comments:

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Water and Solid Waste System

Water company name/number: _____
Potable water stored on-site ____ yes ____ no How many gallons: _____
Solid waste (sewer) company name/number (if different) _____
Water safety systems: eye wash ____ yes ____ no;
body wash ____ yes ____ no

Comments:

Communications Systems

Local telephone company name/number: _____
Long distance company name/number: _____
Type of telephone connections ____ copper wire ____ T1 lines ____ fiber optic cable
Direct access long distance code: _____
PBX system ____ yes ____ no
Direct dial lines (ring down phones) ____ yes ____ no location(s) _____
Pay phone on-site or less than 5 minute walking distance to site ____ yes ____ no
Cell phones ____ yes ____ no Number _____ Type _____
Pagers ____ yes ____ no Number _____
Building Paging system ____ yes ____ no Is paging system on emergency power ____ yes ____ no
Radios ____ yes ____ no Number of channels _____ Number of radios _____
Radio frequency (channel) to use during emergency: _____
Type/manufacturer of radios: _____
Satellite phone ____ yes ____ no

Comments:

Natural Gas System

Natural gas on-site ____ yes ____ no
Name/number of natural gas company _____
Automatic gas shut-off valves ____ yes ____ no
Gas detection system ____ yes ____ no What type of gas? _____
Gas used for air conditioning only ____ yes ____ no
Other uses: _____

Comments:

Emergency Preparedness

Emergency evacuation route posted: ____ yes ____ no Where: _____
Emergency procedures posted: ____ yes ____ no Where: _____
Emergency telephone contacts posted: ____ yes ____ no Where: _____
Emergency supplies kept on-site? ____ yes ____ no Where: _____
What type of supplies? _____

EXPOSURE

People

Number of employees on site _____
24 hr employees on-site _____
Hours operational _____
Days operational _____
Number children or elderly on site (under 5/over 65) _____
Total estimated visitors, vendors, customers typically on site at one time _____

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Building

Community owned building ___ yes ___ no

Building value ___ L ___ M ___ H

Check how value estimated:

___ building replacement costs ___ functional replacement costs ___ reproduction costs ___ economic value

Building leased ___ yes ___ no

Leasing Agent – Name/ Number: _____

Leasehold Value to client ___ none ___ L ___ M ___ H

Alternate site available for relocation of essential functions? ___ yes ___ no

How long would it take to relocate to alternate site? _____

Building Contents

Value of contents ___ L ___ M ___ H

Functional importance of contents to carry out emergency response: ___ L ___ M ___ H

Functional importance of contents to carry out non-emergency community functions: ___L ___M ___H

Comments:

Functions

List top three community functions located in this facility:

- (1) _____
- (2) _____
- (3) _____

Personnel

List personnel required to carry out each of the above functions by name and position:

(1) Function _____

Name:

Position:

Contact Information (location, phone number):

Others:

(2) Function _____

Name:

Position:

Contact Information (location, phone number):

Others:

(3) Function _____

Name:

Position:

Contact Information (location, phone number):

Others:

SECTION THREE – PERFORMANCE IMPROVEMENT

Overview

Purpose

Feasibility and selection of Risk Control Options, including an evaluation of their potential effectiveness. The previous section helps define the community's risk problem. The next step is to identify risk control measures that might be effective in reducing the risks identified.

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Planning Guide R1 - Risk Control Evaluation Checklist

Purpose: Guide the selection of appropriate Risk Control measures to reduce the impact of hazards on an organization's ability to achieve goals and objectives.

Hazard: _____

Exposure or vulnerability to be addressed by the proposed Risk Control Measure:

Brief description of the current non-preferred situation (the current level of exposure and vulnerability):

Preferred or target situation (what level of exposure or vulnerability do you want the Risk Control measure to achieve?)

Proposed Risk Control Technique (check one) to reduce exposure or vulnerability:

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- Avoidance (eliminate risk to organization by not locating in area of potential hazard impact, not purchasing vulnerable land or buildings, and/or refusing to engage in functions that could potentially be impacted)
- Prevention (reduce the frequency of occurrence of the potential hazard impact)
- Loss Reduction – Mitigation (reduce the severity of hazard impact by improving the survivability of people, property, and functions through actions completed prior to hazard impact)
- Loss Reduction – Preparedness (reduce the severity of hazard impact by improving the organizations capability to rescue, salvage, and recover through actions completed after hazard on-set)
- Segregation of Exposures – Separation (increase system capacity and robustness through geographic, physical and operational separation of facilities and functions)
- Segregation of Exposures – Duplication (increase system sustainability by providing back-up support for elements that may be nonfunctional after hazard impact)
- Contractual Transfer (transfer responsibility for hazard impact to another organization)
- Retain risk by accepting potential impacts and planning to pay for financial losses out of existing operating expenses.

Proposed Risk Control Measure: _____

- Each Risk Control Technique has a number of Risk Control Measures that may be selected for implementation. Table X shows a sample of these measures.

Implementation Feasibility

(1) Is the technical information needed to recommend and adopt the proposed Risk Control measure available? Information needs include understanding the nature of the hazard, how the hazard impacts the organization, and what options are available to reduce that impact. Different levels of information will be needed depending upon the type of measure proposed.

_____ yes _____ no _____ uncertain

(2) Are the financial resources available or can they be obtained to implement this risk control measure? Implementation of some measures will require on-going costs in addition to the amount needed to initially recommend and adopt the measure. Will training need to be provided? Will compliance need to be monitored? Will supplies or equipment need to be replenished over time?

_____ yes _____ no _____ uncertain

(3) Is the organization, community, agency or individual that has the authority to implement the proposed risk control measure willing to do so? This is particularly important for voluntary measures, but also applies to those established by law or organizational policy.

_____ yes _____ no _____ uncertain

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- (4) Do the staff or individuals responsible for implementing the risk control measure have the knowledge to do so? For example, implementation of a building code (a mitigation risk control technique) requires that staff in the community's building department understand the code requirements and be able to determine if building plans conform to those requirements.
_____ yes _____ no _____ uncertain

Implementation Effectiveness

_____ **Coverage.** What percentage of the entire community, organization, agency, or individual's home will be addressed by implementation of the proposed risk control measure? For example, implementation of an ordinance restricting development in potential landslide areas may only apply to a small portion of a community where as implementation of a building code may apply to all construction. Similarly, implementation of preparedness measures within an organization could apply to all staff or selected staff units.

_____ **Potential Impact.** Within the area addressed by the proposed Risk Control measure, what is the potential impact of a 100% successful implementation of the proposed measure? For example, a community Risk Control measure that requires all new construction in potential landslide areas to include the installation of a drainage system to manage water on site may have little impact if little or no new construction is occurring in the defined hazard area.

_____ **Implementation Success.** Implementation may be blocked by a number of site-specific and issue-specific characteristics of the community, organization, agency, or individual responsible for implementing the proposed Risk Control measure. This is a subjective estimate of the likelihood that the Risk Control measure will be successfully implemented.

Implementation Cost Assessment

What is the estimated cost (high, medium, low) of adopting the proposed Risk Control measure? Costs include expenditures needed to collect information defining the nature of the hazard, understanding the impacts that the hazard will have on the community, organization, agency, or individual.

SECTION FOUR – PERFORMANCE TRACKING

Overview

Purpose

Establish procedures to monitor the effectiveness of risk control measures. Collection of data on the frequency and severity of natural hazard impacts needs to use a consistent format. If data is gathered using different hazard, exposure, or vulnerability indicators, patterns identified over time will not be meaningful. It will be difficult if not impossible to determine if differences are related to how the data was collected and aggregated versus real differences.

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REFERENCES

American Society for Testing and Materials (ASTM) Standard Guide 1739-95, *Risk Based Corrective Action Applied at Petroleum Release Sites*. "ASTM is in the process of developing a generic RBCA standard that would have application beyond petroleum products. RBCA is a framework or philosophy, a method for approaching a problem.... The objective of RBCA is to reduce risk to public health and environment to an acceptable level." (from www.newjerseyrisk.rog/html/rbca.html)

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The **Asian Urban Disaster Mitigation Program (AUDMP)**, launched in 1995, is the largest regional program of ADPC. The program, with core funding from the Office of Foreign Disaster Assistance of the United States Agency for International Development, will ultimately work in ten or more countries of the region. The program was designed to make cities safer from disasters. The goal of the AUDMP is to reduce the disaster vulnerability of urban populations, infrastructure, critical facilities and shelter in targeted cities in Asia, and to promote replication and adaptation of successful mitigation measures throughout the region. Towards this end, the program develops and supports national demonstration projects, information dissemination and networking activities, and policy seminars and professional training in the target countries of Bangladesh, Cambodia, India, Indonesia, Lao PDR, Nepal, Philippines, Sri Lanka, Thailand and Vietnam.



The **Asian Disaster Preparedness Center (ADPC)** is a regional resource center dedicated to disaster reduction for safer communities and sustainable development in Asia and the Pacific. Established in 1986 in Bangkok, Thailand, ADPC is recognized as an important focal point for promoting disaster awareness and developing capabilities to foster institutionalized disaster management and mitigation policies.

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