

# **Environmental and Social Impact Assessment for the Seismic Survey and Workover Activities of Block IOR-4, Myanmar**

## **Environmental and Social Impact Assessment Report**

15 May 2015

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## Environmental and Social Impact Assessment Report

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<p>This document presents the Environmental and Social Impact Assessment Report and the Environmental and Social Management Plan for the proposed seismic survey and workover activities at Block IOR-4.</p>		15 May 2015			
		Approved by:			
					
		Craig A Reid Partner			
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<p>This report has been prepared by Environmental Resources Management the trading name of 'ERM Hong-Kong, Limited', with all reasonable skill, care and diligence within the terms of the Contract with the client, incorporating our General Terms and Conditions of Business and taking account of the resources devoted to it by agreement with the client.</p> <p>We disclaim any responsibility to the client and others in respect of any matters outside the scope of the above.</p> <p>This report is confidential to the client and we accept no responsibility of whatsoever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies on the report at their own risk.</p>		<p>Distribution</p> <p><input type="checkbox"/> Public</p> <p><input type="checkbox"/> Government</p> <p><input checked="" type="checkbox"/> Confidential</p> <div style="text-align: right;">    </div>			

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## EXECUTIVE SUMMARY

**MPRL E&P Pte Ltd** (MPRL E&P) was awarded the Exploration Block IOR-4 (a.k.a. Pyay) in October 2014 to jointly operate with Myanma Oil & Gas Enterprise (MOGE) under Improved Petroleum Recovery (IPR) Contract. Following the contract award, MPRL E&P is planning to conduct seismic exploration activities, possibly consisting of 2-Dimensional (2D) and 3-Dimensional (3D) surveys, across Block IOR-4. MPRL E&P is also planning to undertake workover activities at selected existing wells within the Block ("the Project"). Pursuant to *Section 7* of the *Environmental Conservation Law* and *Articles 52 and 53* of the *Environmental Conservation Rules* of the Republic of the Union of Myanmar, all Projects undertaken in Myanmar which have the potential to cause significant environmental and social impacts are required to undertake an Initial Environmental Examination (IEE) or an Environmental Impact Assessment (EIA) and to obtain an Environmental Compliance Certificate (ECC) in accordance with the *Environmental Impact Assessment (EIA) Procedures* ("the Procedures").

In relation to the above, MPRL E&P has commissioned **Environmental Resources Management** (ERM), supported by local specialists from **Resource and Environment Myanmar** (REM), to undertake an Environmental and Social Impact Assessment (ESIA) Study for the Project in accordance with the requirements of the *Procedures*.

The overall purpose of the Study is to complete a robust ESIA to meet requirements of the *EIA Procedures* for the ESIA to be approved by the Ministry of Environmental Conservation and Forestry (MOECF).

### KEY ENVIRONMENTAL AND SOCIAL FEATURES

An overview of environmental and social baseline features for Block IOR-4 is presented in the ESIA Study. The main parameters described include:

- Physical environment, including climate and meteorology, geology, noise, air, surface water, groundwater and soil quality;
- Biological environment, including terrestrial habitats as well as the associated flora and fauna including avifauna, butterflies, herpetofauna, mammals and aquatic fauna ; and
- Socio-economic environment, including baseline information of the concerned Project Area, the region and the overall country profile.

Information on the above parameters has been collected through desktop review of publicly available information. Primary data collection has also been undertaken in December 2014 to establish the baseline biological, physical and socio-economic environment of the Project Area. The baseline data obtained have been used to characteristic the Project Area and informed

the assessment of potential environmental and social impacts from the proposed seismic surveys and workover activities at Block IOR-4.

#### *IMPACT ASSESSMENT AND ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN*

During the impact assessment, potential impacts have firstly been identified through a systematic scoping process whereby the activities (both planned and unplanned) associated with the Project have been considered with respect to their potential to interact with environmental and social resources or receptors. Interactions which may generate potentially significant environmental and social impacts ranging from those associated with the land accessibility phase (e.g. loss of access to land by the community), through the preparation / mobilisation phase (e.g. site preparation and clearance impacts to terrestrial habitat and flora and fauna), subsequent seismic survey phase (e.g. impacts of detonation of explosives) and eventually to the close-out phase (e.g. positive impacts from rehabilitation of habitats) of the seismic surveys as well as the well workover activities at Block IOR-4.

The potentially significant environmental and social impacts are further assessed in the ESIA Study, with appropriate mitigation and enhancement measures recommended for alleviating potential negative impacts or enhancing potential positive impacts from the Project. With proper implementation of the mitigation measures, it is predicted that the potential environmental and social impacts causing by the proposed seismic survey and workover activities of Block IOR-4 would be of **Negligible, Minor** or **Moderate** significance.

#### *CUMULATIVE IMPACTS*

Cumulative impacts of the proposed seismic survey and workover activities at Block IOR-4 with other potential development in the vicinity are also assessed in the ESIA Study. Cumulative impact refers to that generated by other developments or activities in the vicinity of the Project Area, which when added to the impacts of the proposed seismic survey and workover activities combine to cause a greater impact.

Block IOR-4 is surrounded by other onshore blocks including Block IOR-6, Block EP-3 and Block EP-4. It is understood that seismic surveys may be carried out concurrently at these blocks and their seismic survey areas may overlapped slightly with that of Block IOR-4 at the boundary between the blocks. However, it is expected that the environmental and social impacts from seismic surveys and well workover activities, if properly mitigated, will be localised within the onshore blocks and restricted to environment / communities within them. As such, it is not expected that seismic surveys at adjacent blocks, if undertaken concurrently, will lead to cumulative impacts to the physical, biological or socio-economic environment within Block IOR-4.

# 1 INTRODUCTION

## 1.1 PROJECT OVERVIEW

**MPRL E&P Pte Ltd** (MPRL E&P) was awarded the Exploration Block IOR-4 (a.k.a. Pyay) in October 2014 to jointly operate with Myanmar Oil & Gas Enterprise (MOGE) under Improved Petroleum Recovery (IPR) Contract. Following the contract award, MPRL E&P is planning to conduct seismic exploration activities, possibly consisting of 2-Dimensional (2D) and 3-Dimensional (3D) surveys, across Block IOR-4. MPRL E&P is also planning to undertake workover activities at selected existing wells within the Block ("the Project").

The location of the Block is shown in *Figure 1.1*.

## 1.2 PROJECT PROPONENT

The proponent of the Project is MPRL E&P Pte Ltd.

MPRL E&P is an independent oil and gas exploration and production company, headquartered in Yangon with operations in various offshore and onshore blocks in Myanmar. Further information about the company is available at the website <http://mprlexp.com/>.

## 1.3 THIS ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Pursuant to *Section 7 of the Environmental Conservation Law* and *Articles 52 and 53 of the Environmental Conservation Rules* of the Republic of the Union of Myanmar, all Projects undertaken in Myanmar which have the potential to cause significant environmental and social impacts are required to undertake an Initial Environmental Examination (IEE) or an Environmental Impact Assessment (EIA) and to obtain an Environmental Compliance Certificate (ECC) in accordance with the *Environmental Impact Assessment (EIA) Procedure* ("the Procedure") <sup>(1)</sup>.

In relation to the above, MPRL E&P has commissioned **Environmental Resources Management (ERM)**, supported by local specialists from **Resource and Environment Myanmar (REM)**, to undertake an Environmental and Social Impact Assessment (ESIA) Study for the Project in accordance with the requirements of the Procedure. This ESIA Report has been prepared for MPRL E&P by ERM and presents the objectives, methodology and outcomes of the IA in accordance with the EIA Procedures.

<sup>(1)</sup> EIA Procedures (8<sup>th</sup> Draft) dated January 2015.



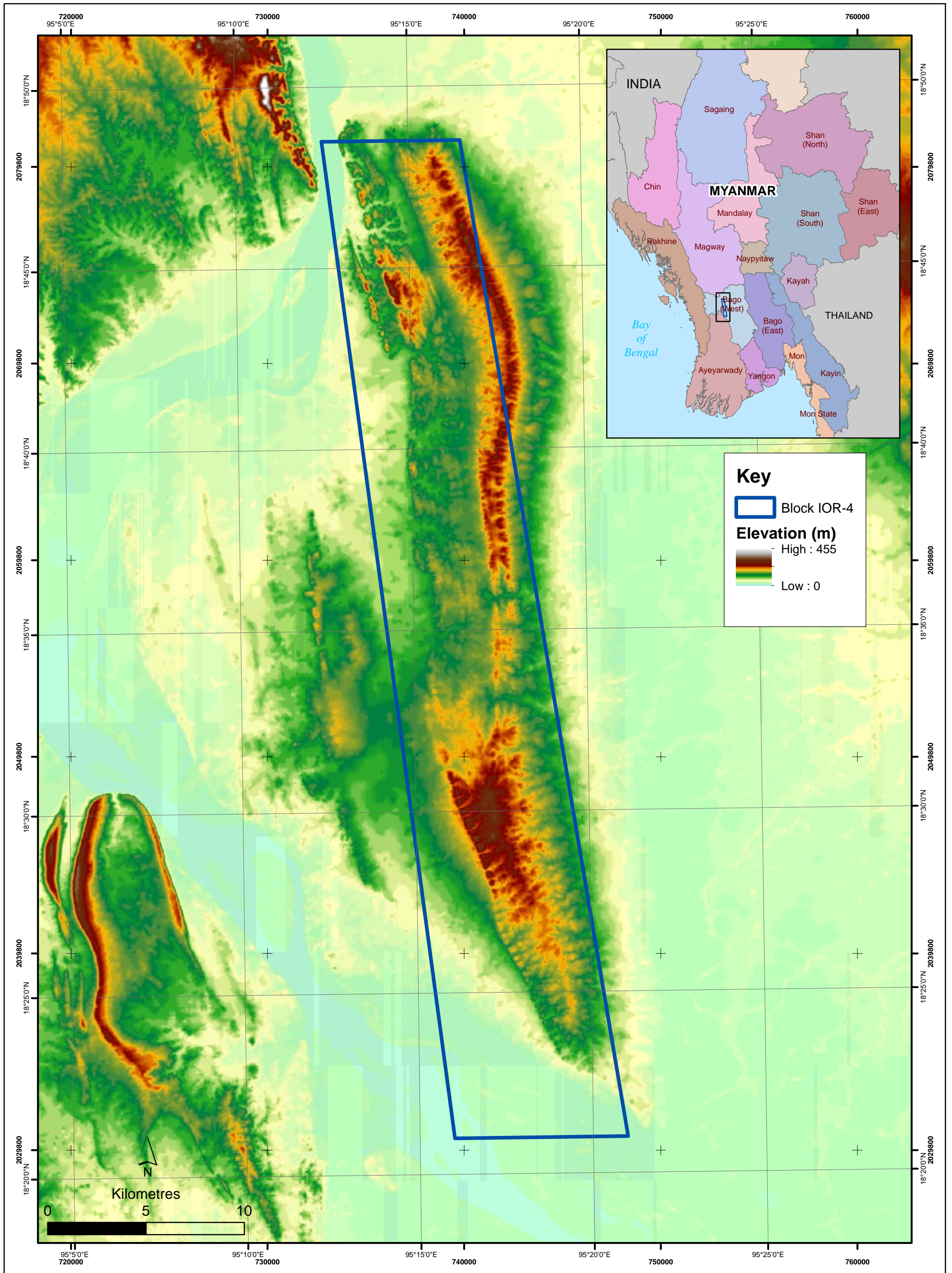


Figure 1.1

Block IOR-4

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Date: 24/3/2015

Environmental  
Resources  
Management



## 1.4

### **IMPACT ASSESSMENT OBJECTIVES**

The overall purpose of the Study is to complete a robust ESIA to meet requirements of the EIA Procedures for the ESIA to be approved by the Ministry of Environmental Conservation and Forestry (MOECAF).

Specifically, the objectives of the ESIA are:

- To review the proposed Project activities including its alternatives with respect to their potential to interact with environmental and social receptors and resources;
- To identify the potentially vulnerable environmental and social components;
- To identify and evaluate environmental and social impacts arising from the Project;
- To recommend mitigation or enhancement measures to remove, reduce or avoid negative impacts;
- To provide an environmental and social management plan (ESMP) including an approach for monitoring; and
- To summarise public consultation and disclosure of the Project.

## 1.5

### **STUDY LIMITATIONS**

This IA is based on the Project description obtained from MPRL E&P at the time of the Study. Any future changes to the Project description, upon which this report is based or additional relevant information revealed as Project design, equipment and service procurement proceed may affect the analysis, assessment and conclusions contained in this report. Should significant changes occur, they would be the subject of further study to verify that the conclusions of this ESIA do not change and to determine whether any additional mitigation, management or monitoring measures are warranted.

## 1.6

### **ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT EXPERTS**

The key ESIA experts deployed for the Project are presented in *Table 1.1* below.



**Table 1.1**      *ESIA Experts deployed for the Project*

Team	Name	Role	Organisation
Project Management Team	Craig A. Reid	Project Director	ERM
Project Management Team	Jovy Tam	Project Manager	ERM
Advisory Team	Dr Robin Kennish	EIA / EMP Expert	ERM
Advisory Team	Neena Singh	SIA Expert	ERM
ESIA and ESMP Technical Team	Dr Jasmine Ng	EIA Specialist	ERM
ESIA and ESMP Technical Team	Mandy To	Noise Specialist	ERM
ESIA and ESMP Technical Team	Winnie Ko	Air Specialist	ERM
ESIA and ESMP Technical Team	Angus Choi	Soil and Groundwater Specialist	ERM
ESIA and ESMP Technical Team	Dr Tom Glenwright	Water Specialist	ERM
ESIA and ESMP Technical Team	Terence Fong	Ecology Specialist	ERM
ESIA and ESMP Technical Team	Manish Singh	SIA Specialist	ERM
ESIA and ESMP Technical Team	Kary Kwok	GIS Specialist	ERM
Local Team	Daw Khin Ohnmar Htwe	SIA Survey Team Leader	REM
Local Team	Thura Aung	Noise, Air, Soil and Groundwater Survey Team Leader	REM
Local Team	Dr Ko Myint		REM
Local Team	Dr Win Kyi		REM
Local Team	Dr Myat Htoo Aung		REM
Local Team	Dr Win Maung	Local Specialist	REM
Local Team	Soe Thura Tun	Local Specialist	REM

The remainder of this report is structured as follows:

- *Section 2* defines the institutional framework for the Project including a summary of legislation, guidelines and standards applicable to the Project.
- *Section 3* presents the Project description and alternatives selection.
- *Section 4* presents a summary of environmental and social baseline conditions within the Project Area.
- *Section 5* presents the impact assessment methodology and the findings of the assessment of potentially significant impacts to environmental and social receptors and resources and proposed mitigation measures.
- *Section 6* presents findings of assessment of cumulative impacts to environmental and social receptors and resources within the Project Area.
- *Section 7* details the Environmental and Social Management Plan and any monitoring measures to be completed.
- *Section 8* presents a summary of the public consultation and disclosure carried out for the Project.

This section sets out the relevant legal and policy context in Myanmar and documents the environmental and social standards with which the Project will achieve compliance as well as the international standards that the Project will follow. Specifically, this section summarises the following:

- MPRL E&P Environmental and Social Policy;
- Myanmar administrative and legislative framework as well as existing regulatory requirements;
- Pending ESIA requirements in Myanmar;
- International organizations such as the World Bank and International Finance Corporation (IFC) environmental and social guidelines and standards that relate to both conducting an ESIA as well as to the technical performance standards considered by the Project; and
- A discussion of international conventions to which Myanmar is a signatory and with which the Project must therefore comply.

Specific benchmarks used to assess individual impacts are also summarized under each assessment topic in *Section 5*.

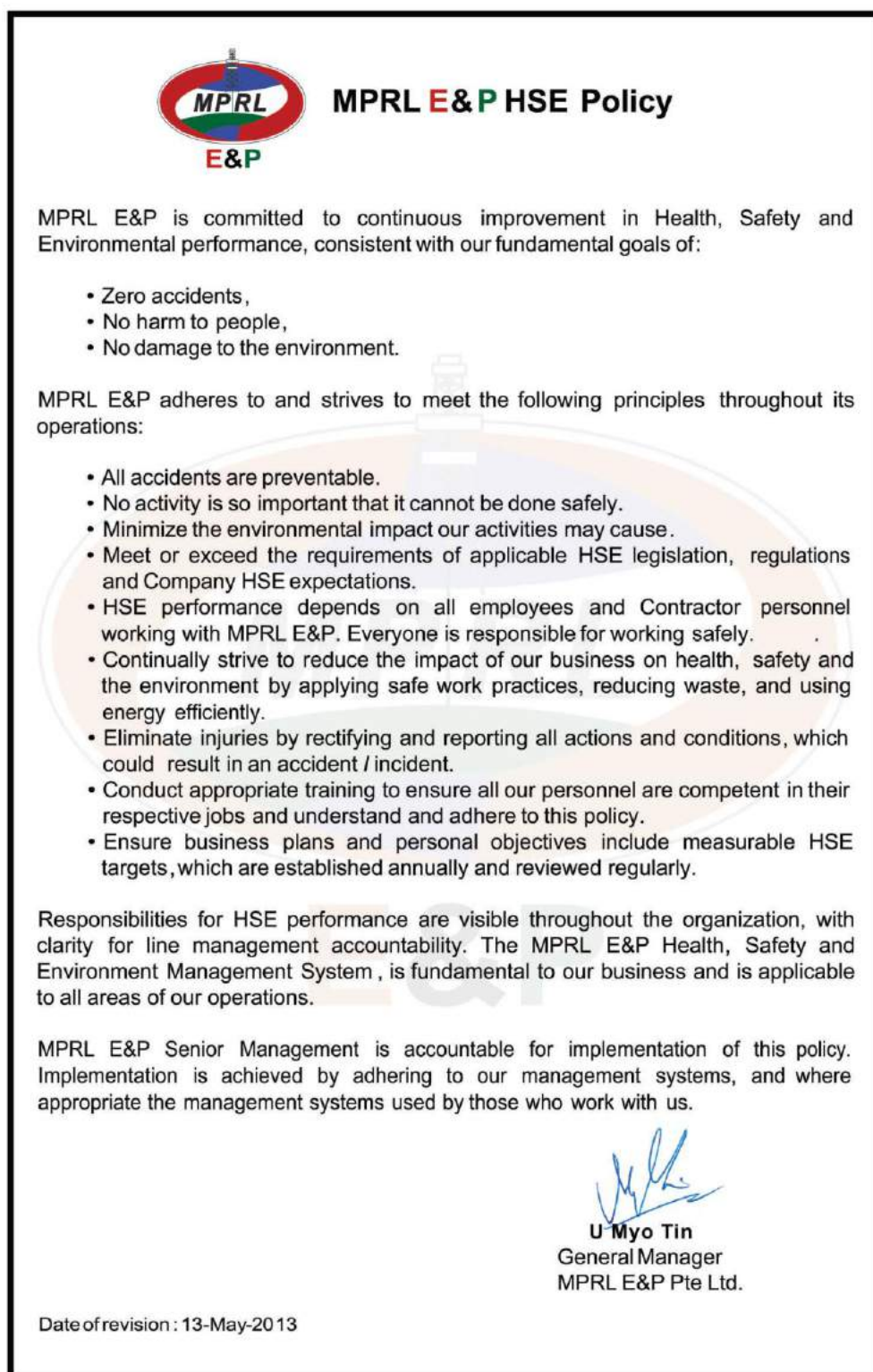
## 2.1

### **CORPORATE ENVIRONMENTAL AND SOCIAL POLICY**

MPRL E&P has adopted a comprehensive HSE Management System. This system is an important and integral part of the company's overall management system and is shown in *Figure 2.1* below. This ESIA Study is conducted in accordance with MPRL E&P's environmental and social guidelines which require the Project to follow the fundamental goals of:

- Zero accidents;
- No harm to people; and
- No damage to environment.

Figure 2.1 MPRL E&P's HSE Policy



Apart from the HSE policy, MPRL E&P also has in place a corporate responsibility policy and a human rights policy, as can be seen in the following *Figures 2.2-3*.

Figure 2.2 MPRL E&P Corporate Responsibility Policy



**MPRL E&P Pte Ltd.**

#### CORPORATE RESPONSIBILITY POLICY

MPRL E&P's policy is to be a responsible investor in the long term development of the host nation, by conducting business operations to the highest standards.

Our goal is to be honest and conduct business with integrity with the people we work with, which can include but is not limited to, local communities, business partners, and governments, and to maintain respect for cultural, national, and religious diversity.

Company directors, personnel and contractors are responsible for ensuring strict compliance with this policy, and specifically to:

- Respect individuality and diversity of all employees, treating them fairly and without discrimination
- Commit to equal opportunity in all aspects of employment and encouragement in diversity
- Stimulate personal growth of all employees through promotion of creativity and teamwork
- Provide a safe secure, worker friendly environment that promotes career opportunities for self-development
- Ensure compliance with MPRL E&P Environmental, Health & Safety Policy by all personnel involved in our activities
- Provide a clear direction on key CSR initiatives, policies, performance data and targets
- Contribute to the sustainable development of communities through active engagement and dialog
- Support selected development of projects in health, education, cultural and civic activities
- Maintain high ethical standards and support transparency in all of our activities
- Encourage our partners and stakeholders to observe and uphold similar standards wherever possible

**U Mae Myint**  
Chief Executive Officer

Figure 2.3 MPRL E&P Human Rights Policy



**MPRL E&P Pte Ltd.**

## HUMAN RIGHTS Policy Statement

MPRL E&P conducts business operations to the highest standard of ethics respecting and protecting internationally recognized Human Rights during the process. We endeavor to protect and promote Human Rights by coordinating with all stakeholders within our sphere of influence.

Human Rights abuses will not be tolerated nor encouraged in all projects undertaken by the company. This Human Rights Policy Statement is applicable to every operation acknowledging the rights of employees and the rights of local communities.

### Community Rights:

MPRL E&P strongly encourages employees, contractors, Non Governmental Organization and governmental bodies to address the rights of communities surrounding our operations, through active engagement and dialog:

- Continuous community consultation and needs assessments are conducted to identify the needs of the community and concerns, enabling us to examine ways to proactively address them;
- We recognize and respect the culture and rights of indigenous peoples and endeavor to promote the practice of their traditions and customs; and
- We recognize communities' right to an essential, free, and full development highlighting our commitment to promoting community empowerment and improvement through sustainable development.

### Employee Rights:

- We provide safe, secure, and worker friendly environment;
- We are an equal opportunities employer;
- We positively stimulate personal growth of our employees through promotion of creativity and teamwork;
- We do not use any forced or compulsory labor;
- We do not discriminate against race, religion, gender, age, sexual orientation, religion, nationality or ethnicity; and
- All employees have the right to join trade unions, where such rights are recognized by law.

**U Moe Myint**  
Chief Executive Officer



Matters pertaining to Health, Safety and Environmental (HSE) requirements are generally under the jurisdiction of the ministries and state-owned enterprises in the oil and gas sector. Key ministries/ agencies / state-owned enterprises that have jurisdiction over HSE matters in oil and gas operations include the following:

- MOECAP;
- Ministry of Fisheries, Livestock and Rural Development;
- Ministry of Labour;
- Ministry of Energy (MOE);
- MOGE; and
- Myanmar Investment Commission (MIC).

Table 2.1 provides a list of laws relevant to HSE of the proposed Project.

**Table 2.1** *List of Existing Sectorial Laws in Myanmar related to Environmental and Social issues as of March 2014*

Sector	Relevant Laws in Myanmar
Administrative	The Territorial Sea and Maritime Zones Law, 1977
	The Emergency Provisions Act, 1950
	The Police Act, 1945
	The Poisons Act, 1919
	The Yangon Police Act, 1899
	The Explosives Act, 1887
	The Penal Code, 1861 of Offences Affecting the Public Health, Safety, Convenience, Decency and Morals
	Foreign Investment Law, 2012
	The Child Law (Law No. 9/93).
	Myanmar Maternal and Child Welfare Association Law (No. 21/90).
	Myanmar Investment Commission Notification (1994)
	The Private Industrial Enterprise Law - SLORC Law No. 22/90
Agriculture and Irrigation	The Fertilizer Law, 2002
	The Plant Pest Quarantine Law, 1993
	The Pesticide Law, 1990
	The Embankment Act, 1909
	Underground Water Act, 1930
	Farmland Rules - Notification No 62/2012 (English)
	Vacant, Fallow and Virgin Lands Management Rules - Notification No. 1/2012
	Vacant, Fallow and Virgin Land Management Act - Pyidaungsu Hluttaw Law No. 10/2012
Culture	The Protection and Preservation of Cultural Heritage Region law, 1998
Public Health	The National Food Law, 1997
	The Traditional Drug Law, 1996
	The Prevention and Control of Communicable Disease Law, 1995, revised in 2011.
	The Narcotics Drugs and Psychotropic Substances Law, 1993

Sector	Relevant Laws in Myanmar
	The National Drugs Law, 1992
	The Union of Myanmar Public Health Law, 1972
	Private Health Act, 2007
	The Penal Code of Offences Affecting the Public Health, Safety, Convenience, Decency and Morals (1861)
Occupational Health and Safety	Factory Act, 1951 (safe and healthy workplaces)
	Employment and skill Development Law, 2013
Tourism	The Myanmar Hotel and Tourism Law, 1993
Industrial	Myanmar Special Economic Zone Law No. 2011
	Dawei Special Economic Zone Law, 2011
	Myanmar Special Economic Zones Law (The Pyidaungsu Hluttaw Law No. 1/2014)
	The Private Industrial Enterprise Law, 1990
	The Factories Act, 1951
	The Oilfield (Labour and Welfare) Act, 1951
	Employment Restriction Act (1959)
	Workmen's Compensation Act 1923, amended in 2005
	Shops and Establishment Act, 1951
	Leave and Holidays Act, 1951
	Minimum Wage Act 1949, replaced by a new law in 2013
	Payment of Wages Act 1936
	Social Security Act 1954
	Trade Dispute Act 1929
	Settlement of Labour Dispute Law (2012)
	Employment and Skill Development Law
	Employment Statistics Act (1948)
	Water Power Act ( 1927)
Land Use	Land Acquisition Act, 1894
	The Towns Act, 1907
	The Village Act, 1907

## 2.3

### PENDING ESIA LEGISLATION IN MYANMAR

Legislation related to environmental assessment, conservation and protection in Myanmar is currently within a development phase. Under *Section 7* of the *Environmental Conservation Law (2012)* and *Articles 52 and 53* of the *Environmental Conservation Rules (2014)* of the Republic of the Union of Myanmar, there is a requirement for the undertaking of an IEE or an EIA to obtain an ECC for certain development projects. Presently, the MOECAP is drafting both *EIA Procedures* and *EIA Guidelines*, along with the supporting of an EIA drafting committee comprising the representatives of relevant union ministries, union attorney general's office, development committees and Non-governmental Organizations (NGOs) and technical support by experts from the Asian Development Bank Greater Mekong Subregion – Environment Operations Center (ADB GMS-EOC). Within the latest *Version 8* of the *EIA Procedures* made publically available in 2015, the requirements for an EIA system are described as follows:

*“An EIA investigation shall consider all biological, physical, social, economic, health, cultural and visual-components of the environment, together with all pertinent legal matters relating to the environment (including land use, resources use, and ownership*

*of and rights to land and other resources) that may be affected by the Project during all project phases including pre-construction, construction, operation, decommissioning, closure, and post-closure; and shall identify and assess all Adverse impacts and risks that potentially could arise from the project. "*

An EIA process is also outlined in the *EIA Procedures* which are described in the following sections.

### 2.3.1 *Screening*

The EIA process starts with the Screening Process as shown in *Figure 2.4*. The MOECAAF is empowered and has the exclusive authority to define screening criteria for a project.

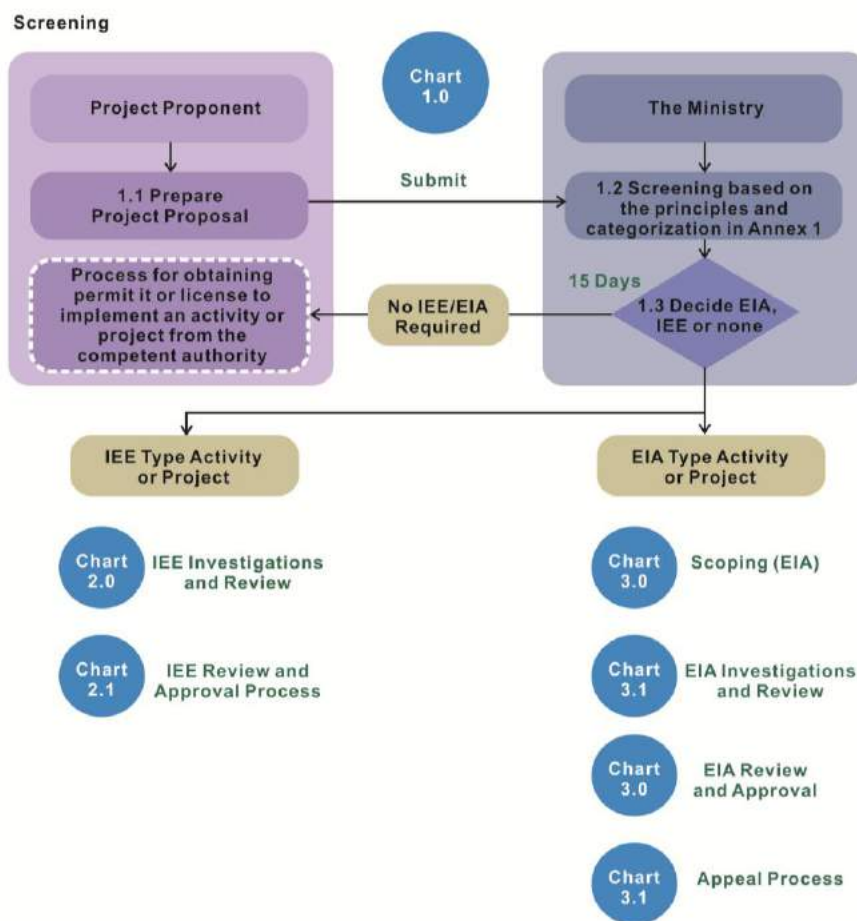
Guidance is provided as to which projects or activities should carry out an IEE or an EIA, as presented in the *Annex to the EIA Procedures (8<sup>th</sup> Draft)* <sup>(1)</sup>. If, as a result of that determination, an IEE or an EIA is required, then the Proponent of the project or activity shall be obliged to prepare, obtain approval for, and implement an appropriate Environmental Management Plan (EMP) in respect of the proposed project or activity. Any appeal from such determination must be made in accordance with the *EIA Procedures*.

The *Annex to the EIA Procedures (8<sup>th</sup> Draft)* shows for each type of economic activity, the criteria for selection of whether IEE or EIA apply to the proposed economic activity. The MOECAAF determines whether the project is an IEE Type Project, or an EIA Type Project, or is neither an IEE or an EIA Type Project and is therefore exempt from (not required) to undertake any environmental assessment.

For the purposes of this Project, the EIA has been selected as the methodology to follow under the *EIA Procedures*.

<sup>(1)</sup> *EIA Procedures (8<sup>th</sup> Draft) Op. cit.*

Figure 2.4 Screening within the Myanmar EIA Process



Source: EIA Procedures (8<sup>th</sup> Draft) Annex 2 - Environmental Assessment Procedure Flowchart <sup>(1)</sup>

On the basis that an EIA is to be conducted for the Project, the remainder of this discussion has focussed on the required EIA process.

The Project Proponent shall be required to submit a project proposal (completed in accordance with MOECAP's guidelines) to the Environmental Conservation Department of MOECAP for screening.

Within 15 days of receiving the complete project proposal, the MOECAP shall determine the type of environmental assessment (EIA, IEE, or none) which the project will require, and shall inform the Project Proponent in writing about its determination. In addition, the MOECAP can change the status of an IEE Type Project to be an EIA Type Project but there are no criteria for changing the status to none or exempt from environmental assessment.

Under the Procedure, a Project Proposal Report which confirmed that an ESIA is required for the proposed seismic activities was submitted to Ministry of Environmental Conservation and Forestry (MOECAP) <sup>(2)</sup>.

<sup>(1)</sup> EIA Procedures (8<sup>th</sup> Draft) *Op. cit.*

<sup>(2)</sup> ERM (2014) Project Proposal Report for the Seismic Surveys at Block IOR-4, Myanmar. Submitted to MOECAP on 18 November 2014.

All EIA Type Projects are required to undergo Scoping. The Project Proponent shall be responsible to ensure that the Scoping and the preparation of the Term of Reference (TOR) for the EIA Report are undertaken in a professional manner and in accordance with any applicable guidelines issued or adopted by the MOECAF. The Scoping shall, in respect to the proposed Project:

- a) Define the Project Area, area of influence, time boundaries, project phases, and potential stakeholders;
- b) Start the process of understanding the applicable regulations and standards, and their context for Project design and completion of the EIA;
- c) Make a provisional identification of environmental, social and, if any, health impacts, focusing in particular on the environmental, social and health issues that need to be addressed in subsequent EIA studies;
- d) Provide an indication of what baseline data and information are required, and how it is proposed to obtain it (although there is no need to actually collect any data at this stage);
- e) Provide an opportunity for consultants, relevant authorities, project developers, interested and affected parties to express their views and concerns regarding the proposal before an EIA proceeds;
- f) Enable an efficient and comprehensive assessment process that saves time, resources, costs and delays; and
- g) Identify potentially affected communities and other stakeholders with an interest in the Project.

As part of the Scoping, the Project Proponent shall ensure that the following public consultation and participation process is carried out.

- a) Disclose information about the proposed Project to the public and civil society through local media, including by means of the prominent posting of legible sign boards and advertising boards at the Project Site which are visible to the public; and
- b) Arrange the required complement of consultation meetings as advised by the MOECAF, with local communities, potentially Project Affected Persons (PAPs), local authorities, community based organisations, and civil society.

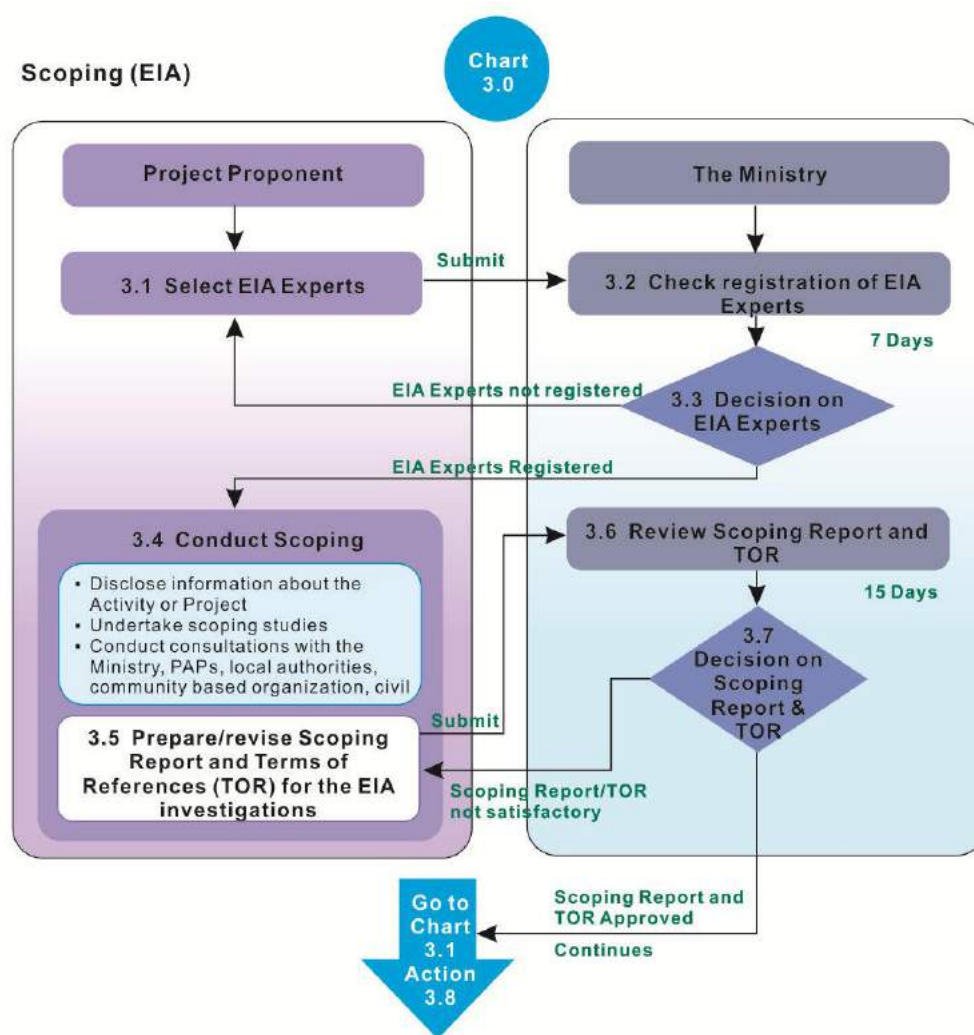
For the Scoping Exercise of the Project, consultations were undertaken amongst the local community in 5 villages from Pyay Township in accordance with the *draft EIA Procedures*. The consultations were undertaken as per the

guidance of the township administrators, and were only carried out in villages where the tract leaders are living.

The Project Proponent shall prepare a Scoping Report and TOR for the EIA investigations and submit the completed Scoping Report and TOR to the MOECFA for review and approval. The Scoping process is shown in *Figure 2.5*.

Under the Procedure, a Scoping Report and TOR for the proposed seismic and workover activities was submitted to Ministry of Environmental Conservation and Forestry (MOECFA) <sup>(1)</sup>.

**Figure 2.5** *Scoping within the Myanmar EIA Process*



Source: EIA Procedures (8<sup>th</sup> Draft) <sup>(2)</sup>

(1) ERM (2015) Scoping Report for the Seismic Surveys and Workover Activities at Block IOR-4, Myanmar. Submitted to MOECFA on 2<sup>nd</sup> February 2015.

(2) EIA Procedures (8<sup>th</sup> Draft) *Op. cit.*



The Project Proponent shall ensure that the EIA investigation properly addresses all adverse impacts and is undertaken in accordance with the approved TOR. The EIA investigation shall consider all biological, physical, social, economic, health, cultural and visual components of the environment, together with all pertinent legal matters relating to the environment (including land use, resources use, and ownership of and rights to land and other resources) that may be affected by the Project during all project phases, including pre-construction, construction, operation, decommissioning, closure, and post-closure; and shall identify and assess all adverse impacts and risks for environment, social and, if relevant, health that potentially could arise from the Project.

The *EIA Procedures* does not address the social impacts of Involuntary Resettlement or which relate to Indigenous People. Separate procedures shall be issued by responsible ministries, and in the absence of such procedures all such Projects shall adhere to international practice on Involuntary Resettlement and Indigenous People (IPs).

The Project Proponent is obliged to use, comply with and refer to applicable national standards, international standards adopted by the Government and/or the MOECAF, or, in the absence of relevant national or adopted international standards, such standards as may be agreed with the MOECAF.

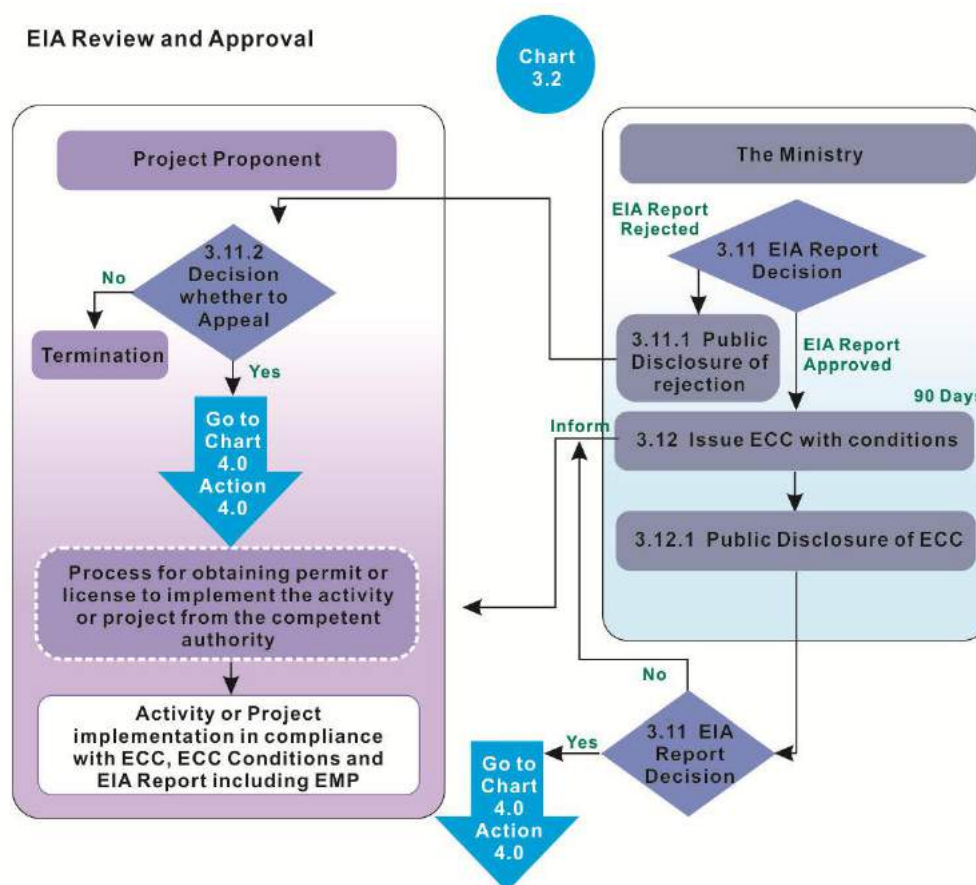
The EIA Report shall consider the views, concerns, and perceptions of stakeholders, communities and individuals that could be affected by the Project or who otherwise have an interest in the Project. The EIA should include the results of public consultations and negotiations with the affected populations on the environmental and social issues. Public concerns should also be taken into account in assessing impacts, designing mitigation measures, and selecting monitoring parameters. After completing all investigations and public consultation and participation processes required for EIA Type Projects, the Project Proponent shall submit the EIA Report to the MOECAF in both digital and hard copy, together with the required service fee.

The MOECAF shall within 10 days after submission disclose the EIA Report to civil society, PAPs, concerned government organisations, and other interested stakeholders. The MOECAF shall submit the EIA Report to the EIA Report Review Body for comment and recommendations and also arrange for public consultation meetings at national and State / Regional / local levels where the Project Proponent shall present the EIA Report. All comments and recommendations received, including those of the EIA Report Review Board, will be collected and reviewed by the MOECAF prior to making a final decision on approval of the EIA Report.

The MOECAF shall deliver its final decision within 90 days of receipt of the EIA Report. All costs incurred in completing to the EIA Report disclosure

and review, including the public participation process, shall be borne by the Project Proponent. Upon completion of its review of the EIA Report, the MOECAP will issue an ECC or inform the Project Proponent of its decision to reject the EIA Report and publically disclose its decision. The proposed flow chart covering the EIA review process is shown in *Figure 2.6*.

**Figure 2.6** *EIA Review and Approval within the Myanmar EIA Process*



Source: EIA Procedures (8<sup>th</sup> Draft) <sup>(1)</sup>

## 2.4 INTERNATIONAL STANDARDS, GUIDELINES AND TREATIES/CONVENTIONS RELEVANT TO THE PROJECT

In addition to national legislation, a range of international standards, including IFC Performance Standards (IFC PS) and the World Bank Guidelines, have been considered for the Project. Where possible, alignment with such standards have been applied which then may complement and reinforce national legislation with a view to allowing the Project to be conducted under international practice. The IFC PS and the World Bank Guidelines provide guidance on how to identify risks and impacts, and are designed to help avoid, mitigate, and manage risks and impacts as a way of doing business in a sustainable way, including stakeholder engagement and

<sup>(1)</sup> EIA Procedures (8<sup>th</sup> Draft) *Op. cit.*

disclosure obligations of the Project Proponent in relation to project-level activities <sup>(1)</sup> <sup>(2)</sup>.

In the case of its direct investments (including project and corporate finance provided through financial intermediaries), the IFC PS require its clients to manage environmental and social risks and impacts so that development opportunities are enhanced.

The applicable guidelines and standards that the Project has aligned with where practical are as follows:

- IFC Performance Standards (IFC PS) (2012);
- World Bank Group (WBG) Environmental Health and Safety (EHS) General Guidelines (2007);
- WBG EHS Guidelines for Onshore Oil and Gas Development (2007); and
- Relevant international treaties to which Myanmar is a signatory, including those related to waste management, biodiversity conservation as well as labour and human rights conventions.

#### **2.4.1 *International Finance Corporation (IFC) Performance Standards (PS)***

The IFC of the World Bank Group updated its Sustainability Framework in January 2012. This included revising the PS which replaced the previous safeguard policies and will be used to evaluate any project seeking funding through the IFC.

The IFC PS represent the 'policy framework' for the ESIA and sustainable social and environmental management for the Project, whereas the World Bank Group's EHS Guidelines provide guidance on general and industry best practice as well as recommended numerical limits for emissions to the atmosphere, noise, liquid and solid wastes, hazardous wastes, health and safety, and other aspects of industrial facilities and other types of development projects. The relevant IFC PS are listed in *Table 2.2* and the General Guidelines and Onshore Oil and Gas Guidelines are detailed in *Table 2.3* and *Table 2.4*, respectively.

<sup>(1)</sup> IFC Performance Standards on Environmental and Social Sustainability, January 2012, International Finance Corporation, World Bank Group.

<sup>(2)</sup> Environmental, Health and Safety (EHS) Guidelines – General EHS Guidelines: Introduction, April 2007, International Finance Corporation, World Bank Group

**Table 2.2 IFC Performance Standards** <sup>(1)</sup>

Performance Standards	Objectives
<p><b>Performance Standard 1 –Assessment and Management of Environmental and Social Risks and Impacts</b></p> <p><i>Underscores the importance of managing social and environmental performance throughout the life of a project (any business activity that is subject to assessment and management).</i></p>	<ul style="list-style-type: none"> <li>• <i>Impact identification and assessment.</i> To identify and assess social and environmental impacts, both adverse and beneficial, in the project's area of influence.</li> <li>• <i>Mitigation.</i> To avoid, or where avoidance is not possible, minimize, mitigate, or compensate for adverse impacts on workers, affected communities, and the environment.</li> <li>• <i>Stakeholder engagement.</i> To ensure that affected communities are appropriately engaged on issues that could potentially affect them.</li> <li>• <i>Effective management.</i> To promote improved social and environment performance of companies through the effective use of management systems.</li> </ul>
<p><b>Performance Standard 2 – Labour and Working Conditions</b></p> <p><i>Recognises that the pursuit of economic growth through employment creation and income generation should be balanced with protection for basic rights of workers.</i></p>	<ul style="list-style-type: none"> <li>• To promote fair treatment, non-discrimination and equal opportunity of workers, and compliance with national labour and employment laws.</li> <li>• To establish, maintain and improve the worker management relationship.</li> <li>• To promote compliance with national employment and labour laws.</li> <li>• To protect the workforce by addressing child labour and forced labour.</li> <li>• To promote safe and healthy working conditions, and to protect and promote the health of workers.</li> </ul>
<p><b>Performance Standard 3 - Resource Efficiency and Pollution Prevention</b></p> <p><i>Recognises that increased industrial activity and urbanisation often generate increased levels of pollution to air, water, and land that may threaten people and the environment at the local, regional, and global level.</i></p>	<ul style="list-style-type: none"> <li>• To avoid or minimise adverse impacts on human health and the environment by avoiding or minimising pollution from project activities.</li> <li>• To promote more sustainable use of resources, including energy and water.</li> <li>• To reduce project –related GHG emissions.</li> </ul>
<p><b>Performance Standard 4 – Community Health, Safety and Security</b></p> <p><i>Recognises that project activities, equipment, and infrastructure often bring benefits to communities including employment, services, and opportunities for economic development.</i></p>	<ul style="list-style-type: none"> <li>• To anticipate and avoid adverse impacts on the health and safety of the Affected Community during the project life from both routine and non-routine circumstances.</li> <li>• To ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimises risks to the Affected Communities.</li> </ul>
<p><b>Performance Standard 5 – Land Acquisition and Involuntary Resettlement</b></p> <p><i>Outlines that involuntary resettlement refers both to physical displacement (relocation or loss of shelter) and to economic displacement (loss of assets or access to assets that leads to loss of income sources or means of livelihood) as a result of</i></p>	<ul style="list-style-type: none"> <li>• To avoid, and when avoidance is not possible, minimise displacement by exploring alternative project designs.</li> <li>• To avoid forced eviction.</li> <li>• To anticipate and avoid, or where avoidance is not possible, minimise adverse social and economic impacts from land acquisition or restrictions on land use by (i) providing compensation for loss of assets</li> </ul>

<sup>(1)</sup> IFC Performance Standards on Environmental and Social Sustainability, January 2012, International Finance Corporation, World Bank Group

Performance Standards	Objectives
<i>project-related land acquisition</i>	<ul style="list-style-type: none"> <li>at replacement cost and (ii) ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation and the informed participation of those affected.</li> <li>To improve, or restore, the livelihoods and standards of living of displaced persons.</li> <li>To improve living conditions among physically displaced persons through the provision of adequate housing with security of tenure at resettlement sites.</li> </ul>
<b>Performance Standard 6 – Biodiversity Conservation and Sustainable Management of Natural Resources</b>  <i>Recognises that protecting and conserving biodiversity – the variety of life in all its forms, including genetic, species and ecosystem diversity – and its ability to change and evolve, is fundamental to sustainable development</i>	<ul style="list-style-type: none"> <li>To protect and conserve biodiversity.</li> <li>To maintain the benefits from ecosystem services.</li> <li>To promote the sustainable management of living natural resources through the adoption of practices that integrated conservation needs and development priorities.</li> </ul>
<b>Performance Standard 7 – Indigenous Peoples</b>  <i>Recognises that Indigenous Peoples, as social groups with identities that are distinct from dominant groups in national societies, are often among the most marginalised and vulnerable segments of the population.</i>	<ul style="list-style-type: none"> <li>To ensure that the development process fosters full respect for the dignity, human rights, aspirations, cultures and natural resource-based livelihoods of Indigenous Peoples.</li> <li>To anticipate and avoid adverse impacts of projects on communities of Indigenous Peoples, or when avoidance is not feasible, to minimise, mitigate, or compensate for such impacts, and to provide opportunities for development benefits, in a culturally appropriate manner.</li> <li>To promote sustainable development benefits and opportunities for Indigenous Peoples in a culturally appropriate manner.</li> <li>To establish and maintain an ongoing relationship based on Informed Consultation and Participation (ICP) with the Indigenous Peoples affected by a project throughout the life of the project.</li> <li>To ensure the Free, Prior and Informed Consent (FPIC) of the Affected Communities of the IPs when the circumstances described in this Performance Standard are present.</li> <li>To respect and preserve the culture, knowledge and practices of Indigenous Peoples.</li> </ul>
<b>Performance Standard 8 – Cultural Heritage</b>  <i>Recognises the importance of cultural heritage for current and future generations. Consistent with the Convention Concerning the Protection of the World Cultural and Natural Heritage, this Performance Standard aims to ensure that clients protect cultural heritage in the course of their project activities.</i>	<ul style="list-style-type: none"> <li>PS 8 aims to protect the irreplaceable cultural heritage and to guide clients on protecting cultural heritage in the course of their business operations. In addition, the requirements of this PS on a project's use of cultural heritage are based in part on standards set by the Convention on Biological Diversity. PS 8 recognises the importance of cultural heritage with an objective to: <ul style="list-style-type: none"> <li>Protect cultural heritage from the adverse impacts of project activities and support its preservation; and</li> <li>Promote the equitable sharing of benefits from the use of cultural heritage in business activities.</li> </ul> </li> <li>The PS requires the project proponent to comply with relevant national law on the protection of cultural heritage, including national law implementing the host country's obligations under the Convention Concerning the Protection of the World Cultural and Natural Heritage and other relevant international law.</li> </ul>

The EHS Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs and the contents are summarised in *Table 2.3* and *Table 2.4*. *Table 2.5* presents effluent and waste guideline values for onshore oil and gas development which may be considered to be adopted by the Project.

Application of the EHS Guidelines to existing facilities may involve the establishment of site-specific targets, with an appropriate timetable for achieving them. The applicability of the EHS Guidelines should be tailored to the hazards and risks established for each project on the basis of the results of an environmental assessment in which site-specific variables, such as host country context, assimilative capacity of the environment, and other project factors, are taken into account. The applicability of specific technical recommendations should be based on the professional opinion of qualified and experienced persons.

Where different standards are prescribed by the different agencies, the most stringent of the national and international standards have been considered for the Project:

*“When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent. If less stringent levels or measures than those provided in these EHS Guidelines are appropriate, in view of specific project circumstances, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human health and the environment.”*



**Table 2.3** *IFC/World Bank General EHS Guidelines* <sup>(1)</sup>

<b>Applicable Guideline</b>
<b>General Environmental Guidelines</b>
1. Environment
1.1 Air Emissions and Ambient Air Quality
1.2 Energy Conservation
1.3 Wastewater and Ambient Water Quality
1.4 Water Conservation
1.5 Hazardous Materials Management
1.6 Waste Management
1.7 Noise
1.8 Contaminated Land
<b>General Occupational Health and Safety Guidelines</b>
2. Occupational Health and Safety
2.1 General Facility and Design and Operation
2.2 Communications and Training
2.3 Physical Hazards
2.4 Chemical Hazards
2.5 Biological Hazards
2.6 Radiological Hazards
2.7 Personal Protective Equipment (PPE)
2.8 Special Hazards Environments
2.9 Monitoring
<b>General Community Health and Safety</b>
3.1 Water Quality and Availability
3.2 Structural Safety and Project Infrastructure
3.3 Life and Fire Safety (L&FS)
3.4 Traffic Safety
3.5 Transport of Hazardous Materials
3.6 Disease Prevention
3.7 Emergency Preparedness and Response
<b>General Construction and Demolition Guidelines</b>
4.1 Environment
4.2 Occupational Health and Safety
4.3 Community Health and Safety

<sup>(1)</sup> Environmental, Health and Safety (EHS) Guidelines – General EHS Guidelines: Introduction, April 2007, International Finance Corporation, World Bank Group.

**Table 2.4** *IFC/World Bank EHS Guidelines for Onshore Oil and Gas Development* <sup>(1)</sup>

<b>Applicable Guideline</b>	
<b>1.0</b>	<b>Industry-Specific Impacts and Management</b>
<b>1.1</b>	<b>Environment</b>
	<ul style="list-style-type: none"> <li>- Air Emissions</li> <li>- Wastewaters</li> <li>- Waste Management</li> <li>- Hazardous Materials Management</li> <li>- Noise</li> <li>- Terrestrial Impacts and Project Footprint</li> <li>- Spills</li> <li>- Decommissioning-</li> </ul>
<b>1.2</b>	<b>Occupational Health and Safety (OH&amp;S)</b>
	<ul style="list-style-type: none"> <li>- Fire and Explosion</li> <li>- Air Quality</li> <li>- Hazardous Materials</li> <li>- Transportation</li> <li>- Well Blowouts</li> <li>- Emergency Preparedness and Response-</li> </ul>
<b>1.3</b>	<b>Community Health and Safety</b>
	<ul style="list-style-type: none"> <li>- Physical Hazards</li> <li>- Hydrogen Sulfide</li> <li>- Security</li> </ul>
<b>2.0</b>	<b>Performance Indicators and Monitoring</b>
<b>2.1</b>	<b>Environment</b>
	<ul style="list-style-type: none"> <li>- Emission and Effluent Guidelines</li> <li>- Environmental Monitoring</li> </ul>
<b>2.2</b>	<b>Occupational Health and Safety (OH&amp;S)</b>
	<ul style="list-style-type: none"> <li>- OH&amp;S Guidelines</li> <li>- Accident and Fatality Rates</li> <li>- OH&amp;S Monitoring</li> </ul>

<sup>(1)</sup> Environmental, Health and Safety Guidelines for Onshore Oil and Gas Development, April 2007, International Finance Corporation, World Bank Group.

**Table 2.5 Effluent and Waste Guideline Values for Onshore Oil and Gas Development**

Parameter	Guideline Value
Produced Water	For discharge to surface waters or to land: <ul style="list-style-type: none"> <li>• Total hydrocarbon content: 10 mg/L</li> <li>• pH: 6 - 9</li> <li>• BOD: 25 mg/L</li> <li>• COD: 125 mg/L</li> <li>• TSS: 35 mg/L</li> <li>• Phenols: 0.5 mg/L</li> <li>• Sulfides: 1 mg/L</li> <li>• Heavy metals (total) <sup>a</sup>: 5 mg/L</li> <li>• Chlorides: 600 mg/l (average), 1200 mg/L (maximum)</li> </ul>
Hydrotest water	For discharge to surface waters or to land, see parameters for produced water above.
Completion and well work- over fluids	For discharge to surface waters or to land: <ul style="list-style-type: none"> <li>• Total hydrocarbon content: 10 mg/L.</li> <li>• pH: 6 - 9</li> </ul>
Stormwater drainage	Stormwater runoff should be treated through an oil/water separation system able to achieve oil & grease concentration of 10 mg/L.
Cooling water	The effluent should result in a temperature increase of no more than 3°C at edge of the zone where initial mixing and dilution take place. Where the zone is not defined, use 100 m from point of discharge.
Sewage	Treatment as per guidance in the General EHS Guidelines, including discharge requirements.
Air Emissions	Emission concentrations as per General EHS Guidelines, and: <ul style="list-style-type: none"> <li>• H<sub>2</sub>S: 5 mg/Nm<sup>3</sup></li> </ul>
Notes:	
a Heavy metals include: Arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, vanadium, and zinc.	

### 2.4.3 International Conventions

Myanmar as a State Party has signed and ratified various international conventions, laws and treaties which are now an obligation for the nation. The related environmental and social conventions are listed below.

#### *Environmental Conventions*

##### The United Nations Convention on Biodiversity 1992

This Convention seeks to conserve biodiversity and promote its sustainable use. It requires the identification and monitoring of the biodiversity in an area and adopting the necessary conservation measure. Myanmar became party to this Convention in 1994.

##### The Basel Convention 1989

This was developed under the auspices of the United Nations Environmental Programme (UNEP) in response to the growing worldwide awareness of the problem of international traffic in hazardous waste. The *Basel Convention 1989* is the first and foremost global environmental treaty that strictly

regulates the trans-boundary movement of hazardous wastes. It obligates parties to ensure environmentally sound management, especially during the disposal process.

The objectives of the Convention are to:

- Ensure that waste is disposed of as near as possible to the place or source of its generation;
- Reduce trans-boundary waste and where it cannot be avoided, to be disposed of in an environmentally sound and efficient manner; and
- Provide assistance to developing countries in the management of hazardous waste and the generation.

#### *Labour and Human Rights Conventions*

Myanmar as a State party has signed and ratified various international conventions, laws and treaties which are now an obligation for the nation. Below mentioned labour conventions provide a comprehensive framework to fight injustice with the blue collar workforce through preventive measures, law enforcement and international cooperation. Also by agreeing to the land and agriculture related conventions the country is promising its people of their right on the land and to practice agriculture on it.

**Table 2.6** *Labour, Land and Human Rights Conventions*

Convention Type	Name of the Convention	Dated
Labour Conventions	Hours of Work (Industry) Convention, 1919	14 Jul 1921
	Unemployment Convention, 1919	14 Jul 1921
	Night Work of Young Persons (Industry) Convention, 1919	14 Jul 1921
	Right of Association (Agriculture) Convention, 1921	11 May 1923
	Weekly Rest (Industry) Convention, 1921	11 May 1923
	Minimum Age (Trimmers and Stokers) Convention, 1921	20 Nov 1922
	Medical Examination of Young Persons (Sea) Convention, 1921	20 Nov 1922
	Workmen's Compensation (Accidents) Convention, 1925	16 Feb 1956
	Workmen's Compensation (Occupational Diseases) Convention, 1925	30 Sep 1927
	Equality of Treatment (Accident Compensation) Convention, 1925	30 Sep 1927
	Inspection of Emigrants Convention, 1926	14 Jan 1928
	Seamen's Articles of Agreement Convention, 1926	31 Oct 1932
	Minimum Wage-Fixing Machinery Convention, 1928	21 May 1954
	Marking of Weight (Packages Transported by Vessels) Convention, 1929	07 Sep 1931
	Workmen's Compensation (Occupational Diseases) Convention (Revised), 1934	17 May 1957
	Holidays with Pay Convention, 1936	21 May 1954
	Convention concerning Statistics of Wages and Hours of Work, 1938 Excluding Parts III and IV	24 Nov 1961
	the New York Convention on the Recognition and Enforcement of Foreign Arbitral Awards	15 <sup>th</sup> July 2013
	Forced Labour Convention, 1930	04 Mar 1955

Convention Type	Name of the Convention	Dated
	Freedom of Association and Protection of the Right to Organise Convention, 1948	04 Mar 1955
Land and Agriculture Conventions	Constitution of the Food and Agriculture Organization	
	Agreement on Agriculture	
	Agreement establishing the International Fund for Agricultural Development	
Human rights Treaties	Convention on the Elimination of All Forms of Discrimination against Women	22 July 1997
	United Nations Convention against Transnational Organized Crime	30 March 2004
	Protocol to Prevent, Suppress and Punish Trafficking in Persons, Especially Women and Children, supplementing the United Nations Convention against Transnational Organized Crime Preamble, supplementing the United Nations Convention against Transnational Organized Crime	30 March 2004
	Protocol against the Smuggling of Migrants by Land, Sea and Air, supplementing the United Nations Convention against Transnational Organized Crime	30 March 2004
	Convention for the Suppression of the Traffic in Persons and of the Exploitation of the Prostitution of Others	14 Mar 1956
	Convention on the Rights of the Child	15 Jul 1991
	Freedom of Association and Protection of the Right to Organise Convention	4 Mar 1955
	Convention concerning Forced or Compulsory Labour	4 Mar 1955
	Convention on the Prevention and Punishment of the Crime of Genocide	14 Mar 1956
	Geneva Convention for the Amelioration of the Condition of the Wounded and Sick in Armed Forces in the Field	25 Aug 1992
	Geneva Convention for the Amelioration of the Condition of Wounded, Sick and Shipwrecked Members of Armed Forces at Sea	25 Aug 1992
	Geneva Convention relative to the Treatment of Prisoners of War	25 Aug 1992
	International Convention for the Suppression of Terrorist Bombing	12 Nov 2001
	International Convention for the Suppression of the Financing of Terrorism	12 Nov 2001
	International Convention for the Suppression of Unlawful Seizure of Aircraft	22 May 1996
	Convention on the Privileges and Immunities of the United Nations	25 Jan 1955

The significance of confirming to the international criminal court is an essential step taken by the country towards universal justice. In a way it has signed in to ensure that no ruler, State or army is an exception to abuse human rights with impunity. Binding to this humanitarian law prohibits Myanmar from torture and other forms of ill treatment to anyone living in the country. The legal principles within the definition of torture have been recognized in previous international treaties, including Geneva Convention. It is mandatory to adopt necessary and corresponding national legislations in conformity with this treaty for Myanmar as a signatory.

This section provides the detailed descriptions of the proposed onshore seismic survey and well workover activities to be conducted across Block IOR-4. Information provided in this section is based on those made available during preparation of this ESIA Report.

### **3.1 PROJECT BACKGROUND**

The existing oil fields within Block IOR 4, Pyay North and Pyay South, are known to be depleted at least from the perspective of primary recovery. Forty-eight (48) wells have been drilled on Pyay North whilst Pyay South included 125 wells. The oil-in-place is estimated by MOGE at 50 MMbbls, of which about 12.75 MMbbls have been produced. The field also includes gas caps over oil rims grading deeper to gas pools with total gas in place estimated to be 170 Bcf, 117 of which has been produced. There appears to be a deeper gas potential discovered in 2006 and estimated at about 400 Bcf, of which a couple of Bcf only has been produced. Having peaked at some 2,435 bopd in 1970, only 16 wells are now producing +/- 102 bopd. No secondary recovery is known to have been performed in the field. The pressure regime is depleted in the oil-bearing reservoirs and increases gradually to overpressures in the deeper gas sands. The salinity of the formation waters is unknown.

Under the IPR Contract, MPRL E&P will be undertaking activities to develop appropriate field redevelopment plans consisting of pilot programmes that will include enhanced oil recovery, production acceleration and further exploration drilling activities. In order to inform the field redevelopment plan, it is necessary to undertake seismic surveys within the block to acquire data on the damaged reservoir zone as well as for evaluating the feasibility of restoring reservoir pressure. In addition, well workover activities are required to improve oil production of existing wells within the block.

### **3.2 PROJECT DESCRIPTION OF SEISMIC SURVEY**

#### **3.2.1 Proposed Location**

Block IOR-4 is located in Central Myanmar in the Bago Region, some 250 km north northwest of Yangon. The Block covers an area of 381 km<sup>2</sup> and includes two oil fields, Pyay North and Pyay South. Both fields were discovered in 1965 by MOGE. The Block location is presented in *Figure 1.1* with coordinates detailed in *Table 3.1* below. The indicative proposed 3D seismic area, which covers an area of 210 km<sup>2</sup>, is illustrated in *Figure 3.1*.



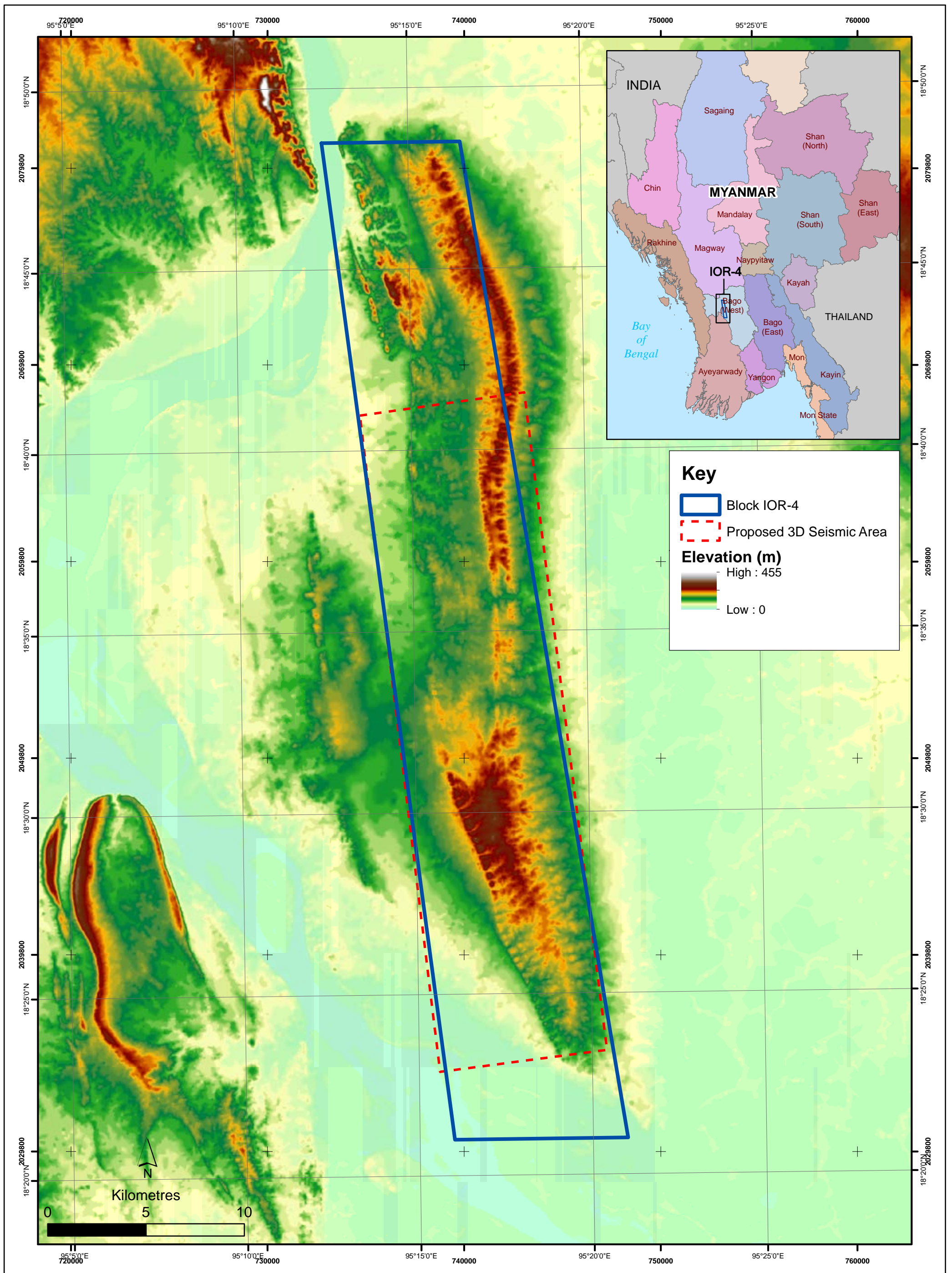


Figure 3.1

## Indicative Proposed Seismic Survey Area of Block IOR-4

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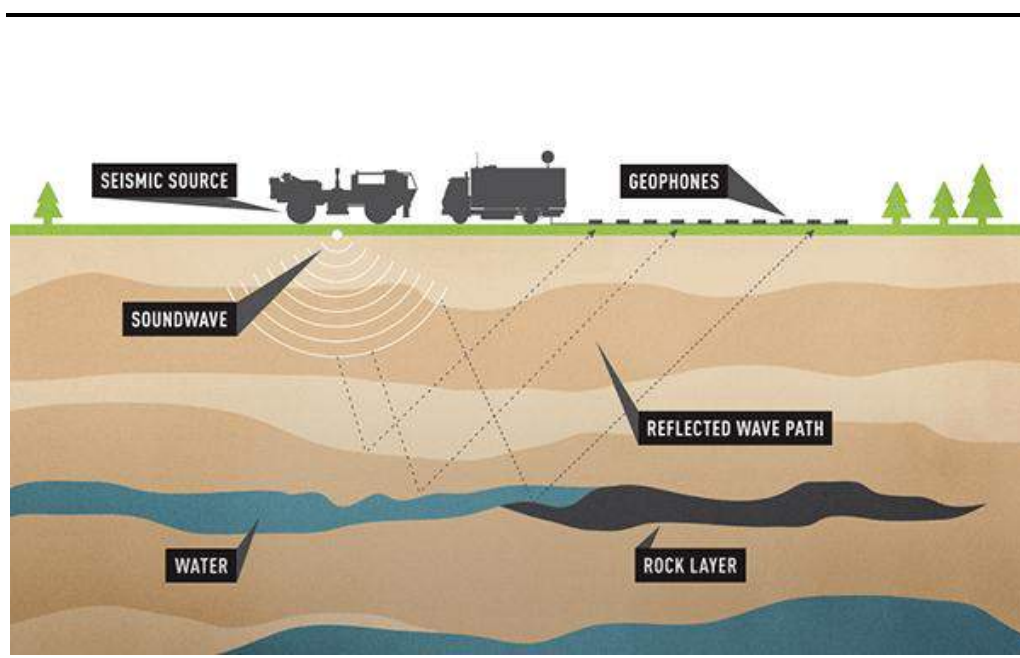
**Table 3.1**      **Block IOR-4 Coordinates**

Point	Latitude	Longitude
A	18° 48' 30'	95° 12' 30'
B	18° 48' 30'	95° 16' 30'
C	18° 21' 0'	95° 21' 00'
D	18° 21' 0'	95°16'00"

### 3.2.2      *General Introduction of Seismic Survey*

The seismic survey method uses high intensity, low frequency sound waves which are directed through layers of rock below the ground surface and reflected at boundaries between geological layers with different physical and chemical properties. The reflected sound waves can be processed to provide information about the structure and composition of geological formations below the surface. This is the basis for the use of high intensity seismic signals to identify prospects for hydrocarbon reservoirs, as well as any shallow drilling hazards. The schematic of the seismic survey network is presented in *Figure 3.2*.

**Figure 3.2**      ***Schematic of Onshore Seismic Surveys***



Seismic surveys are relatively intensive operations utilising large teams of personnel and a number of different machinery and equipment. Whilst being an intensive operation, seismic operations are a well understood practice used the world over and have been demonstrated to have minimal impacts on the surrounding environment and community.

Seismic surveys can typically be divided into the following phases:

- Land accessibility phase;



- Preparation / mobilisation phase;
- Seismic survey phase; and
- Close-out phase.

### 3.2.3 *Programme of the Seismic Survey*

The programme of the proposed seismic survey is presented in *Figure 3.3*. While no land accessibility phase is expected as presented in *Section 3.2.4* below, it is expected that activities associated with the seismic survey will commence in the 1<sup>st</sup> quarter of 2016 for the preparation / mobilisation phase and be completed in the 4<sup>th</sup> quarter of 2016 for the close-out phase.

### 3.2.4 *Land Accessibility Phase*

During the land accessibility phase, ownership of land and properties that fall within the seismic lines will be determined. Appropriate engagement and procedures to obtain permission and notify owners to access land to conduct the survey will be performed. However, it is understood that no land acquisition is planned as all sites required by MPRL E&P will be in areas already occupied by MOGE. The current land uses of those areas are being categorised as vacant land, farming areas and forest areas.

### 3.2.5 *Preparation / Mobilisation Phase*

Preparation and mobilisation generally involves the construction of associated facilities and determination and development of access tracks for equipment, resources and workforce.

According to the preliminary programme, the camp set up will be undertaken in the first quarter of 2016 for the proposed seismic survey in Block IOR-4. Initial information indicates that the proposed camp location of approximately 4,700 m<sup>2</sup> will be located adjacent to the existing GOCS-4 facility (*Figure 3.4*). The camp is expected to have rooms for 120 people with waste, toilet and kitchen facilities. A section of ~455 m of the Yangon-Pyay Road will need to be improved for access to the camp and it is assumed that appropriate drainage facilities will be constructed for the improved road section. It is expected that the camp will be connected to existing power and water lines and a 175 kVA generator will also be available. Materials to be used for the site preparation and road construction (i.e. gravel, shale, sand, cement, wood etc.) are likely to be sourced via local suppliers from the Shwe Taung Township and Pyay Township.

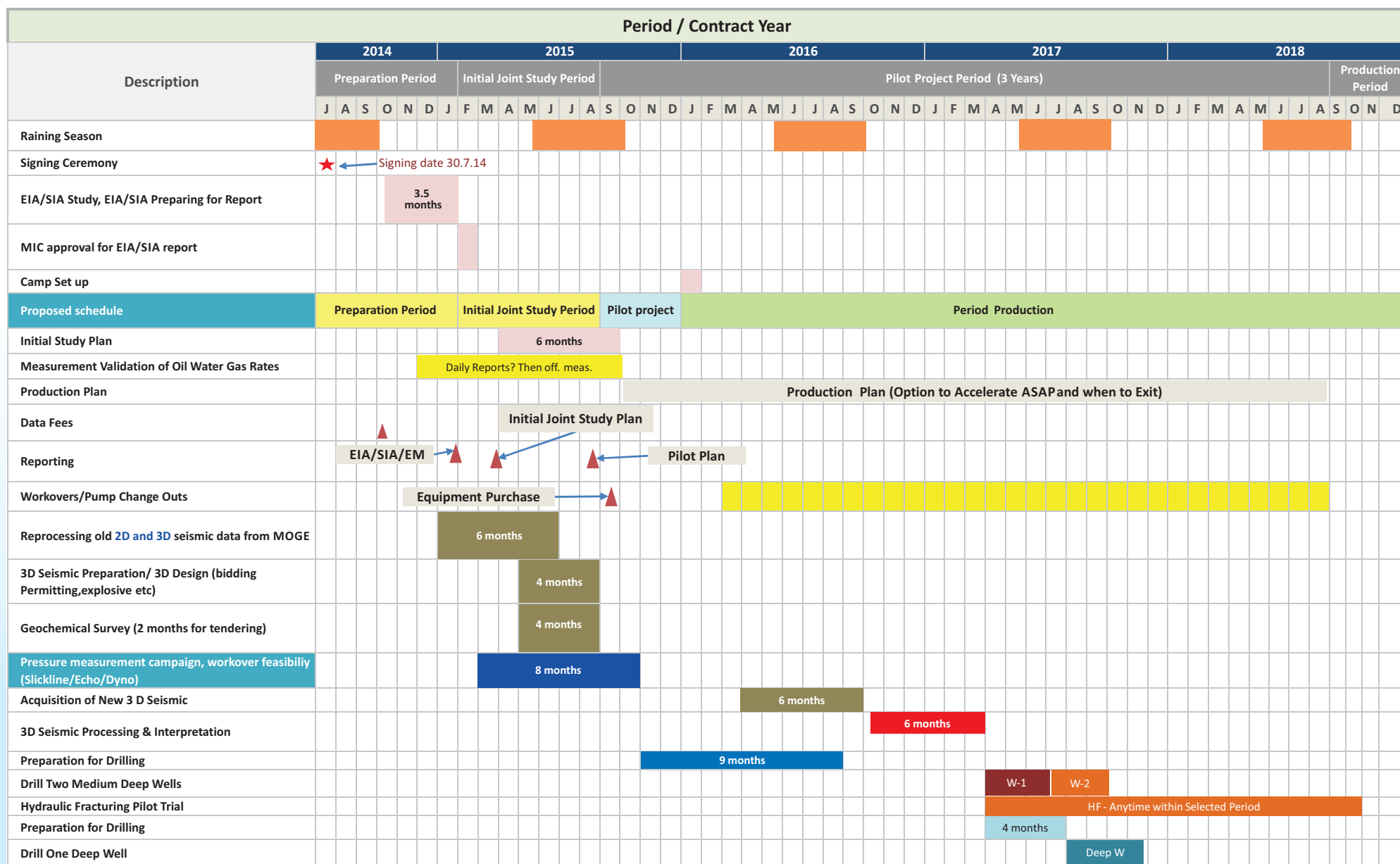


Figure 3.3

Overall Work Programme for Block IOR 4

**Figure 3.4**      *Locations of the Proposed Camp Site*



### **3.2.6**      *Seismic Survey Phase*

The seismic survey is planned to be undertaken in the second-third quarter of year 2016 for a period of about 180 days. It may cover up to the whole block, acquiring indicatively a total of about 210 km<sup>2</sup> (fullfold) 3D seismic survey lines in approximately 30 km (North-South) x 7 km (East-West) grid as shown in *Figure 3.1*.

During the seismic survey phase, vegetation clearance and creation of access routes will be an on-going activity for placement of seismic sources and sensors. Existing access road / tracks will be used as far as possible. In case new road / track are needed, they will be designed and constructed with appropriate drainage facilities to avoid soil erosion.

#### *Seismic and Acoustic Sources*

Given the hilly nature of the seismic area within Block IOR-4, explosive seismic charges will be used as the acoustic source of the survey. The charge will be set off just below the ground surface to generate sound waves which are bounced off underground rock formations and the waves that reflected back to the surface are captured by recording sensors for later analysis. Generally, drilling will be undertaken for the placement of dynamite inside the shot holes along the seismic lines. Shot holes, typically 9-10 m deep and 6-10 cm in diameter, will be drilled using surface water with man portable drills or vehicular mounted drills depending on the type of access available within the seismic area.

Layout parameters of the proposed seismic survey for Block IOR-4 are presented in *Figure 3.5*. For the current survey, there will be a total of 15 source lines within the seismic survey area, each of which measures 30 km in

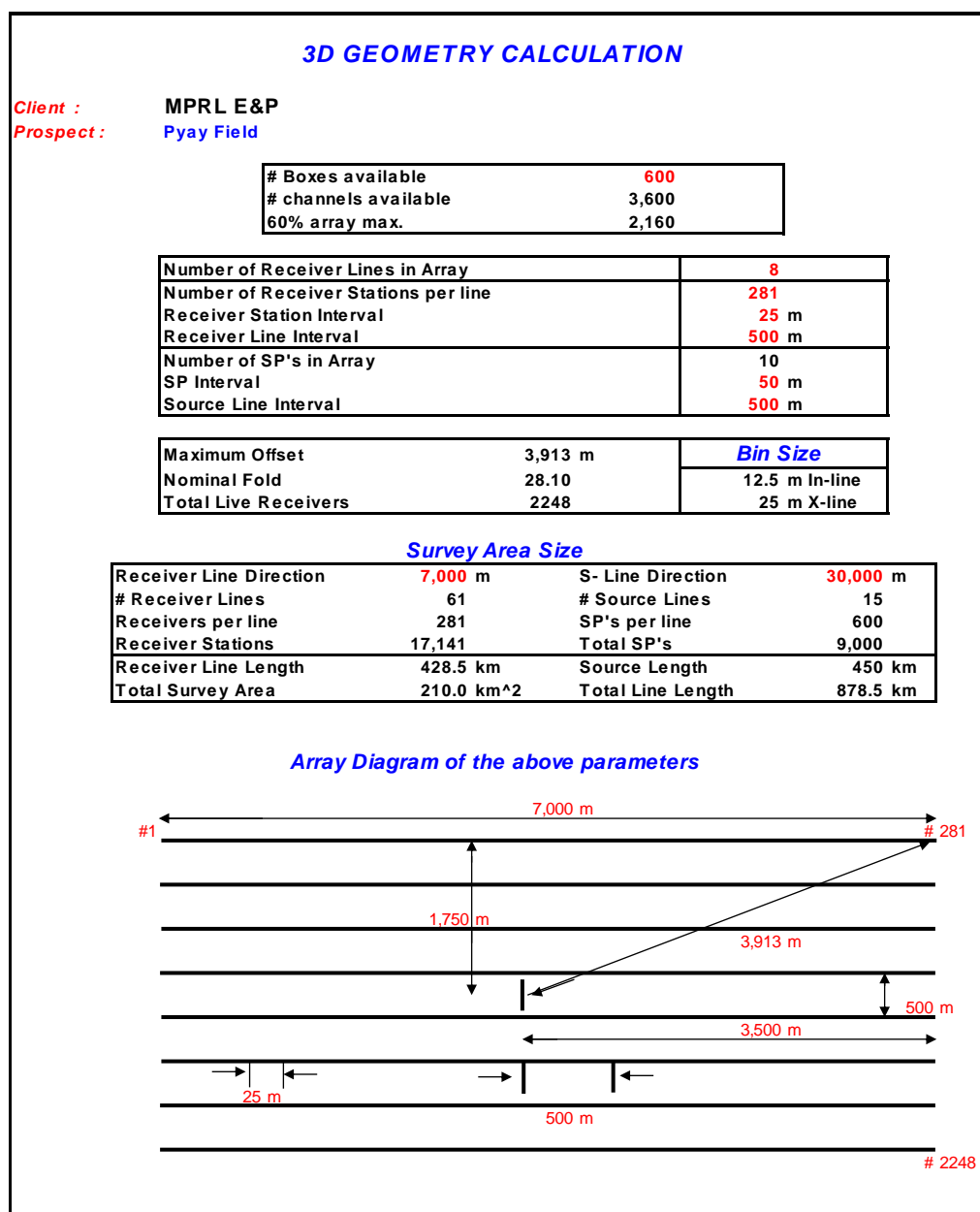
length. The total length of the source lines will thus be 450 km. The distance between adjacent source lines will be 500 m. There will be a total of 9,000 shot points (SPs) on the source lines, with 600 SPs on each of the 15 sources lines. The interval between adjacent SPs will be 50 m.

#### *Seismic Sensors and Processing*

Seismic processing requires the use of seismic sensors to acquire the data generated by the acoustic source. Generally seismic surveys use vector sensors, most notable using Geophones. These sensors are used to record compressional and shear seismic data onshore. This can be used to interpret seismic information including magnitude, force, time, velocity and direction. As geophones are directional sensors and can distinguish between vertical and horizontal earth motions, they are used to record multicomponent seismic data<sup>(1)</sup>. A range of geophones and receiver lines will be deployed in an array along the seismic line in order to receive the seismic data. Sensors need to be planted to ensure good coupling with the earth, typical layout is for 6-12 geophones in a straight line (every 25-30 m). For the current survey, it is preferred to use wireless Geophone but conventional cable systems may also be used depending on the surface area restriction. The Geophone will be placed at receiver stations. A total of 17,141 receiver stations are planned for the current seismic survey. These receiver stations will be distributed along 61 receiver lines, with 281 stations on each line. The distance between adjacent receiver stations will be 25 m. Each receiver line will be ~7 km long and the separation distance will be 500 m between adjacent lines. The total length of the receiver lines is 428.5 km. Layout parameters of the proposed seismic survey for Block IOR-4 are presented in *Figure 3.5*.

(1) [http://petrowiki.org/Seismic\\_data\\_acquisition\\_equipment](http://petrowiki.org/Seismic_data_acquisition_equipment), accessed 20 October 2014

Figure 3.5 Layout Parameters of the Seismic Surveys for Block IOR-4



#### Labour and Accommodation Requirements

The Project will involve a total of 20 people initially and up to a maximum of 400 people during the seismic surveys. The ratio of skilled to unskilled labour is expected to be 1:5 to 1:10, and will be higher when seismic crew is in place. Labour is planning to be hired from local townships for routine work. The seismic crew will be housed in the camp. Water supply will be from existing tube wells while power supply will be from 11 kva power line.

Camp doctor will be available to handle minor injuries / incidents. Serious incidents and injuries will be handled at Pyay Hospital.

### *Materials, Supplies & Logistics*

Materials to be used for the site preparation and road construction (i.e. gravel, shale, sand, cement, wood etc.) are likely to be sourced via local suppliers from the Shwe Taung Township and Pyay Township.

It is expected that high speed diesel of ~250-300 gallons per day will be used during the seismic survey. The fuel will be stored temporarily at MOGE storage area or in a new fuel station to be built for the Project. Fuel may also be obtained from local townships.

For munitions bunkers, they will be in existing military barracks or a new one will be built within the military compound.

For transportation, existing roads and tracks will be used where possible in addition to temporary to semi-permanent roads paved by laterite/gravel. New roads / tracks may be built and it is expected that these roads / tracks will have appropriate drainage. Transportation of labour will mainly use trucks, buses or cars. The existing Yangon Airport will be used to supply the Project. For river transport, the existing facility at Na Ma Yan Foreshore near the Pyay Bridge will be used (*Figure 3.6*).

**Figure 3.6**      *Photo of Existing Facility at Na Ma Yan Foreshore for River Transport*



### **3.2.7**      *Close-Out Phase*

During the close-out phase, the demand for labour, equipment and services will decrease and eventually cease when the seismic survey is completed.

Informed decision-making for reinstatement of terrestrial habitat is highly dependent on the findings and recommendations from the ESIA Study. For

cultivated land, it is expected that rehabilitation will be performed by the farmer / land owner with the crop compensation.

Transportation of equipment, materials, waste and workforce out of the survey area will take place during the close-out phase. A traffic management plan will be developed to minimise the impact associated with road traffic.

### 3.2.8 *Project Alternatives for Seismic Survey*

Consideration of Project options and alternatives is a fundamental requirement in the planning of any project as a means of avoiding or reducing adverse environmental and social impacts and maximising or enhancing project benefits. Several options that have been / are considering for the Project include the following:

- Access requirements: existing roads and tracks will be used as far as practicable to avoid the need to construct new facilities which would lead to a larger environmental footprint of the Project;
- Siting of facilities: existing facilities will be used as far as practicable to avoid unnecessary construction of new facilities and hence disturbance to the environmental and social sensitive receptors. For example, munitions bunkers in existing military barracks will be used. Should a new one be required, it will be built within the military compound which is an already developed area.
- Types of drilling fluid for drilling of shot holes: surface water will be used to reduce the volume and level of contamination in drilling wastes, when compared to the options of using synthetic or oil-based fluid;
- Types of drill: man portable drills with less environmental impacts will be used as far as possible instead of vehicular mounted drills depending on the type of access available within the seismic area; and
- Geophone system: it is preferred to use wireless Geophone which reduce the requirements for receiver line laying, and hence less disturbance to the environment. However, conventional cable systems may also be used depending on the surface area restriction.

Many of these options are of relevance to the assessment of potential impacts. Therefore, as the project options will not be finalised until the tendering process has been completed the relative impacts of each option will be considered where possible in the impact assessment. Where this is not possible a conservative approach will be taken to undertake the subsequent impact assessment as outlined in further in *Section 5*.

### 3.3 *PROJECT DESCRIPTION OF WORKOVER ACTIVITIES*

#### 3.3.1 *Workovers Location*

Workover activities will be undertaken at existing wells within Block IOR-4. These include producing, temporarily suspended, abandoned or water injection / disposal wells. During the preparation of this ESIA Report, the wells where workover activities will be undertaken were as yet not selected.

The locations of all 181 wells within Block IOR-4 are shown in *Figure 3.7*.

#### 3.3.2 *Workovers Activities and Programme*

When a well has been completed and has produced for some time, it must be monitored, maintained and also mechanically altered in response to changing conditions. When a well has been temporarily abandoned, well workovers may also be carried out to reopen them to restart production. Well workovers, or interventions, are typically performed by inserting tools in wellbores to conduct remedial actions for the purpose of restoring, prolonging or enhancing the production of hydrocarbons. Routine maintenance of the well is not being considered as part of the workover activities.

The following workovers activities will be undertaken for the selected wells within Block IOR-4:

- Well Deepening;
- Pump servicing;
- Swabbing and bailing;
- Zone isolation;
- Re-perforations; and,
- Improvement of wellheads

As a pre-requisite for carrying out the workover activities, there will be a requirement to access the wells using drilling equipment. For wells that are temporarily suspended, drilling will include removal of the cement plug on the well with debris removed by scrapping and bailing. On penetration of the well, first operation will include pressure testing and temperature measurements. As the drill passes down the well, risk will include drilling through corroded casings into new formations. Drilling will require use and disposal of cuttings and drilling fluids.

The above activities are scheduled to be undertaken from October 2015 to October 2018. Brief descriptions of the above activities are provided in the following sections. It should be noted that details on plant inventory and plant programme are not available during the preparation of this ESIA Report and thus not presented below.



### *Deepening*

The primary objective of well deepening is to explore opportunity of producing additional oil at deeper depth from the existing wells. The following procedures will generally be adopted for well deepening:

1. Pressure test to all squeezed zones until the test results sound.
2. Drill cement collar and deepen the well to a certain depth below shoe with water based mud (WMB) and then KCL polymer mud. WBM will be recycled as far as possible for the deepening of another well.
3. After reaching objective depth, wireline logging will be conducted and subsequently slotted liner will be set for production testing.

Typical environmental issues related to well deepening include the use, disposal and potential accidental spillage of drilling and waste fluids from the deepening operations.

### *Pump Servicing*

Pump servicing should be conducted when the fluid level is high and the production is not satisfactory. The servicing will be undertaken by well serving truck and will include pumping checking, replacement and cleaning in order to achieve for higher production levels. It is expected that the serviced pump will be quieter. However, pump servicing may lead to the generation of paraffin from the well which will require to be disposed of properly.

### *Swabbing and Bailing*

If the fluid level is found low and the well is producing less or not producing oil, swabbing and bailing will be considered to be undertaken to enhance oil production. Well servicing truck will be used for the swabbing and bailing operations.

Swabbing creates a path for the oil to travel into a production zone. It can clean the perforations and induce the formation fluid come into the hole. The swabbing tool assembly comprises a swab mandrel with a swab cup that extends off the mandrel. The swab mandrel is a steel rod that allow for a quick, easy movement of the swab cup out of the hole. This creates the vacuum that brings the well into production. Before swabbing, scraper will be used to remove scale, mud cake, cement sheath, embedded bullets and other foreign material from the inside of the casing wall to avoid blockage of the swab cup.

For bailing, bailer will be used to remove formation sand/rock and other such debris left over from the well in order to improve production.

Potential hazard associated with swabbing and bailing include the loss of well control during the operations.

#### *Zone Isolation*

Zone isolation will be undertaken for selected wells using production packers, service packers and bridge plug. Production packers are those that remain in the well during well production while service packers are used temporarily during well service activities such as cement squeezing, acidizing, fracturing and well testing. In wells with multiple reservoir zones, packers are used to isolate the perforations for each zone and isolate or temporarily abandon producing zones.

#### *Re-perforations*

Re-perforations is undertaken for better control of the well. Re-perforation creates a channel between the pay zone and the wellbore, causing oil and gas to flow to the wellbore easily. Before re-perforations are conducted, scrapping, bailing, and if necessary drilling, will be undertaken first to remove debris at the desired depth. During re-perforations, casing guns and charges will be used at the desired depth to create the perforations.

#### *Improvement of Wellheads*

Existing well heads will be improved via the following activities:

- The dug earth holes around the wellheads will be replaced by new cemented cellars in which leakage of oil to soil would be reduced;
- Tie backs to surface to provide additional pressure integrity;
- Checking tubing/casing strings for leaks and cementing as required to isolate oil leakage from the existing well;
- Fixing wellhead leaks; and
- General housekeeping around the wellheads.

It is expected that the above activities would be beneficial to the environment by reducing the potential of leakage as well as improving the general environment around the wellheads.

### **3.3.3**

#### ***Waste Generation from Workover Activities***

The type and amount of wastes that may be generated from the workover activities are estimated based on specific data available for similar operations at the Mann Oil Field and also general understanding of typical onshore oil and gas operations. The information is presented in *Table 3.2* below.

It is expected that a Waste Management Plan will be designed and implemented for Block IOR-4 to describe the appropriate means of managing

the predicted waste streams in order to alleviate impacts to the environmental and social sensitive receptors.

**Table 3.2** *Expected Waste Inventory for Workover Activities*

Waste Type	Source	Amount
Food Waste	Camp	20 L / day
Paper Waste (dry waste)	Camp	120 Kg / week
General Waste ( leave , grass)	Workshop & GOCSs	150 Kg / week
Used Lubricating Oil	Vehicle	1 bbl / month
Rags	Petroleum equipment cleaning	1 bbl / for one processing
Oil and Grease Contaminated Waste	GOCS	1 bbl / month
Oily Waste water	Drainage from locations of steaming & cleaning of petroleum equipment	3 bbl / one processing.
Black Water	Camp (toilet)	n.a.
Grey Water	Camp (kitchen, toilet)	n.a.
Workover Fluids which may contain weighted brines, acids, methanol and glycols, and other chemical systems.	Workover wells	n.a.
Drilling Mud ( 3.5 % KCl )	Well deepening	300 bbl / every well deepening
Sludge (formation sand/clay)	GOCS	10 m <sup>3</sup> / month

### 3.3.4 *Project Alternatives for Workover Activities*

Several options that have been / are considering for the workover activities include the following:

- Types of drilling fluid: WMB and KCL polymer mud will be used for the drilling operations to reduce the volume and level of contamination in drilling wastes, when compared to the option of using oil-based fluid; and
- Handling of used drilling fluids: WBM will be recycled, but not disposed of, as far as possible for the deepening of well to reduce the amount of water consumption and waste generation.

As for alternative options of seismic survey, the relative impacts of each option will be considered where possible as the option selected is yet to be finalised. Where this is not possible a conservative approach will be taken to undertaking the subsequent impact assessment as outlined in further in *Section 5*.

This section provides information on the bio-physical and social baseline characteristics and conditions in the Project Area. The discussion is limited to the factors and environmental and social components that could have a direct impact on the Project, or which may be impacted by the Project. The baseline is presented as follows:

- Physical Environment;
- Biological Environment; and
- Socio-economic Environment.

#### **4.1** *SETTING THE STUDY LIMITS*

For the purposes of defining the Project Area, environmental and social components within the entire Block IOR-4, where the proposed seismic survey and workover activities will be carried out, have been considered as appropriate. Other environmental and social resources / components located further away from the block have also been described where relevant to this ESIA.

#### **4.2** *OBJECTIVES AND METHODOLOGY*

The objectives of the baseline review and data collection are as follows:

- To characterise the baseline environmental and social components of the Project Area which may potentially be affected by the Project activities;
- To provide baseline information for the assessment of potential impacts from the Project to the environmental and social components of the Project Area; and
- To provide baseline data before commencement of the Project which may be used for future monitoring of the Project impacts by comparing the baseline data within the impact monitoring (i.e. obtained during Project implementation) and post-project monitoring data (i.e. obtained after Project completion).

The information presented has been obtained through desktop research on secondary information and primary data collection through baseline field surveys, interviews and focus group discussions. Baseline field surveys were conducted in December 2014 (dry season) within Block IOR-4. Detailed methodologies of the baseline field surveys are presented in the relevant sections under which the baseline findings are discussed.

The information provided in this section is based on a desktop review of published information, supplemented with information collected from and provided by various stakeholders consulted as part of the Project, and through review of available MPRL E&P, ERM and REM in-house literature. It is important to note that literature on the physical and biological environment of Myanmar are both limited spatially and temporally, and are arguably outdated in many areas / disciplines.

#### 4.3.1 *Physical Environment*

##### *Project Site Setting*

Block IOR-4 covers an area of 381 km<sup>2</sup>. Within the Block, there are a total of 16 producing wells, 8 temporarily shut wells and 157 permanently shut wells. Locations of these existing wells and GOCS (Gas and Oil Collecting Station) are shown in *Figure 3.7*. Photo of one of the existing GOCSs is shown in *Figure 4.1*. According to the latest available information, the daily production rate from the block is currently 95 barrels. Produced water is generated from the GOCSs and well sites and the volumes are estimated to be 2,500 bwpd and 150 bwpd, respectively. The produced water is temporary stored in concrete cellular and then treated in the produced water treatment system to remove slug, oil and other contaminants (e.g. heavy metals, suspended solids, salinity).

Details of current well production are summarized in *Table 4.1* below.

**Table 4.1** *Well Production in IOR 4 (Pyay Field)*

Parameters	Quantity
Producing Well	16
Temporarily Shut Well	8
Permanently Shut Well	157
Daily Production Rate	95 barrels

Apart from existing oil and gas operations, current land uses included cultivated land, forest and vacant land.



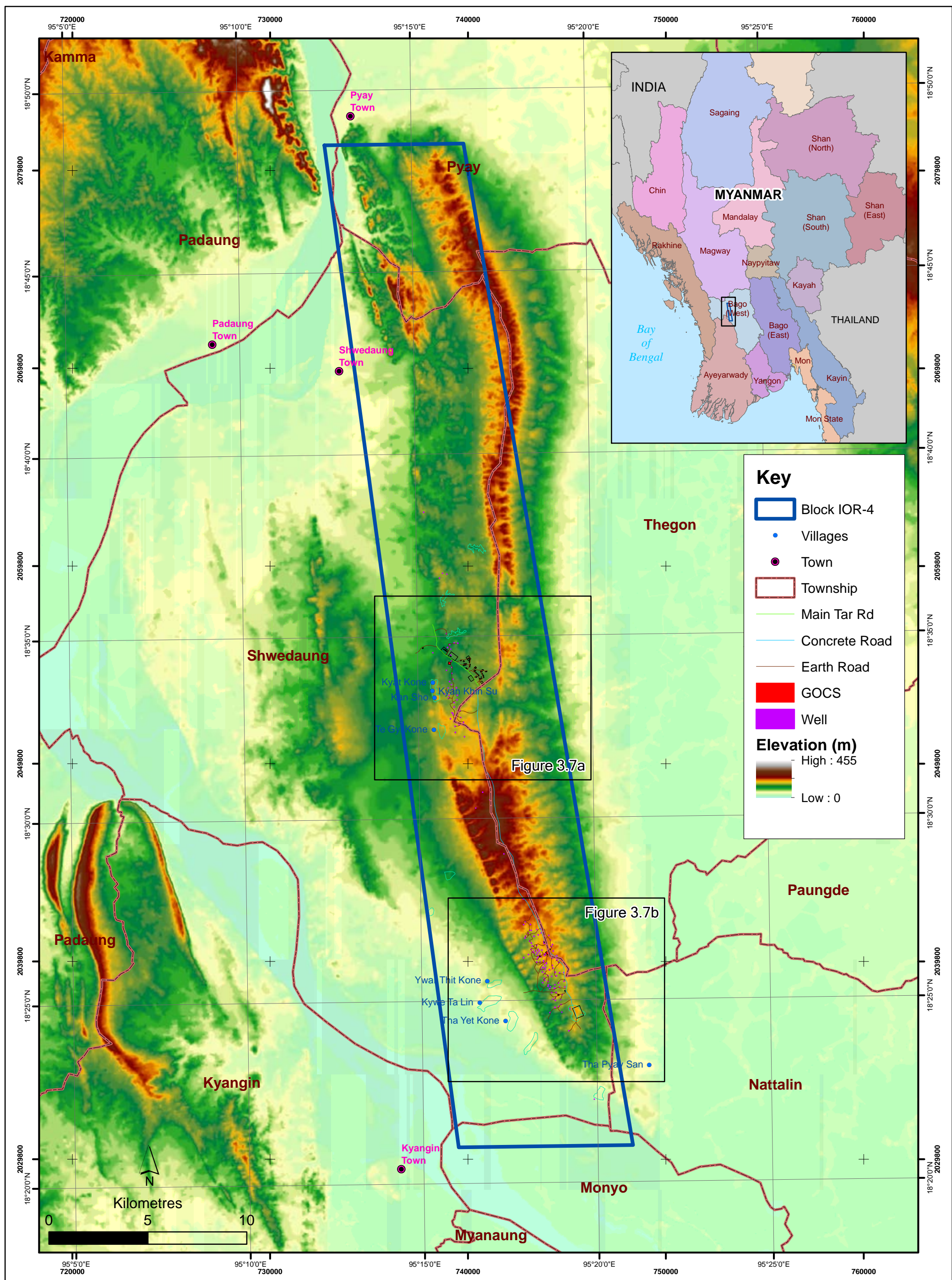
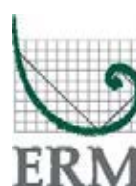


Figure 3.7

## Locations of Wells and GOCS within Block IOR-4 (Key Plan)

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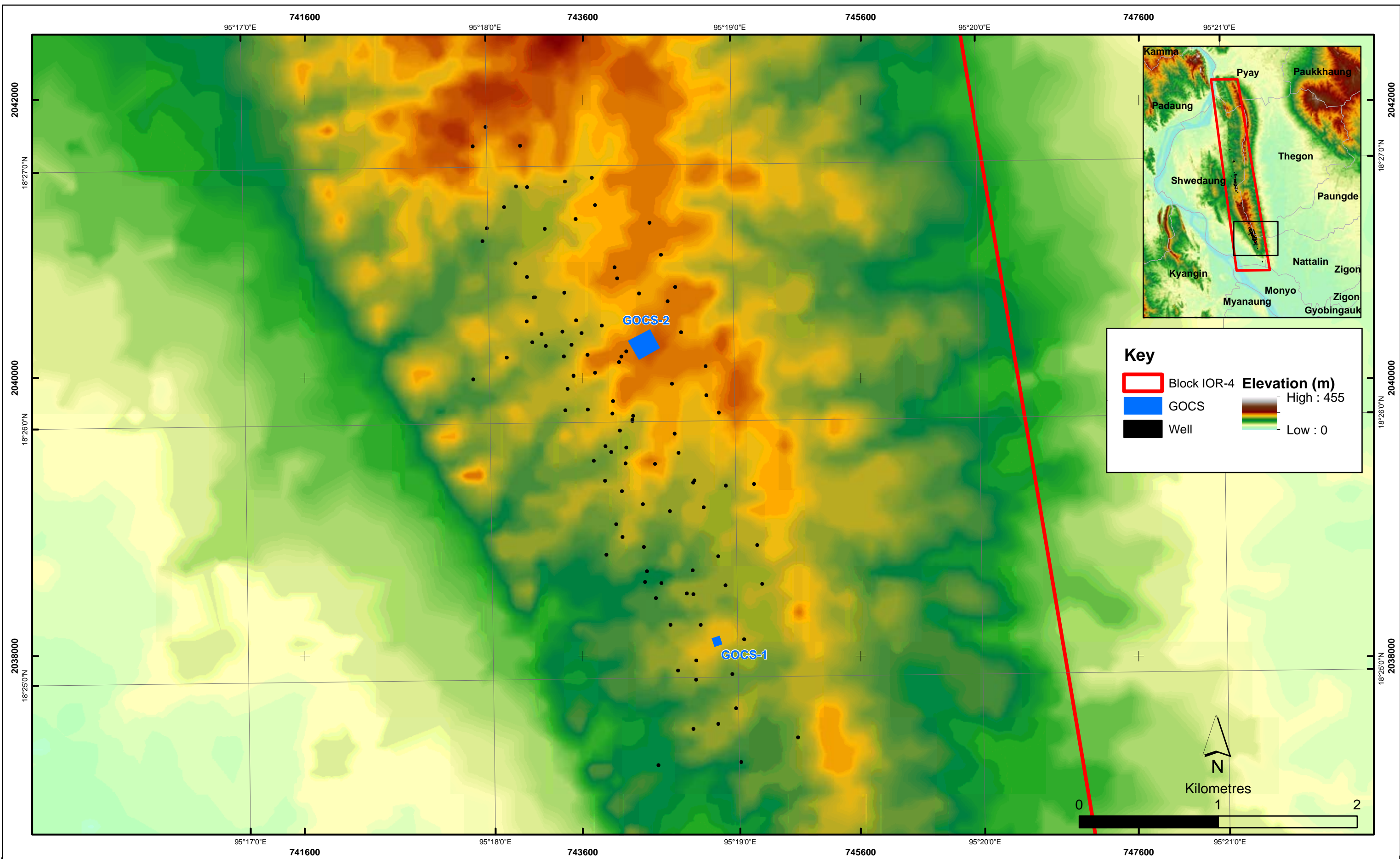


Figure 3.7b

Locations of Wells and GOCS within Block IOR-4 (Sheet 2 of 2)



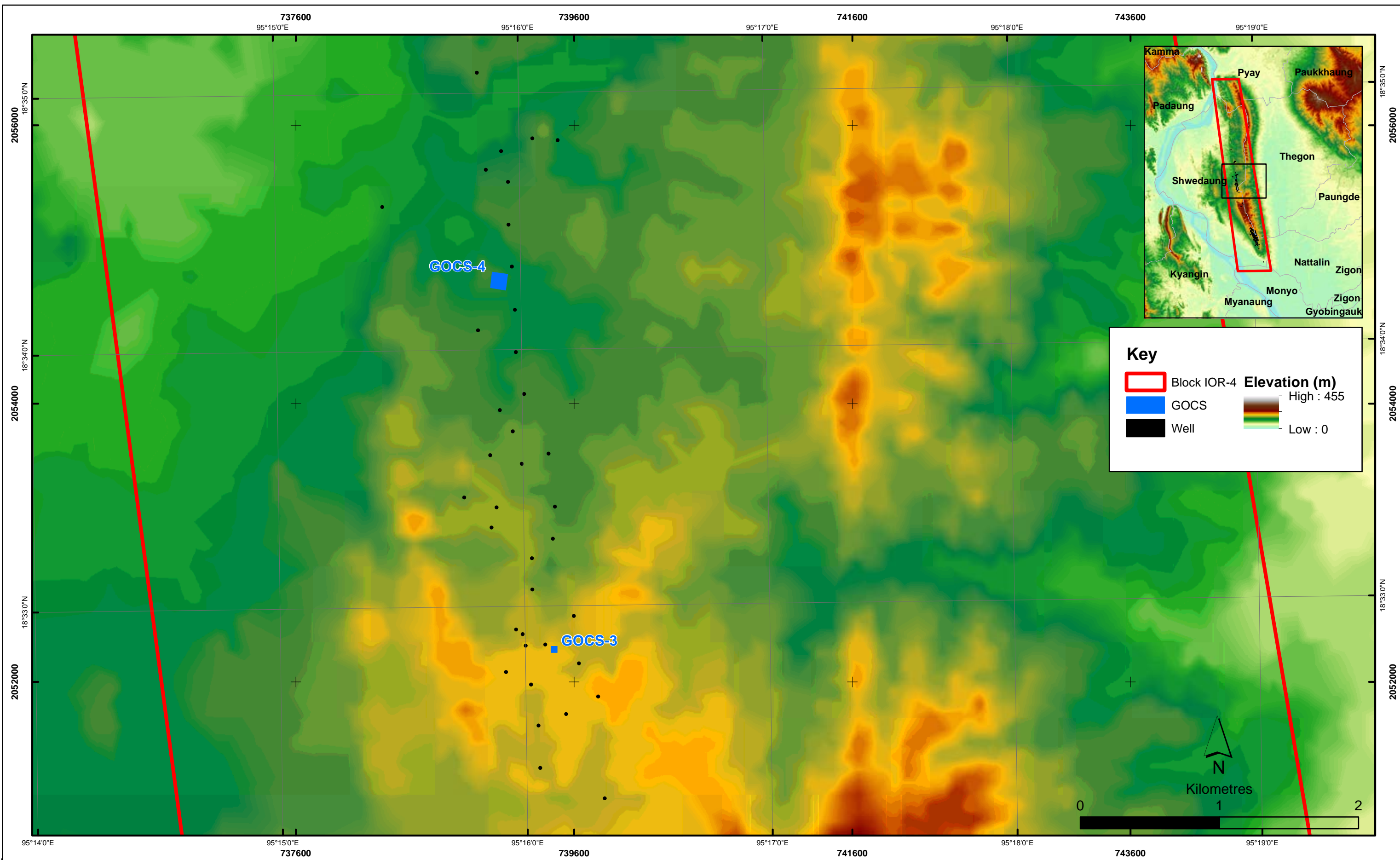


Figure 3.7a

Locations of Wells and GOCS within Block IOR-4 (Sheet 1 of 2)

**Figure 4.1** *Photo of Existing GOCS (Gas and Oil Collecting Station) within Block IOR-4 taken during the Site Visit as part of the Scoping Exercise in October 2014*



### *Geography*

The main geographic features of Myanmar can be divided into four physiogeographic zones, characterized by elongated north-south trend regions (*Figure 4.2*). The four physiogeographic zones are:

- Rakhine Coastal Area
- Western Ranges (Rakhine Mountain Ranges)
- Central Lowlands
- Eastern Highlands

A major topographical feature of Myanmar is the Ayeyarwady River watershed. The Ayeyarwady Delta is considered very fertile and covers about 47,000 km<sup>2</sup>. Hkakabo Razi, which is the highest peak in Southeast Asia at 5,881 m, is located in Myanmar. The Arakan Yoma range (a barrier between India and Myanmar) has peaks that range between 915 m and 1,525 m. Almost half of Myanmar is covered in forests that are comprised of teak, rubber, cinchona, acacia, bamboo, ironwood, mangrove, coconut and betel palm. The forests in the northern highlands are comprised of oak, pine and many varieties of rhododendron. There are many tropical fruits to be found as well, including citrus, bananas, mangoes and guavas in the coastal region.

Block IOR 4 is located within the Central Lowland which is a relatively low-lying terrain drained by the Ayeyarwady River and its major tributaries.



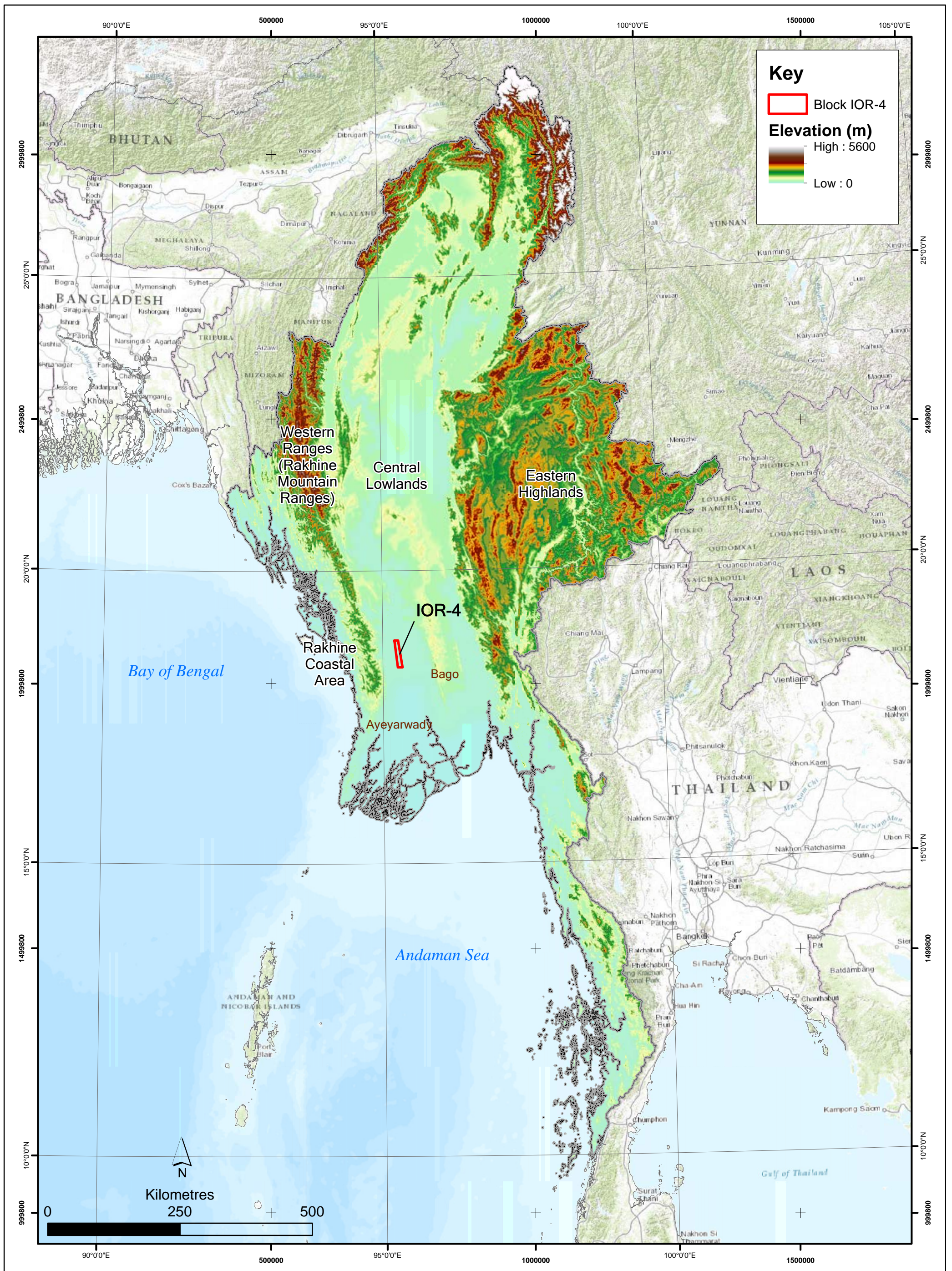


Figure 4.2

## Myanmar's Geographic Zones

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Rolling hills, ridges and small mountains are present in some areas. The region is characterized by folded small mountain ranges.

### *Climate and Meteorology*

Myanmar is characterised by a dominant tropical monsoon climate. Seasons can generally be classified as into a cool dry season from December to April and a hot rainy season from May through November which is driven by the rainy southwest monsoon <sup>(1)</sup>. The southern part of Myanmar is the first part affected by the southwest monsoon starting in May and the entire country is experiencing the rainy season by the beginning of June. Climate variability within the country is largely controlled by topography which affects exposure to the southwest monsoon.

Block IOR-4 is situated adjacent to Pyay District and includes areas of the Bago West Region. The Bago West Region is being categorised as *Tropical Savanna Climate (Köppen climate classification Aw)*. Temperature is hot throughout the year especially in the months before the monsoon from March to May when average maximum temperature has been reported to exceed 36 °C (97 °F) <sup>(2)</sup>. The winter months (December-February) are milder than the rest of the year. Heavy rain falls in the summer particularly in the month of July when 626 mm of rainfall has been recorded in the region <sup>(3)</sup>.

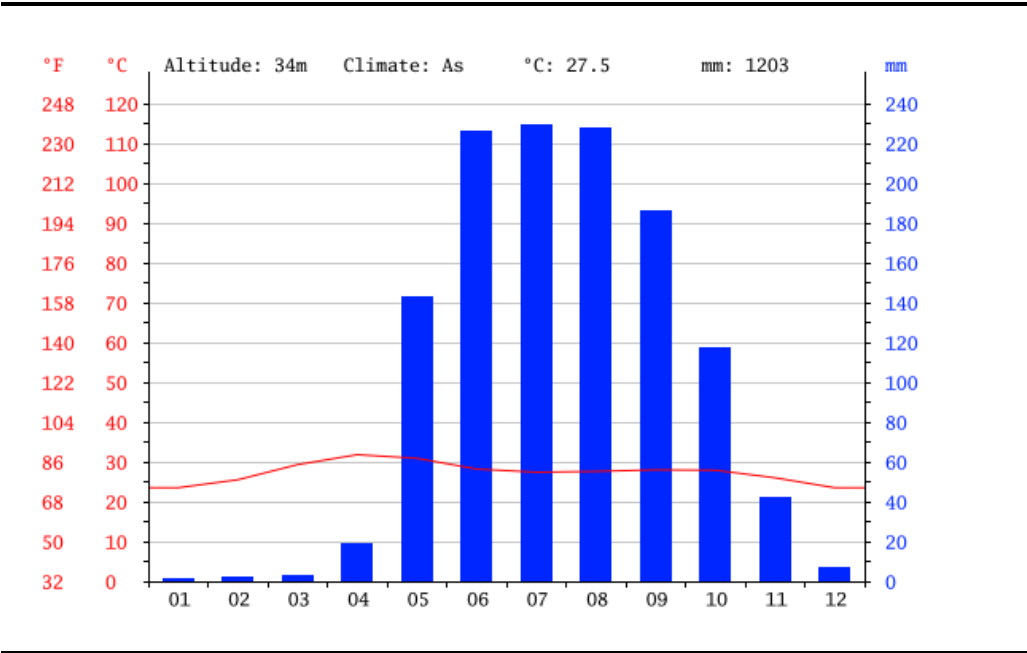
The average temperature and rainfall of the Pyay District are presented in *Figures 4.3a to c*.

<sup>(1)</sup> Kye Baroang (2013) Background Paper No. 1 - Myanmar Bio-Physical Characterization: Summary of Findings and Issues to Explore.

<sup>(2)</sup> <ftp://ftp.atdd.noaa.gov/pub/GCOS/WMO-Normals/RA-II/MM/48077.TXT>, National Oceanic and Atmospheric Administration, accessed 21 Oct 2014

<sup>(3)</sup> <ftp://ftp.atdd.noaa.gov/pub/GCOS/WMO-Normals/RA-II/MM/48077.TXT>, National Oceanic and Atmospheric Administration, accessed 21 Oct 2014

**Figure 4.3a**     *Average Monthly Temperature and Rainfall Chart of Pyay, Myanmar (1982 – 2012) (Sources: <http://en.climate-data.org/location/313/>)*



*Tropical Cyclones*

A tropical cyclone is a tropical storm with rotating winds at speeds of greater than 74 miles (119 km) per hour. Myanmar is vulnerable to cyclones, which often originate in the Southern Andaman Sea and enter the Bay of Bengal. These cyclones can result in heavy rains, storms, and floods. There are two prominent cyclone seasons for the country, between April to May and October to December. Historically, cyclone-related disasters tend to occur every 3 to 4 years in this region and on average every ten years a major cyclone makes a landfall in Myanmar <sup>(1)</sup>.

While the available desktop information did not appear to indicate that the area of Block IOR-4 is frequently affected by tropical cyclone, it should be noted that the Cyclone Mala which hit Myanmar in April 2006 has been reported to affect the nearby area and communication lines in Pyay had been lost (Figure 4.4).

(1) Asian Disaster Reduction Centre, 2003. Theilen-Willige B., (2009) Natural Hazard Assessment of SW Myanmar – A contribution of remote sensing and GIS methods to the detection of areas vulnerable to earthquakes and Tsunami Cyclone Flooding. Science of Tsunami Hazards., Vol. 28 No. 2, page 108

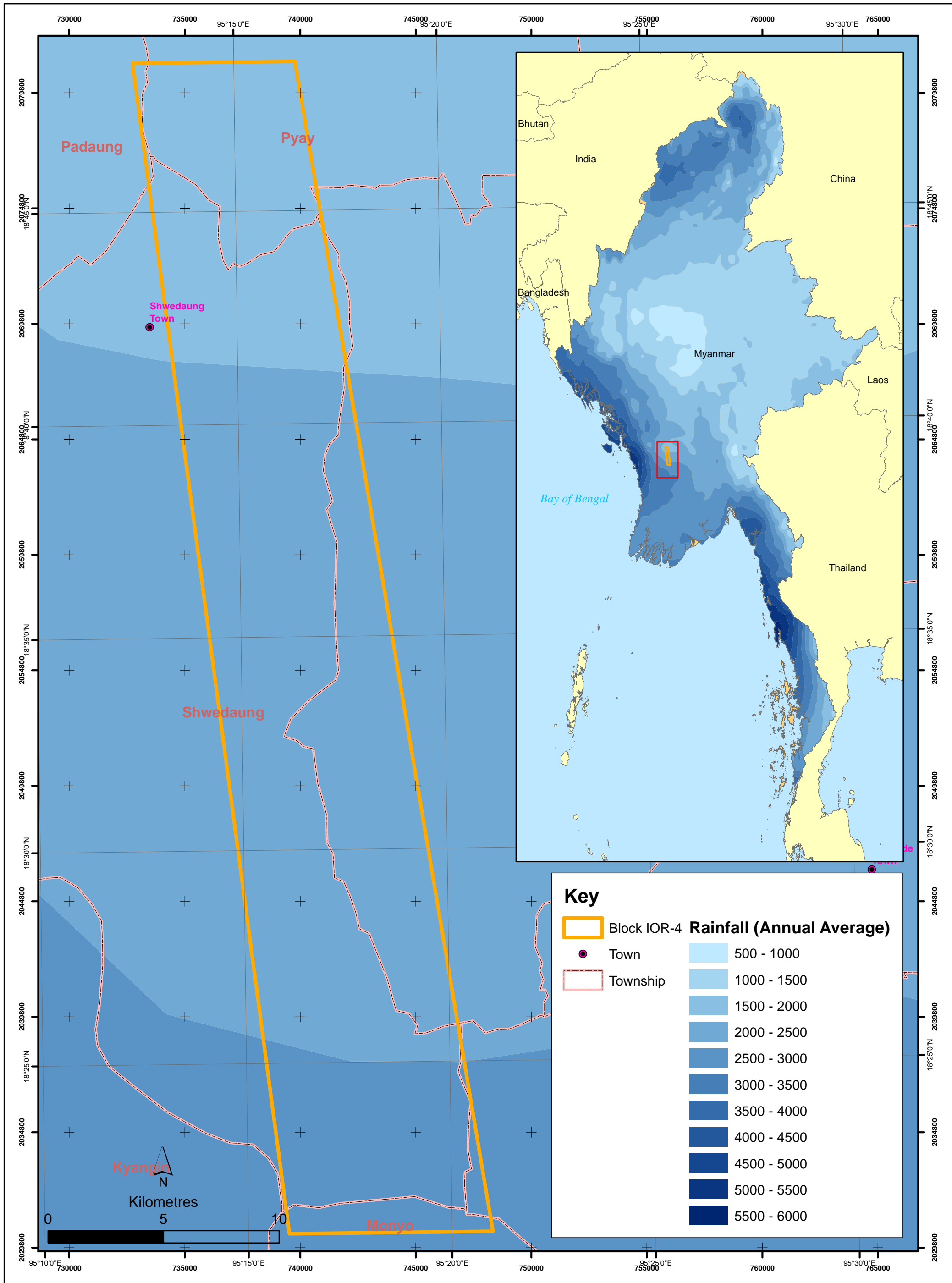


Figure 4.3b

### Rainfall (Annual Average) of Block IOR-4

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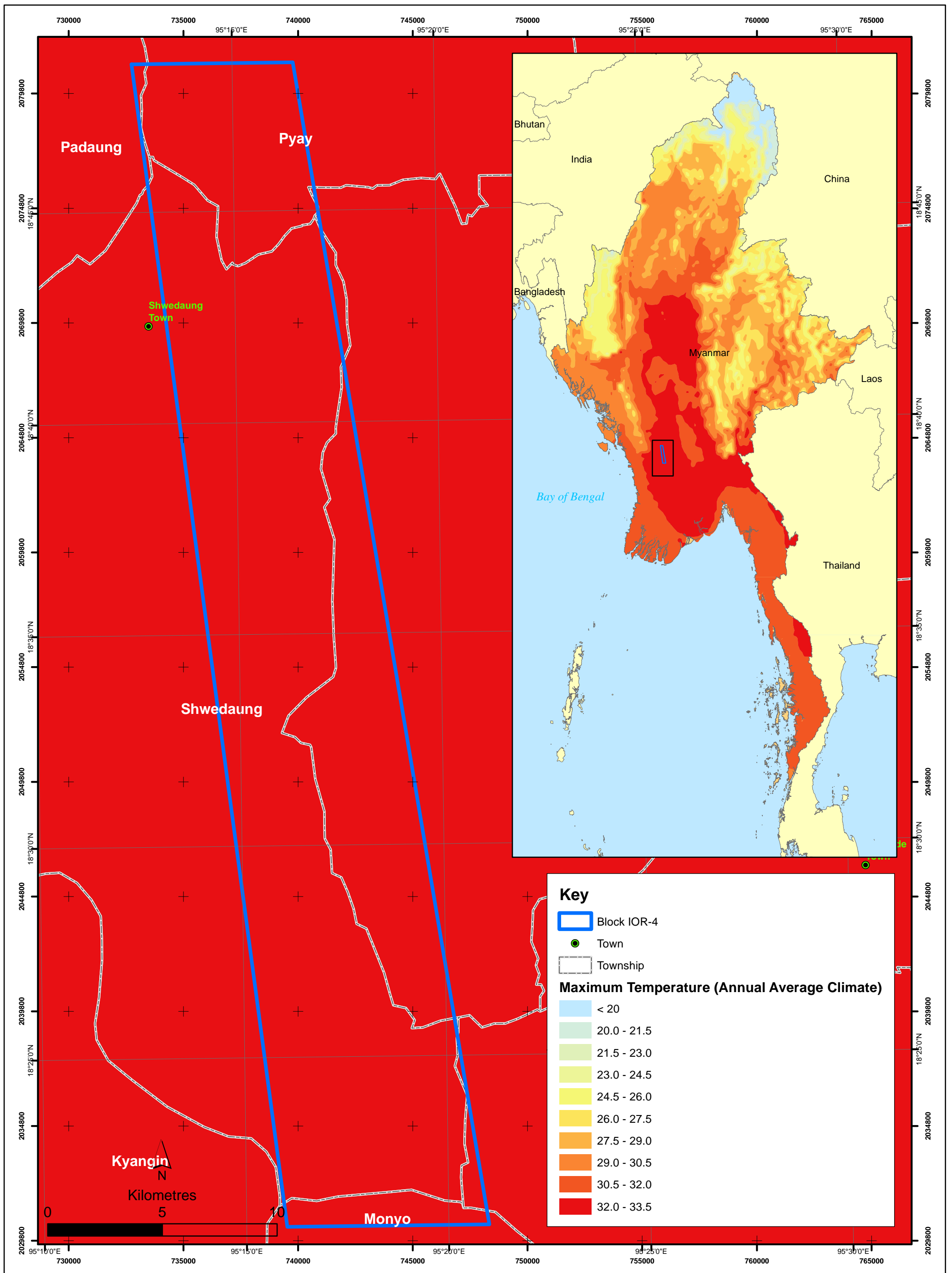


Figure 4.3c

### Maximum Temperature (Annual Average Climate) of Block IOR-4

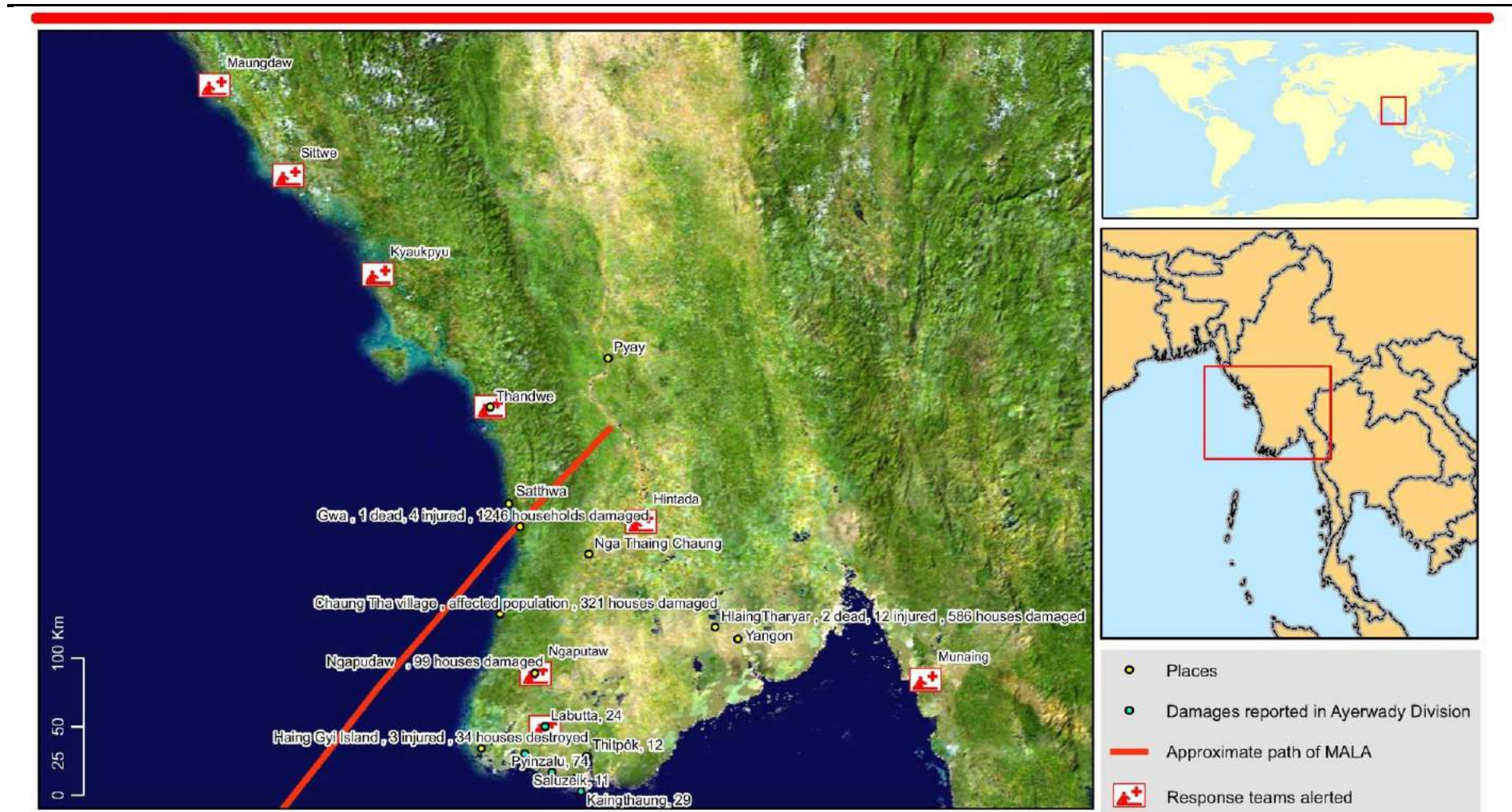
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**Figure 4.4** Track of Tropical Cyclone Mala (Sources: [http://reliefweb.int/sites/reliefweb.int/files/resources/8E8AD333CBB3CC03C12571640036B100-ifrc\\_TC\\_mmr020506.pdf](http://reliefweb.int/sites/reliefweb.int/files/resources/8E8AD333CBB3CC03C12571640036B100-ifrc_TC_mmr020506.pdf))



Projected climate changes over Myanmar have been studied based on both General Circulation Model (GCMs) used in the Intergovernmental Panel on Climate Change (IPCC's) fourth assessment, and using dynamic downscaling with regional climate models forced by the GCMs <sup>(1)</sup>.

Myanmar has been witnessing changing weather events in almost every year during the last two three decades. These include the onset, withdrawal, duration and intensity of monsoon, and the frequency of the monsoon depressions <sup>(2)</sup>. The frequency of hot days and nights is expected to increase, while the frequency of cold days/nights will decrease.

#### *Earthquakes*

A review of available literature has shown that Myanmar is seismologically unstable and vulnerable to earthquakes <sup>(3)</sup>. Historic records show that at least 15 major earthquakes with magnitudes  $M \geq 7.0$  have occurred in Myanmar in the last hundred years (*Figure 4.5*).

Earthquakes occurred within the Ayeyarwady Delta in 1930 at Bago, in 1970 at Yangon and in 1975 at Pagan <sup>(4)</sup>. The Sagaing earthquake of 16 July 1956 caused damages to religious edifices and buildings at Sagaing and about 40 lives were lost <sup>(5)</sup>.

Historical records of earthquakes are noted for the Pyay District and nearby area of Block IOR 4.

#### *Air Quality*

Secondary data are not available on ambient air quality in the Project Area. The principal sources of emissions to the atmosphere in the immediate vicinity of the Project Area are likely to be from household fires for domestic purposes (i.e. heating and cooking) and exhaust emissions from road transportation and oil and gas activities.

#### *Noise*

Secondary data are not available on noise in the Project Area. However, the sources of noise pollution are likely to include the road traffic from the nearby main road and existing oil and gas operations.

<sup>(1)</sup> Intergovernmental Panel on Climate Change. IPCC Fourth Assessment Report (AR4), (2007), Climate Change: Synthesis Report

<sup>(2)</sup> Tun Lwin, Khin and Cho Cho Shein., 2006. Hydrology and Meteorology report of Myanmar.

<sup>(3)</sup> Theilen and Pararas-Carayannis (2009) *Op cite*

<sup>(4)</sup> Union of Myanmar (2009), Hazard Profile - Myanmar

<sup>(5)</sup> <http://aeic.bmg.go.id/aeic/myanmar.html>, accessed 10 July 2014



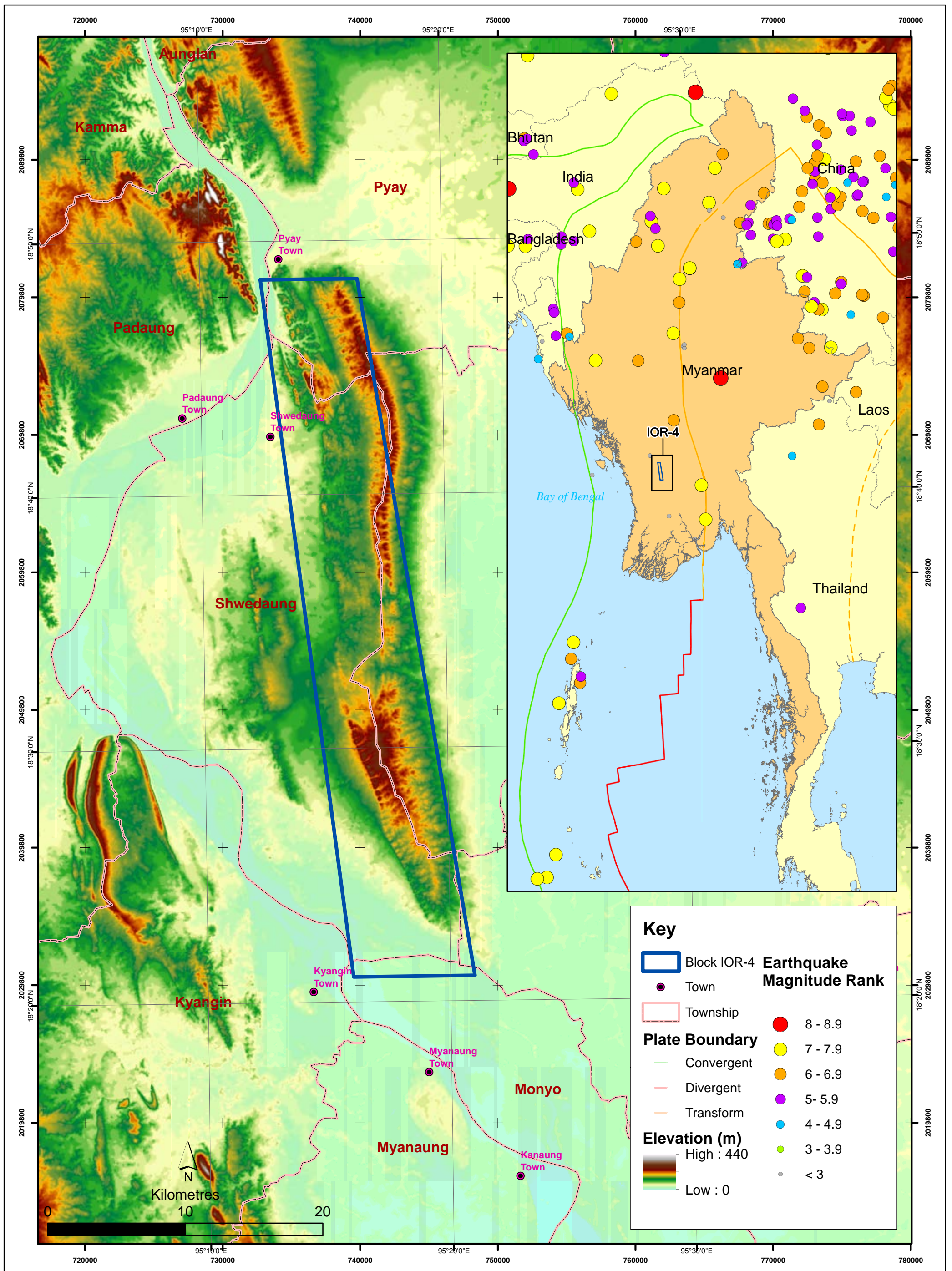


Figure 4.5

Earthquake Magnitude and Tectonic Plate Boundary in Myanmar

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## Soil

The Land Use Division (LUD) of Myanmar Agricultural Service is responsible for carrying out soil surveys, producing soil maps and coordinating the research activities with related agencies for the introduction of soil conservation and land improvement practices. According to the soil analysis undertaken by LUD, Myanmar has altogether 24 different soil types which are related with adaptable crops. The Bago West Region, where Block IOR-4 is located, is being classified as gleysol soil type which is favourable for the cultivation of paddy, pulses, sesame, maize, sugarcane, vegetable, groundnut, cotton, jute, tobacco etc (*Figure 4.6*). High rates of soil erosion and reduced sediment delivery have contributed to a sedimentation problem throughout the Ayeyarwady River Basin. The sediment budget has broad effects upon several processes of soil erosion in the Ayeyarwady River Basin which are of serious concern. In addition, the problem of zinc deficiency is also reported to occur in Bago West which is often observed in rice growing area <sup>(1)</sup>.

## Surface Water Quality

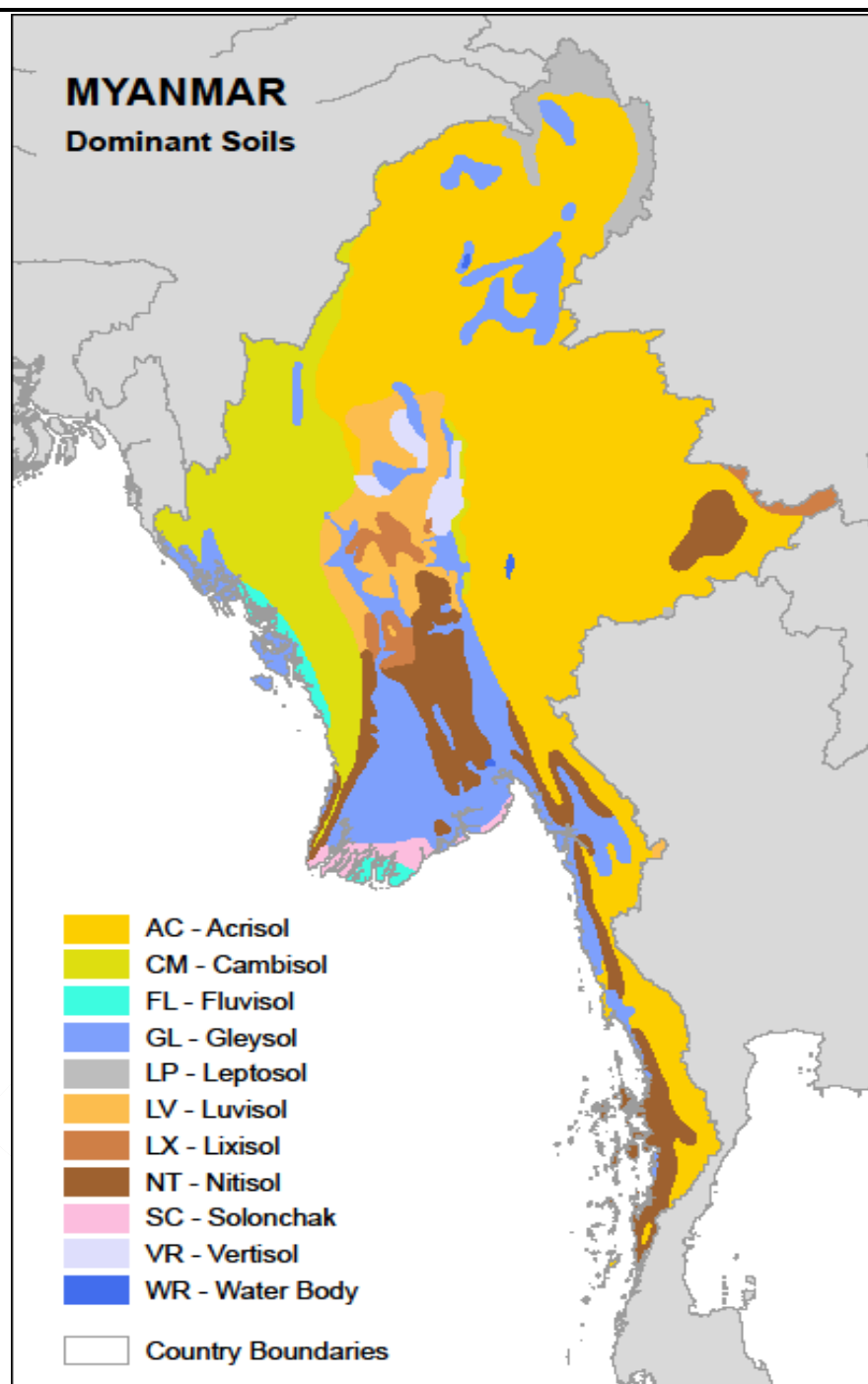
The main source of surface water within Block IOR-4 is noted to be the Ayeyarwady River which is located on the western boundary of the block (*Figure 4.7*). The principal sources of pollution to the Ayeyarwady River are expected to be potential water contamination from agriculture inputs, boat vessel emissions and surface run-off. Agricultural inputs, such as chemical fertilizers and pesticides are increasingly distributed either partially or wholly by the private sector <sup>(2)</sup>. The Project will also use the existing facility at Na Ma Yan Foreshore of the Ayeyarwady River for river transport.

(1) <http://www.fao.org/docrep/010/ag120e/AG120E15.htm>

(2) Kan Zaw, Nu Nu Lwin, KhinThida Nyein, and Mya Thandar, 2011. Agricultural Transformation, Institutional Changes, and Rural Development in Ayeyarwady Delta. Economic Research Institute for Asean and East Asia.



Figure 4.6 Soil Types and Distribution in Myanmar



Source: Reliefweb International (2014) <sup>(1)</sup>

<sup>(1)</sup> [http://reliefweb.int/sites/reliefweb.int/files/resources/329CF8B14D479D85852574560063A495-2-fao\\_NTR\\_mmr080527.pdf](http://reliefweb.int/sites/reliefweb.int/files/resources/329CF8B14D479D85852574560063A495-2-fao_NTR_mmr080527.pdf) accessed, 14 June 2014.



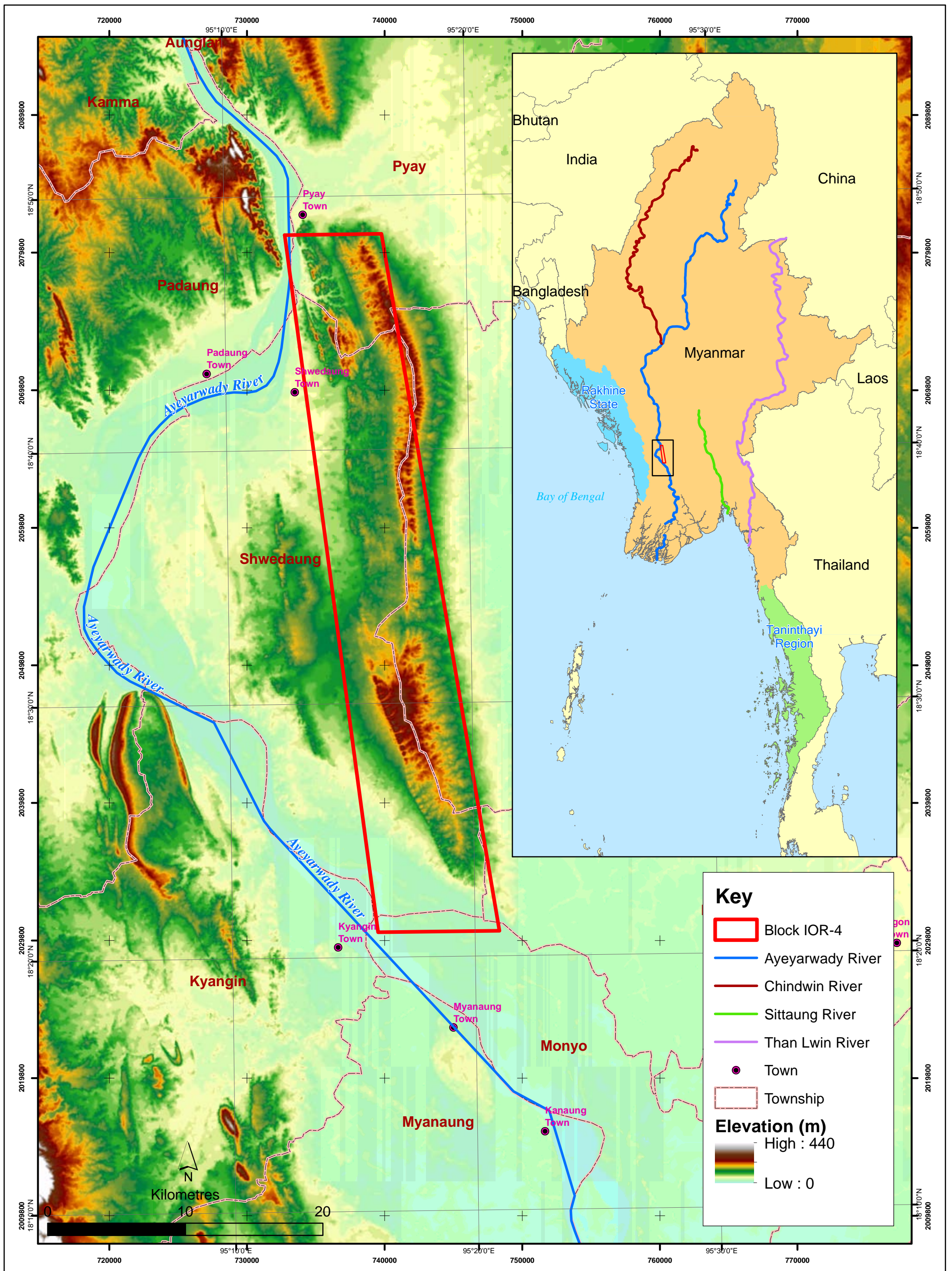


Figure 4.7

## River Basin in Myanmar

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In Myanmar groundwater resources have been estimated as 454 km<sup>3</sup>/year; but a large part of this water (about 443 km<sup>3</sup>/year) comprises the base flow of the rivers and is also accounted for as surface runoff <sup>(1)</sup>. It was estimated that 91% of the total water withdrawal in Myanmar comes from surface water and 9% from groundwater <sup>(2)</sup>. Currently there is no single institution that is responsible for the overall management of national water resources in the public and private sectors.

The area of Block IOR-4 is located within the Lower Ayeyarwady River Basin which has the highest groundwater potential in Myanmar (*Figure 4.8*). Groundwater in the region is dependent upon natural recharge from Ayeyarwady River. Villages within Block IOR-4 reported the use of groundwater from deep tube wells and hand dug wells as water supply. Study in the Ayeyarwady Division, which is adjacent to Block IOR-4 and also located within the Lower Ayeyarwady River Basin, has shown that arsenic contamination is a problem occurred in the groundwater of the basin <sup>(3)</sup>. It was observed that 66.6 % of the groundwater samples from wells have arsenic levels of >50 µg/L, which is much higher than the World Health Organization (WHO) guideline value in drinking water (10µg/L) <sup>(4)</sup>.

#### **4.3.2 Biological Environment**

##### *Habitat*

Myanmar is well endowed with forests and other natural resources. Forests cover about 40% of the total land area (*Figure 4.9*). Forest exploitation is controlled by law but the government allows rural communities to use various forest products (except protected plants and animal species) <sup>(5)</sup>. However, it is noted that loss in forest area is reported to be an ongoing issue in the wider Bago Region due to change in land use <sup>(6)</sup>.

Limited information is available for the habitat type within Block IOR-4. Based on preliminary review of aerial photos with the block and the initial sit visit, it is expected that habitats including developed area (i.e. roads, village areas), cultivated land, forests, woodland, shrubland and streams or rivers will be found within the block. These habitats have the potential to support fauna groups including mammals, birds, amphibians, reptiles, odonates and fishes.

(1) FAO (2010), FAO's information system on water and agriculture, [http://www.fao.org/nr/water/aquastat/countries\\_regions/myanmar/index.stm](http://www.fao.org/nr/water/aquastat/countries_regions/myanmar/index.stm), accessed 19-06-2014

(2) FAO (2010), *Op cite*

(3) <http://www.bioline.org.br/pdf?hn06020>

(4) World Health Organization (2011) Guidelines for Drinking-water Quality. Fourth Edition.

(5) <http://www.fao.org/docrep/005/ac648e/ac648e08.htm>, accessed 21 Oct 2014

(6) <http://rainforests.mongabay.com/20myanmar.htm>



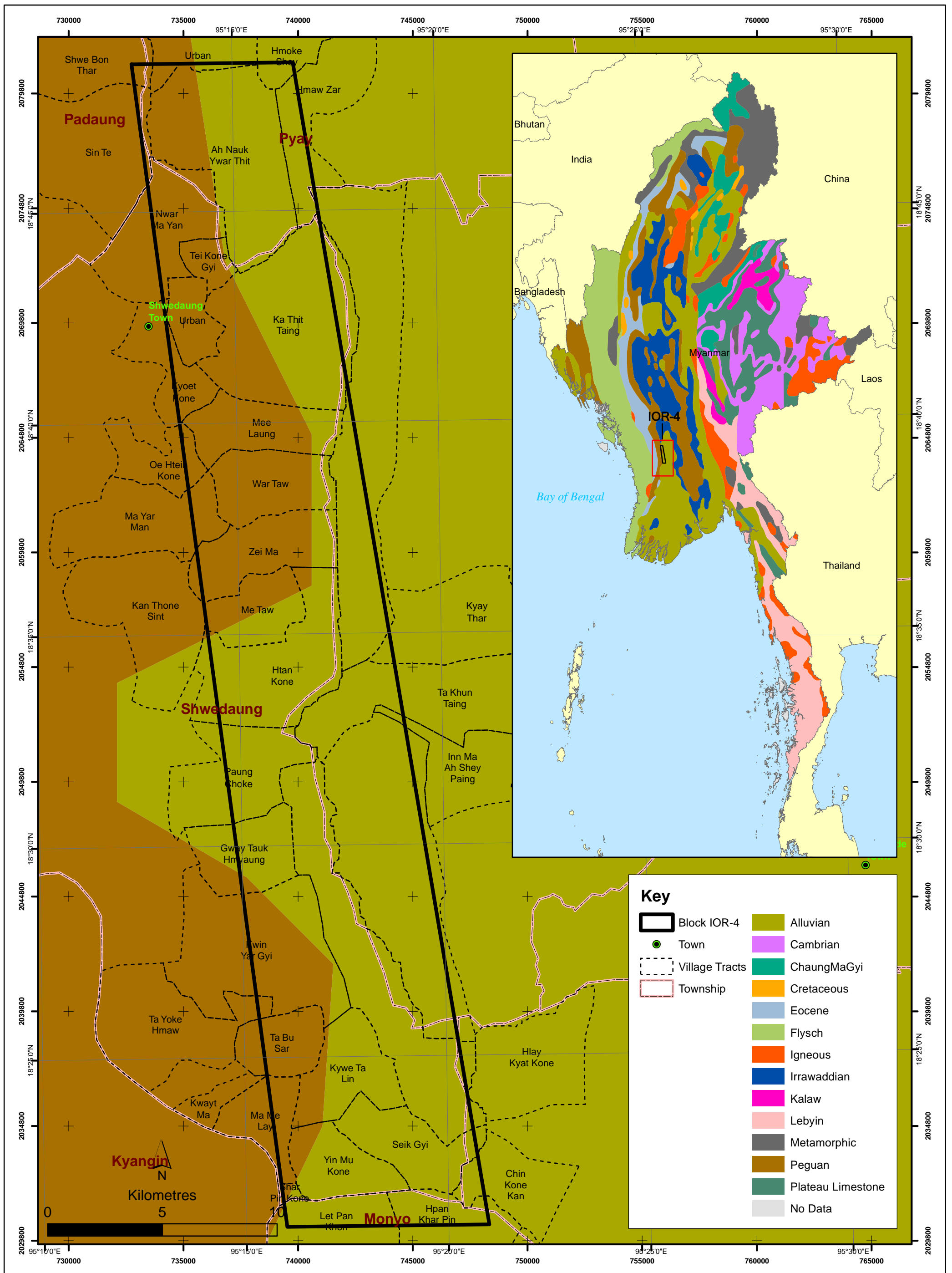


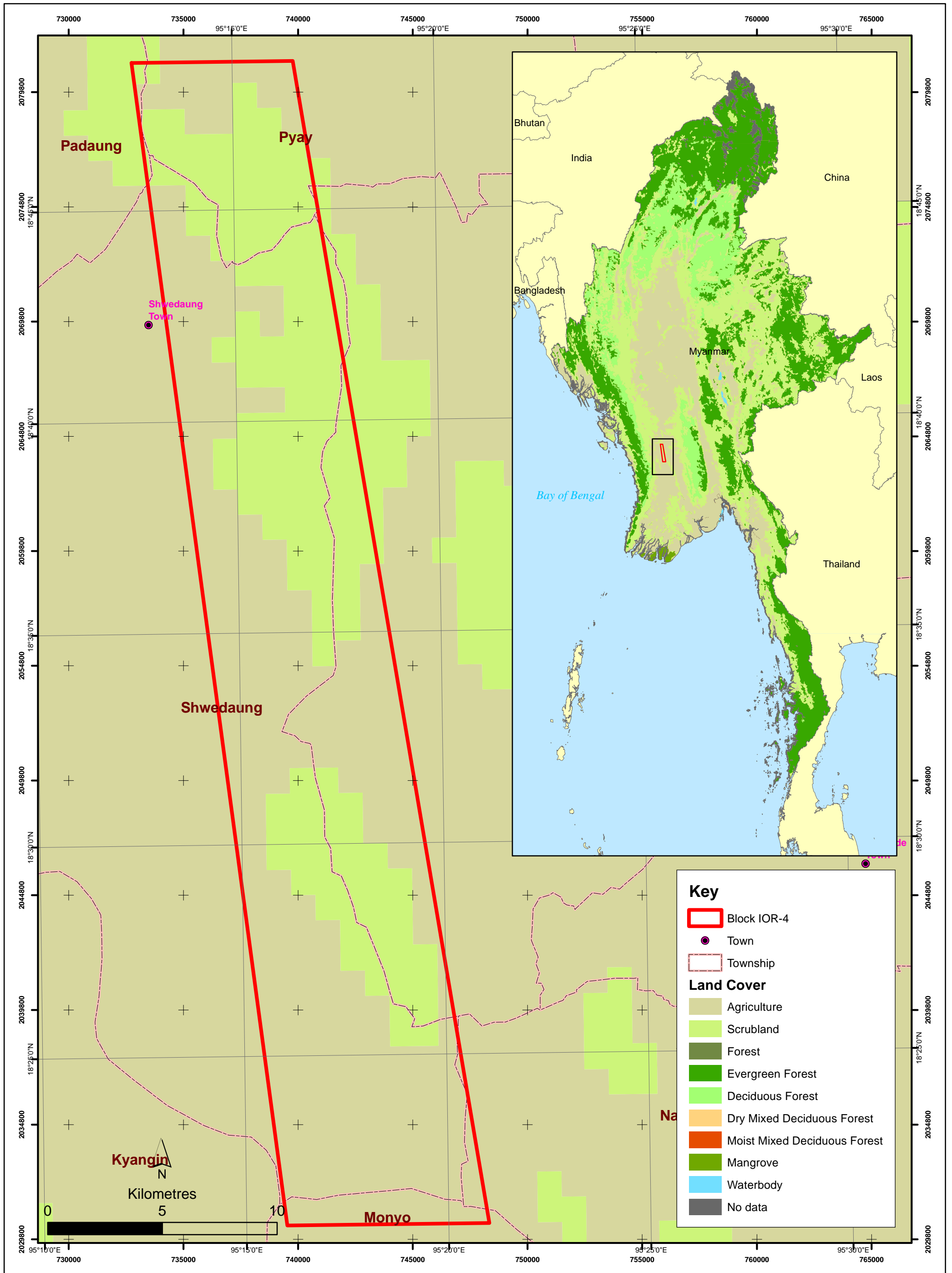
Figure 4.8

## Types of Aquifer in Myanmar

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Limited baseline ecological information is available for the terrestrial and aquatic fauna groups within Block IOR-4. The Ayeyarwady River, where Irrawaddy dolphin was reported, is located adjacent to Block IOR-4. The Irrawaddy dolphin is a euryhaline species of oceanic dolphin found in discontinuous subpopulations near sea coasts and in estuaries and rivers in parts of the Bay of Bengal and Southeast Asia. In Myanmar, it is found in the Mekong, Ganga, Brahmaputra and Ayeyarwady Rivers. There is currently insufficient data to accurately assess the population status in Myanmar. IUCN estimates a population of 58-72 in the Ayeyarwady River (IUCN, 2011) <sup>(1)</sup>. The Irrawaddy Dolphin (Ayeyarwady subpopulation) is regarded as Critically Endangered under the IUCN Red List <sup>(2)</sup>. The Ayeyarwady River is also home to a large diversity of animals, including about 43 fish species <sup>(3)</sup>.

The Ayeyarwady Delta is located to the south of the block and is rich in birds, especially from the end of the rainy season in September-October when a large number of migrant birds fly south from their breeding sites in Central Asia and Siberia to winter in Myanmar. Many of the waders make their way to the paddy plains, coastal mud flats and tidal creeks of the delta <sup>(4)</sup>. Due to the migratory nature of the species, it is expected that some species normally found in the neighbouring delta may pass by or through the Project Site.

#### *Protected & Environmentally Sensitive Areas*

Information from the Istituto Oikos and BANCA (2011) reported a total of 43 designated or proposed protected areas with IUCN categories existing in Myanmar <sup>(5)</sup>. It should be noted that some of the locations are proposed as protected area without authorised designation (i.e. "soft" designation). It is important to note that none of these protected or environmentally sensitive areas lie within the block area. The distance to Taungup Pass/Thandwe-chaung from Block IOR-4 Pyay is around 31km and distance to Bago Yomas from Block IOR-4 Pyay is around 51km (*Figure 4.10*).

### **4.3.3**

#### ***Socio-economic Environment***

This section presents finding of the desktop literature review of the socio-economic environment in the wider regional and country level. The secondary information pertaining to the socio-economic profile of the country, the region and the Project Area is extremely limited and is restricted to the reports of organizations such as United Nation Development Programme

<sup>(1)</sup> The IUCN Red List of Threatened Species, (2011); <http://www.iucnredlist.org/details/44556/0> , accessed 10 Oct 2014

<sup>(2)</sup> The IUCN Red List of Threatened Species lists the Irrawaddy Dolphin as a critically endangered species: <http://www.iucnredlist.org/details/44556/0>

<sup>(3)</sup> <http://fish.mongabay.com/data/ecosystems/Irrawaddy.htm>, accessed 15 Oct 2014

<sup>(4)</sup> <http://www.worldwildlife.org/ecoregions/im0116>, accessed 04 Oct 2014

<sup>(5)</sup> [http://www.istituto-oikos.org/files/download/2012/MyanmarProtectedAreas.Context\\_CurrentStatusandChallenges.pdf](http://www.istituto-oikos.org/files/download/2012/MyanmarProtectedAreas.Context_CurrentStatusandChallenges.pdf)



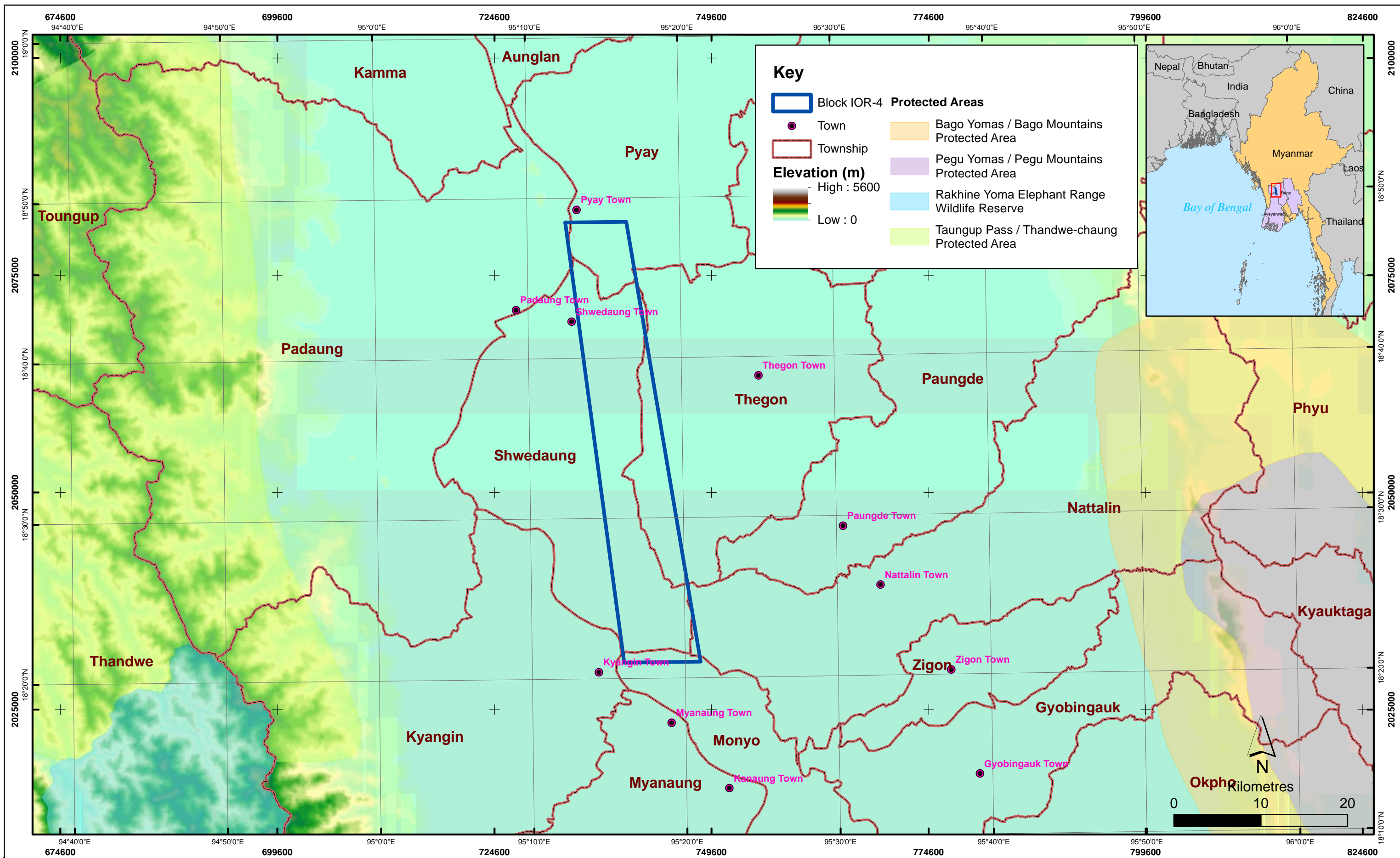


Figure 4.10

### Protected Areas near Block IOR-4

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(UNDP). Thus, the following desktop baseline review has been undertaken on the basis of the limited secondary information available from reliable sources.

#### *Country Profile: Myanmar*

This subsection provides a brief understanding of the socio-economic profile of Myanmar, in terms of its demographic profile, land and livelihood profile.

#### **Administrative Structure**

The Republic of the Union of Myanmar is characterised as a presidential republic with a bicameral legislature. The country is governed by its Constitution, passed in September 2008. The country is divided into seven state and seven regions. The administrative divisions are further subdivided into districts, and in turn townships, wards and villages. An understanding of the administrative divisions in the country is shown in *Table 4.2*.

**Table 4.2** *Administrative Structure of Myanmar*

No.	State/Region	Districts	Townships	Cities /Towns	Wards	Village groups	Villages
1	Kachin State	3	18	20	116	606	2630
2	Kayah State	2	7	7	29	79	624
3	Kayin State	3	7	10	46	376	2092
4	Chin State	2	9	9	29	475	1355
5	Sagaing Region	8	37	37	171	1769	6095
6	Tanintharyi Region	3	10	10	63	265	1255
7	Bago Region	4	28	33	246	1424	6498
8	Magway Region	5	25	26	160	1543	4774
9	Mandalay Region	7	31	29	259	1611	5472
10	Mon State	2	10	11	69	381	1199
11	Rakhine State	4	17	17	120	1041	3871
12	Yangon Region	4	45	20	685	634	2119
13	Shan State	11	54	54	336	1626	15513
14	Ayeyarwady Region	6	26	29	219	1912	11651
	<b>Total</b>	<b>63</b>	<b>324</b>	<b>312</b>	<b>2548</b>	<b>13742</b>	<b>65148</b>

*Source: Wikipedia.org accessed on June 18, 2014*

While regions are understood to be predominantly inhabited by the dominant ethnic group, the states are areas that are occupied by ethnic minorities.

The lowest levels of government offices are generally located in the townships. These in turn report to the government offices at the district and region levels. The regions are governed by a Chief Minister appointed by the President, who in turn is supported by a unicameral legislative assembly (*Figure 4.11*). Each state / region has a unicameral legislative assembly (Hluttaw), but laws passed by the Union Legislative Assembly (Pyidaungsu

Hluttaw) are superior to those passed at the state / region level.

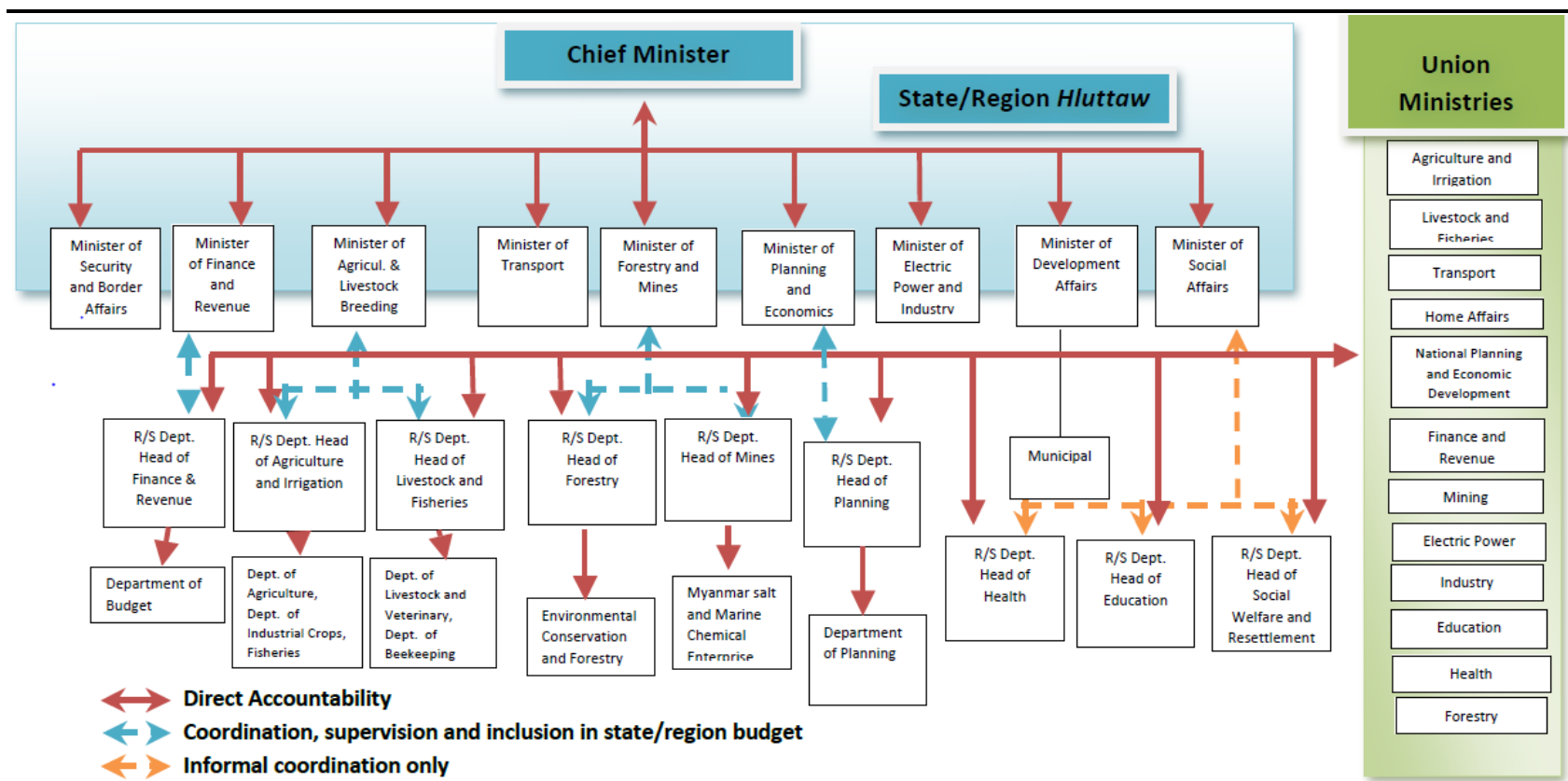
Furthermore, the unicameral legislative assembly can only pass laws for eight (8) sectors listed in *Schedule Two of the Constitution*. While the assembly at the regional level can pass laws on “Energy, Electricity, Mining and Forestry”, it does not have powers to formulate laws for any matters relating to the Oil and Gas sector <sup>(1)</sup>.

The region assemblies can legislate on matters of land revenue, municipal taxes on buildings and land as well as the sales, lease and other matters involving property of the region or state. On the other hand, revenues from the exploitation of the natural resources of a region or state are to be paid to the Union Fund and not the region or State Fund. The Union Government does not need approval from state or regional governments for large scale investments in their local jurisdictions, although they must be informed, and their views are sought as part of the evolving ESIA process and on foreign lease of land in their area.

(1) Myanmar Oil and Gas Sector-Wide Impact Assessment: Government Structure and Legal Framework



### *Indicative Organization of State and Regional Government <sup>(1)</sup>*



(1) MDRI-CESD & The Asia Foundation (2013) State and Region Government in Myanmar

## Demographic Profile

The Republic of the Union of Myanmar is a sovereign state in Southeast Asia. The country borders Laos, Thailand, China, Bangladesh and India. The country of Myanmar is characterised by the following demographic profile in Table 4.3.

**Table 4.3** *Demographic Profile of Myanmar*

Attribute	Number
Area (sq. km)	676,578
Population	52.8 Million
Population Density (population per sq. km)	78.03
Population Growth (average annual % for 2010-2015)	0.8
Sex Ratio (women per thousand men)	971
Urban Population (%) (2012)	33.2
Rural Population (%) (2012)	66.8
Urban Population Growth (average annual % for 2010-2015)	2.5
Rural Population Growth (average annual % for 2010-2015)	-0.1
Population aged 0-14 years (%) (2012)	24.8
Population aged 60+ years (%) (2012)	8.45

Source: UN data <sup>(1)</sup> and BTI (2014) Myanmar Country Report <sup>(2)</sup>

Estimation and classification of Myanmar's population is difficult due to the absence of reliable data and the complex ethnic identity. The last proper census was conducted in 1931 (an incomplete census was also conducted in 1983). The data available is in the form of that collected by different independent agencies such as the United Nations (UN) and World Bank amongst others.

Myanmar with an area of 676,578 km<sup>2</sup> is the 40<sup>th</sup> largest country in the world and the second largest in Southeast Asia. It is also the 24<sup>th</sup> most populous country in the world. The country is characterised by a population density of 78.03 individuals per km<sup>2</sup> with most of the population being concentrated in the rural areas. However, it should be noted that while the rural population is dominant, there has been a shift towards urban areas, with the rural population experiencing a negative average growth rate in the years 2010-2015. In comparison to this, the urban population has experienced a growth rate of 2.5% in the same time period, which is higher than the overall growth rate of the Country.

Of the total population, approximately 33.25% is characterised as dependent population, comprised those below the age of 14 years and higher than 60 years. The country is characterised by a sex ratio of 971 females per thousand males.

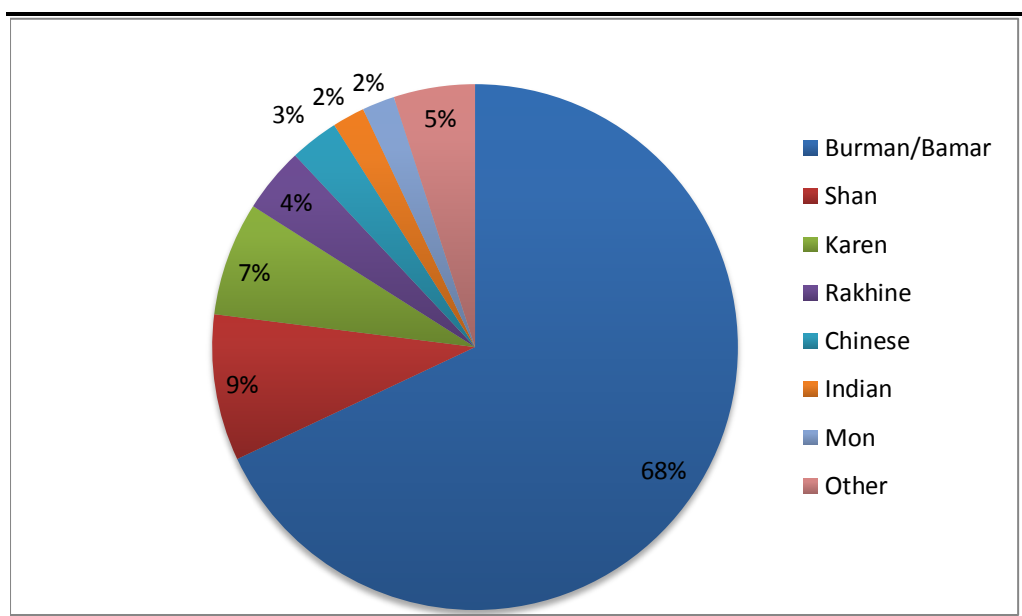
(1) <http://data.un.org/CountryProfile.aspx?crName=MYANMAR#Social>

(2) <http://www.bti-project.org/fileadmin/Inhalte/reports/2014/pdf/BTI%202014%20Myanmar.pdf>

## Social Stratification

The population of the country is composed of a number of ethno linguistic groups. The majority of the population is comprised of Tibeto-Burman groups, along with Tai-Kadai, Hmong-Mien and Austroasiatic groups, including Burman groups. The main ethnic groups include Burman, Shan, Mon, Rakhine, Chin, Kachin, Kernni Kayan, Chinese, Indian, Danu, Akha, Kokang, Lahu, Naga, Palaung, Pao, Rohyinga, Tavoyan and Wa. The following Figure 4.12 provides the ethnic composition of the country.

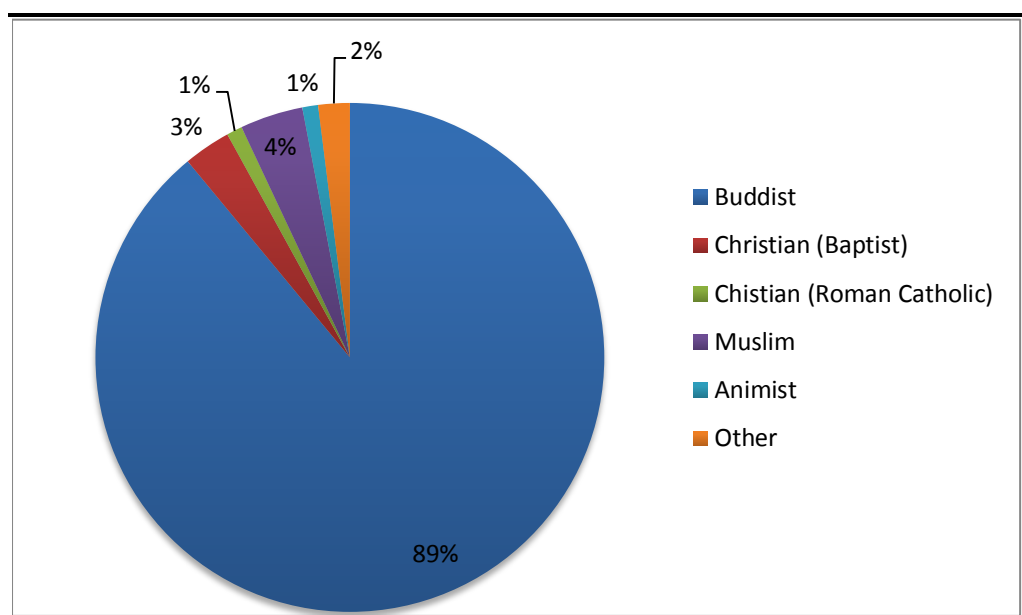
**Figure 4.12** *Ethnic Composition of Myanmar (2014)*



Source: [indexmundi.com](http://indexmundi.com)

Myanmar's population is characterised by four main language families, namely, the Sino-Tibetan, Tai-Kadai, Austro-Asiatic and Indo-European, of which the Sino-Tibetan are the dominant languages. Burmese is the official language of the country.

**Figure 4.13 Religious Composition of Myanmar (2014)**



Source: indexmundi.com

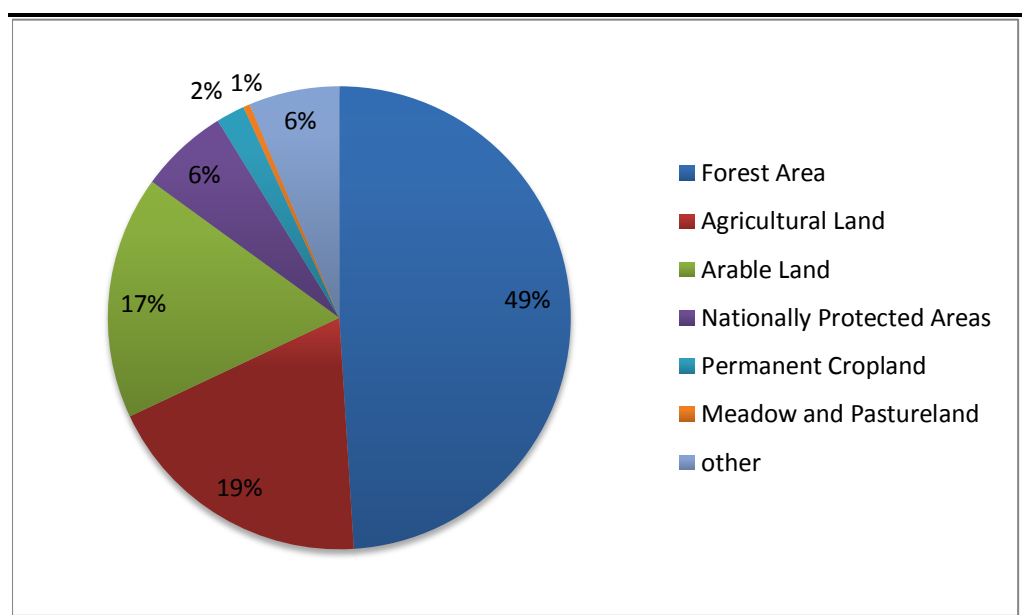
In terms of religious groups, the country is composed of mostly Buddhist population, with the other religious groups included Christianity (Protestant and Catholic), Muslim, Hindu, Animalism, Mahayan Buddhism and other East Asian religions. Figure 4.13 given above provides an understanding of the religious composition of the population.

### **Land Use and Ownership**

The country is divided into three physical zones, namely Uplands, the Dry Zone and the Irrawaddy Delta. The Uplands, comprised of the states of Kachin, Karenni, Karen, Chin and parts of Shan, Mon and Arakan, are characterised by a hilly terrain, ranging from 1,000 to 2,000 m in altitude. In the past swidden agriculture (traditional shifting) was common in the areas. However, due to an increase in the population density, farmers are increasing clearing the steep hills in the area, which are characterised by poor soil quality which does not allow for sustained agriculture or appropriate fallow periods.

The Dry Zone is referred to as the central heartland and spans the semiarid region of the country. The Project Area partly falls in the dry zone. This area is characterised by frequent draughts and increasing land degradation due to loss of natural vegetation, soil erosion and decreasing soil fertility. The following Figure 4.14 provides an understanding of the land classification in the country.

**Figure 4.14** *Land Classifications in Myanmar (2009 – 2010)*



Source: USAID Country Profile: Property Rights and Resource Governance, Burma

As can be seen from the above figure, the dominant land use in the country is forest area followed by agricultural land. Of the agricultural land (~128,549.82 km<sup>2</sup>), approximately 25% is classified as irrigated land. The forest area is comprised of tropical evergreen forests, hill forests and temperate evergreen forests. However, due to activities such as legal and illegal logging and traditional practices there has been a rapid depletion of the country's forest resources, with the country losing 19% of its forest cover during the period of 1990-2010.

The primary central body governing land in Myanmar is the Ministry of Agriculture and Irrigation (MoAI) and departments under the Ministry are responsible for land planning, water resources, irrigation, mechanisation, settlement and land records, amongst other matters. The Farmland Management Body (FMB) and the Central Committee for the Management of Vacant, Fallow and Virgin Land (CCVFV), both established by laws enacted in 2012 and chaired by the head of MoAI are responsible along with their lower-level branches for approving certain requests for land- use rights.

The land ownership in the country is vested in the state, with the citizens and organizations being provided with user rights. While the dependence on land as a source of livelihood is high in the country, especially amongst the rural areas, it is estimated at 30-50% of the rural areas are landless. The average farm size in the country is 6.7 acres, which is considered to be moderate by Southeast Asian standards and low by international standards. The largest average sizes are found in Irrawaddy (11.2 acres), Yangon (9.3 acres) while the lowest is in Chin state (1.7 acres)

The proportion of landless households is reported to vary across the regions in the country with the Bago Region in lower Myanmar, Mandalay Region in Central Myanmar and Rakhine State in Western Myanmar having the highest

proportion. While the country's constitution and the Customary Laws (governing Buddhist groups) guarantees women equal rights before the law in terms of property matters, in practice, however, certain systems applicable on the ground do not afford them equal rights. Furthermore, the country's latest laws pertaining to land such as Farmland Law and Vacant, Fallow and Virgin Land (VFV) Law are reported to not be gender neutral with no mechanism for joint ownership of property between husbands and wives. These laws state that the land will be registered to the head of the household, which is interpreted to mean the husband.

### **Land Tenure Types**

In Myanmar, the state is the owner of all land, thus, all private tenure rights are usufruct rights, and are determined according to the type of land involved. While attempts have been made to simplify the land classifications through several new laws in 2012, their success is still unclear. In 2009, 12 land categories were identified, which are discussed in *Table 4.4* below.

**Table 4.4** *Land Types in Myanmar*

No	Land Type	Description
1	Freehold Land	Freehold land equates roughly to 'ancestral land,' existing mostly in urban areas and rarely in small towns and villages. Freehold land is transferrable, not subject to land revenue taxes and can be taken by the state only pursuant to laws on compulsory acquisition.
2	Grant Land	Owned and allocated by the state, grant land is common in cities and towns, but rare in village areas. The state may lease grant land out for extendable periods of ten, thirty, or ninety years. Grant land is transferable, is subject to land tax and may be reacquired by the state during a lease period in accordance with laws governing compulsory acquisition.
3	Farmland	The Farmland Law of 2012 has replaced the earlier classification of Agricultural Land with Farmland. Farmland includes garden land; paddy lands; dry land (ya); alluvial land (kiang); perennial plant land; coastal land (dhani); shifting cultivation land (taungya); alluvial islands; and land for growing vegetables and flowers.  Farmland is transferable through sale, lease, inheritance and donation, with the condition that transfers must be registered with the state. Farmland rights may also be "pawned" as security for a loan, with the condition that the loan can only be used to finance agricultural production. Unless the user obtains express permission for other uses, land held under a farmland use right must be used for permitted purposes. The user cannot allow the farmland to remain fallow without sound reason and cannot transfer the use right to a foreigner or an organization that includes a foreigner without state permission.
4	Grazing land	Grazing land is for use by cattle of nearby villagers and is protected from trespassers and is not subject to land taxes.
5	Town land	While in most cases, town land is the same as freehold land or grant land, an exception exists in reference to La Na 39 land. This category is provided for in the article 39 of the Land Nationalization Act 1953. This land is defined as farmland that has been re-categorised for another purpose. This land is transferable and those who have it registered under their name must pay land tax to



No	Land Type	Description
		the government.
6	Village land	Village land is land located outside the parameters of town land and can either be grant land or La Na 39 land. Village land is transferable, but only if it has been transformed into La Na 39 land or grant land. Those with village land must pay land tax to the government unless their plot is less than one-fourth of an acre and occupied by a building.
7	Cantonment Land	Cantonment land is land that the state has acquired for the military's exclusive use. When an area is earmarked as cantonment land, the government issues a declaration of the designation, and the state acquires it under the Land Acquisition Act, which provides that owners should be compensated if the land was classified as freehold land, grant land or La Na 39 land. The military is required to surrender cantonment land to the government once it is no longer necessary for military use.
8	Monastery Land	Monastery land is that which the Ministry of Home Affairs has declared as such. If that land is freehold land, grant land, La Na 39 land or farmland, the government must invoke the Land Acquisition Act, and the state must pay compensation to the right holders before acquiring the land for use as monastery land. Land classified as monastery land is not subject to land taxes and retains its classification for eternity.
9	Vacant, Fallow and Virgin Land	According to the VFV Law, land users who hold use rights to vacant, fallow or virgin land cannot mortgage, give, sell, lease or otherwise transfer or divide land without permission from the Cabinet of the Union Government. The seven categories of use of these lands are as follows: <ul style="list-style-type: none"> <li>• Perennial plants and industrial crops;</li> <li>• Orchards;</li> <li>• Use by a rural farmer and a family;</li> <li>• Aquaculture;</li> <li>• Breeding and raising of livestock and poultry;</li> <li>• Mining; and</li> <li>• Other.</li> </ul>

Source: USAID Country Profile: Property Rights and Resource Governance, Burma

Apart from these statutory tenures, there also exist customary tenures, which do not enjoy formal legal recognition. These tenures, though declining, play an important role in the ethnic areas in the Uplands. One such customary tenure is as identified by the Karen group. In practicing shifting cultivation, the Karen population classifies forest areas as rotational farms, irrigated farms, orchard farms, communal forest, grazing land and sacred forest.

### **Livelihood Profile**

Myanmar's economy is heavily dependent upon the natural resources and agriculture. While very limited data is available on the economic profile of the country, the *Table 4.5* provides a summary of the basic economic profile of the country.

**Table 4.5**      *Economic Profile of Myanmar*

Attribute	Number
GDP (Billions current US\$) (2014)	60.29
GDP per capita (current US\$) (2014)	910.36
GNI (current US\$) (2012)	1,126
Labour Force Participation (female) (%) (2011)	75
Labour Force Participation (male) (%) (2011)	84.9
Labour Force Participation (total) (%) (2011)	81.9

Source: <http://data.worldbank.org/country/myanmar> and <http://knoema.com/IMFWEO2014Apr/imf-world-economic-outlook-april-2014?country=1001140-myanmar>

Myanmar characterised by a GDP of US\$55,320 is amongst the countries with the lowest GDP in the world and is significantly lower than the GDP across South Asia at US\$2,303,123.

The economic growth in recent years has averaged at 5% with a per capita income of US\$ 702. Issues such as inadequate infrastructure, limited access to finance, limited access to agricultural and off-farm ‘know-how’ and administrative constraints have resulted in a stagnation of the non-urban economy. This is also reflected in the high poverty levels in the country, with 26% of the population falling below the poverty levels (below US\$ 1.25 per day).

Some of the key sources of income are agriculture, natural resources, employment in the service sector and casual labour.

#### Agriculture

The agriculture in the country varies across the regions. The Uplands are increasingly characterised by a high dominance of rain-fed paddy. On the other hand, the Dry Zone is characterised by commercial farming of cash crops such as sesame, pulses, beans, potatoes, tomatoes, cotton, onions and vegetables. Of these, the crops sesame, pulses and beans are grown for mostly export. The Irrawaddy Delta has mostly paddy cultivation and is identified as the centre of the country’s rice economy, responsible for a large share of the country’s rice export. Myanmar is the 6<sup>th</sup> largest rice exporter in the world, with estimated 1.5 metric tons in export in 2012. This can be seen in the fact that 25% of the households in the region identify paddy cultivation as its most important income source. Rice farmers reportedly keep 25% of the produce for self-consumption and next year’s seeds while 75% is sold in the market. Since 2008, the government has also been encouraging large-scale monoculture plantations of cassava, sugar cane, rice, jatropha, palm oil and rubber, mostly through military- favoured domestic companies.

#### Natural Resource Based Income

Myanmar has rich natural resource reserves including oil and gas, minerals, precious stones and gems (ruby, sapphire, diamond, spinel etc), timber and forest products, hydropower potential etc. Of these, natural gas, rubies, jade and timber logs comprise of a substantial proportion of the national income.

While the Northern Shan Plateau is characterised by deposits of silver, lead, zinc and gold, the Tenasserim region is identified for tin and tungsten while Maymyo in the central basin is known for its reserves of barite. Myanmar also has major coal deposits, mostly concentrated in the upper Irrawaddy and Chindwin valleys.

#### Non-Farm based Activities

Issues such as frequent droughts, floods and landslides, increasing land degradation, increasing population density, loss of natural vegetation, soil erosion, deterioration of soil fertility, increase in extractive industrial activities etc. have resulted in an increasing shift towards non-farm based activities. In terms of non-farm based livelihoods, the main sectors include the industrial and service sectors. The main industries in the country include agricultural processing, wood and wood products, copper, tin, tungsten, iron, cement, construction materials, pharmaceuticals, fertilizers, oil and natural gas, garments etc.

While manufacturing sector has grown in the country since its independence, its growth rate is slower than that across the other countries in the region. The main enterprises in the sector comprise of tobacco producing factories and cottage industries, producing cigarettes and cheroots (a type of small cigar). Apart from this, the other major manufacturing sectors include steel processing, nonelectrical machinery and transportation equipment production, cement production and textiles. While the textile industry has played a crucial role in the areas of Yangon, Myingyan and other cities, the growth of the industry has slowed down since the late 20<sup>th</sup> century due to international sanctions.

#### Water and Sanitation

While limited information is available pertaining to the country's water availability and quality and sanitation facilities, it is understood that the country is characterised by a lack of effective delivery of basic services such as water and sanitation. According to a United Nations Children's Fund (UNICEF) survey undertaken in 1995 and 1996, 59.7% of the total population has access to safe drinking water, while the rural urban proportions were 50 and 78.5%, respectively. The common sources of drinking water are in the form of open wells, springs, rivers or ponds. Most of the villages do not have access to piped water supply and require the households to walk a certain distance to collect water. This task of collecting the water usually falls upon the women and children. The situation is reported to be aggravated during the dry months when due to the drying up of local sources, at times, women and children have to walk several miles for water, or even resort of consumption of contaminated water in situations where safe water is not readily available. The country is characterised by common practices of open defecation, especially in rural areas, and generally poor sanitation knowledge and standards.

## Transport and Communication

The infrastructure in the country is reported to be severely inadequate. The main forms of transport are road, rail and water ways. The railways are reported to be old and rudimentary, having undergone minimal maintenance since their construction in the 19<sup>th</sup> century. Outside of the major cities, the highways are mostly unpaved. In terms of electricity, despite the large deposits of natural gas, the electricity supply in the country is from fossil fuels. However, hydroelectricity is increasingly accounting for a significant portion of the total power supply. Most of the hydropower projects are located on the five main rivers in the country, namely, Irrawaddy, Chindwin, Salween, Sittaung and Tenasserim. About 73% of the population lacks access to electricity and the consumption of electricity is one of the lowest in the world – 20 times less than the world average. Existing power infrastructure can only meet about half of the current demand, resulting in frequent blackouts and rationing of the electricity supply. Telecommunications and internet access are also very limited.

## Education Profile

The country's education system is classified into two sectors: the basic education sub-sector and the higher education sub-sector. The basic education system comprises of 3 years of lower primary level, 2 years in upper primary level, 4 years at lower secondary level and 2 years in upper secondary level. This is followed by a matriculation examination. The education system is based on the United Kingdom's system. Almost all the schools are government operated, however, there has been an increase in the number of privately funded English language schools. Schooling is compulsory till the elementary school level. The following *Table 4.6* provides a summary of the literacy profile the country.

**Table 4.6**      ***Literacy Rate of Myanmar (2012)***

Attribute	Number
Total Literacy Rate (15+ years)	92.68
Male Literacy Rate (15+ years)	95.09
Female Literacy Rate (15+ years)	90.37

Source: <http://data.worldbank.org/country/myanmar>

The high literacy rates, prevalent since independence are associated with the presence of Burmese schools as well as monastic schools, which play a major role in the education of poorer sections of society. While the overall literacy rate is reported to be high, as a result of widespread poverty, only a small percentage of children continue their formal education after primary school. Many schools are under-resourced, lacking essential equipment such as desks and chairs. During the devastating Cyclone Nargis, more than 4,000 schools were either damaged or completely destroyed further limiting access to education for many children. Also, during the socialist regime, the education system is reported to have suffered in terms of the maintenance of infrastructure, teacher education and pay. Furthermore, while during this

period Burmese was made the medium for teaching at all schools, English remained the language at the higher education levels, which in turn resulted in a large proportion of population discontinuing their education.

### Health Profile

As can be seen from the following *Table 4.7*, Myanmar has high rates of infant, under-five and maternal mortality. The country is also characterised by a high prevalence of HIV/AIDS, tuberculosis and malaria. Access to health care facilities is extremely poor outside of the major cities and towns, with only 0.5-3 % of the GDP being allocated to health. While the health care, provided by the government is nominally free, public hospitals lack basic facilities and equipment and often require the patients to pay for their own treatment and medicine.

**Table 4.7** *Health Profile of Myanmar*

Attribute	Number
Life Expectancy (years)	65.2
Infant mortality rate (2010)	50
Under-5 mortality rate (2010)	66
Neonatal mortality rate (2010)	32
Maternal mortality ratio (2010)	200
Fertility Rate (live births per woman) (2010-2015)	1.9

Source: [http://www.unicef.org/eapro/MNH\\_Myanmar.pdf](http://www.unicef.org/eapro/MNH_Myanmar.pdf)

The main diseases in the country pertain to water borne diseases such as diarrhoea, Hepatitis A and typhoid, which are attributed to the poor sanitation facilities in the country. Also due to the poor hygiene, health problems such as intestinal worms and skin diseases are common.

The top causes of death in the country include coronary heart disease, influenza and pneumonia, stroke, tuberculosis, lung diseases, HIV/AIDS, hypertension, malaria, Hepatitis B, drug use, syphilis, peptic ulcer disease, rheumatic heart disease and oral cancer. Of these, the deaths by Hepatitis B, drug use, syphilis, peptic ulcer disease, rheumatic heart disease and oral cancer are the highest in the world. *Bago Region Profile*

The following sub sections provide the socio-economic profile for the Bago Region where the block is located.

### Demographic Profile

The Bago Region is located in the southern central Myanmar and is bordered by Mandalay and Magway division and the Union Territory of Nay Pyi Taw to the north, Mon and Kayin States and the Andaman Sea to the east, Yangon divisions to the south and Ayeyarwady region and Rakhine to the west. The following *Table 4.8* provides an understanding of the brief demographic profile of the region.



**Table 4.8**      *Demographic Profile of the Bago Region*

Attribute	Bago
Districts	4
Townships	28
Wards	254
Village Tracts	1,423
Villages	6,564
Total Population	4,848,206
Area (km <sup>2</sup> )	39,404.6
Population Density (persons per km <sup>2</sup> )	123
Sex Ratio (females per thousand males)	920
Rural Population	40,303,376
Urban Population	817,830
Population in the age group 0-14 years	1,379,892

*Source:* Bago Region Profile Final.

As can be seen from the above table, the Bago Region is characterized by a population of 4,848,206 individuals over an area of 39,404.6 km<sup>2</sup>. It is geographically divided by the Pegu mountain range that runs from north to south through the middle of the region, into Bago East and West. The Bago West is identified as the part of the region which is sloped towards the Ayeyarwady River and forms a part of the Ayeyarwady Delta, while the Bago East is consisted mainly of the floodplains of the Sittaung River.

The population of the region is approximately 9.5% of the total population of the country and has a sex ratio of 920 females per thousand males, which is very close to the national sex ratio of 930. Of this population ~17% is reported to be comprised of urban population.

### Social Groups

The population of the region is comprised of dominantly Bamar Buddhist, along with Kayins, Shans, Paos and Mons as well as people of South Asian and Chinese origin.

**Shans:** Though current census information for Burma is unavailable, there are an estimated 4-6 million Shan in Burma. There are many smaller ethnic groups in Shan State as well, including the Kokang, Lahu, Palaung, Pao and Wa. While most Shan are Theravada Buddhists, Christianity is also practiced among a number of the other ethnic groups in Shan State. In 1947, Shan leaders signed the Panglong Agreement with the Government of Burma, which aimed to create a unified Burma in which Shan State would be largely autonomous, and would have the option to secede from the Union after 10 years of independence.

**Mon:** The Mon people live mostly in Mon State, which is situated in the Southern part of Burma and borders Bago (formerly Pegu) Region, Tanintharyi (formerly Tenasserim) Region and Karen State. It also has access to the Andaman Sea. The Mon are considered to be one of the first peoples in the Southeast Asia and the earliest one to settle in Burma. They were

responsible for spreading Theravada Buddhism, the oldest school of the religion, in Burma and Thailand. Currently, there are estimated to be around 8 million Mon people in Burma. The Mon culture is very rich and ancient. It is credited for having a major influence on the dominant Burmese culture and the Mon script was incorporated into the unified Burmese language.

#### Land Use

The Bago Region falls in the Ayeyarwady Delta. The land in the region is fertile and low lying and is characterised by a soil type of thick alluvium brought down by the Ayeyarwady River. Three main types of soil are reported to be found in the area, meadow gleyey clay soils, meadow swampy soils and saline gleyey soils.

In the Bago West, which is part of the Ayeyarwady Delta, the average farm size per household is 11.2 acres (~4.5 ha) according to a UNDP report and is ranked amongst the highest in terms of farmland size per household. One of the possible reasons identified for this is that the process of settling of immigrants in the delta started only around 100 years ago, thereby making it easy for people to expand their lands. However, due to the high rate of population increase, the ratio of landless farmers in the delta reached non-negligible level. Some people lost their tiller's right to cover school expense or medical payment. There is a big difference between land right holders and landless households in terms of household income. Average household income of the land right holders is more than double than that of landless households.

## Education Profile

In terms of education profile of the region, the trends in Bago are reported to be comparable to that of Myanmar. It is reported that pre-school attendance amongst children aged 3-5 years is low, with only about a fifth of the children attending pre-school in the Bago East. On the other hand, the primary school enrollment rate in Bago East is 87% while that for Bago West is 81%.

However, it is reported that of those enrolled in primary schools, only 51% in Bago West and 44% in Bago East complete schooling on time. Pyay District has three universities which are Pyay University (PU), Pyay Technological University (PTU) and Government Computer University (GCU) <sup>(1)</sup>.

## Livelihood Profile

The Bago Region is characterised by features of both mountains and floodplains, which also plays a role in the livelihood profile of the region. While the forest cover of the mountains serves an important purpose for teak production, the floodplains are used for rice production and other crops such as betel nut, sugarcane, maize, sesame, black gram, green bean, pigeon pea, groundnut, sunflower, beans and pulses, rubber etc. Apart from this, the region also has a proportion of mining and industries, primarily for petroleum production and some processing of agriculture and forest products, including salt, ceramics, sugar, paper, plywood, distilleries and monosodium glutamate (MSG).

While most of the agricultural production is undertaken on small farms, the region plays a critical role in the rice production in the country, being the second largest producer of rice, after Ayeyarwady.

## Social and Physical Infrastructure

### Water and Sanitation

The main sources of drinking water for the region are in the form of private and public taps, deep wells, hand dug wells and open ponds. Most (81.3%) of the region is reported to have access to these services within a radius of 30 minutes.

However, in terms of sanitation facilities, according to the multiple Indicator Cluster Survey (MICS-2010) approximately 12% and 20% of the households in Bago West and Bago East, respectively, do not have access to improved sanitation and 2% and 6% reported practicing open defecation. The Knowledge, Attitude and Practice (KAP-2011) Survey on Water and Sanitation revealed that the situation may actually be much worse, especially in some areas. For example, in Paukkhaung Township (Bago West), almost 44% of households were not using improved latrines and 10% were practicing open defecation.

<sup>(5)</sup> [http://www.unicef.org/myanmar/Bago\\_Region\\_Profile\\_Final.pdf](http://www.unicef.org/myanmar/Bago_Region_Profile_Final.pdf), accessed 21 Oct 2014

## Health Seeking Behaviour

The health services in the region are provided partly by private health facilities (including private clinics, dispensaries, traditional doctors and auxiliary midwives) and partly by the Ministry of Health along with support from various international Non-governmental Organisations (NGOs).

The health services in the region are reported to be comparable to the national averages. However, children in Bago, especially Bago East, are less likely than the average Myanmar child to be born in a health facility where life-saving obstetric care would be available in case of complications. On the other hand, the immunisation rates are reported to be higher, while comparable to the national average. The use of oral rehydration therapy (ORT), to prevent life-threatening dehydration associated with diarrhoea among children, is employed in only 59% of cases in Bago East.

Prevalence of diarrhoea among children aged 0-59 months in Myanmar has increased from about 4% in 2003 to almost 7% in 2009-2010. While diarrhoea prevalence has remained at about 5% in Bago West during the same period, it has increased from 3% to 11% in Bago East.

Furthermore, among those reached by the public health system, fewer than half the pregnant women in Bago (West and East) are likely to be tested for HIV and receive the test result. While use of ART for PMTCT (prevention of mother-to-child transmission) is higher in Bago than the national average, HIV-testing for infants born to HIV-positive mothers within the prescribed period of 2 months after birth is reported to be low, varying from 4% in the West to 14% in the East.

## Areas of Cultural Significance

The Bago Region historically was the capital of the Mon ethnic group and was the capital of the independent Mon Kingdom of the same name. Apart from its political importance, the region has a significant religious significance, primarily stemming from the legend of Buddha travelling around Southeast Asia eight years after his enlightenment and saw a pair of “Hamsa” birds on a small piece of land where the Bago Region is now. As a result of this, the city acquired various Buddha relics and is a major pilgrimage site with several sacred structures built in the 15<sup>th</sup> - 16<sup>th</sup> century. The region presently is characterized by ancient ruins and numerous restored pagodas, some of the main sites in the region are as follows:

- **Shwemawdaw Paya:** this is the tallest pagoda in the country at a height of 375 feet, it is also known as the Golden God Temple. It was originally built in the 8<sup>th</sup> century and has over time been enlarged on numerous occasions, usually following severe earthquakes. The majestic gold-encrusted pagoda takes on the shape of a spire, which was reportedly built by two merchants to house the strands of hair and teeth of the

Buddha. This is reported to be one of the holiest sites in the region and is one of the pilgrimages in Buddhism.

- **The Shwethalyaung Buddha:** the Shwethayaung Buddha is the second largest Buddha in the world with a length of 180 feet and height of 54 feet and is reported to have been built more than 1,000 years ago. The reclining Buddha depicts Gautum Buddha on the eve of his entry into Nirvana.
- **Kanbawzathadi Palace:** the Palace is the home of the 16<sup>th</sup> century royal king Bayinnaung, who was the founder of the Second Myanmar Empire. Though the site was burnt down hundreds of years ago, the golden structure has been thoroughly excavated, revealing structure after structure of this nearly 10-acre complex, and is now almost entirely rebuilt. The palace grounds are adorned with traditional art, statues, and paintings, and beautiful gold embroidered designs on the maroon bases of the palace pillars.
- **Maha Kalyani Sima:** this hall was built in the 15<sup>th</sup> century and has served as the Sacred Hall of Ordination for Theravada Buddhists.
- **Kyaikpun Paya:** Another of Bago's famous Buddha images, the Kyaikpun Paya, depicts four enormous and different images of Buddha. Each are nearly 100 feet (30 meters) tall and are sitting in meditation pose in golden robes almost back-to-back against a cube-shaped pillar, facing the four cardinal directions of the compass.

#### *Project Area Profile*

This sub section provides an understanding of the socio-economic environment of the Project Site in terms of the demographic profile of the region, the economic resources, the health conditions, education and cultural resources of the community.

#### *Populated Areas*

Populated areas in the Bago Region and in or around Block IOR-4 include:

- Pyay District (population of approximately 251,145 people covering an area of 784km<sup>2</sup>) <sup>(1)</sup>;
- Shwedaung Township (population of approximately 121,401 people covering and area of 174 km<sup>2</sup>) <sup>(2)</sup>;
- Kyangin Township (population of approximately 96,090 people covering and area of 1,154km<sup>2</sup>) <sup>(3)</sup>; and

<sup>(1)</sup> <http://www.citypopulation.de/php/myanmar-admin.php?adm2id=070301>, accessed 21 October 2014

<sup>(2)</sup> <http://www.citypopulation.de/php/myanmar-admin.php?adm2id=070306>, accessed 21 October 2014

<sup>(3)</sup> <http://www.citypopulation.de/php/myanmar-admin.php?adm2id=140601>, accessed 21 October 2014



- Inn Ma Township (information on population and area not available from the latest census).

Preliminary assessment of aerial imagery also indicates that there are several smaller settlements located across Block IOR-4.

#### *Economic Resources*

The villages in the Pyay District are reported to not have access to irrigation sources, resulting in single season cultivation. However, given the presence of a number of reservoirs in the block, certain areas are expected to have access to irrigation sources throughout the year. The main crops grown are rice, chilli, long bean and ground nut (*Figure 4.15*). While the chili, long bean and ground nut are grown as household use, rice is the main cash crop in the area. The crop yield for rice is maximum 50 to minimum 20 baskets per acre, where 1 basket is equivalent to 1.6 kg. The market rate is about 420,000 MMK per 100 baskets during cultivating season and 600,000 MMK in ploughing season. One of the key issues with agricultural productivity identified by the community is the low returns on the crop due to the high price of agricultural input.

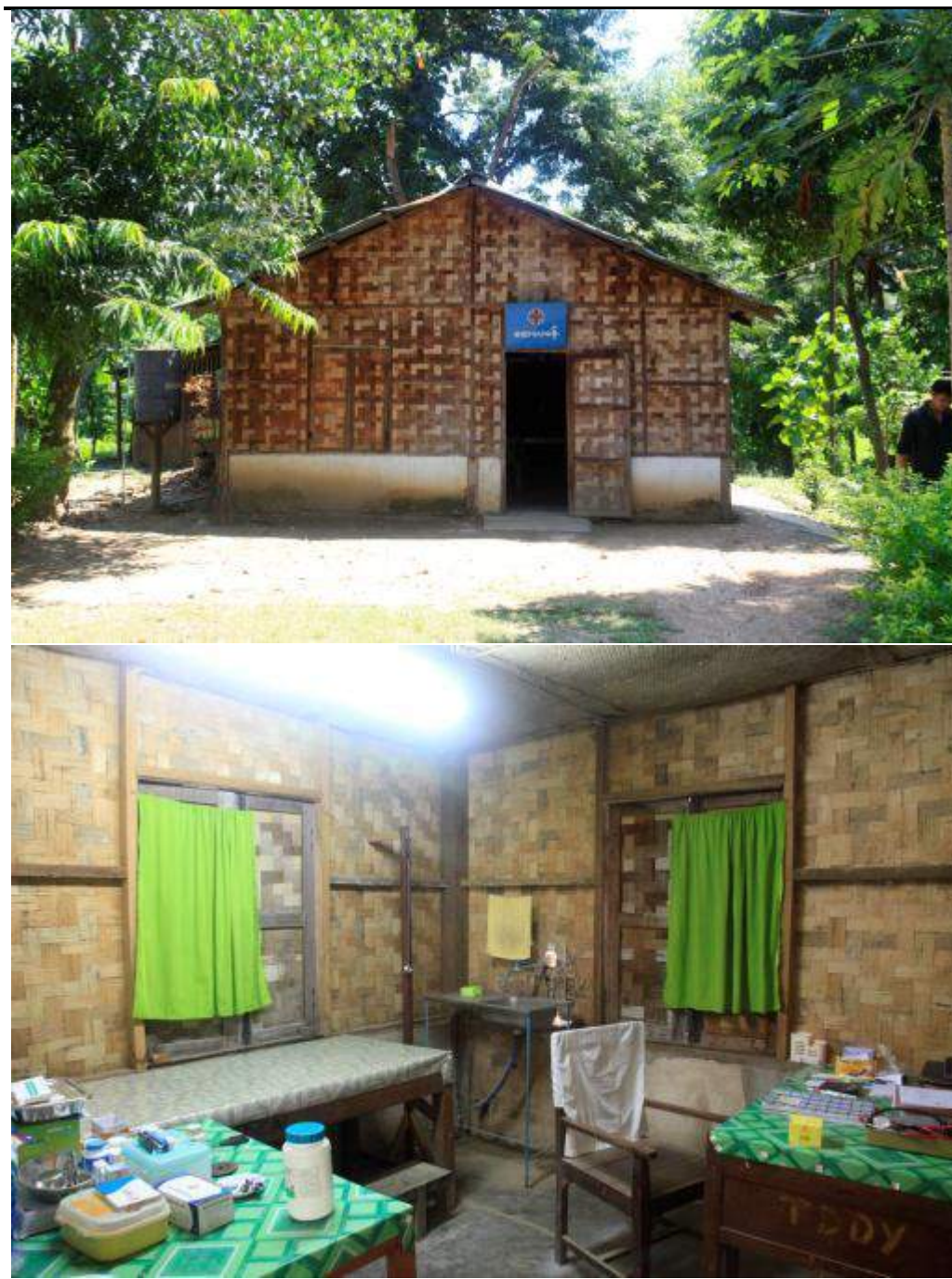
**Figure 4.15** *Cultivated Area recorded within Block IOR-4 during the Site Visit as part of the Scoping Exercise in October 2014*



#### *Demographic and Health Conditions*

According to the information made available, it is understood that most of the villages in the Pyay District have access to one rural health center and one mid wife each (*Figure 4.16*). Also, due to the difficulties in transportation to the towns, most of the villagers rely on the health center in the village.

**Figure 4.16**     *Photos of Medical Facility in Pyay taken during the Site Visit as part of the Scoping Exercise in October 2014*

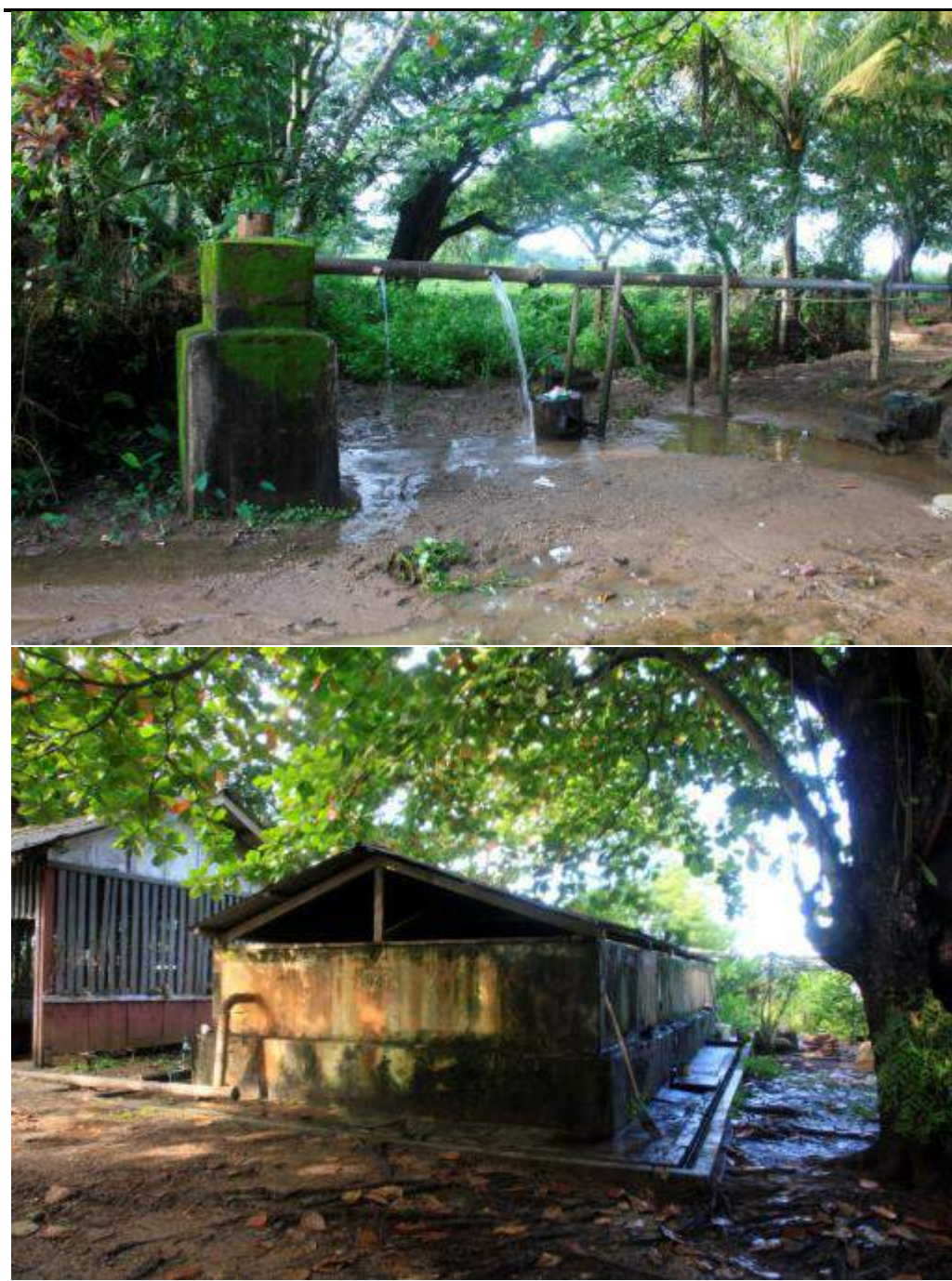


### *Water Supply*

During the consultations undertaken in October 2014, the local community reported dependence upon deep tube wells and hand dug wells for water use (Figure 4.17). While the deep tube wells are usually located at 100 - 500 feet in the villages, the hand dug wells are at about 7 to 10 feet deep. During the dry season, communities in Tae Gyi Gone are reported of using water from a well located at least 30 minutes away.



**Figure 4.17**     *Photos of Water Supply Facilities in Pyay taken during the Site Visit as part of the Scoping Exercise in October 2014*



### *Cultural Heritage*

The irrigated landscape as a result of the Pyu era archaeological remains is still impacting on the rural livelihoods of the modern population of all three Pyu ancient cities, including those of Sri Ksetra and possibly parts of Block IOR-4 (*Figure 4.18*). Furthermore, due to the close proximity of the site, it has been noted that from the walled site of Sri Ksetra immediately adjacent to the Myinbahu mountain range it was possible to trek along the ridge to the south to the satellite town of Thegon, where brick walls and artefacts testify to the use of this route during the Pyu times. Areas of this path may include parts

of the hilled areas of IOR-4 and thus there may be potential for chance finds or the presence of artefacts or items of cultural heritage.

**Figure 4.18** *Photos of Historical Site recorded during the Site Visit as part of the Scoping Exercise in October 2014*





From the literature review of desktop information presented above, it is revealed that significant information gaps existed on the physical, biological and socio-economic environment within Block IOR-4. These data gaps would require to be filled in for the understanding of potentially significant impacts from the Project and derivation of appropriate mitigation measures to control such impacts to the environmental and social receptors. Thus, the baseline surveys of the following aspects were conducted prior to the commencement of the Project to address the key environmental, social and health issues:

For the impact assessment of both seismic survey and workover activities

- Biological Environment
  - Habitat mapping and vegetation surveys
  - Terrestrial fauna surveys, including avifauna (birds), mammals, herpetofauna (amphibians and reptiles) and butterflies
  - Aquatic fauna
- Human Environment
  - Household survey
  - Stakeholder consultation

For the impact assessment of workover activities only:

- Physical Environment
  - Ambient air quality
  - Acoustic environment
  - Groundwater
  - Surface water
  - Soil quality

The methodology and findings of surveys for physical, biological and human environment are detailed in the following *Sections 4.4-6*.



## 4.4 BASELINE SURVEYS FOR PHYSICAL ENVIRONMENT

### 4.4.1 Air Quality

#### *Methodology*

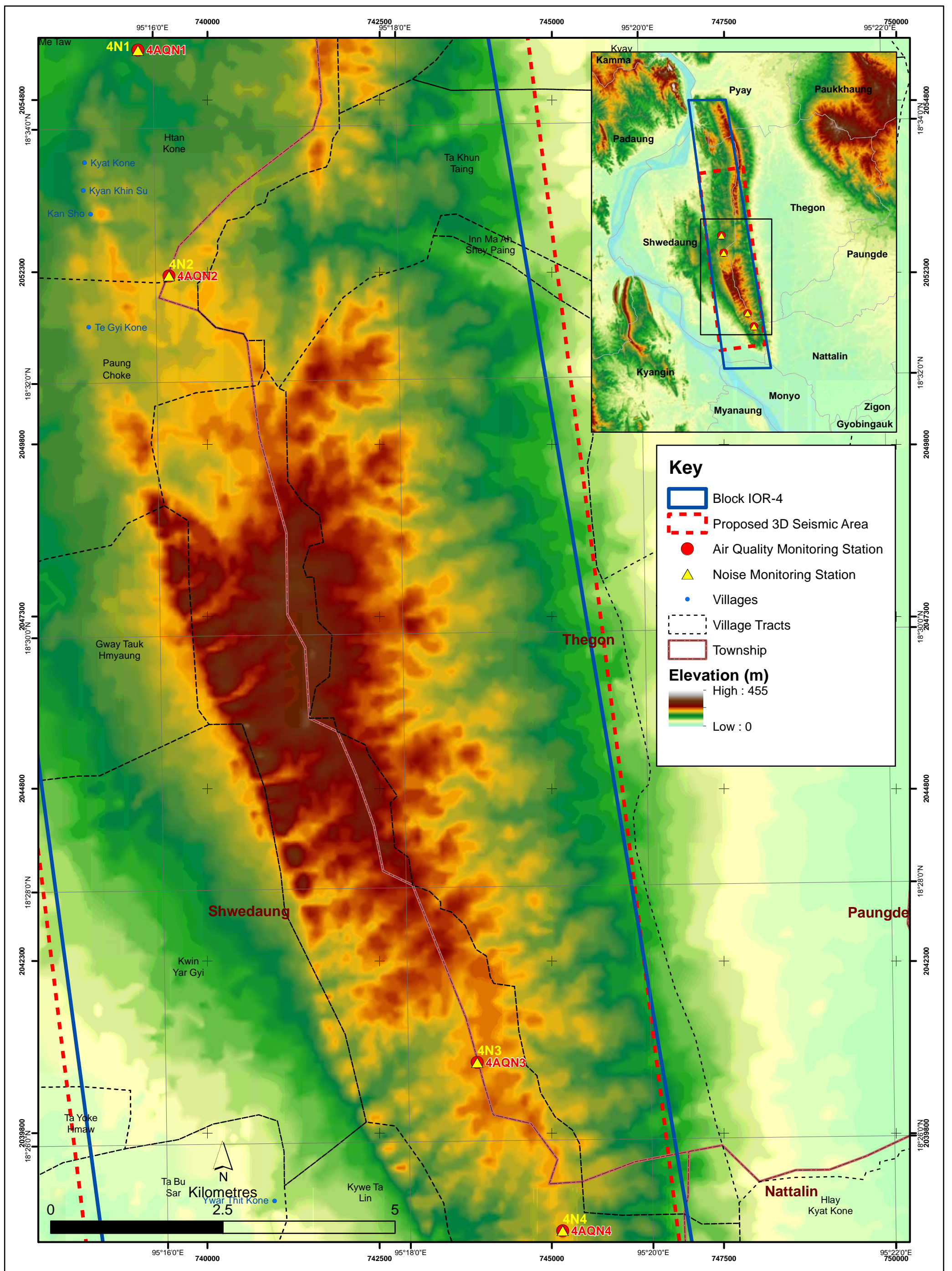
Four air quality monitoring stations (4AQN1, 4AQN2, 4AQN3 and 4AQN4) were set up within the core area for the proposed activities in Block IOR-4. The designated monitoring stations are chosen to assess the potential impacts to the air sensitive receivers (ASRs) in the Project Area due to dust-generating land-based activities of the workover activities. Details of the monitoring location are shown in *Table 4.9* and illustrated in *Figure 4.19*. The surrounding environment of the air quality monitoring stations is showed in *Figure 4.20*.

**Table 4.9** *Ambient Air Quality Monitoring Stations*

Sampling Point	GPS Coordinates	Description	Land Use
4AQN1	18°34'37.15" N 95°15'52.49" E	In the golf playground near MOGE guest house, north of Wadawtha village.	Bare ground
4AQN2	18°32'50.33" N 95°16'6.40" E	At just beside of GOCS No.3 compound, Pyay Oil Field.	Bare ground
4AQN3	18°26'37.15" N 95°18'33.99" E	In the compound of High Pressure Natural Gas Compression (HGC), Pyay Oil Field.	Bare ground
4AQN4	18°25'17.15" N 95°19'15.21" E	At north of MOGE police station in Pyay oil Field.	Agricultural Land

#### Monitoring Parameters and Equipment

Sampling and analysis of ambient air pollutants was conducted accordingly to the guidelines of United States Environmental Protection Agency (U.S. EPA). The Haz-Scanner EPAS Wireless Environmental Perimeter Air Station was used to collect Ambient Air Monitoring data, which is a portable monitor recorded real time data that directly logged the ambient air quality measurements as well as climatological data. The air quality parameters and meteorological data collected in the current survey are listed in *Table 4.10*.





**Figure 4.20**     *Surrounding Environment of Ambient Air Quality and Noise Monitoring Stations*



↑ Station: 4AQN1/ 4N1



↑ Station: 4AQN2/ 4N2

**Figure 4.20b** *Surrounding Environment of Ambient Air Quality and Noise Monitoring Stations*



↑ Station: 4AQN3/ 4N3



↑ Station: 4AQN4/ 4N4



**Table 4.10** *Parameters measured by the Haz-Scanner EPAS Wireless Environmental Perimeter Air Station*

Parameters	Unit	Method and Duration
<u>Air Quality</u>		In situ reading for 24-hour
Sulfur dioxide (SO <sub>2</sub> )	ppm	
Carbon monoxide (CO)	ppm	
Nitric oxide (NO)	ppm	
Nitrogen dioxides (NO <sub>2</sub> )	ppm	
Particulate matter < 2.5 μm (PM2.5)	mg/m <sup>3</sup>	
Particulate matter < 10 μm (PM10)	mg/m <sup>3</sup>	
<u>Meteorological Data</u>		
Relative Humidity (R.H.)	%	
Temperature	°C	
Wind speed	kph	
Wind direction	-	

#### Monitoring Period and Frequency

The ambient air quality and the meteorological data were collected at the four designated air quality monitoring station for 24-hour in December 2014. The sampling dates and hours are summarised in *Table 4.11*.

**Table 4.11** *Sampling Dates and Hours for Ambient Air Quality and Meteorology*

Monitoring Station	Sampling Date	Sampling Hour
4AQN1	23 – 24 December 2014	1200 to 1200 hour
4AQN2	23 – 24 December 2014	1230 to 1230 hour
4AQN3	22 – 23 December 2014	0930 to 0930 hour
4AQN4	22 – 23 December 2014	1030 to 1030 hour

#### *Baseline Air Quality Results*

The monitoring results for air quality and meteorological information are summarized in *Table 4.12*.

The major dust sources in the monitoring period included activities at the existing oil production activities and traffic emission. All air quality parameters are well below the assessment criteria, except for the mean PM2.5 at 4AQN2 which are slightly higher than the IFC's 24-hour average guideline value in some occasions. It is useful to note that 4AQN2 is nearby the traffic road (~ 30m) which may lead to the higher PM2.5 level recorded there.



**Table 4.12 Summary of Baseline Air Quality Monitoring Results in December 2014**

Station	CO (ppm) (min - max)	NO2 (ppm) (min - max)	NO (ppm). (min - max)	PM2.5 (mg/m <sup>3</sup> ) (min - max)	PM10 (mg/m <sup>3</sup> ) (min - max)	SO2 (ppm) (min - max)	Temperature (°C) (min - max)	Relative Humidity (%) (min - max)	Wind Speed (m/s) (min - max)	Wind Direction
4AQN1	0.24	0.04	0.11	0.018	0.04	< 0.01	22.02	72.2	0.13	Southeast
	(< 0.01 - 1.05)	(< 0.01 - 0.1)	(< 0.01 - 3.1)	(0.001 - 0.127)	(0.01 - 0.15)	(< 0.01 - 0.08)	(15 - 37)	(28 - 99)	(0 - 1.67)	
4AQN2	0.26	0.03	0.01	0.026	0.03	< 0.01	21.2	69.24	0.07	Southeast
	(< 0.01 - 1.12)	(< 0.01 - 0.07)	(< 0.01 - 0.3)	(< 0.010 - 0.104)	(0 - 0.08)	(< 0.01 - 0.05)	(15 - 31)	(34 - 97)	(0 - 1.13)	
4AQN3	0.25	0.04	< 0.01	0.025	0.03	< 0.01	21.26	69.64	0.12	Northwest
	(< 0.01 - 0.56)	(< 0.01 - 0.18)	(< 0.01 - 0.2)	(< 0.01 - 0.089)	(0 - 0.07)	(< 0.01 - 0.03)	(16 - 29)	(42 - 96)	(0 - 1.56)	
4AQN4	0.22	0.05	0.14	0.020	0.04	< 0.01	21.6	67.99	0.03	Northwest
	(< 0.01 - 0.48)	(< 0.01 - 0.21)	(< 0.01 - 7.3)	(0.001 - 0.200)	(0.01 - 0.16)	(< 0.01 - 0.05)	(17 - 31)	(39 - 94)	(0 - 0.92)	
<b>Assessment criteria: IFC Guideline Value</b>										
24-hr	-	-	-	0.025	0.05	-	-	-	-	-
1-hr	-	0.2 mg/m <sup>3</sup>	-	-	-	0.02 mg/m <sup>3</sup>	-	-	-	-

#### 4.4.2

#### Noise

The aim of baseline noise monitoring is to establish the background level at nearby Noise Sensitive Receivers (NSRs).

##### *Methodology*

Four noise monitors were set up to measure background noise levels for 24 hours at the identified NSRs, which was the same location and monitoring period as per the ASRs. Details are shown in *Table 4.13* and illustrated in *Figure 4.19*. The surrounding environment of the noise quality monitoring stations is showed in *Figure 4.20*.

**Table 4.13**      **Noise Monitoring Stations**

Sampling Point	GPS Coordinates	Description	Land use
4N1	18°34'37.15" N 95°15'52.49" E	In the golf playground near MOGE guest house, north of Wadawtha village	Bare ground
4N2	18°32'50.33" N 95°16'6.40" E	At just beside of GOCS No.3 compound, Pyay Oil Field	Bare ground
4N3	18°26'37.15" N 95°18'33.99" E	In the compound of High Pressure Natural Gas Compression (HGC), Pyay Oil Field	Bare ground
4N4	18°25'17.15" N 95°19'15.21" E	At north of MOGE police station in Pyay oil Field	Agricultural Land

The 24-hour baseline noise monitoring was conducted by using the portable sound meter (Lutron, SL-0423SD, unit: dB). Noise level ( $L_{Aeq}$ ) were measured and recorded at a ten-minute interval and averaged at an hourly and daily (i.e. 24-hour) interval using the following formula:

$$L_{Aeq} = 10 * \text{LOG}_{10}(\text{AVERGAE}(10^{((\text{RANGE})/10)}))$$

##### *Baseline Noise Measurements*

The results of baseline noise monitoring are summarized in *Table 4.14*.

Since there is no noise standard of operation activities to receptors in Myanmar, the IFC standards for operational activities were adopted to evaluate the measured noise levels in the area which was in the vicinity of existing oil and gas operations (*Table 4.15*). The results of noise monitoring showed that the hourly and daily noise levels at all monitoring stations were well below the standard as stipulated in the IFC guidelines, and it thus appeared that the existing oil producing facilities were operated in environmentally acceptable manner in relation to noise emissions.

**Table 4.14**      *Hourly  $L_{Aeq}$  Values at the Designated Noise Monitoring Stations*

Monitoring Time	Stations			
	4N1	4N2	4N3	4N4
6:00-7:00	45	39	45	46
7:00-8:00	48	47	45	40
8:00-9:00	58	56	42	42
9:00-10:00	49	45	47	39
10:00-11:00	51	47	47	52
11:00-12:00	48	34	41	40
12:00-13:00	53	46	38	33
13:00-14:00	43	34	35	35
14:00-15:00	41	42	34	33
15:00-16:00	38	36	32	32
16:00-17:00	37	41	35	35
17:00-18:00	44	41	45	35
18:00-19:00	47	37	45	37
19:00-20:00	44	53	42	36
20:00-21:00	52	40	37	37
21:00-22:00	46	36	38	37
Day $L_{Aeq}$	46	42	41	38
22:00-23:00	45	37	37	37
23:00-24:00	41	37	38	38
24:00-1:00	47	37	37	37
1:00-2:00	42	38	38	37
2:00-3:00	41	37	37	37
3:00-4:00	42	37	37	37
4:00-5:00	43	37	37	38
5:00-6:00	44	38	37	37
Night $L_{Aeq}$	43	37	37	37

**Table 4.15**      *IFC Noise standards at Operation Stage*

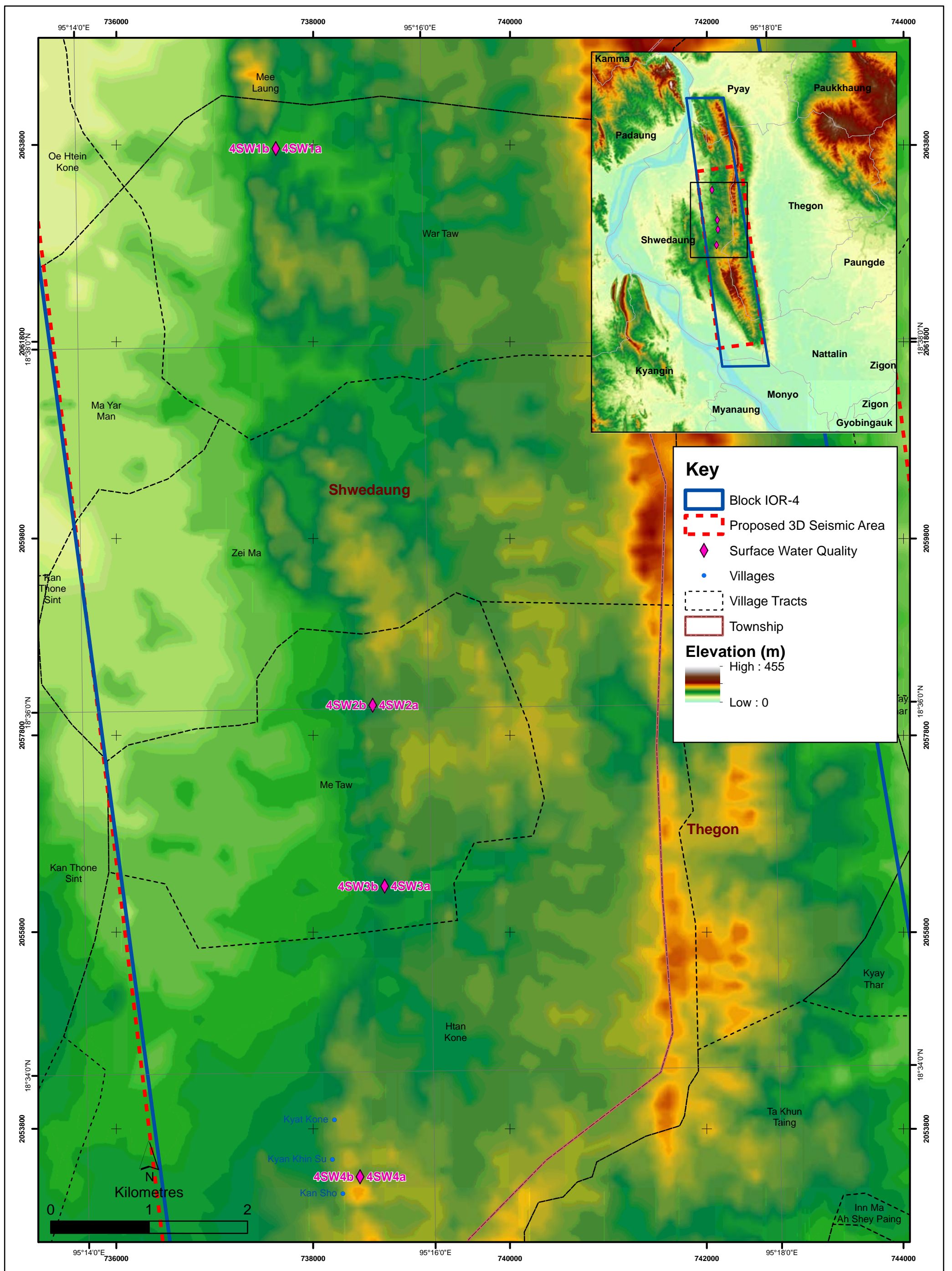
Description	Daytime (Leq, dB) (0700 to 2200, 15 hours)	Nighttime (Leq, dB) (2200 to 0700, 9 hours)
Residential; Institutional; Education	55	45
Industrial; Commercial	70	70

#### 4.4.3      *Surface Water Quality*

##### *Methodology*

##### Sampling Locations

To characterize the surface water quality within the Project Area, surface water sampling was carried out at four locations in December 2014. Details of sampling locations were presented in *Table 4.16* below and indicated in *Figure 4.21*. The surrounding environment of surface water sampling location is shown in *Figure 4.22*.





*Figure 4.22a Surrounding Environment of Surface Water Sampling Locations*



↑ Station: 4SW1



↑ Station: 4SW2



*Figure 4.22b Surrounding Environment of Surface Water Sampling Locations*



↑ Station: 4SW3



↑ Station: 4SW4

**Table 4.16**      *Sampling Locations for Surface Water Quality*

Sampling Location	Coordinates	Description	Sampling Date
4SW1	18°39'5.54" N 95°15'9.29" E	At the western part of Se Gyi Gon dam, east of Nyaung Gyi Gon village, Shwe Taung Township	23 December 2014
4SW2	18°36'1.17" N 95°15'40.40" E	At the western part of Shwe Nyaung Bin dam, east of Kan Tin village, Shwe Taung Township	22 December 2014
4SW3	18°35'1.31" N 95°15'43.75" E	At the western part of Than Tha Yar Aye dam, east of U Yin village, Shwe Taung Township	22 December 2014
4SW4	18°33'25.38" N 95°15'34.04" E	At the Kan Sho lake, East of Kan Sho village, Shwe Taung Township	22 December 2014

### Sampling Procedures

Water samples were taken by Alpha horizontal water sampler and collected in sterilized sample containers. All sampling was in strict accordance with recognized standard procedures. The parameters for *in situ* measures included pH, temperature, dissolved oxygen (DO), electrical conductivity (EC), and turbidity and surface water samples were concurrently collected. Two samples were taken at each sampling location. Samples were then stored at 4 °C for transportation to laboratory analyses under chain-of-custody procedures. The parameters for laboratory analyses were listed in *Table 4.17*. Equipment for surface water sampling is showed in *Table 4.18*.

**Table 4.17**      *Parameters for Laboratory Analyses of Baseline Surface Water Monitoring*

Parameters	Unit
BOD5	mg/L
COD	mg/L
Total Suspended Solids	mg/L
Total Nitrogen	mg/L
Total Phosphorous	mg/L
Total Coliform Bacteria	
Oil and Grease	mg/L
Heavy Metals	

**Table 4.18**      *Equipment for Surface Water Sampling*

Equipment	Brand	Model
Multiparameter (water quality)	HANNA	HI7609829 (with 3 sensors)
pH meter	HANNA	HI 98129
Alpha Bottle (Water Sampler)	Wildlife Supply Company®	-

### *Baseline Surface Water Results*

With reference to *Figure 4.7*, IOR 4 is located within the lower Ayeyarwady River Basin. The total length of lower Ayeyarwady River Basin is 690 km with a total catchment area of 95,600 km<sup>2</sup> and annual surface water of 85.80

km<sup>3</sup> <sup>(1)</sup>. Results of surface water quality monitoring are summarized in *Table 4.19*.

**Table 4.19**      *Result Summary of Surface Water Quality Monitoring*

Item/Sample Name	4SW-1A	4SW-1B	4SW-2A	4SW-2B	4SW-3A	4SW-3B	4SW-4A	4SW-4B
Weather	Slightly Sunny	Slightly Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny
Transparency	High	High	High	High	Medium	Medium	Medium	Medium
Temperature (°C)	24.10	24.10	27.00	27.00	28.30	28.30	21.80	21.80
pH	8.50	8.50	9.07	9.07	8.05	8.05	8.10	8.10
DO (mg/L)	6.25	6.25	6.82	6.82	4.15	4.15	6.42	6.42
EC (µs)	340	340	654	654	368	368	579	579
Turbidity (FNU)	4.40	4.40	41.70	41.70	23.5	23.5	11.6	11.6
Colour	Nil	Nil	15	10	10	10	15	10
Alkalinity	135	135	528	111	171	171	339	399
Hardness	123	144	313	321	159	159	229	228
BOD5 (mg/L)	8	12	15	12	10	14	16	10
COD (mg/L)	32	32	32	32	32	32	32	32
Total Nitrogen (mg/L)	<2	2	<2	5	3	2	4	2
Total Phosphorus (mg/L)	0.034	0.029	0.019	0.065	0.022	0.023	0.039	0.052
Oil and grease (mg/L)	1	<1	1	<1	<1	<1	<1	<1
Total Suspended Solids (mg/L)	<5	<5	15	<5	29	12	8	<5
Total Coliform	<1.8	<1.8	<1.8	<1.8	33	<1.8	<1.8	<1.8

#### 4.4.4      *Groundwater*

##### *Methodology*

To access groundwater quality in the Project Area, a total of four existing residential wells (dug wells and drilled/ tube wells) were sampled. The sampling locations were selected to represent the spatial extent and sensitive receivers in the residential areas of Pyay.

A total of two replicate groundwater samples were collected by sampler or clean bucket at each location. Immediately after collection, the samples were transferred to labelled sample containers containing the necessary preservatives prepared by the laboratory. Samples were then stored at 4 °C for transportation to laboratory analyses under chain-of-custody procedures. The parameters for assessing the groundwater quality are the same as those for the surface water quality monitoring in *Table 4.17*. Details of

<sup>(1)</sup> <http://www.wepa-db.net/pdf/1203forum/10.pdf>

groundwater sampling location are presented in *Table 4.20* and indicated on *Figure 4.23*. The surrounding environment of groundwater sampling is presented in *Figure 4.24*.

**Table 4.20**      *Groundwater Sampling Locations at Block IOR-4*

Sampling Location	Coordinates	Description	Sampling Date
4GW1	18°39'0.54" N 95°14'55.84" E	Well in the middle of Nyaung Gyi Gon village, Shwe Taung Township	23 December 2014
4GW2	18°36'3.84" N 95°15'27.71" E	Tube well at eastern part of Kan Tin village, Shwe Taung Township	22 December 2014
4GW3	18°34'52.49" N 95°15'38.41" E	Well in middle of U Yin village, Shwe Taung Township	22 December 2014
4GW4	18°25'13.21" N 95°16'39.26" E	Tube well in the south of Kywe Da Lin village, Shwe Taung Township	22 December 2014

#### *Baseline Groundwater Quality Monitoring Results*

The aquifer within Block IOR 4 is mainly Alluvian aquifer and Irrawaddian Aquifer (*Figure 4.8*). It is estimated that the groundwater potential in the lower Ayeyarwady region, where IOR 4 is situate at, is approximately 153.25 km<sup>3</sup> <sup>(1)</sup>. Results of groundwater quality monitoring are summarized in *Table 4.21*.

**Table 4.21**      *Results Summary of Groundwater Quality Monitoring*

Item/Sample Name	4GW-1A	4GW-1B	4GW-2A	4GW-2B	4GW-3A	4GW-3B	4GW-4A	4GW-4B
Weather	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny
Transparency	High	High	High	High	High	High	High	High
Temperature (°C)	25.75	25.90	27.30	27.40	26.30	27.10	28.1	28.2
pH	7.26	6.90	7.05	6.93	7.43	7.33	6.73	6.94
DO (mg/l)	3.42	2.90	2.20	1.78	2.81	2.41	2.11	3.34
EC (µs)	1040	1079	2708	2426	1746	1790	191	267
Turbidity (FNU)	3.70	1.2	5.00	5.50	1.50	1.60	0.40	0.40
Colour	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Alkalinity	422	356	620	572	495	504	91	150
Hardness	314	406	1065	972	769	669	65	106
BOD5 (mg/l)	8	10	8	7	12	12	8	8
COD (mg/l)	32	32	32	32	32	32	32	32
Total Nitrogen (mg/l)	<2	<2	<2	<2	<2	3	<2	<2
Total Phosphorus (mg/l)	1.016	0.444	0.022	0.084	0.031	0.112	0.048	0.119
Oil and grease (mg/l)	<1	<1	1	<1	<1	<1	*	<1
TSS (mg/l)	<5	<5	29	<5	<5	<5	<5	<5
Total Coliform	>23	>23	<1.1	<1.1	5.1	1.1	<1.1	<1.1
*Note :Water sample bottle for oil and grease test of 4GW-4A was damaged during sample transportation.								

<sup>(1)</sup> <http://danishwater.dk/wp-content/uploads/2013/09/Ministry-of-Agriculture-and-Irrigation-Department-of-Water-Resources-Utilization-Sustainable-Development-and-Management-of-Groundwater-in-Myanmar.pdf>



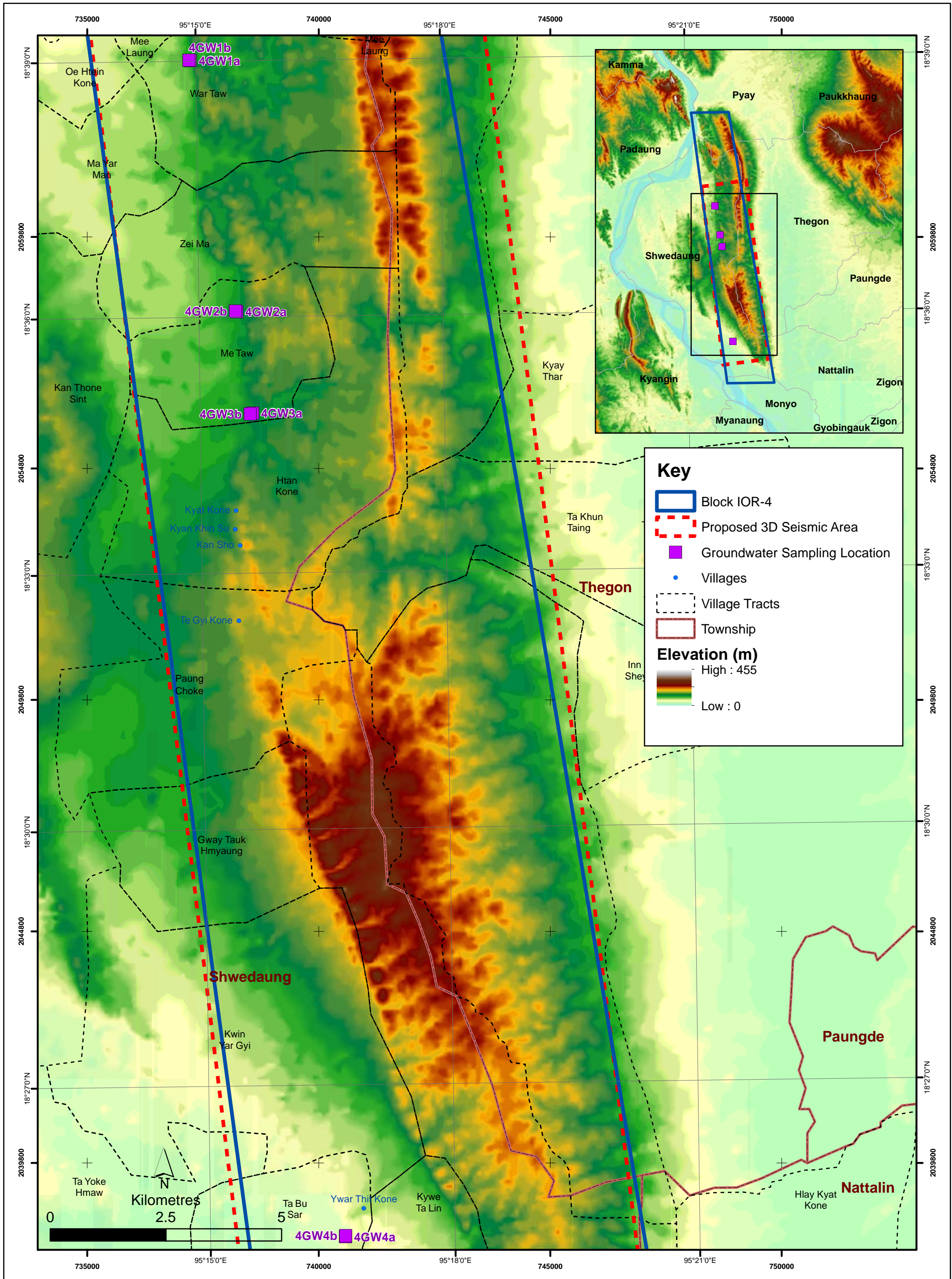




Figure 4.24a Surrounding Environment of Groundwater Sampling Locations



↑ Station: 4GW1



↑ Station: 4GW2

*Figure 4.24b Surrounding Environment of Groundwater Sampling Locations*



↑ Station: 4GW3



↑ Station: 4GW4

*Methodology*Soil Sampling Location

The soil sampling locations were chosen as close as practicable to the existing oil wells within Block IOR-4. For safety reasons, underground utilities inspection was conducted at the proposed borehole location jointly with the staff from MOGE before soil sampling. Details of the monitoring location are shown in *Table 4.22* and illustrated in *Figure 4.25*. The surrounding environment of the soil sampling stations and soil condition are shown in *Figure 4.26*.

**Table 4.22**      ***Baseline Soil Sampling Locations in December 2014***

Sampling Station	Replicate	Coordinates	Description	Sampling Date
4S1	1	18°34'40.39" N 95°15'55.25" E	At northeast of MOGE guest house, Shwe Taung Township	23 December 2014
	2	18°34'42.46" N 95°15'53.74" E		
4S2	1	18°32'52.18" N 95°16'8.17" E	At northeast of GOCS No. 3 in Pyay oil field	22 December 2014
	2	18°32'52.56" N 95°16'5.36" E		
4S3	1	18°26'31.93" N 95°18'37.88" E	At south of High Pressure Natural Gas Compression (HGC), Pyay oil field	22 December 2014
	2	18°26'27.56" N 95°18'36.37" E		
4S4	1	18°25'12.12" N 95°19'11.57" E	At southwest of MOGE police station, Pyay oil field	23 December 2014
	2	18°25'14.04" N 95°19'12.51" E		



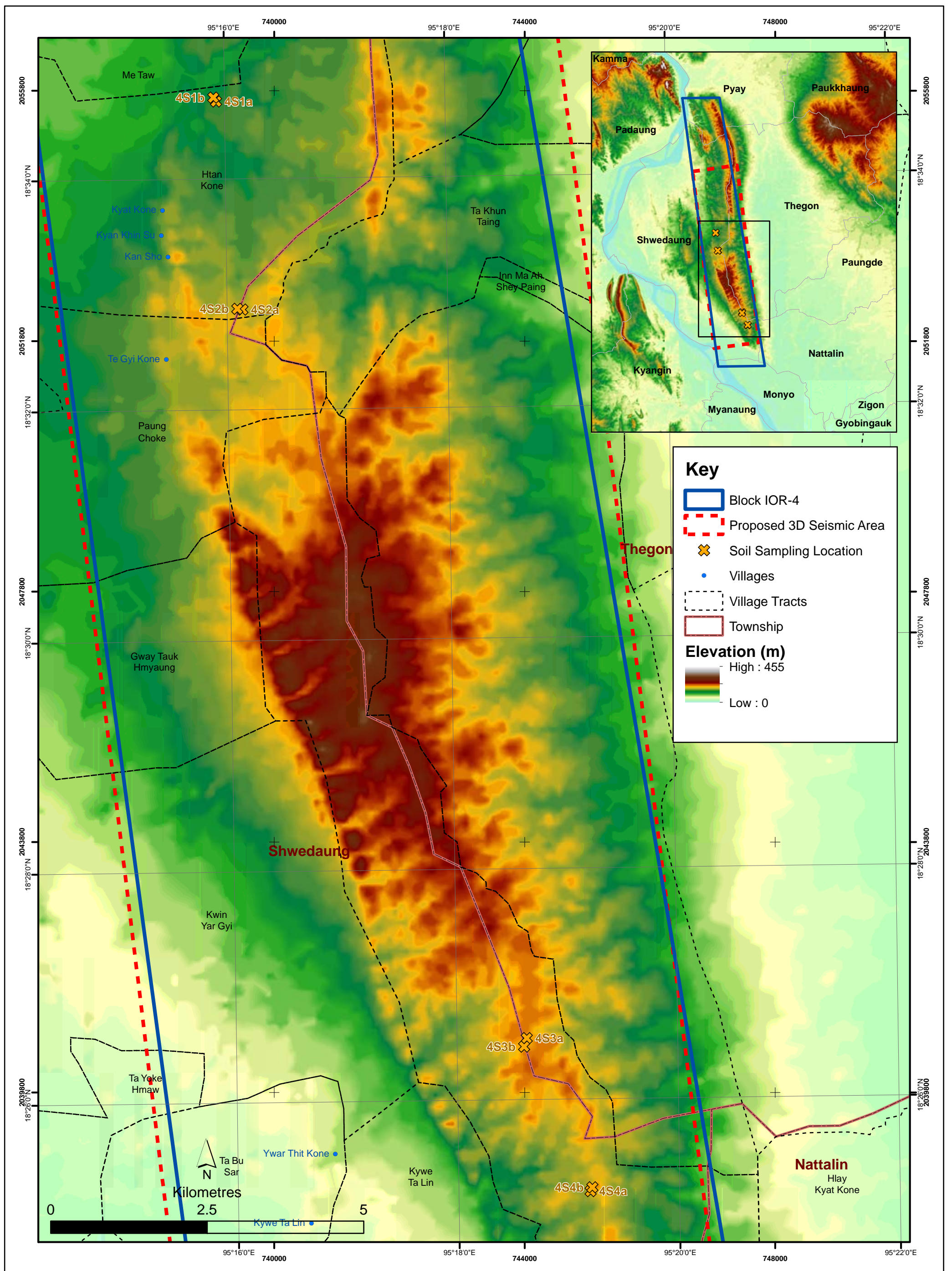


Figure 4.25

## Soil Quality Sampling Location

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Figure 4.26a Surrounding Environment of Groundwater Sampling Locations



↑ Station: 4S1



↑ Station: 4S2

*Figure 4.26b Surrounding Environment of Groundwater Sampling Locations*



↑ Station: 4S3



↑ Station: 4S4

## Sampling Methodology and Equipment

All soil boring/ excavation and sampling were undertaken by means of dry rotary drilling method. A total of two (2) replicate samples were collected for laboratory analyses for each sampling area. Parameters for laboratory analyses included:

- pH;
- Arsenic (As);
- Lead (Pb);
- Cadmium (Cd);
- Copper (Cu);
- Zinc (Zn);
- Manganese (Mn); and
- Iron (Fe).

In the course of survey, sampling procedure, sample preservation and sample analysis recommended in standard operating procedure of U.S. EPA (SOP-2013, SOP2016, and SOP 2003) were referred. In soil sampling, the standard agricultural sampler (Soil Auger) was applied. The sampler is a stainless steel tube that is sharpened on one end and fitted with a long, T-shaped handle. This tube is approximately three inches inside diameter. To refrain from contamination, about 20 – 30 cm of top soil was removed by the sampler before sampling. Then sample was taken and collected in cleaned plastic bag. Chemical preservation of samples was not applied because it is generally not recommended by standard method. Samples were cooled in an ice box which temperature was under 4°C. Samples were protected from sunlight to minimize any potential chemical reaction. Soil texture and colour were also recorded upon sampling.

### *Baseline Soil Quality Results*

The results of baseline soil quality monitoring are summarized in *Table 4.23*.

In general, the soil in the sampling locations is sandy in nature and was previously disturbed by agricultural activities. As there is no relevant national guideline or IFC standard to assess the soil quality, the Dutch Standard 2000 is adopted for evaluation, and all the measured parameters meet the assessment criteria.

**Table 4.23 Results Summary of Baseline Soil Quality Monitoring in December 2014**

Parameter	Unit	Station				Dutch Standard 2000
		4S1	4S2	4S3	4S4	
pH	-	6.3	6.8	6.6	6.7	—
As	mg/kg	N.D.	N.D.	N.D.	N.D.	55
Pb	mg/kg	107.5	119	122.5	112.5	530
Cd	mg/kg	0.005	0.0055	0.0055	0.0065	12
Cu	mg/kg	117.5	122.5	115	92.5	800
Zn	mg/kg	76.5	77.5	67.5	72.5	720
Mn	mg/kg	23.5	26	17.5	19	—
Fe	mg/kg	6,750	5,400	6,035	6,175	—
Soil Texture	-	Silty clay to clayey sand	Silty clay	Silty Sand to clayey sand with gravels	Silty Sand with gravels	—
Soil Colour	-	Yellowish brown to Gray	Gray	Gray to Yellowish Brown	Yellowish Brown	—
Note: N.D. = Not Detected						

#### 4.5 BASELINE SURVEYS FOR BIOLOGICAL ENVIRONMENT – TERRESTRIAL ECOLOGY

This section describes the biological environment of the Project Area for the proposed seismic survey and workover activities. The baseline information has been gathered during focussed baseline field surveys conducted during the dry season in December 2014. The discussion is limited to those biological components either recorded or likely to be found within the Project Area. These include the following:

- Habitats and Vegetation;
- Avifauna (Birds);
- Herpetofauna (Amphibians and Reptiles);
- Mammals;
- Butterflies; and
- Aquatic fauna.

Each of the above are discussed in turn below.

##### 4.5.1 Habitats and Vegetation

###### *Methodology*

Field survey focusing on habitat and vegetation (including trees) within the Project Area was performed in December 2014 to establish the general



terrestrial ecological profile of the Project Area. Habitats were mapped based on publicly available aerial photos and field ground-truthing. Representative areas of each habitat type were surveyed on foot. Plant species of each habitat type encountered and their relative abundance were recorded with special attention to rare or protected species.

### *Results*

The area surveyed within the Project Area was found to comprise five (5) key habitat types, including secondary forest, agricultural land, cultivated land / village, developed area and river / reservoir (*Figure 4.27*). Sizes of these habitats are presented in *Table 4.24*. Secondary forest and agricultural land were the main habitat types within the Project Area, covering 46% and 41% of the Project Area, respectively. Overall, the main feature of the Project Area was that it was predominantly composed of human-modified habitats (i.e. agricultural land, cultivated land / village and developed area).

**Table 4.24** *Areas (Total and Percentage) of Habitat Types recorded within the Project Area during the December 2014 Field Survey*

Habitat	Total Area within the Project Area (sq. km)	Percent of Habitat in the Project Area (%)
Secondary Forest	185	46
Agricultural Land	163	41
Cultivated Land / Village	17	17
Developed Area	13	13
River / Reservoir	24	24
<b>TOTAL</b>	<b>402</b>	<b>100</b>

A total of 138 plant species were recorded within the Project Area (see *Annex A*). No plant species of recognised conservation interest were recorded within the Project Area. The photos of representative plant species recorded in Pyay are shown in *Figure 4.28*.

The following sections present a description of the vegetation of each habitat type along with representative photos.

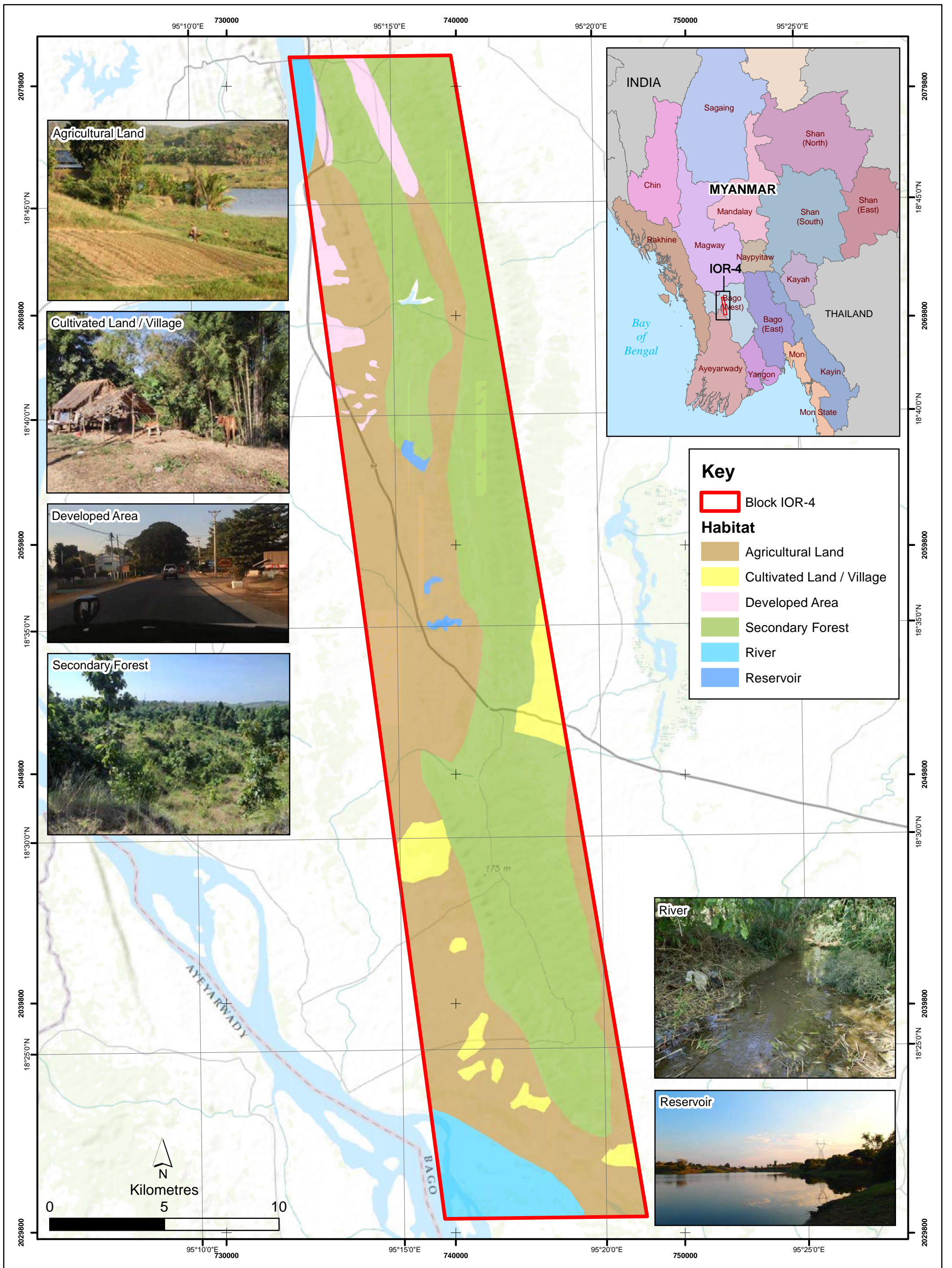


Figure 4.27

## Recorded Habitats in Block IOR-4

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Figure 4.28a Photos of Representative Plant Species



*Alstonia scholaris* L.



*Bridelia retusa* (L.) A. Juss



Figure 4.28b Photos of Representative Plant Species



*Buchanania lanzan* Spreng



*Dipterocarpus obtusifolius* Teysm.



### Secondary Forest

Secondary forest is the habitat with the largest area within the Project Area which mainly occupied the eastern side (see Habitat Map in *Figure 4.27*). It covered approximately 46% of the Project Area (i.e. 185 km<sup>2</sup> of secondary forest within 402 km<sup>2</sup> of Project Area). Secondary forest habitat was found to be restricted to the areas with hilly terrain and was relatively undisturbed from human activities.

Photographic record of the secondary forest is shown in *Figure 4.29*. A total of 124 plant species were recorded in the secondary forest, of which 72 were tree species (see *Annex A*). The dominant plant species recorded in the secondary forest was *Acmella uliginosa* which is a common herb. Plant species of recognised conservation interest was not recorded in the secondary forest.

This habitat type is considered as with medium ecological value / receptor sensitivity with regard to its naturalness and size in the Project Area, as well as the presence of a few species of recognised importance reported within it (please refer to findings of the herpetofauna and mammal surveys in later section).

**Figure 4.29**     *Representative Photo of Secondary Forest Habitat Type*



### Agricultural Land

Agricultural habitat was the second largest habitat type found within the Project Area which mainly occupied the western portion of the Project Area. (see Habitat Map in *Figure 4.27*). This habitat was mainly restricted to low terrain areas and covered a total area of 163 km<sup>2</sup>, which accounted for 41% of the Project Area. Agricultural land is regarded as modified habitat with low ecological value / receptor sensitivity.

Agricultural land is mainly paddy field cultivated with Asian Rice (*Oryza sativa* L). Cultivated patches of Cow Pea (*Vigna catjang* Walp). and Maize (*Zea mays* L). were also commonly recorded (see *Annex A*). A total of 28 plant species were observed at the agricultural land with no plant species of recognised conservation interest found.

Representative photo of agricultural land is shown in *Figure 4.30* below.

**Figure 4.30**     *Representative Photo of Agricultural Land Habitat Type*



### Cultivated Land / Village

Cultivated land and village were often inseparable in terms of habitat mapping given the high extent of planting of fruit and crop trees in village areas. As is common practice, cultivated land / village is used as a habitat type given that no separation is possible across many parts of the Project Area. They are regarded as man-made, disturbed habitat with low ecological value / receptor sensitivity.



Cultivated Land / Village were observed mainly in the middle and southern portion of the Project Area (see Habitat Map in *Figure 4.27*). A photographic record of village/orchard is shown in *Figure 4.31*.

A total of 64 plant species were recorded in cultivated land / village. Common plant species of the cultivated land included Maize (*Zea mays* L.) and Mango Tree (*Mangifera indica* L.) (see *Annex A*). Plant species of recognised conservation interest was not recorded within the cultivated land / village habitat type of the Project Area.

**Figure 4.31**     *Representative Photo of Cultivated Land / Village Habitat Type*



#### Developed Area

Developed area is mainly found in the northern part of the Project Area which covered an area of 13 km<sup>2</sup> (see Habitat Map in *Figure 4.27*). It is mainly the outskirts of Pyay Town and Shwe Taung Town. The developed area is regarded as man-made, disturbed habitat with low ecological value / receptor sensitivity. A photographic record of developed area is shown in *Figure 4.32*.

A total of 60 plant species was found within the developed area of the Project Area (see *Annex A*). The plant species in the developed area was dominated by flowering plants and Mango Tree (*Mangifera indica* L.), Neem (*Azadirachta indica*) and Banana Tree (*Musa* spp) were commonly found. No plant species of recognised conservation interest was recorded within this habitat type.

**Figure 4.32**     *Representative Photo of Developed Area*



#### River and Reservoir

The Ayeyarwady River is the main river identified within the Project Area. Apart from Ayeyarwady River, a few reservoirs were also observed within the Project Area which provided aquatic habitats (*Figure 4.27*). The total area of the river and reservoir recorded within the Project Area was estimated to be approximately 24 km<sup>2</sup>. Vegetation record was not made for the river and reservoir as it was included in the record of adjacent habitats. Reservoir is regarded as a man-made habitat with low ecological value. For the river, it is considered as with medium ecological value / receptor sensitivity with regard to its naturalness and size.

A photographic record of river is shown in *Figure 4.33*.



**Figure 4.33**     *Representative Photo of River Habitat Type*



#### **4.5.2**     *Avifauna (Bird)*

##### *Methodology*

The avifauna (bird) communities of each habitat types within the Project Area were surveyed using the qualitative transect count method. During the survey, all birds seen or heard from either sides of the transect were identified to species where possible with their relative abundance noted. Signs of breeding (eg nests, recently fledged juveniles) within the Project Area were also recorded, if any. Observations were made using binoculars and photographic records were taken, if possible. Special attention was paid to egretry, wetland dependent and migratory birds.

##### *Results*

A total of 43 bird species were recorded during the survey period within the Project Area (see *Annex B*). Eurasian Tree Sparrow (*Passer montanus*), House Sparrow (*Passer domesticus*), Common Myna (*Acridotheres tristis*), Rock Dove (*Columba livia*) and Barn Swallow (*Hirundo rustica*) were common bird species found in the Project Area. The abundance of bird was noted to be higher in agricultural land and developed area while the species richness was highest in secondary forest.

No bird species of recognised conservation interest was found within the Project Area. Photo records of identified bird species are shown in *Figure 4.34*.

**Figure 4.34**    *Photo Records of Identified Bird Species*



Black Drongo (*Dicrurus macrocercus*)



Burmese Shrike (*Lanius collurioides*)

### 4.5.3 *Herpetofauna (Amphibians and Reptiles)*

#### *Methodology*

Herpetofauna survey was conducted through direct observation and active searching in all habitat types in potential hiding places such as amongst leaf litter, inside holes, under stones and logs within the Project Area. Particular attention was given to streams and watercourses. Auditory detection of species-specific calls was also used to survey frogs and toads. During the surveys, all reptiles and amphibians sighted and heard were recorded. Interviews were also conducted with villagers to gather information of the herpetofauna species they found within the Project Area.

#### *Results*

During the herpetofauna survey, three (3) amphibian species and 16 reptiles species were record within the Project Area through observation and interview (see *Annex C*). It is important to note, however, that data obtained through the interviews has not been verified through observation by the survey team. Photo records of identified herpetofauna are shown in *Figure 4.35*.

The species richness of herpetofauna was the highest in secondary forest within the Project Area. According to villagers, the reptile species Yellow-headed Tortoise (*Indotestudo elongata*) (Yellow-headed Tortoise) has previously been collected in secondary forest. This species is listed as an endangered species in the 2015 IUCN Red List of Threatened Species <sup>(1)</sup> and is also protected by *Myanmar Forest Law*. While having a widespread distribution in Asia, its numbers have drastically declined due to over-collection. Owing to its high value in the wildlife trade, it is likely that this species is much depleted in the Project Area. In terms of habitat preference, it is reported that this species prefers humid forest areas and is therefore more likely to occur in less degraded forested areas where canopy cover maintains humidity. Other species recorded are regarded as common and widespread species within no recognised conservation interest.

(1) The IUCN Red List of Threatened Species. Version 2014.3. <[www.iucnredlist.org](http://www.iucnredlist.org)>. Downloaded on 27 January 2015.



Figure 4.35 Photo Records of Identified Herpetofauna Species



Water snake *Xenochrophis piscator*



Malaysian Narrowmouth Toad *Kaloula pulchra*



*Methodology*

As most mammals often occur at low densities, all sightings, tracks, and signs of mammals (including droppings) were actively searched along the survey transects during the field survey. Interviews were also conducted with villagers to gather information of the mammal species they found within the Project Area.

*Results*

Thirteen (13) mammal species were recorded within the Project Area through observation and interview (see *Annex D*). It is important to note, however, that data obtained through the interviews has not been verified through observation by the survey team. Amongst the recorded mammal species, the Chestnut White-bellied Rat (*Niviventer fulvescens*) and Hoary-bellied Squirrel (*Callosciurus pygerythrus*) were considered to be common species within the Project Area. Most mammal species was reported within the secondary forest of the Project Area (*Figure 4.36*).

According to villagers, the mammal species *Manis pentadactyla* (Chinese Pangolin) has previously been observed in secondary forest of the Project Area. This species is considered as a critically endangered species in the 2015 IUCN Red List of Threatened Species <sup>(1)</sup> and is also protected by the *Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law* (1994). The population of this specie is noted to be drastically declined due to high levels of poaching for meat and scales, both targeted and untargeted, across its range. It is reported that this species can be found in a wide range of habitats including primary and secondary tropical forests, limestone forests, bamboo forests, broad-leaf and coniferous forests, grasslands and agricultural fields. The status of this species in Bangladesh, Bhutan, Myanmar and Thailand is unknown. Other mammal species recorded are regarded as common and widespread species within no recognised conservation interest.

(1) Ibid.

**Figure 4.36**     *Footprint of Sambar Deer Cervus unicolor observed at Secondary Forest*



#### **4.5.5**     *Butterflies*

##### *Methodology*

Butterflies at different habitats within the Project Area were surveyed using qualitative transect count method. Butterflies from either side of the survey transect were identified with their relative abundance noted.

##### *Results*

In total, 17 butterflies species were recorded within the Project Area (see *Annex E*). It was noted that the relative abundance of butterfly was higher in developed area and agricultural land while the species richness was the highest at agricultural land. No butterfly species of recognised conservation interest was found within the Project Area. Photo records of identified butterflies species are shown in *Figure 4.37*.

Figure 4.37a Photo Records of Identified Butterflies Species



*Catopsilia pomona*



*Danaus chrysippus*

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**Figure 4.37b** *Photo Records of Identified Butterflies Species*



*Euploea core godartii*

#### **4.5.6**

#### ***Aquatic Fauna***

##### *Methodology*

Fishes were collected with the help of local fishermen within the Project Area by using local fishing gears (e.g. fish traps, gill nets etc) to obtain a qualitative species list. Fish species which could not be identified in the field were preserved in 10% formalin solution and sent to laboratory for later identification.

##### *Results*

A total of 21 fish species were recorded from the aquatic habitats of the Project Area (see *Annex F*). Photo records of identified aquatic fauna species are shown in *Figure 4.38*. Commercially important fish species including Long Whisker Catfish (*Mystus gulio*), Hilsa Shad (*Tenualosa ilisha*), Yellotail Catfish (*Pangasius pangasius*), Catla (*Catla catla*), Bronze Featherback (*Notopterus notopterus*) and Wallago (*Wallago attu*) were recorded within the Project Area. Amongst the recorded species, Butter Catfish (*Ompok bimaculatus*) and Wallago (*Wallago attu*) were considered as near threatened in the 2015 IUCN Red List of Threatened Species <sup>(1)</sup>. However, Butter Catfish (*Ompok bimaculatus*) is reported to be relatively abundant throughout its distribution and no empirical data on declines in its entire range is available. For Wallago (*Wallago attu*), it is also considered as widely distributed and hence has a very large population although it is noted to be overexploited as a food fish.

<sup>(1)</sup> The IUCN Red List of Threatened Species. Version 2014.3. <[www.iucnredlist.org](http://www.iucnredlist.org)>. Downloaded on 27 January 2015.



Figure 4.38 Photo Records of Identified Aquatic Fauna Species



*Macrognathus zebrinus*



*Clarias batrachus*

*Approach and Methodology*

For the purpose of establishing the human environment baseline, a phased participatory approach was adopted, as is discussed in the following sub sections. Through this approach an attempt was made to integrate the local understanding and perspective into the impact assessment process and the identification of the mitigation measures. The purpose of such an approach was to allow for:

- The triangulation of the information available from secondary sources through the information made available by the local community, both qualitative and quantitative;
- Formulation of the socio-economic baseline on the basis of a combination of primary and secondary qualitative and quantitative data;
- An understanding to be developed of the community's perception towards the industries, the past interaction with similar projects and the experiences of the same; and
- An understanding to be developed of the local community's perception of the project and its activities and the possible impacts from the same and the desirable mitigation measures.

In keeping with this approach, the SIA Study was divided into the following stages.

*Definition of Project Area*

The Project Area for the purpose of the social impact assessment was limited to the villages where the seismic survey and workover activities will be carried out. This was done with an understanding that most of the impacts associated with the Project Area are supposed to be localized. The baseline section capture the information pertaining to the villages identified in the Project Area.

*Scoping and Initial Studies*

As part of the scoping exercise for the Project, MPRL E&P undertook a site reconnaissance visit to the proposed block and the surrounding communities. The purpose of this visit was to develop an understanding of the site settings, the environmental and social sensitivities, to identify relevant stakeholders and to collect secondary data relevant to the Project.

As part of the visit, limited consultations with the local community were conducted to understand the local environmental and social issues in the area and to receive feedback from the stakeholders on the same as interviews were

only allowed to be conducted in villages where the village tract leaders lived (only 5 out of 11 identified villages were visited).

In addition to this, an understanding was developed of the national and international regulatory requirements for the Project. Also, a desk based review was undertaken of the Project documents and the information available on the Project Area in the public domain.

#### *Secondary Data Collection*

Refer to *Section 4.3.3* for the detailed findings of the secondary data examination. For the purpose of secondary data collection for the baseline, the information available in the public domain was collected and reviewed. This, along with the primary data collected was used to develop the social baseline for the Project. The secondary data collection and review was undertaken across the Study period. However to start with this was primarily to understand the preliminary socio economic profile of the region, critical issues related to livelihood, gender, ethnic issues ( if any), dependency on land, presence of civil society and NGOs in the area etc. The information specific to the Project Area is limited and generic in the public domain (especially available online). Nevertheless it has informed the development of survey and consultation tools to be used for the purpose of baseline data collection and subsequently informing the impact assessment process for the Project.

#### *Formulation of the Primary data collection tools*

On the basis of the understanding thus developed on the Project, ERM identified the tools for the purpose of the primary data collection for the impact assessment of the Project. These tools included both qualitative and quantitative tools such as Focus Group Discussions (FGD) checklists and household (HH) and community survey tools. The purpose of these tools was to allow for a triangulation of the information available from the secondary sources as well as capture the individual perceptions/viewpoints of the various stakeholder groups towards the Project, its activities and its possible impacts and mitigation measures.

The community and HH survey tools were aimed at allowing for an understanding to be developed of the village profile and the community's perceptions towards the Project and its activities. The FGD Checklists on the other hand were identified for the purpose of understanding the specific impacts on land use and activities such as agriculture due to the Project activities and the perceptions of the various stakeholder groups. These tools were aimed at developing an understanding of the following:

- Previous instances of land acquisition in the area and the impacts associated with it in the long run;
- Changing patterns of land use and livelihood profiles in the villages owing to the oil and gas sector in the area;

- Nature of interaction with Project;
- Tradeoffs between the negative and positive aspects of the Project in the area;
- Sharing of development benefits with the villages and expectations of the community, both directly and indirectly affected; and
- Gender based impacts in the villages.

As part of the primary data collection, a random sample of 38 households in the village tracts Gway Tauk Hmyaung, Kawe Ma, Kwan Yar Gyi, Kywe Ta Lin, Nwar Ma Yan and Shar Taw were covered. In addition to this, community surveys were undertaken across the six (6) villages in the Project Area. Apart from the quantitative data collection, for the purpose of qualitative information, consultations were undertaken with the farmers group and women group in Pyay.

#### *Stakeholder Identification and Analysis*

The stakeholders identified during the scoping stage were updated and an understanding was developed of the individual concerns, expectations and influences of the stakeholders on the Project. The purpose of such an understanding was to allow for a proper assessment and mitigation of the impacts. On the basis of this understanding, an exercise of stakeholder mapping was undertaken, the purpose of which was to:

- Identify each stakeholder group;
- Study their profile and the nature of the stakes;
- Understand each group's specific issues, concerns as well as expectations from the Project; and
- Gauge their influence on the Project.

On the basis of such an understanding, the stakeholders were categorised into High Influence/Priority, Medium Influence/ Priority and Low Influence/Priority on the basis of their influence/power as well as interest in the Project.

#### *Compilation of the Socio-Economic Baseline*

On the basis of the information thus made available from primary and secondary sources, the following socio-economic information for the Project Area was generated:

- Demographic profile of the population
- Socio-economic profile of the affected households/communities;



- Current land use;
- Land ownership and size of holdings;
- Local physical and social infrastructure; and
- Livelihood, health and welfare characteristics of the community.

#### *Social Impact Assessment and Formulation of Mitigation Plans*

On the basis of the baseline thus established, an impact assessment was undertaken in accordance with the national guidelines and with reference to the applicable reference framework. As part of this impact assessment, a process of prediction, evaluation and mitigation of impacts was undertaken. The impacts were evaluated as positive and negative, short term and long terms and direct or indirect. The criteria for the ratings of impacts are provided in *Section 5*.

On the basis of the baseline data and the impact assessment, a number of management plans were formulated for the Project. The details of these are provided in the section on approach and methodology for the Project.

### **4.6.2 Results and Findings**

This section provides the results of the primary data collection undertaken in December 2014, in the form of the socio-economic baseline of the area. Refer to *Section 4.3.3* for the detailed findings of the secondary data examination.

#### *Project Area Profile*

During the primary data collection, the following seven (7) village tracts were identified within the proposed Project Area of Block IOR-4:

- Htan Kone
- Kyaythar
- Paung Choke
- Gwedauk Myaing
- Kwin Ywar Gyi
- Kwema
- Kyetalin

*Figure 4.39* provides an understanding of the Project Area and the identified villages in the vicinity of the proposed seismic area of the Project Area.

The following sub sections provide an understanding of the Project Area socio-economic profile in terms of the village tracts and the villages identified.

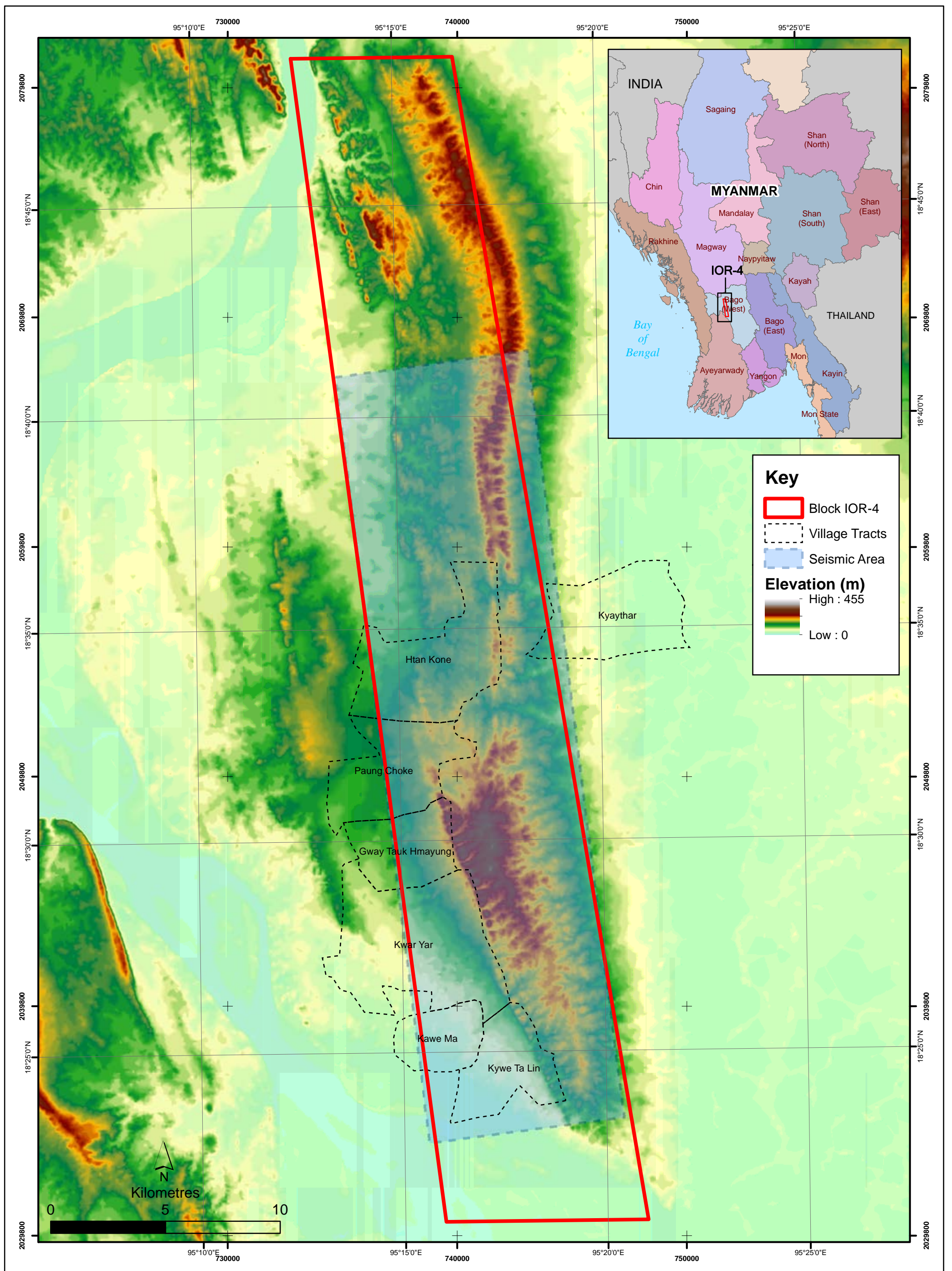


Figure 4.39

Locations of Villages Surveyed during the Primary Data Collection in December 2014

File: T:\GIS\CONTRACT\0267078\Mxd\0267078\_IOR4\_Villages.mxd  
Date: 24/3/2015

Environmental  
Resources  
Management



This profile is based on the secondary information available on the region and the primary data collected through the community and sample household surveys and focus group discussions undertaken in the community.

### **Demographic Profile**

A total of 38 households were surveyed in eight (8) villages within the seven (7) village tracts during the primary data collection field work, whose demographic profile is provided in the table below.

**Table 4.25**      *Demographic Profile of the Villages in the Project Area*

Village Name	Total Population	Total No. of HHs	Number of HHs surveyed	Population Surveyed	Sex Ratio	Average HH size
Gway Tauk Hmayung	946	266	10	37	266	3.70
Kawe Ma	917	255	1	3	255	3.00
Kwan yar Gyi	2,548	778	1	5	1,017	5.00
Kywe Ta Lin	4,752	1,054	4	17	1,054	4.25
Phaung Phyu	NA	NA	1	4	NA	4.00
Pottan	NA	NA	10	34	NA	3.40
Thar Yar Kone	NA	NA	1	5	NA	5.00
Htan Kone	4,919	1,170	10	41	1170	4.10
<b>Grand Total</b>	<b>14,082</b>	<b>3,523</b>	<b>38</b>	<b>146</b>	<b>989</b>	<b>3.84</b>

Village Name	Total Population	Total No. of HHs	Number of HHs surveyed	Population Surveyed	Sex Ratio	Average HH size
Gway Tauk Hmayung	946	266	10	37	266	3.70
Kawe Ma	917	255	1	3	255	3.00
Kwan yar Gyi	2548	778	1	5	1017	5.00
Kywe Ta Lin	4752	1054	4	17	1054	4.25
Phaung Phyu	NA	NA	1	4	NA	4.00
Pottan	NA	NA	10	34	NA	3.40
Thar Yar Kone	NA	NA	1	5	NA	5.00
Htan KOne	4919	1170	10	41	1170	4.10
<b>Grand Total</b>	<b>14082</b>	<b>3523</b>	<b>38</b>	<b>146</b>	<b>989</b>	<b>3.84</b>

As has been mentioned above, the Project Area is characterized by six (6) village tracts and eight (8) villages. Of these eight (8) villages, community surveys were undertaken across five (5) villages. The total population of the villages surveyed is 14,082 individuals, across 3,523 households with an average household size of 3.83 individuals per household and an average sex ratio of 989 females per thousand males.

In the eight (8) villages, as part of the ESIA, household surveys were undertaken across 38 households who reported a population of 146 individuals, an average household size of 3.84 (comparable to that of the Project Area) and a sex ratio of 973, which is higher in comparison to the sex ratio of the region. Amongst the households surveyed, the households in the

villages Kwan Yar Gyi and Thar Yar Kone are reported to have the highest average household size at 5 individuals per household.

In terms of sex ratio, the villages Htan Kone and Kywe Ta Lin are reported to have the highest sex ratio in the region at 1,170 and 1,054 females per thousand males, respectively. Apart from these, the village Kwan Yar Gyi is the only village with a positive sex ratio (with the number of females higher than the number of males).

According to the information, all the households surveyed are reported to be Buddhist. The population in the village tracts is reported to be comprised of primarily Bamars and Kayin population.

Of the 146 individuals in the households surveyed, the dependents are understood to be those individuals who are single, widow(er), either above 60 years of age or below 14 years of age and those who are physically or mentally disabled. The following *Table 4.26* provides an understanding of this dependent population in the households surveyed.

**Table 4.26** *Total Dependent Population in the Households Surveyed*

Village Name	Total Population	Single	Widow(er)	Below 14 years age	Above 60 years age	Disabled
Gway Tauk Hmayung	37	14	3	7	3	0
Kawe Ma	3	1	1			0
Kwan yar Gyi	5	2	1	1	1	0
Kywe Ta Lin	17	8	1	4		0
Phaung Phyu	4	12	4	6	5	0
Pottan	34		1		1	1
Thar Yar Kone	5	2		1		0
Htan Kone	41	11	2	7	5	0
<b>Total</b>	<b>146</b>	<b>50</b>	<b>13</b>	<b>26</b>	<b>15</b>	<b>1</b>

Source: HH survey, 2014

As can be seen from the above table, of the total population of 146 individuals, 50 are reported to be single while 13 are reported to be widow(er)s, comprising 43.15% of the population. In terms of age groups, the number of individuals not in the productive age (below 14 years of age and above 60 years of age) comprises approximately 28.08% (41 individuals of 146) of the total population.

### Women and their Role in Society

As has been discussed, the Project Area is characterized by a negative sex ratio, with more men than women in the village tracts. However, women are reported to have an equal status to men in the society. According to the information made available during the focus group discussion, it is understood that while there is no clear division of labour along gender lines in the society, the women are primarily involved in agriculture and household activities, with men playing a minimal role in the household activities. The contribution of women in the family income is also reported to be increasing



over time with an increase in job opportunities. Women are reported to be engaged in wage labour, especially in the rubber plantations in Bago and sugarcane plantations in Shwe Li.

Furthermore, while the land and other assets are primarily in the name of men, the women understand the ownership to be of a joint nature, with women having a say in the utilization of the movable and immovable asset. In terms of access to education, no differentiation across gender lines was reported, with girls also completing graduation along with the boys. While the role of women in leadership positions is primarily restricted to the realm of the household, increasingly women are reported to be engaged in community leadership activities as well.

### **Land Use and Ownership**

As part of the household survey, an attempt was made to develop an understanding of the land use and ownership by the households. The following table provides an understanding of the total land and number of plots farmed.

**Table 4.27**     *Land Use in the Households Surveyed*

Village Name	Total Land (Acres)	Average of total land (acre)	Total Plots Farmed	Average No. of Plots Farmed
Gway Tauk Hmyaung	88.56	8.86	86	10.75
Kawe Ma	21	21	20	20
Kwan Yar Gyi	10.09	10.09	10	10.
Kywe Ta Lin	27.26	6.81	25.50	8.50
Phaung Phyu	50.17	50.17	50	50.
Pottan	16.55	1.66	17	8.50
Thar Yar Kone	20.50	20.50	20	20.
Htan Kone	41.16	4.57	0	0
<b>Total</b>	<b>275.28</b>	<b>7.44</b>	<b>228.50</b>	<b>13.44</b>

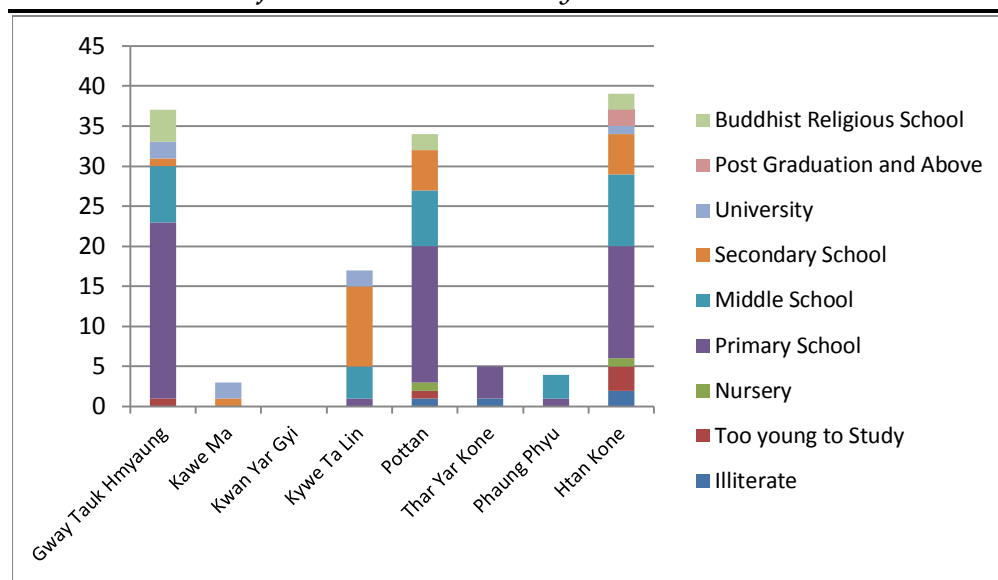
Source: HH survey, 2014

As can be seen from the above table, the total number of plots farmed across the villages is 228.5, while the total area in terms of acre is 275.28 acres. The average land cultivated across the households surveyed is 7.44 acres and 13.44 plots. Of the households surveyed, the households in the village Gway Tauk Hmyaung was reported to have cultivated the highest number of plots and acres.

### **Education Profile**

The following figure provides an understanding of the education levels of the households surveyed as part of the ESIA.

**Figure 4.40** *Education Levels of the Households Surveyed*



Source: HH survey, 2014

As can be seen from the above figure, a majority of the individuals (40.4% or 59 individuals of 146) were reported to have education till primary school level. While only 4 individuals were reported as illiterate, 9 of the 146 individuals (6.16%) were reported to have attended universities or have vocational training or were post graduates and above.

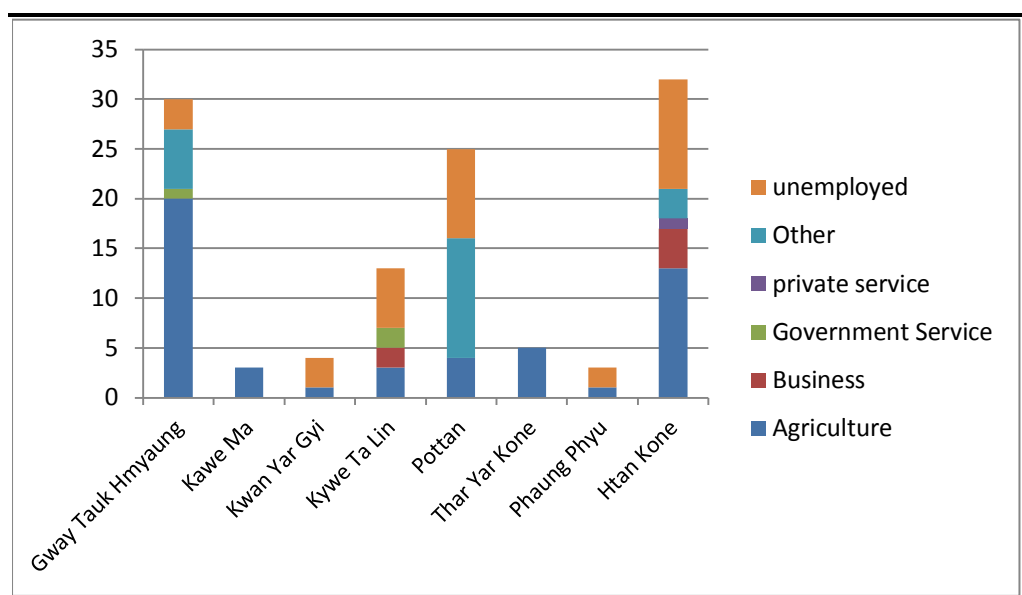
Most of the higher education in universities or for post-graduation and above is reported to be pursued in Pyay. Pyay City has three universities which are Pyay University (PU), Pyay Technological University (PTU), and Government Computer University (GCU) <sup>(1)</sup>.

### **Livelihood Profile**

As can be seen from the following figure, agriculture is the most important and common source of livelihood amongst the households surveyed, with 20 of 52 individuals (38.46%) reporting agriculture as their main occupation.

<sup>(5)</sup> [http://www.unicef.org/myanmar/Bago\\_Region\\_Profile\\_Final.pdf](http://www.unicef.org/myanmar/Bago_Region_Profile_Final.pdf), accessed 21 Oct 2014

**Figure 4.41** *Main Occupation of the Households Surveyed*



Source: HH survey, 2014

Of the 146 individuals, the occupational information is available for 115 individuals. Of these 115 individuals, 25 were reported to not be involved in any income generating activity, being aged, retired, students or housewives. Another nine (9) individuals (8%) were reported as being unemployed.

Apart from agriculture, the individuals were reported to be primarily involved in business activities (6 individuals), government service (3 individuals) and private service (1 individual).

#### Agriculture and Farm Based Activities

As has been discussed in the socio-economic baseline of the Bago Region, the staple crop in the area is rice. However, it is reported that the villages in Pyay do not have access to irrigation and are thus restricted to the cultivation of monsoon paddy, with single crop cultivation. While rice is the main cash crop in the area, other crops such as chilli, long bean, sesame and ground nut are also reported to be grown, but for household consumption. The following table provides an understanding of the production cycle of the main crops.

**Table 4.28 Seasonal Calendar for Main Crops**

Crop	Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Rained Rice	Sowing Period												
	Harvesting Period												
Rained Sesame	Sowing Period												
	Harvesting Period												
Winter Sesame	Sowing Period												
	Harvesting Period												
Peanut	Sowing Period												
	Harvesting Period												

Source: Farmer FGD, 2014



These crops are reported to be chosen based on the consumption needs of the households, the market trends as well as the suitability according to the soil type (Alluvial Sand).

The crop yield in the area for rice is reported to be approx. 20 to 50 baskets per acres. The market rate for rice is about 420,000 MMK per 100 baskets during the cultivating season and 600,000 MMK in the ploughing season. Most of the product is reported to be sold in the market, with the farmers reporting sale on an average of 60% of the paddy produce and 70% of the other crops such as sesame and peanuts. However, as has been discussed earlier, despite the increased value in the ploughing season, most of the farmers are reported to sell their crop just after harvest due to issues such as storage and need for money.

Agriculture activity is understood to be an activity that is undertaken by the entire household, with a division of labour along gender and age lines. The children are usually involved during breaks from their schools and are mostly involved in processes such as weeding and never in pesticide spraying due to the health concerns associated with the exercise. Women are involved in sowing, weeding and harvesting while men undertake activities such as ploughing, spreading the seeds, paddy processing and pesticide spraying. However, the younger generation is reported to be moving from agriculture as a key source of livelihood, with a significant proportion of the youth being reported to resort to migrant labour.

In addition to using the labour from within the family, the farmers also hire local labour during periods such as harvesting time. The wage rate for men and women as labourers vary, with men getting 3,000 / 3,500 kyats per day, while women get 2,000 / 2,500 kyats per day. The men are reported to be preferred as labours than women, despite the higher wage rate. In addition to the wage labour, the other key expense in agriculture pertains to the expenditure on seeds, fertilizers and transportation. The following *Table 4.29* provides a summary of the expenses according to the key crops grown.

**Table 4.29**      *Expenditure in Agriculture*

Crop	Total Expenditure on Labour Per Crop Cycle	Expenditure on fertilizer
Rice	90,000	22,000
Beans and Pulses	200,000	20,000

*Source:* Farmer FGD, 2014

In addition to manual labour, the farmers also reported the use of machinery such as tractors, which are readily purchased from the markets. These agricultural practices in the area and region are supported by the presence of government agriculture schemes. These schemes by the government assist the agriculture in the area by provisioning of better species of paddy, by making technology effective as well as provisioning of agricultural loans. The loans for agriculture are given through the agriculture bank, and usually a

loan of one (1) lakh kyat per acre can be availed, at an interest rate of 500 kyats per one (1) lakh.

Apart from agriculture, the households in the Project Area were also reported to be engaged in rearing of livestock for personal use as well as commercial purposes, with 34 of 38 households reporting to have some livestock. The most common livestock holdings were in the form of poultry, cattle and pigs. The following table provides an understanding of the livestock holdings in the households surveyed.

**Table 4.30** *Livestock Holdings in the Households Surveyed*

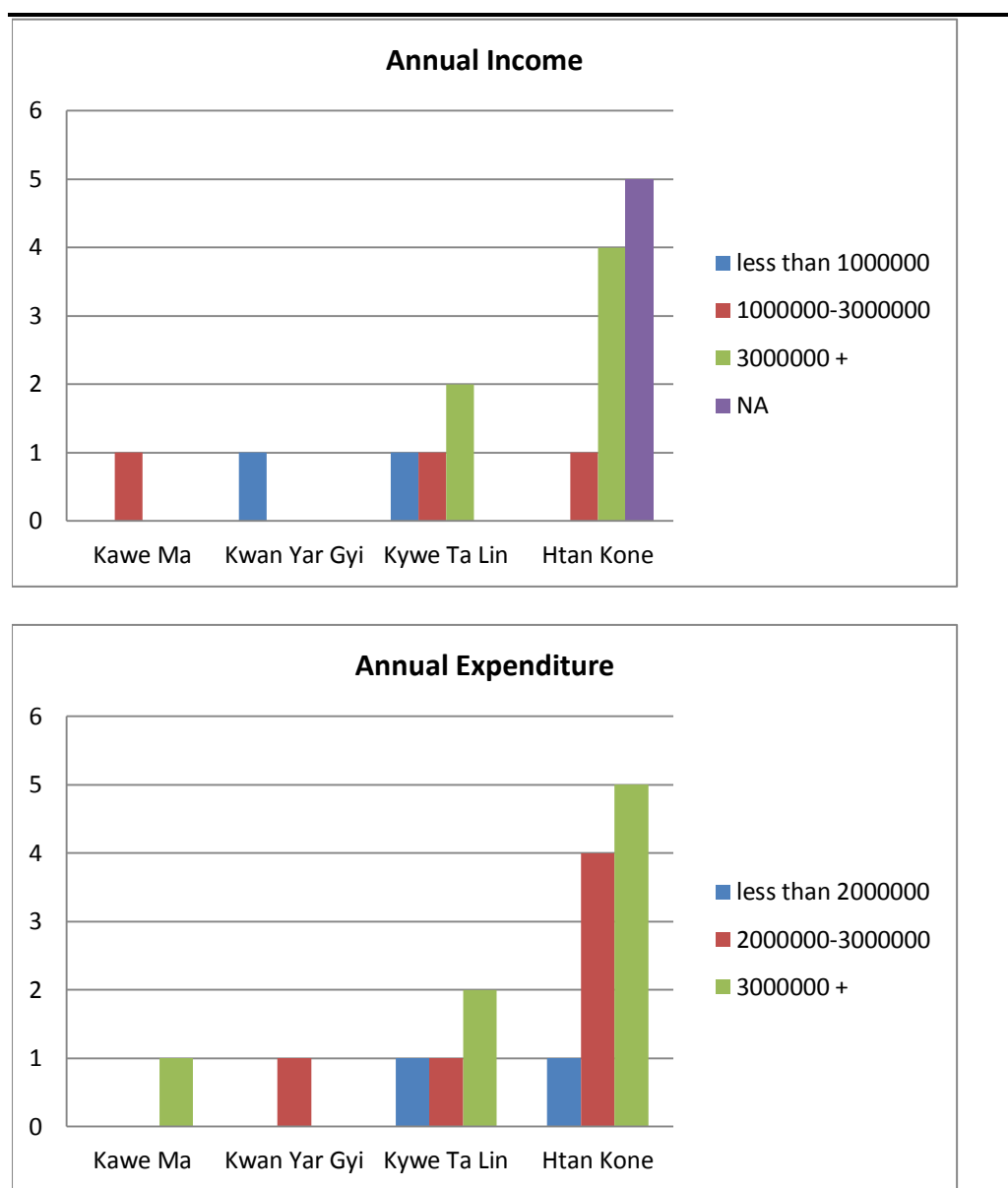
Village Name	Cattle	Poultry	Pigs	Buffaloes	Goats	Horses
Gway Tauk Hmyaung	30	87	4	0	0	0
Kawe Ma	2	2	0	0	0	0
Kwan Yar Gyi	2	3	0	0	0	0
Kywe Ta Lin	2	0	7	0	0	0
Phaung Phyu	9	0	0	0	0	0
Pottan	2	2	3	0	0	0
Thar Yar Kone	4	0	0	0	0	0
Htan Kone		0	0	0	0	0
<b>Total</b>	<b>51</b>	<b>94</b>	<b>14</b>	<b>0</b>	<b>0</b>	<b>0</b>

Source: HH survey, 2014

While the livestock holdings of cattle are reported to be primarily for use by the household in agriculture, the holdings of pigs are primarily for sale purposes for meat. The poultry holdings on the other hand, were reported to be both for self-consumption by the household as well as sale for meat or eggs. **Income and Expenditure**

According to the information made available during the household surveys, most of the households (13 of 34 households) reported an income between 1,000,000 - 3,000,000 MMK. The total income and expenditure across the households is showcased in the figure below.

**Figure 4.42 Annual Income and Expenditure ( in kyat)**

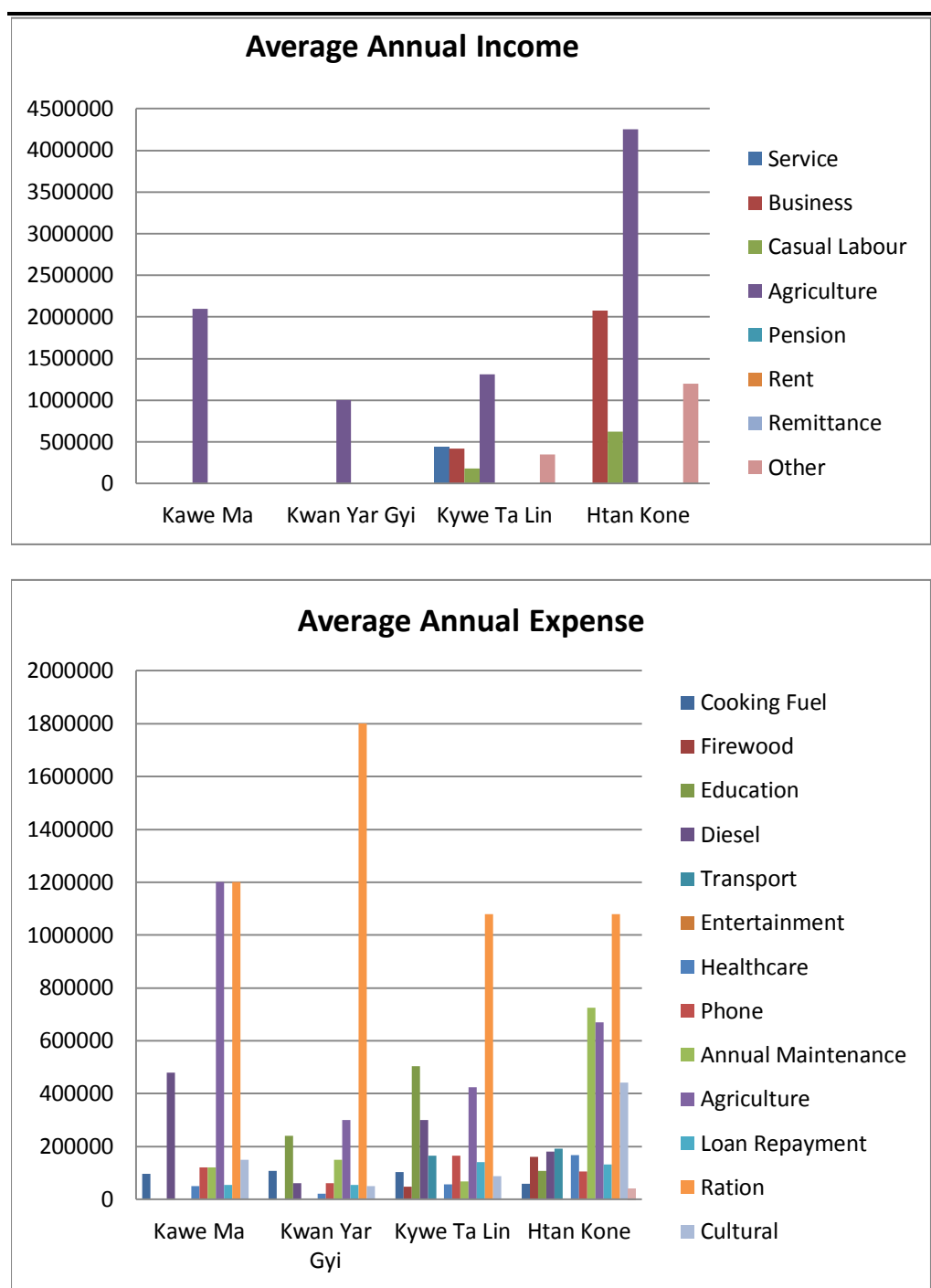


Source: HH survey, 2014

As can be seen from the above figure, of the 33 households for whom information of annual income is available, twelve (12) reported an income of less than 1,000,000 MMK and eight (8) households reported an income of more than 3,000,000 MMK.

In terms of annual expenditure, 14 of the 38 households reported an annual expenditure of more than 3,000,000 MMK, while ten (10) households reported an annual expenditure between 2,000,000-3,000,000 MMK. The following figure provides an understanding of the average expenditure and income across the various heads.

**Figure 4.43** *Average Annual Expenditure and Income across Households Surveyed*



Source: HH survey, 2014

As can be seen from the above figures, the highest average income is from agriculture and business. On the other hand, the highest average expense per household is reported to be for ration, agriculture, diesel and firewood.

### **Social and Physical Infrastructure**

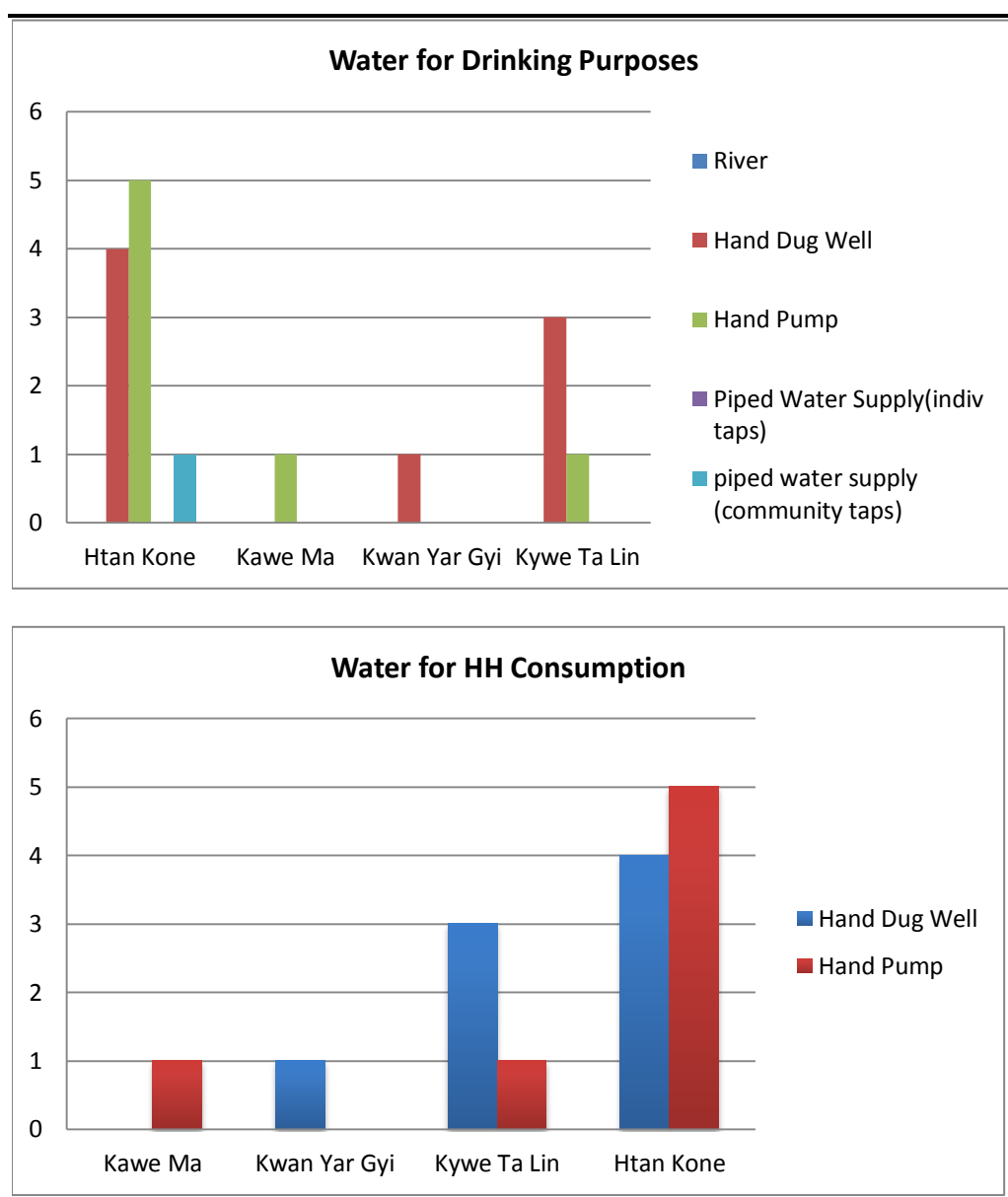
#### **Water and Sanitation**

According to the information made available during the household surveys, most of the households have access to water for household consumption and



drinking purposes through hand pumps and hand dug wells. The following figure provides an understanding of the various sources of water.

**Figure 4.44** *Sources of Water for the Household Surveys*



As can be seen from the above figures, the main sources of water for the community were in the form of the river, hand dug wells and hand pumps. In terms of the months of availability of drinking water, the hand pumps were reported to be perennial sources of water, with most of the households (27 households of the 38) reporting the water as good quality. Twenty four (24) of the 38 households reported having access to drinking water at the household level, while seven (7) households reported having access to drinking water at less than 10 m. In the villages Kywe Ta Lin, Pottan and Gway Tauk Hmyaung, five (5) households were reported having access to drinking water at less than 100 m and two (2) households reported to have water source access only at 1 km.

In terms of water for household consumption, the main sources of water are the river and hand dug wells. Twenty One (21) households reported having access to perennial supply of water. In the villages Kywe Ta Lin, Pottan and Gway Tauk Hmyaung, five (5) households were reported having access to water for household consumption at less than 100 m and two (2) households reported to have water source access only at 1 km. Twenty Seven (27) of the 38 households reported the water quality as good. Twelve (12) households reported a scarcity of water for 2-4 months in a year, ranging from March to July.

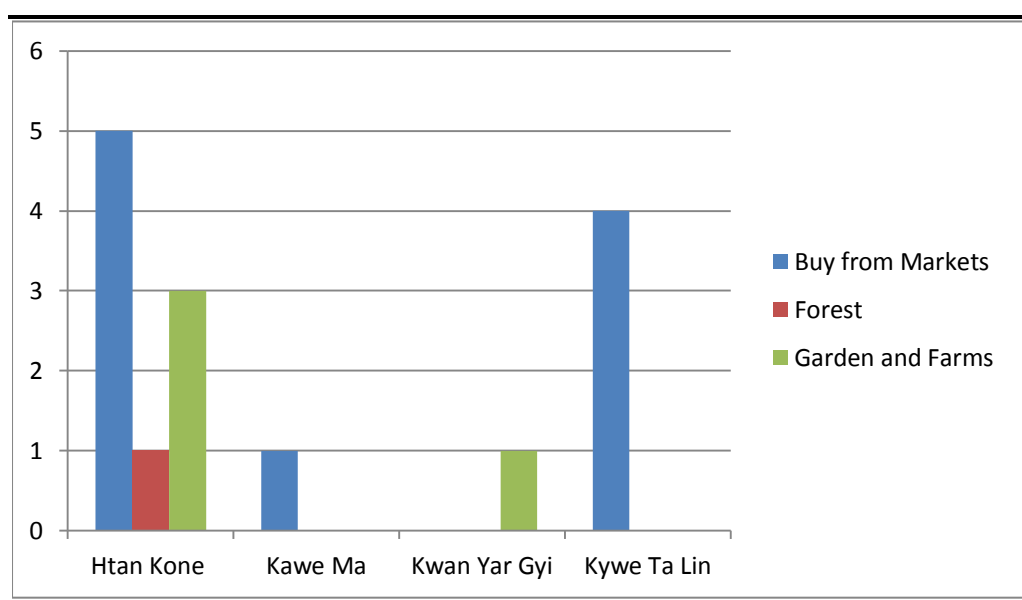
Of the 38 households, 28 were reported to have access to personal latrines with septic tanks, with 10 households from Htan Kone reporting to resorting to open defecation.

#### Access to Electricity and Cooking Fuel

In terms of access of electricity, the households of Htan Kone and Pottan reported access to electricity.

In terms of cooking fuel, all 38 households reported a dependence upon fire wood as cooking fuel. Of these 38 households, 10 reported to purchase the firewood from nearby markets, while four (4) households reported to source the firewood from their farms and gardens while twelve (12) household reported to be dependent upon the nearby forests. The following figure provides an understanding of the sources of firewood for the community.

**Figure 4.45** *Sources of Firewood*



Source: HH survey, 2014

The households reported requirement of one cart of firewood per month.

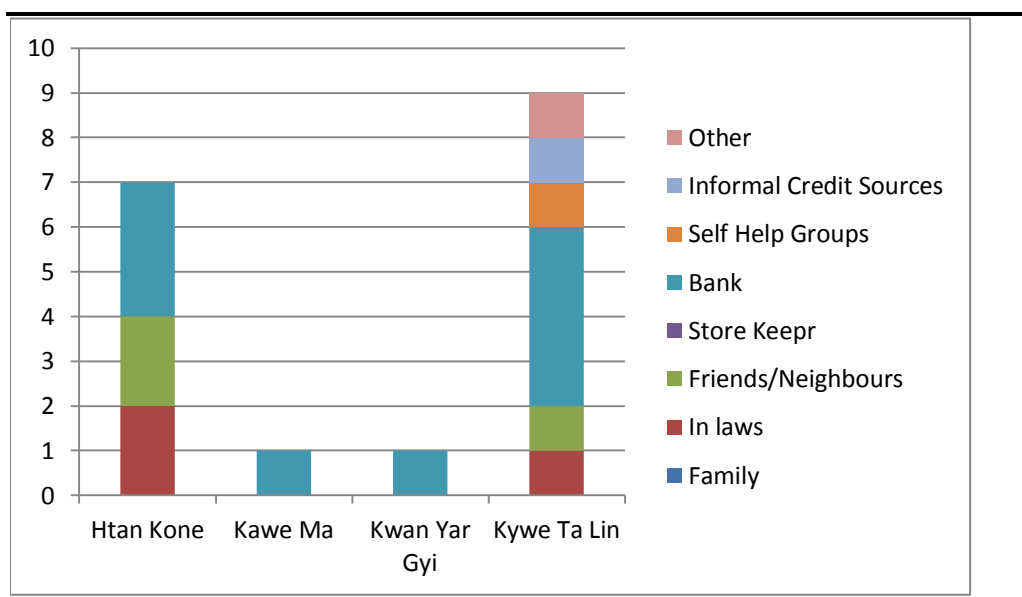
### Access to Health Services and Health Seeking Behaviour

In terms of the availability of health services in the Project Area, it is understood that most of the villages in the Pyay City have access to one rural health center and one mid wife. According to the information made available during the household surveys, 20 of the 38 households reported to prefer private medical facilities located in neighbouring towns, with 21 households reporting preference for facilities located outside the village of residence. The illnesses reported in the last year by the households comprise of common cold and fever.

### Access to Credit and Markets

In terms of access to credit facilities, the households surveyed reported maximum dependence on banks, in-laws and friends and neighbours. The dependence on different sources of income can be seen from the figure below.

**Figure 4.46** *Sources of Credit*



The main reasons for undertaking loans were reported to include field preparation and purchasing seeds and for purchasing food items. This can be seen in the fact that of those households (23 households) who reported a running loan, twenty (20) reported having borrowed the money for agriculture, while ten (10) reported having borrowed money for purchasing food.

The households reported dependence on the local market within their villages for their daily needs. These markets are reported to be located within a distance of 5 minutes for most of the households surveyed (29 of 38). However, for the purpose of buying and selling of seeds, agricultural implements and agricultural produce, 30 of the 38 households reported being dependent upon markets located in the larger villages or township. Most of

the households (30 of 38 households) reported to have these markets located at a distance of 10-30 minutes from their residence.

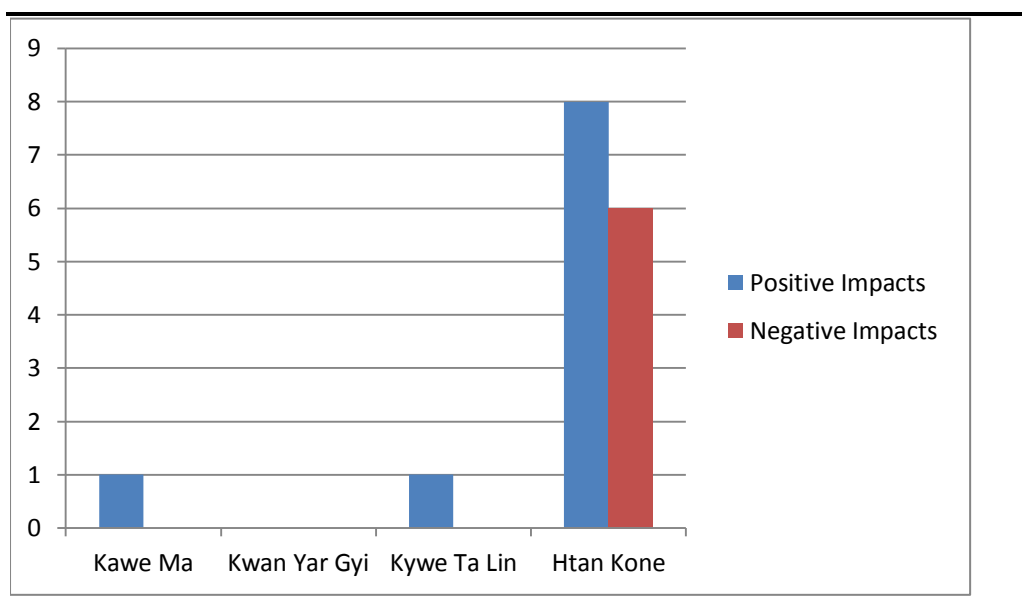
### **Previous Cases of Land Acquisition**

As part of the household surveys, an attempt was made to develop an understanding of the previous cases of land acquisition and the impact of the same on the affected households. Of the 38 households surveyed, nine (9) reported having lost land in previous cases of acquisition which this not related to the current Project. Although seven (7) households reported to have lost land due to the present Project, it is likely that the land was actually lost due to other previous projects since MPRL E&P has not yet commenced any seismic survey and workover operations at the block.

### **Knowledge about the Project**

Of the 38 households, nineteen (19) households reported not having any knowledge about the Project. The households identified the government as the most desirable source of information regarding the Project. Apart from this, the households also reported having received information directly from the company (3 households) and their neighbours (5 households).

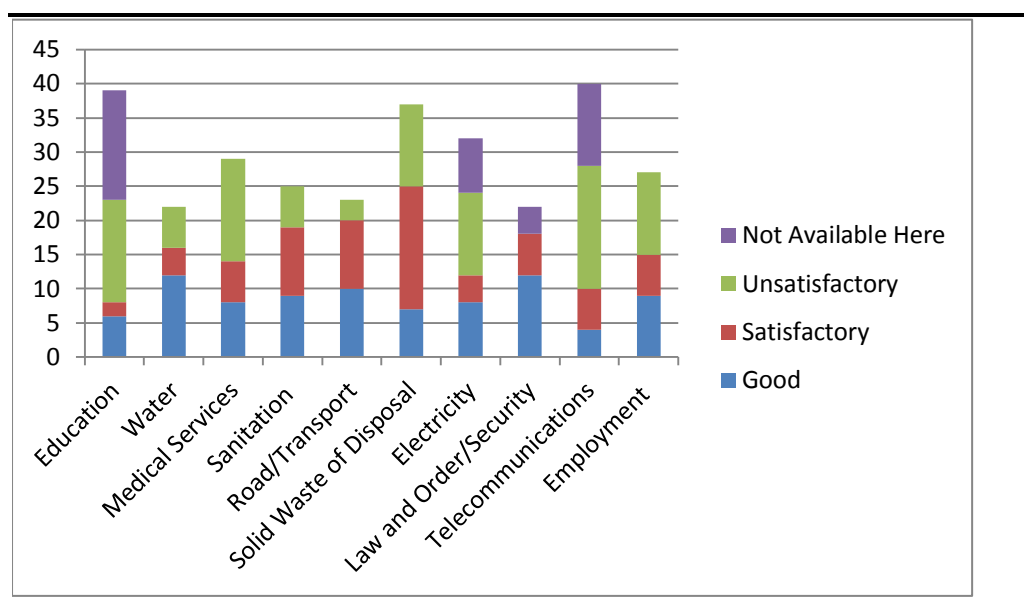
**Figure 4.47** *Anticipated Impacts from the Project*



As can be seen from the above figure, most of the households (12 of 18) reportedly expected the Project to have positive impacts for the community, while 6 households from Htan Kone and Gway Tauk Hmyaung reported anticipation of negative impacts from the Project. The following figure provides an understanding of the expectations from the project, in terms of the availability of services.



**Figure 4.48** *Perception on Existing Services in the Community*



As can be seen from the above figure, the services such as education, medical services, electricity, telecommunications, education and solid waste management are reported to be services which are either not available in the villages or are unsatisfactory nature.

#### *Stakeholder Identification and Analysis*

This sub section summarises the stakeholder identification and analysis undertaken as part of the Project. This sub section provides the list of Project stakeholders identified, consisting of individuals, groups and organisation that are affected or may be influenced by the proposed Project in the area and sorts them according to their impact on the Project and the impact the Project will have on them. This information is then used for the formulation of the Stakeholder Engagement Plan (SEP) for the Project.

The importance of such an analysis lies in the role played by such an understanding in the assessment of the socio-political environment surrounding the Project and its activities. It allows for the:

- Identification of key stakeholders, their primary groupings and sub groupings;
- Identification of the interests, concerns and potential risks surrounding the stakeholders, as well as conflicts of interests (if any);
- Key groups/individuals to be pin pointed who need to informed about the Project activities at various stages,;
- Identifying stakeholders (those who are likely to have an adverse impact on the project) and taking appropriate measures to combat their influence;

- Identification of the impact and influence of the Project on the stakeholders and of the stakeholders on the Project; and
- Generation of information essential to the planning, implementation and monitoring of the Project.

The process of stakeholder identification and analysis thus allows for the formulation of a robust engagement strategy, which in turn allows for the concerned stakeholders to be involved in the process of identification of areas of concerns as well as formulation of mitigation measures. This in turn allows for the stakeholders to develop an understanding of the Project operations as well as the maintenance of positive relations between the stakeholders and the Project proponents.

### **Stakeholder Identification**

A stakeholder is “a person, group, or organization that has a direct or indirect stake in a project/organization because it can affect or be affected by the Project/organisation's actions, objectives, and policies”. As part of this sub section, an attempt has also been made to identify and analysis the stakeholder groups likely to be impacted due to the activities for the Project, which are listed below.

**Table 4.31 Stakeholder Groups**

Primary Stakeholders	Secondary Stakeholders
<ul style="list-style-type: none"> <li>• Local community</li> <li>• Farmers</li> <li>• Vulnerable Groups, including women, elderly, handicapped etc.</li> <li>• Fishing groups</li> </ul>	<ul style="list-style-type: none"> <li>• Government Ministries</li> <li>• Local Authorities</li> <li>• Village Level Institutions</li> <li>• NGOs and Civil Society Organizations</li> <li>• Local Media</li> <li>• Political Parties</li> </ul>

### **Stakeholder Mapping**

“Stakeholder mapping” is a process of examining the relative influence that different individuals and groups have over a Project as well as the influence of the Project over them. The purpose of a stakeholder mapping is to:

- Identify each stakeholder group;
- Study their profile and the nature of the stakes;
- Understand each group’s specific issues, concerns as well as expectations from the Project; and
- Gauge their influence on the Project.

On the basis of such an understanding, the stakeholders are categorised into High Influence/Priority, Medium Influence/ Priority and Low Influence/Priority. The stakeholders who are categorised as high influence

are those who have a high influence on the Project or are likely to be heavily impacted by the Project activities, and are thus high up on the Project proponent's priority list for engagement and consultation. Similarly, the stakeholders categorised as medium influence are those who have a moderate influence on the Project or even though they are to be impacted by the Project, it is unlikely to be substantial and these stakeholders are thus neither high nor low in the Project proponent's list for engagement. On the other hand, the stakeholders with low influences are those who have a minimal influence on the decision making process or are to be minimally impacted by the Project and are thus low in the Project proponent's engagement list.

The following table provides a brief profile of the various stakeholders identified with their key concerns in terms of the Project activities and their degree of influence.

**Table 4.32 Stakeholder Mapping**

Stakeholders	Stakeholder Profile	Level of Influence
<b>Primary Stakeholders</b>		
Local community	This stakeholder group is comprised of the local community in the project, as identified in the social baseline. This group is comprised of the community in the six villages in the area.	High
Farmers	This stakeholder group is comprised of individuals and households who undertake agriculture in the Project Area and its surroundings.	Medium
Vulnerable Groups, including women, elderly, handicapped etc.	This stakeholder group is comprised of those members of the community who due to their socio-economic status are perceived to be more susceptible to the impacts from the project and will required special considerations.	High
Fishing groups	This stakeholder group is comprised of those individuals and households who undertake fishing in the Ayeyarwady river and the other surface water bodies in the area.	High
<b>Secondary Stakeholders</b>		
Government Ministries	<p>This stakeholder group is comprised of the central and region level government departments. These authorities may influence the project in terms of establishing policies, and implementation of the project. This stakeholder group comprises of ministries such as:</p> <ul style="list-style-type: none"> <li>• Ministry of Environment Conservation and Forestry</li> <li>• Ministry of Agriculture and Irrigation</li> <li>• Ministry of Labour</li> <li>• Ministry of Social Welfare, Relief and Resettlements</li> </ul>	High
Local Authorities	<p>this stakeholder group is comprised of the local government bodies, who have the power to regulate or otherwise influence the Project in terms of establishing policy, granting permits and approvals for the Project, monitoring and enforcing compliance with the applicable rules and regulations and making available the necessary infrastructure and resources for the Project. These departments are also store house of relevant information both for the impact assessment as well as to help implement management plans. The authorities which are likely to have the maximum influence on the Project include the authorities such as:</p> <ul style="list-style-type: none"> <li>• Shwe Taung Township Administration</li> <li>• Deputy Township Administration</li> <li>• Community Development Office</li> <li>• City Development Office</li> <li>• Township Education Office</li> <li>• Township Health Office</li> </ul>	High



Stakeholders	Stakeholder Profile	Level of Influence
	<ul style="list-style-type: none"> <li>Township Police Office</li> <li>Township Land Department</li> </ul>	
Village Level Institutions	This stakeholder group is comprised of institutions including the health and education institutions at the village level	Low
NGOs and Civil Society Organizations	This group includes all other people in society who may have an interest in the Project and its social and environmental aspects and non-governmental organisations representing their interests. It includes members of the wider general public in the state and district, civil society organisations such as religious groups, cooperatives, professional associations, cultural groups and citizens' associations, environmental and social groups and universities and other academic and research institutions undertaking work relevant to the Project, who may have views on the Project or information that will be useful for the assessment of Project impacts.	Medium
Local Media		High
Members of Parliament	This stakeholder group comprises of the representatives of the Ayeyarwady region in the parliament. It is important to engage with these stakeholders from an early stage of the Project, as they play a critical role in the formulation of the government policies and norms at the local, regional and national level.	High

On the basis of the understanding thus developed, the process of public consultation and disclosure for the Project was undertaken as part of the ESIA Study as is discussed below.

#### 4.7

#### **SUMMARY OF CONSULTATIONS AND ACTIVITIES UNDERTAKEN**

As part of the ESIA for the Project, meetings were undertaken with the ministry and the local authorities including the MOGE (*Figure 4.49*). As part of these meetings, an understanding was provided of the proposed Project activities and the impact assessment process for the same. In these meetings the local stakeholders who need to be engaged with as part of the impact assessment process were identified. The following table provides the schedule of the meetings and consultations undertaken as part of the ESIA Study.

**Table 4.33** *Schedule of Meetings and Consultations undertaken as part of the ESIA exercise*

Date	Activity	Purpose
18-12-2014	Meet with U Kun Myint Than, General Manager, MOGE	Kick off meeting with MOGE.
	Meet with U Thet Naing Oo, Administrator, General Administrative Department, Shwetaung Township	Seeking Permission for Stakeholder Meeting and permission of field survey.
	Meet with MPRL E&P at Goldern Gust Hotel, Shwetaung	Planning for Field Survey.
19-12-2014	Meet with U Tin Maung Win, Administrator, District Administrative Department, Pyay District	Permission of stakeholder meeting at Pyay.
	Meet with U Thu Hein Soe, Assistant Administrator, General Administrative Department, Shwetaung Township	Collection of Secondary Data.
	Meet with Head of Htan Kone Village Tract	Undertaking community and household surveys across a sample population of the community.
	Meet with Head of Kywe Kone Village Tract	Undertaking community and household surveys across a sample population of the community.
20-12-2014	Meet with Head of Ngwe Ma Yan Village Tract	Undertaking community and household surveys across a sample population of the community.
	Meet with Head of Pang Chuk	Undertaking community and household



*Photo 1: Focus Group Survey in Stakeholder Consultation Meeting for Block IOR 4 at Pyay*



*Photo 2: Stakeholder Consultation Meeting for Block IOR 4 at Pyay*



*Photo 3: Focus Group Discussion in Stakeholder Consultation Meeting for Block IOR 4 at Pyay*



*Photo 4: Women Focus Group Survey for Block IOR 4 at Pyay*



*Photo 5: Farmers Focus Group Survey for Block IOR 4 at Pyay*

Date	Activity	Purpose
	Village Tract	surveys across a sample population of the community.
	Meet with Head of Gwe Tauk Myaing Village Tract	Undertaking community and household surveys across a sample population of the community.
21-12-2014	Meet with Head of Kywe Ma Village Tract	Undertaking community and household surveys across a sample population of the community.
	Meet with Head of Kwin Yar Gyi Village Tract	Undertaking community and household surveys across a sample population of the community.
	Meet with Head of Kyoe Kone Myaing Village Tract	Undertaking community and household surveys across a sample population of the community.
22-12-2014	Meet with U Thu Hein Soe, Assistant Administrator, General Administrative Department, Shwetaung Township.	Collection of Secondary Data.
	Meeting in Swtaung Township with stakeholders	Stakeholder meetings and FGDs with a sample population.

It is understood that the land required for the Project has already been taken control over by the MOGE. In keeping with this, during the engagement with the MOGE, an understanding was developed of the land availability for the Project and the manner in which the engagement with the local community is to be undertaken regarding possible compensation, if any.

In consultation with the MOGE, prior to the commencement of the consultations for the scoping exercise, Project information was disclosed to the local community through pamphlets containing project information.

Post this disclosure of information consultations were undertaken amongst the local community in five (5) villages from Bago and three (3) from the Shwe Taung Townships. The consultations were undertaken as per the guidance of the MOGE representative, township administrators, and were only carried out in villages where the tract leaders are living. For the purpose of these consultations, an MOGE representative was also present with the field team.

Through these engagement activities an attempt was made to develop an understanding of the socio-economic profile, including the livelihood profile, the agricultural patterns in the area, access to health services, water supply and transportation and the village development plans and presence of local civil society organizations in the area.

As part of these engagement activities, a verbal understanding was also provided to the local community representatives of the proposed Project and its activities and the purpose of the engagement activities.



For the purpose of the primary data collection, household surveys were undertaken in eight (8) villages while community surveys were undertaken in six (6) villages in the Project Area. A total of 38 household surveys and six (6) community surveys were undertaken in the eight (8) villages. Apart from this, two focus group discussions were undertaken for farmers and women's group in the Shwe Taung Township.

#### 4.8 KEY FINDINGS OF CONSULTATIONS

As has been mentioned above, as part of the ESIA process a public meeting was undertaken in the Myanaung Township. As part of these meetings, REM and MOGE provided an understanding of the Project and its proposed activities, as well as provided clarifications on any queries of the community.

##### Box 4.1 Message to the Community in Public Meeting

**Deputy Township Officer:** Ministry of Energy is in agreement to find petroleum at No. IOR(4) in Pyay and Shwe Taung Tsp in cooperation with MPRL E&P. ERM in partnership with REM, will carry out ESIA and will help to promote socio-economic program. So, we have invited the local residents, farmers, and women groups from Pawn Gyoke, Gwai Ma, Kywal Ta Lin, Gway Taut Myaung, Htan Kone, and Kwin Yarr Gyi to attend this meeting. There will be advantages and disadvantages when the project is implemented. I would like you to tell us the data of households, other rural facts and information about farmers when we collect the data. You can ask and discuss when you don't understand clearly.

**Consultant Representative:** I am here on the behalf of ERM and REM Company. We are here to undertake environmental and social baseline data collection which will help us in undertaking environmental and social impact assessment of the project. So we will make observation for new project. Ministry of Energy and MPRL E&P will dig up the petroleum in the old places and new places. The location of the project is in the south of Pyay and in the west of Shwe Taung. Environmental Conservation Department and Forestry Department will also be involved and they will ensure that the project follows the rules. This law was brought up on 6 June 2014. For this project, ESIA is required to be undertaken. We will assess the impact of the project on the environment and the public and will give ideas. Our purposes are:

- To get facts about the Project Area.
- To assess the positive and negative effects from the aspect of the environment and social factors.
- To give suggestions to reduce the negative effects.
- To set up environmental management plan to manage impacts when the project is carried out.

So, in the process of EIA,

- we would need to study the area of the project.
- To meet the people live in this area and other responsible persons.
- To collect the data.
- To write a draft report about EIA.

The facts we have to observe and measure are

- The air quality
- The water quality
- Noise pollution
- The quality of land
- Ecosystem

Social problems

- Demography
- Collecting the socio-economic information
- Collecting the data about their daily life
- The cultural heritage
- The rights of famers
- Women right

After assessing, we will suggest concerning

- The methods to reduce the negative impacts on the environment.
- The ways to manage the environment impacts better.
- Receive approval for the EIA proposal.

Seismic surveys will be started in the middle of 2015. Width 3 to 5 ft and depth 30 fts holes will be dugged up and seismic waves will be emitted. Then seismic data will be collected using geophone and wires. Infrastructures that are needed for projects will be constructed and the rations and materials for projects will be bought from local markets. Before the project is started, we have to inform the township administrator, village administrator and land owners. We will also investigate all the possible impacts on environment and socio-economic status of people living in this area. We will also suggest suitable management plan to protect and reduce any negative impacts. We are neither from government department nor from the company. We are the third party group that consults for environmental conservation. We will also include all the suggestions, opinions and ideas of people while writing our report.

Natural environment includes all the geographical features such as forests, mountains, water, ground, animal species and so forth. Social environment includes all the attendees here and the people. We will do impact assessments on both environmental and social aspects. All the attendees can ask whatever you want to know from us. Responsible person U Zaw Maung Maung from MOGE is also here with us. He will also answer the questions concerning oil and gas exploration. Moreover, the attendees can openly discuss your worries and your concerns for the project. Thank you.

The following table provides a summary of the questions/concerns of the community and the responses provided.

**Table 4.24** *Public Meetings undertaken as part of the ESIA Process*

Questions	Answers Provided
By digging up the petroleum, how it will affect the land, the wells and the lakes?	There are 15 old places to dig up the petroleum and the project will dig up in those places again. We cannot tell whether it can damage the land or not to the extent you understand; however there will be some short term impact over the land. If there is something wrong, you can report to the management group. The water from the wells and lakes has already been examined and we will tell about the findings of it in the next meeting. By recording the findings, you can report to the management when there is something wrong.
Will schools, roads, and monasteries be built before the project or after the project?	We will report before the project is started. After that, the Ministry of Energy and Company will carry out the developed programs for the village before the project is done. Further commitments can only be provided by the company.
Gawi Ma and Sate Tan villages are the places to transport the petroleum. One fourth of places are occupied and the stores are built. The farms are also occupied. The big containers to store petroleum are also built and they are close to the village and on the roadside. Now, they damaged them and took them away. So, we want to get the places officially. The one fourth of the village is full of pipe (4 or 5 Inches). These pipes are placed on the land and the noise appears because of the vehicles. The good point is we get electricity in the hospital and on the road.	We will write about it in the report.

Questions	Answers Provided
If they will dig out the petroleum on the land of the famers, what will you do for that?	There is a proper process for the same. Discussions will happen, and another round of detailed study will be conducted before that. The company will get agreement from the head of Village Tract and the relevant ministries and departments concerned. After that, the meeting was finished and they discussed concerning the rights of farmers and women.

Apart from these meetings, engagement was undertaken with the local stakeholders in the form of focus group discussions during the impact assessment process with the farmers and women group, certain key concerns and expectations of the local community were identified during the impact assessment process:

- Impact on Land Availability:** One of the key concerns of the local community was in terms of the impact of the Project activities on the availability of land in the area and the agriculture undertaken by the community. From the information made available it is understood that agriculture is the primary source of livelihood for a majority of the local community. Thus the Project activities are likely to result in a reduction of the land available for agriculture, which in turn would impact the income and livelihood sources for the community. This impact is likely to be heightened for those households who are solely dependent upon agriculture, whose majority land holdings are impacted by the Project and those who do not have alternative land available.
- Payment of Crop Compensation:** According to the information made available by the local community, it is understood that a number of households have lost their land for the Project (7 of the 38 surveyed households) and all of them have received compensation for the loss. Furthermore, the compensation received has been in the form of crop compensation provided by the previous project developers or the government (MOGE). While the exact information pertaining to the number of households compensated and the amount of compensation paid was unavailable, one of the key expectations of the community from the Project was the provisioning of adequate compensation for the loss of land and crop due to the Project. However, it is understood, that according to the discussions undertaken with the government, no further compensation is to be paid for this Project.
- Community Development Activities:** In keeping with this understanding of the impact of the Project activities on the livelihood of the community, the community identified certain areas of expectations from the Project in terms of financial and/or technical assistance for undertaking agriculture and other livelihood activities, especially in terms of providing irrigation facilities.

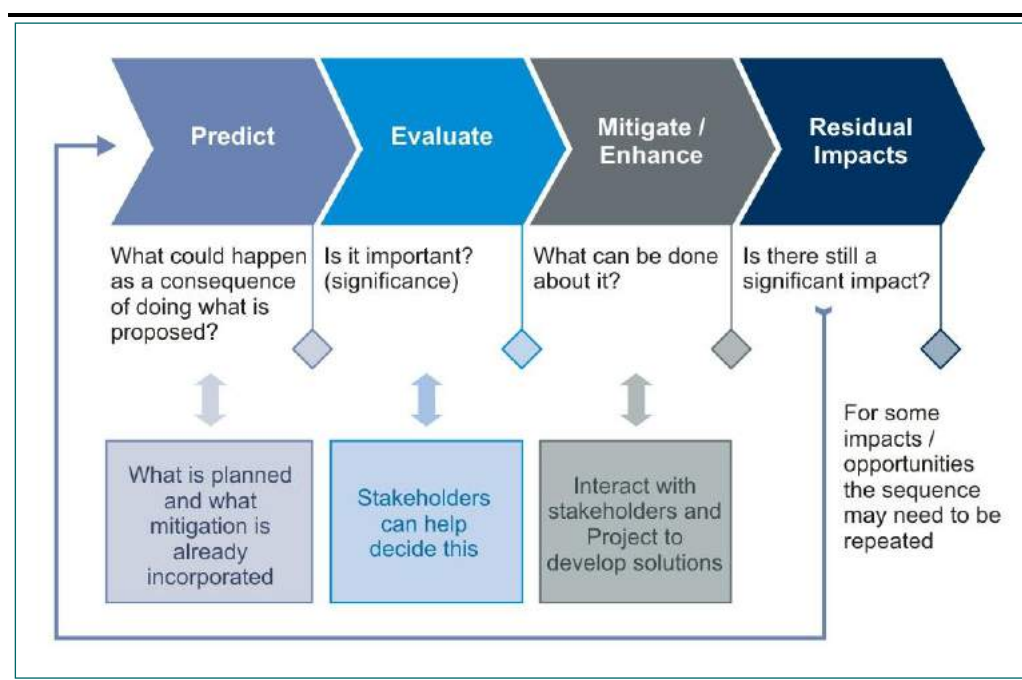
## 5.1

## IMPACT ASSESSMENT METHODOLOGY AND APPROACH

Impact identification and assessment starts with scoping and continues through the remainder of the impact assessment process (IAP). The principal impact assessment (IA) steps are summarized in *Figure 5.1* and comprise:

- Impact prediction: to determine what could potentially happen to resources/receptors as a consequence of the Project and its associated activities.
- Impact evaluation: to evaluate the significance of the predicted impacts by considering their magnitude and likelihood of occurrence, and the sensitivity, value and/or importance of the affected resource/receptor.
- Mitigation and enhancement: to identify appropriate and justified measures to mitigate negative impacts and enhance positive impacts.
- Residual impact evaluation: to evaluate the significance of impacts assuming effective implementation of mitigation and enhancement measures.

*Figure 5.1* Impact Assessment Process



### *Prediction of Impacts*

Prediction of impacts is essentially an objective exercise to determine what could potentially happen to the environment as a consequence of the Project and its associated activities. This is essentially a repeat of the process undertaken in scoping, whereby the potential interactions between the Project



and the Baseline environment are identified. In the impact assessment stage, these potential interactions are updated based on additional Project and Baseline information. From these potential interactions, the potential impacts to the various resources/receptors are identified, and are elaborated to the extent possible. The diverse range of potential impacts considered in the IA process typically results in a wide range of prediction methods being used including quantitative, semi-quantitative and qualitative techniques.

#### *Evaluation of Impacts*

Once the prediction of impacts is complete, each impact is described in terms of its various relevant characteristics (e.g., type, scale, duration, frequency, extent). The terminology used to describe impact characteristics is shown in *Table 5.1*.

**Table 5.1** *Impact Characteristic Terminology*

Characteristic	Definition	Designations
Type	A descriptor indicating the relationship of the impact to the Project (in terms of cause and effect).	Direct Indirect Induced
Extent	The “reach” of the impact (e.g., confined to a small area around the Project Footprint, projected for several kilometres, etc).	Local Regional International
Duration	The time period over which a resource / receptor is affected.	Temporary Short-term Long-term Permanent
Scale	The size of the impact (e.g., the size of the area damaged or impacted, the fraction of a resource that is lost or affected, etc)	[no fixed designations; intended to be a numerical value]
Frequency	A measure of the constancy or periodicity of the impact.	[no fixed designations; intended to be a numerical value]

The definitions for the *type* designations are shown in *Table 5.2*. Definitions for the other designations are resource/receptor-specific, and are discussed in the resource/receptor-specific chapters.

**Table 5.2** *Impact Type Definitions*

Designations (Type)	Definition
Direct	Impacts that result from a direct interaction between the Project and a resource/receptor (e.g., between occupation of a plot of land and the habitats which are affected).
Indirect	Impacts that follow on from the direct interactions between the Project and its environment as a result of subsequent interactions within the environment (e.g., viability of a species population resulting from loss of part of a habitat as a result of the Project occupying a plot of land).
Induced	Impacts that result from other activities (which are not part of the Project) that happen as a consequence of the Project (e.g., influx of camp followers resulting from the importation of a large Project workforce).

The above characteristics and definitions apply to planned and unplanned events. An additional characteristic that pertains only to unplanned events is *likelihood*. The *likelihood* of an unplanned event occurring is designated using a qualitative scale, as described in Table 5.3.

**Table 5.3**      *Definitions for Likelihood Designations*

<b>Likelihood</b>	<b>Definition</b>
Unlikely	The event is unlikely but may occur at some time during normal operating conditions.
Possible	The event is likely to occur at some time during normal operating conditions.
Likely	The event will occur during normal operating conditions (i.e., it is essentially inevitable).

Once an impact's characteristics are defined, the next step in the impact assessment phase is to assign each impact a 'magnitude'. Magnitude is a function of some combination (depending on the resource/receptor in question) of the following impact characteristics:

- Extent
- Duration
- Scale
- Frequency

Additionally, for unplanned events only, magnitude incorporates the 'likelihood' factor discussed above.

Magnitude essentially describes the intensity of the change that is predicted to occur in the resource/receptor as a result of the impact. As discussed above, the magnitude designations themselves are universally consistent, but the definitions for these designations vary on a resource/receptor-by-resource/receptor basis, as further discussed in each of the resource/receptor-specific chapters. The universal magnitude designations are:

- Positive
- Negligible
- Small
- Medium
- Large

In the case of a *positive* impact, no magnitude designation (aside from 'positive') is assigned. It is considered sufficient for the purpose of the IA to indicate that the Project is expected to result in a *positive* impact, without characterising the exact degree of positive change likely to occur.

In the case of impacts resulting from unplanned events, the same resource/receptor-specific approach to concluding a magnitude designation is utilised, but the 'likelihood' factor is considered, together with the other impact characteristics, when assigning a magnitude designation.

In addition to characterising the magnitude of impact, the other principal impact evaluation step is definition of the sensitivity / vulnerability / importance of the impacted resource/receptor. There are a range of factors to be taken into account when defining the sensitivity / vulnerability / importance of the resource/receptor, which may be physical, biological, cultural or human. Other factors may also be considered when characterising sensitivity/vulnerability/importance, such as legal protection, government policy, stakeholder views and economic value.

As in the case of magnitude, the sensitivity/vulnerability/importance designations themselves are universally consistent, but the definitions for these designations vary on a resource/receptor basis. The universal sensitivity/vulnerability/importance designations are:

- Low
- Medium
- High

Once magnitude of impact and sensitivity/vulnerability/importance of resource/receptor have been characterised, the significance can be assigned for each impact. Impact significance is designated using the matrix shown in Figure 5.2.

**Figure 5.2**      **Impact Significances**

		Sensitivity/Vulnerability/Importance of Resource/Receptor		
		Low	Medium	High
Magnitude of Impact	Negligible	Negligible	Negligible	Negligible
	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Major

The matrix applies universally to all resources/receptors, and all impacts to these resources/receptors, as the resource/receptor-specific considerations are factored into the assignment of magnitude and sensitivity/vulnerability/importance designations that enter into the matrix. Box 5.1 provides a context for what the various impact significance ratings signify.

It is important to note that impact prediction and evaluation take into account any embedded controls (i.e., physical or procedural controls that are already planned as part of the Project design, regardless of the results of the IA Process). An example of an embedded control is a standard acoustic enclosure that is designed to be installed around a piece of major equipment. This avoids the situation where an impact is assigned a magnitude based on a hypothetical version of the Project that considers none of the embedded controls.

### Box 5.1

### *Context of Impact Significances*

An impact of **negligible** significance is one where a resource/receptor (including people) will essentially not be affected in any way by a particular activity or the predicted effect is deemed to be 'imperceptible' or is indistinguishable from natural background variations.

An impact of **minor** significance is one where a resource/receptor will experience a noticeable effect, but the impact magnitude is sufficiently small (with or without mitigation) and/or the resource/receptor is of low sensitivity/ vulnerability/ importance. In either case, the magnitude should be well within applicable standards.

An impact of **moderate** significance has an impact magnitude that is within applicable standards, but falls somewhere in the range from a threshold below which the impact is minor, up to a level that might be just short of breaching a legal limit. Clearly, to design an activity so that its effects only just avoid breaking a law and/or cause a major impact is not best practice. The emphasis for moderate impacts is therefore on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP). This does not necessarily mean that impacts of moderate significance have to be reduced to minor, but that moderate impacts are being managed effectively and efficiently.

An impact of **major** significance is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. An aim of IA is to get to a position where the Project does not have any major residual impacts, certainly not ones that would endure into the long-term or extend over a large area. However, for some aspects there may be major residual impacts after all practicable mitigation options have been exhausted (i.e. ALARP has been applied). An example might be the visual impact of a facility. It is then the function of regulators and stakeholders to weigh such negative factors against the positive ones, such as employment, in coming to a decision on the Project.

### *Identification of Mitigation and Enhancement Measures*

Once the significance of an impact has been characterised, the next step is to evaluate what mitigation and enhancement measures are warranted. For the purposes of this IA, ERM has adopted the following Mitigation Hierarchy:

- **Avoid at Source; Reduce at Source:** avoiding or reducing at source through the design of the Project (e.g., avoiding by siting or re-routing activity away from sensitive areas or reducing by restricting the working area or changing the time of the activity).
- **Abate on Site:** add something to the design to abate the impact (e.g., pollution control equipment, traffic controls, perimeter screening and landscaping).



- **Abate at Receptor:** if an impact cannot be abated on-site then control measures can be implemented off-site (e.g., noise barriers to reduce noise impact at a nearby residence or fencing to prevent animals straying onto the site).
- **Repair or Remedy:** some impacts involve unavoidable damage to a resource (e.g. agricultural land and forestry due to creating access, work camps or materials storage areas) and these impacts can be addressed through repair, restoration or reinstatement measures.
- **Compensate in Kind; Compensate Through Other Means:** where other mitigation approaches are not possible or fully effective, then compensation for loss, damage and disturbance might be appropriate (e.g., planting to replace damaged vegetation, financial compensation for damaged crops or providing community facilities for loss of fisheries access, recreation and amenity space).

The priority in mitigation is to first apply mitigation measures to the source of the impact (i.e., to avoid or reduce the magnitude of the impact from the associated Project activity), and then to address the resultant effect to the resource/receptor via abatement or compensatory measures or offsets (i.e., to reduce the significance of the effect once all reasonably practicable mitigations have been applied to reduce the impact magnitude).

#### *Residual Impact Evaluation*

Once mitigation and enhancement measures are declared, the next step in the IA Process is to assign residual impact significance. This is essentially a repeat of the impact assessment steps discussed above, considering the assumed implementation of the additional declared mitigation and enhancement measures.

#### *Management and Monitoring*

The final stage in the IA Process is definition of the management and monitoring measures that are needed to identify whether: a) impacts or their associated Project components remain in conformance with applicable standards; and b) mitigation measures are effectively addressing impacts and compensatory measures and offsets are reducing effects to the extent predicted.

A Environmental Management Plan, which is a summary of all actions which the Project Proponent has committed to executing with respect to environmental/social/health performance for the Project, is also included as part of the EIA report. The Environmental Management Plan includes mitigation measures, compensatory measures and offsets and management and monitoring activities.

For the Project, potential impacts have been identified through a systematic process whereby the activities (both planned and unplanned) associated with the Project have been considered with respect to their potential to interact with environmental and social resources or receptors.

The results from the scoping process for the Project are presented in the Scoping Matrix in *Table 5.4* and *Table 5.5*. The Scoping Matrix displays Project activities against resources/receptors, and supports a methodological identification of the potential interactions each Project activity may have on the range of resources/receptors within the Area of Influence for the Project. Entries in the matrix cells are coloured to indicate whether:

- An interaction is not reasonably expected (white);
- An interaction is reasonably possible but none of the resulting impacts are likely to lead to significant effects (grey);
- An interaction is reasonably possible and at least one of the resulting impacts is likely to lead to an effect that is significant (black); or
- An interaction will possibly lead to positive impacts (green).

For the purpose of the scoping exercise, seismic activities are divided into the following phases for seismic activities:

- Preparation/mobilisation phase;
- Seismic survey phase;
- Close-Out phase; and
- Accidental events.

A separate scoping matrix is presented for the well workover activities.

Table 5.4 Scoping Matrix for Seismic Surveys

Project Activity/ Hazards	Resource/ Receptors	Physical												Biological					Socio/Economic Resources									
		Ambient Air Quality	Global Climate	Ambient Noise	Vibration	Ground Water Quality	Surface Water Quality	Hydrology	Hydrogeology	Soil	Topography	Landscape and Visual Character	Use of Natural Resources	Sediment	Terrestrial Habitat	Terrestrial Flora	Terrestrial Fauna	Aquatic Habitat (freshwater)	Aquatic Flora & Fauna(freshwater)	Designated Areas	Community Health and Safety	Indigenous people	Demographic Pattern	Employment and Income	Transportation	Occupational Health and Safety	Education and Skills	Infrastructure Services
Seismic Exploration																												
Preparation & Mobilisation																												
Construction of workforce camp																												
Labour, equipment and services supply																												
Site preparation/ clearance & creation of access routes																												
Transportation of equipment, materials and waste																												
Mobile Power Generation																												
Disposal of waste																												
Sewage and wastewater discharge																												
Seismic Surveying																												
Labour, equipment and services supply																												
Site preparation/ clearance & creation of access routes																												
Transportation of equipment, supplies and workforce																												
Surveying and pegging route of line																												
Mobile power generation																												
Drilling (daylight hours)																												
Laying of receivers and cables for data collection																												
Detonation of explosives																												
Retrieval of cables and receivers (similar to laying cables but less significance in scale)																												
Reinstatement																												
Waste disposal																												
Sewage and wastewater discharge																												
Close-Out Phase																												
Labour, equipment and services supply																												
Decommissioning of labour camp and facilities																												
Removal of access routes, etc.																												
Transportation of equipment, materials, waste and workforce																												
Disposal of waste																												
Sewage and wastewater discharge																												
Accidental Events																												
Spills/leaks																												
Fires and explosions																												
Vehicle accidents																												
Equipment/infrastructure damage																												
Disruption of utilities																												

- An interaction is not reasonably expected (white);
- An interaction is reasonably possible but none of the resulting impacts are likely to lead to significant effects (grey);
- An interaction is reasonably possible and at least one of the resulting impacts is likely to lead to an effect that is significant (black); or
- An interaction will possibly lead to positive impacts (green).

Table 5.5 Scoping Matrix for Workover Activities

Project Activity/ Hazards	Resource/ Receptors	Physical												Biological						Socio/Economic Resources									
		Ambient Air Quality	Global Climate	Ambient Noise	Vibration	Ground Water Quality	Surface Water Quality	Hydrology	Hydrogeology	Soil	Topography	Landscape and Visual Character	Use of Natural Resources	Sediment	Terrestrial Habitat	Terrestrial Flora	Terrestrial Fauna	Aquatic Habitat (freshwater)	Aquatic Flora & Fauna(freshwater)	Designated Areas	Community Health and Safety	Indigenous People	Demographic Pattern (including livelihood)	Employment and Income	Transportation	Occupational Health and Safety	Education and Skills	Infrastructure Services	Cultural Heritage
Workover Activities																													
Well deepening																													
Pumping servicing																													
Swabbing and bailing																													
Zone isolation																													
Re-perforations																													
Disposal of waste																													
Well heads improvement																													
Accidental Events																													
Spills/leaks																													
Fires and explosions																													
Vehicle accidents																													
Equipment/infrastructure damage																													
Disruption of utilities																													

- An interaction is not reasonably expected (white);
- An interaction is reasonably possible but none of the resulting impacts are likely to lead to significant effects (grey);
- An interaction is reasonably possible and at least one of the resulting impacts is likely to lead to an effect that is significant (black); or
- An interaction will possibly lead to positive impacts (green).



The prioritisation of impacts indicates that the majority of identified interactions of the seismic surveys and workover activities with the environment and social receptors are not expected to be significant. For activities predicted to have no significant impact (ie those in white in the Matrix), no detailed quantification or further assessment will be conducted under the ESIA.

For activities where an interaction is reasonably possible but none of the resulting impacts would be considered likely to lead to significant effects, this evaluation recommends that they be reviewed and confirmed within the detailed ESIA.

Those interactions from seismic survey and workover activities which have the potential to generate **significant** impacts are:

#### *Environmental Impacts of Seismic Survey*

##### **Preparation / Mobilisation Phase**

- Impacts from construction of workforce camp on terrestrial habitats and associated fauna and flora;
- Impacts from labour (including hunting), equipment and services supply on terrestrial and aquatic flora and fauna;
- Impacts from site preparation / clearance and creation of access routes on terrestrial habitats and associated flora and fauna;
- Impacts from mobile power generation on terrestrial fauna;
- Impacts from waste disposal on surface water quality, ground water quality, soil, terrestrial habitats and aquatic habitats as well as their associated flora and fauna; and
- Impacts from sewage and wastewater discharge on surface water quality, ground water quality, soil, terrestrial habitats and aquatic habitats as well as their associated flora and fauna.

##### **Seismic Survey Phase**

- Impacts from labour (including hunting), equipment and services supply on terrestrial and aquatic flora and fauna;
- Impacts from site preparation / clearance and creation of access routes on terrestrial habitats and aquatic habitats as well as their associated flora and fauna;
- Impacts from mobile power generation on terrestrial fauna;
- Impacts from drilling on terrestrial fauna;

- Impacts from detonation of explosive on terrestrial fauna;
- Positive impacts from reinstatement on terrestrial habitats and aquatic habitats as well as their associated flora and fauna;
- Impacts from waste disposal on surface water quality, ground water quality, soil, terrestrial habitats and aquatic habitats as well as their associated flora and fauna; and
- Impacts from sewage and wastewater discharge on surface water quality, ground water quality, soil, terrestrial habitats and aquatic habitats as well as their associated flora and fauna.

### **Close-Out Phase**

- Impacts from labour (including hunting), equipment and services supply on terrestrial and aquatic flora and fauna;
- Positive impacts from removal of access routes on terrestrial habitats and aquatic habitats as well as their associated flora and fauna;
- Impacts from waste disposal on surface water quality, ground water quality, soil, terrestrial habitats and aquatic habitats as well as their associated flora and fauna; and
- Impacts from sewage and wastewater discharge on surface water quality, ground water quality, soil, terrestrial habitats and aquatic habitats as well as their associated flora and fauna.

### **Accidental Events**

- Impacts from spills/leaks on surface water quality, ground water quality, soil, terrestrial habitats and aquatic habitats as well as their associated flora and fauna; and
- Impacts from fires and explosions on air quality, ground water quality, surface water quality, landscape and visual character, use of natural resources, terrestrial habitats and aquatic habitats as well as their associated flora and fauna.

### ***Environmental Impacts of Well Workover Activities***

#### **Well Workover Activities**

- Impacts from operation of mechanical equipment required for workover activities on ambient air and noise conditions;
- Positive impact from pumping service on ambient noise condition;
- Impacts from disposal of waste from workover activities on surface water quality, ground water quality, soil, terrestrial habitats and aquatic habitats as well as their associated flora and fauna; and

- Positive impact from improvement of wellheads on soil, surface water and groundwater quality

### **Accidental Events**

- Impacts from spills/leaks on surface water quality, ground water quality, soil, terrestrial habitats and aquatic habitats as well as their associated flora and fauna; and
- Impacts from fires and explosions on air quality, ground water quality, surface water quality, landscape and visual character, use of natural resources, terrestrial habitats and aquatic habitats as well as their associated flora and fauna.

### ***Social Impacts of Seismic Survey***

#### **Preparation / Mobilisation Phase**

- Impacts from construction of workforce camp on community health and safety, employment and income, infrastructure services and cultural heritage;
- Impacts from labour (including hunting), equipment and services supply on community health and safety, transportation, occupational health and safety and infrastructure services;
- Impacts from site preparation / clearance and creation of access routes on employment and income and cultural heritage;
- Impacts from transportation of materials, equipment and wastes on community health and safety, transportation, occupational health and safety and infrastructure services;
- Impacts from waste disposal on community health and safety; and
- Impacts from sewage and wastewater discharge on community health and safety.

#### **Seismic Survey Phase**

- Impacts from labour (including hunting), equipment and services supply on community health and safety, transportation, occupational health and safety and infrastructure services;
- Impacts from site preparation / clearance and creation of access routes on demographic pattern (including livelihood), employment and income, transportation, occupational health and safety, infrastructure services and cultural heritage;
- Impacts from transportation of equipment, supplies and workforce on community health and safety, transportation, occupational health and safety and infrastructure services;

- Impacts from drilling on community health and safety, occupational health and safety, infrastructure services and cultural heritage;
- Impacts from laying of receivers and cables for data collection on community health and safety and occupational health and safety;
- Impacts from detonation of explosive on community health and safety, occupational health and safety and cultural heritage;
- Impacts from retrieval of receivers and cables on community health and safety and occupational health and safety;
- Impacts from waste disposal on community health and safety, education and skills and infrastructure services; and
- Impacts from sewage and wastewater discharge on community health and safety, education and skills and infrastructure services.

### **Close-Out Phase**

- Impacts from labour (including hunting), equipment and services supply on community health and safety, transportation, occupational health and safety and infrastructure services;
- Impacts from transportation of equipment, materials, waste and workforce on community health and safety, demographic pattern (including livelihood), transportation, occupational health and safety and infrastructure services;
- Impacts from waste disposal on infrastructure services; and
- Impacts from sewage and wastewater discharge on infrastructure services.

### **Accidental Events**

- Impacts from spills/leaks on community health and safety and occupational health and safety;
- Impacts from fires and explosions on community health and safety, employment and income, occupational health and safety and cultural heritage;
- Impacts from vehicle accident on community health and safety and occupational health and safety;
- Impacts from equipment/infrastructure damage on employment and income; and
- Impacts from disruption of utilities on employment and income and infrastructure services.



## *Social Impacts of Well Workover Activities*

### **Well Workover Planned Activities**

- Positive impact from workover activities on employment and income; and
- Impacts from workover activities on community health and safety and occupational health and safety.

## **5.4 ENVIRONMENTAL IMPACT ASSESSMENT AND MITIGATION**

Drawing on the outcomes of scoping, *Sections 5.5 – 5.30* below present the assessment of the potential impacts to the environment associated with the seismic survey and well workover activities. The assessment is presented in the order of impacts as identified during scoping.

### **PREPARATION / MOBILISATION PHASE**

## **5.5 IMPACTS FROM CONSTRUCTION OF WORKFORCE CAMP ON TERRESTRIAL HABITATS AND ASSOCIATED FAUNA AND FLORA**

### **5.5.1 Source of Impact**

Direct impacts to terrestrial ecology associated with the construction of the camp will include:

- Habitat and vegetation loss within the footprint of the camp resulting from land take; and
- Potential loss of inactive or less mobile wildlife that are nesting in or inhabiting the affected area.

Indirect impacts to terrestrial ecology will include:

- Potential impacts to the surrounding habitat and associated wildlife due to disturbance of this habitat including noise and increased human activity

### **5.5.2 Existing/ In Place Controls**

Measures to control/ minimise adverse impacts of habitat loss are assumed to include:

- Footprint of the proposed camp is minimised during the design stage.
- Construction activities will be restricted to works areas that will be clearly demarcated.
- Work site boundaries will be regularly checked to ensure that they are not breached and that damage does not occur to surrounding areas.

- It is assumed felling of large perennial vegetation (i.e. large trees such as roadside trees) will be avoided.
- Works areas in temporarily affected areas would be reinstated with tree/shrub planting after completion of the works, as far as practicable.
- Construction camp is assumed to be temporary and will be removed in the close-out phase.

### 5.5.3 *Significance of Impacts*

The site for the construction camp is located in modified habitat that is characteristic of low sensitivity agricultural land and is subject to existing disturbance particularly from activities associated with operations of the adjacent GOCS facility. Plants are observed to be common and widespread species and none are considered species of conservation interest. Less mobile fauna species of conservation interest at the site have the potential to include King Cobra (Vulnerable), though no direct observation of this species at this site was recorded during surveys. Provided that the existing/in place controls are followed, the impact of habitat loss and disturbance is ranked of **Minor** significance.

**Table 5.6** *Assessment of Impacts on Habitat and Flora (Construction of Construction camp)*

Impact	Loss of habitats and vegetation during construction camp construction				
Impact Type	Direct		Indirect		Induced
Impact Duration	Temporary	Short-term		Long-term	Permanent
Impact Extent	Local		Regional		International
Impact Scale	Direct: <1ha. Indirect: Expected to be confined to the immediate vicinity				
Frequency	Short term.				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low		Medium		High
Impact Significance	Negligible	Minor		Moderate	Major

**Table 5.7**      *Assessment of Impacts on Terrestrial Fauna (Construction of Construction camp)*

Impact	Disturbances to fauna and potential increase in wildlife mortality.				
Impact Nature	Negative		Positive		Neutral
Impact Type	Direct		Indirect		Induced
Impact Duration	Temporary	Short-term	Long-term		Permanent
Impact Extent	Local		Regional		International
Impact Scale	Exact extent of indirect affects unknown but considered local				
Frequency	Continuous				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low		Medium		High
Impact Significance	Negligible	Minor		Moderate	Major

#### 5.5.4      *Additional Mitigation, Management and Monitoring*

The assessment has indicated that impacts with habitat loss and disturbance to fauna are expected to be minor, hence, no additional mitigation or monitoring activities are considered necessary over and above the existing or in-place controls.

#### 5.5.5      *Significance of Residual Impacts*

Residual impacts would be expected to be of **Minor** significance.

### 5.6      *IMPACTS FROM LABOUR (INCLUDING HUNTING), EQUIPMENT AND SERVICES SUPPLY ON TERRESTRIAL AND AQUATIC FLORA AND FAUNA*

#### 5.6.1      *Source of Impact*

Hunting may increase in the surrounding areas as a result of worker influx into the area and increased traffic may result in increase in animal strike on roads. The creation of access routes or cutting of seismic lines and establishment of construction camp does present a risk as this creates access into interior parts of the secondary forest (dry forest) exposing wildlife to the risk of poaching by Project staff/ workers. Hunting, poaching and wildlife trade are critical issues for the conservation of biodiversity globally; unsustainable hunting to obtain meat, animal parts or live individuals for the pet trade has caused population declines and local extinction of many species and threatens some species with global extinction. During surveys, terrestrial wildlife were recorded in forest habitat which are known targets for hunting including species of conservation interest such as Chinese Pangolin (Critically Endangered) and Yellow-headed Tortoise (Endangered). Mammals in forest habitat also include Sambar Deer, Red Muntjac, Wild Pig Common Palm Civet and Leopard Cat, which are potential bush meat species.

#### 5.6.2      *Existing/ In Place Controls*

Measures to control/ minimise adverse impacts will include:

- Oil fields are restricted areas and therefore existing access restrictions will be in place and patrolled within the block. Priority areas for patrolling should be identified within the Environmental Monitoring Plan (e.g. secondary forest areas where new access routes are created).
- Project activities in day light working hours.
- Minimisation of night-time driving.

### 5.6.3 *Significance of Impacts*

In the absence of controls on workforce, loss of fauna due to hunting/poaching (intentional take) have potential to be of up to **Moderate** significance depending on species taken.

**Table 5.8** *Assessment of Impacts on Terrestrial and Aquatic Fauna (Labour)*

Impact	Loss of fauna due to impacts (eg hunting) from labour					
Impact Type	Direct		Indirect		Induced	
Impact Duration	Temporary	Short-term		Long-term	Permanent	
Impact Extent	Local		Regional		International	
Impact Scale	Loss of fauna individuals dependent on hunting effort.					
Frequency	Intermittent.					
Impact Magnitude	Positive	Negligible	Small	Medium	Large	
Resource Sensitivity	Low			Medium		High
Impact Significance	Negligible	Minor		Moderate		Major

### 5.6.4 *Additional Mitigation, Management and Monitoring*

- A Biodiversity Action Plan will be developed by MPRL E&P or a third party administered under the Environmental and Social Management Plan, whereby management and mitigation measures will be provided covering all aspects of biodiversity that may be affected by the Project.
- HSE coordinators will be employed for the duration of the seismic survey. They will be employed by MPRL E&P or a third party and will not be employed directly by the seismic contractor. It will be their job to supervise all activities in relation to biodiversity and to make sure that all mitigation measures are employed during each phase of the seismic survey. Contractor's HSE Manager will assist the HSE coordinators in supervising the implementation of mitigation measures.
- Work areas will be clearly demarcated and any activities outside these areas will be prohibited except under a permit system where necessary and for entry and exit this will occur along designated access routes.
- Induction training for personnel is recommended to include a mandatory segment on biodiversity. In this induction details of key requirements will be provided to include ban on fishing and hunting.



- Prohibit workers from uncontrolled interaction and commerce with the local community in terms of buying and selling goods particularly Non-Timber Forest Products (NTFP), bush meat and wildlife (pets, souvenirs).
- Prohibit staff from introducing pets, livestock and other animals.
- Engagement with local community to convey the message that workers are not allowed buying Non-Timber Forest Products (NTFP), bushmeat and wildlife (pets, souvenirs).
- Work with local authorities and communities through the stakeholder engagement plan to monitor and control hunting and poaching arising from new access in the Project Area.
- A monitoring programme will be established to ensure mitigation measures are being implemented effectively.

#### 5.6.5 *Significance of Residual Impacts*

Based on the assumption that MPRL E&P will be able control and mitigate the impacts arising directly from its own workforce (including contractors), species mortality due to poaching by Project staff/ workers is evaluated to be **Negligible**.

### 5.7 *IMPACTS FROM SITE PREPARATION / CLEARANCE AND CREATION OF ACCESS ROUTES ON TERRESTRIAL HABITATS AND ASSOCIATED FLORA AND FAUNA*

#### 5.7.1 *Source of Impact*

Determination and development of access tracks for equipment, resources and workforce for the seismic survey will commence in the preparation/ mobilization phase. A grid of straight lines to acquire seismic data in both shot and receiver lines will need to be accessed by the survey team. This will involve the survey team accessing the lines on foot requiring them to tread on vegetation and land and where necessary cut vegetation to make or clear a path. The need to cut vegetation will be greater in more densely vegetated areas in secondary forest habitats and less in open areas such as agricultural land, although potentially impacting on planted crops.

The survey team may need to cut vegetation for drilling of shot holes which may cause some vegetation loss in that area. In some areas, vegetation will be cleared for construction of access roads.

Apart from direct vegetation loss, linear constructions such as roads and trails within forest habitat can lead to detrimental ecological effects on wildlife populations due creation of forest fragmentation and edge effects <sup>(1)</sup>. For

<sup>(1)</sup> Laurance, W., Goosem, M. and Laurance, S. (2009) Impacts of roads and linear clearings on tropical forests. Elsevier Ltd, doi:10.1016/j.j.tree.2009.06.009

instance, due to predator avoidance behaviours , some terrestrial fauna may have a tendency to stay away from cutlines, which may impede movements across areas. On the other hand, cutlines can facilitate movements of predators across area which may change predator-prey relationships.

The presence of workforce and associated disturbance such as from noise will likely result in temporary displacement of terrestrial fauna away from works areas in the forest habitat. Affected fauna are likely to include the eleven mammal species recorded in forest habitat such as Sambar Deer, Red Muntjac, Common Palm Civet, Golden Jackel, Wild Pig, Hare, Squirrels and Leopard Cat.

### 5.7.2 *Existing/ In Place Controls*

Measures to control/ minimise adverse impacts will include:

- Teams for deployment of source lines will access areas on foot, as far as practicable and follow/ clear a narrow path.
- On the basis that vegetation clearance for tracks to allow access will be by hand, it is assumed felling of large perennial vegetation (i.e. large trees) will be avoided.
- Minimize footprint of access roads at the design stage (width of any new road should be less than 5 m).

### 5.7.3 *Significance of Impacts*

Impacts on terrestrial flora from clearance and creation of access routes are expected to be local in extent, short-term in duration, reversible and small magnitude. It is unlikely vegetation growth will be significantly reduced where teams have trod across. Crops can be replaced in next planting. Given sensitivity of potentially affected habitats are low or medium, the significance is ranked as **Minor**. However, if not properly managed there is potential for **Moderate** impacts.

Based on the assumption, that vegetation will be by hand and width of lines is narrow, impact of habitat fragmentation and edge effects in the forest is evaluated as **Minor**.

Disturbance and displacement-causing activities will only be temporary in nature and limited in extent and duration. As such the magnitude is considered small. Given terrestrial fauna are typically mobile and will move away from a source of disturbance, sensitivity is considered moderate. Significance of potential impacts to fauna is ranked as **Minor**. Nevertheless due to the potential for adverse worker-wildlife interactions, further management measures are recommended.

**Table 5.9** *Assessment of Impacts on Habitat and Flora (Site Preparation and Clearance of Access Routes)*

Impact	Cutting of vegetation on access to seismic lines.				
Impact Type	Direct		Indirect		Induced
Impact Duration	Temporary	Short-term		Long-term	Permanent
Impact Extent	Local		Regional		International
Impact Scale	Cutting on seismic lines on narrow path				
Frequency	One time activity for any given track				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low			High	
Impact Significance	Negligible	Minor	Moderate		Major

**Table 5.10** *Assessment of Impacts on Terrestrial Fauna (Site Preparation and Clearance of Access Routes)*

Impact	Disturbances to fauna and potential habitat fragmentation effects.				
Impact Nature	Negative		Positive		Neutral
Impact Type	Direct		Indirect		Induced
Impact Duration	Temporary	Short-term	Long-term		Permanent
Impact Extent	Local		Regional		International
Impact Scale	At seismic lines				
Frequency	Disturbance: During presence of survey team. Fragmentation effects: c				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low		Medium		High
Impact Significance	Negligible	Minor		Moderate	Major

#### 5.7.4 *Additional Mitigation, Management and Monitoring*

- A Biodiversity Action Plan will be developed by MPRL E&P or a third party to be administered under the Environmental and Social Management Plan, whereby management and mitigation measures will be provided covering all aspects of biodiversity that may be affected by the Project.
- As part of training under the plan, induction training for personnel is recommended to include a mandatory segment on biodiversity. In this induction details of key requirements will be provided to include:
  - Outline vegetation clearance procedures including species not to cut, and the minimum size of tree that should be felled (20 cm diameter at breast height (dbh) (i.e. diameter of the tree trunk measured at 1.3 m above ground).
  - What to do in the advent of disturbing species (eg snakes) (both from an occupational safety and biodiversity perspective).

- HSE Coordinator will provide training to the field teams on identifying vegetation that should be retained or is ok to remove during cutting of seismic survey lines.
- In forest areas, line of sight for access routes/ seismic lines will be minimised by creating 'dog legs' or angled access points/ meandering lines. 'Dog legs' / angled access points will be used for access/egress points into forest areas or vegetation will be left intact for 20m into the forest at access points to mask the presence of transect lines. Induction training will be provided to relevant contractors on the minimisation of line of sight of access routes / seismic lines.
- Minimise clearing of vegetation along seismic lines ie leave in place smaller vegetation, topsoil, root stock, seeds.
- Minimise clearing of vegetation along seismic lines by selecting the 'path of least resistance' through vegetation.
- Minimise vegetation cutting at shot hole and receiver station, as far as practicable.
- The width of seismic lines will be no greater than 1.5 m and limited even narrower to 1 m where possible in the forest area.
- A monitoring programme will be established to ensure mitigation measures are being implemented effectively.

#### 5.7.5 *Significance of Residual Impacts*

Provided that the mitigations are followed, the residual impact of site preparation and clearance of access route is expected to be **Minor**.

### 5.8 *IMPACTS FROM MOBILE POWER GENERATION ON TERRESTRIAL FAUNA*

#### 5.8.1 *Source of Impact*

Use of mobile power generators for drilling equipment, will give rise to noise emissions and vibration which in turn will have the potential to modify the movement and behaviour of terrestrial fauna. The most common response to disturbance is active avoidance of an area with associated ecological effects (e.g. move from an individual's territory, disturbance of breeding activities etc.).

#### 5.8.2 *Existing/ In Place Controls*

Measures to control/ minimise adverse impacts will include:

- Specifications of power generator
- Project activities limited to day light hours



### 5.8.3 *Significance of Impacts*

While disturbance effects have the potential to occur, they will be temporary in nature and local in scale. The impact magnitude is expected to be small. The sensitivity of terrestrial fauna in forest habitat is considered to range from low to medium. Provided that the existing/in place controls are followed, the impact of disturbance to terrestrial fauna due to mobile power generation is ranked of **Minor** significance.

**Table 5.11** *Assessment of Impacts on Terrestrial Fauna (Mobile Power Generation)*

Impact	Disturbances to fauna.				
Impact Nature	Negative		Positive		Neutral
Impact Type	Direct		Indirect		Induced
Impact Duration	Temporary	Short-term	Long-term		Permanent
Impact Extent	Local		Regional		International
Impact Scale	Exact extent of indirect affects unknown but considered local				
Frequency	Continuous				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low			High	
Impact Significance	Negligible	Minor		Moderate	Major

### 5.8.4 *Additional Mitigation, Management and Monitoring*

The assessment indicates impacts associated with mobile power generations are expected to be minor, hence no further mitigations are required.

### 5.8.5 *Significance of Residual Impacts*

The residual impact of mobile power generation to terrestrial fauna is expected to be **Minor**.

## 5.9 *IMPACTS FROM WASTE DISPOSAL ON SURFACE WATER QUALITY, GROUND WATER QUALITY, SOIL, TERRESTRIAL HABITATS AND AQUATIC HABITATS AS WELL AS THEIR ASSOCIATED FLORA AND FAUNA*

### 5.9.1 *Source of Impact*

Construction of the camp will generate general construction waste and some hazardous waste (eg oily rags, paints, chemicals). Project activities and seismic team accommodated at the camp will generate some quantities of general refuses, recycle waste and other wastes (eg packaging materials and papers).

Improper waste disposal has the potential to lead to contamination of soil and ground water through leachate or direct contamination of surface water and water quality impacts to aquatic fauna.

### 5.9.2 Existing/ In Place Controls

Measures to control/ minimise adverse impacts will include:

- Planning material requirements the at design stage to reduce unnecessary generated waste.
- MPRL E&P HSE Management System requires Waste Management Plan for the Project.

### 5.9.3 Significance of Impacts

Provided that proper disposal mechanism for waste will be implemented in accordance with MPRL E&P HSE Management System requirements and all waste will be removed from site and responsibly disposed by approved waste contractor, the significance of waste disposal is ranked as **Minor**, resulting a short-term incremental increase in demand on local or regional waste disposal facilities.

**Table 5.12** *Assessment of Impacts from Waste Disposal on Surface Water Quality, Ground Water Quality, Soil, Terrestrial Habitats and Aquatic Habitats as well as their Associated Flora and Fauna*

Impact	Impacts on Surface Water Quality, Ground Water Quality, Soil, Terrestrial Habitats and Aquatic Habitats as well as their Associated Flora and Fauna.				
Impact Nature	Negative		Positive		Neutral
Impact Type	Direct		Indirect		Induced
Impact Duration	Temporary	Short-term	Long-term		Permanent
Impact Extent	Local		Regional		International
Impact Scale	Exact extent of indirect affects unknown but considered local				
Frequency	Continuous				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low			High	
	Medium				
Impact Significance	Negligible	Minor		Moderate	Major

### 5.9.4 Additional Mitigation, Management and Monitoring

- A Waste Management Plan will be developed by MPRL E&P or a third party separately from but administered under the Environmental and Social Management Plan. The plan will identify and estimate generated volumes of different waste types and set out procedures for responsible management and disposal and will be regularly audited.
- Induction training for personnel (including contracted local workers) is recommended to include waste management system.

### 5.9.5 Significance of Residual Impacts

Provided the mitigations are followed, the residual impact of surface water quality, ground water quality, soil, terrestrial habitats and aquatic habitats

and their associated flora and fauna in the Project Area is ranked as **Negligible**.

## **5.10 IMPACTS FROM SEWAGE AND WASTEWATER DISCHARGE ON SURFACE WATER QUALITY, GROUND WATER QUALITY, SOIL, TERRESTRIAL HABITATS AND AQUATIC HABITATS AS WELL AS THEIR ASSOCIATED FLORA AND FAUNA**

### **5.10.1 Source of Impact**

It is estimated that up to 400 workers for the seismic surveys will be required. Approximately 120 these workers will be housed on site; the remaining others will be bussed in from local surroundings. Black and grey water will arise from the construction workforce and from drainage from cooking and cleaning activities. The volume of sewage and grey-water generated at the camp is estimated to be in the order of 6 to 9 m<sup>3</sup> per day (based on an average volume of 50 to 75L/person/day).

Discharged wastewater is generally characterized as having a high concentration of solids (suspended and dissolved), biochemical oxygen demand (BOD) and chemical oxygen demand (COD), nutrients (ammonia) and faecal coliform counts. Potential impacts associated with mis-management of sewage and other wastewaters include contamination of surface waters and water supplies, which may result in localised land/ecological contamination and impacts to health.

### **5.10.2 Existing/ In Place Controls**

Measures to control/ minimise adverse impacts to water and soil quality and associated impacts will include:

- Provision of properly designed and installed service tank for sewage from toilet facilities.
- Provision of properly designed and installed water pit for greywater from kitchen.
- Service tank and water pit are separated from drainage and stormwater.
- Ensure the service tank and water pit are well maintained to allow effective operation.

### **5.10.3 Significance of Impacts**

The existing area has no sewerage collection and treatment systems. The water pit and service tank will serve as a septic system which allows for aerobic digestion of organic matter. Effluent from the tanks will pass into groundwater aquifers. No watercourses were identified in proximity to the planned construction camp site indicating there are no significant streams in proximity to the site where discharges could impact aquatic fauna. In groundwater effluent will be subject to dilution by existing groundwater

flows. The duration of the impact will be for the duration of the seismic survey activities and potential for impacts to groundwater will be local in nature. On the assumption that tanks and pit are regularly monitored and maintained to ensure proper functioning, the impact significance is ranked as **Minor**.

**Table 5.13** *Significance of Impacts on Water and Soil Quality from Wastewater and Sewage*

Impact	Operational impacts on water and soil quality from wastewater and sewage				
Impact Nature	Negative		Positive	Neutral	
Impact Type	Direct		Indirect	Induced	
Impact Duration	Temporary	Short-term	Long-term		Permanent
Impact Extent	Local		Regional		International
Impact Scale	The scale of the impact is estimated to be point-based source from the Project Area.				
Frequency	Throughout the life time of the construction camp.				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low		Medium		High
Impact Significance	Negligible	Minor		Moderate	Major

#### 5.10.4 *Additional Mitigation, Management and Monitoring*

The assessment indicates impacts from wastewater and sewage are expected to be minor, hence additional mitigation measures are not recommended.

#### 5.10.5 *Significance of Residual Impacts*

With the implementation of in place controls, the residual impact of wastewater and sewage is ranked as **Minor**.

### SEISMIC SURVEY PHASE

#### 5.11 *IMPACTS FROM LABOUR (INCLUDING HUNTING), EQUIPMENT AND SERVICES SUPPLY ON TERRESTRIAL AND AQUATIC FLORA AND FAUNA;*

##### 5.11.1 *Significance of Residual Impacts*

The impacts, controls and mitigations and residual impact significance during the seismic survey phase are as previously assessed in *Section 5.6*.

**5.12            *IMPACTS FROM SITE PREPARATION / CLEARANCE AND CREATION OF ACCESS ROUTES ON TERRESTRIAL HABITATS AND AQUATIC HABITATS AS WELL AS THEIR ASSOCIATED FLORA AND FAUNA***

**5.12.1        *Existing/ In Place Controls***

Existing controls will be as described previously in *Section 5.7*. In addition, the requirement for clearance and cutting will be reduced by use of wireless geophones on receiver lines, as far as practicable.

**5.12.2        *Significance of Residual Impacts***

The impacts, controls and mitigations and residual impact significance during the seismic survey phase are as previously assessed in *Section 5.7*.

**5.13            *IMPACTS FROM MOBILE POWER GENERATION ON TERRESTRIAL FAUNA***

**5.13.1        *Significance of Residual Impacts***

The in place controls, impacts and residual impact significance during the seismic survey phase are as previously assessed in *Section 5.8*.

**5.14            *IMPACTS FROM DRILLING ON TERRESTRIAL FAUNA***

**5.14.1        *Source of Impact***

At source lines, shot holes will be drilled to 10 m depth and at 50m intervals using portable drills. Noise and increased human activity at the shot hole locations will have the potential to modify the movement and behaviour of terrestrial fauna. The most common response to disturbance is active avoidance of an area with associated ecological effects (e.g. move from an individual's territory, move into sub-optimal habitat, disturbance of breeding activities etc.).

**5.14.2        *Existing/ In Place Controls***

Measures to control/ minimise adverse impacts of drilling will include:

- Drilling of shot holes by portable drills.
- Vegetation cutting by hand to minimise disturbance and degradation of the habitats.
- It is assumed felling of large perennial vegetation (i.e. large trees which typically provide habitat for higher densities of terrestrial fauna) will be avoided.
- Shot holes will be backfilled after shooting is completed.



### 5.14.3 *Significance of Impacts*

Based on baseline survey findings, eleven mammal species including highly-mobile species such as Sambar Deer, Red Muntjac, Wild Pig, Indian Palm Civet, Leopard Cat and Squirrels which occur in low density in secondary forest. Low mobility species in forest area include Yellow-headed Tortoise (Endangered) which also occur in low density. While disturbance effects have the potential to occur, they will be temporary in nature and local in scale. The impact magnitude is expected to be small. Temporarily displaced terrestrial fauna will be expected to move back into an area once activities at a location have ceased. Provided that the existing/in place controls are followed, the impact of disturbance to terrestrial fauna due to drilling is ranked of **Minor** significance.

**Table 5.14** *Assessment of Impacts on Terrestrial Fauna (Drilling)*

Impact	Disturbances to fauna.					
Impact Nature	Negative		Positive		Neutral	
Impact Type	Direct		Indirect		Induced	
Impact Duration	Temporary	Short-term		Long-term	Permanent	
Impact Extent	Local		Regional		International	
Impact Scale	Exact extent of indirect affects unknown but considered local					
Frequency	Continuous					
Impact Magnitude	Positive	Negligible	Small		Medium	Large
Resource Sensitivity	Low		Medium			High
Impact Significance	Negligible		Minor		Moderate	Major

### 5.14.4 *Additional Mitigation, Management and Monitoring*

As good site practice, it is recommended the HSE coordinator will provide training to relevant contractors to check the immediate vicinity of shothole locations for presence of Yellow-headed Tortoise (Endangered) and, if found how to relocate it to a safe distance away from the drilling activity.

### 5.14.5 *Significance of Residual Impacts*

The assessment indicates no further mitigations are required. The residual impact of drilling to terrestrial fauna is expected to be **Minor**.

## 5.15 *IMPACTS FROM DETONATION OF EXPLOSIVE ON TERRESTRIAL FAUNA*

### 5.15.1 *Source of Impact*

Shot holes will be drilled to a depth of 10 m and loaded with a small charge backfilled and a shot-hole plug installed for operation. Explosives used for shooting will therefore generate noise that will be a brief muffled pulse and at low levels. Seismic surveys strive to 'contain' the detonation within the shot hole in order to achieve maximum energy input and eliminate/minimize energy spent on venting.

Short pulsed noises typically elicit a greater behavioural response in terrestrial fauna than continuous noise at the same level. Sudden impulsive noise has potential to elicit a “startle” response in fauna, leading to temporary cessation of normal activities and mobile fauna potentially moving away from the source.

### 5.15.2 *Existing/ In Place Controls*

Measures to control/ minimise adverse impacts of detonations will include:

- Minimise the use of charges as far as practicable.
- Shot holes will be backfilled
- Charges detonated at ~10 m below ground level or as deep underground as practicable.
- Daytime shooting only

### 5.15.3 *Significance of Impacts*

Noise generated by the seismic survey is expected to be small (muffled) and localized and by its nature brief. A typical backfilled explosive has a noise level of 70 dB at a distance of 1m from the hole location and a noise level of 2 bB at a distance of 50m. The acoustic energy produced by the explosion rapidly decreases in proportion to the square of distance. Species of particular conservation interest in secondary forest area are Chinese Pangolin (Critically Endangered), Yellow-headed Tortoise (Endangered) and King Cobra (Vulnerable), but terrestrial fauna occur in low density in the Project Area. Noise impacts from detonation is expected to be small magnitude and brief and limited to temporary behavioural disturbance to any affected individuals, if present. The significance of detonation of explosives to terrestrial fauna is ranked as of **Minor** significance.

**Table 5.15** *Assessment of Impacts on Terrestrial Fauna (Detonation of Explosive)*

Impact	Impact of detonation of explosive on terrestrial fauna.				
Impact Type	Direct	Indirect		Induced	
Impact Duration	Temporary	Short-term	Long-term		Permanent
Impact Extent	Local	Regional		International	
Impact Scale	Noise from firing detectable but likely at similar noise levels to ambient noise levels within in the order of 50m from source.				
Frequency	Throughout seismic survey period.				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low	Medium			High
Impact Significance	Negligible	Minor	Moderate		Major

### 5.15.4 *Additional Mitigation, Management and Monitoring*

The assessment indicates no further mitigations are required.

#### 5.15.5 *Significance of Residual Impacts*

Provided that the in place controls are followed, the residual impact of detonation of explosives is expected to be **Minor**.

#### 5.16 *POSITIVE IMPACTS FROM REINSTATEMENT ON TERRESTRIAL HABITATS AND AQUATIC HABITATS AS WELL AS THEIR ASSOCIATED FLORA AND FAUNA;*

##### 5.16.1 *Source of Impact*

Once seismic shooting activities are completed reinstatement of disturbed areas will be undertaken.

The re-vegetation works will serve to rehabilitate habitat and in secondary forest area will reduce or remove access along seismic lines, thereby reducing potential for hunting and other disturbance.

##### 5.16.2 *Existing/ In Place Controls*

Measures to enhance the positive impact will include:

- MPRL E&P to compensate farmers to reinstate land in cultivated areas
- MPRL E&P commitment to appropriate reinstatement works for seismic survey

##### 5.16.3 *Additional Mitigation, Management and Monitoring*

- Materials introduced by the seismic survey will be removed at the disturbed areas.
- Disturbed areas will be monitored before Project commencement and for one year after completion of Project to track any natural recolonisation by vegetation after the Project completion. If natural recolonisation does not taken place or is not ideal (i.e. significantly different from the original condition as determined by monitoring), the disturbed areas will be restored/rehabilitated as much as is practicable to its original condition; this includes replanting areas where vegetation has been cleared including seismic line access routes, etc, using native vegetation.
- It is recommended a Terrestrial Habitat Reinstatement Plan will be developed in light of detailed plans for locations for seismic survey including temporarily cleared areas. The plan will identify provisions for sourcing native species from nursery and procedures for replanting. It will also identify priority areas for rehabilitation including at for instance *de-facto* protected areas such as near monastery and near cultural heritage location if trees or vegetation are planned to be cleared from these locations. Rehabilitation of vegetation on seismic lines will also be provided.

#### 5.16.4 *Significance of Residual Impacts*

Provided that reinstatement of habitat through planting is implemented appropriately, residual impact of reinstatement is expected to be **Neutral** or **Positive**.

### 5.17 *IMPACTS FROM WASTE DISPOSAL ON SURFACE WATER QUALITY, GROUND WATER QUALITY, SOIL, TERRESTRIAL HABITATS AND AQUATIC HABITATS AS WELL AS THEIR ASSOCIATED FLORA AND FAUNA*

#### 5.17.1 *Source of Impact*

Sources of impact are as described in *Section 5.9*. In addition, wastes will be generated from firing of charges.

Explosive charges and their casings will be burned during firing leaving little residue. Gab wires of the detonator will remain, and could be a source of contamination to water and soil if left uncollected.

#### 5.17.2 *Existing/ In Place Controls*

Measures to control/ minimise adverse impacts are described in *Section 5.9* and will also include:

- Seismic team will collect gab wires to dispose or to re-use.
- Seismic team will check the shot hole and collect remaining residues, as far as practicable, to minimise waste in the area.

#### 5.17.3 *Significance of Impacts*

Significance of impacts is as described in *Section 5.9*.

#### 5.17.4 *Significance of Residual Impacts*

Significance of residual impacts is as described in *Section 5.9*.

### 5.18 *IMPACTS FROM SEWAGE AND WASTEWATER DISCHARGE ON SURFACE WATER QUALITY, GROUND WATER QUALITY, SOIL, TERRESTRIAL HABITATS AND AQUATIC HABITATS AS WELL AS THEIR ASSOCIATED FLORA AND FAUNA*

#### 5.18.1 *Source of Impact*

Sources of impact are as described in *Section 5.10*. In addition, sources of wastewater will include from drilling and sewage from workers in the seismic survey area.

#### 5.18.2 *Existing/ In Place Controls*

Measures to control/ minimise adverse impacts described in *Section 5.10* and also include:

- Fluids to shot hole will be limited to use of small quantities of water.

### **5.18.3      *Significance of Impacts***

Impact significance is as described in *Section 5.10*. Owing to the small depth, small quantities of water will be required which would not be a significant source of impact.

### **5.18.4      *Additional Mitigation, Management and Monitoring***

It is recommended that portable toilet facilities be provided with collection of resultant sanitary waste to be carried out by an approved contractor for proper disposal.

Induction training and briefings for personnel (including contracted local workers) is recommended to include available provided sanitary facilities.

### **5.18.5      *Significance of Residual Impacts***

Provided mitigations are implemented, the residual impact will be as described in *Section 5.10*.

## **CLOSE-OUT PHASE**

### **5.19      *IMPACTS FROM LABOUR (INCLUDING HUNTING), EQUIPMENT AND SERVICES SUPPLY ON TERRESTRIAL AND AQUATIC FLORA AND FAUNA***

#### **5.19.1      *Significance of Residual Impacts***

The impacts, controls and mitigations and residual impact will be as described in *Section 5.6*.

### **5.20      *POSITIVE IMPACTS FROM REMOVAL OF ACCESS ROUTES ON TERRESTRIAL HABITATS AND AQUATIC HABITATS AS WELL AS THEIR ASSOCIATED FLORA AND FAUNA***

#### **5.20.1      *Significance of Residual Impacts***

The impacts and residual impact will be as described in *Section 5.16*.

### **5.21      *IMPACTS FROM WASTE DISPOSAL ON SURFACE WATER QUALITY, GROUND WATER QUALITY, SOIL, TERRESTRIAL HABITATS AND AQUATIC HABITATS AS WELL AS THEIR ASSOCIATED FLORA AND FAUNA***

#### **5.21.1      *Significance of Residual Impacts***

The impacts, controls and mitigations and residual impact will be as described in *Section 5.9*.



5.22      ***IMPACTS FROM SEWAGE AND WASTEWATER DISCHARGE ON SURFACE WATER QUALITY, GROUND WATER QUALITY, SOIL, TERRESTRIAL HABITATS AND AQUATIC HABITATS AS WELL AS THEIR ASSOCIATED FLORA AND FAUNA.***

5.22.1      ***Significance of Residual Impacts***

The impacts, controls and mitigations and residual impact will be as described in *Section 5.10*.

**ACCIDENTAL EVENTS**

5.23      ***IMPACTS FROM SPILLS/LEAKS ON SURFACE WATER QUALITY, GROUND WATER QUALITY, SOIL, TERRESTRIAL HABITATS AND AQUATIC HABITATS AS WELL AS THEIR ASSOCIATED FLORA AND FAUNA***

5.23.1      ***Source of Impact***

Sources of impact include spillage of diesel fuel at fuel storage locations (e.g. MOGE storage area or from a fuel station if built) and refuelling of plant and machinery. Spills could also occur in the seismic survey area during refuelling or emergency servicing of equipment. Fluids for shot hole drilling will be carried in barrels by teams in the seismic survey area.

Uncontrolled spills and leaks of fuel, chemicals or other pollutants have the potential to contaminate surface water, ground water and soil. Exposure to aquatic communities or uptake of contaminants through plant roots close to works areas could occur and could lead to direct lethal/non-lethal effects on vegetation and aquatic organisms.

5.23.2      ***Existing/ In Place Controls***

Measures to control/ minimise adverse impacts from spills/leaks are:

- Drilling fluid for shot hole drilling will be water.
- Hazardous materials / chemicals will be stored at MOGE warehouse facility. Storage facilities at MOGE warehouse incorporate features for appropriate storage of fuels and hazardous materials.

5.23.3      ***Significance of Impacts***

Accidents or malpractice may lead to contamination of water and soil with associated impacts and is a significant environmental risk but one that can be managed and controlled. A major spill such as from loss of containment at the storage facilities is considered unlikely but a small spill is considered likely over the life of the Project. The magnitude of impact is considered small for small spills and medium for larger spills. Resource sensitivity is considered medium. Impacts from spills are considered to be of **Minor** significance for small spills and moderate significance for larger spills.

**Table 5.16**      *Assessment of Impacts on Water, Soil, Habitats, Flora and Fauna (Accidental Spillage and Leaks)*

Impact	Impacts from spills/leaks on water, soil, habitats, flora and fauna.				
Impact Type	Direct		Indirect		Induced
Impact Duration	Temporary	Short-term	Long-term		Permanent
Impact Extent	Local		Regional		International
Impact Scale	Point source at works/refuelling area. Impact on water and soil is considered local.				
Frequency	Throughout the Seismic Survey				
Likelihood	Unlikely for large spills, likely for small spills				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low		Medium		High
Impact Significance	Negligible	Minor		Moderate	Major

#### 5.23.4      *Additional Mitigation, Management and Monitoring*

- Fuel and chemical storage areas will have appropriate secondary containment (drip trays for small storage locations/impervious base and bund walls for tanks) and provide procedures for managing the containment systems. All ancillary equipment (e.g. valves, hoses) should be contained securely within the bund when not in use.
- Oil interceptors will be provided in the drainage system where necessary and regularly emptied to prevent the release of oil and grease into the storm water drainage system after accidental spillages.
- Storage tanks and components will meet international design standards as far as practicable. For example, storage tanks will be equipped with devices that prevent spills and overfills, including overfill alarms, automatic shut-off devices and catch basins around fill pipes.
- Fuel stores should be kept away from vehicle access routes to prevent collisions.
- Maintenance of storage tanks, pipes and components (seals, connectors and valves) will be carried out regularly, including daily inspection of fuelling equipment in satisfactory condition.
- All construction plants and machinery (e.g., trucks) will be maintained in good working order to avoid leakage or spillage of contaminants.
- Routine servicing of plant and equipment will be carried out off-site prior to mobilisation or within workshop facilities equipped with bunded areas and oil interceptor.
- Spill kits and shovels will be available onsite at all times for any accidental leakage of fuel or other hazardous substances during Project

activities; it must be ensured that no such substance enters into groundwater or surface water resources.

- If emergency servicing of equipment is required in the field, spill kits and drip trays will be available.
- Any contaminated soil will be removed from site and disposed of in accordance with the waste management plan.
- Oils and other service fluids will be removed off-site by the Seismic Team and disposed in accordance with the waste management plan.
- The location, type and quantity of any fuel or chemical spill will be reported to HSE coordinator immediately.
- Shot holes will not be located within 50 m of a watercourse or water body.

#### 5.23.5 *Significance of Residual Impacts*

Provided that mitigations are in place to prevent and control spillage/leak risk, residual risk is ranked as **Minor**.

### 5.24 *IMPACTS FROM FIRES AND EXPLOSIONS ON AIR QUALITY, GROUND WATER QUALITY, SURFACE WATER QUALITY, LANDSCAPE AND VISUAL CHARACTER, USE OF NATURAL RESOURCES, TERRESTRIAL HABITATS AND AQUATIC HABITATS AS WELL AS THEIR ASSOCIATED FLORA AND FAUNA*

#### 5.24.1 *Source of Impact*

Accidental events may result from a number of Project activities however those that result in fire (e.g. mishandling of charges or serious traffic accident) have the potential to cause wide scale significant detrimental impacts on secondary forest habitat within the Project Area, which may take years to recover. In addition, an increase in the number of people who smoke (ie workers) could increase the potential for ignition and uncontrolled fires from discarded cigarettes in the Project Area. Other sources of ignition include sparks from machinery and vehicle exhausts. Due to the hot and dry climatic conditions that are prevalent in the year, secondary forest habitat is dry and therefore fire hazard will typically be significant.

#### 5.24.2 *Existing/ In Place Controls*

There are no in place controls at the present time.

#### 5.24.3 *Significance of Impacts*

Impacts from fire outbreaks have been evaluated to result in impacts of up to **Major significance**. This is mostly due to the fact that large habitat area could be lost and low-mobility species including potentially the Yellow-headed Tortoise (Endangered) and Chinese Pangolin (Critically Endangered) will be adversely impacted by such events if the event occurs in secondary

forest habitat. However, the likelihood of such events occurring is considered unlikely, and as such, with the proper mitigation and control measures in place, the residual impacts can be reduced.

**Table 5.17** *Assessment of Impacts on Air, Visual Character, Water, Soil, Habitats, Flora and Fauna (Fire and Uncontrolled Explosions)*

Impact	Impacts from fire and explosions on air, water, soil, habitats, flora and fauna.				
Impact Type	Direct		Indirect	Induced	
Impact Duration	Temporary	Short-term	Long-term		Permanent
Impact Extent	Local		Regional	International	
Impact Scale	Potentially wide scale.				
Frequency	Throughout the Seismic Survey				
Likelihood	Unlikely for large fires				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low		Medium		High
Impact Significance	Negligible	Minor	Moderate	Major	

#### 5.24.4 *Additional Mitigation, Management and Monitoring*

- As administered under the Emergency Preparedness Plan, a Fire Risk Management Plan will be developed including communications protocols and measures to control any fires that do arise and as well as identify where fire control measures should be located.
- Induction training for personnel is recommended to include a mandatory segment on fire safety and actions in the event of a fire.
- All seismic teams will carry first-attack fire-fighting equipment such as fire extinguisher, shovel and communications equipment to respond to small spot fires and communicate with the operations headquarters in the event of a fire.
- HSE induction will be undertaken at the site before work commencement which should include proper use of fire-fighting equipment and communication protocol in case of fire.
- It will be of key importance that explosives are kept in a safe manner and no uncontrolled explosions occur. Implement all required safety and management requirements relating to the transportation, storage and handling of explosives
- Misfired charges from shot holes will be disabled and destroyed.
- Restrict smoking to designated areas only.
- Conduct fire training and response drills.

#### 5.24.5 *Significance of Residual Impacts*

With measures to manage fire risk, it is considered the residual risk can be reduced to **Minor**.

### WORKOVER ACTIVITIES

#### 5.25 *IMPACTS FROM OPERATION OF MECHANICAL EQUIPMENT REQUIRED FOR WORKOVER ACTIVITIES ON AMBIENT AIR AND NOISE CONDITIONS*

##### 5.25.1 *Source of Impact*

Workover rig and well servicing truck will be used for activities at the selected existing wells. The existing wells are located at various locations across the north and south Pyay field in agricultural land or secondary forest and are mostly remote from sensitive receiver locations. A small proportion of wells are relatively nearby residential area, guesthouse, MOGE office and future construction camp, which are considered noise and air sensitive receptors of medium sensitivity. The wells that will be selected for workover will be planned based on the outcome of the seismic survey with any of the wells being potential candidates for workover.

##### *Noise*

Noise emissions from the workover rig and trucks are classed as construction phase noise. The Government of Myanmar has not yet established numerical standards for noise impact arising from construction noise and operation noise. In the absence of national standards, the Ministry of Environmental Conservation and Forestry (MOECAF) typically recommends that internationally accepted numerical environmental standards, such as International Finance Corporation (IFC) to be adopted for any noise assessment. However, the IFC Guidelines only specified noise limits for operation of a facility while no noise limits are set out for construction noise. In this circumstance, reference has been made to the Ambient Noise Standards in Thailand. A-weighted equivalent continuous sound level ( $L_{eq}$ ) 24 hours should not exceed 70 dB(A) and the maximum equivalent sound level ( $L_{eq}$ ) should not exceed 115 dB(A). Ambient noise levels recorded during baseline survey at the Pyay field at four representative locations nearby to sensitive receptor recorded during day ( $LA_{eq}$ ) ranged 38 dB to 46 dB and are well below the standard.

##### *Air*

Impacts to air quality will primarily arise through combustion of diesel fuel by the workover rig generator and service truck engines at the well site. Exhaust gas from vehicles, generator and engines have the potential to affect sensitive residential receptors. The primary pollutants emitted from engines include Particulate matter (PM), Carbon monoxide, (CO), Nitrogen oxides (NO<sub>x</sub>), Hydrocarbons (HC), and Volatile organic compounds (VOCs).



Combustion of fossil fuels in stationary and mobile combustion sources will produce greenhouse gases (e.g. carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O).

#### 5.25.2 *Existing/ In Place Controls*

Measures to control/ minimise adverse impacts on air and noise.

- Activities carried out at existing well sites in existing oil field with separation from sensitive receptors.
- Project activities undertaken with sufficient lighting only.
- Well maintained equipment will be used.
- Noise suppression box will be fabricated over the engine for the PMEs being operated nearby the NSRs (e.g. villages).
- Appropriate PPE e.g. ear protection will be used for MPRL E&P personnel.
- Worker outside will need to be at least 100 m away from the well head.

#### 5.25.3 *Significance of Impacts*

##### *Noise*

Noise levels associated with workover activities at a well site have been calculated to illustrate indicative noise levels at varying distances away from a well.

**Table 5.18**      *Calculated Noise Levels at 50m, 100m, 150m and 200m from Workover Activities*

Equipment to NSR Separation Distance	Workover Activities	Equipment	Noise Level, dB(A)	Assessment Criteria dB(A) <sup>(a)</sup>	Compliance
50m	Well deepening	1 x Tracked hydraulic drilling rig (P100 rig)	72	70	No
	Pump servicing; swabbing and bailing; zone isolation and re-perforations	2x rigid trucks	72	70	No
100m	Well deepening	1 x Tracked hydraulic drilling rig (P100 rig)	69	70	Yes
	Pump servicing; swabbing and bailing; zone isolation and re-perforations	2x rigid trucks	69	70	Yes
150m	Well deepening	1 x Tracked hydraulic drilling rig (P100 rig)	65	70	Yes
	Pump servicing; swabbing and bailing; zone isolation and re-perforations	2x rigid trucks	65	70	Yes
200m	Well deepening	1 x Tracked hydraulic drilling rig (P100 rig)	63	70	Yes
	Pump servicing; swabbing and bailing; zone isolation and re-perforations	2x rigid trucks	63	70	Yes
Note: (a) Ambient Noise Standards in Thailand					

Based on the calculations, it is expected there is potential for small magnitude noise exceedance to occur if noise sensitive receivers are located within about 100 m from the well. The significance of impact to such noise sensitive receivers is assessed as **Moderate**. If well sites are selected for workover that are within 100m from the nearest noise sensitive receiver, additional mitigation would be required.

For workovers at wells that are further than 100m from noise sensitive receivers, noise levels would not be expected to exceed assessment criteria due to activities at the well site.. The significance of impacts to sensitive receivers in this event would thus be **Negligible** and further mitigation measures would not be required beyond good practice measures.

**Table 5.19**      *Assessment of Impacts on Noise Conditions (Well workover)*

Impact	Noise impact from workover drill rig and service trucks				
Impact Type	Direct		Indirect		Induced
Impact Duration	Temporary	Short-term		Long-term	Permanent
Impact Extent	Local		Regional		International
Impact Scale	Noise levels are calculated to comply with noise criteria within about 100 m from the well site.				
Frequency	Throughout workover activity period at a well.				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low		Medium		High
Impact Significance	Negligible	Minor		Moderate	Major

#### *Air*

Potential impacts are likely to be small and limited to the Project Area and hence would be considered to be local, however winds may potentially carry emissions into surrounding communities, if wells selected for workover are nearby air sensitive receivers. The combination of a medium resource sensitivity and small impact magnitude will result in an overall moderate potential impact, and hence additional mitigation measures are recommended.

**Table 5.20**      *Assessment of Impacts on Ambient Air Conditions (Well workover)*

Impact	Air impact from workover drill rig and trucks					
Impact Type	Direct		Indirect		Induced	
Impact Duration	Temporary	Short-term		Long-term	Permanent	
Impact Extent	Local		Regional		International	
Impact Scale	Limited to the Project Area and hence would be considered to be local, however winds may potentially carry emissions into surrounding communities.					
Frequency	Well workover period.					
Impact Magnitude	Positive	Negligible	Small		Medium	Large
Resource Sensitivity	Low		Medium			High
Impact Significance	Negligible	Minor		Moderate		Major

#### **5.25.4**      *Additional Mitigation, Management and Monitoring*

- Well-maintained equipment to be operated on-site.
- Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components.
- Shut down or throttled down between work periods for machines and construction plant items (eg trucks) that may be in intermittent use.
- Shut down generators, compressors, and other equipment when not in use.

- Reduce the number of equipment operating simultaneously as far as practicable.
- Orientate equipment known to emit noise strongly in one direction so that the noise is directed away from receptors as far as practicable.
- Implement control measures, eg noise barrier at site hoarding, movable barrier or barrier that installed on the equipment, whenever applicable. The type of control measure that can be applied will be determined based on site conditions and constraints.

#### 5.25.5 *Significance of Residual Impacts*

##### *Noise*

Provided that mitigation measures are followed, the residual impact of workover activities on ambient noise levels at noise sensitive receivers is expected to be **Negligible**.

##### *Air*

Provided that mitigation measures are followed, the residual impact of workover activities on air quality at noise sensitive receivers is expected to be **Minor**.

#### 5.26 *IMPACTS FROM DISPOSAL OF WASTE FROM WORKOVER ACTIVITIES ON SURFACE WATER QUALITY, GROUND WATER QUALITY, SOIL, TERRESTRIAL HABITATS AND AQUATIC HABITATS AS WELL AS THEIR ASSOCIATED FLORA AND FAUNA*

##### 5.26.1 *Source of Impact*

Solid and liquid wastes will be generated from the well workover activities. This will include scale, mud cake, wax, debris and other foreign material cleared by scrappers from the wells. Drilling including deepening wells will generate cuttings and use drilling muds, which are typically the largest waste stream during the workovers. Well fluids which typically include weighted brines, acids, methanol and glycols and other chemical additives may also be produced that will require disposal. Drill muds used for the workover will be water based mud (WBM) and potassium chloride (KCl) polymer mud.

Improper disposal of waste has the potential to contaminate surface waters and ground water with hydrocarbons or muds giving rise to sub lethal or lethal effects to exposed aquatic organism or terrestrial fauna due to salinity, exposure to elevated suspended solid (TSS) levels and sedimentation and toxicity effects.

##### 5.26.2 *Existing/ In Place Controls*

Measures to control/ minimise adverse impacts of waste disposal from workover activities.

- MPRL E&P HSE policy requires a waste management plan will be developed
- Drill muds used will be WBM and KCl polymer mud and will be recycled and treated for future use.

### 5.26.3 *Significance of Impacts*

On the assumption that proper treatment and disposal mechanism for waste will be implemented and waste will be treated or removed from site and responsibly disposed on-site away from sensitive areas or by approved waste contractor, the significance of waste disposal is ranked as **Minor**, resulting a short-term incremental increase in demand on local or regional waste disposal facilities.

**Table 5.21** *Impacts from Disposal of Waste from Workover Activities on Surface Water Quality, Ground Water Quality, Soil, Terrestrial Habitats and Aquatic Habitats as well as their Associated Flora and Fauna*

Impact	Impacts on Surface Water Quality, Ground Water Quality, Soil, Terrestrial Habitats and Aquatic Habitats as well as their Associated Flora and Fauna.				
Impact Nature	Negative		Positive		Neutral
Impact Type	Direct		Indirect		Induced
Impact Duration	Temporary	Short-term	Long-term		Permanent
Impact Extent	Local		Regional		International
Impact Scale	Exact extent of indirect affects unknown but considered local				
Frequency	Continuous				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low			Medium	High
Impact Significance	Negligible	Minor		Moderate	Major

### 5.26.4 *Additional Mitigation, Management and Monitoring*

- A Waste Management Plan will be developed by MPRL E&P or a third party to be administered under the Environmental and Social Management Plan. The plan will identify and estimate generated volumes of different waste types and set out procedures for responsible management and disposal and will be regularly audited.
- Careful selection of the fluid system to minimize environmental hazards related to chemical additives
- Careful selection of fluid additives taking into account technical requirements, chemical additive concentration, toxicity, bioavailability and bioaccumulation potential.



- Monitoring and minimizing the concentration of heavy metal impurities (mainly mercury and cadmium) in barite stock used in the fluid formulation, if used.

## 5.27 *POSITIVE IMPACTS FROM PUMP SERVICING ON AMBIENT NOISE CONDITIONS*

### 5.27.1 *Source of Impact*

Pump servicing will be undertaken as part of the workover activities which will include pumping checking, replacement and cleaning in order to achieve for higher production levels. It is also expected that the serviced pump will be quieter and would thus need to improvement to ambient noise conditions.

### 5.27.2 *Existing/ In Place Controls*

There is no existing / in place controls for this potential positive impact from pump service.

### 5.27.3 *Significance of Residual Impacts*

Residual impact to ambient noise is expected to be **Positive** after pump servicing

## 5.28 *POSITIVE IMPACT FROM IMPROVEMENT OF WELLHEADS ON SOIL, SURFACE WATER AND GROUNDWATER QUALITY*

### 5.28.1 *Source of Impact*

With the wellhead improvement works, it is expected that the potential of oil leakage from the well sites would be reduced. Also, the installation of cemented cellars will also help to reduce the amount of oil leak to the surrounding. As such, positive impacts on soil, surface water and groundwater quality are expected.

### 5.28.2 *Existing/ In Place Controls*

There is no existing / in place controls for this potential positive impact from wellhead improvement.

### 5.28.3 *Significance of Residual Impacts*

Residual impact to the environment is expected to be **Positive** after wellhead improvement works.

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## ACCIDENTAL EVENTS

### 5.29 *IMPACTS FROM SPILLS/LEAKS ON SURFACE WATER QUALITY, GROUND WATER QUALITY, SOIL, TERRESTRIAL HABITATS AND AQUATIC HABITATS AS WELL AS THEIR ASSOCIATED FLORA AND FAUNA*

#### 5.29.1 *Source of Impact*

Sources of leaks associated with well work over will include accidental spillage in refuelling of workover rig generator. Drilling muds (WBM and KCl polymer WBM) will be stored and treated on site.

Risks associated with workover include loss of well control due to kicks with potential for large volume well fluid release volumes to occur at the surface (i.e. a blowout). Well fluids may be hydrocarbons but can also be formation (fresh or salty) water.

Uncontrolled spills and leaks of fuel, chemicals or other pollutants have the potential to contaminate surface water, ground water and soil. Exposure to aquatic communities or uptake of contaminants through plant roots close to works areas could occur and could lead to direct lethal/non-lethal effects on vegetation and aquatic organisms. .

#### 5.29.2 *Existing/ In Place Controls*

Measures to control/ minimise adverse impacts of spills/leaks from workover activities

- Competent and well-trained workover crews.
- Well-planned, well-supervised and standard workover/ drilling procedures will be used at the wells to maintain well control (eg management of mud weight).
- Implementation of maintenance and inspection procedures.

#### 5.29.3 *Significance of Impacts*

Accidents or malpractice may lead to contamination of water and soil with associated impacts and is a significant environmental risk but one that can be managed and controlled. A major spill such as from loss of well control is considered unlikely but a small spill is considered likely over the life of the Project. The magnitude of impact is considered small for small spills and medium for larger spills. Resource sensitivity is considered medium. Impacts from spills are considered to be of **Minor** significance for small spills and **Moderate** significance for larger spills.

**Table 5.22** *Assessment of Impacts on Water, Soil, Habitats, Flora and Fauna (Accidental Spillage and Leaks)*

Impact	Impacts from spills/leaks on water, soil, habitats, flora and fauna.				
Impact Type	Direct		Indirect	Induced	
Impact Duration	Temporary	Short-term	Long-term		Permanent
Impact Extent	Local		Regional	International	
Impact Scale	Point source at workover well site. Impact on water and soil is considered local.				
Frequency	Throughout the workover period				
Likelihood	Unlikely for large spills, likely for small spills				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low		Medium		High
Impact Significance	Negligible	Minor	Moderate		Major

#### 5.29.4 *Additional Mitigation, Management and Monitoring*

- Develop an Emergency Preparedness and Spill Response Plan to document communication procedures and actions to take in the event of uncontrolled well fluid release.
- Carefully plan drilling operation by identifying shallow hazards, using standard materials for well construction/modification, using standard drilling and well control standard operating procedures, and using proper drilling mud formulation with additives if necessary (well kill fluids, loss control and weighting agents).
- Undertake drilling with international best practice safety procedures.
- Test safety devices prior to start-up for function and integrity.
- Continuously monitor pressure in the well and recycled mud during drilling.
- Train employees on emergency procedures.
- Spill kits and shovels at well sites or appropriate locations for any accidental leakage of fuel or other hazardous substances during Project activities; it must be ensured that no such substance enters into groundwater or surface water resources.
- If emergency servicing of equipment is required in the field, spill kits and drip trays will be available.
- Any contaminated soil will be removed from site and disposed of in accordance with the waste management plan.
- The location, type and quantity of any fuel or chemical or mud spill will be reported to HSE coordinator immediately.

- Develop water treatment and injection facilities, if practicable.
- Improve cellars with double cellars for new and reactivated wells.
- Regularly pump out cellars oil and water separators and treatment water for injection.

#### 5.29.5 *Significance of Residual Impacts*

With measures to manage accidental spill and leaks associated with well workover activities, it is considered the residual risk can be reduced to **Minor**.

### 5.30 *IMPACTS FROM FIRES AND EXPLOSIONS ON AIR QUALITY, GROUND WATER QUALITY, SURFACE WATER QUALITY, LANDSCAPE AND VISUAL CHARACTER, USE OF NATURAL RESOURCES, TERRESTRIAL HABITATS AND AQUATIC HABITATS AS WELL AS THEIR ASSOCIATED FLORA AND FAUNA*

#### 5.30.1 *Source of Impact*

Accidental events may result from a number of Project activities however those that result in fire (e.g. loss of well control and equipment malfunction) have the potential to cause wide scale significant detrimental impacts on secondary forest habitat within the Project Area. In addition, an increase in the number of people who smoke (ie workers) could increase the potential for ignition and uncontrolled fires in the Project Area. Due to the hot and dry climatic conditions that are prevalent in the year, secondary forest habitat is dry and therefore fire hazard will typically be significant.

#### 5.30.2 *Existing/ In Place Controls*

Measures to control/ minimise adverse impacts of impacts from workover activities.

- MPRL E&P HSE policy commitments, including:
  - Assign designated smoking areas.
  - Smoking is only allowed away from the well head of more than 100 feet, up wind, with appropriate ash trays to contain any hot ashes.

#### 5.30.3 *Significance of Impacts*

Impacts from fire outbreaks have been evaluated to result in impacts of up to **Major** significance. This is mostly due to the fact that large habitat area could be lost and low-mobility species including potentially the Yellow-headed Tortoise (Endangered) and Chinese Pangolin (Critically Endangered) will be adversely impacted by such events if the event occurs in secondary forest habitat. However, the likelihood of such events occurring is considered unlikely, and as such, with the proper mitigation and control measures in place, the residual impacts can be reduced.

**Table 5.23** *Assessment of Impacts on Air, Visual Character, Water, Soil, Habitats, Flora and Fauna (Fire)*

Impact	Impacts from fire and explosions on air, water, soil, habitats, flora and fauna.				
Impact Type	Direct		Indirect	Induced	
Impact Duration	Temporary	Short-term	Long-term		Permanent
Impact Extent	Local		Regional		International
Impact Scale	Potentially wide scale.				
Frequency	Throughout the workover activities				
Likelihood	Unlikely				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low		Medium		High
Impact Significance	Negligible	Minor	Moderate	Major	

#### 5.30.4 *Additional Mitigation, Management and Monitoring*

- As administered under the Emergency Preparedness Plan, a Fire Risk Management Plan will be developed including communications protocols and measures to control any fires that do arise.
- Fire control equipment should be located at the well site or appropriate locations.
- Induction training for personnel is recommended to include a mandatory segment on fire safety and actions in the event of a fire.
- It will be of key importance that explosives used for re-perforation activities are kept in a safe manner and no uncontrolled explosions occur. Implement all required safety and management requirements relating to the transportation, storage and handling of explosives
- Misfired charges from re-perforation activities will be disabled and destroyed.
- Restrict smoking to designated areas only.
- Conduct fire training and response drills.

#### 5.30.5 *Significance of Residual Impacts*

With measures to manage fire risk, it is considered the residual risk can be reduced to **Minor**.

### 5.31 *SOCIAL IMPACT ASSESSMENT AND MITIGATION*

Sections 5.32-37 below provide an understanding of the social impacts from the seismic survey and the workover activities for the Project.



## 5.32.1

*Source of Impact*

This section provides an analysis of the potential impacts which may directly affect the health and safety of the community within the Project Area, according to the various phases of the Project life.

*Preparation and Mobilisation*

The construction of the workforce camp is likely to result in an influx of migrant workers in the area, which may place additional pressure on the existing infrastructure and services, especially the social services and healthcare. It is understood that during this phase, there will be requirement of 20 unskilled workers. The influx of migrant workers may also result in a change in the socio-cultural composition of the area, which in turn may result in conflict and unrest in the society. Furthermore, the sewage and waste discharge from the construction camp site may result in a negative impact on the health of the community and workers if not managed properly.

There is expected to be a minor increase in traffic within the local area for the duration of the Project as Project vehicles will be utilised to transport staff, equipment and waste within the local area. While only a slight increase in overall traffic volume is expected, there is the possibility that a vehicle-related collision or other such incident could occur which may constitute significant impact if a member of the local community or the workforce were to be injured.

Waste disposal, sewage and wastewater discharge from the Project may lead to potential contamination of soil, surface water and ground water if undertaken improperly. This may in-turn affect the health and safety of the community and workforce who may in contact with these media. Refer to *Section 5.9* and *Section 5.10* for environmental issues related to waste disposal and discharge of sewage and wastewater.

*Seismic Surveying*

There is expected to be a minor increase in traffic within the local area for the duration of the Project as Project vehicles will be utilised to transport staff, equipment and waste within the local area. While only a slight increase in overall traffic volume is expected, there is the possibility that a vehicle-related collision or other such incident could occur which may constitute significant impact if a member of the local community or workforce were to be injured.

During this stage of the Project, explosives will be transported and utilized. These explosives will be handled in accordance with the best-practice industry safe protocols, which make an accidental discharge incident highly unlikely. However if such an incident were to occur then the potential impact to the health and safety of the workers and the local community could be significant as such an incident could result in serious injury.

When the drilling activities and laying and retrieving of cables and receivers is undertaken, there is a possibility of soil expulsion incidents, whereby soil from the shot holes may be ejected forcibly and rise several meters into the air. While mitigation measures will be in place for the same, in case of such an occurrence, it could potentially result in minor injury to anyone standing in close proximity to the discharge point.

Waste disposal from the Project may lead to potential contamination of soil, surface water and ground water if undertaken improperly. This may in-turn affect the health and safety of the community and workforce who may in contact with these media. Refer to *Section 5.17* for environmental issues related to waste disposal.

Furthermore, the sewage and waste discharge from the construction camp may result in a negative impact on the health of the community and the workers if not managed properly. It is understood that the workforce camps are to include mobile camps and trailers, with an accommodation capacity of at least 4 people per container. Refer to *Section 5.18* for environmental issues related to discharge of sewage and wastewater.

#### *Close-out Phase*

Following the completion of the survey activities, there will be a demobilization and transportation of the Project employees, equipment and the waste generated. This may result in a minor increase in traffic within the local area for the duration of the phase as Project vehicles will be utilised to transport staff, equipment and waste within the local area. While only a slight increase in overall traffic volume is expected, there is the possibility that a vehicle-related collision or other such incident could occur which may constitute significant impact if a member of the local community or the workforce were to be injured.

Waste disposal, sewage and wastewater discharge from the Project may lead to potential contamination of soil, surface water and ground water if undertaken improperly. This may in-turn affect the health and safety of the community and workforce who may in contact with these media. Refer to *Section 5.21* and *Section 5.22* for environmental issues related to waste disposal and discharge of sewage and wastewater.

#### *Workover Activities*

During the activities such as well deepening, pump servicing and swabbing and bailing, there is a possibility of accidental spillages of the drilling and waste fluids. Furthermore, the pump servicing may result in the generation of paraffin, which can result in a significant risk to the workers and community's health if not disposed properly.

### **5.32.2**

#### ***Existing/In Place Controls***

As part of the project design, the accepted industry best practices will be utilized to manage these concerns such as maintain a 100m- radius buffer

around the shot hole within which no pedestrians or traffic will be allowed. For controls related to waste disposal and sewage and wastewater discharges, these have been discussed in *Sections 5.9, 5.10, 5.17, 5.18, 5.21 and 5.22.*

### 5.32.3 *Significance of Impacts*

In the absence of adequate mitigation measures, the impacts on community and occupational health and safety are likely to be **Major**.

**Table 5.24** *Assessment of Impacts on Community and Occupational Health and Safety*

Impact	Community and Occupational Health and Safety				
Impact Type	Direct		Indirect		Induced
Impact Duration	Temporary	Short-term		Long-term	Permanent
Impact Extent	Local		Regional		International
Impact Scale	Affect workforce and local community in Project Area				
Frequency	Intermittent.				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low		Medium		High
Impact Significance	Negligible	Minor	Moderate		Major

### 5.32.4 *Additional Mitigation, Management and Monitoring*

In order to adequately mitigate the potential impacts on the health and safety of the workers and the community, the following mitigation measures will be put in place:

- Proper road safety measures must be adopted including proper signage with relators and paints.
- Timings of traffic movements must synchronise with local community needs and the villages falling in heavy traffic movements must be consulted and speed limits must be fixed.
- If there is any damage to the existing road must be repaired immediately for uninterrupted traffic movements and road blockage.
- There must be ensured availability of break services of heavy vehicles during constriction stage to avoid traffic jams.
- If there are any accidents, the affect family must be given compensation as per country regulations and MPRL E&P rules (in case it is better than the country regulations). Further root cause analysis must be undertaken with and proper records must be maintained, based on the recent surveys. Improper road signage, high speed, diving under the influence of intoxicants such as alcohols, continuous diving without taking proper rest, talking on mobile while driving were identified as some of key factors responsible to accidents. Therefore MPRL E&P must make policy with respect to the same which is applicable to all the works including subcontractor and other supply chain such as labour and logistics.

- The labour camps/ mobile camps or trailers should be placed at a distance from the village settlements.
- All the workers should have pre-employment medical check-ups and establish that only healthy were employed at site.
- Regular health check-ups and health survey of the community must be undertaken to keep record of the changes in the health status. If there are changes in disease pattern, required actions must be taken in collaboration with health department.
- Additional controls related to waste disposal and sewage and wastewater discharges are discussed in *Sections 5.9, 5.10, 5.17, 5.18, 5.21 and 5.22.*

For the purpose of the implementation of these mitigation measures, a Traffic Management Plan will be developed for the Project and will be implemented by the HSE team for the Project.

#### 5.32.5 *Significance of Residual Impacts*

Based on the assumption that MPRL E&P will be able to control and mitigate the impacts arising from its project activities, the impacts on the health and safety of the community and the workforce are likely to be **Minor**.

### 5.33 *IMPACT ON LIVELIHOOD PROFILE OF THE COMMUNITY*

#### 5.33.1 *Source of Impact*

##### *Preparation and Mobilisation*

As part of this phase of the Project, the project is likely to result in the generation of economic opportunities in the form of the labour requirement for the construction of the workforce camp and the site preparation and clearance and support staff during the seismic survey and close out phase. According to the information presently available, it is understood that during the seismic survey activities, approximately 20 unskilled workers will be required, which are likely to be sourced from the Project Area and the surrounding areas.

In addition to this, this phase of the Project is also likely to result in the creation of indirect opportunities due to the influx of the migrant workers in the area through increase in business of local shops and markets, establishment of small shops, rent etc.

##### *Seismic Surveying*

During this phase of the project, the generation of economic opportunities is likely to be restricted to the requirement of unskilled workers for activities such as the site preparation and maintenance and clearance. It is understood that the total worker requirement for this phase of the Project is likely to be

400, of which 320 are likely to be unskilled workers, to be recruited from the Project Area and its surrounding areas.

In addition to this, this phase of the Project will result in the creation of indirect opportunities due to the influx of the migrant workers in the area through increase in business of local shops and markets, establishment of small shops, rent etc.

#### *Close-out Phase*

This phase is likely to result in a negative impact on the livelihood profile of the community, due to a loss of the direct and indirect economic opportunities generated by the Project.

#### *Workover Activities*

The workover activities are likely to result in the generation of contractual employment and other employment opportunities for the local community. However, while the exact number of jobs or employment opportunities to be created is presently not known, it is expected to be comparable to that of the seismic survey, and is thus likely to play an important role in the livelihood profile of the local community.

### **5.33.2 Existing/In Place Controls**

For the purpose of the unskilled workforce and the local subcontractors required, the local community will be given preference. Even in terms of the vehicle 30 % will be hired locally while the 70 % will be company or subcontractors own vehicles.

### **5.33.3 Significance of Impacts**

In the absence of adequate mitigation measures, the significance of the impacts on the livelihood profile of the local community is likely to be **Positive**.

**Table 5.25 Assessment of Impacts on Livelihood Profile of the Community**

Impact	Change in Livelihood Profile of the Community					
Impact Type	Direct		Indirect		Induced	
Impact Duration	Temporary	Short-term		Long-term	Permanent	
Impact Extent	Local		Regional		International	
Impact Scale	Generation of direct and indirect economic opportunities for the local community. The Project is likely to require 400 unskilled workers in the planning and mobilization phase and approx. 320 unskilled workers in the seismic survey phase.					
Frequency	Through the life of the project					
Impact Magnitude	Positive	Negligible		Small	Medium	Large
Resource Sensitivity	Low		Medium		High	
Impact Significance	Negligible		Minor		Moderate	Major



#### 5.33.4 *Additional Mitigation, Management and Monitoring*

So as to maximize the benefits in terms of economic opportunity generation, the following additional measures such as preference to the vulnerable groups according to the skill requirements of the project is recommended.

#### 5.33.5 *Significance of Residual Impacts*

The potential impacts from the project on the livelihood profile of the community are expected to be **Positive**.

### 5.34 *IMPACT ON TRANSPORT AND INFRASTRUCTURE SERVICES*

#### 5.34.1 *Source of Impact*

##### *Preparation and Mobilisation*

The impacts on the transport and infrastructure services in this phase of the Project are likely to pertain to the impacts due to the construction of the workforce camp ( though mobile trailers and renting houses in the local community will be preferred), and transportation of labour, equipment, materials and waste. During this phase there is expected to be a minor increase in traffic within the local area. This may result in vehicle-related collision or other such incident could occur which may constitute significant impact if a member of the local community or the workforce were to be injured.

Refer to *Section 5.9* and *Section 5.10* for management issues related to waste disposal and discharge of sewage and wastewater.

##### *Seismic Surveying*

During this phase of the Project, the main impacts on the transportation and infrastructure services is likely to be resultant from the movement of labour, equipment and waste material. It is understood that the Project will be using existing access roads and will not be creating a new one. Management issues related to waste disposal and discharge of sewage and wastewater are also discussed in *Section 5.17* and *Section 5.18*.

Apart from this, there is a potential of vibrations to be generated from the seismic charges which may damage local infrastructure such as roads, bridges, pipelines or buildings. Furthermore, due to the blasting and drilling exercises, there is a potential of soil expulsion and external vibrations. This in turn may result in an interruption of road and river access as transport routes.

##### *Close-out Phase*

During this phase of the Project, the main impacts on the transportation and infrastructure services is likely to be resultant from the movement of labour, equipment and waste material. *Section 5.21* and *Section 5.22* have provided

the management issues related to waste disposal and discharge of sewage and wastewater.

#### 5.34.2 *Existing/In Place Controls*

Mitigation measures will be put in place to reduce the impacts from the survey activities on the infrastructure of the area, such as maintain a 100m-radius buffer around the shot hole within which no pedestrians or traffic will be allowed. This will be done in order to reduce the potential of external vibrations to interfere with the results of the geophone readings and the prevent injury from soil expulsion upon activation of the seismic charges. In some cases this may result in the temporary interruption of transport routes in the vicinity of the active shot holes, which could be temporarily closed for a period of approximately 20 minutes at a time. This is not expected to be a significant impact, as the interruptions will be temporary in nature. Also, advance notice will be provided to the local residents and any road closures will be undertaken in consultation with the local government authorities.

For controls related to waste disposal and sewage and wastewater discharges are also discussed in *Sections 5.9, 5.10, 5.17, 5.18, 5.21 and 5.22.*

#### 5.34.3 *Significance of Impacts*

The significance of the impacts on transportation and infrastructure services are likely to be **Negligible to Minor**.

**Table 5.26** *Assessment of Impacts on Infrastructure and Transportation Services*

Impact	Impact on infrastructure and transportation services				
Impact Type	Direct		Indirect		Induced
Impact Duration	Temporary	Short-term		Long-term	Permanent
Impact Extent	Local		Regional		International
Impact Scale	Impact on infrastructure and transportation services due to drilling and blasting for the survey and the transportation of labour, equipment and waste.				
Frequency	Through the life of the project				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low			Medium	
Impact Significance	Negligible	Minor		Moderate	Major

#### 5.34.4 *Additional Mitigation, Management and Monitoring*

Since the significance of impacts is considered negligible to minor with exiting control measures, additional measures are not considered necessary. However, as industrial best practices for the minimisation of the potential impacts on the infrastructure and transportation services due to Project activities, the following mitigation measures are recommended to be implemented:

- Proper road safety measures must be adopted including proper signage with relators and paints.
- Timings of traffic movements must synchronise with local community needs and the villages falling in heavy traffic movements must be consulted and speed limits must be fixed.
- If there is any damage to the existing road due to operations, it must be repaired immediately for uninterrupted traffic movements and road blockage.
- There must be ensured availability of break services of heavy vehicles during constriction stage to avoid traffic jams
- Maintaining minimum offset distances from the surrounding infrastructure are recommended.
- Additional controls related to waste disposal and sewage and wastewater discharges are also discussed in *Sections 5.9, 5.10, 5.17, 5.18, 5.21 and 5.22.*

In addition to the above, it is recommended to follow the guidelines of offset distances for seismic charges are shown in *Table 5.27*. These guidelines take into account the mass of the seismic charges, and are a conservative estimate in that they have been developed with significant safety margins which make it highly unlikely that the areas will be potentially impacted, even considering worst-case-scenario parameters. They have been developed based on MPRL E&P's extensive seismic survey experience.

**Table 5.27 Recommended Offset Distances for Seismic Charges (Based on Mass of Charge)**

Constraint	Minimum Horizontal Distance (m)		
Explosives in 21m deep single shot hole	2.0kg	1.0kg	0.5kg
Wooden house	50	40	35
Cement, brick or concrete building	80	60	50
Cement or concrete canals	100	85	75
Ponds and unlined canals	25	15	10
Commercial fish or shrimp ponds	150	120	100
Fish or shrimp hatcheries	150	100	100
Commercial chicken farms	200	150	120
Power transmission line	Site dependent – charges will be placed no closer (horizontal distance from directly below the line) than twice the length of the detonator cable (approx. 60m)		
Tube water wells and concrete ring wells	150	120	100
Concrete bridges	150	100	80
Earth or concrete dams	200	200	200
Rivers and other flowing waterways	5	5	5
Concrete or cement water towers	200	170	150
Place of worship	200	170	150
Religious monuments and archaeological sites	200	170	150
Cemeteries	50	50	50
Gas, oil or main water pipelines	100	70	50
Local radio transmitters	Depends on power and frequency – report to Project Manager		

#### 5.34.5 Significance of Residual Impacts

Based on the assumption that MPRL E&P will be able to effectively implement the mitigation measures identified, the potential impacts on the infrastructure and transportation services are likely to be **Negligible**.

#### 5.35 IMPACT DUE TO LOSS OF LAND AND CROP LOSS

##### 5.35.1 Source of Impact

It is understood that the land requirement for the seismic survey is primarily comprised of the land required for the survey activities and the mobilisation of the equipment. The accommodation will be primarily in the mobile camps and rented accommodation in the nearby settlements. The transportation will happen on the existing roads and no new land will be required for the construction of the access road.

The survey activities are to be undertaken within the Block IOR -4. However survey will also be conducted outside the identified blocks as controlled

samples for proposed block. The area within the block consists of almost entirely cultivated land. It is understood that no land acquisition for the project was undertaken as the land required for the survey is already occupied by MOGE, however, as reported by MPRL E&P no compensation was paid by the government. MPRL E&P as part of the present procedure provides compensation for the crop loss.

Of the 38 households surveyed as part of the impact assessment process, seven (7) reported to have lost land for the purpose of the Project. Of these all seven (7) households reported to have received compensation but did not report to having access to alternate pieces of land for cultivation. It is likely that the previous compensation was paid by either the government (MOGE) or the previous contractors used as MPRL E&P has not yet started the operation. It is also understood that the land acquisition for the land of the Project was undertaken by the government and MPRL E&P was not involved in the negotiations or compensation payment process.

### 5.35.2 *Existing/In Place Controls*

According to the information made available, the previous crop compensation was paid by either the government (MOGE) or the previous contractors used at the time. However, the exact details of the amount of agricultural land impacted, the amount of crop compensation paid and by whom are presently unavailable.

It is not clear if the land will be returned or not to the land losers in case the seismic survey results are not encouraging, or whether there will be another round of compensation (if any) in case the seismic survey results are encouraging.

### 5.35.3 *Significance of Impacts*

The significance of the impacts of land loss and crop loss is due to the Project is considered as **Major**.

**Table 5.28** *Assessment of Impacts owing to land loss and crop loss*

Impact	Loss of Land and crop loss				
Impact Type	Direct		Indirect		Induced
Impact Duration	Temporary	Short-term		Long-term	Permanent
Impact Extent	Local		Regional		International
Impact Scale	The local community in the 6 villages in the Project Area				
Frequency	In the land accessibility phase				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low		Medium		High
Impact Significance	Negligible	Minor		Moderate	Major



For the purpose of minimising the impacts from the land loss, the following mitigation measures are recommended.

- Compensation for the crop loss should be provided and livelihood restoration facilities should be provided, however, this has to be done keeping cognisance of the local laws and regulations.
- In case of landlessness due to project, preference should be given for employment in various works depending upon the skill levels. Livelihood restoration options or support could be considered for these families.
- In case of any new land requirement, the compensation amount and any livelihood restoration options should be identified in consultation with the local community and the local authorities.
- Preference should be provided to the land owners for employment and sub-contractor works, in keeping with the skill requirement of the Project.
- Preference in community development and corporate responsibility activities.

Owing to a certain lack of clarity on the possible losses suffered by the land losers for the Project, it is imperative that before land access to any area, an inventorisation of the losses including assets, crops, trees etc and other details relating to the productivity of the land, land type, irrigation status, cropping pattern of land etc, should be completed. Also livelihood dependence of the family, ownership or tenure records pertaining to land should be collected. Further, alternate land or extra land available with the family should be documented. The asset inventorisation, documentation of the losses and livelihood dependence will help arrive at options for compensation and livelihood restoration options to ensure that the affected family condition is either equal to the previous status or better after the Project.

Owing to the role of the government in the procurement of the land, it is desirable to agree for the livelihood restoration options (preferably in kind keeping the local situation in context) in terms of framework which could be suitably rolled out for various categories of losses. A Livelihood Restoration Plan (LRP) for the Project should be developed keeping the above in context. The LRP based on the assessment of various livelihood restoration options available and preferred by the community and reflective of the needs of the community should be rolled out keeping the government in confidence. The LRP should also have clear reporting and monitoring indicators and the implementation mechanism including the institutional mechanism for the implementation of the same.

### 5.35.5 *Significance of Residual Impacts*

The potential impacts from the land loss for the project are likely to be **Moderate**.

## 5.36 *IMPACTS ON SOURCE WATER VULNERABILITY*

### 5.36.1 *Source of Impact*

It is understood that the water for the Project activities across the various phases and for the workforce camp will be sourced from the local water sources. The water sources identified within the block will be shared between the community and the Project. It is understood that the increased demand for water may have negative impacts during the life of the Project, which may result in a water shortage in the area for the local community. Also, wastes disposal and waste water discharges from the Project may lead to contamination of surface water and groundwater that are used by the community. The details of the competing water demand for the Project and the pressure that exert on the source water accessibility for the community is presently unavailable to be able to comment exactly on the magnitude of impact.

### 5.36.2 *Existing/In Place Controls*

As part of the Project design, the requirements for acceptable water quality standards and waste water discharge standards will be maintained. For controls related to waste disposal and sewage and waste water discharges, readers are referred to *Sections 5.9, 5.10, 5.17, 5.18, 5.21, 5.22 and 5.26*.

### 5.36.3 *Significance of Impacts*

The significance of the impacts due to water vulnerability in the Project is considered to be **Minor**.

**Table 5.29** *Assessment of Impacts due to Source Water Vulnerability*

Impact	Source Water Vulnerability					
Impact Type	Direct		Indirect		Induced	
Impact Duration	Temporary	Short-term		Long-term	Permanent	
Impact Extent	Local		Regional		International	
Impact Scale	local community in the Project Area					
Frequency	Through the life of the project					
Impact Magnitude	Positive	Negligible	Small		Medium	Large
Resource Sensitivity	Low		Medium			High
Impact Significance	Negligible		Minor		Moderate	Major

#### 5.36.4 *Additional Mitigation, Management and Monitoring*

For the purpose of minimizing the impacts on the source water due to the water requirement for the Project, the following additional controls are identified:

- For additional controls related to waste disposal and sewage and waste water discharges, readers are referred to *Sections 5.9, 5.10, 5.17, 5.18, 5.21, 5.22 and 5.26.*
- The local community will be engaged and a water use agreement will be formulated, which would minimize the pressure on the source water and ensure adequate water availability for the community.

#### 5.36.5 *Significance of Residual Impacts*

The potential impacts on the source water for the project are likely to be **Minor**.

### 5.37 *IMPACTS ON CULTURAL HERITAGE*

#### 5.37.1 *Source of Impact*

The planned activities including construction of workforce camp, site preparation / clearance and access routes creation, drilling and detonation of explosives may lead to direct physical impacts to the cultural heritage resources which may exist in the area. These resources may also be impacted by accidental events such as fire and explosions.

#### 5.37.2 *Existing/ In Place Controls*

As part of the Project design, Project facilities / activities will be located away from sensitive cultural heritage resources. For instance, no known monuments, historic buildings and living heritage sites such as cemeteries are located within the proposed workforce camps which are existing facilities.

#### 5.37.3 *Significance of Impacts*

The significance of the impacts on the cultural heritage is considered to be **Minor or Moderate**

**Table 5.30**      *Assessment of Impacts on Cultural Heritage*

Impact	Impact on Cultural Heritage				
Impact Type	Direct		Indirect		Induced
Impact Duration	Temporary	Short-term		Long-term	Permanent
Impact Extent	Local		Regional		International
Impact Scale	The local community in the 6 villages in the Project Area and the region				
Frequency	The entire life of the project				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity	Low		Medium		High
Impact Significance	Negligible	Minor	Moderate		Major

#### 5.37.4      *Additional Mitigation, Management and Monitoring*

For the purpose of minimizing the impacts on the cultural heritage in the area, the following mitigation measures are recommended.

- The Project will meet the international best practice for the documentation and protection of the cultural heritage and in case of chance finds;
- The Project will consider retaining professionals to assist in the identification and protection of cultural heritage;
- In case the removal of nonreplicable cultural heritage is required, the same will be undertaken in consultation with the affected communities and in keeping with the regulatory requirements for the same;
- The Project will ensure that the access to cultural heritage by the local community is not disrupted, and if required, alternative access routes will be provided.
- A proper protocol or Standard Operating Procedures (SOP) may be developed and people at Project site location trained to act suitably in consonance with the regulatory requirement and beliefs and faith of the community, if any.

#### 5.37.5      *Significance of Residual Impacts*

The potential impacts on cultural heritage for the project are likely to be **Minor**.

Cumulative impacts encompasses impacts that result from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted. The IFC (2012) defines cumulative impacts as those generally recognised as important on the basis of scientific concerns and or concerns from Affected Communities <sup>(1)</sup>. Examples given include reduction of water flows in a watershed due to multiple withdrawals, increases in sediment load, increases in traffic congestion and accidents due to increases in vehicular traffic.

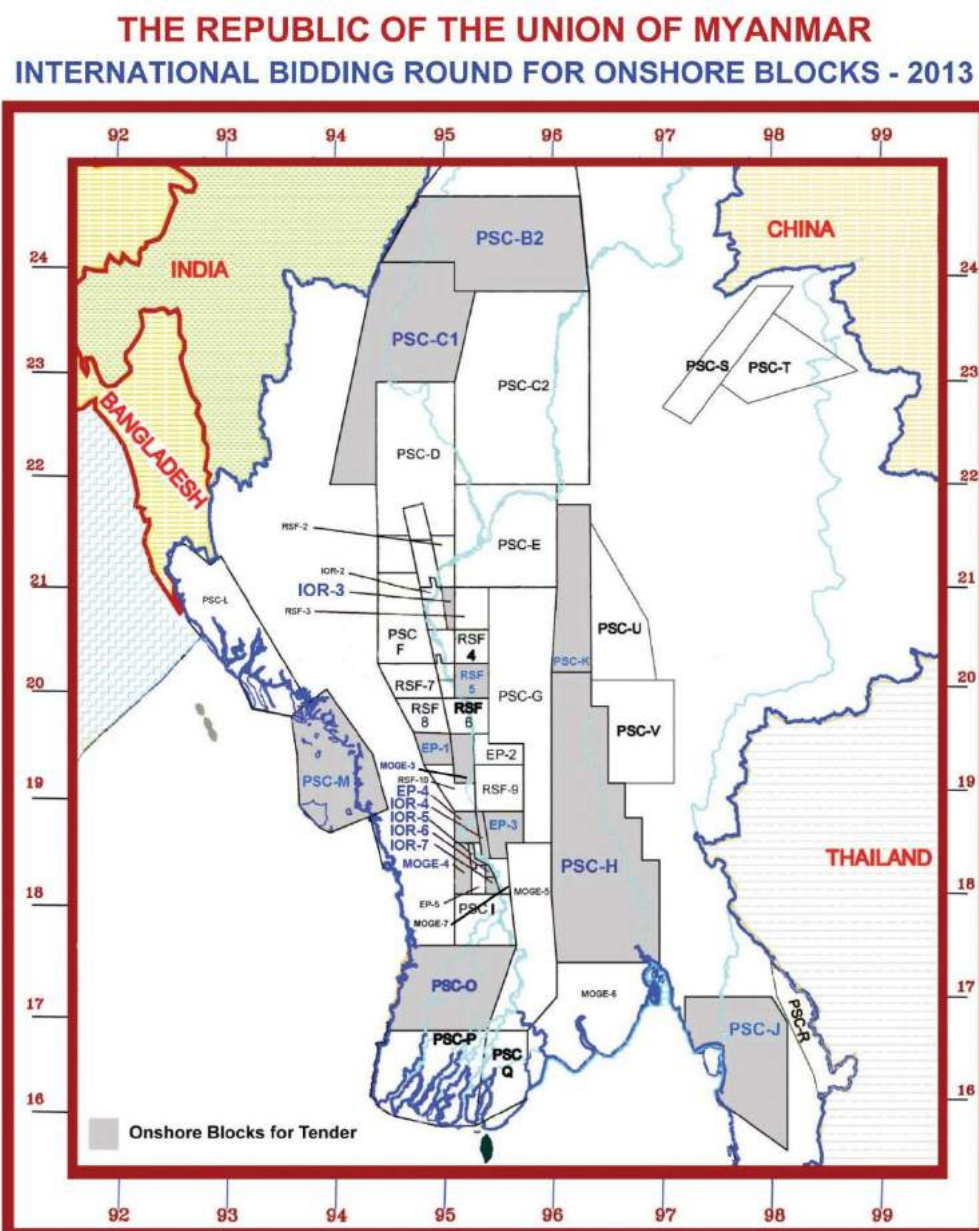
Cumulative impacts summarised in this section refer to the additional impacts that may be generated by other developments or activities in the vicinity of the Project Area that when added to the impacts of the proposed seismic survey and workover activities combine to cause a greater impact. Such impacts may arise due to spatial overlap in an impact (eg overlap in spatial extent of air or water quality changes) or temporal overlap (eg noise impacts caused by construction activities at the same time from different sources).

As indicated in *Figure 6.1*, Block IOR-4 is surrounded by other onshore blocks including Block IOR-6, Block EP-3 and Block EP-4. It is understood that seismic surveys may be carried out concurrently at these blocks and their seismic survey areas may overlapped slightly with that of Block IOR-4 at the boundary between the blocks. However, as assessed in *Section 5*, it is expected that the environmental and social impacts from seismic surveys and workover activities, if properly mitigated, will be localised within the onshore blocks and restricted to environment / communities within them. As such, it is not expected that seismic surveys at adjacent blocks, if undertaken concurrently, will lead to cumulative impacts to the physical, biological or human environment within Block IOR-4.

(1) IFC Performance Standards on Environmental and Social Sustainability, January 2012, International Finance Corporation, World Bank Group



Figure 6.1 Locations of Onshore Blocks, Myanmar



This document provides the Environmental and Social Management Plan (ESMP) for the planning, construction and operation of the Project which is further described in *Section 7.1* below. This ESMP provides the procedures and processes which will be applied to the Project activities to check and monitor compliance and effectiveness of the mitigation measures to which MPRL E&P Pte Ltd (MPRL E&P) has committed. In addition, this ESMP is used to ensure compliance with statutory requirements and corporate safety and environmental policies.

The remainder of this ESMP is structured as follows:

- *Section 7.1* presents the Project description based on which the environmental and social impacts have been assessed with mitigation and monitoring measures derived.
- *Section 7.2* defines the environmental and social policies of the Project as well as the related legal requirements and institutional arrangements.
- *Section 7.3* presents a summary of environmental and social impacts associated with the Project, the recommended mitigation measures and the key elements related to the implementation of these measures as well as the overall HSE system of the Project.
- *Section 7.4* presents other detailed management and monitoring plans which are related to this ESMP.
- *Section 7.5* presents the emergency response plan for the Project.

## 7.1 PROJECT DESCRIPTION

MPRL E&P was awarded the Exploration Block IOR-4 (a.k.a. Pyay) in October 2013 to jointly operate with Myanma Oil & Gas Enterprise (MOGE) under Improved Petroleum Recovery (IPR) Contract. Following the contract award, MPRL E&P is planning to conduct seismic exploration activities, possibly consisting of 2-Dimensional (2D) and 3-Dimensional (3D) surveys, across Block IOR-4 as well as undertake workover activities at selected existing wells within the Block ("the Project").

### 7.1.1 Project Description of Seismic Survey

#### *Proposed Location*

Block IOR-4 is located in Central Myanmar in the Bago Division which covers an area of 381 km<sup>2</sup>. The Block location is presented in *Figure 7.1* with coordinates detailed in *Table 7.1* below. The indicative proposed 3D seismic area, which covers an area of 210 km<sup>2</sup>, is illustrated in *Figure 7.2*.



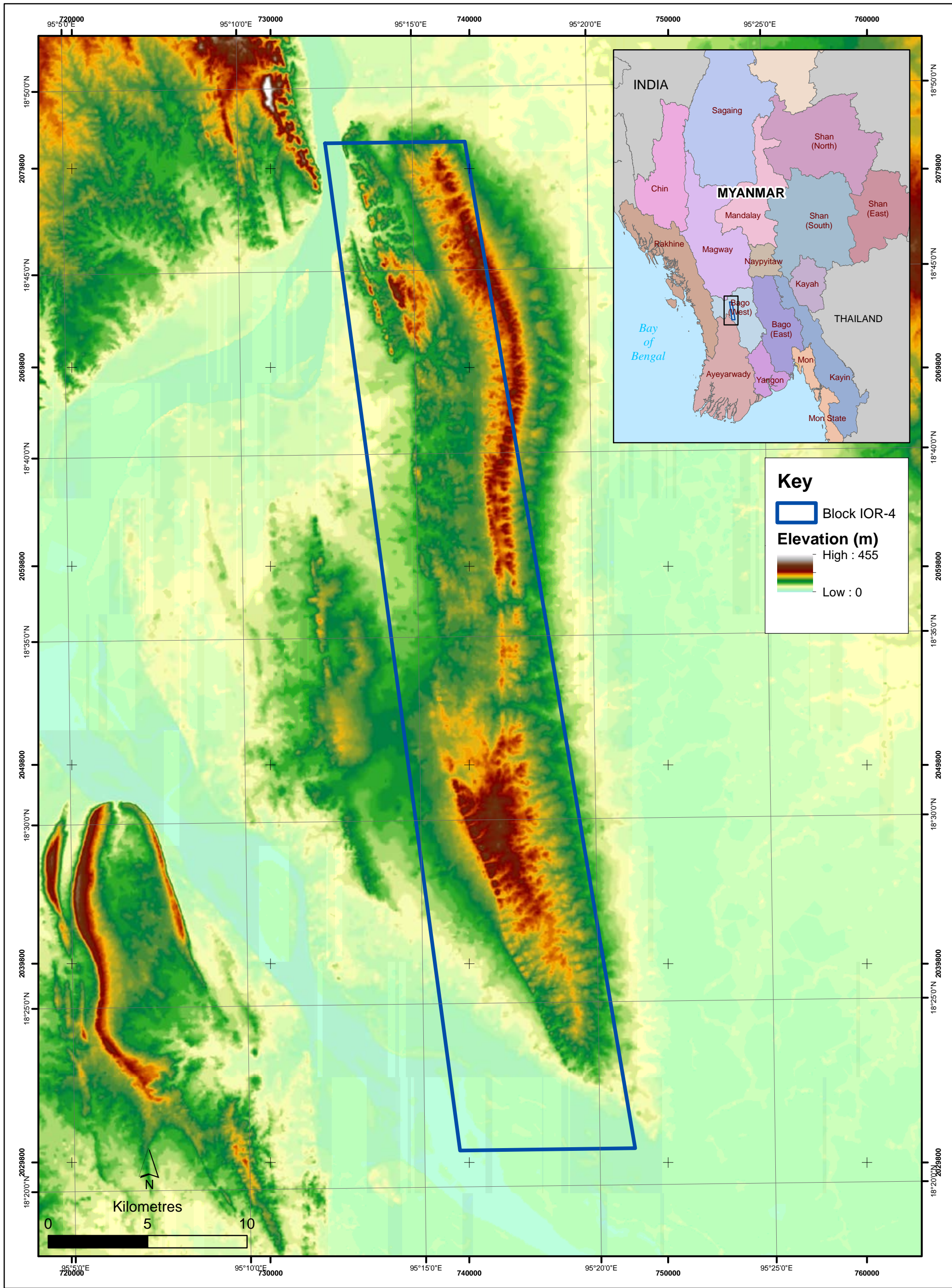


Figure 7.1

Block IOR-4

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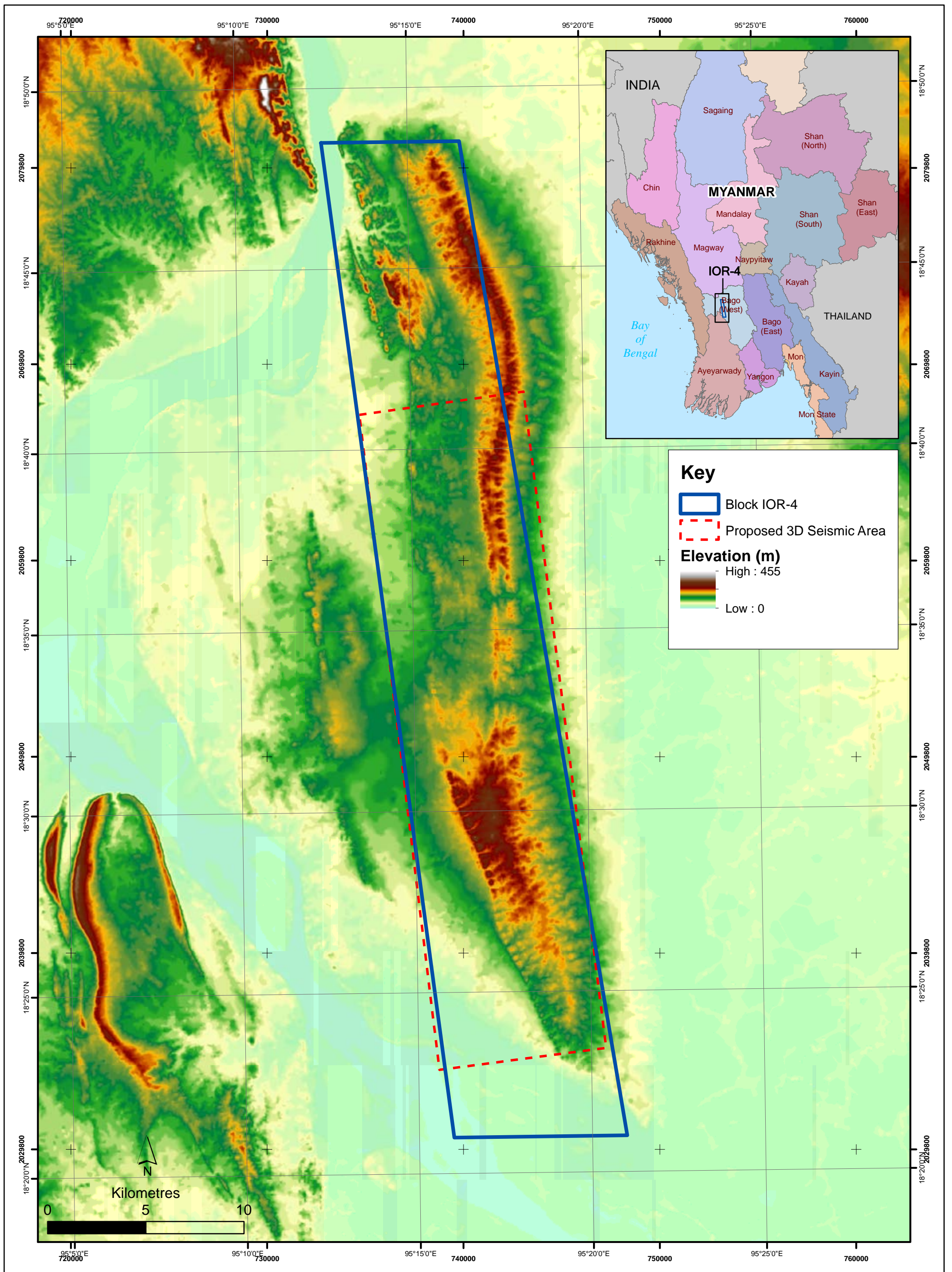


Figure 7.2

## Indicative Proposed Seismic Survey Area of Block IOR-4

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**Table 7.1**      *Block IOR-4 Coordinates*

Point	Latitude	Longitude
A	18° 48' 30'	95° 12' 30'
B	18° 48' 30'	95° 16' 30'
C	18° 21' 0'	95° 21' 00'
D	18° 21' 0'	95°16'00"

*Programme of the Proposed Seismic Survey*

Seismic surveys can typically be divided into the following phases:

- Land accessibility phase;
- Preparation / mobilisation phase;
- Seismic survey phase; and
- Close-out phase.

The programme of the proposed seismic survey is presented in *Figure 7.3*. While no land accessibility phase is expected as presented below, it is expected that activities associated with the seismic survey will commence in the 1<sup>st</sup> quarter of 2016 for the preparation / mobilisation phase and be completed in the 4<sup>th</sup> quarter of 2016 for the close-out phase.

*Land Accessibility Phase*

During the land accessibility phase, ownership of land and properties that fall within the seismic lines will be determined. Appropriate engagement and procedures to obtain permission and notify owners to access land to conduct the survey will be performed. However, it is understood that no land acquisition is planned as all sites required by MPRL E&P will be in areas already occupied by MOGE.

*Preparation / Mobilisation Phase*

Preparation and mobilisation generally involves the construction of associated facilities and determination and development of access tracks for equipment, resources and workforce.

According to the preliminary programme, the camp set up will be undertaken in the first quarter of 2016 for the proposed seismic survey in Block IOR-4. Initial information indicates that the proposed camp location of approximately 4,700 m<sup>2</sup> will be located adjacent to the existing GOCS-4 facility (*Figure 7.4*). The camp is expected to have rooms for 120 people with waste, toilet and kitchen facilities. A section of ~455 m of the Yangon-Pyay Road will need to be improved for access to the camp and it is assumed that appropriate drainage facilities will be constructed for the improved road section. It is expected that the camp will be connected to existing power and water lines and a 175 kVA generator will also be available. Materials to be used for the site preparation and road construction (i.e. gravel, shale, sand, cement, wood



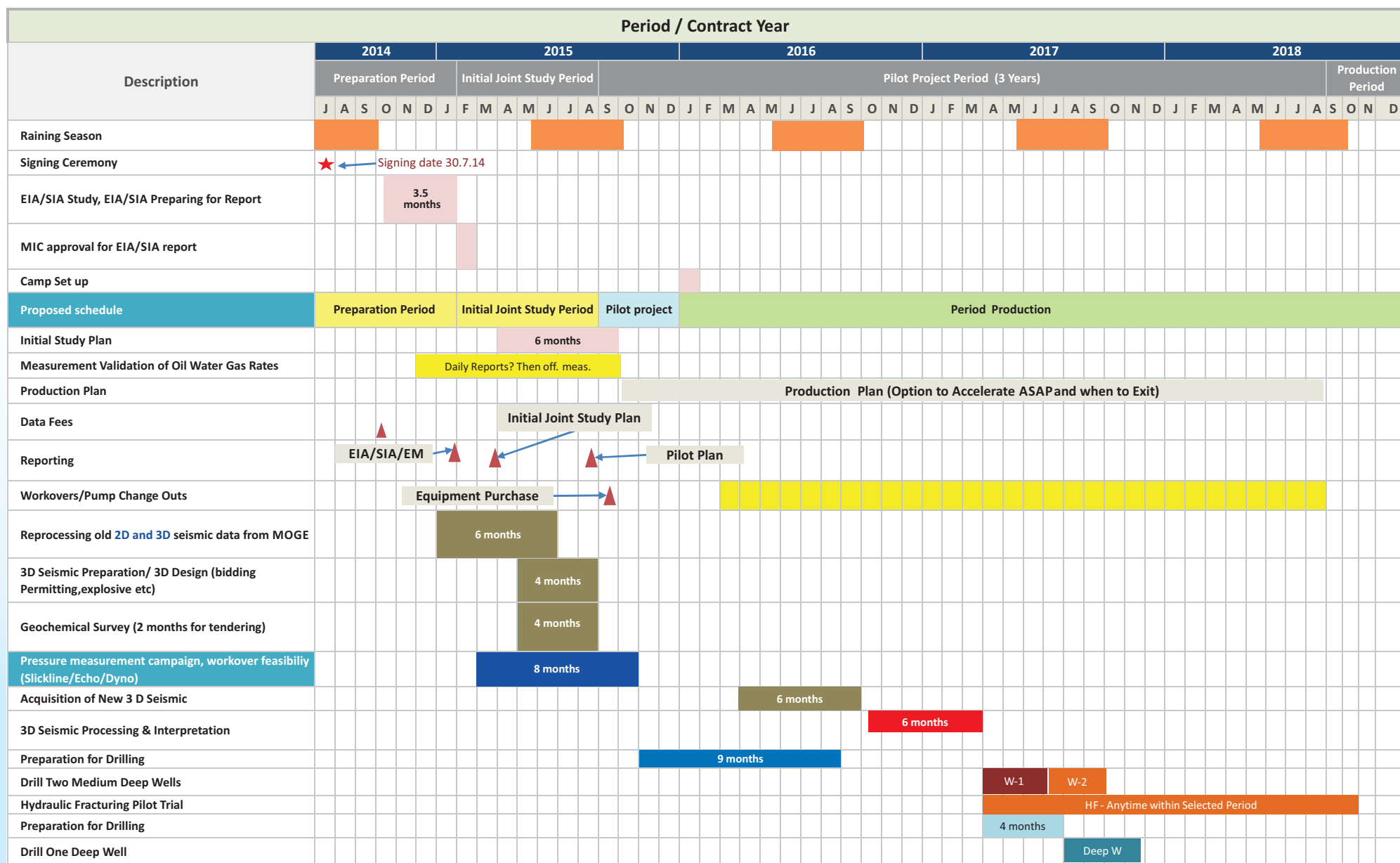


Figure 7.3

Overall Work Programme for Block IOR 4

etc.) are likely to be sourced via local suppliers from the Shwe Taung Township and Pyay Township.

**Figure 7.4**      *Locations of the Proposed Camp Site*



#### *Seismic Survey Phase*

The seismic survey is planned to be undertaken in the second-third quarter of year 2016 for a period of about 180 days. It may cover up to the whole block, acquiring indicatively a total of about 210 km<sup>2</sup> (fullfold) 3D seismic survey lines in approximately 30 km (North-South) x 7 km (East-West) grid as shown in *Figure 7.2*.

During the seismic survey phase, vegetation clearance and creation of access routes will be an on-going activity for placement of seismic sources and sensors. Existing access road / tracks will be used as far as possible. In case new road / track is needed, they will be designed and constructed with appropriate drainage facilities to avoid soil erosion.

#### Seismic and Acoustic Sources

Explosive seismic charge will be used as the acoustic source of the survey. The charge will be set off just below the ground surface to generate sound waves which are bounced off underground rock formations and the waves that reflected back to the surface are captured by recording sensors for later analysis. Generally, drilling will be undertaken for the placement of dynamite inside the shot holes along the seismic lines. Shot holes, typically 9-10 m deep and 6-10 cm in diameter, will be drilled using surface water with man portable drills or vehicular mounted drills depending on the type of access available within the seismic area.

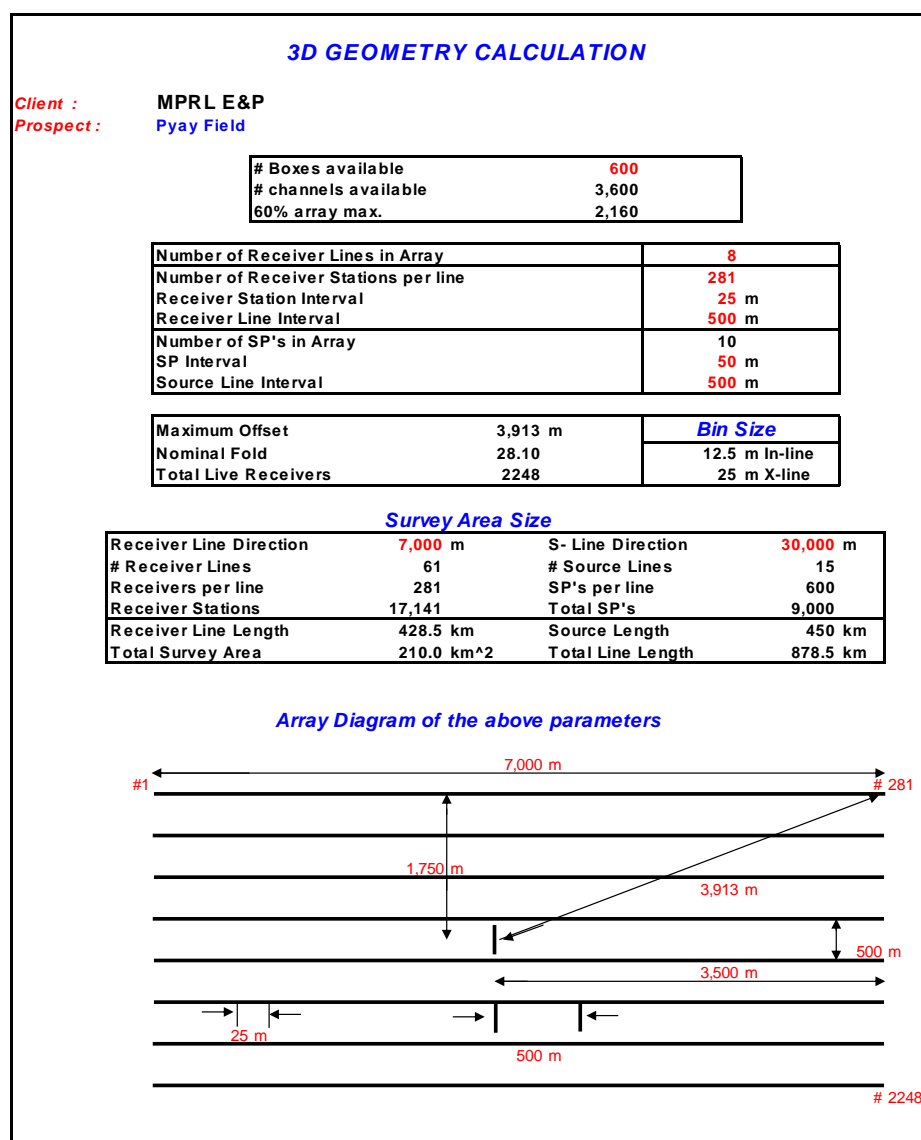
Layout parameters of the proposed seismic survey for Block IOR-4 are presented in *Figure 7.5*. For the current survey, there will be a total of 15

source lines within the seismic survey area, each of which measures 30 km in length. The total length of the source lines will thus be 450 km. The distance between adjacent source lines will be 500 m. There will be a total of 9,000 shot points (SPs) on the source lines, with 600 SPs on each of the 15 sources lines. The interval between adjacent SPs will be 50 m.

### Seismic Sensors and Processing

To acquire the data generated by the acoustic source, it is preferred to use wireless Geophone but conventional cable systems may also be used for the proposed seismic survey depending on the surface area restriction. The Geophone will be placed at a total of 17,141 receiver stations for the current seismic survey. These receiver stations will be distributed along 61 receiver lines, with 281 stations on each line. The distance between adjacent receiver stations will be 25 m. Each receiver line will be ~7 km long and the separation distance will be 500 m between adjacent lines. The total length of the receiver lines is 428.5 km. Layout parameters of the proposed seismic survey for Block IOR-4 are presented in *Figure 7.5*.

**Figure 7.5**      *Layout Parameters of the Seismic Surveys for Block IOR-4*



### Labour and Accommodation Requirements

The Project will involve a total of 20 people initially and up to a maximum of 400 people during the seismic surveys. The seismic crew will be housed in the camp. Water supply will be from existing tube wells while power supply will be from 11 kva power line. Camp doctor will be available to handle minor injuries / incidents. Serious incidents and injuries will be handled at Pyay Hospital.

### Materials, Supplies & Logistics

Materials to be used for the site preparation and road construction (i.e. gravel, shale, sand, cement, wood etc.) are likely to be sourced via local suppliers from the Shwe Taung Township and Pyay Township.

It is expected that high speed diesel of ~250-300 gallons per day will be used during the seismic survey. The fuel will be stored temporarily at MOGE storage area or in a new fuel station to be built for the Project. Fuel may also be obtained from local townships.

For munitions bunkers, they will be in existing military barracks or a new one will be built within the military compound.

For transportation, existing roads and tracks will be used where possible in addition to temporary to semi-permanent roads paved by laterite/gravel. New roads / tracks may be built and it is expected that these roads / tracks will have appropriate drainage. Transportation of labour will mainly use trucks, buses or cars. The existing Yangon Airport will be used to supply the Project. For river transport, the existing facility at Na Ma Yan Foreshore near the Pyay Bridge will be used.

### *Close-Out Phase*

During the close-out phase, the demand for labour, equipment and services will decrease and eventually cease when the seismic survey is completed. Transportation of equipment, materials, waste and workforce out of the survey area will take place during the close-out phase. A traffic management plan will be developed to minimise the impact associated with road traffic.

## **7.1.2 Project Description of Workover Activities**

### *Workovers Location*

Workover activities will be undertaken at existing wells within Block IOR-4. These include producing, temporarily suspended, abandoned or water injection / disposal wells. The locations of all 181 wells within Block IOR-4 are shown in *Figure 7.6*



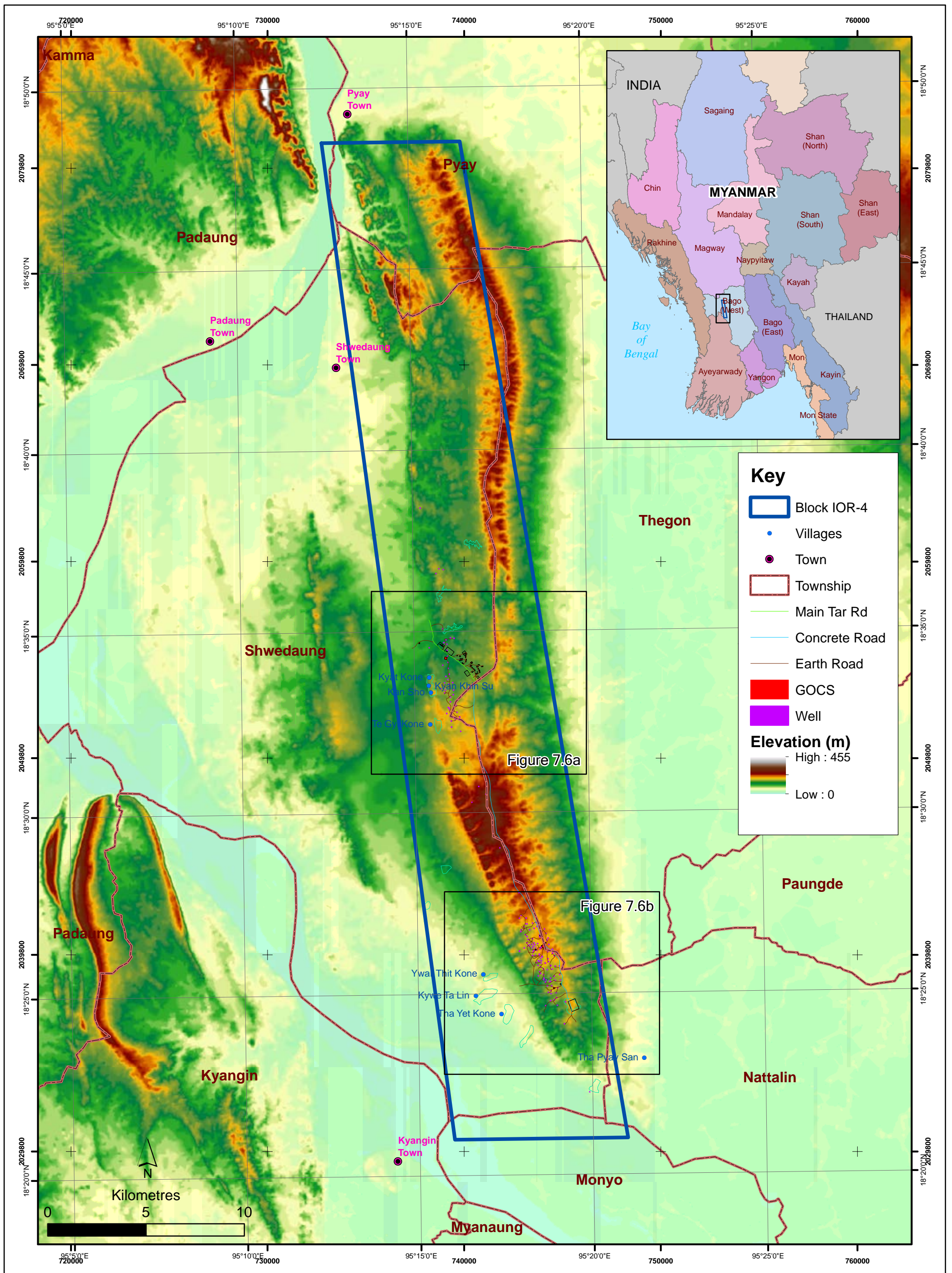


Figure 7.6

Locations of Wells and GOCS within Block IOR-4 (Key Plan)

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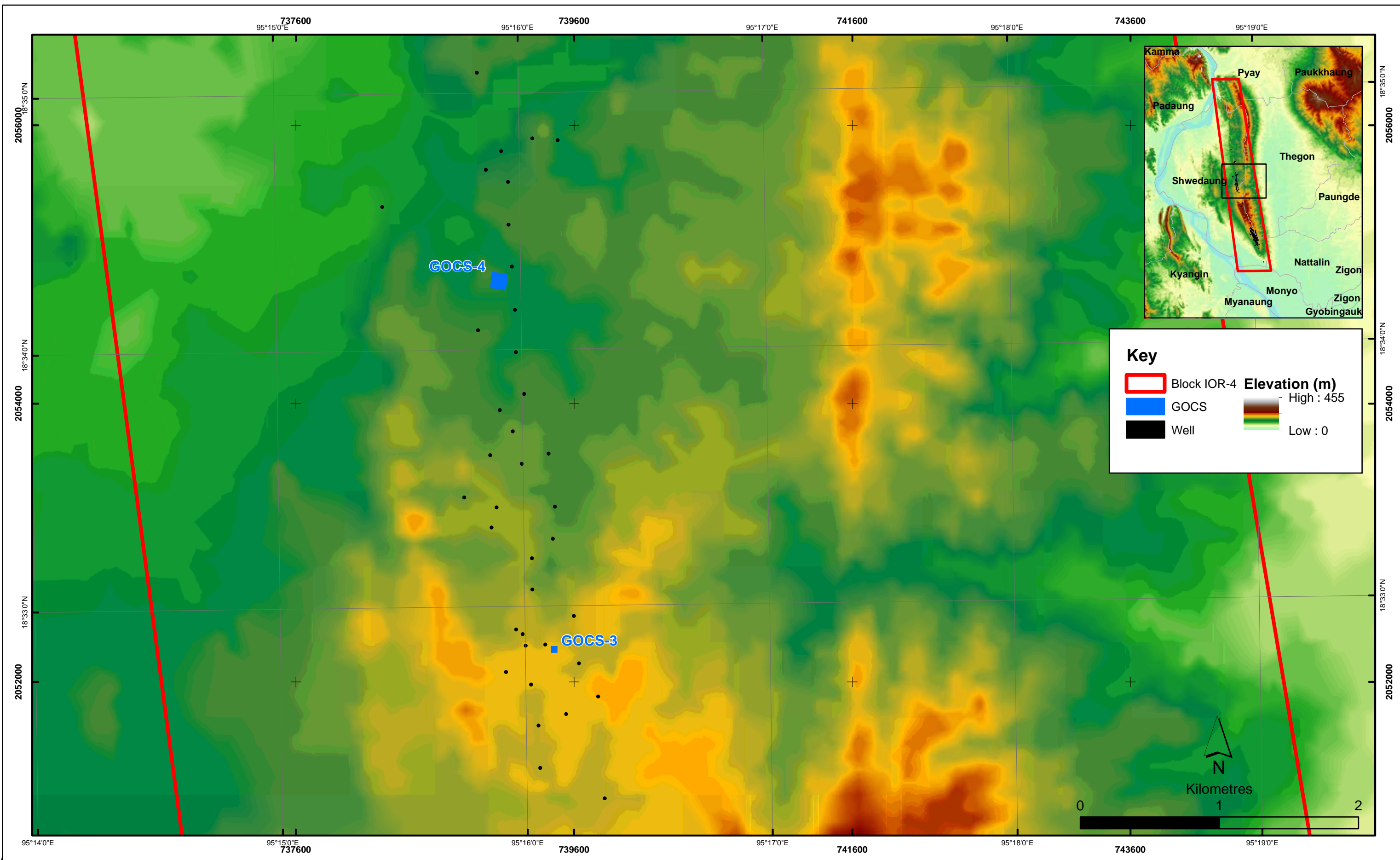


Figure 7.6a

Locations of Wells and GOCS within Block IOR-4 (Sheet 1 of 2)

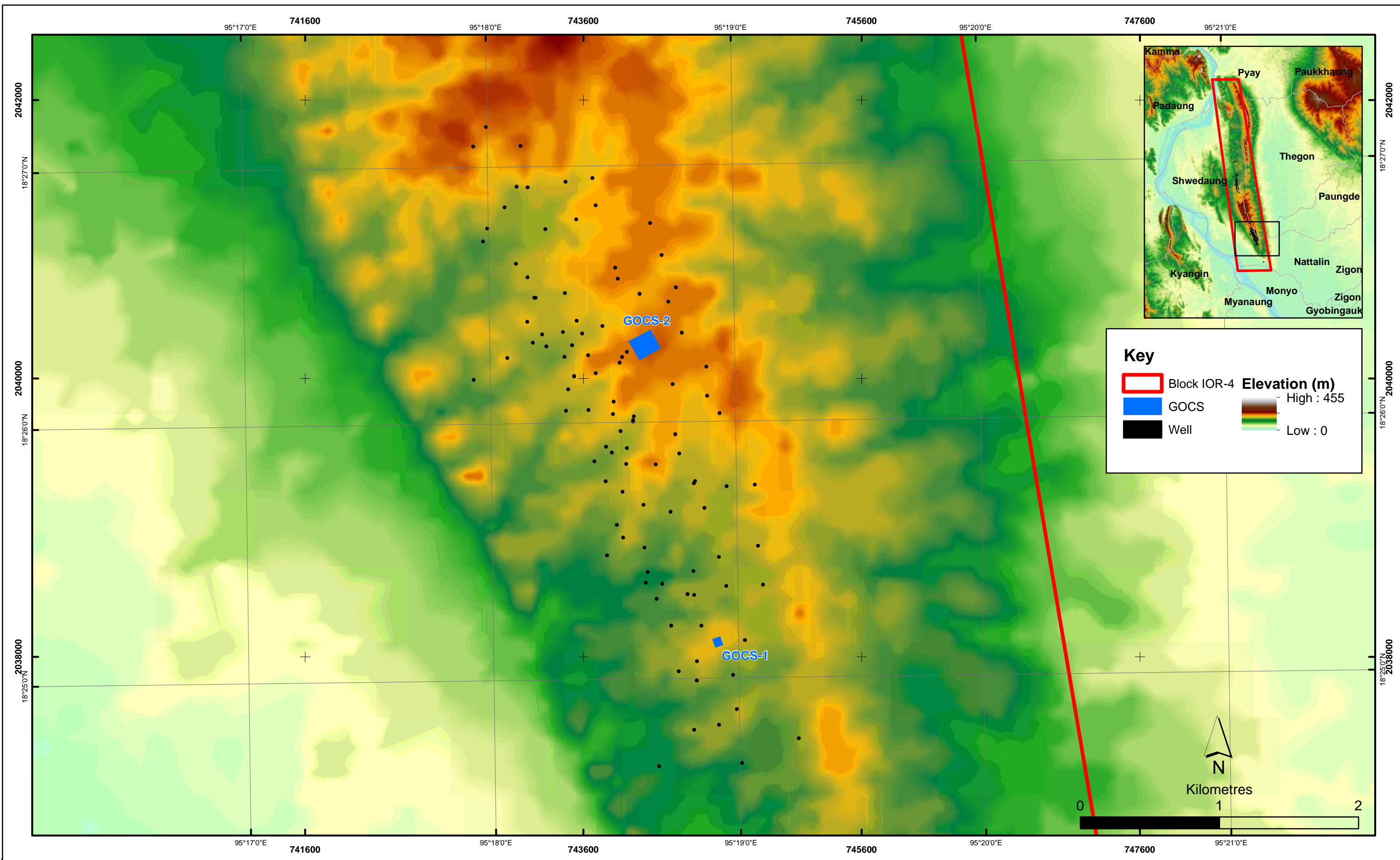


Figure 7.6b

Locations of Wells and GOCS within Block IOR-4 (Sheet 2 of 2)



## *Workovers Activities and Programme*

The following workovers activities will be undertaken for the selected wells within Block IOR-4:

- Well Deepening;
- Pump servicing;
- Swabbing and bailing;
- Zone isolation;
- Re-perforations; and,
- Improvement of wellheads

The above activities are scheduled to be undertaken from October 2015 to October 2018. Brief descriptions of the above activities are provided in the following sections.

### Deepening

The primary objective of well deepening is to explore opportunity of producing additional oil at deeper depth from the existing wells. The following procedures will generally be adopted for well deepening:

1. Pressure test to all squeezed zones until the test results sound.
2. Drill cement collar and deepen the well to a certain depth below shoe with water based mud (WBM) and then KCL polymer mud. WBM will be recycled as far as possible for the deepening of another well.
3. After reaching objective depth, wireline logging will be conducted and subsequently slotted liner will be set for production testing.

Typical environmental issues related to well deepening include the use, disposal and potential accidental spillage of drilling and waste fluids from the deepening operations.

### Pump Servicing

Pump servicing should be conducted when the fluid level is high and the production is not satisfactory. The servicing will be undertaken by well serving truck and will include pumping checking, replacement and cleaning in order to achieve for higher production levels. It is also expected that the serviced pump will be quieter. However, pump servicing may lead to the generation of paraffin from the well which will require to be disposed of properly.

### Swabbing and Bailing

If the fluid level is found low and the well is producing less or not producing oil, swabbing and bailing will be considered to be undertaken to enhance oil production. Well servicing truck will be used for the swabbing and bailing operations.

Swabbing creates a path for the oil to travel into a production zone. It can clean the perforations and induce the formation fluid come into the hole. The swabbing tool assembly comprises a swab mandrel with a swab cup that extends off the mandrel. The swab mandrel is a steel rod that allow for a quick, easy movement of the swab cup out of the hole. This creates the vacuum that brings the well into production. Before swabbing, scraper will be used to remove scale, mud cake, cement sheath, embedded bullets and other foreign material from the inside of the casing wall to avoid blockage of the swab cup.

For bailing, bailer will be used to remove formation sand/rock and other such debris left over from the well in order to improve production.

Potential hazard associated with swabbing and bailing include the loss of well control during the operations.

#### Zone Isolation

Zone isolation will be undertaken for selected wells using production packers, service packers and bridge plug. Production packers are those that remain in the well during well production while service packers are used temporarily during well service activities such as cement squeezing, acidizing, fracturing and well testing. In wells with multiple reservoir zones, packers are used to isolate the perforations for each zone and isolate or temporarily abandon producing zones.

#### Re-perforations

Re-perforations is undertaken for better control of the well. Re-perforation creates a channel between the pay zone and the wellbore, causing oil and gas to flow to the wellbore easily. Before re-perforations are conducted, scrapping, bailing, and if necessary drilling, will be undertaken first to remove debris at the desired depth. During re-perforations, casing guns and charges will be used at the desired depth to create the perforations.

#### Waste Generation from Workover Activities

The type and amount of wastes that may be generated from the workover activities are presented in *Table 7.2* below. A proper Waste Management Plan will be designed and implemented for Block IOR-4 to describe the appropriate means of managing the waste streams in order to avoid impacts to the environmental and social sensitive receptors.

#### Improvement of Wellheads

Existing well heads will be improved via the following activities:

- The dug earth holes around the wellheads will be replaced by new cemented cellars in which leakage of oil to soil would be reduced;
- Tie backs to surface to provide additional pressure integrity;
- Checking tubing/casing strings for leaks and cementing as required to isolate oil leakage from the existing well;
- Fixing wellhead leaks; and
- General housekeeping around the well heads.

It is expected that the above activities would be beneficial to the environment by reducing the potential of leakage as well as improving the general environment around the wellheads.



**Table 7.2**      ***Expected Waste Inventory for Workover Activities***

<b>Waste Type</b>	<b>Source</b>	<b>Amount</b>
Food Waste	Camp	20 L / day
Paper Waste (dry waste)	Camp	120 Kg / week
General Waste ( leave , grass)	Workshop & GOCSs	150 Kg / week
Used Lubricating Oil	Vehicle	1 bbl / month
Rags	Petroleum equipment cleaning	1 bbl / for one processing
Oil and Grease Contaminated Waste	GOCS	1 bbl / month
Oily Waste water	Drainage from locations of steaming & cleaning of petroleum equipment	3 bbl / one processing.
Black Water	Camp (toilet)	n.a.
Grey Water	Camp (kitchen, toilet)	n.a.
Workover Fluids which may contain weighted brines, acids, methanol and glycols, and other chemical systems.	Workover wells	n.a.
Drilling Mud ( 3.5 % KCl )	Well deepening	300 bbl / every well deepening
Sludge (formation sand/clay)	GOCS	10 m <sup>3</sup> / month

## 7.2      ***PROJECT ENVIRONMENTAL AND SOCIAL POLICY AND INSTITUTIONAL ARRANGEMENT***

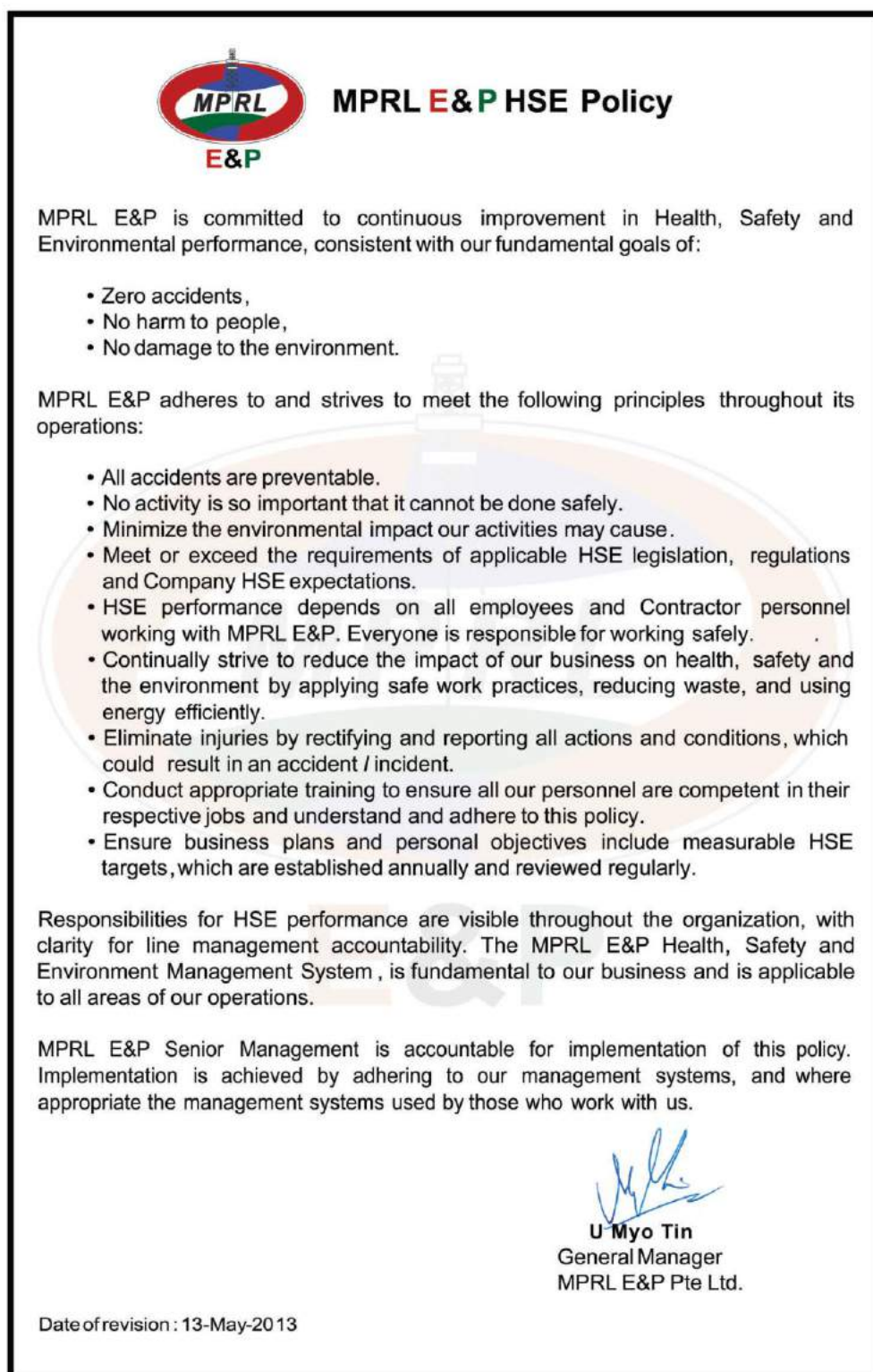
This section sets out the environmental and social policies which are relevant to the Project as well as the institutional arrangement.

### 7.2.1      ***Corporate Environmental and Social Policy***

MPRL E&P has adopted a comprehensive HSE Management System. This system is an important and integral part of the company's overall management system and is shown in *Figure 7.7* below. The Project will be required to follow the fundamental goals of::

- Zero accidents;
- No harm to people; and
- No damage to environment.

Figure 7.7 MPRL E&P's HSE Policy



Apart from the HSE policy, MPRL E&P also has in place a corporate responsibility policy and a human rights policy, as can be seen in the following figures

Figure 7.8 MPRL E&P Corporate Responsibility Policy



**MPRL E&P Pte Ltd.**

#### CORPORATE RESPONSIBILITY POLICY

MPRL E&P's policy is to be a responsible investor in the long term development of the host nation, by conducting business operations to the highest standards.

Our goal is to be honest and conduct business with integrity with the people we work with, which can include but is not limited to, local communities, business partners, and governments, and to maintain respect for cultural, national, and religious diversity.

Company directors, personnel and contractors are responsible for ensuring strict compliance with this policy, and specifically to:

- Respect individuality and diversity of all employees, treating them fairly and without discrimination
- Commit to equal opportunity in all aspects of employment and encouragement in diversity
- Stimulate personal growth of all employees through promotion of creativity and teamwork
- Provide a safe secure, worker friendly environment that promotes career opportunities for self-development
- Ensure compliance with MPRL E&P Environmental, Health & Safety Policy by all personnel involved in our activities
- Provide a clear direction on key CSR initiatives, policies, performance data and targets
- Contribute to the sustainable development of communities through active engagement and dialog
- Support selected development of projects in health, education, cultural and civic activities
- Maintain high ethical standards and support transparency in all of our activities
- Encourage our partners and stakeholders to observe and uphold similar standards wherever possible

**U Mae Myint**  
Chief Executive Officer

Figure 7.9 MPRL E&P Human Rights Policy



**MPRL E&P Pte Ltd.**

### HUMAN RIGHTS Policy Statement

MPRL E&P conducts business operations to the highest standard of ethics respecting and protecting internationally recognized Human Rights during the process. We endeavor to protect and promote Human Rights by coordinating with all stakeholders within our sphere of influence.

Human Rights abuses will not be tolerated nor encouraged in all projects undertaken by the company. This Human Rights Policy Statement is applicable to every operation acknowledging the rights of employees and the rights of local communities.

#### Community Rights:

MPRL E&P strongly encourages employees, contractors, Non Governmental Organization and governmental bodies to address the rights of communities surrounding our operations, through active engagement and dialog:

- Continuous community consultation and needs assessments are conducted to identify the needs of the community and concerns, enabling us to examine ways to proactively address them;
- We recognize and respect the culture and rights of indigenous peoples and endeavor to promote the practice of their traditions and customs; and
- We recognize communities' right to an essential, free, and full development highlighting our commitment to promoting community empowerment and improvement through sustainable development.

#### Employee Rights:

- We provide safe, secure, and worker friendly environment;
- We are an equal opportunities employer;
- We positively stimulate personal growth of our employees through promotion of creativity and teamwork;
- We do not use any forced or compulsory labor;
- We do not discriminate against race, religion, gender, age, sexual orientation, religion, nationality or ethnicity; and
- All employees have the right to join trade unions, where such rights are recognized by law.

**U Moe Myint**  
Chief Executive Officer

## 7.2.2 Myanmar Regulatory Requirements

Table 7.3 provides a list of existing laws relevant to environmental and social aspects of the proposed Project.

In addition to the above existing laws, it is understood that the MOECAP is currently formulating various environmental guidelines and standards, in

consultation with financial institution such as the Asian Development Bank (ADB). References to “*Environmental Quality Standards*” in Article 10, Section 6 of the *Environmental Conservation Law* (2012) are prescribed as follow:

“The Ministry may stipulate the following ***environmental quality standards***:

1. Suitable ***surface water quality standards*** in the usage in rivers, streams, canals, springs, marshes, swamps, lakes, reservoirs and other inland water sources of the public;
2. ***Water quality standards*** for coastal and estuarine areas;
3. ***Underground water quality standards***;
4. ***Atmospheric quality standards***;
5. ***Noise and vibration standards***;
6. ***Emissions standards***;
7. ***Effluent standards***;
8. ***Solid wastes standards***; and
9. ***Other environmental quality standards.***”

Based on the contents of above Article, it is expected that MOECAP will announce the environmental quality standards for various sectors upon the time that the EIA Regulation or Ordinance comes into force. The Project may then be required to follow those national standards when they are being announced and enforced.

**Table 7.3** *List of Existing Sectorial Laws in Myanmar related to Environmental and Social issues as of March 2014*

Sector	Relevant Laws in Myanmar
Administrative	The Territorial Sea and Maritime Zones Law, 1977
	The Emergency Provisions Act, 1950
	The Police Act, 1945
	The Poisons Act, 1919
	The Yangon Police Act, 1899
	The Explosives Act, 1887
	The Penal Code, 1861 of Offences Affecting the Public Health, Safety, Convenience, Decency and Morals
	Foreign Investment Law, 2012
	The Child Law (Law No. 9/93).
	Myanmar Maternal and Child Welfare Association Law (No. 21/90).
	Myanmar Investment Commission Notification (1994)
	The Private Industrial Enterprise Law - SLORC Law No. 22/90
Agriculture and Irrigation	The Fertilizer Law, 2002
	The Plant Pest Quarantine Law, 1993
	The Pesticide Law, 1990



Sector	Relevant Laws in Myanmar
	The Embankment Act, 1909
	Underground Water Act, 1930
	Farmland Rules - Notification No 62/2012 (English)
	Vacant, Fallow and Virgin Lands Management Rules - Notification No. 1/2012
	Vacant, Fallow and Virgin Land Management Act - Pyidaungsu Hluttaw Law No. 10/2012
Culture	The Protection and Preservation of Cultural Heritage Region law, 1998
Public Health	The National Food Law, 1997
	The Traditional Drug Law, 1996
	The Prevention and Control of Communicable Disease Law, 1995, revised in 2011.
	The Narcotics Drugs and Psychotropic Substances Law, 1993
	The National Drugs Law, 1992
	The Union of Myanmar Public Health Law, 1972
	Private Health Act, 2007
	The Penal Code of Offences Affecting the Public Health, Safety, Convenience, Decency and Morals (1861)
Occupational Health and Safety	Factory Act, 1951 (safe and healthy workplaces)
	Employment and skill Development Law, 2013
Tourism	The Myanmar Hotel and Tourism Law, 1993
Industrial	Myanmar Special Economic Zone Law No. 2011
	Dawei Special Economic Zone Law, 2011
	Myanmar Special Economic Zones Law (The Pyidaungsu Hluttaw Law No. 1/2014)
	The Private Industrial Enterprise Law, 1990
	The Factories Act, 1951
	The Oilfield (Labour and Welfare) Act, 1951
	Employment Restriction Act (1959)
	Workmen's Compensation Act 1923, amended in 2005
	Shops and Establishment Act, 1951
	Leave and Holidays Act, 1951
	Minimum Wage Act 1949, replaced by a new law in 2013
	Payment of Wages Act 1936
	Social Security Act 1954
	Trade Dispute Act 1929
	Settlement of Labour Dispute Law (2012)
	Employment and Skill Development Law
	Employment Statistics Act (1948)
	Water Power Act ( 1927)
Land Use	Land Acquisition Act, 1894
	The Towns Act, 1907
	The Village Act, 1907

### 7.2.3 Institutional Arrangement

Matters pertaining to environmental and social requirements of the Project are under the jurisdiction of the ministries and state-owned enterprises in the oil and gas sector which include:

- Ministry of Environmental Conservation and Forestry (MECF);
- Ministry of Labour;

- Ministry of Energy (MOE);
- Myanmar Oil and Gas Enterprise (MOGE); and
- Myanmar Investment Commission (MIC).

Under the IPR Contract, MPRL E&P will mainly liaise with MOGE on the environmental and social issues of the Project who may coordinate with the other institutes as appropriate.

### 7.3

#### *SUMMARY OF IMPACTS AND MITIGATION MEASURES*

Through the Project development and the ESIA process, MPRL E&P has made commitments to actions to ensure or improve environmental and social performance. These commitments are not recommendations, but are binding commitments on the part of the Project.

A summary of the Project impacts and the committed mitigation measures are presented in *Table 7.4* below. Schedule and responsibility of implementation of these mitigation measures are identified as necessary. Additional details on the key elements for the overall environmental and social management of the Project are also presented below.

Table 7.4 Summary of the Key Impacts and Control/Mitigation Measures

Potential Impact/Issue	Control /Mitigation Measures	Significance of Residual Impacts	Monitoring	Timing/Frequency	Responsible Party	Related Plans
<b>Environmental Impacts</b>						
<b>Preparation and Mobilization</b>						
Impacts from Construction of Workforce Camp on Terrestrial Habitats and associated Fauna and Flora	<ul style="list-style-type: none"> <li>Footprint of the proposed camp will be minimised during the design stage.</li> </ul>	Minor	Compliance Audit	Design Phase	MPRL E&P Project Team	N/A
	<ul style="list-style-type: none"> <li>Construction activities will be restricted to works areas that will be clearly demarcated.</li> <li>Work site boundaries will be regularly checked to ensure that they are not breached and that damage does not occur to surrounding areas.</li> <li>It is assumed felling of large perennial vegetation (i.e. large trees such as roadside trees) will be avoided.</li> <li>Works areas in temporarily affected areas would be reinstated with tree/shrub planting after completion of the works, as far as practicable.</li> <li>Construction camp is assumed to be temporary and will be removed in the close-out phase.</li> </ul>		Inspection & Compliance Audit	Implementation Phase	MPRL E&P HSE Team	N/A
Impacts from Labour (including Hunting), Equipment and Services Supply on terrestrial and Aquatic Flora and Fauna	<ul style="list-style-type: none"> <li>A Biodiversity Action Plan will be developed by MPRL E&amp;P or a third party administered under the Environmental and Social Management Plan, whereby management and mitigation measures will be provided covering all aspects of biodiversity that may be affected by the Project.</li> </ul>	Negligible	Compliance Audit	Design Phase	MPRL E&P HSE Team	Biodiversity Action Plan
	<ul style="list-style-type: none"> <li>Oil fields are restricted areas and therefore existing access restrictions will be in place and patrolled within the block. Priority areas for patrolling should be identified within the Environmental Monitoring Plan (e.g. secondary forest areas where new access routes are created).</li> <li>Project activities undertaken with sufficient lighting only.</li> <li>Minimisation of night-time driving.</li> <li>HSE coordinators will be employed for the duration of the seismic survey. They will be employed by MPRL E&amp;P or a third party and will not be employed directly by the seismic contractor. It will be their job to supervise all activities in relation to biodiversity and to make sure that all mitigation measures are employed during each phase of the seismic survey. Contractor's HSE Manager will assist the HSE coordinators in supervising the implementation of mitigation measures.</li> <li>Work areas will be clearly demarcated and any activities outside these areas will be prohibited except under a permit system where necessary and for entry and exit this will occur along designated access routes.</li> <li>Induction training for personnel is recommended to include a mandatory segment on biodiversity. In this induction details of key requirements will be provided to include ban on fishing and hunting.</li> <li>Prohibit workers from uncontrolled interaction and commerce with the local community in terms of buying and selling goods particularly Non-Timber Forest Products (NTFP), bushmeat and wildlife (pets, souvenirs).</li> <li>Prohibit staff from introducing pets, livestock and other animals.</li> </ul>		Inspection & Compliance Audit	Implementation Phase	MPRL E&P HSE Team	Biodiversity Action Plan and Environmental Monitoring Plan
	<ul style="list-style-type: none"> <li>Engagement with local community to convey the message that workers are not allowed buying Non-Timber Forest Products (NTFP), bushmeat and wildlife (pets, souvenirs).</li> <li>Work with local authorities and communities through the stakeholder engagement plan to monitor and control hunting and poaching arising from new access in the Project Area.</li> <li>A monitoring programme will be established to ensure mitigation measures are being implemented effectively.</li> </ul>				MPRL E&P CSR Team	Biodiversity Action Plan and Environmental Monitoring Plan
Impacts from Site Preparation / Clearance and Creation of Access Routes on Terrestrial Habitats and Associated Flora and Fauna	<ul style="list-style-type: none"> <li>Minimize footprint of access roads at the design stage (width of any new road should be less than 5 m).</li> <li>A Biodiversity Action Plan will be developed by MPRL E&amp;P or a third party to be administered under the Environmental and Social Management Plan, whereby management and mitigation measures will be provided covering all aspects of biodiversity that may be affected by the Project.</li> </ul>	Minor	Compliance Audit	Design Phase	MPRL E&P HSE / Communications / CSR Teams	Biodiversity Action Plan

Potential Impact/Issue	Control / Mitigation Measures	Significance of Residual Impacts	Monitoring	Timing/Frequency	Responsible Party	Related Plans
	<ul style="list-style-type: none"> <li>Teams for deployment of source lines will access areas on foot, as far as practicable and follow/ clear a narrow path.</li> <li>On the basis that vegetation clearance for tracks to allow access will be by hand, it is assumed felling of large perennial vegetation (i.e. large trees) will be avoided.</li> <li>As part of training under the Biodiversity Action Plan, induction training for personnel is recommended to include a mandatory segment on biodiversity. In this induction details of key requirements will be provided to include: <ul style="list-style-type: none"> <li>Outline vegetation clearance procedures including species not to cut, and the minimum size of tree that should be felled (20 cm diameter at breast height (dbh) (i.e. diameter of the tree trunk measured at 1.3 m above ground).</li> <li>What to do in the advent of disturbing species (eg snakes) (both from an occupational safety and biodiversity perspective)</li> </ul> </li> <li>HSE Coordinator will provide training to the field teams on identifying vegetation that should be retained or is ok to remove during cutting of seismic survey lines.</li> <li>In forest areas, line of sight for access routes/ seismic lines will be minimised by creating 'dog legs' or angled access points/ meandering lines. 'Dog legs' / angled access points will be used for access/egress points into forest areas or vegetation will be left intact for 20m into the forest at access points to mask the presence of transect lines. Induction training will be provided to relevant contractors on the minimisation of line of sight of access routes / seismic lines.</li> <li>Minimise clearing of vegetation along seismic lines ie leave in place smaller vegetation, topsoil, root stock, seeds.</li> <li>Minimise clearing of vegetation along seismic lines by selecting the 'path of least resistance' through vegetation.</li> <li>Minimise vegetation cutting at shot hole and receiver station, as far as practicable.</li> <li>The width of seismic lines will be no greater than 1.5 m and limited even narrower to 1 m where possible in the forest area.</li> <li>A monitoring programme will be established to ensure mitigation measures are being implemented effectively.</li> </ul>		Inspection & Compliance Audit	Implementation Phase	MPRL E&P HSE and CSR Teams	Biodiversity Action Plan and Environmental Monitoring Plan
Impacts from Mobile Power Generation on Terrestrial Fauna	<ul style="list-style-type: none"> <li>Specifications of power generator.</li> <li>Project activities undertaken within sufficient lighting only.</li> </ul>	Minor	Inspection & Compliance Audit	Implementation Phase	MPRL E&P HSE Team	N/A
Impacts from Waste Disposal on Surface Water Quality, Ground Water Quality, Soil, Terrestrial Habitats and Aquatic Habitats as well as their Associated Flora and Fauna	<ul style="list-style-type: none"> <li>Planning material requirements the at design stage to reduce unnecessary generated waste.</li> <li>MPRL E&amp;P HSE Management System requires Waste Management Plan for the project. A Waste Management Plan will be developed by MPRL E&amp;P or a third party separately from but administered under the Environmental and Social Management Plan. The plan will identify and estimate generated volumes of different waste types and set out procedures for responsible management and disposal and will be regularly audited.</li> </ul>	Negligible	Compliance Audit	Design Phase	MPRL E&P HSE Team	Waste Management Plan
	<ul style="list-style-type: none"> <li>Induction training for personnel (including contracted local workers) is recommended to include: <ul style="list-style-type: none"> <li>Waste management system</li> </ul> </li> </ul>	Negligible	Inspection & Compliance Audit	Implementation Phase	MPRL E&P HSE Team	Waste Management Plan
Impacts from Sewage and Wastewater Discharge on Surface Water Quality, Ground Water Quality, Soil, Terrestrial Habitats and Aquatic Habitats as well as their Associated Flora and Fauna	<ul style="list-style-type: none"> <li>Wastewater treatment facilities will be properly designed and installed</li> <li>Provision of service tank for sewage from toilet facilities</li> <li>Provision of water pit for greywater from kitchen</li> <li>Service tank and water pit are separated from drainage and stormwater.</li> <li>Properly designed and installed</li> <li>Wastewater treatment facilities will be well maintained to allow effective operation.</li> </ul>	Minor	Inspection & Compliance Audit	Design and Implementation Phase	MPRL E&P HSE Team	Waste Management Plan

Potential Impact/Issue	Control / Mitigation Measures	Significance of Residual Impacts	Monitoring	Timing/Frequency	Responsible Party	Related Plans
<b>Seismic Survey</b>						
Impacts from Labour (including Hunting), Equipment and Services Supply on Terrestrial and Aquatic Flora and Fauna	<ul style="list-style-type: none"> <li>A Biodiversity Action Plan will be developed by MPRL E&amp;P or a third party administered under the Environmental and Social Management Plan, whereby management and mitigation measures will be provided covering all aspects of biodiversity that may be affected by the Project.</li> </ul>	Negligible	Compliance Audit	Design Phase	MPRL E&P HSE Team	Biodiversity Action Plan
	<ul style="list-style-type: none"> <li>Oil fields are restricted areas and therefore existing access restrictions will be in place and patrolled within the block. Priority areas for patrolling should be identified within the Environmental Monitoring Plan (e.g. secondary forest areas where new access routes are created).</li> <li>Project activities in day light working hours</li> <li>Minimisation of night-time driving.</li> <li>HSE coordinators will be employed for the duration of the seismic survey. They will be employed by MPRL E&amp;P or a third party and will not be employed directly by the seismic contractor. It will be their job to supervise all activities in relation to biodiversity and to make sure that all mitigation measures are employed during each phase of the seismic survey. Contractor's HSE Manager will assist the HSE coordinators in supervising the implementation of mitigation measures.</li> <li>Work areas will be clearly demarcated and any activities outside these areas will be prohibited except under a permit system where necessary and for entry and exit this will occur along designated access routes.</li> <li>Induction training for personnel is recommended to include a mandatory segment on biodiversity. In this induction details of key requirements will be provided to include ban on fishing and hunting.</li> <li>Prohibit workers from uncontrolled interaction and commerce with the local community in terms of buying and selling goods particularly Non-Timber Forest Products (NTFP), bushmeat and wildlife (pets, souvenirs).</li> <li>Prohibit staff from introducing pets, livestock and other animals.</li> </ul>		Inspection & Compliance Audit	Implementation Phase	MPRL E&P HSE Team	Biodiversity Action Plan and Environmental Monitoring Plan
	<ul style="list-style-type: none"> <li>Engagement with local community to convey the message that workers are not allowed buying Non-Timber Forest Products (NTFP), bushmeat and wildlife (pets, souvenirs).</li> <li>Work with local authorities and communities through the stakeholder engagement plan to monitor and control hunting and poaching arising from new access in the Project Area.</li> <li>A monitoring programme will be established to ensure mitigation measures are being implemented effectively.</li> </ul>				MPRL E&P CSR Team	
Impacts from Site Preparation / Clearance and Creation of Access Routes on Terrestrial Habitats and Associated Flora and Fauna	<ul style="list-style-type: none"> <li>Minimize footprint of access roads at the design stage (width of any new road should be less than 5 m).</li> <li>A Biodiversity Action Plan will be developed by MPRL E&amp;P or a third party to be administered under the Environmental and Social Management Plan, whereby management and mitigation measures will be provided covering all aspects of biodiversity that may be affected by the Project.</li> </ul>	Minor	Compliance Audit	Design Phase	MPRL E&P HSE / Communications / CSR Teams	Biodiversity Action Plan



Potential Impact/Issue	Control / Mitigation Measures	Significance of Residual Impacts	Monitoring	Timing/Frequency	Responsible Party	Related Plans
	<ul style="list-style-type: none"> <li>Teams for deployment of source lines will access areas on foot, as far as practicable and follow/ clear a narrow path.</li> <li>On the basis that vegetation clearance for tracks to allow access will be by hand, it is assumed felling of large perennial vegetation (i.e. large trees) will be avoided.</li> <li>As part of training under the Biodiversity Action Plan, induction training for personnel is recommended to include a mandatory segment on biodiversity. In this induction details of key requirements will be provided to include: <ul style="list-style-type: none"> <li>Outline vegetation clearance procedures including species not to cut, and the minimum size of tree that should be felled (20 cm diameter at breast height (dbh) (i.e. diameter of the tree trunk measured at 1.3 m above ground).</li> <li>What to do in the advent of disturbing species (eg snakes) (both from an occupational safety and biodiversity perspective)</li> </ul> </li> <li>HSE Coordinator will provide training to the field teams on identifying vegetation that should be retained or is ok to remove during cutting of seismic survey lines.</li> <li>In forest areas, line of sight for access routes/ seismic lines will be minimised by creating 'dog legs' or angled access points/ meandering lines. 'Dog legs' / angled access points will be used for access/egress points into forest areas or vegetation will be left intact for 20m into the forest at access points to mask the presence of transect lines. Induction training will be provided to relevant contractors on the minimisation of line of sight of access routes / seismic lines.</li> <li>Minimise clearing of vegetation along seismic lines ie leave in place smaller vegetation, topsoil, root stock, seeds.</li> <li>Minimise clearing of vegetation along seismic lines by selecting the 'path of least resistance' through vegetation.</li> <li>Minimise vegetation cutting at shot hole and receiver station, as far as practicable.</li> <li>The width of seismic lines will be no greater than 1.5 m and limited even narrower to 1 m where possible in the forest area.</li> <li>Use wireless geophones on receiver lines, as far as practicable</li> <li>A monitoring programme will be established to ensure mitigation measures are being implemented effectively.</li> </ul>		Inspection & Compliance Audit	Implementation Phase	MPRL E&P HSE Team	Biodiversity Action Plan and Environmental Monitoring Plan
Impacts from Mobile Power Generation on Terrestrial Fauna	<ul style="list-style-type: none"> <li>Specifications of power generator</li> <li>Project activities limited to day light hours</li> </ul>	Minor	Inspection & Compliance Audit	Implementation Phase	MPRL E&P HSE Team	N/A
Impacts from Drilling on Terrestrial Fauna	<ul style="list-style-type: none"> <li>Drilling of shot holes by portable drills</li> <li>Vegetation cutting by hand to minimise disturbance and degradation of the habitats</li> <li>It is assumed felling of large perennial vegetation (i.e. large trees which typically provide habitat for higher densities of terrestrial fauna) will be avoided.</li> <li>Shot holes will be backfilled after shooting is completed.</li> <li>HSE coordinator will provide training to relevant contractors to check the immediate vicinity of shothole locations for presence of Yellow-headed Tortoise (Endangered) and, if found how to relocate it to a safe distance away from the drilling activity.</li> </ul>	Minor	Inspection & Compliance Audit	Implementation Phase	MPRL E&P HSE Team	N/A
Impacts from Detonation of Explosive on Terrestrial Fauna	<ul style="list-style-type: none"> <li>Minimise the use of charges as far as practicable.</li> <li>Shotholes will be backfilled.</li> <li>Charges detonated at ~10m below ground level or as deep underground as practicable.</li> <li>Daytime shooting only.</li> </ul>	Minor	Inspection & Compliance Audit	Implementation Phase	MPRL E&P HSE Team	N/A
Positive Impacts from Reinstatement on Terrestrial Habitats and Aquatic Habitats as well as their Associated Flora and Fauna	<ul style="list-style-type: none"> <li>It is recommended a Terrestrial Habitat Reinstatement Plan will be developed in light of detailed plans for locations for seismic survey including temporarily cleared areas. The plan will identify provisions for sourcing native species from nursery and procedures for replanting. It will also identify priority areas for rehabilitation including at for instance de-facto protected areas such as near monastery and near cultural heritage location if trees or vegetation are planned to be cleared from these locations. Rehabilitation of vegetation on seismic lines will also be provided.</li> </ul>	Neutral or Positive	Compliance Audit	Design Phase	MPRL E&P HSE Team	Terrestrial Habitat Reinstatement Plan

Potential Impact/Issue	Control / Mitigation Measures	Significance of Residual Impacts	Monitoring	Timing/Frequency	Responsible Party	Related Plans
	<ul style="list-style-type: none"> <li>MPRL E&amp;P commitment to appropriate reinstatement works for seismic survey</li> <li>MPRL E&amp;P to compensate farmers to reinstate land in cultivated areas</li> <li>Materials introduced by the seismic survey will be removed at the disturbed areas.</li> <li>Disturbed areas will be monitored before Project commencement and for one year after completion of Project to track any natural recolonisation by vegetation after the Project completion. If natural recolonisation does not taken place or is not ideal (i.e. significantly different from the original condition as determined by monitoring), the disturbed areas will be restored/rehabilitated as much as is practicable to its original condition; this includes replanting areas where vegetation has been cleared including seismic line access routes, etc, using native vegetation.</li> </ul>		Inspection & Compliance Audit	Implementation Phase	MPRL E&P HSE Team	Terrestrial Habitat Reinstatement Plan
Impacts from Waste Disposal on Surface Water Quality, Ground Water Quality, Soil, Terrestrial Habitats and Aquatic Habitats as well as their Associated Flora and Fauna	<ul style="list-style-type: none"> <li>Planning material requirements the at design stage to reduce unnecessary generated waste.</li> <li>MPRL E&amp;P HSE Management System requires Waste Management Plan for the project. A Waste Management Plan will be developed by MPRL E&amp;P or a third party separately from but administered under the Environmental and Social Management Plan. The plan will identify and estimate generated volumes of different waste types and set out procedures for responsible management and disposal and will be regularly audited.</li> </ul>	Negligible	Compliance Audit	Design Phase	MPRL E&P HSE Team	Waste Management Plan
	<ul style="list-style-type: none"> <li>Induction training for personnel (including contracted local workers) is recommended to include: <ul style="list-style-type: none"> <li>Waste management system</li> <li>Available provided sanitary facilities</li> </ul> </li> <li>Seismic team will collect gab wires to dispose or to re-use</li> <li>Seismic team will check the shot hole and collect remaining residues, as far as practicable, to minimise waste in the area.</li> </ul>	Negligible	Inspection & Compliance Audit	Implementation Phase	MPRL E&P HSE Team	Waste Management Plan
Impacts from Sewage and Wastewater Discharge on Surface Water Quality, Ground Water Quality, Soil, Terrestrial Habitats and Aquatic Habitats as well as their Associated Flora and Fauna	<ul style="list-style-type: none"> <li>Wastewater treatment facilities will be properly designed and installed</li> <li>Provision of service tank for sewage from toilet facilities</li> <li>Provision of water pit for greywater from kitchen</li> <li>Service tank and water pit are separated from drainage and stormwater.</li> <li>Properly designed and installed</li> <li>Wastewater treatment facilities will be well maintained to allow effective operation.</li> <li>Fluids to shot hole will be limited to use of small quantities of water</li> <li>It is recommended that portable toilet facilities be provided with collection of resultant sanitary waste to be carried out by an approved contractor for proper disposal.</li> </ul>	Minor	Inspection & Compliance Audit	Design and Implementation Phase	MPRL E&P HSE Team	Waste Management Plan
<b>Close Out Phase</b>						
Impacts from Labour (including Hunting), Equipment and Services Supply on terrestrial and Aquatic Flora and Fauna	<ul style="list-style-type: none"> <li>A Biodiversity Action Plan will be developed by MPRL E&amp;P or a third party administered under the Environmental and Social Management Plan, whereby management and mitigation measures will be provided covering all aspects of biodiversity that may be affected by the Project.</li> </ul>	Negligible	Compliance Audit	Design Phase	MPRL E&P HSE Team	Biodiversity Action Plan

Potential Impact/Issue	Control / Mitigation Measures	Significance of Residual Impacts	Monitoring	Timing/Frequency	Responsible Party	Related Plans
	<ul style="list-style-type: none"> <li>Oil fields are restricted areas and therefore existing access restrictions will be in place and patrolled within the block. Priority areas for patrolling should be identified within the Environmental Monitoring Plan (e.g. secondary forest areas where new access routes are created).</li> <li>Project activities in day light working hours</li> <li>Minimisation of night-time driving.</li> <li>HSE coordinators will be employed for the duration of the seismic survey. They will be employed by MPRL E&amp;P or a third party and will not be employed directly by the seismic contractor. It will be their job to supervise all activities in relation to biodiversity and to make sure that all mitigation measures are employed during each phase of the seismic survey. Contractor's HSE Manager will assist the HSE coordinators in supervising the implementation of mitigation measures.</li> <li>Work areas will be clearly demarcated and any activities outside these areas will be prohibited except under a permit system where necessary and for entry and exit this will occur along designated access routes.</li> <li>Induction training for personnel is recommended to include a mandatory segment on biodiversity. In this induction details of key requirements will be provided to include ban on fishing and hunting.</li> <li>Prohibit workers from uncontrolled interaction and commerce with the local community in terms of buying and selling goods particularly Non-Timber Forest Products (NTFP), bushmeat and wildlife (pets, souvenirs).</li> <li>Prohibit staff from introducing pets, livestock and other animals.</li> </ul>		Inspection & Compliance Audit	Implementation Phase	MPRL E&P HSE Team	Biodiversity Action Plan and Environmental Monitoring Plan
	<ul style="list-style-type: none"> <li>Engagement with local community to convey the message that workers are not allowed buying Non-Timber Forest Products (NTFP), bushmeat and wildlife (pets, souvenirs).</li> <li>Work with local authorities and communities through the stakeholder engagement plan to monitor and control hunting and poaching arising from new access in the Project Area.</li> <li>A monitoring programme will be established to ensure mitigation measures are being implemented effectively.</li> </ul>				MPRL E&P CSR Team	
Impacts from Waste Disposal on Surface Water Quality, Ground Water Quality, Soil, Terrestrial Habitats and Aquatic Habitats as well as their Associated Flora and Fauna	<ul style="list-style-type: none"> <li>Planning material requirements the at design stage to reduce unnecessary generated waste.</li> <li>MPRL E&amp;P HSE Management System requires Waste Management Plan for the project. A Waste Management Plan will be developed by MPRL E&amp;P or a third party separately from but administered under the Environmental and Social Management Plan. The plan will identify and estimate generated volumes of different waste types and set out procedures for responsible management and disposal and will be regularly audited.</li> </ul>	Negligible	Compliance Audit	Design Phase	MPRL E&P HSE Team	Waste Management Plan
	<ul style="list-style-type: none"> <li>Induction training for personnel (including contracted local workers) is recommended to include: <ul style="list-style-type: none"> <li>Waste management system</li> </ul> </li> </ul>	Negligible	Inspection & Compliance Audit	Implementation Phase	MPRL E&P HSE Team	Waste Management Plan
Impacts from Sewage and Wastewater Discharge on Surface Water Quality, Ground Water Quality, Soil, Terrestrial Habitats and Aquatic Habitats as well as their Associated Flora and Fauna	<ul style="list-style-type: none"> <li>Wastewater treatment facilities will be properly designed and installed</li> <li>Provision of service tank for sewage from toilet facilities</li> <li>Provision of water pit for greywater from kitchen</li> <li>Service tank and water pit are separated from drainage and stormwater.</li> <li>Properly designed and installed</li> <li>Wastewater treatment facilities will be well maintained to allow effective operation.</li> </ul>	Minor	Inspection & Compliance Audit	Design and Implementation Phase	MPRL E&P HSE Team	Waste Management Plan
<b>Seismic Survey - Accidental Events</b>						

Potential Impact/Issue	Control / Mitigation Measures	Significance of Residual Impacts	Monitoring	Timing/Frequency	Responsible Party	Related Plans
Impacts from spills/leaks on surface water quality, ground water quality, soil, terrestrial habitats and aquatic habitats as well as their associated flora and fauna	<ul style="list-style-type: none"><li>● Drilling fluid for shot hole drilling will be water.</li><li>● Hazardous materials / chemicals will be stored at MOGE warehouse facility. Storage facilities at MOGE warehouse incorporate features for appropriate storage of fuels and hazardous materials.</li><li>● Fuel and chemical storage areas will have appropriate secondary containment (drip trays for small storage locations/impervious base and bund walls for tanks) and provide procedures for managing the containment systems. All ancillary equipment (e.g. valves, hoses) should be contained securely within the bund when not in use.</li><li>● Oil interceptors will be provided in the drainage system where necessary and regularly emptied to prevent the release of oil and grease into the storm water drainage system after accidental spillages.</li><li>● Storage tanks and components will meet international design standards as far as practicable. For example, storage tanks will be equipped with devices that prevent spills and overfills, including overfill alarms, automatic shut-off devices and catch basins around fill pipes.</li><li>● Fuel stores should be kept away from vehicle access routes to prevent collisions.</li><li>● Maintenance of storage tanks, pipes and components (seals, connectors and valves) will be carried out regularly, including daily inspection of fuelling equipment in satisfactory condition.</li><li>● All construction plants and machinery (e.g., trucks) will be maintained in good working order to avoid leakage or spillage of contaminants.</li><li>● Routine servicing of plant and equipment will be carried out off-site prior to mobilisation or within workshop facilities equipped with bunded areas and oil interceptor.</li><li>● Spill kits and shovels will be available onsite at all times for any accidental leakage of fuel or other hazardous substances during Project activities; it must be ensured that no such substance enters into groundwater or surface water resources.</li><li>● If emergency servicing of equipment is required in the field, spill kits and drip trays will be available.</li><li>● Any contaminated soil will be removed from site and disposed of in accordance with the waste management plan.</li><li>● Oils and other service fluids will be removed off-site by the Seismic Team and disposed in accordance with the waste management plan.</li><li>● The location, type and quantity of any fuel or chemical spill will be reported to HSE coordinator immediately.</li><li>● Shot holes will not be located within 50 m of a watercourse or water body.</li></ul>		Inspection & Compliance Audit	Implementation Phase	MPRL E&P HSE Team	Emergency Preparedness Plan
Impacts from Fires and Explosions on Air Quality, Ground Water Quality, Surface Water Quality, Landscape and Visual Character, Use of Natural Resources, Terrestrial Habitats and Aquatic Habitats as well as their Associated Flora and Fauna.	<ul style="list-style-type: none"><li>● As administered under the Emergency Preparedness Plan, a Fire Risk Management Plan will be developed including communications protocols and measures to control any fires that do arise and as well as identify where fire control measures should be located.</li></ul>	Minor	Compliance Audit	Design Phase	MPRL E&P HSE and Communications Teams	Emergency Preparedness Plan and Fire Risk Management Plan
	<ul style="list-style-type: none"><li>● Induction training for personnel is recommended to include a mandatory segment on fire safety and actions in the event of a fire.</li><li>● All seismic teams will carry first-attack fire-fighting equipment such as fire extinguisher, shovel and communications equipment to respond to small spot fires and communicate with the operations headquarters in the event of a fire.</li><li>● HSE induction will be undertaken at the site before work commencement which should include proper use of fire-fighting equipment and communication protocol in case of fire.</li><li>● It will be of key importance that explosives are kept in a safe manner and no uncontrolled explosions occur. Implement all required safety and management requirements relating to the transportation, storage and handling of explosives</li><li>● Misfired charges from shot holes will be disabled and destroyed.</li><li>● Restrict smoking to designated areas only.</li><li>● Conduct fire training and response drills.</li></ul>		Inspection & Compliance Audit	Implementation Phase	MPRL E&P HSE and Communications Teams	
Workover Activities – Planned Events						

Potential Impact/Issue	Control / Mitigation Measures	Significance of Residual Impacts	Monitoring	Timing/Frequency	Responsible Party	Related Plans
Impacts from Operation of Mechanical Equipment Required for Workover Activities on Ambient Air and Noise Conditions	<ul style="list-style-type: none"><li>Activities carried out at existing well sites in existing oil field with separation from sensitive receptors.</li><li>Project activities undertaken with sufficient lighting only.</li><li>Well maintained equipment will be used</li><li>Noise suppression box will be fabricated over the engine for the PMEs being operated nearby the NSRs (e.g. villages).</li><li>Appropriate PPE e.g. ear protection will be used for MPRL E&amp;P personnel.</li><li>Workers not involved with the works will need to be at least 100 m away from the well head if practicable.</li><li>Well-maintained equipment to be operated on-site.</li><li>Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components.</li><li>Shut down or throttled down between work periods for machines and construction plant items (eg trucks) that may be in intermittent use.</li><li>Shut down generators, compressors, and other equipment when not in use.</li><li>Reduce the number of equipment operating simultaneously as far as practicable.</li><li>Orientate equipment known to emit noise strongly in one direction so that the noise is directed away from receptors as far as practicable.</li><li>Implement control measures, eg noise barrier at site hoarding, movable barrier or barrier that installed on the equipment, whenever applicable. The type of control measure that can be applied will be determined based on site conditions and constraints.</li></ul>	Negligible for Noise and Minor for Air	Inspection & Compliance Audit	Implementation Phase	MPRL E&P HSE Team	N/A
Impacts from Disposal of Waste from Workover Activities on Surface Water Quality, Ground Water Quality, Soil, Terrestrial Habitats and Aquatic Habitats as well as their Associated Flora and Fauna	<ul style="list-style-type: none"><li>A Waste Management Plan will be developed by MPRL E&amp;P or a third party to be administered under the Environmental and Social Management Plan. The plan will identify and estimate generated volumes of different waste types and set out procedures for responsible management and disposal and will be regularly audited.</li><li>Careful selection of the fluid system to minimize environmental hazards related to chemical additives</li><li>Careful selection of fluid additives taking into account technical requirements, chemical additive concentration, toxicity, bioavailability and bioaccumulation potential.</li></ul>	Minor	Compliance Audit	Design Phase	MPRL E&P HSE Team	Waste Management Plan
	<ul style="list-style-type: none"><li>Drill muds used will be WBM and KCl polymer mud and will be recycled and treated for future use.</li><li>Monitoring and minimizing the concentration of heavy metal impurities (mainly mercury and cadmium) in barite stock used in the fluid formulation, if used.</li></ul>		Inspection & Compliance Audit	Implementation Phase	MPRL E&P HSE Team	Waste Management Plan
Workover Activities - Accidental Events						
Impacts from Spills/Leaks on Surface Water Quality, Ground Water Quality, Soil, Terrestrial Habitats and Aquatic Habitats as well as their Associated Flora and Fauna	<ul style="list-style-type: none"><li>Develop an Emergency Preparedness and Spill Response Plan to document communication procedures and actions to take in the event of uncontrolled well fluid release.</li><li>Carefully plan drilling operation by identifying shallow hazards, using standard materials for well construction/modification, using standard drilling and well control standard operating procedures, and using proper drilling mud formulation with additives if necessary (well kill fluids, loss control and weighting agents).</li><li>Develop water treatment and injection facilities if practicable.</li></ul>	Minor	Inspection & Compliance Audit	Design Phase	MPRL E&P HSE Team	Emergency Preparedness Plan and Spill Response Plan



Potential Impact/Issue	Control / Mitigation Measures	Significance of Residual Impacts	Monitoring	Timing/Frequency	Responsible Party	Related Plans
	<ul style="list-style-type: none"><li>Competent and well-trained workover crews.</li><li>Well-planned, well-supervised and standard workover/drilling procedures will be used at the wells to maintain well control (eg management of mud weight)</li><li>Implementation of maintenance and inspection procedures.</li><li>Undertake drilling with international best practice safety procedures.</li><li>Test safety devices prior to start-up for function and integrity.</li><li>Continuously monitor pressure in the well and recycled mud during drilling.</li><li>Train employees on emergency procedures.</li><li>Spill kits and shovels at well sites or appropriate locations for any accidental leakage of fuel or other hazardous substances during Project activities; it must be ensured that no such substance enters into groundwater or surface water resources.</li><li>If emergency servicing of equipment is required in the field, spill kits and drip trays will be available.</li><li>Any contaminated soil will be removed from site and disposed of in accordance with the waste management plan.</li><li>The location, type and quantity of any fuel or chemical or mud spill will be reported to HSE coordinator immediately.</li><li>Improve cellars with double cellars for new and reactivated wells.</li><li>Regularly pump out cellars oil and water separators and treatment water for injection.</li></ul>		Inspection & Compliance Audit	Implementation Phase	MPRL E&P HSE Team	Emergency Preparedness Plan and Spill Response Plan
Impacts from Fires and Explosions on Air Quality, Ground Water Quality, Surface Water Quality, Landscape and Visual Character, Use of Natural Resources, Terrestrial Habitats and Aquatic Habitats as well as their Associated Flora and Fauna.	<ul style="list-style-type: none"><li>Assign designated smoking areas;</li><li>Smoking is only allowed away from the well head of more than 100 feet, up wind, with appropriate ash trays to contain any hot ashes.</li><li>As administered under the Emergency Preparedness Plan, a Fire Risk Management Plan will be developed including communications protocols and measures to control any fires that do arise.</li></ul>	Minor	Compliance Audit	Design Phase	MPRL E&P HSE Team	Emergency Preparedness Plan and Fire Risk Management Plan
	<ul style="list-style-type: none"><li>Fire control equipment should be located at the well site or appropriate locations.</li><li>Induction training for personnel is recommended to include a mandatory segment on fire safety and actions in the event of a fire.</li><li>It will be of key importance that explosives used for re-perforation activities are kept in a safe manner and no uncontrolled explosions occur. Implement all required safety and management requirements relating to the transportation, storage and handling of explosives</li><li>Misfired charges from re-perforation activities will be disabled and destroyed.</li><li>Restrict smoking to designated areas only.</li><li>Conduct fire training and response drills.</li></ul>		Inspection & Compliance Audit	Implementation Phase	MPRL E&P HSE Team	
Social Impacts						
Land Accessibility Phase						
Impact regarding Loss of Access to Land	<ul style="list-style-type: none"><li>A Livelihood Restoration Plan (LRP) for the Project should be developed based on the assessment of various livelihood restoration options available and preferred by the community and reflective of the needs of the community. The LRP should also have clear reporting and monitoring indicators and the implementation mechanism including the institutional mechanism for the implementation of the same.</li></ul>	Moderate	Compliance Audit	Design Phase	MPRL E&P CSR Team	Livelihood Restoration Plan
	<ul style="list-style-type: none"><li>Compensation for the crop loss should be provided and livelihood restoration facilities should be provided, however, this has to be done keeping cognisance of the local laws and regulations.</li><li>In case of any new land requirement, the compensation amount and any livelihood restoration options should be identified in consultation with the local community and the local authorities.</li><li>In case of landlessness due to Project, preference should be given for employment in various works depending upon the skill levels. Livelihood restoration options or support could be considered for these families.</li></ul>		Compliance Audit	Design Phase	MPRL E&P CSR Team	Livelihood Restoration Plan
	<ul style="list-style-type: none"><li>Preference to land owners for employment and sub-contractor works.</li></ul>		Employment records	Quarterly	MPRL E&P CSR Team	N/A
	<ul style="list-style-type: none"><li>Preference to land owners in community development and corporate responsibility activities.</li></ul>		Community development activity records	Six Monthly	MPRL E&P CSR Team	N/A

Potential Impact/Issue	Control / Mitigation Measures	Significance of Residual Impacts	Monitoring	Timing/Frequency	Responsible Party	Related Plans
Community and Occupational Health and Safety	<ul style="list-style-type: none"> <li>A Traffic Management Plan will be developed for the Project and will be implemented by the HSE team for the Project.</li> </ul>	Minor	Compliance Audit	Design Phase	MPRL E&P HSE Team	Traffic Management Plan
	<ul style="list-style-type: none"> <li>Adopt proper road safety measures</li> </ul>		Road Safety Policy	Prior to the commencement of the planning and mobilization phase	MPRL E&P HSE Team	N/A
	<ul style="list-style-type: none"> <li>Synchronize traffic movements with the local community needs.</li> </ul>		N/A	Monthly	MPRL E&P HSE Team	Traffic Management Plan
	<ul style="list-style-type: none"> <li>Immediate repair of any damage to existing main roads which are caused by Project activities.</li> </ul>		Visual Inspection/Records of repairs	Monthly	MPRL E&P HSE Team	N/A
	<ul style="list-style-type: none"> <li>Ensure availability of break services of heavy vehicles</li> </ul>		Visual Inspection	Monthly	MPRL E&P HSE Team	N/A
	<ul style="list-style-type: none"> <li>In case of at-fault accidents, pay compensation to the affected family or next of kin in keeping with the applicable rules</li> </ul>		Records of accidents and compensation paid/ grievance records	Monthly	MPRL E&P HSE Team/CSR Team	N/A
	<ul style="list-style-type: none"> <li>Undertake a root cause analysis of any accidents which take place</li> </ul>		Root cause analysis reports	Monthly	MPRL E&P HSE Team	N/A
	<ul style="list-style-type: none"> <li>Develop a policy for safety measures to be undertaken while driving</li> </ul>		Road safety policy	Prior to the commencement of the planning and mobilization phase	MPRL E&P HSE Team	N/A
	<ul style="list-style-type: none"> <li>The Labour camps should be placed at a distance from the village settlements</li> </ul>		Visual inspection	Prior to the commencement of the planning and mobilization phase	MPRL E&P HSE Team	N/A
	<ul style="list-style-type: none"> <li>Undertake pre-employment medical check-ups for all workers</li> </ul>		Medical records	Quarterly	MPRL E&P HSE Team	N/A
	<ul style="list-style-type: none"> <li>Undertake regular health check-ups and health survey of the community.</li> </ul>		Health survey reports	Quarterly	MPRL E&P HSE / CSR Team	N/A
Impact on Livelihood Profile of the Community	<ul style="list-style-type: none"> <li>Preference to the vulnerable groups according to the skill requirements of the project</li> </ul>	Positive	Employment records	Quarterly	MPRL E&P CSR Team	N/A
Impact on Transport and Infrastructure Services	<ul style="list-style-type: none"> <li>Adopt proper road safety measures</li> </ul>	Negligible	Road Safety Policy	Prior to the commencement of the planning and mobilization phase	MPRL E&P HSE Team	N/A
	<ul style="list-style-type: none"> <li>Synchronize traffic movements with the local community needs.</li> </ul>		N/A	Monthly	MPRL E&P HSE Team	Traffic Management Plan
	<ul style="list-style-type: none"> <li>Immediate repair of any damage to existing main roads which are caused by Project activities.</li> </ul>		Visual Inspection/Records of repairs	Monthly	MPRL E&P HSE Team	N/A
	<ul style="list-style-type: none"> <li>Ensure availability of break services of heavy vehicles</li> </ul>		Visual Inspection	Monthly	MPRL E&P HSE Team	N/A
Impacts on Source Water Vulnerability	<ul style="list-style-type: none"> <li>As part of the Project design, the requirements for acceptable water quality standards and waste water discharge standards will be maintained.</li> </ul>	Minor	Compliance Audit	Design Phase	MPRL E&P HSE Team	Waste Management Plan
	<ul style="list-style-type: none"> <li>The local community will be engaged and a water use agreement will be formulated, which would minimize the pressure on the source water and ensure adequate water availability for the community.</li> </ul>		Compliance Audit	Design Phase	MPRL E&P CSR Team	N/A
Impacts on Culture Heritage	<ul style="list-style-type: none"> <li>As part of the Project design, Project facilities / activities will be located away from sensitive cultural heritage resources.</li> <li>A proper protocol or Standard Operating Procedures (SOP) may be developed and people at Project site location trained to act suitably in consonance with the regulatory requirement and beliefs and faith of the community, if any.</li> </ul>	Minor	Compliance Audit	Design Phase	MPRL E&P CSR Team	Culture Heritage SOP
	<ul style="list-style-type: none"> <li>The Project will meet the international best practice for the documentation and protection of the cultural heritage and in case of chance finds.</li> <li>The Project will consider retaining professionals to assist in the identification and protection of cultural heritage;</li> <li>In case the removal of nonreplicable cultural heritage is required, the same will be undertaken in consultation with the affected communities and in keeping with the regulatory requirements for the same;</li> <li>The Project will ensure that the access to cultural heritage by the local community is not disrupted, and if required, alternative access routes will be provided.</li> </ul>		Inspection & Compliance Audit	Implementation Phase	MPRL E&P CSR Team	Culture Heritage SOP

#### Seismic Survey

Potential Impact/Issue	Control / Mitigation Measures	Significance of Residual Impacts	Monitoring	Timing/Frequency	Responsible Party	Related Plans
Community and Occupational Health and Safety	<ul style="list-style-type: none"> <li>A Traffic Management Plan will be developed for the Project and will be implemented by the HSE team for the Project.</li> </ul>	Minor	Compliance Audit	Design Phase	MPRL E&P HSE Team	Traffic Management Plan
	<ul style="list-style-type: none"> <li>Adopt proper road safety measures</li> </ul>		Road Safety Policy	Prior to the commencement of the planning and mobilization phase	MPRL E&P HSE Team	N/A
	<ul style="list-style-type: none"> <li>Synchronize traffic movements with the local community needs.</li> </ul>		N/A	Monthly	MPRL E&P HSE Team	Traffic Management Plan
	<ul style="list-style-type: none"> <li>Immediate repair of any damage to existing main roads which are caused by Project activities.</li> </ul>		Visual Inspection/Records of repairs	Monthly	MPRL E&P HSE Team	N/A
	<ul style="list-style-type: none"> <li>Ensure availability of break services of heavy vehicles</li> </ul>		Visual Inspection	Monthly	MPRL E&P HSE Team	N/A
	<ul style="list-style-type: none"> <li>In case of at-fault accidents, pay compensation to the affected family or next of kin in keeping with the applicable rules</li> </ul>		Records of accidents and compensation paid/ grievance records	Monthly	MPRL E&P HSE Team/CSR Team	N/A
	<ul style="list-style-type: none"> <li>Undertake a root cause analysis of any accidents which take place</li> </ul>		Root cause analysis reports	Monthly	MPRL E&P HSE Team	N/A
	<ul style="list-style-type: none"> <li>Develop a policy for safety measures to be undertaken while driving</li> </ul>		Road safety policy	Prior to the commencement of the planning and mobilization phase	MPRL E&P HSE Team	N/A
	<ul style="list-style-type: none"> <li>The Labour camps should be placed at a distance from the village settlements</li> </ul>		Visual inspection	Prior to the commencement of the planning and mobilization phase	MPRL E&P HSE Team	N/A
	<ul style="list-style-type: none"> <li>Undertake pre-employment medical check-ups for all workers</li> </ul>		Medical records	Quarterly	MPRL E&P HSE Team	N/A
	<ul style="list-style-type: none"> <li>Undertake regular health check-ups and health survey of the community.</li> </ul>		Health survey reports	Quarterly	MPRL E&P HSE / CSR Team	N/A
Impact on Livelihood Profile of the Community	<ul style="list-style-type: none"> <li>Preference to the vulnerable groups according to the skill requirements of the project</li> </ul>	Positive	Employment records	Quarterly	MPRL E&P CSR Team	N/A
Impact on Transport and Infrastructure Services	<ul style="list-style-type: none"> <li>Maintain minimum offset distance from surrounding infrastructure</li> </ul>	Negligible	Visual inspection	Daily	MPRL E&P HSE Team	N/A
	<ul style="list-style-type: none"> <li>Adopt proper road safety measures</li> </ul>		Road Safety Policy	Prior to the commencement of the planning and mobilization phase	MPRL E&P HSE Team	N/A
	<ul style="list-style-type: none"> <li>Synchronize traffic movements with the local community needs.</li> </ul>		N/A	Monthly	MPRL E&P HSE Team	Traffic Management Plan
	<ul style="list-style-type: none"> <li>Immediate repair of any damage to existing main roads which are caused by Project activities.</li> </ul>		Visual Inspection/Records of repairs	Monthly	MPRL E&P HSE Team	N/A
	<ul style="list-style-type: none"> <li>Ensure availability of break services of heavy vehicles</li> </ul>		Visual Inspection	Monthly	MPRL E&P HSE Team	N/A
Impacts on Source Water Vulnerability	<ul style="list-style-type: none"> <li>As part of the Project design, the requirements for acceptable water quality standards and waste water discharge standards will be maintained.</li> </ul>	Minor	Compliance Audit	Design Phase	MPRL E&P HSE Team	Waste Management Plan
	<ul style="list-style-type: none"> <li>The local community will be engaged and a water use agreement will be formulated, which would minimize the pressure on the source water and ensure adequate water availability for the community.</li> </ul>		Compliance Audit	Design Phase	MPRL E&P CSR Team	N/A
Impacts on Culture Heritage	<ul style="list-style-type: none"> <li>As part of the Project design, Project facilities / activities will be located away from sensitive cultural heritage resources.</li> <li>A proper protocol or Standard Operating Procedures (SOP) may be developed and people at Project site location trained to act suitably in consonance with the regulatory requirement and beliefs and faith of the community, if any.</li> </ul>	Minor	Compliance Audit	Design Phase	MPRL E&P CSR Team	Culture Heritage SOP
	<ul style="list-style-type: none"> <li>The Project will meet the international best practice for the documentation and protection of the cultural heritage and in case of chance finds.</li> <li>The Project will consider retaining professionals to assist in the identification and protection of cultural heritage;</li> <li>In case the removal of nonreplicable cultural heritage is required, the same will be undertaken in consultation with the affected communities and in keeping with the regulatory requirements for the same;</li> <li>The Project will ensure that the access to cultural heritage by the local community is not disrupted, and if required, alternative access routes will be provided.</li> </ul>		Inspection & Compliance Audit	Implementation Phase	MPRL E&P CSR Team	Culture Heritage SOP

Potential Impact/Issue	Control / Mitigation Measures	Significance of Residual Impacts	Monitoring	Timing/Frequency	Responsible Party	Related Plans
Close Out Phase						
Community and Occupational Health and Safety	<ul style="list-style-type: none"> <li>A Traffic Management Plan will be developed for the Project and will be implemented by the HSE team for the Project.</li> </ul>	Minor	Compliance Audit	Design Phase	MPRL E&P HSE Team	Traffic Management Plan
	<ul style="list-style-type: none"> <li>Adopt proper road safety measures</li> </ul>		Road Safety Policy	Prior to the commencement of the planning and mobilization phase	MPRL E&P HSE Team	N/A
	<ul style="list-style-type: none"> <li>Synchronize traffic movements with the local community needs.</li> </ul>		N/A	Monthly	MPRL E&P HSE Team	Traffic Management Plan
	<ul style="list-style-type: none"> <li>Immediate repair of any damage to existing main roads which are caused by Project activities.</li> </ul>		Visual Inspection/Records of repairs	Monthly	MPRL E&P HSE Team	N/A
	<ul style="list-style-type: none"> <li>Ensure availability of break services of heavy vehicles</li> </ul>		Visual Inspection	Monthly	MPRL E&P HSE Team	N/A
	<ul style="list-style-type: none"> <li>In case of at-fault accidents, pay compensation to the affected family or next of kin in keeping with the applicable rules</li> </ul>		Records of accidents and compensation paid/ grievance records	Monthly	MPRL E&P HSE Team/CSR Team	N/A
	<ul style="list-style-type: none"> <li>Undertake a root cause analysis of any accidents which take place</li> </ul>		Root cause analysis reports	Monthly	MPRL E&P HSE Team	N/A
	<ul style="list-style-type: none"> <li>Develop a policy for safety measures to be undertaken while driving</li> </ul>		Road safety policy	Prior to the commencement of the planning and mobilization phase	MPRL E&P HSE Team	N/A
	<ul style="list-style-type: none"> <li>The Labour camps should be placed at a distance from the village settlements</li> </ul>		Visual inspection	Prior to the commencement of the planning and mobilization phase	MPRL E&P HSE Team	N/A
	<ul style="list-style-type: none"> <li>Undertake pre-employment medical check-ups for all workers</li> </ul>		Medical records	Quarterly	MPRL E&P HSE Team	N/A
	<ul style="list-style-type: none"> <li>Undertake regular health check-ups and health survey of the community.</li> </ul>		Health survey reports	Quarterly	MPRL E&P HSE / CSR Team	N/A
Impact on Livelihood Profile of the Community	<ul style="list-style-type: none"> <li>preference to the vulnerable groups according to the skill requirements of the project</li> </ul>	Positive	Employment records	Quarterly	MPRL E&P CSR Team	N/A
Impact on Transport and Infrastructure Services	<ul style="list-style-type: none"> <li>Adopt proper road safety measures</li> </ul>	Negligible	Road Safety Policy	Prior to the commencement of the planning and mobilization phase	MPRL E&P HSE Team	N/A
	<ul style="list-style-type: none"> <li>Synchronize traffic movements with the local community needs.</li> </ul>		N/A	Monthly	MPRL E&P HSE Team	Traffic Management Plan
	<ul style="list-style-type: none"> <li>Immediate repair of any damage to existing main roads which are caused by Project activities.</li> </ul>		Visual Inspection/Records of repairs	Monthly	MPRL E&P HSE Team	N/A
	<ul style="list-style-type: none"> <li>Ensure availability of break services of heavy vehicles</li> </ul>		Visual Inspection	Monthly	MPRL E&P HSE Team	N/A
Impacts on Source Water Vulnerability	<ul style="list-style-type: none"> <li>As part of the Project design, the requirements for acceptable water quality standards and waste water discharge standards will be maintained.</li> </ul>	Minor	Compliance Audit	Design Phase	MPRL E&P HSE Team	Waste Management Plan
	<ul style="list-style-type: none"> <li>The local community will be engaged and a water use agreement will be formulated, which would minimize the pressure on the source water and ensure adequate water availability for the community.</li> </ul>		Compliance Audit	Design Phase	MPRL E&P CSR Team	N/A
Impacts on Culture Heritage	<ul style="list-style-type: none"> <li>As part of the Project design, Project facilities / activities will be located away from sensitive cultural heritage resources.</li> <li>A proper protocol or Standard Operating Procedures (SOP) may be developed and people at Project site location trained to act suitably in consonance with the regulatory requirement and beliefs and faith of the community, if any.</li> </ul>	Minor	Compliance Audit	Design Phase	MPRL E&P CSR Team	Culture Heritage SOP
	<ul style="list-style-type: none"> <li>The Project will meet the international best practice for the documentation and protection of the cultural heritage and in case of chance finds.</li> <li>The Project will consider retaining professionals to assist in the identification and protection of cultural heritage;</li> <li>In case the removal of nonreplicable cultural heritage is required, the same will be undertaken in consultation with the affected communities and in keeping with the regulatory requirements for the same;</li> <li>The Project will ensure that the access to cultural heritage by the local community is not disrupted, and if required, alternative access routes will be provided.</li> </ul>		Inspection & Compliance Audit	Implementation Phase	MPRL E&P CSR Team	Culture Heritage SOP

Potential Impact/Issue	Control / Mitigation Measures	Significance of Residual Impacts	Monitoring	Timing/Frequency	Responsible Party	Related Plans
<b>Workover Activities</b>						
Community and Occupational Health and Safety	<ul style="list-style-type: none"> <li>A Traffic Management Plan will be developed for the Project and will be implemented by the HSE team for the Project.</li> </ul>	Minor	Compliance Audit	Design Phase	MPRL E&P HSE Team	Traffic Management Plan
	<ul style="list-style-type: none"> <li>Adopt proper road safety measures</li> </ul>		Road Safety Policy	Prior to the commencement of the planning and mobilization phase	MPRL E&P HSE Team	N/A
	<ul style="list-style-type: none"> <li>Synchronize traffic movements with the local community needs.</li> </ul>		N/A	Monthly	MPRL E&P HSE Team	Traffic Management Plan
	<ul style="list-style-type: none"> <li>Immediate repair of any damage to existing main roads which are caused by Project activities.</li> </ul>		Visual Inspection/Records of repairs	Monthly	MPRL E&P HSE Team	N/A
	<ul style="list-style-type: none"> <li>Ensure availability of break services of heavy vehicles</li> </ul>		Visual Inspection	Monthly	MPRL E&P HSE Team	N/A
	<ul style="list-style-type: none"> <li>In case of at-fault accidents, pay compensation to the affected family or next of kin in keeping with the applicable rules</li> </ul>		Records of accidents and compensation paid/ grievance records	Monthly	MPRL E&P HSE Team/CSR Team	N/A
	<ul style="list-style-type: none"> <li>Undertake a root cause analysis of any accidents which take place</li> </ul>		Root cause analysis reports	Monthly	MPRL E&P HSE Team	N/A
	<ul style="list-style-type: none"> <li>Develop a policy for safety measures to be undertaken while driving</li> </ul>		Road safety policy	Prior to the commencement of the planning and mobilization phase	MPRL E&P HSE Team	N/A
	<ul style="list-style-type: none"> <li>The Labour camps should be placed at a distance from the village settlements</li> </ul>		Visual inspection	Prior to the commencement of the planning and mobilization phase	MPRL E&P HSE Team	N/A
	<ul style="list-style-type: none"> <li>Undertake pre-employment medical check-ups for all workers</li> </ul>		Medical records	Quarterly	MPRL E&P HSE Team	N/A
	<ul style="list-style-type: none"> <li>Undertake regular health check-ups and health survey of the community.</li> </ul>		Health survey reports	Quarterly	MPRL E&P HSE / CSR Team	N/A
Impacts on Source Water Vulnerability	<ul style="list-style-type: none"> <li>As part of the Project design, the requirements for acceptable water quality standards and waste water discharge standards will be maintained.</li> </ul>	Minor	Compliance Audit	Design Phase	MPRL E&P CSR Team	Waste Management Plan
	<ul style="list-style-type: none"> <li>The local community will be engaged and a water use agreement will be formulated, which would minimize the pressure on the source water and ensure adequate water availability for the community.</li> </ul>		Compliance Audit	Design Phase	MPRL E&P CSR Team	N/A
Impacts on Culture Heritage	<ul style="list-style-type: none"> <li>As part of the Project design, Project facilities / activities will be located away from sensitive cultural heritage resources.</li> <li>A proper protocol or Standard Operating Procedures (SOP) may be developed and people at Project site location trained to act suitably in consonance with the regulatory requirement and beliefs and faith of the community, if any.</li> </ul>	Minor	Compliance Audit	Design Phase	MPRL E&P CSR Team	Culture Heritage SOP
	<ul style="list-style-type: none"> <li>The Project will meet the international best practice for the documentation and protection of the cultural heritage and in case of chance finds.</li> <li>The Project will consider retaining professionals to assist in the identification and protection of cultural heritage;</li> <li>In case the removal of nonreplicable cultural heritage is required, the same will be undertaken in consultation with the affected communities and in keeping with the regulatory requirements for the same;</li> <li>The Project will ensure that the access to cultural heritage by the local community is not disrupted, and if required, alternative access routes will be provided.</li> </ul>		Inspection & Compliance Audit	Implementation Phase	MPRL E&P CSR Team	Culture Heritage SOP



### 7.3.1

### *Environmental Management Organisation*

MPRL E&P is committed to providing resources essential to the implementation and control of the ESMP. Resources include the appropriate human resources and specialised skills. The structure for the organisation responsible for environmental and social management and implementation of the ESMP is depicted in *Table 7.5*.

**Table 7.5** *Environmental Management Organisation Roles and Responsibilities*

Position	Responsibility
<b>MPRL E&amp;P</b>	
General Manager	Oversee and coordinate all activities pertaining to the Project; ultimately responsible for environmental and social issues. Ensure delivery by the asset of its environmental, social and operational targets. Ensure effective communication with all stakeholders.
Operations Manager	Technical aspects of the Project including contractor supervision during operations. Responsible for the execution of Emergency Response Plan including Oil Spill Contingency Plan.
Construction Manager	Technical aspects of the Project including subcontractor supervision during Project implementation.
HSE Coordinator	Ensuring that the Project and subcontractors operate in accordance with applicable regulatory environmental and social requirements and plans.  Monitor implementation of environmental and social protection measures, and assist with technical input into oil spill response requirements.
Community Liaison Officer	Liaise with local communities, farmer and government regulators on the project's behalf. Implement environmental and social awareness and education programmes with communities.
<b>Contractor</b>	
Project Manager	Responsible for subcontractor technical performance and compliance.
HSE Manager	Ensure that environment and social regulatory requirements are met and that ESMP requirements are properly implemented.

Supervision of subcontractor activities will be conducted by MPRL E&P General Manager and Operations Manager. This will be accomplished through management controls over strategic project aspects and interaction with subcontractor staff where project activities take place. The MPRL E&P organisation will be staffed at a level to allow for continuous effective supervision of subcontractor activities and work products.

The construction manager and HSE coordinator will be placed locally at the Project site to supervise contractors during construction while the operations manager and HSE coordinator will supervise contractors during operational activities. The organisation includes a Community Liaison Officer (CLO) whose role is crucial to the successful implementation of the ESMP and the continuation of liaison with the local community.

### 7.3.2 *Training and Awareness*

MPRL E&P will identify, plan, monitor, and record training needs for personnel whose work may have a significant adverse impact upon the environment or social conditions. The Project recognises that it is important that employees at each relevant function and level are aware of the Project's environmental and social policy; potential impacts of their activities; and roles and responsibilities in achieving conformance with the policy and procedures.

This will be achieved through a formal training process. Employee training will include awareness and competency with respect to:

- Environmental and social impacts that could potentially arise from their activities;
- Necessity of conforming to the requirements of the ESIA and ESMP, in order to avoid or reduce those impacts; and
- Roles and responsibilities to achieve that conformity, including with regard to change management and emergency response.

The HSE coordinator is responsible for coordinating training, maintaining employee-training records, and ensuring that these are monitored and reviewed on a regular basis. The HSE Manager will also periodically verify that staff are performing competently through discussion and observation.

Employees responsible for performing site inspections will receive training by drawing on external resources as necessary. Training will be coordinated by the HSE coordinator prior to Project's implementation. Upon completion of training and once deemed competent by management, staff will be ready to train other people.

Similarly the Project will require that each of the contractors institute training programmes for its personnel. Each contractor is responsible for site HSE awareness training for personnel working on the job sites. The contractors are also responsible for identification of any additional training requirements to maintain required competency levels.

The contractor training program will be subject to approval by the Project and it will be audited to ensure that:

- Training programs are adequate;
- All personnel requiring training have been trained; and

- Competency is being verified.

### 7.3.3

#### *Inspection*

HSE inspections will be conducted by subcontractors on a daily basis. The results of the inspection and monitoring activities will be reported to MPRL E&P on a weekly basis or more frequently if requested by the HSE coordinator or the Operations Manager.

### 7.3.4

#### *Monitoring*

Monitoring will be conducted to ensure compliance with regulatory requirements as well as to evaluate the effectiveness of operational controls and other measures intended to mitigate potential impacts.

As a minimum, the following monitoring on biological and physical monitoring should be undertaken:

##### *Biological Environment Monitoring for both Seismic Survey and Workover Activities*

Habitat mapping and vegetation surveys

Terrestrial fauna surveys, including avifauna (birds), mammals, herpetofauna (amphibians and reptiles) and butterflies

Aquatic fauna

##### *Physical Environment Monitoring for Workover Activities only*

- Ambient air quality
- Acoustic environment
- Groundwater
- Surface water
- Soil quality

The monitoring methodology should follow that adopted for the ESIA Study.

Monitoring should be undertaken during the following periods of the seismic survey:

- At least two weeks before the preparation / mobilisation phase for baseline data collection;
- Once during the preparation / mobilisation phase for monitoring impacts from this phase;
- Once during the seismic survey phase for monitoring impacts from this phase;

- Once during the close-out phase for monitoring impacts from this phase; and
- Once following the rehabilitation activities after the seismic survey to monitor the success of habitat restoration.

For workover activities, monitoring should be undertaken during the following periods:

- At least two weeks before the commencement of the workover activities;
- Quarterly monitoring during the workover activities period; and
- Once following completion of the workover activities.

In addition to the above, a programme will be developed to monitor for compliance with relevant regulatory standards. This programme will also ensure that subcontractors are meeting contractual obligations with respect to work practices and design specifications (eg Project emission standards). Monitoring will be carried out by the MPRL E&P and/or by an appointed third party.

A detailed Environmental Monitoring Plan should be developed to present the background, objective, methodology and reporting requirements of the monitoring programme.

### 7.3.5 *Compliance Auditing*

Beyond the routine inspection and monitoring activities conducted, compliance audits will be carried out internally by MPRL E&P to ensure compliance with regulatory requirements as well as their own HSE standards and policies. Audits to be conducted will also cover the subcontractor self-reported monitoring and inspection activities. The audit shall be performed by qualified staff and the results shall be communicated to the General Manager and management board.

The audit will include a review of compliance with the requirements of the ESIA and of this ESMP and include, at minimum, the following:

- Completeness of EHS documentation, including planning documents and inspection records;
- Conformance with monitoring requirements;
- Efficacy of activities to address any non-conformance with monitoring requirements; and
- Training activities and record keeping.

There will be a cycle of audits into specific areas of the Project such as waste management, and effectiveness of local content plans and discharge controls. The frequency of audits will be risk based and will vary with the stage of the

project (more frequent during construction and in the early stages of the project) and will depend on the results of previous audits.

#### 7.3.6 *Corrective Action*

Impacts will be identified and associated risks addressed before an incident occurs. Investigating a 'near miss' or actual incident after it occurs can be used to obtain valuable lessons and information that can be used to prevent similar or more serious occurrences in the future.

MPRL E&P will implement a formal non-compliance and corrective action tracking procedure for investigating cause and identifying corrective actions in response to accidents or environmental or social non-compliances. This will ensure coordinated action between MPRL E&P and its subcontractors. The HSE coordinator will be responsible for keeping records of corrective actions and for overseeing the modification of environmental or social protection procedures and/or training programs to avoid repetition of non-conformances and non-compliances.

### 7.4 *MANAGEMENT PLANS*

The goal of this ESMP is to ensure full compliance with the Project's policies and with mitigation, monitoring and other commitments made in the ESIA Report. While this ESMP should also be treated as a high-level, framework document, it is linked to a number of detailed management plans as described below which will be developed to lay out the specifications for compliance with specific environmental and social elements.

#### 7.4.1 *Related Management Plans*

A range of management plans will be developed to provide assurances that the outcomes of the ESIA are able to be implemented. These management plans will detail the management and mitigation measures required to be implemented, the time frame and responsibilities for their implementation, detailed training requirements, inspections/audits to check implementation, and reporting requirements. Where responsibilities will lay with bodies external to MPRL E&P (e.g. Contractors) the invitations to tender and contracts will contain specific clauses that bind contractors and sub-contractors. This will apply to all tiers of contractors, with penalties for non-compliance also set out in the contracts and rigorously enforced by MPRL E&P.

The key management plans are outlined in *Table 7.6* with information on how these relate to the activities and impacts being discussed in the ESIA Report, including reference to who has lead responsibility.



**Table 7.6 ESMP Hierarchy of Key Plans**

Plan Name	Includes	Plan Owner
ESMP	Overarching plan linking to other Management Plan	MPRL E&P
Biodiversity Action Plan	Management and mitigation measures will be described covering all aspects of biodiversity that may be affected by the Project.	MPRL E&P or a third party administered under the Environmental and Social Management Plan
Terrestrial Habitat Reinstatement Plan	The plan will identify provisions for sourcing native species from nursery and procedures for replanting. It will also identify priority areas for rehabilitation including at for instance de-facto protected areas such as near monastery and near cultural heritage location if trees or vegetation are planned to be cleared from these locations. Rehabilitation of vegetation on seismic lines will also be provided.	MPRL E&P or a third party administered under the Environmental and Social Management Plan
Waste Management Plan	Project-related waste handling procedures for hazardous and non-hazardous wastes.	MPRL E&P
Emergency Preparedness Plan	Administration (policy, purpose, distribution, definitions, etc), organization of emergency areas (command centres, medical stations, etc), roles and responsibilities, communication systems, emergency response procedures, emergency resources, training and updating, checklists (role and action list and equipment checklist) and business continuity and contingency.	MPRL E&P
Spill Response Plan	As part of the ERP, describes the spill preventative measures and spill response procedures	MPRL E&P
Fire Risk Management Plan	As part of the ERP, including communications protocols and measures to control any fires that do arise and as well as identify where fire control measures should be located.	MPRL E&P
Traffic Management Plan	Controls over prescribed routes, driver training, vehicle maintenance, speed restrictions, appropriate road safety signage, and vehicle loading and maintenance measures and vetting procedures.	MPRL E&P

Plan Name	Includes	Plan Owner
Environmental Monitoring Plan	Groundwater monitoring, routine effluent and discharge monitoring and air quality monitoring, noise monitoring, terrestrial ecology monitoring etc.	MPRL E&P or a third party administered under the Environmental and Social Management Plan
Culture Heritage Standard Operating Procedures	Standard Operating Procedures (SOP) to act suitably in consonance with the regulatory requirement and beliefs and faith of the community, if any, for culture heritage.	MPRL E&P
Livelihood Restoration Plan	Developed based on the assessment of various livelihood restoration options available and preferred by the community and reflective of the needs of the community. The LRP should also have clear reporting and monitoring indicators and the implementation mechanism including the institutional mechanism for the implementation of the same.	MPRL E&P

#### 7.4.2 *Contractor Environmental Management Plan(s)*

The Project will engage contractors to carry out Project activities. The contractors are responsible for performing all work:

- In compliance with relevant national and international HSE legislation and regulations, and with other requirements to which the project subscribes;
- In conformance with the Project's ESMP; and
- In accordance with contractual technical and quality specifications.

The Project will also provide specifications for environmental and social compliance and performance (through this ESIA and ESMP and the associated plans) and, as a contractual requirement, the contractor will develop and provide to the Project its own specific management plans demonstrating how they intend to comply with the stipulated requirements.

Contractors must also provide documentation detailing their plans for:

- Implementing the measures required in the ESIA and this ESMP;
- Local content;
- Logistics; and
- Community relations.

The contractor management plans must conform to the requirements of the Project's overarching plans. Contractor plans will be reviewed and approved

by MPRL E&P and incorporated into, and form part of, the Project's overall ESMP.

Contractors will be required to self-monitor against their plan and the contractor's compliance with the plan will be routinely monitored by MPRL E&P directly or by third-parties. Contractors will be required to submit regular reports of monitoring activities and the project will review these on a regular basis. An external assurance process will be conducted on an annual basis the results of which will be disclosed at completion of the process.

As a contractual requirement, the subcontractors are required to provide sufficient resources to manage HSE aspects of the work to be performed. This includes providing resources to ensure compliance of next tier subcontractors and a process for emergency stop-work orders in response to monitoring triggers.

## 7.5 *EMERGENCY PREPAREDNESS AND RESPONSE*

MPRL E&P has developed plans and procedures to identify the potential for and response to environmental accidents and health and safety emergency situations and for preventing and mitigating potentially adverse environmental and social impacts that may be associated with them.

Emergency preparedness and response will be reviewed by MPRL E&P on at least an annual basis and after the occurrence of any accidents or emergency situations to ensure that lessons learnt inform continuous improvement. Emergency exercises will be undertaken on a regular basis to confirm adequacy of response strategies. Investigations of accidents or incidents will follow formal documented procedures.

### 8.1 METHODOLOGY & APPROACH

It is understood that Myanmar presently has a set of EIA Procedures being drafted by the MOECAP for achieving environmental protection. While Version 8 of the procedures is currently under review, the requirements of the latest version publically available (Version 4) since 2013 were taken into account while undertaking the ESIA for the seismic survey.

These procedures require the following steps to be undertaken as part of the EIA process in context to stakeholder engagement and disclosure of information:

- Scoping exercise:
  - Disclose information about the proposed Project to the public and civil society through local media, including by means of the prominent posting of legible sign boards and advertising boards at the Project site which are visible to the public; and
  - Arrange the required complement of consultation meetings as advised by the Ministry, with local communities, potentially PAPs, local authorities, community based organizations, and civil society.
- EIA process:
  - Take into consideration the views, concerns and perceptions of the stakeholders that could be affected by the Project or who otherwise have an interest in the Project.
  - The EIA should include the results of public consultations and negotiations with the affected population on the environmental and social issues.
  - Timely disclosure of all relevant information about the proposed Project and its likely adverse impacts to the public and civil society through the local and national media, the website of the Project Proponent, at public places such as libraries and community halls and sign boards at the Project site visible to the public.
  - Arrange consultation meetings at the national, state and local level with PAPs, authorities, community based organizations and civil society.
  - Undertake consultations with concerned government organizations including the Ministry, the concerned sector ministry, regional government authorities, and others.

- Field visits for the Ministry and concerned government organizations.

In keeping with these requirements, the engagement activities as part of the scoping and impact assessment process for the Project were undertaken, and are described in the following subsections.

## 8.2 *EVALUATION OF EFFECTIVENESS OF ENGAGEMENT DURING IMPACT ASSESSMENT STAGE*

In terms of undertaking the engagement activities during the scoping and impact assessment process, an attempt was made to conform to the EIA procedures for Myanmar as well as the applicable reference framework for the project. In keeping with this, prior to the commencement of the scoping exercise, meetings were held with the local authorities and the MOGE to identify the key stakeholders and the most appropriate manner in which to undertake the consultations.

Also, prior to the engagement activities for the scoping exercise, Project information was disclosed to the community in the form of pamphlets. However, keeping in mind the literacy levels of the community, the effectiveness of this means of information disclosure was not considered adequate. Thus, in order to ensure that the community had an understanding of the proposed Project activities and the impact assessment process, at the beginning of each consultation, a brief understanding was provided of the proposed Project activities and the purpose of the consultation.

In addition to these measures, certain additional engagement activities have been identified for the future phases of the Project, and these are discussed in the following sub sections.

## 8.3 *FURTHER ON-GOING CONSULTATIONS*

While the above mentioned engagement has been undertaken as part of the impact assessment process, stakeholder engagement is understood to be a process undertaken throughout the life of the Project. In keeping with this, a stakeholder engagement plan has been prepared, which identifies the engagement activities to be undertaken throughout the remaining life of the Project. The proposed engagement activities are to include focus group discussions, community meetings, individual discussions, surveys and checklists etc.

These engagement activities will be undertaken in consultation with MOGE, with the following purpose:

- Allowing the local stakeholders to have an understanding of the Project activities across the various phases.



- To monitor the effectiveness of the mitigation measures for the Project impacts.
- To allow the local stakeholders to provide their feedback on the most desirable manner in which engagement can be undertaken as well as the efficacy of the mitigation measures and the community development activities to be undertaken.

### 8.3.1 *Grievance Redressal Mechanism*

In addition to these activities identified, a key form of engagement with the community will be the grievance redressal mechanism (GRM) of MPRL E&P, which will be implemented in the Project Area. The key purpose of the GRM will be to allow for an understanding to be developed of the community's perception towards the Project, especially in regards to the engagement and compensation process. The following figure provides an understanding of the GRM process proposed for the Project.

[illegible]

In addition to the proposed engagement activities and GRM for the remaining life of the Project, information disclosure will be undertaken through the life of the Project. This information disclosure will be aimed at allowing for the local stakeholders to develop an understanding of the Project activities across the various phases, and the implementation of the mitigation measures identified and the community development activities. The relevant information will be disclosed through the life of the project through pamphlets and reports being made available to the local community, through display of information in community areas and the Project Area signboards and verbally during the engagement activities with the local stakeholders.

Apart from this, the ESIA report for this Project will also be disclosed to the community, in keeping with the EIA procedures of Myanmar. This disclosure will be undertaken through the local media, in which a summary of the report will be provided, the website of the Project Proponent where the ESIA report will be uploaded and verbally in consultation meetings with the local community, if instructed by the MOECAF. On the basis of the feedback thus received, the ESIA will be reviewed and updated. This updated ESIA will then be finally disclosed to the local stakeholders, if deemed necessary.

For the purpose of consultation meetings, the villages will be informed of the purpose of meeting at least 2-3 days ahead before the day of the meeting, so as to allow the community to be prepared in terms of its expectations and queries. Furthermore, MPRL E&P will ensure that any reports disclosed will be made available in the local language in the village head offices or other common areas, as agreed with the community.

## Annex A

# Plant Species Recorded within the Study Area

**Annex A      *List of Plant Species Recorded within the Study Area***

No.	Scientific Name	Family	Common Name(s)	Habit	IUCN status	Remark	Secondary Forest	Developed Area	Agricultural Land	Cultivated Land / Village
1	<i>Abrus precatorius</i> L.	Fabaceae	Bead Vine, Black-eyed Susan, Crab's Eyes, Indian Liquorice	Climber	Not assessed	Common	v			
2	<i>Acacia auriculiformis</i> A. Cunn. Ex Benth.	Fabaceae	Ear-leaf Acacia	Tree	Least Concern	Common		v		v
3	<i>Acmella uliginosa</i> (Sw.) Cass.	Asteraceae	-	Herb	Least Concern	Very common	v	v	v	v
4	<i>Albizia lebeck</i> (L.) Benth.	Fabaceae	Lebeck, Woman's Tongues Tree	Tree	Not assessed	Common				
5	<i>Albizzia procera</i> Benth.	Mimosaceae	Black Siris, False Lebeck, Forest Siris	Tree	Not assessed	Common	v			
6	<i>Alstonia scholaris</i> L.	Apocynaceae	White Cheesewood	Tree	Least Concern	Common	v			
7	<i>Annona squamosa</i> L.	Annonaceae	Custard Apple, Sweetsop	Small tree	Not assessed	Common		v		
8	<i>Antidesma diandrum</i> Roxb.	Phyllanthaceae	-	Small tree	Not assessed	Common	v	v		v
9	<i>Artocarpus heterophyllus</i> Lam.	Moraceae	Jack	Tree	Not assessed	Common	v	v		v
10	<i>Averrhoa carambola</i> L.	Oxalidaceae	Carambola, Star pickle	Small tree	Not assessed	Common		v		v
11	<i>Azadirachta indica</i> A. Juss.	Melicaceae	Neem Tree	Tree	Not assessed	Very common		v		v



No.	Scientific Name	Family	Common Name(s)	Habit	IUCN status	Remark	Secondary Forest	Developed Area	Agricultural Land	Cultivated Land / Village
12	<i>Bambusa siamensis</i> Kurz ex Munro, pro syn.	Poaceae	Monastery Bamboo	Bamboo	Not assessed	Common	v	v	v	v
13	<i>Bauhinia purpurea</i> L.	Fabaceae	Orchid Tree, Hong Kong Orchid Tree, Purple Bauhinia, Camel's Foot, Butterfly Tree, Hawaiian Orchid Tree	Tree	Least Concern	Common	v	v	v	v
14	<i>Bignonia spathacea</i> L. f.	Bignoniaceae	-	Tree	Not assessed	Common	v			v
15	<i>Bombax malabaricum</i> DC.	Malvaceae	Semal	Tree	Not assessed	Common	v			v
16	<i>Borassus flabellifer</i> L.	Arecaceae	Sugar Palm	Tree	Not assessed	Common		v	v	v
17	<i>Bridelia burmanica</i> Hook.f.	Phyllanthaceae	-	Small tree	Not assessed	Common	v	v	v	v
18	<i>Bridelia retusa</i> (L.) A.Juss.	Phyllanthaceae	-	Tree	Not assessed	Common	v			
19	<i>Buchanania lanzan</i> Spreng.	Anacardiaceae	-	Tree	Not assessed	Common	v			
20	<i>Butea monosperma</i> (Lam.) Taub.	Fabaceae	Bengal Kino, Flame Of The Forest	Tree	Not assessed	Common	v			
21	<i>Butea superba</i> Roxb.	Fabaceae	Climbing Palas	Small tree	Not assessed	Common	v			
22	<i>Calotropis gigantea</i> (L.) W. T. Aiton	Apocynaceae	Crown Flower	Shrub	Not assessed	Common	v			
23	<i>Canavalia ensiformis</i> (L.) DC.	Fabaceae	Jack Bean	Climber	Not assessed	Common	v			
24	<i>Capparis tenera</i> Dalz.	Capparaceae	-	Shrub	Not assessed	Common	V			

No.	Scientific Name	Family	Common Name(s)	Habit	IUCN status	Remark	Secondary Forest	Developed Area	Agricultural Land	Cultivated Land / Village
25	<i>Carica papaya</i> L.	Caricaceae	Papaya	Small tree	Not assessed	Common		v	v	v
26	<i>Cassia alata</i> L.	Fabaceae	Candelabra Bush, Candle Bush, Golden Candelabra Tree	Shrub	Not assessed	Common	v			v
27	<i>Chukrasia tabularis</i> A. Juss.	Meliaceae	White Cedar	Tree	Least Concern	Common	v			v
28	<i>Cleome burmannii</i> Wight & Arn.	Cleomaceae	-	Herb	Not assessed	Common	v	v		v
29	<i>Clerodendrum siphonanthus</i> R. Br.	Lamiaceae	-	Shrub	Not assessed	Common		v	v	v
30	<i>Clerodendrum viscosum</i> Vent.	Lamiaceae	-	Shrub	Not assessed	Common	v			
31	<i>Cocos nucifera</i> (L.)	Arecaceae	Coconut	Tree	Not assessed	Common	v			v
32	<i>Colocasia affinis</i> Schott.	Araceae	-	Herb	Not assessed	Common	v	v	v	v
33	<i>Coreopsis tinctoria</i> Nutt.	Asteraceae	-	Shrub	Not assessed	Common	v			
34	<i>Crotalaria striata</i> DC.	Fabaceae	Streaked Rattlepod	Shrub	Not assessed	Common	v			
35	<i>Cyperus</i> sp.	Cyperaceae	Papyrus Sedges, Flatsedges, Nutsedges, Umbrella-Sedges, Galingales	Marsh plant	Least Concern	Common	v			

No.	Scientific Name	Family	Common Name(s)	Habit	IUCN status	Remark	Secondary Forest	Developed Area	Agricultural Land	Cultivated Land / Village
36	<i>Dalbergia cultrata</i> Grah.	Leguminosae	Burma Blackwood	Tree	Near Threatened	Common	v			
37	<i>Dalbergia lanceolaria</i> L.	Leguminosae	Bastard Rose Wood	Tree	Least Concern	Common	v			
38	<i>Dalbergia multiflora</i> B. Heyne.	Fabaceae	-	Tree	Not assessed		v			
38	<i>Dendrocalamus membranaceus</i> Munro.	Gramineae	White Bamboo	Bamboo	Least Concern	Common	v			
39	<i>Dendrocalamus messeri</i> Blatter.	Poaceae	-	Bamboo	Not assessed	Common	v			
40	<i>Desmodium triquetrum</i> (L.) DC.	Fabaceae	Tick Clover	Shrub	Not assessed	Common	v	v	v	v
41	<i>Dillenia pentagyna</i> Roxb.	Dilleniaceae	Dog Teak	Tree	Not assessed	Common	v	v		v
42	<i>Diospyros burmanica</i> Kurz.	Ebenaceae	Persimmon Tree	Tree	Not assessed	Common	v			
43	<i>Diospyros ehretioides</i> Wall. ex G.Don	Ebenaceae	-	Tree	Not assessed	Common	v			
44	<i>Diospyros montana</i> Roxb.	Ebenaceae	-	Tree	Not assessed	Common	v			
45	<i>Dipterocarpus obtusifolius</i> Teysm.	Dipterocarpaceae	-	Tree	Least Concern	Very common	v			
46	<i>Dipterocarpus tuberculatus</i> Roxb.	Dipterocarpaceae	-	Tree	Least Concern	Very common	v			
47	<i>Eclipta alba</i> (L.) Hassk.	Asteraceae	False Daisy	Herb	Data Deficient	Common	v	v	v	v

No.	Scientific Name	Family	Common Name(s)	Habit	IUCN status	Remark	Secondary Forest	Developed Area	Agricultural Land	Cultivated Land / Village
48	<i>Eichornia speciosa</i> Kunth.	Pontederiaceae	Water Hyacinth	Aquatic plant	Not assessed	Common				
49	<i>Emblca officinalis</i> Gaertn.	Phyllanthaceae	-	Tree	Not assessed	Common	v			
50	<i>Enhydra fluctuans</i> Lour.	Asteraceae	Marsh Herb	Herb	Not assessed	Very common	v	v	v	v
51	<i>Eucalyptus albens</i> Benth	Myrtaceae	-	Tree	Not assessed	Common	v	v		v
52	<i>Eugenia diospyrifolia</i> Wall.	Myrtaceae	-	Tree	Not assessed	Common	v			
53	<i>Eupatorium odoratum</i> Walter	Asteraceae	-	Shrub	Not assessed	Common	v			
54	<i>Euphorbia hirta</i> L.	Euphorbiaceae	-	Shrub	Not assessed	Common	v			
55	<i>Euphoria longana</i> Lam.	Sapindaceae	-	Tree	Not assessed	Common	v			
56	<i>Ficus insignis</i> Kurz	Moraceae	-	Tree	Not assessed	Common	v	v		
57	<i>Ficus chittagonga</i> Miq.	Moraceae	Cluster Fig	Tree	Not assessed	Common	v	v		
58	<i>Ficus hispida</i> L.f.	Moraceae	-	Small tree	Not assessed	Common	v	v		v
59	<i>Garuga pinnata</i> Roxb.	Burseraceae	-	Tree	Not assessed	Common	v	v		v
60	<i>Heliotropium ovalifolium</i> Forssk.	Boraginaceae	Grey Leaf Heliotrope	Herb	Least Concern	Common	v			
61	<i>Heterophragma sulfureum</i> Kurz	Bignoniaceae	-	Tree	Not assessed	Common	v			
62	<i>Hibiscus hastatus</i> Michx. ex DC.	Malvaceae	Halberdleaf rosemallow	Shrub	Not assessed	Common	v			

No.	Scientific Name	Family	Common Name(s)	Habit	IUCN status	Remark	Secondary Forest	Developed Area	Agricultural Land	Cultivated Land / Village
63	<i>Hygrophila phlomoides</i> Nees.	Acanthaceae	-	Herb	Not assessed	Common	v	v		v
64	<i>Ipomaea turpethum</i> R.Br.	Convolvulaceae	St. Thomas lidpod	Climber	Not assessed	Common	v			
65	<i>Ipomoea alba</i> L.	Convolvulaceae	Batatillo, Tropical white morning-glory	Cimber	Not assessed	Common	v			
66	<i>Ipomoea aquatica</i> Forsskal	Convolvulaceae	Swamp morning-glory	Climber	Least Concern	Common	v	v	v	v
67	<i>Ipomoea hederifolia</i> L.	Convolvulaceae	Scarletcreeper	Climber	Not assessed	Common	v	v	v	v
68	<i>Jussiaea repens</i> L.	Onagraceae	Creeping Ludwigia	Aquatic plant	Least Concern	Common	v	v	v	v
69	<i>Jussiaea suffruticosa</i> L.	Onagraceae	Mexican primrose-willow	Shrub	Least Concern	Common	v			
70	<i>Lagerstroemia villosa</i> Wall.	Lythraceae	-	Tree	Not assessed	Common	v			
71	<i>Lagerstroemia speciosa</i> (L.) Pers.	Lythraceae	Reina de las flores, Queen of flowers	Tree	Not assessed	Common	v	v	v	v
72	<i>Lannea coromandelica</i> (Houtt.) Merr.	Anacardiaceae	Indian Ash Tree	Tree	Not assessed	Very Common	v			
73	<i>Leucaena glauca</i> Benth.	Fabaceae	Cassie, Cowbush	Small tree	Not assessed	Common	v	v	v	v
74	<i>Leucas aspera</i> (Willd.) Link.	Laminaceae	-	Shrub	Not assessed	Common	v			
75	<i>Mallotus nepalensis</i> Muell.	Euphorbiaceae	-	Small tree	Not assessed	Common	v			



No.	Scientific Name	Family	Common Name(s)	Habit	IUCN status	Remark	Secondary Forest	Developed Area	Agricultural Land	Cultivated Land / Village
76	<i>Mangifera indica</i> L.	Anacardiaceae	Mango	Tree	Data Deficient	Common		v	v	v
77	<i>Markhamia stipulata</i> (Wall.) Seem.	Bignoniaceae	Cat-tail Tree	Tree	Not assessed	Common	v	v		v
78	<i>Mayodendron igneum</i> Kurz	Bignoniaceae	-	Tree	Not assessed	Common	v	v		v
79	<i>Melanorrhoea usitata</i> Wall.	Anacardiaceae	-	Tree	Not assessed	Common	v			
80	<i>Melastoma malabathricum</i> L.	Melastomataceae	-	Shrub	Not assessed	Common	v			
81	<i>Microcos paniculata</i> L.	Malvaceae	Microcos	Small tree	Not assessed	Common	v			
82	<i>Mikania scandens</i> (L.) Willd.	Asteraceae	Climbing Hempvine	Climber	Not assessed	Common	v			
83	<i>Millettia versicolor</i> Baker.	Fabaceae	-	Tree	Not assessed	Common	v			
84	<i>Mimosa dulcis</i> Roxb.	Fabaceae	Madras Thorn, Manila Tamarind, Sweet Inga	Tree	Not assessed	Common	v	v		v
85	<i>Mimosa pudica</i> L.	Fabaceae	Sensitive Plant	Herb	Least Concern	Common	v	v	v	v
86	<i>Mimusops elengi</i> Roxb.	Sapotaceae	Spanish Cherry, Bullet Wood	Tree	Not assessed	Common	v	v		v
87	<i>Mitragyna parvifolia</i> (Roxb.) Korth.	Rubiaceae	-	Tree	Not assessed	Common	v			
88	<i>Morinda tinctoria</i> Roxb.	Rubiaceae	Indian Mulberry	Small tree	Not assessed	Common	v			

No.	Scientific Name	Family	Common Name(s)	Habit	IUCN status	Remark	Secondary Forest	Developed Area	Agricultural Land	Cultivated Land / Village
89	<i>Moringa oleifera</i> Lam.	Moringaceae	Drumstick Tree, Horseradish Tree	Tree	Not assessed	Common	v	v		v
90	<i>Mucuna prurita</i> Hk.	Fabaceae	Velvet Bean	Climber	Not assessed	Common	v	v	v	v
91	<i>Musa</i> sp.	Musaceae	Banana	Herb	Not assessed	Common		v		v
92	<i>Nassella</i> sp.	Poaceae	Needlegrass	Grass	Not assessed	Common	v			
93	<i>Nelumbo nucifera</i> Gaertn.	Nelumbonaceae	Sacred Lotus	Aquatic plant	Not assessed	Common	v			
94	<i>Nymphoides indicua</i>	Menyanthaceae	Water Snowflake	Aquatic plant	Least Concern	Common	v			
95	<i>Oroxylum indicum</i> Vent.	Bignoniaceae	Midnight Horror	Tree	Not assessed	Common	v	v		v
96	<i>Oryza sativa</i> L.	Poaceae	Asian Rice	Grass	Not assessed	Common			v	
97	<i>Passiflora foetida</i> L.	Passifloraceae	Bush Passion Fruit, Wild Water Lemon	Herb	Not assessed	Common	v	v		v
98	<i>Phoenix paludosa</i> Roxb.	Palmae	Mangrove Date Palm	Small tree	Near Threatened	Very Common	v	v		v
99	<i>Physalis minima</i> L.	Solanaceae	Pygmy Groundcherry	Herb	Not assessed	Common	v	v	v	v

No.	Scientific Name	Family	Common Name(s)	Habit	IUCN status	Remark	Secondary Forest	Developed Area	Agricultural Land	Cultivated Land / Village
100	<i>Plumbago zeylanica</i> L.	Plumbaginaceae	Ceylon Leadwort, Doctorbush	Shrub	Not assessed	Common	v			
101	<i>Plumeria acuminata</i> Ait.	Apocynaceae	Red Paucipan, Red-jasmine, Red Frangipani	Small tree	Not assessed	Common	v	v		v
102	<i>Poinciana regia</i> Bojer.	Apocynaceae	Royal Poinciana	Tree	Not assessed	Common	v	v		v
103	<i>Polygonum tomentosum</i> Willd.	Polygonaceae	Pale Persicaria	Aquatic plant	Least Concern	Common	v	v		v
104	<i>Premna latifolia</i> Roxb.	Lamiaceae	Dusky Fire Brand Bark	Tree	Not assessed	Common	v	v		v
105	<i>Prunus macrophylla</i> Sieb. & Zucc.	Rosaceae	-	Tree	Not assessed	Common	v	v		v
106	<i>Psidium guajava</i> L.	Myrtaceae	Guava, Yellow Guava, Lemon Guava	Tree	Not assessed	Common		v		v
107	<i>Pterocarpus macrocarpus</i> Kz.	Fabaceae	Burma Padauk	Tree	Not assessed	Common	v	v		v
108	<i>Rauvolfia serpentina</i> (L.) Benth.	Apocynaceae	Indian snakeroot, Sarpagandha	Shrub	Not assessed	Common	v	v		v
109	<i>Saccharum narenga</i> Wall.	Poaceae	-	Grass	Not assessed	Common	v			
110	<i>Saccharum officinarum</i> L.	Poaceae	Sugarcane	Grass	Not assessed	Common			v	
111	<i>Sandoricum indicum</i> Cav.	Meliaceae	Santol	Tree	Not assessed	Common	v			
112	<i>Schima crenata</i> Korth.	Theaceae	Needlewood	Tree	Not assessed	Common	v			
113	<i>Sesbania grandiflora</i> (L.) Poir.	Fabaceae	Agathi, Baby Boots, Christmas Bells	Small tree	Not assessed	Common	v			

No.	Scientific Name	Family	Common Name(s)	Habit	IUCN status	Remark	Secondary Forest	Developed Area	Agricultural Land	Cultivated Land / Village
114	<i>Shorea obtusa</i> Wall.	Dipterocarpaceae	Taengwood, Balau	Tree	Least Concern	Common	v			
115	<i>Shorea siamensis</i> (Kz.) Miq.	Dipterocarpaceae	Dark Red Meranti, Light Red Meranti, Red Lauan	Tree	Least Concern	Common	v			
116	<i>Sida spinosa</i> L.	Malvaceae	Prickly Fanpetals	Shrub	Not assessed	Common	v			
117	<i>Sida veronicaefolia</i> Lam.	Malvaceae	Country Mallow, Flannel Weed	Shrub	Not assessed	Common	v	v	v	v
118	<i>Sideroxylon assamicum</i> C. B. Cl.	Sapotaceae	-	Tree	Not assessed	Common	v			
119	<i>Smithia sensitiva</i> Ait.	Leguminosae	-	Herb	Least Concern	Common	v			
120	<i>Spilanthes acmella</i> L.	Asteraceae	Toothache Plant, Paracress	Herb	Not assessed	Common	v			
121	<i>Streblus asper</i> Lour.	Moraceae	Siamese Rough Bush, Toothbrush Tree	Small tree	Not assessed	Common	v			
122	<i>Strychnos nux-vomica</i> L.	Loganiaceae	Nux Vomica, Poison Nut, Quaker Buttons	Tree	Not assessed	Common	v			
123	<i>Tamarindus indica</i> L.	Fabaceae	Tamarind	Tree	Not assessed	Common	v	v		v
124	<i>Tectona grandis</i> L.f.	Lamiaceae	Teak	Tree	Least Concern	Common	v	v		v
125	<i>Terminalia alata</i> Heyne & Roth.	Combretaceae	Crocodile Bark	Tree	Not assessed	Common	v			
126	<i>Terminalia bellerica</i> Roxb .	Combretaceae	Bahera, Beleric, Bastard Myrobalan	Tree	Not assessed	Common	v			

No.	Scientific Name	Family	Common Name(s)	Habit	IUCN status	Remark	Secondary Forest	Developed Area	Agricultural Land	Cultivated Land / Village
127	<i>Terminalia catappa</i> L.	Combretaceae	Indian Almond	Tree	Not assessed	Common		v		v
128	<i>Terminalia pyrifolia</i> Kz.	Combretaceae	Lein	Tree	Not assessed	Common	v			
129	<i>Thunbergia laurifolia</i> Lindl.	Acanthaceae	Laurel Clock Vine, Blue Trumpet Vine	Climber	Not assessed	Common	v			
130	<i>Tridax procumbens</i> L.	Asteraceae	Coat Buttons, Tridax Daisy	Herb	Not assessed	Common	v	v		v
131	<i>Typha</i> sp.	Cyperaceae	Bulrush	Marsh plant	Not assessed	Common	v			
132	<i>Uraria rufescens</i> (DC.) Schindl.	Fabaceae	-	Shrub	Not assessed	Common	v			
133	<i>Vigna catjang</i> Walp.	Fabaceae	Catjang	Shrub	Not assessed	Common			v	v
134	<i>Xanthophyllum</i> sp.	Dipterocarpaceae	-	Tree	Not assessed	Common	v			
135	<i>Xylia dolabriformis</i> Benth.	Fabaceae	Ironwood Of Burma	Tree	Not assessed	Common	v			
136	<i>Zea mays</i> L.	Poaceae	Maize	Grass	Not assessed	Common			v	v
137	<i>Ziziphus jujuba</i> (L.) Mill & Lam.	Rhamnaceae	Red Date, Chinese Date	Tree	Least Concern	Common	v	v		v
138	<i>Ziziphus rugosa</i> Lam.	Rhamnaceae	Chunna berry	Small tree	Not assessed	Common	v		v	



## Annex B

### Bird Species Recorded within the Study Area

**Annex B      Full List of Bird Species Recorded within the Study Area in December 2014**

No.	Scientific Name	Common Name(s)	IUCN status	Secondary Forest	Developed Area	Agricultural Land	Cultivated Land/Village
1	<i>Accipiter badius</i>	Shikra	Least Concern	v		v	
2	<i>Acridotheres burmannicus</i>	Vinous-breasted starling	Not Assessed	v		v	v
3	<i>Acridotheres tristis</i>	Common Myna	Least Concern	v	v	v	v
4	<i>Apus nipalensis</i>	House swift	Least Concern		v	v	v
5	<i>Ardeola grayii</i>	Indian Pond Heron	Least Concern	v			
6	<i>Bubulcus ibis</i>	Cattle Egret	Least Concern	v			
7	<i>Butastur indicus</i>	Grey-faced Buzzard	Least Concern	v		v	
8	<i>Centropus sinensis</i>	Greater Coucal	Least Concern	v	v		
9	<i>Cinnyris asiaticus</i>	Purple Sunbird	Not Assessed	v	v	v	
10	<i>Columba livia</i>	Rock Dove	Least Concern		v	v	v
11	<i>Copsychus saularis</i>	Oriental Magpie-Robin	Not Assessed	v	v	v	
12	<i>Copsychus saularis</i>	Oriental Magpie-Robin	Least Concern			v	v
13	<i>Coracias benghalensis</i>	Indian Roller	Not Assessed	v			
14	<i>Corvus splendens</i>	House Crow	Least Concern		v	v	v
15	<i>Cypsiurus balasiensis</i>	Asian Palm-Swift	Not Assessed	v	v	v	v
16	<i>Dendrocitta vagabunda</i>	Rufous Treepie	Least Concern	v			
17	<i>Dicrurus macrocercus</i>	Black Drongo	Least Concern	v	v	v	v
18	<i>Egretta garzetta</i>	Little Egret	Least Concern	v			

No.	Scientific Name	Common Name(s)	IUCN status	Secondary Forest	Developed Area	Agricultural Land	Cultivated Land / Village
19	<i>Ficedula parva</i>	Red-breasted Flycatcher	Least Concern	v		v	v
20	<i>Gallinula chloropus</i>	Common Moorhen	Least Concern	v			
21	<i>Gallus gallus</i>	Red Junglefowl	Least Concern	v			
22	<i>Halcyon smyrnensis</i>	White-breasted Kingfisher	Not Assessed	v			
23	<i>Hirundo rustica</i>	Barn Swallow	Not Assessed	v	v	v	v
24	<i>Lanius collurioides</i>	Burmese Shrike	Least Concern	v			v
25	<i>Megalurus palustris</i>	Striated Grassbird	Least Concern	v		v	
26	<i>Merops orientalis</i>	Asian Green Bee-eater	Not Assessed	v			
27	<i>Metopidius indicus</i>	Bronze-winged Jacana	Least Concern	v			
28	<i>Motacilla alba</i>	White Wagtail	Least Concern	v		v	
29	<i>Oriolus chinensis</i>	Black-naped Oriole	Least Concern	v			
30	<i>Prinia inornata</i>	Plain Prinia	Least Concern	v	v	v	v
31	<i>Psittacula krameri</i>	Rose-ringed Parakeet	Least Concern	v		v	
32	<i>Pycnonotus blanfordi</i>	Streak-eared Bulbul	Least Concern	v	v	v	v
33	<i>Pycnonotus cafer</i>	Red-vented Bulbul	Least Concern	v	v	v	v
34	<i>Riparia paludicola</i>	Plain Martin	Not Assessed		v	v	v
35	<i>Saxicola caprata</i>	Pied Bushchat	Least Concern	v	v	v	v
36	<i>Streptopelia chinensis</i>	Spotted Dove	Not Assessed	v	v	v	v
37	<i>Turdoides gularis</i>	White-throated Babbler	Least Concern	v		v	
38	<i>Vanellus duvaucelii</i>	River Lapwing	Near Threatened	v			

No.	Scientific Name	Common Name(s)	IUCN status	Secondary Forest	Developed Area	Agricultural Land	Cultivated Land/Village
39	<i>Gracupica contra</i>	Asian Pied Starling	Not Assessed	v		v	
40	<i>Passer domesticus</i>	House Sparrow	Least Concern		v	v	v
41	<i>Passer flaveolus</i>	Plain-backed Sparrow	Least Concern	v	v	v	v
42	<i>Passer montanus</i>	Eurasian Tree Sparrow	Least Concern	v	v	v	v
43	<i>Lonchura punctulata</i>	Scaly-breasted Munia	Least Concern	v	v	v	v

Annex C

Herpetofauna Species  
Recorded within the Study  
Area



**Annex C      Full List of Herpetofauna Species Recorded within the Study Area in December 2014**

No.	Scientific name	Common name	Family name	IUCN Status	Remark	Secondary Forest	Developed Area	Agricultural Land	Cultivated Land/ Village
<b>Snake (Myan Aung)</b>									
1	<i>Ophiophagus hannah</i>	King Cobra	Elapidae	Vulnerable	Interview	v		v	v
2	<i>Naja kaouthia</i>	Monocled Cobra	Elapidae	Least Concern	Interview	v	v	v	v
3	<i>Bungarus fasciatus</i>	Banded Krait	Elapidae	Least Concern	Interview	v	v	v	v
4	<i>Daboia russelii</i>	Eastern Russell's Viper	Viperidae	Least Concern	Interview	v	v	v	v
5	<i>Ptyas korros</i>	Indo-Chinese Rat snake	Colubridae	Not Assessed	Interview	v	v	v	v
6	<i>Ptyas mucosa</i>	Indian Rat Snake	Colubridae	Not Assessed	Interview	v		v	
7	<i>Ahaetulla nasuta</i>	Long-nosed Whip snake	Colubridae	Not Assessed	Observed	v			
8	<i>Amphiesma stolata</i>	Buff Striped Keelback	Colubridae	Not Assessed	Observed	v	v	v	v
9	<i>Xenochrophis piscator</i>	Checkered Keelback Water Snake	Colubridae	Not Assessed	Interview	v	v	v	v
10	<i>Xenopeltis unicolor</i>	Asian Sunbeam Snake	Colubridae	Least Concern	Interview	v			

No.	Scientific name	Common name	Family name	IUCN Status	Remark	Secondary Forest	Developed Area	Agricultural Land	Cultivated Land/ Village
<b>Skink</b>									
11	<i>Eutropis multifasciata</i>	Common sun skink	Scincidae	Not Assessed	Observed	v	v	v	v
<b>Lizard</b>									
12	<i>Calotes versicolor</i>	Common Garden Lizard	Agamidae	Not Assessed	Observed	v	v	v	v
13	<i>Gekko gekko</i>	Tokay Gecko	Gekkonidae	Not Assessed	Interview	v	v	v	v
14	<i>Varanus sp</i>	Monitor Lizard	Varanidae	Not Assessed	Interview	v			v
<b>Turtle/Tortoise</b>									
15	<i>Dogania subplana</i>	Malayan Soft-shelled Turtle	Trionychidae	Least Concern	Interview	v			
16	<i>Indotestudo elongata</i>	Yellow-headed Tortoise	Testudinidae	Endangered	Interview	v			
<b>Frog and toad</b>									
17	<i>Bufo melanostictus</i>	Black-spectacled Toad	Bufo	Least Concern	Observed	v	v	v	v
18	<i>Kaloula pulchra</i>	Malaysian Narrowmouth Toad	Microhylidae	Least Concern	Interview	v	v	v	v
19	<i>Microhyla ornata</i>	Ant Frog	Microhylidae	Least Concern	Observed	v		v	v

No.	Scientific name	Common name	Family name	IUCN Status	Remark	Secondary Forest	Developed Area	Agricultural Land	Cultivated Land/ Village
20	<i>Hoplobatrachus tigerinus</i>	Indian Bull Frog	Dicroglossidae	Least Concern	Interview			v	v
21	<i>Fejervarya limnocharis</i>	Asian Grass Frog	Dicroglossidae	Least Concern	Observed			v	v
22	<i>Polypedates maculatus</i>	Himalayan Tree Frog	Rhacophoridae	Least Concern	interview			v	v

Annex D

Mammal Species Recorded  
within the Study Area

**Annex D      Full List of Mammal Species Recorded within the Study Area in December 2014**

No.	Scientific name	Common Name	Family	IUCN Status	Remark	Secondary Forest	Developed Area	Agricultural Land	Cultivated Land / Village
1	<i>Echinosorex gymnura</i>	Moonrat	ERINACEIDAE	Least Concern	Observed		v	v	v
2	<i>Niviventer fulvoscens</i>	Chestnut White-bellied Rat	MURIDAE	Least Concern	Observed		v	v	v
3	<i>Manis pentadactyla</i>	Chinese Pangolin	MANIDAE	Critically Endangered	Interview	v			
4	<i>Lepus peguensis</i>	Burmese Hare	LEPORIDAE	Least Concerned	Interview	v		v	
5	<i>Callosciurus erythraeus</i>	Pallas's Squirrel	SCIURIDAE	Least Concerned	Observed	v	v	v	v
6	<i>Callosciurus pygerythrus</i>	Hoary-bellied Squirrel	SCIURIDAE	Not Assessed	Observed	v	v	v	v
7	<i>Menetes berdmorei</i>	Indochinese Ground Squirrel	SCIURIDAE	Least Concerned	Interview	v			v
8	<i>Canis aureus</i>	Golden Jackal	CARNIDAE	Least Concerned	Interview	v			
9	<i>Paradoxurus hermaphroditus</i>	Common Palm Civet	VIVERRIDAE	Least Concerned	Interview	v			
10	<i>Prionailurus bengalensis</i>	Leopard Cat	VIVERRIDAE	Least Concerned	Interview	v			
11	<i>Sus scrofa</i>	Wild Boar	SUIDAE	Least Concerned	Interview	v			



No.	<i>Scientific name</i>	Common Name	Family	IUCN Status	Remark	Secondary Forest	Developed Area	Agricultural Land	Cultivated Land/ Village
12	<i>Cervus unicolor</i>	Sambar	CERVIDAE	Vulnerable	Interview	<b>v</b>			
13	<i>Muntiacus muntjak</i>	Southern Red Muntjac	CERVIDAE	Least Concerned	Observed	<b>v</b>			

## Annex E

# Butterfly Species Recorded within the Study Area

**Annex E      Full List of Butterfly Species Recorded within the Study Area in December 2014**

No.	Species	Common name	Family	Remark	IUCN Status	Shrubland	Developed Area	Agricultural Land	Cultivated Land/ Village
1	<i>Danaus chrysippus</i> (Linnaeus, 1758)	Plain Tiger	Nymphalidae	Very Common	Not Assessed	v		v	v
2	<i>Danaus genutia</i> (Cramer, 1779)	Common Tiger or Striped Tiger	Nymphalidae	Very Common	Not Assessed		v	v	
3	<i>Euploea core godartii</i> (Lucas, 1853)	Common Indian Crow	Danaidae	Common	Not Assessed		v	v	v
4	<i>Tirumala limniace</i> (Butler, 1866)	-	Danaidae	Common	Not Assessed		v	v	v
5	<i>Papilio memnon agenor</i> (Linnaeus, 1768)	Great Mormon	Papilionidae	Nor Rare	Not Assessed			v	
6	<i>Papilio polytes</i> (Cramer, 1775)	Common Mormon	Papilionidae	Very Common	Not Assessed			v	
7	<i>Papilio demoleus</i> (Linnaeus, 1758)	Lime Butterfly	Papilionidae	Very Common	Not Assessed	v	v	v	v
8	<i>Junonia almana</i> (Linnaeus, 1758)	Peacock Pansy	Nymphalidae	Common	Least Concern	v	v	v	v
9	<i>Junonia atlites</i> (Linnaeus, 1763)	Grey Pansy	Nymphalidae	Common	Not Assessed	v	v	v	v
10	<i>Athyma perius</i> (Linnaeus, 1758)	Common Sergeant	Nymphalidae	Common	Not Assessed	v	v	v	v
11	<i>Hypolimnas bolina</i> (Linnaeus, 1758)	Common Eggfly	Nymphalidae	Common	Not Assessed	v	v	v	v
12	<i>Cupha erymanthis</i> (Drury, 1773)	-	Nymphalidae	Common	Not Assessed			v	v

No.	Species	Common name	Family	Remark	IUCN Status	Shrubland	Developed Area	Agricultural Land	Cultivated Land/ Village
13	<i>Eurema hecabe</i> (Linnaeus, 1758)	Common Grass Yellow	Pieridae	Very Common	Not Assessed	v	v	v	v
14	<i>Catopsilia scylla</i> (Linnaeus, 1763)	Orange Emigrant	Pieridae	Common	Not Assessed	v	v	v	v
15	<i>Hebomoia glaucippe</i> (Linnaeus, 1758)	Great Orange Tip	Pieridae	Common	Not Assessed	v	v	v	
16	<i>Catopsilia pomona</i> (Fabricius, 1775)	Common Emigrant	Pieridae	Very Common	Not Assessed	v	v	v	v
17	<i>Leptosia nina</i> (Fabricius, 1793)	-	Pieridae	Common	Not Assessed			v	
18	<i>Pareronia valeria</i> (Cramer, 1776)	Wanderer	Peridae	Un Common	Not Assessed	v			

Annex F

Fish Species Recorded  
within the Study Area

**Annex F      Full List of Aquatic Fauna Species Recorded within the Study Area in  
December 2014**

No.	Species	Common name	Local name	Family	IUCN Redlist Status
1	<i>Mystus gulio</i>	Long Whisker Catfish	NgaYway	Bagridae	Least Concern
2	<i>Channa striata</i>	Snakehead Murrel	NgaYant	Channidae	Not Assessed
3	<i>Tenualosa ilisha</i>	Hilsa	Ngathalauk	Clupeidae	Least Concern
4	<i>Pangasius pangasius</i>	Pangas Catfish	Nga Dan	Pangasiidae	Least Concern
5	<i>Xenentodon cancila</i>	Freshwater Garfish	Nga-PhaunYoe	Belonidae	Least Concern
6	<i>Sperata seenghala</i>	Giant River Catfish	Ngagyaung	Bagridae	Least Concern
7	<i>Mystus vittatus</i>	Striped Dwarf Catfish	NgaZinYainn	Bagridae	Least Concern
8	<i>Clarias batrachus</i>	Walking Catfish	NgaKhu	Clariidae	Least Concern
9	<i>Heteropneustes fossilis</i>	Stinging Catfish	NgaKyee	Heteropneustidae	Least Concern
10	<i>Ompok bimaculatus</i>	Butter Catfish	Nga Nu Thann	Siluridae	Near Threatened
11	<i>Catla catla</i>	Catla	Nga-gyin Gaungpwa	Cyprinidae	Not Assessed
12	<i>Notopterus notopterus</i>	Bronze Featherback	NgaPhe	Notopteridae	Least Concern
13	<i>Anabas testudineus</i>	Climbing Perch	Nga Byay Ma	Anabantidae	Data Deficient
14	<i>Oreochromis niloticus</i>	Nile Tilapia	TeLarr Pee Yarr	Cichlidae	Not Assessed
15	<i>Cirrhinus mrigala</i>	Mrigal	Nga Gyinn	Cyprinidae	Least Concern
16	<i>Wallago attu</i>	Wallago	Nga Bat	Siluridae	Near Threatened
17	<i>Silonia silondia</i>	Silong Catfish	Ngamyin	Schilbeidae	Least Concern
18	<i>Monopterus albus</i>	Rice Swampel	Ngashint Nee	Synbranchidae	Least Concern
19	<i>Monopterusuchia</i>	Gangetic Mudeel	Ngashint Mwe	Synbranchidae	Least Concern
20	<i>Macrogathus zebrinus</i>	Zebra Spiny Eel	Ngamway doe	Mastacembelidae	Least Concern
21	<i>Channa panaw</i>	Panaw Snakehead	Nga Panaw	Channidae	Least Concern



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