

Appendix 1

プロジェクト議事録

Minutes of Meeting on the Project

**MINUTES OF MEETINGS
BETWEEN
DEPARTMENT OF ROADS
AND
JAPAN INTERNATIONAL COOPERATION AGENCY
ON
TECHNICAL COOPERATION PROJECT FOR CRITICAL SLOPE TREATMENT /
STABILIZATION ALONG THE ROAD NETWORK IN BHUTAN**

The Japanese Detailed Planning Survey Team (hereinafter referred to as “the Team”) organized by Japan International Cooperation Agency (hereinafter referred to as “JICA”) headed by Mr. Nobuyuki Tsuneoka, Senior Advisor of JICA, visited Bhutan from November 25, 2013 to December 5, 2013 for the purpose of working out the details concerning “Technical Cooperation Project for Critical Slope Treatment/Stabilization along the Road Network in Bhutan” (hereinafter referred to as “the Project”)

During its stay in Bhutan, the Team exchanged views and had a series of discussions with Department of Roads, Ministry of Works and Human Settlement (hereinafter referred to as “DOR”) and the concerned organizations of Bhutan with respect to necessary measures to be taken by JICA and the Royal Government of Bhutan (hereinafter referred to as “RGOB”) represented by DOR for the appropriate formulation of the Project.

As a result of the discussions, DOR and JICA agreed upon the matters referred to in the document attached hereto.

Thimphu, December 3, 2013



Karma Galay
Director
Department of Roads
Ministry of Works and Human Settlement
Kingdom of Bhutan



Nobuyuki Tsuneoka
Leader
Detailed Planning Survey Team
Japan International Cooperation Agency
Japan



Rinchen Wangdi
Chief Program Coordinator
Development Cooperation Division
Gross National Happiness Commission
Kingdom of Bhutan

ATTACHED DOCUMENT

I. RECORD OF DISCUSSIONS

Both sides agreed that the Record of Discussions (R/D) will determine the framework of the Project. The draft R/D is attached to this Minutes of Meetings for reference as shown in Appendix-1. It will be agreed and signed between DOR, Gross National Happiness Commission and JICA after the formal approval of both sides.

II. CHANGE OF THE PROJECT TITLE

Both sides agreed to change the Project title from “Technical Cooperation Project for Critical Slope Treatment/Stabilization along the Road Network in Bhutan” to “Project for Master Plan Study on Road Slope Management in Bhutan”.

Appendix-1 Draft Record of Discussions



(DRAFT)
RECORD OF DISCUSSIONS
ON
PROJECT FOR MASTER PLAN STUDY ON ROAD SLOPE
MANAGEMENT IN BHUTAN
AGREED UPON BETWEEN
GROSS NATIONAL HAPPINESS COMMISSION
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

Thimphu, XX, 2013

Yumiko Asakuma
Chief Representative
Japan International Cooperation Agency
Japan

Karma Tshiteem
Secretary
Gross National Happiness Commission
Kingdom of Bhutan

Witnessed by

Karma Galay
Director
Department of Roads
Ministry of Works and Human Settlement
Kingdom of Bhutan

CP

Yumiko Asakuma

Based on the Minutes of Meetings on the Detailed Planning Survey on Project for Master Plan Study on Road Slope Management in Bhutan (hereinafter referred to as "the Project") signed on December 3, 2013 between Department of Roads, Ministry of Works and Human Settlement (hereinafter referred to as "DOR"), Gross National Happiness Commission (hereinafter referred to as "GNHC") and the Japan International Cooperation Agency (hereinafter referred to as "JICA"), JICA held a series of discussions with DOR and relevant organizations to develop a detailed plan of the Project.

Both sides agreed the details of the Project and Main Points Discussed as described in the Appendix 1 and the Appendix 2, respectively, and to request their respective governments to proceed with the necessary procedures for implementation of the Project.

Both sides also agreed that DOR, the counterpart to JICA, will be responsible for the implementation of the Project in cooperation with JICA, coordinate with other relevant organizations and ensure that the self-reliant operation of the Project is sustained during and after the implementation period in order to contribute toward social and economic development of Kingdom of Bhutan (hereinafter referred to as "Bhutan").

The Project will be implemented within the framework of the Colombo Plan Technical Cooperation Scheme and the Note Verbales to be exchanged between the Government of Japan (hereinafter referred to as "GOJ") and the Royal Government of Bhutan (hereinafter referred to as "RGOB").

The effectiveness of the Record of Discussions is subject to the exchange of the Note Verbales.

Appendix 1: Project Description.

Appendix 2: Main Points Discussed

PROJECT DESCRIPTION

Both sides confirmed that there is no change in the Project Description agreed on in the Minutes of Meetings on the concerning Detailed Planning Survey on the Project signed on December 3, 2013.

I. BACKGROUND

Bhutan is dominantly covered by the mountainous areas spreading from the Himalaya. Road traffic is, therefore, the most important and vital transportation system for Bhutan. The major highway network in the country consists of 5 national highways; National Highway No.1 transversally crossing the country in a direction of east and west and 4 national highways advancing southward to the border with India. The total extension of the road in the country is, however, rapidly expanding; it was around a length of 2,300 km in 1990 and stretched to around a length of 3,900 km in 2003 and around a length of 10,600 km in 2013.

In regard to national programs in road sector, the Ministry of Works and Human Settlement (hereinafter referred to as "MOWHS") established the Road Sector Master Plan in 2006. In the master plan, MOWHS aims to expand and improve the national and Dzongkhag road network, to enhance the feeder road network, and to repair or replace or maintain bridges in the coming 20 years until 2027. Meanwhile, in the 10th Five Year Plan targeting from 2008 to 2013, RGOB set a goal of making any access to the nearest road within 2 hours or less.

Since most parts of the road network in Bhutan pass through steep slopes of the precipitous mountainous areas, the slope disaster frequently obstruct the road network in Bhutan. Slope disasters often isolate a Dzongkhag from the capital and other Dzongkhags, disrupt road traffic, and consequently hamper travel and transport of agricultural crops. In the aim of mitigating the damage caused by slope disasters, DOR introduced countermeasures against slope disasters utilizing vegetation and reinforcement. Due to a lack of experience and expertise, however, DOR is facing difficulties in implementing effective countermeasures against slope disasters.

In addition, in order to enhance the ability to grasp an inventory of dangerous slopes requiring countermeasures, RGOB requested GOJ to implement "the Technical Cooperation Project for Critical slope treatment/stabilization along the Road Network in Bhutan". In response to this request, JICA had series of discussion with DOR and other authorities concerned of Bhutan. Based on the agreements between JICA and the authorities concerned of Bhutan, the Minutes of Meetings was signed on December 3, 2013, which leads both parties to conclude this Record of Discussions.



II. OUTLINE OF THE PROJECT

1. Title of the Project

Project for Master Plan Study on Road Slope Management in Bhutan

2. Expected Goals which will be attained after the Project Completion

(1) Goal of the Proposed Project

Slope stability inspection and regular updating are conducted, and record cards of slope stability inspection "Slope Karte" are maintained by DOR.

(2) Goal which will be attained through implementation of the Proposed Project

Critical slopes are identified, and a plan for slope treatment/ stabilization is established by DOR.

3. Outputs

(1) Manuals for slope stability inspection and diagnosis are prepared.

(2) Slope stability inspection is conducted and road slope inventory is produced for the selected road section(s).

(3) Slope stability database including Slope Karte is established for the selected road section(s).

(4) Giving advice on one or two pilot sites to be implemented by DOR based on Slope Karte.

The selected road section(s) is to be decided at the first SC meeting and stipulated as a section of national highways between major towns. The selected road section(s) is subject to the availability of budget and time.

4. Activities

(1) For the output (1) "Manuals for slope stability inspection and diagnosis are prepared."

(a) Prepare manuals for slope stability inspection and diagnosis.

(b) Establish terminology for each slope disaster type in Bhutan.

(c) Revise the manuals for slope stability inspection prepared in (a).

(2) For the output (2) "Slope stability inspection is conducted for the selected road section(s)."

(a) Collect records of disaster and information on countermeasures under taken along the selected road section(s).

(b) Select target segments for the inspection in accordance with degree of risk.

(c) Screen the slopes in the target segments selected in (b), by aerial photo reading or geomorphic analysis.

(d) Confirm the result of screening in (c) on site and decide the target slopes for the inspection.

(e) Conduct field surveys at the target slopes in (d), and produce road slope inventory with the aim of preparing Slope Karte.

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- (f) Execute supplementary surveys including investigation boring and seismic exploration at a couple of slopes to understand mechanism of typical slope failure.
 - (g) Prepare Slope Karte through organizing and analyzing the results of the surveys.
 - (h) Carry out training including OJT for the target group concerning slope stability inspection and Slope Karte operation.
- (3) For the output (3) "Slope stability database is established for the selected road section(s)."
- (a) Establish a database system for managing the results of slope stability inspection including Slope Karte.
 - (b) Prepare operation manuals for the slope stability database system.
- (4) For the output (4) "Giving advice on one or two pilot sites to be implemented by DOR based on Slope Karte."
- (a) Review design documents prepared by DOR.
 - (b) Give advice on investigation for design of countermeasures.

5. Input

(1) Input by JICA

JICA will take, at its own expense, the following measures according to the normal procedures under the Colombo Plan Technical Cooperation:

(a) Dispatch of Mission

- Team Leader/Slope Stability Management Expert (Inspection and Manual)
- Slope Stability Management Expert (Inspection)
- Slope Stability Management Expert (Countermeasure)
- Slope Stability Database System Expert
- Road Maintenance Expert
- Coordinator/Assistant of Slope Stability Management

(b) Training

- Training in Bhutan: OJT, Workshop/Seminar
- Training in Japan

(c) Machinery and Equipment

- GPS for survey: 3 units
- Laser Range Finder: 3 units

In case of importation, the machinery, equipment and other materials under II-5 (1) (c) above will become the property of the RGOB upon being delivered C.I.F. (cost, insurance and freight) to the Bhutan authorities concerned at the ports and/or airports of disembarkation.

Input other than indicated above will be determined through mutual consultations between JICA and DOR during the implementation of the Project, as necessary.



(2) Input by DOR

DOR will take necessary measures to provide at its own expense:

- (a) Services of DOR's counterpart personnel and administrative personnel as referred to in II-6;
- (b) Suitable office space with necessary equipment;
- (c) Supply or replacement of machinery, equipment, instruments, vehicles, tools, spare parts and any other materials necessary for the implementation of the Project other than the equipment provided by JICA;
- (d) Information as well as support in obtaining medical service;
- (e) Credentials or identification cards;
- (f) Available data (including maps and photographs) and information related to the Project;
- (g) Running expenses necessary for the implementation of the Project;
- (h) Expenses necessary for transportation within Bhutan of the equipment referred to in II-5 (1) (c) as well as for the installation, operation and maintenance thereof; and
- (i) Necessary facilities to the JICA experts for the remittance as well as utilization of the funds introduced into Bhutan from Japan in connection with the implementation of the Project

6. Implementation Structure

The Project organization chart is given in the Annex 2.

(1) DOR

- (a) Project Director: Chief Engineer for Maintenance Division
- (b) Maintenance Division
- (c) Construction Division
- (d) Design Division
- (e) Planning and Monitoring Division

Project Director will bear overall responsibility of the Project.

(2) JICA Experts

The JICA experts will give necessary technical guidance, advice and recommendations to DOR on any matters pertaining to the implementation of the Project.

(3) Steering Committee

Steering Committee (hereinafter referred to as "SC") will be established in order to facilitate inter-organizational coordination. SC will be held at least twice a year and whenever deems it necessary. A list of proposed members of SC is shown in the Annex 3.

(4) Working Group

Working Group (hereinafter referred as "WG") will be established and function as a technical unit on a daily-work basis to correspond to the JICA mission. A list of proposed members of WG will be proposed and finalized in the first SC meeting after commencement of the Project.

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7. Project Site(s) and Beneficiaries

(1) Project Site

The main activities of the Project will be implemented at DOR's headquarters and the selected road section(s) mentioned in II.3.

(2) Direct beneficiaries

Direct beneficiaries of the Project will be the staff of DOR.

(3) Indirect beneficiaries

Indirect beneficiaries are road users as well as people living in the selected road section(s).

8. Duration

The duration of the Project will be twenty four (24) months. The tentative Plan of Operation is shown in Annex 1.

9. Reports

JICA will prepare and submit the following reports to DOR in English.

(1) 10 copies of Inception Report at the commencement of the first work period in Bhutan.

(2) 10 copies Progress Report at the time of 7 months after the commencement of the first work period in Bhutan.

(3) 10 copies Interim Report at the time of 13 months after the commencement of the first work period in Bhutan.

(4) 10 copies Draft Final Report at the time of 22 months after the commencement of the first work period in Bhutan.

(5) 20 copies Final Report within one (1) month after the receipt of the comments on the Draft Final Report.

10. Environmental and Social Considerations

(1) DOR agreed to abide by 'JICA Guidelines for Environmental and Social Considerations' in order to ensure that appropriate considerations will be made for the environmental and social impacts of the Project.

III. UNDERTAKINGS OF DOR, RGOB

1. DOR, RGOB will take necessary measures to:

(1) ensure that the technologies and knowledge acquired by the Bhutan nationals as a result of Japanese technical cooperation contributes to the economic and social development of Bhutan, and that the knowledge and experience acquired by the personnel of Bhutan from technical training as well as the equipment provided by JICA will be utilized effectively in the implementation of the Project; and

- (2) grant privileges, exemptions and benefits to the JICA experts referred to in II-5 (1) above and their families, which are no less favorable than those granted to experts and members of the missions and their families of third countries or international organizations performing similar missions in Bhutan.
 - (3) provide security-related information as well as measures to ensure the safety of the JICA experts;
 - (4) permit the JICA experts to enter, leave and sojourn in Bhutan for the duration of their assignments therein and exempt them from foreign registration requirements and consular fees.
2. Other privileges, exemptions and benefits will be provided in accordance with the Note Verbales to be exchanged between GOJ and RGOB.

IV. EVALUATION

JICA will conduct the following evaluations and surveys to mainly verify sustainability and impact of the Project and draw lessons. DOR is required to provide necessary support for them.

1. Ex-post evaluation three (3) years after the project completion, in principle .
2. Follow-up surveys on necessity basis

V. PROMOTION OF PUBLIC SUPPORT

For the purpose of promoting support for the Project, DOR will take appropriate measures to make the Project widely known to the people of Bhutan.

VI. MUTUAL CONSULTATION

JICA and DOR will consult each other whenever any major issues arise in the course of Project implementation.

VII. AMENDMENTS

The Record of Discussions may be amended by the Minutes of Meetings between JICA and GNHC in consultation with DOR.

The Minutes of Meetings will be signed by authorized persons of each side who may be different from the signers of the Record of Discussions.

- Annex 1 Tentative Plan of Operation
Annex 2 Project Organization Chart
Annex 3 A List of Proposed Members of Steering Committee



Draft, Tentative Plan of Operation[PO], Project for Master Plan Study on Road Slope Management in Bhutan

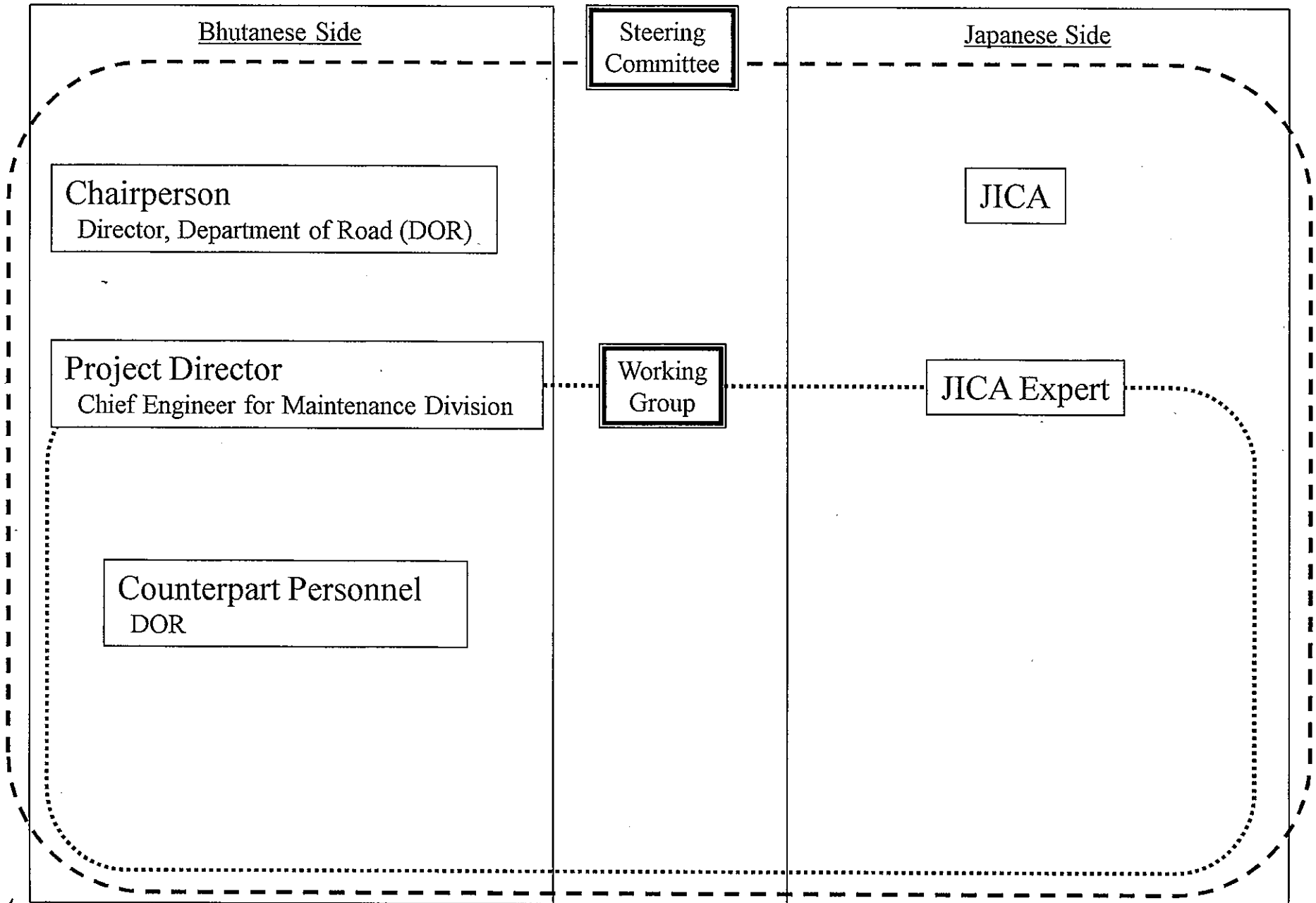
Activities	Year 1												Year 2												
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	
Output1: Manuals for slope stability inspection and diagnosis are prepared.																									
1-1	Prepare manuals for slope stability inspection and diagnosis.	■	■	■	■	■	■	■	■	■	■	■													
1-2	Establish selection standards of countermeasures for each slope disaster type.			■	■	■	■	■	■	■	■	■													
1-3	Revise the manuals for slope stability inspection prepared in 1-1.									■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
Output2: Slope stability inspection is conducted for the selected road section(s).																									
2.1	Collect records of disaster and information on countermeasures under taken along the selected road section(s).	■	■	■	■	■										■	■	■	■						
2.2	Select target segments for the inspection in accordance with degree of risk.		■	■	■	■										■	■	■	■						
2.3	Screen the slopes in the target segments selected in 2-2, by aerial photo reading or geomorphic analysis.			■	■	■	■	■	■	■	■	■					■	■	■	■					
2.4	Confirm the result of screening in 2-3 on site and decide the target slopes for the inspection.						■	■										■	■						
2.5	Conduct field surveys at the targeted slopes in 2-4, with the aim of preparing Slope Karte.							■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
2.6	Execute supplementary surveys including investigation boring and seismic exploration at a couple of slopes to understand mechanism of typical slope failure.															■	■					■	■		
2.7	Prepare Slope Karte through organizing and analysing the results of the surveys.															■	■	■	■	■	■	■	■	■	
2.8	Carry out training including OJT for the target group concerning slope stability inspection and Slope Karte operation.	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
Output3: Slope stability database is established for the selected road section(s).																									
3.1	Establish a database system for managing the results of slope stability inspection including Slope Karte.															■	■	■	■	■	■	■	■	■	
3.2	Prepare operation manuals for the slope stability database system.																	■	■	■	■	■	■	■	
Output4: Giving advice on one or two pilot sites to be implemented by DOR based on Slope Karte.																									
4.1	Review design documents prepared by DOR.																								
4.2	Give advice on investigation for design of countermeasures.																								
Administrative Activities																									
	Steering Committee	▲														▲								▲	
	Inception Report	▲																							
	Interim Report/Progress Report									PR	▲														
	Draft Final Report/Final Report																								
																							DFR	▲	
																								FR	▲

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Organization chart of the Project



LIST OF PROPOSED MEMBERS OF STEERING COMMITTEE

Chairperson: Director, Department of Roads (DOR)

Members:

(1) Bhutanese Side

1) DOR

- Project Director: Chief Engineer for Maintenance Division

2) Representative from GNHC

(2) Japanese Side

1) JICA

2) JICA Experts

- Team Leader/Slope Stability Management Expert (Inspection and Manual)

- Slope Stability Management Expert (Inspection)

- Slope Stability Management Expert (Countermeasure)

- Slope Stability Database System Expert

- Road Maintenance Expert

- Coordinator/Assistant of Slope Stability Management

(3) Others

- Relevant personnel accepted by SC, if necessary



MAIN POINTS DISCUSSED

I. PROJECT PERIOD

Both sides agreed that the duration of the project should be 24 months from the first dispatch of JICA study team.

II. OUTPUTS OF THE PROJECT

- (1) Referring to II-3 (2), number of slopes to be inspected will be 400 at maximum. Those slopes will be located in the selected road section(s).
- (2) Referring to II-3 (4), pilot sites will be selected from Slope Karte. "Giving advice" is stipulated in II-4 (4), and does not include engineering services.
- (3) The selected road section(s) is one or two section(s) identified by SC.

III. INSPECTION TEAM

Both sides agreed that two inspection teams will be established at the first SC meeting. The member of the inspection team will contain at least one Japanese expert and one DOR engineer.

If the third inspection team or more is established by Bhutanese engineers, JICA study team will support in checking the implementation of inspection and Slope Karte operation.

IV. TECHNICAL TRANSFER DURING THE PROJECT

Both sides agreed that technical transfer on slope stability inspection, preparation of Slope Karte, and establishment of the database will be done at OJT basis.

Workshops/Seminars will be held twice in Bhutan.

Training in Japan will be held early or middle period of the Project. DOR requested that trainees in Japan will be one from each of nine DOR's regional offices and three from DOR's headquarters.

V. OPERATION AND MAINTENANCE OF SLOPE KARTE

Both sides agreed that DOR should conduct the remaining slope stability inspection as well as regular updating of Slope Karte by themselves.

VI. OTHERS

DOR requested for two vehicles for the Project considering the lack of transportation.


Appendix 2


討議議事録

*Record of Discussions
on the Project*

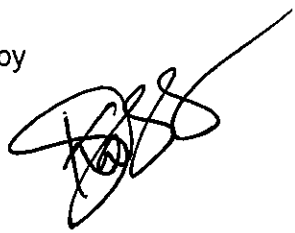
RECORD OF DISCUSSIONS
ON
PROJECT FOR MASTER PLAN STUDY ON ROAD SLOPE
MANAGEMENT IN BHUTAN
AGREED UPON BETWEEN
GROSS NATIONAL HAPPINESS COMMISSION
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

Thimphu, 10th March, 2014


Yumiko Asakuma
Chief Representative
Japan International Cooperation Agency
Japan


Karma Tshiteem
Secretary
Gross National Happiness Commission
Kingdom of Bhutan

Witnessed by


Karma Galay
Director
Department of Roads
Ministry of Works and Human Settlement
Kingdom of Bhutan

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Both sides agreed the details of the Project and Main Points Discussed as described in the Appendix 1 and the Appendix 2, respectively, and to request their respective governments to proceed with the necessary procedures for implementation of the Project.

Both sides also agreed that DOR, the counterpart to JICA, will be responsible for the implementation of the Project in cooperation with JICA, coordinate with other relevant organizations and ensure that the self-reliant operation of the Project is sustained during and after the implementation period in order to contribute toward social and economic development of Kingdom of Bhutan (hereinafter referred to as "Bhutan").

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The effectiveness of the Record of Discussions is subject to the exchange of the Note Verbales.

Appendix 1: Project Description

Appendix 2: Main Points Discussed

Appendix 3: Minutes of Meetings on the Detailed Planning Survey on the Project signed on December 3, 2013



PROJECT DESCRIPTION

Both sides confirmed that there is no change in the Project Description agreed on in the Minutes of Meetings on the concerning Detailed Planning Survey on the Project signed on December 3, 2013.

I. BACKGROUND

Bhutan is dominantly covered by the mountainous areas spreading from the Himalaya. Road traffic is, therefore, the most important and vital transportation system for Bhutan. The major highway network in the country consists of 5 national highways; National Highway No.1 transversally crossing the country in a direction of east and west and 4 national highways advancing southward to the border with India. The total extension of the road in the country is, however, rapidly expanding; it was around a length of 2,300 km in 1990 and stretched to around a length of 3,900 km in 2003 and around a length of 10,600 km in 2013.

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Since most parts of the road network in Bhutan pass through steep slopes of the precipitous mountainous areas, the slope disaster frequently obstruct the road network in Bhutan. Slope disasters often isolate a Dzongkhag from the capital and other Dzongkhags, disrupt road traffic, and consequently hamper travel and transport of agricultural crops. In the aim of mitigating the damage caused by slope disasters, DOR introduced countermeasures against slope disasters utilizing vegetation and reinforcement. Due to a lack of experience and expertise, however, DOR is facing difficulties in implementing effective countermeasures against slope disasters.

In addition, in order to enhance the ability to grasp an inventory of dangerous slopes requiring countermeasures, RGOB requested GOJ to implement "the Technical Cooperation Project for Critical slope treatment/stabilization along the Road Network in Bhutan". In response to this request, JICA had series of discussion with DOR and other authorities concerned of Bhutan. Based on the agreements between JICA and the authorities concerned of Bhutan, the Minutes of Meetings was signed on December 3, 2013, which leads both parties to conclude this Record of Discussions.



II. OUTLINE OF THE PROJECT

1. Title of the Project

Project for Master Plan Study on Road Slope Management in Bhutan

2. Expected Goals which will be attained after the Project Completion

(1) Goal of the Proposed Project

Slope stability inspection and regular updating are conducted, and record cards of slope stability inspection "Slope Karte" are maintained by DOR.

(2) Goal which will be attained through implementation of the Proposed Project

Critical slopes are identified, and a plan for slope treatment/ stabilization is established by DOR.

3. Outputs

(1) Manuals for slope stability inspection and diagnosis are prepared.

(2) Slope stability inspection is conducted and road slope inventory is produced for the selected road section(s).

(3) Slope stability database including Slope Karte is established for the selected road section(s).

(4) Giving advice on one or two pilot sites to be implemented by DOR based on Slope Karte.

The selected road section(s) is to be decided at the first SC meeting and stipulated as a section of national highways between major towns. The selected road section(s) is subject to the availability of budget and time.

4. Activities

(1) For the output (1) "Manuals for slope stability inspection and diagnosis are prepared."

(a) Prepare manuals for slope stability inspection and diagnosis.

(b) Establish terminology for each slope disaster type in Bhutan.

(c) Revise the manuals for slope stability inspection prepared in (a).

(2) For the output (2) "Slope stability inspection is conducted for the selected road section(s)."

(a) Collect records of disaster and information on countermeasures under taken along the selected road section(s).

(b) Select target segments for the inspection in accordance with degree of risk.

(c) Screen the slopes in the target segments selected in (b), by aerial photo reading or geomorphic analysis.

(d) Confirm the result of screening in (c) on site and decide the target slopes for the inspection.

(e) Conduct field surveys at the target slopes in (d), and produce road slope inventory with the aim of preparing Slope Karte.

- (f) Execute supplementary surveys including investigation boring and seismic exploration at a couple of slopes to understand mechanism of typical slope failure.
 - (g) Prepare Slope Karte through organizing and analyzing the results of the surveys.
 - (h) Carry out training including OJT for the target group concerning slope stability inspection and Slope Karte operation.
- (3) For the output (3) "Slope stability database is established for the selected road section(s)."
- (a) Establish a database system for managing the results of slope stability inspection including Slope Karte.
 - (b) Prepare operation manuals for the slope stability database system.
- (4) For the output (4) "Giving advice on one or two pilot sites to be implemented by DOR based on Slope Karte."
- (a) Review design documents prepared by DOR.
 - (b) Give advice on investigation for design of countermeasures.

5. Input

(1) Input by JICA

JICA will take, at its own expense, the following measures according to the normal procedures under the Colombo Plan Technical Cooperation:

(a) Dispatch of Mission

- Team Leader/Slope Stability Management Expert (Inspection and Manual)
- Slope Stability Management Expert (Inspection)
- Slope Stability Management Expert (Countermeasure)
- Slope Stability Database System Expert
- Road Maintenance Expert
- Coordinator/Assistant of Slope Stability Management

(b) Training

- Training in Bhutan: OJT, Workshop/Seminar
- Training in Japan

(c) Machinery and Equipment

- Vehicle for survey: 2 units
- GPS for survey: 3 units
- Laser Range Finder: 3 units

In case of importation, the machinery, equipment and other materials under II-5 (1) (c) above will become the property of the RGOB upon being delivered C.I.F. (cost, insurance and freight) to the Bhutan authorities concerned at the ports and/or airports of disembarkation.

Input other than indicated above will be determined through mutual consultations between JICA and DOR during the implementation of the Project, as necessary.

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(2) Input by DOR

DOR will take necessary measures to provide at its own expense:

- (a) Services of DOR's counterpart personnel and administrative personnel as referred to in II-6;
- (b) Suitable office space with necessary equipment;
- (c) Supply or replacement of machinery, equipment, instruments, vehicles, tools, spare parts and any other materials necessary for the implementation of the Project other than the equipment provided by JICA;
- (d) Information as well as support in obtaining medical service;
- (e) Credentials or identification cards;
- (f) Available data (including maps and photographs) and information related to the Project;
- (g) Running expenses necessary for the implementation of the Project;
- (h) Expenses necessary for transportation within Bhutan of the equipment referred to in II-5 (1) (c) as well as for the installation, operation and maintenance thereof; and
- (i) Necessary facilities to the JICA experts for the remittance as well as utilization of the funds introduced into Bhutan from Japan in connection with the implementation of the Project

6. Implementation Structure

The Project organization chart is given in the Annex 2.

(1) DOR

- (a) Project Director: Chief Engineer for Maintenance Division
- (b) Maintenance Division
- (c) Construction Division
- (d) Design Division
- (e) Planning and Monitoring Division

Project Director will bear overall responsibility of the Project.

(2) JICA Experts

The JICA experts will give necessary technical guidance, advice and recommendations to DOR on any matters pertaining to the implementation of the Project.

(3) Steering Committee

Steering Committee (hereinafter referred to as "SC") will be established in order to facilitate inter-organizational coordination. SC will be held at least twice a year and whenever deems it necessary. A list of proposed members of SC is shown in the Annex 3.

(4) Working Group

Working Group (hereinafter referred as "WG") will be established and function as a technical unit on a daily-work basis to correspond to the JICA mission. A list of proposed members of WG will be proposed and finalized in the first SC meeting after commencement of the Project.

7. Project Site(s) and Beneficiaries

(1) Project Site

The main activities of the Project will be implemented at DOR's headquarters and the selected road section(s) mentioned in II.3.

(2) Direct beneficiaries

Direct beneficiaries of the Project will be the staff of DOR.

(3) Indirect beneficiaries

Indirect beneficiaries are road users as well as people living in the selected road section(s).

8. Duration

The duration of the Project will be twenty four (24) months. The tentative Plan of Operation is shown in Annex 1.

9. Reports

JICA will prepare and submit the following reports to DOR in English.

(1) 10 copies of Inception Report at the commencement of the first work period in Bhutan.

(2) 10 copies Progress Report at the time of 7 months after the commencement of the first work period in Bhutan.

(3) 10 copies Interim Report at the time of 13 months after the commencement of the first work period in Bhutan.

(4) 10 copies Draft Final Report at the time of 22 months after the commencement of the first work period in Bhutan.

(5) 20 copies Final Report within one (1) month after the receipt of the comments on the Draft Final Report.

10. Environmental and Social Considerations

(1) DOR agreed to abide by 'JICA Guidelines for Environmental and Social Considerations' in order to ensure that appropriate considerations will be made for the environmental and social impacts of the Project.

III. UNDERTAKINGS OF DOR, RGOB

1. DOR, RGOB will take necessary measures to:

(1) ensure that the technologies and knowledge acquired by the Bhutan nationals as a result of Japanese technical cooperation contributes to the economic and social development of Bhutan, and that the knowledge and experience acquired by the personnel of Bhutan from technical training as well as the equipment provided by JICA will be utilized effectively in the implementation of the Project; and

- (2) grant privileges, exemptions and benefits to the JICA experts referred to in II-5 (1) above and their families, which are no less favorable than those granted to experts and members of the missions and their families of third countries or international organizations performing similar missions in Bhutan.
 - (3) provide security-related information as well as measures to ensure the safety of the JICA experts;
 - (4) permit the JICA experts to enter, leave and sojourn in Bhutan for the duration of their assignments therein and exempt them from foreign registration requirements and consular fees.
2. Other privileges, exemptions and benefits will be provided in accordance with the Note Verbales to be exchanged between GOJ and RGOB.

IV. EVALUATION

JICA will conduct the following evaluations and surveys to mainly verify sustainability and impact of the Project and draw lessons. DOR is required to provide necessary support for them.

1. Ex-post evaluation three (3) years after the project completion, in principle
2. Follow-up surveys on necessity basis

V. PROMOTION OF PUBLIC SUPPORT

For the purpose of promoting support for the Project, DOR will take appropriate measures to make the Project widely known to the people of Bhutan.

VI. MUTUAL CONSULTATION

JICA and DOR will consult each other whenever any major issues arise in the course of Project implementation.

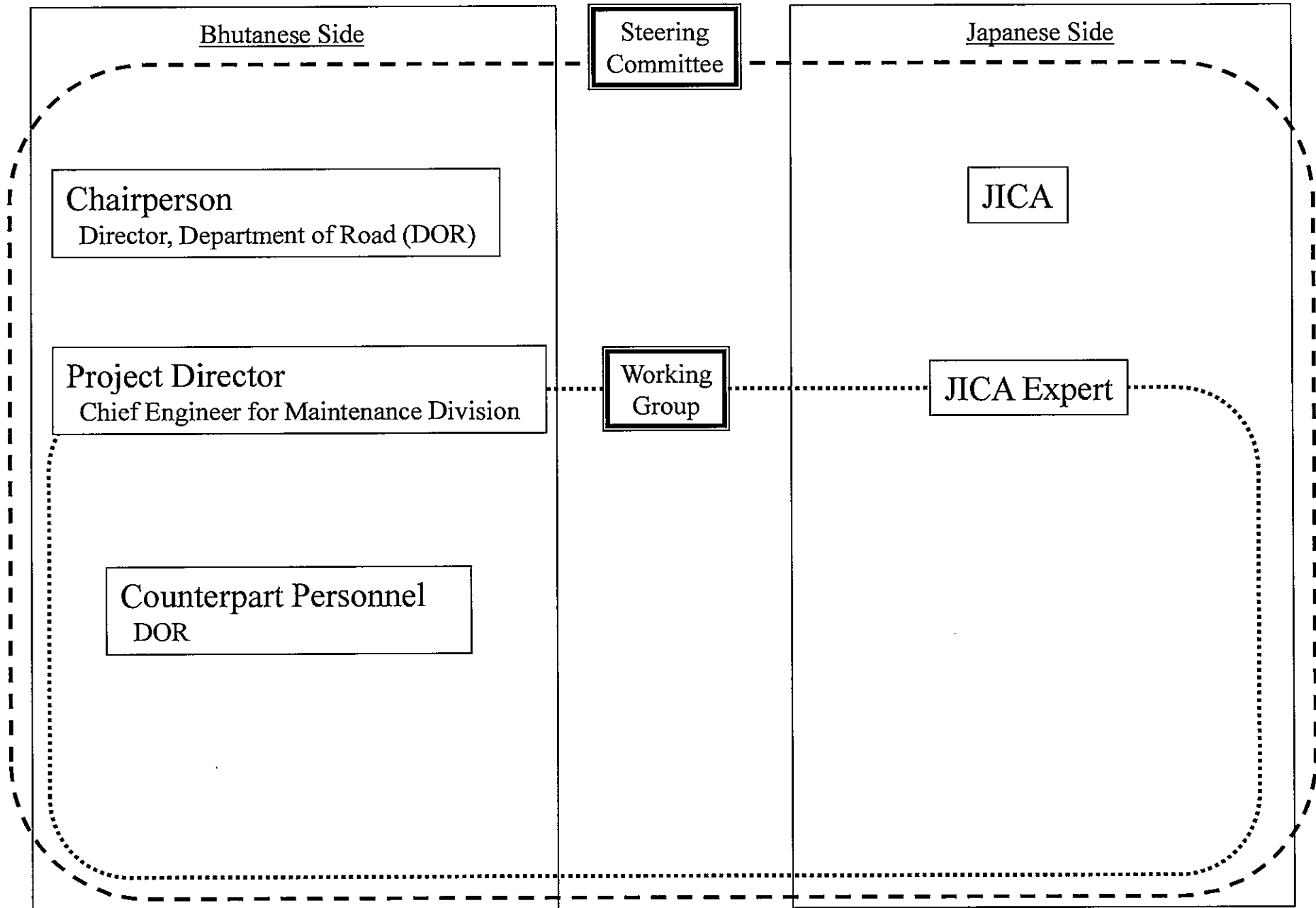
VII. AMENDMENTS

The Record of Discussions may be amended by the Minutes of Meetings between JICA and GNHC in consultation with DOR.

The Minutes of Meetings will be signed by authorized persons of each side who may be different from the signers of the Record of Discussions.

- Annex 1 Tentative Plan of Operation
Annex 2 Project Organization Chart
Annex 3 A List of Proposed Members of Steering Committee

Organization chart of the Project



LIST OF PROPOSED MEMBERS OF STEERING COMMITTEE

Chairperson: Director, Department of Roads (DOR)

Members:

(1) Bhutanese Side

1) DOR

- Project Director: Chief Engineer for Maintenance Division

2) Representative from GNHC

(2) Japanese Side

1) JICA

2) JICA Experts

- Team Leader/Slope Stability Management Expert (Inspection and Manual)

- Slope Stability Management Expert (Inspection)

- Slope Stability Management Expert (Countermeasure)

- Slope Stability Database System Expert

- Road Maintenance Expert

- Coordinator/Assistant of Slope Stability Management

(3) Others

- Relevant personnel accepted by SC, if necessary

MAIN POINTS DISCUSSED

I. PROJECT PERIOD

Both sides agreed that the duration of the project should be 24 months from the first dispatch of JICA study team.

II. OUTPUTS OF THE PROJECT

- (1) Referring to II-3 (2), number of slopes to be inspected will be 400 at maximum. Those slopes will be located in the selected road section(s).
- (2) Referring to II-3 (4), pilot sites will be selected from Slope Karte. "Giving advice" is stipulated in II-4 (4), and does not include engineering services.
- (3) The selected road section(s) is one or two section(s) identified by SC.

III. INSPECTION TEAM

Both sides agreed that two inspection teams will be established at the first SC meeting. The member of the inspection team will contain at least one Japanese expert and one DOR engineer.

If the third inspection team or more is established by Bhutanese engineers, JICA study team will support in checking the implementation of inspection and Slope Karte operation.

IV. TECHNICAL TRANSFER DURING THE PROJECT

Both sides agreed that technical transfer on slope stability inspection, preparation of Slope Karte, and establishment of the database will be done at OJT basis.

Workshops/Seminars will be held twice in Bhutan.

Training in Japan will be held early or middle period of the Project. DOR requested that trainees in Japan will be one from each of nine DOR's regional offices and three from DOR's headquarters.

V. OPERATION AND MAINTENANCE OF SLOPE KARTE

Both sides agreed that DOR should conduct the remaining slope stability inspection as well as regular updating of Slope Karte by themselves.

VI. OTHERS

DOR requested for two vehicles for the Project considering the lack of transportation.

**MINUTES OF MEETINGS
BETWEEN
DEPARTMENT OF ROADS
AND
JAPAN INTERNATIONAL COOPERATION AGENCY
ON
TECHNICAL COOPERATION PROJECT FOR CRITICAL SLOPE TREATMENT /
STABILIZATION ALONG THE ROAD NETWORK IN BHUTAN**

The Japanese Detailed Planning Survey Team (hereinafter referred to as "the Team") organized by Japan International Cooperation Agency (hereinafter referred to as "JICA") headed by Mr. Nobuyuki Tsuneoka, Senior Advisor of JICA, visited Bhutan from November 25, 2013 to December 5, 2013 for the purpose of working out the details concerning "Technical Cooperation Project for Critical Slope Treatment/Stabilization along the Road Network in Bhutan" (hereinafter referred to as "the Project")

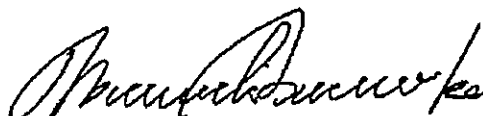
During its stay in Bhutan, the Team exchanged views and had a series of discussions with Department of Roads, Ministry of Works and Human Settlement (hereinafter referred to as "DOR") and the concerned organizations of Bhutan with respect to necessary measures to be taken by JICA and the Royal Government of Bhutan (hereinafter referred to as "RGOB") represented by DOR for the appropriate formulation of the Project.

As a result of the discussions, DOR and JICA agreed upon the matters referred to in the document attached hereto.

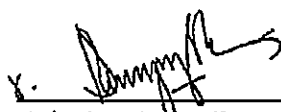
Thimphu, December 3, 2013



Karma Galay
Director
Department of Roads
Ministry of Works and Human Settlement
Kingdom of Bhutan



Nobuyuki Tsuneoka
Leader
Detailed Planning Survey Team
Japan International Cooperation Agency
Japan



Rinchen Wangdi
Chief Program Coordinator
Development Cooperation Division
Gross National Happiness Commission
Kingdom of Bhutan

ATTACHED DOCUMENT

I. RECORD OF DISCUSSIONS

Both sides agreed that the Record of Discussions (R/D) will determine the framework of the Project. The draft R/D is attached to this Minutes of Meetings for reference as shown in Appendix-1. It will be agreed and signed between DOR, Gross National Happiness Commission and JICA after the formal approval of both sides.

II. CHANGE OF THE PROJECT TITLE

Both sides agreed to change the Project title from "Technical Cooperation Project for Critical Slope Treatment/Stabilization along the Road Network in Bhutan" to "Project for Master Plan Study on Road Slope Management in Bhutan".

Appendix-1 Draft Record of Discussions



(DRAFT)
RECORD OF DISCUSSIONS
ON
PROJECT FOR MASTER PLAN STUDY ON ROAD SLOPE
MANAGEMENT IN BHUTAN
AGREED UPON BETWEEN
GROSS NATIONAL HAPPINESS COMMISSION
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

Thimphu, XX, 2013

Yumiko Asakuma
Chief Representative
Japan International Cooperation Agency
Japan

Karma Tshiteem
Secretary
Gross National Happiness Commission
Kingdom of Bhutan

Witnessed by

Karma Galay
Director
Department of Roads
Ministry of Works and Human Settlement
Kingdom of Bhutan

KG

Handwritten signature

Based on the Minutes of Meetings on the Detailed Planning Survey on Project for Master Plan Study on Road Slope Management in Bhutan (hereinafter referred to as "the Project") signed on December 3, 2013 between Department of Roads, Ministry of Works and Human Settlement (hereinafter referred to as "DOR"), Gross National Happiness Commission (hereinafter referred to as "GNHC") and the Japan International Cooperation Agency (hereinafter referred to as "JICA"), JICA held a series of discussions with DOR and relevant organizations to develop a detailed plan of the Project.

Both sides agreed the details of the Project and Main Points Discussed as described in the Appendix 1 and the Appendix 2, respectively, and to request their respective governments to proceed with the necessary procedures for implementation of the Project.

Both sides also agreed that DOR, the counterpart to JICA, will be responsible for the implementation of the Project in cooperation with JICA, coordinate with other relevant organizations and ensure that the self-reliant operation of the Project is sustained during and after the implementation period in order to contribute toward social and economic development of Kingdom of Bhutan (hereinafter referred to as "Bhutan").

The Project will be implemented within the framework of the Colombo Plan Technical Cooperation Scheme and the Note Verbales to be exchanged between the Government of Japan (hereinafter referred to as "GOJ") and the Royal Government of Bhutan (hereinafter referred to as "RGOB").

The effectiveness of the Record of Discussions is subject to the exchange of the Note Verbales.

Appendix 1: Project Description.

Appendix 2: Main Points Discussed



PROJECT DESCRIPTION

Both sides confirmed that there is no change in the Project Description agreed on in the Minutes of Meetings on the concerning Detailed Planning Survey on the Project signed on December 3, 2013.

I. BACKGROUND

Bhutan is dominantly covered by the mountainous areas spreading from the Himalaya. Road traffic is, therefore, the most important and vital transportation system for Bhutan. The major highway network in the country consists of 5 national highways; National Highway No.1 transversally crossing the country in a direction of east and west and 4 national highways advancing southward to the border with India. The total extension of the road in the country is, however, rapidly expanding; it was around a length of 2,300 km in 1990 and stretched to around a length of 3,900 km in 2003 and around a length of 10,600 km in 2013.

In regard to national programs in road sector, the Ministry of Works and Human Settlement (hereinafter referred to as "MOWHS") established the Road Sector Master Plan in 2006. In the master plan, MOWHS aims to expand and improve the national and Dzongkhag road network, to enhance the feeder road network, and to repair or replace or maintain bridges in the coming 20 years until 2027. Meanwhile, in the 10th Five Year Plan targeting from 2008 to 2013, RGOB set a goal of making any access to the nearest road within 2 hours or less.

Since most parts of the road network in Bhutan pass through steep slopes of the precipitous mountainous areas, the slope disaster frequently obstruct the road network in Bhutan. Slope disasters often isolate a Dzongkhag from the capital and other Dzongkhags, disrupt road traffic, and consequently hamper travel and transport of agricultural crops. In the aim of mitigating the damage caused by slope disasters, DOR introduced countermeasures against slope disasters utilizing vegetation and reinforcement. Due to a lack of experience and expertise, however, DOR is facing difficulties in implementing effective countermeasures against slope disasters.

In addition, in order to enhance the ability to grasp an inventory of dangerous slopes requiring countermeasures, RGOB requested GOJ to implement "the Technical Cooperation Project for Critical slope treatment/stabilization along the Road Network in Bhutan". In response to this request, JICA had series of discussion with DOR and other authorities concerned of Bhutan. Based on the agreements between JICA and the authorities concerned of Bhutan, the Minutes of Meetings was signed on December 3, 2013, which leads both parties to conclude this Record of Discussions.

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II. OUTLINE OF THE PROJECT

1. Title of the Project
Project for Master Plan Study on Road Slope Management in Bhutan
2. Expected Goals which will be attained after the Project Completion
 - (1) Goal of the Proposed Project
Slope stability inspection and regular updating are conducted, and record cards of slope stability inspection "Slope Karte" are maintained by DOR.
 - (2) Goal which will be attained through implementation of the Proposed Project
Critical slopes are identified, and a plan for slope treatment/ stabilization is established by DOR.
3. Outputs
 - (1) Manuals for slope stability inspection and diagnosis are prepared.
 - (2) Slope stability inspection is conducted and road slope inventory is produced for the selected road section(s).
 - (3) Slope stability database including Slope Karte is established for the selected road section(s).
 - (4) Giving advice on one or two pilot sites to be implemented by DOR based on Slope Karte.

The selected road section(s) is to be decided at the first SC meeting and stipulated as a section of national highways between major towns. The selected road section(s) is subject to the availability of budget and time.

4. Activities
 - (1) For the output (1) "Manuals for slope stability inspection and diagnosis are prepared."
 - (a) Prepare manuals for slope stability inspection and diagnosis.
 - (b) Establish terminology for each slope disaster type in Bhutan.
 - (c) Revise the manuals for slope stability inspection prepared in (a).
 - (2) For the output (2) "Slope stability inspection is conducted for the selected road section(s)."
 - (a) Collect records of disaster and information on countermeasures undertaken along the selected road section(s).
 - (b) Select target segments for the inspection in accordance with degree of risk.
 - (c) Screen the slopes in the target segments selected in (b), by aerial photo reading or geomorphic analysis.
 - (d) Confirm the result of screening in (c) on site and decide the target slopes for the inspection.
 - (e) Conduct field surveys at the target slopes in (d), and produce road slope inventory with the aim of preparing Slope Karte.

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- (f) Execute supplementary surveys including investigation boring and seismic exploration at a couple of slopes to understand mechanism of typical slope failure.
 - (g) Prepare Slope Karte through organizing and analyzing the results of the surveys.
 - (h) Carry out training including OJT for the target group concerning slope stability inspection and Slope Karte operation.
- (3) For the output (3) "Slope stability database is established for the selected road section(s)."
- (a) Establish a database system for managing the results of slope stability inspection including Slope Karte.
 - (b) Prepare operation manuals for the slope stability database system.
- (4) For the output (4) "Giving advice on one or two pilot sites to be implemented by DOR based on Slope Karte."
- (a) Review design documents prepared by DOR.
 - (b) Give advice on investigation for design of countermeasures.

5. Input

(1) Input by JICA

JICA will take, at its own expense, the following measures according to the normal procedures under the Colombo Plan Technical Cooperation:

(a) Dispatch of Mission

- Team Leader/Slope Stability Management Expert (Inspection and Manual)
- Slope Stability Management Expert (Inspection)
- Slope Stability Management Expert (Countermeasure)
- Slope Stability Database System Expert
- Road Maintenance Expert
- Coordinator/Assistant of Slope Stability Management

(b) Training

- Training in Bhutan: OJT, Workshop/Seminar
- Training in Japan

(c) Machinery and Equipment

- GPS for survey: 3 units
- Laser Range Finder: 3 units

In case of importation, the machinery, equipment and other materials under II-5 (1) (c) above will become the property of the RGOB upon being delivered C.I.F. (cost, insurance and freight) to the Bhutan authorities concerned at the ports and/or airports of disembarkation.

Input other than indicated above will be determined through mutual consultations between JICA and DOR during the implementation of the Project, as necessary.



(2) Input by DOR

DOR will take necessary measures to provide at its own expense:

- (a) Services of DOR's counterpart personnel and administrative personnel as referred to in II-6;
- (b) Suitable office space with necessary equipment;
- (c) Supply or replacement of machinery, equipment, instruments, vehicles, tools, spare parts and any other materials necessary for the implementation of the Project other than the equipment provided by JICA;
- (d) Information as well as support in obtaining medical service;
- (e) Credentials or identification cards;
- (f) Available data (including maps and photographs) and information related to the Project;
- (g) Running expenses necessary for the implementation of the Project;
- (h) Expenses necessary for transportation within Bhutan of the equipment referred to in II-5 (1) (c) as well as for the installation, operation and maintenance thereof; and
- (i) Necessary facilities to the JICA experts for the remittance as well as utilization of the funds introduced into Bhutan from Japan in connection with the implementation of the Project

6. Implementation Structure

The Project organization chart is given in the Annex 2.

(1) DOR

- (a) Project Director: Chief Engineer for Maintenance Division
- (b) Maintenance Division
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- (d) Design Division
- (e) Planning and Monitoring Division

Project Director will bear overall responsibility of the Project.

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The JICA experts will give necessary technical guidance, advice and recommendations to DOR on any matters pertaining to the implementation of the Project.

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Steering Committee (hereinafter referred to as "SC") will be established in order to facilitate inter-organizational coordination. SC will be held at least twice a year and whenever deems it necessary. A list of proposed members of SC is shown in the Annex 3.

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7. Project Site(s) and Beneficiaries

(1) Project Site

The main activities of the Project will be implemented at DOR's headquarters and the selected road section(s) mentioned in II.3.

(2) Direct beneficiaries

Direct beneficiaries of the Project will be the staff of DOR.

(3) Indirect beneficiaries

Indirect beneficiaries are road users as well as people living in the selected road section(s).

8. Duration

The duration of the Project will be twenty four (24) months. The tentative Plan of Operation is shown in Annex 1.

9. Reports

JICA will prepare and submit the following reports to DOR in English.

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(5) 20 copies Final Report within one (1) month after the receipt of the comments on the Draft Final Report.

10. Environmental and Social Considerations

(1) DOR agreed to abide by 'JICA Guidelines for Environmental and Social Considerations' in order to ensure that appropriate considerations will be made for the environmental and social impacts of the Project.

III. UNDERTAKINGS OF DOR, RGOB

1. DOR, RGOB will take necessary measures to:

(1) ensure that the technologies and knowledge acquired by the Bhutan nationals as a result of Japanese technical cooperation contributes to the economic and social development of Bhutan, and that the knowledge and experience acquired by the personnel of Bhutan from technical training as well as the equipment provided by JICA will be utilized effectively in the implementation of the Project; and

- (2) grant privileges, exemptions and benefits to the JICA experts referred to in II-5 (1) above and their families, which are no less favorable than those granted to experts and members of the missions and their families of third countries or international organizations performing similar missions in Bhutan.
 - (3) provide security-related information as well as measures to ensure the safety of the JICA experts;
 - (4) permit the JICA experts to enter, leave and sojourn in Bhutan for the duration of their assignments therein and exempt them from foreign registration requirements and consular fees.
2. Other privileges, exemptions and benefits will be provided in accordance with the Note Verbales to be exchanged between GOJ and RGOB.

IV. EVALUATION

JICA will conduct the following evaluations and surveys to mainly verify sustainability and impact of the Project and draw lessons. DOR is required to provide necessary support for them.

1. Ex-post evaluation three (3) years after the project completion, in principle .
2. Follow-up surveys on necessity basis

V. PROMOTION OF PUBLIC SUPPORT

For the purpose of promoting support for the Project, DOR will take appropriate measures to make the Project widely known to the people of Bhutan.

VI. MUTUAL CONSULTATION

JICA and DOR will consult each other whenever any major issues arise in the course of Project implementation.

VII. AMENDMENTS

The Record of Discussions may be amended by the Minutes of Meetings between JICA and GNHC in consultation with DOR.

The Minutes of Meetings will be signed by authorized persons of each side who may be different from the signers of the Record of Discussions.

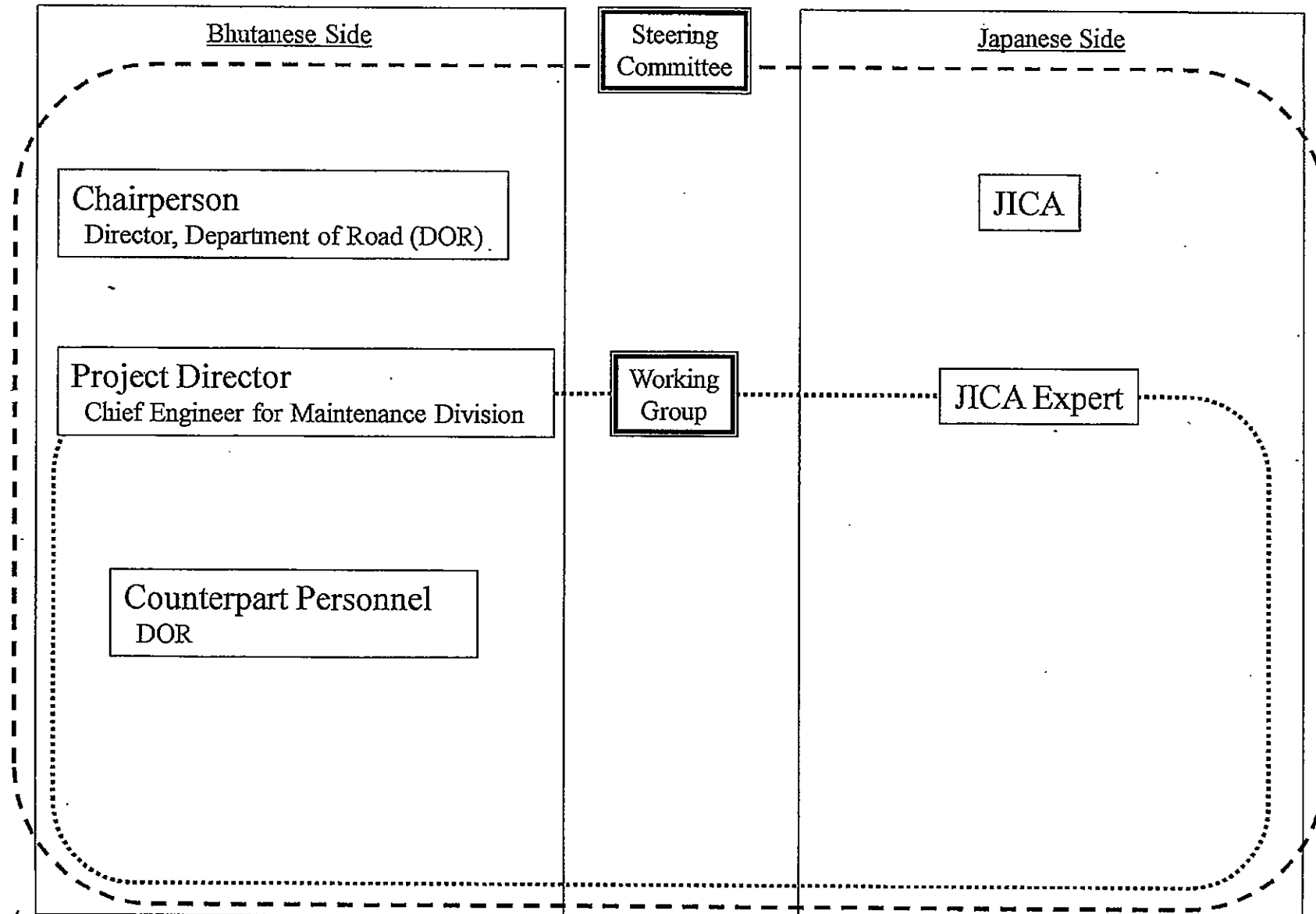
- Annex 1 Tentative Plan of Operation
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Annex 3 A List of Proposed Members of Steering Committee

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Organization chart of the Project



LIST OF PROPOSED MEMBERS OF STEERING COMMITTEE

Chairperson: Director, Department of Roads (DOR)

Members:

(1) Bhutanese Side

1) DOR

- Project Director: Chief Engineer for Maintenance Division

2) Representative from GNHC

(2) Japanese Side

1) JICA

2) JICA Experts

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- Road Maintenance Expert

- Coordinator/Assistant of Slope Stability Management

(3) Others

- Relevant personnel accepted by SC, if necessary

MAIN POINTS DISCUSSED

I. PROJECT PERIOD

Both sides agreed that the duration of the project should be 24 months from the first dispatch of JICA study team.

II. OUTPUTS OF THE PROJECT

- (1) Referring to II-3 (2), number of slopes to be inspected will be 400 at maximum. Those slopes will be located in the selected road section(s).
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Both sides agreed that two inspection teams will be established at the first SC meeting. The member of the inspection team will contain at least one Japanese expert and one DOR engineer.

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Both sides agreed that technical transfer on slope stability inspection, preparation of Slope Karte, and establishment of the database will be done at OJT basis.

Workshops/Seminars will be held twice in Bhutan.

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V. OPERATION AND MAINTENANCE OF SLOPE KARTE

Both sides agreed that DOR should conduct the remaining slope stability inspection as well as regular updating of Slope Karte by themselves.

VI. OTHERS

DOR requested for two vehicles for the Project considering the lack of transportation.

Appendix 3

S C 議事録

*Minutes of Meeting for
Steering Committee*

**MINUTES OF MEETING
ON INCEPTION REPORT FOR
PROJECT FOR MASTER PLAN STUDY
ON ROAD SLOPE MANAGEMENT IN BHUTAN
AGREED UPON BETWEEN
DEPARTMENT OF ROADS
AND THE JAPAN INTERNATIONAL COOPERATION AGENCY**

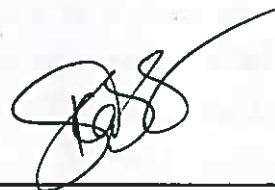
The Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the JICA Expert Team (hereinafter referred to as "JET") to the Kingdom of Bhutan on the Project for Master Plan Study on Road Slope Management in Bhutan (hereinafter referred to as "the Project") in order to explain and consult with the Department of Roads, Ministry of Works and Human Settlement (hereinafter referred to as "DOR") on the contents of the Inception Report of the Project (hereinafter referred to as "the Inception Report") from July 30, 2014.

As a result of discussions, both sides agreed to the matters described on the attached sheets.

Thimphu, August 4, 2014

桑野 健

Takeshi Kuwano
Team leader,
The Expert Team,
Japan International Cooperation Agency



Karma Galay
Director,
Department of Roads,
Ministry of Works and Human Settlement,
Kingdom of Bhutan

Attachment

I. Acceptance of the Inception Report

DOR agreed and accepted the contents of the Inception Report and the undertakings by DOR for the execution of the Project explained by JET. Detailed methods will be adjusted in the course of the Project with mutual cooperation.

II. Determination of the target sections for the Project

JET explained the target sections for the Project where JET and DOR shall prepare the Slope Inventory and the Slope Karte. The target sections have been selected in consideration of the condition on 1) Topography and geological aspects, 2) Connecting a large population to urban areas, 3) Social and economic importance, and 4) Technical transfer to DOR. Both sides agreed that the target sections are shown in **Annex-1**.

III. The Structure of the Project Execution

DOR and JET explained about the structure of the Project which is a component of the JICA's Technical Cooperation Program. The issues discussed are as follows;

1. In accordance with the Record of Discussions agreed upon by DOR and JICA on December 3rd 2013, DOR agreed to set up the Steering Committee (hereinafter referred as "SC") chaired by the Director of DOR in order to facilitate inter-organization coordination. The members are shown in **Annex-2**.
2. DOR also agreed to establish Working Group (hereinafter referred as "WG") as a technical unit on a daily-work basis consisting of technical staff from the DOR, HQ and the Regional Offices of DOR to conduct technical matters for particular issues. The members are shown in **Annex-3**.
3. Both sides agreed that the SC would be conducted on a regular basis as scheduled in **Annex-4**.
4. JET shall organize several Technical Seminars and Workshops at Thimphu Office and Trongsa Office because it is difficult for regional engineers to gather together at Thimphu. JET and DOR think that the sharing of technical skills and hands-on experiences for the regional engineers are important components of the Project and will be conducted throughout the Project period. DOR agreed that DOR assign the counterpart personnel.

III. Discussion on the significant issues

1. Training in Japan

- The training in Japan will be held on July 2015 to improve the technical skills of DOR after DOR implement the actual inspection and investigation in Bhutan supported by JET.

2. The number of the inspection sites

- The maximum number of inspection sites in the Project is 400 sites in the target sections as the Record of Discussions agreed upon by DOR and JICA on December 3rd 2013.

3. Provision of the vehicles

- JICA shall provide two 4WD cars to DOR in the Project period. The vehicle will be owned by JICA. It will be handed over to DoR after the completion of the Project.

Annex-1 Target sections for the Project

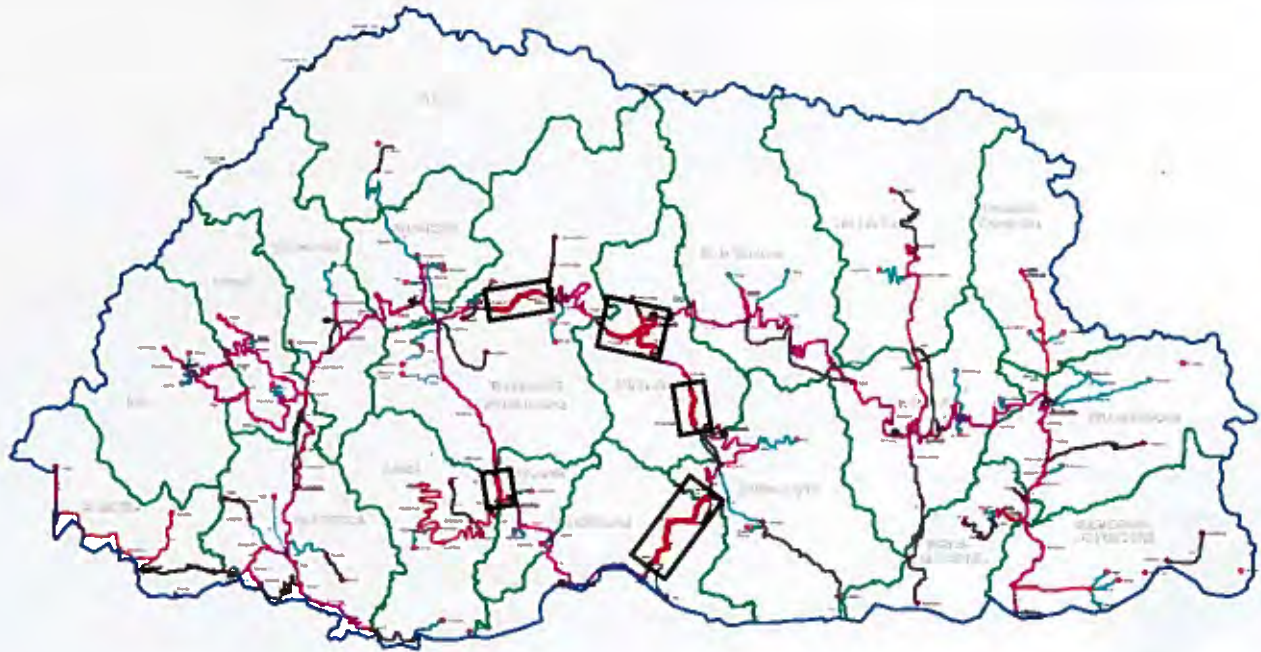
Annex-2 Members of the Steering Committee

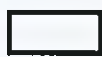
Annex-3 Members of the Working Group

Annex-4 Schedule and Contents of the Steering Committee Meetings

Annex-5 List of members who attended 1st Steering Committee

Target sections for the Project



 : the target sections for the Project

Members of the Steering Committee

Position	Name and Organization	Title/ position
Chairperson	Mr. Karma Galay (DOR)	Director
Members	Mr. Tshering Wangdi 'B'(DOR)	Chief Engineer (Maintenance Division)
	Mr. Dorji Tshering (DOR)	Deputy Executive Engineer.
	Mr. Takeshi Kuwano (JET)	Team Leader/ Road slope management.
	Mr. Kimihiko Kotoo (JET)	Vice Team leader/ slope stability inspection
	Mr. Kunzang L. Sangay (GNHC)	Deputy Chief Planning Officer (Representative)
	JICA HQ and/or JICA Bhutan Office	(Representative)

Members of the Working Group

Name and Title	DOR Office/Place
Mr. Dorji Tshering, Deputy Executive Engineer.	Headquarter, Thimphu
Mr. Dilip Kr. Thapa, Executive Engineer.	Headquarter, Thimphu
Ms. Phuntsho Wangmo, Assistant Architect.	Headquarter, Thimphu
Mr. Dhendup Dorji, Engineer.	Regional Office, Tashigang
Mr. Nim Dorji, Assistant Engineer.	Regional Office, Lingmethang
Mr. Wangchuk, Engineer.	Regional Office, Trongsa
Mr. Karma Dorji, Executive Engineer.	Regional Office, Sarpang
Mr. Sonam Thinley, Assistant Engineer.	Regional Office, Lobesya
Mr. Drakpa Wangdi, Executive Engineer.	Regional Office, Thimphu
Mr. Neten Tshering, Deputy Executive Engineer.	Regional Office, Samdrup Jongkhar
Mr. Karchung, Deputy Executive Engineer.	Regional Office, Zhemgang
Mr. Prabin Gurung, Deputy Executive Engineer.	Regional Office, Phuentsholing.

Proposed Schedule and Contents of the Steering Committees

No.	Proposed Date	Contents / Objectives
1	July 30 2014	Inception Report
2	February 2015	Progress Report
3	October 2015	Interim Report
4	July 2016	Draft Final Report

Steering Committee will be held whenever deems it necessary.

List of members who attended 1st Steering Committee**<BHUTAN SIDE>**Department of Roads, Ministry of Works and Human Settlement (DOR)

Mr. Karma Galay (Director)

Mr. Tshering Wangdi 'B' (Chief Engineer)

Mr. Dorji Tshering (Deputy Executive Engineer)

Mr. Tshering Paljore (Chief Engineer, Planning Division) (Observer)

Mr. Karma Wangdi (DoR) (Chief Engineer, Design Division) (Observer)

Other Ministries/Organizations

Mr. Kuenzang L. Sangay (Deputy Chief Planning Officer, GNHC representative)

Ms. Sangay Choden (GNHC representative)

<JAPAN SIDE>JICA

Ms. Yumiko Asakuma (Resident Representative, JICA Bhutan Office)

Mr. Yasunori Tonegawa (Deputy Assistant Director, JICA HQ)

Mr. Masanori Sunada (Project Formation Advisor, JICA Bhutan Office)

Mr. Krishna Subba(Programofficer, JICA Bhutan Office)

JICA Expert Team

Mr. Takeshi Kuwano (Team leader / Slope stability management)

Mr. Kimihiko Kotoo (Vice team leader / Slope inspection)

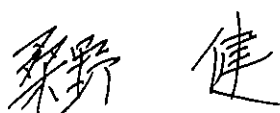
Mr. Yosuke Yamamoto (Coordinator/Slope inspection/Environmental & social consideration)

MINUTES OF MEETING
ON 2ND STEERING COMMITTEE FOR
PROJECT FOR MASTER PLAN STUDY ON ROAD SLOPE MANAGEMENT
IN BHUTAN
AGREED UPON BETWEEN
DEPARTMENT OF ROADS AND
THE JAPAN INTERNATIONAL COOPERATION AGENCY

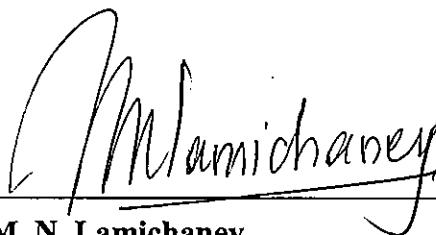
The Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the JICA Expert Team (hereinafter referred to as "JET") to the Kingdom of Bhutan on the Project for Master Plan Study on Road Slope Management in Bhutan (hereinafter referred to as "the Project") in order to conduct with the Department of Roads, Ministry of Works and Human Settlement (hereinafter referred to as "DOR").

As a result of discussions on this 2nd steering committee, all parties agreed to the matters described on the attached sheets.

Thimphu, October 21, 2015



Takeshi Kuwano
Team Leader,
The Expert Team,
Japan International Cooperation Agency
Japan



M. N. Lamichaney
Officiating Director,
Department of Roads,
Ministry of Works and Human Settlement,
Kingdom of Bhutan

Attachment

I. Acceptance of the Interim Report

DOR agreed and accepted the contents of the Interim Report as follows and the undertakings by DOR for the execution of the Project explained by JET.

1. JET has been steadily conducting four (4) components of the Project with cooperation of DOR since JET started it on August 2014. As of the end of September 2015, the draft of Inspection Manual has been completed in Component 1, the slope inventory have been prepared on the Section I, II and III on the roads based on the slope inspection in Component 2, the GIS database is being established in Component 3, and technical advices are being delivered for a tunnel project in Thumang Cliff on the Primary National Highway No. 1 in Component 4.
2. JET has classified 457 slopes into three (3) hazard ranks based on the slope inspection on the Section I, II and III on the National Road No.1 and No.4. Rank 1 is 64 sites, for which, “countermeasure works are necessary.” Rank 2 is 143 sites, for which, “although urgent countermeasures are not necessary, regular checks are needed.” Rank 3 is 250 sites, for which “countermeasure work is not necessary.”
3. The significance is followed by “The technical guideline of slope stability works in Road Construction in Japan (2009)”. The results of investigation give the efficiency in proceeding road projects because uncertainty is contained by the knowledge from the investigation in giving the road planner a well decision making. As for the results of the investigation on site, treatments are advisable for the stability in the basement of the current road at site 1 (Thomang Cliff) in view of the fact that the surface layer (overburden) is relatively thick, which has a potential to slide when there would be rise in groundwater in the rainy season after the combined examination from the topography map, geophysics (seismic refraction method) and boring data.
4. Standard countermeasure for slope disasters has been finalized through discussion between JET and CPs of DOR. Those standard measures were categorized into 2 types as one which can be done by local capacity and one which is required external supports. The flowcharts to select the suitable countermeasure on site have been prepared. The inspector shall select countermeasure by using the flowchart at inspection on the site.
5. JET has decided the modules for database of slope disaster as “Slope inventory and Slope inspection record” and “Web information system for road condition”. The purpose of the database is for DOR to efficiently gather and update the road slope inventory and slope inspection sheet. Additionally the database has the function of understanding the road



condition. The database system has the GIS function so that the location of the slope inventory, slope inspection record and critical disaster point are linked on the Map. From the perspective of self-sustainability, the database is developed as a simple and user friendly system. Finally, the user's manual is being prepared for updating and maintaining the database system.

II. Proposal of the Tunnel Project in Thomang Cliff

DOR has explained that the Thomang Cliff rock slope failure is one of the most problematic stretches on the Thimphu-Trashigang Primary National Highway. A permanent solution is very much needed because:

- I. It lies on the one of the busiest national highway. It has 3rd highest traffic with over 700 vehicles per day.
- II. No alternative routes to reach Trongsa, Bumthang, Mongar, Lhuntse, Trashiyagtse and Trashigang if the road is blocked at this area. This is thereof, a life line to eastern Bhutan which has larger population.
- III. The rock slope failure is active and yearly road is being blocked for about 3-5 days at this point. Further damages to road are foreseen at this point.
- IV. DOR has decided to skip the widening of highway within the proposed tunneling stretch expecting a permanent solution will be in place near future.

However, DOR has also stressed that out of all the permanent solutions, tunneling at this point is found to be more suitable. This is because; the area is very large and with a slight modification to the natural slope, it might trigger very large scale of landslides or rock slope failure. JET has also the same view on this matter. DOR has informed the floor that a proposal of permanent solution (tunnel) at Thomang Cliff has been submitted to JICA through the Gross National Happiness Commission.

III. Acceptance of Activity Plan

DOR agreed and accepted the activity plan since October 2015 as follows explained by JET.

1. The Inspection Manual will be revised and finalized by April 2016 in Component 1, the regular check for Rank 1 and 2 will be completed by March 2016 and subsequently a



slope disaster management plan will be discussed in Component 2, the GIS database will be established and a manual for the database will be prepared in Component 3, and technical advices will be continuously delivered on a detailed survey and a design of slope countermeasures in Component 4.

2. Technical seminars on specific theme will be implemented for the staff of DOR.
3. Draft Final Report will be submitted on June 2016. Final Report which is revised on comments by DOR will be submitted on August 2016.

Annex-1: List of members who attended 2nd Steering Committee



List of members who attended 2nd Steering Committee

<BHUTAN SIDE>

Department of Roads, Ministry of Works and Human Settlement (DOR)

Mr. M.N. Lamichaney (Officiating Director)

Mr. Tshering Wangdi 'A' (Chief Engineer, Construction Division)

Mr. Tshering Wangdi 'B' (Chief Engineer, Maintenance Division)

Mr. Dorji Tshering (Executive Engineer, Maintenance Division)

Mr. Tashi Phuntsho (Executive Engineer, Bridge Division)

<JAPAN SIDE>

JICA

Ms. Yumiko Asakuma (Resident Representative, JICA Bhutan Office)

Ms. Tomoko Miyata (Project Formation Advisor, JICA Bhutan Office)

Mr. Krishna Subba (Program officer, JICA Bhutan Office)

JICA Expert Team

Mr. Takeshi Kuwano (Team leader / Slope stability management)

Mr. Takashi Hara (Slope stability countermeasure)

Mr. Masanori Tozawa (Investigation and monitoring)

Ms. Haruka Yoshida (Coordinator / Slope inspection / Environmental & social consideration)

Mr. Cheku (Assistant of slope stability database management)

Mr. Pema Tshering (Project Assistant)



MINUTES OF MEETING
ON 3RD (FINAL) STEERING COMMITTEE FOR
PROJECT FOR MASTER PLAN STUDY ON ROAD SLOPE MANAGEMENT
IN BHUTAN
AGREED UPON BETWEEN
DEPARTMENT OF ROADS AND
THE JAPAN INTERNATIONAL COOPERATION AGENCY

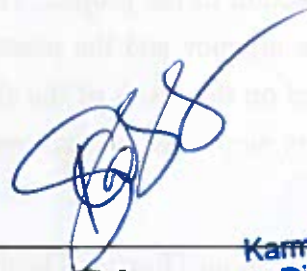
The Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the JICA Expert Team (hereinafter referred to as "JET") to the Kingdom of Bhutan on the Project for Master Plan Study on Road Slope Management in Bhutan (hereinafter referred to as "the Project") in order to conduct with the Department of Roads, Ministry of Works and Human Settlement (hereinafter referred to as "DoR").

As a result of discussions on this 3rd steering committee, all parties agreed to the matters described on the attached sheets.

Thimphu, June 9, 2016

桑野 偉

Takeshi Kuwano
Team Leader,
The Expert Team,
Japan International Cooperation Agency
Japan



Karma Galay
Director,
Department of Roads,
Ministry of Works and Human Settlement,
Kingdom of Bhutan

Karma Galay
Director
Department of Roads
Thimphu · Bhutan

Attachment

I. Acceptance of the Draft Final Report

DoR agreed and accepted the contents of the Draft Final Report as follows and the undertakings by DoR for the execution of the Project explained by JET. DoR send comments to JET by 1st July 2016, to finalize the report as Final Report, which is submitted on August 2016.

1. Type of road slope disaster is categorized four; debris slope failure, rock slope failure, landslide and debris flow. The slope inspections has been carried out for 457 slopes on the Section I, II and III on the National Road No.1 and No.4, and the inspection results were recorded in the inspection sheets and inspection list. As a hazard evaluation, JET has classified 457 slopes into four (4) hazard ranks based on the slope inspection. Rank 1A is 29 sites, Rank 1B is 34 sites, Rank 2 is 145 sites, and Rank 3 is 249 sites. Total of 208 slopes of Rank 1 and Rank 2, were selected for the regular check among the 457 slopes.
2. JET has carried out the prioritization for countermeasure implementation. The target is the slopes of the inspection in the project. The hazardous slopes have been prioritized using factors such as the urgency and the practicability of the countermeasure implementation for the slope, based on the result of the slope inspection and the regular check. 11 slopes as high priority, six slopes as medium priority and remaining slopes as low priority are categorized.
3. JET has developed Slope Disaster Database. The database has two kinds of modules: Module 1 is for the "slope inspection sheets" and "regular check sheets". Module 2 is Web Information System. The purpose of Module 1 is to accumulate and update the slope inspection sheets and the regular check sheet in an efficient manner for DoR. The Module 2 is to provide road condition including road block information through web basis. The database system has GIS function so that location of the slope inventory, the slope inspection record and critical disaster point are linked on the map. From the perspective of self-sustainability, the database has been developed as a simple and user-friendly system. The user's manual has been prepared for updating and maintaining the database system.

II. Handover of the equipment

The certificate of handing over the equipment was signed by Mr. Yamada, Chief representative of the JICA Bhutan Office and Mr. Karma Galay, Director of the DoR. The following equipment was officially handed over from JICA to DoR, MoWHS.

Table 1 List of equipment

No.	Item	Quantity
1	Toyota Hilux Vigo (2015 model) MR0FR22G500791701/A687085	1
2	Toyota Hilux Vigo (2015 model) MR0FR22GX00792584/A697665	1
3	Laser rangefinder Leica DISTO-D510	3
4	Portable GPS GARMIN Map62sc with battery charger	3

Annex-1: List of members who attended 3rd Steering Committee

List of members who attended 3rd Steering Committee

<BHUTAN SIDE>

Department of Roads, Ministry of Works and Human Settlement (DoR)

Mr. Karma Galay (Director)

Mr. Dorji Gyeltshen P (Chief Engineer, Maintenance Division)

Mr. Lungten Jamtsho (Chief Engineer, Design Division)

Mr. Tshewang Dorji (Chief Engineer, Bridge Division)

Mr. Dorji Tshering (Executive Engineer, Maintenance Division)

Gross National Happiness Commission (GNHC)

Ms. Kuenzang L. Sagy (Deputy Chief Research Officer)

<JAPAN SIDE>

JICA

Mr. Koji Yamada (Chief Representative, JICA Bhutan Office)

Ms. Tomoko Miyata (Project Formulation Advisor, JICA Bhutan Office)

Mr. Krishna Subba (Senior Program officer, JICA Bhutan Office)

JICA Expert Team

Mr. Takeshi Kuwano (Team leader / Slope stability management)

Mr. Kimihiko Kotoo (Vice team leader / Slope inspection)

Mr. Takashi Hara (Slope stability countermeasure)

Mr. Tomoharu Iwasaki (Slope risk analysis)

Mr. Takashi Saito (Slope stability database system)

Ms. Haruka Yoshida (Coordinator / Slope inspection / Environmental & social consideration)

Mr. Pema Tshering (Project Assistant)

Appendix 4

ブータンの対策工に係る質問票

*Questionnaire Sheet for
Existing/Available Countermeasure
Works in Bhutan*

Questionnaire for Existing/Available Countermeasure Works in Bhutan

Name: _____

Regional Office Name: _____


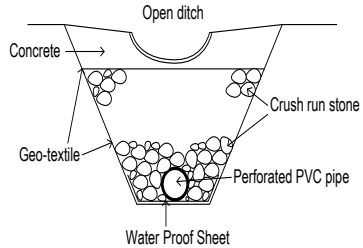


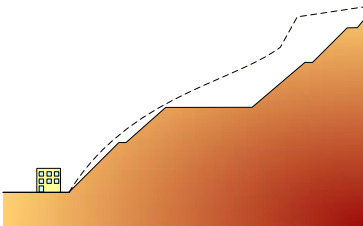
No.	Countermeasure Work	is it available in Bhutan? y/n	
1	Water Channel (Surface drainages)		
2	Horizontal Drainage		
3	Drainage Well		
4	Drainage Tunnel		
5	Buttress (Counterweight Fill)		
6	Piling		
7	Ground Anchor		
8	Grating Crib Work		
9	Slope Crib work (Shotcrete)		
10	Slope Vegetation		
11	Retaining Wall (Concrete)		
12	Retaining Wall (Gabion/Masonry)		
13	Anchor Work		
14	Sabo Dam (Check Dam)		
15	French Cascade		
16	Shed Work		
17	Ground Anchor/Rock Bolt		
18	Wire Rope Net		
19	Removal Work		
20	Concrete Retaining Wall		
21	Foot Protection Work		
22	Shifting Route		
23	Protection Wall (Concrete) and Fence		
24	Protection Wall (Gabion/Masonry)		
25	Rock Removal		
26	Rockfall Net		
27	Fixeing Work by Concrete		
28	Rock Shed		
29	Bonding		
30	Others	Type of work	
31	Others	Type of work	

Appendix 5

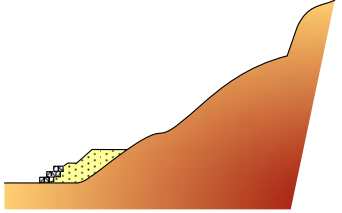



対策工カタログ

*Catalogue of
Countermeasure Works*







CATALOG OF COUNTERMEASURE WORKS FOR SLOPE DISASTERS

LANDSLIDE							
Item	Photo/Drawing	Purpose	Availability	Limitation	Feasibility in Bhutan	Remarks	Application
Surface Drainage (Open ditch)		To collect surface water and to properly drain it out from the landslide area	This is the one of the simplest countermeasure works for landslides. The work can be expected to avert infiltration of rainfall into the landslide block. Generally, maintenance of the work will not be difficult.	A flexible type of drainage maybe required so that it can adjust to movements in the ground surface due to landslide activity. Otherwise, the drainage will be damaged by the ground movements, and then the water will penetrate into landslide from the damaged points.	General open ditch construction will be feasible in Bhutan. However, in the case the ditch construction entails the use of special materials such as corrugated steel piping, the feasibility will depend on the presence of contractors able to carry out work using such materials.	Generally, the effect of the work is assumed to be difficult in the design stage.	Domestic
Open-Blind Ditch (French drain)		To properly collect and to discharge the surface water and shallow groundwater in the landslide area	In case the groundwater level is near to the surface in the landslide area, the work will be effective in draining the groundwater and surface water.	If the groundwater level is deeper than 2 m from the ground surface, the blind ditch (conduit) part will not function.	General open-blind ditch construction will be feasible in Bhutan. However, in the case the construction of the surface ditch part entails the use of special materials such as corrugated steel piping, the feasibility will depend on the presence of contractors able to carry out work using such materials.		Domestic
Horizontal Drainage		To collect groundwater to draw down the groundwater level in the landslide area	This is one of the general countermeasure works for landslides. The ordinary drilling machine can be used for the work. Since the work does not require large scale preparation, it can be applied as an emergency countermeasure.	If the target groundwater level is deep, the work shall not be applied, and maximum length of the drainage shall be less than 50m The work will be difficult to apply if the landslide consists of material with a lot of boulders.	The percussion drilling machine for anchor work is recommended for this work. However, even rotary drilling machines, which can drill in a horizontal direction, can be adopted for this work.	Maintenance of the drainage pipes is required regularly after completion of the work.	Domestic + External technical support
Drainage Well		To collect deep groundwater to draw down the groundwater level in the landslide area.	The well can be adopted if the landslide block is massive and deep to collect groundwater by horizontal drainage.	Generally, the work will require specific machineries and materials such as a small excavator, cylinder liner plate, and small drilling machine, and so on.	The work will be able to be carried out by Joint Venture consisting of local contractors and contractors from other countries such as India.		International
Earth Removal		To reduce the sliding force of landslides by removing the head part of landslide block	This is one of the simplest countermeasure works for landslides. The work can be expected to have a direct effect for stability of landslides. The work can be used as an emergency countermeasure work.	Depending on the shape of slip surface, the work may not contribute to making stable conditions of the slope.	It will be feasible in Bhutan; any local contractor can carry out the work.	The work may trigger another landslide which is located above the target landslide.	Domestic







CATALOG OF COUNTERMEASURE WORKS FOR SLOPE DISASTERS

LANDSLIDE							
Item	Photo/Drawing	Purpose	Availability	Limitation	Feasibility in Bhutan	Remarks	Application
Counterweight Fill		To increase the resisting force against the sliding force of landslides.	This is one of the simplest countermeasure works for landslides. The work can be expected to have a direct effect for stability of landslides. The work can be used as emergency countermeasure work.	Depending on the location of fill (embankment) on the slope, the work may not contribute to making stable conditions on the slope.	It will be feasible in Bhutan; any local contractor can carry out the work	The work may trigger another landslide which is located down from the target landslide.	Domestic
Steel Pile work		To increase the resisting force against the sliding force of landslides by shear strength of piles.	This work is designed to stop a landslide from moving through structural strength. Therefore, the work can be expected to have a direct effect on stability of landslides.	The pile work will not work properly under the following conditions: <ul style="list-style-type: none"> • Locations that show steep slip surface or; • Locations on an active landslide; and • Locations which consists of loose material 	The work can be carried out by Joint Venture consisting of local contractors and contractors from other countries such as India.	The piles for landslide countermeasures, shall not be driven piles but shall be installed in boreholes.	Domestic + External technical support
Cast-in place concrete Shaft (Caisson)		To increase the resisting force against the sliding force of landslides by shear strength of shaft piles.	This work is designed to stop landslides from moving through structural strength. Therefore, the work can be expected to have a direct effect for stability of landslide. If the restraint force of steel piles is insufficient for the required force to stop the landslide, the shaft work can be adopted. The shaft work can be carried out manually to dig the borehole for the the caisson depending on the site condition.	The pile work will not work properly under the following conditions: <ul style="list-style-type: none"> • Locations that show steep slip surface and; • Locations on an active landslide; • Locations which consists of loose material; and • The shaft work requires a firm ground foundation for the structure. 	The work can be carried out by Joint Venture consisting of local contractors and contractors from other countries such as India. The work will be costly.		Domestic + External technical support
Ground Anchor		To fix a landslide body by transferring tension stress of structure to firm ground	The work can be used in the following cases: <ul style="list-style-type: none"> • No ground reaction force is expected at a steep slope; • Immediate effect is required for emergency; and • Stabilization measures will be required at the toe part of landslide against partial collapse. 	The work requires specific machineries, equipment and materials. Such work may not attain its intended effect if the length of the anchor (free length of anchor) needs to be more than 20 m.	The work will be able to be carried out by Joint Venture consisting of local contractors and contractors from other countries such as India. The work will be costly.	A lift-off test is required to check whether the anchor is keeping the planned tension stress or not.	Domestic + External technical support


CATALOG OF COUNTERMEASURE WORKS FOR SLOPE DISASTERS

DEBRIS SLOPE FAILURE								
Item	Photo/Drawing	Purpose	Availability	Limitation	Feasibility in Bhutan	Remarks	Application	
Ditch on slope		To collect surface water and to properly drain it out of the slope	This is the one of the simplest countermeasure works. The work can be expected to avert infiltration of rainfall into the slope. Generally, maintenance of the work will not be difficult.	Nothing special	It will be feasible in Bhutan; any local contractor is able to carry out the work. It is one of the common slope countermeasure works in Bhutan	Regular maintenance is required. The work shall be designed to be constructed on the steps (benches) between the slopes.	Domestic	
Re-vegetation		To support stability of slope surface.	The work can be recommended to apply to all cut slopes if possible. Advantages of the work are as follows: • It is cheap • Easy to implement • Good for environment and landscape	Good effects are not expected on loose conditions of slope surface. If the work is adopted on a loose surface slope, wicker fence or crib works shall be combined with the work to keep plants on the slope.	It will be feasible in Bhutan; any contractor can carry out the work. It is one of the common slope countermeasure works in Bhutan	Plants for the work shall use local species to avoid changing the environment around the site.	Domestic	
Wicker Fence		To maintain stability of a slope surface until the plants planted in the re-vegetation work grow sufficiently	The work can be adopted on a loose surface slope to keep the material of slope surface. The fence can be made by wood and wooden branches. No machinery is required to implement the work.	The work will be difficult to adopt on hard rock slopes.	It will be feasible in Bhutan; any contractor can carry out the work.		Domestic	
Wooden Log Crib		To keep stability of a slope surface until the plants planted in the re-vegetation work grow sufficiently	The work has almost the same function as a wicker fence. The main materials for the work will be wood and stone.	The work will be difficult to adopt on hard rock slopes.	It will be feasible in Bhutan; any contractor can carry out the work.		Domestic	
RRM Retaining Wall	Masonry Wall		To avoid erosion of slope surface and to keep stability of a slope surface	The work can have a good effect on slopes, especially sediment and weathered rock slopes. The work is designed to avoid erosion and weathering on the surface of slopes. Required materials for the work is boulder and concrete.	The masonry wall shall not be expected to support slope stability as the retaining wall does. The wall shall not be adopted on a slope which has many water seepages without any drainage work for the water.	It will be feasible in Bhutan; any contractor can carry out the work. It is one of the common slope countermeasure works in Bhutan	Weep-hole shall be put on the wall to discharge water from behind the wall.	Domestic
	Bended Wall		To support stability of a slope surface and avoid erosion of slope surface	The work can be adopted if the slope cannot be secured at the appropriate/standard angle due to the limitation of site or topography. The work can be applied to various slope conditions such as a slope with earth pressure or failure-prone slope by water seepage.	The work shall not be installed at slope(s) where excavation of the toe part of the slope(s) (for installation of the wall) will make conditions of the slope unstable.	It will be feasible in Bhutan; any contractor can carry out the work. It is one of the common slope countermeasure works in Bhutan, especially Gabion and Masonry wall	Weep-hole shall be put on the wall to discharge water from behind the wall. The retaining wall can be made by Gabion or Reinforced Concrete.	Domestic






CATALOG OF COUNTERMEASURE WORKS FOR SLOPE DISASTERS

DEBRIS SLOPE FAILURE							
Item	Photo/Drawing	Purpose	Availability	Limitation	Feasibility in Bhutan	Remarks	Application
RCC Crib retaining wall		To retain slope stability and to avoid erosion and weathering of the slope	It can be used in emergency cases. According to the structure of the wall, the wall does not receive water pressure from the back slope and can flexibly follow deformation of the back slope.	The design for members of the wall shall be made properly. It will be difficult to obtain an expected retaining force on slope stability.	The work has been applied in Bhutan	Members of the wall shall be stored to be used for emergency cases.	Domestic
Barrier Wall (Concrete / Gabion)		To avert failed debris or fallen rocks from reaching the road	If the countermeasure work is difficult to apply on the slope directly, the work can be installed as a prevention measure.	Sufficient space to catch failed debris or rocks shall be required between the slope and the wall.	It is one of the common slope countermeasure works in Bhutan, especially Gabion and Masonry wall	A rock protection fence will generally be attached on top of the wall. Regular maintenance will be required to secure an open space behind the wall.	Domestic
Re-shaping slope with Benching		To make stable slope conditions with appropriate/standard angle	The work gives a direct effect on slope stability. It is recommended to consider adoption of the work as the first step.	Since a space for machinery like an excavator is required, the work will be difficult to be adopted on steep slopes.	The work is just simple earth work. It is feasible in Bhutan.	When the work is planned, it shall be studied whether the excavation work will disturb the stability of neighboring slopes. Surface drainage shall be installed on benching	Domestic
Shotcrete		To avoid erosion, weathering and infiltration of water into the slope	The work can be adopted on various types of slopes.	Since the work does not have a retaining function, the work shall not be applied on slopes where many unstable rocks are found.	The work will be able to be carried out by Joint Venture consisting of local contractors and contractors from other countries such as India.	If a lot of water seepage is found on a slope, weep holes shall be frequently put on shotcrete surface.	Domestic + External technical support
Surface Protection		To support the slope surface stability	The work can be adopted on various types (forms) of slopes and is a way of avoiding cutting the trees on the slope.	The work may not be adopted on the slope which is considered to have potential of large scale of failure, and which consists of hard rocks.	There are some cases of the work in Bhutan. But the costs are still high.		External technical support
Ground Anchor		To fix a slope surface by transferring tension stress of structure to firm ground	In the following cases, this work will be appropriate. <ul style="list-style-type: none">• No ground reaction force can be expected at a steep slope,• Immediate effect is required for emergency	The work requires specific machineries, equipment, and materials. The effects of this work may not be obtained as planned; in case the anchor length required (free length of anchor) is more than 20 m.	The work will be able to be carried out by Joint Venture consisting of local contractors and contractors from other countries such as India. The work will be costly.	A lift-off test is required to check whether the anchor is keeping the planned tension stress or not.	Domestic + External technical support






CATALOG OF COUNTERMEASURE WORKS FOR SLOPE DISASTERS

DEBRIS SLOPE FAILURE							
Item	Photo/Drawing	Purpose	Availability	Limitation	Feasibility in Bhutan	Remarks	Application
RC Concrete Crib		To support slope surface stability and prevent erosion.	The work can be adopted to various types (forms) and materials of slope. Generally, this work can be applied with ground anchor work.	The work is not used for artificial slopes.	The work is a common measure for slope stability in Japan. It will require technical support from Japan if the work is applied in Bhutan.		International






CATALOG OF COUNTERMEASURE WORKS FOR SLOPE DISASTERS

ROCK SLOPE FAILURE							
Item	Photo/Drawing	Purpose	Availability	Limitation	Feasibility in Bhutan	Remarks	Application
Rock Removal		To remove problematic parts or unstable rocks on slope	The work has a direct effect on hazards of rock slope failures or rockfalls. This work shall be the first option to consider for rock slope failure measures.	The following slope conditions may not be good for implementation of this work. • Hard and massive rocks; • Steep / overhanging slopes; and • No access for the machinery for excavation	The work will be feasible in Bhutan depending on site conditions. Knowledge and experience for works on steep slopes will be required.		Domestic
Concrete Retaining Wall		To support stability of slopes and avoid erosion and weathering of slope surface	The work can be adopted if the slope cannot be secured at the appropriate/standard angle due to limitations of site or topography. The work can be applied to various slope conditions such as failure-prone slopes from water seepage.	The work shall not be installed at the slope where excavation of the toe part of the slope for installation of the wall will make unstable conditions of the slope.	It will be feasible in Bhutan; any contractor can carry out the work. This is one of the common slope countermeasure works in Bhutan, especially Gabion and Masonry wall	Weep-hole shall be put on the pitching wall to discharge water from behind the wall. The retaining wall can be made by Gabion, Masonry or Reinforced Concrete.	Domestic + External technical support
Barrier Wall (Concrete / Gabion)		To avert fallen rocks from reaching the road	In case of the countermeasure work is difficult to apply on the slope directly as with rock removal or protection rock net; this work can be installed as a prevention measure.	Sufficient space to catch failed debris or rocks shall be required between the slope and the wall.	This is one of the common slope countermeasure works in Bhutan, especially Gabion and Masonry wall	A rock protection fence will generally be attached on top of the wall. Regular maintenance will be required to secure an open space behind the wall.	Domestic + External technical support
Protection Rock Net		To fix unstable rocks at original position	The work shall be adopted in case unstable rocks cannot be removed because of the site conditions.	Since the net shall be fixed by anchor bolt on the slope, such work is not recommended to be adopted on slopes with fractured or weathered rocks.	The work can be carried out by Joint Venture consisting of local contractors and contractors from other countries such as India.	Generally, stages for the work will be required.	International
Rock Bolt (Nailing)/Anchor		To fix loose rock slope or unstable rocks at original position	The work shall be adopted for unstable rocks or unstable rock slopes	This work is not recommended to be applied in fractured or weathered rock slopes.	The work can be carried out by Joint Venture consisting of local contractors and contractors from other countries such as India.	Generally, the work is adopted in combination with shotcrete or concrete crib work.	Domestic + External technical support



CATALOG OF COUNTERMEASURE WORKS FOR SLOPE DISASTERS

DEBRIS FLOW							
Item	Photo/Drawing	Purpose	Availability	Limitation	Feasibility in Bhutan	Remarks	Application
Sabo Dam		To catch debris, big boulders or wood debris from trees flowing in the river, such as during a flood, and to discharge only water or with a minimal amount of debris	The work can be adopted in the following cases. <ul style="list-style-type: none"> Expected volume of debris is massive The river is deep 	Firm ground is required for foundation of the dam	The work can be carried out by Joint Venture consisting of local contractors and contractors from other countries such as India.. The work will be costly.		International
Check Dam (Gabion / RRM)		To break speed of debris or water flow, and to catch some debris, boulders or wood debris from trees flowing in the river, such as during a flood.	The work can be applied on small tributary valleys or gulleys as well. The work can be adopted on various gradients of valleys	The dam may not work properly in valleys where there are a lot of debris deposits.	It will be feasible for Bhutan, especially if it is made by Gabion and Masonry wall		Domestic
Buffer Forest		To break energy of debris flow	The work can be adopted on gentle ground. Advantages of the work are as follows: <ul style="list-style-type: none"> Low cost and easy to implement Good for environment and landscape 	The work cannot be adopted in the following cases. <ul style="list-style-type: none"> Steep slopes Rocky slopes 	It will be feasible for Bhutan,		Domestic
Shed Work		To discharge debris flow or river water without affecting the road	The work can be adopted in the following cases, <ul style="list-style-type: none"> The estimated volume of debris flow is too massive to be stopped by a Sabo dam The height of the river bed is higher than the road. 	If the height of the river bed is lower than the road, the work cannot be applied.	The work will not be able to be carried out by Joint Venture (consisting of local contractors and contractors from other countries such as India). The work will be costly.	The width and inclination of shed shall be designed based on the river width and gradient	International
Culvert / Bridge (RRM)		To make flowing debris pass under the road	The work can be adopted in various conditions of water streams.	It cannot be adopted if large size boulders or large amounts of debris surpassing the dimension of water stream are expected to flow down the stream.	The work is a common facility in Bhutan.		Domestic

CATALOG OF COUNTERMEASURE WORKS FOR SLOPE DISASTERS

ROCK FALL							
Item	Photo/Drawing	Purpose	Availability	Limitation	Feasibility in Bhutan	Remarks	Application
Rock Removal		To remove unstable rocks on slopes	The work has a direct effect on hazards of rockfalls. The work shall be the first option to consider for rockfall measures.	The following slope conditions may not be good for implementation of the work: • The place is too high to conduct the work • The machinery for excavation is unable to access the site	The work will be feasible in Bhutan depending on site conditions. Knowledge and experience for work on steep slopes will be required.		Domestic + External technical support
Protection Wall (Concrete / Gabion)		To avert fallen rocks from reaching the road	If the countermeasure work is difficult to apply on the slope directly as with rock removal or protection rock net, this work can be installed as a prevention measure.	Sufficient space to catch failed debris or rocks shall be required between the slope and the wall.	This work is one of the common slope countermeasure works in Bhutan, especially Gabion or Mason wall.	A rock protection fence will generally be attached on top of the concrete wall. Regular maintenance will be required to secure an open space behind the wall.	Domestic
Rock Catch Net		To avert fallen rocks from reaching the road by catching fallen rocks from slopes	The work can be adopted on the slope where unstable rocks are extensively distributed.	The net shall not be expected to deal with large energy of fallen rocks. The target rocks shall not be big rocks or rocks at a high slope.	The work can be carried out by Joint Venture consisting of local contractors and contractors from other countries such as India..	Regular maintenance will be required to secure a space behind the net.	International
Fixing Work by shotcrete		To fix unstable rocks at original position	The work shall be adopted if the unstable rocks cannot be removed because of the site conditions.	Since the work does not have a retaining function, the work shall not be applied on slopes where many or massive unstable rocks are found.	The work will be able to be carried out by Joint Venture consisting of local contractors and contractors from other countries such as India.	Safety measures for the work shall be required due to the high-place work and the worker also shall be required experiences of the high-place work.	Domestic + External technical support
Shed Work		To protect roads from fallen rocks	This work can be adopted for the slope where many unstable rocks, which are difficult to deal with by other measures, are found.	The shed work has capacity limitations for bearing against falling rock energy. Estimated falling rock energy shall be examined in the design stage of the work.	The work will not be able to be carried out by Joint Venture consisting of local contractors and contractors from other countries. The work will be costly.		International

CATALOG OF COUNTERMEASURE WORKS FOR SLOPE DISASTERS

OTHERS							
Item	Photo/Drawing	Purpose	Availability	Limitation	Feasibility in Bhutan	Remarks	Application
Tunnel -Route Shift-		To avoid problematic road sections by shifting routes	The work can be adopted for road sections that cannot be dealt with by other countermeasures because of site conditions or for economic reasons.	The availability shall be determined according to not only topographical and geological conditions, but also economic or political planning.	Depending on the site conditions, the work will not be able to be carried out by Joint Venture (consisting of local contractors and contractors from other countries). The work will be costly.		International
Bridge -Route Shift-		To avoid problematic road sections by shifting routes	The work can be adopted for road sections that cannot be dealt with by other countermeasures because of site conditions or for economic reasons.	The availability shall be determined according to not only topographical and geological conditions, but also economic or political planning.	Depending on the site conditions, the work will not be able to be carried out by Joint Venture (consisting of local contractors and contractors from other countries). The work will be costly.		Domestic / International

Appendix 6

ブータンにおける土地利用データ
Land Use Data in Bhutan

◆ Ratio of Land Cover in Bhutan

Category	(km ²)	(%)
Fir	3,453	8.6
Mixed Conifer	4,868	12.1
Blue Pine	1,286	3.2
Chir Pine	1,009	2.5
Conifer Forest (Total)	10,616	26.5
Broad Leaf+ Conifer Leaf	1,358	3.4
Broad Leaf Forest	13,749	34.3
Conifer Plant	20	0.1
Broad Lea Plant	44	0.1
Forest Plantation	64	0.2
Scrub Forest	3,258	8.1
Forest (Total)	29,045	72.5

Natural Pastures	1,553	3.9
Improv. Pastures	11	0.0
Pasture (Total)	1,564	3.9

Irrigation Wetland	387	1.0
Rainfed Wetland	0	0.0
Wetland Cultivation	388	1.0
Terraced Dryland	111	0.3
Unterraced Dryland	866	2.2
Dryland Cultivation	977	2.4
Tseri	883	2.2
Mixed Cultivation	840	2.1
Agriculture(Total)	3,088	7.7

Category	(km ²)	(%)
Apple Orchards	13	0.0
Citrus Orchards	10	0.0
Orchards	22	0.1
Cardamon Plantation	35	0.1
Areca nut Plantation	0.4	0.0
Ginger Plantation	0.3	0.0
Horticulture Plantation	36	0.1
Horticulture(Total)	58	0.1

Settlement	31	0.1
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Snow Glacier	2,989	7.5
Rock Outcrops	2,008	5.0
Water Spreads	304	0.8
Marshy areas	35	0.1
Landslip/erosion	954	2.4
Others(Total)	6,289	15.7

Forest (Total)	29,045	72.5
Pasture (Total)	1,564	3.9
Agriculture(Total)	3,088	7.7
Horticulture(Total)	58	0.1
Settlement	31	0.1
Others(Total)	6,289	15.7
Grande Total	40,077	100.0

<Reference>

Atlas of Bhutan: Land Cover and Area Statistics of 20 Dzongkhags 1997,
Ministry of Agriculture, Royal Government of Bhutan

Appendix 7

ブータンにおける斜面災害記録
*Road Slope Disaster Record
in Bhutan*

Maintenance Record for Slope Disaster

Name: **Nim Dorji**

Regional Office Name: **Lingmethang, Mongar**

Date of preparation: **22/08/ 2014**

No.	Name of Road	Chainage	Type of Problem	Scale of Problem	Action taken for the problem	Year of Implementation
1	Rotpashong (Dorjilekpa) Gangola- Lhuntse	14km from 14.50	Landslide with all area sliding	Whole area	No rock fallen	N.D.
2						
3						
4						
5						
6						
7						
8						
9						
10						

Name: **Karma Dorji**

Regional Office Name: **Sarpang, Gelephu**

Date of preparation: **22/08/ 2014**

No.	Name of Road	Chainage	Type of Problem	Scale of Problem	Action taken for the problem	Year of Implementation
1	Gelephu - Trongsa	9.15kms from Gelephu	Landslide and flow of debris	80*200mtrs (app)	Slip Clearance	N.D.
2	Gelephu - Trongsa	15 kms from Gelephu	Rotational landslide	250*200	Gabion wall of 3 nos*20*8mtrs and slip	N.D.
3	Gelephu - Trongsa	27.20 kms from Gelephu	Earth fall on valley side	-	-	N.D.
4	Gelephu - Trongsa	49.50 kms from Gelephu	Rock fall and debris	80*100 mtrs	RCC rib wall, check dam, water channel construction	N.D.
5	Gelephu - Sunkosh	44.05 kms from Gelephu	Landslide	15*5 mtrs	Gabion wall and slip clearance	N.D.
6	Gelephu - Sunkosh	88 kms from Gelephu	Rock fall slides	100*50 mtrs	Removal of rock and slip	N.D.
7	Gelephu - Sunkosh	107 kms from Gelephu	Rotational landslide	1500 mtrs	RCC rib wall, cross drainage, surface L-drain, Repair of Water channel, RCC toe wall with Gabion constructed, plantation done.	N.D.
8						
9						
10						

Maintenance Record for Slope Disaster

Name: **R. L. Gautam**

Regional Office Name: **Trongsa**

Date of preparation: **22/08/ 2014**

No.	Name of Road	Chainage	Type of Problem	Scale of Problem	Action taken for the problem	Year of Implementation
1	Yotongla - Chuserbu Road	315 kms from Tashigang	Slope failure	27m * 8.50m * 15m	B/walls, bioengineering	2010 till date
2	Yotongla - Chuserbu PNH	325 kms from Tashigang	Rock slide	50m * 4.50m * 17m	Clearing the rocks	2011 till date
3						
4						
5						
6						
7						
8						
9						
10						

Name: **Prabin Gurung**

Regional Office Name: **Phuentsholing, Chhuka**

Date of preparation: **21.8.2014**

No.	Name of Road	Chainage	Type of Problem	Scale of Problem	Action taken for the problem	Year of Implementation
1	Samtse-P'ling Highway	3.00 Km from Samtse	Landslide	65 m (l)	Under observation period	-
2	Samtse-P'ling Highway	8.50 Km from Samtse	Landslide	50 m (l)	Under observation period	-
3	Samtse-P'ling Highway	7.70 Km from Amochu	Landslide (mass movement)	250 m (l)	Slip Clearance & benching Works	2012-2013
4	Pasakha-Manitar Highway	8.90 Km from Pasakha	Landslide	10 m (l) 5 m (w)	Slip Clearance	2013-2014
5	Pasakha-Manitar Highway	17.00 Km from Pasakha	Landslide	50 m (l) 5 m (w)	Slip Clearance	2013-2014
6	Samtse-Sipsu Highway	10.00 Km from Samtse	Sinking of road	700 m (l)	Drainage and channelling	2012
7	Halhalay-Dorokha Road	12.00 Km from Halhalay	Sinking of road	300 m (l)	Filling Works	2014
8						

Name: **Neten Tshering**

Regional Office Name: **Samdrup Jongkhar (1)**

Date of preparation: **22/08/ 2014**

No.	Name of Road	Chainage	Type of Problem	Scale of Problem	Action taken for the problem	Year of Implementation
1	Dewathang - Phuntsholing SNH	0.15 km from Dewathang	Debris slope failure	100 m(w) * 150m (h)	Constructed the G/B wallatthe hill side and counter measure not done below the road	2013
2	Dewathang - Phuntsholing SNH	8.5km from Dewathang	Debris slope failure (below the road)	150 m(w) * 500m (h)	Counter measure not done	N.D.
3	Dewathang - Phuntsholing SNH	20.2km from Dewathang	Debris slope failure	60m(w) * 150m (h)	Counter measure not done	N.D.
4	Dewathang - Phuntsholing SNH	23.9km from Dewathang	Debris slope failure	50m(w) * 100m (h)	Constructed the G/B wallatthe hill side and geo-engineering below the road. Debris overflow from the wall and it's frequently cleared by machine.	2013
5						
6						
7						
8						

Maintenance Record for Slope Disaster

Name: **Pema Chodea**

Regional Office Name: **Samdrup Jongkhar (2)**

Date of preparation: **25/08/ 2014**

No.	Name of Road	Chainage	Type of Problem	Scale of Problem	Action taken for the problem	Year of Implementation	
1	Tshelengore - Pemagatshel SNH	12.8km -	from Tshelengore	Landslide (Hillside)	70m*25m (Lx H)	Removed the slides	2014
2		15 - 16km		Landslide (Hillside)	100m x10m	Removed the slides	2014
3		16 - 17km		Landslide (Hillside)	100m x10m	Removed the slides	2014
4		21 - 22km					
5	Pemagatshel - Khothakpa SNH	0 - 1km	from Pemagatshel	Sinking/ settlement of roads	50m x 3.50 m 25m x 3.50 20m x 3.50	Cracks sealed	2013
6	Khothakpa - Khar - Tsebar Yurung DR	20.9km	from Khothakpa	Sinking/ settlement of roads	100m x20m	Removed the slides and B/wall constructed but could not withstand and failed	2014
7		30.15km		Sinking/ settlement of roads	60m x20m	Removed the slides	2014
8		32.15km		Sinking/ settlement of roads	60m x20m	Removed the slides	2014
9		36.15km		Debris slope failure (below the	30m x25m	R/wall constructed	2014
10	Tokari - Rasugonpa DR	7.9km	from Mukozor	Debris slope failure (both hillside and below the road)	150m x6m	G/wall constructed	2010

Name: **Karchung**

Regional Office Name: **Tingtibi, Zhemgang**

Date of preparation: **01/09/2014**

No.	Name of Road	Chainage	Type of Problem	Scale of Problem	Action taken for the problem	Year of Implementation
1	Mathangguri - Panbang Road	300m from Mathangguri	Rock fall / Debris fall / earth fall	150m (w) X 20m (h)	Removing by Machine	Every Moonsoon till date
2	Mathangguri - Panbang Road	1km from Mathangguri	Earth flow with boulders	30m (w) X 10m (h)	Removing by Machine	Every Moonsoon till date
3	Mathangguri - Panbang Road	12km from Mathangguri	Rock topple	100m (w) X 25m (h)	Removing by Machine	Every Moonsoon till date
4	Pangbang - Galabi Road	3km from Panbang	Slides translational	100m (w) X 15m (h)	Removing by Machine	Every Moonsoon till date
5	Gomphu - Pangbang Road	5.5km from Panbang	Slides translational / Rotational	300m (w) X 50m (h)	Removing by Machine	Every Moonsoon till date
6						

Maintenance Record for Slope Disaster

Name: **Sonam Thinley**

Regional Office Name: **Lobeysa, Phunaka**

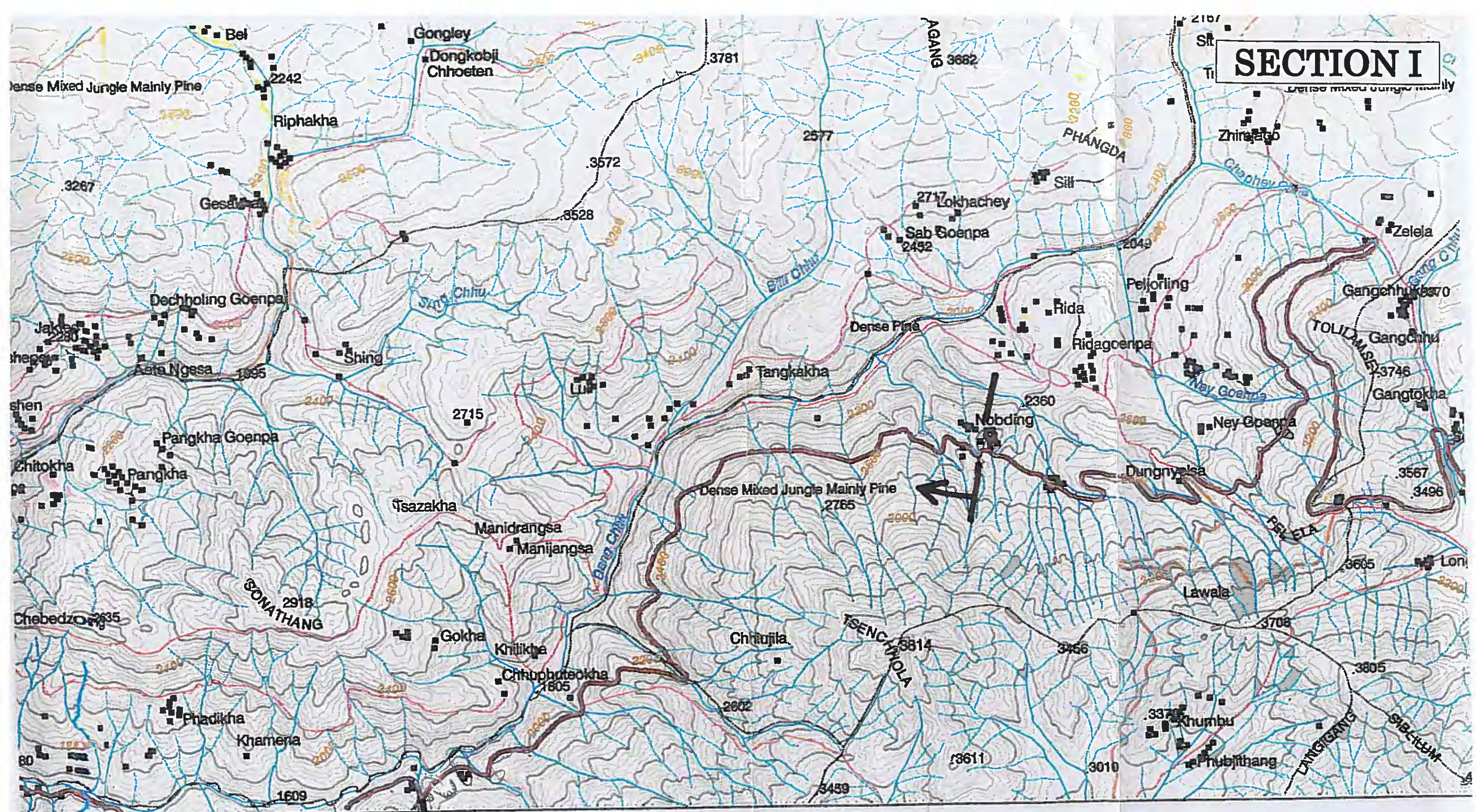
Date of preparation: **26/08/2014**

No.	Name of Road	Chainage	Type of Problem	Scale of Problem	Action taken for the problem	Year of Implementation
1	Punakha - Gasa SNH	48.18 km from Punakha (Lebgang)	Slope Collapse (Hill side)	26m (L) * 5.6m (W) * 42m (H)	Removing of Earth and Rocks	2014
2	Punakha - Gasa SNH	44.2 km from Punakha (Gathana)	Slope Collapse (Hill side)	10m (L) * 4.3m (W) * 9m (H)	Removing of Earth and Rocks	2014
3	Punakha - Gasa SNH	44.7 km from Punakha (Gathana)	Slope Collapse (Hill side)	18m (L) * 5.8m (W) * 19m (H)	Removing of Earth and Rocks	2014
4	Punakha - Gasa SNH	44.95 km from Punakha (Gathana)	Slope Collapse (Hill side)	10m (L) * 4.8m (W) * 20m (H)	Removing of Earth and Rocks	2014
5	Punakha - Gasa SNH	45.18 km from Punakha (Gathana)	Slope Collapse (Hill side)	50m (L) * 4.1m (W) * 25m (H)	Removing of Earth and Rocks	2014
6	Dochula - Chuserbu PNH	382.5 km from Trashigang (Pellele)	Slope Collapse (Hill side)	900m (L) * 20m (H)	Removing of Earth and Rocks	2014
7	Dochula - Chuserbu PNH	409.20 km from Trashigang (Khelekha)	Slope Collapse (Hill side)	250m (L) * 18m (H)	Removing of Earth and Rocks	2014
8	Dochula - Chuserbu PNH	412.20 km from Trashigang (Gemjana)	Slope Collapse (Hill side)	120m (L) * 9m (H)	Removing of Earth and Rocks	2014
9	Dochula - Chuserbu PNH	413.40 km from Trashigang (Shangawang)	Slope Collapse (Hill side)	25m (L) * 25m (H)	Removing of Earth and Rocks	2014
10						

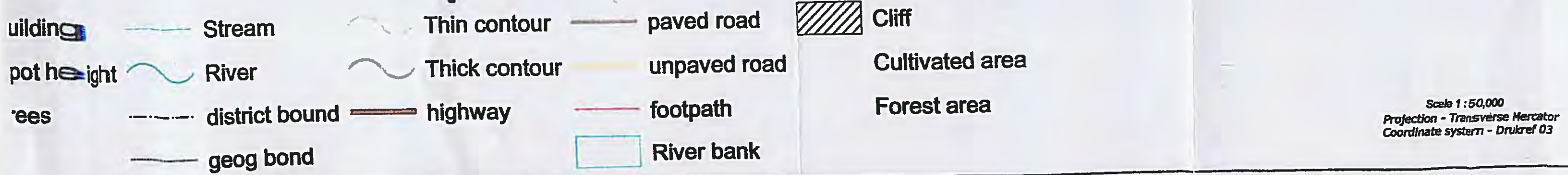
Appendix 8

一次スクリーニングの地図
Map of Primary Screening

SECTION I

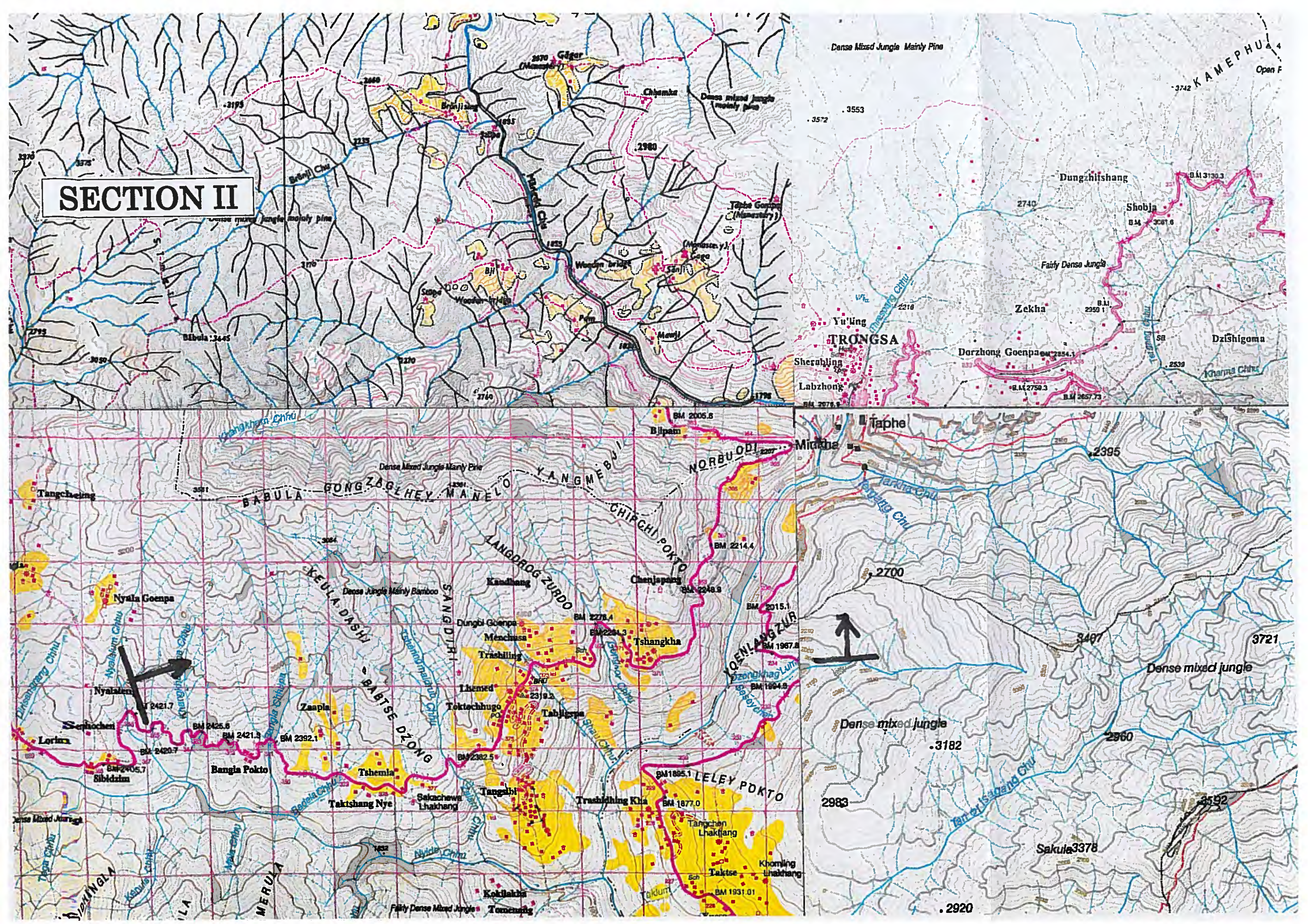


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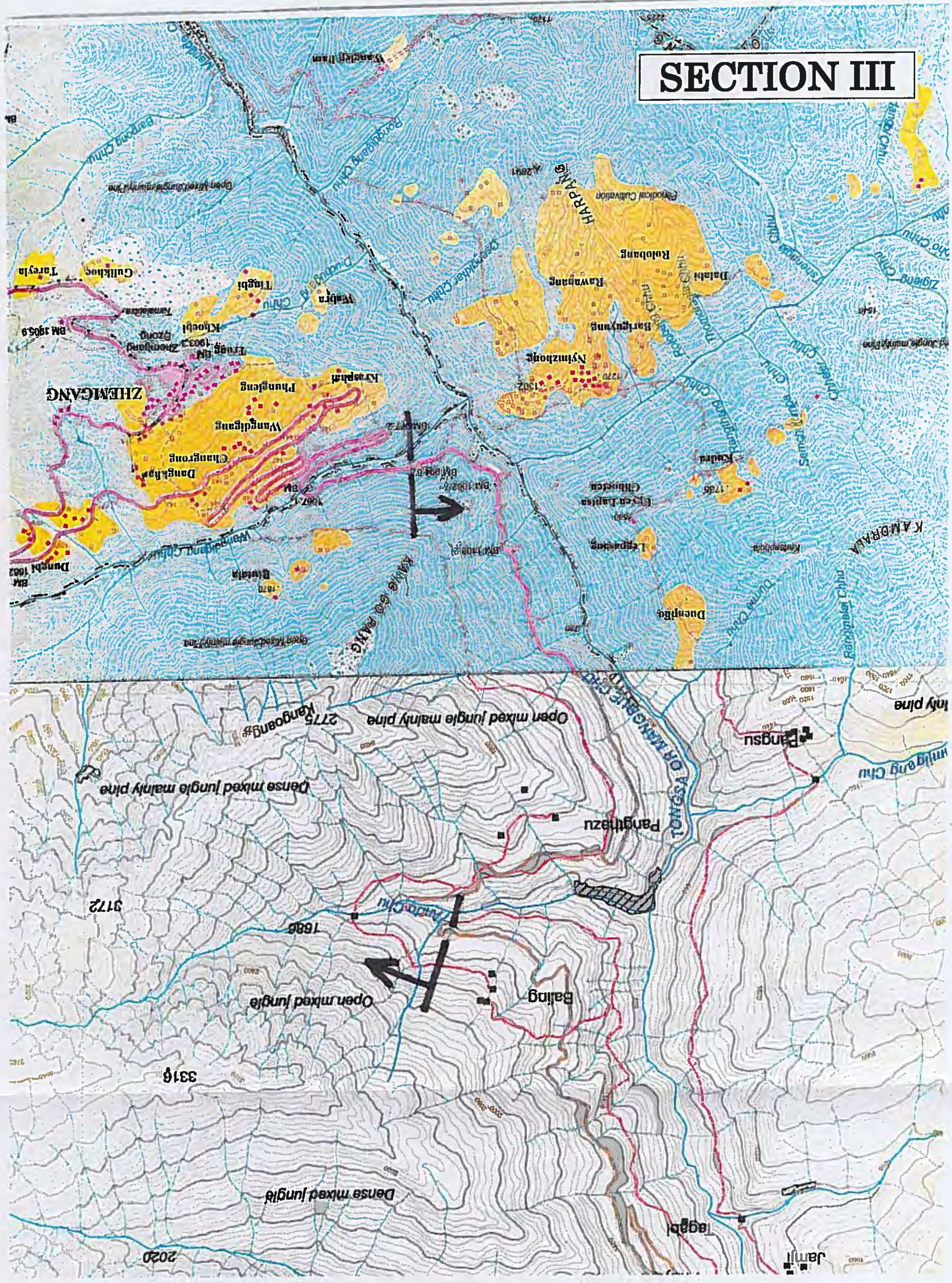


Scale 1:50,000
 Projection - Transverse Mercator
 Coordinate system - Drukref 03

SECTION II



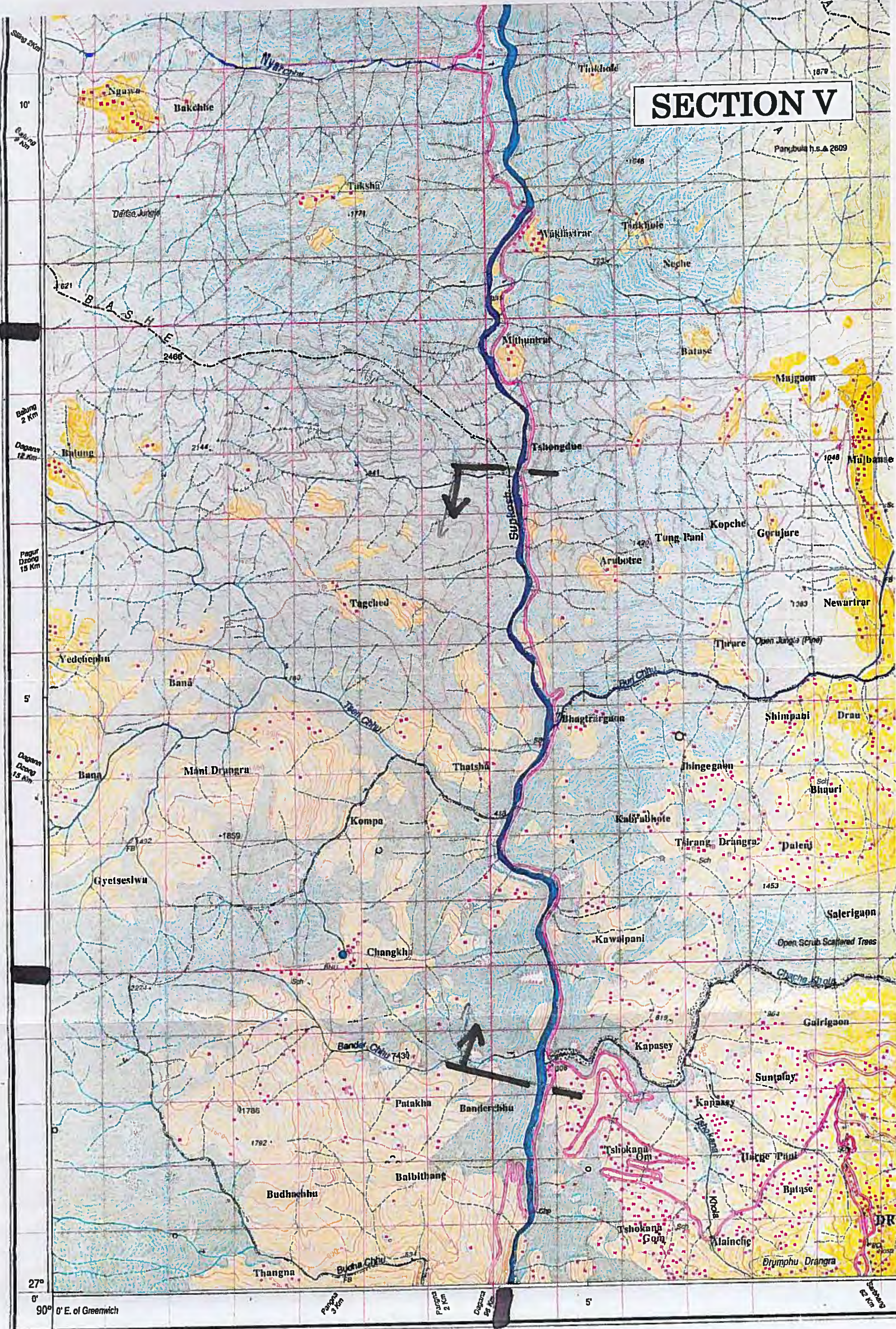
SECTION III



SECTION IV



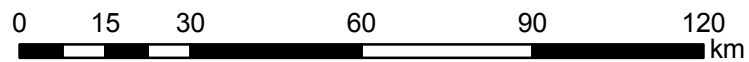
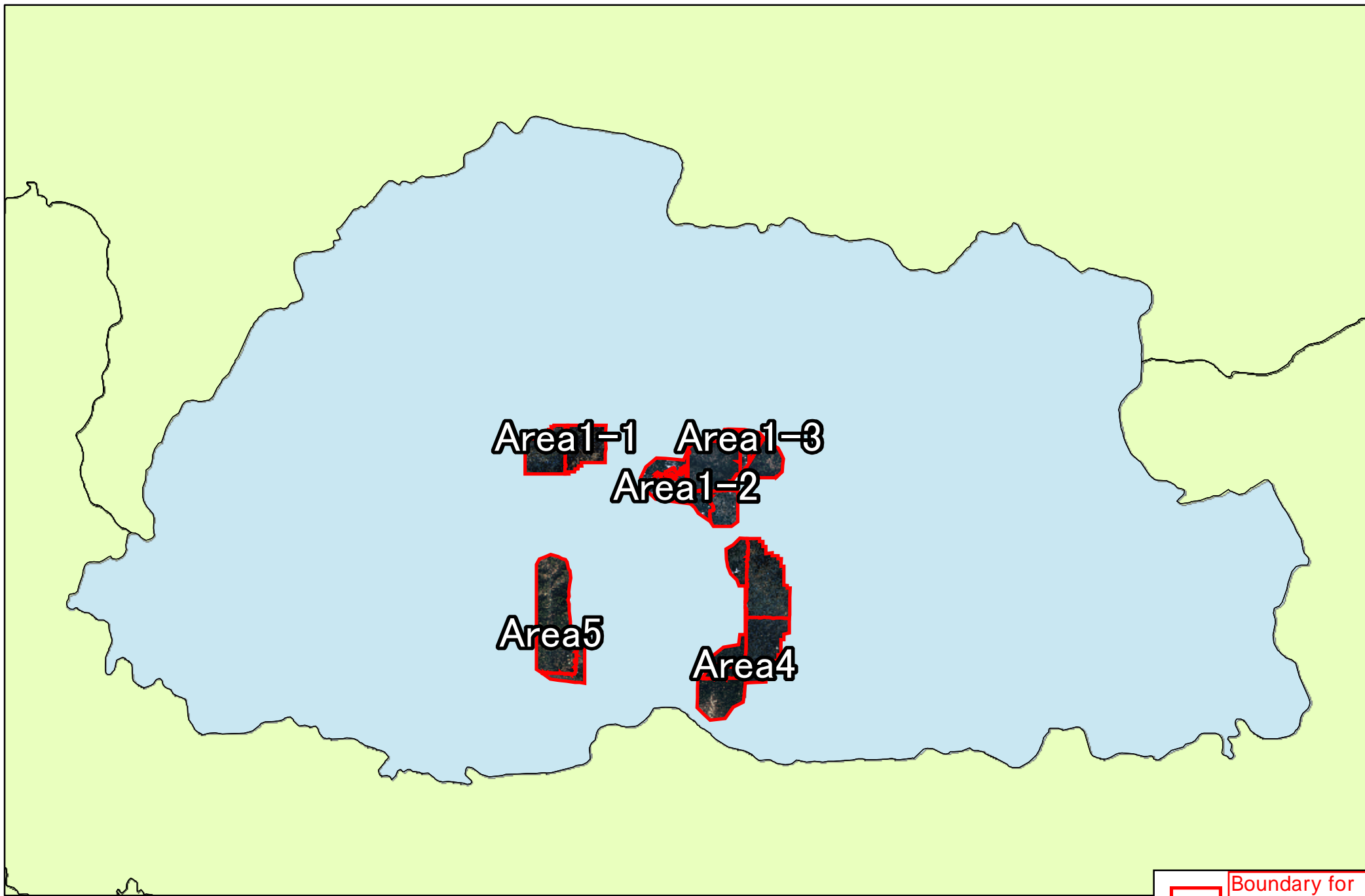
SECTION V



Appendix 9

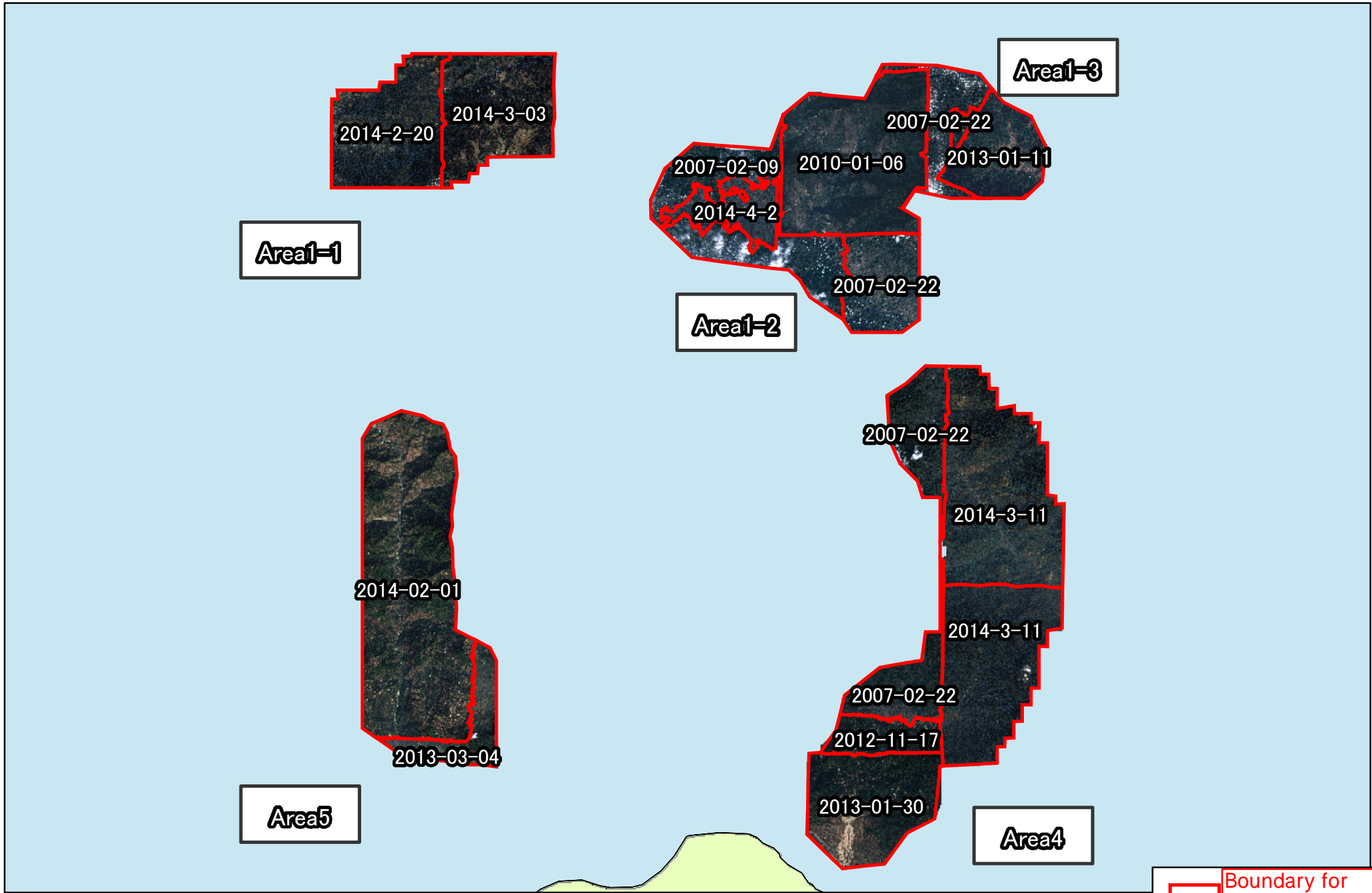
*高解像度衛星写真の調達
Procurement of High Resolution
Satellite Image*

Procured Areas of High Resolution
Satellite Ortho-rectified Image with Pan-sharpen



 Boundary for Segment Shooting

Date on Procured Location of High Resolution Satellite Ortho-rectified Image with Pan-sharpen



0 5 10 20 30 40 km

Boundary for Segment Shooting

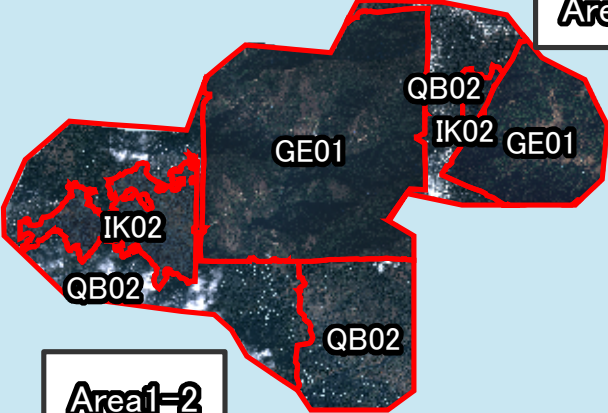
Procured Location of High Resolution Satellite
Ortho-rectified Image with Pan-sharpen



Area1-3



Area1-1



Area1-2

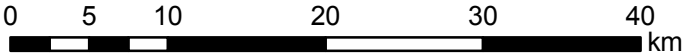
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IK02: IKONOS 2
QB02: Quick Bird 2
GE01: Geo eye 1



Area1-5

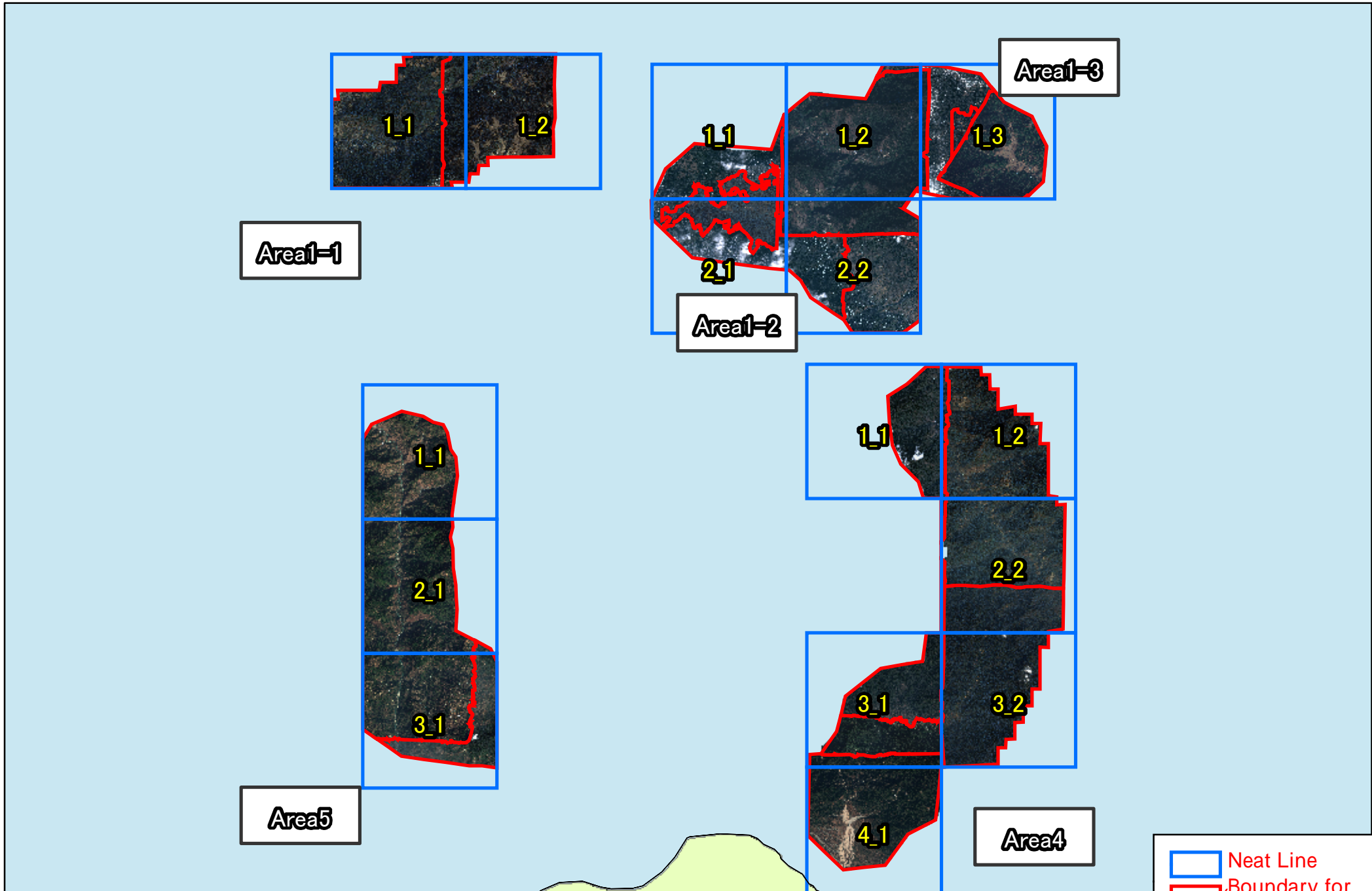


Area1-4



 Boundary for Segment Shooting

Data Filing on Procured Location of High Resolution Satellite Ortho-rectified Image with Pan-sharpen

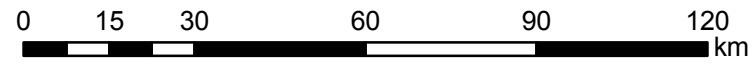
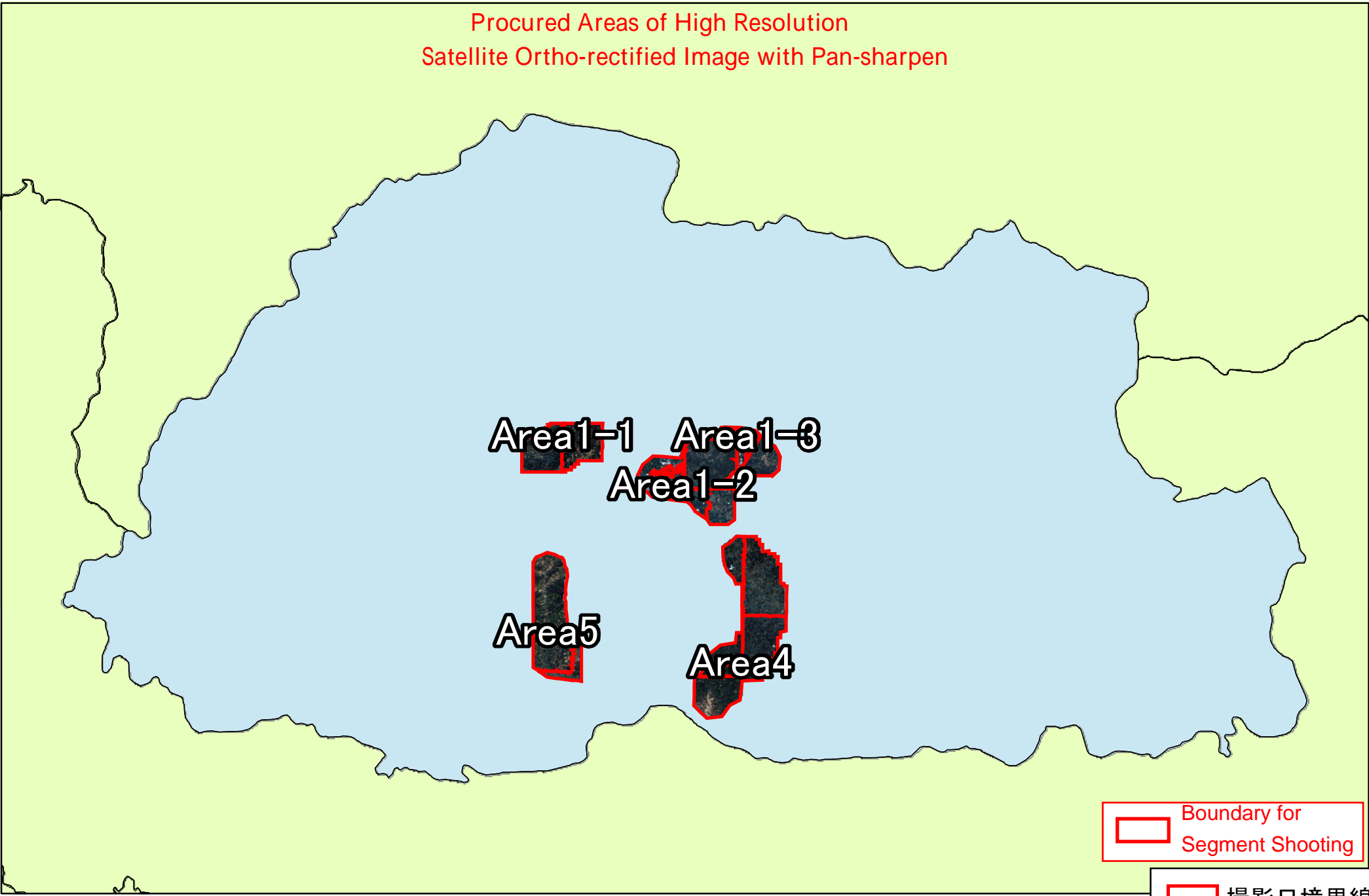


Legend:

- Neat Line
- Boundary for Segment Shooting

パンシャープンオールソモザイク画像データ

Procured Areas of High Resolution
Satellite Ortho-rectified Image with Pan-sharpen

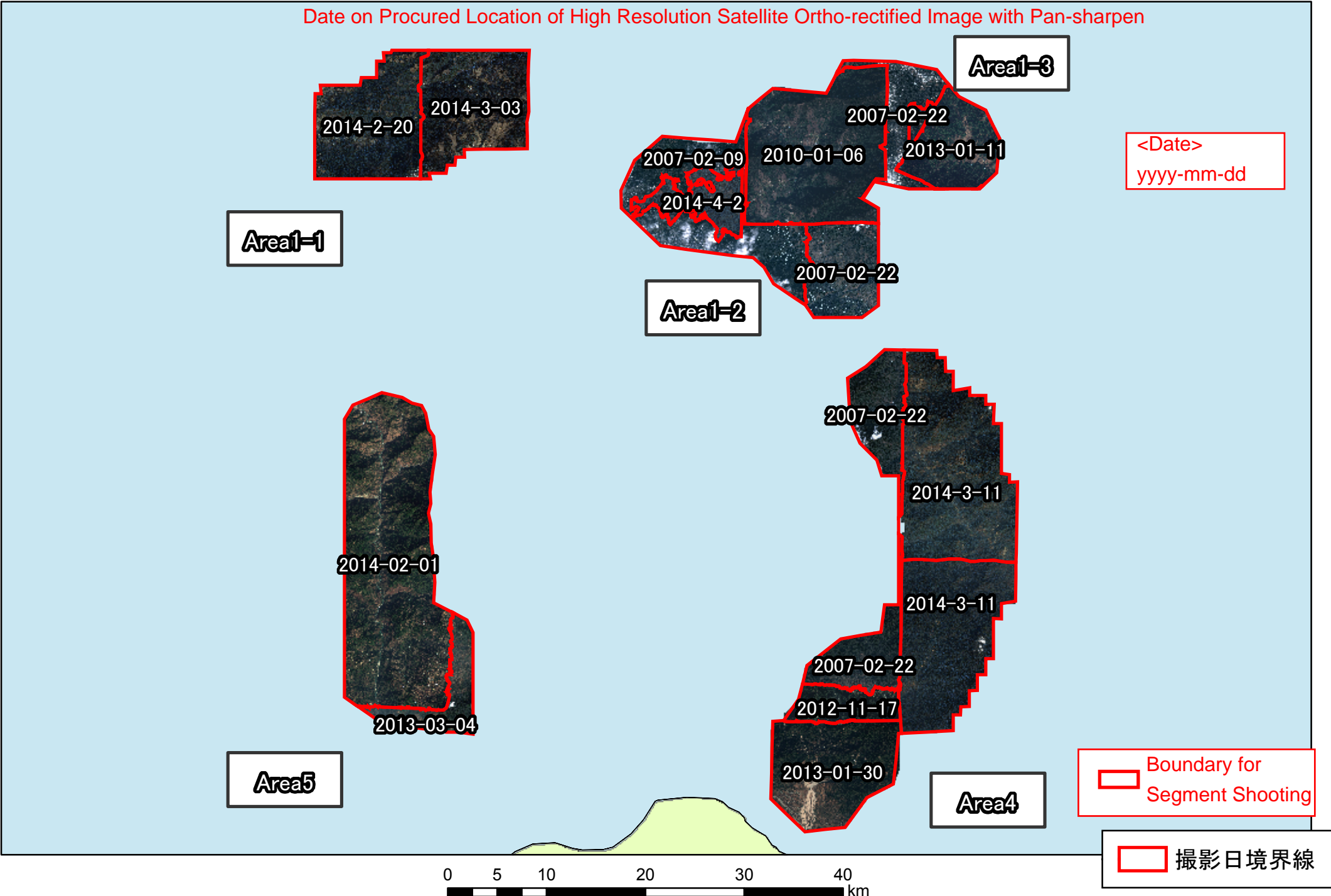


Boundary for Segment Shooting

撮影日境界線

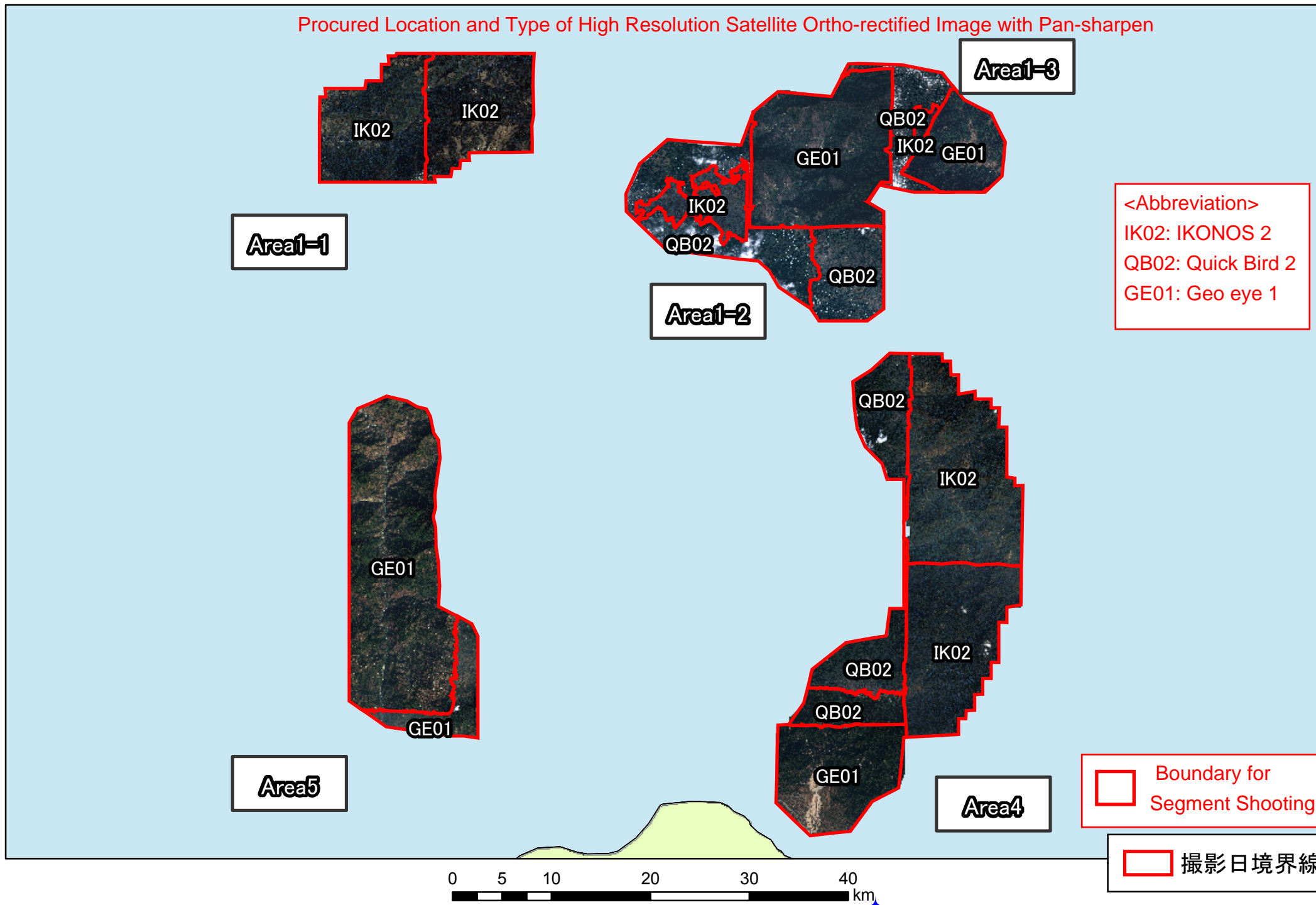
パンシャープンオールソモザイク画像データ

Date on Procured Location of High Resolution Satellite Ortho-rectified Image with Pan-sharpen



パンシャープンオールソモザイク画像データ

Procured Location and Type of High Resolution Satellite Ortho-rectified Image with Pan-sharpen



パンシャープンオールソモザイク画像データ

Data Filing and Neat Line on Procured Location of High Resolution Satellite Ortho-rectified Image with Pan-sharpen



0 5 10 20 30 40 km

Neat Line
Boundary for Segment Shooting

分割図郭
撮影日境界線