Road Development Authority
Ministry of Roads and Highways
Democratic Socialist Republic of Sri Lanka

Preparatory Survey
on
Landslide Disaster Protection Project of the National Road Network Phase 2
in
Sri Lanka

FINAL REPORT

DECEMBER 2019

Japan International Cooperation Agency (JICA)

Nippon Koei Co., Ltd.
Earth System Science Co., Ltd.

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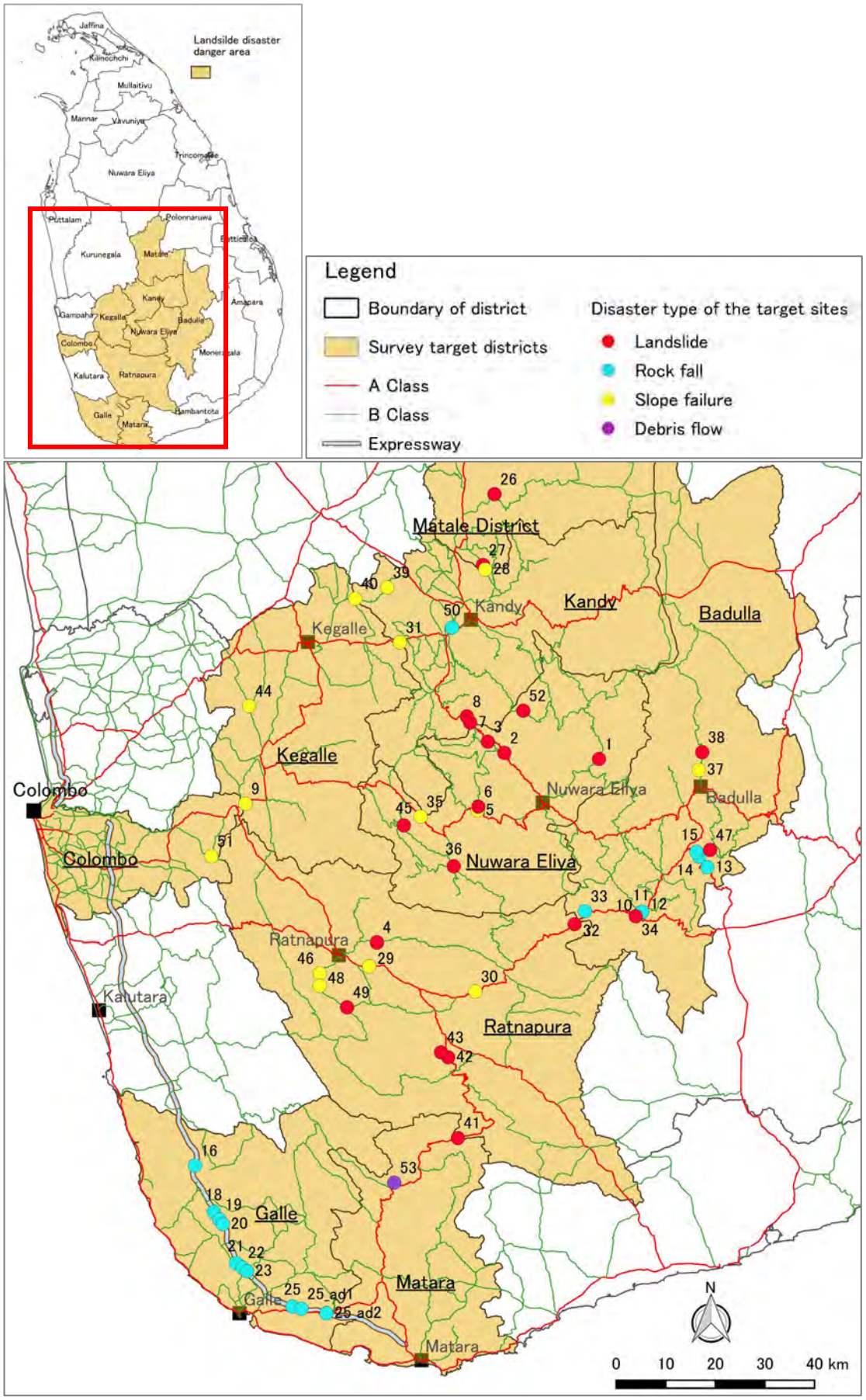
USD 1 = JPY 107.0 = LKR 178.0

(USD: U.S. Dollar, JPY: Japanese Yen, LKR: Sri Lanka Rupee)

Exchange Rate as of October 2019



Source: JICA Survey Team

Location Map

Photo 1: Kick-off meeting with officials of RDA at RDA Head Office.

Photographed on 22nd February 2019

Photo 2: Visit of JICA Survey Team to PMU Office in Kandy District during the first field survey.

Photographed on 27th February 2019

Photo 3: Kick-off meeting with officials of MOHRDPRD at RDA Head Office.

Photographed on 5th March 2019

Photo 4: Explanatory to Japanese construction firms about the Project via TV conference

Photographed on 28th March 2019

Photo 5: Meeting with PMU of RDA regarding to the results of the 2nd selection of target sites at PMU Office

Photographed on 3rd April 2019

Photo 6: Meeting with officials of RDA regarding to the results of the 2nd selection of target sites at RDA Head Office

Photographed on 10th April 2019

Photographed by JICA Survey Team

Photo 7: Invitation to Japan - Meeting with Director General of South Asia Department of JICA.
Photographed on 8th May 2019

Photo 8: Invitation to Japan - Visiting the site managed by Yuzawa Maintenance Branch Office.

Photographed on 9th May 2019

Photo 9: Invitation to Japan - Visiting of NEXCO Communication Plaza Kawasaki.

Photographed on 11th May 2019

Photo 10: Field survey for preliminary design (Land slide site).

Photographed on 4th July 2019

Photo 11: Field survey for preliminary design (Slope failure site).

Photographed on 12th July 2019

Photo 12: Field survey for preliminary design (Rock fall site).

Photographed on 17th July 2019

Photographed by JICA Survey Team

Preparatory Survey on Landslide Disaster Protection Project of the National Road Network Phase 2

Final Report

Summary

1. Introduction

Project Information

Objectives of the Project

- Develop a self-sustaining system for the implementation of landslide risk reduction and landslide countermeasure works on the main national roads through the implementation of landslide countermeasure works for the major national roads with high landslide risk
- Further improve the safety of road networks and the livelihoods of the residents, thereby contributing to socioeconomic development in Sri Lanka.

Project scopes

- Landslide protection for 30 sites of sediment disasters in nine districts (Kandy, Nuwara Eliya and Matale districts in Central Province, Badulla District in Uva Province, Kegalle and Ratnapura districts in Sabaragamuwa Province, Galle and Matara districts in Southern Province and Colombo District in Western Province, See Location Map in Selection of Target Site, P7)
- Establishment of early warning system (EWS) for landslide protection sites of the national road network
- Capacity development for RDA and NBRO

1. Introduction

Project Information

Project approach

- Apply advanced technology of countermeasures against landslide site to secure the safety of road slopes
- Install efficient and effective EWS based on the confirmation of the site conditions
- Conduct capacity building timely and efficiently through updated manuals prepared in Landslide Disaster Protection Project of the National Road Network (LDPP-1)

Relevant government agencies

- Executing Agency: Ministry of Highways & Road Development and Petroleum Resources Development (MOHRDPRD)
- Implementing Agency: Road Development Authority (RDA)
- Technical Advisory Agency: National Building Research Organization (NBRO)

2. Present Conditions of Sediment Disaster in Sri Lanka

Necessity and Rationality of the Project

Validity

- The Project meets both the policy and the plan of Sri Lanka and the Assistance Policy of Japan. The Project will strengthen the achievements of JICA‘s technical assistance in the disaster management sector of JICA Project.

Effectivity

- The Project will reduce road closures of national roads and expressway.
- EWS will contribute to secure safety transportation by introducing traffic regulation system based on monitoring data of rainfall and/or replacement of landslides.
- Capacity development throughout entire period of the Project will strength the capability of RDA and NBRO for slope protection.

Efficiency

- The proposed landslide countermeasures have sufficient economic efficiency (EIRR: 21.1%). It is recommended to implement the Project from the viewpoint of the national economy.

Sustainability

- RDA is planning to establish Landslide Maintenance Management Division (LMMD) to ensure sustainable O&M works of slope protections.
- The Project will be able to contribute to develop the capacity of O&M of RDA.

3. Selection of the Target Sites of the Project

First Selection

Flow of Selection of Target Sites

(1) Collection of Existing Data/Aerial photo, Topography, Meteorological Data etc

↓

(2) Clarification of Sediment Disasters / Failure Type, Area, Scale and/or Dimension

↓

(3) First Selection (34 sites)

↓

(4) Second Selection (30 sites)

↓

Design and Cost Estimate (30 sites)

Source: JICA Survey Team

2) Identifying disaster type and Hazard assessment

Sediment Disaster Type	Magnitude		Probability		
	Rate	Descriptions	Rate	Descriptions	Occurrence
Landslide	i	50 m < Width	a	Clear landslide topography	Less than 5 years
	Ii	20 m < Width <= 50 m	b	Unclear landslide topography	5 years and over
	Iii	Width <= 20 m	-	-	-
Slope Failure	I	20 m < Height	a	Recent collapse scar	Less than 5 years
	Ii	10 m < Width <= 20 m	b	Old collapse scar	5 years and over
	Iii	Width <= 10 m	-	-	-
Rock fall	i	20 m < Height	a	Evidence of falling rocks (stone on the road surface)	Less than 5 years
	ii	10 m < Width <= 20 m	b	No evidence of falling rocks	5 years and over
	iii	Width <= 10 m	-	-	-
Debris flow	i	Volume: more than 500 m^3	a	Alluvial fan	Less than 5 years
	ii	Volume:500 m^3 and under	b	No evidence	5 years and over

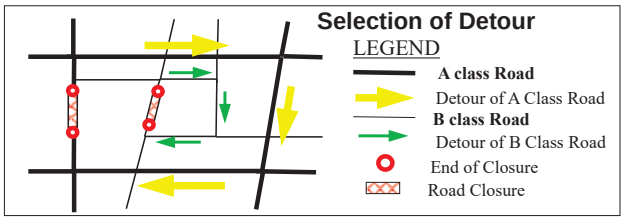
Source: JICA Survey Team

(1) Criteria for the 1st Selection

1) Impact of the Sediment Disasters

A: Distance of Detour: more than 120 km

B: Distance of Detour: 120 km and under



Source: JICA Survey Team

Note:
Detour of expressway includes both A and B Class Roads between interchanges.

(2) Evaluation and Results of First Selection

Classified based on the combination of impact, magnitude and probability of sediment disaster: **34 site classified into I, II or III were selected.**

Probability \ Impact Magnitude	A (more than 120 km)			B (120 km and under)		
	i	ii	iii	i	ii	iii
a	I	II	III	II	III	IV
b	II	III	IV	III	IV	V

Class	Sites	Accumulate	Evaluation
I	3	3	Selected
II	9	12	Selected
III	22	34	Selected
IV	16	48	Not
V	3	53	Not

Source: JICA Survey Team

3. Selection of the Target Sites of the Project

Second Selection and Prioritization

Criteria for Second Selection

Necessity + Efficiency + Effectivity: **60 points and over ⇒ 30 sites were selected.**

Evaluation item			Weight	Scoring
Necessity	Type of sediment disaster	Landslide/ Debris flow/ Rock fall/ Slope failure	15	• Landslide/ Debris flow: 15 pt • Rock fall: 8 pt • Slope failure: 4 pt
	Size of deformation	Extent of steps, subsidence, and cracks on road and natural slopes (topography, cracks on the slopes, subsidence of the road etc.)	15	• Clear deformation: 15 pt • Unclear deformation: 8 pt • No deformation: 4 pt
	Installed countermeasure (effectiveness of existing countermeasures)		10	• No countermeasure: 10 pt • Some effect countermeasure: 6 pt • High effect countermeasure: 2 pt
Efficiency	Traffic volume	Annual Average daily traffic	15	• More than 10,000 pcu/day: 15 pt • More than 5,000 pcu/day – Less than 10,000 pcu/day: 8 pt • Less than 5,000 pcu/day: 4 pt
	Construction cost	Tentative construction cost estimated by RDA	15	• More than 500 mil LKR: 15 pt • More than 250 mil LKR-Less than 500 mil LKR/km: 8 pt • Less than 250 mil LKR: 4 pt
Effectivity	Applicability of New technology		20	• New technology, which has not been utilized in LDPP (phase1), may be applicable: 20 pt • New technology, which has been utilized in LDPP (phase1), may be applicable: 12 pt • Conventional measures may be applicable: 6 pt
	Environmental and social issue		10	• National park, forest reserve area, residential area, sanctuary etc. • More than 1 mile away: 10 pt • More than 0.5 miles - Less than 1 mile away: 6 pt • Less than 0.5 miles away: 2 pt
Total			100	

Source: JICA Survey Team

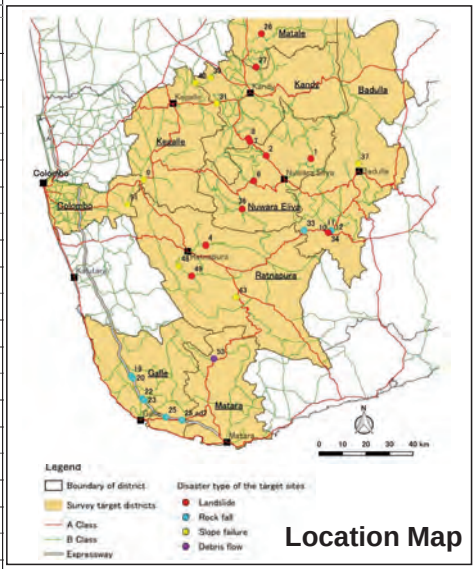
3. Selection of the Target Sites of the Project

Selection of Target Sites

Results of Second Selection and Priority of the Sites

2nd Selection Priority	Item No.	RDA's No	Road Class	Route No	Location		E E Division	District	Sediment Disaster Type	2nd Selection Score							
										Necessity			Efficiency		Effectivity		Total
					Start (Km/cul.)	End (Km/cul.)				Type of sediment disaster	Size of deformation	Installed counter measure	Traffic volume	Construction cost	Applicability of new technology	Environmental social issue	Score
1	1	1	B	B-413	66.75km	67km	Hanguranketha	Nuwara Eliya	Landslide	15	15	10	8	15	20	10	93
2	53	25	A	A-017	62km	62.25km	Deniyaya	Galle	Debris flow	15	15	10	8	15	20	2	85
3	36	17	B	B-149	9.000	9.100	Norwood	Nuwara Eliya	Landslide	15	15	10	4	8	20	10	82
3	7	6	A	A-005	30/9	30/11	Kadugannawa	Kandy	Landslide	15	15	6	8	8	20	10	82
5	49	23	B	B-390	20/9	21/3	Rathnapura	Rathnapura	Landslide	15	15	10	15	4	12	10	81
6	48	22	B	B-390	12/4	12/7	Rathnapura	Rathnapura	Slope Failure	4	15	10	15	4	20	10	78
6	27	13	B	B-462	6+030	6+100	Matale	Matale	Landslide	15	15	6	8	8	20	6	78
8	6	5	B	B-412	30/9	30/11	Nuwara Eliya	Nuwara Eliya	Landslide	15	15	10	8	15	12	2	77
9	19	9	E	E-001	76.7km	77.2km	Welivitiya-Divithura	Galle	Rock fall	8	8	10	15	4	20	10	75
9	20	9	E	E-001	77.9km	79.0km	Welivitiya-Divithura	Galle	Rock fall	8	8	10	15	4	20	10	75
9	22	10	E	E-001	88.0km	88.8km	Baddegama	Galle	Rock fall	8	8	10	15	4	20	10	75
9	23	10	E	E-001	89.3km	89.6km	Bope-Poddala	Galle	Rock fall	8	8	10	15	4	20	10	75
9	40	19	B	B-122	18/3	18/5	Kandy	Kandy	Slope Failure	4	15	10	8	8	20	10	75
9	25	11	E	E-001	101.3km	101.7km	Imaduwa	Galle	Rock fall/Landslide	8	8	10	15	4	20	10	75
9	25_ad2	11	E	E-001	108.6	108.7	Imaduwa	Galle	Rock fall	8	8	10	15	4	20	10	75
16	4	4	B	B-391	11.9 km	12.0 km	Ratnapura	Ratnapura	Landslide	15	15	6	4	15	6	10	71
17	34	16	A	A-004	183km	185/14	Bandarawela	Badulla	Landslide	15	8	10	8	15	12	2	70
18	26	12	B	B-274	11/2	11/4	Matale	Matale	Landslide	15	15	6	4	15	12	2	69
19	10	8	A	A-016	3.85km	4.2km	Bandarawela	Badulla	Rock fall	8	15	10	8	4	20	2	67
19	11	8	A	A-016	5/2	5/4	Bandarawela	Badulla	Rock fall	8	15	10	8	4	20	2	67
19	12	8	A	A-016	5/6	5/8	Bandarawela	Badulla	Rock fall	8	15	10	8	4	20	2	67
19	37	18	B	B-036	4/11	5/3	Badulla	Badulla	Slope Failure	4	15	10	4	4	20	10	67
19	39	19	B	B-122	8/2	8/4	Kandy	Kandy	Slope Failure	4	15	10	8	8	12	10	67
19	43	20	A	A-017	139	140/1	Pelmadulla	Ratnapura	Slope Failure	4	15	10	4	4	20	10	67
25	9	7	A	A-007	3/3	3/5	Ruwanwella	Kegalle	Slope Failure	4	15	6	15	4	12	10	66
25	31	14	A	A-001	99/8	99 km	Kegalla	Kegalla	Slope Failure	4	15	6	15	4	12	10	66
27	33	15	A	A-004	171/5	171/7	Bandarawela	Badulla	Rock fall	8	15	10	15	4	6	6	64
28	51	24	B	B-188	12/4	12/6	Avissawella	Colombo	Slope Failure	4	15	10	4	4	20	6	63
29	2	2	A	A-005	46/2	46/3	Nuwara Eliya	Nuwara Eliya	Landslide	15	8	10	8	8	6	6	61
29	8	6	A	A-005	28/4	28/6	Kadugannawa	Kandy	Landslide	15	8	6	8	8	6	10	61

Source: JICA Survey Team



Location Map

Disaster Types of 30 Selected Sites

Landslide	Slope Failure	Rock fall	Debris flow	Landslide / Rock fall
10	9	9	1	1

Source: JICA Survey Team

4. Natural Condition Survey

Topographical and Geological Surveys

■ Topographical Survey

- Collection of topographical data including LiDAR data and satellite imageries.
- Interpretation of topographical maps and satellite images.
- Topographical plan and cross section survey for the selected 30 sites.

■ Geological Survey

- Collections of past landslide data and actual damage situations.
- Site reconnaissance for the selected 30 sites.
- Geological borehole survey for three landslide sites (No.1, No.7 and No.27).

■ To Understand Topographical and Geological Conditions and Landslide Extents for Outline Design, mainly including below:

- Distribution and scale (or size) of landslide areas, including filling rock blocks.
- Roads and their positions related to landslides, and further damages by landslides.
- Site geological and topographical conditions, as well as groundwater levels.
- Activities, occurrence mechanisms and causes of landslides.
- Geotechnical and physical parameters for outline design.
- Availability/difficulty of access to each sites and land use restraints.

5. Outline Design

Design Policy, Criteria and Standards

Design Policy

- Restoring the road sections to a condition that is safer and better than the original condition, thereby maintaining the national road network and preventing any further disturbances to the traffic.

Criteria and Standards

- Highway Earthwork Series, Published by Japan Road Association, for example, Manual for Slope Protections, Manual for Retaining Wall, etc.
- Sri Lanka codes and standards, e.g., Manual for Road Slope Protection, Specifications for Construction and Maintenance of Roads and Bridges, etc.
- Other internationally accepted Codes and Standards, e.g., Landslides: Investigation and Mitigation, National Research Council, USA, 1996, etc.

Safety Factor – Level of Countermeasures

- Objects to be protected are national roads.
- Initial Safety Factor, Fs = 1.00
- Design (or Planned) Safety Factor, Fsp = 1.20

5. Outline Design

Countermeasure Comparative Analysis

Design Approach (in general)

- Consideration of possible solutions to satisfy the functional and stability requirements;
- Formulation of conceptual countermeasure options incorporating possible solutions;
- Selection of the optimum option or solution by comparison consideration; and
- Provision of detailed engineering design of the optimum solution

Comparison Consideration

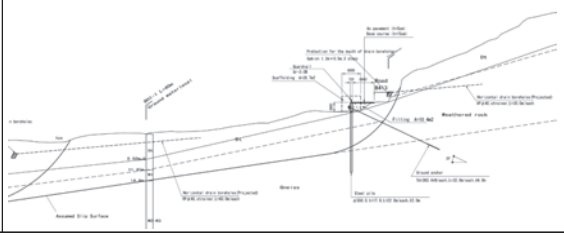
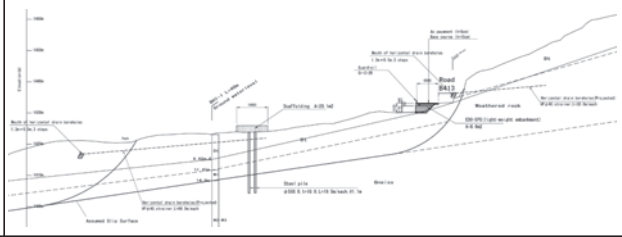
- The degree of stability or reliability necessary for each site,
- The workability of the potential options,
- The influence of the potential options to the road,
- The environmental impacts and aesthetics,
- The cost effectiveness, and
- The post-construction maintenance required.

→ Selection of the Optimum Option for Each Target Site

5. Outline Design

Example of Countermeasure Comparative Analysis

- Alternative plans are consisted of protection measures to protect the road from landslide, and prevention measures to removal unstable slope or stabilize it with structures or their combination.
- Two or three alternatives were compared to determine the most optimum option for each site, in consideration of stability, workability, maintenance, environmental impact and cost-effectiveness.

	1st Plan : Steel Pile with Ground Anchor + Road Widening						2nd Plan : Steel Pile + Road Widening					
Cross Section												
Outline of Countrmeasure												
Stability						3	Comments					3
Workability						3						2
Maintenance & Operation						3						3
Influence to road during construction works						3						3
Environment						2						2
					Subtotal (/15)	14					Subtotal (/15)	13
Rough Construction Cost (Unit: JPY1,000)	Method	Specifications	Unit	Qty	Unit Price	Ammount	Method	Specifications	Unit	Qty	Unit Price	Ammount
	Steel pile		m	***	***	***	EPS filling		m3	***	***	***
	Ground anchor		m	***	***	***	Steel pile		m	***	***	***
	Retaining plate		each	***	***	***	Horizontal drain borehole		m	***	***	***
	Horizontal drain borehole		m	***	***	***	Drain borehole mouth protection		m	***	***	***
	Drain borehole mouth protection		m	***	***	***	Guardrail		m	***	***	***
	Direct Construction Cost				(1,000 yen)	***	Direct Construction Cost				(1,000 yen)	***
	Overhead Cost（65% of Direct Construction Cost)					***	Overhead Cost（65% of Direct Construction Cost)					***
	Total Construction Cost					***	Total Construction Cost					***
Cost					Rate to 1st	1.00					Rate to 1st	1.25
Total Evaluation	1st scheme is the best suited to this site.				Priolity	First	2nd scheme is inferior to the 1st scheme totally.				Priolity	Second

Source: JICA Survey Team

5. Outline Design

Applicability of advanced technology

- Advanced technologies have been proposed in consideration with applicability of the countermeasures, stability of the slope, workability, maintenance & operation, impacts on environment and cost.

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Steel pile with ground anchor
(Source: Isabou.net)
https://isabou.net/sponsor/nm-anchor/jirei.asp

Permeable Sabo dam
(Source: JFE Metal Product Corporation)

Source: JICA Survey Team

6. Cost Estimation

Project Cost

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Source: JICA Survey Team

7. Project Implementation Plan

Implementation Schedule

- Commencement of the Project is July 2020 and End of the Project is August 2028 (Completion of the Civil Works: May 2027).

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Source: JICA Survey Team

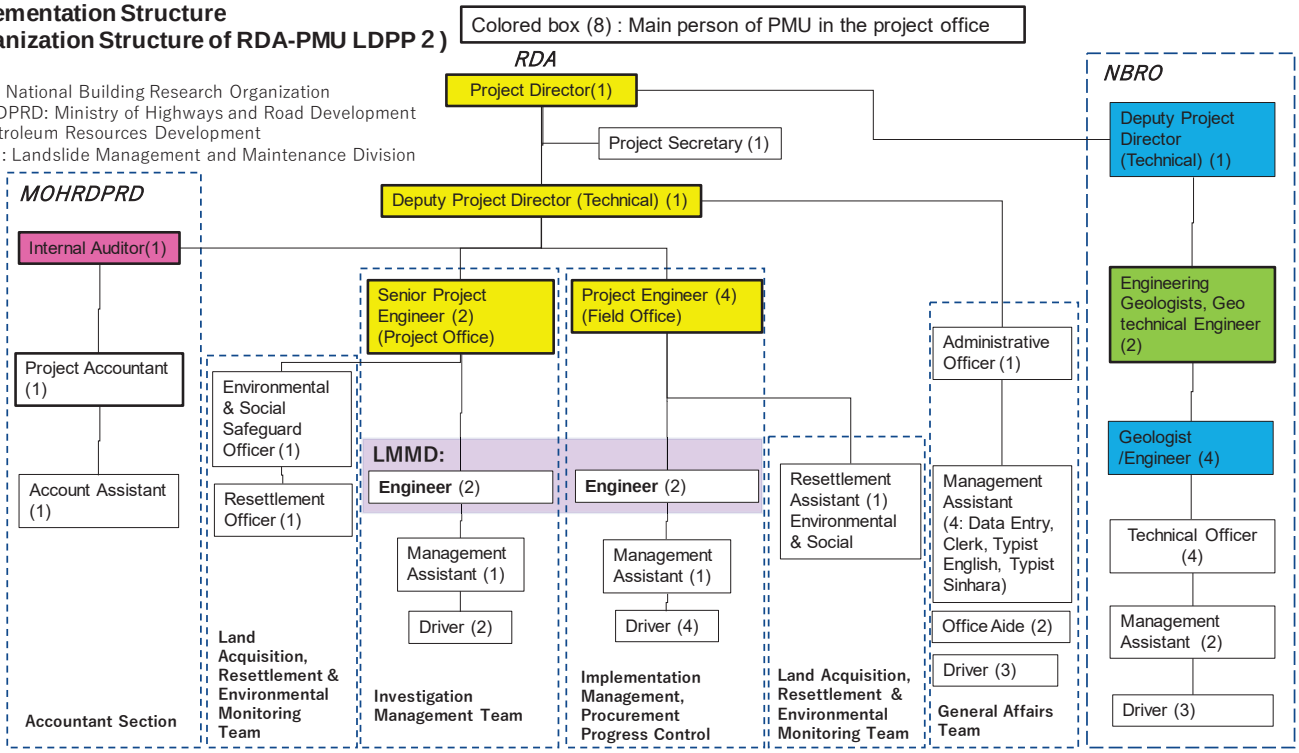
7. Project Implementation Plan

Organizational Structure for Implementation

- RDA, NBRO and MOHRDPRD need to implement the Project in collaboration with each other.

Implementation Structure (Organization Structure of RDA-PMU LDPP 2)

NBRO : National Building Research Organization
MOHRDPRD: Ministry of Highways and Road Development and Petroleum Resources Development
LMMD : Landslide Management and Maintenance Division



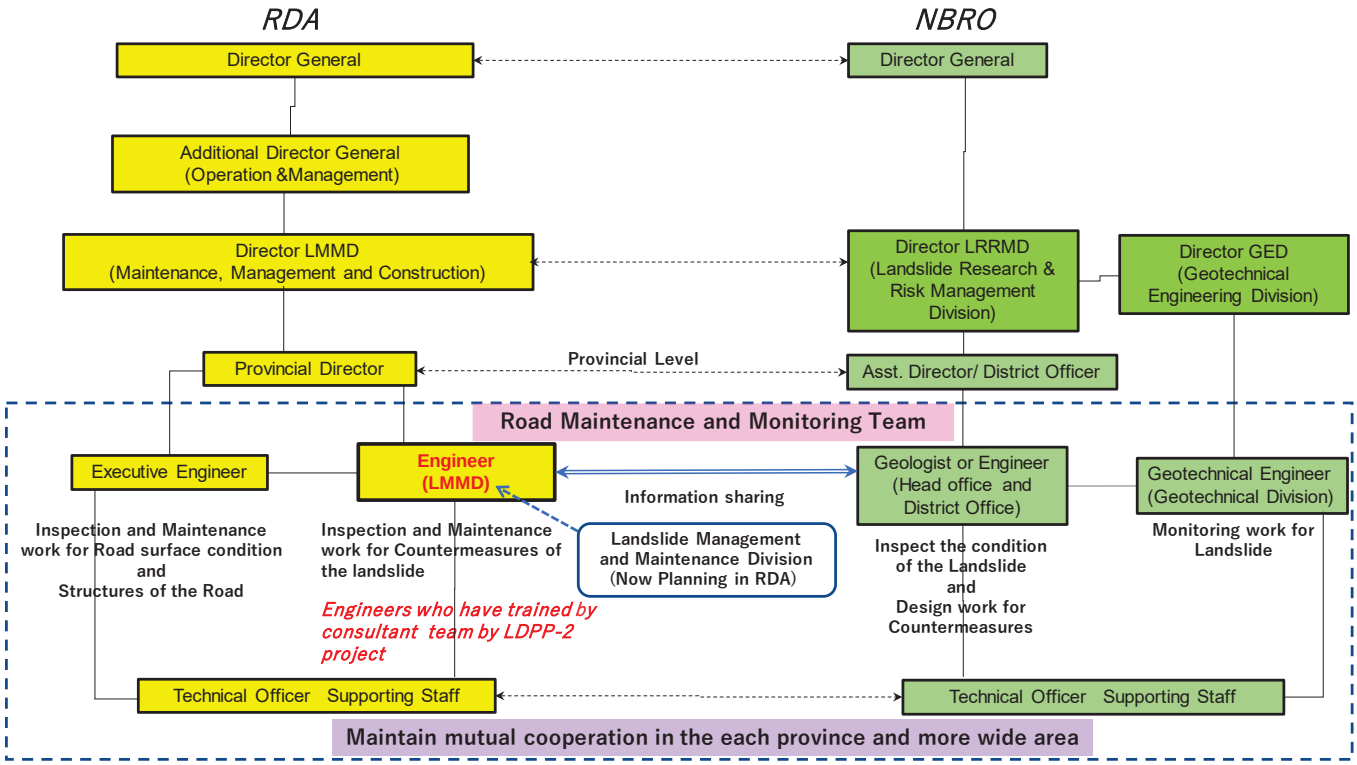
Source: JICA Survey Team

7. Project Implementation Plan

Operation and Maintenance Plan (Organizational Structure of O&M)

- RDA and NBRO need to conduct O&M works in collaboration with each other.

Organizational Structure of Operation and Maintenance



Source: JICA Survey Team

8. Project Evaluation

Economic Internal Rate of Return (EIRR)

- The Project has sufficient economic efficiency (EIRR: 21.1 %). It is recommended to implement the Project from the viewpoint of the national economy.

Results of Economic Analysis

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Source: JICA Survey Team

8. Project Evaluation

Operation and Effect Indicators

- The Project aims to secure safety road networks by reducing risks of landslide disasters to the national road. The following Operation and Effect Indicators have been set to measure its operation and effect quantitatively.

Operation and Effect Indicators

Indicators	Original (2019)	Target (2029)
Annual days of traffic interruption (day/year)	218	0
Annual cost of temporary road recovery (mil LKR/year)	135	0

Note: - Total value at 30 sites
- The indicators have been set on the condition that disasters do not exceed the design scale of the countermeasures.

Source: JICA Survey Team

9. Environmental and Social Consideration

Environmental and Social Impacts

- Environmental and social impacts were examined and necessary management measures were proposed for the Project.

- The Project is by nature not a new road development but an improvement of existing roads, therefore serious impacts are not expected.
- CEA has confirmed that the project does not require to undergo EIA/IEE approval process under the National Environmental Act.
- Cutting trees is expected to construct access road at Site No.53. Detailed mitigation measures should be considered during the detailed design stage to minimize the number of cutting trees.
- Horizontal drain boreholes will cause drawdown of groundwater at some sites (No.1, 4, 6, 7, 26, 34, 49). However, there is no residence that uses groundwater as main water resource.
- The Project will introduce environmentally-friendly technology.

9. Environmental and Social Consideration

Environmental and Social Consideration

- Monitoring will be carried out for the items that negative impacts are expected to some extent.
- During operation stage, there will be almost nothing to affect the environmental and social conditions at the project sites.
- Impacts on private properties, livelihood and economic activities are expected as follows;

Impacts on Private Properties, Livelihood and Economic Activities

Item	Unit	Permanently	Temporarily
Public land to be acquired	ha	3.9	10.7
Private land to be acquired	ha	4.2	19.6
Affected households	number	40	47
Affected persons	number	239	305
Households to be resettled	number	0	0
Persons to be resettled	number	0	0

Source: JICA Survey Team

- An abbreviated Resettlement action plan (A-RAP) and income restoration plan (IRP) will be developed and compensation will be provided to the affected persons.

10. Recommendation

Recommendation to the Project

Implementation Structure

- Assignment of enough number of well experienced RDA-PMU staff are essential for success of the Project implementation.

Investigation and Detailed Design

- Investigations of landslide needs to start at the earliest stage of the Project to ensure enough time of long-term monitoring (at least two years) for the reliable detailed design of countermeasures against landslides.
- Further capacity development activities for RDA and NBRO are necessary through the updating of manuals and timely and efficient training by well-experienced engineers including on-the job training.

Construction Supervision

- Safety management system should be established at the earliest stage of the construction supervision.
- Construction sites cannot avoid the unforeseeable risks in geology of the site. Variation order would be inevitable and should be done in an efficient and timely manner accordingly.
- Foreign engineers with skills of countermeasure design are recommended to be assigned at site during construction supervision.

Democratic Socialist Republic of Sri Lanka
Preparatory Survey on Landslide Disaster Protection Project of the National Road Network
Phase 2

Final Report

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Abbreviations

AD	:	Anno Domini
ACI	:	American Concrete Institute
ADB	:	Asian Development Bank
ADG	:	Additional Director General
ADT	:	Average Daily Traffic
AECEN	:	Asian Environmental Compliance and Enforcement Network
AGA	:	Assistant Government Agents
AIIB	:	Asia Infrastructure Investment Bank
AQI	:	Air Quality Index
a.s.l.	:	Above sea level
BC	:	Before Christ
BIQ	:	Basic Information Questionnaire
BOD	:	Biochemical Oxygen Demand
CE	:	Christian Era
CS	:	Cross Section
CEA	:	Central Environmental Authority
CKD	:	Chronic Kidney Disease
COD	:	Chemical Oxygen Demand
CR	:	Critically Endangered Category
CRIP	:	Climate Resilience Improvement Project
CSC	:	Construction Supervision Consultant
DCS	:	Department of Census and Statistics
DDMCU	:	District Disaster Management Coordination Units
DiMCEP	:	Disaster Management Capacity Enhancement Project
DFR	:	Draft Final Report
DG	:	Director General
DMC	:	Disaster Management Centre
DO	:	Dissolved Oxygen
DOM	:	Department of Meteorology
DRR	:	Disaster Risk Reduction
DSD	:	Divisionary Secretariat District
DWC/DWLC	:	Department of Wildlife Conservation
DTM	:	Digital Terrain Model
EC	:	Electronic Conductivity
EIA	:	Environmental Impact Assessment

EMA	:	External Monitoring Agency
EN	:	Endangered Category
EPA	:	Environmental Protection Area
EPL	:	Environmental Protection Licensing
ESD	:	Environmental and Social Division
ESDAC	:	European Soil Data Centre
FGD	:	Focus Group Discussions
FRCDp	:	Potential Frequency of Road Closure Disaster
GDP	:	Gross Domestic Product
GFDRR	:	Global Facility for Disaster Reduction and Recovery
GL	:	Guidelines
GN	:	Grama Niladhari
GRM	:	Grievance Redress Mechanism
GSMB	:	Geological Survey and Mines Bureau
IEE	:	Initial Environmental Examination
IRP	:	Income Restoration Program
IUCN	:	The International Union for Conservation of Nature
ICTAD	:	Institute for Construction Training and Development
JICA	:	Japan International Cooperation Agency
JPY	:	Japanese Yen
KDN	:	Kanneliya-Dediyagala-Nakiyadeniya
LAA	:	Land Acquisition Act
LAO	:	Land Acquisition Officer
LARC	:	Land Acquisition Resettlement Committee
LD	:	Land Division
LDPP	:	Landslide Disaster Protection Project
LKR	:	Sri Lanka Rupee
LiDAR	:	Laser Imaging Detection and Ranging
MLLD	:	Ministry of Land and Land Development
MOHRDPRD	:	Ministry of Highways & Road Development and Petroleum Resources Development
MOPH	:	Ministry of Ports and Highways
NBRO	:	National Building Research Organization
NCDM	:	National Council for Disaster Management
NEA	:	National Environmental Act
NGI	:	Norwegian Geotechnical Institute
NGO	:	Non-governmental Organization

NIRP	:	National Involuntary Resettlement Policy
NOK	:	Norwegian Krone
NWSDB	:	National Water Supply and Drainage Board
O&M	:	Operation and Maintenance
ODA	:	Official Development Assistance
OP	:	Operational Policy
PAA	:	Project Approving Agency
PAPs	:	Project-affected Persons
PCU	:	Passenger Car Unit
PE	:	Probably Extinct Category
PMU	:	Project Management Unit
Project SABO	:	Project for Capacity Strengthening on Development of Non-Structural Measures for Landslide Risk Reduction
RAP	:	Resettlement Action Plans
RCD	:	Road Closure Disaster
RDA	:	Road Development Authority
RPs	:	Resettlement Plans
RU	:	Resettlement Unit
Rs.	:	Rupee
SR	:	Special Report
SMIs	:	Small and Medium Industries
STDP	:	The Southern Transport Development Project
SPT	:	Standard Penetration Test
TEC	:	Technical Evaluation Committee
TOR	:	Terms of Reference
TSS	:	total suspended solids
TBM	:	Temporary Bench Mark
UDA	:	Urban Development Authority
UNDP	:	United Nation Development Programme
UNESCO	:	United Nations Educational, Scientific and Cultural Organization
USD	:	U.S. Dollar
USGS	:	United States Geological Survey
VRR	:	Victoria, Randenigala, Rantambe
VU	:	Vulnerable Category
WB	:	World Bank
WHO	:	World Health Organization
WSD	:	Working Stress Design

Measurement Units

Length

nm = nanometre
mm = millimetres (10^6 nm)
m = meters (= 100 cm)
km = kilometres (= 1,000 m)

Area

m^2 = Square-meters (1.0 m x 1.0 m)
km^2 = Square kilometre (1.0 km × 1.0 km)
ha = Hectare (10,000 m^2)
ac = Acres (4,046.8 m^2 or 0.40468 ha)

Currency

USD = U.S. Dollar
JPY = Japanese Yen
LKR = Sri Lanka Rupee (Rs.)

Others

°C = Celsius' temperature scale
° = Degree
’ = Minute
pt. = point (s)
pcu = passenger car unit
ppm = parts per million
ds = deci-siemens
MPN= most probable number
Hz = hertz
dB = decibel

Volume

m^3 = Cubic-metres (1.0 m x 1.0 m x 1.0 m or 1,000 lit.)
lit. = Litre (1,000 cm^3)

Weight

µg = Microgram
mg = Milligram (1000 µg)
kg = Kilograms (1,000 g)

Time

sec. = Seconds
min. = Minutes (60 sec.)
hr. = Hours (60 min.)
yr. = Year

Chapter 1 Introduction

1.1 Background of the Project

Landslide disasters are one of the most serious natural disasters in the Democratic Socialist Republic of Sri Lanka (hereinafter referred to as "Sri Lanka"). Especially in the mountainous and hilly areas of the central Sri Lanka, landslide disasters, such as landslides, slope failures, rockfalls and debris flows have frequently occurred in the event of heavy rainfall during the monsoon period due to the rapid development of road network in addition to the fragile geological characteristics and steep topographical conditions. Landslide disasters took approximately 400 lives from 2006 to 2016 throughout Sri Lanka (Des Inventor, UNDRR), being responsible for the greatest casualty loss among natural disasters. In these days, the road transport accounts for 90% of whole inland transportation including domestic passenger and freight transportation in Sri Lanka, and so landslide disasters have caused significant economic losses due to the disruption and closure of the road network.

In the wake of the large-scale tsunami that occurred in the Indian Ocean in December 2004, the Government of Sri Lanka formulated the Disaster Management Act and the National Disaster Management Plan. It also established the National Disaster Management Committee, the Ministry of Disaster Management and the Disaster Management Centre as an important disaster reduction policy to actively address natural disasters. The National Comprehensive Disaster Management Program, which is positioned as an action plan in the National Disaster Management Plan, achieves to meet specific disaster risk reduction goals and establish a disaster management plan to cope with landslide disasters that have caused the most significant damages in Sri Lanka.

Since 2013 JICA has implemented an Official Development Assistance (ODA) loan for the Landslide Disaster Protection Project (LDPP) to improve national roads in the seven districts of the Central Province, Uva Province, and Western Province. However, many disaster potential sites requiring landslide disaster protection countermeasures are still remained and have affected the transportation safety of national roads. Under these circumstances, in May 2018, the Government of Sri Lanka requested for the "Landslide Disaster Protection Project of the National Road Network Phase 2" (hereinafter referred to as the “Project” or “LDPP-2”) to the Government of Japan regarding the implementation of disaster protection countermeasures on unmitigated major national roads. Therefore, JICA has decided to implement the Preparatory Survey on Landslide Disaster Protection Project of the National Road Network Phase 2 (hereinafter referred to as the “Survey”).

1.2 Objective and Scope of the Survey

(1) Objective of the Survey

The objective of the Project is to develop a self-sustaining system for landslide risk reduction through the implementation of landslide countermeasure works on the national roads in the nine districts and the improvement in the safety of road networks and the livelihoods of the residents, thereby contributing to socioeconomic development in Sri Lanka.

The purpose of the Survey is to formulate the Project for a Japanese loan including the project purpose, outline, project cost, project implementation system, operation and maintenance system, environmental and social considerations, etc.

(2) Scope of the Survey

1) Survey target areas

The Survey area covers nine districts, namely Kandy, Nuwara Eliya and Matale Districts in Central Province, Badulla District in Uva Province, Kegalle and Ratnapura Districts in Sabaragamuwa Province, Galle and Matara Districts in Southern Province, and Colombo District in Western Province.

2) Relevant government agencies

The relevant government agencies involved in the project is shown in **Table 1.2.1**.

Table 1.2.1 Government Agencies Involved in the Project

Type of Agency	Government Agency
Executing agency	Ministry of Highways & Road Development and Petroleum Resources Development (hereinafter referred to as MOHRDPRD)
Implementing agency	Road Development Authority (hereinafter RDA)
Technical advisory agency	National Building Research Organization (hereinafter NBRO)

Source: JICA Survey Team

As of the end of November 2019, the executing agency of the Project has changed from MOHRDPRD to "Ministry of Roads and Highways" due to the President election and optional reorganization of the new government in Sri Lanka.

1.3 Work Progress of the Survey

The major activities and events of the Survey are summarised in **Table 1.3.1**.

Table 1.3.1 Major Work Activities and Events

Date/Period	Work Activities
Middle of February 2019	Preparatory works conducted in Japan prior to the field survey to (i) collect and analyse existing data, (ii) prepare inception report, and (iii) explain the report with in JICA Headquarters
15 February 2019	Meeting with JICA to discuss the survey plan
21 February 2019	Launch of field survey
22 February 2019	Meeting with PMU of RDA to explain the inception report and survey plan
5 March 2019	Kick off meeting with MOHRDPRD, RDA, NBRO and JICA Sri Lanka Office to explain the concept and schedule of the Survey at RDA Headquarters
7 March 2019	TV meeting with JICA Headquarters to discuss the progress of the survey, candidate sites, selection criteria, explanatory conference to Japanese companies and invitation program to Japan for relevant agencies
25 March 2019	Explanatory conference to Japanese companies at JICA headquarters
28 March 2019	TV meeting with JICA headquarters to discuss the selection criteria of the 1st screening and the results
29 March 2019	Meeting with PMU of RDA to discuss the criteria of the 1st selection and the results at the PMU Office
3 April 2019	Meeting with PMU of RDA to discuss the revised criteria and the results of the 1st selection and the 2nd selection at the PMU Office
4 April 2019	Skype meeting with JICA Headquarters to discuss the revised criteria and the results of the 1st and the 2nd selection and the invitation program to Japan
8 April 2019	Skype meeting with JICA Headquarters to discuss the revised criteria and the results of the 2nd selection
10 April 2019	Meeting with the Director General of RDA and NBRO to explain the criteria and the results of the 2nd selection at RDA Headquarters
7 May-14 May 2019	Visit in Japan
17 June 2019	Meeting with PMU of RDA to explain the interim report.
2 July 2019	Meeting with DG of RDA to explain the interim report.

Date/Period	Work Activities
5 July 2019	Meeting with PMU of RDA to discuss unit price of the direct cost of countermeasures
12 July 2019	Meeting with PMU of RDA to discuss procurement process, basic concept of design of countermeasures and cost estimate.
22 July 2019	TV meeting with JICA Headquarters to discuss economic analysis, cost estimate and implementation schedule of the Project.
25 July 2019	Meeting with DG of NBRO to explain the interim report and design concept of countermeasures. Meeting with DG of RDA to explain implementation schedule.
15 August 2019	Meeting with PMU of RDA to discuss implementation schedule and organization structure of the Project
19 November 2019	Meeting with RDA DG to explain the draft final report of the Survey.
20 November 2019	Submittal of the draft final report to RDA

Source: JICA Survey Team

1.4 Definition of Terms

(1) Sediment disaster

Phenomena that cause direct or in direct damage to the lives and properties of people, inconvenience of the life of people, and/or the deterioration of the environment, through a large-scale movement of soil and rock (Source: http://www.mlit.go.jp/sogoseisaku/inter/keizai/gijyutu/pdf/sediment_e_02.pdf).
Sediment disaster was classified into four categories, namely landslide, slope failure, rock fall and debris flow described in Chapter 3.

(2) Landslide

Landslide in this Report means one of the movements of soil and rock specified in Chapter 3, and sediment disaster means all categorized movement of soil and rock unless otherwise indicated.
However, “landslide disaster” such as the title of the Project means the same as sediment disaster. These terms have been used as the same meaning in the previous study/survey, because the “landslide” is more common term meaning the movement of soil and rocks. Therefore, “landslide disaster” is used for the meaning the “sediment disaster” also in this Report.

(3) LDPP-1

The Landslide Disaster Protection Project being carrying out since 2013 to implement landslide countermeasure works on the national roads in the seven districts of Central Province, Uva Province and Western Province.

Chapter 2 Present Condition of Sediment Disaster in Sri Lanka

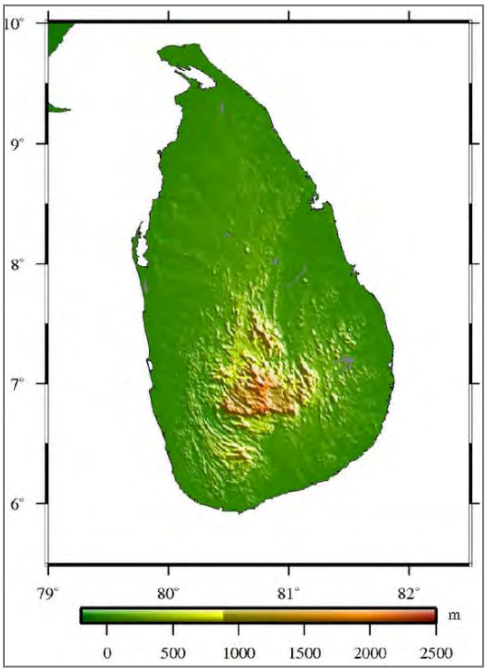
2.1 Outline of Sediment Disaster in Sri Lanka

2.1.1 General Condition of Sri Lanka

(1) Topography

Sri Lanka has an area of 65,000 km^2, including 1,340 km of shorelines with topographic features of the mountain massif. The highest peak of the massif is Pidurutalagala, reaching 2,524 m above sea level (a.s.l.), in the south-central part of the island.

The geomorphology of Sri Lanka is largely divided according to elevation into three regions, namely the Central Highlands, the Plains and the Coastal Belt. The Central Highlands forms the plateau with rugged mountains in the south-central part of Sri Lanka. The land descends to a series of escarpments and ledges at 400 m to 500 m above sea level toward the Plains ranging approximately 30 m to 200 m above sea level. The Plains is surrounded by the relatively narrow Costal Belt of less than 30 m above sea level (**Figure 2.1.1**).



Source: JICA Survey Team

Figure 2.1.1 Geography of Sri Lanka

(2) Geology

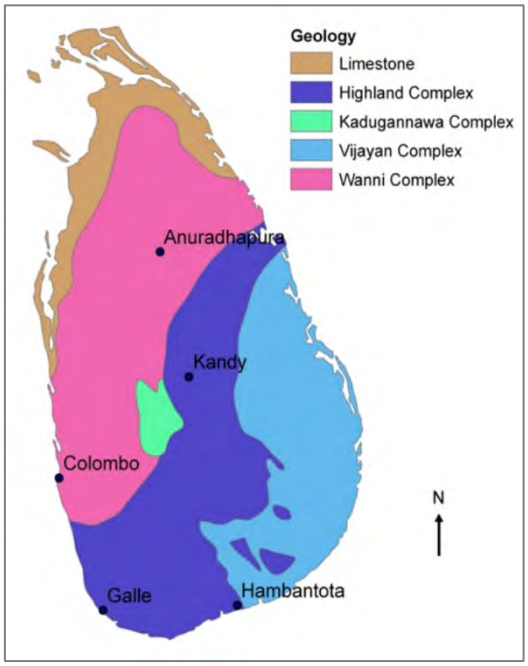
The geology of Sri Lanka consists mainly of crystalline Precambrian metamorphic rocks subdivided as Highland Complex, Wanni Complex, Vijayan Complex and other minor classifications (**Figure 2.1.2**).

Major types of rocks in the Highland Complex are meta-igneous rocks (e.g. charnockites, hornblende-biotite gneiss, migmatitic and quartzofeldspathic rocks) and metasedimentary rocks (e.g. quartzites, marble, dolomite and garnet-sillimanite-graphite schist). The Vijayan Complex that lies east of the Highland Complex consists of metamorphosed granitoids, charnockitic gneisses, migmatites, microcline-bearing quartzofeldspathic rocks, amphibolite and biotite gneiss. The Wanni Complex is located in the west side of the Highland Complex, and its rock types are similar to those of the Vijayan Complex. In addition, a small unit named “Kadugannawa Complex”, composed of amphibolite or hornblendebiotite gneisses, and migmatites, is located in the central part of the country.

Jurassic sandstones, shales and mudstones are distributed in a limited area of faulted basins at Tabbowa and Andigama. Miocene limestone lies unconformably in a small marginal area on the Precambrian basement of the north, northwestern and southeastern coasts.

By the Upper Jurassic Period, Sri Lanka was detached from the southern supercontinent Gondwanaland, and the Indian Ocean began to open up. During this drifting period, Sri Lanka was subjected to at least four major uplifts throughout the Jurassic, Miocene, Pliocene and Pleistocene times.

The hard and compact charnockite rocks and garnetiferrous quartzofelspathic gneisses belonging to the Archaean age are mainly exposed in the Project area. These are overlain by lateritic soils. Outcrops are well-exposed in escarpment slopes and along cut slopes of the road, railroad and landslide scarps. The sub-tropical climate and intense physical and chemical weathering have resulted in a thick yellowish to reddish brown soil. The overburden thickness (including weathered zone) varies from less than a meter to more than 10 m.



Source: ESDAC - European Soil Data Centre

Figure 2.1.2 Geological Map of Sri Lanka.

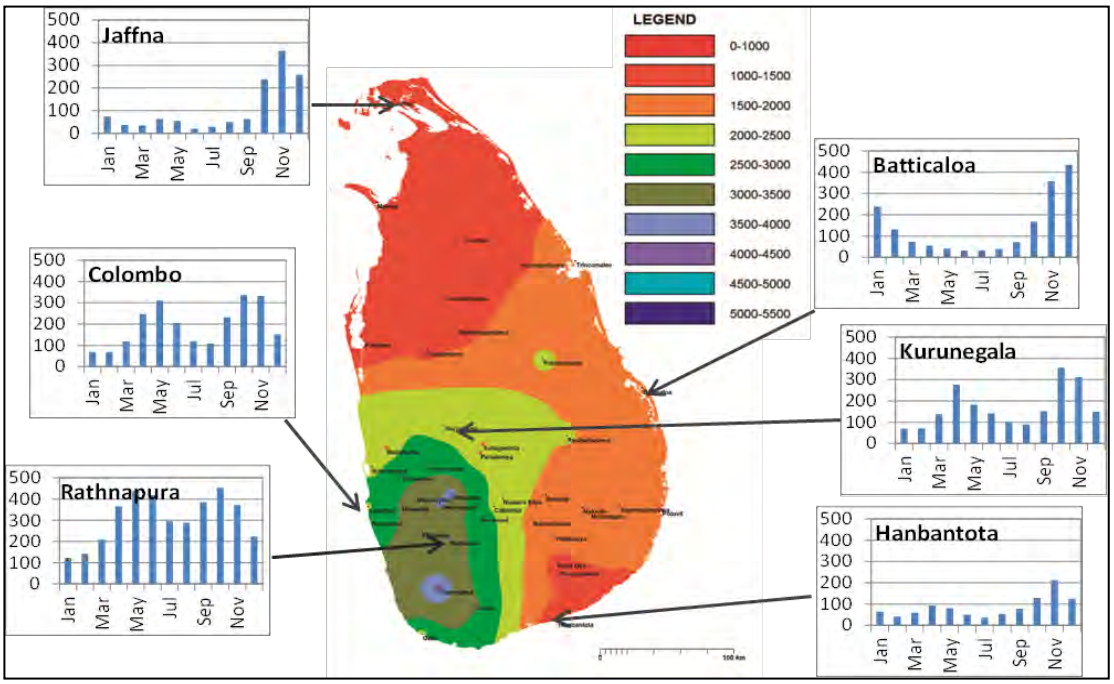
(3) Climate

Sri Lanka is located between 5° 55 to 9° 51 north latitudes and between 79°42 to 81° 53 east longitudes. The country's climate is characterized as tropical. The intertropical convergence zone, which dominates the climate in Sri Lanka, is formed near the equator with a high solar radiation as a low-pressure zone in the global circulation. It generates an ascending air current, which divides into a southward current and a northward current in the upper atmosphere. Both currents form descending currents and then flow into the zone near the earth surface. In Sri Lanka, the year is divided into the following four seasons: (i) First Inter-monsoon season: March to April, (ii) Southwest Monsoon season: May to September, (iii) Second Inter-monsoon season: October to November, and (iv) Northeast Monsoon season: December to February. The mean annual distribution and monthly change of rainfall in Sri Lanka (October 1970 to September 2015) is shown in **Figure 2.1.3**.

The average annual rainfall of the country is 1,861 mm. The amount of rainfall greatly varies depending on the regions. The mountainous region in the southwestern part receives the maximum rainfall of more

than 5,000 mm, while the northwest coastal part receives less than 1,000 mm. Rainfall in the inter-monsoon season occurs due to convection by ascending air current in the intertropical convergence zone and is often accompanied by thunder.

As rainfall in the monsoon season is caused by lifting of wet air in the Indian Ocean with the prevailing wind on the slope, rainfall on the wind oblique slope is greatly experienced. Therefore, rainfall is significantly influenced by the surrounding terrain and area. The seasonal change of rainfall also varies depending on the surrounding terrain and area. The average annual air temperature in lowlands of Sri Lanka is 27 °C and drops to 16 °C in Nuwara Eliya, which has an elevation of 1,800 m. The coldest month is January, and the hottest month is March and April.



Source: Hydrological Annual 2015/16, Irrigation Department

Figure 2.1.3 Mean Annual Distribution and Monthly Change of Rainfall in Sri Lanka (Oct. 1970-Sep.2015)

(4) Population

In Sri Lanka, population census is conducted about every ten years. In recent years, the censuses were conducted in 1981, 2001 and 2012, and the latest population is predicted based on results produced by the Department of Census and Statistics. As shown in **Table 2.1.1**, the population of Sri Lanka in 2017 is estimated at 21,444,000, with an average growth rate of 0.83% per annum during 2001 to 2017. The districts of Kandy, Ratnapura, Galle, and Colombo have a population of over 1 million in 2017. The total population of the nine target districts is 9,997,000, accounting for 46.6% of the total population of the country. The growth rate of the target area is 0.65% per annum, which is slightly lower than that of the country.

Table 2.1.1 Population of Sri Lanka and the Target Area

National/ Province	District	Population ('000)			Population growth (% p.a.)		
		2001	2012	2017	2001-2012	2012-2017	2001-2017
Sri Lanka		18,797.3	20,359.4	21,444	0.73%	1.04%	0.83%

Central	Kandy	1,279.0	1,375.4	1,452	0.66%	1.09%	0.80%
	Nuwara Eliya	703.6	711.6	756	0.10%	1.22%	0.45%
	Matale	441.3	484.5	514	0.85%	1.19%	0.96%
Uva	Badulla	780.0	815.4	864	0.40%	1.16%	0.64%
Sabaragamuwa	Kegalle	785.5	840.6	877	0.62%	0.85%	0.69%
	Ratnapura	1,015.8	1,088.0	1,151	0.63%	1.13%	0.78%
Southern	Galle	990.5	1,063.3	1,113	0.65%	0.92%	0.73%
	Matara	761.4	814.0	851	0.61%	0.89%	0.70%
Western	Colombo	2,251.3	2,324.3	2,419	0.29%	0.80%	0.45%
Total of the target districts		9,008.4	9,517.1	9,997	0.50%	0.99%	0.65%
Ratio of the target districts population		47.9%	46.7%	46.6%			

Source: Economic and Social Statistics of Sri Lanka 2018, Central Bank of Sri Lanka

(5) Economy and Industry

As shown in **Table 2.1.2**, Sri Lankas gross domestic product (GDP) in 2017 was LKR 13,317 billion (USD 87,348 million), and the average growth rate from 2010 to 2017 was 5.5% per annum in real terms. It showed a high growth rate exceeding 8% per annum from 2010 to 2012 after the end of the civil war, but it has been slowed down to 5% per annum or less since 2013. In particular, due to the effects of the drought in 2016, the growth rates of 2016 and 2017 were 3.3% and 2.1%, respectively.

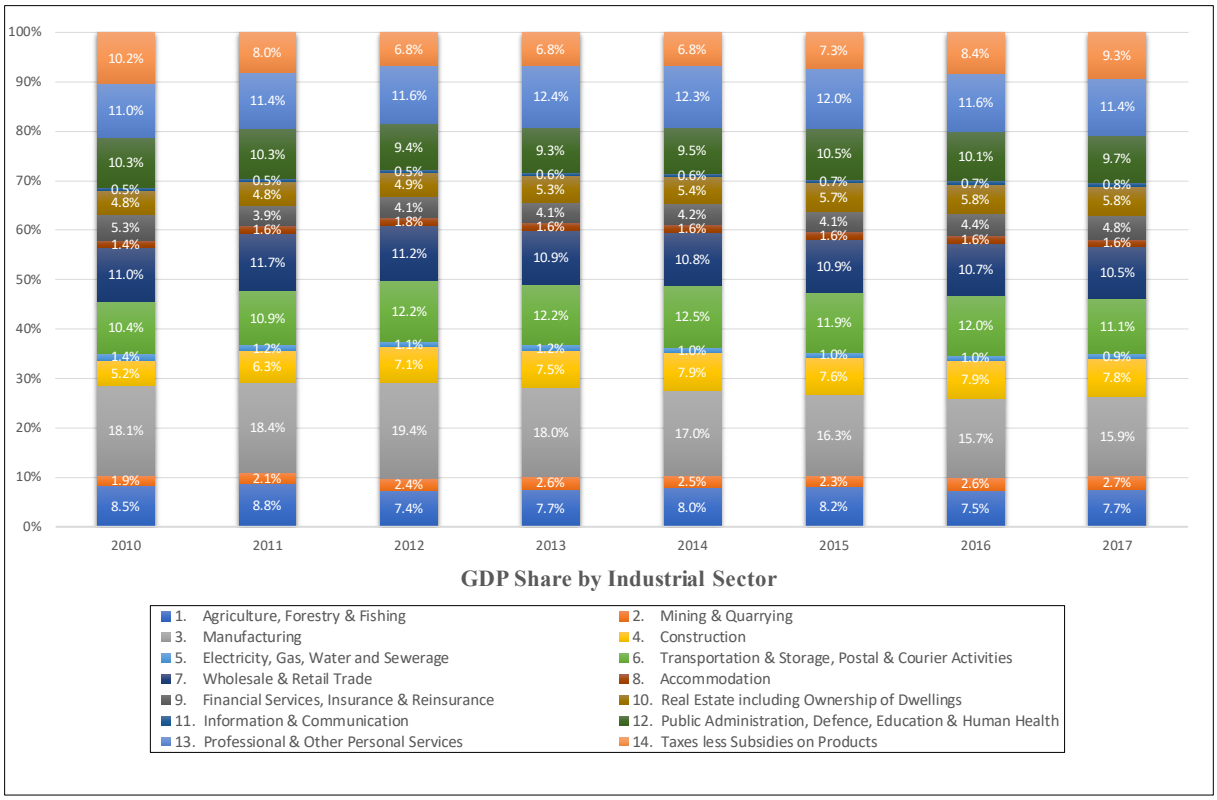
On the other hand, the GDP per capita was LKR 621,000 (USD 4,073) in 2017, and the real growth rate from 2010 to 2017 was 5.0% per annum. Similar to the GDP, the growth rates in 2016 and 2017 remained at 3.3% and 2.1%, respectively.

Table 2.1.2 Major Economic Indicators of Sri Lanka

Major Economic Indicators	2010	2011	2012	2013	2014	2015	2016	2017	Ave. annual growth
GDP at current price (Rs. billion)	6,414	7,219	8,732	9,592	10,361	10,951	11,907	13,317	
GDP at 2010 constant price (Rs. billion)	6,414	6,953	7,589	7,846	8,235	8,648	9,034	9,333	
GDP growth rate (%)	8.0	8.4	9.1	3.4	5.0	5.0	4.5	3.3	5.5
GDP per capita at current price (Rs.)	310,230	345,539	427,515	465,970	498,820	522,322	561,571	621,013	
GDP per capita at 2010 constant price (Rs.)	310,230	332,807	371,554	381,151	396,466	412,477	426,072	435,227	
Growth of GDP per capita (%)	7.0	7.3	11.6	2.6	4.0	4.0	3.3	2.1	5.0
Population (1,000, Mid Year)	20,675	20,892	20,425	20,585	20,771	20,966	21,203	21,444	

Source: Economic and Social Statistics of Sri Lanka 2015, 2016, 2017 and 2018, Central Bank of Sri Lanka

Figure 2.1.4 shows the transition of the industrial structure in Sri Lanka. Although there is no drastic change in the industrial structure, the share of the service sector shows an increasing trend while the share of the agriculture, forestry, and fisheries sector and the share of the industry sector have both decreased relatively. The share of agriculture, forestry, and fisheries was 7.7% in 2017, and it is falling due to the influence of the drought in 2016. The manufacturing sector accounts for a relatively large portion at 15.9%, but its share in the GDP is on a decline. The transportation sector maintains a relatively large share of around 11%, which reflects the importance of this sector including road transportation. Elsewhere, growth in the real estate sector is significant.



Source: JICA Survey Team based on the Economic and Social Statistics of Sri Lanka 2015, 2016, 2017 and 2018, Central Bank of Sri Lanka

Figure 2.1.4 GDP Share by Industrial Sector

Table 2.1.3 shows the changes of the GDP of the target provinces in this Project. The GDP of the Western Province, including Colombo, was high at LKR 4,737 billion in 2016. This is followed by LKR 1,252 billion in Central Province and LKR 1,194 billion in Southern Province. The total GDP of the target provinces is LKR 8,767 billion, which accounts for 73.6% of the total GDP of Sri Lanka. The target area can be said to be a region of great importance to the Sri Lankan economy.

Table 2.1.3 Gross Domestic Product by the Target Area (2010-2016)

National/ Districts	2010	2011	2012	2013	2014	2015	2016
Sri Lanka (Rs. billion)	6,414	7,219	8,732	9,592	10,361	10,951	11,907
Central (Rs. billion)	563	644	776	1,004	1,089	1,161	1,252
Uva (Rs. billion)	253	297	362	500	563	609	687
Sabaragamuwa (Rs. billion)	351	406	467	667	732	824	896
Southern (Rs. billion)	599	719	834	968	1,033	1,106	1,194
Western (Rs. billion)	2,513	2,894	3,244	4,049	4,295	4,366	4,737
Total of the target districts (Rs. billion)	4,279	4,960	5,683	7,188	7,712	8,065	8,767
Ratio of the target districts (%)	66.7	68.7	65.1	74.9	74.4	73.6	73.6

Source: Economic and Social Statistics of Sri Lanka 2017 and 2018, Central Bank of Sri Lanka

Table 2.1.4 shows the GDP and the GDP per capita of the target provinces in 2016. The GDP per capita of Western Province, including Colombo, is the highest amounting to LKR 785,844, which is 40% higher than that of the country. The GDP per capita of the target provinces is LKR 598,657, which is 7% higher than that of the whole country.

Table 2.1.4 GDP and GDP per Capita of the Target Provinces (2016)

National/ Provinces	Population (1,000)	GDP (LKR billion)	GDP per Capita (LKR)
Sri Lanka	21,203	11,907	561,571
Central	2,690	1,252	465,390
Uva	1,333	687	515,684
Sabaragamuwa	2,009	896	445,991
Southern	2,584	1,194	462,214
Western	6,028	4,737	785,844
Total of the target provinces	14,644	8,767	598,657

Source: Economic and Social Statistics of Sri Lanka 2018, Central Bank of Sri Lanka

The target area of the project is an important factor in driving Sri Lankas economy. Transportation is an important sector that accounts for more than 11% of the GDP of Sri Lanka. It is important to reduce human and material damage caused by landslide disasters, which consequently affect the economy due to traffic disruption. It is very important to minimize the impact on economic activities.

(6) Road Network and Traffic

1) Road Network

The road network in Sri Lanka is composed of national roads, provincial road, and expressways as described in **Table 2.1.5**. The RDA is the premier highway authority in the country, and is responsible for the planning, design, construction, operation and maintenance of the National Highway Network are classified into trunk roads (A Class), main roads (B Class), and expressways (E Class). The C Class roads and the D Class roads are operated by the Province Councils.

Table 2.1.5 Road Class in Sri Lanka (31 July 2018)

Type	Road Class	Length (as of 31 July 2018)	Descriptions
National Roads	A Class	4,217.420 km	All roads classified as trunk roads connecting the national capital with the provincial capitals and also connecting these capitals with one another. Also included are other major roads (all roads paved and with bitumen surface with carriageway between 24 ft to 36 ft and platform width 36 ft to 56 ft).
	B Class	8,003.167 km	Main roads connecting other important towns and also providing important links within the trunk route system (metal and bitumen with a small percentage gravelled).
Provincial Roads	C Class	No data	Other roads such as agricultural roads and local roads (single carriage way with width of 12 ft and a platform width of 22 ft; mostly metal but with a small percentage gravelled).
	D Class	No data	Gravelled road with surface with of 8 ft to 10 ft; generally motorable during dry weather only.
Express ways	-	169.845 km	[E01 Expressway (Southern Expressway) opened in 2011.] Toll roads with speed limits ranging from 80 to 110 kph. Pedestrians, bicycles, motorcycles, three wheelers, and tractors are not permitted.

Source: RDA website; JICA (2012) The Data Collection Survey on Road Protection against Natural Disaster, Final Report

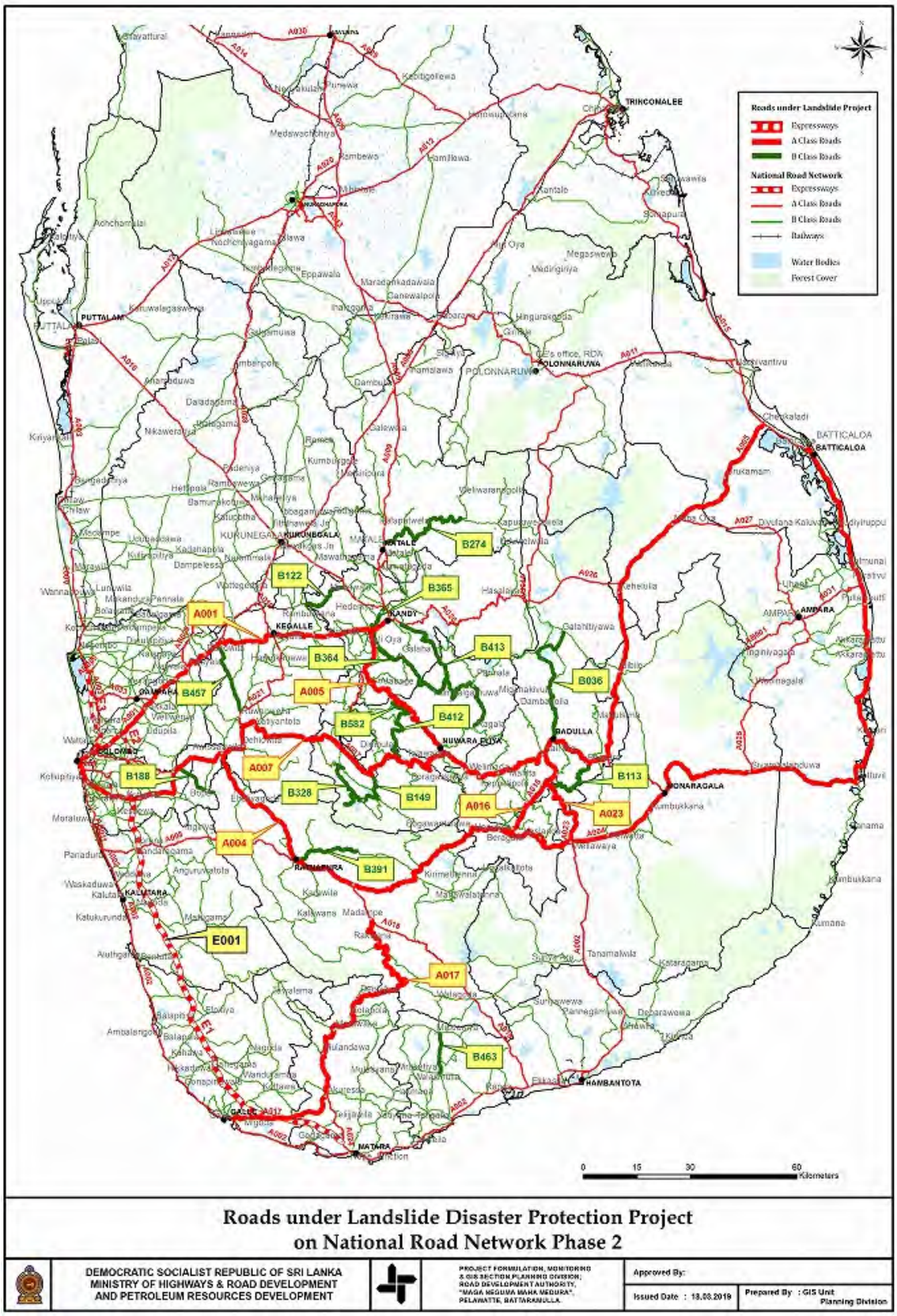
The road networks of the survey area are shown in **Figure 2.1.5**, and the length of each road is shown in **Table 2.1.6**.

Table 2.1.6 Road Networks of the Survey Area

Route	Name	Length (km) as of 31 July 2018
E001	Southern Expressway	124.80
A001	Colombo - Kandy	115.85
A004	Colombo - Ratnapura - Wellawaya - Batticaloa	430.57
A005	Peradeniya - Badulla - Chenkaladi	275.64

A007	Avissawella - Hatton - Nuwara Eliya	118.70
A016	Beragala - Hali-Ela	40.39
A017	Galle - Deniyaya - Madampe	143.93
A023	Wellawaya - Ella - Kumbalwela	30.57
B036	Badulla - Karametiya - Andaulpotha	48.10
B113	Ella - Passara	27.55
B122	Galagedara - Rambukkana	18.50
B149	Hatton - Maskeliya - Dalhousie	32.97
B188	Kaluaggala - Labugama	14.00
B274	Matale - Illukkumbura-Pallegama	46.80
B328	Norton - Maskeliya	16.80
B364	Peradeniya - Deltota - Rikiligaskada	52.13
B365	Peradeniya - Halloluwa - Katugastota	10.61
B390	Ratnapura - Palawela - Karawita	22.53
B391	Ratnapura - Wewelwatte	28.00
B412	Tawalantenne - Talawakela	33.36
B413	Tennekumbura - Rikiligaskada - Ragala	72.67
B457	Warakapola - Ruwanwella	22.53
B463	Weeraketiya - Middeniya	12.87
B582	Gomburuoya - Balapokuna	8.50

Source: RDA website



Source: RDA Documents

Figure 2.1.5 Road Networks of the Survey Area

2) Traffic Volume

Average daily traffic (ADT) data are available for all survey areas, although annual average data were not obtained. The ADT of the survey area was not observed at the same time, and available observation record for each location are limited. The count survey by manual classified vehicles into 14 types, such as motorcycle, three-wheeler, car, van, medium bus, large bus, light good vehicle, medium/large good vehicle, three-axle vehicle, articulated 3-axle vehicle, articulated 4-axle vehicle, articulated 5-axle vehicle, articulated 6-axle vehicle, and farm vehicle.

High traffic volumes of more than 10,000 vehicle counts in the survey area are seen mainly in areas near the Kandy, Kegalla, and Ratnapura districts. Relatively smaller traffic volumes of 2,000 or 3,000 vehicles are observed in the eastern part of the survey area.

2.1.2 Sediment Disaster in Sri Lanka

(1) Data Collection and Analysis

The JICA Survey Team reviewed related study reports and analysed existing data and information, as well as necessary data collected from the related agencies in Sri Lanka. Data and information collected during the Survey are attached in Appendix 2.

(2) Sediment Disaster Record

Topography and geology of Sri Lanka characterize sediment disasters, and heavy rainfalls in the wet season are considered as the main trigger of sediment disasters. In Sri Lanka, 1:50,000 scale landslide zoning maps covering the nine districts of the survey area, were developed by the National Building Research Organisation (NBRO) and are published on the homepage of NBRO. Furthermore, 1:10,000 scale landslide zoning maps were prepared for intensive landslide-prone area around the Central Highlands.

According to the existing hazard map, most of the survey area covering Kandy, Nuwara Eliya and Matale Districts in Central Province, Badulla District in Uva Province, Kegalle and Ratnapura districts in Sabaragamuwa Province, Galle and Matara districts in Southern Province, and Colombo District in Western Province have suffered intensive sediment disasters. Sediment disasters have recently been becoming common even in the Plains surrounding the Central Highlands due to global climate change and expansion of residential areas.

NBRO is analysing sediment disasters records, including the date of occurrence and locations. The database of landslides covering all of Sri Lanka's land will be prepared in the near future. However, the database still remains incomplete at present, the date of the occurrence is limited, and the data for sediment disasters related to road closures are very limited.

Historical records on large sediment disasters and enormous sediment disaster events are available as summarized in **Table 2.1.7** and **Table 2.1.8**. Even though available data on sediment disasters are limited, large landslides occur almost every year and cause tremendous damage to many communities and infrastructures, such as road networks and railways in Sri Lanka. According to the sediment event records as shown in **Table 2.1.9 Sediment Disasters Event Records**

, many slope failures occurred at the artificial cut slope. It may be caused by 1) unsuitable design of the existing cut slopes and 2) lack of proper measurements for slope stability.

Table 2.1.7 Sediment Disaster Records in Last 10 Years (2009-2018)

District	Frequency (times)	Deaths (person)	Injured (person)	Missing (person)	Houses Destroyed (no.)	Houses Damaged (no.)	Indirect Affected (person)	Direct Affected (person)
Matale	8	0	0	0	1	5	0	36
Badulla	34	29	4	31	68	27	0	13,394
Kandy	106	8	24	0	36	300	0	3,660
Nuwara Eliya	78	12	3	0	27	311	0	2,596
Kegalle	70	81	14	122	385	1,898	0	32,799
Ratnapura	79	83	22	34	213	1,130	0	126,669
Colombo	11	5	7	0	1	7	0	51
Galle	8	0	2	0	0	6	0	18
Matara	6	12	1	16	99	293	0	6,626

Source: Homepage of UNDRR DesInventar Sendai, https://www.desinventar.net/DesInventar/

Table 2.1.8 Major Sediment Disasters

No	Major Sediment Disaster	Occurrence	District	Description
1	Watawala landslide	3 June 1992	Nuwara Eliya	After about 50 years of continuous creeping, the landslides occurred and caused major damages on Colombo-Badulla Railway. The moving mass volume was about 3,120 m^2.
2	Helauda debris flow	8 October 1993	Ratnapura	31 victims. Small debris flows followed on 17 May 2003 and 24 August 2006.
3	Palawala landslide	17 May 2003	Ratnapura	The landslide slid down and reached on the opposite slope. Several houses were damaged.
4	Walapane landslide	12 January 2007	Nuwara Eliya	About 100-m long section of the National Highway B413 was affected. 10 victims
5	Mahawewa landslide	Dec.2010-Feb 2011	Nuwara Eliya	After landslides in 2007, housing relocation, no victims
6	Sediment disasters	27-28 May 2017	Kegalle	Landslide 75 locations, 4 victims
7	Sediment disaster	16 December 2012 to 15 January 2013	Matale etc.	28 victims
8	Aranayake landslide	15 May 2016	Kegalle	Triggered by heavy rains of cyclone More than 100 victims
9	Udapotha landslide	2016	Kegalle	22 victims
10	Morawakkanda debris flow	2017	Matara	23 victims

Source: JICA (2012) The Data Collection Survey on Road Protection against Natural Disaster, Final Report
K. Handa et al (2017) Survey Report of Aranayake Disaster, Journal of the Japan Society of Erosion Control Engineering, Vol.69, No.6, pp.67-70.
Project for Capacity Strengthening on Development of Non-structural Measures for Landslide Risk Reduction (Project SABO), Newsletter Vol.1 March 2019

Table 2.1.9 Sediment Disasters Event Records

Occurrence of the Sediment Disasters		2003	2006	2007 July-August	Nov. 2010-Feb.2011	16 Dec. 2012-15 Jan. 2013	2014	2015	2016	2017
Disaster type										
Landslide		211	71	5	75	154	33	25	24	149
Rock fall		33	4	4	13	99 (rockfall and slope failure)	5	18		14
Old landslide		36	5				1	1	8	15
Slope failure of cut slope		123	161	69	43		15	29	40	238
Slope failure of natural slope		187			13					50
Others				7	10	53				9 (debris flow)
Locations of Disaster										
1	Kandy		☑			☑	☑	☑	☑	☑
2	Nuwara Eliya					☑	NA	NA	NA	ANA
3	Matale				☑			☑		☑
4	Badulla		☑				☑	☑		☑
5	Kegalle		☑			☑	☑	☑	☑	☑

6	Ratnapura	☑					☑	☑	☑	☑
7	Galle	☑		☑			☑	☑	☑	☑
8	Matara	☑	☑	☑				☑	☑	☑
9	Colombo	☑	☑	☑			☑			☑
10	Others	☑		☑		☑	☑	☑	☑	☑

Source: Prepared by JICA Survey Team based on NBRO data
Note: NA: Not available
Data before 2012: Summary of one or several events during monsoon period. Data from 2014 to 2017 are summary of available recorded events. It should be noted that the magnitude of each disaster is unknown, and the records of small sediment disaster are not included in the numbers of the Table. The numbers of the events may be subject to revision based on the database of sediment disasters that NBRO is preparing.

(3) Monitoring System

NBRO has developed a monitoring system for early warning since 2005 and has installed and monitored 160 rainfall gauges. Based on the collected data, landslide early warning information is shared in the homepage of NBRO (See **Table 2.1.10** and **Table 2.1.11**).

In 2018, a remote early warning system of Japanese technology (Osasi Technos, Inc.) was installed in landslide-prone sites of Ratnapura District and Nuwara Eliya District which started landslide monitoring. The monitoring site in Ratnapura District is located just above National Highway B-391 Ratnapura-Wewalwatta Road (No. 4 site).

Table 2.1.10 Installed Rainfall Gauge by NBRO

District	UNDP1	NGI	UNDP2	LDPP-1	GFDR	UNDP	GOSL	Total
Badulla				7	9		13	29
Nuwara Eliya			1	9	11		8	29
Kandy			1	7	7		10	25
Matale			2	3			4	9
Kegalle				7	1		7	15
Ratunapura	5				2	14		21
Kurunegala				2			1	3
Kalutana						5	2	7
Galle						5	2	7
Matara						5	4	9
Hambantota						3		3
Monaragala						2		3
Total	5	4	35	30	15	20	51	160

Source: JICA (2017) Data Collection Survey on Disaster Risk Reduction Sector in Sri Lanka

Table 2.1.11 Alert Level for Early Warning

Alert level	Rainfall index
Alert	75 mm/day
Warning	100 mm/day
Evacuation, Off limit	150 mm/day or 75 mm/hr

Source: JICA (2017) Data Collection Survey on Disaster Risk Reduction Sector in Sri Lanka

(4) Sediment Disaster Types

The engineers of Sri Lanka often classify sediment disasters into three types, namely: landslide, slope failure, and rock fall. These classifications seem to be common to the geotechnical and civil engineers in Sri Lanka. The JICA Survey Team classified the sediment disasters of the survey area into four types to identify debris flow, which can occur downward rapidly and can sometimes cause huge damage on infrastructure. Definitions of these terms are discussed in Section 3.2.

2.1.3 Disaster Management Sector in Sri Lanka

(1) Disaster Management Sector

Major organizations/agencies of the sediment disaster management are shown in **Table 2.1.12**.

According to the website of Disaster Management Centre (DMC), DMC is:

- Leading agency for disaster management in Sri Lanka;
- Mandated with the responsibility of implementing and coordinating national and sub-national level programs for reducing the risk of disasters with the participation of all relevant stakeholders; and
- Established as per the provisions of the Sri Lanka Disaster Management Act No. 13 of 2005 under the National Council for Disaster Management (NCDM), which is a high-level inter-ministerial body chaired by the President, that provides direction of the disaster management works.

The main activities of the DMC are:

- Research and development, mitigation, planning preparedness, dissemination of early warning for the vulnerable population, emergency response, coordination of relief, and post disaster activities in collaboration with other key agencies.

Table 2.1.12 Organization/Agency for Sediment Disaster Management

Organization	Descriptions
Disaster Management Centre (DMC)	Leading agency for disaster management, the executing agency of NCDM.
National Council for Disaster Management (NCDM)	A high-level inter-ministerial body, that provides direction of the disaster management works
District Disaster Management Coordination Units (DDMCU)	Established in all districts to carry out disaster risk reduction (DRR) activities at the sub-national level
National Disaster Management Coordination Committee (NDMCC), Technical Committee, Emergency Response Committee, Stakeholder Committee etc.	Depending on the condition, if necessary

Source: JICA (2017) Data Collection Survey on Disaster Risk Reduction Sector in Sri Lanka
Homepage of DMC, http://www.dmc.gov.lk

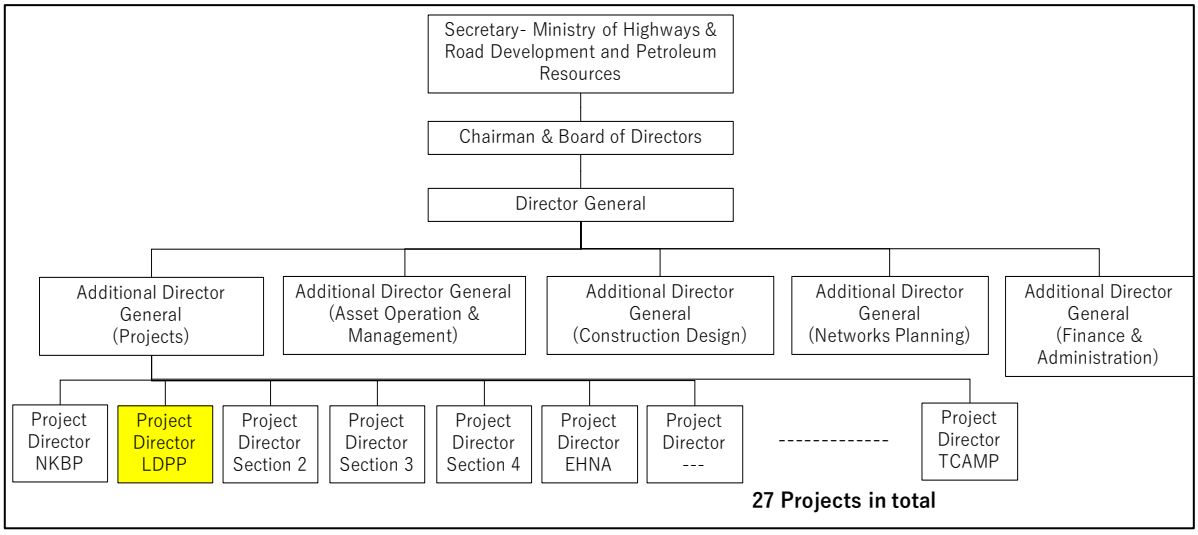
NBRO has been designated as the national focal point for landslide risk management in Sri Lanka by the Government of Sri Lanka in 1993. NBRO carries out landslide-related studies, investigations, mapping, monitoring, early warning and mitigation work, and multiple consulting services for landslide mitigations (Reference: homepage of NBRO, http://www.nbro.gov.lk). The 1:50,000 scale landslide zoning maps, covering the eight districts to be surveyed, were developed by NBRO and shown in the homepage of NBRO, and the 1:10,000 scale landslide zoning maps were prepared for intensive landslide-prone area around the Central Highlands.

(2) Sediment Disaster Management of Road Sector

RDA is responsible for the maintenance of the national highway (RDA Act No.73, 1981), and for the conduct of landslide prevention works of road slopes in consultation with NBRO, if there are technical difficulties.

Emergency activities are carried out in close cooperation with DMC.

A total of 27 project management units, including LDPP are organized under Additional Director General (ADG) (Projects) as shown in **Figure 2.1.6**.



Source: RDA Documents modified by the JICA Survey Team

Figure 2.1.6 Organization Chart of RDA and PMU (LDPP)

2.2 Present Condition and Issues of Slope Protection on the National Road

2.2.1 Present Conditions and Issues

(1) Operation and Maintenance (O&M) of Road Sector

1) Organization for O&M

Condition

The RDA is responsible for the operation and maintenance of the national highway network composed of A Class road, B Class roads and expressways. The O&M of A Class roads and B Class roads are regularly carried out by the Executive Engineers under the administration of the Provincial Director of RDA. On the other hand, the expressway is unitedly managed by the Expressway Operation, Maintenance & Management Division of RDA. These operation and maintenance works were mainly for the road rehabilitation including road widening and repave, and were operated by the fund of the GOSL and international organizations such as WB, ADB and JICA etc.

There have been no experts specializing in sediment disaster protection, although the RDA has Maintenance Management Division. For the O&M of the road sector, the development of the experts and budgetary supports are necessary. Though the activities of LDPP-1, the GOSL has recognized the importance of the O&M of slope protections. Recently the RDA intends to establish Landslide Management and Maintenance Division (LDDM), and two LDDM units are planned to be set in the Central and UVA Provincial offices of RDA.

Conceivable issue

The RDA recognizes the importance of O&M and the LDDM is planned to be established in the near future. The conceivable issues in LDDM are:

- Lack of the experiences of O&M especially for landslide protection;
- Shortage of the engineers specially engaged in O&M; and
- Cooperation system with NBRO including financial support for monitoring of landslides etc.

2) Management of Existing National Highway

Condition

The A Class road connect national and provincial capitals as trunk roads. The B Class roads form links between the trunk roads. These road networks are important for the economic activities for residents.

Most of both class roads are maintained to be good condition through regular/periodical maintenance such as cleaning of drainage ditches and cutting grass and repairing by repavement etc. However, these road networks in the Central Highland and its surrounding area are vulnerable to road closure caused by sediment disasters.

Conceivable issues

- Road closures by sediment disaster will make significant damages on economic activities for residents.
- Especially, in some southern and eastern parts, relatively low in GDP, many national highways still remain narrow, and are likely to be damaged by sediment disasters.

(2) Sediment Disaster Management along Road Slopes

1) Sediment Disasters

Condition

Most of cut slopes along roads in mountainous area are not protected, and many sediment disasters occur every year especially in wet season. Even if cut slopes are stable immediately after the excavation during the road construction, some slopes among them are most likely to collapse due to deterioration of slope condition by weathering.

Conceivable issues

- Heavy rainfalls in wet season possibly trigger landslides in the said slopes deteriorated by weathering. The affected areas by landslides are sometimes too large to treat by conservative methods and require advanced technology of countermeasures;
- Poor experiences of the advanced technology, although some measures were applied in LDPP-1; and
- Upgrading and expanding of early warning system based on appropriate monitoring of landslides.

2) Sediment Disaster Management Sector

Conditions

The said topography and geology in Sri Lanka characterize sediment disasters while heavy rainfalls in wet season are considered as main trigger of sediment disasters. Importance of the drainage works are well recognized in Sri Lanka. The platform to survey sediment disasters has been developed.

- The 1:50,000 scale landslide zoning maps of 13 landslide-prone districts have been prepared by the NBRO and the 1:10,000 scale landslide zoning maps have been developed for intensive landslide-prone area, and these maps were shown in the homepage of NBRO.
- The Manual for the Landslide Mentoring, Analysis and Countermeasure was prepared by NBRO and JICA DiMCEP in 2013
- High resolution topographic maps by LiDAR for topographic interpretation were prepared to identify the landslide especially in the Central Highlands through the JICA Study (2016) entitled "Capacity Development Project for Creating Digital Elevation Model Enabling Disaster Resilience" and the Survey Department of Sri Lanka will proceed the LiDER mapping.
- The NBRO is now preparing a landslide database.
- Remote landslide monitoring devices were installed at landslide areas, and displacement of the ground is monitored by NBRO since 2018.

Conceivable issues

a) Planning/Survey Stage：Identification of Sediment Disaster

- Triggers of sediment disasters are well-assessed in the existing report. However, there are few descriptions of geology, which are needed to formulate the developmental mechanism and movement of sediment disasters.
- Since most of the cut slopes in Sri Lanka remain uncovered/not-protected, geological data are obtained easily. A uniformity of weathering of bedrocks observed on the cut slopes along the National Highway sometimes forms the boundary of a landslide.
- Based on the site reconnaissance, the geology of the survey area is classified to at least four facies, namely: massive and foliated bed rocks, old talus/debris flow deposits, and recent talus deposits. Differences of permeability due to the facies affect the weathering. Many landslides occur near the boundary of the rock facies.

b) Design Parameters for Countermeasure Design

- There are no design standards for structural measurements. To design the countermeasures and to carry out the comparison study of some selected measures, the following factors must be examined:
- Target safety factor (the driving force divided by the resistance force of landslide) in Japan ranges from 1.1 to 1.2, where the original factor is assumed as 1.0

c) Construction Countermeasure Skill

- Many structural measures by new technology such as ground anchor, drainage well, and crib work with shotcrete, were applied in LDPP-1. However, the technician is not familiar with Sri Lankan practices, and it is still difficult for local contractor to implement these new measures. If these new measures are applied for LDPP-2, technical assistance including involvement of Japanese contractors is necessary.
- The best model for skill transfer is for the Japanese Specialised Contractor to work with Sri Lankan Contractors and impart the skills to the Sri Lankan Contractor. If the Sri Lankan Contractor gets the hands-on experience in these skills, the skill will be transferred properly. The Contractor for Package -02 of LDPP 1 is a good example.
- Crib works with nailing of rock bolt, a popular measure in Sri Lanka, seems to have a good effect on the stability of completely weathered rocks or well-consolidated soils. However, it is not suitable for thin-jointed rocks or loose soils. Advanced technology such as Japanese crib works with rock bolts etc. is recommended to apply for slope protections of rocks or loose soils.

d) Other Conceivable Issues Related to LDPP-2

- Construction works of countermeasures at approximately 30 target sites selected in this survey will start around 2023. The condition of the sites possibly becomes worse, and heavy rainfall might trigger new landslides/slope failure/rock fall. If the disaster area expands, the countermeasure designs need to be revised drastically in the detailed design stage of LDPP-2.
- Monitoring for early warning at the critical sites and preparation of quick responses against landslides to carry out timely and effectively when sediment disasters occur are necessary.

2.3 Related Policy and Plan

2.3.1 Policy and Plan Related to Sediment Disaster Management

(1) Vision 2025

The Government of Sri Lanka launched its Vision 2025 in 2017, which emphasize priority reforms to

help the country become more prosperous. The Vision mentions that the equal economic development across provinces and land administration is essential to achieve economic growth in Sri Lanka.
For the sustainable development, disaster management is prioritised in addition to environmental protection and energy security. "Weak environment and disaster management has raised Sri Lanka's vulnerability to natural disasters. The frequent of droughts, floods and landslides impose a heavy human and financial burden falling mostly on less affluent sections of population". Furthermore, the Vision clearly mentions that "the Government will take steps to improve disaster management".

Reference: website of the Prime Minister's Office

(2) Sri Lanka Disaster Management Act, & Policy

The tsunami induced after the 2004 Indian Ocean Earthquake caused serious damage on Sri Lanka. After the tsunami disaster, the Government of Sri Lanka issued "Sri Lanka Disaster Management Act, No.13 of 2005", established by NCDM and DMC and has since then tackled sediment disasters. The Disaster management is taken as one with utmost importance. The "disaster" is defined as "the actual or imminent occurrence of a natural or man-made event, which endangers or threatens to endanger the safety of health of any person or group of persons in Sri Lanka, or which destroys or damages or threatens to destroy or damage any property" in the Act, and "a landslide" is firstly mentioned among the list of 21 disasters.

Reference: website of Ministry of Disaster Management

(3) "National Physical Planning Policy and Plan Sri Lanka 2010-2030"

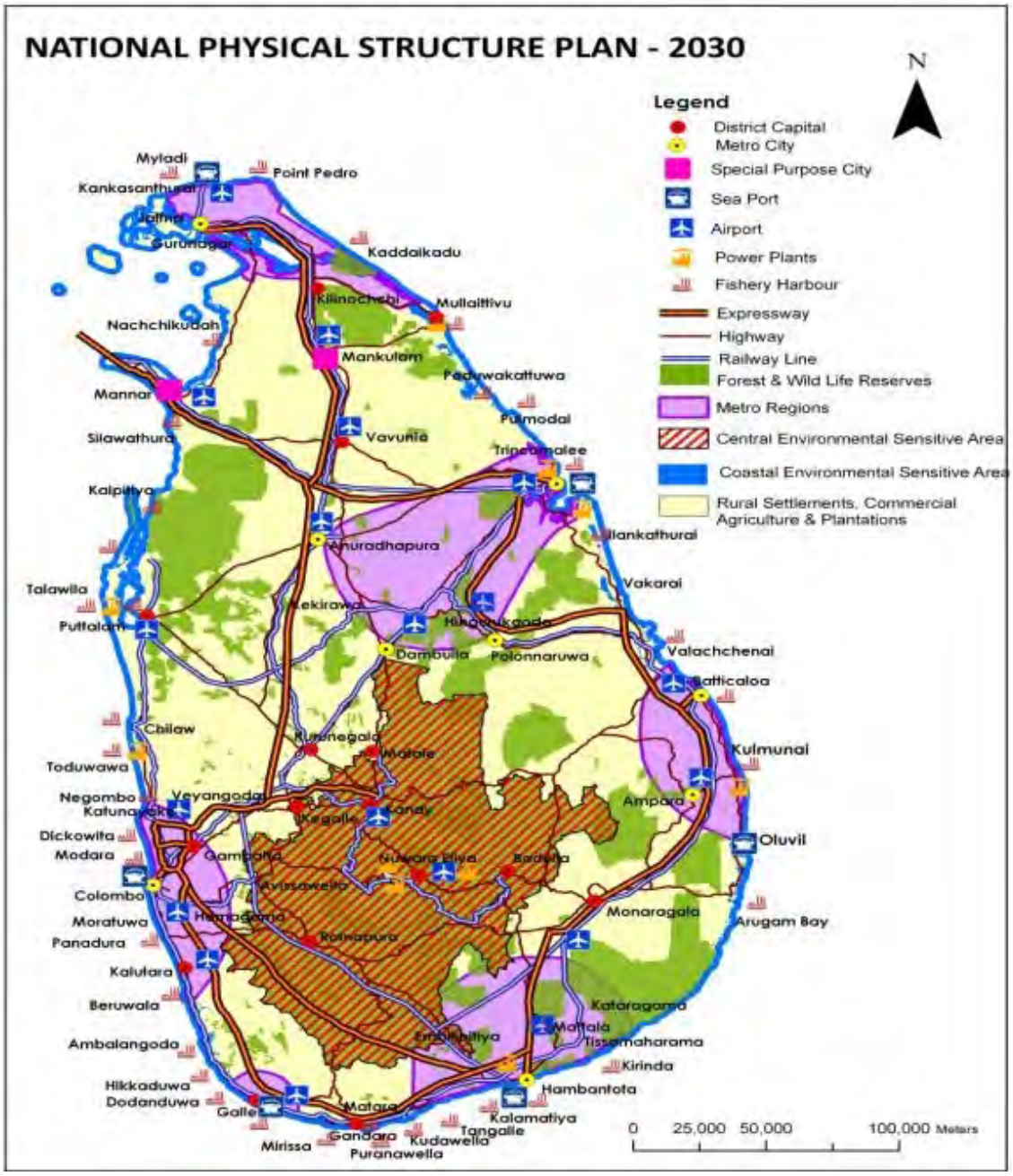
The Draft National Physical Planning Policy has been prepared in 2002 by a Team of engaged under the direction of the National Physical Planning Department as per section 5A(a) of the Town & Country Planning Ordinance No. 13 of 1946 as amended by Act. No. 49 of 2000. The Policy and Plan provide a broad framework to secure Sri Lanka's place in the global economy by promoting economic growth. It is a strategic document that outlines a vision for Sri Lanka in 2030. The main objectives of the Policy and Plan are to achieve economic development through the use of available resources of the country including agriculture, realizing a higher living standard for the people and the establishment of an independence economic status internationally.

Reference: website of National Physical Planning Department

Most of the Central Highland, where landslides fluently occur, is in the "Central Environmental Sensitive Area" of National Physical Structure Plan 2030 as shown in **Figure 2.3.1**. The Policy and Plan aims:

- Incorporating potential internal development opportunities.
- Implementing environmentally friendly sustainable development across the country.
- Strengthening the ethnic integration between the communities.
- Introduction of planned settlement network.
- Conservation of valuable environmentally sensitive areas.
- Mitigating the natural disasters by limiting development in areas prone to natural disasters.

The Government of Sri Lanka gives top priority to disaster management including landslide prevention project.



Source: website of National Physical Planning Department

Figure 2.3.1 National Physical Structure Plan 2030

2.3.2 Assistance by JICA for the Sediment Disaster Management

The Country Assistance Policy and the Rolling Plan of Japan (2018) mentioned disaster risk reduction through both structural and non-structural measures to mitigate vulnerability for sustainable development. The landslide disaster prevention project meets the policy and the rolling plan.

Major assistances related to sediment disaster reduction by JICA are as shown in **Table 2.3.1**.

Table 2.3.1 Major Assistances for Sediment Disaster Reduction by JICA

Year	Study/Project
2007	Basic Design Study Report on the Project for Improvement of Meteorological and Disaster Information Network
2009	Comprehensive Study on Disaster Management
2013-	Landslide Disaster Prevention Project (LDPP) phase-1
2013	Data Collection Survey on Disaster Management Program
2016	Capacity Development Project for Creating Digital Elevation Model Enabling Disaster Resilience
2017	The Project for Improving of Meteorological Observation, Weather forecasting and Dissemination
2017	Data Collection Survey on Disaster Risk Reduction Sector
2018	Technical Cooperation for Landslide Mitigation Project
2018	Technical Assistance for Improvement of Capacity for Planning Road Tunnels

Source: Compiled by the Survey Team

2.3.3 Lessons from LDPP-1

Interview surveys to RDA-PMU, the Consultant and the Contractor of LDPP-1 were carried out in the Survey. Conceivable issues collected by interview survey are follows.

(1) Implementation Structure of RDA-PMU

- Staffing was not enough for RDA-PMU in LDPP-1 through the Project.
- There are 27 PMUs under the administration of an Acting Director General. It is sometimes difficult to manage all projects.

(2) Structure of the Contractor

- The structure of the consortium of the Contractor of Phase-1 consist of a local main contractor associated with foreign companies which are well-experienced in slope protection will be a good system to secure economic efficiency and technical liability in the Project.

(3) Investigations and detailed design stage

- There were many changes of design of countermeasures in the construction stage, and some landslides were not identified in detailed design stage of LDPP-1. At least two years monitoring will be necessary for the reliable detailed design of countermeasures against landslides.
- Capacity development activities for RDA/NBRO in all stages from investigation to O&M were not enough and updating of manuals and timely and efficient training of well-experienced engineers including on-the job training are necessary. The engineers are required English communication skills enough to explain necessary knowledge.

(4) Construction Supervision

- The local contractors sometimes did not comply with safety management regulations,
- Safety devices such and helmet, safety booths and safety belt apparatus etc. are sometimes not used.
- Any countermeasures of sediment disasters cannot eliminate the unforeseeable risks in geology of the site. Variation order would be inevitable and should be done in an efficient and timely manner accordingly.
- Since unexpected landslides might occur due to unforeseeable geology, four foreign engineers with

skills of countermeasure design are desirable to be assigned at the site during construction supervision stage.

(5) Others to be considered

- LDPP-1 contributed to significantly improve local contractor's experiences and their labors capability of slope protection. Especially skilled workers familiar with slope protection measures are important for LDPP-2. However, local contractors are sometimes difficult to continue to employ these skillful workers and pay their salary, unless continuous O&M works of slopes.
- Training of these skilled workers in Japan might be one solution to keep and further develop the capacity of the local contractors.

2.4 Related Project by Other Donners

2.4.1 Climate Resilience Improvement Project (CRIP)

Activities supported by World Bank (WB) are shown in **Table 2.4.1**.

Table 2.4.1 Activities of Slope Protection by CRIP

Project	Route	Start-Completion	Construction Cost (Rs)	Major Structural Measures
Rectification of 4 unstable slope segments between culvert 55/03 and 60th km on Kandy	A026	30 Dec. 2014 to 21 Jan. 2017	247,911,420	Soil nailing, networks, vegetation, drainage works
Rectification of 4 unstable slopes between culverts 43/04 & 51/02 on Kandy-Mahiyanganaya-Road	A026	30 Dec. 2014 to 10 Jan. 2017	183,454,680	Ditto, gabion
Rectification of 7 unstable slope segments between culverts No 37/5 & culvert No 41/10 Kandy- Mahiyanganaya-Padiyathalawa Road	A026	30 Dec 2014 to 18 Aug. 2016	152,983,020	Ditto, shotcreting

Source: Homepage of CRIP

2.4.2 Asia Infrastructure Investment Bank (AIIB)

NBRO is planning landslide prevention projects funded by AIIB. The project consists of 147 sites prone to landslides, which will be implemented in two phases. The Phase I of the project will start in 2019 and structural measures against 27 landslides along road networks, railways, and around residential areas will be constructed. The Phase II will include remaining 120 sites.

2.4.3 Norwegian Geotechnical Institute (NGI)

The technical collaboration on disaster risk reduction has been ongoing since 2012. It almost contributed nearly NOK 8 million (LKR 150 million) and agreed to extend the support with additional funds until 2020. Major supports are technology transfer to identify the landslide risks, and early warning system with remote sensing devices.

Source: Colombo Page, http://www.colombopage.com/archive_17B/Sep25_1506349864CH.php

2.4.4 United Nation Development Programme (UNDP)

Projects undertaken by UNDP are shown in **Table 2.4.2**. Most of the projects supported by UNDP are for the enhancement of technology to mitigate landslide risks, not for the construction of countermeasures.

Table 2.4.2 Activities of Slope Protection by UNDP

Project	Year	Description
Integrated Strategic Environment Assessment	January 2009	Quick response against disaster; Collaboration with DMC, DOM, NBRO, etc.

Hazard Profile of Sri Lanka	December 2012	A multi-agency approach coordinated and supported by Disaster Management Centre (DMC) and United Nations Development Programme (UNDP), December 2012.
Installation of monitoring system (rainfall gauge)	-	Non-structural measures were applied.

Source: Homepage of UNDP etc. summarized by the JICA Survey Team

Chapter 3 Selection of the Target Sites of the Project

3.1 Risk Assessment of the Target Sites

3.1.1 Identification of Current Potential Risk

Disaster analysis (types of disasters, scale of disasters, and economic impacts) was conducted for 53 candidates proposed by RDA. **Table 3.1.1** gives collected information through interview surveys of RDA and site reconnaissance for damage analysis. All information of the trends of occurrence and damage was summarized as inventory sheets shown in *Appendix 3*.

Table 3.1.1 Data Collection for Damage Analysis

Item	Description
1. Slope foundation information	Slope position (road distance, right/left slope, expected disaster type) Disaster type
2. Disaster history	Disaster occurrence information (date and time, scale, damage, etc.) Number of accidents in the past decade
3. Check of hazard evaluation categories (categories) for each hazard evaluation item (item) and calculation sheet of predicted frequency of road accidents (number of accidents/year)	The hazard evaluation items include topographical, geology, vegetation, and transformation conditions. Existing countermeasures structures and road structures and their reliability Estimated frequency of road accidents (number of accidents per year)
4. Forecast scale of hazard situation (sketch)	Status of disaster sources, projected amount of soil reached, and projected extension of road traffic obstruction
5. Amount of damages	Risk before measures: Amount of damage (estimated annual loss)

Source: JICA Survey Team

3.1.2 Clarification of Sediment Disasters

Sediment disasters are recognized as major natural disasters that cause a large number of casualties and resulting in enormous loss in various aspects. There are several literatures that define the term of sediment disaster. In this report, sediment disasters are classified into four types referring to the definition of the United States Geological Survey (USGS). **Table 3.1.2** indicates the relationship between the definition in USGS and the classified phenomenon in this report.

(1) Rock Fall

A rock fall is equivalent to “FALLS” and “TOPPLES” of the material “ROCK” in Table 3.1.2. Rock fall is a phenomenon where foliated rocks and gravel due to enlarged cracks in the bedrock or outcropped rocks start to fall down a slope. It is one of the relatively common phenomena occurring along the roads in the area where most target sites are distributed.

(2) Slope Failure

A slope failure is equivalent to “FALLS” and “TOPPLES” of the material “DEBRIS” and “EARTH” in **Table 3.1.2**, but “rock slope failure” is not included in the “Slope Failure”. The slope failures are generated due to the detachment of mass from a steep slope/cliff along surface with little or no shear displacement. It may be called a “surface failure”. Compared with the landslides, the quick slope moves on a small scale, the inclination angle of the slope failure is relatively high angle with an angle of over

20 degrees. It is one of relatively common phenomena that occurs along the roads in the area where target sites are distributed.

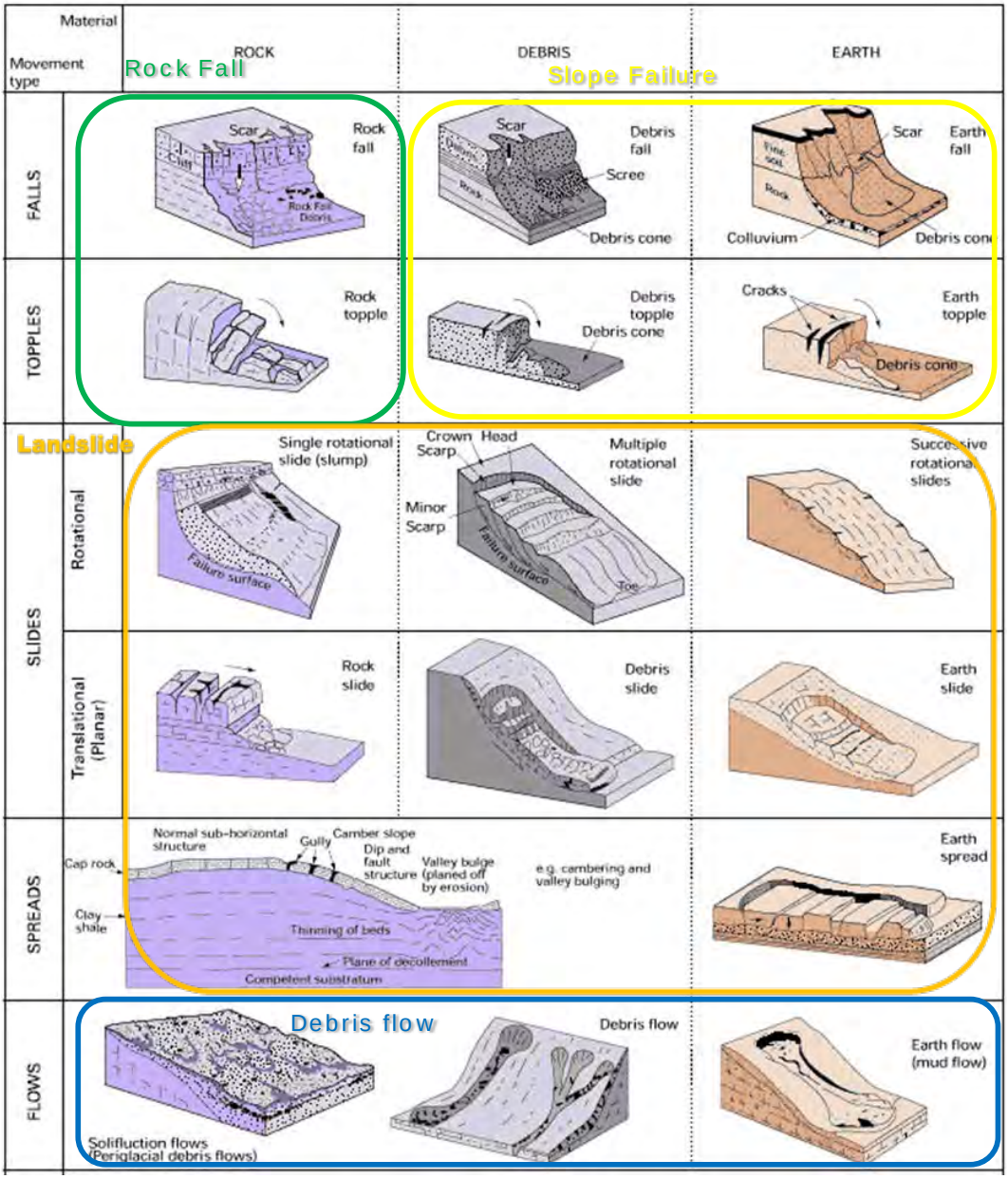
(3) Landslide

A landslide is equivalent to “SLIDES” and “SPREADS” in **Table 3.1.2**. A landslide is a phenomenon where the soil mass on one or more failure (slip) surfaces deep in the ground gradually shifts downward, triggered by heavy rain or earthquake, river erosion, earthworks. Landslide sites tend to be concentrated in areas with specific geology or geological structure. Compared with the slope failure, the gentler slope moves on a large-scale, forming specific topography (landslide topography), the inclination angle of the landslides slope is a relatively low angle (about 5-20 degrees).

(4) Debris Flow

A debris flow is equivalent to “FLOWS” in **Table 3.1.2**. A debris flow is a phenomenon where soil and boulders are liquefied by surface water or groundwater and tend to flow downward rapidly through a mountain torrent. It usually has huge energy and destructive force. Debris flow tends to occur in places where there is massive sediment of unstable debris along a steep torrent, or a large risk of slope failure due to heavy rain in the catchment basin.

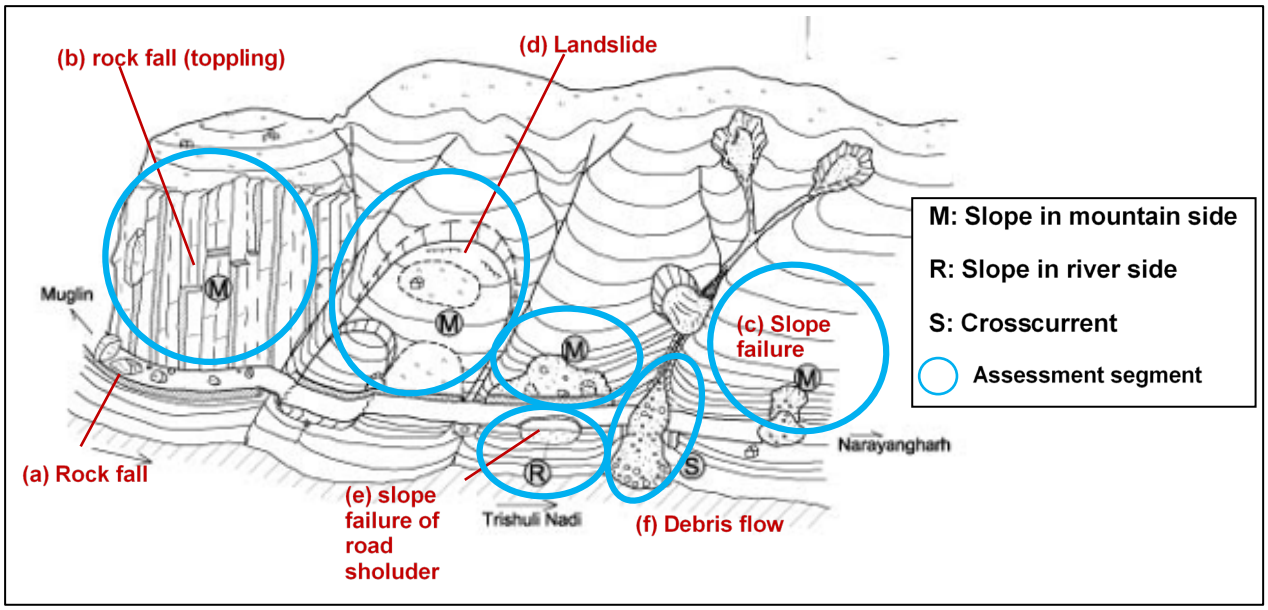
Table 3.1.2 Relationship between the Definition in USGS and the Phenomenon in this Report



Source: USGS partially modified by the JICA Survey Team

In addition to disaster types such as slope failure, landslide, rock fall, and debris flow, comprehensive evaluation was performed in consideration of slope types (slope on the mountain side, slope on the river side, and transverse mountain flow) at the disaster site, as shown in **Figure 3.1.1**. The reason why the classification of the slope type is also adopted is to eliminate the complexity of the evaluation in the case where a plurality of disaster types occurs even on individual slopes or in the case where the disaster types are not clear.

According to the inventory survey, the 53 candidate sites are composed of 17 rock fall, 15 slope failure, 19 landslide, one debris flow and one combined rock fall/landslide site. Details of descriptions of each site are shown in Appendix 3.



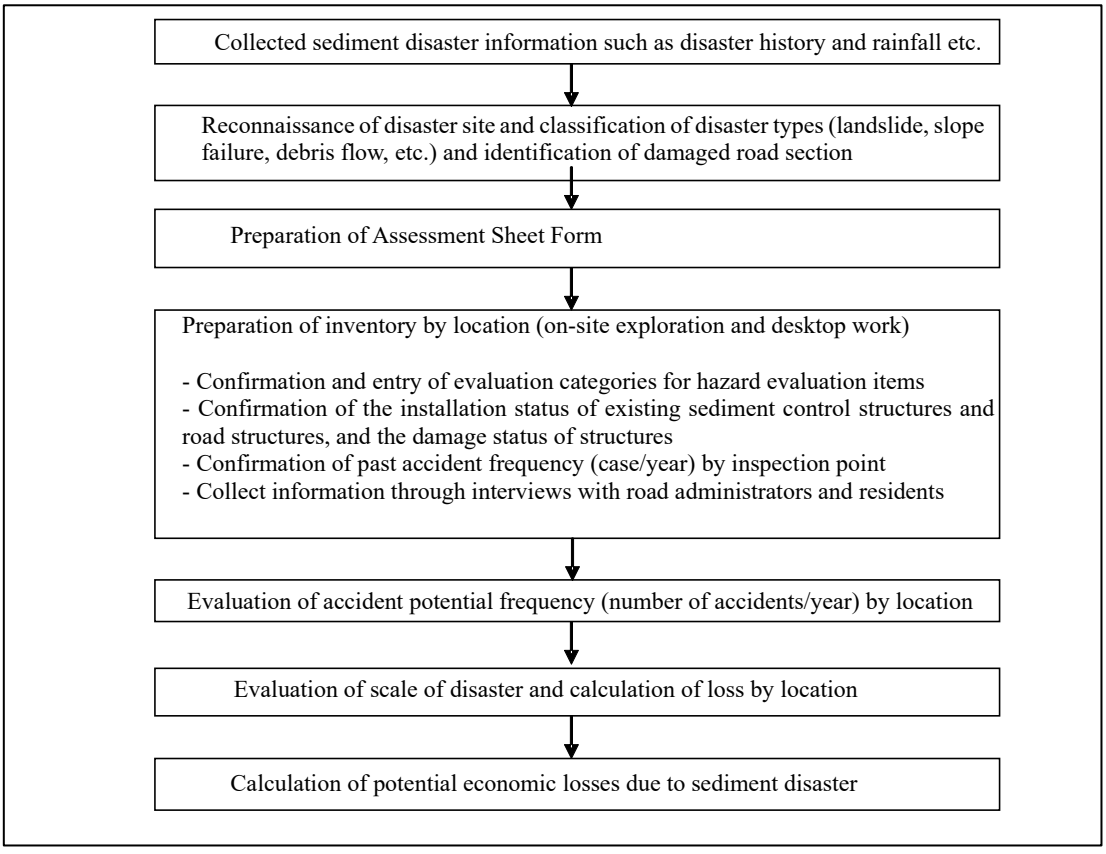
Source: JICA Survey Team

Figure 3.1.1 Slope Type Classification of Sediment Disasters

3.1.3 Risk Assessment

(1) Risk Assessment

The risk assessment of 53 candidate sites was carried out in accordance with the procedure as shown in **Figure 3.1.2**.



Source: JICA Survey Team

Figure 3.1.2 Risk Assessment Workflow

(2) Records of Sediment Disaster of Candidate Sires

Past disaster records are important information to analyse disaster risks of landslides at the candidate sites. However, such data are not systematically managed by RDA and it was necessary to inquire to the regional engineers through PMU. Some recent disaster information was provided by PMU as shown in **Table 3.1.3** to **Table 3.1.5**. Almost all the sites have experienced sediment disasters in recent years, and they caused interruption to the road traffic. In case of Site No.53, 23 people were died, and 15 people were injured due to the debris flow disaster in May 2017. Even within the limited disaster information in recent years, roads, houses, farmlands, and some public utilities were damaged by the landslide disasters. It is evident that the candidate sites are high risk areas of sediment disasters.

(3) Estimation of Potential Economic Losses due to Sediment Disasters

The disaster records provided by RDA PMU include both small and large-scale disasters in recent years. JICA Survey Team have estimated potential economic loss in case of large-scale disaster for each site from the following viewpoints:

- **Economic loss of "Temporary Recovery Cost of damaged roads" after sediment disaster,**
- **Economic loss of "Travel Time Cost (TTC) due to detour" after sediment disaster, and**
- **Economic loss of "Vehicle Operation Cost (VOC) due to detour" after sediment disaster**

If sediment disaster occurs, it is necessary to incur substantial cost for temporary recovery of the damaged roads to secure road traffic. Also, the passengers of the vehicle spend more time to detour the closed section of the road and it is considered loss of productive time of the passengers. Furthermore, the operation cost of the vehicles will increase because it is necessary to drive longer distance to detour the closed section. Both the loss of time and incremental vehicle operation cost continues until temporary recovery of the damaged section. They are all losses caused by the sediment disaster from the viewpoint of national economy.

Other than the economic losses discussed above, the following direct and indirect losses may occur:

- Loss of life,
- Damages to properties such as houses and household goods,
- Damages to agricultural properties,
- Damages to infrastructures such as road, bridges, river and drainage facilities, power and water supply facilities, etc.
- Loss to economic activities including tourism due to stagnation,
- Cost of emergency measures taken by central and/or local governments,
- Loss due to termination of public services such as transportation, communication, electricity and water supply,
- Inconvenience of citizens life,
- Peoples mental stress, etc.

Although all the losses are very important, the main three losses are estimated from the viewpoint of national economy as shown in **Table 3.1.6** and **Table 3.1.7**. Basic conditions to estimate annual average economic loss consisted of loss of recovery cost, loss of TTC and loss of VOC in the tables are presented in *Sub-section 9.5* of this report. Please refer Table 9.5.10, Table 9.5.25 and Table 9.5.28 for the conditions of loss of recovery cost, loss of TTC and loss of VOC as of the year 2019 respectively. Prevention of these losses are the main benefit of the proposed landslide counter measures.

Table 3.1.3 Sediment Disaster Records at Candidate Sites (1/3)

No.	Route No	Name of the Road	Location		Sediment Disaster Records						
			Start (km/cul.)	End (km/cul.)	Mon/ Year	Disaster type	Damages	Road Closure (days)	Type of Recovery Works	Recovery works cost (Mil LKR)	Major Issues due to Disaster
1	B-413	Tennekumbura - Rikillagaskada - Ragala Road.	66.75km	67km	2014	Landslide	Road damage: 650 m Farm land: 12,500 m2	1	Repair of damaged road section and culverts	0.5	Road closure and Damaged to tea farm
					2011	Landslide	Road damage: 600 m Farm land: 12,000 m2	2	Repair of damaged road section and culverts	0.5	Road closure and Damaged to tea farm
					2007	Landslide	Road damage: 500 m House damage: 6 houses Farm land:10,000 m2	3	Repair of damaged road section and culverts	0.5	Road closure and Damaged to tea farm
2	A-005	Peradeniya - Badulla - Chenkaladi road	46/2	46/3	2016	Landslide	Road damage: 200 m	-	Resurfacing of the road section	0.15	Road subsidence
					2014	Landslide	Road damage: 200 m	-	Resurfacing of the road section	0.15	Road cracking and sagging
					2010	Landslide	Road damage: 200 m	-	Resurfacing of the road section	0.15	Road cracking and sagging
3	B-582	Gomburu Oya - Balapokuna road	6/3	6/5	2007	Landslide	Road damage: 200 m House damage: 3 houses	1	Road surface repairing	0.2	Half of the lane damaged by subsidence
4	B-391	Ratnapura - Wewalwatta Road	11.9 km	12.0 km	2015	Landslide	Road damage: 200 m	7	Removal of debris fallen on to the road composed of rock and boulders	0.2	Road closure
6	B-412	Tawalanthenna-Thalawakele road	30/9	30/11	2007	Landslide	Road damage: 200 m House damage: 3 houses	3	Road surface repairing	0.35	Road closure due to edge collapsed
7	A-005	Peradeniya - Badulla - Chenkaladi road	30/9	30/11	1997	Landslide	Road damage:250 m House damage: 2 houses	0.2	Repair of the road	0.05	Road impassable due to subsidence
8	A-005	Peradeniya - Badulla - Chenkaladi road	28/4	28/6	2016	Landslide	Road damage: 100 m Farm land:2000 m2	1.5	Removal of debris fallen on to the road composed of rock and boulders	0.45	Side drain and half of the lane damaged
9	A-007	Avissawella - Hatton - Nuwaraeliya	3/3	3/5	2014	Slope Failure	Road damage: 200 m	0.2	Road repair	0.35	Road edge collapsed
10	A-016	Beragala - Haliela Road	3.85km	4.2km	2014	Rockfall	-	1	Blasting and removal of rock	0.15	Road closure
11	A-016	Beragala - Haliela Road	5/2	5/4	2014	Rockfall	-	0.2	Blasting and removal of rock	0.2	Interruption to the traffic
12	A-016	Beragala - Haliela Road	5/6	5/8	2014	Rockfall	-	0.2	Blasting and removal of rock	0.4	Side drain block and Interruption to the traffic
19	E-001	Kottawa - Godagama Section	76.7km	77.2km	2017	Rockfall	-	0.2	Blasting and removal of rock	0.4	Interruption to the traffic
					2016	Rockfall	-	0.2	Blasting and removal of rock	0.4	Interruption to the traffic
20	E-001	Kottawa - Godagama Section	77.9km	79.0km	2017	Rockfall	-	0.2	Blasting and removal of rock	0.4	Interruption to the traffic
					2016	Rockfall	-	0.2	Blasting and removal of rock	0.4	Road shoulder and drain blocked Interruption to the traffic

Source: JICA Survey Team

Table 3.1.4 Sediment Disaster Records at Candidate Sites (2/3)

No.	Route No	Name of the Road	Location		Sediment Disaster Records						
			Start (km/cul.)	End (km/cul.)	Mon/ Year	Disaster type	Damages	Road Closure (days)	Type of Recovery Works	Recovery works cost (Mil LKR)	Major Issues due to Disaster
22	E-001	Kottawa - Godagama Section	88.0km	88.8km	2017	Rockfall	-	0.2	Blasting and removal of rock	0.4	Interruption to the traffic
					2016	Rockfall	-	0.2	Blasting and removal of rock	0.4	Interruption to the traffic
23	E-001	Kottawa - Godagama Section	89.3km	89.6km	2017	Rockfall	-	0.2	Blasting and removal of rock	0.4	Interruption to the traffic
					2016	Rockfall	-	0.2	Blasting and removal of rock	0.4	Interruption to the traffic
25	E-001	Kottawa - Godagama Section	101.3km	101.7km	2017	Landslide	-	0.2	Removal of debris	0.4	Interruption to the traffic
					2016	Landslide	-	0.2	Removal of debris	0.4	Interruption to the traffic
25ad2	E-001	Kottawa - Godagama Section	108.6	108.7	2018	Rockfall	-	0.2	Blasting and removal of rock	0.4	Interruption to the traffic
26	B-274	Matale-Illukkumbura-Laggala road	11/2	11/4	2011	Landslide	Road damage: 300 m House damage: 5 houses Farm and home land: 20,000 m2	2	Repair of road, culverts and drains	0.6	Interruption to the traffic
27	B-462	Wattegama - Matale road	6+030	6+100	2018	Landslide	Road damage: 150 m Farm land: 15,000 m2	2	Repair of road, culverts and drains	0.5	Interruption to the traffic
28	B-462	Wattegama - Matale road	5/9	6/1	2018	Slope Failure	Injured: 1 person Road damage: 200 m	0.2	Removal of debris	0.5	Interruption to the traffic
31	A-001	Colombo - Kandy road	99/8	99 km	2016	Slope Failure	Road damage: 300 m	0.2	Road edge repair	0.15	Interruption to the traffic
33	A-004	Colombo-Ratnapura-Wellawaya-Batticaloa road	171/5	171/7	2017	Rockfall	Road damage: 100 m House damage: 7 houses	-	Repair of road and culvert	0.05	Interruption to the traffic
34	A-004	Colombo-Ratnapura-Wellawaya-Batticaloa road	183km	185/14	1994	Landslide	Road damage: 500 m	0.05	Road resurfacing with filling of subsidence areas	0.25	Interruption to the traffic After every heavy rain road subsidence occurs
36	B-149	Hatton - Maskeleiya - Delhouse road	9.000	9.100	2018	Landslide	Road damage: 250 m House damage: 2 houses Farm land: 7,500 m2	14	Construction of collapse road section by filling temporary	3	Interruption to the traffic by road closure
37	B-036	Badulla - Karametiya - Andaulpotha road	4/11	5/3	2014	Slope Failure	Road damage: 300 m	3	Removal of debris and road edge repairing	0.75	Half of the lane still closed
39	B-122	Galagedara - Rambukkana	8/2	8/4	2015	Slope Failure	Road damage: 300 m	2	Removal of debris	1.5	Interruption to the traffic by road closure
					2014	Slope Failure	Road damage: 300 m	2	Removal of debris	1.5	Interruption to the traffic by road closure
40	B-122	Galagedara - Rambukkana	18/3	18/5	2015	Slope Failure	Road damage: 350 m	2	Removal of debris	1.5	Interruption to the traffic by road closure
					2014	Slope Failure	Road damage: 350 m	2	Removal of debris	1.5	Interruption to the traffic by road closure
43	A-017	Galle-Deniyaya-Madampe road	139	140/1	2018	Landslide	Road damage: 150 m	1	Removal of debris	0.8	Interruption to the traffic by road closure

Source: JICA Survey Team

Table 3.1.5 Sediment Disaster Records at Candidate Sites (3/3)

No.	Route No	Name of the Road	Location		Sediment Disaster Records						
			Start (km/cul.)	End (km/cul.)	Mon/ Year	Disaster type	Damages	Road Closure (days)	Type of Recovery Works	Recovery works cost (Mil LKR)	Major Issues due to Disaster
45	B-328	Norton-Maskeliya road	0.5km	0.9km	2017	Landslide/ Rockfall					
46	B-390	Ratnapura- Palawela- Karavita Road	7/10	7/11	2017	Slope Failure	Road damage: 200 m	2	Removal of debris	1.2	Interruption to the traffic by road closure
48	B-390	Ratnapura- Palawela- Karavita Road	12/4	12/7	2017	Slope Failure	Road damage: 300 m House damage: 1 houses Farm land: 8,000 m2	3	Removal of debris	1.5	Interruption to the traffic by road closure
49	B-390	Ratnapura- Palawela- Karavita Road	20/9	21/3	2017	Slope Failure	Road damage: 400 m	3	Removal of debris	1.5	Interruption to the traffic by road closure
51	B-188	Kaluaggala - Labugama road	12/4	12/6	2017	Slope Failure	Road damage: 200 m	14	Removal of debris Repair of drains and culverts Repair of the water supply pipe line	2.5	Interruption to the traffic by road closure
53	A-017	Galle-Deniyaya-Madampe road (Morawakkanda Landslide)	62km	62.25km	May 2017	Debris flow	Death: 23 persons Injured: 15 persons House damage: fully 14 houses partially 19 houses Electricity supply Tea farm: 8 ha Forest: 9 ha Paddy field: 2 ha	7		3.5	
Total			-	-	-	-		81.95	-	31.5	-

Source: JICA Survey Team8

Table 3.1.6 Estimation of Potential Economic Loss due to Sediment Disasters (1/2)

No.	Route No	Name of the Road	Years of Landslide recorded	Location		Expected Sediment Disaster			Recovery Works		Occurrence probability (times/year)	Average annual days of road closure (days)	**Average Annual Economic Loss (2019)**			
				Start (km/cul.)	End (km/cul.)	Disaster type	Magnitude Width (m)	Earthwork vol. for recovery (m3)	Economic Cost (Rs.1000)	Period of Road Closure (days)			Loss of recovery cost (Rs.1,000)	Loss of TTC (Rs.1,000)	Loss of VOC (Rs.1,000)	Total loss (Rs.1,000)
1	B-413	Tennekumbura - Rikillagaskada - Ragala road.	2007, 2011, 2004	66.75km	67km	Landslide	160	12,000	87,486	113	0.150	16.95	13,123	59,134	56,039	128,296
2	A-005	Peradeniya - Badulla - Chenkaladi road	2010, 2014, 2016	46/2	46/3	Landslide	190	14,250	103,890	134	0.150	20.10	15,583	275,589	346,351	637,524
3	B-582	Gomburu Oya - Balapokuna road	2007	6/3	6/5	Landslide	80	6,000	43,743	56	0.067	3.73	2,916	2,823	2,580	8,320
4	B-391	Ratnapura - Wewalwatta road	2015	11.9 km	12.0 km	Landslide	60	4,500	32,807	42	0.100	4.20	3,281	13,077	11,023	27,381
6	B-412	Tawalanthenna-Thalawakele road	2007	30/9	30/11	Landslide	110	8,250	60,147	78	0.067	5.20	4,010	12,388	11,321	27,719
7	A-005	Peradeniya - Badulla - Chenkaladi road	1997	30/9	30/11	Landslide	70	5,250	38,275	49	0.040	1.96	1,531	20,973	26,354	48,858
8	A-005	Peradeniya - Badulla - Chenkaladi road	2016	28/4	28/6	Landslide	80	6,000	43,743	56	0.100	5.60	4,374	90,599	122,720	217,693
9	A-007	Avissawella - Hatton - Nuwaraeliya	2014	3/3	3/5	Slope Failure	120	3,480	20,489	33	0.100	3.30	2,049	105,866	151,605	259,520
10	A-016	Beragala - Haliela road	2014	3.85km	4.2km	Rock fall			195	3	3.000	9.00	585	57,455	77,639	135,679
11	A-016	Beragala - Haliela road	2014	5/2	5/4	Rock fall	1050		195	3	3.000	9.00	585	57,455	77,639	135,679
12	A-016	Beragala - Haliela road	2014	5/6	5/8	Rock fall			195	3	3.000	9.00	585	57,455	77,639	135,679
19	E-001	Kottawa - Godagama Section	2016, 2017	76.7km	77.2km	Rock fall	180		390	3	1.000	3.00	390	13,754	9,297	23,441
20	E-001	Kottawa - Godagama Section	2016, 2017	77.9km	79.0km	Rock fall	550		390	3	1.000	3.00	390	13,754	9,297	23,441
22	E-001	Kottawa - Godagama Section	2016, 2017	88.0km	88.8km	Rock fall	310		390	3	1.000	3.00	390	17,494	11,826	29,710
23	E-001	Kottawa - Godagama Section	2016, 2017	89.3km	89.6km	Rock fall	310		390	3	1.000	3.00	390	17,494	11,826	29,710
25	E-001	Kottawa - Godagama Section	2016, 2017	101.3km	101.7km	Landslide	130	9,750	71,082	92	0.200	18.40	14,216	58,819	39,760	112,795
25ad2	E-001	Kottawa - Godagama Section	2018	108.6	108.7	Rock fall	290		390	3	1.000	3.00	390	9,590	6,483	16,462
26	B-274	Matale-Illukkumbura-Laggala road	2011	11/2	11/4	Landslide	180	13,500	98,422	127	0.100	12.70	9,842	35,427	34,627	79,896

Source: JICA Survey Team

Table 3.1.7 Estimation of Potential Economic Loss due to Sediment Disasters (2/2)

(Consultant 2019 price)

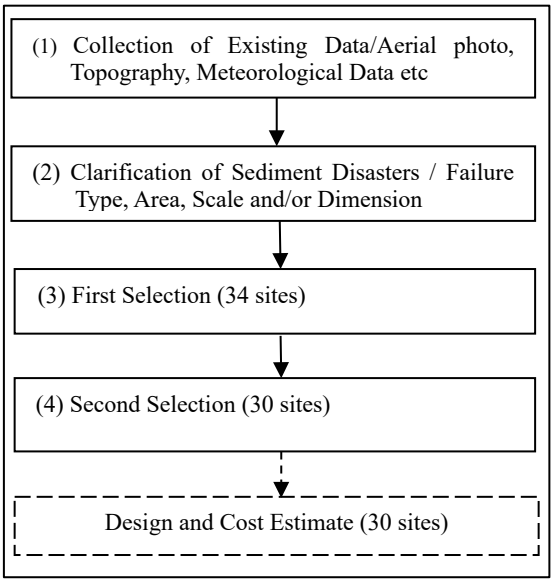
No.	Route No	Name of the Road	Years of Landslide recorded	Location		Expected Sediment Disaster			Recovery Works		Occurrence probability (times/year)	Average annual days of road closure (days)	Average Annual Economic Loss (2019)			
				Start (km/cul.)	End (km/cul.)	Disaster type	Magunitude Width (m)	Earthwork vol. for recovery (m3)	Economic Cost (Rs.1000)	Period of Road Closure (days)			Loss of recovery cost (Rs.1,000)	Loss of TTC (Rs.1,000)	Loss of VOC (Rs.1,000)	Total loss (Rs.1,000)
27	B-462	Wattegama - Matale road	2018	6+030	6+100	Landslide	90	6,750	49,211	64	0.100	6.40	4,921	16,549	14,279	35,748
28	B-462	Wattegama - Matale road	2018	5/9	6/1	Slope Failure	150	4,350	25,612	41	0.100	4.10	2,561	10,602	9,147	22,310
31	A-001	Colombo - Kandy road	2016	99/8	99 km	Slope Failure	100	2,900	17,074	27	0.100	2.70	1,707	104,591	138,196	244,495
33	A-004	Colombo-Ratnapura-Wellawaya-Batticaloa road	2017	171/5	171/7	Rock fall	150		195	3	0.200	0.60	39	8,497	13,142	21,679
34	A-004	Colombo-Ratnapura-Wellawaya-Batticaloa road	1994	183km	185/14	Landslide	300	22,500	164,036	212	0.040	8.48	6,561	13,200	23,145	42,906
36	B-149	Hatton - Maskeleiya - Delhouse road	2018	9.000	9.100	Landslide	160	12,000	87,486	113	0.100	11.30	8,749	22,510	20,016	51,274
37	B-036	Badulla - Karametiya - Andaulpotha road	2014	4/11	5/3	Slope Failure	80	2,320	13,659	22	0.100	2.20	1,366	16,608	19,192	37,165
39	B-122	Galagedara - Rambukkana	2014, 2015	8/2	8/4	Slope Failure	300	8,700	51,223	82	0.200	16.40	10,245	96,679	86,023	192,946
40	B-122	Galagedara - Rambukkana	2014, 2015	18/3	18/5	Slope Failure	170	4,930	29,026	46	0.200	9.20	5,805	54,235	48,257	108,296
43	A-017	Galle-Deniyaya-Madampe road	2018	139	140/1	Landslide	90	6,750	49,211	64	0.100	6.40	4,921	42,442	56,299	103,662
45	B-328	Norton-Maskeliya road	2017	0.5km	0.9km	Landslide/ Rock fall	60	4,500	32,807	42	0.100	4.20	3,281	5,244	3,582	12,107
46	B-390	Ratnapura- Palawela- Karavita road	2017	7/10	7/11	Slope Failure	180	5,220	30,734	49	0.100	4.90	3,073	20,748	18,313	42,134
48	B-390	Ratnapura- Palawela- Karavita road	2017	12/4	12/7	Slope Failure	210	6,090	35,856	57	0.100	5.70	3,586	24,136	21,303	49,024
49	B-390	Ratnapura- Palawela- Karavita road	2017	20/9	21/3	Slope Failure	300	8,700	51,223	82	0.100	8.20	5,122	34,721	30,646	70,489
51	B-188	Kaluaggala - Labugama road	2017	12/4	12/6	Slope Failure	70	2,030	11,952	19	0.100	1.90	1,195	4,901	6,054	12,150
53	A-017	Galle-Deniyaya-Madampe road (Morawakkanda Landslide)	2017	62km	62.25km	Debris flow	110	8,250	81,349	78	0.100	7.80	8,135	100,109	172,519	280,763
									1,333,273	**1,805**	**16.91**	**234.62**	**145.897**	**1,494,918**	**1,764,139**	**3,404,951**

Source: JICA Survey Team

3.2 Methodology for Selection of the Target Sites

Selection of target sites for the Project were carried out through the following two selection process, namely first selection and second selection as shown in **Figure 3.2.1.**

The purpose of the first selection was preliminary screening. Low risk sites were eliminated based on the risk analysis of impact and hazard of each sediment disaster, and consequently 34 sites were selected from the 54 sediment disaster sites nominated by RDA. The purpose of the second section was to select target sites of the Project and the 34 sites selected in the first selection were prioritized through the analysis of three factors consisted of necessity, efficiency and effectivity of countermeasures for each sediment disaster. As the results of the second selection, a total of 30 sites were selected for the target sites for the Project. Data sheets of selected 30 sites are shown in Appendix 4.



Source: JICA Survey Team

Figure 3.2.1 Flow of Selection of Target Sites

3.3 Result of the Selection

3.3.1 First Selection

Classification of impact in five magnitude (size) classes of I to V are estimated on the basis of factors listed from **Table 3.3.1** to **Table 3.3.2** and **Figure 3.3.1**.

First selection was carried out to analysis the impact of road closure by the sediment disaster and hazards of the sediment disasters for each candidate site.

(1) Impact of sediment disasters

Impacts of sediment disaster were evaluated based on detour lengths, which involves additional costs from the aspects of fuel consumption, road type, local speed limits, and many others. Considering these road conditions, selection of detours was mainly performed by choosing same level of road which road type and speed limits are same as shown in **Figure 3.3.1**. Detour length for road closure of expressway was calculated by selecting national roads in the road level next to expressway which completely closed due to sediment disasters.

(2) Hazards

Hazards of sediment disaster were assessed from the aspects of magnitude and probability of the sediment disasters as shown in **Table 3.3.3**.

The classification of (i), (ii) and (iii) is performed based on the potential size (magnitude) of slope disasters by utilizing the result of site reconnaissance. On the other hand, the classification of (a) and (b) is carried out based on the potential occurrence of slope disasters by using historical records and/or the results of site reconnaissance and interviews of local residents.

Table 3.3.1 Impact Element based on Detour Length

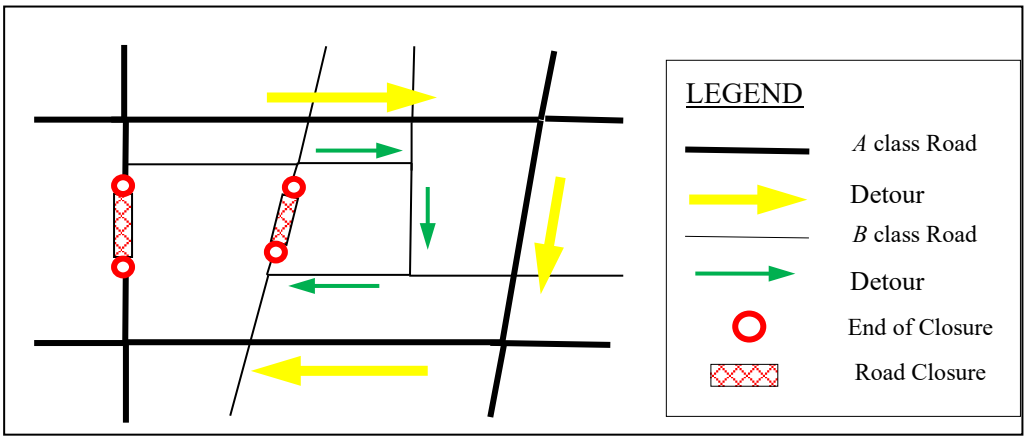
Element	Length of Detour	Remarks
A	More than 120 km	
B	120 km and under	

Source: JICA Survey Team

Table 3.3.2 Criteria of Detour Selection

Road Class	Route of Detour	Remarks
A	A class road	Interchange used for E (Expressway) class road
B	A class and/or B class road	
Expressway	A class and/or B class road	

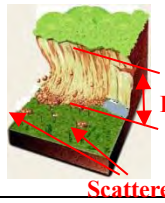
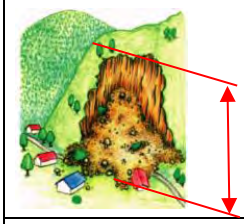
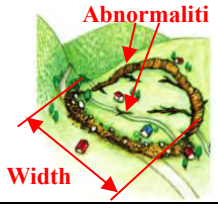
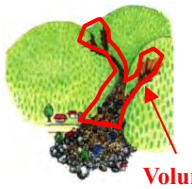
Source: JICA Survey Team



Source: JICA Survey Team

Figure 3.3.1 Calculation of Detour Length in Case of Road Closure

Table 3.3.3 Factors for Hazard Assessment in Each Disasters

Type of Disasters	Magnitude (Size)		Probability		
Rock Fall 	i	Height >20m	a	New scattered rocks found. Interview results of local residents	>2 times/10yr
	ii	20≧Height > 10m	b	No new scattered rocks found. Interview results of local residents	Once/10yr
	iii	Height ≦ 10m			
Slope Failure 	i	Height >20m	a	According to disaster records.	>2 times/10yr
	ii	20≧Height > 10m	b	According to disaster records.	Once/10yr
	iii	Height < 10m			
Landslide 	i	Width >50m	a	Abnormalities due to active sliding confirmed	>2 times/10yr
	ii	20m < Width≦50m	b	No active sliding confirmed.	Once/10yr
	iii	Width ≦ 20m			
Debris Flow 	i	Volume > 500m^3	a	New sediments of debris confirmed. Interview results of local residents	>2 times/10yr
	ii	Volume ≦ 500m^3	b	No visible sediments confirmed. Interview results of local residents	Once/10yr

Source: JICA Survey Team

The candidate sites were evaluated by risk assessment of impact and magnitude of each sediment disaster. The risk levels of sediment disaster were assessed by the combination of the factors as shown in **Table 3.3.4**. Thirty-four (34) sites classified into I (sever), II (high) or III (medium) passed the preliminary screening of the first selection. Sixteen (16) sites and three (3) sites classified into low and very low risk respectively were eliminated. Results of the screening are shown in **Table 3.3.5**. Results of first selection are summarized in **Table 3.3.6** and their locations are shown in **Figure 3.3.2**.

Table 3.3.4 Classification of Risk Levels of Slope Disasters

Impact (length of detour), Magnitude / Probability	A (more than 120 km)			B (120 km and under)		
	i	ii	iii	i	ii	iii
a	I	II	III	II	III	IV
b	II	III	IV	III	IV	V

Source: JICA Survey Team

Table 3.3.5 Summary of First Selection

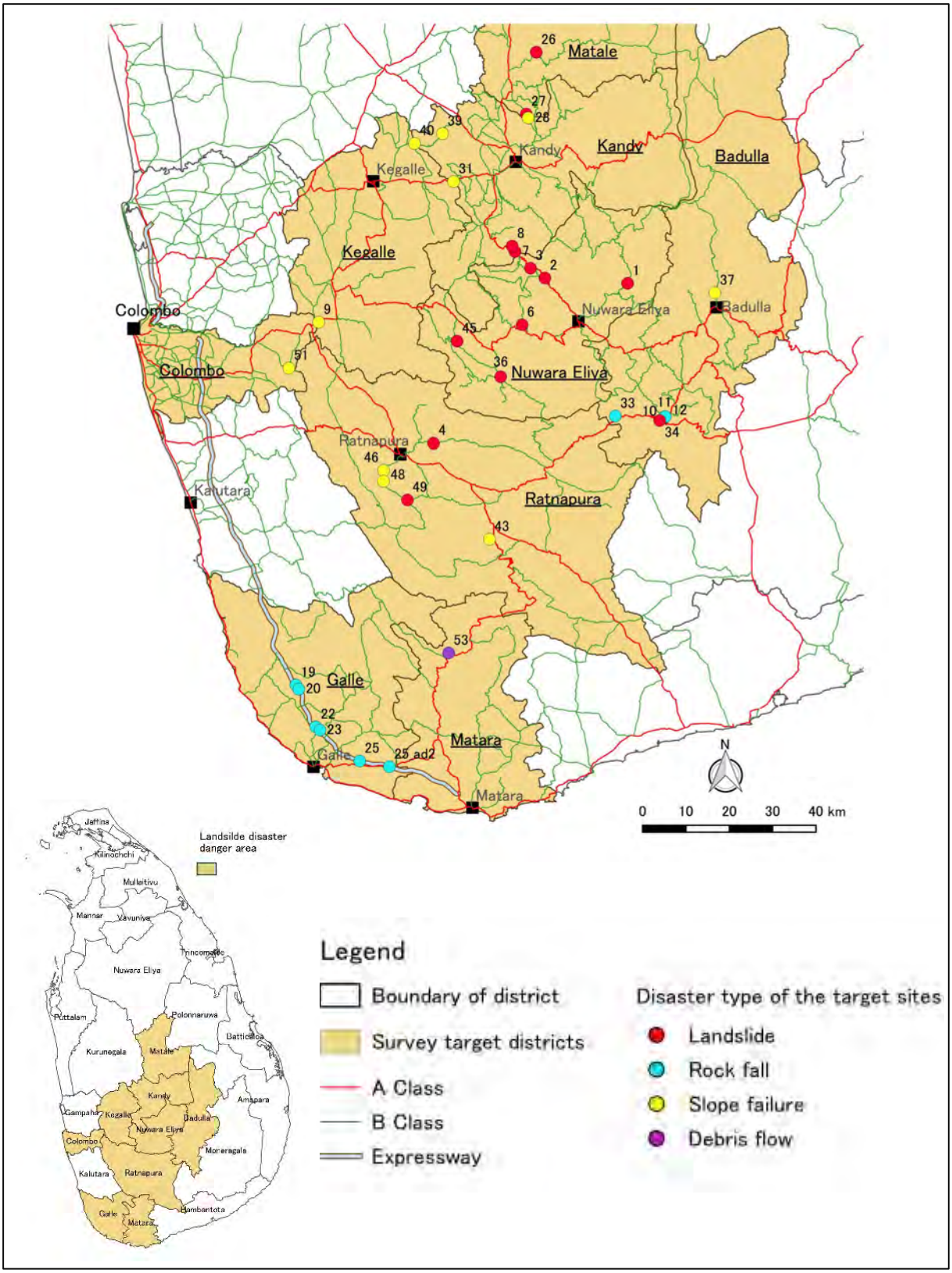
Risk level		Number of Sites	Remarks
I	Severe	3	Thirty-four (34) sites of Risk level classified into I to III are selected through first selection.
II	High	9	
III	Medium	22	
IV	Low	16	
V	Very Low	3	

Source: JICA Survey Team

Table 3.3.6 Results of First Selection

Item No.	Route No	Name of the Road	Year of Landslide recorded	Location		Disaster Type	DS Division	District	Detuour			Slope Disaster				Evaluation	1st Selection
				Start (Km/cul.)	End (Km/cul.)	type			Distance (km)	Detour Route	rate	Potential	Magunitude Width (m)	Magunitude Height (m)	Magunitude rate		Results
1	B-413	Tennekumbura - Rikillagaskada - Ragala Road.	2011	66.75km	67km	Landslide	Hanguranketha	Nuwara Eliya	127	B413-B51-Nitakupitiya Mapakada Wewa Road-A5-B471-B332-B413	A	a	250		i	I	Selected
2	A-005	Peradeniya - Badulla - Chenkaladi road	2016	46/2	46/3	Landslide	Nuwara Eliya	Nuwara Eliya	195	A5-A7-A21-A1-A5	A	a	25		ii	II	Selected
3	B-582	Gomburu Oya - Balapok	2007	6/3	6/5	Landslide	Nuwaraeliya	Nuwaraeliya	20	B412-B412 connection-A5-B431-B412	B	b	65		i	III	Selected
4	B-391	Ratnapura - Wewalwatta Road	2015	11.9 km	12.0 km	Landslide	Ratnapura	Ratnapura	78	B39-B265-A4-B39	B	a	100		i	II	Selected
5	A-007	Avissawella - Hatton - Nuwaraeliya	2012	55/1	55/2	Slope Failure	Nuwara Eliya	Nuwra Eliya	195	A7-A5-A1-A21-A7	A	b	20		iii	IV	-
6	B-412	Tawalanthenna-Thalawakele road	2007	30/9	30/11	Landslide	Nuwara Eliya	Nuwra Eliya	63	B412-B412 connection-A5-A7-Radella Short Road-A7-B412	B	a	100		i	II	Selected
7	A-005	Peradeniya - Badulla - Chenkaladi road	1997	30/9	30/11	Landslide	Kadugannawa	Kandy	195	A5-A7-A21-A1-A5	A	a	200		i	I	Selected
8	A-005	Peradeniya - Badulla - Chenkaladi road	2016	28/4	28/6	Landslide	Kadugannawa	Kandy	195	A5-A7-A21-A1-A5	A	b	30		ii	III	Selected
9	A-007	Avissawella - Hatton - Nuwaraeliya	2014	3/3	3/5	Slope Failure	Ruwanwella	Kegalle	182	A7-A21-A1-A4-A7	A	b		12	ii	III	Selected
10	A-016	Beragala - Haliela Road	2014	3.85km	4.2km	Rock fall	Bandarawela	Badulla	78	A16-A4-A23-A16	B	b		20	i	III	Selected
11	A-016	Beragala - Haliela Road	2014	5/2	5/4	Rock fall	Bandarawela	Badulla	78	A16-A4-A23-A16	B	a		30	i	II	Selected
12	A-016	Beragala - Haliela Road	2014	5/6	5/8	Rock fall	Bandarawela	Badulla	78	A16-A4-A23-A16	B	b		20	i	III	Selected
13	A-023	Wellawaya - Ella - Kumbalwela road	2013/15	19/8	19km	Rock fall	Bandarawela	Badulla	78	A23-A4-A16-A23	B	b		15	ii	IV	-
14	A-023	Wellawaya - Ella - Kumbalwela road	2014	25/1	25/3	Rock fall	Bandarawela	Badulla	78	A23-A4-A16-A23	B	b		20	ii	IV	-
15	A-023	Wellawaya - Ella - Kumbalwela road	2014	27/4	27/5	Rock fall	Bandarawela	Badulla	78	A23-A4-A16-A23	B	b		10	iii	V	-
16	E-001	Kottawa - Godagama Section	2016/ 2017	64.3km	64.5km	Rock fall	Elpitiya	Galle	55	B157-A2-B40-B14	B	b		10	iii	V	-
18	E-001	Kottawa - Godagama Section	2016/ 2017	74.8km	75.0km	Rock fall	Welivitiya-Divithura	Galle	18	B143-B153-B320	B	b		20	ii	IV	-
19	E-001	Kottawa - Godagama Section	2016/ 2017	76.7km	77.2km	Rock fall	Welivitiya-Divithura	Galle	18	B143-B153-B320	B	a		24.6	i	II	Selected
20	E-001	Kottawa - Godagama Section	2016/ 2017	77.9km	79.0km	Rock fall	Welivitiya-Divithura	Galle	18	B143-B153-B320	B	a		17.4	ii	III	Selected
21	E-001	Kottawa - Godagama Section	2016/ 2017	86.6km	87.0km	Rock fall	Baddegama	Galle	28	B320-B128-A2-B129	B	b		15	ii	IV	-
22	E-001	Kottawa - Godagama Section	2016/ 2017	88.0km	88.8km	Rock fall	Baddegama	Galle	28	B320-B128-A2-B129	B	a		20	ii	III	Selected
23	E-001	Kottawa - Godagama Section	2016/ 2017	89.3km	89.6km	Rock fall	Bope-Poddala	Galle	28	B320-B128-A2-B129	B	a		20	ii	III	Selected
25	E-001	Kottawa - Godagama Section	2016/ 2017	101.3km	101.7km	Landslide	Imaduwa	Galle	20	B129-A2-A17	B	a	200		i	II	Selected
ad	E-001	Kottawa - Godagama Section		103.7	104.1	Rock fall	Imaduwa	Galle	20	B129-A2-A17	B	b		12	ii	IV	-
ad	E-001	Kottawa - Godagama Section	2018	108.6	108.7	Rock fall	Imaduwa	Galle	20	B129-A2-A17	B	a		12	ii	III	Selected
26	B-274	Matale-Illukkumbura-Lag	2011	11/2	11/4	Landslide	Matale	Matale	114	B274-A9-B312-B274	B	b	100		i	III	Selected
27	B-462	Wattegama - Matale road	2018	6+030	6+100	Landslide	Matale	Matale	30	B248-B180-B461-B248	B	a	200		i	II	Selected
28	B-462	Wattegama - Matale road	2018	5/9	6/1	Slope Failure	Matale	Matale	30	B248-B180-B461-B248	B	a		12	ii	III	-
29	A-004	Colombo-Ratnapura-Wellawaya-Batticaloa road	2017	107/2	107/3	Slope Failure	Palmadulla	Ratnapura	268	A4-A16-A5-A7-A4	A	b		4	iii	IV	-
30	A-004	Colombo-Ratnapura-Wellawaya-Batticaloa road	2012 / 2017	132/9	132/11	Slope Failure	Palmadulla	Ratnapura	270	A4-A16-A5-A7-A4	A	b		3	iii	IV	-
31	A-001	Colombo - Kandy road	2016	99/8	99 km	Slope Failure	Kegalla	Kegalla	110	A1-A19-A6-A10-A1	B	a		15	ii	III	Selected
32	A-004	Colombo-Ratnapura-Wellawaya-Batticaloa road	2010	167/10	167/11	Landslide	Pelmadulla	Ratnapura	270	A4-A16-A5-A7-A4	A	b	20		iii	IV	-
33	A-004	Colombo-Ratnapura-Wellawaya-Batticaloa road	2017	171/5	171/7	Rock fall	Bandarawela	Badulla	270	A4-A16-A5-A7-A4	A	a		5	iii	III	Selected
34	A-004	Colombo-Ratnapura-Wellawaya-Batticaloa road	1994	183km	185/14	Landslide	Bandarawela	Badulla	74	A4-A23-A16-A4	B	b	150		i	III	Selected
35	A-007	Avissawella - Hatton - Nuwaraeliya	2016	66/3	66/5	Slope Failure	Norwood	Nuwara Eliya	195	A7-A5-A1-A21-A7	A	b		7	iii	IV	-
36	B-149	Hatton - Maskeleiya - Delhouse road	2018	9.000	9.100	Landslide	Norwood	Nuwara Eliya	42	B339-B71-B328-B419-B339	B	a	70		i	II	Selected
37	B-036	Badulla - Karametiya - Andaulpotha road	2014	4/11	5/3	Slope Failure	Badulla	Badulla	112	Nitakupitiya Mapakada Wewa Road (NMWR)-B57-A5-NMWR	B	a		12	ii	III	Selected
38	B-036	Badulla - Karametiya - Andaulpotha road	2012	10km	10.2km	Landslide	Badulla	Badulla	112	Nitakupitiya Mapakada Wewa Road (NMWR)-B57-A5-NMWR	B	b	50		ii	IV	-
39	B-122	Galagedara - Rambukka	2014/2015	8/2	8/4	Slope Failure	Kandy	Kandy	44	B122-B385-B281-A10-B122	B	a		12	ii	III	Selected
40	B-122	Galagedara - Rambukka	2014/2015	18/3	18/5	Slope Failure	Kandy	Kandy	44	B122-B385-B281-A10-B122	B	a		12	ii	III	Selected
41	A-017	Galle-Deniyaya-Madampe road	2015	87.0	87.5	Landslide	Embilipitiya	Ratnapura	226	A17-A18-A2-A24-A17	A	b	10		iii	IV	-
42	A-017	Galle-Deniyaya-Madampe road	2014	137/4	137/6	Landslide	Pelmadulla	Ratnapura	226	A17-A18-A2-A24-A17	A	b	8		iii	IV	-
43	A-017	Galle-Deniyaya-Madampe road	2018	139	140/1	Landslide	Pelmadulla	Ratnapura	226	A17-A18-A2-A24-A17	A	a	7		iii	III	Selected
44	B-457	Warakapola - Ruwanwella Road	2017	13/2	13/5	Slope Failure	Ruwanwella	Kegalle	50	B457-B539-A1-B127-A21-B457	B	b		8	iii	V	-
45	B-328	Norton-Maskeliya road	2017	0.5km	0.9km	Landslide/ Rock fall	Nuwaraeliya	Nuwaraeliya	40	B328-B189-A7-B171-B328	B	a	50		ii	III	Selected
46	B-390	Ratnapura- Palawela-Karavita Road	2017	7/10	7/11	Slope Failure	Rathnapura	Rathnapura	39	B390-A4-B421-B390	B	a		12	ii	III	Selected
47	B-113	Ella-Passara road	2007	4km	5km	Landslide	Bandarawela	Badulla	50	B113-A23-A16-A5-B97-B113	B	b	50		ii	IV	-
48	B-390	Ratnapura- Palawela-Karavita Road	2017	12/4	12/7	Slope Failure	Rathnapura	Rathnapura	39	B390-A4-B421-B390	B	a		12	ii	III	Selected
49	B-390	Ratnapura- Palawela-Karavita Road	2017	20/9	21/3	Slope Failure	Rathnapura	Rathnapura	39	B390-A4-B421-B390	B	a		15	ii	III	Selected
50	B-365	Peradeniya - Halloluwa - Katugastota	2014/2015	3 km	4km	Rock fall	Kandy	Kandy	17	B365-A9-A1-B365	B	b		10	ii	IV	-
51	B-188	Kaluaggala - Labugama road	2017	12/4	12/6	Slope Failure	Avissawella	Colombo	32	B188-A4-N/A-B188	B	a		60	i	II	Selected
52	B-364	Peradeniya-Delthota-Rikillagaskada Road	2014/2015	40/2	40/3	Landslide	Hanguranketha	Nuwara Eliya	79	B364-B154-A1-B518-A26-B413-B364	B	b	50		ii	IV	-
53	A-017	Galle-Deniyaya-Madampe road (Morawakkanda	2017	62km	62.25km	Debris flow	Deniyaya	Galle	226	A17-A18-A2-A24-A17	A	a	more than 500 m3		i	I	Selected

Source: JICA Survey Team



Source: JICA Survey Team

Figure 3.3.2 Result of First Selection (34 sites)

3.3.2 Second Selection and Prioritization of the Target Sites

The second selection was carried out for the purpose of identifying target sites of the Projects. The 34 sites selected in the first selection were prioritized based on the scores of three (3) factors consisted of necessity, efficiency and effectivity of countermeasures against each sediment disaster. As the results of the second selection, a total 30 sites of 60 points and over in total of scores of three factors, were selected for the target sites of the Project among 34 sites. Rating factors for the estimation of each item are chiefly categorized into three. The numerical rating of the weighted factors for these is described below.

(1) Necessity

Factors of necessity are the type of slope disasters, size of deformation and installed countermeasures in addition to existing ones. Estimation factors are composed of weight value and scoring. Details of the scoring criteria are described in **Table 3.3.7** to **Table 3.3.9**.

Table 3.3.7 Rating for Type of Slope Disasters

Category	Score (Weight -15)		
	Low Potentiality	Medium Potentiality	High Potentiality
Rock Fall		8 points	
Slope Failure	4 points		
Landslide			15 points
Debris Flow			15 points

Source: JICA Survey Team

Table 3.3.8 Rating for Size of Deformation

Category	Criteria and Score (Weight -15)		
	Extension of cracks, subsidence of road and natural slopes, Abnormalities indicating potential slope disasters		
	Low Potentiality	Medium Potentiality	High Potentiality
Size of deformation	No visible deformation	Visible deformation	Clear deformation
	4 points	8 points	15 points

Source: JICA Survey Team

Table 3.3.9 Rating for existing countermeasures

Category	Criteria and Score (Weight -10)		
	Low Potentiality	Medium Potentiality	High Potentiality
Existing countermeasures	High effective countermeasures	Effective countermeasures	No countermeasure
	2 points	6 points	10 points

Source: JICA Survey Team

(2) Efficiency

Factors of efficiency are traffic volume of annual average daily traffic and tentative construction cost (per one kilometre) estimated by RDA. Details of scoring criteria are described in **Table 3.3.10** to **Table 3.3.11**.

Table 3.3.10 Rating for Traffic Volume

Category	Criteria and Score (Weight -15)		
	Low Potentiality	Medium Potentiality	High Potentiality
Traffic volume	Less than 5,000 pcu/day	5,000 to 10,000 pcu/day	More than 10,000 pcu/day
	4 points	8 points	15 points

Source: JICA Survey Team

Table 3.3.11 Rating for Construction Cost

Category	Criteria and Score (Weight -15)		
	Low Potentiality	**Medium Potentiality**	**High Potentiality**
Construction cost	Less than LKR 250 million /km	LKR 250 to 500 million /km	More than LKR 500 million /km
	4 points	8 points	15 points

Source: JICA Survey Team

(3) Effectivity

Factors of effectivity are applicability of advanced technology and environmental and social issues; Details of scoring criteria are described in **Table 3.3.12** and **Table 3.3.13**.

Table 3.3.12 Rating for Applicability of Advanced Technology

Category	Criteria and Score (Weight -20)		
	Low Potentiality	**Medium Potentiality**	**High Potentiality**
Applicability of advanced technology	No applicability of advanced technology	Advanced technology, which has been utilized in LDPP-1, may be applicable to LDPP-2	Advanced technology newly applicable to LDPP-2
	6 points	12 points	20 points

Source: JICA Survey Team

Table 3.3.13 Rating for Environment and Social Issue

Category	Criteria and Score (Weight -10)		
	Distance from national park, forest reserve, residential area, sanctuary, etc.		
	High Effectivity	**Medium Effectivity**	**Low Effectivity**
Environmental and social issues	Less than 0.5 miles away	0.5 miles to 1 mile away	More than 1 mile away
	2 points	6 points	10 points

Source: JICA Survey Team

Estimation items and rating factors of **Table 3.3.7** to **Table 3.3.13** are summarized in **Table 3.3.14**.

Numerical values obtained through the evaluation in three factors are utilized for prioritization. A total of 30 sites of 60 points or over in sum of the scores were selected for the target sites of the Project. Results of the second selection and prioritization of the target sites and **Table 3.3.15**. Locations of target sites are shown in **Figure 3.3.3**.

Table 3.3.14 Criteria for Second Selection

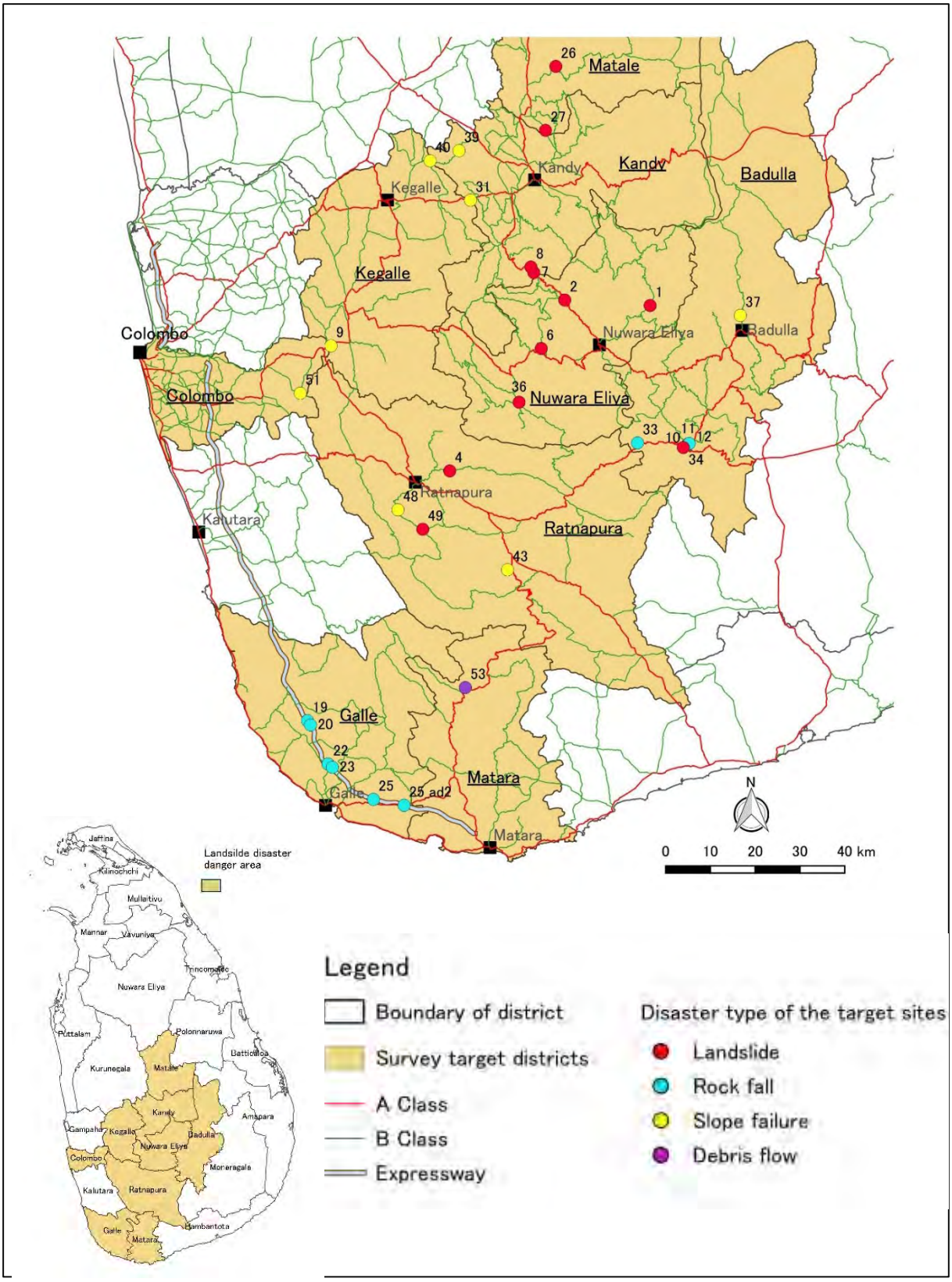
Evaluation item			Weight	Scoring
Necessity	Type of sediment disaster	Landslide/ Debris flow/ Rock fall/ Slope failure	15	• Landslide/ Debris flow: 15 points • Rock fall: 8 points • Slope failure: 4 points
	Size of deformation	Extent of steps, subsidence, and cracks on road and natural slopes (topography, cracks on the slopes, subsidence of the road etc.)	15	• Clear deformation: 15 points • Unclear deformation: 8 points • No deformation: 4 points
	Installed countermeasure (effectiveness of existing countermeasures)		10	• No countermeasure: 10 points • Some effect countermeasure: 6 points • High effect countermeasure: 2 points
Efficiency	Traffic volume	Annual Average daily traffic	15	• More than 10,000 pcu/day: 15 points • More than 5,000 pcu/day – Less than 10,000 pcu/day: 8 points • Less than 5,000 pcu/day: 4 points
	Construction cost	Tentative construction cost estimated by RDA	15	• More than 500 mil LKR: 15 points • More than 250 mil LKR-Less than 500 mil LKR/km: 8 points • Less than 250 mil LKR: 4 points
Effectivity	Applicability of New technology		20	• New technology, which has not been utilized in LDPP (phase1), may be applicable: 20 points • New technology, which has been utilized in LDPP (phase1), may be applicable: 12 points • Conventional measures may be applicable: 6 points
	Environmental and social issue		10	• National park, forest reserve area, residential area, sanctuary etc. • More than 1 mile away: 10 points • More than 0.5 miles - Less than 1 mile away: 6 points • Less than 0.5 miles away: 2 points
Total			100	

Source: JICA Survey Team

Table 3.3.15 Result of Second Selection (Prioritization Result)

Item No.	Route No	Location		DS Division	District	2nd Selection Score								2nd Selection Priority	2nd Selection Evaluation
						Necessity			Efficiency		Effectivity		Total		
		Start (Km/cul.)	End (Km/cul.)			Type of sediment disaster	Size of deformation	Installed counter measure	Traffic volume	Construction cost	Applicability of new technology	Environmental social issue	Score		
1	B-413	66.75km	67km	Hanguranketha	Nuwara Eliya	15	15	10	8	15	20	10	93	1	Selected
53	A-017	62km	62.25km	Deniyaya	Galle	15	15	10	8	15	20	2	85	2	Selected
36	B-149	9.000	9.100	Norwood	Nuwara Eliya	15	15	10	4	8	20	10	82	3	Selected
7	A-005	30/9	30/11	Kadugannawa	Kandy	15	15	6	8	8	20	10	82	3	Selected
49	B-390	20/9	21/3	Rathnapura	Rathnapura	15	15	10	15	4	12	10	81	5	Selected
48	B-390	12/4	12/7	Rathnapura	Rathnapura	4	15	10	15	4	20	10	78	6	Selected
27	B-462	6+030	6+100	Matale	Matale	15	15	6	8	8	20	6	78	6	Selected
6	B-412	30/9	30/11	Nuwara Eliya	Nuwra Eliya	15	15	10	8	15	12	2	77	8	Selected
19	E-001	76.7km	77.2km	Welivitiya-Divithura	Galle	8	8	10	15	4	20	10	75	9	Selected
20	E-001	77.9km	79.0km	Welivitiya-Divithura	Galle	8	8	10	15	4	20	10	75		
22	E-001	88.0km	88.8km	Baddegama	Galle	8	8	10	15	4	20	10	75	9	Selected
23	E-001	89.3km	89.6km	Bope-Poddala	Galle	8	8	10	15	4	20	10	75		
40	B-122	18/3	18/5	Kandy	Kandy	4	15	10	8	8	20	10	75	9	Selected
25	E-001	101.3km	101.7km	Imaduwa	Galle	8	8	10	15	4	20	10	75	9	Selected
25_ad2	E-001	108.6	108.7	Imaduwa	Galle	8	8	10	15	4	20	10	75		
4	B-391	11.9 km	12.0 km	Ratnapura	Ratnapura	15	15	6	4	15	6	10	71	13	Selected
34	A-004	183km	185/14	Bandarawela	Badulla	15	8	10	8	15	12	2	70	14	Selected
26	B-274	11/2	11/4	Matale	Matale	15	15	6	4	15	12	2	69	15	Selected
10	A-016	3.85km	4.2km	Bandarawela	Badulla	8	15	10	8	4	20	2	67		
11	A-016	5/2	5/4	Bandarawela	Badulla	8	15	10	8	4	20	2	67	16	Selected
12	A-016	5/6	5/8	Bandarawela	Badulla	8	15	10	8	4	20	2	67		
37	B-036	4/11	5/3	Badulla	Badulla	4	15	10	4	4	20	10	67	16	Selected
39	B-122	8/2	8/4	Kandy	Kandy	4	15	10	8	8	12	10	67	16	Selected
43	A-017	139	140/1	Pelmadulla	Ratnapura	4	15	10	4	4	20	10	67	16	Selected
9	A-007	3/3	3/5	Ruwanwella	Kegalle	4	15	6	15	4	12	10	66	20	Selected
31	A-001	99/8	99 km	Kegalla	Kegalla	4	15	6	15	4	12	10	66	20	Selected
33	A-004	171/5	171/7	Bandarawela	Badulla	8	15	10	15	4	6	6	64	22	Selected
51	B-188	12/4	12/6	Avissawella	Colombo	4	15	10	4	4	20	6	63	23	Selected
2	A-005	46/2	46/3	Nuwara Eliya	Nuwara Eliya	15	8	10	8	8	6	6	61	24	Selected
8	A-005	28/4	28/6	Kadugannawa	Kandy	15	8	6	8	8	6	10	61	24	Selected
28	B-462	5/9	6/1	Matale	Matale	4	15	10	8	8	6	6	57	26	-
45	B-328	0.5km	0.9km	Nuwaraeliya	Nuwaraeliya	15	8	10	4	8	6	6	57	27	-
46	B-390	7/10	7/11	Rathnapura	Rathnapura	4	8	10	15	4	6	10	57	28	-
3	B-582	6/3	6/5	Nuwaraeliya	Nuwaraeliya	15	8	10	4	8	6	2	53	29	-

Source: JICA Survey Team



Source: JICA Survey Team

Figure 3.3.3 Results of Second Selection (30 sites)

Chapter 4 Natural Condition Survey

4.1 Involved Roads and Site Locations

The selected 30 target sites in the Survey for LDPP Phase 2 lie along the National Roads (A Class and B Class) and the Southern Expressway and cover nine districts of five provinces in Sri Lanka (see Location Map of the Survey). These are shown in **Table 4.1.1** and **Table 4.1.2**.

Table 4.1.1 Summary of the Final Selected Target Sites Related to the National Roads

Route No.		Number of Target Sites	Site No.
A Class	A-001	1	31
	A-004	2	33, 34
	A-005	3	2, 7, 8
	A-007	1	9
	A-016	3	10, 11, 12
	A-017	2	43, 53
	Subtotal	12	
B Class	B-036	1	37
	B-122	2	39, 40
	B-149	1	36
	B-188	1	51
	B-274	1	26
	B-390	2	48, 49
	B-391	1	4
	B-412	1	6
	B-413	1	1
	B462	1	27
	Subtotal	12	
Expressway	E-001	6	19, 20, 22, 23, 25, 25ad2
	Subtotal	6	
Total		30	

Source: JICA Survey Team

Table 4.1.2 Summary of the Final Selected Target Sites Related to Districts

Province	District	Number of Target Site	Site No.
Central	Matale	2	26, 27
	Kandy	4	7, 8, 39, 40
	Nuwara Eliya	4	1, 2, 6, 36
Uva	Badulla	6	10,11, 12, 33, 34, 37
Sabaragamuwa	Ratnapura	4	4, 43, 48,48
	Kegalle	2	9, 31
Southern	Galle	6	19, 20, 22, 23, 25, 25ad2
	Matara	1	53
Western	Colombo	1	51
Total		30	

Source: JICA Survey Team

4.2 Topographic Survey

The topographic survey for the selected target sites (No.4 and No.53 excluded, due to existing data supplied by NBRO) was conducted by a local subcontractor, Construction Survey Company. The topographic survey commenced on 01 April 2019 and was completed on 31 July 2019.

The purpose of the topographic survey was to provide topographic maps and cross sections for each site for the outline design. Topographic maps, cross sections, and factual reports together with survey recordings are given in *Appendix 5_1*.

Because of cost and time constraints, the topographic map survey includes mainly national roads within the selected target sediment disaster areas, approximately 10 m above and below the road. In addition, all kinds of structures and ground deformations around the road were included in the required strip of topographic map. These include, retaining walls, houses, drainage channels, cracks and gaps on the road surface, and so on. The obtained topographic map data were then incorporated into an existing LIDAR data or AW3D Enhanced DTM data (see details in **Table 4.2.1**) to prepare a topographic map with a scale of 1:1,000 to cover the whole target site.

Table 4.2.1 Existing Topographic Data used for the Survey

Existing data	Data type	Source	Resolution	Sites where to be used
LiDAR DEM	Airborne lidar data	Survey Department of Sri Lanka	1~2 m	2, 6, 7, 8, 9, 31, 36, 37, 51
AW3D Enhanced DTM	Satellite imagery	NTT Data	2 m	1, 10, 11, 12, 19, 20, 22, 23, 25, 25ad2, 26, 27, 33, 34, 39, 40, 43, 48, 49

Source: JICA Survey Team

The quantity of topographic survey work is shown in **Table 4.2.2**. Likewise, a cross section was surveyed and prepared as a central reference line for each site for stability analysis and subsequent countermeasure preliminary design. All cross sections were prepared at a scale of 1:500 (vertical and horizontal). Two sets of concrete bench marks were installed for each location.

Table 4.2.2 Quantities of the Contracted and Actually Performed Topographic Survey

No.	Site No.	Surveyed Area of the Topo (m^2)	Surveyed Length of Cross Section (m)	Established Benchmark (nos.)
1	1	33,483	812	2
2	2	2,313	426	2
3	6	2,370	337	2
4	7	3,514	240	2
5	8	11,625	114	2
6	9	5,639	38	2
7	10	49,286	214	2
8	11		237	2
9	12		239	2
10	19	12,338	143	2
11	20	29,628	380	2
12	22	25,290	179	2
13	23	22,749	239	2
14	25	23,788	199	2
15	25ad2	13,488	106	2
16	26	31,700	432	2
17	27	14,971	202	2
18	31	17,164	101	2
19	33	20,475	268	2
20	34	26,609	-	2
21	36	71,188	549	2
22	37	7,943	78	2
23	39	21,623	335	2
24	40	29,233	180	2
25	43	8,645	314	2
26	48	13,544	98	2
27	49	18,017	160	2
8	51	2,900	152	2
Total		411,293	1866	56

Source: JICA Survey Team

4.3 Geological Survey

4.3.1 Site Reconnaissance

Following the interpretation of aerial photographs, a detailed site reconnaissance for all the target sites was conducted. The main purposes of the site reconnaissance were to obtain geological, topographic, hydrologic conditions, and sediment disaster extents for the development of conceptual countermeasure options, as detailed below.

- To identify and delineate landslide areas and blocks through site observation of landslide landform feature and deformation situations, such as shape of scarps, small local settlements and bulges, distribution of crack, etc.;
- To observe the causes and mechanisms of the sediment disasters to obtain basic information for the development of conceptual countermeasure options. For example, for rockfall sites, the maximum size of falling rocks and boulders, either potential or existing, and the height of the fallen rocks and boulders were observed and checked to examine possible solutions for rockfalls;
- To observe the damaged condition of road sections and their locations related to sediment disasters, right-of-way limit, and land use constraints to obtain basic information for the development of conceptual countermeasure options;
- To observe topographic and geologic conditions as well as spring and seepage distributions of the target sites and their surroundings to prepare geological sections and to estimate geotechnical parameters for the preliminary design of conceptual countermeasure options;
- To decide the ranges and areas of topographic map survey and the locations of cross sections for the preliminary design; and
- To plan geological borehole survey for the selected three landslide sites, including the number, location and depth of boreholes.

Detailed site reconnaissance records for all the 30 target sites are given in Appendix 3, while the site reconnaissance results are outlined in **Table 4.3.1** below.

Table 4.3.1 Outline of Site Reconnaissance Results

Site No.	Brief Description of Site Reconnaissance Results
1	- Refer to Section 4.4.2 Geological Borehole Survey, (1) Site No.01 below
2	- The section of the road is located on the upper part of the landslide. - The landslide site is below a high and steep rock slope and the landslide material consists of colluvial materials. - Many cracks were observed across the road, suggesting the range or width of the landslide. - Recent excavation for house building on the lower part of the landslide is the main trigger.
4	- The section of the road is close to the toe of the landslide. In addition, a valley road passes through the top of the landslide. - The site, a reactivated landslide with a clear landslide landform, has been selected by the NBRO as an example for landslide monitoring with auto monitoring instruments, including rain gauge, extensometer, and borehole inclinometer. - The results of the borehole survey and monitoring by NBRO defined the landslide extent.
6	- The section of the road is located at the middle part of the landslide. - New cracks across the road and the settlement of the road were observed. Two houses were relocated because of landslide movement. Deformation and some topographic features defined the landslide area. Additionally, a larger potential landslide was topographically estimated.
7	- Refer to Section 4.4.2 Geological Borehole Survey, (2) Site No.07 below
8	- The section of the road is located closely to the toe of the slope failure. - The slope failure occurred on a steep and unprotected cut slope due to the gradual erosion and deterioration of the cut slope. A stepped landform above the slope failure was observed, suggesting further instability towards its upper slope. - The slope failure involved colluvial materials and strongly weathered rocks.
9	- The section of the road is located on the top of the slope failure. - Long cracks on the road were observed parallel to the valley slope, indicating that the slope failure resulted chiefly from the river erosion. The concentrate rainwater through the road and its flow into the

	valley slope contributed further to erosion and consequently to instability. - No new and large opening cracks were observed on the road, suggesting that slope instability is due to long-term erosion process.
10-12	- The section of the road is below steep and large slope of colluvium and bedrock, artificial and natural. Especially on rock cut slope, vertical joints dip adversely out of the road slope, providing a favourable condition for rockfall occurrence. - Many fallen rocks were observed in a road side ditch and on the valley slope below the road. In addition, many unstable large rock blocks were observed on the road cut slope and its upper natural slope. These features indicated a high potential for further rockfall.
19	- The section of the road is located on the base of vertical cut slope. The slope, 10-30 m high, with a local small berm, consists mainly of gneissic bedrock and its weathered rocks. - Two sets of major joints in the bedrock forms a dip slope, with a large potential for rockfall with larger rock blocks. - Many fallen rocks were observed in the road side ditch, which reportedly reached the road damaging the road surface.
20	- Same as in Site No.19
22	- Same as in Site No.19
23	- Same as in Site No.19
25	- The section of the road is located on the toe of the slope failure. Next to the slope failure, a small collapse occurred and then was stabilized with gabion walls during the road construction. This indicated that slope failure and the previous small collapse were potential failure sites and their stability was disturbed by road excavation. - Stepped landform was observed above the slope failure, suggesting further instability towards its upper slope. - The bedrocks were strongly weathered. Small collapses were observed on the unprotected rock cut slope around the slope failure, presumably indicating potential process of progressive erosion and subsequent instability.
25ad2	- The section of the road is located on the base of a vertical cut slope of 10-20 m height. - The rock cut slope, consisting of highly fractured gneiss, provides a favourable situation for rockfalls. - Small rock collapse during the road construction and then frequent occurrence of rockfalls at the site suggest that the site is highly susceptible to rockfalls and has a high potential for further rockfall occurrence.
26	- The section of the road is located on the middle part of a large landslide. The landslide site is a populated area with many residential houses. - Many deformations and damages on the road and other street roads indicated that the landslide was a long-term and slowly-moving landslide. - Some surface and subsurface drainage methods were implemented locally in the landslide site. However, the methods were not enough to stabilize the landslide movement.
27	- Refer to Section 4.4.2 Geological Borehole Survey, (3) Site No.27 below
31	- The section of the road is located on the top part of the slope failure. The road around the slope failure was constructed with filling. - New cracks on the road and damages to retaining walls indicated recent movement and defined the area of the slope failure. - Two sets of joints were observed to contribute to instability. In addition, poor road drainage and runoff from the road to the valley slope of the slope failure site caused serious erosion, further triggering the slope failure.
33	- The section of the road is below steep rock cut slope followed by a large natural slope. Especially on the natural slope above the road cut slope, many large, individual unstable rock blocks and boulders are distributed, and they provide the source of rockfall. - Road shoulder and the retaining wall on the valley side of the road were damaged presumably due to the concentration of runoff to the section and the resulting erosion.
34	- The section of the road is located at the middle part of the large landslide. - The landslide site is below a high and steep rock slope, the landslide slope consists of colluvial materials. - Many cracks were observed across the road, suggesting the range or width of the landslide. Culverts were damaged due to landslide movement. - Poor road drainage and the concentration of runoff to the section caused erosion at the valley slope of the road – the lower part of the landslide site, consequently triggering the landslide movement.
36	- The section of the road is located at the middle part of the landslide. The landslide is located on the reservoir rim slope. - The landslide slope consists of colluvium and the underlying weathered gneiss. On the gneiss foliation joints, dipping downslope with dip angle of about 25-30 degrees formed a potential sliding surface. - The reservoir operation of rapid drawdown of reservoir water level may destabilize the landside slope by removing lateral confining pressure of the reservoir water, while retaining a high pore water pressure in the landslide slope, thereby causing landslide occurrence.
37	- The section of the road is located at the top part of the slope failure.

	- The site consists of gneissic rocks, and on the rocks, almost vertical joints were well developed, which were parallel to the direction of the failure surface. - Poor road drainage and the concentration of runoff to the section caused erosion and generated pore water pressure inside joints at the valley slope of the road, consequently triggering the slope failure occurrence.
39	- The section of the road is located below the slope failure on steep rock road cut slope of 10 to 15 m height. - Small collapses and rockfalls have frequently occurred locally on unprotected road cut slopes. - Road shoulder on the valley side of the road was damaged, due presumably to the concentration of runoff to the section and the resulting erosion.
40	- The section of the road is below a small road cut slope followed by a large natural slope. Especially on the natural slope above the road cut slope, many large, individual unstable rock blocks and boulders are distributed. These provide the source of rockfall. - The site mainly consists of colluvium and includes many large boulders and rock blocks. - A small collapse occurred locally on the road cut slope. As the small collapse progresses in the colluvium, the large boulders and rock blocks may become unstable, causing rockfalls.
43	- The section of the road is located closely on the toe of the slope failure. - The slope failure occurred on steep, unprotected cut slope, probably due to gradual erosion and deterioration of the cut slope. A stepped landform above the slope failure was observed, suggesting further instability towards its upper slope. - The slope failure involved colluvial materials and strongly weathered rocks.
48	- The section of the road is located on the toe of the slope failures, including a larger failure and two small collapses. - The site consists mainly of colluvium and includes many large boulders and rock blocks. - Any further slope failure, small or larger, may be associated with rockfalls of large rock blocks, therefore posing a significant risk to traffic.
49	- The section of the road is located on the toe of the landslide. - No cracks and deformations were observed on the road. However, on the upper slope of the landslide, cracks were observed on house walls and retaining wall, suggesting the landslide may be enlarged towards the upper slope. - The landslide, together with some small local collapse and rockfall on the road cut slope, indicated that the site has a high potential for further instability.
51	- The section of the road is located below the slope failure. - The failure materials washed down the road section, causing damage to the road. - Except for the source area of the slope failure, a large volume of the failure materials remains on the gentle slope above the road. - Any further slope failure and flood involving the existing failure materials may cause damage to the road.
53	- The road section is located on the debris fan of the debris flow. - The debris flow occurring in 2017 killed 23 people and destroyed 23 residential houses. - A large amount of sediment remains on the source area of debris flow. Any further debris flow may cause damage to the road. - Besides the road to be protected from further debris flow, some residential houses and public school building are located on the debris fan and are thus at risk of exposure to further debris flows.

Source: JICA Survey Team.

4.3.2 Geological Borehole Survey

Three large landslide sites, No._01, No._07, and No._27 were selected to make the geological borehole survey. The geological borehole survey was conducted by the local subcontractor, Engineering & Laboratory Services (PVT.), from 17 June 2019 to 20 September 2019.

The geological borehole survey consisted of core drilling, standard penetration test (SPT), and groundwater level measurement. The purpose of the survey was to determine the depth of the sliding surfaces through the observation of obtained cores and to check the actual groundwater levels within the landslide areas, which were necessary for stability analysis and subsequent countermeasure design.

The performed quantity of the geological borehole survey is shown in **Table 4.3.2**. The results of geological borehole survey are detailed in Appendix 5_2.

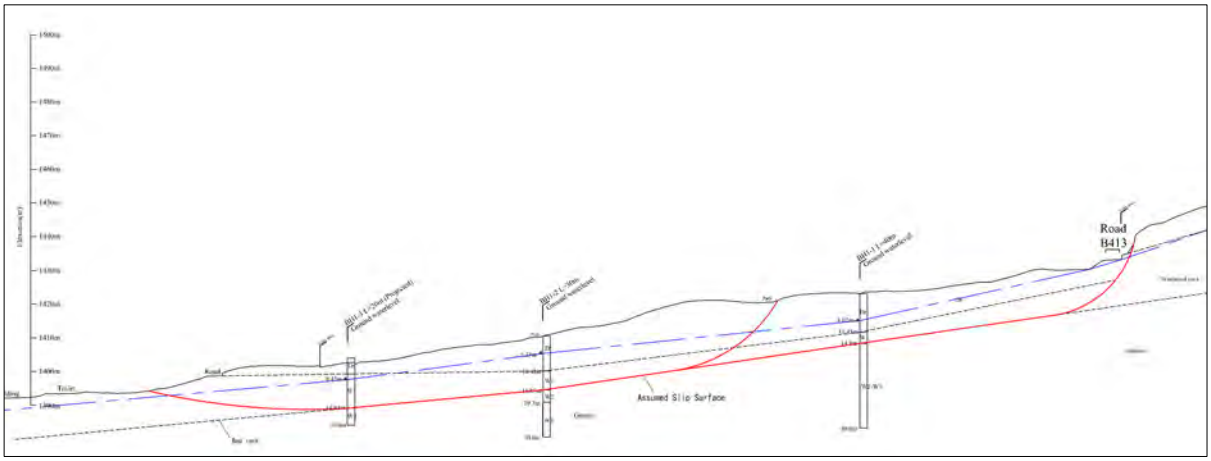
Table 4.3.2 Performed Quantity of Geological Borehole Surveys

Site No.	Borehole No.	Coordinate		SPTs (nos.)	Drilling Depth (m)
		Easting (m)	Northing (m)		
1	BH-1-01	485839.37	778123.37	15	40.0
	BH-1-02	485921.53	778085.87	15	30.0
	BH-1-03	485982.05	778066.51	14	30.0
7	BH-7-01	459897.59	785502.00	9	20.2
	BH-7-02	459875.49	785486.65	11	20.0
27	BH-27-01	462528.73	817216.82	2	20.0
	BH-27-02	462494.07	817199.05	6	20.0
Total				72	170.2

Source: JICA Survey Team

(1) Site No. 01

- The section of the road is located on top of the landslide area. The horizontal alignment of the road is along the main scarp of the landslide (**Figure 4.3.1**).
- Topographic interpretation shows a clear landslide landform, including concave scarp, side small gullies and abundant springs. These topographic features indicated that the landslide is a previous landslide.
- No settlement of the road was observed during site reconnaissance; however, opening depression right below the road and distinct damages to the retaining wall and culvert around the road section were observed. These deformations indicated that the landslide has recently moved or has been reactivated.
- A total of three geological boreholes were drilled to observe subsurface conditions and potential sliding surfaces. According to the obtained core observation, the sliding surface was formed between the strongly weathered rocks and moderately weathered rocks.



Source: JICA Survey Team

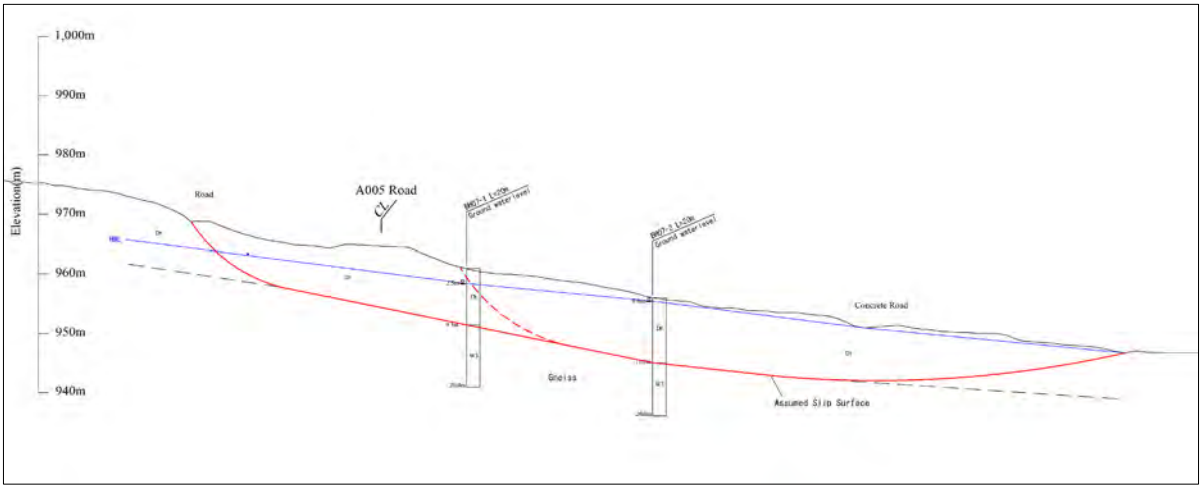
Figure 4.3.1 Geological Section at Site No._01

(2) Site No. 07

- The section of the road passes through the upper part of the landslide area.
- In 1997, a large-scale landslide including the target No._07 site occurred. The No._07 site is a reactivated landslide with a stepped landform, which is generally formed due to long-term

movement (**Figure 4.3.2**).

- A clear and significant settlement of the road is observed, indicating that the landslide developed through long-term and slow movements.
- Some surface and subsurface drainage methods were implemented at the upper part of the landslide site. However, the methods were not enough to stabilize the landslide movement.
- A total of two geological boreholes were drilled to observe subsurface conditions and potential sliding surfaces. Core observation shows that the sliding surface was formed along the colluvial soils and the underlying bedrock, a pre-existing sliding surface.

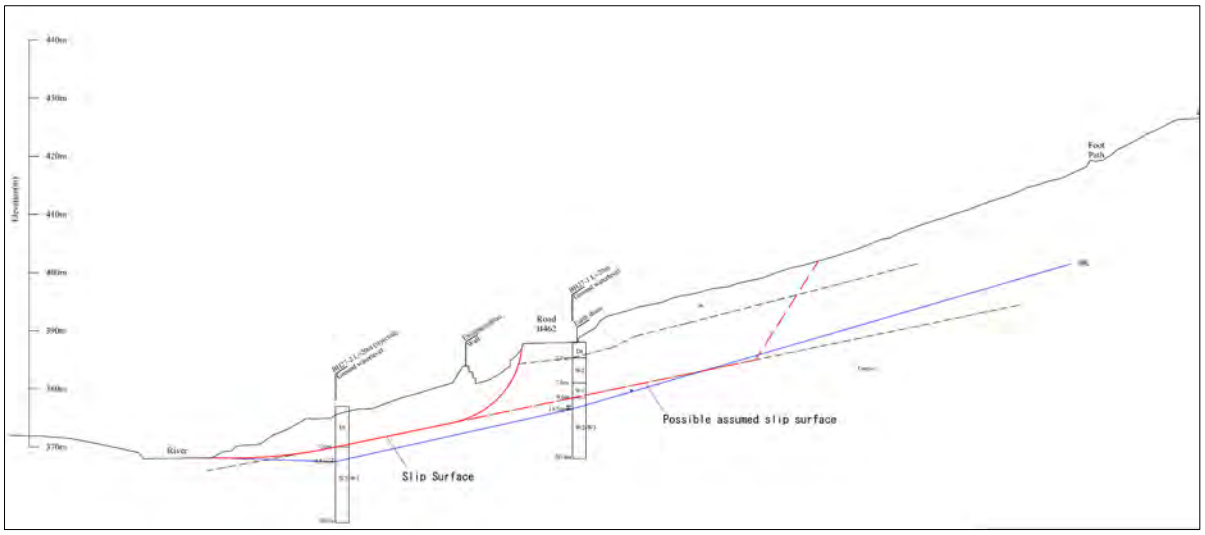


Source: JICA Survey Team

Figure 4.3.2 Geological Section at Site No._07

(3) Site No. 27

- The section of the road is located on top of the landslide (red solid line in **Figure 4.3.3**). The landslide was formed due to stream erosion at the toe of the landslide and its stability was further disturbed or reduced by the placement of gabion walls in its depression.
- Recent and new cracks and depression were observed within the landslide, suggesting an active landslide.
- As the landslide moves, its upper slope including the road section was much likely to be unstable and to form a potential landslide (red broken line in **Figure 4.3.3**) due to the loss of toe support.
- A total of two geological boreholes, one in an active landslide and the other in a potential landslide, were drilled to observe subsurface conditions and potential sliding surfaces. Core observation shows that the sliding surface was formed along the colluvial soils and the underlying bedrock for the active landslide. For the potential landslide, the sliding surface was formed between the strongly weathered rocks and moderately weathered rocks.



Source: JICA Survey Team

Figure 4.3.3 Geological Section at Site No._27

Chapter 5 Preliminary Design

5.1 Preliminary Design of Countermeasures

5.1.1 Design Policy

(1) Basic Concept

Based on the risk assessment of the candidate sites described in Chapter 3, 30 sediment disaster sites have been identified and prioritized as target sites for this project. Their disaster types are composed of:

- 10 landslide sites;
- 9 slope failure sites;
- 10 rockfall sites; and
- 1 debris flow site.

These sediment disasters are detrimental to the function of the roadways and pose a serious threat to traffic safety. These therefore require reasonable and proper countermeasures. Sediment disaster countermeasures were designed to restore the highway section to an original condition or in some cases, to restore the sections to a condition that is safer and better than the original condition, thereby maintaining the national road network and preventing any further disturbances to the traffic.

In designing the sediment disaster countermeasures, an overall review and whole layout were made based on the following considerations:

- Mechanism and dimension of sediment disasters;
- Damage and situation of the road sections due to sediment disasters;
- Site specific topographic and geologic conditions;
- Land use constraints and right-of-way for each site;
- Safety of construction personnel and traffic during construction;
- Availability of construction material and equipment;
- Environmental and social effects during construction; and
- Engineering experience and judgments.

(2) Countermeasure or Mitigation Strategies

In general, there are three basic strategies to mitigate a sediment disaster:

- Prevention or stabilization measure;
- Protection measure; and
- Avoidance measure.

Prevention measure seeks to address one or more key mechanisms and causes of sediment disaster and improve the stability of the road slope around sediment disaster section. The latter two mitigation strategies allow sediment disaster occurrence and seek to avoid, protect against, or limit the associated impacts on the road and traffic safety.

1) Prevention measure

Prevention measures for sediment disasters, such as landslide and slope failure, are performed to directly improve their stabilities to meet the required levels. Typical prevention measures include grading the unstable portion of the slope to a lower or stable gradient, construction of rock buttresses

and retaining walls, drainage improvements, and the increase of force resistance against sliding or failure. In general, prevention measures have typically moderate to high cost, but provide a long-term solution with low long-term maintenance costs.

2) Protection measure

Protection measures for sediment disasters primarily focus on control, containment and/or the diversion of the moving debris of sediment disaster, thereby protecting the road and traffic from sediment disaster. Such measures include retaining (containment) walls, protection fences and nets, and sabo dams. Protection measures are generally low to moderate in cost compared to the other two mitigation strategies. However, considerable long-term maintenance costs are often associated with these measures to clean out and dispose of accumulated debris behind and inside these facilities.

3) Avoidance measure

Avoidance measures constitute a permanent solution to a sediment disaster without maintenance and involve relocating or placing the highway into a more stable situation. Avoidance measures mainly include realignment away from the sediment disaster site and the construction of tunnels, bridges, and rock sheds that allow passage of sediment disaster materials above and beneath the roads. The typical high cost of these measures is offset by the elimination of further sediment disaster-related maintenance costs and exposure to sediment disaster risk.

(3) Introduction of Advanced Technologies

In selecting countermeasures, some advanced technologies and those that have not been used in LDPP Phase 1 will be actively and preferentially introduced for the identified sites as part of technology transfer.

In LDPP Phase 1, the following countermeasures were mainly used:

- Surface drainage methods (ditch, channel);
- Horizontal drain boreholes;
- Drainage wells;
- Slope cutting and filling;
- Vegetation;
- Crib work;
- Mortar spraying;
- Soil nailing;
- Retaining walls (concrete and gabion);
- Reinforced earth walls;
- Ground anchor;
- Steel pile;
- Crib work with ground anchor;
- Retaining wall with ground anchor;
- Rockfall protection fence and net; and
- Rockfall protection walls.

Besides the above-mentioned countermeasures, the following advanced technologies have been proposed and designed in the Survey for LDDP Phase 2:

- Open drain and closed conduit;
- Steep piles with ground anchor;

- Reinforced earth walls;
- Steel gabion;
- Sabo dam (Permeable type);
- Training wall;
- Revetment method;
- Foot protection;
- Bonding method;
- Wire rope method;
- Reinforced earth wall (rockfall protection);
- Rockfall protection fence and net (high-intensity, pocket type);
- Rope-fixation rockfall prevention method; and
- Rock shed.

5.1.2 Design Criteria and Standards

(1) Design Standards and Technical References Used

The preliminary design for the Preparatory Survey basically follows the Sri Lankan codes, standards and practices complemented with the internationally accepted codes and standards including Japanese standards and manuals.

The following Sri Lankan codes and standards are referred to:

- Manual for Road Slope Protection – Design Guideline (draft), Prepared by LDPP-1;
- Manual for Road Slope Protection – Investigation and Selection of Landslide Countermeasures, Prepared by LDPP-1;
- Specifications for Construction and Maintenance of Roads and Bridges, Ministry of Construction and Engineering Services, ICTAD No. SCA/5, 2009;
- Geometric Design Standard of Roads, Road Development Authority, 1998;
- Geometric Design Standard of Expressways, Road Development Authority, 2017;
- Specifications for Building Works – Volume I, Ministry of Construction and Engineering Services, ICTAD No. SCA/4/I, 2004; and
- Specifications for Water Supply Sewerage and Storm Water Drainage Works, Ministry of Construction and Engineering Services, ICTAD No. SCA/3/2, 2002.

The following Japanese standards and manuals related to road construction and maintenance are referred to:

- Highway Earthwork Series – Manual for Execution, Japan Road Association, 1986;
- Highway Earthwork Series – Manual for Slope Protections, Japan Road Association, 2009;
- Highway Earthwork Series – Manual for Retaining Wall, Japan Road Association, 2012;
- Highway Earthwork Series – Manual for Drainage, Japan Road Association, 1987;
- Highway Earthwork Series – Manual for Culvert, Japan Road Association, 2009;
- Highway Earthwork Series – Manual for Filing Work, Japan Road Association, 2010;
- Highway Earthwork Series – Manual for Rock Fall Countermeasures, Japan Road Association, 2017;
- Manual for Highway Earthworks, Japan Road Association, 2009;
- Technical Standards for River and Sabo Facilities, Ministry of Construction, Japan, 1997;
- Disaster Notebook, Japan construction Engineers' Association, 2018;

- Manual for Design and Construction of Ground Anchor Works, Japanese Geotechnical Society, 2012;
- Manual for Design and Construction of Crib Work, Japan Slope Protection Association, 2012; and
- Structural Specification for Design and Construction of Concrete Structures, Part 1. Design, Japan Society of Civil Engineers, 1986.

In addition, other countries' codes and standards are referred to:

- Landslides: Investigation and Mitigation, Special Report, SR247, by Transportation Research Board, National Research Council, USA, 1996;
- Soil Nail Wall – Reference Manual, U.S. Department of Transportation Federal Highway Administration, 2015; and
- American Society for Testing Materials (ASTM).

(2) General Engineering Design Parameters

These general engineering design parameters are based on the above-listed standards and technical references as well as common engineering practices. They are mainly applied for the determination of structure sizes for safety.

1) Unit weight

Unit weight of soils shall generally be determined by the results of laboratory tests. If there are no test data available, a general unit weight of 18.0 kN/m^3 is commonly used for design purposes, regardless of different soil layers. Furthermore, the following standard values of unit weight may be used.

Table 5.1.1 General Engineering Values of Unit Weights

Materials	Unit Weight (kN/m^3)
1. Reinforced Concrete, Common	24
2. Plain Concrete	23
3. Mortar	21
4. Structural Steel	77
5. Cast Iron	71
6. Stone Masonry	22
7. Water	10
8. Soil: Dry (Undisturbed)	16
Wet (compacted)	18
Under Water	8
9. Sand/Gravel (Compacted)	19

Source: JICA Survey Team

Table 5.1.2 Typical Values of Unit Weights

Materials	Unit Weight (kN/m^3)
1. Sand	18
2. Sand and Gravel	19
3. Deposits (in case of no test results)	18
4. Rock Block (in case of no test results)	26
5. Prestressed Concrete	25

Source: Manual for Rock Fall Countermeasures, Japan Highway Public Corporation, 2017

2) Internal friction angle and cohesion

The geotechnical properties, internal friction angle, and cohesion of soils are generally estimated from the following empirical relationship with N-values and unconfined compressive strength or from the conventionally adopted empirical tables of soil parameters. These empirical relationships can be used to estimate geotechnical parameters for stability analysis of slope failure and their countermeasure examination.

Table 5.1.3 Empirical Relationship of c and ϕ with N-Value and q_u

Soil Type	Empirical Correlation	Source
1. Sandy soils	$\phi = (15N)^{0.5}+15$ $\leqq 45$ (N>5)	Japan Road Association (2009)
2. Sandy soils	$\phi = (15N)^{0.5}+15$	Osaki et al. (1959)
3. Cohesive soils	c = (6 to 10) N (kN/m^2)	Japan Road Association (2009)
4. Cohesive soils	$c_u = q_u/2$	Japan Road Association (2009)

Notes: a) N= SPT N-value, b) q_u = Unconfined compression strength, c) ϕ = Internal friction angle, d) c = c_u =Undrained shear strength of cohesive soil.

Table 5.1.4 Empirical Estimation of Design Parameters for Natural Soils

Geology	Soil Condition	Unit Weight (kN/m^3)	Internal Friction Angle (degree)	Cohesion (kN/m^2)	Soil Classification
Gravels	Dense or poorly graded	20	40	0	GW, GP
	Loose or well graded	18	35	0	
Gravelly Sands	Dense	21	40	0	GW, GP
	Loose	19	35	0	
Sands	Dense or poorly graded	20	35	0	SW, SP
	Loose or well graded	18	30	0	
Sandy Soils	Dense	19	30	Less than 30	SM, SC
	Loose	17	25	0	
Cohesive Soils	Very firm or stiff	18	25	Less than 50	ML, CL
	Firm	17	20	Less than 30	
	Soft	16	15	Less than 15	
Clay/Silts	Very firm or stiff	17	20	Less than 50	CH, MH, ML, OH
	Firm	16	15	Less than 30	
	Soft	14	10	Less than 15	

Source: Manual for Highway Earth Works, Japan Highway Public Corporation, 2005

Table 5.1.5 Fine-grained Soil Strength

Term	Field Identification	qu (kPa)	SPT N-Value
Very soft	Easily penetrated several inches by fist	<25	0-1
Soft	Easily penetrated several inches by thumb	25-50	2-4
Firm	Can be penetrated several inches by thumb with moderate effort	50-100	5-8
Stiff	Readily indented by thumb but penetrated only with great effort	100-250	9-15
Very stiff	Readily indented by thumbnail	250-500	16-30

Hard	Indented with difficulty by thumbnail	>500	31 or more

Source: modified after ISRM (1981), AASHTO (1988).

In case of landslide, the cohesion, c, shall be usually determined from the thickness of sliding mass as shown in the table below and then the internal friction angle shall be determined through back calculation using the assumed safety factor.

Table 5.1.6 Relation between Cohesion and Vertical Thickness of Landslide Mass

No.	Vertical Thickness of Sliding Mass (m)	Cohesion, c（kN/m²）
1	Less than 5	5
2	Between 5 and 10	10
3	Between 10 and 15	15
4	Between 15 and 20	20
5	Over 25	25

Source: Technical Standards for River and Sabo Facilities, Ministry of Construction, Japan, 1997

Soil strength parameters for filling materials are generally determined based on empirical estimation, as shown in the following table.

Table 5.1.7 Soil Strength Parameters of Filling Materials Related to Soil Types

Type of Filling Materials	Internal Friction Angle (degree)	Cohesion, c（kN/m²）
1. Gravelly Soil	35	-
2. Sandy Soil	30	-
3. Cohesive Soil (w_L< 50%)	25	-

Note: w_L = Liquid limit of soils
Source: Manual for Retaining Wall, Japan Road Association, 2012

3) Bearing capacity of the ground

The ultimate bearing capacity of the ground, in principle, is determined by conducting an in-situ test (standard penetration test). When it is difficult to conduct an in-situ test for the design of structures, the values shown in the table below can be used based on geological observations.

Table 5.1.8 Allowable Bearing Capacity of Foundations (Long-term)

Geology		Allowable Bearing Capacity (kPa)	Measured N-Value	q_u (kPa)
Bedrocks		Over 1,000	Over 100	
Sandstone Ground		500	Over 50	
Mudstone Ground		300	Over 30	
Gravelly Soils	Dense	600	-	
	Not dense	300	-	
Sandy Soils	Very dense	300	30 – 50	
	Dense	200	20 – 30	
	Medium dense	100	10 – 20	
	Loose	50	5 – 10	
	Very loose	00	Below 5	
Cohesive Soils	Very stiff	200	15 – 30	Over 250
	Stiff	100	8 – 15	100 – 250
	Med stiff	50	4 – 8	50 – 100
	Soft	20	2 – 4	25 – 50

	Very soft	00	0 – 2	Less than 25

Source: Modified from Manual for Retaining Wall, Japan Road Association, 2012.

4) Friction coefficient of the ground with structures

The friction coefficient between ground and structures, such as a retaining wall and revetment, is generally estimated in accordance with the following table.

Table 5.1.9 Ground Friction Coefficient Estimated by Geologic Conditions

Foundation Ground		Coefficient of Friction at the Bottom of the Wall
Bedrock	Hard or Cracked	0.7
Gravel Ground	Dense or Loose	0.6
Sandy Ground	Dense	0.6
	Medium	0.5
Clayey Ground	Very hard	0.5
	Hard	0.45
	Medium	-

Source: Manual for Highway Earthworks, Japan Road Association, 2009

(3) Estimated Skin Frictional Resistance

Table 5.1.10 Estimated Skin Frictional Resistance of Anchors

Ground Type			Friction Resistance (MN/m^2)
Bedrocks	Hard Rock		1.5 – 2.5
	Soft Rock		1.0 – 1.5
	Weathered Rock		0.6 – 1.0
	Semi-Consolidated Soil		0.6 – 1.2
Sand and Gravel Ground	N-Value	10	0.10 – 0.20
		20	0.17 – 0.25
		30	0.25 – 0.35
		40	0.35 – 0.45
		50	0.45 – 0.70
Sandy Soil Ground	N-value	10	0.10 – 0.14
		20	0.18 – 0.22
		30	0.23 – 0.27
		40	0.29 – 0.35
		50	0.30 – 0.40
Cohesive Soil Ground		-	1.0*C (C: Cohesion)

Source: Manual for Slope Protections, Japan Road Association, 2009

Table 5.1.11 Estimated Skin Frictional Resistance of Rock Bolts (or Nails)

Ground Type		Friction Resistance (N/mm^2)
Bedrocks	Hard Rock	1.2
	Soft Rock	0.8
	Weathered Rock	0.5
	Semi-Consolidate Soil	0.5

Sand and Gravel Ground	N-Value	10	0.08
		20	0.14
		30	0.20
		40	0.28
		50	0.36
Sandy Soil Ground	N-value	10	0.08
		20	0.14
		30	0.18
		40	0.23
		50	0.24
Cohesive Soil Ground		-	0.8*C (C: Cohesion)

Source: Manual for Cut Reinforced Earth Design and Construction, Japan Highway Public Corporation, 1998

(4) Design Flood

The design flood for different structures is determined according to the Technical Standards for River and Sabo Facilities, Ministry of Construction, Japan, 1997 and Geometric Design Standard of Expressways, Road Development Authority, 2017.

Table 5.1.12 Design Flood of Structures to Be Designed

Structure Designed	Return Period (year)
Sabo dam[1)]	100
Major bridge[2)]	100
Minor bridge[2)]	50
Culvert[2)]	25
Channel and ditch[1)]	20

Source: 1) Technical Standards for River and Sabo Facilities, Ministry of Construction, Japan, 1997, and
2) Geometric Design Standard of Expressways, Road Development Authority, 2017.

(5) Slope Stability Analysis

The slope stability analysis is an analytical tool for assessing the stability of a slope using a simple method of slices or failure model in analysis, mostly focusing on two-dimensional limit equilibrium analysis. Many methods of stability analysis have been developed.

However, mostly in Japan, such as the Manual for Slope Protections, Japan Road Association (2009) and Technical Standards for River and Sabo Facilities, Ministry of Construction, Japan (1997), as the following equation shows, the Swedish slice method, also called as Ordinary Slice Method, is generally used for evaluating the present stability of a critical slope and the subsequent determination of the scale and quantity of landslide countermeasures for the survey.

$$Fs = \frac{(\Sigma N - \Sigma U) \times \tan\phi + C \times \Sigma L}{\Sigma T}$$

Where,

N (kN/m) : Normal force attributable to the gravity of a slice, N=W・cos α
T (kN/m) : Tangential force attributable to the gravity of a slice, N=W・sin α
α (°) : Angle of the base of the slice to the horizontal plane
U (kN/m) : Pore pressure acting on the base of the slice
L (m) : Length of sliding surface acting on the slice

C (kN/m^2) : Cohesion of the sliding surface
ϕ (°) : Internal friction angle of the sliding surface

(6) Factor of Safety

In coping with an instability, the most important step is to decide how much safety should be incorporated into the countermeasures. Such decision not only largely affects the cost of countermeasures but also leads to improved future stability or safety.

1) Determination of the initial factor of safety

The initial factor of safety (Fs) is estimated based on landslide activity, movement conditions, and landslide types. These are given in the tables below. Accordingly, the initial factor of safety was set to be 1.0 at the preliminary design stage.

Table 5.1.13 Determination of the Initial Factor of Safety Related to Landslide Activity

Initial (or Present) Factor of Safety (Fs)	Landslide Activity State
0.95	- Landslide is moving.
0.98	- Landslide periodically moves associated with rainfall or other factors.
1.00	- Landslide movement is calming down.

Source: Disaster Notebook, Japan construction Engineers' Association, 2018

Table 5.1.14 Determination of the Initial Factor of Safety Related to Activity and Type of Landslide

Movement Conditions	Initial Safety Factor Related to Landslide Type			
	Bedrock Landslide	Weathered Rock Landslide	Colluvial Soil Landslide	Cohesive Soil Landslide
Inactive	1.10	1.05 - 1.10	1.03 - 1.05	1.00 -1.03
Active	0.95 – 1.00			

Source: Safety Factor Related to Landslide Type

2) Determination of planned factor of safety

The planned factor of safety cannot be generally determined with certainty. Therefore, a degree of risk should be assessed in the adopted design. The factor of safety should consider not only the uncertainties in the design parameters but also the consequence of landslide or slope failure. Where the consequences of a landslide or slope failure are slight, a greater risk of landslide/slope failure or a lower factor of safety may be acceptable. The planned factor of safety (Fsp) is the target value for enhancing the degree of safety of the slope and achieving the conservation of the slope by means of countermeasures or structures. In determining the planned factor of safety, overall consideration shall be given to the phenomena of landslide and its scale, degree of importance of the object of conservation, and degree of damage that is liable to occur as a result of the landslide.

The object to be protected in the project is a national road, A or B class, and therefore the planned factor of safety is determined to be 1.20 for the identified sites according to the following tables.

Table 5.1.15 Determination of Planned Factor of Safety

Fsp	Criteria and Conditions to be Considered
1.10 to 1.20	- Sudden and severe movement; and - Landslide liable to cause significant damages to human lives, houses, main road and river, and other public facilities.
1.05 to 1.10	- A large landslide has little effect on houses and public facilities; or

	- Prevention works are aimed at ensuring safety for the moment as temporary countermeasures.

Source: Technical Standards for River and Sabo Facilities, Ministry of Construction, Japan, 1997

Table 5.1.16 Determination of Planned Factor of Safety

Fsp	Criteria and Conditions
1.20	- Basically, Fsp, as target level, is determined to be 1.20; and - Fsp should be determined in consideration of landslide causes, landslide scale, land uses at its surroundings, cost-effectiveness, and so on.

Source: Manual for Highway Earth Works, Japan Highway Public Corporation, 2005

5.1.3 Countermeasure Comparative Analysis

(1) Design Approach

The complete design process is likely to involve the following five steps:

- Consideration of possible solutions to satisfy the functional and stability requirements;
- Formulation of conceptual countermeasure options incorporating possible solutions;
- Selection of the optimum option or solution by comparing the stability (or reliability), workability, maintenance cost, influence on the road, environmental impacts and cost effectiveness; and
- Provision of detailed engineering design of the optimum solution.

In addition, the detailed engineering design is beyond the scope of the Survey.

(2) Selection Criteria of Countermeasures

Countermeasures for each site is firstly selected with respect to the type or classification of sediment disasters including landslide, slope failure, rockfall, and debris flow. This section will describe the selection criteria of countermeasures for each type of sediment disaster.

In addition, all sediment disasters have occurred during heavy rainfall; this indicated that the greatest cause of the sediment disasters is the action of rainwater and groundwater. Therefore, taking appropriate measures against surface water and groundwater is extremely important for securing slope stability. For this purpose, it is necessary to take full precaution for permanent drainage for all types of sediment disasters.

1) Selection criteria of countermeasures for landslides

Generally, an adequate combination of two or more countermeasures is cost-effective and is selected in consideration of the following points:

- The countermeasures selected should address the mechanism(s) of the landslide, the relationship between precipitation, groundwater and landslide movement, geological, topographical and soil properties, the scale and movement type of landslide and its likely movement velocity.
- Drainage and earthwork (cutting and filling) should be regarded as the main methods of landslide control, while anchoring and piling works should be adopted for the stabilization of small landslides to protect the road, houses, etc.
- Where landslide movement is closely related to rainfall, surface drainage work should be performed immediately to minimize the infiltration of rainwater.
- When a landslide is moving, drainage and earthworks should be performed first; ground anchor, steel pile and other structures can then be done after drainage and earthworks halt the movement of landslide.

Any or a combination of the following countermeasures for landslide is recommended:

- Surface drainage (side ditch and drainage channel)
- Subsurface drainage (open drain and closed conduit, horizontal drain boreholes, drainage wells)
- Earth removal and counterweight fill methods
- Retaining wall and gabion wall
- Reinforced earth wall
- Crib works
- Rock bolts and soil nailing
- Steel piles
- Ground anchor

2) Selection criteria of countermeasures for slope failure

Generally, the following criteria are used for the selection of countermeasures:

- Whenever possible, cutting or reshaping method is preferred. In planning the cutting method, slope stability and harmony with the surrounding environment should be considered.
- In principle, surface drainage is considered positively. Subsurface drainage work is adopted if spring water exists during normal times and/or rainfall or if a depression exists near the top of the slope.
- Whenever the slope gradient and soil conditions will allow vegetation to grow, it shall be used to prevent erosion due to rainfall. Where slopes are unsuited for vegetation, other slope protection methods, such as pitching work, shotcrete work, and crib work shall be considered.
- Retaining walls are selected if the foot of a slope must be stabilized or if it is to be used as the foundation for other measures.
- Even though costly, anchoring or piling should be planned if other methods are not expected to control slope failure.
- When a potential slope failure is large, avoiding the unstable area by using an alternate route or by the construction of a bridge or a similar structure shall be considered.

Any or a combination of the following countermeasures for slope failures are recommended:

- Surface drainage (drainage channel, vertical and horizontal drainage, drainage at the top of slope)
- Subsurface drainage (horizontal drain boreholes)
- Slope protection (vegetation, mortar spraying, crib work)
- Retaining walls and gabion wall
- Reinforced earth wall
- Rock bolts and soil nailing
- Ground anchor
- Steep pile

3) Selection criteria of countermeasures for rockfall

Adequate and effective countermeasures for preventing rockfall are selected in consideration of topographical and geological conditions, vegetation, rockfall history, and effects of the countermeasure by predicting the size and height of the rockfall.

The following criteria are used for the selection of countermeasures against rockfall:

- If there is a danger of rockfall, in principle, the rockfall source should be removed. When these methods are difficult to implement, protection measures should then be adopted.
- In selecting countermeasures, it is essential to consider not only the conditions of the slope (slope

height and steepness) and rockfall (size and location on slope), but also the road structure, traffic conditions, and ground conditions.

- In selecting countermeasures, their constructability should be carefully considered. The selected many sites along the highways and expressways have unique space and right-of-way characteristics, for example, the difficulty of installing a wide, large protection walls and reinforced earth wall, or limited access to slopes for installing protection net, etc.
- It is necessary to combine various kinds of works together because the function of single countermeasure for rockfalls is limited.
- Countermeasures for rockfalls are designed by assuming the external forces to be safely borne by each work and by using this as the external design forces.

Any or a combination of the following countermeasure for rockfalls are recommended:

- Removal and scaling
- Foot protection
- Bonding (with mortar)
- Wire rope with rock bolts
- Mortar spraying
- Crib work
- Rock bolt and anchor
- Rockfall protection fence and net (cover and pocket types, low to high energy absorption)
- Rope-fixation rockfall prevention method
- Rockfall protection wall
- Reinforced earth wall (rockfall protection)
- Rockfall shed

4) Selection criteria of countermeasures for debris flow

In selecting the countermeasures for a stream prone to debris flow, various types of countermeasures can be reasonably combined in consideration of the likely occurrence, frequency, volume (scale), flow characteristics, topography, and the objects (road or other public building) to be protected. The basic sabo plan for debris flow should be formulated to effectively control the harmful sediments within the affected area.

The heights of the streambed and road surface are the most important conditions for the selection of countermeasures against debris flows. For streams with a high frequency of debris flow occurrence, the following criteria are used for selection and planning:

- If a road exists in the upper part of the debris flow accumulation area, it is advisable for the road to be relocated upstream or downstream of the existing road.
- When the path of the debris flow passes below the road surface, a bridge, culvert, or causeway is applicable. Whereas a debris flow shed, or cover would be used when the path of the debris flow is higher than the road surface.
- When the path of the debris flow and the related road surface are of the same height, a causeway is cost-effective, where debris flow can pass over the road surface without presenting an obstacle to the debris flow. In this case, the road surface should have a thick pavement that is resistant to the scouring caused by debris flows.
- The design sediment volume (sediment discharge) is calculated based on surveys of deposits within the streambed, including topographical analysis, field surveys, and records of past debris

flow.

Any or a combination of the following countermeasures for debris flows are recommended:

- Culvert
- Causeway
- Revetment
- Retaining wall and gabion wall
- Training wall and dike
- Sabo dam (permeable and non-permeable types)
- Debris flow deposition channel

(3) Conceptual Countermeasure Options

For the conceptual countermeasure options, two to three options or plans are developed for each site following the above-mentioned selection criteria and in consideration of the following technical and natural factors:

- Topographic, geologic and drainage conditions;
- Causes and mechanism of sediment disasters;
- Causes and actual situation of the road damage;
- Demission and type of sediment disasters;
- Land use constraint and right-of-way limit;
- Safety of works and traffic during construction;
- Accessibility of plant/storage and workers to the site;
- Availability of construction equipment and material; and
- Environmental impacts during construction.

(4) Comparison considerations

The conceptual remedial options for each site are developed along with consideration regarding stability, workability, effectiveness, work quantity, and estimated costs.

Selection of the most appropriate countermeasures for each site is based on the following factors:

- The degree of stability or reliability necessary for a site;
- The workability of the potential options;
- The post-construction maintenance required;
- The influence of the potential options for the road;
- The environmental impacts and aesthetics; and
- The cost effectiveness.

Each of the above-mentioned factors is rated in the range of 1 to 3, as shown in **Table 5.1.17**, and accordingly each option or plan for each target site are finally evaluated as First, Second or Third Plan on the basis of total scores. Obviously, the greater the total score for each plan the more optimum the plan is. The plan with the greatest scour will be selected as First Plan - the most optimum option for each target site.

Table 5.1.17 Criteria for Evaluation Items for Countermeasure Comparative Analysis

No.	Factor to Be Considered	Criterial (Score)		
1	The degree of stability or reliability necessary for a site	High (3)	⟷	Low (1)
2	The workability of the potential options	Easy (3)	⟷	Difficult (1)
3	The post-construction maintenance required	Less (3)	⟷	Much (1)

4	The influence of the potential options for the road	Small (3) ⟷	Large (1)
5	The environmental impacts and aesthetics	Small (3) ⟷	Large (1)
6	The construction cost	Cheap (3) ⟷	Expensive (1)

Source: JICA Survey Team.

The results of the countermeasure comparative analysis are shown in *Appendix 6*. The selected optimum option for each site is summarized in the tables below.

Table 5.1.18 Summary of the Finally Selected Optimum Countermeasures for Landslide Sites

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Table 5.1.19 Summary of the Finally Selected Optimum Countermeasures for Slope Failure Sites

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Table 5.1.20 Summary of the Finally Selected Optimum Countermeasures for Rockfall Sites

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Table 5.1.21 Summary of the Finally Selected Optimum Countermeasures for Debris Flow Site

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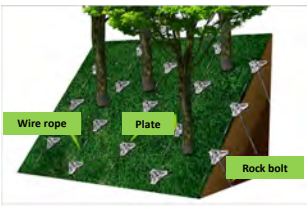
5.2 Applicability of Advanced Technology

5.2.1 Proposed Advanced Technology

The JICA Survey Team examined the applicability of advanced Japanese technologies for slope protection countermeasures. The countermeasure methods, which have advantages for Japanese technologies shown in **Table 5.2.1** were applied to the suitable sites in consideration of the feasibility of installation, stability of the slope, workability, maintenance operation, effect on environment and cost.

Table 5.2.1 Proposed Advanced Japanese Technologies

Conventional Technology (General Name)	General Outline of the Technology	Advantages	Effects of the Advantages	Candidate Sites
Steel piles with ground anchors	Deformation of road due to landslide is effectively controlled by a combination of steel piles and ground anchors.  Source: Isabou.net (https://isabou.net/sponsor/nm-anchor/jirei.asp)	- Abundant construction experience in Japan - Joint of steel piles - Special installation method with small construction stage, noise and vibration	- Workability is superior through the special joint of piles instead of welding works. - Noise and vibration are largely reduced by the special drilling method.	No. 1, No. 7
Permeable Sabo dam	Permeable sabo dam is required for preventing road and facilities from	- Abundant construction experience in Japan	- Little environmental impact	No. 53

	debris flow with big boulders and driftwoods. Soil cement (riverbed material on the site is mixed with cement) can be used for core material of the dam body.  Source: JFE Metal Product Corporation	- Quality of steel pile - Experience of soil cement for sabo dam body - Official handbook for construction of sabo soil cement	- Sustainance of the capacity of catching debris flow without sedimentation - Permeable sabo dam is also effective for driftwoods accompanying debris flow. - Soil cement is a cost-effective and environment-friendly method.	
Reinforced earth wall	Reinforced earth wall by geotextile and a protection structure against falling rocks and earth can receive rockfalls ranging from a relatively small to a large mass (5,500 kJ at maximum).  Source: Association of Protection MSE-Wall/GeoRockWall	- Abundant construction experience in Japan - Special geo-synthetics using textile fabric and received material - High energy absorption for a small width of the wall	- Because of its flexible structural characteristics as a soil structure, it can effectively absorb the impact energy of rockfall and slope failure materials and be built under various site conditions. - Construction cost is reduced because of the utilization of on-site soils. - The method matches landscape by greening the wall surface. - Maintenance is easy.	No. 12, No. 51
Wire rope with rock bolts	Wire rope with rock bolts (non-frame method) is required for the slope at risk for surface failure. The work prevents an unstable slope surface through the combination of wire ropes and rock bolts without slope cutting and tree trimming.  Source: Non-frame Society	- Abundant construction experience in Japan - Official manual for design and construction of the non-frame method	- Beneficial for environment and landscape - Workability is superiority by using lightweight construction machines. - The method leads to cost reduction.	No. 9
Free frame crib work	Crib work is required for the protection of slope from weathering and then	- Abundant construction experience in Japan	- Workability is superior by using flexible wire form	No. 2, No. 8, No. 11,

	prevention against further instability. The free frame made of wire form is fixed in size and the shape is flexible to changes in topography.  Source: Free Frame Society (http://www.freeframe.gr.jp/method/ff/nc2-s.php)	- Flexible wire form - Guideline for design and construction of free frame method  Source: Free Frame Society (http://www.freeframe.gr.jp/method/ff/one-touch.php)	to eliminate slope change. - Environment is also improved by vegetation inside the frame.	No. 20, No. 22, No. 25, No. 25ad2, No. 27, No. 36, No. 39, No. 43, No. 48, No. 49
Rockfall prevention method	Rockfall prevention method is required for fixing unstable rock blocks and stones. Rope-fixation type rockfall prevention method holds large non-attached stones, in areas with the fall of small and large stones.  Source: Tokyo Rope MFG. Co., Ltd. (http://www.tokyorope.co.jp/product/eg/rakuseki_m/#anc09)	- Abundant construction experience in Japan - High-intensity structure by using rope between anchors (Rope-fixation type rockfall prevention method) - Lightweight materials - Tough coating against salt corrosion	- Friendly to environment and landscape - The method is cost-effective for long term in addition to less maintenance cost. - Materials and equipment are light weight, for an easy assembly.	No. 10, No. 11, No. 12, No. 19, No. 20, No. 22, No. 23
Drainage well	Drainage wells are constructed to remove deep groundwater within large-scale landslide. Boreholes collecting groundwater are installed from the well to the radial direction.  Source: JFE Metal Product Corporation (https://www.jfe-kenzai.co.jp/product/08/01/index.html)	- Abundant construction experience in Japan - Light and high-intensity liner plates - High-intensity borehole pipe with corrosion-resistant courting	- Workability and safety construction are superior by using light and high-intensity liner plates. - The function of dewatering groundwater remain for long term by using high-intensity borehole pipe with corrosion-resistant courting that prevents clogging.	No. 26, No. 34
Steel gabion	Steel gabion is required for retaining a hilly slope with high earth pressure, as	- Abundant construction experience in Japan	- Stability of the slope, especially including abundant	No. 4, No. 9, No. 49,

	long-term stabilization structure, especially superior for sites where groundwater is abundant.  Source: JFE Metal Product Corporation (https://www.jfe-kenzai.co.jp/product/09/08/index.html)	- Stiff welded steel frame of panel type	groundwater, will be improved. - The method matches the landscape.	No. 51
Bonding work	Bonding work is required for unstable loose rock blocks on the steep slope where access and utilization of heavy construction equipment are difficult. Unstable loose rock blocks are bonded to the stable foundation rock by special mortar.  Source: : Kensetsu-plaza.com (http://www.kensetsu-plaza.com/catalog/post/7955/280740)	- Abundant construction experience in Japan - Special bond mortar	- The work can be executed without heavy construction equipment. - Workability and safety construction are superior. - The method matches the landscape.	No. 40

Source: JICA Survey Team

5.2.2 Opinion Exchanges among Enforcement Agency and Japanese Companies for Advanced Technologies

JICA had an invitation program to Japan for relevant persons of implementing, enforcement, and technical advisory agency on 7 to 14 May 2019 as shown in **Table 5.2.2**.

Table 5.2.2 Major Activities of Invitation Program in Japan on 7 to 14 May 2019

Date	Program	Stay
7 May (Tue.)	Arriving in Tokyo	Tokyo
8 May (Wed.)	Meeting in JICA Lecture by Japan Bosai Platform Visiting Kanto Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism (MLIT)	Yuzawa, Niigata Prefecture
9 May (Thu.)	Field visits of early warning system and rock fall prevention measures of National Road No.17, Yuzawa Maintenance Branch Office, MLIT Visiting Japan factory of disaster prevention production	Takasaki, Gunma Prefecture
10 May (Fri.)	Field visits of check dam sites and rockfall prevention measures managed by Nikko Civil Engineering Office, Tochigi Prefecture	Nikko Tochigi Prefecture

11 May (Sat.)	Visiting NEXCO Central Communication Plaza Kawasaki, Central Nippon Expressway	Tokyo
12 May (Sun.)	-	Tokyo
13 May (Mon.)	Visiting Japan factory of disaster prevention product Session for opinion exchanges about Japanese technology	Tokyo
14 May (Tue.)	Leaving Japan	-

Source: JICA Survey Team

In the program, a session of opinion exchange about advanced technologies between the enforcement agency officers and Japanese companies was held for a better understanding of the Japanese technologies on 13 May 2019. The session was composed of two programs; 1) Introduction of the Project and 2) Presentation of advanced technologies related to slope protections by Japanese companies. Japanese companies explained their technology directly to the enforcement agency officers at separate booths and conducted the exchange of views with the officers.

(1) Comment of enforcement agency officers

According to the interview of officers of RDA-PMU, they were expecting:

- To introduce advanced technologies against landslides of Japan to Sri Lanka;
- To conduct technology transfer of the slope protection also to local contractors in Sri Lanka; and
- Local contractors to have skills of the slope protection works and participate in also abroad slope protection projects in the future.

(2) Comment of Japanese companies participated in the 13 May session

According to the questionnaire obtained after the session,

- The answers of 15 companies participated in the 1st Program (out of 18 companies) were positive attitudes or possible to participate in the Project.
- All companies (eight in total) participated in the 2nd Program answered that the program was a very good chance to explain their technology and they were satisfied to exchange opinions with the enforcement agency at the separate booth.

Chapter 6 Cost Estimation

6.1 Construction Planning

6.1.1 Construction Package of the Project

The construction packages of the Project are prepared considering as follow factors:

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Figure 6.1.1 Location Map of Planned Construction Packages

The construction packages of the Project are summarized in **Table 6.1.1**.

Table 6.1.1 Summary of Planned Construction Packages

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6.1.2 Construction Plan of the Project

(1) Construction period for each site

- Construction volume per one day of each site was basically estimated referring to 1) Ministry of Land, Infrastructure, Transport and Tourism (MLIT), Japan, (2019), Civil engineering cost estimate standards, 2) Aichi Prefecture, Japan (2018), Cost estimate standards for civil engineering and 3) JICA (2017), Design and cost estimate manual (supplement).
- One month for mobilization and one month for demobilization for each site were considered before and after the construction works.
- Finally, construction period was optimized through alternative study by identifying critical path of construction works.

(2) Construction plan for each construction package

- Three months for preparatory works were set before the commencements of the construction works. During the three months of preparatory works, management system for construction works will be established between the Client and the Contractor. All necessary documents for construction supervision such as scheduling, quality control, safety management etc. will be prepared by the Contractor.
- Since the above preparatory works in the early stage of each construction package is critical to success of the Project, three months differences in the commencement of each construction package enough time were arranged considering availability of staff of RDA.
- Availabilities of heavy machines and machines specialized for countermeasures were also considered to optimize their workability and shorten the construction period.
- Finally, construction period was optimized through alternative study by identifying critical path of construction works.

6.2 Project Cost Estimation

6.2.1 Basic Conditions for Project Cost Estimation

The conditions applied to the cost estimations are as follows:

1) Prices as of 2019 are used.
   Base Year/Month for cost estimation is 2019/11.
2) The following exchange rates are used for the cost estimation:
   USD 1.0 = JPY 107.0 =LKR 178.0
   LKR 1.0 = JPY 0.601
3) Project period is from March 2020 to November 2029.
4) Fiscal year is from January to December.
5) Annual price escalation rates are assumed to be 1.72% for FC and 3.00% for LC.
6) Physical contingencies are 10.0% for construction cost and 5.0% for consultant.
7) Rate of administration cost is 5.0%.
8) Rates of tax are 15.0% for VAT and 15.0% for import tax.
9) Rates of interest during construction are 0.95% for construction cost and 0.01% for consultant.
10) Rate of front-end fee is 0.2% of the accumulated loan portion.
11) Defects notification period is 12 months.
12) The Project costs are categorised into F/C portion and L/C portion, as follows:

F/C Portion:

- Civil works sub total
- Price escalation
- Physical contingency
- Consulting services
- Interest during construction

L/C Portion:

- Front-end fee
- Land acquisition
- Administration cost
- VAT, import tax and other taxes.

6.2.2 Project Cost

The total Project cost is estimated to be JPY_____ million (equivalent to LKR_____ million), consisting of JPY _____ million for the F/C portion and LKR _____ million (equivalent to JPY_____ million) for the L/C portion. Breakdown of total Project cost in different currencies form is shown in the tables below.

Table 6.2.1 Project Cost (Cost by Item) (Mix Version)

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Table 6.2.2 Project Cost (Cost by Item) (JPY Version)

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Table 6.2.3 Project Cost (Cost by Item) (LKR Version)

「Hidden in pre-release version」

(1) Civil Works Cost

The Civil Works Cost consists of Construction Cost and General and Administrative Expenses. Construction Cost is composed of Direct Cost, Common Temporary Expenses (indirect cost), and Site Management Costs (indirect cost).

Direct Cost was calculated by multiplying the construction unit price and the quantities determined from the outline design, while indirect cost was calculated with reference to Japanese cost estimation standard published by the Ministry of Land, Infrastructure, Transport and Tourism. General and Administrative Expenses was calculated by multiplying the Construction Cost and the rate determined by the cost estimation standard aforesaid.

There are 30 target sites in the Project. As distance between each two sites is over 1 km (No.10, No.11, and No.12 excluded), the civil works cost has been calculated for each target site. The target sites were divided into four packages. The Civil Works Cost is composed of the four packages and technology transfer cost. The total base Civil Works Cost is JPY _____.

For the convenience of bidding, technology transfer cost will be allocated to each package; the civil works cost of the target sites and the allocated technology transfer cost constitute the cost of each package. Cost breakdown for each package is shown in the tables below.

Table 6.2.4 Cost of each package

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(2) Consulting Services Cost

The Project Management Unit (PMU) will employ an international Project Management Consultant (PMC) for the overall management of the Project activities. The base cost of the consulting services by PMC was estimated based on the tentative assignment schedule of PMC as well as the draft terms of reference. The base cost of the consulting services consists of the remuneration for international and national experts, and the direct costs such as transportation, communications, office rental, office furniture and equipment, report preparation, capacity development, investigation and monitoring, and O&M cost for countermeasure works. The summary of the cost of consulting services is shown in **Table 6.2.5** below.

Table 6.2.5 Summary of Cost Estimation for Consulting Services

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(3) Administration Cost and Other Cost

The ineligible portion of the yen loan will be funded by the Government of Sri Lanka. This portion includes front-end fee, land acquisition, administration cost, and VAT, import tax, and other taxes. The summary of administration and other costs is shown in **Table 6.2.6** below.

Table 6.2.6 Summary of Cost Estimation for Administration Cost and Other Costs

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6.3 Cost Reduction Measures

Cost reduction for the implementation of the Project was thoroughly considered in this survey. Main items and measures which lead to cost reduction are shown in **Table 6.3.1**. The Project cost has been reduced by approximately 5% in total through these considerations for the cost reduction.

Table 6.3.1 Considered Main Items for Cost Reduction for Implementation of the Project

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6.4 Annual Disbursement Schedule

Based on the JICA funding policy, the administration cost, taxes and duties, interest during construction and front-end fee relating to the Project activities will not be covered by the JICA loan. As a result, the total cost to be shouldered by the Government of Sri Lanka is estimated at JPY _____ million, while the total cost to be covered by the loan is estimated at JPY _____ million.

The annual disbursement schedule of LDPP2 is shown in the following table.

Table 6.4.1 Summary of Annual Disbursement Schedule

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Chapter 7 Project Implementation Plan

7.1 Implementation Strategy

The Project is composed of 1) the detailed design of slope protections, 2) tendering to procure the contractor, 3) construction works of slope protections and 4) defect liability period. In line with the project concept and approach mentioned in *Chapter 6*, the following implementation processes are adopted for each stage.

7.1.1 Detailed Design Stage

(1) Investigation, Monitoring and Analysis of Landslide

For the detailed design of countermeasures, proper quantity and precise survey and analysis of landslide based on enough time for landslide monitoring are appropriate for the following:

- Collect data related to the Project and review and verify all available data;
- Carry out all necessary engineering surveys and investigations such as topographical survey, hydrological survey, geotechnical investigations, material availability survey, etc, as applicable to the concerned project components;
- Install monitoring devices such as extensometers and inclinometers etc, and monitor the deformation of landslides through wet seasons to confirm the shapes and activities of landslides precisely (continuous two year's monitoring is recommended to obtain effective data of the deformation of landslide during wet seasons); and
- Prepare comprehensive geological investigation reports for the detailed design.

(2) Detailed Design

- Prepare the detailed design of the Project in sufficient detail to ensure clarity and understanding by the RDA, the Contractors and other relevant stakeholder;
- Prepare the detailed design in conformity with the Democratic Socialist Republic of Sri Lanka Standards or with appropriate international standards;
- Prepare the detailed design including, but not limited to, construction drawings, detailed cost estimates, necessary calculations to determine and justify the engineering details for the Project, associated bid documents to include specifications, bill of quantities (BOQ), and implementation schedule for the Project;
- Prepare the specifications containing contents in relation to 1) quality control of plant materials and workmanship, 2) safety and 3) protection of the environment; and
- Prepare the detailed design in close consultation with RDA to meet their requirements.

7.1.2 Tendering Stage

(1) Pre-Qualification (PQ)

- Define technical and financial requirements, capacity and/or experience for the PQ criteria taking into consideration the technical feature of the Project;
- Prepare PQ documents in accordance with the latest version of the Standard Prequalification Documents under Japanese ODA Loans;
- Assist RDA in PQ announcement, addendum/corrigendum, and clarifications to the applicants' queries;

- Evaluate PQ applications in accordance with the criteria set forth in the PQ documents; and
- Prepare a PQ evaluation report for approval of the PQ evaluation committee.

(2) Bidding Procedures

- Prepare bidding documents in accordance with the latest version of the Standard Bidding Documents under Japanese ODA Loans for Procurement of Works together with all relevant specifications, drawings, and other documents;
- Prepare bidding documents including 1) clauses stating that the Contractor is to comply with the requirement of the environmental impact assessment report, such as Environmental Impact Assessment (EIA) and Initial Environmental Examination (IEE), whichever applicable, the Environmental Management Plan (EMP) and JICA Guidelines for Environmental and Social Considerations (April 2010), 2) the specification clearly stipulating the safety requirements in accordance with the laws and regulations in the country of the Borrower, relevant international standards, if any, 3) the requirement to furnish a safety plan to meet the safety requirements, 4) the requirement for the personnel for key positions to include an accident prevention officer and 5) the requirement to submit method statements and safety plan to RDA and the Consultant at the construction stage;
- Evaluate bids in accordance with the criteria set forth in the bidding documents, and carefully confirm that bidders' submissions in their technical proposal including, but not limited to; site organization, mobilization schedule, method statement, construction schedule, safety plan, and EMP, have been prepared in consistent with each other and meet requirements set forth in applicable laws and regulations, specifications and other parts of the bidding documents; and
- Prepare a bid evaluation report for the approval of the bid evaluation committee.

7.1.3 Construction Stage

- Apply the FIDIC MDB Harmonized Edition (2010) complemented with the Specific Provisions as included in the Standard Bidding Documents under the Japanese ODA Loans for Procurement of Works to the civil works of the Project;
- Assess the Contractor's performance security, advance payment security and required insurances;
- Assess adequacy of all inputs such as materials, labour and equipment provided by the Contractor;
- Check and approve the Contractor's method of work, including site organization, program of performance, quality assurance system, safety plan, and environmental monitoring plan so that the requirements set forth in the applicable laws and regulations, the specifications or other parts of the contract are to be duly respected;
- Regularly monitor physical and financial progress, and task a appropriate action to expedite progress if necessary, so that the time for completion set forth in the contract will be duly respected by the Contractor;
- Explain and/or adjust ambiguities and/or discrepancies in the Contract Documents and issue any necessary clarifications or instructions. Issue further drawings and give instructions to the Contractor for any works that may not be sufficiently detailed in the contract documents, if any;
- Organize, as necessary, management meetings with the Contractor to review the arrangements for future work. Prepare and deliver minutes of such meetings to the Employer and the Contractor;
- Supervise the works so that all the contractual requirements are met by the Contractor, including

those in relation to i) quality of the works, ii) safety, and iii) protection of the environment. Confirm that an accident prevention officer proposed by the Contractor is duly assigned at the project site. Require the Contractor to take appropriate remedies if any questions are recognized regarding the safety measures;
- Inspect the construction method, equipment to be used, workmanship at the site, and attend shop inspection and manufacturing tests in accordance with the specifications;
- Modify the designs, technical specifications and drawings, relevant calculations and cost estimates as may be necessary in accordance with the actual site conditions, and issue variation orders (including necessary actions in relation to the works performed by other contractors working for other projects, if any);
- Perform the inspection of the works, including Test on Completion, and to issue certificates such as Taking Over Certificate, and Performance Certificate as specified in the contract;

7.1.4 Defect notification period

Defect notification period is set after the completion of the construction works.
According to Sub-Clauses 11 of FIDIC, the Contractor is still under the obligation to carry out any work which becomes instructed by the Engineer or Employer, to the extent that a defect occurs which is or is not attributable to the Contractor.
Instead civil law practitioners often assume that the Defects Notification Period replaces the legal defects liability according to their law, which is an incorrect assumption. The legal defects liability only starts after acceptance of the Works which will happen when the Engineer issues the Performance Certificate

7.2 Organizational Structure for Implementation and Maintenance

7.2.1 Organization of RDA

Source: Road Development Authority Annual Report 2017.

(1) Role of Organization

The RDA is the premier highway authority in the country, who is responsible for the maintenance and development of the National Highway Network. This includes the trunk (A Class) roads, main (B Class) roads and expressways and the planning, design and construction of new highways, bridges and expressways to augment the existing road network.

(2) Vision

To be valued as the premier national institution of multi-disciplinary excellence in highway engineering, which meets the community's expectations by providing an excellent national highway network

(3) Mission

As the premier national organization of the road sector, to provide an adequate and efficient network of national highways, to ensure mobility and accessibility at an acceptable level of safety and comfort, in an environment friendly manner, for the movement of people and goods paving way for the socio-economic development of the nation.

(4) Goals and Objectives (9 items)
- Achieve an adequate national highway network;

- Achieve an acceptable level of mobility in the national highway network through;
- Maintaining the roads at an acceptable condition;
- Provide a high mobility expressway network;
- Take measures to reduce road user cost;
- Improve road safety in the national highway network;
- Ensure protection of the environment in all its activities;
- Ensure efficient utilization of assets and investments;
- Promote organizational development to enhance overall performance of RDA; and
- Assist in the development of the local road construction industry.

(5) Organization

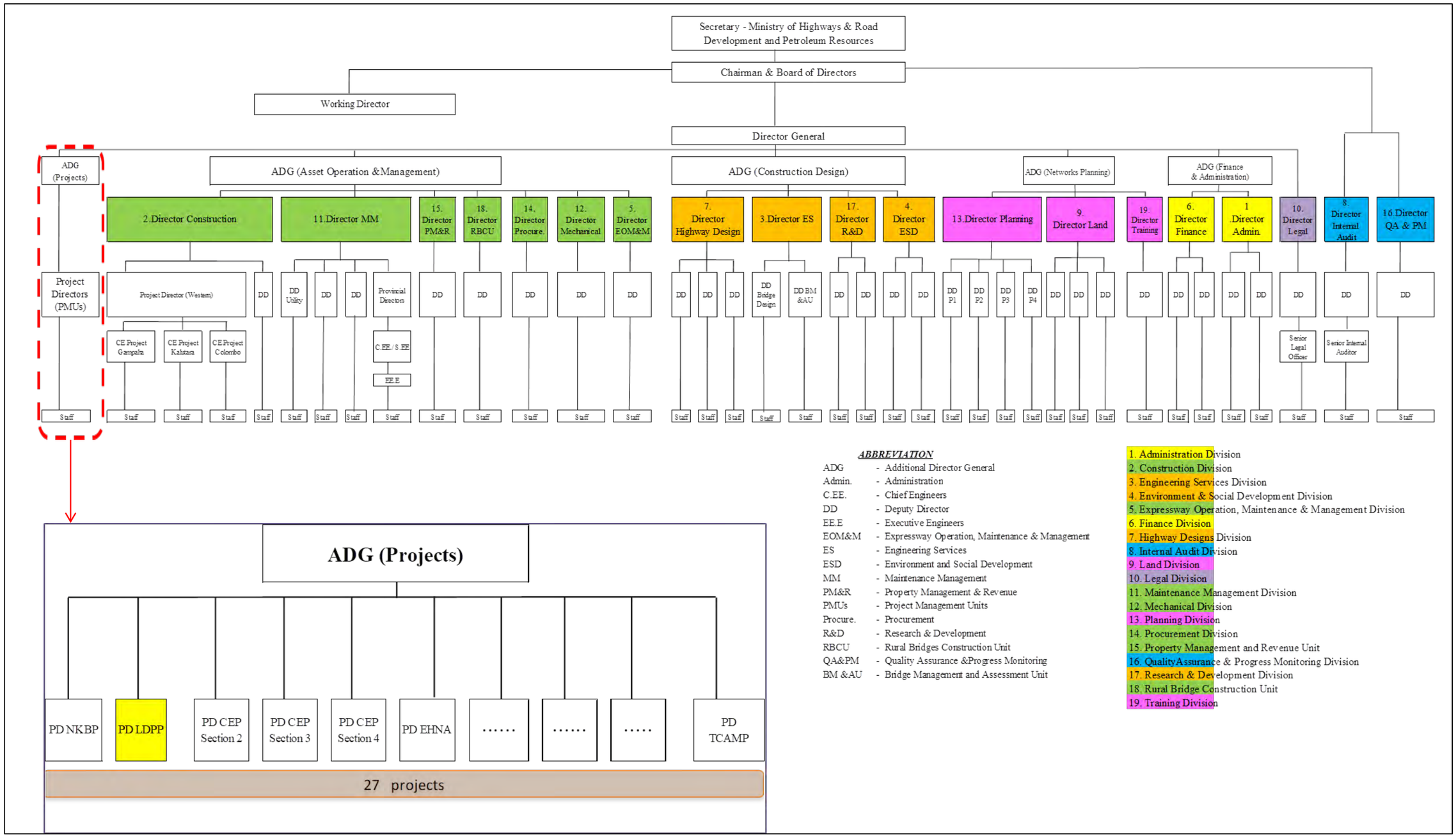
The RDA is composed of the Chairman & Board of Directors (17) under the Ministry of Highways and Road Development and Petroleum Resources (MOHRDPRD). Please see **Figure 7.2.1** for the RDA Organization Structure. The number of the employees is summarized in **Table 7.2.1**.

The RDA is supervised by the Secretary of the Ministry of Highways and Road Development and Petroleum Resources (MOHRDPRD). According to the Constitution of the Democratic Socialist Republic of Sri Lanka Revised 2015 Chapter VIII THE EXECUTIVE THE CABINET OF MINISTERS 52. Secretaries to Ministries, "the Secretary to a Ministry shall, subject to the direction and control of his Minister, exercise supervision over the departments of government and other institutions in charge of the Minister".

Table 7.2.1 Number of Employees of RDA

No.	Category of Employees	Number Approved Cadre 2107
1	Senior management service	88
2	Engineering service	669
3	Administrative officer's service	19
4	Information technology service	19
5	Accountants service	29
6	Legal officers service	6
7	Junior administrative service	47
8	Account / Audit assistant's service	70
9	Associate officer's service	78
10	Technical Service - I	103
11	Technical Service - II	952
Extra service		
12	Clerical and Allied Service	1,753
13	Supportive staff	2,550
Sub-total		**6,383**
14	Labor (Permanent)	4,024
15	Labor (Casual)	
Total		**10,407**

Source: Road Development Authority Annual Report, 2017



Source: JICA Survey Team

Figure 7.2.1 Organization Structure of RDA

(6) Financial status of RDA

The RDAs annual budget in 2017 was LKR 202,648 million in total. The national budget is LKR 55,775 million, approximately 25% of the annual budget, and the 75% was financed by public development assistance through international organizations as shown in in **Table 7.2.2**. A Total amount of LKR 2,048 million, about 1% of the annual budget, was allocated for the activities of natural disaster affected road rehabilitation as shown in **Table 7.2.3**. The allocation of expenses of LDPP-1 was LKR 1,548 million, occupying 75% of the amount for disaster prevention projects, and the expenditure was LKR 1,353 million. The financial performances from 2011 to 2017 are summarized in **Table 7.2.4**.

Table 7.2.2 Annual Revenue of RDA for the year 2017

Revenue	Amount (M LKR)
Domestic Funds (DF)	55,775
Foreign Aid Loan (FAL)	128,132
Reimbursable Foreign Aid Loan (RFAL)	112
Foreign Aid related Domestic Funds (FARDF)	18,629
Total	**202,648**

Source: Annual Report (2017)

Table 7.2.3 Financial Performance of RDA for the year 2017

Activities	Allocation (M LKR)	Expenditure (M LKR)	Financial Performance (%)
Expressways Development	82,984	79,429	95.72
Highways Development	80,994	76,589	94.56
Widening and Improvement of Roads	10,737	9,212	85.79
Construction of Bridges and Flyovers	19,774	17,557	88.79
Natural Disaster Affected Roads Rehabilitation	2,048	1,353	66.07
Instructional Support	6,110	6,109	99.98
Total	**202,648**	**190,249**	**93.88**

Source: Annual Report (2017)

Table 7.2.4 Financial Performances from 2011 to 2017

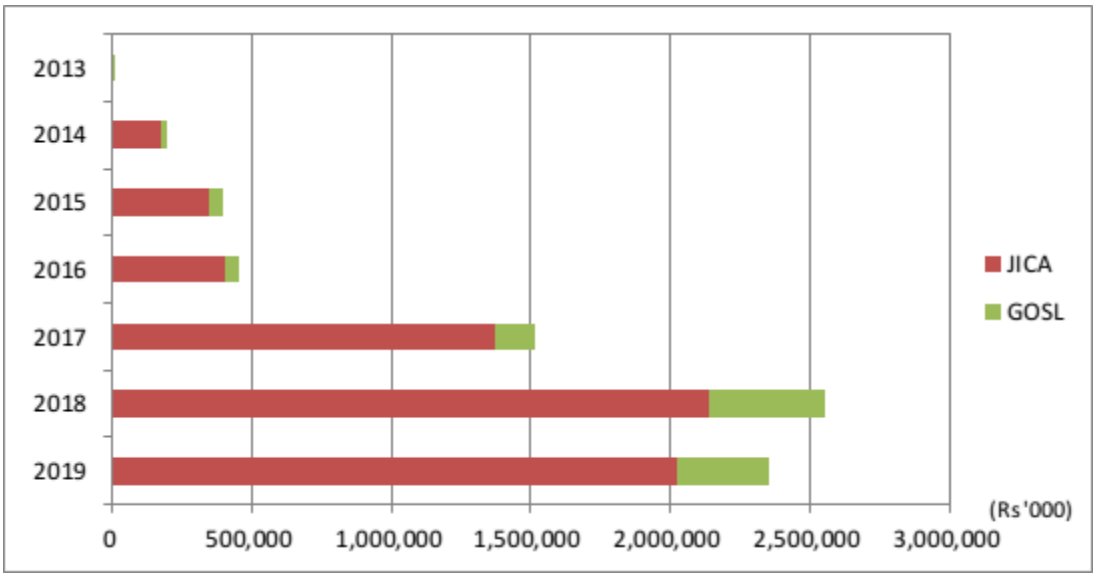
	Unit	2011	2012	2013	2014	2015	2016	2017
Total Funds	LKR in Million	N/A	N/A	N/A	N/A	191,214	171,989	202,648
Equity	LKR in Million	3,109	69,335	124,553	170.634	160,410	208,725	204,813
Total Assets	LKR in Million	14,361	96,830	178,670	305,966	318,685	378,180	413,094
Equity Ratio	%	21.6	71.6	69.7	55.8	50.7	55.19	49.58
Current asset	LKR in Million	12,551	15,365	16,505	25,615	25,441	37,620	48,082
Current Liabilities	LKR in Million	17,033	18,535	16,429	22,898	26,296	35,820	55,204
Current Ratio	%	73.7	82.9	100.5	111.9	96.0	105.0	87.1

Source: Annual Report (2014~2017), arranged by the JICA Survey Team

The annual budget of RDA has ranged from LKR 170-200 billion since 2015, with an equity ratio (%) of around 50% and a current ratio (%) of around 87-110%.

The operation of RDA has been stable financially. In addition, the RDA has a steady income from highway usage fees and road advertising billboards exceeding LKR 7,000 million from 2016 to 2017. These have been contributing to the stabilization of RDAs finances.

The expenditure of LDPP-1 increased in accordance with the progress of the construction as shown in **Figure 7.2.2**.



Source: RDA data, JICA Survey Team arranged
Note: The amount of 2019 is the data as of almost half of the year.

Figure 7.2.2 Annual Expenditure of LDPP-1

(7) Accounting department and its accounting management capacity

The RDA has a Finance Division and the "Final Accounts Unit of the Finance Division" is responsible for preparing and submitting the monthly accounts, annual financial statements, and other financial information to the Management and Board of Directors. This unit is also responsible for maintaining general ledger accounts by obtaining related information from the regional unit accounts and other functional units in the Finance Division" (RDA Annual Report, 2016).

The RDA has set up an internal audit function for each project and local office. Their performance of the Internal Audit Function is carried out under the Internal Audit Division under the Chairman of the RDA. The internal audit division is headed by a Director who is assisted by the deputy director, internal auditors, audit officers, technical officers, and supporting staff.

An internal auditor is dispatched from the supervisory authority of the MOHRDPRD to the office of each accounting unit, such as DRA-PMU, and audits account of the project. The RDAs accounting ability could keep above a certain level by employing this mechanism.

(8) Technical level and management capacity of the counterpart (including training and training system)

There is no objective report for the technical level and management capacity of the RDA. However, the highway network has been steadily designed and constructed by utilizing funds from other countries and the extension has been utilized. As for disaster prevention projects, the World Bank Fund on the Climate Resilience Improvement Project (CLIP) and JICAs Landslide Disaster Protection Project (LDPP) of the National Road Network have been implemented and operated in cooperation with other specialized organizations (NBRO). Therefore, the technical level of RDA has been maintained. The O&M ability is important for site managers such as LDPPs Project Engineer. They do not have sufficient construction experience for disaster prevention measures. It is necessary to continue training in the future.

Regarding the training and training system, the Training Division within the RDA functions as a point of contact for creating training opportunities involving external organizations and training in third world

countries. Almost all trainings related to disaster prevention projects are carried out in each project. The Training Division does not record all of the management of disaster prevention training records for each project.

(9) Experience and performance of implementing similar projects by the counterpart

The following two projects (**Table 7.2.5**) including the LDPP are similar disaster prevention construction project implemented in the past, both of which were operated with international funds.

Table 7.2.5 Landslide Disaster Management Project including Landslide Prevention Works of RDA

Name of Project	Project Cost	Donor	Year
Climate Resilience Improvement Project (CRIP)	Appx. JPY 15 Billion (RDA: JPY 1.12 Billion)	WB	2014~2019
Landslide Disaster Protection Project of The National Road Network (LDPP-1)	Appx. JPY 10 Billion (Loan + GOSL)	JICA	2013~2019

Source: JICA Survey Team

The Climate Resilience Improvement Project (CRIP) is a disaster prevention related project that has been implemented since 2014 by the World Bank fund in response to climate change. Wide-area disaster prevention construction is underway and the total budget until 2019 exceeds USD 150 million. The RDA has established a project team specializing in CRIP, which is planning, ordering, and construction supervision for implementation.

Besides this, although not directly related to RDA, Reduction of Landslide Vulnerability by Mitigation Measures (RLVMM) is scheduled to be implemented as a disaster prevention project of the AIIB fund from 2019 and consultant procurement was recently implemented. The purpose of this project is to prevent slope disasters at about 150 locations (railway maintenance), to develop land for housing in low-income communities, and to improve infrastructure. The NBRO will organize the PMU and implement the disaster prevention work for this project. The total project cost is expected to be about JPY 2 billion. As mentioned above, the NBRO participates as a technical core member in any of the projects, and performs monitoring, countermeasure design, and project planning and management.

7.2.2 Organization of NBRO

(1) Responsibility

The functions of NBRO are to:

- Engage in applied research and development work related to disaster risk reduction and safe built environment;
- Play the role as the national focal point for landslides and geo-hazards;
- Carry out research and provide guidelines on planning and development of sustainable housing and safe human settlements in disaster-prone areas and in areas endangered with climatically varying conditions;
- Carry out research & development activities on the utilization of areas with technologically problematic soils;
- Improve alternative sources of building materials, products and technologies;
- Provide standard reports on buildings and construction, damage assessment and technical solutions;
- Provide information, educational programmes, training and technological services by specialized resource persons; and
- Undertake testing and consultancy assignments and conducting research projects on geology, geo-

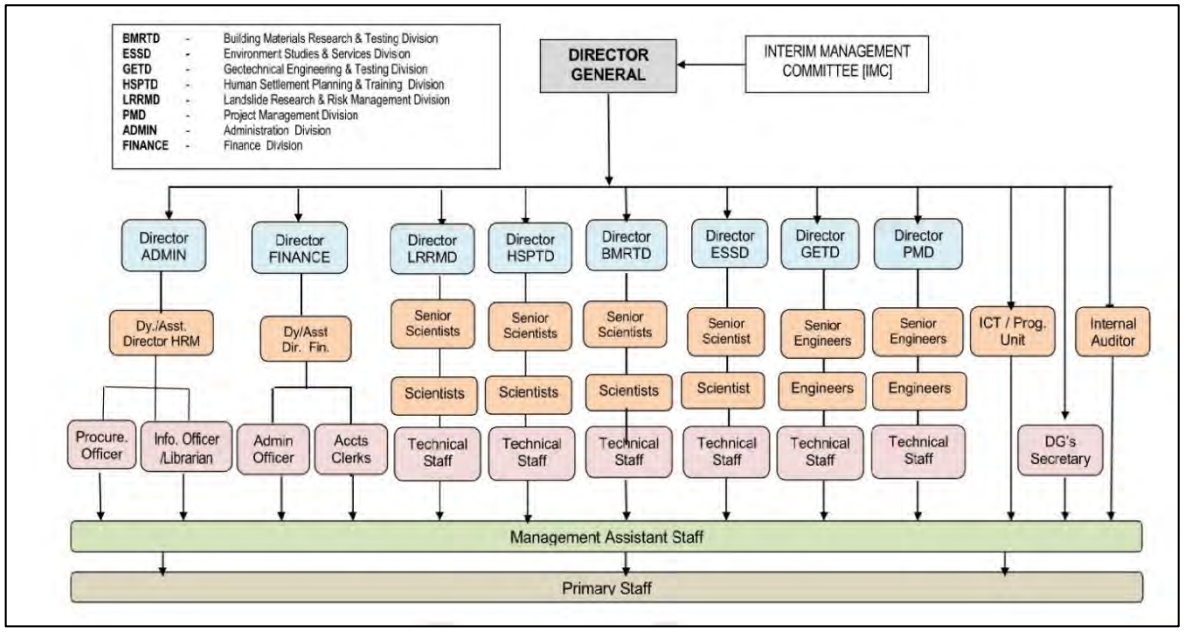
technical engineering, building materials, structural engineering and building services, project management, environmental management, human settlements planning and in areas relevant to carrying out the objectives of the organisation.

Source: NBRO homepage
http://www.nbro.gov.lk/index.php?option=com_content&view=article&id=12&Itemid=166&lang=en

(2) Organization

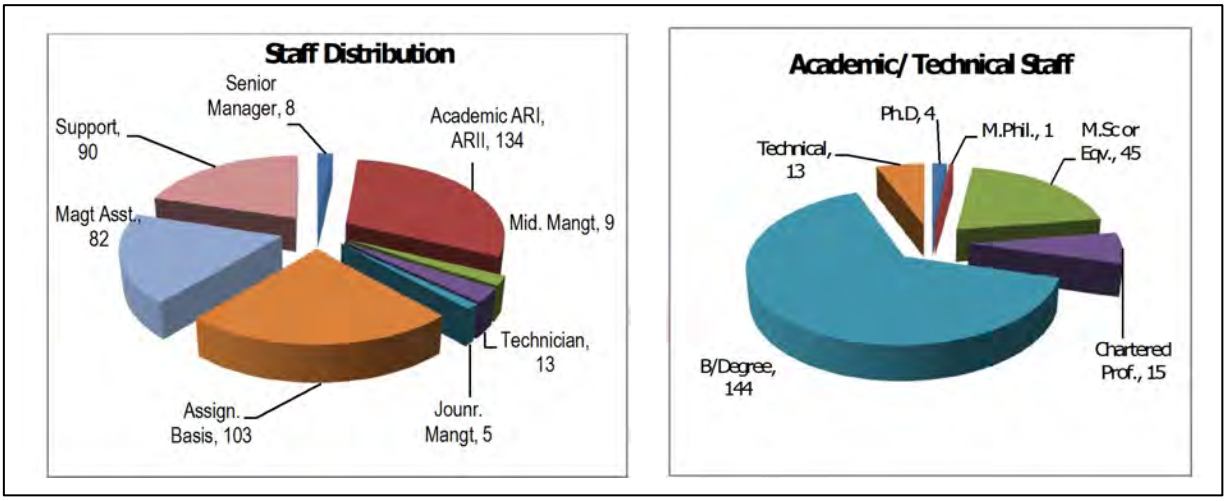
The NBRO is composed of eight divisions under the Director General and 10 district offices. There are 444 staffs in total and 222 academic/technical staffs among them. Landslide Research & Risk Management Division (LRRMD) and Geotechnical Engineering & Testing Division (GETD) are main sectors related to sediment disaster management.

The organization structure and staff distribution of NBRO are shown in **Figure 7.2.3** and **Figure 7.2.4** respectively.



Source: NBRO Annual Report (2018)

Figure 7.2.3 Organization Structure of NBRO



Source: NBRO Annual Report (2018)

Figure 7.2.4 Staff Distribution of NBRO

7.2.3 Project Implementation Structure

(1) Project Management Unit for LDPP-2

1) Member composition (position, number of persons, TOR of each position, experience, and results)

Regarding the construction of the LDPP-2 implementation system, the organizational chart (draft) shown in **Figure 7.2.5** was examined with reference to the LDPP-1 system. The necessary staff for the PMU is shown in **Table 7.2.6**. The PMU members should include technical experts of NBRO to receive efficiently and timely technical advices of landslide protection works for the LDPP-2. The good corroboration between RDA and NBRO is a key to success the Project. The NBRO members in PMU are necessary to increase as shown in **Table 7.2.6**.

Table 7.2.6 Main Staff of RDA-PMU

Position	Number	Organization	Clarification etc.
Project Manager	1	RDA	Senior Engineer、practical experience higher than a deputy Project Director
Deputy Project Director	1	RDA	Senior Engineer、practical experience higher than a Project Engineer
Senior Project Engineer	2	RDA	Senior Project Engineer 5 years of work experience
Project Engineer	4	RDA	Senior Engineer 5 years of work experience
Engineer	4	RDA	Engineer, Staff of LMMD
Internal Auditor	1	Ministry	Work experience of Auditor
Project Accountant	1	Ministry	Work experience of Accountant
Director Technical	1	NBRO	Senior Geotechnical Engineer Work experience of Director Technical
Engineering Geologist/Geotechnical Engineer	2	NBRO	Senior Geotechnical Engineer 5 years of work experience
Geologist/Engineer	4	NBRO	Geotechnical Engineer

Source: JICA Survey Team

The project implement structure for LDPP-2 needs to be considered the following aspects:

- Project scale and the number of sites of LDPP-2 are expected to be almost double that of LDPP-1. For the LDPP-2, project engineers and engineers, who are expected to be active in the field;
- Key personnel assigned to the position are necessary to be qualified staffs as engineers, geotechnical engineers or geologists instead of technical officers assigned in LDPP-1, since technical officers are usually temporally employees and they are difficult to obtain necessary technical skills continuously and systematically; and
- RDA newly intends to establish LMMD which has responsibility for the operation and maintenance of landslide measures, and timely and efficient technical training for the LMMD staff are expected to be done in the Project by the Consultant.

2) Personnel employment plan

The above system should start from the construction supervision stage when the consultant team operates in the field.

Considering the coordination with related organizations involved in construction approval, local responses related to the site and the environment, technology transfer in design work, etc., are considered appropriate to be set as shown in **Table 7.2.7**.

Table 7.2.7 Expected MM schedule of RDA-PMU (Tentative)

Position	Number of Persons	Institution	Stage
Project Director	1	RDA	All
Deputy Project Director	1	RDA	All
Senior Project Engineer	2	RDA	All
Project Engineer	4	RDA	All
Engineer	4	RDA	D/D, C/S
Internal Auditor	1	Ministry	All
Project Accountant	1	Ministry	All
Deputy Project Director	1	NBRO	All
Engineering Geologist/Geotechnical Engineer	2	NBRO	All
Geologist/Engineer	4	NBRO	D/D, C/S

Source: JICA Survey Team

3) Discussion on decision-making and administrative management system

It is thought that the Project will function according to the framework of LDPP-1 as it is basically for decision-making and administrative management systems in PMU-based organizations. Projects of RDA have been implemented within the PMU as a result of project directors making decisions as an organization under the auspices of key members. No information has been reported that a major failure has occurred in this system.

Regarding the administrative management system, receiving technical supports from NBRO, RDA carries out geological surveys, monitoring, disaster prevention design, and accounting and auditing operations. The accounting of the projects is properly reported to RDA headquarters and Project Steering Committee (PSC). Therefore, the technical quality management and accounting administrative procedures are being implemented accurately. According to lessons of LDPP-1, there were some items that seemed to have insufficient communication between the PMU and the consultant team in LDPP-1. Close communication between PMU and the Consultant team in the field is required for the Project and information sharing is important to facilitate the Project. In particular, the Consultant's opinion should be actively incorporated during the technical examination of the pre-qualification and technical evaluation of contractors for tendering.

4) Expedience of communication with relevant organizations and supervisory ministries

During the LDPP-1, meetings between PMU and local government and relevant organizations were sometimes required to facilitate the construction works of countermeasures. RDA-PMU is expected to expedite the good communications with relevant organizations during the Project. In addition, coordination with power utilities, water utilities, public transport, and various communication infrastructure organizations is also necessary for project implementation. RDA-PMU should promote a mutual understanding with the local community for a smooth project operation after an accurate information exchange and communication within relevant organization.

(2) Composition of PSC members necessary for coordination of project implementation

The Secretary to the Ministry is in a position to oversee the Project regarding the contact system with the supervisory ministry. Progress of the Project will be regularly reported at PSC. The letter "Cadre and Remuneration Management of Project" (15/03/2019) issued by the Ministry of Finance describes the requirements for the establishment of PSC, members, frequency of implementation, and participant compensation. When a problem occurs at the site level, a solution is discussed in the PSC.

In LDPP-1, the PSC has been held every two months to share and coordinate information among

concerned parties. The participants and institutions of LDPP-1are shown in **Table 7.2.8**.

Table 7.2.8 Participating Members of PSC of LDPP-1（28th May 2019）

Institution		Position	Number of Attendance
MOHRDPRD		Secretary, Additional Secretary, Director (Planning and Programme), Chief Financial Officer	6
Ministry of Finance	PMM	Asst Director	Ministry of Finance
	ERD	Asst Director	1
RDA/PMU		Director General, Project Director, and Senior Geologist	3
JICA		Project Specialist	1
Consultant		Team Leader, Deputy Team Leader, Senior Contract Specialist, and Resident Engineer	5
Contractor		General Manager, Deputy General Manager, and Project Manager	4
		Total Number of Attendees	21

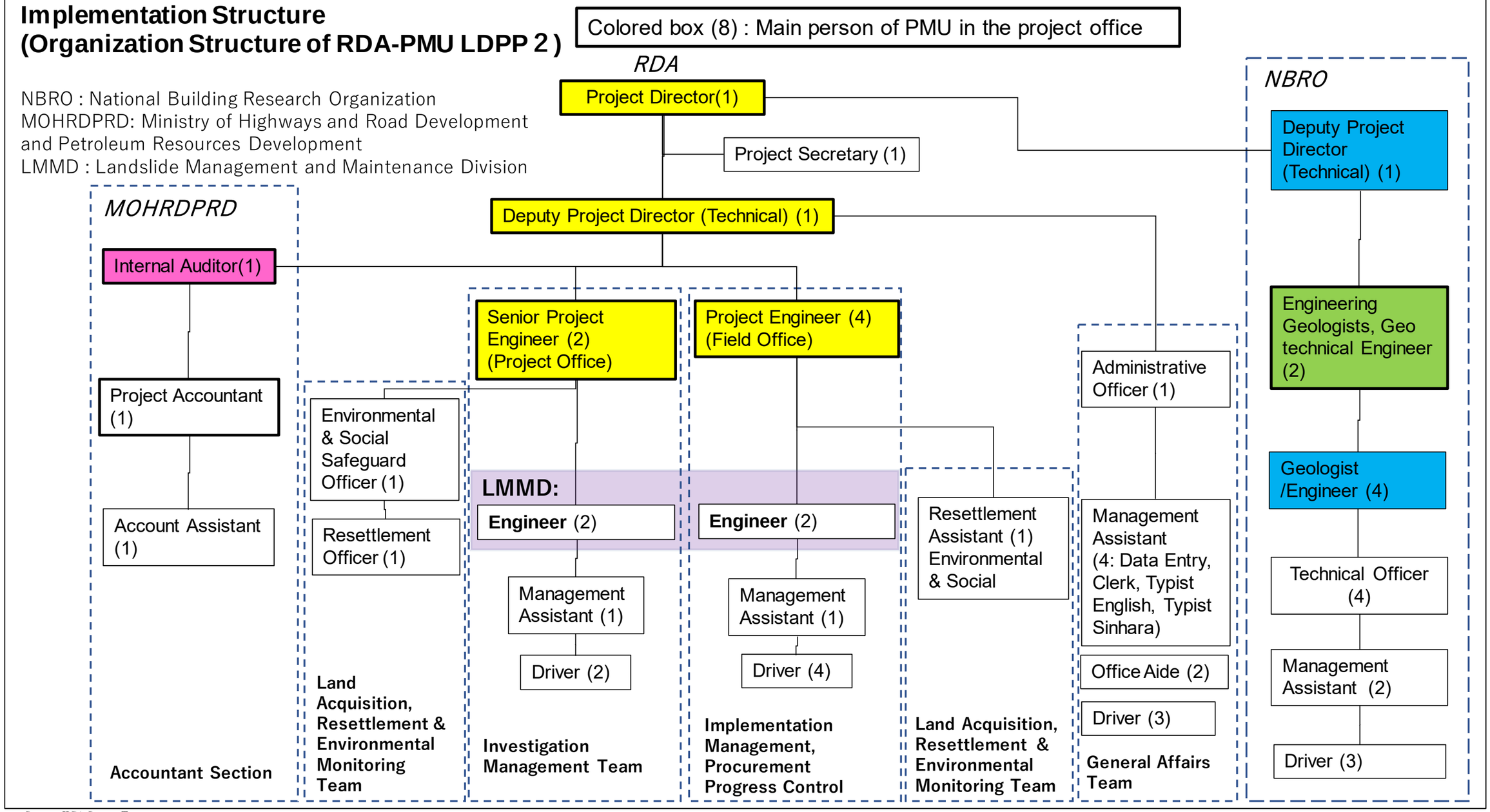
Source: Handout document of PSC May 2019

Six members, including three secretary members from MOHRDPRD and RDA as the host organization, participate as members. Their functions as the supervisory authority is considered to be working effectively. In addition, attendance from two organizations of the Ministry of Finance is fixed. Participation from PMM, ERD is a letter “Cadre and Remuneration Management of Project” issued by the Ministry of Finance (15/03/2019).

A total of 12 participants from RDA-PMU, consultant team, and contractor has attended in the PSC. The consultant team was responsible for compiling the materials of LDPP-1 and the RDA-PMU provided explanations. Budget expenditure, construction progress and topics related to the management of the Project were mainly discussed in the PSC. The PSC of LDPP-2 is considered to function effectively. LDPP-2 will also inherit this PSC framework.

Implementation Structure
(Organization Structure of RDA-PMU LDPP 2)

NBRO : National Building Research Organization
MOHRDPRD: Ministry of Highways and Road Development and Petroleum Resources Development
LMMD : Landslide Management and Maintenance Division



Source: JICA Survey Team

Figure 7.2.5 Recommended Organizational Structure of the RDA-PMU (Draft)

7.3 Implementation Schedule

7.3.1 Implementation Schedule for Overall Management

(1) Overall Implementation Schedule

The total project period for implementation of LDPP-2 will be 98 months including defect notification period. The implementation schedule expected is as shown in **Table 7.3.1** Implementation Schedule Expected

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Table 7.3.1 Implementation Schedule Expected

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The overall implementation schedule is shown in **Figure 7.3.1**. The detailed implementation schedule for each lot is given in the following sections. In order to expedite prompt project commencement and smoothly execute the Project, the following must be considered:

1) Detailed Design Stage
- Scheduling enough time to design countermeasures
- Employing engineers with a lot of experiences in developing countermeasures
- Geological investigations in the early stage and monitoring of landslides for the detailed design
- Since heavy rainfall possibly triggers landslide and the relationships between rainfall and movement of landslides are important to analyse landslide mechanism, monitoring of landslide is recommended to continue at least two years for obtaining sufficient data of deformation of landslide and rainfall especially during rainy season for the detailed design of countermeasures.

2) Construction Stage
- Scheduling enough time for construction works
- Despatching inspectors at each site for quality control, management of schedule and safety control
- Establishing the management system in RDA-PMU to control construction sites.
- Appropriate staffing and office establishment to manage construction sites

3) Operation and Maintenance Stage
- Capacity development of LDDM
- Taking budgetary steps for the O&M of slope protection

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Source: JICA Survey Team

Figure 7.3.1 Detailed Implementation Schedule

(2) Overall Project Management Activities

For implementation activities to run efficiently and smoothly, the Project plans to execute several activities for overall project management facilitation as mentioned below.

1) Pre-arrangement
- Establishment of implementation structures
- Orientation of the Project and team building for RDA-PMU

2) Procurement of the Consultant
- Tender process for the Consultant
- Contract of the Consultant

3) Detailed Design Stage

4) Tendering Stage of the Contractor
- Pre-qualification of the Contractor for each package
- Procurement of the Contractor for each package

5) Construction Stage

6) Defect Notification Period

7.3.2 Implementation Schedule of Each Stage

(1) Procurement of the Consultant

The Consultant will be procured in accordance with the Guidelines for the Employment of Consultant under Japanese ODA Loan (April 2012). Procedure of procurements of the Consultant and their schedule are shown in **Table 7.3.2**.

Table 7.3.2 Procedure and Expected Period of Procurement of the Consultant

No.	Items	Responsibility	Expected Period (Month)
1	Preparation of RFP	Owner (RDA)	1.0
2	Review and concurrence by JICA	JICA	0.5
3	Advertising	Owner (RDA)	2.0
4	Technical bid evaluation	Owner (RDA)	1.0
5	Review and concurrence by JICA	JICA	0.5
6	Price bid evaluation	Owner (RDA)	1.0
7	Review and concurrence by JICA	JICA	0.5
8	Contract negotiation	Owner (RDA	1.0
9	Review and concurrence by JICA	JICA	0.5
	Total		**8.0**

Source: JICA Survey Team

(2) Detailed Design Stage

The technical specifications of investigations will be prepared by the Consultant procured above through the detailed design of the structural measures against landslides.

The Procedure of detailed design stage and their schedule are shown in **Table 7.3.3**.

Table 7.3.3 Procedure and Expected Period of the Detailed Design Stage

No.	Items	Expected Period (Month)
1	Investigation, monitoring and analysis	24.0
2	Detailed design	21.0

Source: JICA Survey Team

(3) Procurement of the Contractor

Tender documents will be prepared for each contract package of the Project. Reflated guidelines are the Guidelines for Procurement under Japanese ODA Loans (April 2012), Standard Bidding Documents

(Works), Evaluation Guide for Prequalification and Bidding under JICA ODA Loans (June 2010). Procedure of tender and their expected schedule are shown in **Table 7.3.4**.

Table 7.3.4 Procedure and Expected Period for Tendering

No.	Items	Implementation (by)	Expected Period (month)
1	**Prequalification**		
1.1	Preparation of Prequalification	Owner (RDA) assisted by the Consultant	1.0
1.2	Review and Concurrence	JICA	0.5
1.3	Prequalification Advertising	Owner (RDA)	1.5
1.4	Evaluation of Prequalification	Owner (RDA) assisted by the Consultant	1.0
1.5	Review and Concurrence	JICA	0.5
2	**Tender Stage**		
2.1	Preparation of Bidding Documents	Owner (RDA) assisted by the Consultant	2.0
2.2	Review and Concurrence	JICA	0.5
2.3	Advertising	Owner (RDA)	3.0
2.4	Technical Bid Evaluation	Owner (RDA) assisted by the Consultant	1.0
2.5	Review and Concurrence	JICA	0.5
2.6	Price Bid Evaluation	Owner (RDA) assisted by the Consultant	1.0
2.7	Review and Concurrence	JICA	0.5
2.8	Contract Negotiation and Contracting	Owner (RDA) assisted by the Consultant	1.0
2.9	Review and Concurrence	JICA	0.5

Source: JICA Survey Team

(4) Construction Stage

The procedure for construction stage is shown in **Table 7.3.5**.

Table 7.3.5 Items to be Carried Out in the Construction Stage

No.	Items
1	Kick-off meeting with Contractor
2	Checking methodology and implementation plan submitted by the Contractor
3	Construction Supervision
3.1	Supervision and management for schedule, cost, scope, quality, safety, environmental, documentation, inspection and testing, contract and communication
3.2	Reconfirmation of the compliance with the approved methodology and implementation plan
3.3	Inspection to equipment and materials
3.4	Project cost management
3.5	Update of project schedule
3.6	Daily, weekly, monthly meeting and report
3.7	Update of reimbursement schedule
3.8	Update of the project progress and completion of the landslide disaster prevention works
3.9	Quantity survey
3.10	Settlement of claims from the contractor
3.11	Environmental monitoring
3.12	Reporting

Source: JICA Survey Team

(5) Defect Notification Period

The defect notification period will be 12 months after the completion of the construction works.

7.4 Operation and Maintenance Plan

7.4.1 Operation and Maintenance Structure

The RDA is responsible for maintaining the function of disaster prevention structures as a facility for maintaining road functions. Therefore, it is necessary to periodically check disaster prevention structures and evaluate their soundness. In addition, depending on the evaluation results, repairs, and repair work will be carried out to maintain the functions. The NBRO is responsible for checking the safety of the

site, where disaster prevention works are carried out. The site inspection method is to collect, organize, and analyse monitoring data for landslide moving. In addition, NBRO provides advice and guidance to RDA from a professional perspective. Moreover, it is possible to determine the effectiveness of countermeasure work by continuing the monitoring work of landslide areas after construction. The above inspection and evaluation results are data closely related to maintaining road safety. It is also important for RDA/NBRO to technically upgrade and share the information. The expected related institution for operation and maintenance of the Project and their responsibility are summarised in **Table 7.4.1**.

Table 7.4.1 Related Institutions and Operation and Maintenance Works

Institution	Maintenance work
RDA	Inspection and soundness assessment of landslide countermeasures Maintenance and repair work of landslide countermeasures
NBRO	Monitoring and assessment of landslide at the project site Maintenance of equipment for monitoring landslide

Source: JICA Survey Team

7.4.2 Examination of Necessary Operation and Maintenance Costs and Funding Sources

RDA has a responsibility for the operation and maintenance (O&M) of road networks. RDA is expected to prepare necessary budget for the O&M. Although LMMD is intended to be established, the funding sources for the O&M after the defect notification period of LDPP-1 still remain undecided. Maintenance costs of inspection works for one year (regular monitoring) after the defect notification period of LDPP-1 are estimated as shown in **Table 7.4.2**. LDPP-2 also require budgetary preparation for the O&M stage. RDA should consider allocating these necessary budgets for the O&M activities. Details of operation and maintenance costs and repair and replacement cost for LDPP-2 are discussed in Clause 9.6.

Table 7.4.2 Estimated Maintenance Costs for Inspection Works required for one year after Defect Notification Period of LDPP-1

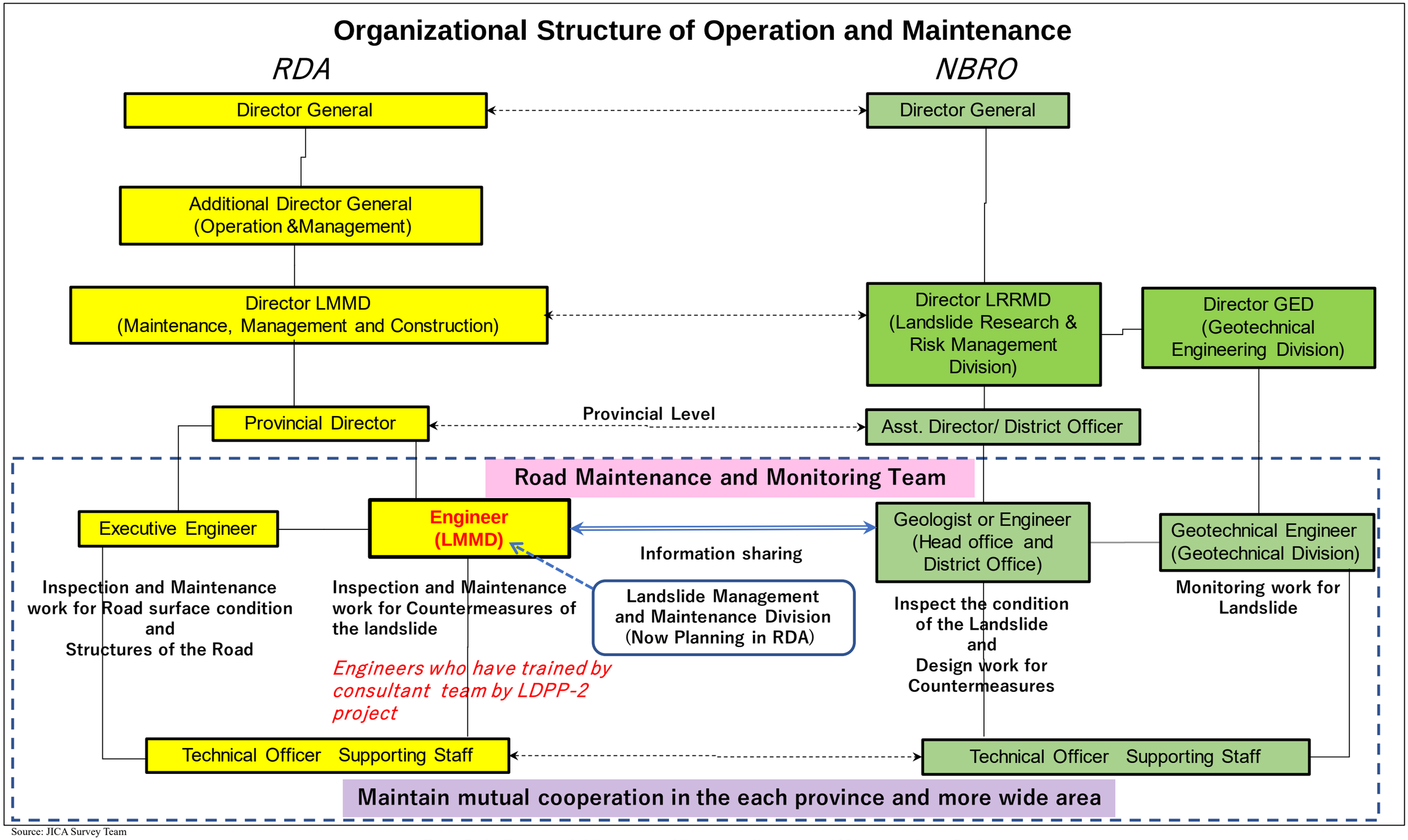
Institution	Party / Frequency	Estimated Budget (Direct cost)	Remarks
RDA	2 person × 2 party	LKR 70,000 ×2×2×12month = LKR 3,360,000	Team from LMMD Annual work
NBRO	Once in a month	Monitoring and Reporting for 1L.S = LKR 7,481,000	Cost estimation from NBRO

Source: JICA Survey Team

7.4.3 System of operation and maintenance department

(1) Organizational Structure for O&M

As of August 2019, RDA intends to establish LMMD for the function of O&M of disaster prevention structures. It is under consideration to install two units in the UVA and Central Province and to operate under the control of each provincial director. **Figure 7.4.1** shows recommended organization structure for the O&M stage.



Source: JICA Survey Team

Figure 7.4.1 Recommended Organizational Structure of Operation and Maintenance Stage (Draft)

(2) Staffing

The RDAs L MMD Division is in the process of selecting members. However, it has not been confirmed at this time its organizational size and whether it will shift regular employment members or hire people as a project unit (or both). In the planning of LDPP-2, there will be a fixed engineer-class staff to each package. After being dispatched from the LMMD to a consultant team, the staff is to learn the design, construction, and maintenance techniques.

The engineer will take charge of operation and maintenance management for the future.

(3) Responsibility of LMMD

As mentioned in (b) above, LDPP-2 aims to have an assignment of permanent RDA staff from LMMD, receive technical transfer from the consultant team, and be able to provide guidance and supervision within RDA for the future. Therefore, hiring outside personnel will be postponed until the skill level of the person in charge of the maintenance of LMMD exceeds a certain level and the work volume remains stable. The following conditions are desirable for new employment due to the lack of personnel. "Engineer of Operation and Maintenance of Landslide Countermeasures" are recommended to be professionally qualified B.Sc./Eng. or its equivalent with a minimum of five years of experience as Construction Engineer or Landslide Engineer.

Personnel expenses should be paid in accordance with the rules of RDA. A salary of LKR 70,000/month, which is about to be equivalent to the PS4 Category D Engineer (lowest class of Engineer), will be necessary.

(4) Training plan for LMMD members

Regular engineers will have training at the practical work using the OJT method to acquire many skills. For efficient capacity development of LMMD staff, it is desirable that the LMMD staffs closely work together with the Engineer through the whole Project period. During the construction stage, the LMMD staff are recommended to stay at the site office with the Engineer to obtain necessary skills through on the job training. The LMMD staff will be required to continuously work for the Project, and it is desirable to consider giving them the necessary titles and responsibilities for stable employment of LMMD staff.

(5) Standards and manuals for operation and maintenance

Regarding the standards and manuals related to the maintenance, consultant teams and construction companies have been prepared for several items in LDPP-1 and TCLMP. Their contents have not yet been released. LDPP-2 will consider using the above manual for training and practice based on brushing up. The manuals related to the maintenance and management of disaster prevention structures assumed at the present time are as follows:

- Diagnosis and repair manual for concrete structure
- Repair manual of rock net
- Cleaning manual for groundwater drain boring holes
- Ground anchor tension, anchorage, and test manual

(6) Status of possession of materials and equipment

Several materials are scheduled to be supplied to RDA from LDPP-1 for maintenance and management, but since the main construction is still ongoing, the handover has not yet been completed. The following

list includes the equipment expected to be provided, but the specifications and quantity have not been confirmed.

- Tools for determining concrete strength (Schmidt hammer, etc.)
- A set of tools for repairing the lock net and replacing the wire mesh
- A set of compressors, nozzle, etc., for groundwater drain boring cleaning
- Ground anchor tension fixing jack, test gauge, etc.

7.5 Procurement Plan and Schedule

7.5.1 Procurement Methods

Procurement of works, goods, and services financed by JICA loans will be carried out in accordance with the "Guidelines for Procurement under Japanese ODA Loans, April 2012". In most cases, international competitive bidding (ICB) shall be followed regarding the procurement of goods and services for the project. However, if it is not attractive to invite foreign firms by nature or scope, the procurement procedures generally used in Sri Lanka as local competitive bidding (LCB) could be applied.

In Sri Lanka, the procurement method is principally based on the "Standard Bidding Document (SBD) Procurement of Works, Second Edition January 2007" prepared by the Institute for Construction Training and Development (ICTAD). The SBD document, largely based on the World Bank Standard Bidding Document for Small Contract, was prepared for use by both the International Competitive Biddings (ICB) and by the National Competitive Bidders (NCB), according to SBD Procurement of Works. The applicability of the ICTAD SBD for Procurement of Works is shown in **Table 7.5.1**.

Table 7.5.1 Applicability of ICTAD SBD Procurement of Works

ICTAD/SBD /No	Standard Bidding Document	Recommended for use on the Contract (M. LKR)	Remarks
ICTAD/SBD/03	Procurement of Works for Minor Contracts	Up to 10	-
ICTAD/SBD/01	Procurement of Works	10 to 100	For works of higher values, which are not of a complex nature
ICTAD/SBD/02	Procurement of Works for Major Contracts	More than 100	For contracts a lesser value, which are a complex nature
ICTAD/SBD/04	Procurement of Works for Design and Build Contracts		For Works/Contracts where the contractor is responsible for the design and construction of the works on specified approvals obtained from the Employer
ICTAD/SBD/06	Procurement of Works for Shopping Procedure (under preparation)	Up to 5	-
ICTAD/SBD/07	Procurement of Works for Construction Related Plant (under preparation)		Under Preparation For use when procuring construction related plant such as air-condition system, elevators, large generators etc where substantial installation is involved

Source: SBD Procurement of Works ICTAD/SBD/01, Second Edition, January 2007, Page vi,

7.5.2 Tendering Methods

The procedure of the tendering is:

1) Deciding to get pre-qualified bid
2) Programming the bidding process
3) Studying the bidding documents/projects, Specifications, Drawings, Instructions to Bidders, Conditions of Contract, Bonds, checking BOQ with Drawings and Specifications, site inspection

4) Clarification of Bidding documents and pre-bid meetings
5) Decision to bid based on items the above 1), 2) and 3)
6) Collecting and calculating cost information
7) Preparing the estimate
8) Forecasting the cash flow (approximate)
9) Estimator's report
10) Adjudication of bid (risk analysis and mark-up)
11) Review of the bid proposal and final check
12) Bid submission

(reference: Guideline for Effective Construction Management, ICTAD)

7.5.3 Procurement Plan for Consultant Services

- Package of the tender and contract: One package
- Number of procurement body: One consultant
- Period of the contract: 98 months in total
- Main executive body for procurement: RDA-PMU
- TOR preparation: by PMU
- In compliance with: Guidelines for the Employment for Consultants under Japanese ODA Loans, April 2012

7.5.4 Procurement Plan for the Contractor

The bid documents will be prepared by the Consultant in accordance with the "Guidelines for Procurement under Japanese ODA Loans, April 2012". Considering the lessons learnt from LDPP-1, the JICA Survey Team recommend adding the following criteria for the evaluation of bid documents to be submitted by the applicants.

- Detailed requirements including experiences of advanced technology of countermeasures to clarify the capability of the applicants.
- In addition to the taking-over certificate/performance certificate, the specific condition experiences of a sole contractor/a consortium in the past projects of contractors should be confirmed through site inspection or reliable ways (e.g. confirmation of the structures by google earth).

7.6 Safety Management

7.6.1 Construction Safety Issues

Construction safety is the most important and one of the top priority issues especially in landslide projects for the construction of civil works on steep slope. In this Project, the following safety issues are conceived:

1) Most of the identified sediment disasters sites, active or highly potential, may cause local failures and collapses due to cutting and filling as well as other countermeasure execution, and therefore have significant safety risks during construction.
2) Countermeasures for each site generally consist of two or more works or methods, and therefore have safety risks especially when they are planned from the upper slope to the lower slope in terms of construction sequence.
3) Most of the designed countermeasures are to be executed on steep slope with limited access, and

therefore have safety risks, especially when heavy equipment is required.

4) In most of the identified sediment disaster sites, slope excavation and foundation preparation will produce a large amount of excavated materials, and the excavated materials, especially from slopes above the road would have traffic safety risk to the roads during and after excavation.

In general, these safety risks will be studied and clarified at the design stage, and measures to prevent the occurrence of these risks will be made at the construction supervision stage by the consultant team and contractors.

7.6.2 Safety Consideration at Design Stage

The following actions or methods are to be taken at the detailed design stage to avoid any accident during the construction supervision stage in view of the above-mentioned safety issues:

1) Selection of prevention or protection measures,
2) Avoidance of heavy equipment use on steep slope,
3) Construction sequence from upper slope to lower slope,
4) Construction sequence from control measures to constraint measures,
5) Provision of temporary measures for traffic safety, and
6) Effective use of early warning system.

(1) Selection of prevention or protection measures

In selecting countermeasures, prevention or protection measures will be considered in light of the steepness of and access to the source areas, and the distance between the road and the source area. In the case where the source area is on high and steep slope with difficult access, protection measures will be preferentially considered to avoid any accident that would be caused due to construction on steep slope. Instead, protection measures will be designed between the road and the source area on a gentler area.

In Site No. 51 Slope Failure and Site No. 53 Debris Flow, the designed countermeasures consisted of protection measures that are planned on a gentle slopes or areas to protect the rad from further slope failures on the source areas.

(2) Avoidance of heavy equipment use on steep slope

Construction method including the equipment to be used will be studied for the selection of countermeasures so that a designed countermeasure is safely constructed. Some countermeasures on steep slopes, especially when using heavy equipment for construction, have significant safety risks. A basic approach to reduce such safety risks is to select countermeasures or construction methods without the use of heavy equipment. For example, for some individual big unstable rock blocks or boulders on high and steep slopes with a difficult access, the appropriate countermeasures against such rockfalls is to perform simple methods such as scaling, foot protection, and bonding method that can be implemented by manpower or with simple tools and light equipment.

In Site No. 10 to Site No. 12 Rockfalls and Site No. 33 Rockfall, the designed countermeasures include some simple methods, namely, foot protection, bonding method, wire rope method, reinforced earth wall (catch type), etc.

(3) Construction sequence

A safe execution plan for each site will incorporate a) construction sequence from upper slope to lower slope, b) construction sequence from control measures to constraint measures, and c) selection and combination of construction equipment.

Especially, since most of the identified 30 sediment disaster sites are either active or highly potential for further instability, any local excavation for slope cut or foundation preparation may cause local failures and partial instability, thereby posing safety risks to the structures to be constructed and contract workers. The basic approach to reduce such safety risks is to prepare execution plan chiefly with the following construction sequence:

1) Construction sequence for each site is to start from upper slope to lower slope. This will reduce any accidents due to upper slope failure/debris and fallen materials from the upper slope.
2) Construction sequence for each site is to start from control measures, such as horizontal drain boreholes, drainage well, cutting method, and filling method, to constraint measures, such steel pile, ground anchor, soil nailing, rock bolt. It can stop the movement of active landslides or slope failures to precede all control measures, thereby assuring the construction safety of constraint measures, consequently reducing construction safety risk.
3) Most of the identified sites include slope cut or reshaping and combine with slope protection methods such as crib work with ground anchors and crib with rock bolts. Construction procedure for cut slope is to start with rough excavation at the cutting section, followed by shaping and finishing of the slope surface, and the execution of slope protection method or other structures such as crib work with ground anchor, soil nailing, and crib work with rock bolts. This construction procedure will assure stability of the cut slope, thereby reducing the safety risks associated with slope cut.

(4) Provision of temporary measures for traffic safety

To protect the road from excavated materials or fallen materials from the upper slope, temporary measure, e.g., sand bag or fence, is to be placed and provided along the road on the mountain site for almost all of the identified sites. This temporary measure has been incorporated into the design drawings for all sites.

(5) Effective use of early warning system

Some of the identified 30 sites are active and may start movement during the construction period especially in the rainy seasons, and therefore have significant safety risks to contract crews and project team as well as the nearby public and traffic. This Project includes development of early warning system and installation of landslide instruments. With these early warning system and landslide instruments, a warning system related to construction safety will be studied and used to control construction progress in the rainy seasons. **Table 7.6.1** shows an example.

Table 7.6.1 Tentative Standard Values for Early Warning System

Warning Level	Critical Value	Response Related to Construction
Normal	R: Below 10mm/h E: Below 1mm/1h	✓ Keep construction in progress
Attention	R: 10 – 20 mm/h E: 1 – 2 mm/h	✓ Keep construction in progress ✓ Site inspection/monitoring once a day

Altert	R: 20 – 50 mm/h or A: Above 100 mm E: 2 – 4 mm/h	✓ Keep construction in progress ✓ Site inspection/monitoring every four hours
Warning	R: Above 50 mm/h A: Above 120 mm E: Over 4mm/h	✓ Stop construction

Note: R = Rainfall, A = Accumulative rainfall, E = Extensometer
Source: JICA Survey Team

7.7 Potential Risks in LDPP-2

Table 7.7.1 lists the conceivable risks in the Project and possible mitigation measures for each risk.

Table 7.7.1 Conceivable Risks and Mitigation Measures for LDPP-2

Risk Management Framework

Project Name: Landslide Disaster Protection Project of the National Road Network Phase 2 (LDPP-2)
Country: The Democratic Socialist Republic of Sri Lanka
Sector: Road Development Authority (RDA)

Probability : H= High, M= Middle, L= Low
Impact : H= High, M= Middle, L= Low

Potential Project Risks	Assessment
1. Stakeholder Risk	
1.1 Commitment of the Government	Probability: Low
(Description of risk) Change of the priority of the Project due to advent of a new administration. Risk of loss of commitment for the Project.	Impact: Middle Analysis of probability and impact: The Employer has completed a number of projects funded by international donor agencies, and familiar with the requirements of international agencies. Low probability. Mitigation measures: Having a regular meeting between the Employer and JICA, especially prior to the preparation of the government budget for the coming year. Action during the implementation: Earlier consultation with JICA. Contingency plan (if applicable):
1.2. Social Environmental Consideration	Probability: Middle
(Description of risk) 【EIA/IEE】 1) EIA/IEE will be required for eight target sites, namely: Nos. 10, 11, 12, 25, 33, 34, 51 and 53, if these sites are located within one mile from the boundary of a National Reserve. 2) Considerable cutting of trees might be necessary for the construction of temporary roads to approach the Site No.53. Obtaining permission from Forest Department or Department of Wildlife Conservation will be difficult, if	Impact: High Analysis of probability and impact: Delay of the commencement of the Project if it takes time for EIA/IEE. Mitigation measures: 1) Start the EIA/IEE from the early stage of the Project to ensure enough time and examine mitigation measures in D/D stage. 2) Reexamine the route of the access road in D/D stage based on the detailed topographic maps, and minimize the area of the cutting trees. Action during the implementation: 1) For acceleration of EIA/IEE process, include the foreign environmental expert from the early stage of the Project, and conduct EIA/IEE works by subletting to skillful local consultants familiar with EIA/IEE in Sri Lanka. 2) Re-examine the access route in the D/D stage to minimize the cutting trees and monitor the construction works in the C/S stage.

large volume of cutting trees is required. Additionally, reforestation equivalent to three times the volume of cutting trees will be required to obtain the permission.	Contingency plan (if applicable): Start the technical assistance of EIA prior to the commencement of the Project.
1.3. Landowners	Probability: Middle
(Description of risk) 1) Outstanding land acquisition, delay of the process of land acquisition. 2) Expansion of land acquisition area due to unforeseeable incidents such as new landslides caused by heavy rain after D/D. 3) Disposal area for earth materials might be difficult to obtain close to the Project area.	Impact: High Analysis of probability and impact: Significant impacts on cost and progress of the works. 1)It is possible for the Employer not to be able to complete all land acquisition prior to the commencement of the works. 2) New landslides might occur due to heavy rain after D/D. Mitigation measures: 1) The Employer to complete all land acquisition prior to the signing of the contract. 2) Periodical consultation with landowners who might be affected by the works from the preparation stage of EIA and RAP. 3) Detailed topographic mapping, geological investigations and monitoring prior to the D/D stage. 4) Confirmation of the land use and D/D based on the survey. Action during the implementation: Confirm the land use of the Project area in the D/D stage. Change the sequence of the works, if possible to avoid the suspension of the works. Contingency plan (if applicable): Allow time and cost, if outstanding land acquisition will most likely remain by the time of the commencement of the works.
2. Executing Agency Risk	
2.1. Capacity Risk	Probability: High
(Description of risk) Shortage of human resources in PMU hinder the Project. The PMU staff do not stay for long, which will cause difficulty for their capacity development.	Impact: Middle Analysis of probability and impact: All PMU members planned for LDPP1 were not staffed. The Project area of LDPP-2 is much wider than LDPP1, and construction works at a maximum of 16 sites will be conducted. Shortage of the PMU staff possibly affects the progress of the works. Mitigation measures: Discuss lesson from LDPP-1 and effective measures to improve the outcome. Discuss this matter in SPC. Action during the implementation: Earlier consultation with JICA. Contingency plan (if applicable):
2.2. Governance Risk	Probability: Low
(Description of risk) Possibility of delay of the parliamentary approval of E/N and/or L/A.	Impact: Middle Analysis of probability and impact: The Employer has completed a number of projects funded by international donor agencies, and familiar with the requirements of international agencies. Low probability. Mitigation measures: Having a regular meeting between the Employer and JICA, especially prior to the preparation of the government budget for the coming year. Action during the implementation:

	Earlier consultation with JICA.
	Contingency plan (if applicable):
2.3. Fraud and Corruption Risk	Probability: Low
(Description of risk) Inadequacy of the system for procurement, financial management, and anti-corruption. Auditing and necessary disclosure may not be implemented timely.	Impact: Middle
	Analysis of probability and impact: The Employer has completed a number of projects funded by international donor agencies, and familiar with the requirements of international agencies. Low probability.
	Mitigation measures: Having a regular meeting between the Employer and JICA, especially prior to the preparation of the government budget for the coming year.
	Action during the implementation: Earlier consultation with JICA.
	Contingency plan (if applicable):
3. Project Risk	
3.1. Design Risk (1)	Probability: High
(Description of risk) Shortage of necessary components to achieve the Project. Former projects might affect the achievement of the Project.	Impact: High
	Analysis of probability and impact: Guidelines/manuals for investigation, design, procurement, construction supervision, and operation and maintenance have been prepared in LDPP-1. However, technical transfer based on each manual is not enough in LDPP-1. Further capacity development for RDA is necessary.
	Mitigation measures: Discuss lesson from LDPP-1 and effective measures to improve the outcome.
	Action during the implementation: Include the capacity development expert at the early stage of the Project and ensure enough time to prepare the program of capacity development.
	Contingency plan (if applicable): Conduct technology transfer including the temporary works for the Project and preparation of necessary manuals for RDA.
3.1. Design Risk (2)	Probability: High
(Description of risk) Considerable number of design changes, disruption and delay of the Project as a result.	Impact: High
	Analysis of probability and impact: Due to complex geological conditions, it is highly likely that the Project encounters unforeseeable ground conditions, which normally result in design changes. According to the lessons of LDPP-1, many ground anchors become longer than original design and unexpected landslides occurred near the sites, which caused design changes.
	Mitigation measures: Ensure enough time for geological investigations and monitoring of landslide and identify geological condition for the detailed design.
	Action during the implementation: Conduct monitoring slopes regularly to identify unusual evidences which might indicate deformation of slopes during the C/S stage. Minimize the disruption of the works by altering the original sequence of the works, if applicable.
	Contingency plan (if applicable): Allocate contingency both in construction schedule and budget.

3.1. Design Risk (3)	Probability: High
(Description of risk) Deficiency in the performance of the Contractor	Impact: High
	Analysis of probability and impact:
	Local contractors have few experiences of advanced countermeasures of slope protections. Foreign contractors familiar with the advanced countermeasures of slope protection are necessary to be involved in the Project.
	Mitigation measures:
	Confirm the ability of the contractors based on the check of their experiences and performance. Prepare appropriate PQ clarifications to ensure the good companies.
	Action during the implementation:
	Prepare appropriate PQ clarifications to ensure the good companies.
	Contingency plan (if applicable):
3.1. Design Risk (4)	Probability: High
(Description of risk) Significant groundwater level drop, which might affect the livelihood of residents.	Impact: High
	Analysis of probability and impact:
	Drainage wells and drainage holes will lower the groundwater levels of the landslide. The groundwater level drop might affect the livelihood of residents, such as depletion of well and damage on agricultural products.
	Mitigation measures:
	Monitor groundwater during the construction. Consider compensation facilities including preparation of some catch basin, if necessary.
	Action during the implementation:
	Monitor groundwater level. Prepare compensation facilities, if necessary. Regularly consult with the residents most likely affected in the area.
	Contingency plan (if applicable):
3.1. Design Risk (5)	Probability: Middle
(Description of risk) Increasing project cost due to external factors	Impact: High
	Analysis of probability and impact:
	Changes of procurement costs of the materials and the fluctuation of exchange rate will directly affect the Project cost.
	Mitigation measures:
	Allocate contingency. Change the number of target sites in accordance with the budget. Confirm availability of budgetary steps of the Government of Sri Lanka.
	Action during the implementation:
	Modify the implementation schedule and construction plan in accordance with the change of external factors.
	Contingency plan (if applicable):
3.1. Design Risk (6)	Probability: High
(Description of risk) Risks during construction	Impact: High
	Analysis of probability and impact:
	Conceivable risks during the C/S stage are: 1) Complaints of noise vibration and dust from residents, 2) Defective works due to the shortage of the contractors, 3) Unforeseeable landslides, with design change and delay of the Project as a result, 4) Complaints of blocked roads from residents, and 5) Traffic accidents at the sites.

	Mitigation measures: 1) Cover with crushed stone for construction road, Use road sprinkler, Prohibit night works at the sites close to residence. 2) Prepare necessary manuals for quality check including requirements of qualifications of the engineers and the procedures for quality control. 3) Prepare appropriate construction procedure, install early warning system for each site, and quick response to incidents. 4) Keep at least one-sided traffic. 5) Include permanent safety engineers both in the Consultant and the Contractor, conduct regular safety management meeting, and include traffic guides at each site for the safety of the traffic.
	Action during the implementation: Prepare implementation plan in consideration of the risks in the D/D stage.
	Contingency plan (if applicable):
3.2. Program and Donor Risk (1)	Probability: Middle
(Description of risk) Disturbance of the Project due to dispute over the evaluation of design changes.	Impact: High Analysis of probability and impact: High probability of design changes due to complex geology. Disputes over the evaluation of the extension of time and additional cost and time due to design changes are highly likely and cost would be significant.
	Mitigation measures: Include well-experienced contract experts (foreign and local) in the Consultant. Inform and engage the Dispute Board from the early stage of events which will be likely developed into dispute in the future.
	Action during the implementation: Monitor and analyze the construction schedule throughout the Project by critical pass-based software, particularly when design change takes place.
	Contingency plan (if applicable): Allocate contingency both in construction schedule and budget.
3.2. Program and Donor Risk (2)	Probability: High
(Description of risk) Construction schedule and delay	Impact: High Analysis of probability and impact: Construction sites of LDPP2 are located widely, and the works will be done simultaneously at 16 sites at the maximum. The Project may be delayed due to the significant number of remedial works.
	Mitigation measures: Cooperative approach among the Employer, the Consultant, and the Contractor.
	Action during the implementation: Identify any issue which may have impact on the progress of the works as early as possible and notify other parties and take actions to minimize possible delay.
	Contingency plan (if applicable): Allocate contingency both in construction schedule and budget.
3.3. Delivery Quality Risk (1)	Probability: High
(Description of risk)	Impact: Middle Analysis of probability and impact:

Difficulty in the management of the Project both in the C/S stage and O&M stage due to the shortage of staff.	All PMU members planned for LDPP-1 were not staffed. The Project area of LDPP-2 is much wider than LDPP-1, and the construction works at a maximum of 16 sites will be conducted. Shortage of the PMU staff possibly affects the progress of the works.
	Mitigation measures:
	Discuss lesson from LDPP-1 and effective measures to improve the outcome. Discuss this matter in SPC.
	Action during the implementation:
	Earlier consultation with JICA.
	Contingency plan (if applicable):
3.3. Delivery Quality Risk (2)	Probability: High
(Description of risk) Disruption and delay of the Project due to natural disasters	Impact: High
	Analysis of probability and impact:
	New landslides might occur due to heavy rain during the Project.
	Mitigation measures:
	Quick response to prevent new landslides and minimize the effect of the landslide.
	Action during the implementation:
	Conduct capacity development for quick response against landslides and prepare necessary manuals.
	Contingency plan (if applicable):
	Allocate contingency both in construction schedule and budget.
3.3. Delivery Quality Risk (3)	Probability: Low
(Description of risk) Contractor experiences financial difficulty during the Project, and progress of the work is affected significantly. Possible termination of the contract.	Impact: High
	Analysis of probability and impact:
	Contractor may experience financial difficulties during the Project.
	Mitigation measures:
	Rigorously check the financial status of tenderers. The JV agreement shall include a clause dealing with the replacement of the lead member by another member in case of the lead member being financially disabled.
	Action during the implementation:
	Monitor financial status of the Contractor, specially payments to its subcontractors, suppliers, and labor.
	Contingency plan (if applicable):
4. Other Risk	Probability: Middle
(Description of risk) Hindrance of work progress due to traffic accidents	Impact: Middle
	Analysis of probability and impact:
	Traffic accidents may increase during construction. Reinstatement of accident site and investigation will disturb the construction activity and delay the progress.
	Mitigation measures:
	Prepare safety management plan during construction. Effective and strict traffic control by employment of skillful traffic guides.
	Action during the implementation:
	Preparation of standard emergency procedure.
	Contingency plan (if applicable):

Source: JICA Survey Team

7.8 Recommendation of Measures for Improvement of Project Implementation Capacity and Development of Project Effects

Construction works of countermeasures at approximately 30 target sites selected in this survey will start around 2023. The condition of the sites possibly becomes worse, and heavy rainfall might trigger new landslides/slope failure/rock fall. If the disaster area expands, the countermeasure designs need to be revised drastically in the detailed design stage of LDPP-2.

Considering the above situations, the JICA Survey Team recommended:

- To investigate especially for landslides at the earliest stage;
- To monitor the deformation of the landslide at least two years to use detailed design of countermeasures;
- To install EWS at the critical sites at the earliest stage of the Project for safety of the national road networks; and
- To carry out the capacity development for RDA and NBRO for the preparation of quick responses against landslides to carry out timely and effectively when sediment disasters occur.

Chapter 8 Project Evaluation

8.1 Economic Analysis

Since public resources are limited, it is important to ensure that scarce resources are used efficiently and effectively to maximize social benefits. Therefore, economic analysis of public infrastructure investment is conducted to confirm the economic feasibility of the investment from the viewpoint of national economy.

In order to evaluate economic feasibility of the proposed landslide countermeasures, economic analysis has been conducted. Unlike usual road development projects, the benefit of such disaster risk reduction projects is estimated from the reduction of economic loss. The results and methodology of the analysis are discussed in the following subsections.

8.2 Results of Economic Analysis

The results of the economic analysis indicated that the investment for the landslide countermeasures has sufficient economic efficiency with an EIRR of 21.1%, B/C ratio of 2.15, and NPV of LKR. million. The results are as summarized in **Table 8.2.1**.

Table 8.2.1 Results of Economic Analysis

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8.3 Basic Condition

The economic analysis of the landslide countermeasures has been carried out based on the following basic conditions:

(1) Price Level and Exchange Rate

The economic analysis has been made at the price level of October 2019, and the applied foreign exchange rates are: USD 1 equivalent to LKR 178.0 and LKR 1 equivalent to JPY 0.601.

(2) Project Life

The project life depends on the useful life of facilities. The proposed landslide countermeasures, especially concrete structures, perform their functions for a long period of time with proper operation and maintenance. Therefore, a project life of 40 years is assumed. Replacement cost covers replacement of rock fall protection facilities made of metallic materials after 25 years from construction. The residual value of the facilities at the end of the project life is neglected since it does not have a significant effect on the results of the analysis.

(3) Discount Rate

A social discount rate of 12% has been applied for the calculation of B/C ratio and net present value. This rate has been adopted for economic analyses of similar public works projects in Sri Lanka.

(4) Economic Price

In the economic analysis, the feasibility of the proposed project is analysed from the viewpoint of the

national economy. For this purpose, the concept of economic price is applied to evaluate the benefit and the cost of the project. Market price (financial price) is generally distorted by various factors such as taxes, import duties, public utility charges, etc. Therefore, market price should be converted to economic price to reflect its true value.

In this study, a standard conversion factor (SCF) has been used to convert financial prices into economic prices. SCF is calculated by comparing the world price and the domestic price of commodities. SCF can be multiplied by the domestic market price of a non-traded item to convert it to an equivalent border price. **Table 8.3.1** shows the process of calculation of the standard conversion factor.

Table 8.3.1 Calculation of Standard Conversion Factor (SCF)

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In this study, the SCF of is applied for the local currency portion (LC) of financial cost. No price adjustment is made for the foreign currency portion (FC) since it is considered that FC already reflects the true economic value in the international market.

(5) Cost of Land Acquisition

The costs of land acquisition and compensation are required for the construction of the landslide countermeasure facilities. However, such areas are situated in the risk area of landslide disasters and are considered unproductive land from the viewpoint of the national economy. Therefore, only the land acquisition cost is considered in the economic analysis. Estimated land acquisition cost is converted to economic cost by multiplying SCF.

(6) Criteria for Economic Analysis

The economic internal rate of return (EIRR), net present value (NPV), and benefit cost ratio (B/C Ratio) are the criteria to be utilized for measuring a project's effectiveness and efficiency from the economical viewpoint. EIRR is a discount rate, which satisfies the following equation.

$$\sum_{i=1}^{k} \{(\text{Net Benefit of } i^{th} \text{ year}) / (1 + \text{EIRR})^{i}\} = 0$$

where, k is a number of years of the project life.

In other words, EIRR is a discount rate, which makes the total net benefit of the project to be zero in the present value. EIRR indicates an investment efficiency of the project in terms of the national economy. NPV is a total amount of annual net benefit discounted by the social discount rate of the nation. This value indicates an amount of social surplus of the project to the economy. B/C ratio is a ratio of the total benefit against the total cost of the project. The benefit and the cost are discounted by the social discount rate of the economy. This value denotes the efficiency of the project as well as the EIRR.

(7) Sites Subject to Economic Analysis

The proposed countermeasures are expected to prevent/mitigate the issues caused by landslide disasters to national roads and to benefit the national economy. Economic analysis is conducted for the proposed countermeasures at the candidate sites selected through the first and second screenings.

8.4 Socio-economic Framework

The future socioeconomic framework has been estimated as shown in **Table 9.4.1**. The future GDP has been estimated based on the actual growth rate (4.4% p.a.) during the last five years, from 2013 to 2017. It has been assumed that the same growth continues until 2040. Regarding the population projection, the standard projection of the World Population Prospects 2019 of United Nations has been applied. According to the projection, the total population of Sri Lanka will become the peak number, 22,194 thousand in 2038. After that, it will decrease gradually.

Based on the above assumption, the GDP per capita has been estimated as shown in **Table 8.4.1**. The GDP per capita in 2019 was estimated at LKR 731,532. It is assumed to grow at 4.0% to 4.3% p.a. until 2040 on constant 2019 price basis.

Table 8.4.1 Future Socio-economic Framework of Sri Lanka

(Constant 2019 price)

Index / Year	Unit	2019	2020	2030	2040	2050	2060
GDP	LKR. bn	15,599	16,285	25,050	38,531	59,267	91,163
Annual growth rate of GDP	%	4.4	4.4	4.4	4.4	4.4	4.4
Population	1,000	21,324	21,413	22,023	22,186	21,814	20,972
Per capita GDP	LKR	731,532	760,527	1,137,432	1,736,695	2,716,924	4,346,825
Annual growth rate of per capita GDP	%	4.0	4.0	4.1	4.3	4.6	4.8

Source: JICA Survey Team

8.5 Benefits of the Project

The objective of the Project is to develop a self-sustaining system for the implementation of landslide risk reduction and landslide countermeasure works on national roads through the implementation of landslide countermeasure works for selected national roads with high landslide risks. The Project aims to improve the safety of road networks and the livelihoods of the residents, thereby contributing to socioeconomic development in Sri Lanka. The benefit of the project is estimated from the difference of the "With Project" and the "Without Project" conditions. The main benefits to be taken into account are:

- **Reduction of "Temporary Recovery Cost of Damaged Roads" after Landslide Disaster**
- **Reduction of "Travel Time Cost (TTC) due to Detour" after Landslide Disaster**
- **Reduction of "Vehicle Operation Cost (VOC) due to Detour" after Landslide Disaster**

Under the "Without Project" condition, if landslide disaster occurs, it is necessary to incur substantial cost for temporary recovery of the damaged roads to secure road traffic. Also, passengers of the vehicle spend more time to detour the closed section of the road, and this is considered loss of productive time of the passengers. Furthermore, the operation cost of the vehicles will increase because it is necessary to drive a longer distance to detour the closed section. Both the loss of time and incremental vehicle operation cost continues until temporary recovery of the damaged section. These losses caused by the landslide disaster from the viewpoint of the national economy.

Under the "With Project" condition, it is expected that such losses are prevented and that the difference between the "Without Project" and the "With Project" conditions are considered as the benefit of the Project.

- Reduction of loss of life
- Reduction of damages to properties such as houses and household goods
- Reduction of damages to agricultural properties
- Reduction of damages to infrastructures, such as road, bridges, river and drainage facilities, power and water supply facilities, etc.

The following indirect benefits are also expected:

- Reduction of influence to economic activities including tourism due to stagnation
- Reduction of cost of emergency measures taken by central and/or local government units
- Reduction of termination of public services such as transportation, communication, electricity, and water supply
- Reduction of inconvenience of citizens life
- Reduction of peoples mental stress

Although various benefits are expected to arise from the projects, the main benefits are taken into consideration for the economic analysis.

8.5.1 Reduction of "Temporary Recovery Cost of Damaged Roads"

(1) Estimation of Temporary Recovery Cost

Past disaster records are important information to analyse disaster risks of the candidate sites. However, they are not systematically managed by RDA and it was necessary to inquire about this from the regional engineers through PMU. Some relatively small-scale disaster information was recently provided by PMU. Therefore, it was necessary to estimate the temporary recovery cost from the relatively large-scale landslide disasters that occur once every few decades. The following temporary recovery works are assumed to estimate the cost for the candidate sites.

1) Landslide and Debris Flow

It is assumed that roads are completely collapsed by the landslide/ debris flow disaster. Filling of

soil in a trapezoidal shape with length of the risk site is estimated.

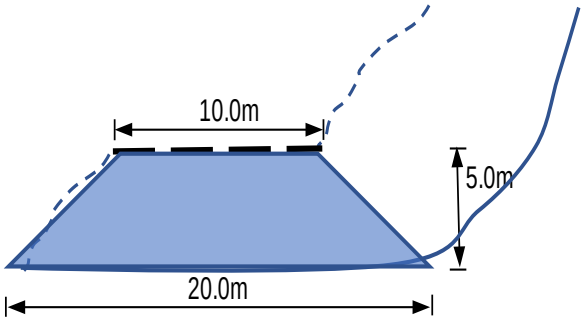

Figure 8.5.1 Image of Temporary Recovery of the Damaged Road from Landslide/Debris Flow

2) Slope Failure

Removal of sediment accumulated on the road in the triangle shape is estimated with length of the risk site.

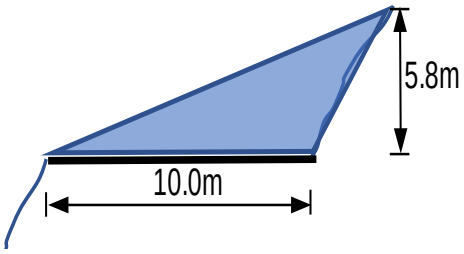

Figure 8.5.2 Image of Temporary Recovery of the Damaged Road from Slope Failure

3) Rock Fall

In case of rock fall, removal of the fallen rocks and confirmation of safety at the sites are required. The actual costs provided by PMU were applied.

The temporary recovery cost has been estimated for the candidate sites as shown in tables below.

Table 8.5.1 Temporary Recovery Cost after Landslide Disaster (1/9)

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Table 8.5.2 Temporary Recovery Cost after Landslide Disaster (2/9)

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Table 8.5.3 Temporary Recovery Cost after Landslide Disaster (3/9)

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Table 8.5.4 Temporary Recovery Cost after Landslide Disaster (4/9)

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Table 8.5.5 Temporary Recovery Cost after Landslide Disaster (5/9)

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Table 8.5.6 Temporary Recovery Cost after Landslide Disaster (6/9)

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Table 8.5.7 Temporary Recovery Cost after Landslide Disaster (7/9)

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Table 8.5.8 Temporary Recovery Cost after Landslide Disaster (8/9)

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Table 8.5.9 Temporary Recovery Cost after Landslide Disaster (9/9)

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(2) Frequency of Occurrence of Landslide Disasters

As discussed above, with the limited information of past disaster records, the frequency of occurrence of landslide disasters is assumed, as shown below depending on the available disaster information.

1) Occurrence probability of landslide, slope failure, and debris flow disasters

Record of landslide, slope failure and debris flow	Occurrence probability
Two records in last 10 years	2/10 = 0.200
Three records in last 20 years	3/20 = 0.150
One record in last 10 years	1/10 = 0.100
One record in last 15 years	1/15 = 0.067
One record in last 20 years	1/20 = 0.050
One record in last 25 years	1/25 = 0.040

2) Occurrence probability of rock fall based on information from PMU

Record of rock fall	Occurrence probability
Once in five years	1/5 = 0.200
Once a year	1/1 = 1.000
Three times a year	3/1 = 3.000

(3) Benefit of Reduction of "Temporary Recovery Cost"

Under the "With Project" condition, landslide disasters are expected to be prevented, and the cost for temporary recovery works will be reduced. Reduction of the cost is considered as one of the benefits of the Project. Based on the temporary recovery cost and the frequency of occurrence of landslide disasters, the benefit of reduction of the temporary recovery cost has been estimated as shown below:

(Temporary Recovery Cost) x (Occurrence Probability) = Average Annual Benefit of Reduction of Temporary Recovery Cost

The average annual benefit of reduction of temporary recovery cost is presented in **Table 8.5.10**.

Table 8.5.10 Benefit of Reduction of Temporary Recovery Cost

No.	Route No	Name of the Road	Years of Landslide Recorded	Location		Expected Sediment Disaster		Temporary Recovery Works		Occurrence probability (times/ year)	Average annual benefit of reduction of temporary recovery cost (LKR.1,000)
				Start (km/cul.)	End (km/cul.)	Disaster Type	Maguni-tude Width (m)	Earthwork Volume of Recovery Works (m^3)	Economic Cost (LKR .1000)		
1	B-413	Tennekumbura - Rikillagaskada - Ragala Road.	2007, 2011, 2004	66.75km	67km	Landslide	160	12,000	87,486	0.150	13,123
2	A-005	Peradeniya - Badulla - Chenkaladi Road	2010, 2014, 2016	46/2	46/3	Landslide	190	14,250	103,890	0.150	15,583
4	B-391	Ratnapura - Wewalwatta Road	2015	11.9 km	12.0 km	Landslide	60	4,500	32,807	0.100	3,281
6	B-412	Tawalanthenna-Thalawakele road	2007	30/9	30/11	Landslide	110	8,250	60,147	0.067	4,010
7	A-005	Peradeniya - Badulla - Chenkaladi Road	1997	30/9	30/11	Landslide	70	5,250	38,275	0.040	1,531
8	A-005	Peradeniya - Badulla – Chenkaladi Road	2016	28/4	28/6	Landslide	80	6,000	43,743	0.100	4,374
9	A-007	Avissawella - Hatton - Nuwaraeliya	2014	3/3	3/5	Slope Failure	120	3,480	20,489	0.100	2,049
10	A-016	Beragala - Haliela Road	2014	3.85km	4.2km	Rock fall			195	3.000	585
11	A-016	Beragala - Haliela Road	2014	5/2	5/4	Rock fall	1,050		195	3.000	585

12	A-016	Beragala - Haliela Road	2014	5/6	5/8	Rock fall			195	3.000	585
19	E-001	Kottawa - Godagama Section	2016, 2017	76.7km	77.2km	Rock fall	180		390	1.000	390
20	E-001	Kottawa - Godagama Section	2016, 2017	77.9km	79.0km	Rock fall	550		390	1.000	390
22	E-001	Kottawa - Godagama Section	2016, 2017	88.0km	88.8km	Rock fall	310		390	1.000	390
23	E-001	Kottawa - Godagama Section	2016, 2017	89.3km	89.6km	Rock fall	310		390	1.000	390
25	E-001	Kottawa - Godagama Section	2016, 2017	101.3km	101.7km	Landslide	130	9,750	71,082	0.200	14,216
25ad2	E-001	Kottawa - Godagama Section	2018	108.6	108.7	Rock fall	290		390	1.000	390
26	B-274	Matale-Illukkumbura-Laggala Road	2011	11/2	11/4	Landslide	180	13,500	98,422	0.100	9,842
27	B-462	Wattegama - Matale Road	2018	6+030	6+100	Landslide	90	6,750	49,211	0.100	4,921
31	A-001	Colombo - Kandy Road	2016	99/8	99 km	Slope Failure	100	2,900	17,074	0.100	1,707
33	A-004	Colombo-Ratnapura-Wellawaya-Batticaloa Road	2017	171/5	171/7	Rock fall	150		195	0.200	39
34	A-004	Colombo-Ratnapura-Wellawaya-Batticaloa Road	1994	183km	185/14	Landslide	300	22,500	164,036	0.040	6,561
36	B-149	Hatton - Maskeleiya - Delhouse Road	2018	9.000	9.100	Landslide	160	12,000	87,486	0.100	8,749
37	B-036	Badulla - Karametiya - Andaulpotha Road	2014	4/11	5/3	Slope Failure	80	2,320	13,659	0.100	1,366
39	B-122	Galagedara - Rambukkana	2014, 2015	8/2	8/4	Slope Failure	300	8,700	51,223	0.200	10,245
40	B-122	Galagedara - Rambukkana	2014, 2015	18/3	18/5	Slope Failure	170	4,930	29,026	0.200	5,805
43	A-017	Galle-Deniyaya-Madampe road	2018	139	140/1	Landslide	90	6,750	49,211	0.100	4,921
48	B-390	Ratnapura- Palawela- Karavita Road	2017	12/4	12/7	Slope Failure	210	6,090	35,856	0.100	3,586
49	B-390	Ratnapura- Palawela- Karavita Road	2017	20/9	21/3	Slope Failure	300	8,700	51,223	0.100	5,122
51	B-188	Kaluaggala - Labugama road	2017	12/4	12/6	Slope Failure	70	2,030	11,952	0.100	1,195
53	A-017	Galle-Deniyaya-Madampe Road (Morawakkanda Landslide)	2017	62km	62.25km	Debris flow	110	8,250	81,349	0.100	8,135
										Total Benefit of All the Candidate Sites:	**134,067**

Source: JICA Survey Team

8.5.2 Reduction of "Travel Time Cost (TTC) due to Detour"

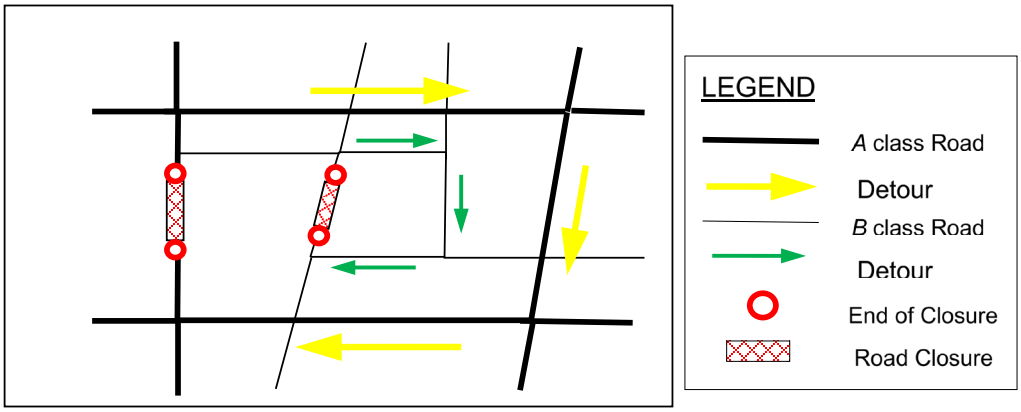
(1) Detour due to Landslide Disaster

When a large-scale landslide disaster occurs at a candidate site, the national road will be damaged, and the roads will be closed until temporary recovery. All traffic must be detoured to reach their destinations. It usually takes more time to reach the destinations, and there is loss of time value of the passengers of the vehicles. The routes of detours have been selected based on the criteria shown in **Table 8.5.11** and **Figure 8.5.3**.

Table 8.5.11 Criteria of Detour Selection

Class of Affected Road	Route of Detour	Remarks
A	A class road	Interchange used for E (Expressway) class road
B	A class and/or B class road	
E	A class and/or B class road	

Source: JICA Survey Team



Source: JICA Survey Team

Figure 8.5.3 Calculation of Detour Length in Case of Road Closure

Based on the above criteria, the distance and time of the detour have been estimated as shown in **Table 8.5.12**. Travel speed on the detour routes is assumed at 50km/h for Class A roads and 30km/h for Class B roads.

Table 8.5.12 Distance and Time of Detour due to Landslide Disasters

No.	Road Class	Route No	Name of the Road	Location		Detour due to Disaster	
				Start (km/cul.)	End (km/cul.)	Distance (km)	Time (hr)
1	B	B-413	Tennekumbura - Rikillagaskada - Ragala Road	66.75km	67km	127	4.23
2	A	A-005	Peradeniya - Badulla - Chenkaladi Road	46/2	46/3	195	3.90
4	B	B-391	Ratnapura - Wewalwatta Road	11.9 km	12.0 km	78	2.60
6	B	B-412	Tawalanthenna-Thalawakele Road	30/9	30/11	63	2.10
7	A	A-005	Peradeniya - Badulla - Chenkaladi Road	30/9	30/11	195	3.90
8	A	A-005	Peradeniya - Badulla - Chenkaladi Road	28/4	28/6	195	3.90
9	A	A-007	Avissawella - Hatton - Nuwaraeliya	3/3	3/5	182	3.64
10	A	A-016	Beragala - Haliela Road	3.85km	4.2km	78	1.56
11	A	A-016	Beragala - Haliela Road	5/2	5/4	78	1.56
12	A	A-016	Beragala - Haliela Road	5/6	5/8	78	1.56
19	E	E-001	Kottawa - Godagama Section	76.7km	77.2km	18	0.60
20	E	E-001	Kottawa - Godagama Section	77.9km	79.0km	18	0.60
22	E	E-001	Kottawa - Godagama Section	88.0km	88.8km	28	0.93
23	E	E-001	Kottawa - Godagama Section	89.3km	89.6km	28	0.93
25	E	E-001	Kottawa - Godagama Section	101.3km	101.7km	20	0.67
25ad2	E	E-001	Kottawa - Godagama Section	108.6	108.7	20	0.67
26	B	B-274	Matale-Illukkumbura-Laggala Road	11/2	11/4	114	3.80
27	B	B-462	Wattegama - Matale Road	6+030	6+100	30	1.00
31	A	A-001	Colombo - Kandy Road	99/8	99 km	110	2.20
33	A	A-004	Colombo-Ratnapura-Wellawaya-Batticaloa Road	171/5	171/7	270	5.40
34	A	A-004	Colombo-Ratnapura-Wellawaya-Batticaloa Road	183km	185/14	74	1.48
36	B	B-149	Hatton - Maskeleiya - Delhouse Road	9.000	9.100	42	1.40
37	B	B-036	Badulla - Karametiya - Andaulpotha Road	4/11	5/3	112	3.73
39	B	B-122	Galagedara - Rambukkana	8/2	8/4	44	1.47

40	B	B-122	Galagedara - Rambukkana	18/3	18/5	44	1.47
43	A	A-017	Galle-Deniyaya-Madampe Road	139	140/1	226	4.52
48	B	B-390	Ratnapura- Palawela- Karavita Road	12/4	12/7	39	1.30
49	B	B-390	Ratnapura- Palawela- Karavita Road	20/9	21/3	39	1.30
51	B	B-188	Kaluaggala - Labugama Road	12/4	12/6	32	1.07
53	A	A-017	Galle-Deniyaya-Madampe Road (Morawakkanda Landslide)	62km	62.25km	226	4.52

Source: JICA Survey Team

(2) Estimation of Travel Time Cost (TTC)

In order to estimate the benefit of reduction of "Travel Time Cost (TTC)", it is necessary to estimate the value of time of the vehicle passengers by type of vehicle. For this purpose, the same procedure as the one in the guide "Assessing Public Investment in the Transport Sector, Department of National Planning, Ministry of Finance and Planning, December 2000" has been applied.

If landslide disaster is prevented by the Project, the passengers of the vehicle can save time by not going through the detour. This is one of the important benefits of the Project. Reduction of the travel time cost can be estimated using the following equation:

Value of time of a passenger by type of vehicle × *Numbers of passengers in each type of vehicle* × *Numbers of vehicles by type per day* × *Incremental travel time due to detour* = *Travel Time Cost due to detour per day*

1) Estimation of Value of Time by Type of Vehicle

The guide assumes that public and private transport user groups (i.e., car users, motorcycle users, and public transport users) could be linked to particular income categories. Therefore, the latest household income data has been applied from the Household Income and Expenditure Survey 2016.

Table 8.5.13 Average Monthly Household Income by Decile Group in 2016

Decile Group	Average Income (LKR)
1	10,419
2	19,914
3	26,810
4	33,204
5	39,855
6	47,462
7	57,288
8	71,399
9	95,000
10	162,460

Source: Household Income and Expenditure Survey 2016

Based on the average monthly household income by decile group, the average monthly household income by type of vehicle has been estimated. Classification of income group by type of vehicle is based on the guide entitled, "Assessing Public Investment in the Transport Sector, Department of National Planning, Ministry of Finance and Planning, December 2000". The growth rate from 2016 to 2019 is estimated at 4.76% p.a. based on the average growth of the wage rate index from 2010 to 2018 on nominal basis, "Annual Report, Central Bank of Sri Lanka 2012, 2013, 2014, 2015, 2016, 2017, and 2018".

Table 8.5.14 Average Monthly Household Income by Type of Passenger Vehicle

Unit: LKR (current price)

	Income Group (Decile)	2016	2019
Car passengers	10th	162,460	186,781
Van passengers	9th	95,000	109,222
Motor cyclists	7th and 8th	64,344	73,976
Public transport passengers	1st to 8th	38,294	44,027

Source: JICA Survey Team

According to the Household Income and Expenditure Survey 2016, the number of income receiver is 1.8/household. Therefore, the average monthly income per person by type of vehicle has been estimated as shown in

Table 8.5.14. The monthly income can be converted to hourly income by using the following equation.

Hourly Income (LKR/hr.) = Monthly Income (LKR/month) x 12 (months/year) / 2000 (hrs/year)

According to the guide, higher income earners relatively make more trips than lower income earners. Therefore, the hourly income rate has been multiplied by a factor of 1.5 to adjust for mobility. Weighted hourly income rate can therefore be developed to incorporate the mobility effect, as follows:

Weighted Hourly Income of User Group (LKR/hr) = Mean Monthly Income of User Group (LKR/month) x 1.5 x 12 (months/year) / 2000 (hrs/year)

Average monthly income and the weighted hourly income of income receiver in 2019 are presented in **Table 8.5.15**.

Table 8.5.15 Average Monthly Income and Weighted Hourly Income of Income Receiver in 2019

(constant 2019 price)

	Unit	Average Monthly Income	Weighted Hourly Income (WHI) (LKR / hour)
Car passengers	LKR /person	103,767	934
Van passengers	LKR /person	60,679	546
Motor cyclists	LKR /person	41,098	370
Public transport passengers	LKR /person	24,459	220

Source: JICA Survey Team

The value of time varies depending on the purpose of the trip. According to the guide, the following percentages of work trips are indicated.

Table 8.5.16 Percentage of Work Trips by Sector of Travel

	Urban Sector	Rural Sector	Intercity Sector
Car passengers	10-20%	5-10%	25-30%
Van passengers	15-30%	10-15%	20-25%
Motor cyclists	5-15%	15-30%	0-5%
Public transport passengers	3-5%	5-10%	5-10%

Source: Assessing Public Investment in the Transport Sector, Department of National Planning, Dec. 2000

The median percentage of the intercity sector has been applied to calculate the value of time per passenger by type of vehicle. The value of travel time for each user group can then be calculated as follows:

VOT of User Group = Weighted Hourly Income of User Group x (1.2 x Percent of Work Trips

+ 0.2 x Percent of Non-Work Trips) / 100

Table 8.5.17 Calculation of Value of Time per Passenger by Type of Vehicle

(Constant 2019 price)

	Percentage of work trip	Value of work trip (WHI x 1.2) (LKR/hour)	Value of non-work trip (WHI x 0.2) (LKR/hour)	Value of time per passenger (LKR/hour)
Car passengers	27.5%	308	135	444
Van passengers	22.5%	147	85	232
Motor cyclists	2.5%	11	72	83
Public transport passengers	7.5%	20	41	61

Source: JICA Survey Team

The value of time per passenger has to be multiplied by the vehicle occupancy rate to estimate the total value of travel time in each type of vehicle. The median values of the intercity sector have been applied to estimate the total value by the type of vehicle.

Table 8.5.18 Vehicle Occupancy and Value of Time per Vehicle

(constant 2019 price)

	Vehicle Occupancy without crew (person/vehicle)	Value of time per vehicle (LKR/vehicle/hr)
Car, Pick up	2.5	1,109
Van	4.5	1,044
Motorcycle, three-wheeler	1.5	125
Medium and large buses	40.0	2,421

Source: JICA Survey Team

The Future value of time per vehicle is estimated on the assumption that the income of passengers grows at the same rate as the growth of the per capita GDP predicted in the socioeconomic framework in this study. The future value of time per vehicle is presented in **Table 8.5.19**.

Table 8.5.19 Future Value of Time per Vehicle

	Value of Time per Vehicle (LKR/hr)				
	2019	2020	2025	2030	2040
Car, Pick up	1,109	1,153	1,406	1,724	2,633
Van	1,044	1,086	1,324	1,624	2,480
Motorcycle, three-wheeler	125	130	159	194	297
Medium and large buses	2,421	2,517	3,069	3,764	5,748

Source: JICA Survey Team

2) Traffic Demand Forecast

The prediction of future traffic demand is important information to conduct the economic analysis of the Project because the proposed landslide countermeasure facilities prevent landslide disasters for a long time after construction. If the facilities are not constructed, the potential of economic loss due to landslide disaster will become higher due to socioeconomic development and increase of future traffic demand.

The prediction of future traffic demand has been performed by the Planning Division of RDA by using JICA-Strada software and latest statistic data. Results of the calculation are presented in the tables below.

Table 8.5.20 Traffic Demand Forecast for the Candidate Sites (1/4)

No.	Route No	Name of the Road	Location		Year	Number of vehicles by type												
			Start (km/cul.)	End (km/cul.)		Motor-cycle	Three-wheeler	Car	Van	Medium bus	Large bus	Pick up	Medium truck	Large truck	3 axle combined	3 -6 axle articulated	Farm vehicle	Total
1	B-413	Tennekumbura - Rikillagaskada -	66.75km	67km	2019	505	372	133	137	35	76	140	91	124	4	2	1	1,620
		Ragala Road.			2020	516	381	136	141	36	79	143	94	127	4	3	1	1,660
					2025	700	516	185	191	49	107	195	127	172	6	4	2	2,252
					2030	925	682	245	252	64	141	257	168	227	7	5	2	2,977
					2040	1,275	941	337	348	89	194	355	232	314	10	7	3	4,103
2	A-005	Peradeniya - Badulla - Chenkaladi	46/2	46/3	2019	909	795	1,262	787	153	218	165	187	218	22	1	11	4,728
		road			2020	928	812	1,288	804	157	223	169	192	223	23	2	12	4,831
					2025	1,211	1,059	1,681	1,049	205	291	220	250	291	30	3	15	6,305
					2030	1,561	1,365	2,167	1,352	264	375	284	323	375	39	3	20	8,128
					2040	2,216	1,938	3,075	1,919	375	532	403	458	532	55	5	28	11,534
4	B-391	Ratnapura - Wewalwatta Road	11.9 km	12.0 km	2019	846	657	184	122	65	119	210	179	26	1	0	12	2,421
					2020	864	671	188	124	67	122	215	183	27	1	0	13	2,476
					2025	876	681	191	126	68	124	218	185	28	1	0	13	2,511
					2030	889	690	194	128	69	126	221	188	28	1	0	13	2,547
					2040	1,127	875	246	162	88	159	280	238	36	2	0	16	3,230
6	B-412	Tawalanthenna-Thalawakele road	30/9	30/11	2019	514	1,218	153	157	56	119	145	75	94	9	0	9	2,549
					2020	525	1,244	156	160	58	122	149	77	96	10	0	10	2,607
					2025	725	1,716	216	221	80	168	205	106	133	13	0	13	3,597
					2030	961	2,275	286	293	106	223	272	141	176	18	0	18	4,769
					2040	1,399	3,312	417	427	154	324	396	206	257	26	0	26	6,942
7	A-005	Peradeniya - Badulla - Chenkaladi	30/9	30/11	2019	709	620	985	614	120	170	128	146	170	17	1	8	3,688
		road			2020	724	633	1,005	627	123	174	132	150	174	18	2	9	3,770
					2025	1,032	903	1,433	894	175	248	188	213	248	26	2	13	5,374
					2030	1,168	1,022	1,621	1,012	198	280	212	241	280	29	2	15	6,082
					2040	1,729	1,512	2,399	1,498	293	415	314	357	415	43	4	22	9,000
8	A-005	Peradeniya - Badulla - Chenkaladi	28/4	28/6	2019	1,260	2,094	1,472	692	101	304	355	402	120	12	7	0	6,819
		road			2020	1,286	2,137	1,503	706	104	311	363	411	123	13	8	0	6,965
					2025	1,835	3,049	2,144	1,008	148	443	518	586	176	18	12	0	9,936
					2030	2,103	3,493	2,457	1,155	170	508	593	672	202	20	14	0	11,386
					2040	2,993	4,972	3,497	1,643	241	723	844	956	287	29	19	0	16,205
9	A-007	Avissawella - Hatton - Nuwaraeliya	3/3	3/5	2019	4,904	4,072	2,434	897	257	1,105	684	630	825	58	18	17	15,901
					2020	5,005	4,156	2,484	916	263	1,128	698	643	843	60	19	18	16,232
					2025	5,479	4,550	2,719	1,002	288	1,235	764	704	922	66	21	20	17,770
					2030	6,421	5,332	3,186	1,175	337	1,447	896	825	1,081	77	25	23	20,824
					2040	8,462	7,026	4,199	1,548	445	1,907	1,180	1,087	1,424	102	33	30	27,443
10	A-016	Beragala - Haliela Road	3.85km	4.2km	2019	1,525	1,799	1,152	430	194	394	475	399	179	42	28	15	6,632
					2020	1,557	1,837	1,176	439	199	402	485	407	184	43	30	16	6,775
					2025	1,574	1,857	1,189	444	201	407	491	412	186	44	30	16	6,851
					2030	2,248	2,652	1,698	634	287	581	700	588	265	63	43	23	9,782
					2040	2,956	3,488	2,233	834	377	764	921	773	349	82	57	31	12,865

Table 8.5.21 Traffic Demand Forecast for the Candidate Sites (2/4)

No.	Route No	Name of the Road	Location		Year	Number of vehicles by type												
			Start (km/cul.)	End (km/cul.)		Motor-cycle	Three-wheeler	Car	Van	Medium bus	Large bus	Pick up	Medium truck	Large truck	3 axle combined	3 -6 axle articulated	Farm vehicle	Total
11	A-016	Beragala - Haliela Road	5/2	5/4	2019	1,525	1,799	1,152	430	194	394	475	399	179	42	28	15	6,632
					2020	1,557	1,837	1,176	439	199	402	485	407	184	43	30	16	6,775
					2025	1,574	1,857	1,189	444	201	407	491	412	186	44	30	16	6,851
					2030	2,248	2,652	1,698	634	287	581	700	588	265	63	43	23	9,782
					2040	2,956	3,488	2,233	834	377	764	921	773	349	82	57	31	12,865
12	A-016	Beragala - Haliela Road	5/6	5/8	2019	1,525	1,799	1,152	430	194	394	475	399	179	42	28	15	6,632
					2020	1,557	1,837	1,176	439	199	402	485	407	184	43	30	16	6,775
					2025	1,574	1,857	1,189	444	201	407	491	412	186	44	30	16	6,851
					2030	2,248	2,652	1,698	634	287	581	700	588	265	63	43	23	9,782
					2040	2,956	3,488	2,233	834	377	764	921	773	349	82	57	31	12,865
19	E-001	Kottawa - Godagama Section	76.7km	77.2km	2019	0	0	7,572	3,456	235	207	1,988	291	932	104	103	0	14,888
					2020	0	0	7,727	3,527	240	211	2,029	298	951	106	106	0	15,196
					2025	0	0	10,864	4,959	338	297	2,852	419	1,337	150	150	0	21,365
					2030	0	0	15,429	7,042	479	422	4,051	595	1,899	212	212	0	30,343
					2040	0	0	16,558	7,558	514	453	4,347	638	2,038	228	228	0	32,562
20	E-001	Kottawa - Godagama Section	77.9km	79.0km	2019	0	0	7,572	3,456	235	207	1,988	291	932	104	103	0	14,888
					2020	0	0	7,727	3,527	240	211	2,029	298	951	106	106	0	15,196
					2025	0	0	10,864	4,959	338	297	2,852	419	1,337	150	150	0	21,365
					2030	0	0	15,429	7,042	479	422	4,051	595	1,899	212	212	0	30,343
					2040	0	0	16,558	7,558	514	453	4,347	638	2,038	228	228	0	32,562
22	E-001	Kottawa - Godagama Section	88.0km	88.8km	2019	0	0	6,193	2,826	192	169	1,625	238	762	85	84	0	12,174
					2020	0	0	6,320	2,884	196	173	1,659	244	778	87	87	0	12,428
					2025	0	0	8,442	3,853	262	231	2,216	325	1,039	116	116	0	16,602
					2030	0	0	13,593	6,204	422	372	3,569	524	1,673	187	187	0	26,731
					2040	0	0	16,098	7,348	500	440	4,226	620	1,982	222	222	0	31,657
23	E-001	Kottawa - Godagama Section	89.3km	89.6km	2019	0	0	6,193	2,826	192	169	1,625	238	762	85	84	0	12,174
					2020	0	0	6,320	2,884	196	173	1,659	244	778	87	87	0	12,428
					2025	0	0	8,442	3,853	262	231	2,216	325	1,039	116	116	0	16,602
					2030	0	0	13,593	6,204	422	372	3,569	524	1,673	187	187	0	26,731
					2040	0	0	16,098	7,348	500	440	4,226	620	1,982	222	222	0	31,657
25	E-001	Kottawa - Godagama Section	101.3km	101.7km	2019	0	0	4,754	2,169	147	129	1,248	183	585	65	64	0	9,344
					2020	0	0	4,851	2,214	151	133	1,274	187	597	67	67	0	9,540
					2025	0	0	7,478	3,413	232	204	1,963	288	921	103	103	0	14,707
					2030	0	0	12,409	5,664	386	339	3,258	478	1,528	171	171	0	24,402
					2040	0	0	15,243	6,958	474	417	4,002	588	1,877	210	210	0	29,977
25ad2	E-001	Kottawa - Godagama Section	108.6	108.7	2019	0	0	4,754	2,169	147	129	1,248	183	585	65	64	0	9,344
					2020	0	0	4,851	2,214	151	133	1,274	187	597	67	67	0	9,540
					2025	0	0	7,478	3,413	232	204	1,963	288	921	103	103	0	14,707
					2030	0	0	12,409	5,664	386	339	3,258	478	1,528	171	171	0	24,402
					2040	0	0	15,243	6,958	474	417	4,002	588	1,877	210	210	0	29,977

Table 8.5.22 Traffic Demand Forecast for the Candidate Sites (3/4)

No.	Route No	Name of the Road	Location		Year	Number of vehicles by type												
			Start (km/cul.)	End (km/cul.)		Motor-cycle	Three-wheeler	Car	Van	Medium bus	Large bus	Pick up	Medium truck	Large truck	3 axle combined	3 -6 axle articulated	Farm vehicle	Total
26	B-274	Matale-Illukkumbura-Laggala road	11/2	11/4	2019	725	569	175	45	9	94	74	123	30	0	0	1	1,845
					2020	741	582	179	47	9	96	76	126	31	1	0	2	1,890
					2025	951	747	230	60	12	124	97	162	39	1	0	2	2,427
					2030	1,217	955	295	77	16	158	125	208	50	2	1	3	3,105
					2040	1,682	1,320	407	106	21	219	172	287	70	2	1	4	4,291
27	B-462	Wattegama - Matale road	6+030	6+100	2019	1,825	1,580	670	515	38	187	302	211	126	23	3	3	5,483
					2020	1,862	1,613	684	526	39	192	309	216	129	24	4	3	5,602
					2025	2,093	1,813	769	591	44	215	347	243	145	27	4	4	6,295
					2030	2,940	2,547	1,081	830	62	302	487	341	203	38	6	5	8,844
					2040	4,076	3,530	1,498	1,151	86	419	675	473	282	53	9	7	12,259
28	B-462	Wattegama - Matale road	5/9	6/1	2019	1,825	1,580	670	515	38	187	302	211	126	23	3	3	5,483
					2020	1,862	1,613	684	526	39	192	309	216	129	24	4	3	5,602
					2025	2,093	1,813	769	591	44	215	347	243	145	27	4	4	6,295
					2030	2,940	2,547	1,081	830	62	302	487	341	203	38	6	5	8,844
					2040	4,076	3,530	1,498	1,151	86	419	675	473	282	53	9	7	12,259
31	A-001	Colombo - Kandy road	99/8	99 km	2019	4,369	5,735	7,383	2,486	271	1,602	926	1,192	1,009	70	54	12	25,109
					2020	4,459	5,853	7,534	2,537	277	1,635	946	1,217	1,030	72	56	13	25,629
					2025	4,568	5,997	7,719	2,599	284	1,675	969	1,247	1,055	74	58	13	26,258
					2030	4,678	6,140	7,904	2,662	290	1,715	992	1,277	1,081	75	59	13	26,887
					2040	6,272	8,233	10,598	3,569	389	2,300	1,330	1,712	1,449	101	79	18	36,052
33	A-004	Colombo-Ratnapura-Wellawaya-	171/5	171/7	2019	1,543	1,407	885	334	48	215	259	199	312	19	29	6	5,256
		Batticaloa road			2020	1,575	1,436	903	342	50	220	265	204	318	20	30	6	5,369
					2025	1,784	1,627	1,023	387	57	249	300	231	361	23	34	7	6,082
					2030	1,993	1,818	1,143	432	63	279	335	258	403	25	38	8	6,795
					2040	2,937	2,678	1,684	637	93	411	494	379	594	37	56	12	10,011
34	A-004	Colombo-Ratnapura-Wellawaya-	183km	185/14	2019	389	347	250	166	13	157	88	306	0	37	32	0	1,785
		Batticaloa road			2020	397	355	255	170	14	161	90	312	0	38	33	0	1,826
					2025	597	533	384	256	21	242	135	469	0	57	50	0	2,743
					2030	809	722	520	347	29	327	183	636	0	77	67	0	3,717
					2040	1,186	1,059	762	508	43	480	268	932	0	113	99	0	5,449
36	B-149	Hatton - Maskeleiya - Delhouse	9.000	9.100	2019	499	1,115	321	149	34	195	140	155	65	15	0	5	2,693
		road			2020	510	1,138	328	152	36	199	143	158	67	16	1	6	2,753
					2025	542	1,210	348	162	38	212	152	168	71	17	1	6	2,926
					2030	574	1,281	369	171	40	224	161	178	76	18	1	6	3,098
					2040	903	2,014	580	269	63	352	253	280	119	28	1	10	4,871
37	B-036	Badulla - Karametiya - Andaulpotha	4/11	5/3	2019	1,027	310	401	390	26	342	101	904	0	18	4	13	3,536
		road			2020	1,049	317	410	399	27	350	104	923	0	19	6	14	3,617
					2025	1,347	407	526	512	35	449	133	1,186	0	25	7	18	4,646
					2030	1,738	525	679	661	46	580	172	1,530	0	32	10	23	5,996
					2040	2,465	745	963	938	65	822	244	2,170	0	45	14	32	8,502

Table 8.5.23 Traffic Demand Forecast for the Candidate Sites (4/4)

No.	Route No	Name of the Road	Location		Year	Number of vehicles by type												
			Start (km/cul.)	End (km/cul.)		Motor-cycle	Three-wheeler	Car	Van	Medium bus	Large bus	Pick up	Medium truck	Large truck	3 axle combined	3 -6 axle articulated	Farm vehicle	Total
39	B-122	Galagedara - Rambukkana	8/2	8/4	2019	4,197	4,123	1,286	308	96	262	330	296	65	5	5	4	10,977
					2020	4,284	4,207	1,312	315	99	268	337	303	67	6	6	4	11,208
					2025	4,489	4,409	1,375	330	103	281	354	317	70	6	6	5	11,745
					2030	4,695	4,611	1,438	345	108	294	370	332	74	6	6	5	12,283
					2040	7,501	7,367	2,298	551	173	469	591	530	118	10	10	8	19,625
40	B-122	Galagedara - Rambukkana	18/3	18/5	2019	4,197	4,123	1,286	308	96	262	330	296	65	5	5	4	10,977
					2020	4,284	4,207	1,312	315	99	268	337	303	67	6	6	4	11,208
					2025	4,489	4,409	1,375	330	103	281	354	317	70	6	6	5	11,745
					2030	4,695	4,611	1,438	345	108	294	370	332	74	6	6	5	12,283
					2040	7,501	7,367	2,298	551	173	469	591	530	118	10	10	8	19,625
43	A-017	Galle-Deniyaya-Madampe road	139	140/1	2019	1,337	652	420	43	11	172	239	117	49	0	0	1	3,041
					2020	1,364	666	429	44	11	176	244	120	50	0	0	2	3,106
					2025	1,853	904	582	60	16	239	332	163	68	0	0	2	4,218
					2030	2,352	1,148	739	77	20	303	421	207	86	0	0	3	5,356
					2040	3,380	1,650	1,062	110	28	435	605	297	124	0	0	4	7,695
48	B-390	Ratnapura- Palawela- Karavita Road	12/4	12/7	2019	4,017	3,015	845	203	127	256	273	282	50	3	0	6	9,077
					2020	4,100	3,077	863	208	130	261	279	288	52	4	0	6	9,267
					2025	5,633	4,228	1,186	285	178	359	383	396	71	5	0	9	12,734
					2030	6,945	5,212	1,462	352	220	443	473	488	88	6	0	11	15,698
					2040	11,155	8,371	2,348	565	353	711	759	784	141	10	0	18	25,215
49	B-390	Ratnapura- Palawela- Karavita Road	20/9	21/3	2019	4,017	3,015	845	203	127	256	273	282	50	3	0	6	9,077
					2020	4,100	3,077	863	208	130	261	279	288	52	4	0	6	9,267
					2025	5,633	4,228	1,186	285	178	359	383	396	71	5	0	9	12,734
					2030	6,945	5,212	1,462	352	220	443	473	488	88	6	0	11	15,698
					2040	11,155	8,371	2,348	565	353	711	759	784	141	10	0	18	25,215
51	B-188	Kaluaggala - Labugama road	12/4	12/6	2019	2,877	2,129	666	172	80	112	370	271	735	4	0	1	7,417
					2020	2,936	2,173	680	176	83	115	378	277	751	5	0	2	7,575
					2025	3,518	2,604	815	211	99	138	453	332	899	5	0	2	9,077
					2030	4,785	3,542	1,109	288	135	188	616	452	1,223	7	0	2	12,347
					2040	6,411	4,745	1,485	385	180	251	825	605	1,639	10	0	3	16,542
53	A-017	Galle-Deniyaya-Madampe road	62km	62.25km	2019	2,853	1,087	542	365	55	311	432	619	196	92	4	231	6,787
		(Morawakkanda Landslide)			2020	2,912	1,110	554	373	56	317	442	632	200	94	5	236	6,932
					2025	4,222	1,609	803	541	81	460	640	917	290	137	7	343	10,051
					2030	5,283	2,013	1,005	677	102	576	801	1,147	363	171	9	429	12,576
					2040	7,242	2,760	1,377	927	140	789	1,098	1,572	498	234	12	588	17,238

Source: Planning Division, RDA, August 2019

Note: Numbers of articulated trucks with 3, 4, 5 and 6 axles were tallied up in "3 -6 axle articulated" by JICA team.

3) Incremental Travel Time Cost (TTC) due to Detour

Based on the value of time per vehicle, the future traffic demand, the time of detour above, the incremental travel time cost per day has been estimated as shown in the **Table 8.5.24**. The future values of TTC per day have also been estimated by using the future value of time and the future traffic demand up to 2040.

Table 8.5.24 Incremental Travel Time Cost (TTC) per Day up to 2040

No.	Route No	Name of the Road	Location		Detour		Incremental TTC per day (LKR 1,000)				
			Start (km/cul.)	End (km/cul.)	Distance (km)	Time (hr)	2019	2020	2025	2030	2040
1	B-413	Tennekumbura - Rikillagaskada - Ragala road	66.75km	67km	127	4.23	3,489	3,725	6,161	9,990	21,024
2	A-005	Peradeniya - Badulla - Chenkaladi road	46/2	46/3	195	3.90	13,711	14,563	23,178	36,646	79,400
4	B-391	Ratnapura - Wewalwatta road	11.9 km	12.0 km	78	2.60	3,114	3,317	4,104	5,104	9,883
6	B-412	Tawalanthenna-Thalawakele road	30/9	30/11	63	2.10	2,382	2,537	4,268	6,940	15,425
7	A-005	Peradeniya - Badulla - Chenkaladi road	30/9	30/11	195	3.90	10,701	11,366	19,753	27,421	61,959
8	A-005	Peradeniya - Badulla - Chenkaladi road	28/4	28/6	195	3.90	16,178	17,185	29,895	42,018	91,308
9	A-007	Avissawella - Hatton - Nuwaraeliya	3/3	3/5	182	3.64	32,080	34,055	45,458	65,340	131,474
10	A-016	Beragala - Haliela road	3.85km	4.2km	78	1.56	6,384	6,780	8,360	14,639	29,397
11	A-016	Beragala - Haliela road	5/2	5/4	78	1.56	6,384	6,780	8,360	14,639	29,397
12	A-016	Beragala - Haliela road	5/6	5/8	78	1.56	6,384	6,780	8,360	14,639	29,397
19	E-001	Kottawa - Godagama Section	76.7km	77.2km	18	0.60	9,169	9,729	16,679	29,053	47,604
20	E-001	Kottawa - Godagama Section	77.9km	79.0km	18	0.60	9,169	9,729	16,679	29,053	47,604
22	E-001	Kottawa - Godagama Section	88.0km	88.8km	28	0.93	11,663	12,377	20,161	39,815	71,995
23	E-001	Kottawa - Godagama Section	89.3km	89.6km	28	0.93	11,663	12,377	20,161	39,815	71,995
25	E-001	Kottawa - Godagama Section	101.3km	101.7km	20	0.67	6,393	6,786	12,757	25,962	48,695
25ad2	E-001	Kottawa - Godagama Section	108.6	108.7	20	0.67	6,393	6,786	12,757	25,962	48,695
26	B-274	Matale-Illukkumbura-Laggala road	11/2	11/4	114	3.80	2,790	2,978	4,662	7,314	15,435
27	B-462	Wattegama - Matale road	6+030	6+100	30	1.00	2,586	2,749	3,767	6,491	13,737
31	A-001	Colombo - Kandy road	99/8	99 km	110	2.20	38,738	41,106	51,354	64,495	132,043
33	A-004	Colombo-Ratnapura-Wellawaya-Batticaloa road	171/5	171/7	270	5.40	14,162	15,060	20,801	28,503	64,122
34	A-004	Colombo-Ratnapura-Wellawaya-Batticaloa road	183km	185/14	74	1.48	1,557	1,660	3,041	5,054	11,313
36	B-149	Hatton - Maskeleiya - Delhouse road	9.000	9.100	42	1.40	1,992	2,118	2,745	3,564	8,557
37	B-036	Badulla - Karametiya - Andaulpotha road	4/11	5/3	112	3.73	7,549	8,034	12,585	19,919	43,129
39	B-122	Galagedara - Rambukkana	8/2	8/4	44	1.47	5,895	6,263	8,004	10,266	25,044
40	B-122	Galagedara - Rambukkana	18/3	18/5	44	1.47	5,895	6,263	8,004	10,266	25,044
43	A-017	Galle-Deniyaya-Madampe road	139	140/1	226	4.52	6,632	7,049	11,671	18,176	39,875
48	B-390	Ratnapura- Palawela-Karavita road	12/4	12/7	39	1.30	4,234	4,497	7,535	11,393	27,940
49	B-390	Ratnapura- Palawela-Karavita road	20/9	21/3	39	1.30	4,234	4,497	7,535	11,393	27,940
51	B-188	Kaluaggala - Labugama road	12/4	12/6	32	1.07	2,580	2,745	4,011	6,692	13,688
53	A-017	Galle-Deniyaya-Madampe road (Morawakkanda Landslide)	62km	62.25km	226	4.52	12,835	13,633	24,102	36,990	77,413

Source: JICA Survey Team

4) Benefit of Reduction of "Travel Time Cost (TTC) due to Detour"

It is expected that landslide disasters are prevented under the "With Project" condition, and the incremental travel time cost due to detour will be reduced. Reduction of the travel time cost is considered as one of the benefits of the Project. The average annual benefit of reduction of travel time cost is calculated by the following equations:

Incremental Travel Time Cost per day × *Period of Temporary Recovery Works (Road Closure)* × *Occurrence probability* = *Average Annual Benefit of Reduction of Travel Time Cost*

Once a landslide disaster occurs, temporary recovery works will be implemented to secure the traffic. During the recovery works, the road section is blocked, and detour of the vehicles will be needed until completion of the recovery works. The period of road closure (period of detour) is estimated on the following assumption:

a. Landslide, Debris Flow, and Slope Failure

- Period of recovery work is estimated by necessary earthwork volume divided by approximately. m^3/day (assumed efficiency of earthwork per day).
- 40% of unworkable days is added, since landslide disasters are prone to occur during the rainy season.

b. Rock Fall

- The duration of road closure due to rock fall is assumed to be three days in order to check the safety of the site and surrounding areas.
- In case of expressways, only one side is assumed to be affected (assumed half of traffic).

Average annual benefit of reduction of travel time cost is presented in **Table 8.5.25**.

Table 8.5.25 Average Annual Benefit of Reduction of TTC up to 2040

No.	Route No	Name of the Road	Location		Period of recovery works (days)	Occur-rence proba-bility	Ave. annual days of road closure	Average Annual Benefit of Reduction of TTC (LKR.1000)				
			Start (km/cul.)	End (km/cul.)				2019)	2020	2025)	2030	2040
1	B-413	Tennekumbura - Rikillagaskada - Ragala road	66.75km	67km	113	0.150	16.95	59,134	63,147	104,436	169,337	356,353
2	A-005	Peradeniya - Badulla - Chenkaladi road	46/2	46/3	134	0.150	20.10	275,589	292,721	465,877	736,587	1,595,933
4	B-391	Ratnapura - Wewalwatta road	11.9 km	12.0 km	42	0.100	4.20	13,077	13,933	17,235	21,437	41,508
6	B-412	Tawalanthenna-Thalawakele road	30/9	30/11	78	0.067	5.20	12,388	13,191	22,196	36,091	80,212
7	A-005	Peradeniya - Badulla - Chenkaladi road	30/9	30/11	49	0.040	1.96	20,973	22,277	38,716	53,744	121,440
8	A-005	Peradeniya - Badulla - Chenkaladi road	28/4	28/6	56	0.100	5.60	90,599	96,234	167,414	235,300	511,325
9	A-007	Avissawella - Hatton - Nuwaraeliya	3/3	3/5	33	0.100	3.30	105,866	112,381	150,013	215,623	433,863
10	A-016	Beragala - Haliela road	3.85km	4.2km	3	3.000	9.00	57,455	61,016	75,237	131,755	264,577
11	A-016	Beragala - Haliela road	5/2	5/4	3	3.000	9.00	57,455	61,016	75,237	131,755	264,577
12	A-016	Beragala - Haliela road	5/6	5/8	3	3.000	9.00	57,455	61,016	75,237	131,755	264,577
19	E-001	Kottawa - Godagama Section	76.7km	77.2km	3	1.000	3.00	13,754	14,593	25,019	43,580	71,407
20	E-001	Kottawa - Godagama Section	77.9km	79.0km	3	1.000	3.00	13,754	14,593	25,019	43,580	71,407
22	E-001	Kottawa - Godagama Section	88.0km	88.8km	3	1.000	3.00	17,494	18,565	30,242	59,722	107,992
23	E-001	Kottawa - Godagama Section	89.3km	89.6km	3	1.000	3.00	17,494	18,565	30,242	59,722	107,992
25	E-001	Kottawa - Godagama Section	101.3km	101.7km	92	0.200	18.40	58,819	62,435	117,361	238,846	447,994

25ad2	E-001	Kottawa - Godagama Section	108.6	108.7	3	1.000	3.00	9,590	10,180	19,135	38,942	73,042
26	B-274	Matale-Illukkumbura-Laggala road	11/2	11/4	127	0.100	12.70	35,427	37,816	59,207	92,888	196,028
27	B-462	Wattegama - Matale road	6+030	6+100	64	0.100	6.40	16,549	17,593	24,107	41,539	87,918
31	A-001	Colombo - Kandy road	99/8	99 km	27	0.100	2.70	104,591	110,987	138,655	174,137	356,515
33	A-004	Colombo-Ratnapura-Wellawaya-Batticaloa road	171/5	171/7	3	0.200	0.60	8,497	9,036	12,481	17,102	38,473
34	A-004	Colombo-Ratnapura-Wellawaya-Batticaloa road	183km	185/14	212	0.040	8.48	13,200	14,078	25,784	42,860	95,933
36	B-149	Hatton - Maskeleiya - Delhouse road	9.000	9.100	113	0.100	11.30	22,510	23,933	31,016	40,278	96,694
37	B-036	Badulla - Karametiya - Andaulpotha road	4/11	5/3	22	0.100	2.20	16,608	17,674	27,687	43,822	94,884
39	B-122	Galagedara - Rambukkana	8/2	8/4	82	0.200	16.40	96,679	102,719	131,263	168,369	410,722
40	B-122	Galagedara - Rambukkana	18/3	18/5	46	0.200	9.20	54,235	57,623	73,635	94,451	230,405
43	A-017	Galle-Deniyaya-Madampe road	139	140/1	64	0.100	6.40	42,442	45,115	74,692	116,327	255,201
48	B-390	Ratnapura- Palawela-Karavita road	12/4	12/7	57	0.100	5.70	24,136	25,632	42,947	64,938	159,260
49	B-390	Ratnapura- Palawela-Karavita road	20/9	21/3	82	0.100	8.20	34,721	36,873	61,783	93,420	229,111
51	B-188	Kaluaggala - Labugama road	12/4	12/6	19	0.100	1.90	4,901	5,215	7,620	12,714	26,008
53	A-017	Galle-Deniyaya-Madampe road (Morawakkanda Landslide)	62km	62.25km	78	0.100	7.80	100,109	106,338	187,994	288,520	603,820
Total:								**1,455,502**	**1,546,495**	**2,337,488**	**3,639,142**	**7,695,171**

Note: Average annual benefit of reduction of TTC is expressed in economic price (constant 2019 price)
Source: JICA Survey Team

8.5.3 Reduction of "Vehicle Operation Cost (VOC) due to Detour"

(1) Estimation of Unit Value of Vehicle Operation Cost (VOC) by Type of Vehicle

As in the case of travel time cost, when traffic is interrupted due to a landslide disaster, it is necessary to travel a longer distance than usual by detouring in order to travel to the destination. This incremental vehicle operation cost (VOC) is considered a loss for the national economy.

Under the "With Project" condition, the risk of landslide disaster is reduced, and such incremental vehicle operation cost is saved. It is considered as another benefit of the Project. The vehicle operation cost includes capital cost, fuel cost, lubricant cost, tire cost, regular maintenance cost, insurance cost, and labour (driver) cost. The latest price and tax information have been used to estimate the VOC. The estimation of the VOC per km by type of vehicle is presented in **Table 8.5.26**.

Table 8.5.26 Estimation of Unit Value of Vehicle Operation Cost (VOC) per km by Type of Vehicle

(Constant 2019 price)

Item	Unit	Vehicle Type						
		Car	Motor Cycle	Three-wheeler	Medium Bus	Large Bus	Pickup Truck	Medium-Large Truck
		Toyota Yaris 1300	TVS Metro 100cc	Bajaj 4 stroke	TATA LP407	Tata LPO 1515	Tata Super Ace	Tata LPT1615
Price of Vehicle								
Market price of vehicle	LKR	7,000,000	238,000	862,100	3,550,000	6,475,000	2,075,000	4,425,000
(Import duty)	%	Fixed amount	90%	105%	12%	12%	Fixed amount	Fixed amount
	LKR	4,160,000	112,736	383,968	380,357	693,750	650,000	1,000,000
(VAT) (15%)	LKR	913,043	Exempted	112,447	Exempted	Exempted	Exempted	Exempted
(Tax total)	v	5,073,043	112,736	496,415	380,357	693,750	650,000	1,000,000
Economic price of vehicle		1,926,957	125,264	365,685	3,169,643	5,781,250	1,425,000	3,425,000
Capital Cost per km								
Average annual distance of vehicles	km	30,000	20,000	50,000	100,000	100,000	100,000	100,000
Average life of vehicles	years	10	10	6	5	5	5	5
Average life distance	km	300,000	200,000	300,000	500,000	500,000	500,000	500,000
Economic cost per km	LKR/km	6.42	0.63	1.22	6.34	11.56	2.85	6.85
Fuel Cost	Type	Gasoline	Gasoline	Gasoline	Diesel	Diesel	Diesel	Diesel
Fuel cost per liter	LKR/liter	138	138	138	104	104	104	104
Tax on fuel per liter (49%)	LKR/liter	45	45	45	34	34	34	34
Fuel consumption (distance per liter)	km/liter	12	65	30	7	4	16	4
Economic fuel cost per km	LKR/km	7.75	1.43	3.10	10.00	17.50	4.38	17.50
Lubricant	Type	Gasoline engine	Gasoline engine	Gasoline engine	Diesel engine	Diesel engine	Diesel engine	Diesel engine
Price of lubricant per liter	LKR	1,355	1,355	1,355	1200	1200	1,200	1200
Tax on lubricant per liter (49%)	LKR	445	445	445	394	394	394	394
Capacity of lubricant of vehicle	liter	4	1	1.5	7	15	5	12
Interval of changing oil	km	5,000	2,500	3,000	10,000	10,000	10,000	10,000
Economic cost per km	LKR/km	0.73	0.36	0.46	0.56	1.21	0.40	0.97
Tire Cost								
Market price of tire (total per vehicle)	LKR	48,000	11,362	11,850	132,000	360,000	48,000	360,000
(Import duty) (30%)	LKR	9,632	2,280	2,378	26,488	72,240	9,632	72,240
(VAT) (15%)	LKR	6,260	1,482	1,545	17,217	46,956	6,260	46,956
(Tax total)	LKR	15,892	3,762	3,923	43,705	119,196	15,892	119,196
Average life of tires	km	30,000	15,000	35,000	50,000	50,000	50,000	50,000
Number of tires	Nos	4	2	3	6	6	4	6
Economic cost per km	LKR/km	1.07	0.51	0.23	1.77	4.82	0.64	4.82
Regular Maintenance Cost								
Market price per year	LKR	12,000	2,000	3,000	12,000	14,000	12,000	14,000
(VAT) (15%)	LKR	1,565	260	391	1,565	1,826	1,565	1,826
Frequency of regular maintenance	km	5,000	2,500	3,000	10,000	10,000	10,000	10,000

Item	Unit	Vehicle Type						
		Car	Motor Cycle	Three-wheeler	Medium Bus	Large Bus	Pickup Truck	Medium-Large Truck
		Toyota Yaris 1300	TVS Metro 100cc	Bajaj 4 stroke	TATA LP407	Tata LPO 1515	Tata Super Ace	Tata LPT1615
Economic cost per km	LKR /km	2.09	0.70	0.87	1.04	1.22	1.04	1.22
Insurance Cost								
Average insurance cost per year	LKR	144,480	13,009	14,456	58,025	102,037	38,695	75,091
(VAT) (15%)	LKR	18,845	1,696	1,885	7,568	13,309	5,047	9,794
(Other tax charges)	LKR	429	38	42	172	303	114	222
(NBL)	LKR	2,512	226	251	1,009	1,775	673	1,306
(Tax total)	LKR	21,786	1,960	2,178	8,749	15,387	5,834	11,322
Economic cost of annual insurance	LKR/year	122,694	11,049	12,278	49,276	86,650	32,861	63,769
Economic cost per km	LKR /km	4.09	0.55	0.25	0.49	0.87	0.33	0.64
Labor Cost				Rs. 300/= per day				
Driver's labor cost per month	LKR	0	0	7,800	50,000	60,000	40,000	60,000
Driver's labor cost per km	LKR /km	0.00	0.00	1.87	6.00	7.20	4.80	7.20
Vehicle Operation Cost (VOC) per km	LKR km	**22.15**	**4.18**	**7.99**	**26.21**	**44.37**	**14.44**	**39.19**

Source: JICA Survey Team

(2) Incremental Vehicle Operation Cost due to Detour

Based on the unit value of VOC, the future traffic demand, the detour distance above, the incremental vehicle operation cost per day has been estimated as shown in **Table 8.5.27**. The future value of VOC per day has also been estimated by using the future traffic demand forecast up to 2040.

Table 8.5.27 Incremental Vehicle Operation Cost per Day up to 2040

No.	Route No	Name of the Road	Location		Detour		Incremental VOC per day (LKR 1000)				
			Start (km/cul.)	End (km/cul.)	Distance (km)	Time (hr)	2019	2020	2025	2030	2040
1	B-413	Tennekumbura - Rikillagaskada - Ragala road	66.75km	67km	127	4.23	3,306	3,397	4,607	6,090	8,394
2	A-005	Peradeniya - Badulla - Chenkaladi road	46/2	46/3	195	3.90	17,231	17,617	22,994	29,641	42,062
4	B-391	Ratnapura - Wewalwatta road	11.9 km	12.0 km	78	2.60	2,625	2,688	2,727	2,765	3,506
6	B-412	Tawalanthenna-Thalawakele road	30/9	30/11	63	2.10	2,177	2,230	3,077	4,079	5,937
7	A-005	Peradeniya - Badulla - Chenkaladi road	30/9	30/11	195	3.90	13,446	13,750	19,596	22,179	32,823
8	A-005	Peradeniya - Badulla - Chenkaladi road	28/4	28/6	195	3.90	21,914	22,399	31,956	36,619	52,118
9	A-007	Avissawella - Hatton - Nuwaraeliya	3/3	3/5	182	3.64	45,941	46,911	51,354	60,182	79,310
10	A-016	Beragala - Haliela road	3.85km	4.2km	78	1.56	8,627	8,816	8,915	12,729	16,741
11	A-016	Beragala - Haliela road	5/2	5/4	78	1.56	8,627	8,816	8,915	12,729	16,741
12	A-016	Beragala - Haliela road	5/6	5/8	78	1.56	8,627	8,816	8,915	12,729	16,741
19	E-001	Kottawa - Godagama Section	76.7km	77.2km	18	0.60	6,198	6,327	8,896	12,634	13,558
20	E-001	Kottawa - Godagama Section	77.9km	79.0km	18	0.60	6,198	6,327	8,896	12,634	13,558
22	E-001	Kottawa - Godagama Section	88.0km	88.8km	28	0.93	7,884	8,049	10,753	17,313	20,504
23	E-001	Kottawa - Godagama Section	89.3km	89.6km	28	0.93	7,884	8,049	10,753	17,313	20,504
25	E-001	Kottawa - Godagama Section	101.3km	101.7km	20	0.67	4,322	4,414	6,804	11,289	13,868
25ad2	E-001	Kottawa - Godagama Section	108.6	108.7	20	0.67	4,322	4,414	6,804	11,289	13,868
26	B-274	Matale-Illukkumbura-Laggala road	11/2	11/4	114	3.80	2,726	2,802	3,598	4,602	6,361
27	B-462	Wattegama - Matale road	6+030	6+100	30	1.00	2,231	2,282	2,565	3,603	4,995
31	A-001	Colombo - Kandy road	99/8	99 km	110	2.20	51,184	52,248	53,530	54,812	73,496
33	A-004	Colombo-Ratnapura-Wellawaya-Batticaloa road	171/5	171/7	270	5.40	21,904	22,391	25,364	28,337	41,751
34	A-004	Colombo-Ratnapura-Wellawaya-Batticaloa road	183km	185/14	74	1.48	2,729	2,793	4,196	5,686	8,336
36	B-149	Hatton - Maskeleiya - Delhouse road	9.000	9.100	42	1.40	1,771	1,813	1,927	2,040	3,208
37	B-036	Badulla - Karametiya - Andaulpotha road	4/11	5/3	112	3.73	8,723	8,927	11,468	14,799	20,987
39	B-122	Galagedara - Rambukkana	8/2	8/4	44	1.47	5,245	5,360	5,617	5,874	9,385
40	B-122	Galagedara - Rambukkana	18/3	18/5	44	1.47	5,245	5,360	5,617	5,874	9,385
43	A-017	Galle-Deniyaya-Madampe road	139	140/1	226	4.52	8,797	8,991	12,207	15,501	22,272
48	B-390	Ratnapura- Palawela-Karavita road	12/4	12/7	39	1.30	3,737	3,818	5,246	6,468	10,389
49	B-390	Ratnapura- Palawela-Karavita road	20/9	21/3	39	1.30	3,737	3,818	5,246	6,468	10,389
51	B-188	Kaluaggala - Labugama road	12/4	12/6	32	1.07	3,186	3,257	3,903	5,309	7,112
53	A-017	Galle-Deniyaya-Madampe road (Morawakkanda Landslide)	62km	62.25km	226	4.52	22,118	22,601	32,768	41,002	56,200

Source: JICA Survey Team

(3) Benefit of Reduction of "Vehicle Operation Cost due to Detour"

It is expected that landslide disasters are prevented under the "With Project" condition and that the incremental vehicle operation cost due to detour will be reduced. Reduction of the vehicle operation cost is considered as one of the benefits of the Project. The average annual benefit of reduction of vehicle operation cost is calculated using the following equation:

Incremental Vehicle Operation Cost per day × *Period of Temporary Recovery Works (Road Closure)* × *Occurrence probability* = *Average Annual Benefit of Reduction of Vehicle Operation Cost*

Average annual benefit of reduction of vehicle operation cost is estimated as shown in **Table 8.5.28**.

Table 8.5.28 Average Annual Benefit of Reduction of VOC up to 2040

No.	Route No	Name of the Road	Location		Period of recovery works (days)	Occur-rence proba-bility	Ave. annual days of road closure	Average Annual Benefit of Reduction of VOC (LKR 1,000)				
			Start (km/cul.)	End (km/cul.)				2019	2020	2025)	2030	2040
1	B-413	Tennekumbura - Rikillagaskada - Ragala road	66.75km	67km	113	0.150	16.95	56,039	57,571	78,085	103,227	142,273
2	A-005	Peradeniya - Badulla - Chenkaladi road	46/2	46/3	134	0.150	20.10	346,351	354,105	462,186	595,789	845,444
4	B-391	Ratnapura - Wewalwatta road	11.9 km	12.0 km	42	0.100	4.20	11,023	11,288	11,451	11,613	14,727
6	B-412	Tawalanthenna-Thalawakele road	30/9	30/11	78	0.067	5.20	11,321	11,594	16,000	21,211	30,875
7	A-005	Peradeniya - Badulla - Chenkaladi road	30/9	30/11	49	0.040	1.96	26,354	26,949	38,409	43,471	64,333
8	A-005	Peradeniya - Badulla - Chenkaladi road	28/4	28/6	56	0.100	5.60	122,720	125,434	178,955	205,067	291,858
9	A-007	Avissawella - Hatton - Nuwaraeliya	3/3	3/5	33	0.100	3.30	151,605	154,806	169,469	198,600	261,722
10	A-016	Beragala - Haliela road	3.85km	4.2km	3	3.000	9.00	77,639	79,346	80,238	114,561	150,669
11	A-016	Beragala - Haliela road	5/2	5/4	3	3.000	9.00	77,639	79,346	80,238	114,561	150,669
12	A-016	Beragala - Haliela road	5/6	5/8	3	3.000	9.00	77,639	79,346	80,238	114,561	150,669
19	E-001	Kottawa - Godagama Section	76.7km	77.2km	3	1.000	3.00	9,297	9,491	13,344	18,951	20,337
20	E-001	Kottawa - Godagama Section	77.9km	79.0km	3	1.000	3.00	9,297	9,491	13,344	18,951	20,337
22	E-001	Kottawa - Godagama Section	88.0km	88.8km	3	1.000	3.00	11,826	12,074	16,130	25,970	30,756
23	E-001	Kottawa - Godagama Section	89.3km	89.6km	3	1.000	3.00	11,826	12,074	16,130	25,970	30,756
25	E-001	Kottawa - Godagama Section	101.3km	101.7km	92	0.200	18.40	39,760	40,605	62,595	103,862	127,589
25ad2	E-001	Kottawa - Godagama Section	108.6	108.7	3	1.000	3.00	6,483	6,620	10,206	16,934	20,803
26	B-274	Matale-Illukkumbura-Laggala road	11/2	11/4	127	0.100	12.70	34,627	35,588	45,695	58,449	80,786
27	B-462	Wattegama - Matale road	6+030	6+100	64	0.100	6.40	14,279	14,607	16,414	23,060	31,965
31	A-001	Colombo - Kandy road	99/8	99 km	27	0.100	2.70	138,196	141,069	144,531	147,993	198,440
33	A-004	Colombo-Ratnapura-Wellawaya-Batticaloa road	171/5	171/7	3	0.200	0.60	13,142	13,435	15,218	17,002	25,050
34	A-004	Colombo-Ratnapura-Wellawaya-Batticaloa road	183km	185/14	212	0.040	8.48	23,145	23,687	35,579	48,219	70,686
36	B-149	Hatton - Maskeleiya - Delhouse road	9.000	9.100	113	0.100	11.30	20,016	20,486	21,774	23,053	36,246
37	B-036	Badulla - Karametiya - Andaulpotha road	4/11	5/3	22	0.100	2.20	19,192	19,639	25,230	32,558	46,170
39	B-122	Galagedara - Rambukkana	8/2	8/4	82	0.200	16.40	86,023	87,901	92,119	96,337	153,916
40	B-122	Galagedara - Rambukkana	18/3	18/5	46	0.200	9.20	48,257	49,310	51,677	54,043	86,343
43	A-017	Galle-Deniyaya-Madampe road	139	140/1	64	0.100	6.40	56,299	57,541	78,127	99,203	142,538

48	B-390	Ratnapura- Palawela-Karavita road	12/4	12/7	57	0.100	5.70	21,303	21,763	29,905	36,867	59,217
49	B-390	Ratnapura- Palawela-Karavita road	20/9	21/3	82	0.100	8.20	30,646	31,308	43,021	53,036	85,189
51	B-188	Kaluaggala - Labugama road	12/4	12/6	19	0.100	1.90	6,054	6,188	7,415	10,087	13,513
53	A-017	Galle-Deniyaya-Madampe road (Morawakkanda Landslide)	62km	62.25km	78	0.100	7.80	172,519	176,286	255,590	319,813	438,360
Total:								**1,730,515**	**1,768,948**	**2,189,312**	**2,753,019**	**3,822,235**

Note: Average annual benefit of reduction of VOC is expressed in economic price (constant 2019 price)
Source: JICA Survey Team

8.5.4 Annual Economic Benefit

Based on the three main benefits discussed above, the total annual economic benefit has been estimated as shown in **Table 8.5.29**. Since the benefits of reduction of TTC and VOC were estimated for the year 2019, 2020, 2025, 2030 and 2040, the benefits of the years in between them are assumed to increase linearly. The benefits after 2040 are assumed to continue the same level of those for 2040.

Table 8.5.29 Annual Economic Benefit of the Project

(Unit: million LKR/year)

Year	Reduction of TTC	Reduction of VOC	Reduction of Recovery Cost	Total Benefit
2020	1,546.5	1,768.9	134.1	3,449.5
2021	1,704.7	1,853.0	134.1	3,691.8
2022	1,862.9	1,937.1	134.1	3,934.1
2023	2,021.1	2,021.2	134.1	4,176.3
2024	2,179.3	2,105.2	134.1	4,418.6
2025	2,337.5	2,189.3	134.1	4,660.9
2026	2,597.8	2,296.2	134.1	5,028.1
2027	2,858.1	2,403.2	134.1	5,395.4
2028	3,118.5	2,510.1	134.1	5,762.6
2029	3,378.8	2,617.0	134.1	6,129.9
2030	3,639.1	2,753.0	134.1	6,526.2
2031	4,044.7	2,859.9	134.1	7,038.8
2032	4,450.3	2,966.9	134.1	7,551.3
2033	4,856.0	3,073.8	134.1	8,063.8
2034	5,261.6	3,180.7	134.1	8,576.3
2035	5,667.2	3,287.6	134.1	9,088.9
2036	6,072.8	3,394.5	134.1	9,601.4
2037	6,478.4	3,501.5	134.1	10,113.9
2038	6,884.0	3,608.4	134.1	10,626.4
2039	7,289.6	3,715.3	134.1	11,138.9
2040	7,695.2	3,822.2	134.1	11,651.5
2041	7,695.2	3,822.2	134.1	11,651.5
2042	7,695.2	3,822.2	134.1	11,651.5
2043	7,695.2	3,822.2	134.1	11,651.5
2044	7,695.2	3,822.2	134.1	11,651.5
2045	7,695.2	3,822.2	134.1	11,651.5
2046	7,695.2	3,822.2	134.1	11,651.5
2047	7,695.2	3,822.2	134.1	11,651.5
2048	7,695.2	3,822.2	134.1	11,651.5
2049	7,695.2	3,822.2	134.1	11,651.5
2050	7,695.2	3,822.2	134.1	11,651.5
2051	7,695.2	3,822.2	134.1	11,651.5
2052	7,695.2	3,822.2	134.1	11,651.5
2053	7,695.2	3,822.2	134.1	11,651.5
2054	7,695.2	3,822.2	134.1	11,651.5
2055	7,695.2	3,822.2	134.1	11,651.5
2056	7,695.2	3,822.2	134.1	11,651.5
2057	7,695.2	3,822.2	134.1	11,651.5
2058	7,695.2	3,822.2	134.1	11,651.5
2059	7,695.2	3,822.2	134.1	11,651.5

Source: JICA Survey Team

The benefits before the year 2026 were calculated, but they are not utilized since the landslide countermeasure works will be partially completed in 2026 and will begin to take effect from 2026.

8.6 Economic Project Cost

8.6.1 Project Cost

As discussed in Subsection 9.3 Basic Condition, in the economic analysis, the concept of economic price is used to evaluate the benefit and the cost of the project. Therefore, the market price should be converted into the economic price to reflect its true value. In this study, an SCF has been used to convert financial prices into economic prices. The SCF of 0.844 is applied for the LC portion of financial cost. No price adjustment has been made for the FC portion, since it is considered that FC portion already reflects true economic value through market mechanism.

Table 8.6.1 Financial and Economic Project Cost

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8.6.2 Operation and Maintenance Cost

In order for the landslide countermeasure facilities to function as expected, proper inspection and maintenance are essential.

(1) Inspection Cost

Inspection of the landslide countermeasure facilities consists of two levels of inspection, i.e., routine inspection and periodic inspection. The inspection cost has been estimated on the following conditions shown in **Table 8.6.2**:

Table 8.6.2 Condition of Estimation of Inspection Cost

Type of Inspection	Condition of Estimate		
	Frequency	Quantity	Reference
Routine Inspection (conducted during regular patrol)	2 times/year	• 1 Engineer, 1 common worker, 1 driver • 3 sites per day • Direct cost is assumed at 7% of labour costs • 50km of VOC of pickup truck is assumed to travel to and from a site	• Standard labour cost is used • Manual on O&M of landslide countermeasures works in Japan • VOC of pickup truck is used
Periodic Inspection	Once/ 5 year	• 1 Engineer, 2 common workers, 1 special worker, 1 driver • 2 sites per day • Direct cost is assumed at 7% of labour costs • 50km of VOC of pickup truck is assumed to travel to and from a site	• Standard labour cost is used • Manual on O&M of landslide countermeasures works in Japan • VOC of pickup truck is used

Source: JICA Survey Team

Based on the basic condition discussed above, the cost of the routine and periodic inspections is estimated and presented in **Table 8.6.3**.

Table 8.6.3 Condition of Estimation of Inspection Cost

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(2) Repair and Replacement Cost

Based on the routine and periodic inspections, if any damage is found, repair works will be implemented in order to keep the facilities in good condition. Meanwhile, the useful lifetime of such facilities, like rockfall prevention fences and nets are made of metallic materials, and replacement of the facilities are necessary. Conditions of estimation of such repair and replacement costs are shown in **Table 8.6.4**.

Table 8.6.4 Condition of Estimation of Repair and Replacement Costs

Type of Maintenance	Condition of Estimate		
	Frequency	Quantity	Reference
Cleaning of drainage channel	once/year	• Total length of drainage	• Standard unit price in Sri Lanka
Repair of slope frame	once/ 10 years	• 5% of slope frame areas	• Unit price of construction of slope frame in Japan
Cleaning of horizontal boring holes	once/ 10 years	• Total length of horizontal boring holes for water collecting	• Labour cost in Sri Lanka is applied for the standard productivity in Japan
Re-tensing of ground anchors	once/ 25 years	• Numbers of ground anchors	• Labour cost in Sri Lanka is applied for the standard productivity in Japan
Replacement of rockfall prevention fences and nets	once/ 25 years	• Numbers of rockfall prevention fences and nets	• Unit price of construction of rockfall prevention fence and net in Japan
Repair of channel works for erosion control	once/ 10 years	• 5% of concrete volume of channel works for erosion control	• Unit price of construction of channel works for erosion control in Japan

Source: JICA Survey Team

Based on the basic condition discussed above, the costs of the repair and replacement works have been estimated for all the candidate sites. The repair and replacement costs are converted to the economic price by multiplying an SCF of 0.844. The estimated repair and replacement costs are presented in the tables below.

Table 8.6.5 Repair and Replacement Cost of Landslide Countermeasure Facilities (1/7)

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Table 8.6.6 Repair and Replacement Cost of Landslide Countermeasure Facilities (2/7)

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Table 8.6.7 Repair and Replacement Cost of Landslide Countermeasure Facilities (3/7)

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Table 8.6.8 Repair and Replacement Cost of Landslide Countermeasure Facilities (4/7)

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Table 8.6.9 Repair and Replacement Cost of Landslide Countermeasure Facilities (5/7)

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Table 8.6.10 Repair and Replacement Cost of Landslide Countermeasure Facilities (6/7)

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Table 8.6.11 Repair and Replacement Cost of Landslide Countermeasure Facilities (7/7)

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8.6.3 Annual Economic Cost

Based on the implementation schedule of the Project, the financial project costs are allotted in each year, and are converted to economic price as discussed in Subsection 9.6.1. The economic operation and maintenance costs are also allotted based on the scheduled frequency of the O&M works discussed in Subsection 8.6.2. The annual economic cost of the Project is presented in **Table 8.6.12**.

Table 8.6.12 Annual Economic Cost

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8.7 Economic Viability

Based on the economic benefits and costs discussed above, economic viability of the proposed landslide countermeasures has been examined by cost-benefit analysis. The results of the economic analysis are summarized in **Table 8.7.1** and the economic cash flow of the projects is presented in **Table 8.7.2**

Table 8.7.1 Results of Economic Analysis

(Constant 2019 price)

	EIRR (%)	B/C Ratio	NPV (Mil LKR)
Landslide Countermeasures for National Roads	21.1	2.15	

Note: B/C Ratio and NPV are calculated at discount rate of 12%
Source: JICA Survey Team

Table 8.7.2 Economic Cash Flow of the Project

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The results of the economic analysis indicated that the proposed landslide countermeasures have sufficient economic efficiency with an EIRR of 21.1%, B/C ratio of 2.15, and NPV of LKR million. The sensitivity analysis has been examined for the countermeasures in nine cases, 10% increase and decrease in costs and 10% increase and decrease in benefits. The countermeasures indicated sufficient economic efficiency with an EIRR of 18.7 % even under the most severe condition of cost increase by 10% and benefit decrease by 10%, as shown in **Table 8.7.3**.

Table 8.7.3 Results of Sensitivity Analysis

			Cost		
			10% Decrease	Base Case	10% Increase
Benefit	10% Increase	EIRR	24.7%	23.0%	21.5%
		B/C	2.67	2.40	2.18
		NPV			
	Base Case	EIRR	23.1%	21.1%	20.1%
		B/C	2.42	2.15	1.98
		NPV			
	10% Decrease	EIRR	21.5%	20.0%	18.7%
		B/C	2.18	1.96	1.79
		NPV			

Note: NPV is in million LKR at constant 2019 price.
Source: JICA Survey Team

From the results of economic analysis, it is recommended to implement the landslide countermeasures at the earliest opportunity in order to secure the important functions of the national road network.

8.8 Operation and Effect Indicators

JICA conducts project evaluation for improvement of the project and ensuring accountability to the public. The project evaluation should grasp the effects of the project properly and have a viewpoint that it contributes to improve the future similar projects. In order to grasp the effect properly, the indicators are set to compare the states before and after implementation of the project.

"Operation and Effect Indicators" are used to quantitatively measure the operation and effect of the project. In other words, when proposed facilities (outputs) were constructed by the project, the Operation and Effect Indicators are used to measure if the outputs are appropriately used and fulfil their expected functions. Since this project aims to secure safety road networks by reducing risks of landslide disasters to the national roads, the Operation and Effect Indicators have been set as shown in **Table 8.8.1**.

Table 8.8.1 Operation and Effect Indicators

Indicators	Original (2019)	Target (2029)
Annual days of traffic interruption (day/year) (Total value at 30 sites)	218	0
Annual cost of temporary road recovery (mil LKR/year) (Total value at 30 sites)	135	0

Source: JICA Survey Team

The indicators have been set on the condition that disasters do not exceed the design scale of the countermeasures.

Other than the Operation and Effect Indicators discussed above, in order to grasp the effectiveness of the Project from various perspectives, the following other indicators are also proposed by the JICA Survey Team as presented in **Table 8.8.2**.

Table 8.8.2 Other Indicators

Indicators	Target (2029)
• Record of operation and maintenance (O&M) activities based on the O&M manual to be prepared during the Project • Design standard for landslide countermeasure works is established based on transfer of knowledge during the Project.	• Implemented as scheduled in the O&M manual • Design standard for landslide countermeasures
• Traffic accident caused by landslide disasters at the target sites (per year) • Loss of life due to landslide disasters at the target sites (per year) • Damages (houses, household properties, agricultural properties, public utilities) due to landslide disasters at the target sites (per year)	• 0 case/ year • None/ year • No damage/ year

Source: JICA Survey Team

Chapter 9 Environmental and Social Consideration

9.1 Environmental and Social Consideration

9.1.1 Outline of the Project Components which Likely Impact Environmentally and Socially

(1) Background of the Project

Landslide disasters are among the most serious natural disasters in the Democratic Socialist Republic of Sri Lanka. Especially in mountainous and hilly areas in the central area, landslide disasters such as collapse of steep slopes and landslide frequently occur in the case of heavy rainfall during the monsoon period due to the rapid development in addition to the fragile geological characteristics and steep topographical conditions. In Landslide disasters from 2006 to 2016, approximately 400 people lost their lives throughout Sri Lanka, and the deaths and missing people caused by the disaster accounted for the largest factor. In Sri Lanka, the road network accounts for 90% of domestic passenger and freight transportation, and the disruption and blockage of the road network caused by landslide disaster cause significant economic losses.

Since 2013, "Landslide Disaster Protection Project of the National Road Network" (LDPP) has been conducted to implement slope countermeasures for major national roads in five districts of Central Province, Uva Province, and Western Sabaragamuwa Province, which are at high-risk of Landslide disaster, through Japan ODA loan. However, slope countermeasures have not yet been developed on many major national roads. Under these circumstances, the Government of Sri Lanka has received a loan from the Japan International Cooperation Agency to finance the Landslide Disaster Protection Project of the National Road Network Phase 2 (Project) which is to develop a self-sustaining system for the implementation of landslide risk reduction and landslide countermeasure works for the national main roads in nine districts, and further improve the safety of road networks and the livelihoods of the residents, thereby contributing to socioeconomic development in Sri Lanka.

(2) Objectives of the Project

The objectives of the Project are to develop a self-sustaining system for the implementation of landslide risk reduction and landslide countermeasure works on the national main roads through the implementation of landslide countermeasure works for the major national roads with high landslide risk in nine districts and further improve the safety of road networks and the livelihoods of the residents, thereby contributing to socioeconomic development in Sri Lanka.

(3) Scope of the Project

The project scopes are:

- Landslide protection for 25 sites (30 locations) of sediment disasters in 21 DS Divisions in nine (9) Districts, namely Kandy, Nuwara Eliya and Matale Districts in Central Province, Badulla District in Uva Province, Kegalle and Ratnapura Districts in Sabaragamuwa Province, Galle and Matara Districts in Southern Province and Colombo District in Western Province;
- Establishment of early warning system for landslide protection sites of national road network; and
- Capacity development for RDA and NBRO.

The outline of the project components which likely impact environmentally and socially is shown in **Table 9.1.1**.

Table 9.1.1 Outline of the Project Components

[Hidden in pre-release version]

9.1.2 Basic Environmental and Social Conditions

9.1.2.1 Natural and social environment

Basic environmental and social conditions are summarized referring to "Environmental Resource Profile" (CEA).

(1) Nuwara Eliya District

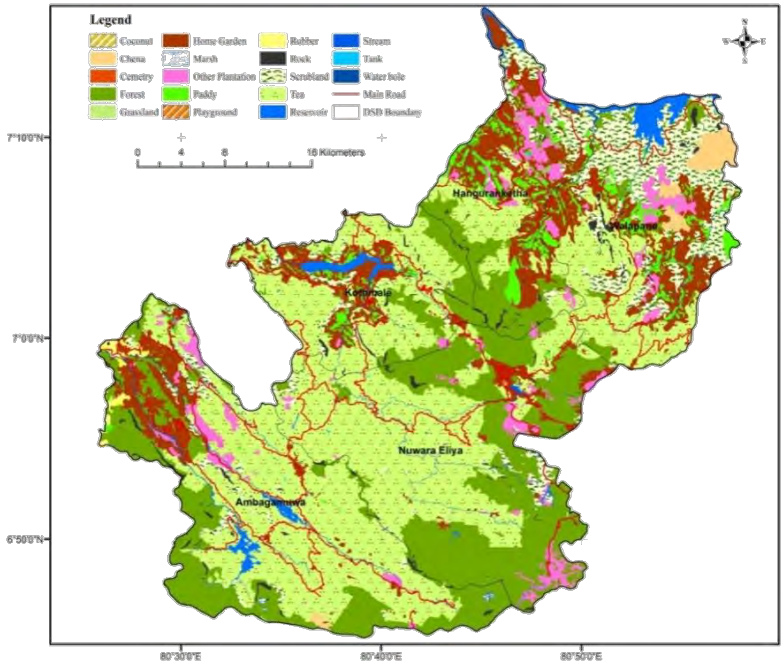
1) General Feature

Nuwara Eliya is situated in the country's highest Peneplain at an altitude of 1,868 m. The land elevation of the district varies from 3,000 feet to about 8,000 feet. The district consists of a complex landform including mountain ranges, basins, mountain summits, denuded plateaus, plains, parallel ranges and slopes. The district is surrounded by many important mountains such as Sri Pada or Adam's Peak (7,360 feet) Namunukula (6,360 feet), Kirigalpotta (7,875 feet) and Pidurutalagala (8,292 feet). The grasslands of Horton Plains, Moon Plains, Kandepola-Sita Eliya Plains and Elk plains all are situated close to the District.

It is bounded by Kandy district, Rathnapura district, Badulla district and by Kegalle district. The land area of the district is 1,720.5 square kilometers. It has 5 Divisional Secretariat divisions and 491 Grama Niladhari divisions.

2) Land Use

The land use of the district is mainly consisting of Plantations, Forest, scrublands, home gardens and water resources. Major agricultural plantation in the district is Tea, but paddy, rubber and highland crops and vegetables such as beet, leeks, and potato are also cultivated. The district is prone to landslides due to removal of natural vegetation for these cultivations.



Source: Environmental Resource Profile, CEA

Figure 9.1.1 Land Use Map of Nuwara Eliya District

3) Climate

The climate of Nuwara Eliya district is very cold. The highest rainfall (5588 mm) and the lowest temperature (7.2°C) are recorded from this district. Annual average rainfall of the district is above 1,500 mm and the annual mean daily maximum and minimum temperatures are 20.2°C and 11.6°C. The relative humidity ranges between 65% -87% during the day and 69% - 93% during the night. During the south-west monsoon the wind speed exceeds 12 km/hr. Sometimes winds are as strong as 50 km/hr.

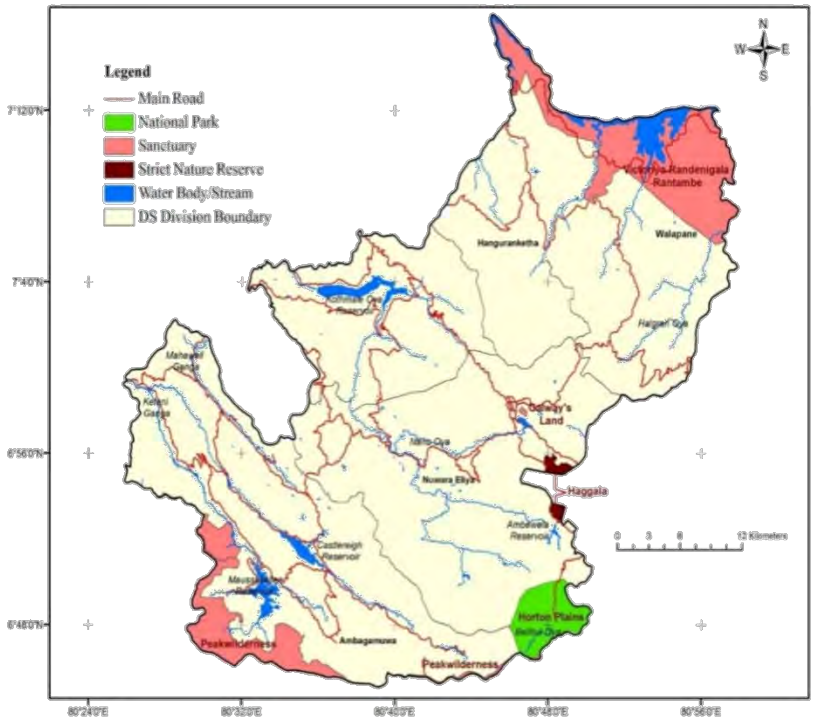
4) Forest Resources

The total forest cover of the district is 58,450 hectares and is distributed as the dense forest, Open forest, Scrublands and forest plantations. The dense forest cover of the district consists of montane temperate forests and the sub-montane evergreen forests.

The montane temperate forest confined to hills above 1500m, has low canopy reaches with about 13m in better sites. The effect of the wind on these montane ecosystems is prominent in places where wind channels are developed. The sub-montane evergreen forests are found on the Adam's Peak range around Hatton in hills between 900m to 1,350m.

5) Wildlife Protected Areas

The wildlife protected areas in the district consist of National Parks, Sanctuaries and Strict nature reserves. Horton Plains is an important National Park in the country with unique ecosystems. Horton Plains, its surroundings forests and the adjoining Peak Wilderness, constitute Sri Lanka's most important catchments area of almost all major rivers. The plains are also of outstanding scenic beauty and conservation importance, containing most of the habitats and endemic plants and animals' representatives of the country's wet and montane zones. It is well recognized for its rich biodiversity, its flora given to a high level of endemism. 5% of the species are found to be endemic to Sri Lanka. Galway's Land Bird Sanctuary, Vctoria Randenigala and Rantambe Sanctuary, Haggala strict Nature Reserve are other important wildlife sites located within the district.



Source: Environmental Resource Profile, CEA

Figure 9.1.2 Wildlife Protected Areas

6) Historical/Cultural and Archeological Important Sites

There are about 117 Historical/cultural and Archeological Important monuments within the district including old buildings, Buddhist temples, hindu kovils, Bodhi trees, Ambalama, Caves etc. Historically, this mountainous region was called as " Malaya Rata", enveloped the present day Kothmale Valley, Hewaheta, Nuwara Eliya and Walapane. In the 2nd Century BC, Prince Dutugemunu lived in Kothmale of Nuwara Eliya District in disguise due to a dispute with his father and later became the King of Magampura and King of the unified Sri Lanka. Traces of mining for Gems and Iron ore had been found on hill sides of Nuwara Eliya. Mr. Henry Cave states (in 1900) that several ancient moonstones were found at "Moon Plains" area. Also, there are remains of ancient irrigation systems in the districts which ultimately become the systems for supplying water for the rivers of the low country.

7) Settlements of Ethnic Minority Groups

According to the DCS, 2012, the total population of the district was 711,644. The major ethnic group of the district is Indian Tamil, followed by Sinhalese, Sri Lankan Tamil, Sri Lankan Moors, Burgher, Malay and others. These groups belong to different Religions where majority are Hindu, Buddhist, and then Catholic, Islam, Christians and others.

Table 9.1.2 Population by Ethnic/Religious Groups in Nuwara Eliya District

Population by ethnic group			Population by religious group		
Sinhalese	282,053	40%	Buddhist	278,254	39%
Sri Lankan Tamil	32,563	5%	Hindu	363,163	51%
Indian Tamil	377,637	53%	Catholic	33,476	5%
Sri Lankan Moor	17,652	2%	Islam	21,116	3%
Burgher	761	0.1%	Christian	15,508	2%
Malay	543	0.1%	Others	127	0.02%
Sri Lanka Chetty	75	0.01%	-	-	-
Bharatha	11	0.002%	-	-	-
Others	349	0.05%	-	-	-
Total	711,644	100%	Total	711,644	100%

Source: Department of Census and Statistics, 2012

(2) Kandy District

1) General Feature

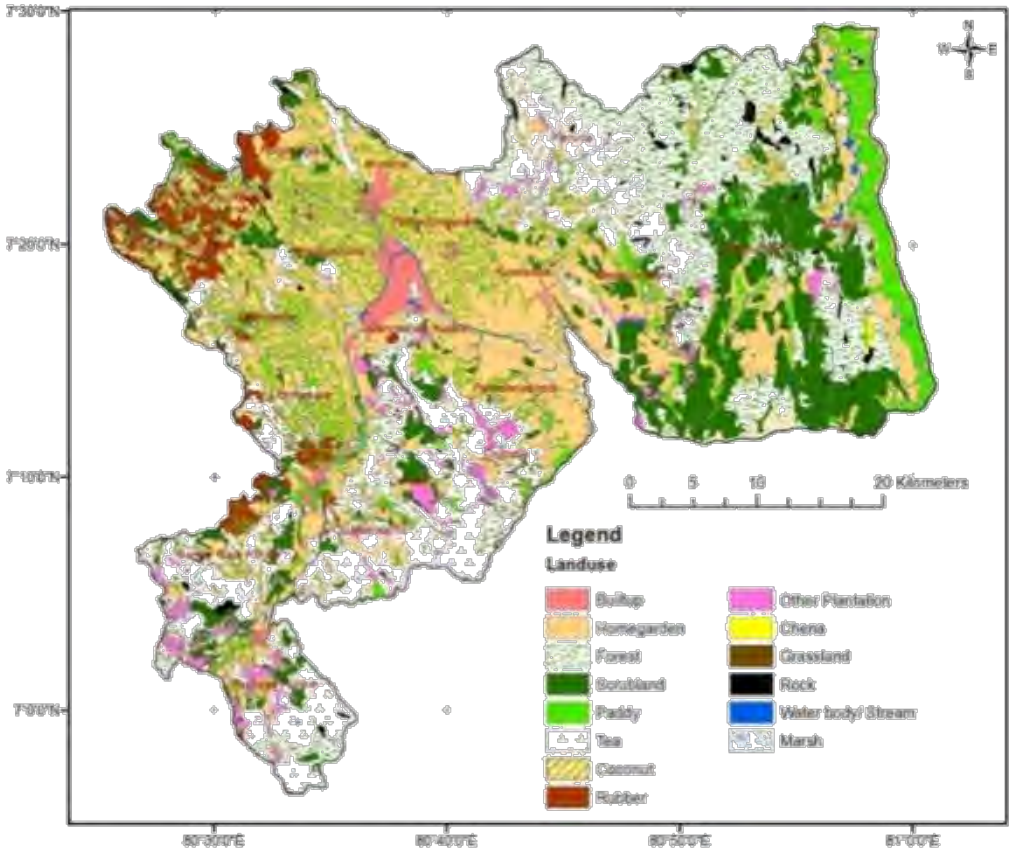
The district is the 2nd most urbanized district in Sri Lanka and the capital city of central province. The land area is 1921 km^2 which consists of 20 Divisional Secretariat Divisions and 1188 Grama Niladhari Divisions. Population is around 1,369,857 with the density of 712 per square kilometer. Kandy is famous for its cultural value especially for the Temple of Tooth Relic. The district situated in hilly topographical terrain and is bounded by Matale, Nuwara Eliya, Kurunegala, Kegalle Districts and Badulla District.

2) Climate

The average annual temperature is 22.5 –25.0°C with its highest value reached in February, March and April and the lowest temperature in December and January. Average annual rainfall is around 2000 – 2500 mm and received from south west monsoon and convectional rains. Elevation ranges from 600m to 900m unevenly throughout the district.

3) Land Use

Forests, scrublands, grasslands, rock outcrops, home garden and urban areas, tea, rubber, coconut, pinus, eucalyptus, paddy and vegetable cultivation can be found as land cover types in the district.



Source: Environmental Resource Profile, CEA

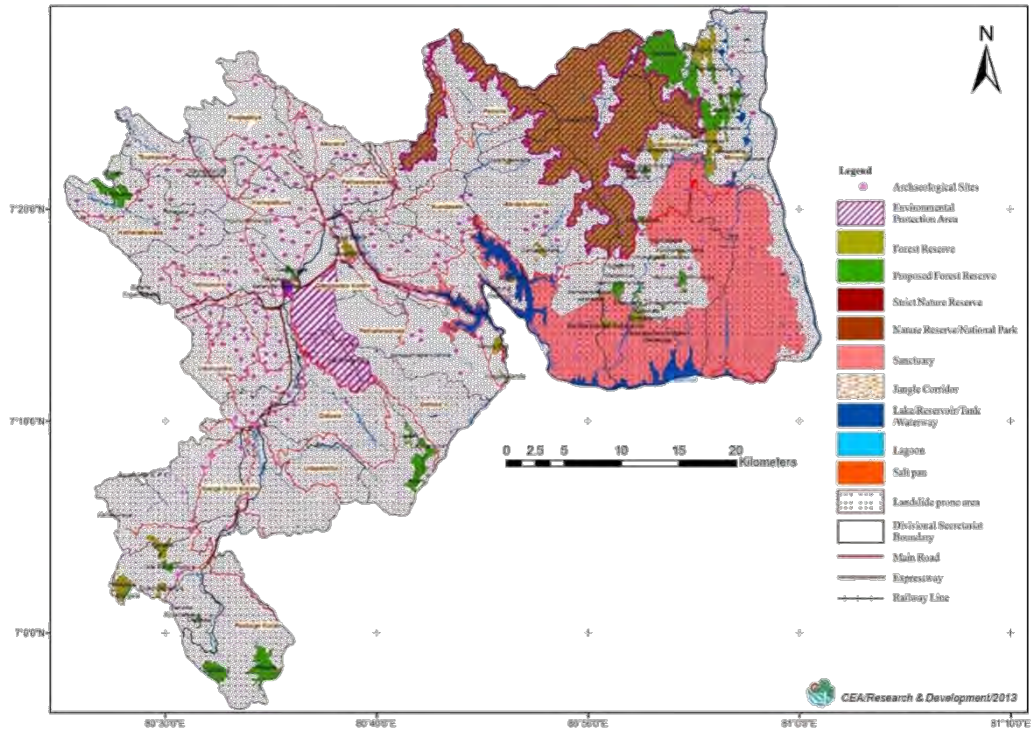
Figure 9.1.3 Land Use Map of Kandy District

4) Environment Sensitive areas

There are many environment sensitive areas in the districts including Environment Protection areas, nature reserves, forest reserves, national parks, sanctuaries, lagoons and water bodies etc.

- Environmental Protection Areas

There are two declared Environmental Protection Areas in Kandy District. The first one is Knuckels Mountain range declared under the Gazette Notification No. 1507/9 in 2007 is one of the World Heritage sites in Sri Lanka. It was declared as a climatic Reserve in 1873, a conservation forest in April 2000 and as a National Man and Biosphere Reserve. The conservation forest, extends to 312.8 km2, possess variety of climatic conditions from extreme wet rainfall of 5000mm and strong winds to nearly-arid with less than 2500mm rainfall. With variety of climatic conditions, the reserve exhibits very high floral & faunal diversity and many vegetation types. A total of 1033 flowering plant species belonging to 141 families have been recorded from the Knuckles. Out of which 288 are woody plant species and 15% of the plant species are endemic. It provides habitats to 128 bird species, 20 amphibians species, 60 butterflies species, 17 mollusk species, 31 mammal species, 53 reptile species, and 15 fish species. Many tributaries of the country origin from the range in the northern and western zones flow into the Mahaweli River.



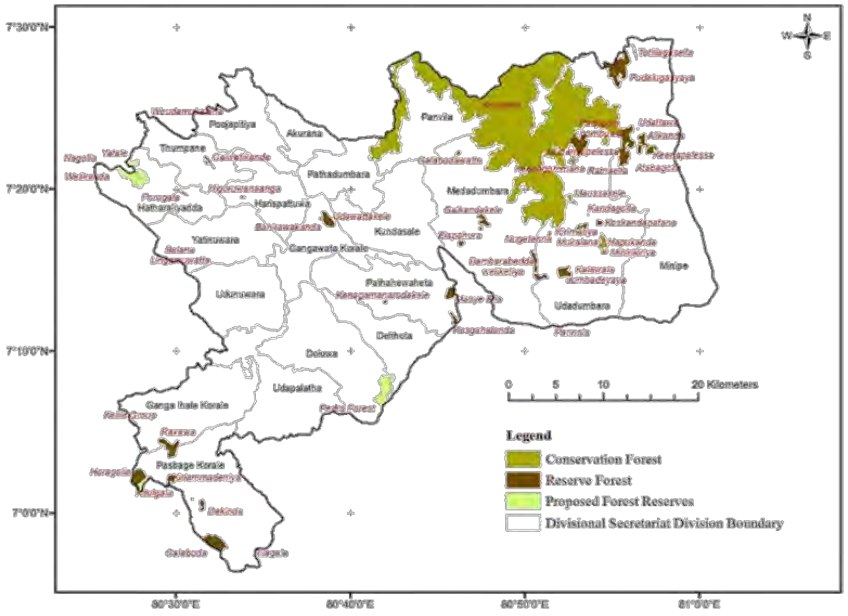
Source: Environmental Resource Profile, CEA

Figure 9.1.4 Environment Sensitive Areas

The second environment protection area is Hanthana Mountain Range declared under Gazette Notification No. 1641/ 28 in 2010. The place is rich in bio- diversity with around 200 floral species and several faunal species, including endemic and endangered species. This area has been declared by the CEA as an Environmental Protection Area as measures taken against threats, such as soil erosion, landslides, clearing of vegetation in the catchment areas, human imposed forest fires, disposal of waste, and spreading of alien invasive plant species.

- Forest Resources

The forest resources in the district include 32 reserve forests and 10 conservation forests. Other than that, there are 5 proposed forest reserves in the country.



Source: Environmental Resource Profile, CEA

Figure 9.1.5 Map of Forest Reserves

5) Wild life protected Areas:

There are two wildlife protected areas in the districts. The Victoria, Randenigala, Rantambe (VRR) sanctuary is the largest among the sanctuaries declared (in 1987) so far with an extent of 42,088.8 ha. It includes three reservoirs built across the Mahaweli River, Victoria, Randenigala and Rantambe which provide main hydroelectricity power of Sri Lanka. The different climatic conditions show diverse habitats for many plants and animals including herds of elephants.

Udawatta Kele Sanctuary or the Royal Forest Park of Kandy is the 2nd sanctuary situated which extents about 257 acres. The Government declared it as a Forest Reserve in1856 and later in 1938, as a sanctuary. The forest helps in air purification of the urban centers and water supply to Kandy Lake through its catchment area. It is rich with vegetation consisting with canopy, sub canopy and an understory with creepers. Some of the Tree species found in the forest are 'Acronychia pedunculata' (Ankenda), Adenanthera pavonina (Madatiya), Aleurites moluccana (Tel kekuna), Antidesma bunius (Karawala Kebella). Myroxylon balsamum is one of a largely spread invasive in the forest.

6) Historical/Cultural and Archeological Important Sites

The district has many Historical/cultural and Archeological Important Sites and monuments as it is the final kingdom of the island, which encountered legendary stories and ruins of ancient time period. The Temple of the Tooth Relic, one of the most sacred places of the Buddhists enshrined in Sri Dalada Maligawa, Kandy built by many kings including King Wimaladharmasuriya I (1592 - 1603), Wimaladharmasuriya II (1686 - 1706), King Viraparakrama Narendrasinha (1706 - 1738) and Sri Wickrama Rajasinghe (1797 - 1814). All the structures and buildings of the Maligawa shown architectural structures of Kandyan Period.

Kandy Lake , National Museum Kandy built during Sri Wickrama Rajasingha era (with over 5000 artifacts representing various aspects of historical and cultural events of the Kandyan period), Embekke Devalaya (an ancient shrine and a temple with world famous for its wood carvings built by king Vikramabahu the 3rd of Gampola A.D 1357-1374) , Lankathilaka Viharaya, (an ancient temple constructed in the 14th century AD by King Buvanekabahu the 4th, with a statue of a standing Buddha, designing of stonework and wood, a pillared "mandapaya" consists of 40 festooned pillars made purely out of stone), Gadaladeniya Rajamaha Viharaya with an ancient monastery built by King Wickramabahu in the year 1344), Degaldoruwa Rajamaha viharaya built in 1771 AD by King Rajadi Rajasinha (a Cave Temple with Kandyan era Paintings and Architecture), the cave shrine and monastery known as Hindagala Raja MahaVihara are other major archeology important sites located in Kandy district.

7) Settlements of Ethnic Minority Groups

According to the DCS, 2012, the total population of the district was 1,375,382. The major ethnic group of the district is Sinhala, followed by Sri Lankan Moors, Indian Tamils, Sri Lankan Tamil, Burgher, Malay, Chetty, Bharatha and others. These groups belong to different Religions where majority are Buddhists (1,009,220), and then Islam (197,076), Hindus (133,744), Roman Catholic (22,379), Christians (12,798) and other (165).

Table 9.1.3 Population by Ethnic/Religious Groups in Kandy District

Population by ethnic group			Population by ethnic group		
Sinhalese	1,023,488	74%	Buddhist	1,009,220	73%
Sri Lankan Tamil	69,210	5%	Islam	197,076	14%
Indian Tamil	85,111	6%	Hindu	133,744	10%
Sri Lankan Moor	191,570	14%	Catholic	22,379	2%
Burgher	2,384	0.2%	Christian	12,798	1%

Malay	2,444	0.2%	Others	165	0.01%
Sri Lanka Chetty	91	0.01%	-	-	-
Bharatha	33	0.002%	-	-	-
Others	1,051	0.1%	-	-	-
Total	1,375,382	100%	Total	1,375,382	100%

Source: Department of Census and Statistics, 2012

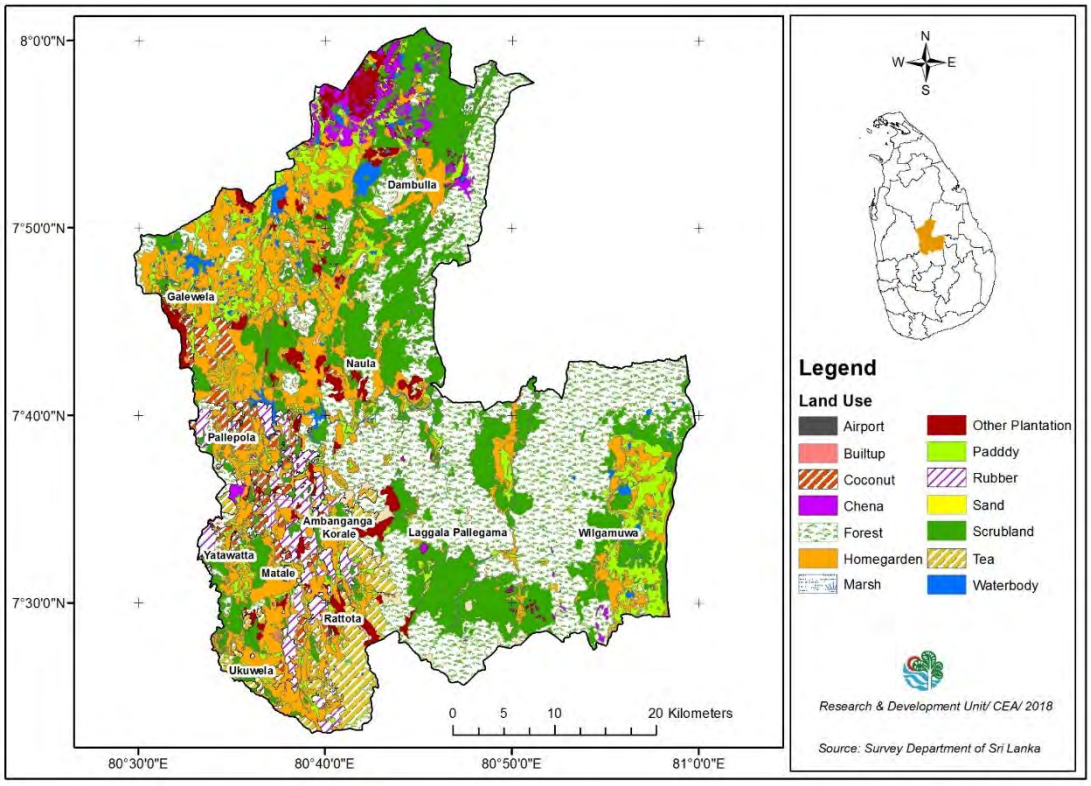
(3) Matale District

1) General Feature

Matale is in Central Province with the total area of 2056.39 km^2. It consists of 11 Divisional Secretariat Divisions, 545 Grama Niladhari Divisions, two Municipal Councils and nine Pradeshiya Sabha.

2) Land Use

Land use pattern of the district is mainly consisting of agricultural crops; Paddy, Tea, Rubber, Coconut, Cinnamon, Cardamom, Pepper and vegetable cultivation. Paddy is cultivated using major and minor irrigation systems and rain fed system in Maha and Yala seasons. Home gardens, scrublands, grasslands, water bodies are other main land cover/ land use types that can be found within the district *(District Statistical Hand Book, Matale,2016).*



Source: Environmental Resource Profile, CEA

Figure 9.1.6 Land Use Map of Matale District

3) Climate

The average annual temperature of the district is 25.3ºC. April is the hottest month of the year while December and January are the coldest months. The average annual rainfall of the district varies between 1250mm - 3000mm throughout the district. The highest rainfall receives from October to December and

the lowest received during the months of February to March and also from June to August. The highest rainfall received by the district during the 2nd Inter Monsoon and the North Eastern Monsoon.

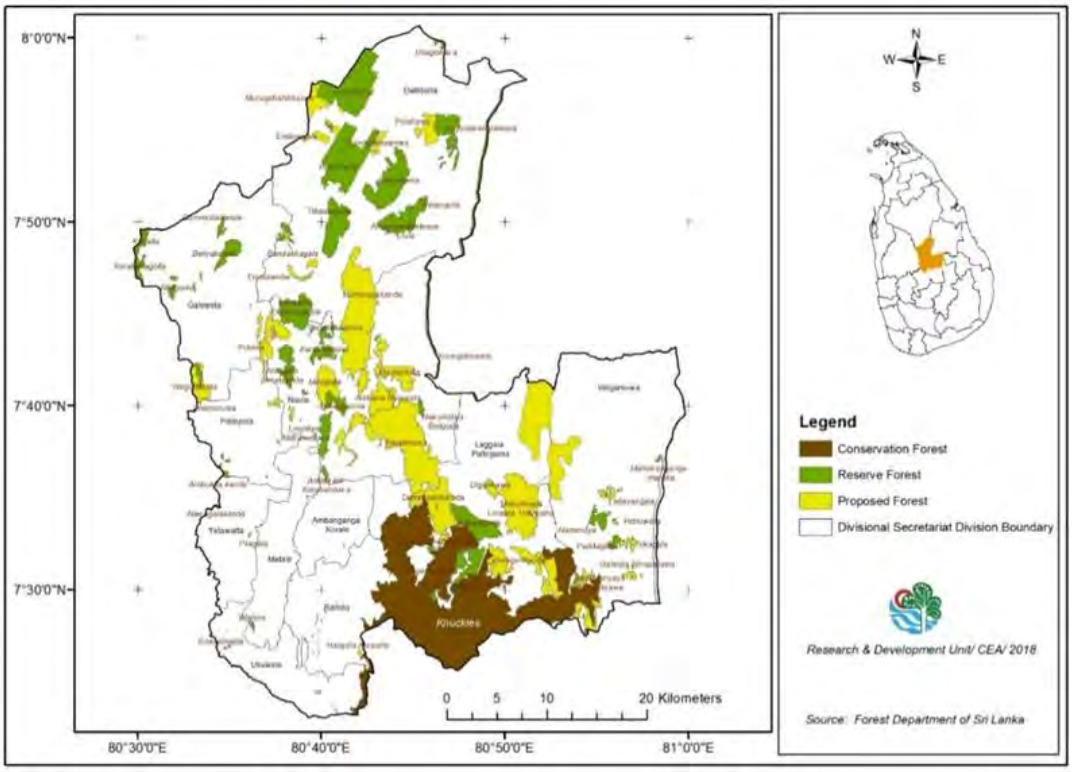
4) Forest Reserves

Sub- montane, lowland rain and moist monsoon forest types are prominent in wet mountainous areas of the district while dry monsoon forests and teak plantations are mainly found in dry zone low terrains. There are many natural, conservation forest and plantation forests in the district. Knuckles is a major conservation forest administrate by the Forest Department. Pinus and Eucalyptus are plantation forests in the district.

Knuckles Conservation Forest, the world heritage site situated above 3000ft above mean sea level covering land area of around 31286.4ha consists of five peaks; Kirigalpotta, Knuckles, Gombaniya, Kobonilagala and Dotulugala. It is also known as cloud forests due to hovering clouds most of the time periods of the year. The vegetation varies;

- Valleys and foothills - semi evergreen vegetation with large trees,
- Upper slopes - tropical sub montane humid evergreen rain forest
- Upper levels - cloud forests; a moist forest with a low-level cloud cover

Various endemic species of Ferns, Orchids, Lichens and Mosses grow profusely in these forest types. Other types of vegetation are grasslands (eg/ "Pitawala Patana"), Riverine forests alongside the rivers and waterways, Scrublands, Pygmy forests (height 1-2m). These types are adapted to the adverse weather conditions; mainly to the winds throughout the year. Teak Plantations can be found in Inamaluwa area. Forests in Pelwehera and Kandalama are some major dry monsoon forest types in the district.



Source: Environmental Resource Profile, CEA

Figure 9.1.7 Map of Forest Reserves

5) Wild life Protected Areas within the District

- Distribution of Endemic, Critically Endangered, Endanged and Vulnerable species in the district

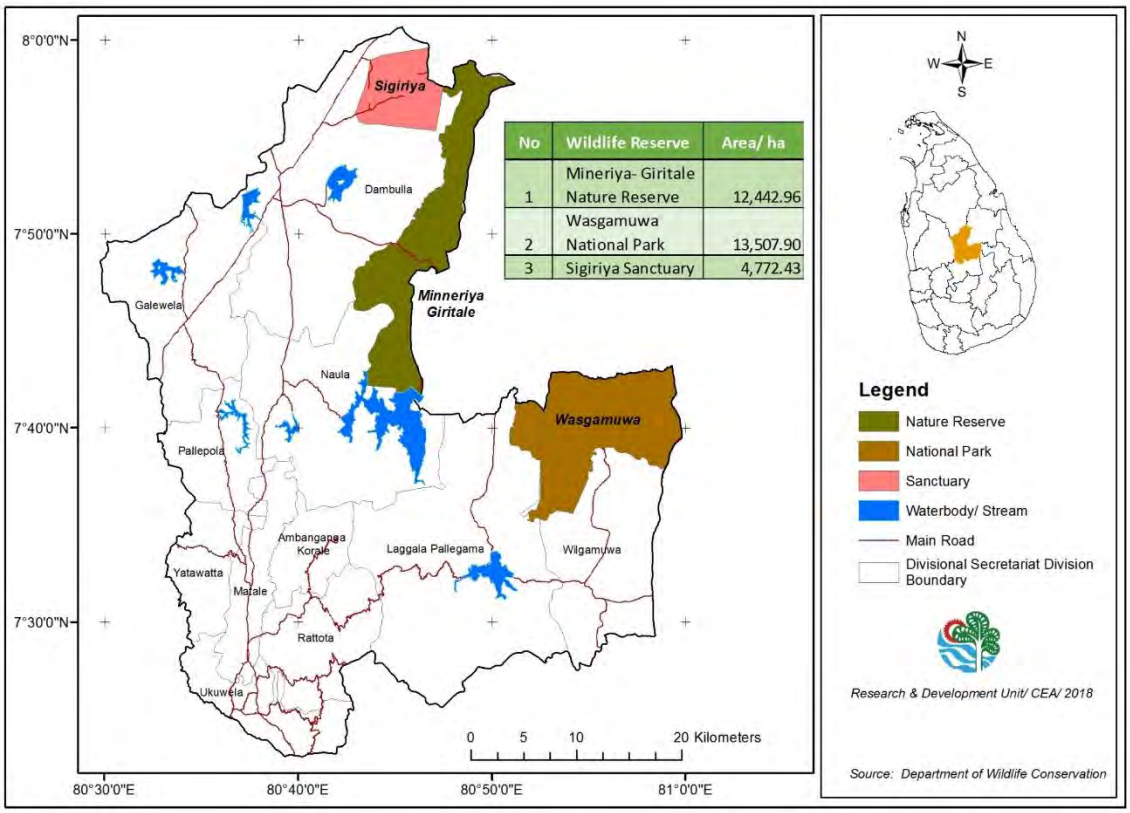
Wasgamuwa National Park, Minneriya Girithale Nature Reserve and Sigiriya Sanctuary are the major wild life protected areas administrated by the Department of Wildlife Conservation. Large herds of elephants are visible in dry, primary and secondary riverine forests and grasslands in Wasgamuwa National Park. Around 150 floral species with a 1,700 year old Tamarind tree can be found in the park. 23 species of mammals such as the endemic purple-faced Langur and Toque Macaque Monkey, Water Buffalo, Wild Boar, Sambar and Axis Deer, Sloth Bear and Leopard habitat there. Water Monitor, Mugger Crocodile, Estuarine Crocodile along with Lizards such as Calotes ceylonensis and Otocryptis wiegmanni, are five endemic reptile species. 17 species of fish, 50 species of butterflies, of which eight are endemic and 143 bird species found here. The endemic bird species include the Ceylon Jungle Fowl, Red Faced Malkoha and winter visitors include Peafowl, Painted Stork, White Necked Stork, Black-Headed Ibis and Eurasian Spoonbill amongst others.

Minneriya Giritale Nature Reserve is declared as a protection area mainly to protect the catchment of Minneriya tank and the wildlife of the surrounding area. The tank is of historical importance, having been built by King Mahasen in third century AD. Sigiriya Sanctuary is a well-protected area as it is a UNESCO World Heritage Site. Waterways and thick canopied forests make it a heaven for birds.

- Other Environment Protection areas in the district

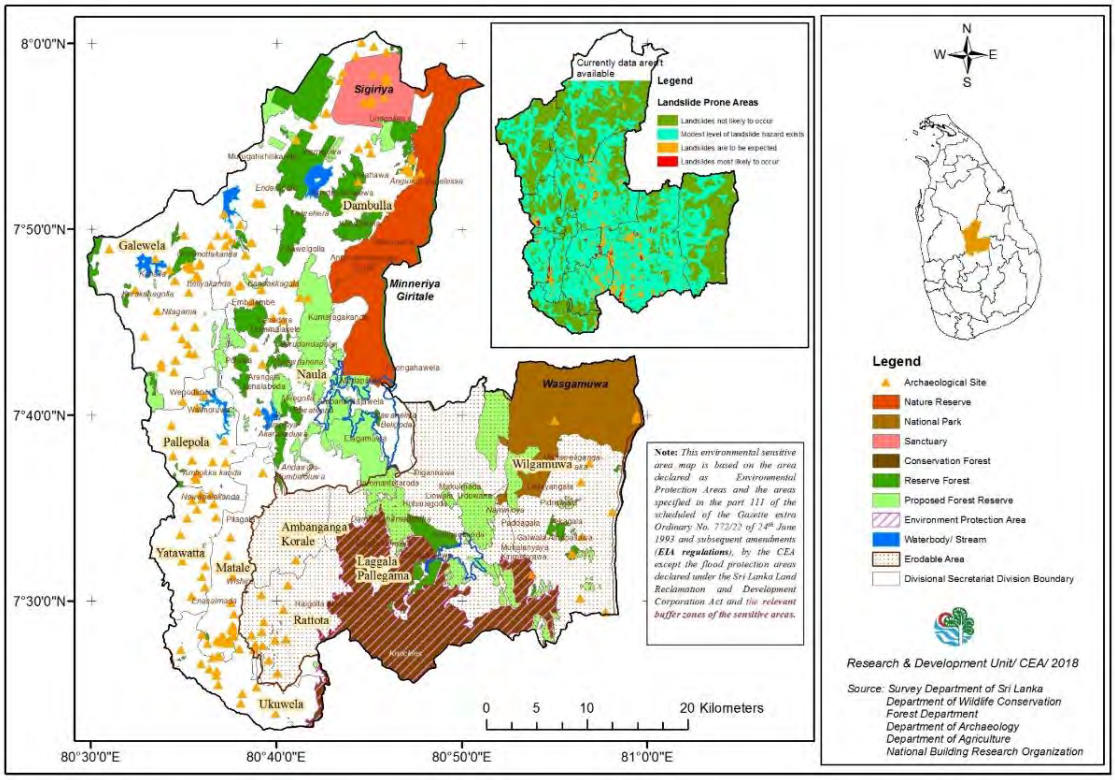
Knuckles Environmental Protection Area:

Knuckles mountain range is one of the world Heritage sites in Sri Lanka, which exhibits the conditions of all the climatic zones of the country, with very high floral & faunal diversity. This area has been declared as an Environmental Protection Area, as a measure adopted to control possible negative impacts, due to development activities, in the private lands within the World Heritage Site. The lands declared by the Forest Department have been excluded from the Protection Area, as they are already well protected under the Forest Ordinance.



Source: Environmental Resource Profile, CEA

Figure 9.1.8 Wildlife Protected Areas



Source: Environmental Resource Profile, CEA

Figure 9.1.9 Environment Sensitive Areas (Forest Reserves and Wildlife)

Pansalathenne Maussawa Environmental Protection Area (EPA)

Pansalathenne-Maussawa mountainous in Ukuwela Divisional Secretariat Division has been declared as an Environmental Protection Area by the Gazette Notification No. 2075/15 dated 2018.06.11, by the CEA as per the provisions of the Sections 24C and 24D of the National Environmental Act No. 47 of 1980. Total land area of the Pansalathenne-Maussawa Environmental Protection Area is 103.4614 ha. This area serves as the main catchment of the Theppukulama Lake which irrigates more than hundreds of acres of paddy fields, the Bowathanna and Moragahakanda reservoirs and Amban Ganga/River which is a main tributary of Mahaweli River. Moreover, this area has been identified as a landslide prone area by the NBRO. Pansalathenne-Maussawa comprised of variety of eco systems including natural forests, shrub vegetation, grasslands.etc. and hosts a vast number of faunal and floral species. The main objectives of declaration of the Pansalathanna Mausssawa EPA were to provide legal protection against the possible adverse anthropogenic impacts and to adopt sustainable management practices, while enhancing and upgrading the eco system services offered by this environmentally significant area.

6) Historical/Cultural and Archeological Important Sites

Matale is one of the three districts of Central Province and historically it was important for ancient kingdoms. There are 184 archeological sites within the district including kingdoms, caves, temples and monuments. Matale is the only district of Sri Lanka, with a book of written history known as Ancient Matale.

The most historically important places within the district include rock cave temple in Dambulla, and Sigiriya (one of the 8th world wonder). Pidurangala, Aluviharaya temples are well known for the tourism industry of Sri Lanka.

Sigiriya or Sinhagiri is an ancient rock fortress located in the northern of the District. The name refers to a site of historical and archaeological significance that is dominated by a massive column of rock

nearly 200 meters (660 ft) high. According to the ancient Sri Lankan chronicle the Culavamsa, this site was selected by King Kasyapa (477 – 495 CE) for his new capital. He built his palace on the top of this rock and decorated its sides with colorful frescoes. On a small plateau about halfway up the side of this rock he built a gateway in the form of an enormous lion. The name of this place is derived from this structure - Sīnhāgiri, the Lion Rock (an etymology similar to Siṃhapura, the Sanskrit name of Singapore, the Lion City). The capital and the royal palace were abandoned after the king's death. It was used as a Buddhist monastery until the 14th century. Sigiriya today is a UNESCO listed World Heritage Site. It is an unmatched combination of urban planning, water engineering, horticulture and arts. The famous arts of women with different portraits which are identical to arts in Ajantha caves, India are known as the women of king's harem and also known as worshippers of Pidurangala Viharaya. The fortress also famous for its "Kurutu gee". Considering the uniqueness of Sigiriya UNESCO declared it a World Heritage site in 1982 and is also declared by UNESCO as the eighth wonder of the world. (*https://sigiriyatourism.com* and *(https://en.wikipedia.org/wiki/Sigiriya)*

The Aluvihare Temple is another historic location where the Thripitakaya was first written down completely in text on ola (palm) leaves in 29 BC in Pali language. (*http://aluvihara.virusinc.org/history.html*). Dambulla Rock Temple had first been constructed during the period of King Vattagamini Abhaya (103 BC and 89-77 BC). It is home to the Worlds most acclaimed Cave complex of magnificent Buddha Images and Rock Paintings of vivid colors and shapes constructed and painted from around Anuradhapura era and continued up to the Kandyan era. The temple is composed of five caves of varying size and magnificence. Drip ledges made along this large cave made it suitable to withstand rainy weather and avoided water seeping inside the caved areas. *(https://www.srilankaview.com/dambulla_temple.htm)*

Keppetipola Walauwa is an archeologically protected monument in Hulangamuwa area, the residence of Monarawila Keppetipola who rebels against British troops. Christ Church, Matale was consecrated by Bishop James Chapman on 30 December 1860 is another archaeologically protected monument. *(https://en.wikipedia.org/wiki/Matale)*

7) Settlements of Ethnic Minority Groups

Population of the district is 484,531 according to the census data in 2012. Ethnically 80% are Sinhalese, 8.7% Sri Lankan Moor, 5.5% Sri Lankan Tamil, 5.3% Indian Tamil, 0.12% Sri Lankan Malay, 0.09% Burgher and 0.12% are other ethnic groups in the district.

Table 9.1.4 Population by Ethnic/Religious Groups in Matale District

Population by ethnic group		
Sinhalese	391,305	81%
Sri Lankan Tamil	24,279	5%
Indian Tamil	23,238	5%
Sri Lankan Moor	44,786	9%
Burgher	386	0.1%
Malay	392	0.1%
Sri Lanka Chetty	22	0.005%
Bharatha	11	0.002%
Others	112	0.02%
Total	484,531	100%

Source: Department of Census and Statistics, 2012

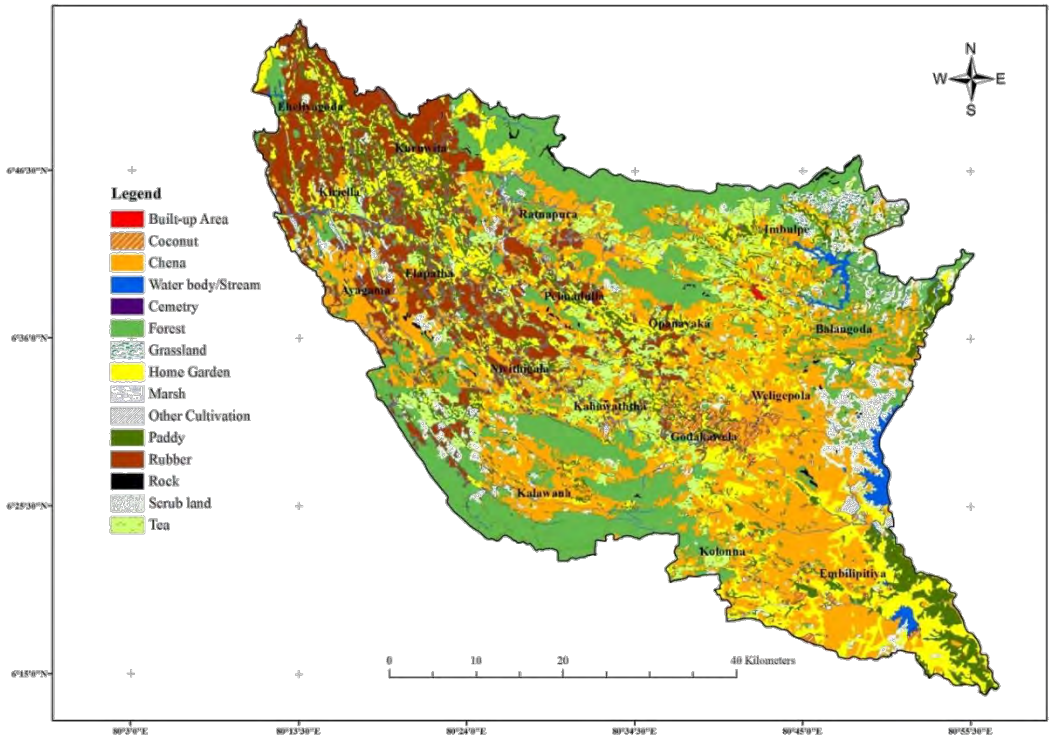
(4) Ratnapura District

1) General Feature

Ratnapura is situated at an elevation ranging from 30- 130 meters above sea level and surrounded by 9 districts. The land area of the district is about 3236 sq km. Ratnapura District is divided into 17 Divisional Secretariat Divisions and 575 GN Divisions. The district is famous for its mineral resources, especially for gems in Sri Lanka.

2) Land Use

The land use of the district is mainly consisting of forests, mountains, plantations (Chena, tea, rubber, paddy) and Home gardens. The district can be divided into three main morphological regions; the lowlands with basins of the Kalu Ganga and the Walawe Ganga, the uplands with ridges, valleys and hills and the southern platform of the Central Highlands with plains and plateaus, mountain peaks, ridges, and rock knob plains etc.



Source: Environmental Resource Profile, CEA

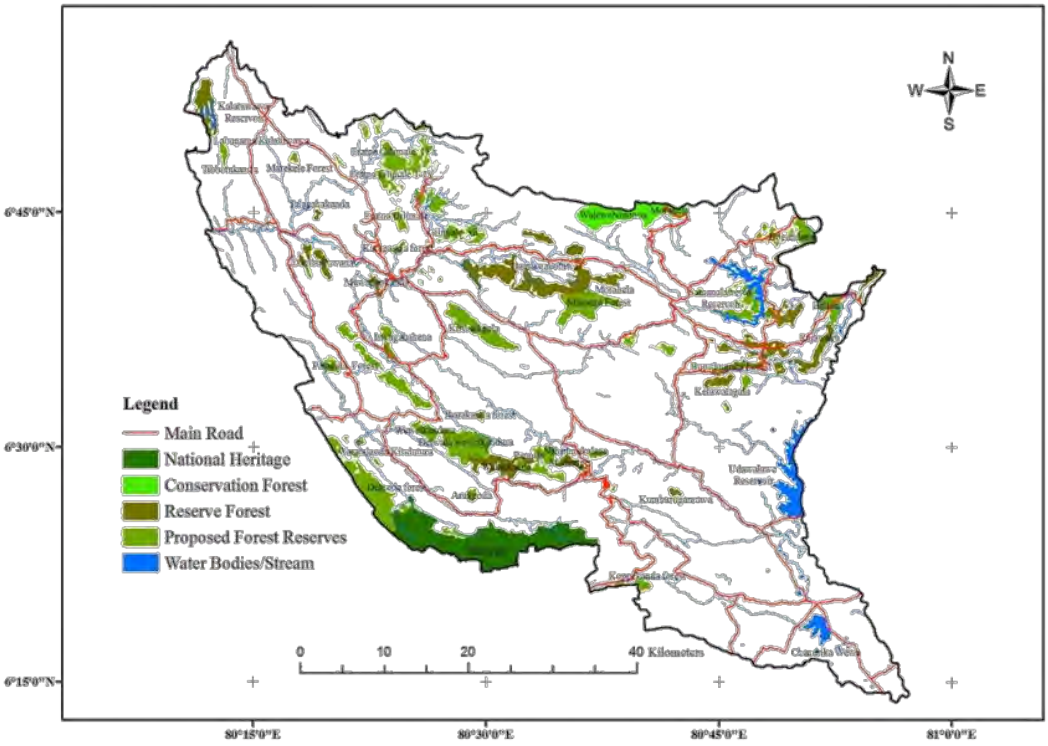
Figure 9.1.10 Land Use Map of Ratnapura District

3) Climate

Ratnapura has a tropical climate. The average annual rainfall is about 4,000 to 5,000 mm and receives mainly from south-western monsoons from May to September. The average temperature of the district varies from 24 to 35 °C, and there are high humidity levels.

4) Forest Reserves and Wild Life Protected Areas

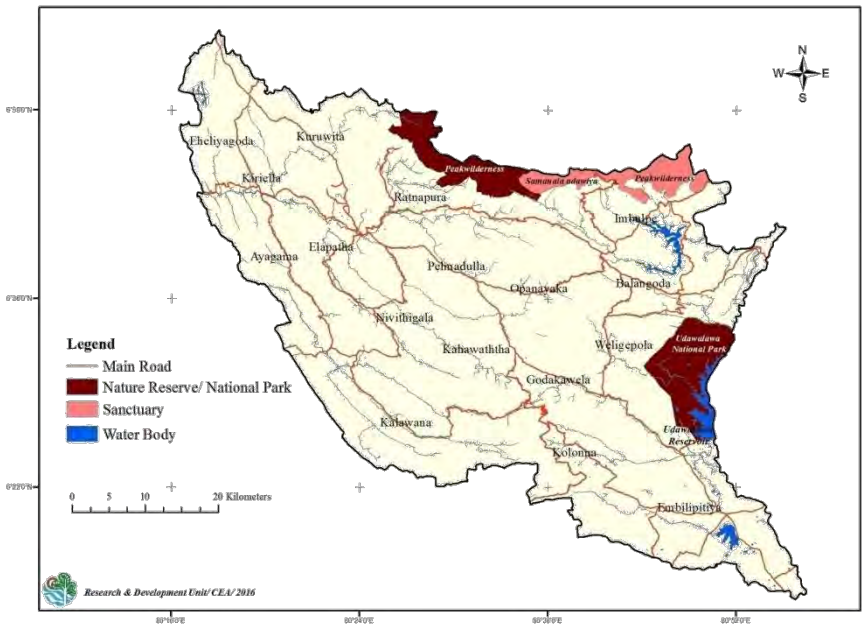
Two main vegetation types occur in the Ratnapura district are the tropical rain forest and the mountain forest. The tropical rain forest found in the Sinharaia forest, Waratelgoda, Delgoda, Delwala, Kuduminiya, Damalakandd and Welankanda .Sinharaja World Heritage Wilderness Man and Biosphere Reserve is the main primary lowland tropical rain forest reserves falls within the district. With its unique ecosystems, it provides habitats for a large proportion of the flora (60%) and fauna species (more than 50% of mammals and butterflies, 95% of birds). Apart from that there are many forest reserves and proposed reserves within the district and the details are given below.



Source: Environmental Resource Profile, CEA

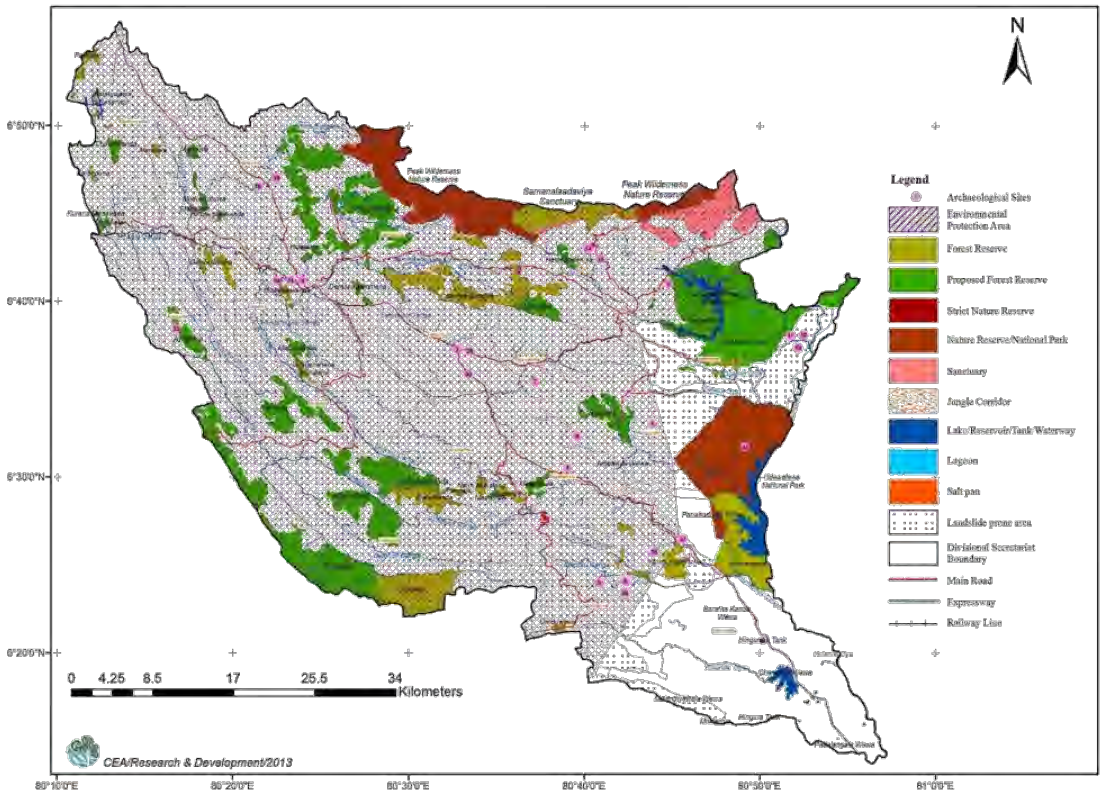
Figure 9.1.11 Map of Forest Reserves

Second to Sinharaja, the Kitulgala forest reserve is another primeval rain forest with lush tropical flora including several species of trees and Lichanas that are endemic to this area. Many of the lowland endemics who also inhabit Sinharaja can be seen in Kitulgala. It is also excellent for many rare and endemic species of butterflies, fish, and amphibians. Part of the Udawalawe National Park is also bordering the Ratnpaura District.



Source: Environmental Resource Profile, CEA

Figure 9.1.12 Wildlife Protected Areas in Ratnapura District



Source: Environmental Resource Profile, CEA

Figure 9.1.13 Environment Sensitive Areas

5) Historical/Cultural and Archeological Important Sites

There are about 43 historical, cultural and Archeological Important Sites in and around the city. Buddhist places of worship are more in number, which is to be expected since Buddhists constitute the great majority in the area. Eg. The mountain Sri Pada, Maha Saman Devalaya, Delgamu Viharaya. Diva Guhavacaves are most important sites.

Sripada or the Adam's peak is the fourth highest mountain in Sri Lanka and the most venerated mountain in the world. Pilgrims from different parts of the world including Buddhist, Hindus, Muslims and Christians visit this place every year during the pilgrim season. Diva Guhava in Buddhist literature is a cave system with the area of 6,800 m^3 (240,000 cu. ft.). In Buddhism it is believed to be the cave in which the Lord Buddha spent the day after placing his footprint on Adam's Peak, from where he supposedly proceeded to Dighavapi.

Delgamuwa viharaya is another important site and the history goes back to the Sitawaka kingdom.

With the arrival of Portuguese in 1505 and subsequent political stability, in 1549 the tooth Relic was brought to Delgamuwa Viharaya for safety with the guidance of king Mayadunne. Maha Saman Devalaya is another important place in Ratnapura District dedicated to God Saman, who considered to be the guardian of Ratnapura. The shrine was destroyed by Portuguese, but again rebuild by Kandyan kingdom. Currently this shrine is a very important place of worship for Buddhists.

6) Settlements of Ethnic Minority Groups

According to the DCS, 2012, the total population of the district was 1,088,007. The major ethnic group of the district is Sinhala, Followed by Indian Tamils, Sri Lankan Tamil, Sri Lankan Moors, Burgher, Malay and others. These groups belong to different Religions where majority are Buddhists (943,464), and then Hindus (101,962), Islam (24,446), Catholic (10,844), Christians (7,212) and other (79).

Table 9.1.5 Population by Ethnic/Religious Groups in Ratnapura District

Population by ethnic group			Population by religious group		
Sinhalese	947,811	87%	Buddhist	943,464	87%
Sri Lankan Tamil	54,437	5%	Hindu	101,962	9%
Indian Tamil	62,124	6%	Islam	24,446	2%
Sri Lankan Moor	22,346	2%	Catholic	10,844	1%
Burgher	405	0.04%	Christian	7,212	1%
Malay	288	0.03%	Others	79	0.01%
Sri Lanka Chetty	35	0.003%			
Bharatha	12	0.001%			
Others	549	0.05%			
Total	1,088,007	100%		1,088,007	100%

Source: Department of census and Statistics, 2012

(5) Kegalle District

1) General Feature

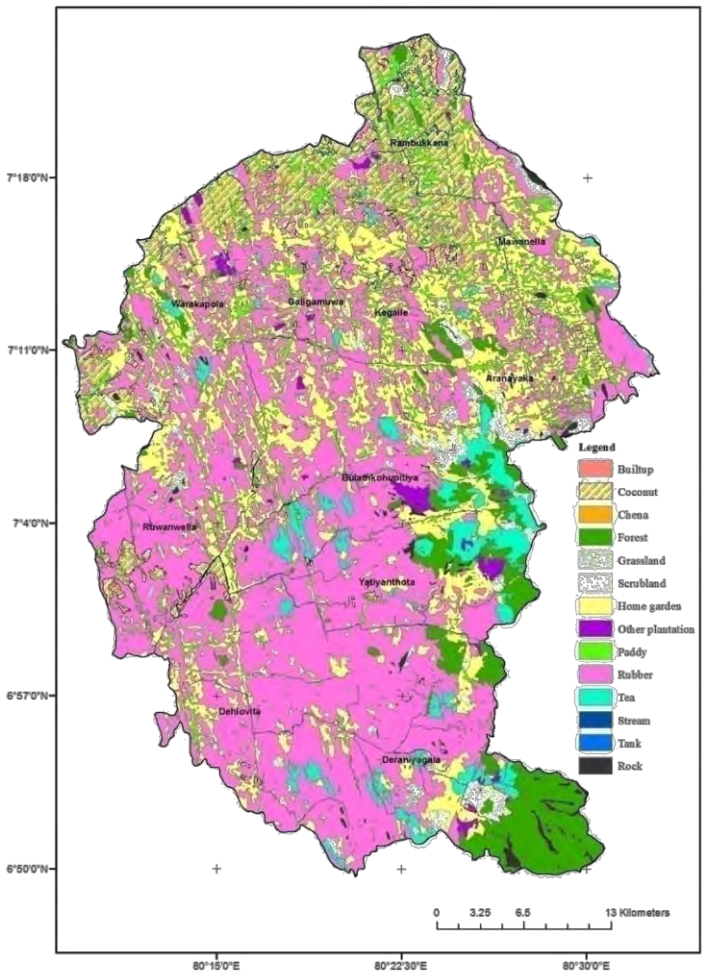
Kegalle district is belong to the Sabaragamuwa Province and is situated in between the central highlands and western southern planes. Height varies between 166m – 1000m from the sea level. Rubber is the major cultivation and minor export crops such as coffee, cocoa, pepper, clove and nutmeg takes an important place in the economy of the District. The extent of the District is 1,692.8 km^2. The district is bounded by the Kurunegala district, Ratnapura district, Gampaha district, Kandy and Nuwara Eliya districts. The administrative structure of the district consists of the 11 Divisional Secretariat divisions, 537 Grama Niladhari divisions and 1677 villages.

2) Climate

By climatic regions, the Kegalle district represents the wet zone and shows tropical climatic features. The rainfall in the district varies spatially with the impact of the south west monsoon and the elevation. The inter monsoon rain and the tropical depression also contribute to the seasonal rains. The annual rainfall of the district ranges between 2500 mm to 3000 mm. The mean annual temperature is between 20 – 25°C rising up to 25 °C around February, March and April. The lowest temperature (20 – 22 °C) is recorded is December– January when it is about. In June and July, the temperature is relatively low a result of the impact of the south west monsoon.

3) Land Use

Land use of the district consists of home gardens (34.97 %), rubber cultivation (30.62%), Paddy fields (6.33%), Tea and coconut (2.48% and 3.93%). The rest is covered by Chena cultivation, built up areas and natural vegetation. The Forests cover of the district is 6908.28 Ha. This includes natural forests, forest plantation, scrub lands, mash and mangroves. Water bodies cover 860.24 Ha of the land in district.



Source: Environmental Resource Profile, CEA

Figure 9.1.14 Land Use Map of Kegalle District

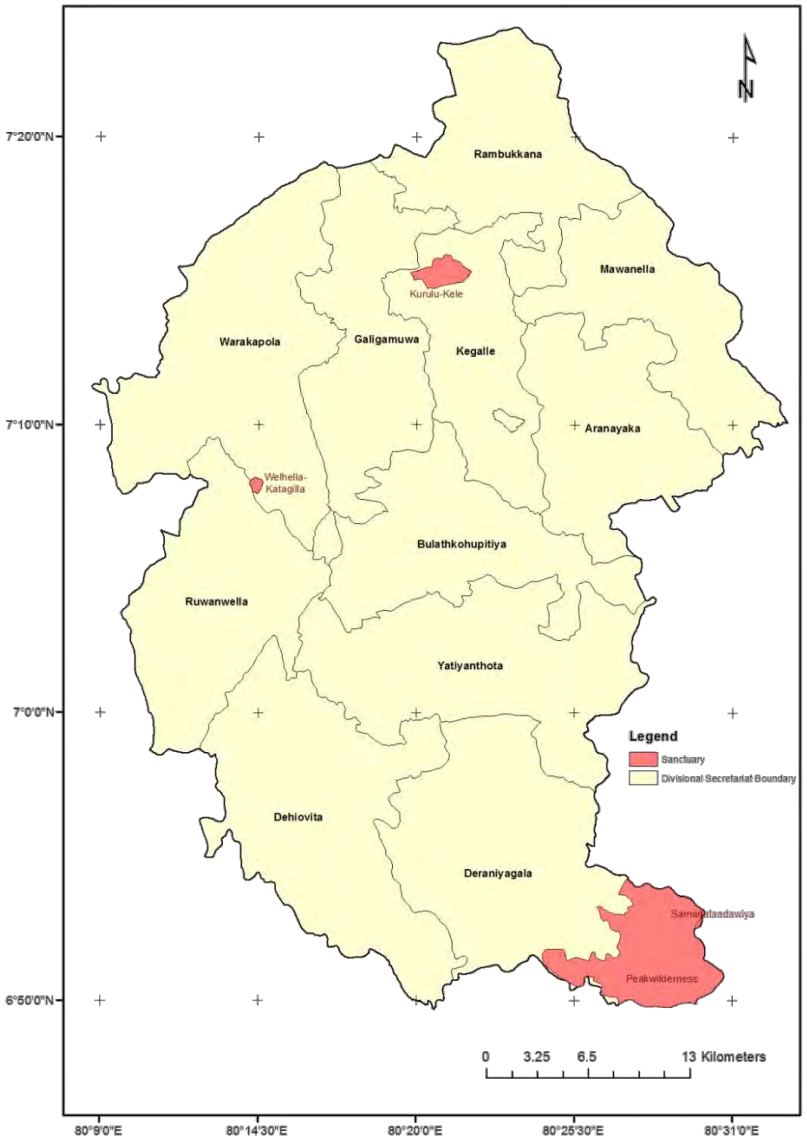
4) Environment Sensitive Areas

- Forest Resources

Kegalle district is located in the low country and mid country regions of Sri Lanka, therefore most of the forests in the district are belongs to tropical wet evergreen forests and wet semi evergreen forests. Total natural forest cover in 1994 was 15,938 hectares, which is 20% of the total forest cover of the island. The important forest reserves in Kegalle district include Ma Oya Reserve Nagolla Kanda forest reserve, Talduwa Deraniaygala mountains reserve, Udabage reserve, Narambedda reserve, Kurelukele sanctuary, Kithulgala Belilena reserve and Salgala forest reserve.

- Protected areas

Kurulukele sanctuary is situated in the Kegalle Divisional Secretariat Division and covers 9.32ha. It falls under lowland wet evergreen forest vegetation type. Pinnawala Elephant Orphanage is another protected site as an orphanage, nursery and captive breeding ground for wild Asian elephants. Pinnawala is notable for having the largest herd of captive elephants in the world. In 2011, there were 84 elephants, including 37 males and 51 females from 3 generations, living in Pinnawala. It was established in 1975 by the Sri Lanka Department of Wildlife Conservation (DWC). In 1978, the orphanage was taken over by the Department of National Zoological Gardens Sri Lanka. Peack wilderness and Wehella- katagilla are other protected areas within the district (sanctuaries) managed by the DWLC.



Source: Environmental Resource Profile, CEA

Figure 9.1.15 Wildlife Protected Areas

5) Historical/Cultural and Archeological Important Sites

There are about 99 Historical/cultural and Archeological Important Sites/ monuments within the district including Caves, Buddhist temples, Hindu kovils, Ambalama etc. Out of which Beligala rock, Dorawka Pre Historic cave, Ancient Fort, Makelwala Caves, Kithulgala Beli lena and Uthuwan Kanda are the important sites. According to the evidence of Beli lena, Dorawaka lena, Alu lena, Asmadala, Padavigampola, Batalegala, Lenagala, Ambala Kanda, Halamada, Heenatipana, Uthuwankanda, Beligala, Salawa, Yahalena, Salgala and Kela Dambulla, the history of the area dates back to the stone age of Sri Lanka.

Uthuwan Kanda is famously known as the hide out of Deekirikevage Saradiel alias Utuwankande Sura Saradiel. He was a gang leader and outlaw who rebelled against the British authorities during the colonial rule. He is a bandit who became a legendary figure in Sri Lanka also known as the "Robin Hood of Sri Lanka". Belilena is another special archeological cave in the district, in which the 12,000 – 16,000-year-old skeletal remains of the prehistoric 'Balangoda man' (Homesepiens Balangodensis). From 1978 to 1983 the site was scientifically excavated and researched by the Archaeological Department of Sri Lanka. Rich assemblages of cultural, faunal and human remains were discovered.

These materials include bone tools, evidence of the use of fire and geometric microlithic stone tools and numerous remains of game animals, such as Sambar deer, Wild boar, Indian muntjac, several monkey species, porcupines, Indian giant squirrels and a large number of local reptiles and fish. The site has been declared an Archaeological Reserve of the Archaeological Department under the Antiquities Ordinance. Since these caves have yield artifacts belonging to the 30,000 BP, it is an important site to whole of Asia as these tools are considered to have first originated in Europe around 12,000 BP. (*https://lanka.com/about/attractions/belilena-cave/)*

6) Settlements of Ethnic Minority Groups

According to the DCS, 2012, total population of the district was 840,648. the major ethnic group of the district is Sinhala, followed by Sri Lankan Moors, Indian Tamils, Sri Lankan Tamil, Malay, Chetty and others. These groups belong to different Religions where majority are Buddhists (707,830), and then Muslims (60,575), Hindu (53,997), Roman Catholic (8,221) Christian (5,865), and others (115).

Table 9.1.6 Population by Ethnic/Religious Groups in Kegalle District

Population by ethnic group			Population by religious group		
Sinhalese	715,723	86%	Buddhist	707,830	85%
Sri Lankan Tamil	20,250	2%	Islam	60,575	6%
Indian Tamil	41,468	5%	Hindu	53,997	7%
Sri Lankan Moor	57,952	7%	Catholic	8,221	1%
Burgher	577	0.07%	Christian	5,865	1%
Malay	168	0.02%	Others	115	0.01%
Sri Lanka Chetty	37	0.004%			
Others	428	0.05%			
Total	836,603	100%		836,603	100%

Source: Department of Census and Statistics, 2012

(6) Badulla District

1) General Feature

Badulla is the capital of Uva Province, Sri Lanka. Total population is 837,000. Economy of the district is based on agricultural farming and livestock. There are 15 Divisional Secretariat divisions consist 567 Grama Niladhari divisions and 2229 villages. There is 1 Municipal Council, 2 Urban Councils and 15 Pradeshiya Sabhas in its administrative structure.

2) Land Use

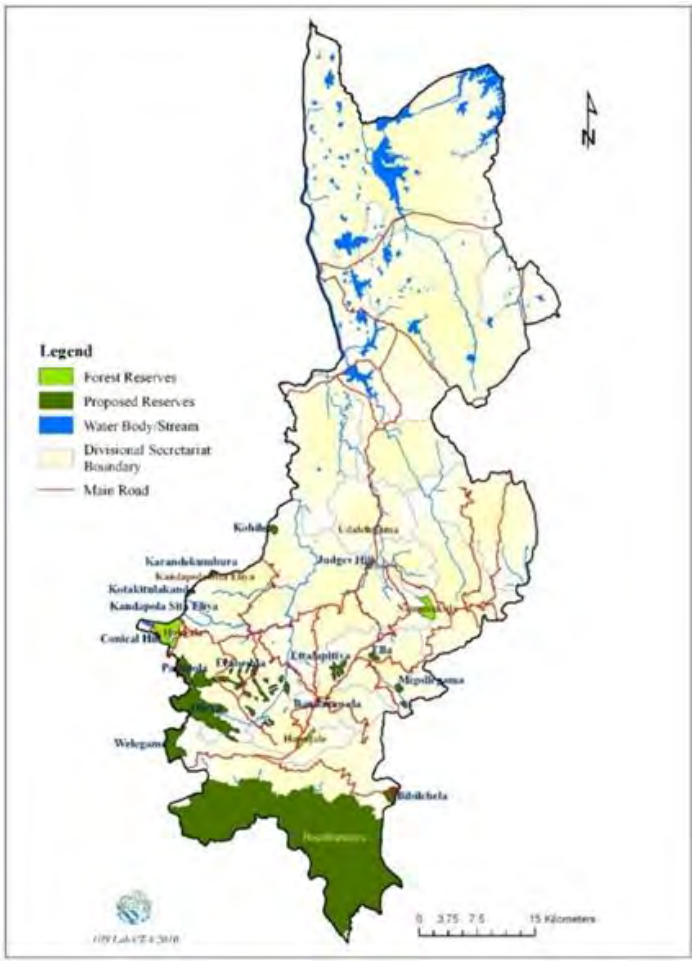
The total land area of the district is 282,200 hectares (2,861 km²) or 4.51%. 56% of the total land area is under agricultural crops (tea, vegetable and paddy), 24% is forest, and 9% is covered by scrub and grassland. The landscape of the Badulla district positioned to the east of the central highlands is characterized by complex relief. The specific morphological features are mountain ranges, dissected plateaus, scarps, faults, defiles, and narrow alleys. Mainly the district is divided in to two portions as Upper region and Lower region according to climatic and geographical characteristics.

3) Climate

The average annual temperature of the district varies between 20 – 25°C depending on the altitude. The average annual rainfall in the district is about 2000mm but varies from 900mm in the Northern and Southern most extremities of the district to cover 2500mm in the Eastern flanks of the Central highlands, Namunukula and Lunugala ridges. The rainfall is received from Northeast Monsoon (December and February), inter-monsoon season (March to mid-May) and Southwest monsoon season (mid-May to September).

4) Forest Resources

The forest types in Badulla District include Montane, Sub Montane, Moist Monsoon and Dry Monsoon forests. The dry pathana grasslands are distributed in the crests and upper slopes of hills in Passara, Ella, Haldummulla and Migahakivula. The total natural forest cover found in the Badulla district is about 55,945ha, which is approximately 24.2% of the land area.



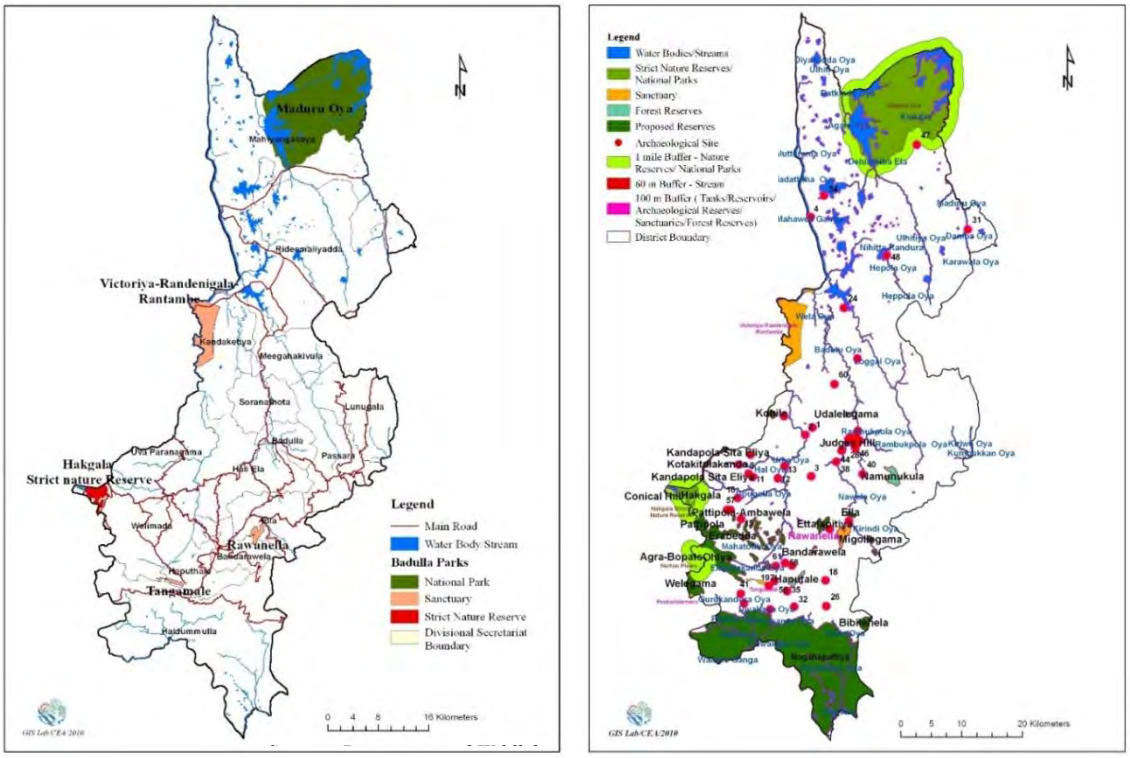
Source: Environmental Resource Profile, CEA

Figure 9.1.16 Map of Forest Reserves

5) Wildlife Protected Areas

Maduru oya National Park, Ravana Ella Sanctuary, Thangamale, Hakgala Strict nature Reserve are the major protected areas within the district.

Part of the Maduruoya National Park lies towards the Eastern border of district which is an important Elephant habitat distributed in the area. About 1932 hectares of Ravana Ella Sanctuary is located around the Ravana Ella falls. Large number of mammals, birds and reptiles distributed within the sanctuary of Rawana Ella. Hakgala Mipilimana Forest Reserve and Thangamale Sanctuary also provide greater diversity to this area. Other than that, Haputale Forest Reserve provides greater diversity of avifauna in this area



Source: Environmental Resource Profile, CEA

Figure 9.1.17 Environment Sensitive Areas in Badulla District

6) Settlements of Ethnic Minority Groups

According to the DCS, 2012, the total population of the district was 815,405. The major ethnic group of the district is Sinhalese, followed by Indian Tamils, Sri Lankan Moors, Sri Lankan Tamil, Malay,Burgher, Chetty, Bharatha and others. These groups belong to different Religions where majority are Buddhists (591,799), and then Hindus (157,608), Islam (47,192), Roman Catholic (12,020), Christians (6,615) and other (171).

Table 9.1.7 Population by Ethnic/Religious Groups in Badulla District

Population by ethnic group			Population by religious group		
Sinhalese	595,372	73%	Buddhist	591,799	73%
Sri Lankan Tamil	21,880	3%	Hindu	157,608	19%
Indian Tamil	150,484	18%	Islam	47,192	6%
Sri Lankan Moor	44,716	5%	Catholic	12,020	1%
Burgher	992	0.1%	Christian	6,615	1%
Malay	1,351	0.2%	Others	171	0.02%
Sri Lanka Chetty	66	0.01%			
Bharatha	16	0.002%			
Others	528	0.1%			
Total	815,405	100%		815,405	100%

Source: Department of census and Statistics, 2012

7) Historical/Cultural and Archeological Important Sites in Badulla District

There are 61 Historical/cultural and Archeological Important Sites/ monuments in the district, out of which Mahiyangana Raja Maha Viharaya, Muthiyangana Raja Maha Vihara, Saman Devalaya, Sorabora Wewa and Bogoda Wooden Bridge are the most important sites.

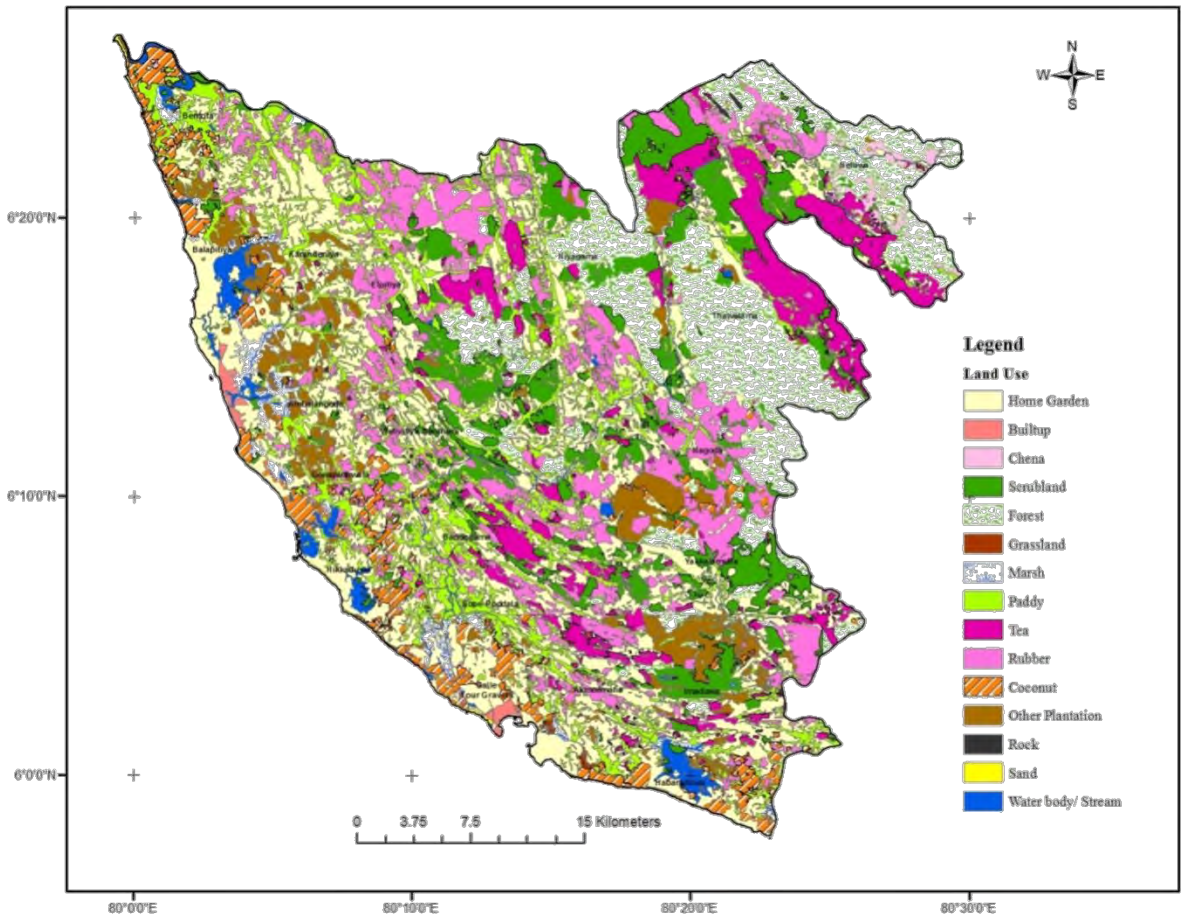
Mahiyangana Raja Maha Vihara is an ancient Buddhist temple, believed to be the site of Gautama

Buddha's first visit to the country and Muthiyangana Raja Maha Viharaya believed to be Lord Buddha's 3rd arrival to the island. These two sites are out of the 16 sacred religious locations in Sri Lanka. The Sorabora Wewa is an ancient reservoir in Mahiyangana, Badulla and thought to have been constructed during the reign of King Dutugemunu (161 BC – 137 BC) by a giant named Bulatha. The Bogoda Wooden Bridge was built in the 16th century during the Dambadeniya era and said to be the oldest surviving wooden bridge in Sri Lanka. The roof tiles show the influence of Kingdom of Kandy.

(7) Galle District

1) General Feature

Galle District bounded on the North by Benthara River, South and West by coast of the Indian Ocean and East by Matara and Rathnapura Districts and Its area is 1,652 km² in which 35 km² is water and 1,617 km² island. Galle District is divided into 19 Administrative Divisions (Divisional Secretariat Divisions), 895 GN Divisions and 2477 villages.



Source: Environmental Resource Profile, CEA

Figure 9.1.18 Land Use Map of Galle District

2) Climate

Galle district lies in a temperate climatic zone where the climate is almost similar in throughout the year. Annual rain fall of the districts is between 2000-2500mm and the annual mean temperatures ranges from 25-27°C. The driest months of the year are January and February.

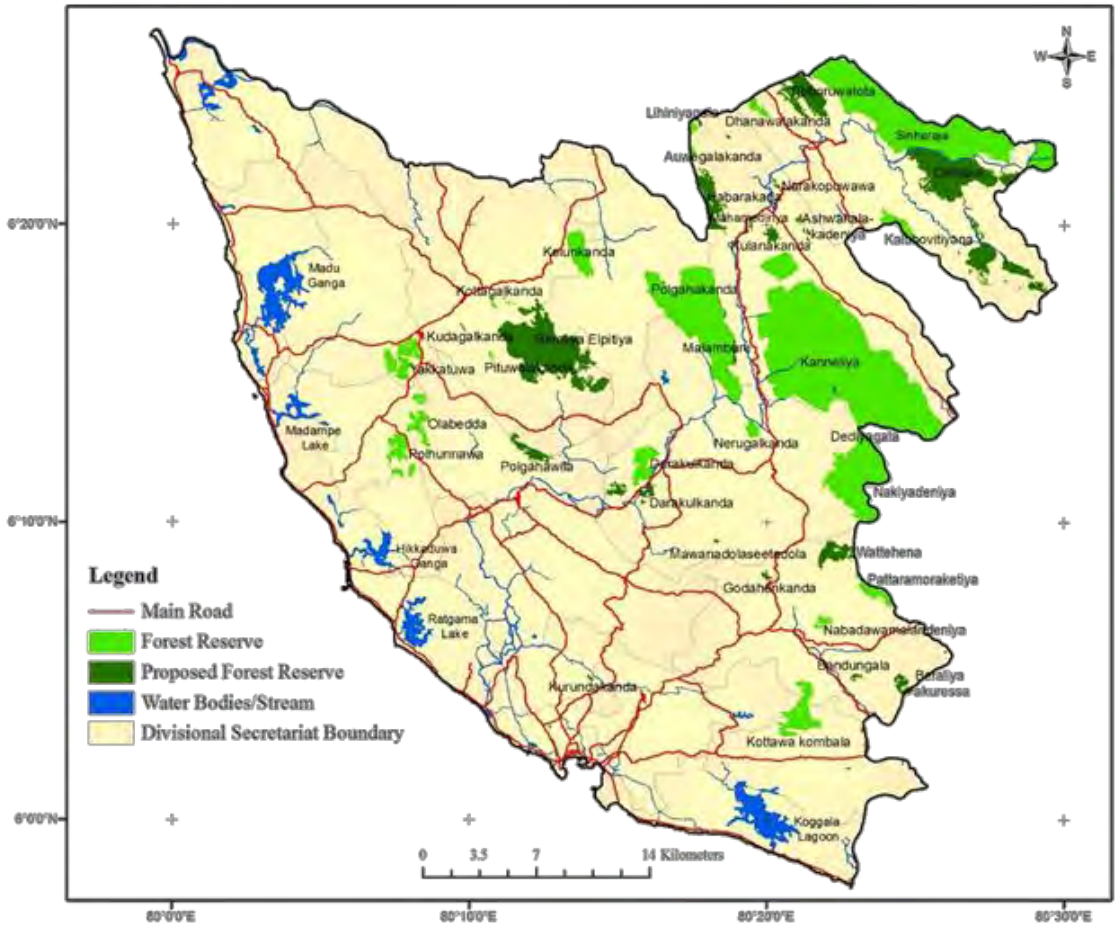
3) Natural Ecosystems

Galle district is rich in forest resources which provide habitats for different flora and fauna. Factors such as rainfall, soil, surface and groundwater conditions and topography have resulted in different types of

vegetation such as low Evergreen Tropical Rain Forest, Swamp vegetation, Mangroves and Littoral vegetation. The low evergreen tropical forest extends about 275 ha from low hills and rises to upland areas.

4) Forest Reserves

There are about 13,374 ha of forests reserves in the district and about 92% of these are distributed close to the Sinharaja Forest Reserve. The Hiniduma Rain Forest is the water catchment area for most of the rivers and lakes flows across Galle District including Sinharaja forest. About 16,381 ha of land extent have been identified as proposed forest reserves.

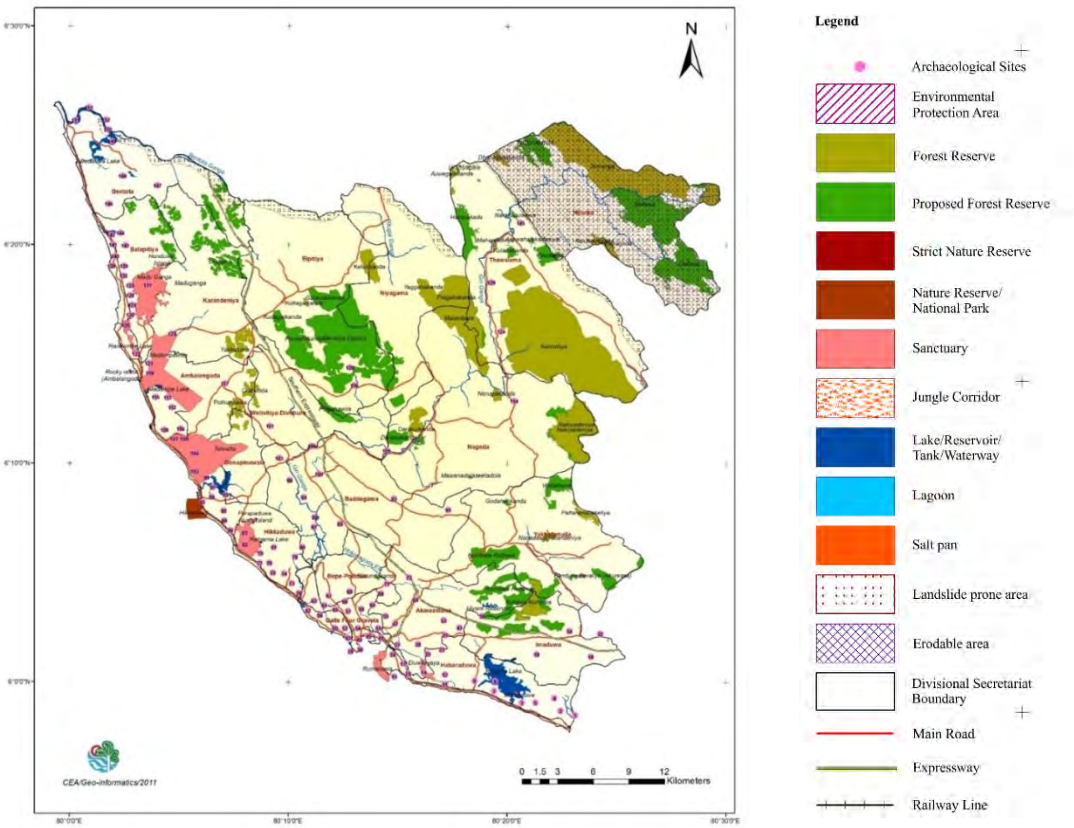


Source: Environmental Resource Profile, CEA

Figure 9.1.19 Map of Forest Reserves

Two of the most important forest reserves in the country; Sinharaja and Kanneliya are located in the District. Sinharaja Forest Reserve is a national park and a biodiversity hotspot in Sri Lanka. It is of international significance and has been designated as a Biosphere Reserve (1978) and World Heritage Site (1989) by UNESCO. The reserve is only 21 km from East to West, and a maximum of 7 km from North to South, but it is a treasure trove of endemic species, including trees, insects, amphibians, reptiles, birds and mammals. Kanneliya-Dediyagala-Nakiyadeniya or KDN is a forest complex situated 35 km North-west of city of Galle. The forest complex designated as a biosphere reserve in 2004 by UNESCO. The KDN complex is the last large remaining rainforest in Sri Lanka other than Sinharaja .The rain forest is a major catchment area for two of the most important rivers in southern Sri Lanka, the Gin and Nilwala Rivers.

5) Wildlife Protected Areas



Source: Environmental Resource Profile, CEA

Figure 9.1.20 Environment Sensitive Areas

Kanneliya and Sinharaja forests are bio diversity hotspots which provides habitat for many fauna and flora species. Around 20 endemic species of fish, 19 (14 endemic) species of Amphibian, 124 (23 endemic) species of birds, 53 species of butterfly, 59 species of reptiles and different species of chameleon could be observed here. The Bonavista coral reef**,** which is approximately 100,000 sq meters in size with over 82% live coral cover, is situated at the base of Rumassala Cliff at the south eastern corner of Galle Bay. The reef is home to a wide range of flora/algae and fauna, including a great variety of fish, shrimps, crabs and mollusks, turtles etc. It has 481 recorded species of fish belong to 185 genera in 68 families, which constitute the highest number of species recorded on any Sri Lankan reef. Of the 36 species of Chaetodontis in 5 genera recorded in Sri Lankan reefs, 25 species in 3 genera of the family Chaetodontidae (butterfly fish) are known to inhabit Bonavista reef, which is the highest number for a Sri Lankan reef. The Bonavista and Unuwatune reefs are the best coral reefs in the southwest, or even possibly in the whole of Sri Lanka.

6) Historical/Cultural and Archeological Important Sites

Due to its location in the southern coast of Sri Lanka, Galle District secured an important place in the battles against enemies as the capital city of Southern Province In the ancient Sri Lanka. Ancient legends reveal that in 1072 A.C. King Vijayabahu I started his battle against "Soli" in Thambalagamuwa of Hinidum Pattu. According to legends, during the reign of King Dambhadeniya Parakramabahu carried out his battle against Queen Sugala in the Galle District. Galle was a very important area during the reign of King Maha Parakramabahu and it very much helped the Dutch, Portuguese and English establish their kingdoms. Due to its exposure to many nationalities and religions in ancient times, about 153 archeologically and historically important monuments including temples, Hindu kovils. Mosques and Catholic churches could be observed.

Galle Fort, which was built in bay of southern coast in 1588 by the Portuguese, and then by the Dutch during the 17th century from 1649 onwards is a major historical, archaeological and architectural

heritage monument. Rumassala is another important site in Galle and its history goes back to the Rama – Rawana and Hanuman time. The entire Rumassala area including both the forest and coral reefs are now protected as a sanctuary due to its valuable biodiversity.

7) Settlements of Ethnic Minority Groups

According to the DCS, 2012, the total population of the district was 1,063,334. The major ethnic group of the district is Sinhala, followed by Sri Lankan Moors, Sri Lankan Tamil, Indian Tamils, Burgher, Malay and others. These groups belong to different Religions where majority are Buddhists (998,647), and then Islam (39,267), Hindus (15,584), Catholic (4,415), Christians (5,315) and other (106).

Table 9.1.8 Population by Ethnic/Religious Groups in Galle District

Population by ethnic group			Population by religious group		
Sinhalese	1,003,722	94%	Buddhist	998,647	94%
Sri Lankan Tamil	13,953	1%	Islam	39,267	4%
Indian Tamil	6,146	1%	Hindu	15,584	1%
Sri Lankan Moor	38,790	4%	Catholic	4,415	0.4%
Burgher	256	0.02%	Christian	5,315	0.5%
Malay	106	0.01%	Others	106	0.01%
Sri Lanka Chetty	12	0.001%			
Bharatha	8	0.001%			
Others	341	0.03%			
Total	1,063,334	100%		1,063,334	100%

Source: Department of census and Statistics, 2012

(8) Matara District

1) General Feature

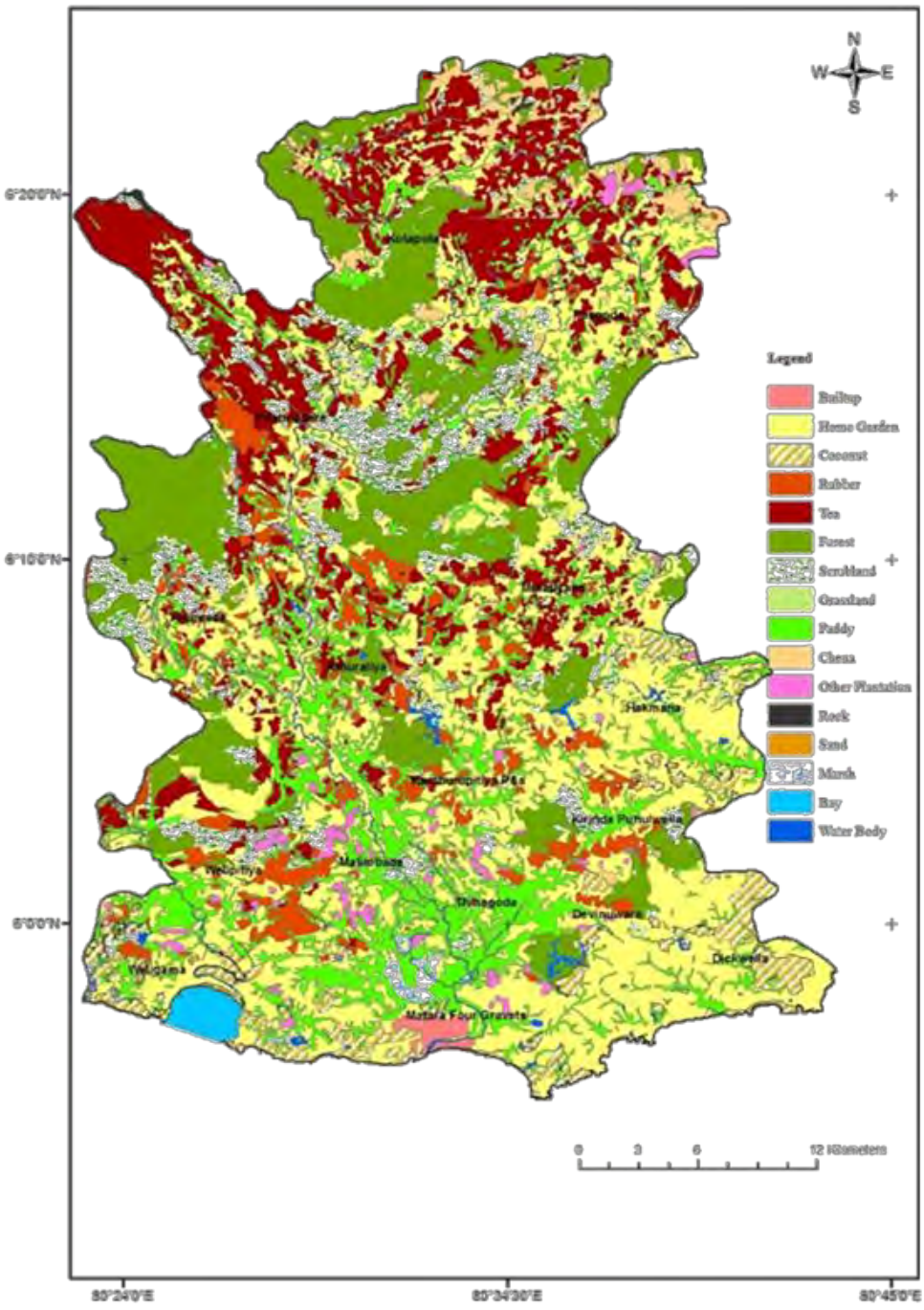
Matara district is located in the south west of Sri Lanka with elevation ranging from 2m - 1158m above sea level at hilly region. The land area of the district is 1,282.5km^2 and is surrounded by 55 km long coastal belt from its southern side and districts of Ratnapura, Hambanthota and Galle in North, East and Western side. The district is divided into 16 Divisional Secretariat Divisions and 650 Grama Niladhari Divisions with 1,658 villages.

2) Land Use

The district covers 1.96% of total extent of land of the Island and 23.14% of Southern Province. Major cultivations of the district include paddy, tea, rubber and commercial crops such as Pepper, Coffee and Cinnamon. Majority of the district's land use consists of forests, Paddy and Tea Cultivations and home gardens. Rest of the areas of the district consists of built up areas, Rubber and Coconut cultivations, Chena cultivation, water bodies, Grasslands, Scrub and Marshes.

3) Climate

The district has a tropical climate. The average annual temperature of the district is 26.8 °C while the annual mean temperatures ranges from 25-27 ^{O}C. The annual rain fall of the district is between 2000-2500mm and mainly received from the South-West monsoon during the month of March-August .

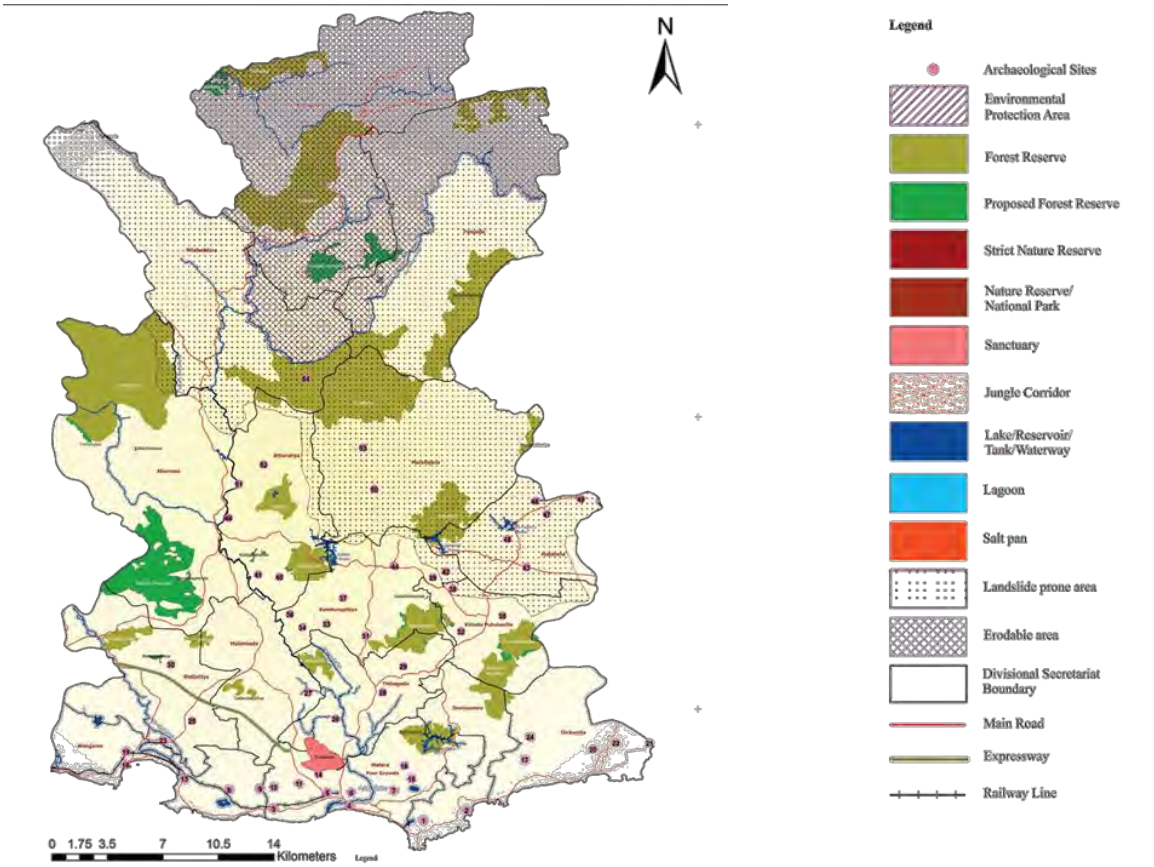


Source: Environmental Resource Profile, CEA

Figure 9.1.21 Land Use Map of Matara District

4) Wildlife Protected Areas

Part of the World Heritage of Sinharaja Forest is located within the district. The Kiralakele Sanctuary is another significant wild life protected area. Plant species of the sanctuary include mangrove species such as Kirala, Ketala and Kumbuk, waterborne plants like Mimosa pudica, fruits such as Madan, Kirala and mango. When the Fauna in Kiralakele is considered birds (about 68 species), reptiles, butterflies and fish can be seen.



Source: Environmental Resource Profile, CEA

Figure 9.1.22 Wildlife Protected Area

5) Historical/cultural and Archeological Important Sites

Matara district has a long history up to Ravana period and is described in Sinhala Mahawansa as the city of aliens, Bengal of wealthy people and institute of intellectuals. By archeological evidences it is proved that power was under Naga tribe even before the arrival of Wijaya Prince. Kapparatota in Weligama area had been used by foreign people for anchoring their commercial ships and Agrabhodhi Vihara of Weligama had been built during the reign of king Devanam Piyatissa. Hathbodhi watte and Matara Bodhi were built in the reign of king Kumaradasa.

There are about 54 historical/ cultural and Archeological Important Sites and monuments located within the district. Pitabaddara Athuela Bridge at Nilella, Morawaka, Devinuwara Light House and the well-preserved Dutch fort are the other main important monuments among them (*Source: Statistic Division – Matara).*

6) Settlements of Ethnic Minority Groups

According to the DCS, 2012, the major ethnic group of the district is Sinhala, followed by Sri Lankan Moors, Indian Tamils, Sri Lankan Tamils and others. These groups belong to different religions where majority are Buddhists (756,098), and then Christian (25,982), Islam (18,908), Hindu (2,901) and others (110).

Table 9.1.9 Population by Ethnic/Religious Groups in Matara District

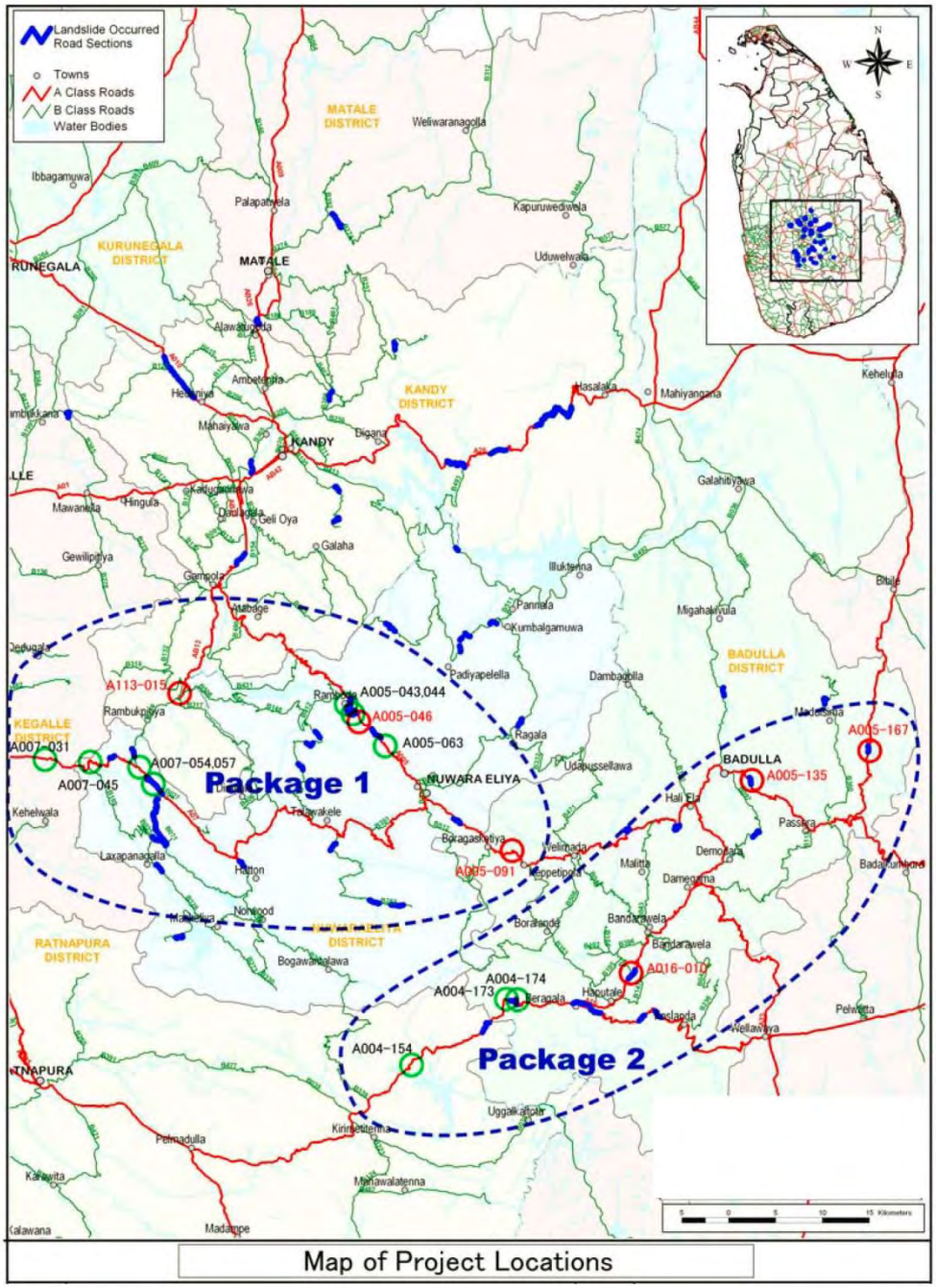
Population by ethnic group			Population by religious group		
Sinhalese	757,046	94%	Buddhist	756,098	94%
Sri Lankan Tamil	5,060	1%	Islam	18,908	2%

Indian Tamil	17,937	2%	Hindu	2,901	0.4%
Sri Lankan Moor	23,635	3%	Christian	25,982	3%
Others	321	0.04%	Others	110	0.01%
Total	803,999	100%		803,999	100%

Source: Department of Census and Statistics, 2012

9.1.2.2 Pollution

Most of the project areas are rural areas with a small population. Since periodical environmental monitoring is not carried out there, there is little information about the current state of pollution such as air quality, water quality or noise. As limited information, the monitoring results of LDPP in December 2018 were obtained. The monitoring sites of LDPP are shown in **Figure 9.1.23** and the locations are shown in **Table 9.1.10**. The monitoring results are also shown in **Table 9.1.11** ~ **Table 9.1.18**.



Source: JICA Survey Team

Figure 9.1.23 Location Map of LDPP's Pollution Monitoring Areas

Table 9.1.10 Location of LDPP's Pollution Monitoring Areas

Package 1

No.	Name	Road	Mile-post	GND	DSD	District	Disaster Type
1	Nawalapitiya	A113	Km 015	Nawalapitiya North & South	Pasbage Korale	Kandy	Landslide
2	Theligama	A007	Km 031	Theligama	Yatiyantota	Kegalle	Slope Failure
3	Pitawala	A007	Km 045	Pitawala	Ambagamuwa	Nuwara Eliya	Rockfall
4	Ginigathena	A007	Km 054	Ginigathena	Ambagamuwa	Nuwara Eliya	Slope Failure
5	Diyagala	A007	Km 057	Ginigathena	Ambagamuwa	Nuwara Eliya	Slope Failure
6	Kothmalegama-1	A005	Km 043	Ramboda	Kothmale	Nuwara Eliya	Rockfall
7	Kothmalegama-2	A005	Km 044	Ramboda	Kothmale	Nuwara Eliya	Rockfall
8	Ramboda	A005	Km 046	Ramboda	Kothmale	Nuwara Eliya	Rockfall
9	Toppass	A005	Km 063	Toppass	Nuwaraeliya	Nuwara Eliya	Slope Failure
10	Keppetipola	A005	Km 091	Gawarammana	Welimada	Badulla	Slope Failure

Package 2

No.	Name	Road	Mile-post	GND	DSD	District	Disaster Type
1	Imbulpe	A004	Km 154	Seelogama	Imbulpe	Ratnapura	Slope Failure
2	Pussella	A004	Km 173	Kalupahana	Haldummulla	Badulla	Slope Failure
3	Walhaputenna	A004	Km 174	Walhaputenna	Haldummulla	Badulla	Slope Failure
4	Kahagalla	A016	Km 010	Panketiya	Haputale	Badulla	Landslide
5	2nd Mile Post	A005	Km 135	Badulla	Badulla	Badulla	Landslide
6	Lunugala	A005	Km 167	Yapamma	Lunugala	Badulla	Landslide

Source: JICA Survey Team

(1) Air quality

Regardless of the construction period, all items satisfied the national standards at any points. It indicates that air quality in the areas is generally very good. Since the target areas of the Project (LDPP2) are under similar environmental conditions, it is presumed that the air quality is also in good condition.

However, at three sites, namely A004-Km174, A016-Km010 and A005-Km135 of the Package 2, PM values exceeded the standard value of international guidelines, though the values satisfied the national standards. There is concern about the impact of road traffic or construction activities on National Highway A-004, A-005, and A-016.

Table 9.1.11 Monitoring Results of LDPP (Package 1) [Ambient Air Quality]

Project stage: Construction (December 2018)

No.	Name	Road	Mile-post	Item	Averaging Time	Measured Value (µg/m³)		National Standards	WHO Guidelines
						mean	max		
1	Nawalapitiya	A113	Km 015	SO_2	1 hr	13.3	15	200	-
				NO_2	1 hr	17.3	18	250	200
				CO	1 hr	1,468	1,520	30,000	-
				O_3	1 hr	5	6	200	-
				PM10	3 hrs	36	38.2	100 (24 hrs)	50 (24 hrs)
2	Theligama	A007	Km 031	SO_2	1 hr	33.66	36	200	-
				NO_2	1 hr	26	28	250	200
				CO	1 hr	2,147	2,200	30,000	-
				O_3	1 hr	6.33	8	200	-
				PM10	3 hrs	n/a	n/a	100 (24 hrs)	50 (24 hrs)
3	Pitawala	A007	Km 045	SO_2	1 hr	19.33	22	200	-
				NO_2	1 hr	20.33	21	250	200
				CO	1 hr	2,290	2,350	30,000	-
				O_3	1 hr	5	5	200	-
				PM10	3 hrs	n/a	n/a	100 (24 hrs)	50 (24 hrs)
4	Ginigathena	A007	Km 054	SO_2	1 hr	21.6	23	200	-
				NO_2	1 hr	16.3	17	250	200
				CO	1 hr	1,591	1,610	30,000	-
				O_3	1 hr	4.3	5	200	-
				PM10	3 hrs	36.53	41.2	100 (24 hrs)	50 (24 hrs)
5	Diyagala	A007	Km 057	SO_2	1 hr	23	24	200	-
				NO_2	1 hr	18.6	20	250	200
				CO	1 hr	2,325	2,330	30,000	-
				O_3	1 hr	4.3	5	200	-
				PM10	3 hrs	24.86	28.2	100 (24 hrs)	50 (24 hrs)
6	Kothmalegama-1	A005	Km 043	SO_2	1 hr	17.6	18	200	-
				NO_2	1 hr	14.6	15	250	200
				CO	1 hr	1,223	1,225	30,000	-
				O_3	1 hr	5.6	6	200	-
				PM10	3 hrs	36.2	38.2	100 (24 hrs)	50 (24 hrs)
7	Kothmalegama-2	A005	Km 044	SO_2	1 hr	15.3	16	200	-
				NO_2	1 hr	18.6	20	250	200
				CO	1 hr	1,655	1,660	30,000	-
				O_3	1 hr	4	5	200	-
				PM10	3 hrs	35.4	38.2	100 (24 hrs)	50 (24 hrs)
8	Ramboda	A005	Km 046	SO_2	1 hr	18.6	21	200	-
				NO_2	1 hr	15	16	250	200
				CO	1 hr	1,181	1,225	30,000	-
				O_3	1 hr	4.33	5	200	-
				PM10	3 hrs	29.9	31.2	100 (24 hrs)	50 (24 hrs)
9	Toppass	A005	Km 063	SO_2	1 hr	21	22	200	-
				NO_2	1 hr	20.3	21	250	200
				CO	1 hr	1,238	1,255	30,000	-
				O_3	1 hr	6.33	7	200	-
				PM10	3 hrs	30.3	32.6	100 (24 hrs)	50 (24 hrs)
10	Keppetipola	A005	Km 091	SO_2	1 hr	16.3	18	200	-
				NO_2	1 hr	15.3	16	250	200
				CO	1 hr	2630	2680	30,000	-
				O_3	1 hr	5	5	200	-
				PM10	3 hrs	23.3	28.5	100 (24 hrs)	50 (24 hrs)

Source: Quarterly Environmental Quality Monitoring Report for the Landslide Disaster Protection Project National Road Network Packag-1 (JICA Format) Report No-05 (December 2018)

Table 9.1.12 Monitoring Results of LDPP (Package 2) [Ambient Air Quality]

Project stage: Construction (December 2018)

No.	Name	Road	Mile-post	Item	Averaging Time	Measured Value (µg/m³)		National Standards	WHO Guidelines
						mean	max		
1	Imbulpe	A004	Km 154	SO_2	1 hr	17	18	200	-
				NO_2	1 hr	15	16	250	200
				CO	1 hr	2,341	2,400	30,000	-
				O_3	1 hr	4.3	5	200	-
				PM10	24 hrs	40.3	42.6	100	50
2	Pussella	A004	Km 173	SO_2	1 hr	16	17	200	-
				NO_2	1 hr	15	16	250	200
				CO	1 hr	3,235	3,260	30,000	-
				O_3	1 hr	5	6	200	-
				PM10	24 hrs	44.13	45.6	100	50
3	Walhaputenna	A004	Km 174	SO_2	1 hr	16	17	200	-
				NO_2	1 hr	15	16	250	200
				CO	1 hr	2,255	2,260	30,000	-
				O_3	1 hr	5	6	200	-
				PM10	24 hrs	54.3	57.2	100	50
4	Kahagalla	A016	Km 010	SO_2	1 hr	24	25	200	-
				NO_2	1 hr	15	16	250	200
				CO	1 hr	2,525	2,530	30,000	-
				O_3	1 hr	4	5	200	-
				PM10	24 hrs	83	85	100	50
5	2nd Mile Post	A005	Km 135	SO_2	1 hr	14	15	200	-
				NO_2	1 hr	13	14	250	200
				CO	1 hr	1,625	1,630	30,000	-
				O_3	1 hr	5	5	200	-
				PM10	24 hrs	49.6	55.2	100	50
6	Lunugala	A005	Km 167	SO_2	1 hr	-	-	200	-
				NO_2	1 hr	-	-	250	200
				CO	1 hr	-	-	30,000	-
				O_3	1 hr	-	-	200	-
				PM10	24 hrs	-	-	100	50

Source: Quarterly Environmental Quality Monitoring Report for the Landslide Disaster Protection Project National Road Network Package 2- JICA Format Report No-06 (December 2018)

(2) Water quality

The monitoring is for water quality of effluents. Regarding pH, TSS, BOD_5, Lead and Oil & Grease, both national and international standards were satisfied at all monitoring sites. However, turbidity tended to be high overall, and exceeded international guidelines at some sites. Since the values of TSS, BOD_5, Lead and Oil & Grease were low, contamination due to organic matter and chemical substances is not considered, but it is considered that turbidity increased due to mixing of earth and sand generated by construction activities. At the sites, A004-Km173 and A016-Km010, coliform bacteria did not satisfy the international guidelines. If fecal coliforms contaminated water, the concentration of BOD_5, which is an indicator of organic pollution, should have increased as the coliform count increased. However, since the BOD_5 concentration remained low, it is unlikely that anthropogenic pollution was a major cause. High value of coliform count is thought to be due to the increase of soil-derived coliform rather than the effect of fecal coliform.

Table 9.1.13 Monitoring Results of LDPP (Package 1) [Effluent/Wastewater Water Quality]

Project stage: Construction (December 2018)

No.	Name	Road	Mile-post	Item	Unit	Measured Value		National Standards	Inter-national Guidelines
						mean	max		
1	Nawalapitiya	A113	Km 015	EC	(S/m)	0.031	0.063	-	-
				pH	(mg/L)	6.9	7	6.0 - 8.5	6 - 9
				DO	(mg/L)	12.73	13.2	-	-
				Turbidity	(mg/L)	0.19	0.26	-	<0.2
				TSS	(mg/L)	8.1	13	50	50
				BOD_5	(mg/L)	0.37	0.6	30	30
				Lead	(mg/L)	ND	ND	0.1	-
				Oil & grease	(mg/L)	0.26	0.4	10	10
				Coliform	(MPN/ 100mL)	35	39	40 (Fecal)	400 (Total)
2	Theligama	A007	Km 031	EC	(S/m)	0.025	0.061	-	-
				pH	(mg/L)	6.2	6.5	6.0 - 8.5	6 - 9
				DO	(mg/L)	3.05	3.1	-	-
				Turbidity	(mg/L)	0.17	0.23	-	<0.2
				TSS	(mg/L)	2.9	5.8	50	50
				BOD_5	(mg/L)	0.36	0.49	30	30
				Lead	(mg/L)	ND	ND	0.1	-
				Oil & grease	(mg/L)	1.0	1.5	10	10
				Coliform	(MPN/ 100mL)	33	35	40	400
3	Pitawala	A007	Km 045	EC	(S/m)	0.124	0.138	-	-
				pH	(mg/L)	6.8	7.3	6.0 - 8.5	6 - 9
				DO	(mg/L)	2.7	3.2	-	-
				Turbidity	(mg/L)	0.18	0.25	-	<0.2
				TSS	(mg/L)	1.42	2.4	50	50
				BOD_5	(mg/L)	1.6	2.4	30	30
				Lead	(mg/L)	ND	ND	0.1	-
				Oil & grease	(mg/L)	2.9	4.8	10	10
				Coliform	(MPN/ 100mL)	35	39	40	400
4	Ginigathena	A007	Km 054	EC	(S/m)	0.113	0.183	-	-
				pH	(mg/L)	6.9	7	6.0 - 8.5	6 - 9
				DO	(mg/L)	3.1	3.6	-	-
				Turbidity	(mg/L)	0.19	0.28	-	<0.2
				TSS	(mg/L)	0.5	1	50	50
				BOD_5	(mg/L)	1.35	2.2	30	30
				Lead	(mg/L)	ND	ND	0.1	-
				Oil & grease	(mg/L)	0	0	10	10
				Coliform	(MPN/ 100mL)	37	40	40	400
5	Diyagala	A007	Km 057	EC	(S/m)	0.012	0.021	-	-
				pH	(mg/L)	7.2	7.5	6.0 - 8.5	6 - 9
				DO	(mg/L)	9.76	10.1	-	-
				Turbidity	(mg/L)	0.19	0.43	-	<0.2
				TSS	(mg/L)	4.83	12.5	50	50
				BOD_5	(mg/L)	0.36	0.6	30	30
				Lead	(mg/L)	ND	ND	0.1	-
				Oil & grease	(mg/L)	0	0	10	10
				Coliform	(MPN/ 100mL)	30	32	40	400

6	Kothmalegama-1	A005	Km 043	EC	(S/m)	0.034	0.062	-	-
				pH	(mg/L)	6.9	7.1	6.0 - 8.5	6 - 9
				DO	(mg/L)	10.9	12.7	-	-
				Turbidity	(mg/L)	0.1	0.24	-	<0.2
				TSS	(mg/L)	15.33	34	50	50
				BOD_5	(mg/L)	0.84	1.71	30	30
				Lead	(mg/L)	ND	ND	0.1	-
				Oil & grease	(mg/L)	0	0	10	10
				Coliform	(MPN/ 100mL)	31	34	40	400
7	Kothmalegama-2	A005	Km 044	EC	(S/m)	0.023	0.029	-	-
				pH	(mg/L)	6.9	7	6.0 - 8.5	6 - 9
				DO	(mg/L)	9.23	9.8	-	-
				Turbidity	(mg/L)	0.18	1.9	-	<0.2
				TSS	(mg/L)	8.16	13	50	50
				BOD_5	(mg/L)	0.37	0.6	30	30
				Lead	(mg/L)	ND	ND	0.1	-
				Oil & grease	(mg/L)	0.2	0.4	10	10
				Coliform	(MPN/ 100mL)	30	33	40	400
8	Ramboda	A005	Km 046	EC	(S/m)	0.05	0.06	-	-
				pH	(mg/L)	6.9	7	6.0 - 8.5	6 - 9
				DO	(mg/L)	12.6	13	-	-
				Turbidity	(mg/L)	0.17	0.24	-	<0.2
				TSS	(mg/L)	15.5	46	50	50
				BOD_5	(mg/L)	1.5	3.6	30	30
				Lead	(mg/L)	ND	ND	0.1	-
				Oil & grease	(mg/L)	0.6	1	10	10
				Coliform	(MPN/ 100mL)	32	36	40	400
9	Toppass	A005	Km 063	EC	(S/m)	0.085	0.138	-	-
				pH	(mg/L)	7	7.1	6.0 - 8.5	6 - 9
				DO	(mg/L)	11.16	12.9	-	-
				Turbidity	(mg/L)	0.19	0.26	-	<0.2
				TSS	(mg/L)	0.3	0.5	50	50
				BOD_5	(mg/L)	1.2	1.4	30	30
				Lead	(mg/L)	ND	ND	0.1	-
				Oil & grease	(mg/L)	0	0	10	10
				Coliform	(MPN/ 100mL)	30	32	40	400
10	Keppetipola	A005	Km 091	EC	(S/m)	0.239	0.356	-	-
				pH	(mg/L)	6.9	7	6.0 - 8.5	6 - 9
				DO	(mg/L)	12.23	13.2	-	-
				Turbidity	(mg/L)	0.02	0.07	-	<0.2
				TSS	(mg/L)	4.83	10.5	50	50
				BOD_5	(mg/L)	2.23	4.1	30	30
				Lead	(mg/L)	ND	ND	0.1	-
				Oil & grease	(mg/L)	0.06	0.2	10	10
				Coliform	(MPN/1 00mL)	30	32	40	400

Source: Quarterly Environmental Quality Monitoring Report for the Landslide Disaster Protection Project National Road Network Packag-1 (JICA Format) Report No-05 (December 2018)

ND: not detected

Table 9.1.14 Monitoring Results of LDPP (Package 2) [Effluent/Wastewater Water Quality]

Project stage: Construction (December, 2018)

No.	Name	Road	Mile-post	Item	Unit	Measured Value		National Standards	Inter-national Guidelines
						mean	max		
1	Imbulpe	A004	Km 154	EC	(S/m)	0.051	0.056	-	-
				pH	(mg/L)	6.5	6.7	6.0 - 8.5	6 - 9
				DO	(mg/L)	12.8	13.1	-	-
				Turbidity	(mg/L)	1.27	1.78	-	<0.2
				TSS	(mg/L)	1.66	2	50	50
				BOD_5	(mg/L)	1.2	1.4	30	30
				Lead	(mg/L)	ND	ND	0.1	-
				Oil & grease	(mg/L)	ND	ND	10	10
				Coliform	(MPN/ 100mL)	75	81	40	400
2	Pussella	A004	Km 173	EC	(S/m)	0.055	0.058	-	-
				pH	(mg/L)	6.8	7.1	6.0 - 8.5	6 - 9
				DO	(mg/L)	11.9	12.2	-	-
				Turbidity	(mg/L)	0.83	0.92	-	<0.2
				TSS	(mg/L)	3.33	5	50	50
				BOD_5	(mg/L)	0.7	1.0	30	30
				Lead	(mg/L)	ND	ND	0.1	-
				Oil & grease	(mg/L)	ND	ND	10	10
				Coliform	(MPN/ 100mL)	1,800	**1,800**	40	400
3	Walhaputenna	A004	Km 174	EC	(S/m)	0.073	0.078	-	-
				pH	(mg/L)	6.8	6.9	6.0 - 8.5	6 - 9
				DO	(mg/L)	10.3	10.6	-	-
				Turbidity	(mg/L)	ND	ND	-	<0.2
				TSS	(mg/L)	3.8	4.0	50	50
				BOD_5	(mg/L)	0.8	1.1	30	30
				Lead	(mg/L)	ND	ND	0.1	-
				Oil & grease	(mg/L)	ND	ND	10	10
				Coliform	(MPN/ 100mL)	77	89	40	400
4	Kahagalla	A016	Km 010	EC	(S/m)	0.087	0.091	-	-
				pH	(mg/L)	7.0	9.0	6.0 - 8.5	6 - 9
				DO	(mg/L)	11.1	11.2	-	-
				Turbidity	(mg/L)	0.62	0.62	-	<0.2
				TSS	(mg/L)	7.6	9.0	50	50
				BOD_5	(mg/L)	2.1	2.6	30	30
				Lead	(mg/L)	ND	ND	0.1	-
				Oil & grease	(mg/L)	ND	ND	10	10
				Coliform	(MPN/ 100mL)	1,800	**1,800**	40	400
5	2nd Mile Post	A005	Km 135	EC	(S/m)	0.134	0.148	-	-
				pH	(mg/L)	6.9	7.0	6.0 - 8.5	6 - 9
				DO	(mg/L)	8.5	8.8	-	-
				Turbidity	(mg/L)	0.77	0.79	-	<0.2
				TSS	(mg/L)	ND	ND	50	50
				BOD_5	(mg/L)	0.11	0.15	30	30
				Lead	(mg/L)	ND	ND	0.1	-
				Oil & grease	(mg/L)	ND	ND	10	10
				Coliform	(MPN/ 100mL)	13	18	40	400

6	Lunugala	A005	Km 167	EC	(S/m)	-	-	-	-
				pH	(mg/L)	-	-	6.0 - 8.5	6 - 9
				DO	(mg/L)	-	-	-	-
				Turbidity	(mg/L)	-	-	-	<0.2
				TSS	(mg/L)	-	-	50	50
				BOD_5	(mg/L)	-	-	30	30
				Lead	(mg/L)	-	-	0.1	-
				Oil & grease	(mg/L)	-	-	10	10
				Coliform	(MPN/ 100mL)	-	-	40	400

Source: Quarterly Environmental Quality Monitoring Report for the Landslide Disaster Protection Project National Road Network Package 2- JICA Format Report No-06 (December 2018)

ND: not detected

(3) Noise

Though noise levels at day time slightly exceeded the standard value of international guidelines at many sites, national standards was satisfied at all sites. Though noise levels at night time were only measured at the sites of Package 1, the values were about the maximum level of national standards and comparatively in good condition at most sites. However, the noise level at night far exceeded the standard value of national standards at the site A007-Km054. At the site A007-Km054, day time noise and night time noise are almost the same level, and there is no difference between day and night. The reason for high noise level in the daytime is thought to be due to both traffic noise on the main road and noise from construction work. However, since construction work was not done in the nighttime, the noise from construction work should not have been mixed in the noise in the nighttime. Therefore, the reason for high noise level in the nighttime is likely to be due to high traffic volume similar to that in the daytime.

Table 9.1.15 Monitoring Results of LDPP (Package 1) [Noise]

Project stage: Construction (December, 2018)

No.	Name	Road	Mile-post	Time Zone	Measured Value (dB(A))		National Standards	Inter-national Guidelines
					mean	max		
1	Nawalapitiya	A113	Km 015	Day Time (6:00-21:00)	69.6	71	75	70
				Night Time (21:00-6:00)	47.2	**51**	50	70
2	Theligama	A007	Km 031	Day Time	68.8	72.2	75	70
				Night Time	46.5	48.2	50	70
3	Pitawala	A007	Km 045	Day Time	70	71.2	75	70
				Night Time	46.2	48	50	70
4	Ginigathena	A007	Km 054	Day Time	69.6	71	75	70
				Night Time	65.7	**68**	50	70
5	Diyagala	A007	Km 057	Day Time	69.6	71	75	70
				Night Time	46.5	49	50	70
6	Kothmalegama-1	A005	Km 043	Day Time	69.6	71	75	70
				Night Time	46.3	48	50	70
7	Kothmalegama-2	A005	Km 044	Day Time	68.6	70	75	70
				Night Time	47.5	**52**	50	70
8	Ramboda	A005	Km 046	Day Time	68.6	70	75	70
				Night Time	47.4	**52**	50	70
9	Toppass	A005	Km 063	Day Time	67.6	70	75	70
				Night Time	48.9	**53**	50	70
10	Keppetipola	A005	Km 091	Day Time	67	70	75	70
				Night Time	45.7	49	50	70

Source: Quarterly Environmental Quality Monitoring Report for the Landslide Disaster Protection Project National Road Network Packag-1 (JICA Format) Report No-05 (December 2018)

Table 9.1.16 Monitoring Results of LDPP (Package 2) [Noise]

Project stage: Construction (December 2018)

No.	Name	Road	Mile-post	Time Zone	Measured Value (dB(A))		National Standards	Inter-national Guidelines
					mean	max		
1	Imbulpe	A004	Km 154	Day Time (6:00-21:00)	69	72	75	70
				Night Time (21:00-6:00)	-	-	50	70
2	Pussella	A004	Km 173	Day Time	68	70	75	70
				Night Time	-	-	50	70
3	Walhaputenna	A004	Km 174	Day Time	70	72	75	70
				Night Time	-	-	50	70
4	Kahagalla	A016	Km 010	Day Time	70	73	75	70
				Night Time	-	-	50	70
5	2nd Mile Post	A005	Km 135	Day Time	71	72	75	70
				Night Time	-	-	50	70
6	Lunugala	A005	Km 167	Day Time			75	70
				Night Time			50	70

Source: Quarterly Environmental Quality Monitoring Report for the Landslide Disaster Protection Project National Road Network Package 2- JICA Format Report No-06 (December 2018)

(4) Vibration

Vibration level satisfied both national standards and international guidelines at all monitoring sites. It indicates that vibration level in the areas is generally very good.

Table 9.1.17 Monitoring Results of LDPP (Package 1) [Vibration]

Project stage: Construction (December 2018)

No.	Name	Road	Mile-post	Frequency of Vibration (Hz)	Measured Value (dB(A))		National Standards		Inter-national Guidelines
							Type of Vibration		
					mean	max	Conti-nuous	Inter-mittent	
1	Nawalapitiya	A113	Km 015	0 - 10	-	-	1.0	2.0	-
				10 - 50	-	-	2.0	4.0	-
				50 <	0.55	0.58	4.0	8.0	-
2	Theligama	A007	Km 031	0 - 10	-	-	1.0	2.0	-
				10 - 50	-	-	2.0	4.0	-
				50 <	0.45	0.55	4.0	8.0	-
3	Pitawala	A007	Km 045	0 - 10	-	-	1.0	2.0	-
				10 - 50	-	-	2.0	4.0	-
				50 <	0.4	0.46	4.0	8.0	-
4	Ginigathena	A007	Km 054	0 - 10	-	-	1.0	2.0	-
				10 - 50	-	-	2.0	4.0	-
				50 <	0.52	0.55	4.0	8.0	-
5	Diyagala	A007	Km 057	0 - 10	-	-	1.0	2.0	-
				10 - 50	-	-	2.0	4.0	-
				50 <	0.55	0.58	4.0	8.0	-
6	Kothmalegama-1	A005	Km 043	0 - 10	-	-	1.0	2.0	-
				10 - 50	-	-	2.0	4.0	-
				50 <	0.62	0.65	4.0	8.0	-
7	Kothmalegama-2	A005	Km 044	0 - 10	-	-	1.0	2.0	-
				10 - 50	-	-	2.0	4.0	-
				50 <	0.54	0.56	4.0	8.0	-
8	Ramboda	A005	Km 046	0 - 10	-	-	1.0	2.0	-
				10 - 50	-	-	2.0	4.0	-
				50 <	0.52	0.55	4.0	8.0	-
9	Toppass	A005	Km 063	0 - 10	-	-	1.0	2.0	-
				10 - 50	-	-	2.0	4.0	-

				50 <	0.65	0.7	4.0	8.0	-
10	Keppetipola	A005	Km 091	0 - 10	-	-	1.0	2.0	-
				10 - 50	-	-	2.0	4.0	-
				50 <	0.52	0.55	4.0	8.0	-

Source: Quarterly Environmental Quality Monitoring Report for the Landslide Disaster Protection Project National Road Network Packag-1 (JICA Format) Report No-05 (December 2018)

Table 9.1.18 Monitoring Results of LDPP (Package 2) [Vibration]

Project stage: Construction (December 2018)

No.	Name	Road	Mile-post	Frequency of Vibration (Hz)	Measured Value (dB(A))		National Standards		Inter-national Guidelines
							Type of Vibration		
					mean	max	Conti-nuous	Inter-mittent	
1	Imbulpe	A004	Km 154	0 - 10	-	-	1.0	2.0	-
				10 - 50	-	-	2.0	4.0	-
				50 <	0.47	0.55	4.0	8.0	-
2	Pussella	A004	Km 173	0 - 10	-	-	1.0	2.0	-
				10 - 50	-	-	2.0	4.0	-
				50 <	0.65	0.71	4.0	8.0	-
3	Walhaputenna	A004	Km 174	0 - 10	-	-	1.0	2.0	-
				10 - 50	-	-	2.0	4.0	-
				50 <	0.74	0.76	4.0	8.0	-
4	Kahagalla	A016	Km 010	0 - 10	-	-	1.0	2.0	-
				10 - 50	-	-	2.0	4.0	-
				50 <	0.77	0.85	4.0	8.0	-
5	2nd Mile Post	A005	Km 135	0 - 10	-	-	1.0	2.0	-
				10 - 50	-	-	2.0	4.0	-
				50 <	0.69	0.75	4.0	8.0	-
6	Lunugala	A005	Km 167	0 - 10	-	-	1.0	2.0	-
				10 - 50	-	-	2.0	4.0	-
				50 <	-	-	4.0	8.0	-

Source: Quarterly Environmental Quality Monitoring Report for the Landslide Disaster Protection Project National Road Network Package 2- JICA Format Report No-06 (December 2018)

9.1.3 Policy, Legal and Institutional Framework

Policy, legal and institutional framework related to environmental and social conditions are summarized referring to CEA Website (www.cea.lk).

(1) Initiating the EIA Process

The project proponent first has to find out whether the project proposal falls within the "prescribed project" list by verifying with the CEA or referring to the Government Gazette No. 772/22 of 24.06.93, 859/14 of 23.02.95, 1104/22 of 06.11.99 and 1108/1 of 29.11.99. The CEA may provide the project proponent with a Basic Information Questionnaire (BIQ) to submit essential information of the project in order for CEA to determine the above (The BIQ may be obtained from the EIA Unit of the CEA Head Quarters or the Provincial / District offices of the CEA. It could also be downloaded from the CEA website.). If the project is a prescribed project requiring EIA/IEE, the CEA will then determine which will be the appropriate Project Approving Agency (PAA) for administering the EIA/IEE process. The PAA will guide the project proponent in preparation of an EIA/IEE.

If the project is located within the coastal zone, then the project proponent should contact the Director General, Coastal Conservation Department. If the project is located within one mile from the boundary of a National Reserves, the project proponent should contact the Director General of Wildlife Conservation.

(2) Project Approving Agencies

The Project Approving Agencies which can grant approval for IEE / EIA as set out in the Gazette Extra Ordinary No. 859/14 of 23.02.95 and Gazette Extra Ordinary No. 1373/6 of 29.12.04 are given below.

- The respective Ministries to which the following subjects are assigned: -National Planning, Irrigation, Energy, Agriculture, Lands, Forests, Industries, Housing, Construction, Transport, Highways, Fisheries, Aquatic Resources, Plantation Industries
- The Department of Coast Conservation.
- The Department of Wildlife Conservation.
- The Department of Forest
- The Central Environmental Authority.
- The Urban Development Authority
- The Geological Survey and Mines Bureau
- The Ceylon Tourist Board
- The Mahaweli Authority of Sri Lanka
- The Board of Investment of Sri Lanka

(3) Steps in EIA process in Sri Lanka

1) Submission of Preliminary Information

The project proponent should submit PAA information regarding the nature, location and impacts of a proposed project that requires an EIA/IEE.

The best time for a project proponent to submit the preliminary information on the proposed project is as soon as the project concept is finalized, and the location of the project is decided.

2) Environmental Scoping

Environmental scoping is an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action. The PAA will invite all concerned agencies, the project proponent and other interested persons (if necessary) for the scoping process. The PAA will issue the Terms of References (ToR) for the EIA/IEE after the scoping process.

3) EIA/IEE Report Preparation

It is the responsibility of the project proponent to prepare the EIA / IEE report and to submit it to the PAA for evaluation. Preparation of EIA reports may require the services of a team of consultants as many specialized areas have to be covered. A list of consulting firms who prepare EIA reports is available at the CEA. In addition to this, project proponents may use the services of suitably qualified consultants who may not have registered in the CEA. It is important to note that project proponent should obtain the services of reliable and adequately qualified experts in the relevant field, in order to ensure that the EIA reports will be of the required standard.

4) Public Participation & Evaluation of the Report

On receipt of an EIA report, it will be subjected to an adequacy check in order to ensure that the ToR issued by the PAA has been met. It will then be open for public inspection / comments for a period of 30 working days.

If there are any public comments on the EIA report, they will be sent to the project proponent for response.
Subsequent to the public commenting period the PAA will appoint a Technical Evaluation Committee (TEC) to evaluate the EIA report and make its recommendations.
IEE reports are not required to be opened for public comments and are thus subjected to technical evaluation only.

5) Decision Making
Based on the recommendation of the TEC, the PAA makes its decision on whether to grant approval for a project. If the PAA is not the CEA, it should obtain the concurrence of the CEA prior to granting approval.
If the project proponent doesn't agree with the decision, he has a right to appeal to the Secretary to the Ministry of Environment. The decision of the Secretary to the Ministry of Environment is final.

6) Compliance Monitoring
EIA / IEE approval is generally given with conditions which the project proponent is expected to meet. The CEA or the PAA will monitor the implementation of conditions / mitigation measures. If the project proponent violates the conditions, the approval may be revoked.
EIA regulations are published in following Gazette notifications;

- Gazette Extra Ordinary No. 772/22 dated 24.06.93
- Gazette Extra Ordinary No. 1159/22 dated 22.11.2000

(4) Law, Policy and Institutional Arrangement for EIA in Sri Lanka
1) EIA under the Coast Conservation Act
This applies to projects that come within the "Coastal Zone; the area lying within a limit of 300 meters land ward of the mean high-water line and a limit of 2 kilo meters seawards of the mean low water line.

2) EIA in the National Environmental Act
The National Environmental (Amendment) Act No. 56 of 1988 introduced EIA, as a part of the strategy to achieve sustainable development for the entire country and the Central Environmental Authority was assigned regulatory functions.
Part IV C of the amendment act mandated that all "prescribed" development projects are required to be subjected to Environmental Impact Assessment. Only large-scale development projects that are likely to have significant impacts on environment are listed as prescribed projects. In addition, "prescribed projects" if located in "environmental sensitive areas" are required to undergo EIA irrespective of their magnitude. The prescribed projects are listed in the gazette No 772/22 of 24th June 1993, 859/14 of 23rd February 1995, 1104/22 of 5th November 1999 and 1108/1 of 29th November 1999.
The National Environmental Act stipulates that approval for all prescribed projects must be granted by a Project Approving Agency (PAA). At present, 23 Government Agencies have been designated as PAAs. A single Project Approving Agency is established as responsible for administrating the EIA process for a project. When there is more than one PAA is involved the appropriate PAA is decided by the CEA. It is important to note that a state agency which is a project proponent cannot function as a PAA for that project. Project Approving Agencies are listed in the Gazette Extra Ordinary No. 859/14 of 23rd

February 1995 and Gazette Extra Ordinary, No. 1373/6 of 29th December 2004.
The National Environmental Act has identified two levels in the EIA process. If the environmental impacts of the project are not very significant then the project proponent may be asked to do an Initial Environmental Examination (IEE), which is a relatively short and simple study. However, if the potential impacts appear to be more significant, the project proponent may be asked to do an Environmental Impact Assessment (EIA) which is a more detailed and comprehensive study of environmental impacts. EIA reports must be kept open for public comments for 30 working days. IEE reports have been exempted from this requirement. However, an Initial Environmental Examination report shall be deemed to be a public document for the purposes of sections 74 and 76 of the Evidence Ordinance (Chapter 21) and shall be open for inspection by the public.

3) EIA in the Fauna and Flora Protection Ordinance as amended by Acts No. 44 of 1964, No.1 of 1970 and No. 49 of 1993

EIA provisions are also included in the Fauna and Flora Protection Act No. 49 of 1993. According to this Act, any development activity of any description what so ever proposed to be established within one mile from the boundary of any National Reserve, is required to be subject to EIA, and written approval should be obtained from the Director General, Department of Wild Life Conservation prior to implementation of such projects.
According to the Fauna and Flora Protection Ordinance, various activities are strictly restricted in the National Reserves. No person other than the Director shall enter or remain within any National Reserves except for the purpose of discharging any official duty on the instructions or with the written permissions of the Director, or under the authority and in accordance with the conditions of a written permit from the Director only for the purpose of authorizing scientific research. No person shall disturb the fauna and flora in any National Reserve. No person shall fell, girdle, lop, tap, burn or in any way damage or destroy any plant, or take, collect, or remove any plant therefrom. No person shall clear or break up any land for cultivation, mining or for any other purpose. No person shall erect any building, whether permanent or temporary, or occupy any building so erected except under the authority of a permit. No person shall construct or use any road or path so constructed by him.
The Ordinance also mentions the restriction on development activity within a distance of one mile of the boundary of any National Reserve. However, unlike above-mentioned restrictions in the National Reserve, development activities within one mile from the boundary of the Reserve can be approved except for constructing a tourist hotel and providing any similar services or facilities provided by a tourist hotel, if it is confirmed by the Director that the environmental impacts are not serious.

4) Institutional and Organizational Structure of Environmental and Social Consideration in Sri Lanka

Sri Lanka's administrative system is characterized by a form of government in which power is divided between one central authority and several regional ones. As of today, Sri Lanka has 25 districts organized into nine provinces. In 1987, Provincial Councils were introduced as a new level of intermediary governance between the Central and Local governments. The governance structure in Sri Lanka is three-tiered:

- the Parliament is at the national level,
- the Provincial Councils act at the provincial level and
- the Local Authorities consisting of Municipal Councils, Urban Councils and Pradeshiya Sabhas act

at the local level.

The sovereignty of Sri Lanka is vested in the people, while the Parliament exercises the legislative power of the people, and the President exercises the executive power. Excluding the event of parliamentary privileges, the judicial power lies with the courts, tribunals and institutions created and established by law or the Constitution. Laws formulated by the Parliament enjoy immunity from challenge upon passing, and a Court or tribunal may not question the validity of any such law made by the Parliament (CEA, AECEN and ADB 2006).

5) Major Laws Pertaining to Environment and Social Consideration of Sri Lanka

- National Environmental Act No. 47 of 1980 (as amended by acts No. 56 of 1988 and 53 of 2000)
- Fauna and Flora Protection Ordinance No. 2 of 1937 (as amended by Acts No. 49 of 1993 and 12 of 2005) and the Regulations under then Ordinance
- Forest Ordinance No. 16 of 1907 (as amended) and the Rules and Regulations
- Mahaweli Authority Sri Lanka Act No. 23 of 1979 (as amended) and the Regulations under the Act
- State Lands Ordinance No. 8 of 1947 (as amended) – Parts VI,
- Mines and Minerals Act No. 33 of 1992
- Coast Conservation Act No. 57 of 1981 (as amended)
- Fisheries and Aquatic Resources Act No. 2 of 1996 (as amended)
- National Heritage Wilderness Areas Act No. 3 of 1988
- Plant Protection Act No. 35 of 1999
- Felling of Trees (Control) Act No. 9 of 1951 (as amended)
- Water Hyacinth Ordinance No. 4 of 1909

6) Governmental Organizations related to Environmental and Social Considerations in Sri Lanka.

Organization	Major Functions
Ministry of Mahaweli Development and Environment	The Ministry of Mahaweli Development and Environment is the most relevant entity with regard to environmental considerations at the national level, the ministry is in charge of providing 'leadership to manage the environment and natural resources in order to ensure national commitment for sustainable development for the benefit of the present and future generations
Ministry of Sustainable Development and Wildlife (former The Ministry of Regional Development)	The Ministry focus on strengthening of regional economy and aiming at establishing specified development projects in the industry areas of Agro-Industries, Tourism Industries, Wild life and other Industries for the national economic development through a balanced, sustainable regional development.
Ministry of National Policies and Economic Affairs	The Ministry of National Policies and Economic Affairs is a cabinet ministry of the Government of Sri Lanka responsible for formulation of national economic-, national development and monetary policies and strategies, and for coordinating with international agencies and mobilizing foreign resources for the country's economic development.
Ministry of Industry and Commerce	The Ministry plays a dynamic role in the development of the industrial sector and is responsible for promoting industrial development in the country within the wide policy framework by the government. This Ministry which is the policy formulating entity for the industrial sector has taken several initiatives to increase the industrial sector performance through planning, formulating, coordinating, implementing and setting up of the necessary infrastructure for the promotion and development of the industrial sector.
Minister of Finance	The Ministry is responsible for Design, propose, execute and evaluate, with efficiency and transparency, economic and fiscal policies of the country towards promoting investment and economic development to ensure quality living for the people
Ministry of Primary	To formulate & implement policies & strategies and deliver results in creative and

Organization	Major Functions
Industries & Social Empowerment	innovative ways to provide people friendly – social & economic services to marginalized & disadvantaged people (Poor, Elderly, Disabled, Single Parent Families, Substance-Addicts, Orphans) through institutions, networks & professionals in effective, efficient, speedy & productive manner to enhance their Quality of Life in collaboration with local & global agencies.
Department of Census and Statistics (DCS)	The DCS is the Central Government Agency responsible for policy formulation and planning aimed at development of the country by providing accurate timely statistics, more effectively by means of new technology, and utilizing the services of dedicated staff under a strategic leadership to become a prosperous nation in the globalized environment.
Ministry of Economic Reform and Public Distribution	The MERPD is responsible for the formulation of policies, programmers and projects; implementation, monitoring and evaluation in relation to the subjects Economic Reforms and Public Distribution, Food Supply & Distribution and to formulate evidence based Economic Reforms Policies and programmers necessary to increase and sustain the GDP growth of the nation and undertaking economic and data analysis in order to develop National Policies.
Ministry of Internal & Home Affairs and Provincial Councils & Local Government	Enhancing income generation capacity of every province while using available human capital and environmental resources effectively applying Good Governance, Formulate and introduce an appropriate policies and long run programs to minimize the out-migration of the Provinces which have relatively higher rate of out migration, Ensuring the utility of available human resources in each province for overall socioeconomic development process of the country, Mobilization of resources available in the provinces and empowerment of values and capacities of rural communities by improving public participation for grassroots level community development activities. Integrating disaster risk reduction and adaptation measures into regional level development activities while ensuring sustainable usage of natural resources in each Province. To ensure efficient and effective Provincial and Local Government Administrative system through human resource development and upgrading the LAs on scientific basis.
Ministry of Health	To contribute to social and economic development of Sri Lanka by achieving the highest attainable health status through promotive, preventive, curative and rehabilitative services of high quality made available and accessible to people of Sri Lanka.

Source: JICA Survey Team

a. The Ministry of Mahaweli Development and Environment

The Ministry of Mahaweli Development and Environment of Sri Lanka remains committed for the management of the environment and natural resources of the country, maintaining the equilibrium between the trends in rapid economic development and use of natural resource base. Social and economic behavior of the increasing human population has put a major threat in achieving these objectives. The ministry has framed key policies for adoption in management of environment and natural resources of the country. These policies are implemented with the participation of stakeholders including government, agencies, NGO's and communities.

Agencies under the Ministry

- Central Environmental Authority
- Coast Conservation and Coastal Resource Management Department
- Forest Department
- Gem and Jewellery Research and Training Institute
- Geological Survey and Mines Bureau (GSMB)
- Mahweli Authority of Sri Lanka
- Marine Environment Protection Authority
- National Gem and Jewellery Authority

- State Timber Corporation
- Central Engineering Consultancy Bureau

b. The Central Environmental Authority (CEA)

Related legal structure and legal grounds of the CEA

The Central Environmental Authority (CEA) was established in August 1981 under the provision of the National Environmental Act No:47 of 1980. The Ministry of Environment and Natural Resources (ME&NR) (Now Ministry of Mahaweli Development and Environment) which was established in December 2001 has the overall responsibility in the affairs of the CEA with the objective of integrating environmental considerations in the development process of the country. The CEA was given wider regulatory powers under the National Environment (Amendment) Acts No:56 of 1988 and No:53 of 2000.

Main Roles of CEA

- Provision of Environmental Protection Licensing (EPL)

  The EPL is a regulatory/legal tool under the provisions of the National Environmental Act No: 47 of 1980 amended by Acts No 56 of 1988 and No 53 of 2000. Industries and activities which required an EPL are listed in Gazette Notification No 1533/16 dated 25.01.2008. Industries are classified under 3 lists (i.e., List "A","B" and "C") depending on their pollution potential. EPL for industries in lists "A" and “B” have to be obtained from the relevant Provincial Offices or District Offices of the CEA. EPL for the industries in List "C" has to be obtained from the respective Local Authorities.
- Approvals for EIA/IEE

  The importance of the Environmental Assessments as an effective tool for the purpose of integrating environmental considerations into development planning is highly recognized in Sri Lanka. EIA/IEE is a mandatory requirement for establishment of development projects in Sri Lanka under the National Environmental Act.
- Environmental Recommendation

  Assessing site suitability is one of the most important procedures adopted by the CEA for non-prescribed activities under the EIA regulations. All proposed industrial activities which are going to be sited outside the industrial estates approved under part IV C of the NEA those which are provided with proper environmental infrastructure facilities such as common waste water treatment systems etc. are required to adopt and manage with environmentally sound pollution control measures before the operational stage. Therefore, all potential industrial sites or the establishment of new industrial activities which are not subject to EIA, particularly the small and Medium scale industries (SMIs) are advised to obtain environmental recommendation from the CEA for the proposed sites. In considering the suitability, the proposed sites are evaluated in terms of its compatibility with respect to the zoning plans of relevant local Authorities surrounding land use, land availability for buffer zones, and the capacity of the area to receive additional pollution load and waste disposal requirements. The main objective of the environmental recommendation procedure is to take adequate mitigatory measures in advance to abate or minimize the anticipated environment pollution arising from a proposed industrial activity.

c. Department of Forest Sri Lanka

Forest Department was started as the Office of the Conservator of Forests in 1887 denoting the

commencement of forest conservation and scientific forestry in Sri Lanka. The first Forest Ordinance of Sri Lanka was passed in 1885. Both forest and wildlife management were carried out by the Forest Department until the establishment of Department of Wildlife Conservation in 1949. Today about 55% of the forest lands of the country falls under the purview of the Forest Department while the balance forest area is primarily managed by the Department of Wildlife Conservation with an exception of very small extents of isolated forest patches under the purview of other state agencies and private ownership. Forest Department also manages ninety thousand hectares of forest plantations.

d. Ministry of Sustainable Development and Wildlife

Related legal structure and legal grounds

Ministry of Sustainable Development and Wildlife was established under the Extra Ordinary Gazette Notice 1933/33 dated 21/09/2015 issued by H.E The President. Department of Wildlife Conservation, Department of National Zoological Gardens, Department of National Botanical Gardens, Wildlife Trust, Sustainable Development Council are the institutions come under the purview of the Ministry.

e. Department of Wildlife Conservation

The Department of Wildlife Conservation has been entrusted with the responsibility of preserving eco system endowed with various plants and animal species which has inherited the country with enormous bio-diversity. The main function of the Department of Wildlife Conservation established in 1949 is the conservation of wildlife resources in Sri Lanka. Accordingly, the sources of water feeding all the main revivers in Sri Lanka and catchment areas of 40 major reservoirs providing water for agriculture and hydro-power generation are protected within this wildlife reservation network which exceed 13% of the total land area of the island. The responsibility of managing this wildlife reservation network is solely falling upon the Department of Wildlife Conservation. This network consists of reservations declared under various reservation levels.

Related legal structure and legal grounds

- Fauna And Flora Protection Ordinance Nos, 2 of 1937, 31 of 1942, 12 of 1944, 12 of 1945 and Act Nos, 38 of 1949, 44 of 1964, 1 of 1970 and 49 of 1993

Fauna and flora protection ordinances nos. 2 of 1937, an ordinance to provide for the protection, conservation and preservation of the fauna and flora of Sri Lanka; for the prevention of the commercial exploitation of such fauna and flora ; and to provide for matters connected therewith or he incidental thereto.

(5) Environmental Standard and Emission/Effluent/Discharge Regulations for the Qualities of Air, Water, Noise, Vibration, Waste, Soil, Odor, etc.

1) Air Quality

The National Environmental (Ambient Air Quality) Regulations published under the Gazette Notification No. 1562/22 dated 15.08.2008

Pollutant	Average Time	Maximum permissible level	
		in µg/m^3	in ppm
Nitrogen Dioxide (NO_2)	24hr 8hr 1hr	100 150 250	0.05 0.08 0.13
Sulfur Dioxide (SO_2)	24hr 8hr 1hr	80 120 200	0.03 0.05 0.08
Ozone (O_3)	1hr	200	0.10
Carbon Monoxide (CO)	8 hr 1 hr Any time	10,000 30,000 58,000	9 26 50
PM 10	Annual 24hr	50 100	_ _
PM 2.5	Annual 24hr	25 50	_ _

* Minimum number of observations required to determine the average over the specified period

- 03 hour average - 03 consecutive hourly average
- 08 hour average - 08 hourly average
- 24 hour average - 18 hourly average
- Yearly average - 09 monthly average with at least 02 monthly average each quarter.

2) Water Quality

National Environmental (Protection and Quality) Regulations, No. 1 of 2008. (Water)

A) Tolerance limits for the discharge of industrial waste in to inland surface waters

Parameter	Unit	Tolerance Limit
Total suspended solids	mg/1, max.	50
pH at ambient temperature	-	6.0 – 8.5
Biochemical oxygen demand (BOD_5 in 5 days at 20^0C or 3 days at 270c)	mg/1, max.	30
Temperature of discharge	^{0}C, max.	shall no exceed 40^0 C in any section of the stream within 15 m downstream from the outlet.
Oils and greases	mg/1, max.	10
Phenolic compounds (as C_6H_5OH)	mg/1, max.	1
Chemical oxygen demand (COD)	mg/1, max.	250
Dissolved phosphates (as P)	mg/1, max.	5
Total Kjeldahl nitrogen (as N)	mg/1, max.	150
Ammoniacal nitrogen (as N)	mg/1, max.	50
Cyanide (as CN)	mg/1, max.	0.2
Total residual chlorine	mg/1, max.	1.0
Flourides (as F)	mg/1, max.	2.0
Sulphide (as S)	mg/1, max.	2.0
Arsenic (as As)	mg/1, max.	0.2
Cadmium (as Cd)	mg/1, max.	0.1
Chromium, total (as Cr)	mg/1, max.	0.5
Chromium, Hexavalent (as Cr^{6+})	mg/1, max.	0.1

Copper (as Cu)	mg/1, max.	3.0
Iron (as Fe)	mg/1, max.	3.0
Lead (as Pb)	mg/1, max.	0.1
Mercury (as Hg)	mg/1, max.	0.0005
Nickel (as Ni)	mg/1, max.	3.0
Selenium (as Se)	mg/1, max.	0.05
Zinc (Zn)	mg/1, max.	2.0
Colour	Wavelength/Range	Maximum spectral absorption coef
	436 nm (Yellow)	7m-1
	525 nm (Red)	5m-1
	620 nm (Blue)	3m-1
Pesticides	mg/1, max.	0.005
Detergents	mg/1, max.	5
Fecal Coliform	MPN/100ml, max	40

Note: All efforts should be made to remove unpleasant odor as far as possible. These values are based on dilution of effluents by at least 8 volumes of clean receiving water. If the dilution is below 8 times, the permissible limits are multiplied by the 1/8 of the actual dilution. The above mentioned general standards shall cease to apply with regard to a particular industry when industry specific standards are notified for that industry. Pesticides as per World Health Organization's (WHO's) and Food and Agriculture Organization's (FAO's) requirements.

B) Tolerance limits for industrial waste discharged on land for Irrigation Purpose

Parameter	**Unit**	**Tolerance Limit**
	type of limit	*value*
Total dissolved solids	mg/1, max.	2100
pH at ambient temperature	-	5.5 - 9.0
Biochemical oxygen demand (BOD_5 in five days at 20^0 C or BOD_3 in three days at 270c)	mg/1, max.	250 30
Oils and greases	mg/1, max.	10
Chemical Oxygen Demand (COD)	mg/1, max.	400
Chlorides (as C1)	mg/1, max.	600
Sulphates (as SO_4)	mg/1, max.	1000
Boron (as B)	mg/1, max.	2.0
Arsenic (as As)	mg/1, max.	0.2
Cadmium (as Cd)	mg/1, max.	2.0
Chromium, total (as Cr)	mg/1, max.	1.0
Lead (as Pb)	mg/1, max.	1.0
Mercury (as Hg)	mg/1, max.	0.01
Sodium adsorption ratio (SAR)	-	10 - 15
Residual sodium carbonate (RSC)	mo1/1, max.	2.5
Electrical conductivity	µS/cm. max.	2250
Fecal coliform	MPN/100m1, max.	40
Copper (as Cu)	mg/1, max.	1.0
Cyanide (as CN)	mg/1, max.	0.2
Radio Active Material:		
(a) Alpha emitters	Micro curie. /m1, max.	10-9
(b) Beta emitters	Micro curie/m1, max.	10-8

C) Hydraulic loading applicable for different soils :

Soil Texture Class	Recommended dosage of settled Industrial Effluents (m^3 /ha, day)
Sandy	225 - 280
Sandy loam	170 - 225
loam	110 - 170
Clay loam	55 - 110
Clay	35 - 55

3) Noise

National Environmental (Noise Control) Regulations No.1 1996 Maximum Permissible Noise Levels at Boundaries in Laeq 'T

A) Maximum permissible Noise Levels for prescribed activities

Area	Laeq T	
	Day Time (6:00-18:00)	Night Time (18:00-6:00)
Low Noise	55	45
Medium Noise	63*	50
High Noise	70	60
Silent Zone	50	45

* The noise level should not exceed 60 dB (A) inside existing houses, during day time.

B) Maximum permissible Noise Levels at Boundaries of the land which the source of noise is located in construction activities.

Day Time (06.00 - 21.00)	Night Time (21.00 - 06.00)
75 dB(A)	50 dB(A)

C) Maximum permissible Noise Levels at Boundaries in Laeq, T, for industrial activities.

Areas	Laeq ', T	
	Day Time	Night time
Rural Residential Area	55	45
Urban Residential Area	60	50
Noise Sensitive Area	50	45
Mixed Residential	63	55
Commercial Areas	65	55
Industrial Area	70	60

4) Vibration

Interim Standards for Vibration Control

A) Interim Standards for vibration of the Operation of Machinery, Construction Activities and Vehicle Movements Traffic

Category of the structure	Type of Vibration	Frequency of Vibration (Hz)	Vibration in PPV (mm/Sec.)
Type 1 (Multi story buildings of reinforced concrete or structural steel, with in filling panels of block work, brick work or precast units not designed to resist earthquakes	Continuous	0 –10	5.0
		10-50	7.5
		Over 50	15.0
	Intermittent	0 –10	10.0
		10 –50	15.0
		Over 50	30.0
Type 2 (Two-story domestic houses & buildings constructed of reinforced block work, precast units, and with reinforced floor & roof construction, or wholly of	Continuous	0 -10	2.0
		10-50	4.0
		Over 50	8.0
	Intermittent	0 –10	4.0

reinforced concepts or similar, not designed to resist earthquakes.		10 –50	8.0
		Over 50	16.0
Type 3 (Single and two-story houses & buildings made of lighter construction, using lightweight materials such as bricks, cement blocks etc., not designed to resist earthquakes)	Continuous	0 -10	1.0
		10 - 50	2.0
		Over 50	4.0
	Intermittent	0 - 10	2.0
		10 – 50	4.0
		Over 50	8.0
Type 4 (Structures that, because of their sensitivity to vibration, do not correspond to those listed above 1,2 & 3, & declared as archeologically preserved structures by the Department of Archaeology)	Continuous	0 - 10	0.25
		10 – 50	0.5
		Over 50	1.0
	Intermittent	0 – 10	0.5
		10 - 50	1.0
		Over 50	2.0

Notes: Please see separate measurement methods.
The values given above are in such a way that minor damage is unlikely as the nearby house/building.

B) Interim Standards on Air Blast Over Pressure and Ground Vibration for Blasting Activities

Category of the structure as given in Table A	Type of Vibration	Type of Blasting	Ground Vibration in PPV (mm/sec.)	Air blast over Pressure (dB (L)
Type 1	Impulsive	Single bore hole	8.0	105
		Multi bore hole with delay detonators	10.0	115
Type 2	Impulsive	Single bore hole	6.0	105
		Multi bore hole with delay detonators	7.0	11.5
Type 3	Impulsive	Single bore hole	4.0	115
		Multi bore hole with delay detonators	5.0	120
Type 4	Impulsive	Single bore hole	0.5	95
		Multi bore hole with delay detonators	0.75	100

Note: Please see separate measuring methods.
The values given above in such a way that minor damage to unlikely to occur at the nearby house/building.

C) Interim standards on vibration for the inconvenience of the occupants in buildings

Place	Time	Multiplying factors		
		Continuous vibration (day time and night time) *	Impulsive vibration (max. of 3 occurrences/ day	Intermitted vibration
Critical working areas	Day & Night	0.141	0.141	0.141
Residential	Day	0.705	5.640	2.820
	Night	0.282	1.410	0.705
Office	Day & Night	0.846	11.280	4.230
Workshop	Day & Night	1.41	1.41	7.05

Note * “day time” from 0600 to 1800h, “night time” from 1800h to 0600h

(6) Existing Gaps of Sri Lankan Laws and JICA Policies

There are differences between JICA Guidelines and Sri Lankan laws/policies in relation to environmental and social consideration. Although both are more or less similar, the gaps between JICA Guidelines and the Sri Lankan Laws/policies are analyzed in **Table 9.1.19**.

Table 9.1.19 Comparative Analysis on the Gaps between the Sri Lankan Laws/Policies and the JICA Guidelines

Subject	JICA Guidelines	Laws/Policies in Sri Lank	Existence of Gap, and Measures to bridge the Gap
Underlying Principles	Environmental impacts that may be caused by projects must be assessed and examined in the earliest possible planning stage. Alternatives or mitigation measures to avoid or minimize adverse impacts must be examined and incorporated into the project plan (JICA Guidelines, Appendix 1, 1.1)	The EIA report is a more comprehensive document whereby alternatives to the proposed project are considered and the option with the least impact on the environment identified and assessed. Mitigation measures for the impacts identified as significant are part of an EIA report. The timing of the IEE/EIA is crucial if it is to become a useful tool in decision-making. If the timing is late then many important decisions would have been made. Project proponents are thus advised to come within the EIA process at a very early stage in the project cycle. (Guidance for Implementing the EIA Process No.2, CEA)	No
Information Disclosure	EIA reports (which may be referred to differently in different systems) must be written in the official language or in a language widely used in the country in which the project is to be implemented. When explaining projects to local residents, written materials must be provided in a language and form understandable to them. (JICA Guidelines, Appendix 2)	The main text of the document should be translated into Sinhala and Tamil and made available for public scrutiny. IEEs/EIAs may be in English, Sinhala or Tamil, but project proponents must be advised that it may become necessary for the document to be made available to the public in Sinhala and Tamil at the public inspection. (Guidance for Implementing the EIA Process No.1)	No
	EIA reports are required to be made available to the local residents of the country in which the project is to be implemented. The EIA reports are required to be available at all times for perusal by project stakeholders such as local residents and copying must be permitted. (JICA Guidelines, Appendix 2)	Upon receipt of the EIA report, the Project Approving Agency (PAA) shall submit a copy thereof to the Authority and by prompt notice published in the Gazette and in one national newspaper published daily in the Sinhala, Tamil and English languages invite the public to make written comments, if any, thereon to the PAA within thirty days from the date of the first appearance of the notice, either in the Gazette or in the newspaper. The notification shall specify the times and places at which the report shall be made available for public inspection. The PAA shall make available copies of the Report to any person interested to enable him to make copies thereof. (Gazette Extra Ordinary No. 772/22	No

Subject	JICA Guidelines	Laws/Policies in Sri Lank	Existence of Gap, and Measures to bridge the Gap
		dated 24.06.93)	
Public Consultation	For projects with a potentially large environmental impact, sufficient consultations with local stakeholders, such as local residents, must be conducted via disclosure of information at an early stage, at which time alternatives for project plans may be examined. The outcome of such consultations must be incorporated into the contents of project plans. (JICA Guidelines, Appendix 1, 5.1)	There should be an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action. During the early stages of processing a prescribed project the PAA should undertake environmental scoping. Essentially, the scoping process involves a series of formal and informal meetings with people who may be affected by the proposed project. Scoping will provide the PAA and affected people with an opportunity to assess the proposed project and identify the potential environmental issues and alternative strategies. (Guidance for Implementing the EIA Process No.2)	No
	In preparing EIA reports, consultations with stakeholders, such as local residents, must take place after sufficient information has been disclosed. Records of such consultations must be prepared. (JICA Guidelines, Appendix 2)	Due to the need for frank, open discussion and the avoidance of posturing before the media, summaries of the scoping process can be prepared for release to newspaper, radio, television, or other public information centers It is essential that the project proponent prepare a concise packet of information to distribute to confirmed participants prior to the meeting or be prepared to devote a considerable amount of time in the meeting providing background descriptions and answering rudimentary questions. Members of the PAA or the EIA team should always maintain thorough and detailed notes of all interviews and informal discussions. This information should be summarized and recorded in written format and included as part of the appendix to the environmental assessment. (Guidance for Implementing the EIA Process No.2)	No
	Consultations with relevant stakeholders, such as local residents, should take place if necessary, throughout the preparation and implementation stages of a	PAAs should establish procedures for making EIAs readily available to the public for reading in Colombo and in the district or division in which the project is proposed. PAAs should establish an efficient process to allow	Yes (Holding consultations when the items to be considered in the EIA are being selected and when the draft EIA report is being prepared is not

Subject	JICA Guidelines	Laws/Policies in Sri Lank	Existence of Gap, and Measures to bridge the Gap
	project. Holding consultations is highly desirable, especially when the items to be considered in the EIA are being selected, and when the draft report is being prepared. (JICA Guidelines, Appendix 2)	copies of EIAs to be made for the public upon request and upon payment of the full reproduction costs by the requesting party or parties. PAAs should forward all comments received to the project proponent for review and response. Upon receipt of the project proponent's written response to comments, the PAAs should evaluate the responses before making decision. (Guidance for Implementing the EIA Process No.1)	stipulated.) Following the JICA Guideline, consultation with relevant stakeholders such as local residents should take place when the draft report is being prepared.
Impact Assessment Items	The impacts to be assessed with regard to environmental and social considerations include impacts on human health and safety, as well as on the natural environment, that are transmitted through air, water, soil, waste, accidents, water usage, climate change, ecosystems, fauna and flora, including trans-boundary or global scale impacts. These also include social impacts, including migration of population and involuntary resettlement, local economy such as employment and livelihood, utilization of land and local resources, social institutions such as social capital and local decision-making institutions, existing social infrastructures and services, vulnerable social groups such as poor and indigenous peoples, equality of benefits and losses and equality in the development process, gender, children's rights, cultural heritage, local conflicts of interest, infectious diseases such as HIV/AIDS, and working conditions including occupational safety. (JICA Guidelines, Appendix 1, 3.1)	The primary technical topics commonly addressed in An EIA include: Water Resources Pollution Issues Soils and Land Use Forests Wildlife and Biological Diversity Socio-Cultural and Economic Conditions (Guidance for Implementing the EIA Process No.2)	Yes (There is a difference of impact assessment items.) JICA Guidelines and RDA Manual (RDA Environmental and Social Safeguards Manual (July 2007)) were used as references for environmental impact assessment items. Although there are a few different expressions in writing between JICA Guidelines and RDA Manual, the contents are almost same. Then the items in the JICA Guidelines were followed.

Subject	JICA Guidelines	Laws/Policies in Sri Lank	Existence of Gap, and Measures to bridge the Gap
	In addition to the direct and immediate impacts of projects, their derivative, secondary, and cumulative impacts as well as the impacts of projects that are indivisible from the project are also to be examined and assessed to a reasonable extent. It is also desirable that the impacts that can occur at any time throughout the project cycle should be considered throughout the life cycle of the project. (JICA Guidelines, Appendix 1, 3.2)	The first task will be to correctly define the physical, biological, and social areas that will be directly or indirectly affected by the proposed project activities. (Guidance for Implementing the EIA Process No.2) Whether the action is related to other actions whose impacts are individually insignificant, but which cumulatively are apt to be significant. Significant impacts may occur if it is reasonable to anticipate a cumulatively significant impact on the environment. (Guidance for Implementing the EIA Process No.1)	Yes (Derivative impacts and the impacts of project that are indivisible from the project are not clearly mentioned.) Following the JICA Guideline, in addition to the direct and immediate impacts, their derivative, secondary and cumulative impacts as well as the impacts that are indivisible from the project should be also assessed. And the impacts that can occur at any time throughout the project cycle should be considered throughout the life cycle of the project.
Monitoring, Grievance Redress, etc.	Project proponents etc. should make efforts to make the results of the monitoring process available to local project stakeholders. (JICA Guidelines, Appendix 1, 9.3)	Upon request, the PAA should make available to the public the results of relevant monitoring. (Guidance for Implementing the EIA Process No.1)	Yes (Positive disclosure of monitoring data is not mentioned.) Following the JICA Guideline, the project proponent and the PAA should be encouraged to make the results of the monitoring process available to local project stakeholders.
	When third parties point out, in concrete terms, that environmental and social considerations are not being fully undertaken, forums for discussion and examination of countermeasures are established based on sufficient information disclosure, including stakeholders' participation in relevant projects. Project proponents etc. should make efforts to reach an agreement on	The National Environmental Act (NEA) states that a public hearing may be held at the discretion of the PAA when it thinks that it would be in the public interest to do so. A variety of situations may fall within the meaning of "public interest", and these cannot be exhaustively defined. Factors for the PAA to consider are: • Whether a proposed prescribed project is highly controversial, whether more expressions of public views are essential to make decision;	No

Subject	JICA Guidelines	Laws/Policies in Sri Lank	Existence of Gap, and Measures to bridge the Gap
	procedures to be adopted with a view to resolving problems. (JICA Guidelines, Appendix 1, 9.4)	• Whether the proposed prescribed project might cause unusual national or regional impacts; • Whether it might threaten a nationally important environmentally sensitive area; • Whether a formal request for a public hearing has been requested by an interested party. (Guidance for Implementing the EIA Process No.1)	
Ecosystem and Biota	Projects must not involve significant conversion or significant degradation of critical natural habitats and critical forests. (JICA Guidelines, Appendix 1, 6.1)	There are laws and regulations to conserve ecosystem and biota. However, they do not clearly mention that projects must not involve significant conversion or significant degradation of critical natural habitats and critical forests.	Yes Following the JICA Guideline, it should be considered that Projects must not involve significant conversion or significant degradation of critical natural habitats and critical forests.
Indigenous People	Any adverse impacts that a project may have on indigenous peoples are to be avoided when feasible by exploring all viable alternatives. When, after such an examination, avoidance is proved unfeasible, effective measures must be taken to minimize impacts and to compensate indigenous peoples for their losses. (JICA Guidelines, Appendix 1, 8.1)	There is no corresponding description under laws, regulations and guidance related to environmental impact assessment.	Yes Following the JICA Guideline, it should be considered that any adverse impacts that a project may have on indigenous peoples, if any, are to be avoided.

Source: JICA Survey Team

(7) Environmental Permits required for the Implementation of the Project

Responding by the official letter dated 6 November 2019 to an inquiry from RDA, CEA has confirmed that the project does not require EIA/IEE approval process under the National Environmental Act. Since some sites of the project fall adjacent to protected areas/ forest reserves, CEA also advised RDA to obtain recommendations from the Department of Wildlife Conservation and/or Forest Department who administer the areas.

Other than the approval related to EIA/IEE, the project will require permits for some preparation works such as cutting trees, borrow pit and movement of soil prior to construction activities.

Felling trees will require permits from the Department of Wildlife Conservation and/or Forest Department. For operation of quarry sites and borrow areas, approvals should be obtained from relevant authorities such as Geological Survey and Mines Bureau (GSMB), local authority, Divisional Secretariat

and CEA. All blasting/quarrying activities shall be carried out under valid licenses issued by GSMB and CEA. Required approval/ license for operation of asphalt plants, crusher plants and concrete batching plants should be obtained from CEA.

Suitable disposal grounds /land fill sites should be identified, and approval should be obtained from the relevant local authority before commencing any kind of clearing activity. Setting up of labour camps should be done with prior approval of the relevant authorities such as local authorities.

9.1.4 Comparison of Project Alternatives including Zero Option without the Project

In this preparatory survey, the original 53 candidate project sites were classified into 5 risk levels according to the evaluation categories such as risk factor, hazard and vulnerability, and 34 sites in the top 3 levels were selected as the first selection. After that, environmental and social consideration was added to the evaluation categories and intensity levels were set up for each category. The scores of the intensity levels were summed up and 30 sites with higher score were selected as the second selection by comparing the total scores. Details are described in **Chapter 3**.

Alternatives were studied on not a combination of candidate sites but a method of construction for each site from the viewpoint of stability, workability, maintenance and operation, influence on road, environmental impact and construction cost. Details are described in **Chapter 5**.

In this Chapter, alternatives were divided into cases with and without (zero option) sediment disaster mitigation measures, and two cases are compared. The result is shown in **Table 9.1.20**.

Table 9.1.20 Comparison of Project Alternatives

Alternative	Zero Option	LDPP 2 Project
Outline	• No sediment disaster mitigation measures • Continuation of current slope condition	• Sediment disaster mitigation measures for 30 sites
Impact on natural environment	• Unstable slopes would trigger further sediment disasters that devastate the slopes and run the soil off. It would permanently cause significant negative impact on local ecosystem.	• Construction activities would temporally cause negative impact on natural environment to some extent. • The Project will protect the areas against further degradation of natural environment due to sediment disasters.
Impact on socio-economy	• Residents' safety and security will continue to be threatened. • Frequent slope disasters would often obstruct road traffic and stagnate the movement of people and goods, which seriously affects the socio-l economy.	• Part of resident' assets will be lost to construct the countermeasure facilities against sediment disasters and their livelihood is affected. • The Project will stabilize the slopes, and contributes to safe and stable use of land and local resources and to improving current living and livelihood.
Involuntary resettlement	• There will be no resettlement in the short term • Unstable slopes would trigger large-scale sediment disasters, and many houses and cultivated land would be lost and more people would be forced to relocate.	• There will be no person to be resettled.
Pollution	• Slope disasters often cause traffic congestion due to detours and lane restrictions. It would increase air pollutant emissions.	• Construction activities would temporally cause air pollution, water pollution and noise to some extent. • The Project does not plan any facilities such as parking areas or service areas that newly emit pollutants.

Alternative	Zero Option	LDPP 2 Project
Road traffic safety	• Unstable slopes would trigger frequent slope failures and rock falls that make the road traffic unsafe	• Construction activities would temporally disturb road traffic. • The Project will mitigate sediment disasters and reduce the risk of accidents to both residents and road traffic.
Technology	• Sediment disaster countermeasure technology would not advance in Sri Lanka, and the resilience for sediment disasters, which are expected to increase due to climate change, would become lower.	• Advanced technology of sediment disasters countermeasures would disseminate in Sri Lanka, and the ability to adapt to climate change would strengthen.
Costs	• In the short term, there will be no costs associated with project implementation. However, in the long term, frequent sediment disasters would incur huge costs for road restoration, compensation for victims and economic losses due to road closures.	• In the short time, a large amount of investment for the Project is needed.
Comprehensive Evaluation	• Current situation would not be maintained, but unstable slope would induce more/larger landslide disasters. • It would result in significant damage to natural environment such as topography, geology, ecosystem and landscape. • Furthermore, the impact on traffic of main roads and logistics would increase, and the negative impact on socio-economic conditions would only expand. • In the long term, both precipitation and rainfall intensity are expected to increase due to climate change, and it is expected that the frequency and scale of landslide disasters triggered by rainfall would be accelerated. Vulnerability for landslide disasters would be accelerated.	Some impacts would temporally occur during construction. However, the impacts would cease after the completion of construction, the resilience will increase with respect to sediment disasters, and disaster risk will be reduced. As a result, the effects of improving vulnerability of arterial road traffic and regional economy would be significant.

Source: JICA Survey Team

9.1.5 Scoping and TOR for the Survey on Environmental and Social Consideration

9.1.5.1 Scoping

Expected environmental and social impacts were considered based on the project outline and the current condition of environmental and social baseline, and scoping was conducted. The extent of impact was rated from A to D according to the following criteria. The evaluation is based on the assumption that the Project is conducted without implementing any special mitigation measures.

A: Significant impact is expected. (+: positive impact, -: negative impact)
B: Impact is expected to some extent. (+: positive impact, -: negative impact)
C: Extent of impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses)
D: No impact is expected.

9.1.5.2 Results of the Scoping

Table 9.1.21 shows the results of the scoping for 30 project sites. Since impact occurs at each stage of the Project, the results of the scoping are shown in two stages of the Project, namely pre-construction and construction stage (P&C) and operation stage(O).

Regarding the impact items concentrated on, the contents and methods of assessment are shown in **Table 9.1.21**.

Table 9.1.21 Scoping

Category	Item		Primary Assessment Stage		Assessment Reason
			P&C	O	
Pollution	1	Air Quality	B-	D	**P&C:** Air quality is expected to temporarily deteriorate with the operation of vehicles and equipment. **O:** The objective of the Project is to take countermeasures against sediment disasters on the slope along the existing roads, and any facilities that newly emit air pollutants are not included. Since the Project will not increase traffic volume, pollutants from road traffic are not expected to increase.
	2	Water Quality	B-	B+	**P&C:** Water quality is expected to temporarily deteriorate with turbid effluent and oil/fuel spillage from vehicle and equipment at the construction sites. **O:** The Project will prevent further runoff of soil or sediment on the bare or devastated slopes due to previous sediment disasters. It would contribute to mitigating water pollution of rivers and reservoirs.
	3	Waste	B-	D	**P&C:** It is expected that solid wastes such as surplus sediment or waste material are generated from the construction sites. **O:** Since the Project does not plan any facilities that newly generate wastes, no impact is expected.
	4	Soil Contami-nation	B-	D	**P&C:** Oil and fuel spillages from vehicles or equipment for construction work may contaminate the soil of the project sites. **O:** Since the Project does not plan any facilities that newly generate contaminants, no impact is expected.
	5	Noise and Vibration	B-	D	**P&C:** Noise and vibration are expected to temporarily affect the environment of project areas with the operation of vehicles and equipment. **O:** The Project does not plan any facilities that newly generates noise and vibration. Since the Project will not increase traffic volume, noise and vibration from road traffic are not expected to increase.
	6	Subsidence	D	D	**P&C:** Since the grounds of project sites are not soft, subsidence would not be caused by the drawdown of groundwater during construction stage. **O:** Since the drawdown of groundwater aims at eliminating excessive groundwater that triggers landslide, subsidence is not expected.
	7	Odor	C	D	**P&C:** Odor may temporally occur when exhaust gas is released in large quantities with the operation of vehicles and equipment for construction work. **O:** Since the Project does not plan any facilities that generates odor, no impact is expected.

Category	Item		Primary Assessment Stage		Assessment Reason
			P&C	O	
	8	Sediment	B-	B+	**P&C:** When water quality of rivers or reservoirs temporarily deteriorates with turbid effluent and oil/fuel spillage from vehicle and equipment at the construction sites, it would affect sediment of such water bodies. **O:** The Project will rather prevent further runoff of soil or sediment from the slopes devastated by the previous sediment disasters.
Natural Environment	9	Protected Areas	B-	B+	**P&C:** Since some of the project sites may be located within one mile from the boundaries of National Reserves, obtaining recommendations from Department of Wildlife Conservation and /or Forest Department is required. Unlike restrictions in the National Reserves, development activities within one mile from the boundary of the Reserve can be approved if the environmental impacts are not serious. **O:** The Project will contribute to protecting the areas against further degradation of natural environment due to sediment disasters.
	10	Ecosystem	B-	B+	**P&C:** Since the project sites are slopes along the existing roads that are devastated by the previous sediment disasters, no precious fauna and flora exist. Cutting trees will be necessary to construct structures for countermeasures and temporary access roads. **O:** The Project will rather contribute to protecting ecosystem in the areas from further degradation of natural environment due to sediment disasters.
	11	Hydrology	B-	B±	**P&C:** At the Site 53, the Project will construct check dams in river channel. Construction of the dams may affect the flow and the bed of the river. **O:** The dams may affect the river flow. On the other hand, the dams will mitigate further debris flow and prevent the downstream flow from alteration.
	12	Topography and Geology	B-	B+	**P&C:** Cut and excavation will be necessary to construct structures for countermeasures and temporary facilities such as access roads. At the Site No.53, a certain volume of cut and excavation will be done to widen the existing path for temporary access road. **O:** The Objective of the Project is to exactly stabilize the slopes along the existing roads implementing countermeasures to reduce land slide, slope failure and rock fall.
Social Environment	13	Land Acquisition and Resettlement	B-	D	**P&C:** Lands will be acquired permanently for countermeasures and temporarily for access roads and storages. But no resettlement is expected due to the land acquisition. **O:** Additional land acquisition and resettlement at the operation stage is not expected.
	14	The Poor	C	D	**P&C:/ O:** Poor families may be included in PAPs. Compensation and assistance for them, as vulnerable households, will be provided.
	15	Ethnic Minorities and Indigenous	D	D	**P&C:/ O:** There are no ethnic minorities and indigenous people in the project areas.

Category	Item		Primary Assessment Stage		Assessment Reason
			P&C	O	
		Peoples			
	16	Living and Livelihood	D	B+	**P&C:/ O:** The Project is rather small-scale road improvement project to implement countermeasures against sediment disasters on the slopes along the existing roads. Therefore, no impact is expected on living and livelihood of the target areas. On the other hand, the Project will reduce the risks of sediment disaster and road closures, and rather contribute to safe and stable living and livelihood.
	17	Use of Land and Local Resources	B-	B+	**P&C:** Land acquisition and construction of countermeasures will change the current use of land and local resources to some extent. **O:** The objective of the Project is to implement countermeasures against sediment disasters on the slopes along the existing roads aiming at stabilization of disaster-prone areas. Therefore, no negative impact is expected, and the Project will rather contribute to safe and stable use of land and local resources.
	18	Water Resources	B-	B±	**P&C:** Turbid and polluted effluents generated by the construction works may affect the surrounding surface water resources. Drawdown of groundwater caused by underground construction work may affect the surrounding groundwater resources. **O:** The Project will rather contribute to improvement of quality of surrounding water resources by stabilizing the disaster-prone slopes. However, the groundwater drain facilities will keep drawing the groundwater level down to prevent land slide and may affect the surrounding groundwater resources.
	19	Existing Social Infrastructure and Social Services	B-	B+	**P&C:** In some sites, construction works may affect the existing schools, hospitals, temples and utilities such as water supply pipes, power transmission lines/posts and telephone lines/posts. **O:** No impact is expected. Because all social infrastructure and services will be restored at the operation stage.
	20	Social Capital and Society Organization such as Decision-making Body	D	D	**P&C:/ O:** Since the Project is not a new road development project but a sediment disaster mitigation project for the existing roads, no impact is expected.
	21	Uneven Distribution of Damage and Benefits	D	D	**P&C:/ O:** Since the Project is not a new road development project but a sediment disaster mitigation project for the existing roads, uneven distribution of damage and benefits is not expected.
	22	Conflict of Interest within the Region	D	D	**P&C:/ O:** Since the Project is not a new road development project but a sediment disaster mitigation project for the existing roads, conflict of interest within the region is not expected.
	23	Cultural Heritage	D	D	**P&C:/ O:** There are no local archeological, historical, cultural and religious heritages at the project sites.
	24	Landscape	D	D	**P&C:/ O:** Since the project sites are the slopes along the

Category	Item		Primary Assessment Stage		Assessment Reason
			P&C	O	
					existing roads that are devastated by the previous sediment disasters, no esthetic values exist.
	25	Gender	C	D	**P&C:** Though no impact is expected, possible impacts should be assessed based on the results of the social assessment survey. **O:** No impact is expected.
	26	Children's Rights	C	D	**P&C:** Though no impact is expected, possible impacts should be assessed based on the results of the social assessment survey. **O:** No impact is expected.
	27	HIV/AIDS and other Infectious Diseases	C	D	**P&C:** Though it may be small-scale, there would be an influx of construction labor from outside to the project areas. Infectious diseases may spread to the areas. **O:** No impact is expected.
	28	Working Conditions (including occupational safety	B-	B+	**P&C:** Most project sites are located in mountainous and remote areas. Adequate measures should be taken for working conditions of the sites. **O:** The Project will reduce the risk of sediment disasters. It will rather contribute to improvement of working conditions in the areas.
Others	29	Accident	B-	B+	**P&C:** As construction works will be done on steep slopes or near high traffic roads, accidents may happen. **O:** The Project will mitigate sediment disasters and reduce the risk of accidents to both residents and road traffic caused by rock fall, slope failure and land slide.
	30	Cross-border Effects and Climate Change	D	D	**P&C:/ O:** The Project is rather small-scale road improvement project to implement countermeasures against sediment disasters on the slopes along the existing roads. Therefore, cross-border effects or climate change are not expected.

A+/- : Significant positive/negative impact is expected.
B+/- : Positive/negative impact is expected to some extent.
C : Extent of impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses.)
D : No impact is expected.
Source: JICA Survey Team

Table 9.1.22 TOR for Further Examination

Item of Impact	Item for Further Examination	Method of Examination
Study on Project Alternatives	1. Reconsideration of the project sites (locations) 2. Reconsideration of engineering design	1. Minimizing the extent of land acquisition and the number of affected persons 2. Reconsideration of method to mitigate possible negative impacts
Air Quality	1. Current air quality around the project sites 2. Existing houses, schools and hospitals 3. Impact caused by construction	1. Review of existing data and information 2. Field visits and social assessment survey 3. Identification of construction method, type of equipment, etc. 4. Review of the monitoring data of the LDPP Phase1 Project
Water Quality	1. Current water quality around the project sites 2. Current water use from	1. Review of existing data and information 2. Field visits and social assessment survey 3. Identification of construction method, type of

Item of Impact	Item for Further Examination	Method of Examination
	the water bodies around the project sites 3. Impact caused by construction	equipment, etc. 4. Review of the monitoring data of the LDPP Phase1 Project
Waste	1. Disposal of construction wastes	1. Interview with PMU-LDPP 2. Identification of construction method, etc.
Soil Contamination	1. Impact caused by construction	1. Identification of construction method, type of equipment, etc. 2. Interview with PMU-LDPP
Noise and Vibration	1. Current noise and vibration around the project sites 2. Existing houses, schools and hospitals 3. Impact caused by construction	1. Review of existing data and information 2. Field visits and social assessment survey 3. Identification of construction method, type of equipment, etc. 4. Review of the monitoring data of the LDPP Phase1 Project
Odor	1. Impact caused by construction	1. Identification of construction method, type of equipment, etc. 2. Interview with PMU-LDPP 3. Field visits
Sediment	1. Impact caused by construction	1. Identification of construction method, etc. 2. Interview with PMU-LDPP 3. Field visits
Protected Areas	1. Distance from the boundary of the protected area.	1. Measurement of the distances between the project sites and the protected areas on the map 2. Consultation with ESD of RDA and PMU-LDPP
Ecosystem	1. Existing ecological conditions around the project sites	1. Review of existing data and information 2. Field visits 3. Review of the example of the LDPP Phase1 Project
Hydrology	1. Existing water bodies such as river, lake, reservoir and water well 2. Impact caused by construction	1. Review of existing data and information 2. Field visits and social assessment survey
Land Acquisition and Resettlement	1. Extent of land acquisition and number of affected persons 2. Abbreviated RAP	1. Field visits and social assessment survey by interviewing affected persons according to the RDA Social Assessment Manual. 2. Preparation of draft abbreviated RAP based on JICA Guidelines and RDA's Manual.
The Poor	1. Existence of people in poverty and impact by the project	1. Field visits and social assessment survey
Living and Livelihood	1. Current conditions of living and livelihood at the project areas	1. Field visits and social assessment survey
Use of Land and Local Resources	1. Current conditions of living and livelihood at the project areas	1. Field visits and social assessment survey
Water Resources	1. Existing water use from the water bodies such as river and water well around the project site 2. Impact by construction	1. Field visits and social assessment survey 2. Identification of construction method 3. Review of the example of the LDPP Phase1 Project

Item of Impact	Item for Further Examination	Method of Examination
Existing Social Infrastructure and Social Services	1. Existing houses, schools, hospitals and utilities such as water pipes and power transmission lines	1. Field visits and social assessment survey 2. Identification of construction method.
Gender	1. Impact by the project	1. Social assessment survey 2. Review of existing data and information
Children's Rights	1. Impact by the project	1. Social assessment survey 2. Review of the example of the LDPP
HIV/AIDS and other Infectious Diseases	1. Impact by the project	1. Review of the example of the LDPP
Working Conditions (including occupational safety)	1. Measures	1. Review of the example of the LDPP Phase1 Project 2. Social assessment survey 3. Identification of construction method
Accident	1. Possible accidents at the construction stage	1. Review of the example of the LDPP 2. Social assessment survey

Source: JICA Survey Team

9.1.6 Results of the Survey on Environmental and Social Consideration including Prediction of Impacts

Results of the survey based on the scoping are shown in **Table 9.1.23**.

Table 9.1.23 Results of the Survey on Environmental and Social Consideration

Item of Impact	Results of the Survey
Air Quality	**P&C Stage:** Exhaust gas will be emitted from vehicles and equipment for construction activities. According to the monitoring results of LDPP, the same kind of project, the air quality standards were almost satisfied. PM10 satisfied the national standards but slightly exceeded the value of international guidelines at a few sites. Though impacts are not expected, monitoring should be carried out. **O Stage:** The Project does not plan any facilities such as parking areas or service areas that newly emit air pollutants. Therefore, impacts are not expected.
Water Quality	**P&C Stage:** Most sites are currently bare or devastated slopes due to previous sediment disasters, and earthmoving activities are small-scale cutting of surface layer of the slope. For these reasons, the amount of soil runoff generated by the construction activities would be limited and the impacts on water quality in the downstream water areas are not expected. Oil and fuel spillages from vehicles or equipment for construction work may contaminate the surrounding water or groundwater. Those vehicles and equipment should be maintained and re-fuelled in a proper manner. Wastewater generated from the construction sites and the worker's camps may also contaminate the surrounding water or groundwater. The wastewater should be properly collected and treated. According to the monitoring results of LDPP, the water quality standards were almost satisfied. However, turbidity exceeded the value of international guidelines at many sites, and coliform (bacteria) exceeded the value of international guidelines at a few sites. Though serious impacts are not expected, monitoring should be carried out. **O Stage:** The Project does not plan any facilities such as parking areas or service areas that newly generate effluents. Therefore, impacts are not expected. On the other hand, the Project will prevent further runoff of soil or sediment on the bare or devastated slopes due to previous sediment disasters. It would contribute to

Item of Impact	Results of the Survey
	mitigating water pollution of rivers and reservoirs.
Waste	**P&C Stage:** It is estimated that 63,000m^3 of surplus sediment will be generated from all project sites. At the Site No.53, comparative large volume of surplus sediment (31,000m^3) will be generated due to removal of unstable sediment deposited in the river channel and construction of temporary access roads by widening existing paths. Though a portion of surplus sediment will be reused as soil cement material for construction of dams, remaining sediment should be disposed appropriately. Disposal yard for surplus sediment will be proposed from the contractor, and PMU will negotiate with the landowner, obtain the permission for using it and supervise the disposal. Solid wastes generated from the construction sites and the worker's camps should be properly collected and disposed of. **O Stage:** The Project does not plan any facilities such as parking areas or service areas that newly generate wastes. Therefore, impacts are not expected.
Soil Contamination	**P&C Stage:** Oil and fuel spillages from vehicles or equipment for construction work may contaminate the soil of the sites. Those vehicles and equipment should be maintained and re-fuelled in a proper manner. **O Stage:** The Project does not plan any facilities such as parking areas or service areas that newly generate contaminants. Therefore, impacts are not expected.
Noise and Vibration	**P&C Stage:** Noise and vibration will be generated from vehicles and equipment for construction activities. According to the monitoring results of LDPP, day time noise level satisfied the national standards, but night time noise level slightly exceeded the national standards at some sites. Monitoring should be carried out and appropriate mitigation measures should be taken as the need arises. Vibration level satisfied the national standards at all sites and no impact is expected. **O Stage:** The Project will not significantly change traffic volume and pattern. The Project does not plan any facilities that newly generate noise and vibration. Therefore, the Project will not affect the noise and vibration level.
Odor	**P&C Stage:** Odor may temporally occur when exhaust gas is released in large quantities with the operation of vehicles and equipment for construction work. **O Stage:** The Project does not plan any facilities that newly generate odor. Therefore, impacts are not expected.
Sediment	**P&C Stage:** When water quality of rivers or reservoirs temporarily deteriorates with turbid effluent and oil/fuel spillage from vehicle and equipment at the construction sites, it would affect sediment of such water bodies. **O Stage:** No impact is expected because contaminated soil or water will not flow into the water bodies. On the other hand, the Project will prevent further runoff of soil or sediment on the bare or devastated slopes due to previous sediment disasters. It would contribute to mitigating sediment pollution of rivers and reservoirs.
Protected Areas	**P&C Stage:** The project sites are not located in the protected areas and would not affect the areas. According to the measurement on the map, some sites (No.10, 11, 12, 25, 33, 34, 51, 53) may be located within one mile from the boundaries of National Reserves. Unlike restrictions in the National Reserve, development activities within one mile from the boundary of the Reserve can be approved if the environmental impacts are not serious. CEA has confirmed that the project does not require undergoing EIA/IEE approval process, and also advised RDA to obtain recommendations from the Department of Wildlife Conservation and/or Forest Department. **O Stage:** The Project will rather protect the areas against further degradation of natural environment due to sediment disasters.
Ecosystem	**P&C Stage:** Most project sites are currently bare or devastated slopes due to previous sediment disasters. The project sites do not encompass primeval forests, tropical rain forests, ecologically valuable habitats and the protected habitats of endangered species. Since the project activities are confined to

Item of Impact	Results of the Survey
	particular landslide prone location, there is a less possibility of disturbing migratory paths, habitat fragmentation, etc. Cutting trees in forests is needed to construct countermeasures and temporary access roads for construction activities. The extent of cutting trees is estimated to be 15.5 hectares in total. Among them, the Site No.53 covers 10.4 hectares and the other each site less than 1 hectare. Approval for cutting trees should be applied to Forest Department or Department of Wildlife Conservation. **O Stage:** Since the project sites are not located at undeveloped areas, there is no possibility that the Project will result in extensive loss of natural environments. The Project will rather protect the areas against further degradation of the natural environment due to sediment disasters.
Hydrology	**P&C Stage:** Construction of horizontal drain boreholes will cause drawdown of groundwater level. Monitoring of groundwater level will be carried out. However, according to the site visits and social assessment survey, there is no household that uses water wells as main water source for its daily life in the project sites. There would be little interference with water use. **O Stage:** The Project will only rehabilitate the slopes devastated by sediment disasters. The Project will not alter the topographic features and installation of structures will not adversely affect surface water and groundwater flows. Though check dams will be installed at the Site No.53, they are permeable structures that do not obstruct normal river flow. Therefore, installation of dams would not adversely affect surface water flows.
Topography and Geology	**P&C Stage:** The volume of excavation and cutting is estimated to be 52,300 m^3 in total, and 25,500 m^3 and 12,500 m^3 of which are at Site No.53 and Site No.43 respectively. Since the project areas are sediment disaster prone areas, there is a possibility that sediment disasters happen during construction stage. **O Stage:** The project is to exactly stabilize the slopes along the existing roads and will contribute to protecting natural environment including topography and geology.
Land Acquisition and Resettlement	**P Stage:** Efforts were made to minimize involuntary resettlement at the conceptual design stage. As a result, there will be no person to be resettled. One (1) household will lose a portion of the land and two buildings they are occupying. However those buildings are not used for residences but for a small shop and a shed, and will be rebuilt in the same premises to continue the business there. Land permanently required for construction of the countermeasures against sediment disasters in 30 sites from the private land owned by individual PAPs is estimated to be 1,041 perches (2.6 ha). On an average, approximately 35 perches (0.09 ha) will be permanently acquired in each site. This is very small extent compared with land acquired by other projects. According to the social assessment survey, many PAPs are willing to sacrifice a few perches of their lands for a worthy cause because they well understand that the Project will mostly benefit them. Other use of the land of 6,169 perches (15.6 ha) from the private land is temporary use for access roads or storage spaces for construction materials, and the land will be returned to the PAPs after the completion of construction work. Compensation policies have been explained to PAPs during the social assessment survey and prepared in the draft abbreviated RAP. The draft abbreviated RAP will be reviewed and updated during the detail design stage, and the RAP will be implemented. According to the RAP, compensation will be paid based on full-replacement cost and livelihood assistance will be provided to PAPs. Organization framework has been developed and described in the RDA's resettlement manual. Capacity and budget for compensation will be secured as same as LDPP. **C&O Stage:** Land acquisition will be completed prior to the implementation of

Item of Impact	Results of the Survey
	construction. Internal and external monitoring will be carried out. Therefore, no impact is expected.
The Poor	**P&C Stage:** There are two (2) poor families in the project areas. Compensation and assistance for the families, as vulnerable households, will be provided according to the RAP. **O Stage:** Internal and external monitoring will be carried out. No impact is expected.
Living and Livelihood	**P&C Stage:** According to the social assessment survey, there will be no significant businesses losses. The PAP who loses buildings will be compensated for the losses and paid for temporary disruption of business till rebuilding the shop in the same premises. Temporary loss of income from plantation crops will be compensated for 11 temporarily affected plantation estates. The PAPs who lose trees will be compensated for losses and felled trees will be handed over to them. Productivity losses from the cultivable lands due to construction activities are eligible for compensation. There are 10 vulnerable families in the project areas. Compensation and assistance for the families should be provided according to the RAP. On the other hand, construction would expand an employment opportunity around the project areas. **O Stage:** Since the Project does not involve a new road development or expansion of road capacity. Therefore, the Project would not affect the existing means of transportation and the associated workers or would not cause significant impacts such as changes in sources of livelihood or unemployment. On the other hand, the Project will reduce the risk of sediment disasters, and rather contribute to improving current living condition and livelihood.
Use of Land and Local Resources	**P&C Stage:** Land acquisition and construction of countermeasures will change the existing use of land and local resources. However, most project sites are currently bare or devastated slopes due to previous sediment disasters and are unused. Impact would not be significant. **O Stage:** The project will stabilize the slopes at risk of sediment disasters. The Project will rather contribute to safe and stable use of land and local resources.
Water Resources	**P&C Stage:** Effluents polluted by construction will deteriorate water quality of rivers and reservoirs around the project areas. According to the monitoring results of LDPP, the parameters except turbidity would satisfy the water quality standards. Though serious impacts are not expected, monitoring should be carried out. Construction of horizontal drain boreholes will cause drawdown of groundwater level. However, there is no household that uses water wells as main water source for its daily life around the project sites. There would be little interference with water use. At the site No.53, river water is taken at the upper reach and conveyed through pipes along the river. The pipes should be relocated. **O Stage:** The project will stabilize the slopes at risk of sediment disasters. The Project would rather contribute to improvement of quality of water resources. On the other hand, the horizontal drain boreholes will keep drawing the groundwater level down to prevent land slide. Ground water level should be monitored after construction.
Existing Social Infrastructure and Social Services	**P&C Stage:** There are schools and hospitals in some project areas. Since the structures will be constructed not to relocate or disturb those facilities, no impact is expected. Utilities such as water pipes, power transmission lines/posts and telephone lines/posts will be shifted at some project sites. **O Stage:** No impact is expected. The Project would rather contribute to preventing the social infrastructures from damaging due to sediment disasters.
Gender	**P&C Stage:** The number of women of the PAPs is 76. Among them only one woman (a souse of the shop owner) will lose buildings but she will rebuild them in the same premises. They will lose collectively 370 rubber plants and some

Item of Impact	Results of the Survey
	garden trees. But they will be compensated for the losses. The project proponent should coordinate with contractor to provide suitable jobs during the construction stage to enhance the family income of the affected women. **O Stage:** No impact is expected.
Children's Rights	**P&C Stage:** There is a possibility that children will be employed as labors for construction activities. The project proponent should coordinate with contractor not to employ children for construction work or disturb their studies. **O Stage:** No impact is expected. Construction activities may disturb children's going to school or studies.
HIV/AIDS and other Infectious Diseases	**P&C Stage:** Since there would be an influx of construction labor from outside to the project areas, infectious diseases may spread to the areas. Awareness programs will be needed for both residents and construction labor. **O Stage:** Since there would not be an influx of visitors, no impact is expected.
Working Conditions (including occupational safety)	**P&C Stage:** There is a possibility that construction contractor will violate laws and regulations associated with the working conditions. Considering that most project sites are located in mountainous, steep or remote areas, there is a high risk of accidents such as sliding on slopes or falling from high places and it may be difficult to quickly transport an injured person or suddenly ill person to hospital. **O Stage:** The Project will reduce the risk of sediment disasters. It will rather contribute to improving working conditions in the areas.
Accident	**P&C Stage:** At most project sites, one-side lane will be used for construction because there are not enough spaces between slopes and roads at most sites. It would cause traffic congestion. Proper measures should be taken to mitigate the traffic congestion and prevent traffic accidents. Since the project areas are sediment disaster prone areas, there is a possibility that sediment disasters happen during construction stage. **O Stage:** Since the Project does not change existing road structures, the road will not impede the movement of inhabitants in the project areas or would not affect the road traffic in the surrounding areas. The project would rather contribute to reducing accidents caused by sediment disasters.

Source: JICA Survey Team

9.1.7 Assessment of the Impacts

An environmental assessment matrix is arranged based on the above environmental and social consideration and shown in **Table 9.1.24**.

Table 9.1.24 Environmental Impact Assessment Matrix

Category	No.	Item	Assessment during Scoping		Assessment based on the survey results		Reason
			Stage		Stage		
			P/C	O	P/C	O	
Pollution	1	Air Quality	B-	D	B-	D	**P/C:** Referring to the monitoring results during construction stage of LDPP Phase 1, ambient air quality would almost satisfy the national and international standards. But PM10 would slightly exceed the standard value. **O:** Since the Project does not plan any

Category	No.	Item	Assessment during Scoping		Assessment based on the survey results		Reason
			Stage		Stage		
			P/C	O	P/C	O	
							facilities that newly emit air pollutants, ambient air quality would satisfy the national and international standards.
	2	Water Quality	B-	B+	B-	B+	**P/C:** Oil and fuel spillages from construction vehicles or equipment may contaminate the surrounding water or groundwater. Wastewater generated from the construction sites and the worker's camps may pollute the surrounding water or groundwater. **O:** The Project will prevent further runoff of soil or sediment on the devastated slopes due to previous sediment disasters and would contribute to mitigating water pollution of surrounding rivers and reservoirs.
	3	Waste	B-	D	B-	D	**P/C:** At the Site No.53, comparatively large volume of surplus sediment will be generated. Solid wastes will be generated from the construction sites and the worker's camps. **O:** Since the Project does not plan any facilities that newly generate wastes, impact is not expected.
	4	Soil Contami-nation	B-	D	B-	D	**P/C:** Oil and fuel spillages from construction vehicles or equipment may contaminate the soil of the sites. **O:** Since the Project does not plan any facilities that newly generate contaminants, impact is not expected.
	5	Noise and Vibration	B-	D	B-	D	**P/C:** Referring to the monitoring results during construction stage of LDPP Phase 1, noise would satisfy the national standards at day time, but noise level would not at night time. Vibration level would satisfy the national standards at all sites. **O:** The Project would not significantly change traffic volume and pattern. The Project does not plan any facilities that newly generate noise and vibration. Impact is not expected.
	6	Subsidence	D	D	D	D	**P/C:** Since the grounds of the project sites are not soft, the drawdown of groundwater would not cause subsidence. **O:** For the same reason as above, the drawdown of groundwater would not cause subsidence.
	7	Odor	C	D	B-	D	**P/C:** Odor may temporally occur when

Category	No.	Item	Assessment during Scoping		Assessment based on the survey results		Reason
			Stage		Stage		
			P/C	O	P/C	O	
							exhaust gas is released in large quantities with the operation of vehicles and equipment. **O:** The Project does not plan any facilities that newly generate odor. Therefore, impacts are not expected.
	8	Sediment	B-	B+	B-	B+	**P/C:** Turbid effluent or oil/fuel spillage may temporally affect sediment of surrounding rivers or reservoirs. **O:** The Project will prevent further runoff of soil or sediment on the bare or devastated slopes due to previous sediment disasters. It would contribute to mitigating sediment pollution of rivers and reservoirs.
Natural Environ-ment	9	Protected Areas	B-	B+	B-	B+	**P/C:** Some sites may be located within one mile from the boundaries of national reserves. CEA has confirmed that the project does not require undergoing EIA/IEE approval process, and also advised RDA to obtain recommendations from the Department of Wildlife Conservation and/or Forest Department. **O:** The Project will rather protect the areas against further degradation of natural environment due to sediment disasters.
	10	Ecosystem	B-	B+	B-	B+	**P/C:** Since the project activities are confined to particular landslide prone location, there is a less possibility of disturbing migratory paths, habitat fragmentation, etc. Cutting trees in forests is needed to construct countermeasures and temporary access roads for construction activities. Approval for cutting trees should be applied to Forest Department or Department of Wildlife Conservation. **O:** The Project will rather protect the areas against further degradation of the natural environment due to sediment disasters.
	11	Hydrology	B-	B±	B-	D	**P/C:** Construction of horizontal drain boreholes will cause drawdown of groundwater level. Monitoring of groundwater level should be carried out. **O:** The Project will not alter the topographic features and installation of structures will not adversely affect surface water and groundwater flows.
	12	Topography	B-	B+	B-	B+	**P/C:** The volume of excavation and

Category	No.	Item	Assessment during Scoping		Assessment based on the survey results		Reason
			Stage		Stage		
			P/C	O	P/C	O	
		and Geology					cutting is estimated to be 52,300 m^3 in total. **O:** The Project is to exactly stabilize the slopes along the existing roads and will contribute to protecting natural environment including topography and geology.
Social Environment	13	Land Acquisition and Resettlement	B-	D	B-	D	**P/C:** 1,041 perches (2.6ha) of private land will be permanently acquired and 6,169 perches temporally acquired. But no person will be resettled. Capacity and budget for compensation should be secured as same as LDPP. **O:** Internal and external monitoring should be carried out.
	14	The Poor	C	D	B-	D	**P/C:** There are two (2) poor families in the project areas. Compensation and assistance for the families, as vulnerable households, should be provided according to the RAP.
	15	Ethnic Minorities and Indigenous Peoples	D	D	D	D	**P/C:/ O:** There are no ethnic minorities and indigenous people in the project areas.
	16	Living and Livelihood	B-	B+	B-	B+	**P/C:** There will be a PAP who loses buildings used for a small shop and a shed and will be disrupted the business during rebuilding the buildings in the same premises. There will be the PAPs who lose trees and productivity from the cultivable lands. There are 10 vulnerable families in the project areas. **O:** The Project will reduce the risk of sediment disasters, and rather contribute to improving current living condition and livelihood.
	17	Use of Land and Local Resources	B-	B+	B-	B+	**P/C:** Land acquisition will change the existing use of land and local resources. However, most project sites are currently bare or devastated slopes due to previous sediment disasters and are unused. Impact would not be significant. **O:** The Project will rather contribute to safe and stable use of land and local resources.
	18	Water Resources	B-	B±	B-	B±	**P/C:** Construction of horizontal drain boreholes will cause drawdown of groundwater level. At the site No.53, the water pipes along the river should be relocated.

Category	No.	Item	Assessment during Scoping		Assessment based on the survey results		Reason
			Stage		Stage		
			P/C	O	P/C	O	
							O: The Project would rather contribute to improvement of quality of water resources. On the other hand, the horizontal drain boreholes will keep drawing the groundwater level down to prevent land slide. Ground water level should be monitored after construction.
	19	Existing Social Infra-structure and Social Services	B-	B+	B-	B+	**P/C:** Utilities such as water pipes, power transmission lines/posts and telephone lines/posts will be shifted at some project sites. **O:** The Project would rather contribute to preventing the social infrastructures from damaging due to sediment disasters.
	20	Social Capital and Society Organization such as Decision-Making Body	D	D	D	D	**P/C:/ O:** Since the Project is not a new road development project but a sediment disaster mitigation project for the existing roads, no impact is expected.
	21	Uneven Distribution of Damage and Benefits	D	D	D	D	**P/C:/ O:** Since the Project is not a new road development project but a sediment disaster mitigation project for the existing roads, uneven distribution of damage and benefits is not expected.
	22	Conflict of Interest within the Region	D	D	D	D	**P/C:/ O:** Since the Project is not a new road development project but a sediment disaster mitigation project for the existing roads, conflict of interest within the region is not expected.
	23	Cultural Heritage	D	D	D	D	**P/C:/ O:** There are no local archeological, historical, cultural and religious heritages at the project sites.
	24	Landscape	D	D	D	D	**P/C:/ O:** Since the project sites are the slopes along the existing roads that are devastated by the previous sediment disasters, no esthetic values exist.
	25	Gender	C	D	B-	D	**P/C:** The number of women of the PAPs is 76. Among them only one woman will lose buildings. They will lose collectively 370 rubber plants and some garden trees. **O:** The project will mitigate sediment disasters and secure safer living conditions in the areas by its nature. No negative impact is expected on women.
	26	Children's Rights	C	D	B-	D	**P/C:** There is a possibility that children will be employed as labors for construction. Construction activities may disturb children's going to school or

Category	No.	Item	Assessment during Scoping		Assessment based on the survey results		Reason
			Stage		Stage		
			P/C	O	P/C	O	
							studies. O: The project will reduce the risk of sediment disasters and secure safer living conditions in the areas. No negative impact is expected on children's rights.
	27	HIV/AIDS and other Infectious Diseases	C	D	B-	D	**P/C:** Since there would be an influx of construction labor from outside to the project areas, infectious diseases may spread to the areas. **O:** No impact is expected
	28	Working Conditions (including occupational safety	B-	B+	B-	B+	**P/C:** There is a possibility that construction contractor will violate laws and regulations associated with the working conditions. Considering that most project sites are located in mountainous, steep or remote areas, there is a high risk of accidents such as sliding on slopes or falling from high places and it may be difficult to quickly transport an injured person or suddenly ill person to the hospital. **O:** The Project will reduce the risk of sediment disasters and will rather contribute to improving working conditions in the areas.
Others	29	Accident	B-	B+	B-	B+	**P/C:** At most sites, one-side lane will be used for construction and may cause traffic congestion and accident. **O:** The project would rather contribute to reducing accidents directly and indirectly caused by sediment disasters.
	30	Cross-border Effects and Climate Change	D	D	D	D	P&C:/ O: Since the Project is rather small-scale road improvement project, cross-border effects or climate change are not expected.

A+/- : Significant positive/negative impact is expected.

B+/- : Positive/negative impact is expected to some extent.

C : Extent of impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses.)

D : No impact is expected.

Source: JICA Survey Team

9.1.8 Mitigation Measures and Costs for Implementation

Based on the above environmental assessment, mitigation measures against possible impacts and environment management were planned for each stage of the Project as shown in **Table 9.1.25** ~ **Table 9.1.26**.

9.1.9 Monitoring Plan

Regular monitoring will be carried out to confirm that the environmental management plan is properly

implemented. Monitoring is necessary to assess the effectiveness of mitigation measures and to determine if additional measures are needed.

There are various types of monitoring, from visual observation to measurement of parameters, the outline of which is shown in **Table 9.1.27 ~ Table 9.1.29**. Draft environmental monitoring forms are also shown in **Section 9.3.1**.

9.1.10 Implementation System

Institutional systems to implement the above environmental management plan (EMP) and environmental monitoring plan (EMoP) are shown in **Figure 9.1.24 ~ Figure 9.1.27**.

Source: JICA Survey Team

In the case of LDPP2, the executing agency is Ministry of Highways & Road Development and Petroleum Resources Development (MOHRDPRD), and the implementation agency is Road Development Authority (RDA). RDA will implement the project under the supervision of MOHRDPRD and manage the project.

The implementation of environmental mitigation actions lies with the construction contractor(s) during construction stage and with the ESDD during operational stage under the supervision of the executing agency, MOHRDPRD, and the implementation agency, RDA. EMP and EMoP will form part of the respective bid documents and it will be a part and parcel of the contract after contract award. RDA, through the Project Management Unit (PMU) of LLDP2, will supervise the effectiveness of the implementation of the EMP and EMoP in collaboration with other agencies.

The EMP and EMoP will be included in the bid documents as part of the project requirements. The bidders will be advised to carefully consider the EMP and EMoP requirements when preparing the bid and pricing the items of work. When the contractor fails to implement the said requirements, the PMU will take whatever actions it is deemed necessary to ensure that the EMP is properly implemented.

Main responsibility for monitoring the project activities will lie with the implementation agency (RDA) assisted by the PMU. The PMU will facilitate the contractors in carrying out the required work.

During the construction stage, the contractor is responsible to report the progress of environmental compliance to the PMU on monthly basis and the PMU will submit progress report on environmental compliance to JICA and CEA through ESDD on quarterly basis. During the operational stage, ESDD is responsible to report the progress of environmental compliance and will submit progress report on environmental compliance to JICA and CEA on semi-annually basis. CEA will be appointed for the compliance monitoring of project activities.

Consulting services may be provided to support the PMU and facilitate efficient and proper preparation and implementation of EMP and EMoP.

The PMU is also responsible to obtain required environmental permits from relevant authorities such as operation permit of quarry sites and borrow sites from GSMB, felling trees permit from Forest Department, and disposal site permit and labor camp setting permit from local authorities.

Table 9.1.25 Environmental Management Plan (Pre and Construction Stage)

Category	Item	Potential Impact	Proposed Management Measures	Location	Responsible Entity		Cost
					Implementation	Supervision	
Pollution	Air Quality	• Generation of dust • Emissions from construction equipment and vehicles	• Spraying water • Covering of rear platforms of vehicles • Proper maintenance of equipment and vehicles • Proper planning and siting of construction activities • Monitoring of ambient air quality	Site 1, 2, 4, 6, 7, 8, 9, 10, 19, 26, 27, 31, 33, 34, 36, 37, 39, 40, 43, 48, 49 and 53 (22 sites)	Contractor	PMU	Included in contractor ’s cost
	Water Quality	Effluent to water bodies	• Monitor of water quality of effluent • Portable toilets at the construction sites and worker’s camps • Appropriate treatment and disposal of miscellaneous wastewater • Simplified sedimentation pond before the effluent flows into the water bodies • Silt fencing to prevent turbid water flows into the water bodies, if necessary	Site 6, 9, 26, 27, 31, 33, 36, 51 and 53 (9 sites), and worker’s camp (tentatively 4 camps)	Contractor	PMU	Included in contractor ’s cost
		Impact on groundwater quality due to underground construction works such as horizontal drain borehole or ground anchor	• Monitoring of groundwater quality • Arrangement of method and quantity of construction activities • Temporary halt of construction activities • Temporary water supply by water truck, if necessary	Site 1, 2, 4, 7, 8, 34, 43 and 49 (8 sites)	Contractor	PMU	Included in contractor ’s cost
		Activities of workers	• Provide portable toilets at the construction sites and worker’s camps, and appropriate treatment and disposal	All 30 sites and worker’s camp (tentatively 4 camps)	Contractor	PMU	Included in contractor ’s cost
		Spillage, leak and accident discharge of oil from equipment and vehicles	• Proper use and maintenance of construction equipment and vehicles • Establish and implement emergency plan in case of spills	All 30 sites	Contractor	PMU	Included in contractor ’s cost
	Waste	Contamination caused by construction spoil and solid waste	• Careful planning of temporary storage and disposal of surplus soil. • Cover temporary stockpile with sheet	All 30 sites	Contractor	PMU	Included in contractor

Category	Item	Potential Impact	Proposed Management Measures	Location	Responsible Entity		Cost
					Implementation	Supervision	
			• Reuse of excavated soil on site for soil cement and earth wall as much as possible • Appropriate disposal to the designated sites • Disposal yard for surplus soil/sediment will be proposed from the contractor, and PMU will obtain permission for using it and supervise the disposal. • Especially special attention including the above measures should be paid for surplus soil generated at Sabo dam construction site.				’s cost
		Contamination caused by solid waste generated from worker’s camp	• Building worker’s camps away from the existing village • Appropriate disposal of garbage	All worker’s camps (tentatively 4 camps)	Contractor	PMU	Included in contractor ’s cost
	Soil Contamination	Contamination caused by oil and fuel spillages from construction vehicles or equipment	• Proper maintenance and refuelling of construction vehicles and vibration	All 30 sites	Contractor	PMU	Included in contractor ’s cost
	Noise and Vibration	Increase noise/vibration level in the vicinity of the construction sites	• Use of low noise/vibration type equipment and vehicles • Careful attention to the working time and schedule when working near the facilities that need silence such as hospitals, schools, temples • Avoiding high noise/vibration construction activities at night and on holiday • Avoiding simultaneous operation of multiple equipment with high noise/vibration levels • Prior notice of construction schedule to neighboring communities • Monitoring noise and vibration levels	Site 1, 2, 4, 6, 7, 8, 9, 10, 19, 26, 27, 31, 33, 34, 36, 37, 39, 40, 43, 48, 49 and 53 (22 sites)	Contractor	PMU	Included in contractor ’s cost

Category	Item	Potential Impact	Proposed Management Measures	Location	Responsible Entity		Cost
					Implementation	Supervision	
	Odor	Offensive odor associated with exhaust gas from construction equipment and vehicles in the vicinity of the construction sites	• Proper use and maintenance of equipment and vehicles • Proper planning and siting of construction activities • Monitoring of offensive odor	Site 1, 2, 4, 6, 7, 8, 9, 10, 19, 26, 27, 31, 33, 34, 36, 37, 39, 40, 43, 48, 49 and 53 (22 sites)	Contractor	PMU	Included in contractor ’s cost
	Sediment	Deterioration of sediment of surrounding rivers or reservoirs caused by turbid effluent or oil/fuel spillage	• Proper water quality management • Proper waste management • Slight compaction of sand and soil stockpile to avoid erosion by rain • Temporary drainage around the sand and soil stockpile • Simplified sedimentation pond before the effluent flows into the river or reservoirs	All 30 sites and worker’s camp	Contractor	PMU	Included in contractor ’s cost
Natural Environment	Protected Areas	Some sites located within one mile from the boundaries of national reserves.	• Proper planning and siting of construction activities • Obtaining recommendations from Department of Wildlife Conservation and/or Forest Department	Site 10, 11, 12, 25, 33, 34, 51 and 53 (8 sites)	PMU	RDA/ESDD	Included in project cost
			• Monitoring of biological environment • To avoid installment of worker’s camp at the site • To minimize the extent of construction facilitating facilities such as access roads or yards • Mitigating impacts such as air pollution, water pollution, waste, noise, vibration and so on	Site 10, 11, 12, 25, 33, 34, 51 and 53 (8 sites)	Contractor	PMU	Included in contractor ’s cost
	Ecosystem	Disturbance to protected areas	• Obtaining approval by the Director General of Department of Wildlife Conservation, if the project is located within one mile from the boundary of a National Reserves.	Site 10, 11, 12, 25, 33, 34, 51 and 53 (8 sites)	PMU	RDA/ESDD	Included in project cost
		Impact on precious	• Monitoring of biological environment.	All 30 sites	Contractor	PMU	Included

Category	Item	Potential Impact	Proposed Management Measures	Location	Responsible Entity		Cost
					Implementation	Supervision	
		species	• If the precious species is found, interrupt the construction work and take necessary measures.				in contractor ’s cost
		Cutting trees	• Obtaining permission for cutting trees from Forest Department or Department of Wildlife Conservation. • Trees will be felled after obtaining permission. Shortcutting access road by using monorail • Reforestation, if necessary	Site 53	PMU/Contractor	RDA/ESDD	Included in project cost
			• Use a technology of Non-frame Method which prevents unstable slope surface through the combination of wire ropes and rock bolts without cutting slope and trees	Site 9	Contractor	PMU	Included in contractor ’s cost
	Hydrology	Obstructing normal river flow by dam construction.	• Use a technology of Permeable Sabo Dam which does not obstruct normal river flow	Site 53	Contractor	PMU	Included in contractor ’s cost
	Topography and Geology	Impact on topography and geology by cutting slope and excavating ground	• Use a technology of minimizing the volume of excavation including reuse of excavated soil on site. • Monitoring of landslide	Site 2, 6, 7, 8, 9, 25, 26, 27, 34, 36, 37, 40, 43, 48, 49, 51 and 53 (17 sites)	Contractor	PMU	Included in contractor ’s cost
Social Environment	Land Acquisition and Resettlement	Impacts on private properties, and livelihood and economic activities	• Consultation with PAPs • Development and implementation of RAP and income restoration plan • Provision of compensation to PAPs	Lands affected	PMU	RDA/LD	Included in project cost (Local fund)
	The Poor	Impact on the project affected poor families	• Compensation and assistance for the families as vulnerable households	Site 6, 33	PMU	RDA/LD	Included in project cost (Local fund)
			• Employment in project related activities	Site 6, 33	Contractor	PMU	Included

Category	Item	Potential Impact	Proposed Management Measures	Location	Responsible Entity		Cost
					Implementation	Supervision	
							in contractor ’s cost
	Living and Livelihood	Impacts on the living and livelihood of the PAPs	• Compensation and assistance for the PAPs	Lands affected	PMU	RDA/LD	Included in project cost (Local fund)
			• Employment in project related activities	Lands affected	Contractor	PMU	Included in contractor ’s cost
	Use of Land and Local Resources	Impacts on the existing use of land and local resources	• Compensation for losses of land, building, productive tree and income	Lands affected	PMU	RDA/LD	Included in project cost (Local fund)
	Water Resources	Impact on use of water resources	• Monitoring of groundwater level • Detour a water pipe along river course	Site 1, 4, 6, 7, 8, 26, 34 and 49 (8 sites) Site 53	Contractor	PMU	Included in contractor ’s cost
	Existing Social Infra-structure and Social Services	Damage to utilities (power lines/steel towers, telecommunication lines, water pipes and sewerage system)	• Detail survey at the detail design stage • Construction avoiding the utilities • Close coordination with utility operation/management bodies • Relocation if necessary	Site 1, 2, 6, 7, 8, 9, 11, 12, 26, 27, 31, 33, 34, 36, 37, 39, 40, 48, 49 and 51 (20 sites)	Contractor/PMU	PMU	To be finalized during the detail design stage
	Gender	Impact on women of the PAPs	• Compensation for losses of land, building and productive tree	Site 2, 6, 9, 26, 27, 31, 33, 34, 36, 37, 39, 40, 49, 51 and 53 (15 sites)	PMU	RDA/LD	Included in project cost (Local fund)
			• The project proponent’s coordination with contractor to provide suitable jobs during the construction stage to enhance	Site 2, 6, 9, 26, 27, 31, 33, 34, 36, 37, 39, 40,	Contractor/PMU	PMU	Included in contractor

Category	Item	Potential Impact	Proposed Management Measures	Location	Responsible Entity		Cost
					Implementation	Supervision	
			the family income of the affected women.	49, 51 and 53 (15 sites)			's cost
	Children's Rights	Impact on children's rights such as right to education	• The project proponent's coordination with contractor not to employ children for construction work or disturb their studies	All sites	Contractor	PMU	Included in contractor 's cost
	HIV/AIDS and other Infectious Diseases	Spread of infectious diseases through an influx of construction labor from outside to the project areas	• Awareness programs on infectious diseases including sexually transmitted diseases to be carried out for both workers and surrounding residents if foreign labors are employed • To separated male and female lodgings in worker's camps	All sites	Contractor	PMU	Included in contractor 's cost
	Working Conditions (including occupational safety)	Violation of laws and regulations associated with the working conditions, and	• The project proponent's observation of laws and regulations associated with the working conditions and coordination with contractor	All 30 sites	PMU	RDA/ESDD	Included in project cost
		Dealing with illnesses and accidents.	• Appropriate use of protective gear such as helmets, masks, gloves and goggles during work • Provision of training and awareness program to worker • To pay due attention to hygiene of construction sites and worker's camps • Provision of first aid kit and household medicine at the worker's camp • Provision of dedicated transport at all work sites to take injured persons to hospitals • Keeping a list of all nearest hospitals at each construction site	All 30 sites and worker's camp (tentatively 4 camps)	Contractor	PMU	Included in contractor 's cost
Others	Accident	Traffic accident	• Arrangement of traffic control personnel (flagmen) • Installation of one-side lane control sign	All 30 sites	Contractor	PMU	Included in contractor

Category	Item	Potential Impact	Proposed Management Measures	Location	Responsible Entity		Cost
					Implementation	Supervision	
			• Secure passages and install signs for pedestrian • Develop measures to alleviate traffic congestion and prevent accidents in and around the villages during construction • Inform residents about the restrictions on use of the roads.				's cost

Source: JICA Survey Team

Table 9.1.26 Environmental Management Plan (Operation Stage)

Category	Item	Potential Impact	Proposed Management Measures	Location	Responsible Entity		Cost
					Implementation	Supervision	
Social Environment	Water Resources	Impact on use of groundwater resources	• Monitoring of groundwater level	Site 1, 2, 4, 7, 8, 34, 43 and 49 (8 sites)	RDA/ESDD	RDA	To be included in the RDA's budget

Source: JICA Survey Team

Table 9.1.27 Environmental Monitoring Plan (Pre Construction Stage)

Item	Parameter	Method	Frequency	Location	Responsible Entity		Cost (Rs.)
					Implementation	Supervision	
Air Quality	SO_2, NO_2, CO, O_3, PM_{10}, $PM_{2.5}$	Air sampling and analysis as per applicable standard	One time	Site 1, 2, 4, 6, 7, 8, 9, 10, 19, 26, 27, 31, 33, 34, 36, 37, 39, 40, 43, 48, 49 and 53 (22 sites)	Contractor (through approved monitoring organization)	PMU	Included in contractor's cost (25,000/time/site 550,000)
Water Quality (effluent)	EC, pH, TSS, BOD_5, Oil and grease , Coliform (Fecal)	Water sampling and analysis as per applicable standard	One time	Site 6, 9, 26, 27, 31, 33, 36, 51 and 53 (9 sites), and worker's camps (tentatively 4 camps)	Contractor (through approved monitoring organization)	PMU	Included in contractor's cost (10,000/time/site 130,000)
Water Quality (groundwater)	EC, pH, TSS, BOD_5, Oil and grease , Coliform (Fecal)	Water sampling and analysis as per applicable standard	One time	Site 1, 2, 4, 7, 8, 34, 43 and 49 (8 sites)	Contractor (through approved monitoring organization)	PMU	Included in contractor's cost (10,000/time/site 80,000)
Waste	Capacity of designated disposal sites	Interview to the authority concerned	One time	All 30 sites	Contractor	PMU	Included in contractor's cost
Soil Contamination	Appearance	Visual observation	One time	All 30 sites	Contractor	PMU	Included in contractor's cost
Noise	Noise level (dB(A)) L_{Aeq}	Monitoring by noise level meter as per applicable standard	One time	Site 1, 2, 4, 6, 7, 8, 9, 10, 19, 26, 27, 31, 33, 34, 36, 37, 39, 40, 43, 48, 49 and 53 (22 sites)	Contractor (through approved monitoring organization)	PMU	Included in contractor's cost (21,000/time/site 462,000)
Vibration	Vibration level in PPV (mm/sec) Frequency range (Hz)	Monitoring by noise level meter as per applicable standard	One time	Site 1, 2, 4, 6, 7, 8, 9, 10, 19, 26, 27, 31, 33, 34, 36, 37, 39, 40, 43, 48, 49 and 53 (22 sites)	Contractor (through approved monitoring organization)	PMU	Included in contractor's cost (14,000/time/site 308,000)
Odor	Offensive odor	Survey by smell	One time	Site 1, 2, 4, 6, 7, 8, 9, 10, 19, 26, 27, 31, 33, 34, 36, 37, 39, 40, 43, 48, 49 and 53 (22 sites)	Contractor (through approved monitoring organization)	PMU	Included in contractor's cost
Sediment	Appearance	Visual observation	One time	All 30 sites	Contractor (through approved monitoring organization)	PMU	Included in contractor's cost
Protected Areas	Appearance	Visual observation and consultation with	One time	Site 10, 11, 12, 25, 33, 34, 51 and 53	PMU	RDA/ESDD	Included in project cost

Item	Parameter	Method	Frequency	Location	Responsible Entity		Cost (Rs.)
					Implementation	Supervision	
		Department of Wildlife Conservation and /or Forest Department					
Ecosystem	Number and type of precious species	Visual observation and literature survey	One time	All sites	PMU	RDA/ESDD	Included in project cost
Hydrology	Appearance of river (course, depth and width)	Visual observation	One time	Site 53	PMU	RDA/ESDD	Included in project cost
Topography and Geology	Appearance	Visual observation	One time	Site 2, 6, 7, 8, 9, 25, 26, 27, 34, 36, 37, 40, 43, 48, 49, 51 and 53 (17 sites)	PMU	RDA/ESDD	Included in project cost
Land Acquisition and Resettlement	Number of AHHs and PAPs, and the compensation policies	Updating RAP	One time	Lands affected	PMU	RDA/LD	Included in project cost (Local fund)
	Frequency of implementing income restoration program	Updating RAP	One time	Lands affected	PMU	RDA/LD	Included in project cost (Local fund)
The Poor	Number of poor AHHs and PAPs	Updating RAP	One time	Site 6, 33	PMU	RDA/LD	Included in project cost (Local fund)
	Compensation policies for the poor AHHs and PAPs	Updating RAP	One time	Site 6, 33	PMU	RDA/LD	Included in project cost (Local fund)
Living and Livelihood	Compensation and assistance policies	Updating RAP	One time	Lands affected	PMU	RDA/LD	Included in the project cost (Local fund)
Use of Land and Local Resources	Compensation and assistance policies	Updating RAP	One time	Lands affected	PMU	RDA/LD	Included in the project cost (Local fund)
Water Resources	Groundwater level from ground	Measuring by tape	One time each in rain and dry seasons	Site 1, 4, 6, 7, 8, 26, 34 and 49 (8 sites)	Contractor	PMU	Included in contractor's cost (600/time/site 9,600)

Item	Parameter	Method	Frequency	Location	Responsible Entity		Cost (Rs.)
					Implementation	Supervision	
Existing Social Infrastructure and Social Services	Exact location of the existing utilities	Consultation meeting with utility operation/management bodies and interview to the PAPs	One time	Site 1, 2, 6, 7, 8, 9, 11, 12, 26, 27, 31, 33, 34, 36, 37, 39, 40, 48, 49 and 51 (20 sites)	PMU	RDA/LD	Included in the project cost (Local fund)
Gender	Compensation and assistance policies	Updating RAP	One time	Site 2, 6, 9, 26, 27, 31, 33, 34, 36, 37, 39, 40, 49, 51 and 53 (15 sites)	PMU	RDA/LD	Included in the project cost (Local fund)
Children's Rights	Exact locations of schools and routes for children going to and from school	Consultation with GN and interviews to the residents	One time	All sites	Contractor	PMU	Included in contractor's cost
HIV/AIDS and other Infectious Diseases	Numbers of sufferers of infectious diseases in the project areas	Interviews to DS or GN and authorities concerned	One time	All sites	PMU	RDA/LD	Included in the project cost
Working Conditions (including occupational safety)	A list of all nearest hospitals at each project site	Interviews to DS or GN and authorities concerned	One time	All sites	Contractor	PMU	Included in contractor's cost
Accident	Current frequency of congestion and accidents around the project sites	Interview with the authorities concerned and residents	One time	All sites	Contractor	PMU	Included in contractor's cost
	Landslide movement	Landslide monitoring and warning system	Continuously	All sites	PMU	RDA	Included in the project cost

Note: At the pre-construction stage, items, parameters, frequencies and locations at the construction stage should be determined in detail through PMU's inspection in consultation with PDA/ESDD.
Source: JICA Survey Team

Table 9.1.28 Environmental Monitoring Plan (Construction Stage)

Item	Parameter	Method	Frequency	Location	Responsible Entity		Cost (Rs.)
					Implementation	Supervision	
Air Quality	SO_2, NO_2, CO, O_3, PM_{10}, $PM_{2.5}$	Air sampling and analysis as per applicable standard	Quarterly	Site 1, 2, 4, 6, 7, 8, 9, 10, 19, 26, 27, 31, 33, 34, 36, 37, 39, 40, 43, 48, 49 and 53 (22 sites)	Contractor (through approved monitoring organization)	PMU	Included in contractor's cost (25,000/time/site 2,200,000/yr.)
Water Quality (spill and leakage)	Oil and grease	Visual inspection	Daily	All 30 sites	Contractor	PMU	Included in contractor's cost
Water Quality (effluent)	EC, pH, TSS, BOD_5, Oil and grease, Coliform (Fecal)	Water sampling and analysis as per applicable standard	Quarterly	Site 6, 9, 26, 27, 31, 33, 36, 51 and 53 (9 sites), and worker's camps (tentatively 4 camps)	Contractor (through approved monitoring organization)	PMU	Included in contractor's cost (10,000/time/site 520,000/yr.)
Water Quality (groundwater)	EC, pH, TSS, BOD_5, Oil and grease, Coliform (Fecal)	Water sampling and analysis as per applicable standard	Quarterly	Site 1, 2, 4, 7, 8, 34, 43 and 49 (8 sites)	Contractor (through approved monitoring organization)	PMU	Included in contractor's cost (10,000/time/site 320,000/yr.)
Waste	Volume of generated surplus soil and disposed surplus soil	Estimation referring to the construction records	Monthly	All 30 sites	Contractor	PMU	Included in contractor's cost
	Appearance of temporary storage of surplus soil and solid waste	Visual observation	Monthly	All 30 sites	Contractor	PMU	Included in contractor's cost
Soil Contamination	Appearance	Visual observation	Monthly	All 30 sites	Contractor	PMU	Included in contractor's cost
Noise	Noise level (dB(A)) L_{Aeq}	Monitoring by noise level meter as per applicable standard	Quarterly	Site 1, 2, 4, 6, 7, 8, 9, 10, 19, 26, 27, 31, 33, 34, 36, 37, 39, 40, 43, 48, 49 and 53 (22 sites)	Contractor (through approved monitoring organization)	PMU	Included in contractor's cost (21,000/time/site) 1,848,000/yr.
Vibration	Vibration level in PPV (mm/sec) Frequency range (Hz)	Monitoring by noise level meter as per applicable standard	Quarterly	Site 1, 2, 4, 6, 7, 8, 9, 10, 19, 26, 27, 31, 33, 34, 36, 37, 39, 40, 43, 48, 49 and 53 (22 sites)	Contractor (through approved monitoring organization)	PMU	Included in contractor's cost (14,000/time/site 1,232,000/yr.)
Odor	Offensive odor	Interview to residents	Monthly	Site 1, 2, 4, 6, 7, 8, 9, 10, 19, 26, 27, 31, 33, 34, 36, 37, 39, 40, 43, 48, 49 and	Contractor	PMU	Included in contractor's cost

Item	Parameter	Method	Frequency	Location	Responsible Entity		Cost (Rs.)
					Implementation	Supervision	
				53 (22 sites)			
Sediment	Appearance	Visual observation	Monthly	All 30 sites	Contractor	PMU	Included in contractor's cost
Protected Areas	Disturbance to protected areas	Visual observation and recording	Monthly (to be included in the monitoring of Ecosystem)	Site 10, 11, 12, 25, 33, 34, 51 and 53	Contractor (through approved monitoring organization)	PMU	Included in contractor's cost
Ecosystem	Number and type of precious species	Visual observation and recording	Monthly	All sites	Contractor (through approved monitoring organization)	PMU	Included in contractor's cost
	Number and type of trees to be cut	Visual observation and recording	Before and after cutting trees	All sites	Contractor	PMU	Included in contractor's cost
Hydrology	Stagnant flow or drying up of the river	Visual observation	Monthly	Site 53	Contractor	PMU	Included in contractor's cost
Topography and Geology	Volume of excavation	Estimation referring to the construction records	Monthly (to be included in the monitoring of Waste)	Site 2, 6, 7, 8, 9, 25, 26, 27, 34, 36, 37, 40, 43, 48, 49, 51 and 53 (17 sites)	Contractor	PMU	Included in contractor's cost
Land Acquisition and Resettlement Land Acquisition and Resettlement	Landslide movement	Reading the recorded data of meters	Monthly	All 30 sites	PMU	RDA	Included in the project cost
	Provision of compensation to PAPs	Consultation meeting and interview survey with PAPs	Monthly	Lands affected	PMU	RDA/LD	Included in the project cost (Local fund)
The Poor The Poor	Income restoration program	Consultation meeting and interview survey with PAPs	Monthly	Lands affected	PMU	RDA/LD	Included in the project cost (Local fund)
	Provision of compensation and	Interview to the PAPs	Monthly	Site 6, 33	PMU	RDA/LD	Included in the project cost

Item	Parameter	Method	Frequency	Location	Responsible Entity		Cost (Rs.)
					Implementation	Supervision	
	assistance to the PAPs						(Local fund)
Living and Livelihood Living and Livelihood	Employment in project related activities	Interview to the PAPs	Monthly	Site 6, 33	PMU	RDA/LD	Included in the project cost (Local fund)
	Provision of compensation and assistance to the PAPs	Consultation meeting and interview to the PAPs	Monthly	Lands affected	PMU	RDA/LD	Included in the project cost (Local fund)
Use of Land and Local Resources	Employment in project related activities	Consultation meeting and interview to the PAPs	Monthly	Lands affected	PMU	RDA/LD	Included in the project cost (Local fund)
Use of Land and Local Resources	Provision of compensation for the losses to the PAPs	Consultation meeting and interview to the PAPs	Monthly	Lands affected	PMU	RDA/LD	Included in the project cost (Local fund)
Water Resources	Groundwater level from ground	Measuring by tape	2 times each in rain and dry seasons	Site 1, 4, 6, 7, 8, 26, 34 and 49 (8 sites)	Contractor	PMU	Included in contractor's cost (600/time/site 19,200/yr.)
Existing Social Infrastructure and Social Services Gender	Necessity of shifting utilities (power lines/steel towers, telecommunication lines, water pipes and sewerage system)	Consultation meeting with utility operation/management bodies and interview to the PAPs	Monthly	Site 1, 2, 6, 7, 8, 9, 11, 12, 26, 27, 31, 33, 34, 36, 37, 39, 40, 48, 49 and 51 (20 sites)	PMU	RDA/LD	Included in the project cost (Local fund)
	Provision of compensation and assistance to the PAPs	Consultation meeting and interview to the PAPs	Monthly	Site 2, 6, 9, 26, 27, 31, 33, 34, 36, 37, 39, 40, 49, 51 and 53 (15 sites)	PMU	RDA/LD	Included in the project cost (Local fund)
Children's Rights	Employment in project related activities	Consultation meeting and interview to the PAPs	Monthly	Site 2, 6, 9, 26, 27, 31, 33, 34, 36, 37, 39, 40, 49, 51 and 53 (15 sites)	PMU	RDA/LD	Included in the project cost (Local fund)
Children's Rights	Employment of	Consultation	Monthly	All sites	PMU	RDA/ESDD	Included in the

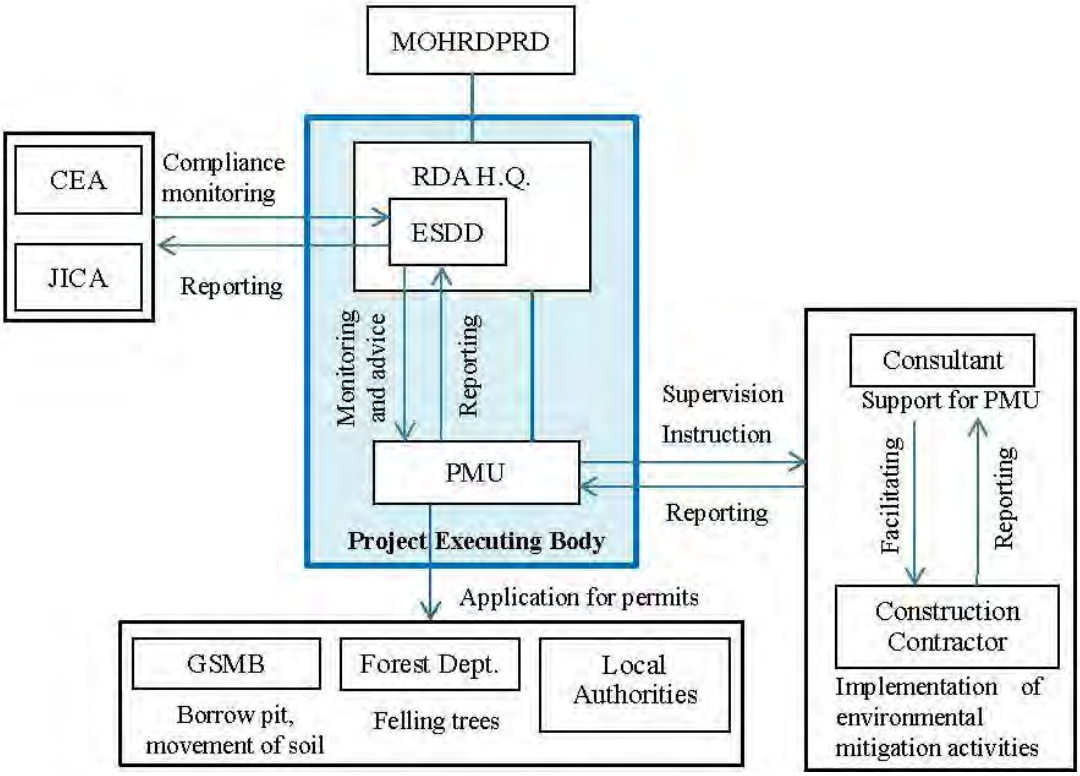
Item	Parameter	Method	Frequency	Location	Responsible Entity		Cost (Rs.)
					Implementation	Supervision	
	children for construction work Disturbance to children's studies	meeting and interview to the PAPs					project cost
HIV/AIDS and other Infectious Diseases Working Conditions (including occupational safety)	Dissemination of awareness programs on infectious diseases for both workers and surrounding residents	Number of carrying out of the awareness programs	Monthly	All sites	Contractor	PMU	Included in contractor's cost
	Violation of laws and regulations associated with the working conditions	Inspection	Monthly	All sites	PMU	RDA/ESDD	Included in the project cost
Accident	Dealing with illnesses and accidents	Inspection	Monthly	All sites	Contractor	PMU	Included in contractor's cost

Note: Items, parameters, frequencies and locations at the construction stage should be determined in detail at the pre-construction stage through PMU's inspection in consultation with PDA/ESDD.
Source: JICA Survey Team

Table 9.1.29 Environmental Monitoring Plan (Operation Stage)

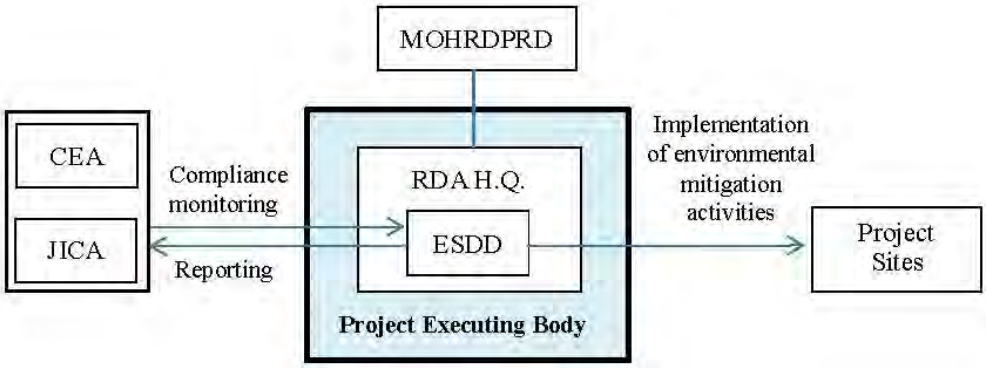
Item	Parameter	Method	Frequency	Location	Responsible Entity		Cost (Rs.)
					Implementation	Supervision	
Water resources	Groundwater level from ground	Measuring by tape	One time each in rain and dry seasons for 2 years	Site 1, 4, 6, 7, 8, 26, 34 and 49 (8 sites)	RDA/ESDD	RDA	Included in RDA management cost (600/time/site 9,600/yr.)

Note: Items, parameters, frequencies and locations at the operation stage should be determined in detail by RDA/ESDD based on the monitoring results during the construction stage.
Source: JICA Survey Team



Source: JICA Survey Team

Figure 9.1.24 EMP Implementation System (Construction Stage)



Source: JICA Survey Team

Figure 9.1.25 EMP Implementation System (Operation Stage)

CEA: Central Environmental Authority
DS: Divisional Secretary
ESDD: Environmental and Social Development Division
GSMB: Geological Survey and Mines Bureau
JICA: Japan International Cooperation Agency
MOHRDPRD: Ministry of Highways and Road Development and Petroleum Resources Development
PMU: Project Management Unit
RDA H.Q.: Road Development Authority Headquarters

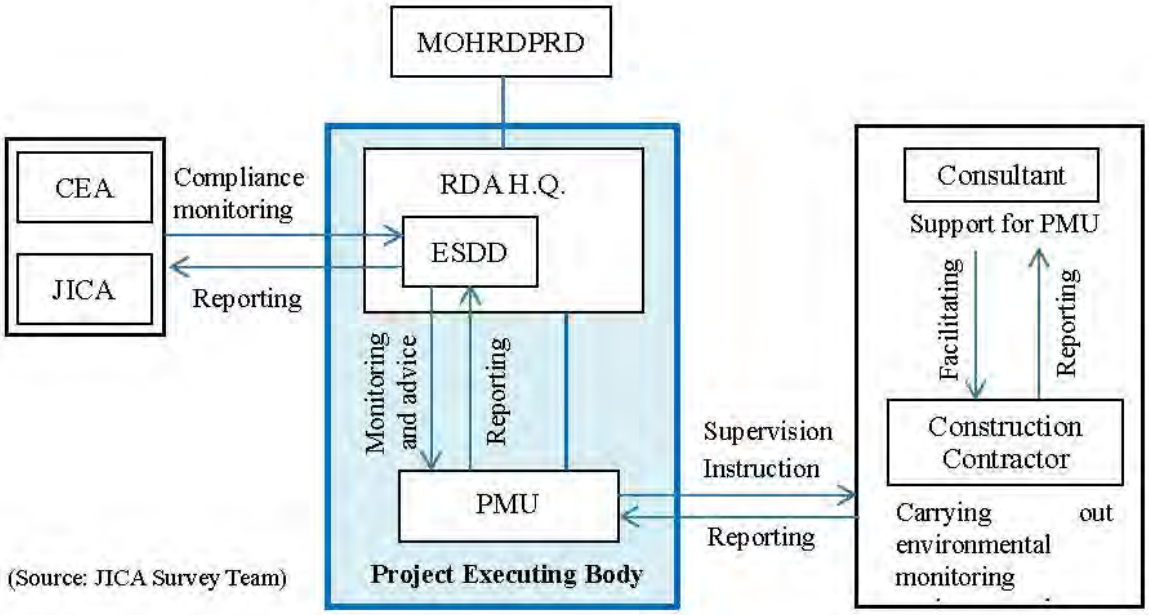
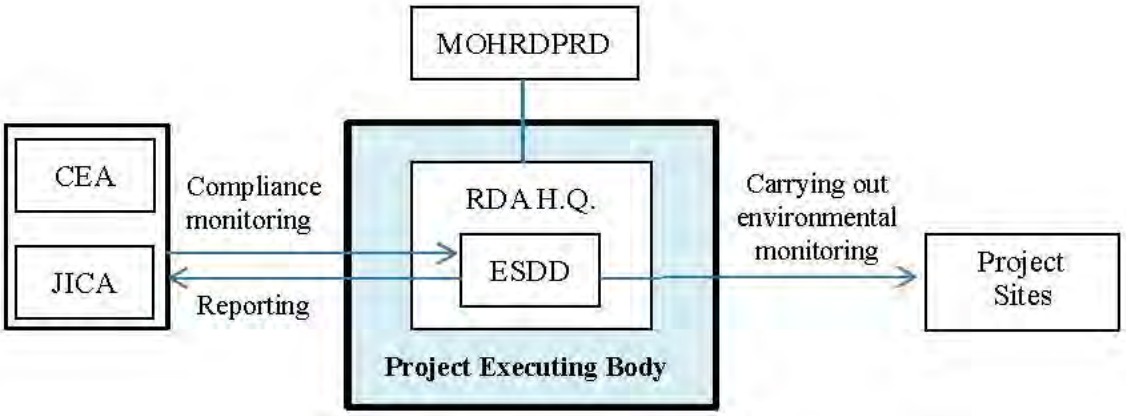


Figure 9.1.26 EMoP Implementation System (Construction Stage)



Source: JICA Survey Team

Figure 9.1.27 EMoP Implementation System (Operation Stage)

CEA: Central Environmental Authority
ESDD: Environmental and Social Development Division
JICA: Japan International Cooperation Agency
MOHRDPRD: Ministry of Highways and Road Development and Petroleum Resources Development
PMU: Project Management Unit
RDA H.Q.: Road Development Authority Headquarters

9.1.11 Stakeholder Consultation

The consultations with the stakeholders were conducted as shown in **Table 9.1.30** below. At the beginning of every meeting, showing the layout plan of the countermeasures against sediment disasters, the purpose and outline of the project, possible positive and negative impacts due to the project, the policy of compensation for land acquisition and other losses including cut-off date and provision of support and assistance for livelihood restoration of the PAPs were explained and discussed.

Main opinions of the participants at the meetings are summarized as follows.

- The areas they reside in are sediment disaster prone areas and have been repeatedly hit by the disasters. As there are some disaster-prone sites other than the project sites, they need to take countermeasures for such sites as well.
- Measures taken after disaster were technically inadequate and supports were economically inadequate.
- Since the areas where national roads traverse are rich in bio diversity, water resources, fruit orchards home gardens, tea and rubber cultivations, an appropriate environmental safeguard should be considered when countermeasures are taken.
- If land of the private person is used for the countermeasures, the person should be reasonably compensated
- Since the area depends on agriculture and tourism, and national roads are highly important in terms of transporting agricultural produce to the market and transporting tourists, temporary closure of national road due to sediment disaster causes significant damage to the local economy. They want to engage in agriculture and tourism in a safe environment without the risk of sediment disasters, increase their income, and develop the local economy.
- The project does not aim at an emergency measures, but a full-scale measures against sediment disasters, and. They highly expect that Japanese advanced technology is applied, and are willing to cooperate for this project.
- They expect that preference should be given to local labor during construction stage.

Above opinions were informed to PMU/RDA. PMU/RDA will not only construct countermeasures for 30 project sites but also continue to take countermeasures developing technology transferred through the project even after the completion of the project. PMU/RDA will compensate the PAPs for land acquisition and other losses as same as in the case of LDPP Phase 1. It has been confirmed that PMU/RDA will explain the above intention to the PAPs and get their consent at stakeholder consultations in the next stage.

Table 9.1.30 List of conducted Stakeholder Consultations

Site No.	Date	Participant			Theme
	Time	Gender	Position	Affiliation	
7, 8	22.07.2019 5.00pm	Male	GN (Grama Niladhari)	GND (GN Division) - Pussella	Explanation of the project to local government head, and request for his cooperation on various aspects of the project
7, 8	24.07.2019 11.30am	Female	DS (Divisional Secretary)	DSD (DS Division) - Udapalatha	Explanation of the project to local government head, and request for her cooperation on various aspects of the project
7, 8	24.07.2019 12.00am	Male	Land use planning officer	DSD-Udapalatha	Explanation of the project to local government senior official, and request for his cooperation
26	24.07.2019 2.00pm	Male	GN	GND - Punchi Rathtota.	Explanation of the project to local government head, and request for his cooperation on various aspects of the project

Site No.	Date	Participant			Theme
	Time	Gender	Position	Affiliation	
26	24.07.2019 2.30pm	4 females 2 males	Six (6) Residents *		Explanation and discussion regarding the effect of the project and compensation policy for the losses due to the project to/with the residents
26	24.07.2019 3.30pm	Male	DS	DSD - Rathtota.	Explanation of the project to local government head, and request for his cooperation on various aspects of the project
26	24.07.2019 04.30pm	Male	Retired postman		Explanation and discussion regarding the effect of the project and compensation policy for the losses due to the project to/with the resident
27	25.07.2019 10.30am	Male	DS	DSD - Ukuwela	Explanation of the project to local government head, and request for his cooperation on various aspects of the project
27	25.07.2019 11.30pm	Female	GN	GND - Kaduwela	Explanation of the project to local government head, and request for her cooperation on various aspects of the project
39	25.07.2019 2.00pm	Female	GN	GND - Polwatta Ihalagama	Explanation of the project to local government head, and request for her cooperation on various aspects of the project
39	25.07.2019 2.30pm	4 females 2 males	GN and five (5) residents *	GND - Polwatta Ihalagama	Explanation and discussion regarding the effect of the project and compensation policy for the losses due to the project to/with the residents
49	26.07.2019 02.00pm	Male	DS	DSD - Nivithigala	Explanation of the project to local government head, and request for his cooperation on various aspects of the project
49	26.07.2019 03.00pm	Male	Disaster relief services officer	DSD - Nivithigala	Explanation of the project to local government senior official, and request for his cooperation
39, 40	29.07.2019 11.00am	Female	Assistant DS	DSD - Hathara Liyadda	Explanation of the project to local government executive, and request for her cooperation on various aspects of the project
39	29.07.2019 00.15pm	Male	GN	GND - Polwatta Pahalagama	Explanation of the project to local government head, and request for his cooperation on various aspects of the project
40	29.07.2019 2.15pm	Male	Timber businessman		Explanation and discussion regarding the effect of the project and compensation policy for the losses due to the project to/with the resident
31	30.07.2009 9.30am	Male	Assistant DS	DSD - Mawanella	Explanation of the project to local government executive, and request for his cooperation on various aspects of the project
4	30.07.2019 1.45pm	Female	GN	GND – Galabada Wasama	Explanation of the project to local government head, and request for her cooperation on various aspects of the project
4	30.07.2019 2.30pm	Female	Development officer	GND – Galabada Wasama	Explanation of the project to local government senior official, and request for her cooperation
4	30.07.2019 4.30pm	Female	DS	DSD - Ratnapura	Explanation of the project to local government head, and request for her cooperation on various aspects of the project
51	31.07.2019 9.15am	Male	Assistant DS	DSD - Padukka	Explanation of the project to local government executive, and request for his cooperation on various aspects of the project

Site No.	Date	Participant			Theme
	Time	Gender	Position	Affiliation	
51	31.7.2019 10.15am	Male	GN	GND - Thummodara	Explanation of the project to local government head, and request for his cooperation on various aspects of the project
51	31.7.2019 11.00am	Female	Retired clerk		Explanation and discussion regarding the effect of the project and compensation policy for the losses due to the project to/with the resident
9	31.07.2019 00.30pm	Male	DS	DSD - Dehiowita	Explanation of the project to local government head, and request for his cooperation on various aspects of the project
9	31.07.2019 01.00pm	Male	GN	GND - Ihalatalduwa	Explanation of the project to local government head, and request for his cooperation on various aspects of the project
27	02.08.2019 10.00am	Male	Proprietary planter		Explanation and discussion regarding the effect of the project and compensation policy for the losses due to the project to/with the owner of plantation estate
49	05.08.2019 9.30am	Female	GN	GND - Pahala Karawita	Explanation of the project to local government head, and request for her cooperation on various aspects of the project
49	05.08.2019 11.00am	Male	Proprietary planter		Explanation and discussion regarding the effect of the project and compensation policy for the losses due to the project to/with the owner of plantation estate
48	05.08.2019 00.00pm	Female	Field Development Officer	GND - Niriella Niriellawatta	Explanation of the project to local government senior official, and request for her cooperation
48	05.08.2019 1.30pm	Female	DS	DSD - Elapatha	Explanation of the project to local government head, and request for her cooperation on various aspects of the project
43	05.08.2019 3.30pm	Male	Disaster relief services officer	DSD - Godakawela	Explanation of the project to local government senior official, and request for his cooperation
43	05.08.2019 4.30pm	Female	Administrative officer	DSD - Godakawela	Explanation of the project to local government senior official, and request for her cooperation
43	05.08.2019 5.30pm	Male	Estate superintendent	Hapugastenna estate	Explanation and discussion regarding the effect of the project and compensation policy for the losses due to the project to/with the representative of plantation estate
2	06.08.2019 9.00am	Male	Tea factory owner		Explanation and discussion regarding the effect of the project and compensation policy for the losses due to the project to/with the owner of the factory
6	07.08.2019 9.00am	Male	DS	DSD - Nuwaraeliya	Explanation of the project to local government head, and request for his cooperation on various aspects of the project
6	07.08.2019 10.30am	Five (5) males	One (1) community leader and four (4) farmers *		Explanation and discussion regarding the effect of the project and compensation policy for the losses due to the project to/with the residents
36	07.08.2019 01.00pm	Male	DS	DSD - Ambagamuwa	Explanation of the project to local government head, and request for his cooperation on various aspects of the project
36	07.08.2019 02.00pm	Male	GN	GND - Newweligama	Explanation of the project to local government head, and request for his cooperation on various aspects of the project

Site No.	Date	Participant			Theme
	Time	Gender	Position	Affiliation	
36	07.08.2019 03.00pm	Female	Flower grower		Explanation and discussion regarding the effect of the project and compensation policy for the losses due to the project to/with the resident
2	08.08.2019 8.00am	Male	GN	GND - Ramboda	Explanation of the project to local government head, and request for his cooperation on various aspects of the project
2	08.08.2019 9.30am	Female	DS	DSD - Kotmale	Explanation of the project to local government head, and request for her cooperation on various aspects of the project
6	08.08.2019 00.00 pm	Male	Disaster relief services officer	DSD - Nuwaraeliya	Explanation of the project to local government senior official, and request for his cooperation
37	09.08.2019 8.30am	Female	DS	DSD - Soranathota	Explanation of the project to local government head, and request for her cooperation on various aspects of the project
37	09.08.2019 09.30am	Female	Bank officer		Explanation and discussion regarding the effect of the project and compensation policy for the losses due to the project to/with the resident
37	09.08.2019 00.30pm	Male	Businessman		Explanation and discussion regarding the effect of the project and compensation policy for the losses due to the project to/with the resident
1	09.08.2019 01.00pm	Male	Development field assistant	DSD - Walapane	Explanation of the project to local government senior official, and request for his cooperation
33, 34, 10, 11, 12	09.08.2019 4.30pm	Female	Assistant DS	DSD - Haldummulla	Explanation of the project to local government executive, and request for her cooperation on various aspects of the project
10, 11, 12	12.8.2019 3.00pm	Male	Estate superintendent	Glennove Estate Haldummulla	Explanation and discussion regarding the effect of the project and compensation policy for the losses due to the project to/with the representative of plantation estate
19, 20	15.8.2019 9.00am	Female	DS	DSD – Weliwita Divithura	Explanation of the project to local government head, and request for her cooperation on various aspects of the project
19, 20	15.8.2019 11.00am	Female	GN	GND - Nugethota	Explanation of the project to local government head, and request for her cooperation on various aspects of the project
22, 23	15.8.2019 2.00pm	Male	DS	DSD - Baddegama	Explanation of the project to local government head, and request for his cooperation on various aspects of the project
22	15.08.2019 3.30pm	Male	GN	GND - Kohombanawa	Explanation of the project to local government head, and request for his cooperation on various aspects of the project
25, 25_ad2	16.08.2019 1.30pm	Female	Assistant DS	DSD - Imaduwa	Explanation of the project to local government executive, and request for her cooperation on various aspects of the project
25, 25_ad2	16.08.2019 2.30pm	Female	Assistant Director-Planning	DSD - Imaduwa	Explanation of the project to local government senior official, and request for her cooperation
9	19.08.2019 10.00am	Male	Retired Army Officer		Explanation and discussion regarding the effect of the project and compensation policy for the losses due to the project to/with the resident

Site No.	Date	Participant			Theme
	Time	Gender	Position	Affiliation	
34	19.08.2019 1.00pm	Male	Businessman		Explanation and discussion regarding the effect of the project and compensation policy for the losses due to the project to/with the resident
33	21.08.2019 00.15pm	Male	GN	GND - Uvatenna	Explanation of the project to local government head, and request for his cooperation on various aspects of the project
11, 12	21.08.2019 2.00pm	Female	Medical officer	University of Sabaragamuwa	Explanation and discussion regarding the effect of the project and compensation policy for the losses due to the project to/with the resident
34, 10, 11, 12	22.08.2019 1.30pm	Male	GN	GND - Viharagala	Explanation of the project to local government head, and request for his cooperation on various aspects of the project
23	25.08.2019 3.00pm	Female	Administrative officer	DSD - Bope Poddala	Explanation of the project to local government senior official, and request for her cooperation
23	25.08.2019 3.45pm	Male	Assistant Director-Planning	DSD - Bope Poddala	Explanation of the project to local government senior official, and request for his cooperation
31	28.08.2019 00.30pm	Male	Businessman		Explanation and discussion regarding the effect of the project and compensation policy for the losses due to the project to/with the resident
53	9.9.2019 11.00am	Female	GN	GND - Morawaka Wasama	Explanation of the project to local government head, and request for her cooperation on various aspects of the project
53	9.9.2019 1.30pm	Male	DS	DSD - Kotapola	Explanation of the project to local government head, and request for his cooperation on various aspects of the project
53	9.9.2019 2.30pm	Male	Retired GN		Explanation and discussion regarding the effect of the project and compensation policy for the losses due to the project to/with the resident

Source: JICA Survey Team

* Group meetings

Note: Lay out plans for items No 10, 11 &12 have not been prepared separately instead locations 5/2-5/4 &5/6-5/8, and been taken as 5/2-5/8 merging location 5/4 &5/6 within 5/2-5/8

9.2 Land Acquisition and Resettlement

9.2.1 Necessity of Land Acquisition and Resettlement

The project areas required for countermeasures are sediment disaster prone areas where landslides, slope failures or rockfalls once occurred or there is a high risk of sediment disasters. Therefore, most of the areas are not used for residences or commercial facilities. In this Survey, considering locations and methods of the countermeasures, the facilities were designed to avoid residential, agricultural and plantation areas and to minimize the extent of affected areas as much as possible. As a result, displacement or involuntary resettlement is not expected.

The extents of required lands and affected units and persons are summarized in **Table 9.2.1Table 9.2.2**. The total land required for permanent use is 8.1 hectares and that for temporary use is 30.3 hectares. The total numbers of permanently affected units are 40 (private lands), 7 (plantation estate lands) and 15 (government lands), and those of temporarily affected units are 47 (private lands), 11 (plantation estate lands) and 17 (government lands). The total numbers of permanently affected persons are 148 (private lands), 29 (plantation estate lands) and 62 (government lands), and those of temporarily affected persons are 183 (private lands), 57 (plantation estate lands) and 65 (government lands).

Since the above data were obtained based on the layout plans of conceptual design, they should be reviewed at the detail design stage.

Table 9.2.1 Summary of Required Land and Project Affected Units/Persons

Item	Unit	Permanently	Temporarily
Required Lands	ha (hectare)	8.1	30.3
Private land	ha	2.6	15.6
Plantation estate land	ha	1.6	4.0
Government land	ha	3.9	10.7
Project affected units	unit	62	75
Private land	household	40	47
Plantation estate land	unit	7	11
Government land	unit	15	17
Project affected persons	person	239	305
Private land	person	148	183
Plantation estate land	person	29	57
Government land	person	62	65
Units to be displaced	unit	0	0
Persons to be displaced	person	0	0

Source: JICA Survey Team

9.2.2 Legal Framework related to Land Acquisition and Resettlement

Legal framework related to land acquisition and resettlement are summarized as below.

(1) Legal and Policy Framework related to Land Acquisition and Resettlement

1) Acts and Ordinances relevant to Resettlement in Sri Lanka

- The Land Acquisition Act (LAA) 1950 & 2008
- Land Development Ordinance (1935)

- Road Development Authority Act No. 73 of 1981
- State Land Ordinance No 8 of 1947
- Prescriptive Ordinance No 22 (1871)
- National Environmental Act No 47 of 1980 (NEA)
- Land Acquisition Resettlement Committee (LARC) Process (2001)
- Super LARC (Ministerial Compensation Appeal Board)

2) Policy Frameworks related to Resettlement

- National Involuntary Resettlement Policy (NIRP) 2001
- Safeguard Policy Statement, 2009 of ADB
- Operational Policy of World Bank on Involuntary Resettlement (OP.4.12)

(2) General Procedures of Relocation/Resettlement in Sri Lanka under each Regulations/Law

1) The Land Acquisition Act 1950

The Land Acquisition Act (LAA) is the most important legal provision with regard to land acquisition process in Sri Lanka. The LAA permits the acquisition of private land in any area, if the land is required for a 'public purpose'. Large-scale development in Sri Lanka would fall within this definition. It provides the payment of compensation at market rates for lands, structures and crops. The operational procedures/steps of LAA (1950) are as follows;

- Preparation and submission of land acquisition proposal Project by executing/implementing agency.
- Issuance of order to survey (LAA S. 2) by Ministry of Land and Land Development
- Preparation and posting of notices (S. 2) by Divisional Secretary
- Preparation of advance tracing by Survey Department
- Issuance of order to acquire the land (S. 4) Ministry of Land and Land Development
- Posting and publication of notices (S. 4) by Divisional Secretary, Government Press
- Objection inquiries by Project executing/implementing agency
- Gazette notification (S. 5) by Divisional Secretary and Department of Government Printing
- Preparation of preliminary plan by Survey Department
- Gazette notification (S. 7) by Divisional Secretary
- Inquiries (S. 9) by Divisional Secretary
- Decision (S. 10-1) by Divisional Secretary
- Valuation by Valuation Department
- Award (S. 17) by Divisional Secretary
- Payment of compensation by Divisional Secretary
- Order (S. 38a) by Ministry of Land and Land Development and Department of Government Printing
- Provision (S. 38a) by Ministry of Land and Land Development, Department of Government Printing
- Taking over the vacant possession by Divisional Secretary, Project executing/implementing agency
- Registration of land Divisional Secretary, Project executing/implementing agency

(Source: Social Assessment and Involuntary Resettlement Compliance Manual, Road Development

Authority of the Ministry of Highways and Road Development, 2009.)

2) LAA Regulations in 2008

Although, LAA valuation of properties is based on market value, there was a widespread general opinion that compensation paid for land through LAA process was very much less than the prevailing market values. This perception was undesirable to the land acquisition process and negatively affected the progress of development projects in the country. The regulations made by Hon. Minister of Land and Land Development in 2008 (herein after "LAA 2008 regulations") is an attempt to resolve underpayment for land and structures. The LAA 2008 regulation has following considerations;

- In case of land, when a part of land acquired, it has to be assessed considering the market value of the total land and give proportionate value to the acquired portion.
- When a building is used for residential or business purpose or intended to do so, difference between the cost of re-construction and the value of building based on market value has to be paid.
- For paddy lands, development potential could be considered if permission to use paddy lands for development purposes is given by the Commissioner General of Agrarian services.
- In case of buildings occupied by tenants protected by the provisions of Rent Act, tenants will have proportion of compensation
- Injurious affections and severance- damages caused by any severance and injurious affection are fully paid
- Payment to Disturbances and other Expenses Compensation for disturbances based on the "value to the owner" disturbances;
    - Expenses incurred for appearing for section 9 inquiry
    - Expenses for finding alternative accommodation
    - Cost incurred in change of residence
    - Cost of advertising
    - Re-fixing cost of fixtures and fittings
    - Expenses incurred for transport
    - Loss of earnings from business (within the limit given in prevailing Act)
    - Increased overhead expenses
    - Double payments
    - All other expenses to the owner due to the acquisition
    - Any other additional expenses for disturbances or compensation not connected under any other Sub section of this act which is directly not connected to market value of the land
    - When the owner of a house or an investment property is displaced additional 10% based on market value.

LAA provides compensation only for land, structures, and crops and provisions are not available to address key resettlement issues to mitigate or avoid impacts on people resulting from land acquisition. In addition, people without titles to the land and other dependents on land cannot be assisted under the LAA. The procedure under the LAA was inadequate due to arbitrary nature of land acquisition, inadequate compensation, resettlement issues following the acquisition of land, not consulting affected persons in the resettlement process.

3) Land Development Ordinance (1935)

According to this ordinance and its subsequent amendments, households that are occupying crown land may request permission from the Divisional Secretary to be regularized on the Land in question. The Acquiring officer at Divisional Secretary first makes an investigation and may recommend giving a one–year permit initially, if the land is not reserved land or not required for any other government purpose. Subsequently, the person may be given a long lease which constitutes a legal title without right to disposal. The term for such titles is 'Swarna Boomi' (golden land) or 'Jaya Boomi' (victorious land). There are two categories of encroachments into crown land.

- Middle income category, the households that have other agricultural land
- Lower income category, the landless households will be given special consideration for allocation of crown land that is not reserved land.

4) Road Development Authority Act No. 73 of 1981

The Road Development Authority Act (1981), Part II deals with declaring areas for 'road development', which includes the construction of new roads or the maintenance or improvement of existing roads. Section 22 deals with land acquisition for road development as a "public purpose" and provides for the acquisition by, and transfer to, the RDA of immovable or moveable property within any declared road development area, for which the RDA will pay any sum payable under the LAA [Section 22 (2)]. Therefore, after the Section 2 notice has been published, if land or other property is to be acquired, the procedures to do so are as set out in the LAA.

5) State Land Ordinance No 8 of 1947

Section (b) of the land ordinance explains the land grants which can be made and the rents to be obtained for the grants. As it is mentioned in section 22, the period of the grant be up to 50 years only and the prescribed form given in the ordinance be filled and signed by the officer authenticated to sign for the grant. A person seeking a crown land has to appeal to the Government Agent of the area. Such person has to pay the rent decided by the Land Commissioner or the Government Agent of the area. Provisions also have provided to officers such as General Manager Railways and chairman of the Colombo Port to rent out the lands under their purview, under special circumstances.

6) Prescriptive Ordinance No 22 (1871)

Under sections 3 and 13 of this ordinances, households who have encroached into private land and have been occupying the land for at least 10 years may apply through the courts for prescriptive rights to the land. Depending on the project and the client, there are the other subsequent statute laws, which enable the compulsory purchase of property for special purposes or have interfered with the compensation in the term of 'Market Value' and has imposed certain restrictions, conditions and circumstances in which value has to be determined, when properties are compulsorily acquired by the State or become vested in the state, by the force of legislations on payment of compensation.

- Urban Development Authority Law No 41 of 1978
- National Housing Development Authority Act No.17 of 1979
- Greater Colombo Economic commission Law No.4 of 1978
- Town and Country Planning Ordinance Of 1946
- Land Reform Law No.1 of 1972

- Land Reform Commission Act. No.26 of 1972
- Colombo District (Low Lying Areas) Reclamation Development Board Act No.15 1968
- Rent Act No.7 of 1972 and amendments thereto, No.55 of 1980 and No.26 of 2002
- Co-operative Societies Law No.5 of 1972
- Ceiling on Housing Property Laws No1 of 1973
- Apartment Ownership Law No.11 of 1973
- Tourist Development Act No.14 of 1968
- Coast Conservation Act
- Agrarian services Act no.58 of 1979
- Roads and Thoroughfares Act no.45 of 1956 and Law no.37 of 1973
- Mahaweli Authority of Sri Lanka Act No.23 of 1979
- Walawe Lands Act No.11 of 1958

7) National Environmental Act No 47 of 1980 (NEA)

There are some provisions in the NEA Act No.47 of 1980, with the amended Act No 56 of 1988 which refers to Involuntary Resettlement. The Minister by gazette notification No 858/14 of 23rd February 1995 has determined the types of projects and undertakings which need the approval under the terms of the NEA. The schedule includes item 12 which refers to "involuntary resettlement exceeding 100 families, other than resettlement resulting from emergency situations" needs an EIA**.**

8) Land Acquisition Resettlement Committee (LARC) Process (2001)

The Southern Transport Development Project (STDP), which required taking over and acquisition of 1500 buildings and a large extend of land along a 126km stretch and subsequent issues, the government decided to introduce a new scheme to compensate the affected people in 2001, outside the LAA. This was achieved by creating a body called Land Acquisition and Resettlement Committee (LARC). This body was set up to determine the replacement cost (not the depreciated value) of the buildings and the market value of the land of the displaced people. The important feature of this committee is that the displaced person himself is a vote carrying member of the board.

The LARC is composed of the following members;

- The Divisional Secretary or Assistant Divisional Secretary (Chairman) of Relevant DS
- Representative of the Valuation Dept
- Representative of the Survey Dept
- Representative of the RDA
- Displaced person.

Under LAA any aggrieved party on the valuation determined by the Valuation Department is expected to appeal to the Land Acquisition Review Board within 21 days of receipt of the Section 17 order from the Divisional Secretary. If party is dissatisfied with the decision of the Review Board, the party can make a petition of appeal to the Supreme Court. No stamp duty is charged for this appeal. However, experience showed that the process involved here was time consuming; moreover, in most occasions, variation between the assessment of the Valuation Dept. and the review board's decision was very marginal.

This system was abolished with the introduction of 2008 land acquisition regulations. However, in 2013 the LARC system was reintroduced to some selected projects.

9) Super LARC (Ministerial Compensation Appeal Board)

Any displaced person who is not satisfied with the quantum of compensation decided by the LARC will have option of appealing to the super LARC committee which is established by the decision of the cabinet of ministers.

Composition of the super LARC

- Secretary Ministry of Ports and Highways or a person delegated by him/ her.
- Chief Valuer or his representative.
- Secretary Land or his representative
- Survey General or his representative
- Director General of RDA or his representative.

The displaced person will also be called for the inquiry and the decision of the super LARC is final.

(3) General Procedures of Relocation/Resettlement in Sri Lanka under different Policy Frameworks.

1) National Involuntary Resettlement Policy (NIRP) 2001

LAA provides compensation only for land, structures, and crops and provisions are not available to address key resettlement issues to mitigate or avoid impacts on people resulting from land acquisition. In addition, non-titled people and other dependents on land cannot be assisted under the LAA. To address the current gaps in the LAA in addressing the key resettlement issues such as exploring alternative project options that avoid or minimize impacts on people, the government of Sri Lanka (through the cabinet of Ministers) adopted the National Policy on Involuntary Resettlement (NIRP) on the 24th May 2001. The NIRP also highlights the need for consultation of Displaced Persons and their participation in the resettlement process actively. The Central Environment Authority was tasked to review and approve Resettlement Plans (RPs) prepared by project executing agencies. The plans also required to be publicly available.

NIRP calls for amendments to be made to the LAA so as to create a protective framework for people who are displaced due to development projects. Through the NIRP, displaced persons are assured of a standard of living comparable to that at the time of displacement. NIRP took all ill-effects of land acquisition into consideration with the aim of ensuring 'that all efforts are made to minimize involuntary resettlement in projects and where it is unavoidable, affected people are assisted to re-establish their livelihoods' (NIRP Forward). NIRP assign responsibility of implementing a Resettlement Plan addressing key resettlement issues such as

- exploring alternative project options which avoid or minimize impacts on people;
- compensate those who do not have title to land;
- consulting displaced persons and host community on resettlement options,
- providing for successful social and economic integration of the displaced persons and their hosts; and;
- full social and economic rehabilitation of the displaced persons.

It guarantees adequate compensation for affected persons in a timely manner – Compensation is based on full replacement cost including transactions costs, and is calculated to include the loss of land, structures, other assets and income. Compensation is not limited only to persons with documentary evidence of their interest in land. The policy also provides for the authorities to re-establish income sources and livelihoods of affected persons. The policy provides for resettlement action plans of varying levels of detail – depending on the number of families being displaced – to be published, and to be made

publicly available. Further, affected persons are to be fully involved in the selection of relocation sites. Through this process, affected persons are made active stakeholders in the process.

NIRP was developed thorough a consensus reaching process with the participation of all concerned government agencies and authorities; NGOs and foreign development agencies and other stakeholders. The steering committee appointed by the government reviewed the existing laws and policies and approved the National Involuntary Resettlement Policy on 5th March 2001 and the government of Sri Lanka adopted it by cabinet approval as a National Policy on 24th May 2001.

NIRP applies 'to all development induced land acquisition and Resettlement Action Plan must be prepared where 20 or more families' (NIRP Forward). NIRP requires that a comprehensive RP be prepared where 20 or more families are displaced. In case where less than 20 families are displaced, the NIRP still requires a RP with lesser level of detail. NIRP applies to all projects irrespective of source of funding.

However full compliance with NIRP requires the government to amend existing laws in order to bring them in line with NIRP principles. NIRP offers a workable and officially recognized framework through which durable solutions to the ethical and practical dilemmas of development-induced displacement can be realized. There have been attempts to incorporate selected aspects of NIRP into statutory law. For instance, two Gazette notifications were passed in April 2009 and subsequently in November 2013, under the LAA, which improved the LAA's system of compensation. However, these regulations fall short of full compliance with NIRP, as the regulations were only applicable to certain identified projects.

2) Safeguard Policy Statement, 2009 of ADB

The ADB's Safeguard Policy Statement (SPS) 2009, recognizes and addresses the resettlement and rehabilitation impacts of all the displaced persons, irrespective of their titles, and requires the preparation of RP in every instance where involuntary resettlement occurs. The ADB policy requirements are to: (a) avoid or minimize impacts where possible; (b) consultation with the displaced people in project planning and implementation; (c) payments of compensation for acquired assets at the replacement cost; (d) ensure that no one is worse off as a result of resettlement and would maintain at least their original standard of living; (e) resettlement assistance to Displaced persons, including non-titled persons; and; (f) special attention to vulnerable people/groups.

The main policy principles of the SPS are to Screen the project early on to identify past, present, and future involuntary resettlement impacts and risks, Carry out meaningful consultations with displaced persons, host communities, and concerned non-government organizations, Improve, or at least restore, the livelihoods of all displaced persons, Provide physically and economically displaced persons with needed assistance, Improve the standards of living of the displaced poor and other vulnerable groups, including women, to at least national minimum standards, Develop procedures in a transparent, consistent, and equitable manner if land acquisition is through negotiated settlement, Ensure that displaced persons without titles to land or any recognizable legal rights to land are eligible for resettlement assistance and compensation for loss of non-land assets, Prepare a resettlement plan elaborating on displaced persons' entitlements, the income and livelihood restoration strategy, institutional arrangements, monitoring and reporting framework, budget, and time-bound implementation schedule, Disclose a draft resettlement plan, including documentation of the consultation process in a timely manner, before project appraisal, in an accessible place and a form and language(s) understandable to displaced persons and other stakeholders. Disclose the final resettlement

plan and its updates to displaced persons and other stakeholders, Conceive and execute involuntary resettlement as part of a development project or program, Pay compensation and provide other resettlement entitlements before physical or economic displacement. Implement the resettlement plan under close supervision throughout project implementation, Monitor and assess resettlement outcomes, their impacts on the standards of living of displaced persons, and whether the objectives of the resettlement plan have been achieved by taking into account the baseline conditions and the results of resettlement monitoring.

3) Operational Policy of World Bank on Involuntary Resettlement (OP.4.12)

The World Bank experience indicates that involuntary resettlement under development projects, if unmitigated, often gives rise to severe economic, social, and environmental risks. The policy includes safeguards to address and mitigate these impoverishment risks. Following are the key principles in the Bank's policy on involuntary resettlement.

a. Involuntary resettlement should be avoided where feasible, or minimized, exploring all viable alternative project designs.
b. Displaced persons are to be provided prompt and effective compensation at full replacement cost for losses of assets attributable directly to the project.
c. Resettlement activities should be conceived and executed as sustainable development programs
d. Displaced persons should be meaningfully consulted and should have opportunities to participate in planning and implementing resettlement programs.
e. Displaced persons should be assisted in their efforts to improve their livelihoods and standards of living or at least to restore them, in real terms, to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher.
f. The absence of a formal legal title to land is not a bar to WB policy entitlements.
g. Particular attention is paid to the needs of vulnerable groups among those displaced, especially those below the poverty line, the landless, the elderly, women and children, indigenous peoples, ethnic minorities, or other displaced persons who may not be protected through national land compensation legislation.
h. The full costs of resettlement activities necessary to achieve the objectives of the project are included in the total costs of the project. i) Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey. j) Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based.

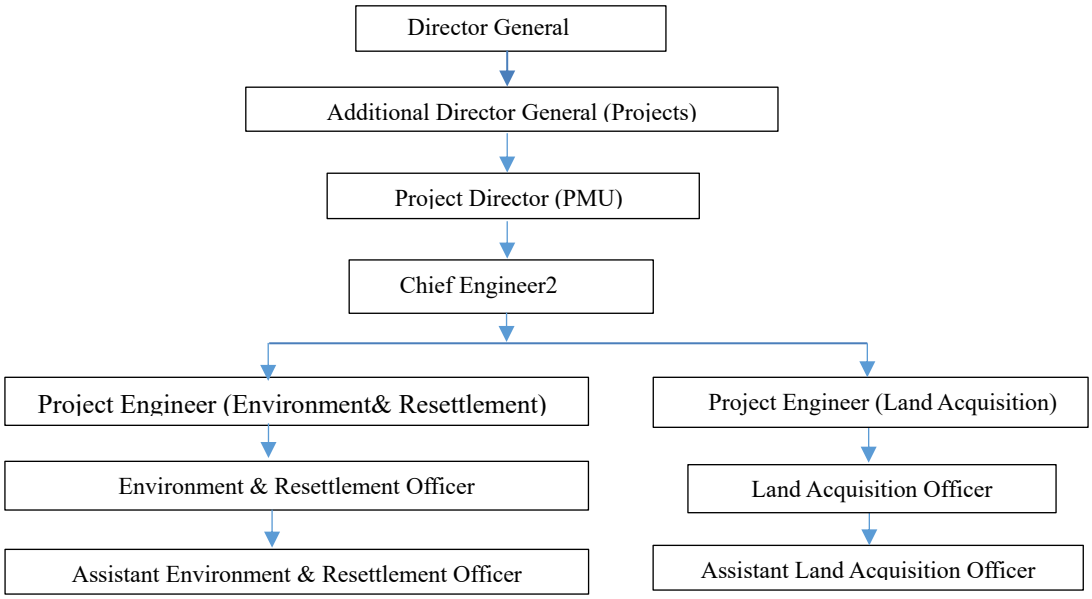
(4) Institutional Arrangement during RAP procedure

1) Road Development Authority (RDA)

Involuntary resettlement planning, implementation and monitoring involve various ministries and agencies. The Land Division (LD) of RDA headed by a director is the main division that deals with land acquisition and payment of compensation as per the RAP. However, under certain conditions Project Management Units (PMUs) responsible for specific projects which are entrusted to carry out land acquisitions related to their projects in consultation with LD, to expedite the land acquisition process. It is therefore necessary that PMU effectively and efficiently coordinate with these agencies, so that land acquisition and involuntary resettlement activities are carried out properly and expeditiously.

Project Management Unit (PMU) of RDA

The responsibility of implementing the RAP will rest with the RDA, and its direct responsibility lies with the PMU established for implementation of the Project. The PMU operates as a time bound project office headed by a project director and staff consisting of engineering, resettlement, land acquisition, environmental and other supporting grades.



A Resettlement Unit (RU) will be established in the PMU under Project Director. The Land Division of RDA will assign staff to the PMU as Land Acquisition Officers (LAO) and assistant LAOs to be entrusted with monitoring and implementation of land acquisition and resettlement activities. The RU will provide monthly progress/monitoring reports to LD, PMU, and ESD. Regarding resettlement planning and implementation, the PMU attends to following;

a. Preparation of RAP

Assist resettlement consultant/team to develop RAP for the project through facilitating to trace the ROW, identification of APs, assist to conduct social and environmental assessments in the area through surveys and collection of other primary and secondary information, assist and participate in awareness creation meetings at Divisional Secretaries level, support stakeholder meetings and Focus Group Discussions (FGD)s and review processes of draft RAP.

b. Land Acquisition

Following activities will be undertaken during Land Acquisition

- Preparation of land acquisition application and submit to MOHRDPRD (Ministry of Highways and Road Development and Petroleum Resources Development) who will submit it to Ministry of Land and Land Development (MLLD) with RAP as an attachment
- After accepting the Land Acquisition application by MLLD, with the appointment of DS as the Acquisition Officer, support implementation of land acquisition. This includes preparation of necessary papers for each stage of land acquisition, translation of them in to all three languages, maintain a close support up to the end of the land acquisition process ending with the taking over of the possession of land in to RDA ownership
- Coordinate with Consultant in hiring the NGO to obtain assistance for planning and implementation of income restoration program (IRP)

- Support APs to receive compensation for land, structures and crops as per the RAP by assisting them to prepare for land ownership inquiries (including Section 9 inquiries) with necessary documents and proofs, provide, if needed, transport facilities especially for vulnerable people to attend to inquiries.
- Make sure that funds are adequately available with PMU/DS/RDA to pay compensation without delays as applicable.

c. Handling Resettlement Benefits

- Initiate information disclosure on formal approval of RAP
- Pay cash resettlement benefits as per Entitlement Matrix
- Pay special attention when cash benefits are given to vulnerable persons, women and sick persons ensuring that they receive proper amounts and use them properly
- Maintain highest transparency in cash payments
- Ensure availability of funds with PMU/RDA for issuing resettlement benefits. (Resettlement benefits are not paid through DSs).
- Replace community and religious properties damaged by the project without undue delays.
- Implement agreed income restoration projects for selected APs
- Support self- relocation APs when they need support
- Initiate resettlement sites if they are included in the proposal with the approval of the RAP. This involves acquisition/purchase of suitable lands, beneficiary participation, host community concurrence, infrastructure development, housing construction etc.
- Implementation of Internal Monitoring with Assistance of CSC (Construction Supervision Consultant) and external monitoring by EMA (External Monitoring Agency) on RAP implementation respectively.

<u>Environmental and Social Division (ESDD) of RDA</u>

The ESDD oversees land acquisition and resettlement planning and monitoring and the implementation of safeguards compliance under various RDA projects. The ESDD helps to prepare terms of reference (TORs) for RAP preparation, orients RAP preparers, reviews RAP, prepares quarterly internal resettlement monitoring reports, helps prepare TORs for external monitoring agencies, and conducts spot checks at various stages of preparation and implementation of resettlement plans. However, in the absence of skills and expertise in most PMUs, the ESDD may provide the necessary expertise to the respective division or PMU, ESDD assist all projects in RDA currently to maintain land acquisition database.

All damages caused during construction will be compensated by the contractor. This activity will be monitored by the Social and Environmental Impact Monitoring Officers attached to the ESDD.

2) Divisional Secretaries (DS)

DSs and their staff have important roles in the implementation of RAP. In the first instance, their involvement is related to preparation RAP and the land acquisition. For administrative requirement, application for land acquisition has to accompany an approved RP from MOHRDPRD when it is submitted to MLLD.

The PMU/RDA will have a responsibility to make DSs are aware about the Project, and subsequently have a formal awareness meeting with relevant DS officers including Grama Niladaries, poverty

alleviation officers, women development offices, land officers and staff of relevant government agencies operating in the division, NGOs, religious leaders, community leaders, members of local councils etc. In this awareness meeting, resources persons drawn from subject specific agencies make presentations on introduction of the project, resettlement planning, land acquisition procedures and property valuation etc. It has plenary sessions to discuss matters important to audience.

After approving proposed land acquisition by MLLD, DS is appointed as the acquisition officer for the DS division, and he/she initiates land acquisition process as per the RAP until possession of land taken. This include initial notification and formal surveys by Dept. of Surveys, title inquiries by acquisition officers, valuations by Dept. of Valuations, appeals by prescribed review boards etc. Land Acquisition is a routine function of DS offices and they are geared to undertake land acquisition with laws, procedures, systems and resources, including manpower. However, at certain times, there may be resource gaps with regard to preparation of statuary documents in three stipulated languages and staff mobility due to limited financial resources. In these occasions, as mentioned earlier, PMU/RDA supports DS office to increase its capacity where it has shortfalls, because this is an important event for PMU/RDA as they have a time bound project before them.

In case of RAP implementation, DS is an important position as he/she is the coordinator of all development programs in the division. The RAP is prepared on the information collected through resettlement survey and social and economic survey. With completion of land acquisition, the information collected for the resettlement plan will be verified, and this information will be incorporated into the revision of RAP. Information available at DS office could be used to verify AP profiles with regard to their encroacher, tenant or lessee situation, vulnerability, income levels, employment etc. This is useful when PMU is paying cash and another resettlement assistance suggested in the RAP.

PMU can draw assistance of DS and his subject specific staff in the areas of poverty alleviation, gender development, youth officers., Nearly 40-60 development officers are available to support PMU's resettlement plans in general, and income generating programs and resettlement sites/village programs with particular attention. Resettlement site operation needs strong coordination among its stakeholders for establishing utility services and future maintenance responsibilities. The collaboration with respective DSs in this area strengthens PMU's coordination and implementation of resettlement sites. DS holds the responsibility of coordinating all government development programs in the division.

PMU is responsible for assisting displaced APs to find suitable lands (including APs who wish self-resettlement) if they require, for schooling of displaced children in nearby schools, approval for new housing construction from local councils etc. closely working with DS. In addition, when land is required for resettlement sites, DS is in a good position to help PMU as he is the custodian of government land not allocated to specific institutions.

3) Survey Department

In the land acquisition process, Survey Department has a statutory role as per the RAP to survey land and prepare survey plans. On the formal request issued to Surveyor General by the acquisition officer (DS), Survey Department employs its licensed surveyors to survey lands and show them with the names of claimants. In the final survey plans (primary plans) prepared by the Department of Surveys, survey plans of all land plots required to be acquired are given with tenement list (list of persons claiming ownership for land/structures) to the acquisition officer following standard survey techniques and procedures. This survey plans, and list of names are important reference information for the acquiring

officer when he/she holds ownership inquiries.
In certain circumstances, there is a shortage of licensed surveyors in the department and lack of resources for surveyors to mobilize soon, especially when they are occupied with previously arranged assignments. In these circumstances, PMU assists Dept. of Surveys to hire licensed surveys to work under the direction of Surveyor General with necessary resources for mobilization and other assistance at field level.

4) Valuation Department
As per the RAP, Chief Valuer (highest official position of the Valuation Department) or any other officer authorized by him/her only can attend to valuation of properties expected to be acquired.
As per LAA, valuation of properties is based on market price approach conventionally. The LAA regulation 2008 will help Valuation Department to make reasonable assessments close to realistic market prices. On the request of Acquisition Officer, Valuation Department assigned their staff to value properties to be acquired and report to acquisition officers through Chief Valuer. The Chief Valuer's endorsement is the expression of statutory commitment of the Valuation Department for its valuation, and readiness to go to any review board or court of law.
In the case of valuation of properties, officers assigned by the Valuation Department visit the property, individually or jointly and make their assessment based on following;

- field conditions and surrounding environment of the property
- Purpose of the use of the property (residential, commercial or agricultural purposes etc.)
- available documentary evidence related to values of properties: deeds, valuation certificates, loan documents, income earning evidence etc. if available
- consultation of people
- Study secondary information available in DS offices, Provincial and Central Tax offices etc.

The valuation of properties by Valuation Department is property specific, site specific and user specific. It gives individual values for each and every property. The PMU can support the Valuation Dpt. to attend to the work of the project as per the schedules, providing mobilization support to the visiting valuation officers to visit expected sites.

(5) RAP Approval Process
MOHRDPRD is the national agency responsible for approving RAPs prepared for road development projects of RDA. Although NIRP has assigned approval of RAPs to CEA in its section on 'Institutional Responsibilities', in practical terms this has become a mere policy level broad statement. This has to be taken as an implicit approval rather than a formal approval by CEA. As per present practice, when RAP is submitted to CEA along with environment clearance application, if it is accepted by CEA, this acceptance is considered as the approval of CEA for all practical purposes.
The Ministry of Land and Land Development (MLLD) holds the responsibility of implementation of the NIRP and Project Executing Agency has been assigned with the responsibility for 'compiling with all the requirements for planning and implementing resettlement according to the NIRP'. Thus the Ministry of Land and Land Development becomes the premier agency responsible for overall implementation of resettlement plans in the country, as they are within the scope of NIRP. As in the case of CEA, MLLD too doesn't issue formal approval for RAPs and shows its explicit approval by accepting it for initiating land acquisition process. All land acquisition applications submitted by project

implementing agencies have to annex a copy of RAP prepared along the guidelines of NIRP. MLLD doesn't accommodate land acquisition applications without a RAP approved by the project approving authority, Ministry of Highways and Road Development and Petroleum Resources Development in case of road development projects of RDA.

The reason for MLLD and CEA to keep away from granting administrative level of approval to RAPs is understandable. RAPs are prepared by PMUs/PIAs following guidelines of NIRP and other GOSL policies and procedures. In addition, when projects are funded by external agencies, PMUs/PIAs have to consider donor requirements also in RAP planning process. The RDA manual referred to above has instructions to submit RAP to 'donor agency' to seek its concurrence (informally) at ESD level, before it is submitted to MOHRDPRD as the approving agency. To an extent, formal approvals require intervening in to internal systems of PMUs/PIAS through checking, supervising and guiding etc. As PMUs/RDA have the resources and knowledge base for RAP implementation, MLLD and CEA don't wish to narrow down the scope of RAP implementation by taking operational approval responsibility to them. If this responsibility is taken out of subject specific approving agencies like MOHRDPRD, RAPs may be prepared to satisfy minimum level required for formal approving agency (like MLLD or CEA), instead of becoming a fully-fledged document with undivided commitment to implement by PMU/PIA and MOHRDPRD finally. MLLD and CEA wish to hold a broader responsibility by staying at policy level and influence the effective implementation of resettlement principles in the country. If and when resettlement planning and implementation deviate from accepted policies and principles MLLD and CEA will have authority to correct them through their monitoring processes.

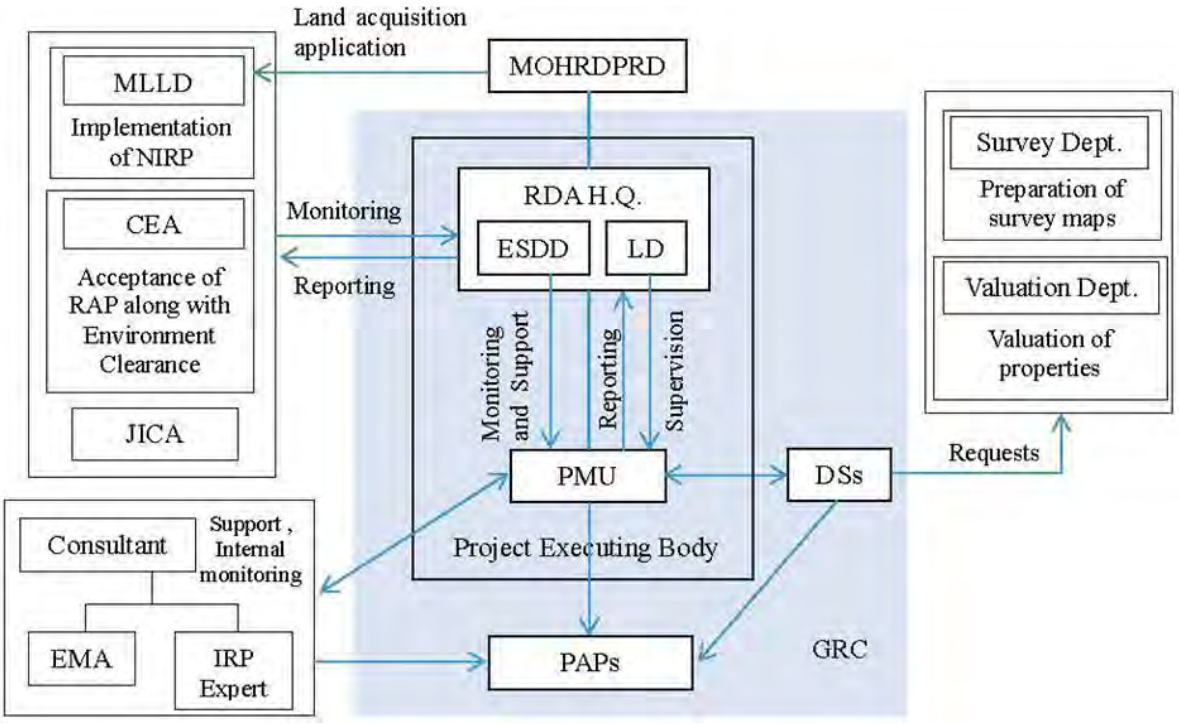
The institutional responsibilities in resettlement process are shown in the following **Table 9.2.2**, and the conceptual figure of RAP implementation system is shown in **Figure 9.2.1**

Table 9.2.2 Institutional Responsibilities in Resettlement Process

Related Activities	Responsible Agency
Setting up Resettlement Unit and placement of staff	PMU/RDA
Arrangement of relocation for AHs	PMU/RDA
Arrangement of relocation for Government Agencies/Institutes and Kovil (Hindu religious place)	PMU/RDA
Securing resettlement site (Acquisition/purchase of suitable land)	PMU/RDA
Implementing consultation with the host community	PMU/RDA
Develop basic infrastructure in resettlement site	PMU/RDA
Construction of houses in resettlement site	PMU/RDA
Preparation of land acquisition application to be submitted to MOHRDPRD	PMU/RDA
Submission of land acquisition application and RAP to MLLD	MOHRDPRD
Acceptance of the land acquisition application	MLLD
Appointment of DS as the Acquisition Officer	MLLD
Formal request issued to Survey General	DS, Acquisition Officer
Employment of NGO for preparation and implementation of Income Restoration Program	PMU/RDA
Employment of External Monitoring Agency	PMU/RDA
Establishment of GRC (Grievance Redress (Mechanism) Committee)	PMU/RDA
Request for valuation to valuation department	DS, Acquisition Officer
Formal surveys	Dept. of Surveys,
Title inquiries	DS, acquisition officers,
valuations	Dept. of Valuations (Chief Valuer)

Related Activities	Responsible Agency
Updating RAP and submit it to JICA	PMU/RDA
Assist APs to in preparation of land ownership inquiries with necessary documents and proofs	PMU/RDA
Pay cash compensation and/or other assistance to APs	PMU/RDA
Assist displaced APs to find suitable lands if necessary	PMU/RDA with assistance of DS
Assist displaced APs to get approval for new housing construction from local councils	PMU/RDA with assistance of DS
Support physical relocation of APs when necessary	PMU/RDA
Support APs in schooling of displaced children in nearby schools	PMU/RDA with assistance of DS
Implement income restoration programs	PMU/RDA with assistance of DS
Implement day to day monitoring on land acquisition and resettlement activities	PMU/RDA
Implement monitoring on damages caused during construction	ESD/RDA
Prepare monthly progress/monitoring reports and submit them to LD and ESD	PMU/RDA
Prepare quarterly internal resettlement monitoring reports	ESD/RDA

Source: JICA Survey Team



Source: JICA Survey Team

Figure 9.2.1 RAP Implementation System

CEA: Central Environmental Authority
DSs: Divisional Secretaries
EMA: External Monitoring Agency
ESDD: Environmental and Social Development Division
GRC: Grievance Redress Committee
IRP: Income Restoration Program
LD: Land Division
MLLD: Ministry of Land and Land Development
MOHRDPRD: Ministry of Highways and Road Development and Petroleum Resources Development
NIRP: National Involuntary Resettlement Policy
PAPs: Project Affected Persons

PMU: Project Management Unit
RAP: Resettlement Action Plan
RDA H.Q.: Road Development Authority Headquarters

(6) Examples of the Latest Similar Projects

Examples of RAP prepared for the latest similar projects in Sri Lanka are as follows;

- RAP - Landslide Disaster Protection Project (Phase 1)
- The Southern transport development project (the first large scale development project which adopted the principles of the NIRP)
- RAP - National Highway Sector Project
- RAP - Kelani Bridge
- RAP – Ruwanpura Expressway Project
- RAP- Northern Expressway Project
- RAP- Southern Expressway Project
- RAP: Mahaweli Water Security Investment Program North Western Province Canal Project Tranche 1.
- RAP- Rehabilitation of St. Sebastian South Canal

(7) JICA policies on involuntary resettlement

The key principle of JICA policies on involuntary resettlement is summarized below.

I. Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives.
II. When, after such an examination, avoidance is proved unfeasible, effective measures to minimize impact and to compensate for losses must be agreed upon with the people who will be affected.
III. People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels.
IV. Compensation must be based on the full replacement cost[i] as much as possible.
V. Compensation and other kinds of assistance must be provided prior to displacement.
VI. For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. It is desirable that the resettlement action plan include elements laid out in the World Bank Safeguard Policy, OP4.12, Annex A.
VII. In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people.
VIII. Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans.
IX. Appropriate and accessible grievance mechanisms must be established for the affected people and their communities.

Above principles are complemented by World Bank OP 4.12, since it is stated in JICA Guideline that "JICA confirms that projects do not deviate significantly from the World Bank's Safeguard Policies". Additional key principle based on World Bank OP 4.12 is as follows.

X. Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advance of such benefits.

XI. Eligibility of Benefits include, the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying.

XII. Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based.

XIII. Provide support for the transition period (between displacement and livelihood restoration.

XIV. Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic minorities etc.

XV. For projects that entail land acquisition or involuntary resettlement of fewer than 200 people, abbreviated resettlement plan is to be prepared.

In addition to the above core principles on the JICA policy, it also laid emphasis on a detailed resettlement policy inclusive of all the above points; project specific resettlement plan; institutional framework for implementation; monitoring and evaluation mechanism; time schedule for implementation; and, detailed Financial Plan etc.

[1] Description of "replacement cost" is as follows.

Land	Agricultural Land	The pre-project or pre-displacement, whichever is higher, market value of land of equal productive potential or use located in the vicinity of the affected land, plus the cost of preparing the land to levels similar to those of the affected land, plus the cost of any registration and transfer taxes.
	Land in Urban Areas	The pre-displacement market value of land of equal size and use, with similar or improved public infrastructure facilities and services and located in the vicinity of the affected land, plus the cost of any registration and transfer taxes.
Structure	Houses and Other Structures	The market cost of the materials to build a replacement structure with an area and quality similar or better than those of the affected structure, or to repair a partially affected structure, plus the cost of transporting building materials to the construction site, plus the cost of any labor and contractors' fees, plus the cost of any registration and transfer taxes.

(8) Existing Gaps of Sri Lankan Laws and JICA Policies (WB.OP. 4.12)

Sri Lanka has a complex legal system to manage land acquisition and regulate land use. It has an advanced system for valuation of properties, both in specialized and non-specialized categories involving different methods. The existing legal provisions come close to meeting the JICA Guidelines and the WB's safeguard requirements in respect of land acquisition and involuntary resettlement. Specifically, the NIRP and the Land Acquisition Regulations (LAR) 2008 and 2013 seek to address gaps thus bringing the process closer to the JICA Guideline and the WB's safeguard policies.

However, unless the project operations supported under the project are accorded "specialized projects" under LAR 2013, provisions contained in the LAR 2013 may not apply in the context of the project. Further, the NIRP while being largely consistent with the JICA Guidelines is nevertheless a statement of policy intention without specific rules and prescriptions to guide safeguards implementation.

There are differences/gaps between the JICA Guidelines and Sri Lankan laws/policies in relation to land acquisition and resettlement. Although the JICA Guidelines and NIRP are more or less similar, there are some gaps when compared with the JICA Guidelines and LAA. **Table 9.2.3** analyzes gaps between the JICA Guidelines and Sri Lankan laws/policies applicable to the project and proposes measures to bridge the gaps.

Table 9.2.3 Comparative Analysis on the Gaps in the Sri Lankan Laws/Policies and the JICA Guideline

No.	JICA Guidelines	Laws/Policies in Sri Lank	Existence of Gap, and Measures to bridge the Gap
1	Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives. (JICA Guidelines (GL))	LAA does not require it but discourages unnecessary acquisition and requires that the land should be used for the purpose for which it is acquired. NIRP requires to avoid or reduce involuntary resettlement as much as possible by reviewing alternatives.	Yes: between LAA and JICA GL, No: between NIRP and JICA GL The project proponent (PP) should follow the NIRP and JICA GL.
2	When population displacement is unavoidable, effective measures to minimize impact and to compensate for losses should be taken. (JICA GL)	NIRP requires avoiding and minimizing the impacts. NIRP requires that affected persons (APs) should be involved at the earlier stage with regard to resettlement sites, compensation for losses of livelihoods and recovery of livelihoods.	Yes: between LAA and JICA GL, No: between NIRP and JICA GL The PP should follow the NIRP and JICA GL and take effective measures to compensate the APs for the losses on the basis of an agreement between the APs and the PP.
3	People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels. (JICA GL)	LAA regulation 2008 has considerations for the period, like paying expenses for finding alternative accommodation etc. and other payments for disturbances. NIRP provides that income should be restored, livelihood be reestablished, and standard of living improved.	No Following the NIRP and JICA GL, the PP should pay the APs for restoration of livelihoods, expenses and compensation for displacement.
4	Compensation must be based on the full replacement cost as much as possible. (JICA GL)	LAA regulation 2008 provides for valuation at replacement cost. NIRP provides that compensation for loss of land, structures, other assets and income should be based on full replacement cost and should be paid promptly.	No Following the NIRP and JICA GL, compensation should be based on the full replacement cost.
5	Compensation and other kinds of assistance must be provided prior to displacement. (JICA GL)	LAA provides taking over possession before payment of compensation. NIRP does not allow it. Road Development Authority's	Yes: between LAA and JICA GL, No: between NIRP and JICA GL Following the NIRP and JICA GL, compensation and other

No.	JICA Guidelines	Laws/Policies in Sri Lank	Existence of Gap, and Measures to bridge the Gap
		(RDA's) customary practice is not to remove APs before paying compensation.	kinds of assistance should be provided prior to displacement.
6	For projects that entail large-scale involuntary resettlement, resettlement action plans (RAPs) must be prepared and made available to the public. (JICA GL)	LAA does not require a RAP. NIRP requires a comprehensive RAP for the project exceeding displacement of more than 20 families. A project affecting 100 families is considered as a prescribed project and required EIA under the NEA.	Yes: between LAA and JICA GL, No: between NIRP and JICA GL If more than 20 families are displaced by the project, the PP should prepare and make available to the public following the NIRP and JICA GL.
7	In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. (JICA GL)	LAA does not require a consultation with the APs. NIRP requires it. LAA statutorily imposes all communication to be publicly announced through legal notifications in print media, and through GN officers. If the project is subject to IEE or EIA, the report should be available for the information of the public or public comments respectively. No stipulation on disclosure of RAP to the public is found.	Yes: between LAA and JICA GL, Almost No: between NIRP and JICA GL RAP should be disclosed to the public and available in the web site of RDA and JICA, and consultations with the APs and their communities should be held. An entitlement matrix should be translated in local languages and distributed to the APs.
8	When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people. (JICA GL)	Under NEA, IEE/EIA report should be prepared in Sinhala, Tamil and English, and disclosed to the public. Although there is no stipulation on language to be used for consultations, usually Sinhala and Tamil are used.	(No as policies) Following JICA GL and NEA, Sinhala, Tamil and English should be used for consultations.
9	Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans. (JICA GL)	LAA does not require participation of APs in planning, implementation and monitoring of RAP. NIRP requires the full participation of the provincial and local authorities in the planning and implementing process.	Yes: between LAA and JICA GL, No: between NIRP and JICA GL Following JICA GL, participation of APs should be promoted in planning, implementation and monitoring of involuntary resettlement and restoration of livelihood.
10	Appropriate and accessible grievance mechanisms must be established for the affected people and their communities. (JICA GL)	LAA has provisions for formal appeals in the country's legal system. NIRP requires establishing a project-based grievance redress mechanism (GRM).	No Following the NIRP and JICA GL, an appropriate and accessible GRM should be established.
11	Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and	NIRP states the importance for identification of APs at initial stage but does not stipulate identification of APs through initial baseline survey.	Yes: between LAA/NIRP and JICA GL Following JICA GL, APs should be identified through initial baseline survey.

No.	JICA Guidelines	Laws/Policies in Sri Lank	Existence of Gap, and Measures to bridge the Gap
	socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advance of such benefits. (WB OP4.12 Para.6)		
12	Eligibility of benefits includes, the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying. (WB OP4.12Para.15)	LAA considers that only titleholders and tenants are protected under Rent Act 1972. NIRP policy principles states that APs who do not have documented titles to land should receive fair and just treatment. It is government policy to pay rehabilitation assistance to the replacement cost of structures owned by no-title holders.	Yes: between LAA and JICA GL, No: between NIRP and JICA GL Following the NIRP and JICA GL, entitlement should be provided to those who have no-title for the land or structures in the project area prior to the cut-off date for eligibility or resettlement assistance.
13	Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based. (WB OP4.12 Para.11)	NIRP states that replacement land should be an option for compensation in the case of loss of land, in the absence of replacement land, cash compensation should be an option for all APs.	No Following the NIRP and JICA GL, land replacement should be a principle for compensation, in the absence of replacement land, cash compensation should be an option.
14	Provide support for the transition period (between displacement and livelihood restoration). (WB OP4.12 Para.6)	There is no stipulation that refers to support for the transition period	Yes Following JICA GL, support should be provided for the transition period.
15	Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic minorities etc. (WB OP4.12 Para.8)	LAA does not mention this matter. NIRP requires special treatment for the vulnerable groups	Yes: between LAA and JICA GL, No: between NIRP and JICA GL Following the NIRP and JICA GL, particular attention should be paid for the vulnerable groups.
16	Where impacts on the entire displaced population are minor or fewer than 200 people are displaced, an abbreviated resettlement plan may be agreed with the borrower. (WB OP4.12 Para.25)	LAA does not require a RAP. NIRP requires an abbreviated RAP for the projects that entail displacement of fewer than 20 families.	Yes: between LAA and JICA GL, No: between NIRP and JICA GL Following the NIRP and JICA GL, an abbreviated RAP should be prepared for the projects that entail displacement of fewer than 20 families.

Source: JICA Survey Team

(9) The Project's policies on land acquisition and involuntary resettlement

I. The Government of Sri Lank will use the Project Resettlement Policy (the Project Policy) tor the

Landslide Disaster Protection Project of the National Road Network Phase 2 specifically because existing national laws and regulations have not been designed to address involuntary resettlement according to international practice, including JICA's policy. The Project Policy is aimed at filling-in any gaps in what local laws and regulations cannot provide in order to help ensure that PAPs are able to rehabilitate themselves to at least their pre-project condition. This section discusses the principles of the Project Policy and the entitlements of the PAPs based on the type and degree of their losses. Where there are gaps between the Sri Lank legal framework for resettlement and JICA's Policy on Involuntary Resettlement, practicable mutually agreeable approaches will be designed consistent with Government practices and JICA's Policy.

II. Land acquisition and involuntary resettlement will be avoided where feasible, or minimized, by identifying possible alternative project designs that have the least adverse impact on the communities in the project area.

III. Where displacement of households is unavoidable, all PAPs (including communities) losing assets, livelihoods or resources will be fully compensated and assisted so that they can improve, or at least restore, their former economic and social conditions.

IV. Compensation and rehabilitation support will be provided to any PAPs, that is, any person or household or business which on account of project implementation would have his, her or their:

- Standard of living adversely affected;
- Right, title or interest in any house, interest in, or right to use, any land (including premises, agricultural and grazing land, commercial properties, tenancy, or right in annual or perennial crops and trees or any other fixed or moveable assets, acquired or possessed, temporarily or permanently);
- Income earning opportunities, business, occupation, work or place of residence or habitat adversely affected temporarily or permanently; or
- Social and cultural activities and relationships affected or any other losses that may be identified during the process of resettlement planning.

V. All affected people will be eligible for compensation and rehabilitation assistance, irrespective of tenure status, social or economic standing and any such factors that may discriminate against achievement of the objectives outlined above. Lack of legal rights to the assets lost or adversely affected tenure status and social or economic status will not bar the PAPs from entitlements to such compensation and rehabilitation measures or resettlement objectives. All PAPs residing, working, doing business and/or cultivating land within the project impacted areas as of the date of the latest census and inventory of lost assets(IOL), are entitled to compensation for their lost assets (land and/or non-land assets), at replacement cost, if available and restoration of incomes and businesses, and will be provided with rehabilitation measures sufficient to assist them to improve or at least maintain their pre-project living standards, income-earning capacity and production levels.

VI. PAPs that lose only part of their physical assets will not be left with a portion that will be inadequate to sustain their current standard of living. The minimum size of remaining land and structures will be agreed during the resettlement planning process.

VII. People temporarily affected are to be considered PAPs and resettlement plans address the issue of temporary acquisition.

VIII. Where a host community is affected by the development of a resettlement site in that community, the host community shall be involved in any resettlement planning and decision-making. All attempts shall be made to minimize the adverse impacts of resettlement upon host

communities.

IX. The resettlement plans will be designed in accordance with Sri Lanka's National Involuntary Resettlement Policy and JICA's Policy on Involuntary Resettlement.

X. The Resettlement Plan will be translated into local languages and disclosed for the reference of PAPs as well as other interested groups.

XI. Payment for land and/or non-land assets will be based on the principle of replacement cost.

XII. Compensation for PAPs dependent on agricultural activities will be land-based wherever possible. Land-based strategies may include provision of replacement land, ensuring greater security of tenure, and upgrading livelihoods of people without legal land titles. If replacement land is not available, other strategies may be built around opportunities for re-training, skill development, wage employment, or self-employment, including access to credit. Solely cash compensation will be avoided as an option if possible, as this may not address losses that are not easily quantified, such as access to services and traditional rights, and may eventually lead to those populations being worse off than without the project.

XIII. Replacement lands, if the preferred option of PAPs, should be within the immediate vicinity of the affected lands wherever possible and be of comparable productive capacity and potential[1]. As a second option, sites should be identified that minimize the social disruption of those affected; such lands should also have access to services and facilities similar to those available in the lands affected.

XIV. Resettlement assistance will be provided not only for immediate loss, but also for a transition period needed to restore livelihood and standards of living of PAPs. Such support could take the form of short-term jobs, subsistence support, salary maintenance, or similar arrangements.

XV. The resettlement plan must consider the needs of those most vulnerable to the adverse impacts of resettlement (including the poor, those without legal title to land, ethnic minorities, women, children, elderly and disabled) and ensure they are considered in resettlement planning and mitigation measures identified. Assistance should be provided to help them improve their socio-economic status.

XVI. PAPs will be involved in the process of developing and implementing resettlement plans.

XVII. PAPs and their communities will be consulted about the project, the rights and options available to them, and proposed mitigation measures for adverse effects, and to the extent possible be involved in the decisions that are made concerning their resettlement.

XVIII. Adequate budgetary support will be fully committed and made available to cover the costs of land acquisition (including compensation and income restoration measures) within the agreed implementation period. The funds for all resettlement activities will come from the Government.

XIX. Displacement does not occur before provision of compensation and of other assistance required for relocation. Sufficient civic infrastructure must be provided in resettlement site prior to relocation. Acquisition of assets, payment of compensation, and the resettlement and start of the livelihood rehabilitation activities of PAPs, will be completed prior to any construction activities, except when a court of law orders so in expropriation cases. (Livelihood restoration measures must

[1] Agricultural land for land of equal productive capacity means that the land provided as compensation should be able to produce the same or better yield the AP was producing on his/her land prior to the project. The production should be in the planting season immediately following the land acquisition. It can be for a future period if transitional allowance equal to the household's previous yield is provided to the AP household while waiting for the land to get back to the same productivity as the previous land.

also be in place but not necessarily completed prior to construction activities, as these may be ongoing activities.)

XX. Organization and administrative arrangements for the effective preparation and implementation of the resettlement plan will be identified and in place prior to the commencement of the process; this will include the provision of adequate human resources for supervision, consultation, and monitoring of land acquisition and rehabilitation activities.

XXI. Appropriate reporting (including auditing and redress functions), monitoring and evaluation mechanisms, will be identified and set in place as part of the resettlement management system. An external monitoring group will be hired by the project and will evaluate the resettlement process and final outcome. Such groups may include qualified NGOs, research institutions or universities.

Cut-off-date of Eligibility

The cut-off-date of eligibility refers to the date prior to which the occupation or use of the project area makes residents/users of the same eligible to be categorized as PAPs and be eligible to Project entitlements.

In the Project, cutoff date for land owners with titles is the date of publication of the Sec 02 notice under Land Acquisition Act (LAA), and cutoff date for occupants of land without titles is the date of the commencement of the land acquisition and resettlement survey which is 24th July 2019. This date has been disclosed to each affected village by the relevant local governments and the villages have disclosed to their populations. The establishment of the eligibility cut-off date is intended to prevent the influx of ineligible non-residents who might take advantage of Project entitlements.

Persons who encroach on the area after the cut-off date are not entitled to compensation or any other form of resettlement assistance. With the assistance of GN through DS, PMU/RDA will patrol the sites and warn such persons against encroachment. They will be given sufficient advance notice and requested to vacate premises and dismantle structures prior to project implementation.

Principle of Replacement Cost

All compensation for land and non-land assets owned by households/shop owners who meet the cut-off-date will be based on the principle of replacement cost. Replacement cost is the amount calculated before displacement which is needed to replace an affected asset without depreciation and without deduction for taxes and/or costs of transaction as follows:

Replacement Cost: Replacement cost involves replacing an asset at a cost prevailing at the time of its acquisition. This includes fair market value, transaction costs, interest accrued, transitional and restoration costs, and any other applicable payments, if any. Depreciation of assets and structures should not be taken into account for replacement cost. Where there are no active market conditions, replacement cost is equivalent to delivered cost of all building materials, labor cost for construction, and any transaction or relocation costs.

(Reference: Social Assessment and Involuntary Resettlement Compliance Manual (RDA), Government Gazette No. 1837/47 dated 22nd November 2013)

9.2.3 Scale and Range of the Land Acquisition and Resettlement

The land acquisition and resettlement survey and socio-economic survey (LARS & SES survey) was conducted to understand the scale and range of the land acquisition and resettlement caused by the

Project implementation. The survey was mainly conducted by an experienced local team (the LARS & SES Team) of trained enumerators under close supervision of a resettlement specialist employed by the JICA Preparatory Survey Team. Firstly, preliminary discussion was conducted between the JICA Survey Team and the local resettlement specialist to share the understanding of the parameters of the project. Before venture onto the project sites, a meeting was held with the senior staff attached to the LDPP project office of the PMU at Kandy on 24 July 2019 to obtain their views and information that should be included in the RAP.

Prior to field visits, the LARS & SES Team prepared the questionnaire to be used for the collection of data on loss of assets and socio-economic and demographic information of the "would be affected people". The LARS & SES Team visited the project sites for an initial screening. With the help of a Geographical Information Officer, the divisional secretariats where the project sites are located were identified. Using the layout plans of the countermeasures against sediment disasters, the extents of permanent and temporary lands to be required for the construction of countermeasures were ascertained. Key persons of the relevant areas were interviewed to ascertain their views on the proposed project and to solicit their cooperation for the successful completion of the project. Socio economic information and data on impacts were obtained by the enumerators of the team using the prepared questionnaire. Collected data were analysed and relevant information was gathered.

There are three (3) categories of land that are affected (i) The land owned by individual PAPs (ii) the land owned by plantation estate companies (iii) government owned lands. All these lands can be divided into two uses. One is permanently required land for construction of countermeasures at the project site, and the other is temporarily required land for construction facilitating activities e.g. opening access roads or storing construction materials.

Types and extents of lands affected by the project are shown in **Table 9.2.1** and **Table 9.2.5**. Permanently required land for all 30 sites to be acquired from individual private PAPs is 1,041 perches (2.6 ha). If an understanding cannot be achieved with the owners of the lands to return the lands back to them after the construction of countermeasures to arrest landslides which will benefit them mostly, the lands may have to be acquired. But many PAPs are willing to sacrifice few perches of their lands for a worthy cause according to the discussion the LARS & SES team had with them. On an average approximately 35 perches (0.09 ha) is required to construct the countermeasures in each site, this is very small extent compared with land acquired for other projects. Temporarily required land from individual private PAPs is 6,169 perches (15.6 ha) and this land will be returned to the PAPs after the completion of construction work. Of this extent, 4,233 perches (10.7 ha) is required for the Site No.53 (A017-62.0km-62.25km) since three Sabo Dams are planned to be constructed at three different elevations from the road to arrest landslides.

Permanently required land from plantation estates is 645 perches (1.6 ha), and 1,577 perches (4.0 ha) for temporarily required land from plantation estates. Permanently required land from government lands is 1,532 perches (3.9 ha), and 4,231 perches (10.7 ha) for temporarily required land from government lands. There is no acquisition or payment of compensation for state owned lands but a request from the RDA through MOHRDPRD to the relevant state institution which owns the land is necessary.

In total, permanently required land is 3,218 perches (8.1 ha) and temporarily required land is 11,977 perches (30.3 ha).

Number of projects affected units (PAUs) and affected persons (PAPs) are summarized in **Table 9.2.1** and **Table 9.2.4**. None of PAUs or PAPS is required for displacement permanently and temporarily. The

number of families losing land permanently for the project is 40, and temporarily 47. The number of plantation estate losing land permanently for the project is 7, and temporarily 11

The total number of permanently affected PAPs in the private land is 148, and temporarily 183. The number of PAPs of plantation estate land comprises owners of the plantation estates and their employees.

The numbers and extents of buildings and utilities affected at all project sites are estimated as shown in **Table 9.2.6**. The total number and extent of the affected private buildings are two (2) and 1650 ft2. The same person owns both buildings and does not use them for residence. One building is used for a small shop and the other for a shed. The numbers of utilities displaced are 60 waterlines, 109 electric posts and 115 telephone lines/posts.

The numbers of trees affected are as shown in **Table 9.2.7**. The amount is 467, out of which 370 are rubber trees, coconut 13 and Jak 36, which is a substitute for rice. Fruit trees account for 45 out of the affected trees. The PAPs are entitled to compensation for the loss of trees and the felled trees will be given to them.

Table 9.2.4 Number of Project Affected Units (PAUs) and Affected Persons (PAPs)

Type of land		No. of PAUs			No. of PAPs		
		Legal	Illegal	Total	Legal	Illegal	Total
Required for displacement							
Permanently affected							
	Private land	0	0	0	0	0	0
	Plantation estate land	0	0	0	0	0	0
	Government land	0	0	0	0	0	0
	Total	0	0	0	0	0	0
Temporarily affected							
	Private land	0	0	0	0	0	0
	Plantation estate land	0	0	0	0	0	0
	Government land	0	0	0	0	0	0
	Total	0	0	0	0	0	0
Not Required for displacement							
Permanently affected							
	Private land	30	10	40	113	35	148
	Plantation estate land	7	0	7	29	0	29
	Government land	0	15	15	0	62	62
	Total	37	25	62	142	97	239
Temporarily affected							
	Private land	47	0	47	183	0	183
	Plantation estate land	8	3	11	45	12	57
	Government land	0	17	17	0	65	65
	Total	55	20	75	228	77	305
Grand Total		92	45	137	370	174	544

Source: JICA Survey Team

Table 9.2.5 Type and Extent of Land Affected

Item (Site) No.	District	DSD	Route No.	Location		Private Lands				Plantation Estate Lands				Government Lands			
						Permanently		Temporarily		Permanently		Temporarily		Permanently		Temporarily	
				Start	End	No. of Households	Extent (perches)	No. of Households	Extent (perches)	No. of Estates	Extent (perches)	No. of Estates	Extent (perches)	No. of Lots	Extent (perches)	No. of Lots	Extent (perches)
1	Nuwaraeliya	Walapane	B-413	66.75km	67km					1	31	1	266				
2	Nuwaraeliya	Kotmale	A-005	46/2	46/3	3	72	3	321					1	99	1	54
4	Ratnapura	Ratnapura	B-391	11.9km	12.0km					1	20	4	56				
6	Nuwaraeliya	Nuwaraeliya	B-412	30/9	30/11	4	55	5	62							1	90
7	Kandy	Udapalatha	A-005	30/9	30/11									1	75	1	285
8	Kandy	Udapalatha	A-005	28/4	28/6							1	30	1	66	1	139
9	Kegalle	Dehiovita	A-007	3/3	3/5	1	2							1	92	1	72
10	Badulla	Haldummulla	A-016	3.85km	4.2km					1	201	1	233				
11-12	Badulla	Haldummulla	A-016	5/2	5/8					1	30	1	300			1	21
19	Galle	Weliwita-Diwithura	E-001	76.7km	77.2km									1	57	1	158
20	Galle	Weliwita-Diwithura	E-001	77.9km	79.0km									1	38	1	222
22	Galle	Baddegama	E-001	88.0km	88.8km									1	256	1	278
23	Galle	Bopepoddala	E-001	89.3km	89.6km									1	177	1	224
25	Galle	Imaduwa	E-001	101.3km	101.7km									1	280	1	460
25_2	Galle	Imaduwa	E-001	108.6	108.7									1	138	1	154
26	Matale	Raththota	B-274	11/2	11/4	4	12	5	26								
27	Matale	Ukuwela	B-462	6+030	6+100	6	44	6	100								
31	Kegalle	Mawanella	A-001	99/8	99km	1	1	2	22					1	50	1	115
33	Badulla	Haldummulla	A-004	171/5	171/7	3	24	7	77					1	64	1	67
34	Badulla	Haldummulla	A-004	183km	185/14	2	33	2	30					1	3	1	21
36	Nuwaraeliya	Ambagamuwa	B-149	9.000	9.100			2	4	1	95	1	80	1	97	1	180
37	Badulla	Soranathota	B-036	4/11	5/3			1	8					1	27	1	25
39	Kandy	Hatharaliyadda	B-122	8/2	8/4	5	139	6	158								
40	Kandy	Hatharaliyadda	B-122	18/3	18/5	2	165	4	229								
43	Ratnapura	Godakawela	A-017	139	140/1					1	108	1	222				
48	Ratnapura	Elapatha	B-390	12/4	12/7					1	160	1	390				
49	Ratnapura	Niwithigala	B-390	20/9	21/3	1	132	1	490								
51	Colombo	Padukka	B-188	12/4	12/6	2	135	3	409								
53	Matara	Kotapola	A-017	62km	62.25km	6	227		4,233						13		1,666
Total						40	1,041	47	6,169	7	645	11	1,577	15	1,532	17	4,231

Source: JICA Survey Team

Table 9.2.6 Buildings and Utilities Affected

Item (Site) No.	District	DSD	Route No.	Location		No. of electric post displaced	No. of water lines displaced	No. of telephone lines / posts displaced	No. of Private Bldgs. Affected		Extent of Private Bldgs. Affected (sq. ft)		No. of Government Bldgs. affected	
				Start	End				Fully	Partially	Fully	Partially	Fully	Partially
1	Nuwaraeliya	Walapane	B-413	66.75km	67km	8		6						
2	Nuwaraeliya	Kotmale	A-005	46/2	46/3	6		4						
4	Ratnapura	Ratnapura	B-391	11.9km	12.0km									
6	Nuwaraeliya	Nuwaraeliya	B-412	30/9	30/11	4		2						
7	Kandy	Udapalatha	A-005	30/9	30/11	6	2	7						
8	Kandy	Udapalatha	A-005	28/4	28/6	4		4						
9	Kegalle	Dehiovita	A-007	3/3	3/5	6	1	8						
10	Badulla	Haldummulla	A-016	3.85km	4.2km									
11-12	Badulla	Haldummulla	A-016	5/2	5/8	10		12						
19	Galle	Weliwita-Diwithura	E-001	76.7km	77.2km									
20	Galle	Weliwita-Diwithura	E-001	77.9km	79.0km									
22	Galle	Baddegama	E-001	88.0km	88.8km									
23	Galle	Bopepoddala	E-001	89.3km	89.6km									
25	Galle	Imaduwa	E-001	101.3km	101.7km									
25_2	Galle	Imaduwa	E-001	108.6	108.7									
26	Matale	Raththota	B-274	11/2	11/4	13	2	15						
27	Matale	Ukuwela	B-462	6+030	6+100	4		3						
31	Kegalle	Mawanella	A-001	99/8	99km	2	3	3	1	1	150	1,500		
33	Badulla	Haldummulla	A-004	171/5	171/7	7		7						
34	Badulla	Haldummulla	A-004	183km	185/14	4	50	2						
36	Nuwaraeliya	Ambagamuwa	B-149	9.000	9.100	5		6						
37	Badulla	Soranathota	B-036	4/11	5/3			5						
39	Kandy	Hatharaliyadda	B-122	8/2	8/4	6		7						
40	Kandy	Hatharaliyadda	B-122	18/3	18/5	6		5						
43	Ratnapura	Godakawela	A-017	139	140/1									
48	Ratnapura	Elapatha	B-390	12/4	12/7	7		5						
49	Ratnapura	Niwithigala	B-390	20/9	21/3	6		8						
51	Colombo	Padukka	B-188	12/4	12/6	5	2	6						
53	Matara	Kotapola	A-017	62km	62.25km									
Total						109	60	115	1	1	150	1,500	0	0

Source: JICA Survey Team

Table 9.2.7 Affected Trees

Type of tree	Amount
Rubber	370
Coconut	13
Jak	36
Mango	20
Banana	25
Kithul	3
Total	467

Source: JICA Survey Team

Socio-Economic Profile

In each project site, both permanently affected families and temporarily affected families reside in the same communities. Therefore, only the permanently affected families are taken for socio economic analysis.

The project directly benefits in 22 DSDs. The number of PAPs families considered for analysis is 40 comprising 72 males and 76 females.

Family sizes of the affected households are shown in **Table 9.2.8**. The average family size is 3.7, over 55 % of the families are having between 3-4 members. The number of families having 1-2 members per family is 10 indicates that they are young married couples. There are no families with more than 6 members. The family size is almost equal to the national average of 3.8 (Census &Statistics). Plantation owners were not considered for socio-economic analysis.

Table 9.2.8 Distribution of Project Affected Households by Family Size

Household Members	No of Households	Percentage (%)
1_2	10	25
3_4	22	55
5_6	8	20
7 and above	0	0
Total	40	100

Source: JICA Survey Team

Ethnic and gender composition of the affected persons households are shown in **Table 9.2.9**. The predominant ethnicity is Sinhalese accounting for 83.8% of the affected population. Tamils is the second highest with a population of 11.5 % of the total PAPs. Muslims is the third with only 4.7 % of the total PAPs.

Number of women among the PAPs is 76 while men accounts for 72 of the population. Male to female ratio is 94:100 in other words the percentage of women among the PAPs is 51.4% which is slightly less than the national percentage of 51.9%.

Table 9.2.9 Ethnic Composition

Ethnicity	No.			Percentage (%) Male
	Male	Female	Total	
Sinhala	61	63	Sinhala	61
Tamil	8	9	Tamil	8
Muslim	3	4	Muslim	3
Moor	0	0	Moor	0
Other	0	0	Other	0
Total	72	76	Total	72

Source: JICA Survey Team

Religious composition of the affected persons households is shown in **Table 9.2.10**. Buddhists among the PAPs constitute 83.1% of the population. Hindus comprise the next highest religious group with 9.5%. Muslims constitute 4.7 % and Catholics 2.7 %. There were no major incidents of religious disharmony reported from these areas in the recent past except few skirmishes by few misguided individuals. They assist each other in religious activities.

Table 9.2.10 Religious Composition

Religion	No.			Percentage (%)
	Male	Female	Total	
Buddhist	61	62	123	83.1
Catholic	2	2	4	2.7
Hindu	6	8	14	9.5
Islam	3	4	7	4.7
Total	72	76	148	100.0

Source: JICA Survey Team

Project affected households (AHHs) and project affected persons (PAPs) by Divisional Secretary Division (DSD) are shown in **Table 9.2.11**. Out of the 22 affected DSDs only 11 DSDs are having PAPs. Highest number of PAPs is in Hatharaliyadda DSD totalling 25, next highest number of PAPs is in Kotapola DSD totalling 22 in Matara District. The lowest number of PAPs are in Nivitigala DSD of Rathnapura District amounting for four belonging to one household.

Table 9.2.11 Summary of AHHs and PAPs by DSD

District	DS Division	No. of AHHs	PAPs		
			Male	Female	Total
Nuwaraeliya	Kotmale	3	5	4	9
Matale	Raththota	4	10	7	17
Matale	Ukuwela	6	7	9	16
Kegalle	Mawanella	1	2	3	5
Badulla	Haldummulla	5	8	13	21
Kandy	Hatharaliyadda	7	14	11	25
Rathnapura	Nivithigala	1	2	2	4
Colombo	Padukka	2	5	4	9
Nuwaraeliya	Nuwaraeliya	4	7	8	15
Kegalle	Dehiowita	1	2	3	5
Matara	Kotapola	6	10	12	22
Total		40	72	76	148

Source: JICA Survey Team

Number of AHHs by Land ownership are shown in **Table 9.2.12**. Households having titles to the project affected land is 25. There are three (3) lessees, those who are having coownership to the project affected land is two (2). There are 15 squatters in government land, 10 encroachers in private lands. The number of owners of plantation properties is 7 and they were not considered for socio economic analysis.

Table 9.2.12 Land Ownership Classified According to the Type of Ownership

Land Ownership	No. of AHHs	
	Permanently	Temporarily
Legal Ownership of private land	25	40
Lease of private land	3	5
Co-owners of private land	2	2
Encroachers on private land	10	0
Sub total	40	47
Legal ownership of plantation land	7	8
Illegal ownership of plantations land	0	3
Sub total	7	11
Squatters on government lands	15	17
Total land owners	62	75

Source: JICA Survey Team

Number of Affected Household Head by Gender and Age Category are shown in **Table 9.2.13**. Out of the project affected household heads 34 are males and six (6) are females. The age group of 46-60 constitute 18 households representing 45% of the households. Number of households above 60 years is 12 constitute 30% of the households. Within the age bracket of 31-45, the number of households is eight.

Table 9.2.13 Household Heads Disaggregated by Age and Gender

Age Category	Male		Female		Total	
	Number	%	Number	%	Number	%
18 - 30	2	5.9	-	-	2	5.0
31 - 45	7	20.6	1	16.7	8	20.0
46 - 60	14	41.2	4	66.6	18	45.0
>60	11	32.3	1	16.7	12	30.0
Not disclosed	-	-	-	-	-	-
Total	34	100	6	100	40	100

Source: JICA Survey Team

Educational Achievements of Household Heads by Gender are shown in **Table 9.2.14**. All household heads have attended school. Out of them 11 men and one woman had studied only up to 5th standard, 14 up to General Certificate of Education Ordinary Level (GCE'O'Level), five has been successful at GCE-O'Level and 4 had passed GCE Advanced Level (GCE-A' level). There are 4 graduates all of them are males and 1 PhD holder who is a male.

Table 9.2.14 Educational Achievements of Household Heads Disaggregated by Gender

Educational Achievement	Male	Female	Total	%
Below school going age	0	0	0	0
Not attended School	0	0	0	0
Up to 5th Grade	11	1	12	30.0
Grade 6-10	10	4	14	35.0
Pass O Level	5	0	5	12.5
Pass A Level	3	1	4	10.0
Degree	4	0	4	10.0
Post Graduate (PhD)	1	0	1	2.5
Total	34	6	40	100.0

Source: JICA Survey Team

Project Affected Population by Age and Gender are shown in **Table 9.2.15**. Of the total number of PAPs, the male population is 72 and the females are 76. Over 30% of the population is in the age category of 15-30. The next highest age group is between 5-14 constituting 18.3%of the population. The children below 5 years is comprising of 7.4 % which is little below the national percentage of 8% (Census & Statistics). The senior citizens represent 12.8% of the population which little more than national percentage of 12.4 (Census & Statistics).

Table 9.2.15 Project Affected Population Disaggregated by Age and Gender

Age Category	Number of Males	%	Number of Females	%	Total Number	%
Below 5	5	6.9	6	7.9	11	7.4
5_14	13	18.1	14	18.4	27	18.3
15-30	23	31.9	22	28.9	45	30.4
31-45	12	16.7	13	17.1	25	16.9
46-60	10	13.9	11	14.5	21	14.2

Over 60	9	12.5	10	13.2	19	12.8
Not disclosed	0	0	0	0	0	0
Total	72	100	76	100	148	100

Source: JICA Survey Team

Educational Achievement of Project Affected People by Gender are shown in **Table 9.2.16**. All the project affected people have attended school. There are no illiterate people. Number of people studied up to GCE-O'Level is 35. Out of them 17 are males and 18 are females constituting 23.7% of the population. The number of PAPs successful at the GCE O'Level is 42 accounting for 28.4% of the population. but successes at the GCE'Advanced Level is 10.8%. There are 11 graduates and two post graduates which is quite impressive.

Table 9.2.16 Educational Achievement of Project Affected People Disaggregated by Gender

Educational Achievement	Male	%	Female	%	Total	%
Below school going age	5	6.9	6	7.9	11	7.4
Up to 5th Grade	13	18.1	17	22.4	30	20.3
Grade 6-10	17	23.6	18	23.7	35	23.7
Passed O Level	20	27.8	22	28.9	42	28.4
Passed A Level	9	12.5	7	9.2	16	10.8
Degree	6	8.3	5	6.6	11	7.4
Post Graduate	2	2.8	1	1.3	3	2.0
Total	72	100	76	100	148	100

Source: JICA Survey Team

Civil Status of Project Affected People by Gender are shown in **Table 9.2.17**. The number of married PAPs is 66 equally from both sexes. There are 28 unmarried PAPs, out of them 17 are men and 11 are women. The widowed amounts to 07. This reflects the longevity of women as against men since there are no widowers among the PAPs. In Sri Lanka today the life expectancy of men is 72 years and that of women is 77. There are number of reasons for less longevity of men compared with women. Lack of adequate rest, proper nutritious, exposure to inclement weather and consumption of alcohol are main reasons. Consumption of cheap illicit liquor is rampant among men in the plantation areas. PAPs who have not reached the legal marriageable age of 18 years is 47. Out of them 22 are men and 25 are women.

Table 9.2.17 Civil Status of Project Affected People Disaggregated by Gender

Status	Male		Female		Total	
	Number	%	Number	%	Number	%
Married	33	45.8	33	43.4	66	44.6
Unmarried	17	23.6	11	14.5	28	18.9
Widow	0	0	7	9.2	7	4.7
Minor	22	30.6	25	32.9	47	31.8
Total	72	100	76	100	148	100

Source: JICA Survey Team

Sources of Income of Project Affected People by Gender are shown in **Table 9.2.18**. The number of PAPs engaged in employment is 64. Out of them 42 are males and 22 are females. In addition to primary employment 4 PAPs are having a secondary employment also. Those who have taken to business as a source of earning is 11 two of them is having a secondary employment too. There are 9 PAPs employed in the public sector, out of them 3 are holding executive posts. There are 16 PAPs

attached to the private sector establishments, out of them 06 are women. Skilled and wage labour constitute 17 PAPs. The number of PAPs eligible for employment is (between the age of 14-60) is 91, out of them 64 are employed, the Labour Force Participation Ratio is 70.3% which is much higher than the national ratio of 53.8% (Source: Dept. of Census & Statistics 2015)

Table 9.2.18 Sources of Income of Project Affected People Disaggregated by Gender

Category of Employment	Primary Employment			Secondary
	Male	Female	Total	
Self-employment	3	6	9	0
Business	10	1	11	2
Public Sector Executive jobs	1	2	3	0
Public sector other grade jobs	5	1	6	0
Private sector Executive jobs	2	4	6	0
Private Sector other grade jobs	8	2	10	0
Foreign Employment	1	0	1	0
Security jobs	1	0	1	0
Skilled Labour	4	1	5	0
Wage labour	7	5	12	2
Total	42	22	64	4

Source: JICA Survey Team

Average Monthly Income of PAPs by Gender are shown in **Table 9.2.19**. The average monthly income of a PAP is Rs.38,203 which is above the national poverty line (USD1.90/day). Of the 40 households taken for socio-economic analysis, the average number of persons employed in a family is (64/40) is 1.6. On this basis average income of a family is Rs.61,125.00 per month. The number of families falls into the category of middle class is 22 as they are earning more than Rs.62,500.00 per month. Only two families which are earning less than Rs.10,000.00 monthly could be considered as very poor. None of these PAPs are losing their employment because there is no relocation involved.

Table 9.2.19 Average Monthly Income of PAPs by Gender

Income Category	Males	Females	Total	%
>5000	1	0	1	1.6
5,001-10,000	0	1	1	1.6
10,001-15,000	1	3	4	6.2
15,001-25,000	10	6	16	25.0
25,000-50,000	13	8	21	32.8
50,000-75,000	11	3	14	21.9
75,000-100,000	4	0	4	6.2
100,000-150,000	2	0	2	3.1
above 150,000	1	0	1	1.6
Total	42	22	64	100.0

Source: JICA Survey Team

Monthly Expenditure of Project Affected Families are shown in **Table 9.2.20**. Nearly half of the monthly expenditure is for food. The average monthly expenditure for a family is Rs.45,349. All 40 families are spending money for children's education. There is not much of expenditure on alcohol and tobacco. Number of families who contribute for charity is 28. Most of the people depend on surface water that they tap by using UPVC pipes. Since average monthly income of a family is more than the monthly expenditure PAP families could sustain themselves without getting indebted.

Table 9.2.20 Monthly Expenditure of Project Affected Families

Item of Expenditure	No. of Families Responded	Average Amount Rs. / Month
Food	40	21,950
Clothes	16	942
Water	15	350
Electricity	40	250
Fuel	19	3,568
Gas	22	888
Tobacco/Betel	28	375
Alcohol	16	2,440
Communication	34	1,250
Entertainment	27	560
Charity	28	391
Vehicle Maintenance	19	1,283
Health	35	967
Transport	31	2,250
Education	40	2,971
Miscellaneous	35	866
Religious activities	30	300
House Repair	15	1,567
Home Appliance	31	1,171
Donation	32	163
Insurance	19	650
Cultural Activities	24	197
Total	-	45,349

Source: JICA Survey Team

Vulnerable Families are shown in **Table 9.2.21**. Vulnerable families are entitled to a onetime allowance of Rs.15,000 and material assistance and advise if required from the PMU to restore their lives. They will not become vulnerable due to the implementation of the project. They are classified as vulnerable due to the disadvantages they are faced with due to circumstances beyond their control.

Table 9.2.21 Vulnerable Families

Type of Vulnerability	No. of Families
Very Poor	2
Very old without a reasonable income	3
Disabled	2
Women headed families without a reasonable income	3
Total	10

Source: JICA Survey Team

9.2.4 Concrete Measures of Compensation and Support

(1) Eligibility Criteria

Any individual, household or a community impacted physically, economically due to acquisition of properties by the state is eligible to receive compensation to cover the value of such losses. The affected will not be impoverished and the policy of the NIRP and safeguard statement of Word Bank 2009, JICA requires the affected to be better in status enjoyed prior to the project or at least maintain status quo. But project will endeavour to make them better economically and socially.

In order to address the issue of compensation number of mechanisms is in operation

(2) Valuation determined by the Chief Valuer and by EAC

1) Compensation for land and structures

Chief Valuer will determine the compensation payable for land and structures based on the 2013 regulations enacted by Parliament. In deciding the value for land, the prevailing market value for such lands will be taken into consideration including transaction costs. When a small portion of a land plot is acquired the rate is determined on the basis, the value that could be realized, if that land is sold as one entity. Compensation is available for injurious affection, severance and disturbances too.

If a portion of the structure is acquired the compensation will be calculated to the next structural support point. After acquisition if the remaining portion of the structure is not structurally sustainable full compensation will be paid for the structure. If the balance portion of the structure collapses within 06 months after acquisition, the project will meet all the costs associated with such an event determined by the Entitlement Assessment Committee (EAC).

2) Compensation for Uneconomical Parcels

Uneconomical parcel of lands for e.g. after acquisition, if the remaining extent is less than stipulated extent required for construction of a house or a commercial building in a local authority area such uneconomical lots will be acquired by the project or pay 25% of the computed value of the land if the PAP agreeable to receive the injury while retaining the uneconomical parcel of land.

3) Compensation for houses and shops falling under Rent Control ACT

Does not apply in this project

4) Compensation for Loss of Income

For complete loss of income formal businesses (Registered businesses with documentary proof of payment of income tax) are entitled for three (3) years average net income immediately preceding acquisition. For informal businesses, Rs. 15,000 or up to three months net income whichever is higher will be paid, if the income is ascertained through supporting documents .

5) Loss of Livelihood and Employment

Those who are self-employed and temporarily affected due to loss of income will be entitled for a loss of livelihood payment during business/employment reestablishment. The persons who lose the wages of employment due to the permanent acquisition of their places of employment will be entitled for the payment for lost income and rehabilitation package to provide support and income restoration.

6) Entitlement Matrix

The entitlement matrix is shown in **Table 9.2.22**.

Table 9.2.22 Entitlement Matrix

Type of Impacts/Entitlements	Compensation	Eligibility	Responsibility	Implementation Issue
Permanent Loss of land 1.1 Non-agricultural land (e.g. residential lands, barren lands)	A) All (cash) payments for acquisition of land will be on the basis of replacement cost as determined by the Chief Valuer. The difference between the statutory compensation determined by the Land Acquisition Act (LAA) and the replacement cost is payable as an ex-gratia payment. All ex-gratia payment shall be determined by Land Division of RDA (LD). B) If the portion remaining after the acquisition cannot be used as a separate plot, and if the PAP desires to keep the remaining portion with him/her, the Land Division of RDA will consider paying the compensation for that part as well.	Land owner or affected persons losing assets on productive land	Chief Valuer （CV）, Divisional Secretary (DS), RDA/ ESDD, LD, PMU Provincial Director/RDA, The Committee termed Land Acquisition and Resettlement Committee (LARC) and Super LARC.	The project will not need to acquire the affected land to construct its landslide mitigation measures, when the memorandum of agreement to be signed between RDA and the individual affected private land owners/plantation estates/ other government organizations allows RDA to install the structures in the affected lands and then return the land to its owner after the work is completed. However, in the event during the construction and operation period when land is permanently acquired, then these measures will apply.
1.2 Agricultural lands	A) For agricultural lands, compensation will be paid as item 1.1 above. B) If the remaining portion after acquisition is no longer economically viable, the Land Division of RDA could decide whether to acquire the whole property or pay compensation for the residual land. Reasonable time will be given to harvest perennial crops, or payment will be made at market value.	Land owner or affected persons losing assets on productive land	CV,DS RDA/ESSD, LD, PMU Provincial Director/RDA. Agrarian Service Department, LARC and Super LARC	
1.3 Temporary Loss of land	A) The plots of private lands and plantation estates will be temporarily taken on lease during construction stage. The land lease fee will be calculated by multiplying the market price of lease and required duration of the land. The payment shall be determined by the Land Division of RDA.	Private land owners or affected persons losing assets on affected productive land	CV,DS RDA/ESSD, LD, PMU Provincial Director/RDA. Agrarian Services	Additional lands may be needed by the contractor for its temporary construction facilities (i.e. access road, construction camp, garage, temporary disposal sites, etc.) to facilitate the construction work.

Type of Impacts/Entitlements	Compensation	Eligibility	Responsibility	Implementation Issue
	B) Compensation and other entitlements will be paid to affected persons for any loss of non-movable assets and/or loss income described in Item 2 below.		Department LARC and Super LARC	
2. Lost Assets (Buildings and Structures) • Parts of structures; Access of business and residential places/concrete steps • Remaining portion of the structure after acquisition if unusable.	A) Pay replacement cost for the affected portion based on the extent (volume) of the structure without depreciation. B) Compensation should be paid for the unusable portion at replacement cost.	Owners of affected structures with proof of ownership	CV,DS, RDA/ESDD, LD, PMU Provincial Director/RDA, RE LARC and Super LARC	Applicable to the following cases: • A permanent building (a small store) and a temporary building (a hut) belonging to the same owner are affected. However, these buildings are not used for a residence and will be rebuilt in the same premises. • 60 PVC pipelines where PAPs are tapping water from fountains.
3. Loss of Business 3.1. Informal (non-tax payers)	A) If income could be proved by supporting documents, Rs.15,000.00 or net income of three (3) months whichever is higher.	All informal business owners who are affected	CV,DS RDA/ESDD, LD, PMU Provincial Director/RDA, RE LARC and Super LARC.	There are no businesses that may be affected by the Project implementation. However, in the event such case occurs during the construction phase, this measure will apply.
3.2. Formal (tax payers)	A) Adjusted average net profit of three (3) years preceding the publication of Sec.07 notice under LAA	All formal business owners who are affected	CV,DS RDA/ESDD, LD, PMU Provincial Director/RDA, RE LARC and Super LARC.	There is no expected loss of formal business due to the Project implementation. However, should such event occur during construction, these measures will apply.

Type of Impacts/Entitlements	Compensation	Eligibility	Responsibility	Implementation Issue
3.3. Temporary Disruption of business	A) Payment will be made for the business disruption period including the preparation period necessary for income reestablishment. The Land Division of RDA will arrange and determine the payment in detail.	All Business owners who are affected	CV,DS RDA/ESDD, LD, PMU Provincial Director/RDA, RE, LARC and Super LARC	The business of eleven (11) companies owning tea plantations will be disrupted during the implementation stage when the land is temporarily acquired for construction related activities. They are entitled to disruption of business if they agree to hand over their lands without acquisition. It takes at least three (3) years to obtain an income after getting the land back. Assuming a period of two (2) years for construction, it will take at least five (5) years to establish the business. Though the Entitlement Matrix provides payment of disruption of business during business reestablishment for five (5) years, the quantum of disruption of business for plantation companies should be determined by the LD. The business of one (1) shop will be disrupted during rebuilding affected shop and shed for one (1) year. The owner is entitled to the allowance for temporary disruption of business. The payment should be determined by the LD.
3.4. Loss of livelihood (Temporarily affected)	A) Payment will be made during business or employment reestablishment based on the income that can be proved by supporting documents. The Land Division of RDA will arrange and determine the payment in detail.	All temporarily affected employees, wage or daily labours and self-employees	CV,DS RDA/ESDD, LD, PMU Provincial Director/RDA, RE , LARC and Super LARC	There is no expected loss of livelihood of employees or self-employees due to the project implementation. However, should such event occur during construction, this measure will apply
3.5 Loss of livelihood (Permanently affected)	A) Payment for lost income, and rehabilitation package to provide support and income restoration. Payment of allowance of Rs.15,000 or three (3) months basic salary whichever is high (subject to proof of six (6) months employment before the publication of the notice under Sec02 of LAA)	All permanently affected employees, wage or daily labours and self-employees	CV,DS Social staff of RDA and PMU/LD Provincial Director/RDA, RE, LARC and Super LARC	There is no expected loss of employment due to the project implementation. However, should such event occur during construction, this measure will apply.

<table>
<tr><th>Type of Impacts/Entitlements</th><th>Compensation</th><th>Eligibility</th><th>Responsibility</th><th>Implementation Issue</th></tr>
<tr><td>4. Vulnerable Households</td><td>A) An extra payment shall be paid for families in a vulnerable situations as determined by the Land Division of RDA

At present, RDA pays one-time allowance of Rs.15,000 per family.

The vulnerable HH will be provided the following:
• Assistance to improve income
• Help in finding employment for vulnerable families in the project if suitable jobs are available</td><td>All household that fall within the category of vulnerable households e.g. elderly, women headed households without a reasonable income, poor, disabled, indigenous people</td><td>CV,DS
RDA/ESDD, LD, PMU

Provincial Director/RDA, RE LARC and Super LARC</td><td></td></tr>
<tr><td>5.Loss of Trees</td><td>A) Cash payment for loss of trees on market value on the basis of type, age and productive value of affected trees. For tenant, the payment will be paid to the tenant.</td><td>Person who plants trees owned by private</td><td>CV,DS
Social staff of RDA and PMU/LD
Provincial Director/RDA, RE, LARC and Super LARC</td><td>The payment for the damaged productive trees such as fruit trees and rubber trees
All trees including miscellaneous trees will be cut and given back to the owners.</td></tr>
<tr><td>6. Temporary Residential facilities</td><td>A) Payments applicable to APs for temporary residential facilities.

Rate depends on the floor area of the house occupied by the APs prior to the date of the Order published under Sec.02 of the LAA.

<table><tr><th>Floor Area (ft^2)</th><th>MC (Rs)</th><th>UC (Rs)</th><th>PS (Rs)</th></tr><tr><td><500</td><td>50,000</td><td>40,000</td><td>20,000</td></tr><tr><td>500-700</td><td>60,000</td><td>50,000</td><td>50,000</td></tr><tr><td>700-1000</td><td>75,000</td><td>60,000</td><td>40,000</td></tr><tr><td>>1000</td><td>100,000</td><td>75,000</td><td>50,000</td></tr></table>MC: Municipal council areas
UC: Urban council areas
PS: Pradeshiya sabha areas</td><td>The affected persons who hand over the possession of a cultivated land or a residential building before the date specified by the Acquisition Officer</td><td>CV,DS,
RDA/ESDD, LD, PMU
Provincial Director/RDA, RE, LARC and Super LARC</td><td>There is no expected PAP who needs temporary residential facilities. However, if such need arises during construction, this measure will apply.</td></tr>
</table>

<table>
<tr><th>Type of Impacts/Entitlements</th><th>Compensation</th><th>Eligibility</th><th>Responsibility</th><th>Implementation Issue</th></tr>
<tr><td>7. Change of residence Entitlement</td><td>A) Transfer Allowance is based on the total floor area (ft^2) as follows:<table><tr><th>Floor Area (ft^2)</th><th>Amount (Rs)</th></tr><tr><td><500</td><td>50,000</td></tr><tr><td>500-750</td><td>75,000</td></tr><tr><td>750-1000</td><td>100,000</td></tr><tr><td>>1000</td><td>150,000</td></tr></table></td><td>The affected persons who hand over the possession of a cultivated land or a residential building before the date specified by the Acquisition Officer</td><td>CV,DS
Social staff of RDA and PMU/LD
Provincial Director/RDA, RE, LARC and Super LARC.</td><td>If the permanent house is to be removed prior to the date specified by the Acquisition Officer, the PAP is entitled to the allowance indicated in the table of Item 6.</td></tr>
<tr><td>8. Payment for Relocation
8.1 Title holder</td><td>A) Entitlement to a block of land not exceeding an extent of 20 perches from a fully serviced resettlement site equivalent to the unimproved land value determined by the Land Division of RDA or to cash payment applicable for self-relocation as specified in the next Item 9.</td><td>Every resettler affected by the acquisition with a title to the land acquired</td><td>CV,DS
ESDD/RDA, LD, PMU
Provincial Director/RDA, RE, LARC and Super LARC.</td><td rowspan="3">There will be no relocation due to the project. However, when such event occur during construction, this measure will apply.</td></tr>
<tr><td>8.2 Encroacher</td><td>A) Offering a block of land up to an extent of 10 perches from a resettlement site or cash payment applicable for self-relocation as specified in the next Item 9.</td><td>Encroachers of state lands where the LD deems that it is reasonable and justifiable</td><td>CV,DS
ESDD/RDA, LD, PMU
Provincial Director/RDA, RE, LARC and Super LARC.</td></tr>
<tr><td>8.3 Sub families</td><td>A) Entitlement to a block of land up to an extent of 10 perches from a resettlement site or to 50 % of the cash payment applicable for self-relocation as specified in the next Item 9.</td><td>The sub families who are living in the same house registered under the same register of electors or separate registers of electors, at least three (3) years prior to the date of the Order published under Sec02 of the LAA</td><td>CV,DS
ESDD/RDA, LD, PMU.
Provincial Director/RDA, RE,
LARC and Super LARC.</td></tr>
</table>

<table>
<tr><th>Type of Impacts/Entitlements</th><th>Compensation</th><th>Eligibility</th><th>Responsibility</th><th>Implementation Issue</th></tr>
<tr><td>9. Self-Relocation
9.1 Principal Occupants</td><td>A) Entitlement for a payment specified in the following table in lieu of a land depending on the area in which the property to be acquired is situated.
<table><tr><td>MC (Rs)</td><td>UC (Rs)</td><td>PS (Rs)</td></tr><tr><td>500,000</td><td>300,000</td><td>150,000</td></tr></table></td><td>The persons affected by the prospective acquisition who wish to self-relocate</td><td>CV,DS
RDA/ESDD, LD, PMU
Provincial Director/RDA, RE, LARC and Super LARC</td><td rowspan="2">There will be no relocation due to the project. However, if there will be permanently displaced HH , during the construction phase, then this measure will apply.</td></tr>
<tr><td>9.2 Sub families</td><td>A) 50 % of the cash payment is applicable for self-relocation as specified in the following table.
<table><tr><td>MC (Rs)</td><td>UC (Rs)</td><td>PS (Rs)</td></tr><tr><td>250,000</td><td>150,000</td><td>75,000</td></tr></table></td><td>The sub families registered under the same register of electors or separate registers of electors, living in the same house for a period at least three (3) years prior to the date of the Order published under Sec02 of the LAA</td><td>CV,DS
RDA/ESDD, LD, PMU
Provincial Director/RDA, RE, LARC and Super LARC.</td></tr>
<tr><td>10. Compensation for Encroachers/ Squatters
10.1. Improvements done on the land</td><td>A) No payment for land will be made to the encroachers on state lands.
B) Payment for the improvement of the land will be made. All (cash) payments for structure will be made at replacement cost and for any developments at market price.</td><td>The encroachers who are in occupation of untitled land prior to the date of the Order under Sec.02 of LAA is published.</td><td>CV,DS
RDA/ESDD, LD, PMU.
Provincial Director/RDA, RE, LARC and Super LARC.</td><td></td></tr>
<tr><td colspan="4">Above table is based on the provisions contained in the Government Gazette No. 1837/47 dated 22nd November 2013 (Land Acquisition (Payment of Compensation) Regulations 2013); and RDA Social Assessment and Involuntary Resettlement Compliance Manual (SAIRC Manual) .</td><td></td></tr>
</table>

Source: JICA Survey Team

Note: The Land Division of RDA (LD) has a responsibility on determination and implementation of above compensations. In case the LD finds it difficult, LARC procedure will be followed.

LARC will be appointed based on Land Acquisition (Payment of Compensation) Regulations 2013. According to the Regulations 2013, the market value of any land or

the compensation for any injurious affection caused by the acquisition of any land for a specified project, shall be assessed by the LARC appointed for the respective Divisional Secretary's Division (DSD) in which the land acquired is located.

A LARC is established at the DSD level to assist with the resettlement process, consultation with PAPs, determination of administrative matters, and resolution of disputes regarding compensation. The LARC may refer any grievance regarding the amount of compensation for an acquired land parcel or structure to the Chief Valuer of the Valuation Department for determination of its replacement value. Each LARC is chaired by DS, and comprises of officers from RDA and representatives of the Survey Department, the Valuation Department and Grama Niladhari (GN). PAPs and their representatives are invited to attend the sessions.

Since the Southern Transport Development Project (STDP) required a large extent of land acquisition and resettlement, the government decided to introduce a new scheme to compensate the affected people outside the LAA in 2001. This was achieved by creating a body called Land Acquisition and Resettlement Committee (LARC). This body was set up to determine the replacement cost (not the depreciated value) of the buildings and the market value of the land of the displaced people.

This system was abolished with the introduction of 2008 land acquisition regulations (LAA Regulations in 2008). However, in 2013 the LARC system was reintroduced to some selected projects. Every person affected by the acquisition of relevant land shall be given an opportunity to make their representation at the proceedings of the LARC. Any displaced person who is not satisfied with the quantum of compensation decided by the LARC will have option of appealing to the super LARC committee which is established by the decision of the cabinet of ministers.

The Government Gazette No.1837/47dated 22nd November 2013**,** prescribes the members of the LARC to be appointed by the Hon. Minister of Land and Land Development.

9.2.5 Grievance Redress Mechanism

Even though resettlements are absent in this project assets of the people will be either acquired or used for construction activities on mutual understanding. Well formulated mechanisms for the resolutions of grievances of PAPs are a must in development induced involuntary resettlement projects. They are institutions, instruments, methods and processes by which a resolution to a grievance could be sought and provided. Project implementing authorities will take adequate care to minimize grievances through careful designs and good participatory management processes. Problems and grievances are inevitable even under extremely efficient planning and expert management, due to unforeseen circumstances. A built-in mechanism in the form of an institutionalized grievance redress system will allow aggrieved project affected people (PAP) to submit their grievances for a resolution. A forum of this nature helps to alleviate suspicions and misunderstanding between the PAPs and the project management. It provides easy access to the PAPs without incurring expenses and timely solutions. It helps to achieve the project objectives without many hiccups.

The RAP identifies the potential social and economic impact associated with the counter measures planned to arrest landslides at the identified candidate sites and illustrates the measures and procedures needed to redress or mitigate grievances. Some of the economic impacts would be the loss of income, loss of employment, loss of property in the process of construction though not identified at this stage. Some of the inadequacies of compensation, delay in payment of compensation, significant social impacts, would be severance or disruption of relationship, marginalization, disruption of children's education and access to facilities within easy reach if relocation is involved. In this project relocation does not trigger now as per the construction designs.

The main purpose of the measures of redresses recommended in RAP is to avoid economic and social hardships to people resulting from the construction effects of the project. The note below provides a draft for the grievance redress measures, steps and procedures to be adopted by the PMU for the project.

(1) Proposed Grievance Redress Steps and Procedures

1) Creation of Awareness of the Grievance Redress Mechanism

Wide publicity will be given by the PMU regarding the establishment of GRCs to the PAPs and closely related officials to the GRC mechanism for e.g. Gram Niladharis, Local Samurdhi Officers and Social Development officers of the Divisional Secretariats and Pradeshiya Sabhas of the areas concerned.

2) Publicity Measures

PMU will prepare flyers indicating

- Project brief including the benefits of the project to the community
- Procedure for registering a complaint
- Categories of persons, institutions and property/assets affected that can claim
- compensation,
- Explanation on those who would not be considered as an affected person,
  Property & etc.
- The address of the authority to receive and register the application with the name of the officer in-charge, address, and telephone/fax numbers to contact.

3) Receiving Application for Redress

The applications regarding grievances for redresses can be submitted to the Resident Engineer (RE) of

the relevant Divisional Secretariat area on week days during office hours. These applications are registered in the RE's office with all details such as names of the person, type of grievance

Well thought measures will be taken to prevent grievances rather than going through redresses system. Grievances can be minimized through careful project design and implementation by ensuring active participation and consultation with PAPs, establishing rapport between the community and PMU through frequent interactions, transparency and monitoring.

4) Maintaining of Complaint Register

As a first step of the grievance redress process a complaint register will be maintained at the Project Engineer's office in the relevant DS division. On receiving a complaint, it will be registered, and complaint will be given a reference number. Then RE will review the complaint received and its documentation and also make arrangements to redress it.

(2) Composition of Grievance Redress Mechanism

Grievance redress will be handled at 05 levels

Tier 01: Resident Engineer will attempt to redress the grievance at his/her level failing to arrive at a solution acceptable to the PAP without compromising the prevailing policies and rules. The issues discussed with the aggrieved party will be submitted to the LRC by the RE with his/her observations within one week of receipt of complaint.

Tier 02: The Local Resettlement Committee (LRC) constitute of representatives of the project affected households, Grama Niladharis, and key community leaders. This committee will be chaired by a person nominated by the affected people at local level. If the LRC is unsuccessful in solving the problem of the PAP, the issue will be referred to the Grievance Redress Committee (GRC) chaired by the relevant Divisional Secretary. The decision of the LRC will be given within one week with its observations.

Venue of LRC: A suitable location as decided by the LRC at its first meeting. The first meeting will be held at the auditorium of the Divisional Secretariat.

Date &Time .1st and 3rd Tuesday at 10.am

Tier 03: The GRC comprise of

(a) Divisional Secretary (Chairman)
(b) Chairman of LRC
(c) Resident Engineer (Secretary)
(d) Grama Niladhari
(e) A representative of PAPs
(f) A representative of the plantation sector if plantation properties are affected.

Venue: Office of the Divisional Secretary.

Date & Time: 2nd and 4th Thursday of the month at 2.00pm

The GRC is a common forum to resolve problems of the affected in all sub projects that fall within the purview of the PMU.

If the GRC fail to arrive at a decision acceptable to the PAP, it will be referred to the next level which is headed by the Project Director of the LDPP 2(PMU).

Tier 04: The Project Director of LDPP2(PMU)

If the PAP has not consented to accept the decision of the GRC the issue will be referred to the Project Director of PMU .If the PAP is still not satisfied with the decision given by the project Director PMU

the issue will be referred will be referred to the next level which is the IGP .A brief containing the issues surfaced and the solutions offered will be submitted to the IGP by the Project Director within one week.
Venue: Office of the Project Director, LDPP2
Date &Time: 4th Wednesday of each mon**th at 10am**

Tier 05: Independent Grievance Panel (IGP). The IGP is composed of following members

(a) Representative of the Ministry of Land and Land Development
(b) Representative of the Ministry of Child Development & Women's Affairs
(c) Representative of the Valuation Department
(d) Retired civil servant of the rank of a Secretary of the GOSL
(e) A representative of Civil Society

Ideally this committee will be chaired by a retired civil servant as he is independent and equipped with experience to handle issues of this nature and will be more acceptable to the aggrieved party.

This forum comprises of high officials and knowledgeable people, the IGP will deliver its verdict within 14days.
Venue: Office of the Provincial Director of Road Development Authority in the province where the candidate site is located.
Date and Time: 4th Monday of each month at 10.00am
If the PAP is still not satisfied, he could seek judicial interventions by taking his grievance to Court of Appeal (CA).If the PAP is not satisfied with the decision of the CA, he could appeal to the apex judicial forum of the country the Supreme Court (CA).The Supreme Court first review the revision application submitted by the PAP and if find sufficient ground to examine the application in detail, leave to proceed will be allowed .The decision of the supreme court is final. Apart from litigation, the PAP could submit his grievance to the Mediation Board, Parliamentary Ombudsman, Human Rights Commission, and Parliamentary Select Committee of the Ministry of Mega polis and Western Development for redress.

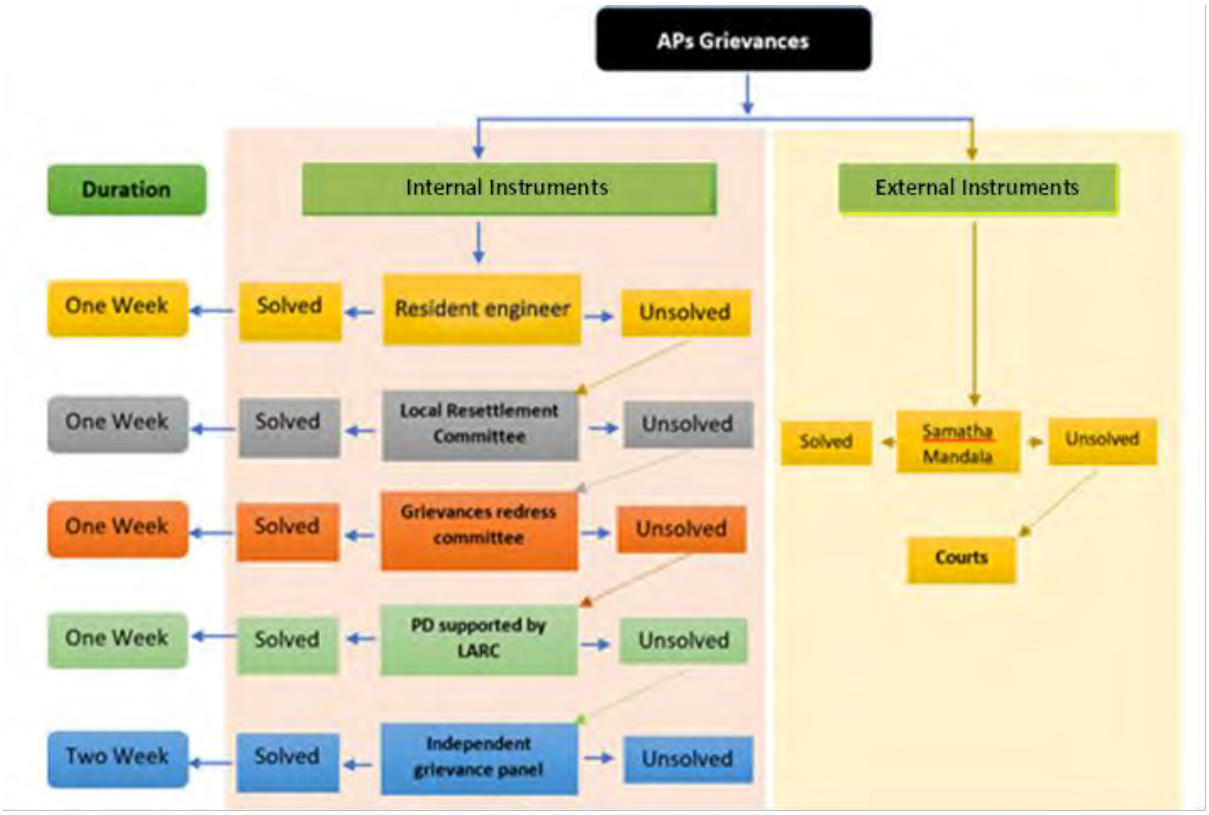
(3) Grievance Redress Committee Meetings (GRCMs), Hearings, Proceedings and Recommendations
If the dates mentioned falls on a holiday, the meeting will be held on the following day, proceedings, will be recorded by the GRC Secretary.
Minutes will be signed by all members of GRC. Applications, investigation reports, minutes of meetings and the decisions of the committees on each of the application for redress will be maintained in the office of the (PMU) for future reference.

1) Implementation of decisions of the Committees

The decisions at all levels will also be sent to the relevant applicants for his/her information. The recommendations will be implemented before the construction work is commenced in respective candidate sites if the grievance is in respect of compensation.

(4) Monitoring of Grievance Redress Mechanism

Grievance redress mechanism will be monitored closely during the monitoring phase of the RAP with measurable indicators for e.g. number of complaints received, number solved at RE's level, number referred to LRC, GRC, to Project Director LDPP2 and IGP
Note; The above mechanism will operate for each DS division to address the grievances of the PAP's



Source: JICA Survey Team

Figure 9.2.2 Grievance Redress Process

9.2.6 Implementation System (Responsible Organizations and their Roles)

The lead role in implementing the Resettlement Action Plan rests with the Social Expert of the Project Management Unit of the LDPP2. The implementation of the construction programme is devolved on a team headed by a senior engineer from RDA who is designated as the Project Director. Authority to the PMU derives from the Director General of RDA who is reporting to the Secretary, Ministry of Highways, Road Development and Petroleum Resources.

PMU will be supported by relevant experts in technical, social, land administration, and financial disciplines. In the implementation of the RAP the Social Officers and Community Development Officers of the PMU have a major role to play.

(1) Organizational Arrangement for the Implementation of RAP

The PMU will be responsible for the implementation of the RAP. The eligible PAPs will be decided by the Divisional Secretary of each division where the candidate locations are situated. The Acquiring Officer (DS) after the completion of the inquiries under the Sec.09 of the LAA issue the award to the PAP under Sec17 of LAA, indicating the extent and share of the land due to the PAP and the quantum of statutory valuation decided by the Chief Valuer based on replacement cost under 2013 regulations approved by parliament in November 2013 and submit the list to the PMU for the payment of statutory valuation to the PAP. The ex-gratia payment will be determined by the LD of RDA . When it is difficult to determine or arrange the payment, LARC procedures will follow. LARC and Super LARC established under 2013 regulations. Since 40 affected lots are distributed among 11 DS Divisions this

work could be undertaken by relevant DS and staff. In this project relevant DS will function as the chairperson of the LARC.

- The PMU will be staffed with the following officers before the implementation process commence.
- Project Director of the PMU (An Experienced Engineer)
- Chief Engineers (3 - RDA)
- Scientists (2 – NBRO)
- Environmental Officer (at least for one year)
- Administrative Staff
- Accounts Staff

The project office now functioning in Kandy established for the implementation of LDPP 1 will take charge of the social, resettlement and construction activities of LDPP 2 also, since they have gained experience in providing counter measures for landslide disasters. Kandy is strategically located within the Central Highlands and could be reached the candidate locations of Matale Ratnapura, Kegalle, Badulla and Nuwaraeliya within 1-3 hours. The other Project sites which are located in Colombo, Galle and Matara Districts also could be reached without much difficulty as the road network is pretty well developed in these areas too. Similar to the arrangement put in place for LDPP Phase 1, One of the senior engineers will be in charge of obtaining lands and coordinating with people.

- The implementation schedule carries the time frame of accomplishment of each and every activity of the plan. Preparation of Resettlement Plan for the preparatory study of LDPP2 has already commenced.

The Social Expert of the PMU of RDA with the assistance of staff will undertake the following activities.

- Coordinating with the Divisional Secretary's to complete the land acquisition process
- Arrange the inquiries at the LARC to decide on the compensation due to PAPs
- If the PAP is not satisfied with the decision of the LARC, initiate action to refer the matter to Super LARC.
- Take action to pay the compensation promptly
- Attend to grievances and activate the GRC mechanism
- Attend to income restoration
- Afford them reasonable time to vacate the fully affected lands, if possible, allow them to harvest the standing crops.
- Attend to gender issues
- Monitor the RAP implementation process
- Make arrangements to pay the interest due on acquired assets.

The implementation schedule carries the time frame of accomplishment of each and every activity of the plan. Resettlement activities will commence with allocation of staff to scheduled activities.

(2) Review of Mandate and Capacity of Resettlement Agencies

1) Review of Mandate and Capacity of Resettlement

In implementing the RAP, the collaboration of several related agencies is vital for achieving the

outcomes. Departments of Valuation, Survey Department, and Government Printer. In particular the PMU assists the Acquiring Officer with technical assistance when required. Since only 40 PAPs are involved, the necessity of recruiting an Acquiring Officer to accelerate the process of land acquisition does not arise. This arrangement arises only if acquisition triggers due to failure of negotiations to get the relevant land released from the PAPs without compensation

The following are the key state agencies that will have direct involvement with resettlement interventions:

- Ministry of Highways,Road Development and Petroleum Resource Development
- Ministry of Land and Land Development and Parliamentary Affairs
- Acquiring Officer
- Consultants on land acquisition and ressettlement
- Survey Department
- Valuation Department
- Government Printer
- Central Environmental Authority
- Local Government Institutions of the project area.
- Ceylon Electricity Board
- Water Supply and Drainage Board
- Sri Lanka Telecom Ltd.

The PMU carries out the following activities in implementing the Resettlement Programme:

- Conduct awareness meetings with stake holders to disseminate and update information and also receive feedback from stakeholders with the assistance of Consultants.

Establish Public Information Centre (PIC) and develop and

- Distribute informative bulletins and relevant materials to ensure transparency.
- Prepare Resettlement Plan and implement them with the aim of restoring/improving the lives of the PAPs at least to the pre project level or beyond
- Conduct Land Acquisition and Resettlement (LARS) and Social and Economic (SES) surveys to collect necessary data for resettlement planning through hired consultants.
- Coordinate with the AO to complete the land acquisition process
- Advise the PAPs regarding the list of documents to be submitted at the title determination inquiries conducted under Section 9 of the LAA, if acquisition triggers

Arrangement to pay the interest due on the statutory payments.

- Ensure the execution of the entitled compensation package and realize the objectives of the NIRP and JICA, expedite payment of compensation by assisting the AO and the PAPs.
- Arrange the inquiries at the LARC to decide on the compensation due to PAPs
- If the P AP is not satisfied with the decision of the LARC, initiate action to refer the matter to Super LARC.
- Assist/ and coordinate with relevant agencies to restore/improve the income of the PAPs.
- Afford them reasonable time to vacate the fully affected lands
- Ensure flow of funds to maintain a healthy cash flow.
- Store all data in respect of compensation in a pre-prepared database.

- Maintain a file for each PAP, this file will contain, data on each PAP collected at LARS and SES survey and the details of payments made and other correspondence with the PAPs
- Coordinate/monitor the activities of GRCs.
- Assist vulnerable groups including women and the poor.
- Develop a plan to address gender concerns.
- Prepare/submit required periodic reports to the relevant stakeholders including JICA.
- An Issue a certificate to each household head indicating the list of compensation paid.
- Maintain MIS for the project through networking with relevant agencies

2) Divisional Secretary (DS)

Divisional Secretary is responsible for civil administration of the division and hence empowered with statutory provisions to acquire land within the division and vest them with the agencies that required land under LAA.

Contractors and consultants employed by the PMU, Community Based Organizations of APs, NGOs and other civic organizations also play a significant role in the implementation process of the RAP. The involved government agencies have sufficient capacity and experience to efficiently and effectively contribute to the implementation of the RAP. Their contribution is well within their respective mandates. The PMU coordinates the efforts and whenever required supports them with technical assistance.

The PMU/ provides for capacity building, including technical assistance, when required or when new types of interventions and procedures are called for like in the case of the Southern Expressway.

Table 9.2.23 Matrix of Roles and Responsibilities of Government Agencies and Other Organizations involved in Resettlement Planning and Implementation.

Agency / Unit	Roles and Responsibilities
PMU/Ministry of Highways, Road Development and Petroleum Resource Development	Preparation of land acquisition proposals, staffing, coordination with other relevant agencies, consultation with stake holders, dissemination of information, secure funds, identify lands/houses for resettlement with PAPs, arrange IRP, attend to internal monitoring, progress review, Project MIS and documentation.
PMU/Ministry of Highways, Road Development and Petroleum Resource Development	Provide necessary policy guidelines, provide funds, coordinate with the WB and give directions to the PMU on implementation issues.
	Submit proposals forwarded by the PMU of RDA to MOL, arrange for funds including reimbursement responsibility.
Ministry of Land and Parliamentary Affairs	Approvals of the publications of relevant orders under LAA, on the request of Ministry of LLD&PA. Monitor the progress of land acquisition and liaise with the AO at different stages of acquisition process.
Acquiring Officer	Acquisition of land is done by the Acquiring Officer /Divisional Secretary to after the relevant orders are issued by Ministry of Land and Parliamentary Affairs. PMU provide technical assistance on request to the Acquiring Officer. The AO support the implementation of RAP when necessary on PMUs' request. Support rehabilitation and improvement of public utilities disturbed by land acquisition and construction program if extra acquisition is required to shift the utilities..
Grama Niladari/Land Officer of PMU	Delivery of notices under LAA to the PAPs on the request of the AO, consultation, facilitation of acquisition of alternate lands, during preparation of advance tracing and final plan by assisting the surveyors to identify the claimants.
Valuation Department	Preparation of valuation reports for the affected properties, assist in LARC and Super LARC processes.
Government Printer	Publication of gazette notifications relevant to land acquisition.

Agency / Unit	Roles and Responsibilities
NGO	Consultations, dissemination of information, assist APs at the title determination inquiries (Sec.09),on grievance resolution ,external monitoring on the invitation of the PMU if their involvement is necessary..
Affected People	Assist the PMU to implement the resettlement programme.
Construction Supervision Consultants	Ensure the contractor will carry out the construction work without damaging the public and private properties.
Contractor	Construct is expected to take precautionary measures during construction to avoid damages to private and public property, if damage is caused, he will restore such structures to its original status at his own cost on the instructions of the PMU. /CSC.
JICA	Review Missions

Source: JICA Survey Team

9.2.7 Implementation Schedule

The period of implementation of land acquisition and resettlement will commence from December 2021 and continue up to September 2023. The time schedule by activity is shown in the following **Figure 9.2.3**.

Activities	Responsibility	2021			2022												2023									
		10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10
Supplemental socio-economic survey	PMU/Consultant																									
Review and update of the RAP	PMU/Consultant																									
Awareness meetings with stakeholders prior to construction programme	PMU/Consultant																									
Entering into memorandum of understanding with the land owners for temporary possession of land during construction	PMU/Consultant																									
Preparation of acquisition proposal	PMU, RDA/MOHRDPRD																									
Publication of first notice and preparation of Advanced Tracing	PMU, RDA, MLLD, DS, Survey Departmet																									
Investigation and calling for objections	PMU, RDA, MLLD, DS																									
Decision to acquire the land	PMU, RDA, MLLD, DS, Survey Departmet																									
Inquiry into claims and payment of compensation	PMU, DS, MOHRDPRD, Valuation Department																									
Taking over of possession after the acquisition	PMU, DS, MOHRDPRD, RDA, MLLD																									
Vesting of certificate	PMU, DS, RDA, MLLD																									
Physical relocation of PAPs	PMU, DS																									
Grievance Redressing	PMU, DS																									
Preparation and implementation of IRP	PMU/Consultant																									
Internal Monitoring	PMU/Consultant																									
External Monitoring	PMU/EMA																									

Abbreviations
DS: Divisional secretary
EMA: External monitoring agency
IRP: Income Restoration Program
MLLD: Ministry of land and land development
MOHRDPRD: Ministry of highways and roads development and petroleum resources development
PAPs: Project affected persons
PMU: Project Management Unit
RAP: Resettlement action plan

Source: JICA Survey Team

Figure 9.2.3 Land Acquisition Implementation Schedule

9.2.8 Cost and Resources

Necessary cost for land acquisition activities is estimated and shown in **Table 9.2.24**.

This tentative cost estimate is based on the rules on payment of compensation enacted in parliament in November 2013 under the LAA by the Minister of Land and Land Development and made operative by the Government Gazette No.1837/47of 22nd 2013 and revised Entitlement Matrix of the RDA

The values for land and structures were calculated on market value and replacement cost respectively on the data collected by enumerators during the LARS & SES. Notaries, housing estate dealers and knowledgeable residents of the area were consulted. Advice was taken from the Local Valuer also. Their general view was that during the past 3 – 4 years land / property prices have not significantly changed in the areas where counter measures for landslides to be implemented.

Table 9.2.24 Land Acquisition and Resettlement Budget

Item	Quantity	Unit	Rs./unit (Ave.)	Total	
				(Rs.)	(USD)
Lands [1)]					
Private Lands	1,041	perches	75,000	78,075,000	433,608
Plantation Estate Lands	645		40,000	25,800,000	146,591
Sub Total	1,686		-	103,875,000	590,199
Structures					
Temporary House	150	sq. ft	1,500	225,000	1,278
Permanent House	1,500		3,000	4,500000	25,568
Sub Total	1,650		-	4,725,000	26,847
Trees					
Rubber	370	nos.	2,500	925,000	5,256
Coconut	13		3,000	39,000	222
Jack	36		3,000	108,000	614
Fruit trees	45		2,000	90,000	511
Others	3		2,000	6,000	34
Sub Total	467		-	1,168,000	6,636
Shifting of Utilities					
Waterlines of the PAPs [2)]	60	nos.	10,000	600,000	3,409
Sub Total	60		-	600,000	3,409
Temporary Disruption of Business					
Temporary loss of income from plantation crops [3)]	1,577 perches/160 =10 Acres	acres	750,000	7,500,000	42,614
Temporary disruption of business of a shop (one (1) year)	1	AHH	250,000	250,000	1,420
Sub Total	-	-	-	7,750,000	44,034
Other Assistance					
Support and income restoration	-	-	Lump Sum	500,000	2,841
Assistance for Vulnerable Families	10	AHH	15,000[4)]	150,000	852
Expenses for GRC	40 [5)]	nos.	10,000	400,000	2,273
Sub Total	-	-	-	1,050,000	5,966
Monitoring & Evaluation and Administration					
Internal monitoring	20	months	-	-	-
External Monitoring	14	months	Lump sum	4,500,000	25,568
Administration Expenses [6)]	-	-	Lump Sum	5,000,000	28,409

Item	Quantity	Unit	Rs./unit (Ave.)	Total	
				(Rs.)	(USD)
Sub Total	-	-	-	9,500,000	53,977
Total	-	-	-	128,668,000	731,068
Contingencies 10%	-	-	-	12,866,800	73,107
Grand Total	-	-	-	141,534,800	804,175

Source: JICA Survey Team **USD =Rs.176**

1) When private land is needed for construction facilitating activities such as access road or storage of materials, the plot of the land will be temporarily taken on the basis of voluntary provision from the land owners. However, a land lease fee may be paid if the PMU fails to obtain the agreement of the land owner. The land lease fee will be calculated by multiplying the market unit price and the duration of occupying the land.
2) Relaying of existing PVC pipes owned by PAPs
3) When plantation land is used for construction purposes, existing plantation crops need to be removed. If a tea bush is removed, it takes at least three (3) years to obtain the income earned prior to removal of trees after getting the land back on completion of construction work. Assuming the construction period of two (2) years, the loss of income stretches for five (5) years.
4) This is the amount approved by the RDA for vulnerable families in other projects. LARC could decide a higher allowance.
5) Two GRC meetings for 18 DS Divisions and one GRC meeting for 4 DS Divisions
6) The administration is done by the PMU, if a separate office is maintained for the implementation of the RAP, then only it will function as a separate cost centre but salaries are a sunk cost. The staff will be drawn from the human resources available with the PMU. Normally they do not apportion cost of employee's time for attending to project activities since the employees are in the permanent cadre of RDA except for consultants hired for a specific job for which funds have been provided under Admin expenses and in the Contingencies.

There is no direct provision in the 2013 regulations to deal with temporary possession of land, but the Land Division of RDA could decide on the loss of income to be paid. Or the estimate provided in the budget could be built into the contract and RDA could settle the payment and deduct the amount from the contractors claim. The estimate for the loss of income for the temporary possession of land cultivated with tea by private estates is based on the following formula:

1. Average yield of green tea per acre per year is = 3,000 kg
2. Total yield for 10 acres for a year = 30,000 kg
3. Average price of green leaf (tea) per kilogramme is = Rs.100
3. Loss of revenue for 5 years: 30,000kg/yr*5yrs*Rs.100/kg = Rs.15,000,000
4. Less cost of production: 50% of revenue = Rs 7,500,000
5. Loss of income: Rs.15,000,000 – Rs.7,500,000 **= Rs 7,500,000**

The number of acres of plantation land temporary required is approximately 1,577 perches or 10 acres. One acre consists of 160 perches.

Number of electric posts to be shifted is 109 and telephone post is 115. The cost of shifting these utilities does not come under the resettlement budget. It is part of the construction cost. The water lines are the property of the PAPs and are treated as a resettlement cost.

9.2.9 Monitoring System and Form by the Implementation

Monitoring and Evaluation is one of the important features of any project. Monitoring helps to detect any short comings or whether project is in correct course and function as a whistle blower to take remedial measures before the events get out of control. Resettlement Monitoring refers to the collection, processing, analysis, reporting and use of information on the progress of resettlement based on the RAP. Monitoring is focuses on physical and financial targets and the delivery of entitlements to displaced persons. Monitoring is usually conducted internally by the executing agency, sometimes with the assistance of external monitoring specialists.

(1) Internal Monitoring

Internal monitoring will be done by the PMU. The period of internal monitoring will commence from March 2022 when the acquisition proposal is prepared and will continue for 20 months. The Social Specialist will play a key role at the PMU level. Internal monitoring will be focused on timely execution of safeguard activities in line with the RAP including RAP implementation, scheduling with civil works, monitoring the role of contractors, managing and monitoring safeguards, expected from consultants and their outputs, documentation of progress with regard to eligibility list preparation, disclosure and consultation, grievance registration and resolution, disbursement of entitlements, day-to-day relocation support, etc. Internal Monitoring will pay special attention to the following:

- Efficiency and effectiveness of the day to day planning and implementation of the RAP;
- Efficient and transparency in disbursement of compensation, Resettlement &Rehabilitation (R&R) benefits;
- Data collection, feedback information, identification of bottlenecks and troubleshooting;
- Documentation for informed decision making, and efficient response to implementation issues;
- Maintenance of each APs entitlement updated file;
- Management of baseline information on socio economic conditions of the APs, to access whether the socio-economic conditions improve and income and living standard improve/ restored;
- Preparation of progress reports; and Coordination within the implementing organization as well as with outside agencies.

1) Tools for Internal Monitoring Include:

- Document review
- Surveys of APs
- Key informant interviews
- In-depth case studies
- Focus group meetings
- Public, community meetings, and
- Observations.

(2) External Monitoring

The PMU will engage an external monitoring and review agency for independent review of the safeguard implementation program to determine whether intended goals are being achieved, and if not, what corrective actions are needed. The period of external monitoring will commence from September 2022 when inquiry into claims and payment of compensation are started and will continue for 14 months. External monitoring will have two objectives.

Verify if the safeguard program is being implemented in accordance with the approved framework; and

verify whether APs, households and communities are able to address negative impacts and either improved or at least restore their livelihoods and living standards.

1) External Monitoring is intended to:

Verify that the RAP has been implemented according to approved plans and procedures;

- Assess that the objectives of the RAP have been achieved;
- Determine that APs livelihood and living standards have been restored or improved and if not suggesting ways and means of improving performance;
- Obtain views of the APs on their relocation, entitlements and Grievance Redress Committee's performance;
- Evaluate the performance of the, all implementing Agencies including PMU, NGOs, CBOs and other Government Agencies associated with the implementation of the project;
- All social development goals have been met; and
- Review of all reports by the internal monitoring agencies.

The external monitoring agency will carry out a baseline survey prior to implementation and carry out periodic updates as agreed. The findings of external monitoring will be submitted to the PMU and considered at the Project Steering Committee. A TOR for hiring such a consultant will be is provided.

The design of the monitoring system will also involve the delineation of the monitoring roles and responsibilities and mechanisms for coordination of monitoring. The monitoring system will provide for both internal and external monitoring and reporting. Social audits on the progress of the safeguard program will be conducted as an integral part of external monitoring.

(3) Monitoring Indicators

The main monitoring indicators for the project are given in **Table 9.2.25**:

Table 9.2.25 Monitoring Indicators

Type	Indicator	Examples of Variables
Process Indicators	Staffing	Have all land acquisition and resettlement staff been appointed and mobilized for the field and office work on schedule No. of surveyors & valuation officers, resettlement officers available for training programs held for the project staff No of unit/field offices established
	Consultation	Have consultations taken place as scheduled including meetings, groups, community activities? No. of awareness meetings held with the stake holders and participation No. of flyers/handbills distributed How many PAPs know their entitlements?
	Participation	No of training programs held for the, officers No. of informative bulletins distributed How many officers attended training programmes
	Grievance Resolution	No. of GRC established How much do APs know about grievance procedures and conflict resolution procedures? Have any PAPs used the grievance redress procedures? What were the outcomes? Have conflicts been resolved. No. of complaints received and resolved
Output Indicators	Acquisition of Land	Type and extent of private land acquired Type and extent of state land acquired Has all land been acquired and taken possession in time for project implementation?
	Structures,	No. type and area of private structures acquired No. type and area of state structures acquired

		No. type and area of community structures acquired
	Trees & Crops	No. and type of trees/crops owned by private people acquired No. and type of trees/crops owned by state agencies Acquired Have the owners compensated for the loss of trees
	Compensation and Rehabilitation	How much PAPs know about resettlement procedures and entitlements? Do APs know their entitlements? Have all PAPs received entitlements according to numbers and categories of loss set out in the entitlement matrix? Have PAPs received compensation on time? Have all PAPs received entitlements according to numbers and categories of losses set out in the entitlement matrix? Have all PAPs received the agreed transport costs, relocation costs, income substitution support and any resettlement allowances according to schedule? Were house compensation payments made free of depreciation, fees or transfer costs to the AP.? How many PAPS have received housing as per relocation? options in the RAP No. of households displaced according to type of losses Ag. compensation paid for a perch of land Ag. compensation paid for a sq. ft. of buildings Type, number and total of allowances paid No. of households displaced according to type of losses No. of structures restored by PAPs No. of auxiliary structures restored by PMU. No. of auxiliary structures restored by PAPs Did businesses affected receive sufficient assistance to re-establish themselves? Have vulnerable groups been provided income earning opportunities?
Impact	Household Earning Capacity	No. obtained loans from bank and other sources No. assisted by IRP No. employed by the project What changes have occurred in patterns of occupation, production and resource use compared to the pre-project situation? What changes have occurred in income and expenditure patterns compared to pre project situation? Have APs income kept pace with these changes? What changes have taken place in key social and cultural parameters relating to living standards? What changes have occurred for vulnerable people?
	Changes to Status of Women	Participation in Community Based activities Loss of employment Empowerment /facilitation of gender issues Participation in project activities
	Changes to status of Children	Changes in school attendance by gender No. attending new schools, gender wise Improvement in education levels
	New Settlement & Population	Generation of new businesses, Influx of population Outsiders buying land in the vicinity of the project, increase in land value increase in encroachers /non titled people on state lands Due to influx of construction workers, is there any increase in violence? Is there any increase in sexually transmitted diseases? (could be compared with data available in the respective police stations and health institutions)
	Impact of the community living close to the project areas	Do a sample survey of people in the near vicinity of the project to ascertain the impact on their socio economic status as a result of the project for a comparison with the APS.

Source: JICA Survey Team

(3) Evaluation Plan

Evaluation is conducted during and after implementation. It assesses whether the resettlement objectives were appropriate and whether they were met specifically whether livelihoods and living standards have been restored and enhanced. The evaluation assesses the efficiency, effectiveness, impact and sustainability drawing lessons as a guide to future resettlement planning.

Evaluation differs from monitoring because of its broader scope, its less frequent timing and its involvement of independent specialists.

Evaluation will be based on the following objectives:

- Efficiency; the economical use of resources in producing the outputs.
- Effectiveness; the degree to which objectives have been achieved.
- Impact; positive/negative, planned or unplanned consequences of the project relevance; the degree to which the project can still be justified in relation to local and national development priorities.

Evaluation will take into account relevance;

Sustainability the extent to which the positive effects of the project will continue to benefit APs after the conclusion of the project (external funding).

The evaluation will be carried out by an external agency and will cover all aspects of the project, if relevant participation of affected people in M&E will be encouraged. The external evaluation will be participatory in the sense that inputs will be obtained from all stakeholders; particularly the affected people through the use of participatory tools and findings will be used in policy advocacy.

1) Reporting Requirements

The key output of Monitoring will consist of various types of written and oral reporting including

- Periodic Reports (Monthly; Internal, Quarterly, and Annual);
- Ad hoc Reports, especially on particular subject at the request of the management; and
- Internal notes or oral presentation for informal management review sessions.

The reports will be on a standardized format so that information received could be easily compared with previous reports. It will be precise and concise; timely and highlight exceptions and departure from plans and schedules.

2) Reporting Responsibilities

Reporting to the APs will constitute an important element of the accountability arrangements. The reporting mechanisms at this level would be simple and be accessible to all. Reporting will consist of briefing material, notices in regard to safeguard measures, and leaflets that can be distributed to persons and households. The monthly progress review meetings of the Project will also constitute the reporting mechanism.

- Reporting to the PMU and Steering Committee and The Stakeholder Forum
- The Monitoring and Evaluation Cell will report to the PD who will in turn report monthly to the Project Steering Community.

3) Reporting Contents

Reporting will focus on the following:

- Number of affected persons (PAPs) by specific categories
- Land acquisition with details of the process, e.g. number of Section 2 notices issued etc.
- Number of (PAPs) prepared and number of Section 38 (a) issued etc.
- Number of PAPs paid statutory and extra compensation

- Number of Buildings/structures taken over by PMU
- Number of self-relocated people
- Number of people of vulnerable groups assisted by the PMU by category
- Number of gender issues/practical issues of female APs reported by the APs
- Number of gender issues/ practical issues of female APs resolved
- Number of sexually transmitted diseases reported to the health authorities
- No of crimes reported to the police
- Number of PAPs that require income and livelihood restoration assistance
- Number of PAPs assisted under IRP – training; self - employment; engaged in project etc.
- Number of PAPs facing losses due to contractors' storage, accommodation, parking etc.
- Number of GRC meetings held
- Number of complaints received by the GRC
- Number of grievances resolved by the GRC
- A base- line report taking into account the entire foregoing scenario.

9.2.10 Community Consultation

As described in Section 9.1.11, the consultations with the stakeholders were conducted as shown in **Table 9.1.30**. The participant list and the memo of discussion are shown in **Appendix6_2 and Appendix6_3** respectively.

Showing the layout plan of the countermeasures against sediment disasters, the purpose, the outline, possible positive/negative impacts, the policy of compensation for land acquisition and other losses were explained.

Main opinions of the participants at the meetings are serious situation of sediment disaster which they are suffering from, and expectation of full-scale countermeasures to protect their living and livelihood from sediment disasters. Though a few requests for environmental and social consideration were made, no particular opinion against the project was raised.

The opinions were informed to PMU/RDA. PMU/RDA will reasonably compensate the PAPs for land acquisition and other losses as same as in the case of LDPP Phase 1. It has been confirmed that PMU/RDA will explain the intention to the PAPs and get their consent at stakeholder consultations in the next stage.

9.3 Others

9.3.1 Draft Monitoring Forms

(1) Environmental Monitoring Form

1. Permits and Approvals, Explanation

Monitoring Period: from Date Month Year to Date Month Year

Monitoring Item	Monitoring Results during Report Period
Response to matters indicated by authorities	Pre-construction and construction stages Monthly basis Operation stage Semi-annual basis

2. Pollution

2.1 Air Quality (Ambient Air Quality)

1) Pre-construction Stage

Location:

Monitoring Period: from Date Month Year to Date Month Year

Item	Averaging Time	Unit	Measured Value		National Standards (Max.)[*1]	International Guidelines[*2]	Remarks
			Mean	Max.			
SO_2	24 hrs.	$\mu g/m^3$			80	20	a) Frequency 1 time
	8 hrs.				120	-	
	1 hr.				200	-	
NO_2	24 hrs.	$\mu g/m^3$			100	-	b) Implementation Contractor
	8 hrs.				150	-	
	1 hr.				250	200	
CO	8 hrs.	$\mu g/m^3$			10,000	10,000	c) Supervision PMU
	1 hr.				30,000	-	
	Any time				58,000	-	
O_3	8 hrs.	$\mu g/m^3$			-	100	
	1 hr.				200	-	
PM10	24 hrs.	$\mu g/m^3$			100	50	
	1 yr.				50	20	

PM2.5	24 hrs.	µg/m^3			50	25	
	1 yr.				25	10	

*1: The National Environmental (Ambient Air Quality) Regulations published under the Gazette Notification No. 1562/22 dated 15.08.2008
*2: Air quality guidelines – global update 2005 (WHO Europe, 2005)

2) Construction Stage

Location:

Monitoring Period: from Date Month Year to Date Month Year

Item	Averaging Time	Unit	Measured Value		Baseline Data	National Standards (Max.)*1	International Guidelines*2	Remarks
			Mean	Max.				
SO_2	24 hrs.	µg/m^3			Values measured at the Pre-construction stage	80	20	a) Frequency 4 times/year
	8 hrs.					120	-	
	1 hr.					200	-	
NO_2	24 hrs.	µg/m^3				100	-	b) Implementation Contractor
	8 hrs.					150	-	
	1 hr.					250	200	c) Supervision PMU
CO	8 hrs.	µg/m^3				10,000	10,000	
	1 hr.					30,000	-	
	Any time					58,000	-	
O_3	8 hrs.	µg/m^3				-	100	
	1 hr.					200	-	
PM10	24 hrs.	µg/m^3				100	50	
	1 yr.					50	20	
PM2.5	24 hrs.	µg/m^3				50	25	
	1 yr.					25	10	

*1: The National Environmental (Ambient Air Quality) Regulations published under the Gazette Notification No. 1562/22 dated 15.08.2008
*2: Air quality guidelines – global update 2005 (WHO Europe, 2005)

2.2 Water Quality (spill and leakage)

1) Construction Stage

Monitoring Period: from Date Month Year to Date Month Year

Monitoring Item	Monitoring Results
Appearance of spill and leakage of oil and grease	Frequency: Daily

2.3 Water Quality (Effluent/Wastewater, Groundwater)

1) Pre-construction Stage

Location:

Monitoring Period: from Date Month Year to Date Month Year

Item	Unit	Measured Value		National Standards (Max.)*1	International Guidelines*2	Remarks
		Mean	Max.			
EC (Electrical Conductivity)	S/m			-	-	a) Frequency 1 time
pH	-			6.0 – 8.5	6 – 9*2	
TSS	mg/L			50	50*2	b) Implementation Contractor
BOD_5	mg/L			30	30*2	
Oil & Grease	mg/L			10	10*2	
Coliform	MPN/100mL			40 (Fecal Coliform)	400*2 (Total Coliform)	c) Supervision PMU

*1: National Environmental (Protection and Quality) Regulations, No. 1 of 2008. (Water), Tolerance limits for the discharge of industrial waste in to inland surface waters
*2: IFC EHS general guidelines, for treated sanitary sewage discharges (2007)

2) Construction Stages

Location:

Monitoring Period: from Date Month Year to Date Month Year

Item	Unit	Measured Value		Baseline Data	National Standards (Max.)*1	International Guidelines*2	Remarks
		Mean	Max.				
EC (Electrical Conductivity)	S/m			Values measured at the Pre-construction stage	-	-	a) Frequency 4 times/year
pH	-				6.0 – 8.5	6 – 9*2	
TSS	mg/L				50	50*2	b) Implementation Contractor
BOD_5	mg/L				30	30*2	
Oil & Grease	mg/L				10	10*2	
Coliform	MPN/100mL				40 (Fecal Coliform)	400*2 (Total Coliform)	c) Supervision PMU

*1: National Environmental (Protection and Quality) Regulations, No. 1 of 2008. (Water), Tolerance limits for the discharge of industrial waste in to inland surface waters
*2: IFC EHS general guidelines, for treated sanitary sewage discharges (2007)

2.4 Waste

1) Pre-construction Stage

Monitoring Period: from Date Month Year to Date Month Year

Monitoring Item	Monitoring Results
Capacity of designated disposal sites	Frequency: one time

2) Construction Stage

Monitoring Period: from Date Month Year to Date Month Year

Monitoring Item	Monitoring Results
Volume of generated surplus soil and disposed surplus soil	Frequency: Monthly
Appearance of temporary storage of surplus soil and solid waste	Frequency: Monthly

2.5 Soil Contamination

1) Pre-construction Stage

Monitoring Period: from Date Month Year to Date Month Year

Monitoring Item	Monitoring Results
Appearance	Frequency: one time

2) Construction Stage

Monitoring Period: from Date Month Year to Date Month Year

Monitoring Item	Monitoring Results
Appearance	Frequency: Monthly

2.6 Noise

1) Pre-construction Stage

Location:

Monitoring Period: from Date Month Year to Date Month Year

Item	1 hr. L_{Aeq}	Unit	Measured Value		National Standards (Max.)[*1]	International Guidelines[*2]	Remarks
			Mean	Max.			
Noise	Daytime (6:00-18:00)	dB(A)			(6:00-18:00) 55	(7:00-22:00) 55	a) Frequency 1 time b) Implementation Contractor
	Night time (18:00-6:00)				(18:00-6:00) 45	(22:00-7:00) 45	

							c) Supervision PMU

*1: National Environmental (Noise Control) Regulations No.1 1996 Maximum Permissible Noise Levels at Boundaries in L_{Aeq} 'T, for industrial activities in rural residential area

*2: IFC EHS general guidelines, for acceptable indoor noise level for residential, institutional and educational settings refer to WHO (1999)

2) Construction Stage

Location:

Monitoring Period: from Date Month Year to Date Month Year

Item	1 hr. L_{Aeq}	Unit	Measured Value		Baseline Data	National Standards (Max.)*1	International Guidelines*2	Remarks
			Mean	Max.				
Noise	Daytime (6:00-21:00)	dB(A)			Values measured at the Pre-construction stage	(6:00-21:00) 75	(7:00-22:00) 55	a) Frequency 4 times/year b) Implementation Contractor c) Supervision PMU
	Night time (21:00-6:00)					(21:00-6:00) 50	(22:00-7:00) 45	

*1: National Environmental (Noise Control) Regulations No.1 1996 Maximum Permissible Noise Levels at Boundaries in L_{Aeq} 'T, the land which the source of noise is located in construction activities

*2: IFC EHS general guidelines, for acceptable indoor noise level for residential, institutional and educational settings refer to WHO (1999)

2.7 Vibration

1) Pre-construction Stage

Location:

Monitoring Period: from Date Month Year to Date Month Year

Item	Unit	Frequency Band	Measured Value		National Standards (Max.)*1	International Guidelines	Remarks
			Mean	Max.			
Vibration (Continuous)	mm/sec	0-10 Hz			1.0	-	a) Frequency 1 time b) Implementation Contractor c) Supervision
		10-50 Hz			2.0	-	
		50 Hz <			4.0	-	
Vibration (intermittent)		0-10 Hz			2.0	-	
		10-50 Hz			4.0	-	
		50 Hz <			8.0	-	

							PMU

*1: Interim Standards for vibration of the operation of machinery, construction activities and vehicle movements traffic, for category of structure "Type 3"

2) Construction Stage

Location:

Monitoring Period: from Date Month Year to Date Month Year

Item	Unit	Frequency Band	Measured Value		Baseline Data	National Standards (Max.)*1	International Guidelines	Remarks
			Mean	Max.				
Vibration (Continuous)	mm/sec	0-10 Hz			Values measured at the Pre-construction stage	1.0	-	a) Frequency 4 times/year b) Implementation Contractor c) Supervision PMU
		10-50 Hz				2.0	-	
		50 Hz <				4.0	-	
Vibration (intermittent)		0-10 Hz				2.0	-	
		10-50 Hz				4.0	-	
		50 Hz <				8.0	-	

*1: Interim Standards for vibration of the operation of machinery, construction activities and vehicle movements traffic, for category of structure "Type 3"

2.8 Odor

1) Pre-construction Stage

Monitoring Period: from Date Month Year to Date Month Year

Monitoring Item	Monitoring Results
Offensive odor	Frequency: one time

2) Construction Stage

Monitoring Period: from Date Month Year to Date Month Year

Monitoring Item	Monitoring Results
Offensive odor	Frequency: Monthly

2.9 Sediment

1) Pre-construction Stage

Monitoring Period: from Date Month Year to Date Month Year

Monitoring Item	Monitoring Results
Appearance	Frequency: one time

2) Construction Stage

Monitoring Period: from Date Month Year to Date Month Year

Monitoring Item	Monitoring Results
Appearance	Frequency: Monthly

3. Natural Environment

3.1 Protected Areas

1) Pre-construction Stage

Monitoring Period: from Date Month Year to Date Month Year

Monitoring Item	Monitoring Results
Appearance	Frequency: one time

2) Construction Stage

Monitoring Period: from Date Month Year to Date Month Year

Monitoring Item	Monitoring Results
Disturbance to protected areas	Frequency: Monthly (to be included in the monitoring of Ecosystem)

3.2 Ecosystem

1) Pre-construction Stage

Monitoring Period: from Date Month Year to Date Month Year

Monitoring Item	Monitoring Results
Number and type of precious species	Frequency: one time

2) Construction Stage

Monitoring Period: from Date Month Year to Date Month Year

Monitoring Item	Monitoring Results
Number and type of precious species	Frequency: Monthly
Number and type of trees to be cut	Frequency: Monthly (before and after cutting trees for each time)

3.3 Hydrology

1) Pre-construction Stage

Monitoring Period: from Date Month Year to Date Month Year

Monitoring Item	Monitoring Results
Appearance of river (course, depth and width)	Frequency: one time

2) Construction Stage

Monitoring Period: from Date Month Year to Date Month Year

Monitoring Item	Monitoring Results
Stagnant flow or drying up of the river	Frequency: Monthly

3.4 Topography and Geology

1) Pre-construction Stage

Monitoring Period: from Date Month Year to Date Month Year

Monitoring Item	Monitoring Results
Appearance	Frequency: one time

2) Construction Stage

Monitoring Period: from Date Month Year to Date Month Year

Monitoring Item	Monitoring Results
Volume of excavation	Frequency: Monthly (to be included in the monitoring of Waste)
Landslide movement	Frequency: Monthly

4. Social Environment

Items, “Land Acquisition and Resettlement”, “The Poor”, “Living and Livelihood”, “Use of Land and Local Resources”, “Existing Social Infrastructure and Social Services” and “Gender” will be monitored using “RAP Monitoring Form”.

4.1 Water Resources

1) Pre-construction Stage

Location:

Monitoring Period: from Date Month Year to Date Month Year

Item	Unit	Measured Value		Frequency	Implementation	Supervision	Remarks
		Mean	Max.				
Groundwater Level	m			1 time each during dry and rainy seasons	Contractor	PMU	

2) Construction Stage

Location:

Monitoring Period: from Date Month Year to Date Month Year

Item	Unit	Measured Value		Baseline Data	Frequency	Implementation	Supervision	Remarks
		Mean	Max.					
Groundwater	m			Values measured at the	2 times each during dry	Contractor	PMU	

Level				Pre-construction stage	and rainy seasons			

3) Operation Stage
Location:
Monitoring Period: from Date Month Year to Date Month Year

Item	Unit	Measured Value		Baseline Data	Frequency	Implementation	Supervision	Remarks
		Mean	Max.					
Groundwater Level	m			Values measured at the Pre-construction stage	1 time each during dry and rainy seasons for 2 years	RDA/ESDD	RDA	

4.2 Children's Rights
1) Pre-construction Stage
Monitoring Period: from Date Month Year to Date Month Year

Monitoring Item	Monitoring Results
Exact locations of schools and routes for children going to and from school	Frequency: one time

2) Construction Stage
Monitoring Period: from Date Month Year to Date Month Year

Monitoring Item	Monitoring Results
Employment of children for construction work	Frequency: Monthly
Disturbance to children's studies	Frequency: Monthly

4.3 HIV/AIDS and other Infectious Diseases
1) Pre-construction Stage
Monitoring Period: from Date Month Year to Date Month Year

Monitoring Item	Monitoring Results
Numbers of sufferers of infectious diseases in the project areas	Frequency: one time

2) Construction Stage
Monitoring Period: from Date Month Year to Date Month Year

Monitoring Item	Monitoring Results
Dissemination of awareness programs on infectious diseases for both workers and surrounding residents	Frequency: Quarterly

4.4 Working Conditions

1) Pre-construction Stage

Monitoring Period: from Date Month Year to Date Month Year

Monitoring Item	Monitoring Results
A list of all nearest hospitals at each project site	Frequency: one time

2) Construction Stage

Monitoring Period: from Date Month Year to Date Month Year

Monitoring Item	Monitoring Results
Violation of laws and regulations associated with the working conditions	Frequency: Monthly
Dealing with illnesses and accidents	Frequency: Monthly

4.5 Accident

1) Pre-construction Stage

Monitoring Period: from Date Month Year to Date Month Year

Monitoring Item	Monitoring Results
Current frequency of congestion and accidents around the project sites	Frequency: one time
Landslide movement	Frequency: Continuously

2) Construction Stage

Monitoring Period: from Date Month Year to Date Month Year

Monitoring Item	Monitoring Results
Frequency of congestion and accidents around the project sites	Frequency: Monthly
Landslide movement	Frequency: Monthly

(2) RAP Monitoring Form

1. Public Consultation

Date: Day Month Year

No.	Date	Place	Attendants	Contents of the consultation, Main comments by PAPs and responses

2. RAP

Monitoring Period: from Date Month Year to Date Month Year

Activity	Plan	Unit	Progress		Progress Rate (%)		Planned date of Completion	Remarks
			Until the previous month	Until the current month	Until the previous month	Until the current month		
Socio-economic Survey and Census								
Approval of the RAP			Date of approval					
Finalization of PAPs List								

3. Land Acquisition and Resettlement

Monitoring Period: from Date Month Year to Date Month Year

Site No.	Activity	Number of lot	Plan	Unit	Progress		Progress Rate (%)		Planned date of Completion	Remarks
					Until the previous month	Until the current month	Until the previous month	Until the current month		
	Land Acquisition	1		perch						
		2								
		3								
	Compensation	1		household						
		2								
		3								
	Land Acquisition	1		perch						
	Compensation	1		household						
	Land Acquisition	1								
		2								
	Compensation	1								
		2								

4. Income/Livelihood Restoration

Date: Day Month Year

Item	Contents	Results

5. Grievance Redress

Date: Day Month Year

Date and Complainant	Contents of Grievance/Complaint	How to deal with the Grievance/Complaint

9.3.2 Environmental Check List

Table 9.3.1 Environmental Check List

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process?	N	By the official letter dated 6 November 2019, Central Environment Agency (CEA) has confirmed that EIA/IEE is not required for the project by the domestic law.
		(b) Have EIA reports been approved by authorities of the host country's government?	N	-
		(c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied?	-	-
		(d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government	N	Since some sites of the project fall adjacent to protected areas/ forest reserves, RDA/PMU will obtain recommendations from Department of Wildlife Conservation and/or Forest Department who administer the areas. Other than the approval related to EIA/IEE, the project will require permits for cutting trees, borrow pit and movement of soil, operation of quarry sites, operation of asphalt plants/ crusher plants/ concrete batching plants, disposal grounds/ landfill sites and setting up labour camps prior to construction activities. Operation of quarry sites and borrow pits, and movement of soil → (apply to) Geological Survey and Mines Bureau (GSMB), local authorities DS and CEA Cutting trees → (apply to) Forest Dept. or Dept. of Wildlife Conservation Operation of asphalt plants/ crusher plants/ concrete batching plants→ (apply to) CEA Disposal grounds/ landfill sites → (apply to) relevant local authorities Setting up labour camps→ (apply to) relevant local authorities
	(2) Explanation to the local stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the local stakeholders based on appropriate procedures, including information disclosure? Is understanding	Y	When the social assessment survey was carried out, contents and the potential impacts were explained to the local stakeholders such as Divisional Secretaries and residents. There was no objection against the project but requests for expediting measures against sediment disasters.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		obtained from the local stakeholders?		
		(b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	N	Not yet. The comment from the stakeholders will be reflected to the project design at the detail design stage.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	Y	Some alternative plans have been examined and more detailed plans will be examined at the detail design stage.
2 Pollution Control	(1) Air Quality	(a) Is there a possibility that air pollutants emitted from the project related sources, such as vehicles traffic will affect ambient air quality? Does ambient air quality comply with the country's air quality standards? Are any mitigating measures taken?	Y	The project does not plan any facilities such as parking areas/service areas that newly emit air pollutants. Exhaust gas will be emitted from vehicles and equipment during construction stage. But the number of units operating is limited and limited to the area, so there would be little impact on the surrounding residents and communities. According to the monitoring results of LDPP Phase1 Project (LDPP1), the same kind of project, the air quality standards were generally satisfied during the construction, and the impact would be negligible in LDPP2 as well.
		(b) Where industrial areas already exist near the route, is there a possibility that the project will make air pollution worse?	N	There is no industrial area in the target areas of the project, and the air environment would not be further deteriorated.
	(2) Water Quality	(a) Is there a possibility that soil runoff from the bare lands resulting from earthmoving activities, such as cutting and filling will cause water quality degradation in downstream water areas?	Y	The construction sites at many points are bare lands due to the previous slope failures and landslides, and also earthmoving activities are small scale cutting of surface layer of the slope. For this reason, the amount of soil runoff from the slope surface is small and the impact on water quality in the downstream water area is negligible. Regarding Site 53, a large amount of sediment will be generated due to removal of unstable sediment deposited in the river channel and construction of access roads by widening existing paths. Some of the sediment will be reused as soil cement material necessary for dam construction and the remaining sediment will be disposed appropriately.
		(b) Is there a possibility that surface runoff from roads will contaminate water sources, such as	Y	During construction stage, surface runoff from slope to road may contaminate water sources such as groundwater. However the ranges of construction are limited and the impacts on groundwater would be limited.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		groundwater?		Monitoring of water quality of surface runoff will be carried out.
		(c) Do effluents from various facilities, such as parking areas/service areas comply with the country's effluent standards and ambient water quality standards? Is there a possibility that the effluents will cause areas not to comply with the country's ambient water quality standards?	Y	The project does not plan any facilities such as parking areas/service areas that newly generate effluents. During construction stage, vehicles and equipment will be maintained and re-fueled in such a manner that oil/diesel spillages does not occur and contaminate the surrounding soil/water. Portable toilets will be provided at the construction sites and worker's camps, and appropriate treatment and disposal will be done to prevent the effluent from polluting water bodies. Monitoring of water quality of effluents will be carried out.
	(3) Wastes	(a) Are wastes generated from the project facilities, such as parking areas/service areas, properly treated and disposed of in accordance with the country's regulations?	Y	The project does not plan any facilities such as parking areas/service areas that newly generate wastes. During construction stage, wastes generated from construction sites and worker's camps will be appropriately collected and disposed of. The soil disposal yard will be proposed from the contractor, and PMU will obtain permission for using it and supervise the disposal. Especially special attention including appropriate measures should be paid for surplus soil generated at Sabo dam construction site.
	(4) Noise and Vibration	(a) Do noise and vibration from the vehicle and train traffic comply with the country's standards?	Y	The project will not significantly change traffic volume and pattern, and that noise and vibration levels would not increase..
3 Natural Environment	(1) Protected Areas (2) Ecosystem	(a) Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	N	The project sites are not located in the protected area and would not affect the protected area. The project would rather protect the areas against further degradation of the natural environment due to sediment disasters. However, some sites may be located within one mile from the boundaries of national reserves. According to CEA's advice, RDA will obtain recommendations from Department of Wildlife Conservation and/or Forest Department.
		(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)?	N	Proposed project sites do not encompass primeval forests, tropical rain forests and ecologically valuable habitats.
		(b) Does the project site encompass	N	The project sites do not encompass the protected habitats of endangered species.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		the protected habitats of endangered species designated by the country's laws or international treaties and conventions?		
		(c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem?	Y	If significant impacts will be identified, mitigation measures will be implemented under the supervision and in accordance with recommendations of the relevant government agency.
		(d) Are adequate protection measures taken to prevent impacts, such as disruption of migration routes, habitat fragmentation, and traffic accident of wildlife and livestock?	N	Since proposed project activities are confined to particular landslide prone location, there is a less possibility of disturbing migratory paths, habitat fragmentation etc..
		(e) Is there a possibility that installation of roads will cause impacts, such as destruction of forest, poaching, desertification, reduction in wetland areas, and disturbance of ecosystems due to introduction of exotic (non-native invasive) species and pests? Are adequate measures for preventing such impacts considered?	N	If alien/exotic flora species grow over slope protection measure, relevant mitigation measures shall be proposed.
		(f) In cases the project site is located at undeveloped areas, is there a possibility that the new development will result in extensive loss of natural environments?	N	The project sites are not located at undeveloped areas. The project would rather protect the areas against further degradation of the natural environment due to sediment disasters.
	(3) Hydrology	(a) Is there a possibility that alteration of topographic features and installation of structures, such	Y	The project will only restore the slopes damaged by sediment disasters, which will not alter the topographic features. At the Site 53, check dams will be installed, but they are permeable structures

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		as tunnels will adversely affect surface water and groundwater flows?		that do not obstruct normal river flow. Therefore, installation of dams would not adversely affect surface water flows. In general, construction of drainage will affect groundwater level. But there are no households which use water wells as main water sources for their daily life in the project sites. There would be little interference with water use.
	(4) Topography and Geology	(a) Is there any soft ground on the route that may cause slope failures or landslide? Are adequate measures considered to prevent slope failures or landslides, where needed?	Y	The project is exactly adequate measures to prevent slope failure and landslide.
		(b) Is there a possibility that civil works, such as cutting and filling will cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides?	Y	Objective of the project is to exactly implement measures to reduce slope failures and landslides. During construction stage, monitoring of landslide will be carried out for safety.
		(c) Is there a possibility that soil runoff will result from cut and fill areas, waste soil disposal sites, and borrow sites? Are adequate measures taken to prevent soil runoff?	Y	Temporal storage of the cut soil will be prepared. Wooden fence or wattle will be built to prevent an outflow of soil from there.
4 Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement?	Y	Efforts were made to minimize involuntary resettlement at the conceptual design stage. As a result, no involuntary resettlement is expected.
		(b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement?	Y	Explanations on policy of compensation and income/livelihood restoration assistance were given to PAPs during social assessment survey. Further, detail explanation will be given at the detail design stage.
		(c) Is the resettlement plan,	Y	Draft abbreviated RAP was prepared. Compensation with full replacement cost,

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement?		restoration of livelihoods and living standard is planned in the draft abbreviated RAP. The plan will be reviewed and updated during the detail design stage.
		(d) Are the compensations going to be paid prior to the resettlement?	Y	There is a gap between LAA and JICA's policy. Following NIRP and JICA Guidelines, compensation shall be paid prior to displacement.
		(e) Are the compensation policies prepared in document, and in case the scale of resettlement is large, has the resettlement plan been disclosed.	Y	Compensation policies were prepared in the draft abbreviated RAP. According to the policy, compensation will be paid based on full-replacement cost and livelihood assistance will be provided to PAPs.
		(f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples?	N	The draft abbreviated RAP mentions that an extra compensation and assistance for vulnerable households shall be provided
		(g) Are agreements with the affected people obtained prior to resettlement?	Y	RDA/PMU will obtain agreement of PAPs once the locations of the project sites are finalized during detail design stage.
		(h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan?	Y	Organizational framework was proposed and described in the draft abbreviated RAP. Capacity and budget for the RAP will be secured by RDA as same as in the case of LDPP1.
		(i) Are any plans developed to monitor the impacts of resettlement?	Y	Monitoring structure and format were developed in the draft abbreviated RAP referring to LDPP1 and the comments of RDA/ESDD.
		(j) Is the grievance redress mechanism established?	Y	Grievance Redress Mechanism was proposed in the draft abbreviated RAP referring to LDPP1.
	(2) Living and Livelihood	(a) Where roads are newly installed, is there a possibility that	N	As the project does not involve a new road development and expansion of road capacity, the project would not affect the existing means of transportation and

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		the project will affect the existing means of transportation and the associated workers? Is there a possibility that the project will cause significant impacts, such as extensive alteration of existing land uses, changes in sources of livelihood, or unemployment? Are adequate measures considered for preventing these impacts?		the associated workers or would not cause significant impacts such as changes in sources of livelihood or unemployment.
		(b) Is there any possibility that the project will adversely affect the living conditions of the inhabitants other than the target population? Are adequate measures considered to reduce the impacts, if necessary?	N	For the same reason above, the project would not affect the living conditions of the inhabitants other than the target population.
		(c) Is there any possibility that diseases, including infectious diseases, such as HIV will be brought due to immigration of workers associated with the project? Are adequate considerations given to public health, if necessary?	Y	Awareness programs on infectious diseases including sexually transmitted diseases will be carried out for both workers and surrounding residents if foreign labours are employed.
		(d) Is there any possibility that the project will adversely affect road traffic in the surrounding areas (e.g., increase of traffic congestion and traffic accidents)?	N	As the project does not involve a new road development and expansion of road capacity, the project would not affect road traffic in the surrounding areas. During construction, one-side lane will be used for construction because there are not enough space between slopes and roads at almost all sites. In that case, traffic congestion would increase. Necessary measures such as traffic control personnel or installation of one-side lane control sign will be arranged to mitigate the traffic congestion and prevent traffic accidents.
		(e) Is there any possibility that roads will impede the movement of inhabitants?	N	As the project does not change existing road structure, the road will not impede the movement of inhabitants. During construction, passages will be secured, and signs will be installed for pedestrian. The restrictions on use of roads will be informed to the residents

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
				prior to construction.
		(f) Is there any possibility that structures associated with roads (such as bridges) will cause a sun shading and radio interference?	N	The project includes a bridge construction at the Site 53. As it is not a tall structure, it would not cause problems such as sun shading and radio interference.
	(3) Heritage	(a) Is there a possibility that the project will damage the local archaeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	N	There are no local archaeological, historical, cultural and religious heritages in the project sites.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	Y	Installment of slope protection measures and retaining wall may change aesthetic characteristics of the mountain area to some extent. However, the project will introduce environmentally-friendly structures that are match to natural scene, and the impacts would be mitigated.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous people?	N	There are not any ethnic minorities and indigenous people in the project sites.
		(b) Are all of the rights of ethnic minorities and indigenous people in relation to land and resources respected?	N	There are not any ethnic minorities and indigenous people in the project sites.
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project?	Y	RDA/PMU shall observe laws and ordinances associated with the working conditions of the country are not violated
		(b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety	Y	Adequate supply of personal protective equipment to all workers.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		equipment which prevents industrial accidents, and management of hazardous materials?		
		(c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.?	Y	Adequate measures will be planned by contractor during the construction as described below; • Ensure that first aid kits are available in all work areas, supplies with adequate material to treat common workplace injuries, • Training of all construction workers in basic sanitation and healthcare issues, general health and safety matters, and on the specific hazards of their work, • Dedicated transport should be provided at all work sites to take injured persons to hospitals if needed. Record of all nearest hospitals and health centers should be kept at each construction site, and • A regular medical facility should be provided at each camp with suitable qualified staff and equipment to treat minor ailments and injuries.
		(d) Are appropriate measures taken to ensure that security guards involved in the project will not violate safety of other individuals involved, or local residents?	N	Not yet, but measures will be taken.
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)?	Y	Effective mitigation measures will be implemented according to the Environmental Management Plan (EMP). Proper planning and siting of construction activities Proper maintenance of equipment and vehicles to prevent air pollution or water pollution Provide portable toilets at the construction sites and worker's camps, and appropriate treatment and disposal to prevent water pollution If necessary, silt fencing will be provided near water bodies to prevent water turbidity. Reuse of excavated soil on site for soil cement and earth wall as much as possible A designated solid waste disposal site will be secured. In addition, a disposal site should be away from water streams. Disposal yard for surplus soil/ sediment will be proposed from the contractor, and PMU will obtain permission for using it and supervise the disposal.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
				Use of low noise/vibration type equipment and vehicles Careful attention to the working time and schedule when working near the facilities that need silence such as hospitals, schools, temples Monitoring of air quality, water quality, noise and vibration
		(b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts?	Y	Effective mitigation measures will be implemented according to the Environmental Management Plan (EMP). Adequate measures will be planned and provided to mitigate the negative impacts to the natural environment during construction stage, such as no construction yard in the forest area. If the precious species is found, interrupt the construction work and take necessary measures. The project will use advanced technology such as Non-frame Method that prevents unstable slope surface through the combination of wire ropes and rock bolts without cutting slope and trees
		(c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	Y	Effective mitigation measures will be implemented according to the Environmental Management Plan (EMP). Adequate measures will be planned and provided to reduce the negative impacts to the social environment during construction stage, such as provision of traffic signs to minimize congestion and risk of accidents. Construction activity and schedule will be arranged to minimize the impact on surrounding community. Construction will be done avoiding existing buildings and water and electricity facilities as much as possible.
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts?	Y	Monitoring will be implemented according to the Environmental Monitoring Plan (EMoP) and the Environmental Monitoring Forms. RDA/PMU will plan and conduct monitoring of items which concern environmental impacts.
		(b) What are the items, methods and frequencies of the monitoring program?	Y	In the construction stages, air quality (4 times/yr.), water quality (4 times/yr.), noise (4 times/yr.), vibration (4 times/yr.) and groundwater level (2 times each in rain/dry season) will be monitored. In the operation stage, groundwater level (1 time each in rain/dry season) will also be monitored. Items, methods and frequencies are listed in the EMoP.
		(c) Does the proponent establish an	Y	PMU will establish an adequate monitoring framework with personnel and

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)?		adequate budget based on the experience of LDPP phase 1 project. Consultant will fully support PMU and RDA/ESDD will provide proper advice to PMU.
		(d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	Y	PMU will regularly submit the monitoring report to RDA/ESDD, and RDA/ESDD will regularly submit the monitoring reports to CEA and JICA regularly.

Source: JICA Survey Team

9.3.3 Possible Services of the Construction Supervision Consultant

(1) Facilitation of Implementation of Environmental Management Plan (EMP), Environmental Monitoring Plan (EMoP) and Resettlement Action Plan (RAP)

The Consultant shall:

(a) Update EMP and EMoP as appropriate; incorporate necessary technical specifications with design and contract documentation;
(b) Assist RDA in preparation of necessary documents in accordance with the EMP for the Project if necessary;
(c) Assist RDA in dissemination and explanation of additionally confirmed and identified environmental issues to public including holding public consultations;
(d) Assist RDA in obtaining necessary permissions from relevant authorities concerned in accordance with the planned implementation schedule;
(e) During the preparation of bidding documents, clearly identify environmental responsibilities as explained in the EMP;
(f) Assist RDA to review the Construction Contractor's Environmental Program to be prepared by the contractor in accordance with EMP, relevant plans and JICA Environmental Guidelines and to make recommendations to RDA regarding any necessary amendments for its approval
(g) Assist RDA to implement the measures identified in the EMP;
(h) Monitor the effectiveness of EMP and negative impact on environment caused by the construction works and provide technical advice, including a feasible solution proposal, so that RDA can carry out improvement when necessary;
(i) Monitor compliance with the requirements under EMP and JICA Environmental Guidelines. Submit the Environmental Monitoring Report to RDA at every month after the commencement of the services until the completion of the construction. After the completion of the construction, the Report will be submitted semiannually until the completion of the Project. The Environmental Monitoring Form attached in the Section 9.3.1 will be filled and attached to the Report;
(j) After verifying the Environmental Monitoring Report by RDA, assist submitting the report to JICA as part of the Progress Status Report at every three months after the commencement of the services until the completion of the construction and semiannually until the completion of the Project after the completion of the construction;
(k) Assist RDA in preparation of the answer to the request from JICA's advisory committee for environmental and social considerations if necessary;
(l) Assist RDA in the capacity building of RDA staff on environmental management through on-the-job training on environmental assessment techniques, mitigation measure planning, supervision and monitoring, and reporting;
(m) Update and/or prepare RAP as necessary based on detailed design in accordance with the agreed resettlement framework, including entitlement matrix and compensation plan; coordinate with various agencies in preparing the procedures for timely land acquisition and disbursement of compensation to project affected persons (PAPs);
(n) Assist RDA in identifying the eligible PAPs, and in preparation/updating of the list of eligible PAPs and 'Payment Statement' for individual eligible PAPs. The places where each eligible PAPs will relocate to are necessary to be recorded so that RDA could implement monitoring on income and living conditions of resettled persons;

(o) Assist RDA in conducting the social assessment, or supplementing the existing social assessment when necessary, including, but not limited to, the baseline survey for monitoring and evaluating the income restoration plan and the needs assessment survey for identifying income restoration options, during early stage of the detailed design stage and review the existing income restoration plan and special assistance plan for vulnerable PAPs and revise/update the contents of the plans if necessary based on priorities identified with support of relevant government agencies and Non-Governmental Organizations (NGOs). The following contents should be considered to be included in the plans
    i. Skills training
    ii. Project related job opportunities
    iii. Provision of social welfare grant
    iv. Provision of agricultural extension services
    v. Provision of the special allowance to vulnerable PAPs

(p) Assist RDA to conduct detailed measurement survey and to implement the measures identified in the revised RAP;

(q) Monitor land acquisition, involuntary resettlement, and compensation activities being undertaken by RDA and/or competent authorities in terms of compliance with conditions stated in the RAP and JICA Environmental Guidelines. Submit the Land Acquisition and Resettlement Monitoring Report monthly after the commencement of the services until land acquisition and resettlement activities including livelihood restoration program are completed. The RAP Monitoring Form attached in the Section 9.3.1 will be filled and attached to the Report;

(r) After verifying the Land Acquisition and Resettlement Monitoring Report by RDA, assist submitting the Report to JICA as part of the Progress Status Report every three months after the commencement of the services until the completion of the land acquisition and resettlement, and semiannually until the completion of the RAP activities including livelihood restoration program;

(s) Assist RDA in facilitating stakeholder's participation (including focus group discussions for vulnerable PAPs) and providing feedback their comments on RAP;

(t) Assist RDA in establishment of grievance redress mechanism including formation of Grievance Redress Committee;

(u) Assist RDA to ensure that the PAPs are fully aware of the grievance redress procedure and the process of bringing their complaints, investigate the veracity of the complaints, and recommends actions/measures to settle them amicably, fairly and transparently before they go to the redress committee or the courts of law;

(v) Provide technical services with grievance redress committee for keeping and updating records when necessary; and

(w) Assist RDA in the capacity building of RDA staff on land acquisition, resettlement, and livelihood restoration through on-the-job training on JICA Environmental Guidelines, supervision and monitoring, and reporting.

(2) Environment and Resettlement Monitoring

(a) Environmental Monitoring Report (10 copies): To be submitted at every month after the commencement of the services until the completion of the construction, presenting the environmental impacts and implementation of environmental mitigation measures. After the completion of the construction, the Report will be submitted semi-annually until the completion of

the Project. The Environmental Monitoring Forms attached in the Section 9.3 will be filled and attached to the Report.

(b) Land Acquisition and Resettlement Monitoring Report (10 copies): To be submitted at every month until land acquisition and resettlement are completed. After that, the Report will be submitted semi-annually until the completion of the RAP activities including livelihood restoration program. The RAP monitoring form attached as Section 9.3.1 will be filled and attached to the Report.

Environmental and Social Safeguard Evaluation Report (10 copies): To be submitted by the end of the services, presenting the EMP, the EMoP and the RAP prepared.

9.3.4 Climate Change Adaptation

(1) Recent trends and prediction of future changes

1) Climate change scenarios accepted in Sri Lanka

In Sri Lanka, the RCP (Representative Concentration Pathways) for two emission scenarios RCP 4.5 (low emission scenarios) and RCP 8.5 (high emission scenarios) is used as a new scenario for climate change instead of an old scenario SRES (Special Report on Emissions Scenarios). And Multi Assembled Model for three time periods 2020- 2040, 2040-2060, 2070-2090 is used as a Regional Climate Model (RCM) in Sri Lanka. The model includes General Circulation Models (GCM: CanESM2, CNRM-CM5, CSIRO-MK3-6-0, GFDL-CM3, MRICGCM3 and NCAR-CCSM4). *(Source: Department of Meteorology, Sri Lanka)*

Other modelling approaches used for projecting climate change in Sri Lanka are;

- Regional climatic models (RCM) and
- Statistically downscaled GCM models.

(Source Eriyagama, N., V. Smakhtin., L. Chandrapala and K. Fernando (2010) Impacts of climate change on water resources and agriculture in Sri Lanka: a review and preliminary vulnerability mapping. Colombo, Sri Lanka: International Water Management Institute: 51pp. (IWMI Research Report 135). [doi:10.5337/2010.211]).

2) Recent trends and predicted future changes of precipitation and rainfall patterns under the impact of climate change

Study 1

A study conducted by Jayawardena et al, 2018 presents analyses of the trends in 20 annual extreme indices of temperature and precipitation for Sri Lanka. The analyses were conducted using long term and high-quality datasets for 19 meteorological stations, for a period between 1980 and 2015.

Some of the indices in this study can be good indicators for climate extremes in Sri Lanka. The annual total precipitation has indicated a significant increasing over 1980-2015. More than 80% of stations showed an increasing trend in precipitation indices. Nearly 75% and 65% of the stations showed significant increasing trend in annual total precipitation and number of days above 10 mm rainfall at the 5%-10% level.

The trends in extreme precipitation events such as maximal one-day precipitation, maximal five-day precipitation, and total precipitation on extreme rainfall days are increasing at most locations, indicating that the intensity of the rainfall is increasing.

(Source: Recent Trends in Climate Extreme Indices over Sri Lanka, I. M. Shiromani Priyanthika Jayawardena, D. W. T. Thanuja Darshika, H. M. Roshan C. Herath , Department of Meteorology,

Colombo, Sri Lanka. American Journal of Climate Change, 2018, 7, 586-599 , ISSN: 2167-9495)

Study 2

Statistically downscaled data into 25km x 25km grid resolution of six earth system models under Coupled Model Inter-comparison Project 5 (CMIP5) are analyzed to see the future changes in annual as well as seasonal rainfall over Sri Lanka for three time periods 2020-2040, 2040-2060, 2070-2090 relative to baseline climatology period 1975-2005 for two emission scenarios.

Rainfall changes are indicated that annual rainfall anomaly is negative in North-eastern parts, and positive in South-western parts for the period 2020-2040 and positive and increasing thereafter under RDP 4.5 scenario. Annual rainfall anomaly is positive and increasing for all three time periods under RCP 8.5 scenario.

South-west monsoon rainfall anomaly is positive and increasing in both RCP 4.5 and RCP 8.5 scenarios with significant increase in rainfall over the Wet zone.

North-east monsoon rainfall anomaly negative and negative trend is observed in both scenarios. Decrease in rainfall is significant in the Dry zone.

First Inter Monsoon rainfall anomaly is negative in 2020-2040, slightly negative in 2040-2060 and positive except North-eastern parts under RCP 4.5. First Inter Monsoon rainfall anomaly is negative in all three time periods under RCP 8.5. No significant trend is evident in RCP 8.5.

Second Inter Monsoon rainfall anomaly is negative in North-eastern parts, and positive in South-western parts in 2020-2040 and positive and increasing after that under RCP 4.5. Second Inter Monsoon rainfall anomaly is positive and increasing in RCP 8.5 with increase in rainfall is significant in the South-western parts.

(Source: Multi Model Ensemble Climate Change Projections for Annual and Seasonal Rainfall in Sri Lanka , D. W. T. T. Darshika, I. M. S. P. Jayawardana, D. M. S. C. Dissanayake, Sri Lanka Journal of Meteorology, Contents Vol. 3, September 2018)

Other studies

Key global projections applicable to Sri Lanka are projections for Asia in fourth and fifth assessments reports (AR4 and AR5) of IPCC. The general agreement of these projections is that South Asia will increasingly become warmer (Cruz et al., 2007; Hijioka et al., 2014). The warming is projected to be stronger than global mean in South Asia. Some of the predictions with high confidence applicable for South Asia are: mean annual temperature will increase by greater than 3 ^{o}C; increase in precipitation by mid-21st century; increased precipitation extreme related to monsoons, and ; oceans getting warmer in tropical Asia (Hijioka et al., 2014).

Ahmed and Supachalasai (2014), based on a RCM, predicted that temperature could rise by 3.6 ^{o}C, 3.3 ^{o}C and 2.3 ^{o}C under A2, A1B and Bi scenarios (SRES), respectively by 2080. Like in the case of observed changes, projections also are less certain about the changes in rainfall pattern. Ahmed and Supachalasai (2014) predict increases in precipitation level by 39.6%, 35.5% and 31.3%, respectively, under A2, A1B and B1 scenarios by 2080.

However, locally downscaled models have predicted on change in precipitation towards both directions; increasing as well as decreasing mean annual rainfall (Eriyagama et al., 2010). According to one projection, mean annual rainfall will increase by 14% for A2 and 5% for B2 by 2050s compared with 1960-1991 (De Silva, 2006). This overall increase is not uniform, and it predicts a decrease of 34% for A2 and 26% for B2 in North-east monsoon while predicting increases of 38% for A2 and 16% for B2 in South-west monsoon.

Another recent projection has predicted that climate pattern in Sri Lanka is getting more polarized where the Dry zone becomes drier and the Wet zone becomes wetter in years to come (Marambe et al., 2015; Punyawardena et al., 2013).
(Source: National Adaptation Plan for Climate Change Impacts in Sri Lanka, Climate Change Secretariat, Ministry of Mahaweli Development and Environment, 2016)

(2) Necessity of adaptation measures

1) Increasing hazards

As described in the previous **section** (1), extreme rainfall event is projected to increase in future by the climate change in Sri Lanka. It is expected that the increase of annual precipitation and intensity of rainfall trigger sediment disasters and increase frequency, scale and points of the disasters.
Under such condition, the damage directly caused by sediment disaster increases in the upper of a river. Range and damage of debris flow expand in the lower of a river and it is feared that the debris flow affects dam facilities, river channel and coast.

2) Capacity to cope with sediment disaster

Large landslides occur almost every year and cause tremendous damage to many communities and infrastructures such as road networks and railways in Sri Lanka. Many slope failures occurred at the artificial cut slope which may be due to unsuitable design of the existing cut slopes and lack of proper measurements for slope stability.
On the other hand, monitoring system for landslide early warning has been developing. NBRO has developed a monitoring system since 2005 and installed 160 rainfall gauges. Based on the collected data, landslide early warning information is shared in the homepage of NBRO. Moreover, a telemetering early warning system of Japanese technology was installed in 2018 at the landslide-prone sites of Ratnapura District and Nuwara Eliya District which started landslide monitoring.

3) Vulnerability

Sediment disasters are one of the most serious natural disasters in Sri Lanka. Especially in the mountainous and hilly areas of the central Sri Lanka, sediment disasters, such as steep slope failures and landslides have frequently occurred in the event of heavy rainfall during the monsoon period due to the rapid development in addition to the fragile geological characteristics and steep topographical conditions. Sediment disasters are responsible for the greatest casualty loss among natural disasters. Additionally, the road network accounts for 90% of domestic passenger and freight transportation in Sri Lanka, and so the disruption and closure of the road network due to sediment disasters has caused significant economic losses. Most of the survey areas have suffered intensive sediment disasters. Sediment disasters have also recently been becoming common in the Plains surrounding the Central Highlands due to global climate change and expansion of residential areas.

4) Necessity of adaptation measures

If there is no way but to accept the climate change and adapt to it, practical adaptation measures would be necessary to increase the capacity to cope with sediment disasters and to reduce the vulnerability.

(3) Adaptation measures provided by the project

To increase the capacity to cope with sediment disasters, the project will introduce advanced technology to mitigate sediment disasters as a structural measure and transfer the design and construction technology to the Sri Lankan side through training as a non-structural measure. The project will also install monitoring equipment such as rain gauge, extensometer and borehole inclinometer as a safeguard during construction which can be a non-structural measure.

(4) Effect of the adaptation measures

Implementation of countermeasures against sediment disaster will contribute to reducing the hazard risk in the project area even if the climate changes in future. Furthermore, the design and construction technology transferred through the project will contribute to reducing the risk of sediment disaster in the whole country when it is disseminated.

Improvements in the safety of road networks and the livelihoods of the residents will contribute to reducing economic losses and socio-economic vulnerability due to the sediment disasters.

The monitoring equipment installed by the project will contribute to increasing the capacity to cope with sediment disaster through the development of NBRO's landslide early warning system.

9.3.5 Gender Consideration

1) Sri Lankan Gender Consideration in brief

In the United Nations Development Programme Human Development Report 2016, Sri Lanka ranked 73rd (of 188 countries) with a high human development index (HDI) of 0.766 in 2015, and was way ahead of the next South Asian DMC (Developing Member Country) in the list, Maldives, which was ranked 105th with a high HDI of 0.701; all other South Asian DMCs had medium HDIs. With a gross development product per capita of $10,789 (South Asia average was $5,799), Sri Lanka is approaching upper middle income-country status.

However, the gender development index (GDI) and gender inequality index (GEI) of Sri Lanka in 2015 suggest that women and men in the country do not equally enjoy the benefits of this progress. Gender inequality in Sri Lanka manifests mainly in labor force participation (35.9% of women of working age versus 74.7% of men of working age) and in political participation (only 4.9% of seats in the parliament were occupied by women, which was the lowest among the six DMCs in South Asia). This means that parity in secondary education with 80.2% of women (ages 25 and older) and 80.6% of men (same age range) in 2015 is not mirrored in labor market participation.

Sri Lanka has made good progress in achieving gender equity in health and education, brought about through giving women their right to vote, free education and health services. Universal adult franchise introduced in 1931 and free education system put in place in 1945 contributed substantially to make a progressive change in the lives of women. Sri Lanka has almost achieved the MDG targets for universal primary education and gender equity in education. In 2006, it attained a primary enrolment rate of 97.5 percent, and practically reached gender parity in primary education, with the ratio of girls to boys at 99 percent (UNDP, 2012).

According to the United Nations Committee reviewing Sri Lanka's progress in implementing the Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW), a major problem is in equitably preparing girls and boys for the needs and challenges of the labor market. Women are more likely than men to be unemployed, underemployed, or out of the labor force. Women's unemployment rate in 2015 was more than double that of men—7.6% for women compared to 3% for

men; and while unemployment rates have come down for both women and men in recent years, rate for women has consistently been double that of men.

Female labor force participation rate was also lower in 2015, 35.9% compared to 74.7% of men. Gender discrimination has also been generally observed in the workplace, where women and men with same skills are treated differently. Men are paid more, and women with higher cognitive skills are not correspondingly rewarded – suggesting that skill acquisition is not enough to increase female labor force participation in Sri Lanka. The way working young women have imbibed this gender inequity appears to manifest in their lower salary expectations. For instance, a study found 29% of women respondents versus 55% of men respondents to aspire for a salary above LKR 30,000. Similarly, a World Bank study on wage disparities of youth aged 18–29 considering factors such as years of secondary education and occupational experience found that in all sectors and ethnic groups, women received lower wages than men did. This study pointed to the need to address wage disparities to promote work equal opportunities for young women and men.

The 2014 Annual Report of the Central Bank of Sri Lanka emphasized the need to address this gender gap in labor force participation and in occupational choices by highlighting the results of a study that found Sri Lanka's total per capita income loss due to gender gap in labor force participation at 20% (higher than the world average of 8.5%), and due to gender gap in occupational choices at 6% (higher than the world average of 5%). Gender gap in labor force participation and employment has been attributed to various factors, foremost to sociocultural norms, specifically gender stereotypes in occupations.

There is a widespread perception that equal opportunities have been achieved—that whatever path a woman chooses is open to her. However, gender stereotyped roles of women in the family, workplace, and public sphere seem deeply entrenched and thus limit their occupational choices. For instance, the topmost reason for women's economic inactivity in 2013 (62.1% of women who were out of labor force) was their engagement in household work. Moreover, being married and having young children reduce the probability of women being in paid employment, and conversely, for men, being married increases the probability of paid employment. Marriage and motherhood also dampen the willingness of women to travel outside of their districts for work; and this unwillingness increases with age—28% of young women of aged 19–20; 33% of women of aged 21–25; and 42% of women of aged 26-30. With the increase in the aging population of Sri Lanka, women's expected caregiving roles could further limit their employment if gender stereotyping of occupations is not addressed.

Source: Gender Equality and Social Inclusion Framework March 2017, Skills Sector Development Program (2014–2020) Prepared by the Ministry of Skills Development and Vocational Training, Government of Sri Lanka for Asian Development Bank.

On the other hand, there are large gender disparities in access to and control over resources (e.g. land, water and inputs), access to markets and access to skills training. Sri Lanka's constitution is nondiscriminatory regarding land ownership. However, inequalities in land ownership persist due to gender biases in Sri Lanka's Land Development Ordinance and other customary laws. Only 16 percent of all privately-owned land in the country belongs to women (Agriculture and Environment Statistics Division, 2002). This lack of land ownership limits women's ability to obtain agricultural assets, services and benefits (e.g. subsidies, credit and irrigation water). Female-targeted programs have frequently supported women in activities connected with their basic means of livelihood. These programs however, have not been designed to improve women's access to and control over resources.

They have not promoted women as active participants in agricultural operations, enabled them to receive their fair share of agricultural assistance or participate equally in decision-making processes.
(Source: Gender Issues in Agriculture-Sri Lanka. (A review of women's involvement/empowerment in agriculture) Ranjith Ratnayake - Sri Lanka Water Partnership)

2) Progress and Gaps in Key Gender Indicators

In 2007, the Center for Women's Research compiled data on gender dimensions of the Millennium Goals in Sri Lanka (CENWOR, 2007) and identified areas in which gender parity has been reached and areas in which gender gaps have not been reduced significantly (**Table 9.3.2**). It is clear that Sri Lanka has reached or nearly reached gender parity with regard to welfare related indicators, pointing to the effectiveness of state policies on health and education.

Table 9.3.2 Millennium Development Goals, indicators and gender gaps for selected variables

Goals/Indicators	Situation (% – year)	Target at 2015
1) Eradicate extreme poverty and hunger		
i. Proportion of population below national poverty line	8.9 - 2001	Already
ii. Poverty gap ratio (incidence and depth of poverty)	5.1 - 2001	reached
iii. Prevalence of under-weight children under 5 yrs. age	29.4 - 2000	19.0
iv. Proportion of population below minimum dietary energy consumption	51.3 - 2002	25.0
2) Achieve universal primary education		
i Net enrolment ratio in primary school, 6-10 years.	Male 97.1 - 2002	99
	Fm. 95.6 - 2002	99
ii. Proportion of pupils in grade 1 who reach grade 5	Male 96.9 - 2001	100
	Fm. 98.3 - 2001	100
iii. Literacy rate of 15-24 yrs. old	Male 95.1 - 2001	99
	Fm. 96.0 - 2001	99
3) Promote gender equality and empower women		
i. Ratio of girls to boys in primary education	94.8 - 2002	100
ii. Ratio of girls to boys in secondary education	104.6 - 2002	104
iii. Ratio of girls to boys in tertiary education	89.8 - 2001	100
iv. Ratio of literate women to men 15-24 yrs. old	109.0 - 2001	109
v. Share of women in wage employment in non-agricultural sector	31	50
vi. Proportions of seats held by women in national parliament	4.9 - 2004	10
4) Reduce child mortality		
i. Child mortality rate (per 1,000 population of 0-4 yrs. age group)	Male 4.7 -1997 Fm. 4.1 -1997	Male 1.4 Fm. 1.1
ii. Infant mortality rate	16.3 -1997	5.9
iii. Proportion of one-year old children immunized against measles	89.5 -1997	99
5) Improve maternal health		
i. Maternal mortality rate (per 10,000 live births)	1.4 -2002	1.4
ii. Proportion of births attended by skilled health personal	96.0 -2002	99

Source: CENWOR, 2007

Over 20 percent of Sri Lankan households are headed by women (Household and Income Expenditure Survey, 2006/2007). The percentage of women headed households according to the 2006/2007 survey

stands at 25.5 percent, 23 percent and 22.9 percent in the urban, rural and estate sectors respectively. In 2004, Sri Lanka's Gender Development Index (GDI) was 0.737 and the Gender Empowerment Index (GEM) was 0.274 (NCED, 2005). UNDP's 2010 Human Development report (UNDP, 2010), which focused on gender equality, reported that by 2007, the GDI had risen slightly to 0.756 and the GEM to 0.389. In 2011, according to gender indices and ranking Sri Lanka scored 0.419. More recently, the issues related to women's empowerment are also reflected in the index, the Gender Inequality Index (GII). GII reflects gender-based inequalities in three dimensions: reproductive health, empowerment and the labor market. Sri Lanka's GII is high at 0.565 compared to most countries in the medium human development category, indicating inequalities (UNDP, 2012). On the indicators considered for the GII, Sri Lanka performs well on maternal mortality and education, but could improve performance on labor force participation and parliamentary representation.

Key statistics on women's status and gender equality in Sri Lanka are summarized in **Table 9.3.3**.

Table 9.3.3 Gender inequalities on key variables

Inequality Indication (year)	Female	Male
Unemployment rate (2012)	6.5	2.8
percent unemployment rate (education G.C.E. (A/L) &above) (2012)	9.3	4.9
Daily wage (2012) Sri Lankan Rupees	512.0	691.0
Underweight children below 5 yrs (2010)	29.8	29.0
Literacy rate of 15-24-year old (2011)	96.0	95.1
Gross enrolment in primary education 6-10 years (2007)	91.4	92.2
Primary enrolment rate (2007)	83.6	83.6
Proportion of pupils starting grade 1 reaching grade 9 (2001)	86.3	79.1
Labour Force Participation rate (2012)	31.6	66.7
percent of employed in agriculture (2012)	34.7	29.0
percent of employed in industry (2012)	24.7	25.8
percent of employed in services (2012)	40.6	45.1
percent of employed working as own account worker (2012)	23.6	34.9
percent of employed working as unpaid family worker (2012)	20.9	3.7
percent of employed working as employee (2012)	54.3	57.5
percent in the parliament (2004)	5.8	94.2

Source: Dept. of Census and Statistics 2012; UNDP, 2012; NCED, 2010.

While there is a high level of basic literacy among women, in practice traditional patriarchal attitudes limit the interaction of a vast majority of women in community decision making and in commerce. In conflict-affected areas, women bear the brunt of social instabilities, with gender-based violence having increased due to the overall environment of violence and insecurity over the past 20 years (ADB, 2010a). For women, labor force participation rates are low; they are paid less than men, a difference not explained by their productive capacity and true for all sectors. A related area for improvement is women's empowerment. From 2004 to 2010, less than 6 percent of the 255 members of Parliament were women; inclusion in governance mechanisms at the sub-national level is lesser (UNDP, 2012). The country gender assessment carried out by the ADB (ADB, 2008a) showed that that gender discrimination

in employment has resulted in widespread inequality, with women engaged in low-paying, low-skills jobs and mostly in the informal sector. This reinforces the conditions for women's poverty.

(Source: Gender review of national energy policies and programs in Sri Lanka June 2015 ADB GRANT-9158 REG , ETC project number 129019)

3) Gender Equality Commitments of the Government of Sri Lanka

Many national commitments have been made by the Sri Lankan Government regarding gender consideration and equality such as the elaboration of the National Plan of Action on Sex and Gender-based violence (2017-2021), a dedicated Chapter on Women's Rights in the Human Rights Action Plan (2017-2021), the National Framework for Women-Headed Household (2017-2019) and the introduction of quotas and Gender Mainstreaming committees within the public institutions.

- One of the fundamental rights set out in **Sri Lanka's Constitution** is the right to equality, including guarantees of equal treatment and protection, and prohibition against discrimination on grounds of sex. At the same time, the constitution allows special provisions for the advancement of women. These are percentages of students from primary to secondary first stage (grades 1–11) in the government schools, private schools, and pirivenas out of the population within the compulsory education age group of 5–16.
- **The Women's Charter adopted in 1993** is a key policy document that outlines rights in a range of areas and the commitments of the state to secure those rights. In addition to political and civil rights, the charter addresses rights to education and training economic activity and benefits, health care and nutrition, protection from social and discrimination, and protection against gender-based violence. A National Plan of Action to give effect to Women's Charter was developed with the participation of government and nongovernment organizations. However, as this plan was never formally approved and posted as an official document, it has not been enforced, supported by funds, or implemented.
- **The National Action Plan for the Protection and Promotion of Human Rights, 2011–2016** included a section on the rights of women and the concerns include economic participation and earnings, employment and working conditions, violence against women, political representation, elimination of discriminatory laws, and the effective reintegration of women affected by conflict. The Government of Sri Lanka has shown interest in gender equality issues and addressing challenges, such as encouraging banks to support women entrepreneurs. The government has also reiterated its intention to develop measures to increase women's participation in elected institution to 25%.25 18.
- **The Women's Bureau of Sri Lanka, established in 1978**, has a network of women's development officers in all districts and divisional secretariats. An important role of the women's development officer is to work with women's action societies organized at the village level and registered with the Bureau. These groups function as self-help groups and facilitate government outreach to women at the village level. The outreach programs of the Women's Bureau focus on economic empowerment through livelihood options and skills training. The bureau is also involved in the prevention of violence against women and in the improvement of the situation of widows and female-headed households. Sri Lanka also has many active women's organizations that pursue a variety of advocacy, research and social service activities.

(Source: Gender Equality and Social Inclusion Framework March 2017, Skills Sector Development Program

(2014–2020) Prepared by the Ministry of Skills Development and Vocational Training, Government of Sri Lanka for Asian Development Bank.)

- **National Action Plan for the Protection and Promotion of Human Rights 2017 – 2021:** The Government of Sri Lanka (GOSL) has identified gender equality and women's empowerment as priority areas and is a party to numerous international conventions and declarations including the Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW). The government is currently working towards achieving gender equality through the enactment of gender sensitive laws, formulation of policy and through action plans. Sri Lanka has made progress in many areas related to women's empowerment, particularly in the health and education sector.

Gender equality has been addressed through the Fundamental Rights Chapter in the Constitution and by meeting treaty obligations as well as by achieving gender indicators in the Sustainable Development Goals adopted by the United Nations in 2015. This National Action Plan reiterates the need to achieve substantial equality particularly in the economic, political and cultural spheres. Women's participation in the labour force is lower than men in both urban and rural areas.

The welfare of migrant women particularly in low skilled work is an issue despite the adoption of the National Policy on Labour Migration. Protection and economic, social and infrastructural needs of war affected women require immediate attention. It is crucial to incorporate gender in the transitional justice process as stipulated in the United Nations Security Council Resolution 1325. Despite the allocation of a quota (25%) for women in local government bodies, continuous advocacy is essential to increase women's representation in Parliament and Provincial Councils. Action is needed to enhance sensitivity amongst the general public and law enforcement agencies to eliminate gender-based violence at home, in the work place and in the community. A concerted effort is required to eliminate discriminatory attitudes and gender role stereotypes of women at all levels of society. Therefore, the National Action Plan enhances the government's commitment in realizing gender equality, eliminating discrimination, ensuring equal rights and enabling the empowerment of women, through effective implementation mechanisms, adequate resources and a monitoring system to achieve the objectives of the Plan.

(Source: National Action Plan for the Protection and Promotion of Human Rights 2017 – 2021)

4) Institutional set up for gender equality and women's empowerment

Sri Lanka created the Ministry for Women's Affairs in 1983, which was subsequently converted into the Ministry of Child Development and Women's Affairs is composed of the Ministry, the National Committee on Women, the Women's Bureau of Sri Lanka, and the Children's Secretariat. The National Committee on Women was established in 1993 as the implementing arm of the Women's Charter. Women' Bureau is the operational arm of the ministry and engaged in coordinating activities and formulating and registering women's organizations and District Federations. The Ministry is responsible for implementing relevant policies and disbursing funds. It addresses issues related to women in plantations, those in war and conflict affected areas, and women securing overseas employments and migrating on work, providing training and introducing income generation opportunities. The Ministry has appointed Women Development Officers at Divisional Secretariat levels to support programmers and form grassroots women's organizations and link them with extension services.

5) Gender Consideration in Infrastructure projects

A recent ADB Country Gender Assessment report points out that while infrastructure development is a major area of priority in national policy in Sri Lanka, gender issues have been largely invisible in infrastructure-related policies and have not received adequate recognition. This is critical since the employment structure of Sri Lanka is characterized by male dominance, and the conflict-areas have significant number of females headed households and population of working women. Further, adverse impacts on women and vulnerable groups, especially in the form of resettlement impacts, are known to be hard on females, female-headed households, poor and other vulnerable groups. The social impact assessment carried out as part of the feasibility studies and the pilot transaction will consider gender impacts of the proposed interventions, and the sub-project specific safeguards instruments will prepare a detailed plan for addressing impacts on women and other vulnerable groups.

(Source: Country Gender Assessment Sri Lanka An Update Country Gender Assessment Sri Lanka 2015, Asian Development Bank)

6) Gender Development and Inclusion in Resettlement Planning

Gender is a key issue in social safeguard management in view of the differential vulnerabilities of affected men and women. In view of their higher vulnerability levels, specific measures are proposed to enable the affected women – especially the poor and vulnerable – to cope with the Restatement & Relocation process. The process of gender and socially inclusive social management and resettlement planning includes the gender and inclusion analysis, project specific gender considerations, and a gender and inclusion strategy and action plan. These measures adopted under the social safeguards framework will complement the overall gender and inclusion strategy prepared for the Projects and the (NAPP) National Agency for Public Private Partnership (PPP).

Based on the gender and inclusion analysis, the Project will be able to develop a better understanding of differences in gender roles, activities, needs, and opportunities for the concerned PPP projects; and support in the development of a monitoring framework to ensure disaggregation of quantitative data by gender, vulnerability and inequalities. Applied to PPP projects, the process for gender and inclusion will among others include:

- Identification of gender-based differences in access to resources to predict how different members of households, groups, and societies will participate in and be affected by planned development interventions in the various PPP projects;
- Specific measures to achieve the goals of effectiveness, efficiency, equity, and empowerment through designing policy reform and supportive programme strategies; - Training packages to sensitize development staff on gender issues and training strategies for beneficiaries;
- Measures to enhance participation of women and vulnerable groups in the overall institutional and implementation framework of the PPP project and the NAPPP.

Specially in the context of the RPF, the social management and resettlement instruments prepared for the individual PPP Projects will include a strong section on gender and social inclusion statement. Some of the gender considerations that will be addressed in the safeguard's instruments (e.g., RAP) include:

(a) provision of title of the alternative house in the name of the woman only (if the original house was in the name of the woman only) or in the joint names of both partners (if the original house

was in the name of the man only and both parties are willing or if the original house was in the name of both parties) and in the name of the woman and the children, in case the other partner is dead;

(b) Special attention to women headed households in the relocation and post resettlement process with targeted livelihood assistance;

(c) gender sensitive provision of civic infrastructure including sanitation, transport furniture, and facilities for women in recreational places created as a part of the project; and

(d) Actively encouraging women and ensuring their equal participation in management of resettlement buildings. The objective of this gender strategy is to ensure equity in the resettlement process enabling women and their families to re-establish their shelter and livelihoods in a sustainable manner.

The RPF as well as the overall design of the Project emphasizes on the need to pay special attention to issues of gender, inclusion, social accountability and citizen engagement. It provides principles for strengthening social accountability and inclusion through public information; citizen involvement in planning and monitoring of services. In respect of social inclusion and gender mainstreaming, the RPF sets out guidelines for ensuring participation of women in resettlement planning process and special assistance to the economically weak, women-headed and vulnerable households for restoring their livelihoods and incomes that may be affected due to resettlement.

Guiding Principles with regard to gender consideration for Resettlement/Land Acquisition under PPP Projects

1. Screen the potential PPP projects early on to identify past, present, and future involuntary resettlement impacts and risks. Accordingly, the scope of resettlement planning will be determined through a survey and/or census of affected persons, including a gender analysis, specifically related to resettlement impacts and risks. Measures to avoid and minimize involuntary resettlement impacts will include:
2. The entitlements, compensation and eligibility, including preparation of the EM, is based on the provisions in the LAA of 1950 and LAR of 2008 together with the principles of the NIRP and the relevant WB policies. The RPF provides additional guidelines for integrating social inclusion, accountability and gender considerations in planning and implementing resettlement activities depending on the rights of APs.

(Source: Framework Development And Infrastructure Financing to Support Public Private Partnerships Resettlement Policy Framework (RPF), 24 April 2018, Government of Sri Lanka Ministry of Finance National Agency For Public Private Partnership)

7) Gender Consideration in the Project

- Impact by the Project

The number women are 76, out of them 7 are widows, 22 women are employed, 33 married and 25 are below the legal marriageable age. Only one woman (a spouse of the shop owner) will lose two buildings, but she will rebuild the buildings in the same premises. Although 40 women will lose a portion of land permanently, none of them will be displaced. They will lose collectively 370 rubber plants which is roughly equal to one acre of rubber land and some garden trees for which they will be compensated.

- Role of PMU

Women will be assisted with advice and financial help by PMU as per the provisions of the Entitlement

Matrix and pre -project status of their lives could at least be restored. Women will be encouraged by the PMU to obtain the loan facilities provided by the government under the new loan schemes to commence a business. PMU will coordinate with the contractor to provide suitable jobs during the construction period to enhance the family income of affected women.

PMU will draw up a program to improve the capacity of women to undertake income generating activities and engage in community based social and economic activities. Women will benefit from the micro credit programs of the state, Cooperative Credit Societies and NGOs. The assistance of the existing government machinery with dedicated officers for women affairs also will be sought by the PMU when gender issues surfaces during construction phase.

- Awareness Programs

Since there would be an influx of construction labor from outside, to the project area, the women who live close to the construction camps in their dwellings during day time might be vulnerable to violence and sexual advances by the migrant labor whose tenure is temporary and not subject to peer pressure and lack of concern to observe the accepted social norms.

Assistance of the NGOs and relevant District Medical Officers (MOH) and their staff will be obtained by the PMU to conduct awareness meetings on sexually transmitted diseases. The Social Officer attached to the PMU will coordinate this function with the relevant health officials. He will address the issues of women and children during construction and immediate construction phase.

This education program could be opened to other unaffected women too. The PMU will request police personnel in the respective areas to be more vigilant during the construction period to arrest incidents of violence and sexual harassments to women. PMU will apprise the police on such apprehensions. There is a Women Development Officer normally a female graduate attached to every Divisional Secretariat. She has a dedicated function to attend to empowerment of women and women related issues.

During monitoring and evaluation, the gender issues will be monitored, evaluated and well documented. Such information is useful when formulating gender action plans for future projects.

Chapter 10 Conclusion and recommendation

10.1 General

This is the draft final report prepared by the JICA Survey Team in accordance with the contract for the "Preparatory Survey on Landslide Disaster Protection Project of the National Road Network Phase 2", agreed upon between the Japan International Cooperation Agency (JICA) and a Joint Venture of Nippon Koei Co., Ltd. and Earth System Science Co., Ltd. on 8 February 2019.

10.2 Project Information

10.2.1 Project Goals and Objectives

The objectives of the Project are: a) to develop a self-sustaining system for the implementation of landslide risk reduction and landslide countermeasure works on the main national roads through the implementation of landslide countermeasure works for the major national roads with high landslide risk in eight districts; and b) further improve the safety of road networks and the livelihoods of the residents, thereby contributing to socioeconomic development in Sri Lanka.

10.2.2 Project Scope

The Project scopes are:

- Landslide protection for 30 sites of sediment disasters in nine districts, namely; Kandy, Nuwara Eliya and Matale districts in Central Province, Badulla District in Uva Province, Kegalle and Ratnapura districts in Sabaragamuwa Province, Galle and Matara districts in Southern Province and Colombo District in Western Province;
- Establishment of early warning system (EWS) for landslide protection sites of the national road network; and
- Capacity development for RDA and NBRO.
-

10.2.3 Project Approach

In order to achieve the purpose, project approaches for LDPP-2 are:

- To apply advanced technology of countermeasures against landslides to secure the safety of road slopes;
- To install efficient and effective EWS based on the confirmation of the site conditions and establish appropriate threshold for EWS; and
- To conduct capacity building timely and efficiently through updating manuals prepared in LDPP-1 and TCLMP.

10.2.4 Project Indicators

The Project aims to secure safety road networks by reducing risks of landslide disasters to the national road. The following operation and effect indicators have been set to measure its operation and effect quantitatively (**Table 10.2.1**).

Table 10.2.1 Operation and Effective Indicators

Indicators	Original as of 2019	Target at 2029
Annul days of traffic interruption (day/year)	218	0
Annual cost of temporary road recovery (million LKR/year)	135	0

Source: JICA Survey Team

10.2.5 Executing Agency

Road Development Authority (hereinafter referred to as "RDA") of the Ministry of Highways and Road Development and Petroleum Resource Development (hereinafter referred as "MOHRDPRD"), and National Building Research Organization (hereinafter referred as "NBRO")
Ministry of Public Administration, Disaster Management and Rural Economic Affairs.

10.2.6 Project Components of the LDPP2

Project components are 1) Construction of countermeasures at 30 target sites on the main national roads with landslide risks, 2) Establishment of early warning system for the target sites for safety of national road networks and 3) Capacity development for RDA and NBRO.
Currently, the Project is expected to comprise the following contract packages shown in **Table 10.2.2**:

Table 10.2.2 Contract Packages of the Project

「Hidden in pre-release version」

10.3 Necessity and Rationality of the Project

10.3.1 Validity of the Project

LDPP-2 meets both the policy and the plan of Sri Lanka and the Assistance Policy of Japan. The technology for landslide prevention and several related manuals prepared during the past assistances by JICA will be verified and revised during LDPP-2, if necessary.

10.3.2 Effectivity

The Project will reduce road closures of national roads and expressway by installation of proper measures against landslide. Early warning system for construction sites will be established for national road network, and these will contribute to secure safety transportation by introducing traffic regulation system based on monitoring data of rainfall and/or replacement of landslides. Capacity development throughout entire period will strength the capability of RDA and NBRO for slope protection in all activities for investigation, detailed design of countermeasures, tendering, construction supervision, and operation and maintenance stage.

10.3.3 Efficiency

The Project can contribute to reduce the sediment disasters along the National roads and expressways, and strength economic development especially in the landslide-prone area through decreasing the detour due to road block and accidents by sediment disasters. The proposed landslide countermeasures have sufficient economic efficiency with EIRR of 21.1%, B/C ratio of 2.15, and NPV of 18,269.5 million LKR.
From the viewpoint of the national economy, it is recommendable to implement the landslide countermeasures in order to secure the important function of national road network.

10.3.4 Sustainability

RDA is planning to establish Landslide Maintenance Management Division (LMMD) to ensure sustainable O&M works of slope protections. LDPP-2 will be able to contribute to develop the capacity of not only RDA-PMU and NBRO but also LDDM though all activities and the O&M manuals will be

updated before the end of the construction works.

10.3.5 Environmental Consideration

LDPP-2 is by nature not a new road development but an improvement of existing roads, and serious impacts are not expected. Some sites (No.10, 11, 12, 25, 33, 34, 51, 53) may be located within one mile from the boundaries of national reserves. Though no disturbance is expected, the project proponent should apply to the Director General of Department of Wildlife Conservation for approval. Cutting trees is expected to construct access road at Site No.53. Detailed mitigation measures should be considered during the detail design stage to minimize the number of cutting trees. Horizontal drain boreholes will cause drawdown of groundwater at some sites (No.1, 4, 6, 7, 26, 34, 49). There is no residence that uses groundwater as main water resource. The Project will introduce environmentally-friendly technology.
Monitoring will be carried out for the items that negative impacts are expected to some extent. During operation stage, there will be almost nothing to affect the environmental and social conditions at the project sites.
Impacts on private properties, livelihood and economic activities are expected as shown in **Table 10.3.1**. Resettlement action plan (RAP) and income restoration plan (IRP) will be developed and compensation will be provided to the affected persons.

Table 10.3.1 Summary of Assumed Land Acquisition and Resettlement of the Project

Item	Unit	Total
Public land to be acquired	ha	3.9
Private land to be acquired	ha	4.2
Affected households	number	40
Affected persons	number	148
Households to be resettled	number	0
Persons to be resettled	number	0

Source: JICA Survey Team

10.4 Recommendations

10.4.1 Implementation Structure of Client

Staffing was not enough for PMU in LDPP1 through the Project. Assignment of enough number of well experienced RDA PMU staff are essential for success of the Project implementation.

10.4.2 Investigation and Detailed Design Stage

Investigations of landslide needs to start at the earliest stage of the Project to ensure enough time of long-term monitoring (at least two years) for the reliable detailed design of countermeasures against landslides.
Further capacity development activities for RDA/NBRO in all stages from investigation, detailed design, tendering, construction supervision and operation and maintenance of slope protections are necessary through the updating of manuals and timely and efficient training by well-experienced engineers including on-the job training are necessary. The engineers are required English communication skills enough to explain necessary knowledge.

10.4.3 Construction Supervision Stage

Since the local Contractor sometimes does not comply with safety management regulations, safety management system needs to be established at the earliest stage of the construction supervision.
Construction sites cannot avoid the unforeseeable risks in geology of the site. Variation order would be

inevitable and should be done in an efficient and timely manner accordingly.
Since unexpected landslides might occur due to unforeseeable geology, four foreign engineers with skills of countermeasure design are recommended to be assigned at site during construction supervision stage.

10.4.4 Others to be considered

LDPP-1 contributed to significantly improve local contractor's experiences and their labours capability of slope protection. Especially skilled workers familiar with slope protection measures are important for LDPP-2. Continuous training for local contractor is recommended. Training of these skilled workers in Japan might be one solution to keep and further develop the capacity of the local contractors.

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