PERTAMINA
GEOTHERMAL ENERGY

Sarulla
Operations Ltd

Environmental Impact Statement

Development of Sarulla Geothermal Field and Power Plant of 330 MW Capacity

North Tapanuli Regency, North Sumatera Province

August 2009

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CHAPTER I
INTRODUCTION

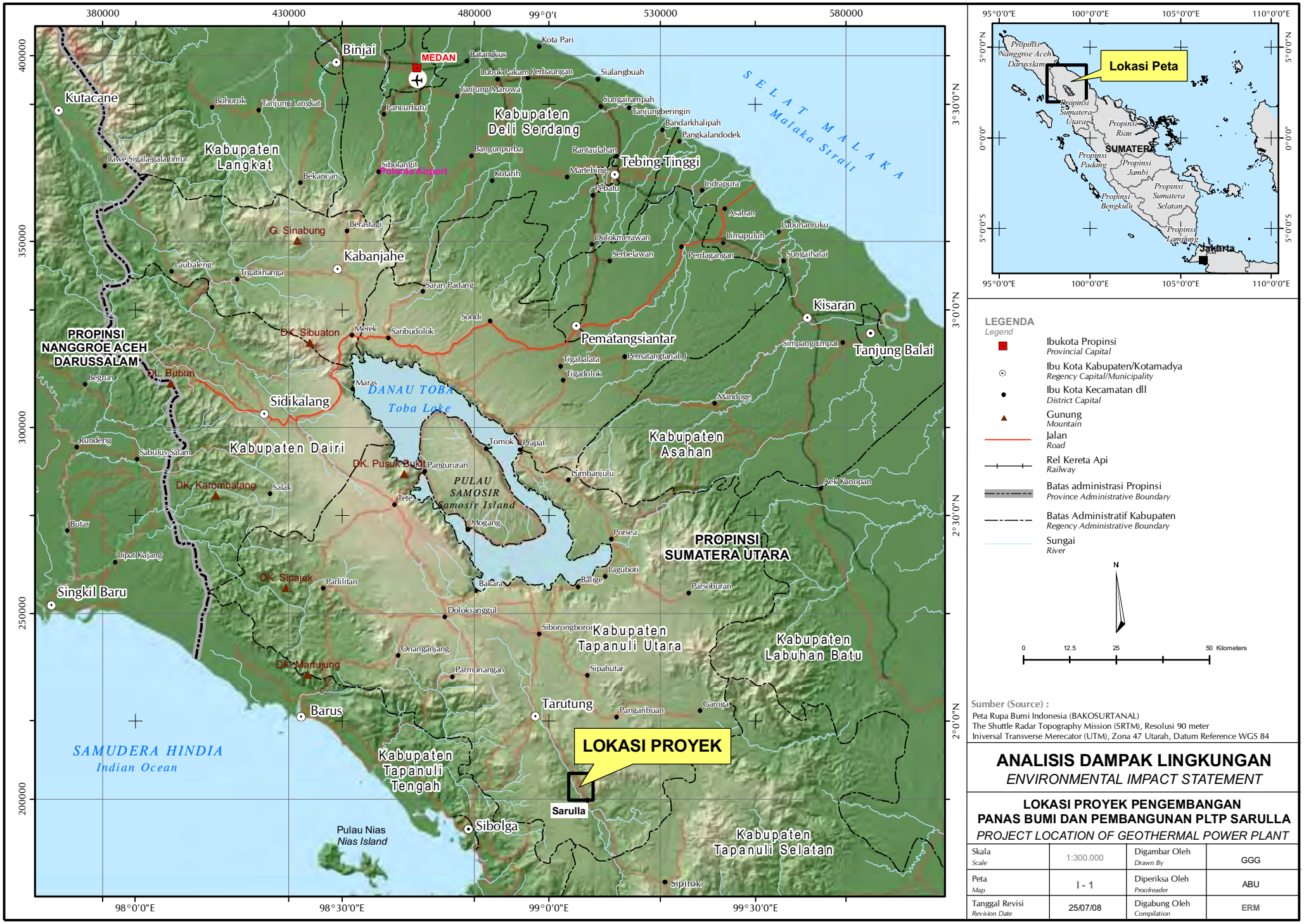
1.1 BACKGROUND

The development of geothermal energy is a priority for the Government of Indonesia in securing alternative energy sources. This is inline with the Government's policies in energy diversification, fuel oil (*Bahan Bakar Minyak* = BBM) consumption reduction and anticipating the rise in electricity demand in Indonesia, especially in North Sumatera.

The development of Sarulla geothermal field and the construction of Sarulla power plant in Pahae Julu and Pahae Jae Districts, North Tapanuli Regency, North Sumatera Province (**Map I-1**) commenced in 1993 by Unocal North Sumatera Geothermal (UNSG) that was officially awarded the right as contractor from PERTAMINA to develop Sarulla geothermal field and power plant. The owner of Sarulla Geothermal Working Area, through Joint Operation Contract (JOC) and direct right (through PERTAMINA), has access to sell electricity to PT. *Perusahaan Listrik Negara* (PLN, the State Utility Company) according to Energy Sales Contract (ESC). UNSG conducted a number of engineering technical and environmental studies covering the exploration, the development of Sarulla geothermal resources and the related infrastructures between 1994 to 1997. According to the JOC, all infrastructures and assets were properties of PERTAMINA and UNSG had the right to use them.

In 2002 UNSG decided to sell their right as contractor to PLN. In February 2004, PLN acquired the entire concession ownership from UNSG. The acquisition was approved by PERTAMINA and the Minister of Energy and Mineral Resources. At the same time, the tender process to transfer PLN ownership as PERTAMINA contractor to a third party was also approved.

In 2004, PLN started an international tender process to transfer the concession ownership for the development and the operation of 330 MW power plant at Sarulla geothermal field. It was stated in the Request for Proposal, that the winning company would have the right to fund, design, build, test, operate and maintain the field, and also to have the right as contractor of PERTAMINA to develop Sarulla geothermal field through DOA (*Deed of Assignment*).



Sumber (Source) :
Peta Rupa Bumi Indonesia (BAKOSURTANAL)
The Shuttle Radar Topography Mission (SRTM), Resolusi 90 meter
Inviersal Transverse Merecator (UTM), Zona 47 Utarah, Datum Reference WGS 84

ANALISIS DAMPAK LINGKUNGAN
ENVIRONMENTAL IMPACT STATEMENT

LOKASI PROYEK PENGEMBANGAN PANAS BUMI DAN PEMBANGUNAN PLTP SARULLA
PROJECT LOCATION OF GEOTHERMAL POWER PLANT

Skala *Scale*	1:300.000	Digambar Oleh *Drawn By*	GGG
Peta *Map*	I - 1	Diperiksa Oleh *Proofreader*	ABU
Tanggal Revisi *Revision Date*	25/07/08	Digabung Oleh *Compilation*	ERM

After three rounds of tendering process, in June 2005, PLN issued a Letter of Intent (LOI) for PT. Geo Dipa Energi (a joint venture between PLN and PERTAMINA) as the tender winner based on the lowest offered electricity price ($4.445 cent/kWh). PLN and PERTAMINA gave more than one year for PT. Geo Dipa Energi to present their financial plan as a basis to approve the changes of the ESC and the JOC. However, PT. Geo Dipa Energi could not meet the deadline and hence the LOI was cancelled in July 2006.

On 25 July 2006, PLN awarded the LOI to a Consortium of Medco-Ormat-Itochu as the second lowest bidder on electricity price ($4.642 cent/kWh). The Consortium was awarded the right from PLN to develop Sarulla geothermal field and power plant.

Head of Agreement authorization to develop Sarulla geothermal field in North Tapanuli Regency, North Sumatera Province, was signed by PERTAMINA, PLN and the Consortium on 20 August 2007, witnessed by the Prime Minister of Japan, Mr. Shinzo Abe, and the President of Republic of Indonesia, Mr. Soesilo Bambang Yudhoyono at the Indonesia–Japan Business Forum.

SOL is the operation company established by the Consortium (PT MEDCO GEOPOWER SARULLA, ORSARULLA INC., SARULLA POWER ASSET LTD., and KYUDEN SARULLA Pte Ltd.) which plans to develop the geothermal field and the power plant in Sarulla, in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency, North Sumatera Province.

In the development of Sarulla geothermal field and power plant at 330 MW capacity, the Consortium and SOL signed a DOA with PT. PLN (*Persero*); a JOC with PERTAMINA Geothermal Energy; and an ESC [1] with PERTAMINA Geothermal Energy - and PT. PLN (*Persero*) on 14 December 2007 (See **Appendix 6**).

The proposed activity is located ± 40 km south of Tarutung at the side of the Trans Sumatera Highway (Tarutung – Sipirok). Administratively, the project is located in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency, North Sumatera Province. The development of this project will give positive impacts but on the other hand, negative impacts towards the following components: physical-chemical, biological, and socio-economic and cultural.

According to Article 24 of the Government Regulation No. 27 of 1999, the validity of an approved AMDAL documents is three (3) years. The AMDAL documents prepared by PT. PLN were approved by the Governor of North Sumatera on 21 November 2005.

[1] PT. Pertamina Geothermal Energy is a subsidiary of Pertamina which manages geothermal business sector.

Considering (a) additional activities such as drilling and operation of production wells; (b) changes in cooling system for steam and brine, from water to air which is more environmentally friendly; (c) construction and operation of internal electricity transmission from SIL to NIL; (d) changes of proponent from PT. PLN (Persero) to SOL. In order to accommodate the above changes, the 2005 AMDAL documents have been revised to continue with the plan to develop Sarulla geothermal field and power plant.

The preparation of this ANDAL document is in accordance with the Minister of Environment Decree No. 08 of 2006 concerning Guidance in Preparing Environmental Impact Assessment Documents (AMDAL).

1.2 PROJECT PURPOSED AND BENEFITS

1.2.1 Purpose

- To overcome electricity shortage in Indonesia, especially in North Sumatera;
- To support the Government of Indonesia policy in energy diversification and oil fuel consumption reduction;
- To optimize the use geothermal energy that has high economic potential.

1.2.2 Benefits

The Government of Indonesia will benefit from this proposed project as the project will increase electricity supply by 330 MW from the geothermal energy which is environmentally friendly and locally available. This project can help to reduce fossil fuel dependency in producing electricity.

The benefit will also reach local governments and the community in North Sumatera Region as the direct beneficiary of the power generated from this project. It will help to improve the local economy by providing business and employment opportunities, particularly at project location.

This project will give economic, social and technological benefits at national and regional levels. The benefits include:

- An increase in electricity supply especially for North Sumatera;
- Improvements in regional industry and economy;
- Providing multiplier effect to local economy, which is expected to be sustained;
- An increase in regional incomes at provincial and regencies level, through tax and non tax incomes;
- Creating job opportunities for local communities, according to company's requirements and conditions.

1.3 APPLICABLE LAWS AND REGULATIONS

The preparation of this ANDAL study is accordance with applicable laws and regulations listed in **Table I-1**:

Table I-1 Laws and regulations

Laws and regulations	*Rationale*
LAW	
Law No. 5 of 1960 regarding basic provisions of agrarian regulation. (State Gazette of the Republic Indonesia No. 104 of 1960, Addendum of State Gazette of Republic of Indonesia No. 2043)	Rights of land which will be used for this project are related to the Agrarian regulations which have been stipulated by the Government
Law No. 20 of 2002 regarding power generation	This is a basis for the development of power generation in Indonesia
Law No. 5 of 1990 regarding the Conservation of Natural Resources and its Ecosystem (State Gazette of Republic of Indonesia No. 49 of 1990 and Addendum of State Gazette of Republic of Indonesia No. 3419)	This project has to maintain the balance in the existing ecosystems, particularly in conservation areas
Law No. 14 of 1992 regarding traffic and road transportation	This project will refer to this law during construction and operation i.e. mobilization and demobilization of equipment
Law No. 23 of 1992 regarding health (State Gazette of Republic of Indonesia No. 100 of 1992 and Addendum of State Gazette of Republic of Indonesia No. 3495)	This law is a reference for health matters in general, particularly environmental health
Law No. 5 of 1994 regarding ratification on UN convention concerning biological diversity	Biodiversity concept in this law will be followed in managing biodiversity in the project location
Law No. 23 of 1997 regarding environmental management (State Gazette of Republic of Indonesia No. 68 of 1997, Addendum of State Gazette of Republic of Indonesia No. 3699)	The development of Sarulla geothermal field and power plants is an activity with potential to generate significant negative impacts to the environment. Therefore, the proponent must prepare AMDAL documents. The documents are also the basis of permitting where sanctions will be applied if violating the permit conditions
Law No. 27 of 2003 regarding geothermal energy	This law is a reference in development of Sarulla geothermal field, and the development and the operation of the power plant
Law No. 13 of 2003 on employment (State Gazette of Republic of Indonesia No. 39 of 2003, Addendum of State Gazette of Republic of Indonesia No. 279)	Employment related to the project must fulfill the terms specified in this Law
Law No. 7 of 2004 on water resources (State Gazette of Republic of Indonesia No. 32 of 2004, Addendum of State Gazette of Republic of Indonesia No. 4377)	The project will use water for its activities, which come from nearby sources
Law No. 17 of 2004 regarding ratification of the Kyoto Protocol to the United Nations Framework Convention on Climate Change	The project activities have the potential to emit greenhouse gases which are the cause of climate change

Laws and regulations	*Rationale*
(State Gazette of Republic of Indonesia No. 72 of 2004, Addendum of State Gazette of Republic of Indonesia No. 4403)	
Law No. 32 of 2004 regarding regional government	The project is located in North Tapanuli Regency, therefore any issues related to the regional government will be handled in accordance to this Law
Law No. 33 of 2004 regarding financial balance between the central and regional governments	This law regulates the financial balance of an activity for the central and regional governments
Law No. 26 of 2007 regarding spatial planning	This project will be undertaken according to the spatial planning conditions applied in the project area
GOVERNMENT REGULATION	
Government Regulation No. 41 of 1993 regarding land transportation (State Gazette of Republic of Indonesia No. 59 of 1993, Addendum of State Gazette of Republic of Indonesia No. 3527)	The project proponent will adhere to this regulation in matters related to transportation
Government Regulation No. 7 of 1999 regarding conservation of flora and fauna	This project will refer to this regulation in the management of protected fauna found in the project area
Government Regulation No. 41 of 1999 regarding air pollution control (State Gazette of Republic of Indonesia No. 86 of 1999, Addendum of State Gazette of Republic of Indonesia No. 3853)	The project has the potential to emit gases which can decrease air quality so that control measures are required in accordance to the regulation
Government Regulation No. 18 of 1999 regarding the management of hazardous and toxic wastes (State Gazette of Republic of Indonesia No. 31 of 1999, Addendum of State Gazette of Republic of Indonesia No. 3815)	The project has the potential to produce hazardous and toxic (B3)waste so that the management has to follow the regulation
Government Regulation No. 85 of 1999 regarding changes to Government Regulation No. 18 of 1999 regarding the management of hazardous and toxic wastes (State Gazette of the Republic of Indonesia No. 190 of 1999, Addendum of State Gazette of Republic of Indonesia No. 3910)	The project has the potential to produce hazardous and toxic (B3) waste so that the management has to follow the regulation
Government Regulation No. 27 of 1999 regarding environmental impact assessment (AMDAL) (State Gazette of the Republic of Indonesia No. 59 of 1999, Addendum of State Gazette of Republic of Indonesia No. 3838)	The project has the potential to generate significant negative impacts to the environment. Therefore, an environmental impact assessment study is required based on this regulation
Government Regulation No. 65 of 2001 regarding regional tax	Regional tax payment will comply with this regulation
Government Regulation No. 74 of 2001 regarding the management of hazardous and toxic material (State Gazette of the Republic of Indonesia No. 138 of 2001, Addendum of State Gazette of Republic of Indonesia No. 4153)	This project will transport, store and use materials considered as hazardous and toxic (B3). Handling of such materials will follow this regulation
Government Regulation No. 82 of 2001 regarding water quality and water pollution	The project will produce liquid waste with potential to impact water quality, therefore

Laws and regulations	*Rationale*
management (State Gazette of the Republic of Indonesia No. 153 of 2001, Addendum of State Gazette of Republic of Indonesia No. 4161)	management measures to prevent and control water pollution are required
Government Regulation No. 16 of 2004 regarding land use	The project will refer to this regulation
Government Regulation No. 38 of 2007 regarding the sharing of responsibilities between the central, provincial, and regency governments (State Gazette of the Republic of Indonesia No. 82 of 2007, Addendum of State Gazette of Republic of Indonesia No. 3747)	This project is located in a provincial area which has certain authorities as granted by the central government.
Government Regulation No. 38 of 2007 regarding the sharing of responsibilities between the central, provincial, and regency governments	Based on this regulation (Article 7 (2)), local governments have authority in environmental sector
JOINT DECREE	
Joint Decree Letter (SKB) between Minister of Mining and Energy, and Minister of Forestry No. 969/K/05/M.PE/1989, 429/KPTS-II/1989 regarding guidance in the management of mining and energy industry in forest area	This decree regulates mining and energy activities in forest area
DECREE OF MINISTER OF ENERGY AND MINERAL RESOURCES	
Decree of Minister of Mining and Energy No. KEP-1158.K/008/M.PE/1989 regarding AMDAL implementation for mining and energy sector	This project requires an AMDAL study to identify, predict and evaluate significant impacts to the environment; and to compile environmental management and monitoring plan
Decree of Minister of Mining and Energy No. KEP-103.K/008/M.PE/1989 regarding supervision of the implementation of environmental management and monitoring plan for mining and energy sector	The implementation of SOL's environmental management and monitoring plan will be supervised and evaluated according to conditions prescribed in this decree
Decree of Minister of Mining and Energy No. 01.P/47/MPE/1992, regarding open space for high and extra high voltage transmission line for electricity distribution	This project will construct high voltage transmission line and therefore will comply with this decree
Decree of Minister of Mining and Mineral Resources No. 1457K/28/MEM/2000 regarding technical guidance in environmental management for mining and energy sector	SOL activities potentially have significant impacts to the environment. The techniques in environmental management to prevent and manage the environmental impacts from SOL activities will refer to the conditions prescribed in this decree
Decree of Minister of Energy and Mineral Resources No. 45 of 2006 regarding the management of drilling mud, slurry waste and drill powder in oil and gas exploration	The management of liquid waste from drilling and production process will refer to this regulation
DECREE OF MINISTER OF DOMESTIC AFFAIR	
Regulation No. 15 of 1975 regarding land acquisition procedures	The project land acquisition procedures will refer to this decree

Laws and regulations	*Rationale*
Regulation No. 2 of 1976 regarding land acquisition for government usage by private institutions	The project land acquisition procedures will refer to this decree
DECREE OF MINISTER OF AGRICULTURE	
Decree of Minister of Agriculture No. 54/kpts/UM/2/1982 regarding tree species in forest conservation area	This project is situated in a forest area where there maybe protected tree species according to this regulation
DECREE / REGULATION OF MINISTER OF FORESTRY	
Decree of Minister of Agriculture No. 54/kpts/UM/2/1982 regarding tree species in forest conservation area	This project is situated in a forest area where there maybe protected tree species according to this regulation
Decree of Minister of Forestry No. 261/kpts-IV/1990 on addendum to the Decree of Minister of Forestry No. 54/kpts/UM/2/1972 (tree species in forest conservation area)	This project is situated in a forest area where there maybe protected tree species according to this regulation
Decree of Minister of Forestry No. 301/kpts-II/1991 on the inventory of protected fauna and its parts which are kept by individuals	This project is situated in a forest area where there maybe protected fauna species according to this regulation
Decree of Minister of Forestry No. 52/Kpts-II/2001 regarding guidance for watershed management	All project activities that will generate impacts to the watersheds will follow this decree
Decree of Minister of Forestry No. SK.44/Menhut-II/2005 regarding designation of forest area in North Sumatera Province of ± 3,742,120 (Three million seven hundred forty two thousand and one hundred twenty) hectares	The land use in the development of Sarulla geothermal field and power plant within the designated forest area will refer to this decree
DECREE / REGULATION OF MINISTER OF PUBLIC WORKS	
Decree of Minister of Public Works No. 48 of 1990 on water and water resources management of river area	The water and water resources utilization in this project will follow this regulation
Decree of Minister of Public Works No. 49 of 1990 on the procedures and permit conditions for water and water resources utilization	The use of water and water resources in this project require permits according to this regulation
Decree of Minister of Public Works No. 63/PRT/1993 on the riverbank, benefit area, river utilization area and former river area	The use of water and water resources in this project require permits according to this regulation
DECREE OF MINISTER OF TRANSPORTATION	
Decree of Minister of Transportation No. 68 of 1993 regarding the transportation of goods	This project will transport goods using road transport, not parts of the road system in the mining area, and therefore will follow this regulation
DECREE /REGULATION OF MINISTER OF ENVIRONMENT	
Decree of Minister of Environment KEP-45/MENLH/II/1996 regarding air pollution standard index	One of the potential impacts from SOL activities is air pollution. The ambient air quality will be monitored and classified according to the air pollution standard index

Laws and regulations	*Rationale*
Decree of Minister of Environment KEP-48/MENLH/11/1996 regarding noise quality standards	One of the potential impacts from SOL activities is noise. The noise level will be monitored and classified according to the noise standards specified in this regulation
Decree of Minister of Environment No. 50 of 1996 regarding odor quality standards	The construction and operation stages of this project will have impacts to odor (H_2S) and therefore the odor management will follow this regulation
Decree of Minister of Environment No. 40 of 2000 regarding guidance on the working procedures of AMDAL Evaluation Committee	The AMDAL documents will be assessed the Provincial Evaluation Committee as specified in this decree
Decree of Minister of Environment No. 41 of 2000 regarding guidance on the establishment of AMDAL Evaluation Committee at regency or city levels	This regulation provides guidelines on environmental impact assessment process by local governments
Decree of Minister of Environment No. 112 of 2003 regarding domestic wastewater standards	Domestic wastewater discharge of this project must comply with the standards specified in this decree
Decree of Minister of Environment No. 45 of 2005 regarding guidance on the preparation of Environmental Management Plan (RKL) and Environmental Monitoring Plan (RPL) implementation report	The compilation of RKL and RPL implementation reports of this project will refer to this regulation
Minister of Environment Regulation No. 8 of 2006 regarding guidance on the preparation of Environmental Impact Analysis (AMDAL) documents	The preparation of AMDAL documents (consists of KA-ANDAL, ANDAL, RKL, RPL, and executive summary) for this project will refer to this regulation
Minister of Environment Regulation No. 11 of 2006 regarding the types of business and/or activities requiring an AMDAL	Based on this regulation, it is compulsory for an exploitation and development of geothermal resources and/or the development of geothermal resources to generate electricity $\geq$ 55 MW to prepare an AMDAL. The capacity of this project is 330 MW and therefore it requires an AMDAL
Minister of Environment Regulation No. 4 of 2007 regarding wastewater standards for oil and gas, and geothermal sectors	The management of wastewater from the power plant and the production process will comply with this regulation
DECREE OF HEAD OF ENVIRONMENTAL IMPACT MANAGEMENT AGENCY (BAPEDAL = *BADAN PENGENDALIAN DAMPAK LINGKUNGAN*)	
Decree of the Head of Bapedal No. 56 of 1994 regarding guidance on significant impacts criteria	The criteria of significant impacts from SOL activities will be evaluated using this regulation
Decree of the Head of Bapedal KEP-68/BAPEDAL/05/1994 regarding procedures to acquire licenses for the storage, collection, operation of processing equipment, processing and dumping of B3 wastes	The handling of B3 wastes produced by SOL activities requires permits for storing, collecting, operating processing equipment, processing and dumping B3 wastes
Addendum to Decree of the Head of Bapedal KEP-01/BAPEDAL/09/1995 regarding procedures and technical requirements for the storage and collection of B3 wastes	B3 wastes produced by SOL operation will be stored and collected in line with the procedures and technical requirements stipulated by this regulation

Laws and regulations	*Rationale*
Addendum to Decree of the Head of Bapedal KEP-05/BAPEDAL/09/1995 regarding symbols and labeling of B3 wastes	B3 wastes from this project will be labeled following this regulation
Decree of the Head of Bapedal KEP-205/BAPEDAL/07/1996 regarding technical guidance on air pollution control for stationary sources	Emissions will be technically controlled to meet the requirements stipulated in this regulation
Decree of the Head of Bapedal KEP-255/BAPEDAL/08/1996 regarding guidelines and requirements for the storage and collection of used lubricant oil	This project's operational stage specifically on the use of lubricant oil will refer to this regulation
Decree of the Head of Bapedal KEP-299/BAPEDAL/11/1996 regarding technical guidance on the assessment of social aspects in AMDAL preparation	The assessment of social aspects in this AMDAL study will refer to this decree
Circular Letter from the Head of Bapedal No. 08/SE/02/1997 regarding the distribution of used lubricant oil	This project's operational stage specifically on the use of lubricant oil will refer to this regulation
Decree of the Head of Bapedal KEP-124/12/1997 regarding technical guidance on the assessment of public health aspects in AMDAL preparation	The assessment of public health aspects in this AMDAL study will refer to this decree
Decree of the Head of Bapedal No. 08 of 2000 regarding community participation and information disclosure in the AMDAL process	The regulation will be used as guidance in socialization and public consultation as part of the AMDAL process
DECREE OF THE HEAD OF NATIONAL LAND AGENCY (BPN = *BADAN PERTAHANAH NASIONAL*)	
Head of BPN Regulation No. 3 of 2007 regarding the implementation of Presidential Decree No. 36 of 2005 as revised in Presidential Decree No. 65 of 2006	The land acquisition process for this project will follow this decree
DECREE / REGULATION OF MINISTER OF HEALTH	
Minister of Health Regulation No. 416/MENKES/PER/IX/1990 regarding conditions and monitoring of water quality	The clean water quality for domestic use will be monitored and the monitoring results will be compared with the standards prescribed in this regulation
Decree of Minister of Health No. 876/MENKES/SK/VIII/2001 regarding technical guidance on the analysis of environmental health impact	The assessment of public health aspects will refer to the technical guidance in this decree
Decree of Minister of Health No. 128/MENKES/SK/II/2004 regarding the basic policy for public health center	The assessment of public health aspects and specification for public health center will refer to this decree
NORTH SUMATRA PROVINCIAL REGULATION	
North Sumatera Governor Decree No. 50/285/K/2002, regarding the implementation of AMDAL process in North Sumatera Province	AMDAL process for this project will refer to the requirements in this decree

Laws and regulations	*Rationale*
NORTH TAPANULI REGENCY REGULATION	
North Tapanuli Regency Regulation No. 21 of 2001 regarding spatial planning for North Tapanuli Regency area	This project will fulfill and follow the requirements stated in General Spatial Plan of North Tapanuli Regency

CHAPTER II
PROJECT AND/OR ACTIVITY PLANNING

2.1 IDENTITIES OF PROJECT PROPONENT AND AMDAL CONSULTANT

2.1.1 Identity of project proponent

Company	:	SARULLA OPERATIONS Ltd. (SOL)
Address	:	Graha Niaga 8th Floor Jl. Jend. Sudirman Kav. 58 Jakarta 12190 - Indonesia
Telephone	:	021-2505459
Facsimile	:	021-5225977
Person in charge	:	Aries Pardjimanto
Position	:	Director

2.1.2 Identity of AMDAL consultant

2.1.2.1 Company profile

Company	:	PT. ERM Indonesia
Address	:	Wisma Aldiron Dirgantara 2nd Floor, Suite #238-239, Jl. Jend. Gatot Subroto Kav.72, Jakarta 12780, Indonesia
Telephone	:	021–7918 1904
Facsimile	:	021–7918 1905
Person in charge	:	Luiz Guimarâes
Position	:	President Director

2.1.2.2 Study team composition

This AMDAL study was conducted by PT ERM Indonesia with the team composition as follows:

Team leader	:	Dr. Yahya Husin, BSc., MS (AMDAL A and B)
Resource person	:	Prof. Dr. Alexander Ternala Barus (USU)

Study team:

1. Geophysical chemistry

Hydrology	: Ir. Hafid Hadi, MM (AMDAL A, B)
Geology	: Budi Hadi, ST
Soil and physiography	: Ir. Hafid Hadi, MM (AMDAL A, B)
Air quality, noise and meteorology	: Dra. Eva Marlina Ginting, M.Si (AMDAL A and B)
Water quality	: Dr. Yahya Husin, BSc. MS (AMDAL A and B) Muhammad Nizar, ST

2. Biology

Terrestrial biota	: Ir. Abu Bakar Siddik Harahap, MSi (AMDAL A)
Aquatic biota	: Rafeldy Noviar, SSi, (AMDAL A)

3. Socio-economic, socio-cultural and public health

Socio-economic	: Ir. Syarif Bastaman (AMDAL B)
Socio-cultural	: Dra. Sri Alem Sembiring, MSi
Public health	: Drs. Heru Santoso, MSi

2.2 PROJECT DESCRIPTION

2.2.1 SOL project location

This AMDAL study covered the development of Sarulla geothermal field, the development and operation of geothermal power plants (SIL and NIL power plants) and the transmission line between SIL and NIL. The AMDAL was prepared alongside the technical feasibility study for power plant development.

In relation to Regency Spatial Plan, the Government of North Tapanuli Regency issued North Tapanuli Regency Regulation No. 19 of 1994 regarding North Tapanuli Regency spatial planning, which designated the districts of Pahae Jae, Tarutung and Pahae Julu as areas of geothermal natural resources. This status was strengthened by Decree of Regent of North Tapanuli Regency No. 334 of 1997 on 3 February 1997, regarding the designation of locations to PERTAMINA – geothermal area EP Sibayak as geothermal drilling location and the preparation area for power plant in Silangkitang, Pahae Jae District. North Tapanuli Regency Regulation No. 21 of 2001 regarding North Tapanuli

Regency spatial planning stated that Pahae Jae and Pahae Julu Districts are areas for the development of geothermal field.

The Silangkitang field (SIL) has three (3) existing well pads developed by the former project proponent, UNSG. The pads are SIL 1, SIL 2 and SIL 3 and located in these coordinates:

SIL 1 - N201,374 and E510,500;

SIL 2 - N202,126 and E508,614;

SIL 3 - N199,925 and E510,910.

SIL is located in Pahae Jae District, North Tapanuli Regency. The pad locations can also be described as follow:

- SIL 1 - located in Silangkitang Village, about 50 meter from Sumatera Highways (Tarutung – Sipirok);
- SIL 2 - located at the north-east of SIL 1, on the side of Aek Batang Toru which is part of Sigurung-gurung Village;
- SIL 3 - located at the south of SIL 1, in Pardomuan Nainggolan Village.

SIL 1 has three existing wells i.e. SIL 1-1, 1-2 and 1-3. SIL 1-2 and 1-3 are planned as production wells for SIL PLTP. Additional production wells will be drilled in this same pad to obtain the geothermal fluid quantity needed for SIL PLTP.

SIL 1-1 is intended to be one of the reinjection wells. Reinjection well is used to collect the geothermal fluid discharged or used in the PLTP in the forms of brine and condensed steam, or mixed of brine and/or condensate. The well at SIL 2 i.e. SIL 2-1 is part of the additional wells that will be drilled during the construction phase and will also be used as injection wells. SIL 3-1 at SIL 3 will be used as a backup injection well.

During the preconstruction stage, SIL 1-2 and 1-3 will be reconstructed to improve its casing conditions. All existing wells will be checked for blockages to prevent clogging since geothermal wells not in operation may get clogged.

Namora I Langit (NIL) field has three (3) existing well pads. The pads are NIL 1, NIL 2 and NIL 3 and located in these coordinates:

NIL 1 - N207,509 and E501,941;

NIL 2 - N208,245 and E501,131;

NIL 3 - N208,745 and E503,328.

The pad locations can also describe as follow:

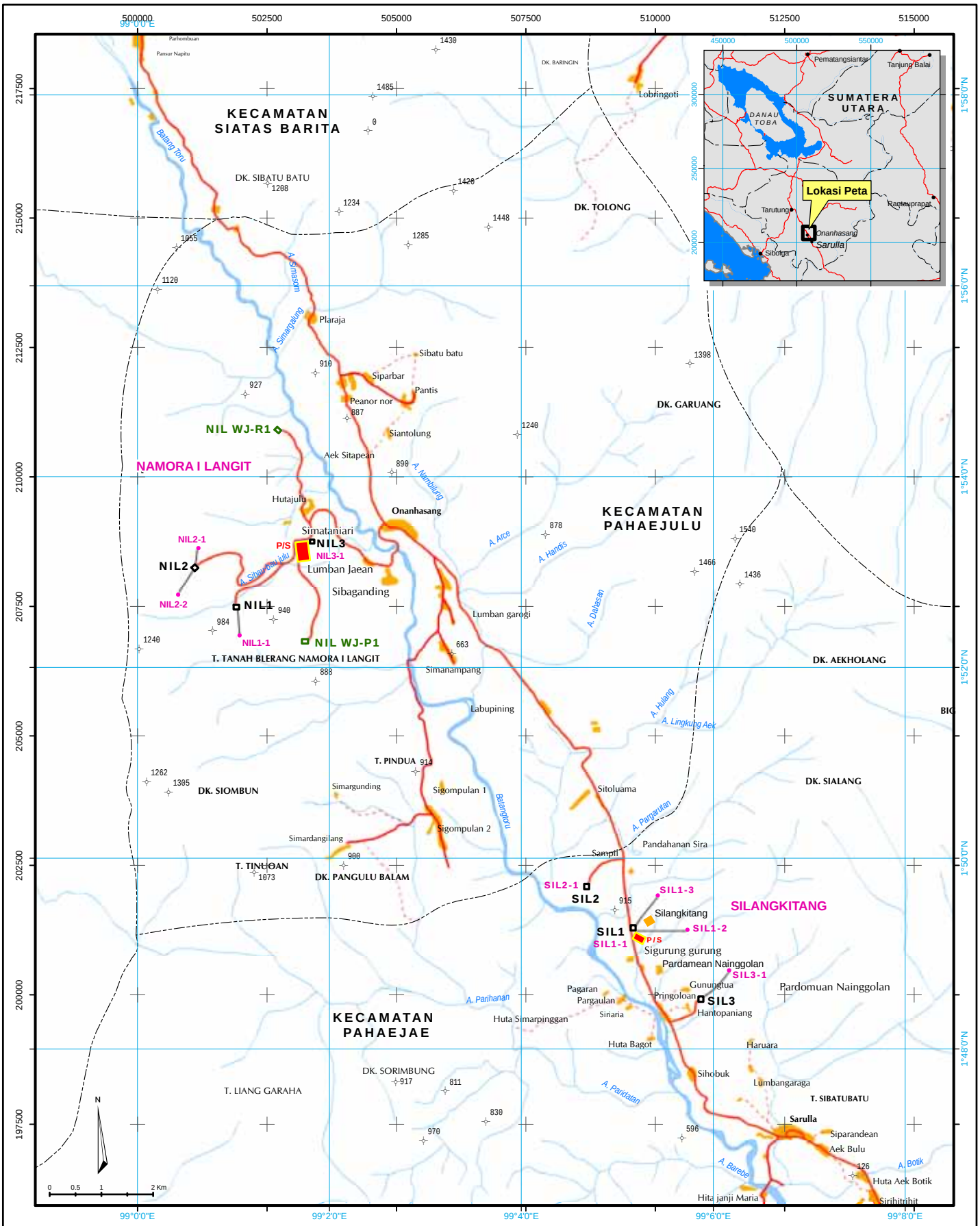
- NIL 1 - located in Sibaganding, Lumban Jayan, and Simataniari Villages (there is one investigation well);
- NIL 2 - located in Sibaganding, Lumban Jayan, and Simataniari Villages (there are two investigation wells);

- NIL 3 - located in Sibaganding, Lumban Jayan, and Simataniari Villages (there is one investigation well).

Administratively, NIL is located in Pahae Julu District, North Tapanuli Regency.

NIL 1 and NIL 2 will be used as production wells and the project aims to develop further wells at these pads. NIL 3 will be used as reinjection well. A new reinjection well will be developed in NIL at N206,864 and E503,205.

A map illustrating the development plan for Silangkitang (SIL) and Namora I Langit (NIL) geothermal fields is shown in **Map II-1**.



Legenda
Legend

- Titik Ketinggian — *Elevation Point*
- Jalan Arteri — *Arteri Road*
- Jalan Kolektor — *Collector Road*
- Jalan Lokal — *Local Road*
- Batas Kecamatan — *Kecamatan Boundary*
- Sungai — *River*
- Permukiman — *Village*
- Sumur Eksplorasi Namora I Langit dan Silangkitang — *Namora I Langit and Silangkitang Exploration Wells*
- Lokasi Sumur Baru (West JEC) — *New Well Site (West JEC)*
- P/S Pembangkit Listrik — *Power Station*

Keterangan :
Note :

DK : Bukit — *Hill*
Aek : Sungai — *River*
T. :Tinggi — *Elevation*

Sumber (Source) :

Peta Topografi - BAKOSURTANAL, 1977, Skala 1 : 50,000.
Medco Geothermal Indonesia

ANALISIS DAMPAK LINGKUNGAN
ENVIRONMENTAL IMPACT STATEMENT

LOKASI LAPANGAN SILANGKITANG (SIL) DAN NAMORA I LANGIT (NIL)

POWER PLANT OF SILANGKITANG AND NAMORA I LANGIT

Skala *Scale*	1 : 100.000	Digambar Oleh *Drafter*	GGG
Peta *Map*	II - 1	Diperiksa Oleh *Proofreader*	ABU
Tanggal Revisi *Date Revision*	23/10/08	Digabung Oleh *Compilation*	ERM

2.2.2 *Stages of project activity*

The development of Sarulla geothermal field and 330 MW power plant includes the following activities:

- The development of Sarulla geothermal field i.e. Silangkitang (SIL) field and Namora I Langit (NIL) field;
- The construction and operation of 330 MW geothermal power plant, one unit at SIL and two units at NIL each with a capacity of 110 MW;
- The construction of 150 kV (high voltage) transmission line from Silangkitang field (SIL 1) to Namora I Langit field (NIL 1), with an approximate distance of 15 km.

Drilling activity for new production and injection wells will mostly take place at the existing well pads previously developed by UNSG. Some will be in new areas, such as in NIL. A majority of the development areas at NIL are farmland whilst at NIL are a combination of farmland and mixed forest.

The power plant locations for both SIL and NIL will be at plantation areas whereby the power plant at SIL will be located at community plantation areas whilst at the power plants at NIL will be at mixed plantation areas. SIL is situated approximately 500 meter from the nearest residential area whilst NIL is located far from a residential area. The project schedule for the development of Sarulla 330 MW power plant at SIL and NIL is displayed in **Table II-1**.

Table II-1 Project schedule for the development of Sarulla 330 MW power plant at Silangkitang (SIL) and Namora I Langit (NIL)

Time / *Activity*	*Month*						
	0	+10	+20	+30	+40	+50	>50
Preconstruction							
Construction							
SIL							
NIL 1							
NIL 2							
Operation							
SIL							
NIL 1							
NIL 2							

2.2.2.1 Pre-construction stage

2.2.2.1.1 The development of Sarulla geothermal field

This activity consists of preliminary study, detailed construction design, and land acquisition.

1) Preliminary study

a. Technical planning

Technical planning includes:

- Planning of equipment for geothermal fluid production such as wells, separators, brine accumulators, distribution valves, and safety devices for geothermal field;
- Planning of equipment to anticipate abnormal conditions in steam production process;
- Planning to distribute geothermal fluid to power plants and reinjection from power plants to reinjection wells.

b. Topographic measurement

This is to designate positions, area and determination of the subsequent construction boundaries including supporting facilities at the proposed well locations i.e. pipelines, roads, and transmission line.

c. Project socialization

The following consultation activities were conducted to socialize the development of Sarulla geothermal field and 330 MW power plant:

- Project socialization at Silangkitang on 5th February 2008;
- Public consultation in relation to AMDAL preparation in Pahae Julu on 28th March 2008;
- Project socialization with government institutions in Tarutung on 6th May 2008;
- Project socialization regarding land acquisition process for reinjection route on 6th June 2008;
- Socialization of well workover activity in Silangkitang on 15th July 2008;
- Well workover ceremony in Silangkitang on 15th August 2008;
- Socialization of the land acquisition process in Silangkitang on 27th September 2008.

2) *Construction design*

This stage consists of a feasibility study and technical design on the development of Sarulla geothermal field which will supply geothermal fluid to power plants.

Geotechnical investigation includes field investigations, laboratory testing, analysis and recommendations to understand the subsurface conditions for design and construction planning for the preparation of project location and civil engineering work.

3) *Land acquisition*

The land acquisition process will be undertaken in stages as the construction of the geothermal field progresses. The process will be conducted using direct negotiations and agreements between land owners and SOL, facilitated by the government of North Tapanuli Regency. A total of 66.9 ha land, located in the districts of Pahae Jae and Pahae Julu, North Tapanuli Regency. Power plants construction, employee residential area, landfill, construction worker accommodation area, well pads, and access roads at SIL and NIL to well locations will require another 50.5 ha of lands out of a total of 117.4 ha that is still needed. The land use plan for the development at SIL and NIL is shown in **Table II-2**.

Table II-2 Land use plan and area required for SIL and NIL

No.	*Location*	*Land Use Planning*	*Required Area (m^2)*
1	Silangkitang	Brine injection pipeline	42,000
T O T A L			**42,000**
2	Silangkitang	Power plant	80,000
3	Silangkitang	Employee residential area	40,000
4	Silangkitang	Landfill	61,250
5	Silangkitang	Construction worker accommodation area	9,000
6	Silangkitang	Access road	5,000
T O T A L			**195,250**
8	Namora I Langit	Power plants	210,000
9	Namora I Langit	Expansion of 3 existing areas	15,000
10	Namora I Langit	Access road to WJP1	40,000
		New well pad of WJP1	15,000
11	Namora I Langit	Access road to WJR1	20,000
		New well pad of WJR1	10,000
12	Namora I Langit	Transmission tower (25mx25m) x 50 towers	40,000
13	Namora I Langit	Base camp	30,000
14	Namora I Langit	Landfill	50,000
15	Namora I Langit	Other supporting roads	42.000
T O T A L			**472,000**

SOL will identify and survey all areas already acquired based on the standard of compensation for assets and properties provided by Agricultural Agency of North Tapanuli Regency. The standard will be used as a reference in the negotiation and compensation.

2.2.2.1.2 Construction of geothermal power plant

SOL will construct, operate and maintain a power plant at 330 MW total installed capacity. To fulfill the capacity, three unit power plants will be constructed where each will generate approximately 110 MW. The first unit will be built at SIL and another two units at NIL.

1) Preliminary study

Based on the geothermal conditions of each well and wells spread rate curve (wellhead pressure vs. flow rate and enthalpy), separator pressure is calculated to obtain the most effective power generation configuration in order to minimize project cost.

This stage consists of three phases of power plant construction, one plant at SIL and two plants at NIL. Each power plant has a capacity of 110 MW (a total of 330MW) and each consists of one Ormat Geothermal Combined Cycle Unit (GCCU) unit, plus two Ormat Energy Converters (Brine OEC) units. A GCCU consists of one backpressure steam turbine generator and four Bottoming OECs.

Sarulla power plant will use air cooled condenser from OEC. Hence, Sarulla power plant will not require make up water. All brine water and steam condensate will be injected into the ground through reinjection wells and pH will be controlled by H_2SO_4 addition to avoid scaling formation. The quantity of acid will depend on the characteristic of brine and condensate mixture.

A diagram of Geothermal Combined Cycle Unit (GCCU) and Ormat Energy Converter (OEC) technology is shown in **Figure II-1**.

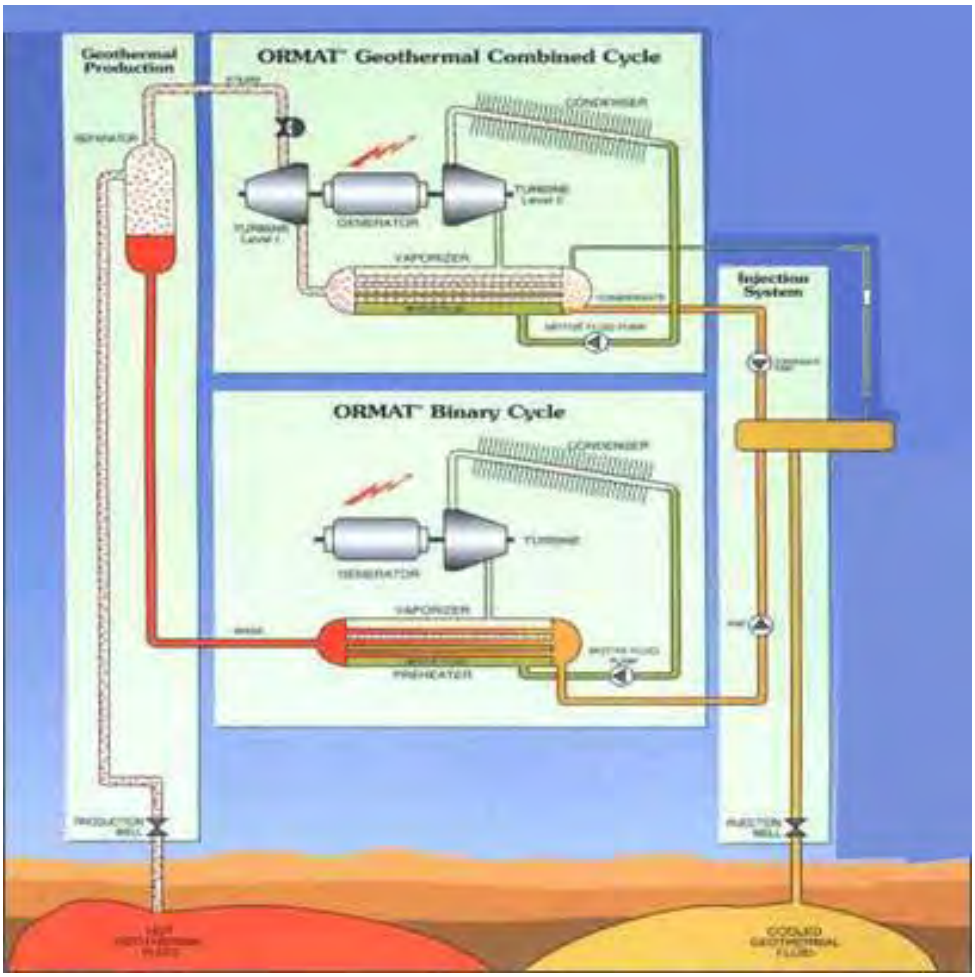


Figure II-1 Typical diagram of Geothermal Combined Cycle Unit (GCCU) and Ormat Energy Converter (OEC) technology

2) Land acquisition

The land required for the power plant construction is already taken into account in the land acquisition process for the development of geothermal field and construction of access roads. In the construction plan, one power plant unit will be built at SIL and two units will be built at NIL where each will have a capacity of 110 MW (a total of 330 MW). The amount of land required for the power plants is approximately 7 ha for SIL and 12 ha for NIL (a total of 19 ha).

2.2.2.1.3 Transmission line construction between SIL and NIL

1) Land acquisition

The process will be conducted using direct negotiations and agreements between land owners and SOL, facilitated by the government of North Tapanuli Regency. The land required to build the transmission towers is not yet purchased. The plan is not to use productive land, cemetery or residential areas.

The purchased land will be used as platforms for transmission tower and not for transmission lines. Approximately 40 towers will be built with 3 towers per 1 km. It is estimated that each transmission tower will require 225 m^2, and therefore the total of land required for 40 towers is 2 ha.

2.2.2.2 *Construction stage*

2.2.2.2.1 *Sarulla geothermal field development*

This stage involves construction of new well pads, access roads, improvement of existing well pads, drilling of new wells, and installation of associated well pad equipment such as separators, accumulators, pipelines for well production testing. The construction will take 4 years.

1) Workforce recruitment

The number of workforce who will be involved in the development of Sarulla geothermal field is approximately 100 – 150. This consists of 5% for administration, 30- 40% as supervisors and technicians, and 55-65 % as staff.

Table II-3 Estimated workforce required during SOL project

No	Activity	Estimated workforce required				
		Expatriate	Manager/ Engineer/ Supervisor	Skilled/ Semi Skilled	Worker	Total
I	**Drilling**					
1	Construction	6	18	381	195	600
2	Operation	2	6	127	65	200
II	**Power plant**					
1	Construction	10	70	920	400	1400
2	Operation	2	38	140	20	200
III	**Transmission line**					
1	Construction	2	18	250	30	300
2	Operation	-	-	-	-	-

2) Mobilization of equipment and materials

Construction activities start with mobilization of equipment and materials that will be used in the project. The equipment to be mobilized is:

- Earth-moving equipment such as dozers, loaders, dumptrucks, excavators, etc;
- Drilling equipment and its associated facilities such as cementing units, diesel generators, pumps, etc;
- Mechanical construction equipment such as cranes, welding machines, cutting torches, etc.

Other equipment and materials required in the field development activities will also include:

- Drill pipes and casing;
- Cementing material;
- Additional drilling materials;
- Commonly used construction materials, i.e. lumber, reinforcing and structural steel, concrete, etc;
- Pipes, insulation materials, isolation materials etc.

Whenever possible, materials used in this project will be supplied locally. If not, the materials will be supplied from the nearest area. Materials will be transported inland by trucks using the route Medan–Tarutung – Sarulla towards storage facility around project location in SIL and NIL.

3) Land preparation

The land preparation consists of two main activities as follows:

- Vegetation clearing;
- Land clearance and removal.

Considering that the current land use is a combination of farmland, plantation or dry land (*tegalan*), and bushes, tree cutting will be at a minimum. Typically, the tree species that will be cut down after completion of the compensation process include rubber, pines, coffee, fruit, and small tree grades.

Stripped soil from the project site will be placed in a disposal area where new trees will be re-planted and some parts of the disposal area will be used for supporting facility area.

4) Civil engineering construction

a. Civil engineering construction

1) Improvements of Sumatera Highways roads and bridges at project location

Due to mobilization of heavy equipment, improvements and reinforcements of Sumatra Highways roads and bridges at the project location (Sarulla) will be undertaken if necessary, based recommendations given by contractors following inspections of connecting roads and bridges.

Existing bridges on access road to NIL will be reinforced or renovated to allow for mobilization of heavy equipment.

2) Well pad foundation

This includes foundation for well pad equipment such as separators, foundation accumulators, pipe supports, etc.

b. Access roads and well pads

1) Access road and well pads preparation

Improvements and reinforcements of roads to the well pads and new road building will be undertaken if necessary in order to mobilize equipment and materials needed to prepare the land for the well pads and well construction.

Well pads, mudpits for the circulation of drilling mud and disposal of drilling cuttings, and supporting facilities will be prepared and constructed during this stage.

The well pads will be prepared by removing top soil, grading and leveling. Both new pads and extensions of the existing well pads will be equipped with mud pits and cellars for additional wells, etc.

In the development of Sarulla geothermal field, the development and operation of power plant, 10 wells and 25 wells at SIL and NIL respectively will be drilled, as production and reinjection wells (**Table II-4**).

It is assumed that the success rate of production wells is 90%, and therefore the number of drilling failure is 1 for SIL and 2 for NIL.

Table II-4 Numbers of wells to be drilled at SIL and NIL

Well pad	*Numbers of wells*			*Output Capacity Target (Mwe)*	*Average Well Capacity (Mwe/Well)*
	Existing	*New*	*Total*		
SIL					
Production	2	3 (included 1 failure)	5	110	27.5
Reinjection	0	5	5	For total liquid to be injected	-
NIL					
Production	0	19 (included 2 failures)	19	220	12.9
Reinjection	0	6	6	For total liquid to be injected	-

Source: West JEC Table 3.1.1-1
Note: Numbers of wells may change subject to well testing results

Basic designs for access road are illustrated in **Figure II-2** and shown in **Table II-5 and Table II-6.**

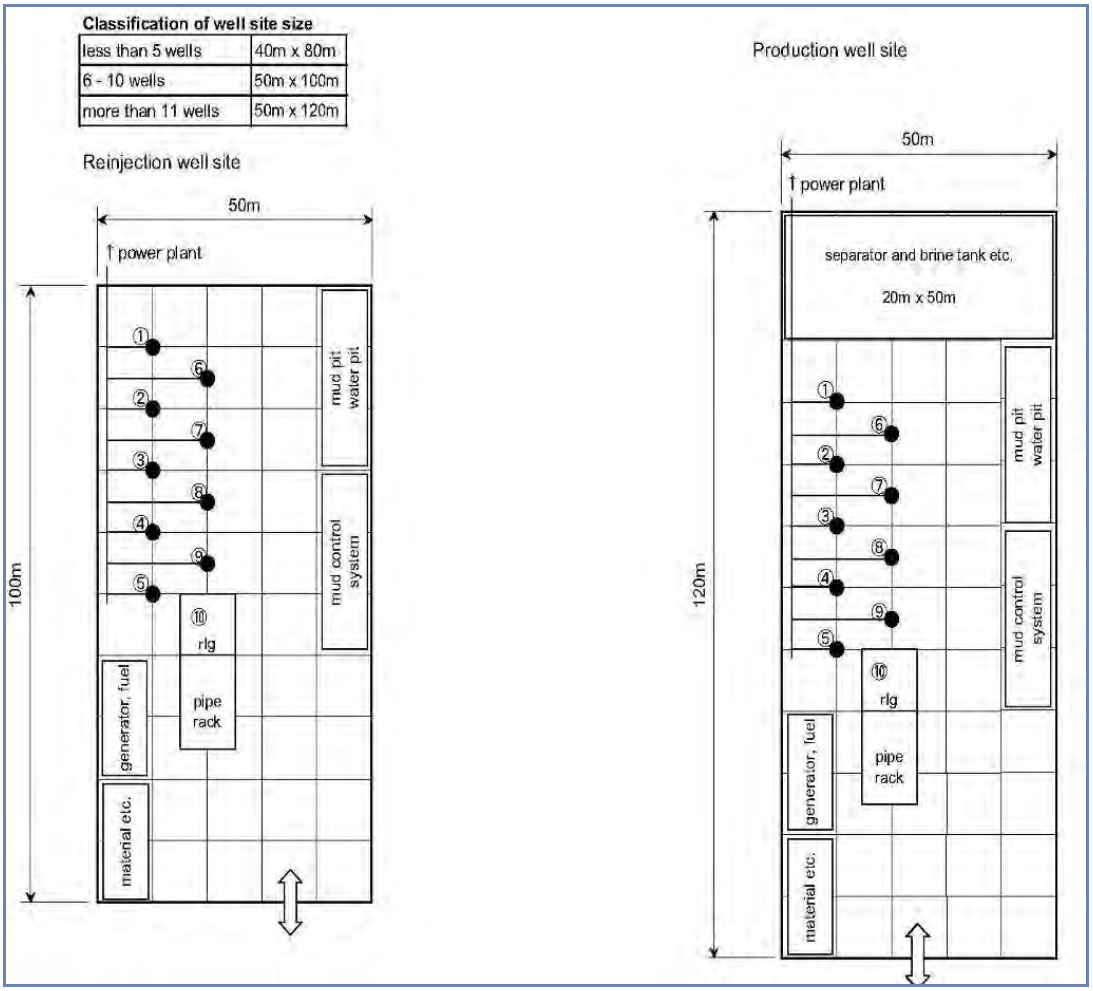


Figure II-2 Well pad layout

Source: WestJEC, 2007

Table II-5 Civil engineering work for access roads

No.	Description	Approximate Width (m)	Approx. Length (m)	Note
1	Existing access road (Main road – SIL 2)	5	1,000	Repaired
2	Main road to P/P (NIL)	6	4,400	Repaired, + bridge
3	Existing access road (NIL 1 – NIL 2 – NIL 3)	5	5,000	Repaired, +2 bridges
4	P/S (NIL) to NIL WJ-R1	5	2,300	Repaired
5	P/S (NIL) to NIL WJ-P1	5	2,100	New road

P/S = Power Station
Source: WestJEC, 2007

Table II-6 Civil engineering work for well pads

No.	Pad	Initial Area	Required Area Approx.	Additional Area	Note
1	SIL 1	40m x 120m = 4,800m²	40mx 180m = 7,200m²	2,400m²	Expanded and repaired
2	SIL 2	30m x 80m = 2,400m²	40m x 80m = 3,200m²	800m²	Expanded and repaired
3	NIL 1	50m x 100m = 5,000m²	50mx 120m = 6,000m²	1,000m²	Expanded and repaired
4	NIL 2	40m x 80m = 3,200m²	50mx 120m = 6,000m²	2,800m²	Expanded and repaired
5	NIL 3	50m x 100m = 5,000m²	5,000m²	0	Repaired
6	NIL WJ-PI	0m²	40mx 100m = 4,000m²	4,000m²	New pad
7	NIL WJ-RI	0m²	40m x 80m = 3,200m²	3,200m²	New pad

Source: WestJEC, 2007

The size of the well pad depends on the number of wells, and hence, extensions are needed for a number of well pads.

2) Production well Pads

Four production well pads are initially required to develop these areas where three of the well pads are already exist i.e. SIL 1, NIL 1 and NIL 2. The new proposed well pad is NIL WJ-P1, located about 1 km south east from NIL 1.

Regardless of the distance required for drilling, a well pad site must have a sufficient size (around 25m x 40m) to facilitate the separator and other supporting facilities (**Figure II-2**).

3) Reinjection well pads

Four reinjection well pads (2 pads at SIL and 2 pads at NIL) are required for the start-up wells where three are existing pads (SIL

1, SIL 2 and NIL 3). These pads will be located far from the production area to minimize the risk of reservoir cooling. One new proposed pad, WJ-R1, will be built at NIL.

4) Constructions of temporary facilities – worker accommodation area and working area

Contractor will provide all temporary facilities, including offices, worker accommodation area, storage materials area, and working area.

5) Disposal area

All unused or excess materials during construction activity will be collected and deposited in a landfill by the contractor.

6) Temporary drainage during site preparation

Temporary drainage system will be provided by the contractor during the site preparation construction work. The system will include temporary ditches, collection pits and sedimentation basins for mud water treatment.

c. Drilling and production test

Drilling is conducted to prepare production and reinjection wells. It is anticipated that 35 wells will be drilled at SIL and NIL. The drilling will use a conventional drilling rig, equipped with outpouring prevention equipment and H_2S detection tool, to drill up to 3,500 meter.

The drilling activities will utilize water from Batang Toru River approximately 400m^3 for each well.

The drilling process will use water based mud to prevent the borehole walls from caving during drilling. At certain depths, well casing will be installed to prevent caving of the borehole, and to prevent leakage from or to soil and rock formations. After the drilling is completed, wellhead will be equipped with tools to control fluid flow rate from the well. The chemicals used will have MSDS (*Material Safety Data Sheet*). The procedures to manage drilling mud, mud waste and cuttings will refer to Regulation of Minister of Energy and Mineral Resources No. 45 of 2006.

After the drilling is completed, production tests will be carried out at each well pad. Wellhead equipment for well testing consist of wellhead separators, flow rate measuring equipment for steam and brine, sampling equipment for steam and brine, steam muffler, brine muffler, etc.

Geothermal fluids from production wells will be separated into steam and brine in a separator. During production test, steam will be discharged through a steam muffler, while separated brine will be re-injected to reinjection wells. The main equipment at a well pad is a separator for power plant operation. The separated steam and brine from separator will be transported to the power plant to generate electricity.

Figure II-3 and **Figure II-4** illustrate types of casing for production and reinjection wells respectively. The time required to drill one production well using a conventional drilling rig up to 3,500 m depth is typically 1.5–2 months.

Equipment used in the drilling activity can be classified as the main equipment and supporting equipment. The main equipment is a conventional drilling rig, which consists of a number of components with its own functions and connected to each other. The estimated workforce required is 200-300 people.

Chemicals required for drilling activity consist of water based mud and cementing materials. The types and the amounts of the chemicals required depend on the depth and the characteristics of the drilled formations. The typical chemicals required are as follow:

- Barite;
- Bentonite;
- Caustic soda;
- Sodium bicarbonate;
- High temp defloculent;
- High temp fluid (control additive).

Each chemical has its own MSDS and most of the chemicals are categorized as non-hazardous and non-toxic (non-B3) based on a list published by the United States Environmental Protection Agency (US-EPA). Storage and treatment of these chemicals and their residuals will refer to the associated MSDS.

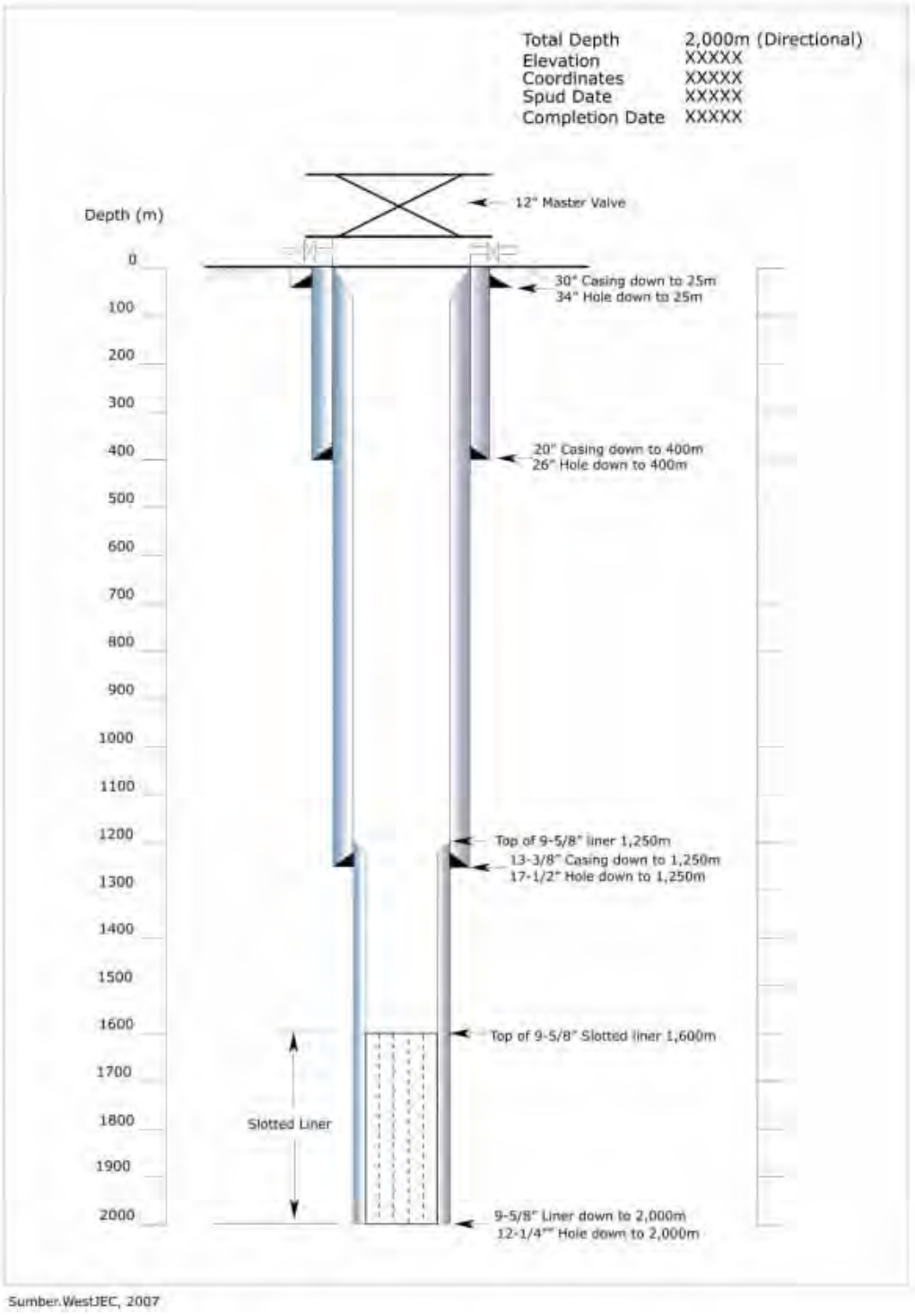


Figure II-3 Typical casing for production well (at SIL and NIL)

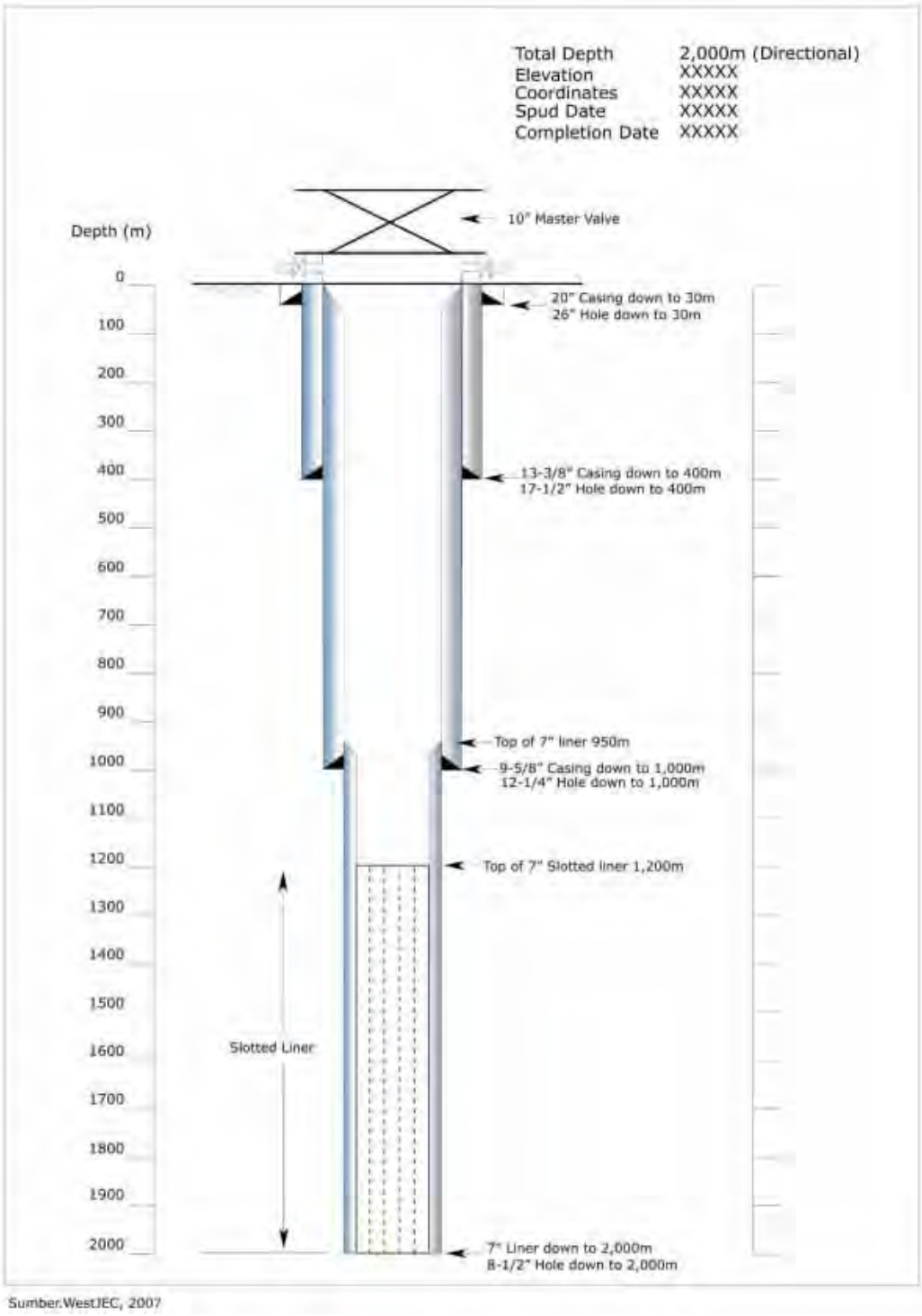


Figure II-4 Typical casing for reinjection well (at SIL and NIL)

2.2.2.2.2 Construction of geothermal power plant

1) Workforce recruitment

A total of 1,400 employees will be needed during the peak of the construction stage.

2) Mobilization of equipment and materials

Heavy equipment will be transported from Medan using the existing road network i.e. Sumatera Highways (Medan–Tarutung). The proposed route is Belawan Port –Medan – Deli Serdang – Serdang Bedagai – Tebing Tinggi – Pematang Siantar – Parapat – Balige – Tarutung – Sarulla project locations (Pahae Julu and Pahae Jae).

The major power plant equipment such as turbines, generators, transformers, and other equipment will be imported.

Whenever possible, materials used in this project will be supplied locally. Materials will be transported inland by trucks.

Construction materials and equipment, if available, will be supplied locally. Equipment and materials mobilization will be transported through land roads and will use sufficient capacity trucks.

3) Land preparation for power plant and employee residential area

The sites will be prepared by removing all the top soil, grading and leveling to the required elevations. At NIL, an inventory of tress already undertaken, and the land clearing including tree cutting and leveling will be carried out according to the applicable regulations. Details of the land required for power plant sites and employee residential area are shown below:

- SIL (see **Figure II-5**)

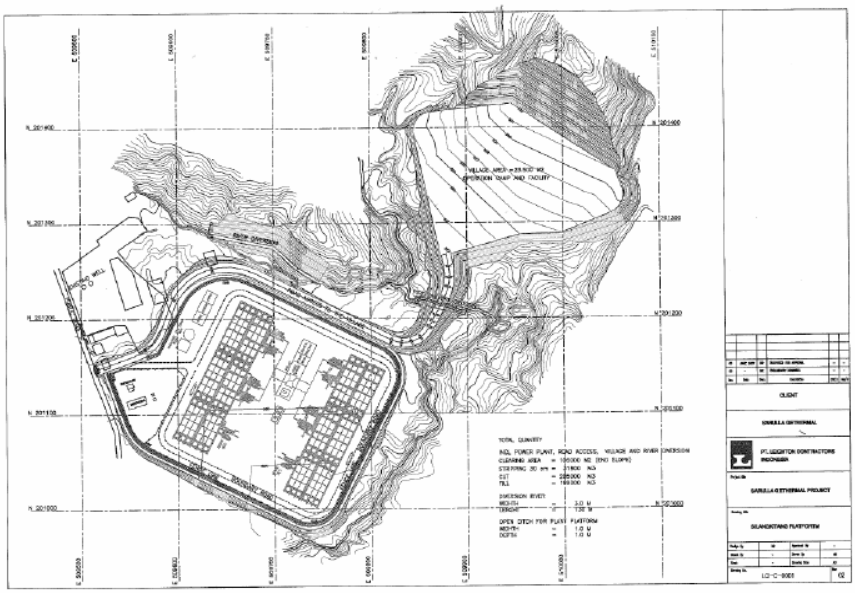
  Area : about 265m x 300m
  Elevation : 537m above sea level
- NIL (see **Figure II-6**)

  Area : about 460m x 300m
  Elevation : 830m above sea level
- Employee residential area (see **Figure II-5**)

  Area : about 2 ha

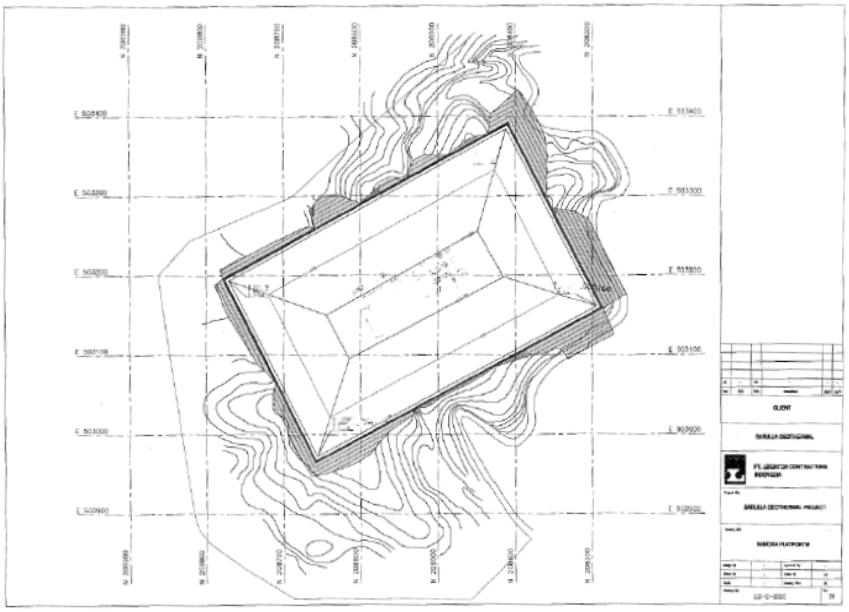
The land preparation stage will cover the foundations within the power plant complex such as the power plant itself, steam turbine, air cooled condenser, pipelines, switchyard, office and administrative buildings.

The land for the power plants will be prepared at the same time as the land preparation for the development of geothermal fields at SIL and NIL.



Source: WestJEC, 2007

Figure II-5 Site plan for SIL and employee residential area



Source: WestJEC, 2007

Figure II-6 Site plan for NIL

4) Power plant construction

The construction stage will include civil engineering work and building construction. Civil engineering work will be undertaken along the roads towards the direction of the power plant and other supporting facilities.

Gravel and sand required will be taken from a quarry with license from the authority. The civil engineering work includes:

- Land preparation, covering road construction towards the power plant, power plants construction, steam separator facility and other supporting facilities;
- Improvements of existing and new access roads to the power plant locations and well pads;
- Constructions of the power plant office buildings and supporting facilities.

The construction will be designed and built according to guidelines for earthquake resistance buildings (SNI 03-1726-2002) or other international standards.

5) Mechanical and electrical constructions

Mechanical construction includes installations of power plant equipment such as: steam turbine generator and supporting tools, OEC units, condenser with air cooler, overhead crane, etc.

Electrical construction includes assembly and installation of generator, control system and relays, transformers, switchgears, and lighting facility.

Other activities include painting and installation of pipe insulator. The insulator will be used to stabilize the temperature and pressure of steam and brine from wells to power plants.

2.2.2.2.3 Construction of transmission line between SIL and NIL

1) Workforce recruitment

Workforce is needed to mobilize equipment and materials, land preparation, and installation of transmission. The number of workforce required at the peak of this activity is between 200-300 people.

2) Mobilization of equipment and materials

The mobilization will be using existing road network. Whenever possible, materials used in this project will be supplied locally. If not, the materials will be supplied from the nearest area. Materials will be transported inland by trucks using the route Medan – Tarutung – Sarulla towards storage facility around project location.

3) Land preparation

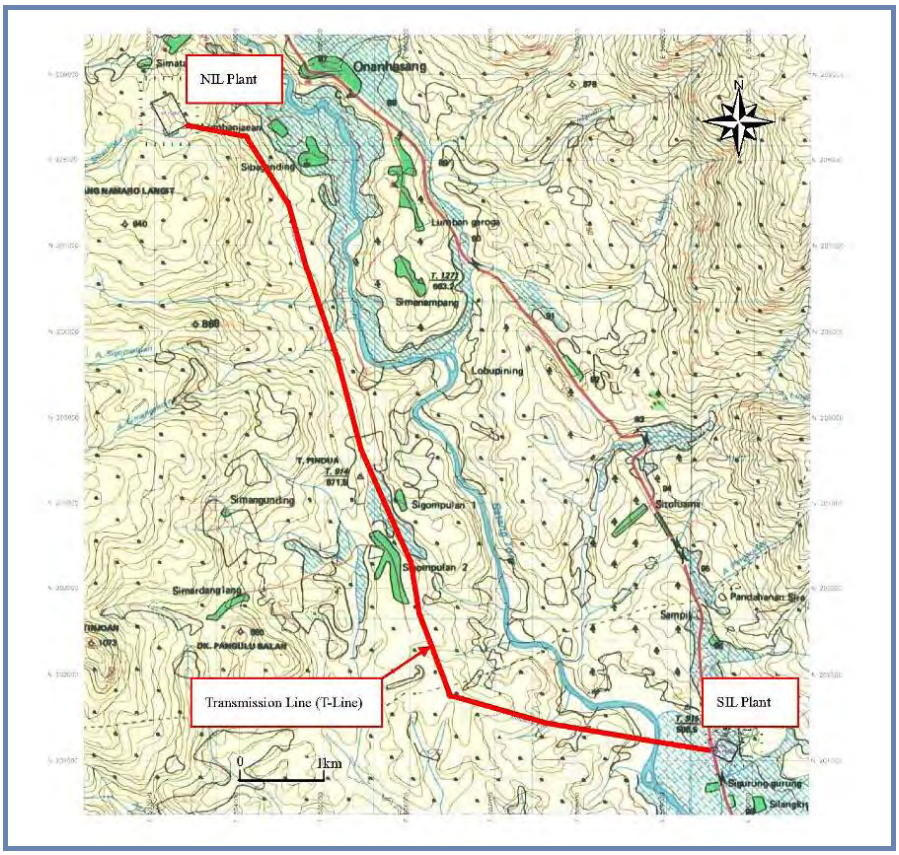
The land preparation consists of two main activities i.e. vegetation clearing, and land clearance and removal.

Land will be prepared not for the whole transmission line (15 km) but at certain locations i.e. areas for transmission towers. Equipment required will include wood cutting machine, machete, and typical heavy equipment.

4) Installation of transmission tower

This activity consists of constructions of towers for the High Voltage Transmission Line. The towers will be constructed at certain distances. The transmission line with capacity of 150 kV and approximate length of 15 km will connect SIL and NIL.

Interconnection point between PLN and Sarulla power plants will be at the dead end tower at NIL (**Figure II-7**).



Source: WestJEC, 2007

Figure II-7 Transmission line connecting SIL and NIL

2.2.2.2.4 Environmental impact management

1) Waste debris

Construction debris collected during the construction stage will be mounted up in a specific project area. The disposal method for the waste debris will be land fill, incineration, third-party services contracting, etc.

Stripped soil generated during the civil engineering construction will be utilized as the soil generated from construction of the geothermal field i.e. cut and fill.

Solid waste i.e. iron and wire will be collected and stored in the project disposal area which will be integrated with the storage areas for construction and transmission waste.

2) Domestic waste

Domestic waste from the construction stage will be accumulated in a temporary storage area in the project location. It will then be removed to a final and closest disposal area by a third party after a permit is granted.

2.2.2.3 Operation stage

2.2.2.3.1 The development of Sarulla geothermal field

The operation stage is to operate the steam production system to generate electricity. The system consists of production sources, well heads, safety valves, pipe lines, separators and brine accumulator units, and control tools.

Geothermal fluid from reservoir will be channeled to separators in order to separate steam and brine at an optimum pressure. Both steam and brine are used to generate electricity at 330 MW capacity. In an emergency situation, a brine storage pond will be used as a temporary reservoir before pumping the brine to re-injection well.

During the operation stage, additional wells and well pads will be constructed, in order to anticipate the decrease in the quality of the production and reinjection wells. Based on research undertaken, it is expected that productivity of a well is 30 years.

2.2.2.3.2 Power plant operation stage

Steam from SIL and NIL is exploited from a geothermal reservoir. The steam is separated into steam and brine which will then sent to the power plants to generate electricity. Before the steam is sent to the turbine, it is purified in a separator to maintain a dryness of ±99.95% and non condensable gas (NCG) contents of ±2.1% weight in SIL and ±3.7% in NIL.

a. Employee recruitment

Workforce required at an operation stage is significantly smaller than at a construction stage because the equipment system will be supported with an automated computer system. It is estimated that the workforce required is 200, which includes SOL employees and unskilled workers.

b. Commissioning

Commissioning or testing is one of the project's milestones. This activity will include equipment test, functional test, protection test, interlock test,

etc. All relevant stakeholders will be involved during the commissioning. PLN representative also will be invited to witness the Unit Capacity Test.

Steam collection will be carried out in stages for an 18 months period, which will include 6 stages from the beginning of production to the maximum capacity of 330 MW.

c. Operations of steam turbine and condenser with Geothermal Combined Cycle Unit (GCCU) and Ormat Energy Converter (OEC)

The power plant will use a single flow backpressure turbine, with rotating speed of 3,000 rpm, coupled with a generator with a capacity of 60 MW. The turbine input pressures are 19.5 and 10.3 bar abs for SIL for NIL respectively and output pressures are 1.3 bar abs for each site.

The steam flow rate required to operate one turbine at a full load (electricity output) is ± 580 ton per hour for SIL and 720 ton per hour for NIL. NIL will require two units of turbine. The turbine is designed to have zero steam leak, no vibration and low noise level (i.e. ≤ 55dB from the fence boundary ± 250m).

Table II-7 Steam chemical property

No.	Component	Well			
		SIL 1-1	SIL 2-1	SIL 3-1	SIL 1-2
Liquid					
1	pH	8.98	8.52	7.35	7.45
2	Total Dissolved Solid	2,944	2,972	2,222	2,556
3	Lithium (Li)	1.11	2.87	2.51	5.36
4	Natrium (Na)	937	853	501	584
5	Kalium (K)	55.4	59.3	79.3	129.8
6	Calcium (Ca)	8.01	3.5	5.18	1.08
7	Magnesium (Mg)	0.136	0.027	0.058	0.006
8	Silicate (SiO_2)	260	270	504	693
9	Boron (B)	24.6	21.5	17.9	28.3
10	Chlor (Cl)	748	736	595	914
11	Flour (F)	8.4	3.4	5.8	6.3
12	Sulphate (SO_4)	422	499	89	35
13	Hydrocarbonate (HCO_1)	479	522	394	155
14	Ammonia	n.a	0.8	27.56	0.5
15	Cesium (Cs)	0.75	0.38	0.77	1.11
16	Rubidium (Rb)	0.46	0.45	0.92	1.99
17	dO^{18}	-5.47	-6.47	-5.89	-5.65
18	DD	-50.2	-54.7	-52.9	-57.1
Gas					
19	Wt % NCG	2.2	2.02	2.77	2.71
20	CO_2	89.5	98	92.6	98.9
21	H_2S	0.173	0.157	2.05	0.954

No.	Component	Well			
		SIL 1-1	SIL 2-1	SIL 3-1	SIL 1-2
22	CH_4	0.255	0.0391	0.73	0.0325
23	H_2	0.584	0.219	0.712	0.00909
24	N_2	7.9	0.647	2.29	0.00023
25	NH_2	1.49	0.898	1.66	0.0518
26	Argon (Ar)	0.0801	0.00929	0.0108	0.00023
27	Cobalt (Co)	0.00205	0.00081	0.00107	0.00024

Source: PERTAMINA – UNSG, 1996

Note: Ions in solution is calculated as (ppm) in reservoir condition (Pre-flash). Gases are reported in (% mol)

d. Bottoming Ormat Energy Converter (Bottoming OEC)

From the turbine outlet, geothermal steam will be channeled to four Bottoming OEC heat exchangers where the thermal energy will be extracted to produce pentane steam. Pentane is used in Binary System. The steam will become a condensate (80^{o}C) and will be pumped to reinjection wells.

The pentane steam generated will trigger the OEC turbines to generate extra electricity (bottoming OEC generate about 30% of total electricity capacity produced by the power plant). The steam will be cooled into liquid and transferred back into the heat exchangers with cyclical pumps. The pentane fluid will be circulated in a closed circuit.

e. Brine Ormat Energy Converter (Brine OEC)

Geothermal brine separated from the steam at separators will be sent to the power plant, will be directed to Brine OECs heat exchangers (two Brine OECs per unit), and will be extracted to produce pentane steam. The brine will be sent to reinjection wells. Brine inlet and outlet temperatures will be approximately 210^{o}C and 140^{o}C in SIL, and 180^{o}C and 130^{o}C in NIL. An inlet temperature of OEC Brine Unit is the temperature before cooling while an outlet temperature is after cooling.

f. The management of occupational health and safety (Kesehatan dan Keselamatan Kerja = K3)

Policlinic and ambulance will be provided at the project site to address accidents at work. In a case of further medical assistance is required, the field medical staff will transfer the victim to the nearest hospital in Tarutung or Medan. Service hour of onsite emergency facilities is 24 hours. Since no patient will be treated permanently at the policlinic, there will be no wastes that require special handling. The assumption will also apply to laboratory wastes at the project site where no special waste handling will be required as the laboratory will only conduct analyses of steam, brine and condensate.

To anticipate the possibility of fires at the project site, trained health and safety officers to use fire safety equipment will be available. Fire extinguishers and hydrants will be placed in accessible locations.

Any criminal activity at the project site will be reported immediately to the nearest police station in Sarulla by security staff. Regular communications with the nearest police station will be done to report the security at the project site.

2.2.2.3.3 Operation of transmission line from SIL to NIL

Electricity generated by SIL and NIL power plants will be transmitted to transmission lines T/L 150Kv which is part of the North Sumatera subsystem grid constructed by PLN close to NIL.

The transmission line between the PLN substation and NIL power plant will have a voltage of 150 KV, two (2) circuits with sufficient capacity per circuit to transmit electricity from Sarulla power plant units.

To obtain a more reliable transmission line, the interconnected line between NIL and SIL power plants will have two (2) circuits, each with a capacity to transmit electricity from Silangkitang power plant.

1) Workforce recruitment

The number of workforce required to operate the transmission line is very few and will be integrated with the workforce required for operation of the power plants.

2) Transmission line facility maintenance

In addition to routine transmission line facility maintenance, land route under the high voltage transmission line will be monitored and will be cleared from weed. The land route will be cleared from residential areas and tall plants.

2.2.2.3.4 Environmental impact management

1) Gas treatment

Non-condensable gases (mostly CO_2 and a small amount of H_2S) will be transferred from the Bottoming OECs heat exchangers to air cooled condenser fan and released to the atmosphere.

2) Solid waste treatment

Solid waste will be stored in a temporary storage area in the project location. It will then be collected by a third party and removed to a final approved disposal area.

3) Liquid waste treatment

Condensate collected from the steam trap along the pipeline which transfers geothermal steam from production wells to power plants will be injected and precipitated in a pond filled with gravels. The condensate formed in rock muffler at well pads will be transferred to the ponds. Separators located near the power plants will be injected to natural channels.

Liquid waste from the power plant operation stage will be from domestic waste and condensate. Domestic waste will be treated in septic tank whilst the condensate will be injected to reinjection wells where the pH will be controlled by acid (H_2SO_4 if necessary). Characteristics of the condensate are presented in **Table II-8**. Condensate will be transferred, with flow rate of approximately 0.7 m^3/second (approx. 2500 tones/hour/unit) at SIL and approximately 1.1 m^3/second (approx. 3700 tones/hour/unit) at NIL, through special pipelines to injection wells without passing the sedimentation pond. Similar to the brine injection system, the condensate injection system is designed based on the principle of pump system. If there is a problem with the injection condensate pump the backup pump will be operated. The condensate injection process will be controlled from the control room which can monitor, activate pumps and control valves automatically.

Domestic liquid wastes from construction camps, toilets, showers, and canteen will be processed using a wastewater treatment facility.

The liquid waste from:

1. Steam condensate and brine in the power plants will be re-injected to the reinjection wells.
2. Steam condensate will flow through steam traps drip onto a drain pit, which is a ditch filled with gravel.
3. Collected brine from well pads will be re-injected to the reinjection wells.

Table II-8 Condensate characteristics

No	*Parameter*	*Concentration (mg/L)*
1.	Na	2.94
2.	B	0.66
3.	SiO_2	0.39
4.	Cl	4.78
5.	NH_4N	-
6.	Sulphuric Acid (as H_2S)	-
7.	Mercury	-
8.	Arsenic	-

Source: PERTAMINA – UNSG, 1998
Note: Analysis results from Thermochem Laboratory for 1-2 May 1995
Average concentration from 2 samples

4) Oil and chemical waste treatments

The oil and chemical waste will be treated according to Government Regulation No 85 of 1999 regarding changes to Government Regulation No 18 of 1999 regarding the management of hazardous and toxic waste (B3). Used lubricant oil will be stored temporarily in a drum (see **Table II-9**) and will be handled by an approved third party.

Table II-9 Sources, characteristics and quantities of hazardous wastes (B3) generated by SOL operation

No	Source	Characteristic	Quantity
1.	Drilling mud waste	Non explosive, inflammable, inactive, toxic, non-infectious, non-corrosive	1,200 m^3 About 90% of drilling mud waste is in liquid phase which will be re-injected into the wells. Only 10% of the waste is in solid phase
2.	Cuttings from 30 wells	Non explosive, inflammable, inactive, non-toxic, non infectious, non-corrosive	11,953 m^3
3.	Lubricant	Non explosive, flammable, inactive, toxic, non-infectious, non-corrosive	240 drums (4,800 liters)

2.2.2.4 *Post-operation stage*

Post-operation stage will be conducted at the end of the project cycle. This stage will be conducted by a project contractor.

1) Closure of production and reinjection wells

Deactivation of wells will be conducted according to wells closure procedure. Reclamation of the wells area will be conducted by re-planting grass and plants. The process is as follows:

- Replenishing of wells – wells will be closed with cement (a minimum of 30 m depth). The cement layer will be placed on top of casing shoe. Another layer of cement will be put on top of it. Mud with similar density as the cement, which is also used as drilling mud, will fill in the gap between the two cement layers;
- Production and reinjection wells closure will follow the procedure for permanent well closure.

2) Deactivation of pipelines and supporting facilities

When the operation stage is over, pipelines, pumps, and separators will be deactivated. The deactivation will be conducted in stages as follows:

- Pipelines, pumps, and supporting facilities, will be dismantled, loaded onto a truck and sold to a scrap metal buyer, or disposed in a designated disposal area;
- Well pads will be replanted with grass and local plants.

3) Deactivation of geothermal power plants

Following completion of the operation stage, all power plants will not be used anymore. The deactivation process will be as follows:

- All equipment that can be utilized will be dismantled and re-used in other projects within or outside of Indonesia. Non-usable equipment will be sold;
- The remaining buildings and equipment will be demolished. The debris will be sold or disposed in a designated disposal area;
- Power plant locations will be rehabilitated through reclamation scheme by planting grass and local plants;
- Land will be sold if it is not used anymore;
- SOL workforce release will follow the applicable law and regulations.

2.2.2.4.1 Transmission line dismantling procedure

The transmission line will be dismantled and the location will be cleared of any remaining building materials. All equipment which can still be reused will be dismantled and transferred to other projects. Reclamation will be performed if needed.

2.2.3 Activities around project site

The main activities in the vicinity of the development of Sarulla geothermal field area (SIL and NIL) are:

1) Farmland and Plantation

There are many farmland and plantation activities near the project area particularly paddy fields and community plantations.

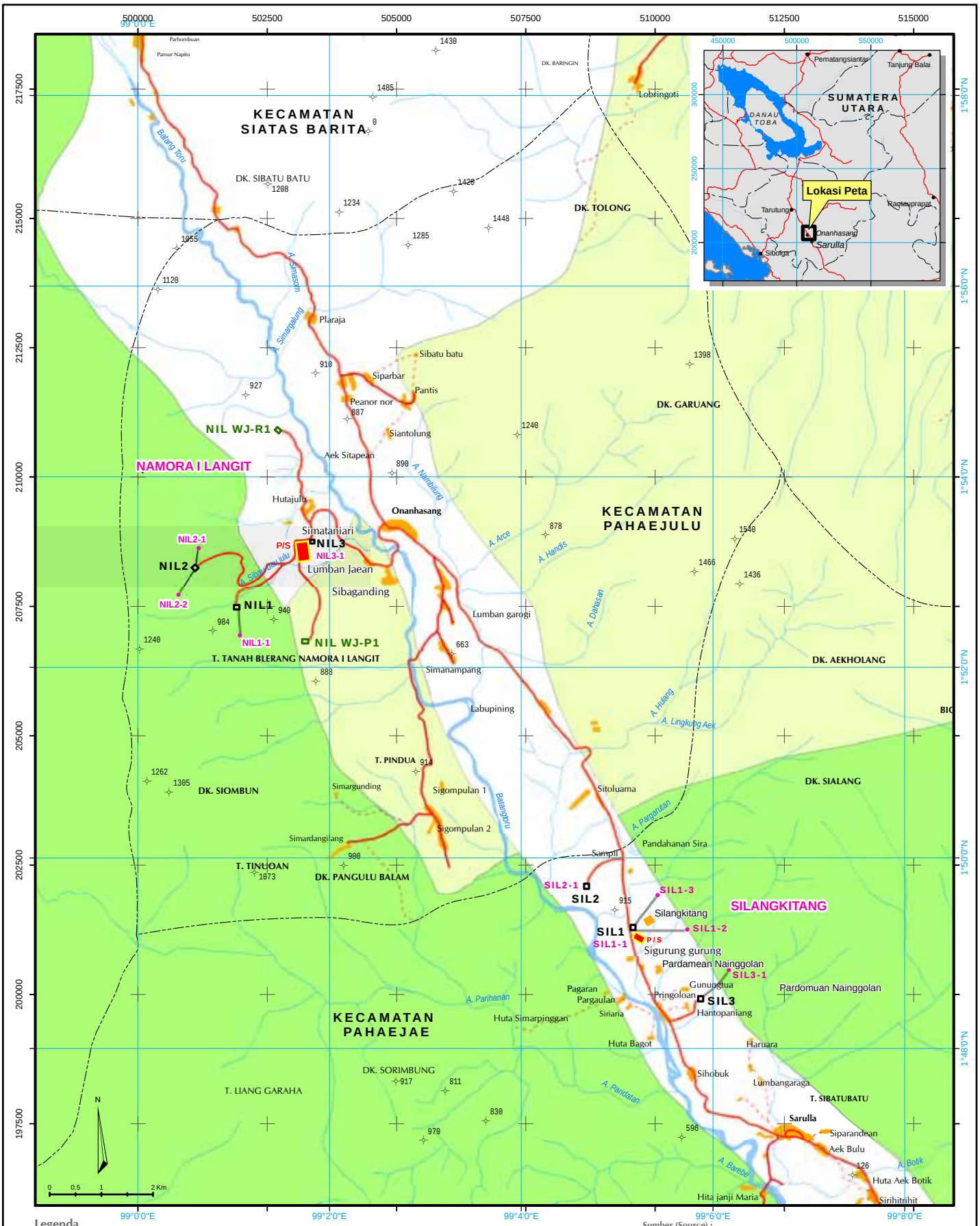
2) Forest area

Based on the map of North Sumatera forests and waters areas (attachment to Decree of Minister of Forestry No. 44/Menhut-II/2005 regarding designation of forest area in North Sumatera Province of ± 3,742,120 hectares), there is forest area within the area for the development of Sarulla geothermal field and power plant. Formally according to the land use map, the project area particularly at has a forest status but in reality, the area consists of bushes and community

plantations dominated by plantation crops and bushes. The land use and forest status in the area of the development of Sarulla geothermal field and power plant are shown in **Map II-2**.

2.2.4 Alternative in AMDAL Study

The locations for and the technology used in the development of Sarulla geothermal field and power plant were already determined and therefore, no alternatives need to be assessed in this AMDAL study. Project sites, both in SIL and NIL, will be developed to utilize the geothermal resources to generate electricity. The electricity generated will be distributed to PLN grid.



Legenda
Legend

- Titik Ketinggian — *Elevation Point*
- Jalan Arteri — *Arteri Road*
- Jalan Kolektor — *Collector Road*
- Jalan Lokal — *Local Road*
- Batas Kecamatan — *Kecamatan Boundary*
- Sungai — *River*
- Permukiman — *Village*
- Sumur Eksplorasi Namora I Langit dan Silangkitang — *Namora I Langit and Silangkitang Exploration Wells*
- Lokasi Sumur Baru (West JEC) — *New Well Site (West JEC)*
- P/S Pembangkit Listrik — *Power Station*

Keterangan : *Note :*

DK : Bukit — *Hill*
Aek : Sungai — *River*
T. :Tinggi — *Elevation*

Penggunaan Hutan
Land Use by Concession

- Hutan Produksi yang dapat di Konversi — *Convertible Production Forest*
- Hutan Produksi — *Production Forest*
- Areal Penggunaan Lain — *Other Usage*

Sumber (Source) :
- Peta Kawasan Hutan dan Perairan Sumatra Utara Skala 1:250 000 (Lampiran SK MENHUTBUN No. 44/Menhut-II/2005 Tgl 16 Februari 2005
- Peta Topografi - BAKOSURTANAL, 1977, Skala 1 : 50,000.
- Medco Geothermal Indonesia

ANALISIS DAMPAK LINGKUNGAN
ENVIRONMENTAL IMPACT STATEMENT

STATUS HUTAN YANG TERDAPAT DI AREAL PENGEMBANGAN LAPANGAN PANAS BUMI SARULLA
STATUS OF EXISTING FORESTS IN AREA OF SARULLA GEOTHERMAL FIELD DEVELOPMENT

Skala *Scale*	1 : 100.000	Digambar Oleh *Drafter*	GGG
Peta *Map*	II - 2	Diperiksa Oleh *Proofreader*	ABU
Tanggal Revisi *Date Revision*	23/10/08	Digabung Oleh *Compilation*	ERM

CHAPTER III
ENVIRONMENTAL BASELINE STUDY

3.1 GEOPHYSICAL AND CHEMICAL COMPONENTS

3.1.1 Climate

Analysis of environmental baseline and potential impacts of the development of Sarulla Geothermal field and power plant on climate conditions and air quality is one of the main focuses of this study. Generally, this project is considered as a clean alternative energy project, compared to fossil fueled energy sources. Nevertheless, geothermal electricity production still emits gases and steam to ambient air which means a survey and study on the climatic conditions and air quality are necessary.

Important parameters for climate and air quality analyses are: temperature, humidity, pressure, wind speed and direction, and rain fall. In order to provide general descriptions of the climatic conditions in the study area, data from the Meteorological and Geophysical Agency (BMG) of Medan were acquired.

Similar to typical climatic conditions in Indonesia, the climate pattern in the study location is classified as Monsoon, which is generally indicated by the cycle of 2 seasons i.e. dry and wet seasons. However, the differences between the dry and wet seasons cannot be clearly defined. Rainy days present every month throughout the year but with variations between the dry and wet seasons.

The following sections describe the general climatic conditions in Pahae (North Tapanuli Regency) based on the data available in Medan BMG from 2002-2008.

3.1.1.1 Temperature

Average temperature in the study area was relatively stable throughout the year varied between 21 – 22°C. The maximum averages ranged between 26 – 28°C whilst the minimum averages ranged between 19 – 20°C (see **Figure III-1,** for ranges of temperature in the study area).

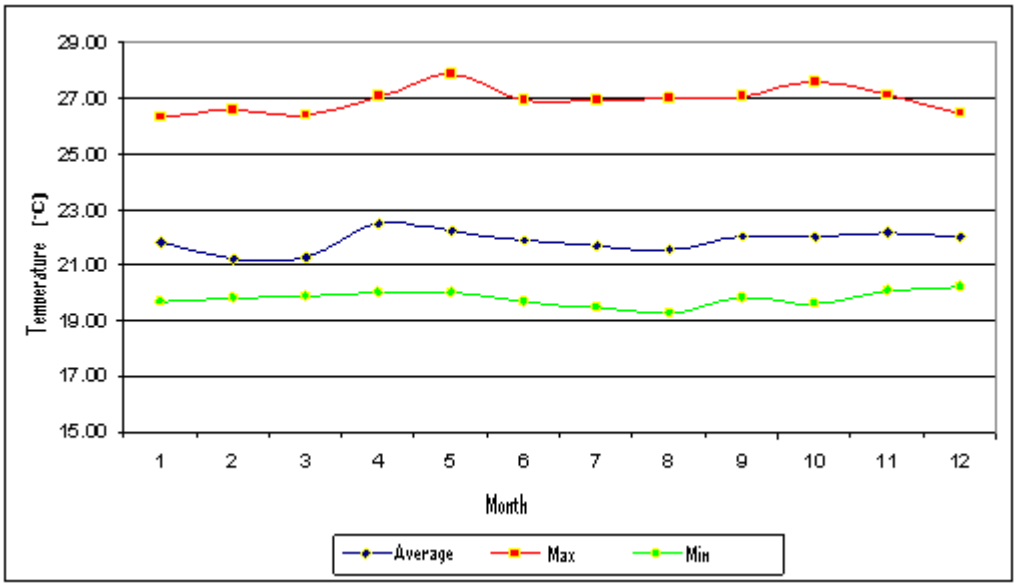


Figure III-1 Average temperature in the study area

3.1.1.2 Rainfall

Between 2002 - 2008 average annual rainfall in the study area was 198 mm. The lowest annual rainfall was 147 mm (i.e. in 2008) and the highest was 263 mm (i.e. in 2003). Monthly averages were above 100 mm for all months throughout the years, and therefore classified as wet.

Based on Koppen climate classification, the study area can be classified as an Af climate i.e. a wet tropical climate, with temperature at least 18 °C, yearly rainfall above 1700 mm, and average monthly rainfall above 60 mm throughout the year. Meanwhile, according Schmidt-Ferguson classification, Q value (dry /wet months) in the study area was 0.098 which means an A type climate (very wet).

Average monthly rainfall data in the study area is shown in **Figure III-2**.

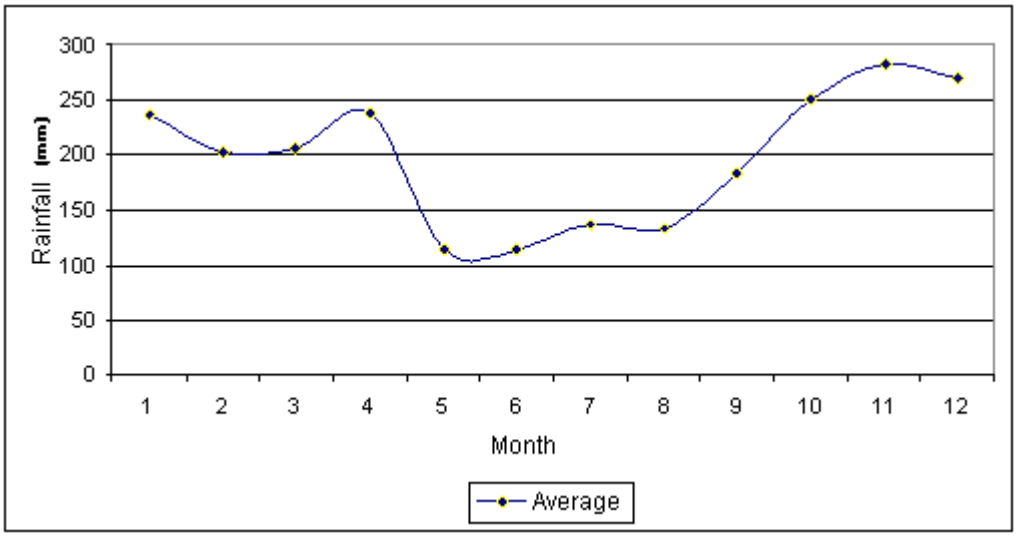


Figure III-2 Average rainfall in the study area

3.1.1.3 *Humidity*

Humidity in the study area from 2002 to 2008 was considered as relatively stable. The maximum averages ranged from 83 to 87% whilst the minimum average ranged from 71 to 78%. Higher level of humidity was recorded from November to December and the lowest humidity was typically between May to July (see **Figure III-3** for further details).

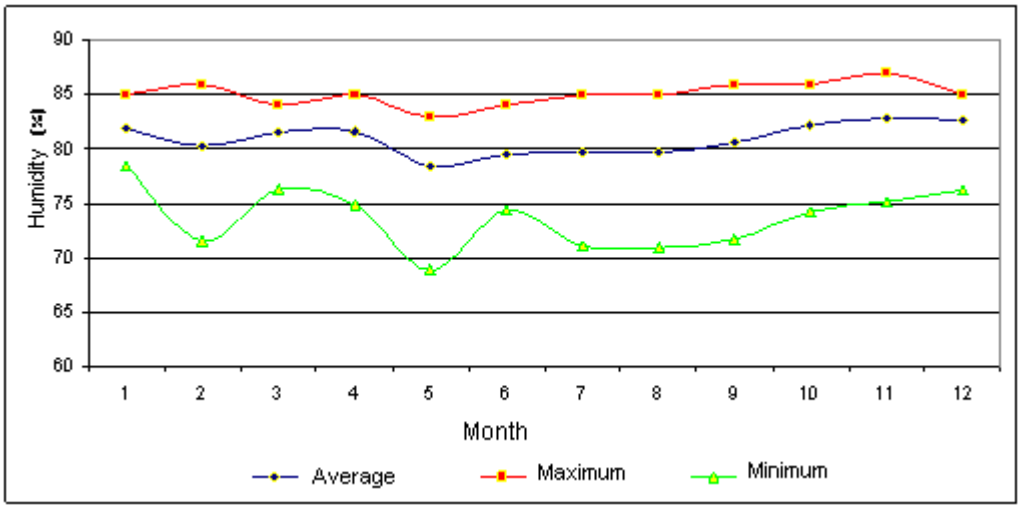


Figure III-3 Average humidity in the study area

3.1.1.4 *Wind direction and speed*

Wind speed and direction data presented in this section is only for 2008. Data from previous years was not sufficient to be analyzed. Average wind speed in

the study area was 4.7 knots. **Figure III-4** illustrates monthly wind speed averages in the study area.

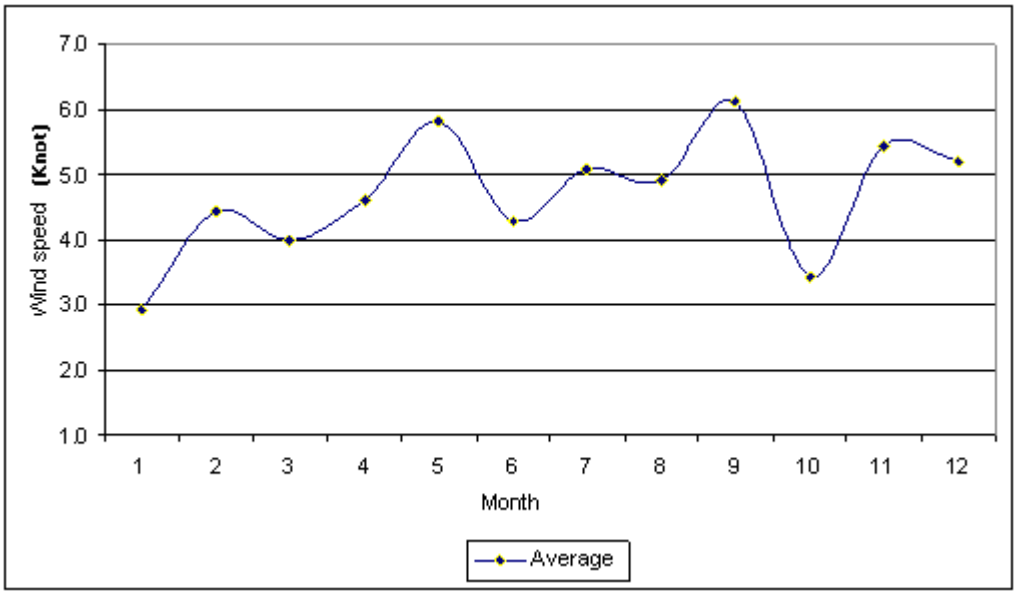


Figure III-4 Average monthly wind speed in the study area

3.1.2 Air quality

Sulfur oxides and nitrogen oxides emissions from geothermal power generation are significantly less than fossil fuel power generation. However, emissions from potential gases should be studied particularly hydrogen sulfide (H_2S). Other gases potentially emitted from geothermal energy are ammonia (NH_3) and a number of particulates in steam.

Baseline study included air quality measurements in 4 locations representing general conditions of the study area. Three sampling points were located around well locations (UK-1: SIL-1, UK-2: SIL-2, and UK-3: NIL-2) and one point (UK-4) was at the nearest residential area i.e. Simataniari Village.

Measurements of SOx, NOx, NH_3, H_2S, Pb and dust (TSP) were undertaken on 27 and 28 March 2008. The results of ambient air quality measurements are shown in **Table III-1**.

The measurements indicated good air quality in the study area as all parameters achieved the standards applicable in Indonesia. The study area is relatively close to the main road of Trans Sumatera Highways which makes transportation emissions as the main contributor to air pollution. This was indicated by concentrations measured at UK-1 (the location of SIL-1) and UK-4 (Simataniari Village) which showed higher dust concentrations compared to other locations (forest area and farmlands).

3.1.3 *Noise*

Generally, noise generated from geothermal power generation is less than conventional power generation using fossil fuel. The main potential source of noise is during the construction stage and smaller potential during the production stage. However, noise survey and assessment shall be undertaken to anticipate the potential noise impacts from this project.

Noise survey was undertaken at the same time and locations as the air quality measurements i.e. at 4 sampling points: UK-1, UK-2, UK-3, and UK-4).

The results showed that general noise conditions were far below the threshold for industrial activities (70 dBA) and for residential areas (55 dBA). However, considering the proximity to the main road of Trans Sumatera Highways, the noise level at certain period may increase above the threshold.

Table III-1 Ambient air quality in the study area

No	Parameter	Unit	Result				Limit Value	Method
			UK-1	UK-2	UK-3	UK-4		
1	SO_x	µg/Nm³	38.35	36.95	22.50	39.88	900	Pararosanilin
2	NO_x	µg/Nm³	28.55	20..60	16.75	29.20	400	Salztman
3	Pb	µg/Nm³	0.105	nd	nd	0.195	1	Extraction/AAS
4	Dust	µg/Nm³	28.75	16.75	15.15	30.55	230	High Volume Sampler
5	NH_3	ppm	0.605	0.570	0.515	0.810	*2.0	Indofenol
6	H_2S	ppm	nd	nd	0.0095	nd	*0.02	Mercurytiocyanide
7	Noise							
	Range	dBA	40-42	34-36	32-34	42-44	**55 ***70	Sound Level Meter
	Average	dBA	41	35	33	43	**55 ***70	Sound Level Meter

Source: Laboratory analysis results from the Center of Natural Resources and Environmental Researches, University of North Sumatera (2008)

Note:
National Ambient Air Quality Standard according to Government Regulation No. 41 of 1999
* Odor Level Standard according to: KEP-50/MENLH/11/1996
** Noise Level Standard according to: KEP-48/MENLH/11/1996 for Residential Area
*** Noise Level Standard according to: KEP-48/MENLH/11/1996 for Industrial Area
nd: not detected

3.1.4 *Hydrology*

Surface water in the study area generally infiltrate back into the soil. Dendritic flow patterns are found upstream due to the presence of non-compacted rocks and alternate layers of fine and coarse tuff (parts of the *Tefra Toba*).

Rivers around the study area play important roles for local communities i.e. for bathing, cooking, traditional irrigation, and source of livelihood. River catchment areas are shown in **Map III-1.**

Hydrology of the study area is important for geological structure, lithography, morphology, and land cover. The geological structure is indicated by an inline normal fault in the same direction as the main Sumatera structure forming several horizontal faults from a high order composing a fault zone with a high porosity level and create water infiltration area. Generally rocks in the area come from volcanic activities. Hydrological characteristics will be different if the morphology and the land cover are different. These parameters will influence the impacts of rainfall in an area.

This area is interesting for hydrological research as the sub-depression in the upstream area of the river acts as infiltration area and flows out the cliff ravine as spring. Then it flows into the river and infiltrates back (inflow) in the middle and downstream part of the river where the power plant will be located.

3.1.5 Water quality

3.1.5.1 Surface water

Surface water quality samples were collected on 28 and 29 March 2008 at 4 locations i.e. KA-1: Batang Toru River before SIL, KA-2: Batang Toru River after SIL, KA-3: Batang Toru River before NIL, and KA-4: Batang Toru River after NIL. The samples were analyzed by Center of Natural Resources and Environmental Researches, University of North Sumatera (PPSDAL USU) and in Intertek Laboratory at Jakarta (for dissolved metals). Laboratory results were compared to Government Regulation No. 82 of 2001 as shown in **Table III-2.**

3.1.5.2 Physical parameters

1) Temperature

Water temperature of Batang Toru River before SIL and after SIL was 29˚C, while of Batang Toru River before and after NIL was 27˚C. There were no significant difference between sampling locations and the temperature was considered as normal.

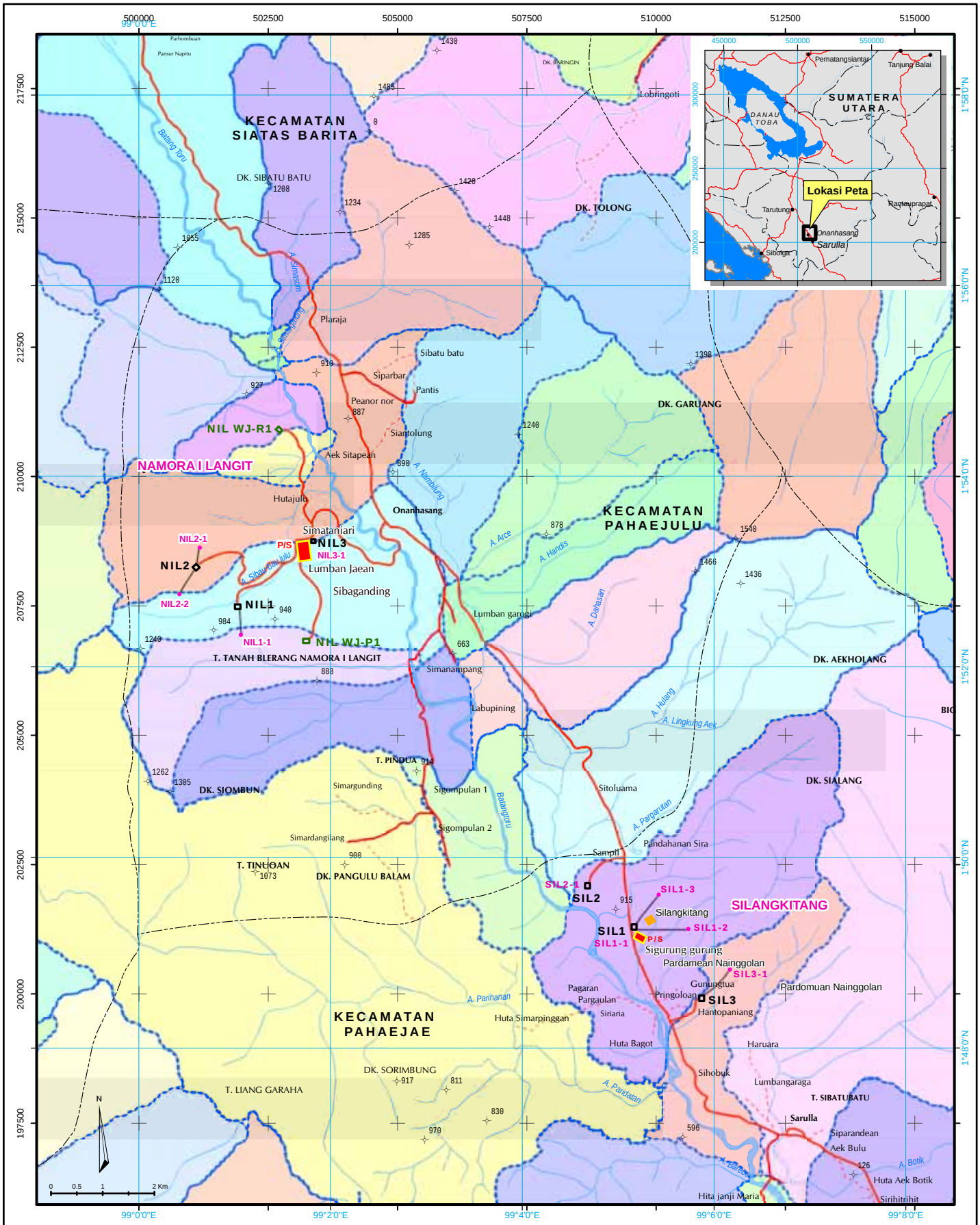
2) Total Suspended Solids (TSS)

Total suspended solids (TSS) concentrations ranged from 114 to 138 mg/L, which could be considered as high. The highest concentration was found at Batang Toru River after SIL whilst the lowest was at Batang Toru River before NIL. All measured TSS concentrations were below the maximum permitted level of 1000 mg/L according to Government Regulation No. 82 of 2001.

3) Total Dissolved Solids (TDS)

Total Dissolved Solids (TDS) concentrations show the amount of colloid particles in the river. The measurements indicated that the TDS concentrations ranged from 30 to 40 mg/L. The highest TDS was found at Batang Toru River

after SIL and the lowest was found at Batang Toru River before NIL. The TDS concentrations at all sampling locations were below the standard of 50 mg/L.



Legenda
Legend

- Titik Ketinggian — *Elevation Point*
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- Permukiman — *Village*
- Sumur Eksplorasi Namora I Langit dan Silangkitang — *Namora I Langit and Silangkitang Exploration Wells*
- Lokasi Sumur Baru (West JEC) — *New Well Site (West JEC)*
- P/S — Pembangkit Listrik — *Power Station*
- Sub Daerah Tangkapan Air — *Sub Catchment Area of the Rivers*
- Catatan : Batas warna mewakili setiap sub daerah tangkapan air
  Note : Color boundaries repsenting each sub catchment area of the rivers

Keterangan : *Note :*

- DK : Bukit — *Hill*
- Aek : Sungai — *River*
- T. :Tinggi — *Elevation*

Sumber (Source) :

Peta Topografi - BAKOSURTANAL, 1977, Skala 1 : 50,000.
Medco Geothermal Indonesia

ANALISIS DAMPAK LINGKUNGAN
ENVIRONMENTAL IMPACT STATEMENT

DAERAH TANGKAPAN AIR
CATCHMENT AREA OF THE RIVERS

Skala *Scale*	1 : 100.000	Digambar Oleh *Drafter*	GGG
Peta *Map*	III - 1	Diperiksa Oleh *Proofreader*	ABU
Tanggal Revisi *Date Revision*	23/10/08	Digabung Oleh *Compilation*	ERM

Table III-2 Surface water quality in the study area

Parameter	Unit	Result				Method	Standard *)
		KA-1	KA-2	KA-3	KA-4		
PHYSICAL							
Temperature	^{0}C	29	29	27	27	Thermometer	Dev 3
Conductivity	Umhos/cm	286	296	205	190	SCT-Meter	-
Dissolved Solid	mg/L	36	40	30	34	Gravimetric	50
Suspended Solid	mg/L	128	138	114	124	Gravimetric	1000
Turbidity	NTU	3.27	3.38	2.63	2.86	Turbidymeter	-
CHEMICAL							
pH		6.8	6.8	7.1	6.9	Electrometric	6 – 9
Dissolved Oxygen	mg/L	5.55	5.53	5.92	5.65	DO-Meter	> 4
BOD	mg/L	2.06	2.27	1.85	1.91	Winkler	3
COD	mg/L	22.56	25.44	19.88	20.67	Reflux Titration	25
Chloride	mg/L	10.22	25.84	8.81	10.99	Titration	-
Sulfide	mg/L	nd	nd	nd	nd	Spectrophotometer	0.002
Sulfate	mg/L	48.50	54.20	38.25	39.75	Spectrophotometer	-
Nitrate (N-NO_3)	mg/L	4.14	4.20	3.52	3.89	Spectrophotometer	10
Nitrite (N-NO_2)	mg/L	0.078	0.082	0.075	0.078	Spectrophotometer	0.06
Ammonia (N-NH_3)	mg/L	1.27	1.33	0.97	1.14	Spectrophotometer	-
Hardness	mg/L	87.5	82.5	89.5	81.0	Titration	-
Phosphate	mg/L	0.60	0.64	0.43	0.45	Spectrophotometer	0.2
DISSOLVED METALS							
Arsenic (As)	mg/L	0.0005	0.0007	<0.0005	<0.0005	HVAAS	1
Barium (Ba)	mg/L	< 0.1	< 0.1	< 0.1	< 0.1	FAAS	-
Boron (B)	mg/L	0.1	0.1	< 0.1	< 0.1	Colorimetric	1
Cadmium (Cd)	mg/L	< 0.005	< 0.005	< 0.005	< 0.005	FAAS	0.01
Calcium (Ca)	mg/L	9.67	9.76	9.52	9.39	FAAS	-
Chromium Hexavalent (Cr^{6+})	mg/L	< 0.002	0.002	0.003	< 0.002	Colorimetric	0.05
Cobalt (Co)	mg/L	< 0.02	< 0.02	< 0.02	< 0.02	FAAS	0.2
Copper (Cu)	mg/L	< 0.01	< 0.01	< 0.01	< 0.01	FAAS	0.02
Iron (Fe)	mg/L	0.16	0.31	0.15	0.18	FAAS	-
Lead (Pb)	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	GFAAS	0.03
Magnesium (Mg)	mg/L	2.25	2.25	2.25	2.21	FAAS	-
Manganese (Mn)	mg/L	0.02	0.04	0.02	0.03	FAAS	-
Mercury (Hg)	mg/L	0.00025	0.00037	0.00008	0.00009	CVAAS	-
Nickel (Ni)	mg/L	< 0.02	< 0.02	< 0.02	< 0.02	FAAS	-
Potassium (K)	mg/L	4.84	4.85	4.78	4.90	FAAS	-
Selenium (Se)	mg/L	<0.0005	< .0005	< .0005	<0.0005	HVAAS	-
Sodium (Na)	mg/L	8.49	8.91	6.61	6.61	FAAS	-
Zinc (Zn)	mg/L	< 0.005	< 0.005	< 0.005	< 0.005	FAAS	-

Note:
1 PPSDL USU laboratory analysis result
2 Intertek laboratory analysis result
*) Standards based on Government Regulation No. 82 of 2001 concerning Management and Control of Water Quality Class II
Sampling locations:
KA-1. Batang Toru River before SIL
KA-2. Batang Toru River after SIL
KA-3. Batang Toru River before NIL
KA-4. Batang Toru River after NIL

4) Turbidity

Turbidity levels in 4 locations in the study area ranged from 2.63 to 3.38 NTU. The highest level of turbidity was found at Batang Toru location after SIL while the lowest levels were at Batang Toru location before NIL. There is no turbidity standard for water Class II in Government Regulation no. 82 of 2001.

According to Lloyd (1985), increased turbidity level in clear and shallow water body up to 25 NTU may decrease primary productivity by 13 to 15%. Increased turbidity level up to 5 NTU in lakes may decrease primary productivity by 75% whilst in rivers by 3to 13%.

3.1.5.3 Chemical parameters

1) Acidity (pH)

pH of surface water in the study area ranged from 6.8 to 7.1, which were within the standard for Class II Water as prescribed in Government Regulation No. 82 of 2001 i.e. 6 - 9. pH plays an important role in determining water usage for organism life. pH changes cause imbalance of carbon dioxide, bicarbonate and carbonate compositions in water. Fishes and other aquatic biota can tolerate water environment with pH of 4 – 11 (Jones, 1964 and Sweingle, 1968). Ideal pH level for aquatic life is 6.5 to 8.5 (NTAC, 1964 and Swingle, 1968).

2) Biochemical Oxygen Demand (BOD)

BOD is defined as the amount of oxygen needed by bacteria to modify organic matters aerobically. According to Boyd (1979), BOD in water is affected by temperature, plankton density, organic matter concentration and several other factors. Center and Hill (1979) suggested that rivers with low flow rate, 5 mg/L BOD represents low water quality but for rivers with high flow rate, 30 mg/L BOD does not represent significant disturbance.

BOD in the study area ranged between 1.85 – 2.27 mg/L, which were below the standard of 3 mg/L.

3) Chemical Oxygen Demand (COD)

COD describes total oxygen required to oxidize organic materials completely. Thus, COD increases as organic material concentration increases. COD can also be used to predict BOD since both parameters typically increase at the same time.

Laboratory analysis showed that the highest COD i.e. 25.44 mg/L was at Batang Toru River after SIL which was slightly above the standard of Class II water quality of 25 mg/L. At other locations, COD were in the range of 19.88 to 22.56 mg/L.

4) Dissolved Oxygen (DO)

Dissolved Oxygen is essential for respiration and is one of the main components for aquatic biota metabolism. Oxygen in water comes from the atmosphere and photosynthesis (Welch, 1952). Fish's demand for oxygen depends on its type, stadium, and activity. Wind and water current support aeration process which provides sufficient amount of dissolved oxygen.

DO in the study area ranged from 5.53 to 5.92 mg/L where the highest DO was measured at Batang Toru River before NIL and the lowest was at Batang Toru River after SIL. This indicated good condition and compliance with the standard of > 4 mg/L specified in Government Regulation No. 82 of 2001.

5) Phosphate

Phosphate is an important nutrient for aquatic biota growth. Total phosphate contents in the study area ranged from 0.43 to 0.64 mg/L. The highest phosphate content was measured at Batang Toru River after SIL and the lowest was at Batang Toru River before NIL. Phosphate contents in the study area were higher than the standard of 0.2 mg/L prescribed in Government Regulation No. 82 of 2001.

6) Nitrate and nitrite

Nitrogen is the main component of protein for growth of organism. In water, nitrogen exists in the forms of gas (N_2), nitrite (NO_2-N), nitrate (NO_3-N) and ammonia (NH_3-N). These compounds, within nature, are found as dissolved, suspended, and precipitated salts.

Nitrate concentrations in the study area ranged from 3.52 to 4.2 mg/L which were below the standard of 10 mg/L. Nitrite concentrations ranged from 0.075 to 0.082 mg/L, which were slightly higher than the standard of 0.06 mg/L.

7) Ammonia contents (NH_3-N)

Ammonia is the main product of protein destruction in anaerobic conditions, which is toxic for water organisms. High level of ammonia may be generated by household activities, farming, and industry. Sylvester (1958) proposed ammonia content of no more than 1.5 ppm while Pescod (1973) suggested content of no more than 1 ppm in tropical areas.

Ammonia contents in the study area ranged from 0.97 to 1.33 mg/L. The highest was measured at Batang Toru River after SIL whilst the lowest was at Batang Toru River before NIL. There is no ammonia standard specified in Government Regulation No. 82 of 2001 for Class II water quality.

8) Dissolved metals

Generally, dissolved metal contents in all sampling locations were below the standards specified in Government Regulation No. 82 of 2001.

Furthermore, barium (Ba), cadmium (Cd), cobalt (Co), copper (Cu), lead (Pb), nickel (Ni), selenium (Se) and zinc (Zn) contents in the study area were below the detection limits indicating very low concentrations.

Iron (Fe) concentrations ranged from 0.15 to 0.31 mg/L. The highest concentration was detected at Batang Toru River after SIL whilst the lowest was at Batang Toru River before NIL. Government Regulation No. 82/2001 does not specify a standard for iron.

Arsenic (Ar) concentrations in Batang Toru River before and after SIL were very small i.e. 0.0005 and 0.0007 mg/L respectively. Furthermore, Ar contents were under the detection limit in Batang Toru River before and after NIL.

Boron (B) concentrations at Batang Toru River before and after SIL were detected 0.1 mg/L whereas at Batang Toru River before and after the NIL the concentrations were under the detection limit (< 0.1).

Very low hexavalent chrome (Cr^{6+}) contents were measured at Batang Toru River after SIL and before NIL i.e. 0.002 and 0.003 mg/L respectively. At Batang Toru River before SIL and after NIL, the concentrations were not detected by the analytical instrument or were under the detection limit.

The lowest content of Calcium (Ca) was at Batang Toru River after NIL i.e. 9.39 mg/L and the highest was found at Batang Toru River after SIL i.e. 9.76 mg/L.

Magnesium (Mg) concentration of 2.25 mg/L was measured in almost all study areas except at Batang Toru River after NIL where a concentration of 2.21 mg/L was measured.

Manganese (Mn) concentration was found to be very small in all study areas as follow 0.02 mg/L at Batang Toru River before SIL and NIL, 0.04 mg/L at Batang Toru River after SIL, and 0.03 mg/L at Batang Toru River after NIL.

Mercury (Hg) contents were also very small. The highest concentration was at Batang Toru River after SIL i.e. only 0.00037 mg/L whereas the lowest concentration was measured at Batang Toru River before NIL i.e. 0.00008 mg/L.

Batang Toru river after NIL recorded the highest potassium (K) concentration i.e. 4.9 mg/L. Whereas Batang Toru River before the NIL recorded the lowest concentration i.e. 4.78 mg/L.

Sodium (Na) concentrations at Batang Toru River before and after SIL respectively were 8.49 and 8.91 mg/L. This was higher than in Batang Toru River before and after NIL i.e. 6.61 mg/L.

9) Soluble salts, hardness and electrical conductivity

Soluble salts in water bodies are chloride and sulfate salts. The higher the salt concentrations, the higher the hardness and the conductivity in the water bodies. Laboratory analysis showed high level of soluble salts in the study area. The lowest level of chloride salt (Cl) was 8.81 mg/L (in Batang Toru River before the NIL) and the highest was 25.84 mg/L (in Batang Toru River after SIL). The lowest content of sulfate salt was 38.25 mg/L (in Batang Toru River before NIL) while the highest was 54.20 mg/L (in Batang Toru River after SIL).

Therefore, the hardness and conductivity in the study area were considered high. The highest hardness was at Batang Toru River before NIL i.e. 89.5 mg/L and the lowest was at Batang Toru River after NIL i.e. 81.0 mg/L. The lowest conductivity was found at Batang Toru River after NIL whilst the highest was found at Batang Toru River after SIL.

Government Regulation No. 82 of 2001 does not specify the quality standards for soluble salts contents, hardness, and electrical conductivity for Class II water quality.

Generally, water quality in the study area is considered in good conditions as it meets most of the criteria specified in Government Regulation No. 82 of 2001.

3.1.5.4 *Groundwater*

Ground water analysis results showed that all measured parameters were in compliance with the standards stipulated in Minister of Health Regulation No. 416/PER/MENKES/IX/1990 regarding Clean Water Quality Criteria. **Table III-3** presents the analytical results.

Table III-3 Groundwater quality in the study area

Parameter	*Unit*	*Result*		*Method*	*Standard *)*
		AT-1	*AT-2*		
PHYSICAL[1]					
Taste and smell	-				No Taste and Smell
Total Dissolved Solid (TDS)	mg/L	142	94	Gravimetric	1500
Total Suspended Solid (TSS)	mg/L	18	14	Gravimetric	-
Turbidity	NTU	1.32	1.31	Turbidimetric	25
Temperature	^{o}C	27	29	Thermometer	Dev 3
Color	TCU	6.2	5.8	Spectrophotometer	50
CHEMICAL[1]					
pH	-	6.7	6.9	Electrometric	6. 5 – 9.0
Cyanide (CN)	mg/L	nd	nd	Spectrophotometer	01
Sulfide	mg/L	nd	nd	Spectrophotometer	-
Nitrate (N-NO_3)	mg/L	2.07	2.36	Spectrophotometer	10
Nitrite (N-NO_2)	mg/L	0.81	0.52	Spectrophotometer	1.0
Sulfate	mg/L	88.25	70.10	Spectrophotometer	400
Chloride	mg/L	16.88	12.78	Titration	600

Parameter	Unit	Result		Method	Standard *)
		AT-1	AT-2		
Total Hardness	mg/L	137	81	Titration	500
Ammonia (N-NH_3)	mg/L	0.24	0.25	Spectrophotometer	-
Phosphate	mg/L	nd	nd	Spectrophotometer	-
Organic Chemical					
Organic Matter s $KMnO_4$	mg/L	3.10	2.12	Titration	10
Microbiology					
Total Coliform	Jlh/100 ml	50	42	MPN	1000
Fecal Coliform	Jlh/100 ml	12	10	MPN	1000
Dissolve Metals[2]					
Arsenic (As)	mg/L	<0.0005	<0.0005	HVAAS	0.05
Barium (Ba)	mg/L	< 0.01	< 0.01	FAAS	-
Boron (B)	mg/L	< 0.01	0.01	Colorimetric	-
Cadmium (Cd)	mg/L	< 0.005	< 0.0005	FAAS	0.005
Calcium (Ca)	mg/L	38.2	15.3	FAAS	-
Chromium Hexavalent (Cr^{6+})	mg/L	< 0.002	< 0.002	Colorimetric	0.05
Cobalt (Co)	mg/L	< 0.02	< 0.02	FAAS	-
Copper (Cu)	mg/L	< 0.01	< 0.01	FAAS	-
Iron (Fe)	mg/L	< 0.05	< 0.05	FAAS	1
Lead (Pb)	mg/L	< 0.001	< 0.001	GFAAS	0.05
Magnesium (Mg)	mg/L	2.76	3.45	FAAS	-
Manganese (Mn)	mg/L	0.04	< 0.01	FAAS	0.5
Mercury (Hg)	mg/L	0.00007	0.00024	CVAAS	0.001
Nickel (Ni)	mg/L	< 0.02	< 0.02	FAAS	-
Potassium (K)	mg/L	4.7	8.35	FAAS	-
Selenium (Se)	mg/L	<0.0005	<0.0005	HVAAS	0,01
Sodium (Na)	mg/L	7.27	14.1	FAAS	-
Zinc (Zn)	mg/L	0.031	0.005	FAAS	15

Description:
[1] PPSDL USU laboratory analysis result; [2] Intertek laboratory analysis result
*) Standards based on Minister of Health Regulation No. 416/PER/MENKES/IX/1990 regarding Clean Water Quality Criteria
Sampling locations: AT-1: Village well water in SIL; AT-2: Village well water in NIL

3.1.6 *Geology and stratigraphy*

Stratigraphy of the study area is a series of rock dating from Late Carboniferous to Early Permian, which consists of Tapanuli group, Formation of Toru Volcano, Toba Tuff, Toru Formation, and River Alluvium. Rocks found in the study area mainly consist of rocks produced from volcano eruption and meta-sediment rocks (**Map III-2**). The rock series from old to young ages are as follows:

1) Tapanuli group

Tapanuli group was formed from inseparable sediment rock and weakly metamorphosed rock. This type of rock sediment is very diverse, which is generally immense (not stratified), sandy, and contains fragment of clastic from a schisst, quartzite, and limestone. Based on the stratigraphic position and fossil analysis, this group is estimated from age of Carbon-Early Permian. Along the east wing of Sarulla Graben and Batang Toru, this Tapanuli group is difficult to be classified into formations because the rock constituents are generally pebbly mudstone which is vast, unstratified

with classic fragment of schisst, quartzite, vein of quartz, granite, and limestone. The size of classic fragment might reach > 80 cm with mineral content and varying rock kinds, generally has color from light bluish grey pale to black. In addition, this rock often shows the existence of crack with various direction. In several parts, this massive wacke is still experiencing interbedded with rock from kluet formation. However, domination of the existence of wacke is more increased to east direction, as found in area of study. Whereas weakly metamorphosed rock consists of green schisst and homfels that partly found in partition of intrusion and often contains vein of quartz. Sometimes, this rock contains also rock kinds that are similar with the kluet formation with more coarse grain and not-spread metaargillite. In Tarutung road, the Tapanuli group is represented by the kluet formation, from age of Late Carbon-Early Permian, which comprises of wacke volcaniclasic.

2) Toru Volcanic Formation

The formation of Toru volcano that forms the study area is tertiary volcanic sediment. The rock, which form this formation are agglomerate andesitic, lava andesitic, breccias, and rhyodacitic ignimbrite. Andesite sometimes has porphyritic texture with minerals of plagioclase or pyroxenes. This formation is found on km 11-13 of Tarutung-Sipirok road, with thickness of weathered soil around 2-4 m. It has clayey sand, high permeability, high porosity, and loose. Rocks in centre of Sibualbuali comprise rhyodacitic ignimbrite, rhyolitic vault, and gap eruption. Based on position of stratigraphy and period analysis, this rock group is estimated from Miocene age. This formation is found on the West and East of Sarulla and Tarutung Graben, which may be very close to centres of eruption. Its exact locations along the Graben of Sarulla and Tarutung are not known yet.

3) Toba Tuff

Toba Tuff that found in the area of study generally takes the form of volcanic sediment. It consists of sandy tuff, crystal tuff, and pumice tuff. Sometimes, insertion of volcanic breccias is found among the tuffs. In several places, this tuff may contain quartz and mica. Near source of hot spring water, it is caolinized very strongly. However, the lower part of this rock generally is strong, often contains light grey matrix of glass shard with quartz crystal, biotite, sanidine, hornblende, and plagioclase. It also contains elements of minor minerals, namely apatite, magnetite, ilmenite, hypersthene, allanite, and zircon. Ignimbrite is getting finer to south, west, and east. Bemmelen (1939, 1970) mentioned the existence of late quarter volcanism, which is very wide, varied with Barisan Axial Zone. Very wide ignimbrite was formed at north side that is recognized as Toba Tuff.

Toba Tuff was formed at east and west of Sarulla and Tarutung Graben. It is shown by the existence of fiamme, the less number of small scale horizontal layer on areas which have lower reliefs. This indicates that the

sedimentation is caused by ash flow (Smith, 1960), which is estimated from Late Pleistocene. The wide aperture is found in west of Sarulla and Tarutung Graben, sometimes separated by existing valleys.

4) Toru Formation

This formation occupies the widest part of project area. It generally consists of tuff sand, does not have layers, is relatively soft, and is sometimes silty. The existence of diatomae horizon is very general found. The Toru formation has very various position of rock slope, which may be caused by movement of Toru Fault. This formation is found all along the road from Tarutung to Sipirok in km 23 and 31 m, with thickness of its weathered soil of 0.5+3 m. It is sandy silt with whitish brown, really porous, and fragile. This formation is covered by alluvial sediment from river, which also often contains reworked Toba Tuff sediment.

5) River Alluvium

Alluvial sediment of river as the youngest sediment is estimated to be from recent age. It comprises free gravel, sand, silt, clay, some peat, and carbonate clay. This sediment is formed in fluviatil to lakustrin environment. In Graben of Tarutung and Sarulla, this rock often contains cracks of Toba Tuff and Toru Formation, dacitic and andesitic tuffs, lava, mudflow, ignimbrite, rhyolitic vault and andesit of gap eruption. In the Fault zone of Toru-Asik in Sipirok, this sediment contains mud, with rock generally consisted of semi-consolidated alluvial fan, locally comes from gravel conglomerate, and bad isolated sand, in fluviatil and coluvial sediment environments. The map of geology of study area is shown in **Map III-2** .

3.1.7 Tectonics and seismicity

3.1.7.1 Tectonics

The island of Sumatera is overlain on subduction zone between two tectonic plates i.e. Sundanese continent plate and Hindia-Australia ocean plate. The Sumatran Island as well as other lands in South-East Asia is part of Sundanese continent plate. This plate is relatively moving southward whereas the Indian Ocean, which is part of the Indian Ocean-Australia plate, is relatively moving northeastward. These movements cause the two plates to be sub ducted to form a trench, which is called Sunda Trench. The rate of subduction is estimated to be 80 mm/year (Curray *et al*, 1979). Because of this subduction, all along the Barisan Mountains, in line with plate boundaries, Sumatran Fault System was formed. The fault is right-lateral (dextral) fault. The movement caused by this Sumater fault system is estimated to reach 400 km.

Magma that was formed by the process of subduction along the Sunda Trench, rises to the surface through Sumatran volcanic arc that was formed

since Cenozoic and dominated geology of Sumatran Island. The plate subduction also formed an island arc, which stretches from Sumatra, Java, Bali, and other eastern islands with distance of more than 1600 km.

The Sumatra Fault System plays an important role in localizing activity of magma and high flow rate of hydrothermal fluid as seen in present days (Fitch, 1972; Guzman-speziale and Ni, 1996). The Sumatran Fault System itself consists of northwestward-moving faults in line with plate edges and in accordance with model of active strike-slip fault. Along the Sumatran Fault System, it is found the extension regime (normal fault), translation regime (strike-slip fault) and contraction regime (reverse fault) (Davies, 2002). Plate of Sibolga/Padang Sidempuan where project site is located is representation of fore-arc basin, volcanic arc, back-arc basin, and continental crust.

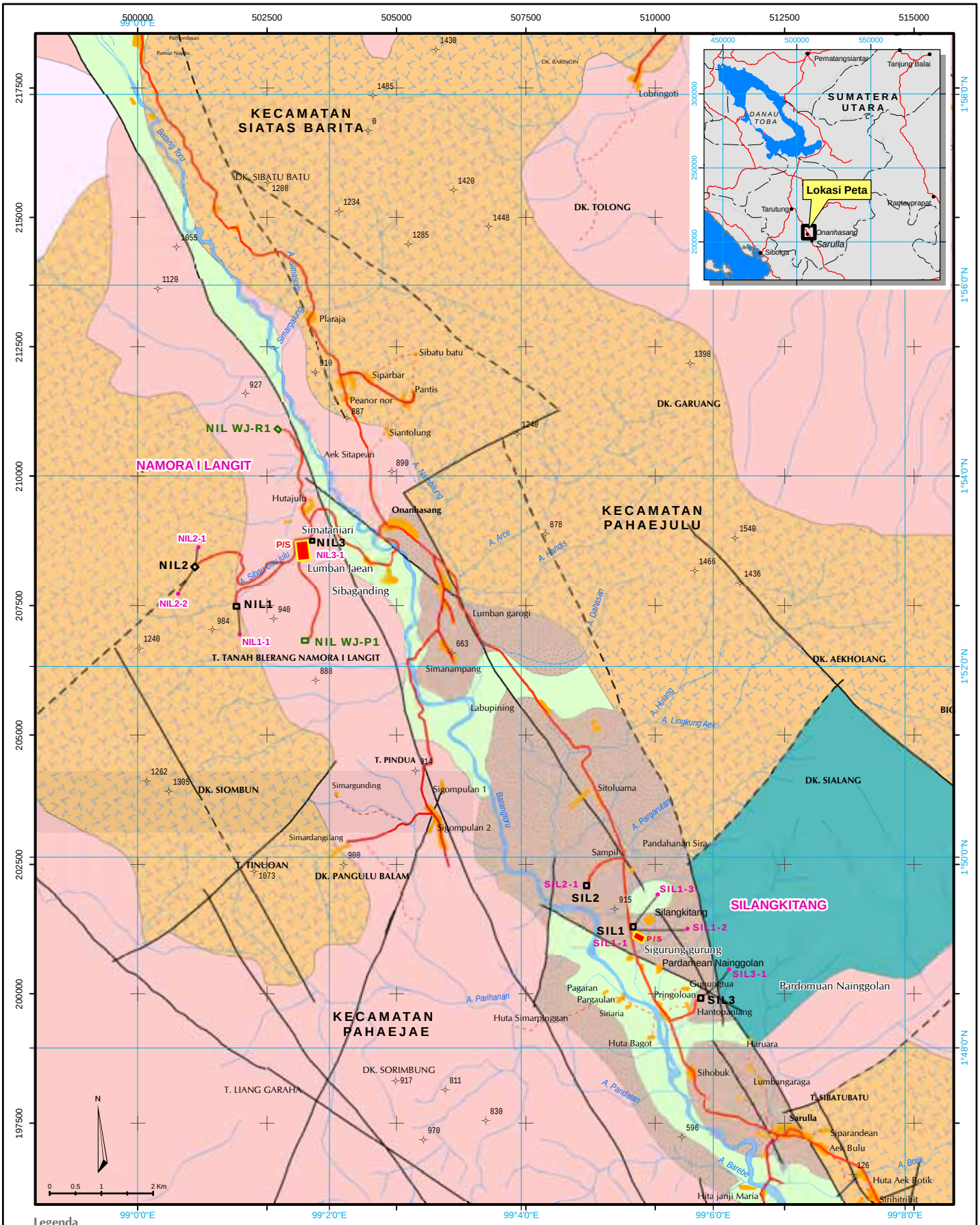
Zone of stability of the ground motion along the Tarutung-Sepirok can be divided into 4 zones (dir. GTL, 1982), which is based on geological conditions (the physical aspect/ rock, lithology and geological structure), landscape (slope and shape of the surface), content water, and soil precipitation, land use, and vegetation cover, namely:

- Stable zone: This zone trends almost no ground movement, generally in the area nearly flat (slope 5%) or in the occupied areas hard and compact rocks;

- Relatively stable zones: the region occupies a little steep - very steep (5 -> 70%) with the physical condition of the soil has erosion potential. This condition can control with reforestation, water usage settings, and using dry farming. Vegetation in this zone is generally good, consisting of forests, forest cover, reforestation, and plantation areas. Hydrology is in good condition and land use is generally dry. Sometimes, debris slides happens on a local and not widespread, for example on the sides of steep slopes or river basins;

- Unstable zones: the region occupies a slightly steep to a very steep (15 - 70%); almost without any vegetation (consisting barren land, scrub, and farming); the use of slightly damp soil with high water content. Sometimes, indication of latest ground movement can be found. New ground movement occurred in several places and the old ground motion unstable. If rainfall increases, the ground motion may occur on a rather broad region;

- Ground movement occurs has very diverse dimensions with width range from 3 to 100 meters long and 5 to 120 meters. The most common ground movement occurs on a steep slope with poor drainage. In addition, the physical nature of the bedrock slope, weathered soil, and rainfall also affect ground movement. In some places, the barren land with perennials crops will greatly hinder the development of ground movement in the study area.



Legenda
Legend

- Titik Ketinggian — *Elevation Point*
- Jalan Arteri — *Arteri Road*
- Jalan Kolektor — *Collector Road*
- Jalan Lokal — *Local Road*
- Batas Kecamatan — *Kecamatan Boundary*
- Sungai — *River*
- Permukiman — *Village*
- Sumur Eksplorasi Namora I Langit dan Silangkitang — *Namora I Langit and Silangkitang Exploration Wells*
- Lokasi Sumur Baru (West JEC) — *New Well Site (West JEC)*
- P/S — Pembangkit Listrik — *Power Station*

Keterangan : *Note :*

DK : Bukit — *Hill*
Aek : Sungai — *River*
T. :Tinggi — *Elevation*

Batuan Sedimen dan Vulkanik
Sediments and Volcanics

- Aluvium — *Alluvium*
- Formasi Kluet — *Kluet Formation*
- Formasi Toru — *Toru Formation*
- Desitan - Amdesitan berasosiasi dng Lava — *Andesitic to Dasitic Volcanics with Associated Lavas*
- Tufa Toba — *Toba Tuff*
- Formasi Gunung Api Toru — *Toru Volcanic Formation*
- Sesar — *Fault*
- Sesar Diperkirakan — *Sesar where Inferred*

Sumber (Source) :
Pusat Penelitian dan Pengembangan Geologi lembar Padangsidempuan&Sibolga
Peta Topografi - BAKOSURTANAL, 1977, Skala 1 : 50,000.
Medco Geothermal Indonesia

ANALISIS DAMPAK LINGKUNGAN
ENVIRONMENTAL IMPACT STATEMENT

PETA GEOLOGI DAERAH STUDY
GEOLOGY MAP OF STUDY AREA

Skala *Scale*	1 : 100.000	Digambar Oleh *Drafter*	GGG
Peta *Map*	III - 2	Diperiksa Oleh *Proofreader*	ABU
Tanggal Revisi *Date Revision*	23/10/08	Digabung Oleh *Compilation*	ERM

3.1.7.2 Seismicity

Indonesia is one of the most active seismic areas in the world. The centers of earthquake are mainly found at plate edges and subduction zone, along big strike-slip fault, or at compressed areas. Sumatera, which is located at subduction zone, has plenty of potential earthquake areas all along the plate edges as well as all along the Sumatera Strike Slip Fault. Most potential areas are at the face of basin arc and only a few are at magmatic arc and back of arc where they are connected to Sumatera Fault System.

The earthquake record in Tapanuli started in 1939. Map of seismic had been made based on Sarulla earthquake data in 1984 and Tarutung earthquake data in 1987. To avoid damage and victims, the activities must be kept away from the fault zone considering the epicenters are generally at all along the fault. This zone has also potency of land subsidence. This disaster is much related to the activity of tectonics in Zone of Semangko Fault, which is in line with the island of Sumatera. This fault zone is still active and frequently causes the earthquake disaster.

Several places in the area of study are susceptible to land subsidence because of their loose lithology of steep slope and very steep slope. The tectonic activity and earthquake, although in small scale, are frequently happened. These will really trigger the land subsidence.

The stability zones for land subsidence along Tarutung-Sepirok can be divided into 4 zones (Dir. GTL, 1982), based on geological conditions (physical/rock aspect, lithology and structure of geology), landscape (slope and shape of land surface), content of water and soil and precipitation, land use, and cover vegetation, are as follows:

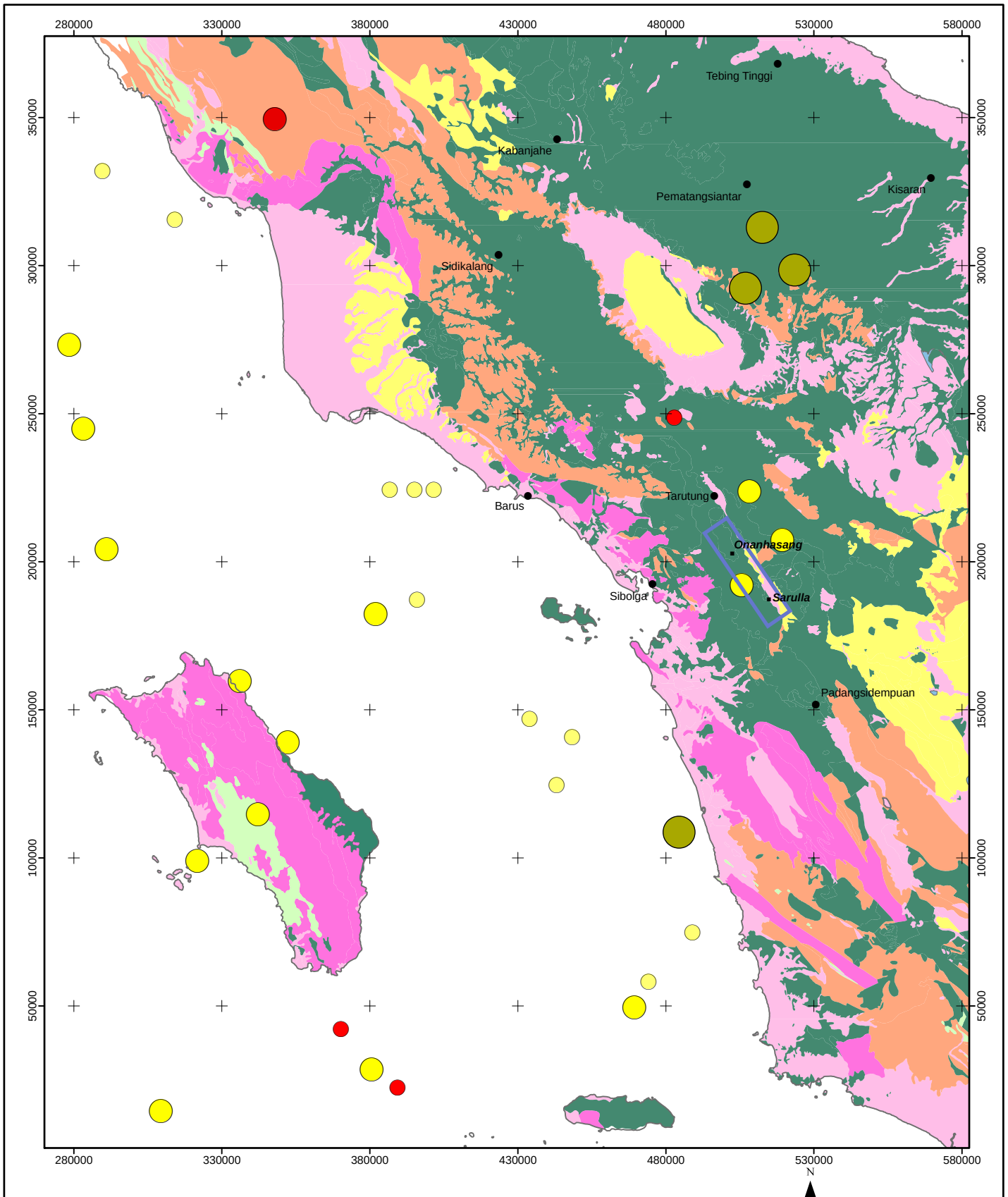
- Stable zone: in this zone, almost there is no land subsidence trend. Generally, it is an area which is almost very flat (slope of 5%) or an area of hard and compact rock;
- Relative stable zone: it is an area of slightly steep to very steep slopes (5 - > 70%) whose physical condition of soil tends to move. This condition can be prevented with reforestation, control of water use, and dry agriculture. Vegetation on this zone is generally good, consists of forest, cover forest, area of reforestation and plantation. Water condition is good and land use is generally dry. Debris slide sometimes happens locally and not widely, for example at sides of steep slopes or river basins;
- Unstable zone: is the area of slightly steep to very steep slopes (15 – 70%) almost without the existence of vegetation (vegetation is dominated by scrub or farming). Soil is rather wet and high acidic. Traces of previous land subsidence sometimes can be still found. Land subsidence had happened in several places and it is not stable yet. If rainfall is increased, the land subsidence can happen at wider areas;

- The land subsidence that had happened have diverse dimension with width of 3 to 100 meters and length of 5 to 120 meters. Cliff slopes and soil piles with bad drainage caused the subsidence mostly. In addition to the slope, the physical characteristics of source rock and its weathered soil as well as rainfall have also influences on the land subsidence. On several places, the existence of cover vegetation either hard plants and or plantation crops really will prevent the land subsidence in the area of study.

3.1.8 Spatial plan, soil and land cover

3.1.8.1 Spatial plan

Geothermal is a very strategic and potential energy source for power generation, as explained in Tapanuli Regency Regulation No. 19 of 1994 regarding Spatial Plan Level II Territory of North Tapanuli Regency. In the second chapter about the Concept of Agricultural Area Development, Paragraph 20, it is stated that Pahae Jae District is designated to be a geothermal area, as well as Tarutung and Pahae Julu Districts. This status is legitimated by North Tapanuli Regency Decree No. 334 of 1997, dated 3 February 1997, concerning Location Designated for PERTAMINA Area Geothermal EP Sibayak to be used for the preparation of geothermal drilling and power plant area in Silangkitang, Pahae Jae District. North Tapanuli Regency Regulation No. 21 of 2001 on North Tapanuli Regency Spatial Plan considers the districts of Pahae Jae and Pahae Julu as the area of geothermal field development (see **Map III-4**).



Legenda
Legend

- Kota Kabupaten — *District Capitol*
- Sarulla Project Area — *Sarulla Project Area*

Magnitude 5 - 8
Kedalaman (km)
Depth (km)

- 0 - 50
- 50 - 100
- 100 - 200

Magnitude > 8
Kedalaman (km)
Depth (km)

- 0 - 50
- 50 - 100

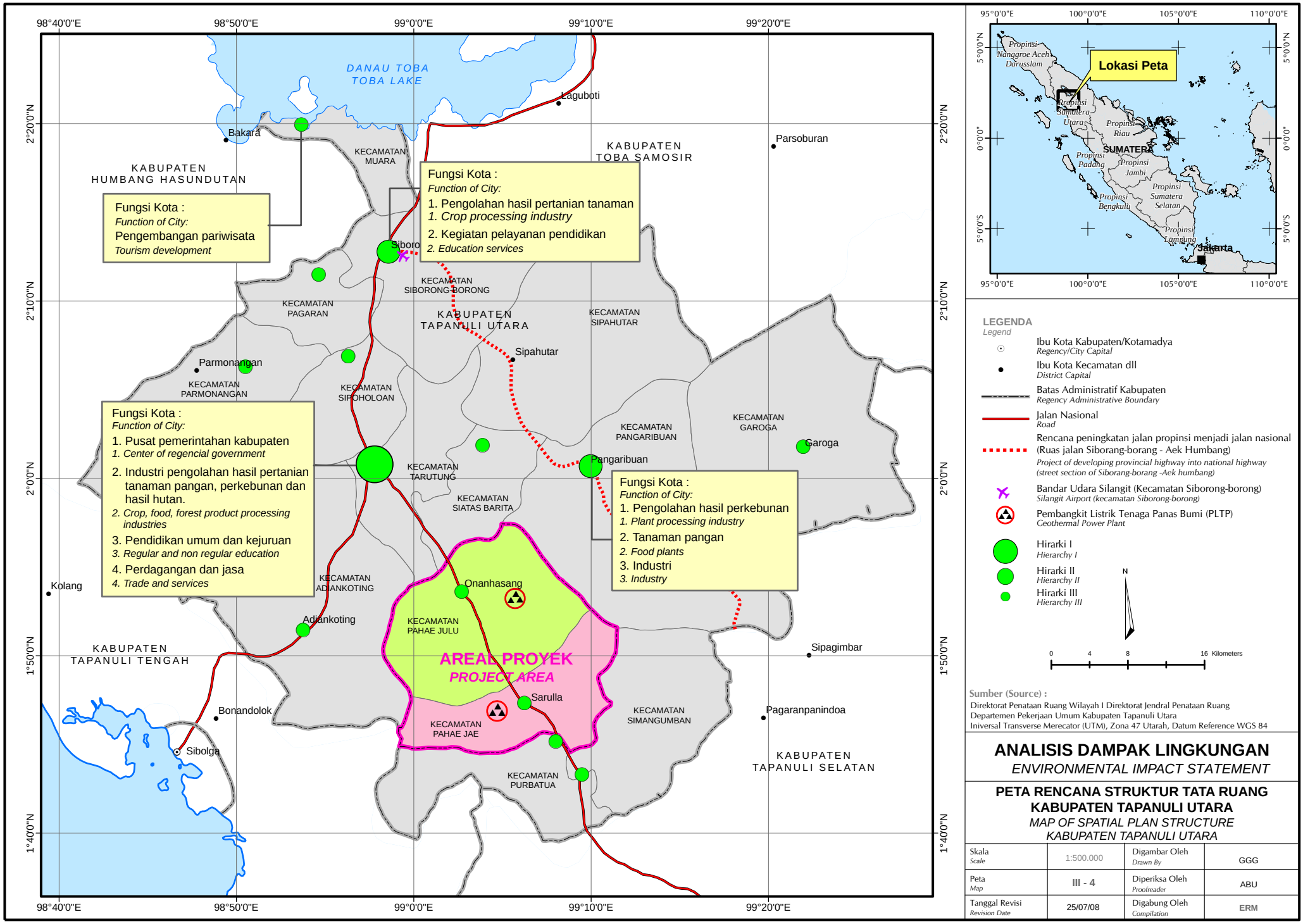
- Trench — *Trench*
- Kerak Benua — *Continental Crust*
- Busur Belakang — *Back - Arc*
- Busur Depan — *Fore - Arc*
- Busur Magmatis — *Magmatic - Arc*
- Tak Terpilahkan — *Undefined*

Sumber (Source) :
Peta Topografi - BAKOSURTANAL, 1977, Skala 1 : 50,000.
Earthquake Information from US Geological Survey

ANALISIS DAMPAK LINGKUNGAN
ENVIRONMENTAL IMPACT STATEMENT

SEJARAH GEMPA DI WILAYAH SUMATERA UTARA
NORTH SUMATERA EPICENTER

Skala *Scale*	1 : 800.000	Digambar Oleh *Drafter*	GGG
Peta *Map*	III - 3	Diperiksa Oleh *Proofreader*	ABU
Tanggal Revisi *Date Revision*	25/07/08	Digabung Oleh *Compilation*	ERM



Sumber (Source) :
Direktorat Penataan Ruang Wilayah I Direktorat Jendral Penataan Ruang
Departemen Pekerjaan Umum Kabupaten Tapanuli Utara
Inversal Transverse Merecator (UTM), Zona 47 Utarah, Datum Reference WGS 84

ANALISIS DAMPAK LINGKUNGAN
ENVIRONMENTAL IMPACT STATEMENT

PETA RENCANA STRUKTUR TATA RUANG KABUPATEN TAPANULI UTARA
MAP OF SPATIAL PLAN STRUCTURE KABUPATEN TAPANULI UTARA

Skala *Scale*	1:500.000	Digambar Oleh *Drawn By*	GGG
Peta *Map*	III - 4	Diperiksa Oleh *Proofreader*	ABU
Tanggal Revisi *Revision Date*	25/07/08	Digabung Oleh *Compilation*	ERM

3.1.8.2 Soil

3.1.8.2.1 Soil morphology

According to land and soil maps of Padang Sidempuan and Sibolga, scale of 1:250.000 (Sumatera Sheets Number No. 0617 and 0717) and previous studies (2005AMDAL Document), soil types in the study area are Tropaquents, Dystropepts, Tropaquepts, Humitropepts, Troporthents, Haplults and Eutropepts (see **Map III-5**). The soil types are classified into Entisols, Inceptisol, and Ultisols.

1) Ultisol

This type of soil is formed from the ultrabasic source rock, has good drainage, has granular to lump structure. It has the loamy clay until tough textures, and is consistently sticky. Ultisol in the study area can be found in Udie humid area (wet). The distribution of this soil is wide enough in thrust and fault groups from intrusion of alkali and ultramafic rock. Ultisol in this area of study is categorized as Hapludults. This type of soil, based on PPT (1983), is also acknowledged as podsolic soil. In study area, this soil is found at eastern area and border with cambisol soil. The areas formed by this soil are hills and curved. This soil is found at deep to very deep layer with argillic horizon. Its upper layer is brown to dark chocolate (5YR 3/4). Its texture is clayey loam. It has weak structure, which is consistently loose.

Ultisol is soil that experienced profile weathering. It is characterized by the existence of compact argilic horizon whose lower surface has higher clay content than its upper part. This soil develops from source material of the alkali rock, which is generally found at curved to hilly areas.

2) Entisol

Entisol soil has water-saturated characteristic in some time of year round. In the depth of >50 cm, it contains >35% coarse fragment. Therefore, Entisol in study area is categorized into Tropaquents.

Entisol is classified as soil, which did not yet experience profile weathering with horizon composition of AC, ACR, or AR with thin solum. In the area of study, it has small distribution area i.e. in alluvial physiographic group (route of river meander and the narrow plain between hills).

In alluvial plain, the Entisol soil is generally in deep layer. It has structure of clayey sand and has clear material stratification. It has good drainage and rather fast permeability with quite acidic soil reaction.

This soil is found at middle to very deep layer characterized by ochric horizon. Its upper horizon is grayish chocolate (5Y 3/2). Its texture is dusty to sandy loam. It has massive structure with soft, paltic, and loose consistencies.

In hilly area, the Entisol soil has shallow depth, gravels, and rocky underneath. It has good drainage and rather fast permeability. It has texture of clay until sandy clay and acidic soil reaction. In re-vegetated former mine locations, the soil has various depth, rather shallow, having gravels and rocky. Drainage is slightly bad to bad. Its texture is clayey until loamy clay. Its soil reaction is acidic.

3) Inceptisols

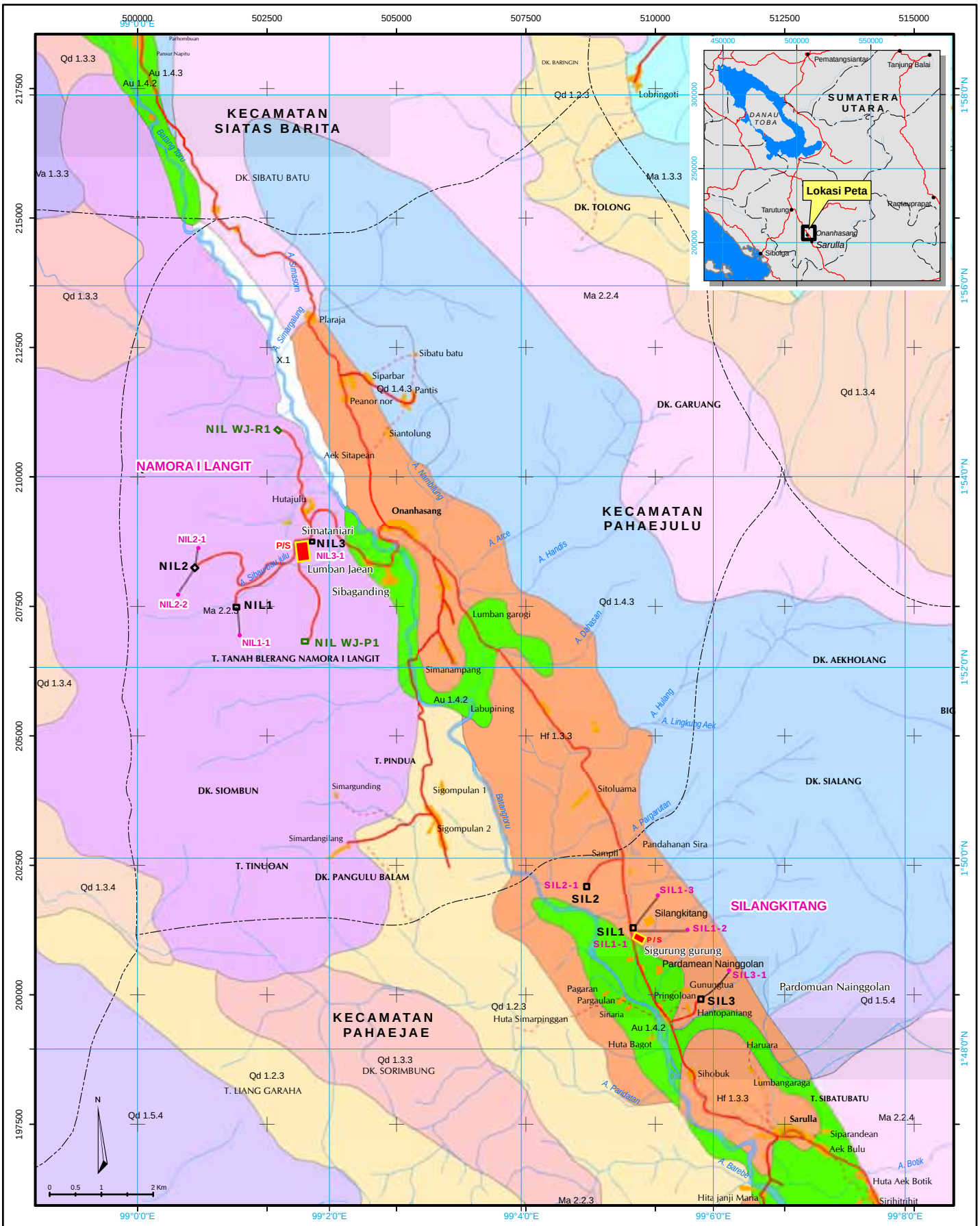
Inceptisol soil is classified as young soil; its development is still weak, characterized by horizon of B-cambic with horizon composition of ABwC or ABgC. Source material of soil varies from alluvium/ lacustrine, colovial, conglomerate, shale and limestone deposits. Inceptisol in area of study is categorized into Dystropepts, Humitropepts, and Eutropepts. This type of soil, based on PPT (1983), is also recognized as cambisol soil (1983).

The cambisol soil is developed from dacitic tuff. Its effective depth varies from middle to high with cambic horizon. Its upper layer is dark reddish brown (5YR 3/4), texture of clay from soft to middle lump structure and firm consistency. Its lower layer is yellowish brown (10YR 5/4) through light grey (10YR 3/2), texture of dusty clay, sandy clay, until sand with clump structure to unstructured and firm to loose consistency.

Inceptisol soil in alluvial depression or rather curved alluvial plain has hindered drainage resulting from water stagnation. It has tough texture and rather acidic soil reaction. The depth of the soil varies from shallow to medium depth. In re-vegetated former mine location, the soil has various depths, rather shallow, gravelled and rocky.

3.1.8.2.2 Topography

Based on topography map, scale of 1: 50,000 (Bakosurtanal), the general topography of NIL area **(Map III-6)** consists of 0 – 8% flat; 8 – 15% gently slope; and 15 –30% hilly. While of SIL (**Map III-7)**, it consist of 0 – 8% flat and 8 – 15% slightly slope.



Legenda
Legend

- Titik Ketinggian — *Elevation Point*
- Jalan Arteri — *Arteri Road*
- Jalan Kolektor — *Collector Road*
- Jalan Lokal — *Local Road*
- Batas Kecamatan — *Kecamatan Boundary*
- Sungai — *River*
- Permukiman — *Village*
- Sumur Eksplorasi Namora I Langit dan Silangkitang — *Namora I Langit and Silangkitang Exploration Wells*
- Lokasi Sumur Baru (West JEC) — *New Well Site (West JEC)*
- P/S Pembangkit Listrik — *Power Station*

Keterangan :
Note :
Legenda terlampir halaman berikut
Legends can be seen on the next page

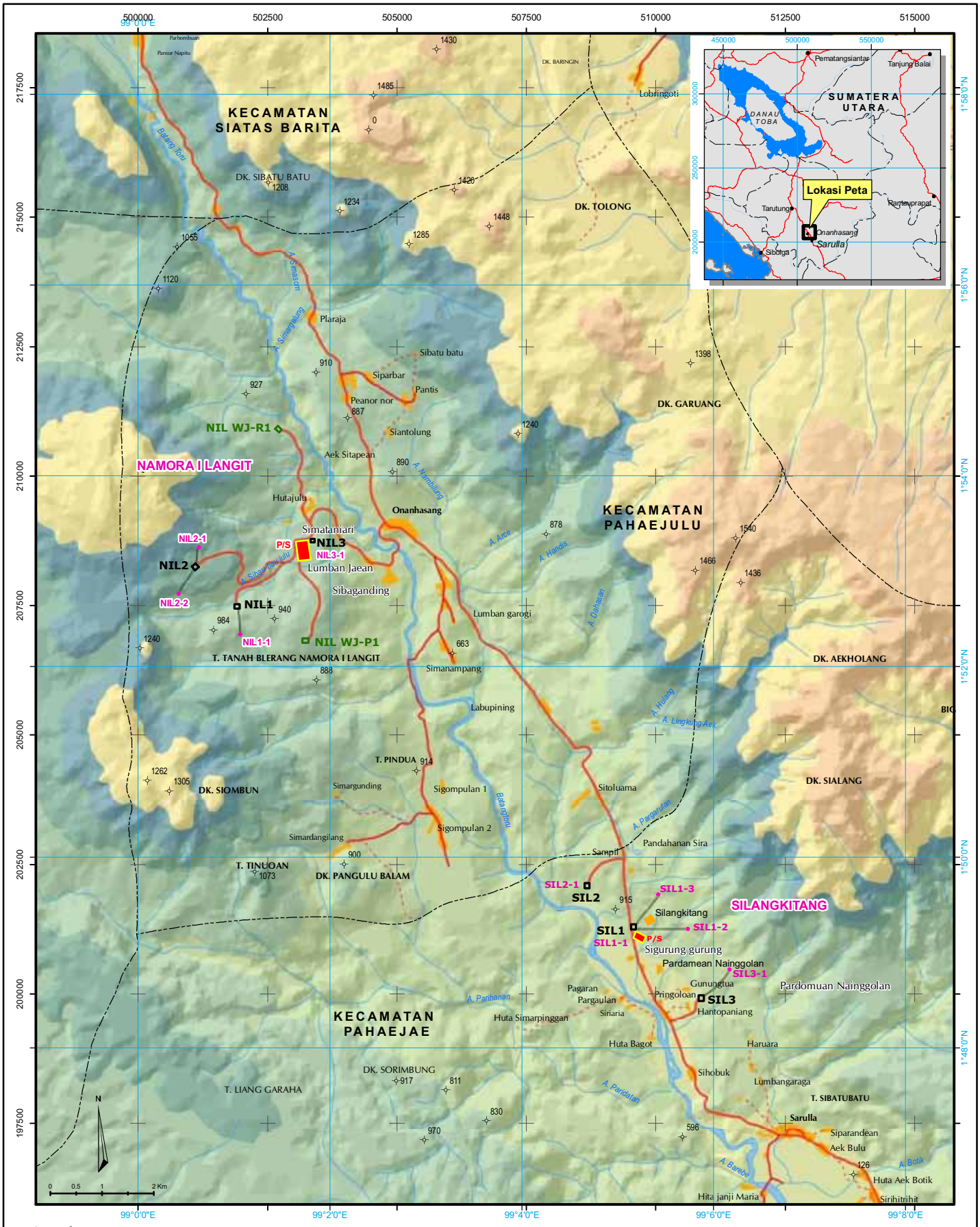
Keterangan :
Note :
DK : Bukit — *Hill*
Aek : Sungai — *River*
T. :Tinggi — *Elevation*

Sumber (Source) :
Land Unit and Soil Map of Padangsidempuan and Sibolga Sheet
Peta Topografi - BAKOSURTANAL, 1977, Skala 1 : 50,000.
Medco Geothermal Indonesia

ANALISIS DAMPAK LINGKUNGAN
ENVIRONMENTAL IMPACT STATEMENT

JENIS TANAH WILAYAH STUDI
SOIL OF STUDY AREA

Skala *Scale*	1 : 100.000	Digambar Oleh *Drafter*	GGG
Peta *Map*	III - 5	Diperiksa Oleh *Proofreader*	ABU
Tanggal Revisi *Date Revision*	23/10/08	Digabung Oleh *Compilation*	ERM



Legenda
Legend

- Titik Ketinggian — *Elevation Point*
- Jalan Arteri — *Arteri Road*
- Jalan Kolektor — *Collector Road*
- Jalan Lokal — *Local Road*
- Batas Kecamatan — *Kecamatan Boundary*
- Sungai — *River*
- Permukiman — *Village*
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- P/S Pembangkit Listrik — *Power Station*

Tingkat Ketinggian (dpl)
Elevation Level (asl)

- 374 - 500 m
- 500 - 800 m
- 800 - 1000 m
- 1000 - 1100 m
- 1100 - 1200 m
- 1200 - 1400 m
- 1400 - 1775 m

Keterangan :
Note :

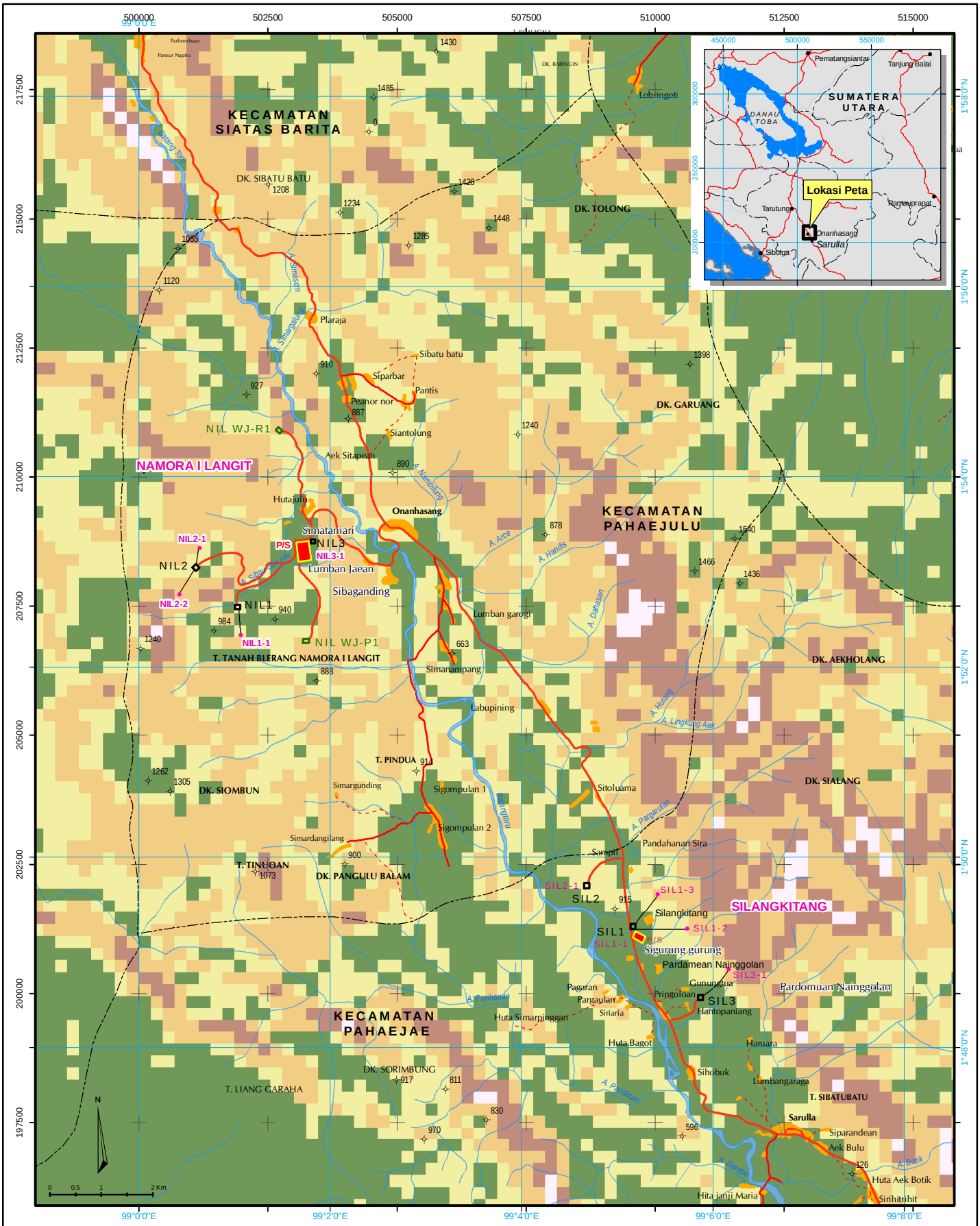
DK : Bukit — *Hill*
Aek : Sungai — *River*
T. :Tinggi — *Elevation*

Sumber (Source) :
Peta Topografi - BAKOSURTANAL, 1977, Skala 1 : 50,000.
Medco Geothermal Indonesia

ANALISIS DAMPAK LINGKUNGAN
ENVIRONMENTAL IMPACT STATEMENT

PETA KETINGGIAN DI WILAYAH STUDI
ELAVATION MAP OF STUDY AREA

Skala *Scale*	1 : 100.000	Digambar Oleh *Drafter*	GGG
Peta *Map*	III - 6	Diperiksa Oleh *Proofreader*	ABU
Tanggal Revisi *Date Revision*	23/10/08	Digabung Oleh *Compilation*	ERM



Legenda
Legend

- Titik Ketinggian — *Elevation Point*
- Jalan Arteri — *Arteri Road*
- Jalan Kolektor — *Collector Road*
- Jalan Lokal — *Local Road*
- Batas Kecamatan — *Kecamatan Boundary*
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- P/S — Pembangkit Listrik — *Power Station*

Kelass Class	Simbol Symbol	Lereng (%) Slope (%)	Relief Relief
I		> 8	Datar *Flat*
II		9 - 15	Landai *Slope slightly*
III		16 - 30	Agak Curam *Lightly Steep*
IV		30 - 45	Curam *Steep*
V		> 45	Sangat Curam *Very Steep*

Keterangan : *Note :*
DK : Bukit *Hill*
Aek : Sungai *River*
T. :Tinggi *Elevation*

Sumber (Source) :
Peta Topografi - BAKOSURTANAL, 1977, Skala 1 : 50,000.
Medco Geothermal Indonesia

ANALISIS DAMPAK LINGKUNGAN
ENVIRONMENTAL IMPACT STATEMENT

KELAS LERENG WILAYAH STUDI
SLOPE CLASS OF STYDU AREA

Skala *Scale*	1 : 100.000	Digambar Oleh *Drafter*	GGG
Peta *Map*	III - 7	Diperiksa Oleh *Proofreader*	ABU
Tanggal Revisi *Date Revision*	23/10/08	Digabung Oleh *Compilation*	ERM

3.1.8.2.3 Land suitability

Land suitability for plant growth (seasonal, yearly and forestry plants) indicates the inherent capacity of the land in supporting the plants to grow optimally and simultaneously, and not to cause significant damage to the environment and land resources. Land suitability is physically determined through the comparison between plant growth prerequisite (agronomic prerequisite) with actual land biophysics conditions. The biophysics conditions are: a) climate (annual average temperature, annual average rainfall and water availability per month); b) slope; c) soil characteristics (pH, exchangeable cation capacity, total nitrogen, P-available, exchangeable K, aluminum saturation, texture, drainage and effective depth); d) level of erosion hazard; e) condition of rocks on land surface; and f) flood risk.

An evaluation of land suitability was conducted using criteria from research on land suitability in Technical Guidance for Land Evaluation (Centre of Soil and Agroclimatic Research, 1993). The evaluation was conducted for actual biophysics, potential land conditions where input for improvement was required to support plant growth, and production.

Due to the variety of land use in the study area, the evaluation of land suitability was conducted for farm rice, gogo rice, corn, rubber, palm coconut, cacao, robusta coffee, *Agathis lorantifolia*, *Albizia falcataria*, *Acacia auriculiformis*, *Eucalyptus grandis* and *Pinus Merkusii*. Evaluation result is presented in **Table III-4.**

Table III-4 Land suitability in the study area

Land unit	Slope class	Plant type											
		1	2	3	4	5	6	7	8	9	10	11	12
Ma.2.2.3	0-8%	S1n	S1n	S1n	S1n	S1n	S1n	S1n	S1n	S1n	S1n	S1n	S1n
	8-15%	S2ns	S2ns	S2ns	S2n	S2n	S2n	S2n	S2n	S2n	S2n	S2n	S2n
	15-30%	N1ns	N1ns	N1ns	S3ns	N1ns	S3ns	S3ns	S3ns	S3ns	S3ns	S3ns	S3ns
Qd 1.5.4	0-8%	S1n	S1n	S1n	S1n	S1n	S1n	S1n	S1n	S1n	S1n	S1n	S1n
	8-15%	S2ns	S2ns	S2ns	S2n	S2n	S2n	S2n	S2n	S2n	S2n	S2n	S2n

Description:

Plant type

1 = Farm Rice
2 = Gogo Rice
3 = Corn
4 = Rubber
5 = Pal Coconut
6 = Cacao
7 = Robusta Coffee
8 = *Agathis lorantifolia*
9 = *Albizia falcataria*
10 = *Acacia auriculiformis*
11 = *Eucalyptus grandis*
12 =*Pinus merkusii*

Land Suitability Class:

Boundary Factors:

N2 = permanently unsuitable
N1 = currently unsuitable
S3 = marginally suitable
S2 = slightly suitable
S1 = suitable

s = slope
n = nutrient availability

3.1.8.2.4 Soil erosion

Annual average of soil erosion (in long term) was calculated using USLE model. Soil erosion of a land unit is equal to rain erosivity (R), soil erodibility (K), length of slope (L), slope class (S), plant cover and management (C) and the land and water conservation.

Rain erosivity is calculated using Bols formula (1978) whereas soil erodibility is calculated by using Wischmeier and Smith formula (1978) by considering texture of soil (very fine sand, dust, clay), soil organic matter, permeability as well as the form and development of soil structure. Length of slope in each land unit is measured from the upper top where the surface flow will happen to a place where the change in configuration of the slope happening so that some sediments brought by the erosion will be deposited or the flow will enter rivers or ditches.

Potential erosion hazard on land damage and environmental resources are evaluated using Erosion Hazard Index (Hammer, 1981) and Level of Erosion Hazard (Director General of Reforestation and Land Rehabilitation, 1996). The Erosion Hazard Index (EHI) is the comparison between potential soil erosion and tolerable erosion, whereas the Level of Erosion Hazard (LEH) is the index obtained by combining the level of potential erosion that can happen when land is opened with its solum condition. EHI and LEH are presented in **Table III-5**. This table shows that erosion is a hazard, which may damage land and environmental resources at the study area if land clearing and its management are not followed by appropriate soil and water conservation.

Table III-5 Soil erosion in the study area

Land unit	*Slope class*	*Land use*	*USLE*					*Erosion*
			R	*K*	*LS*	*C*	*P*	*(ton/ha/y)*
Ma 2.2.3	0-8%	MG	3389.7	0.16	4.37	0.8	1	1896.06
	0-8%	B	3389.7	0.16	4.37	0.3	1	237.01
	8-15%	MG	3389.7	0.16	5.50	0.8	1	745.73
Qd1.5.4	8-15%	B	3389.7	0.16	5.50	0.3	1	298.29
	15-30%	MOPF	3389.7	0.16	8.10	0.005	1	39.54

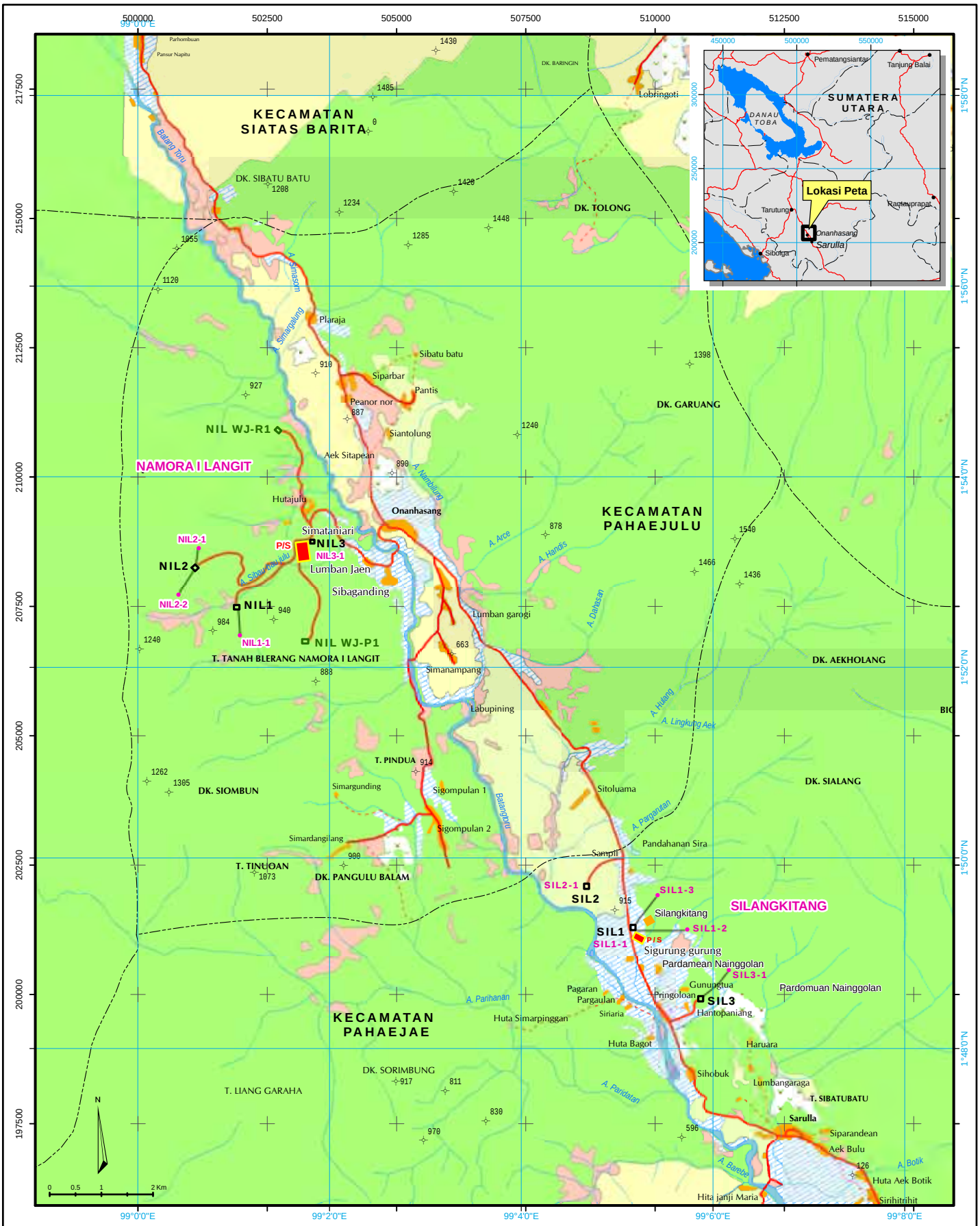
Note:
Land Use
MOPF : Mid Opened Primary Forest
MG : Mixed Garden
B : Bushes

Table III-6 Erosion Hazard Index (EHI) and Level of Erosion Hazard (LEH) in the study area

Land Unit	EP (ton/ha/y)	TSL (ton/ha/y)	EHI (value)	Solum (cm)	LEH (level)
Ma 2.2.3	1896.06	0.37	5171.07	110	Very high
	237.01	0.41	578.07	123	Very high
	745.73	0.40	1879.99	119	Very high
Qd 1.5.4	298.29	0.41	721.67	124	Very high
	39.54	0.38	103.15	115	Medium

3.1.8.3 *Land cover*

It is estimated that around 115 ha area of land will be used for roads, well pads, and supporting facilities. Current land usage in the study area was for mixed plantation, paddy-fields and forest areas. Land cover map can be seen in **Map III-8**.



Legenda
Legend

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Keterangan : *Note :*

DK : Bukit — *Hill*
Aek : Sungai — *River*
T. :Tinggi — *Elevation*

Penggunaan Lahan *Landuse*

- Belukar — *Shrub*
- Hutan — *Forest*
- Kebun — *Crops*
- Perkebunan Karet — *Rubber Plantation*
- Rumput — *Grass*
- Sawah — *Rice Field*

Sumber (Source) :

Peta Topografi - BAKOSURTANAL, 1977, Skala 1 : 50,000.
Medco Geothermal Indonesia

ANALISIS DAMPAK LINGKUNGAN
ENVIRONMENTAL IMPACT STATEMENT

PENUTUPAN LAHAN WILAYAH STUDI
LANDUSE OF STUDY AREA

Skala *Scale*	1 : 100.000	Digambar Oleh *Drafter*	GGG
Peta *Map*	III - 8	Diperiksa Oleh *Proofreader*	ABU
Tanggal Revisi *Date Revision*	23/10/08	Digabung Oleh *Compilation*	ERM

3.2 BIOLOGICAL COMPONENTS

3.2.1 Terrestrial biota

3.2.1.1 Vegetation

Types of vegetation in the study area are mixed forest plant, mixed plantation, and shrub.

Mixed forest plantation consists of secondary forest and dominated by horticultural plants e.g. rubber plant (*Havea brasiliensis)* and fruits. Mixed plantation is area planted with crops species like rubber, coconut, cacao, coffee, and fruits. Shrub is area filled with Congo grass (*imperata cylindrical*), maple (*Saccharum spontaneum*), pteridophyta, and crept plants. Detailed vegetation in the study area can be seen in **Table III-7**.

Table III-7 Vegetation in the study area

No	Scientific name	Local name
Mixed plantation species		
1	*Aleuritas moluccana*	*Kemiri*
2	*Areca calechu*	*Pinang*
3	*Arenga pinnata*	*Aren*
4	*Arthocarpus heterophylla*	*Nangka*
5	*Baccaurea racemosa*	*Menteng*
6	*Calamus sp.*	*Rotan*
7	*Carica papaya*	*Pepaya*
8	*Cocos nucifera*	*Kelapa*
9	*Coffea sp*	*Kopi*
10	*Durio zibethinus*	*Duren*
11	*Gigantochloa apus*	*Bambu tali*
12	*Havea brasiliensis*	*Karet*
13	*Lansium domesticum*	*Pisilan*
14	*Mangifera foetida*	*Limus/Kemang*
15	*Musa paradisiacal*	*Pisang*
16	*Nephelium lappaceum*	*Rambutan*
17	*Parkia speciosa*	*Petai*
18	*Persea Americana*	*Alpukat*
19	*Syzigium aqueum*	*Jambu air*
20	*Theobroma cacao*	*Coklat*
21	*Acalypha wilkesiana*	*Dawolang*
22	*Alimenthera ficoides*	*Kriminil*
23	*Ananas comosus*	*Nenas*
24	*Anona muricata*	*Sirsak*
25	*Arthocarpus heterophylla*	*Nangka*
27	*Caladium sp.*	*Keladi hias*
29	*Canna hybrida*	*Bunga tasbih*
30	*Capsicum frutescens*	*Cabe rawit*

No	Scientific name	Local name
31	*Carica papaya*	*Pepaya*
32	*Ceiba petandra*	*Kapuk*
33	*Citrus aurantifolia*	*Jeruk*
34	*Collocasia esculenta*	*Talas*
35	*Cordyline fruticosa*	*Hanjuang*
36	*Cymbophogon nardus*	*Serai*
37	*Dieffenbachia fourneri*	*Kasinlu*
38	*Duranta erecta*	*Anak nakal*
39	*Glyciridia sepium*	*Gamal*
40	*Hippeastrum puniceum*	*Bakung*
41	*Impatiens balsamina*	*Pacar air*
42	*Coleus sp.*	*Jengger ayam*
43	*Langus galangal*	*Laos*
44	*Mangifera indica*	*Mangga*
45	*Manihot utilisima*	*Singkong*
46	*Marantha sp.*	*Sagu*
47	*Musa parasidiaca*	*Pisang*
48	*Nephelium lappaceum*	*Rambutan*
49	*Occimum basilium*	*Kemangi*
50	*Ophiopogon sp.*	*Petai*
51	*Parkia speciosa*	*Bunga es lilin*
52	*Psidium guajava*	*Jambu bali*
53	*Rosa sp.*	*Bunga rosa*
54	*Saccharium ollicianium*	*Tabe*
55	*Sechium edule*	*Labu siam*
56	*Solanum melongena*	*Terung*
58	*Syzigium malacensis*	*Jambu bol*
60	*Tagetes erecta*	*Bunga tahi ayam*
61	*Zinna legens*	*Bunga kertas*
Mixed forest vegetation		
1	*Havea brasiliensis*	*Karet*
2	***Styrax** benjoin*	*Kemenyan*
3	***Arthocarpus sp***	*Nangka hutan*
4	***Arenga sp***	*Aren*
Shrub vegetation		
1	*Imperata cylindrica*	*Alang-alang*
2	*Melastoma sp*	*Harendong*
3	*Pteridhopyta*	*Paku-pakuan*
4	*Cyperus sp*	*Teki-tekian*
5	*Oriza sp*	*Padi-padian*

3.2.1.1.1 Mixed forest vegetation

This terminology represents exploited forest area and re-vegetated with horticultural plants, which is mostly found in NIL.

This included rubber plant, kemenyan (*Styrax benjoin*), aren (*Arenga sp*), and various fruits. Vegetation composition tends to be homogeneous, forming the forest ecosystem (**Figure III-5**).

Figure III-5 Mixed forest vegetation

3.2.1.1.2 Mixed plantation vegetation

Mixed plantation area cultivated by crop species. The area is typically by fruits and non-timber products.

Typical mixed plantation area in the study area is illustrated in **Figure II-6**.

Figure III-6 Community's mixed plantation

3.2.1.1.3 Shrub

Low layer vegetation dominates typical shrub founding the study area i.e. vegetation with < 70 cm height. It is in the process of secondary succession because it is in seed form. Secondary succession is forest regeneration process, usually preceded by pioneer species i.e. fast growing species, which will dominate the area. There is no available data describing this type of ecosystem.

Figure III-7 Shrub

3.2.1.2 Wildlife habitat

Mixed forest area can only be found in NIL. Vegetation is a mixture of crops and forest species. Typical species include *Aleuritas moluccana* (pecan), *Areca catechu* (palm), *Arenga pinnata* (nut), *Arthocarpus heterophylla* (Cempedak forest), *Baccaurea racemosa*, *Calamus sp.* (rattan), *Carica papaya* (papaya), *Cocos nucifera* (coconut), *Coffea sp* (coffee), *zibethinus Durio* (durian), *Gigantochloa apus*, *Havea brasiliensis* (rubber), *Lansium domesticum* (complexioned), *Mangifera foetida* (mango) etc. Such vegetation is generally used by wildlife, in this case primate, to search for food and roaming areas.

In plantation area dominated by fruits, mammals and birds could also be found in addition to primates that eat leaves and fruits.

Several species of herpetofauna (reptile and amphibian) uses shrub to seek food, shelter (nest) and cover (protection). Rodent uses shrub to hide from predators.

Based on survey data, there is no protected species found in the study area. Typical vegetation is cultivation crops utilized by human.

3.2.1.3 Wild fauna

Based on survey results and data from AMDAL in 2005, four fauna classes are were found in study area i.e. Aves, Mammal, Reptile and Amphibian. The identification was direct or indirect encounters through traces of their presence. The results of wild fauna observation can be seen in **Table III 8**.

Table III-8 Fauna in the study area

No	Scientific name	Local name	Conservation Status		
			GR No 7 of 1999	IUCN	CITES
Aves					
1	*Egretta intermedia*	*Kuntul Perak*	P	-	-
2	*Egretta garzetta*	*Kuntul perak kecil*	P	Least Concern	Appendix III
3	*Bubulcus ibis*	*Kuntul kerbau/Bangau putih*	P	Least Concern	Appendix III
4	*Spilornis cheela*	*Elang Ular Bido*	P	Least Concern	Appendix II
5	*Spizaetus cirrhatus*	*Elang Brontok*	P	Least Concern	-
6	*Alcedo meninting*	*Raja udang meninting*	P	Least Concern	-
7	*Lacedo pulchella*	*Cekakak btu*	P	Least Concern	-
8	*Aceros undulatus*	*Julang emas*	P	Least Concern	Appendix II
9	*Buceros rhinoceros*	*Rangkong badak*	P	Near threatened	Appendix II
10	*Megalaima oorti*	*Takur bukit*	P	Least Concern	-
11	*Megalaima haemacephala*	*Takur ungkut-ungkut*	P	Least Concern	-
12	*Nectarinia jugularis*	*Burung madu sriganti*	P	-	-
13	*Aethopyga siparaja*	*Burung madu sepah raja*	P	Least Concern	-
14	*Aethopyga mystacalis*	*Burung madu jawa*	P	Least Concern	-
15	*Arachnothera longirostra*	*Pijantung kecil*	P	Least Concern	-
Mammals					
1	*Arctitis binturong*	*Binturung*	P	Vulnerable	
2	*Lutra sumatrana*	*Lutra Sumatra/berang-berang*	P	Endangered	Appendix II
3	*Cynogale bennetti*	*Musang air*	P		Appendix II
4	*Hystrix brachyura*	*Landak*	P	Least Concern	Appendix III
5	*Hylobates agilis*	*Serundung*	P	Endangered	Appendix I
6	*Hylobates lar*	*Unko*	P	Endangered	Appendix I
7	*Macaca fasicularis*	*Monyet ekor panjang*	P	Least Concern	-
8	*Macaca nemestrina*	*Bokoi, Beruk mentawai*	P	Vulnerable	Appendix II
9	*Manis javanica*	*Trenggiling, Peusing*	P	Endangered	Appendix II
10	*Tragulus javanicus*	*Pelanduk*	P	Data Deficient	-
11	*Tragulus napu*	*Napu*	P	-	-
12	*Muntiacus muntjak*	*Kijang*	P	Least Concern	-
13	*Felis bengalensis*	*Kucing hutan, Meong congkok*	P	-	Appendix II
14	*Felis marmorata*	*Kuwuk, Kucing bulu Pardofelis marmorata*	P	-	Appendix II
15	*Lariscus insignis*	*Bajing tanah*	P	Least	-

No	Scientific name	Local name	Conservation Status		
			GR No 7 of 1999	IUCN	CITES
				Concern	
Reptile					
1	*Phyton sp.*	*Sanca*	P	-	Appendix II

Note: P = Protected, IUCN= International Union for Conservation of Nature, CITES= Convention on International Trade in Endangered Species of Wild Fauna and Flora, Appendix I=List of all wild animal and plant species which are restricted in all forms of international trade, Appendix II=List of species which are not threatened by extinction, nevertheless they may be threatened if they are still traded without any control, Appendix III=List of wild animal and plant species which are protected in certain country in their habitat boundary, and they can be upgraded into Appendix II or Appendix I Status.

Based on **Table III-8**, there were 31 mammal species in the study area that can be classified into several categories. Civet species found were Luwak Civet (*Paradoxurus hemaproditus*), Binturung (*Arctitis binturong*), Masked Civet (*Paguma larvata*), and Civet Cat (*Viverra tangalunga*). Civet is categorized as carnivorous mammal with poultry as its food source. Its habitats were forest area and residential areas. Primate mammals found were Ungko (*Hylobathes lar*), Serudung (*Hylobathes agilis*), long-tail monkey (*Macaca fasicularis*) and Macaque (*Macaca nemestrina*). Their main habitat was the mixed plantation forest in NIL with rubber leaves bud as food source. Typical food sources for monkey species (*Macaca sp*.) were leaves and fruits. Monkeys tend to adapt quickly to its and not affected much by activities in the surrounding area, except for *Hylobathes sp*. Their habitats included mixed forest and plantation with fruits. Herbivore mammals in the study area were deer (*Muntiakus muntjak*) and mouse deer (*Tragulus javanicus*). Their food source was low layer of vegetation and leaves, with forest as its main habitat. They are sensitive to human activities. Mammals that eat fruits included Squirrel (*Tupaia tana*), Bajing (*Callociurus notatus*), and Bajing Tanah (*Larius insignis*) found in plantation and residential areas. Rodents included Red mouse (*Maxomis surifer*), Bamboo mouse (*Leopoidamys sabanus*), Rat (*Rattus diardii*), Field Rat (*Rattus exulans*), and Mencil Sawah (*Mus caroli*). Rodents are considered as omnivore found in plantation, paddy field, forest and residential areas. Predators included Macan dahan (*Felis bengalensis*) and Kucing hutan (*Felis marmorata*) found in the forest depending on the locations of its preys i.e. deer, wild boar, and other mammals.

Aves classes are categorized based on its food source. Field survey showed that insectivore that eats insects such as pest was the dominant bird species. Insectivorous birds included like Kekep (*Artamus leucorynehus*), Srigunting hitam (*Dicrurus macrocercus*), Srigunting kelabu(*Dichrurus leucophaeus*), Kepodang (*Oriolus chinensis*), Sikatan, prenjak, ungkut-ungkut, and caladi ulam. Their habitat included forest, shrub and mixed plantation. The type of nectar birds were Burung madu (honey bird), Burung kuning (*Nectarinia jugularis*), and Jantung kecil (*Arachnothera longirosta*). They were normally found in areas with fruits such as mixed plantation and community gardens. Seed eater birds included Pigeon (*Treron sp.*), Mandar padi (*Gallirallus striatus*), Turtle-dove (*Stretopilia chinensis*), Perkutut (*Geopilia striata*), Parakeet (*Loriculus galgulus*), Gelatik stone (*Parus Mayor*), Bondol (*Lonchura Malacca*), Bondol

pilgrim (*Lonchura maja*), Sparrow (*Passer montanus*), Emprit (*Ploceus philippinus*) and Jalak (*Sturnus stuninus*). They were generally found in agriculture area (rice, corn) and shrub (seeds). Fish eater birds included Heron species (*Egretta sp.*), Kokokan (*Ixobrychus cinnamomeus*), Raja udang (*Lacedo pulchella*), and Maninting (*Alcedo maninting*). Fish eater birds generally live in waters such as river, sea, paddy field, dam, and coast. Within the study area, they were found in wet agricultural land (paddy field) and river. Carnivorous birds included Elang brontok (*Spizaetus cirratus*) and Elang ular bido (*Spizaetus cheela*). Their food sources were small mammals, birds and reptiles and they lived in trees.

3.2.2 *Aquatic biota*

3.2.2.1 Plankton

Plankton is aquatic organism which floats passively and is carried by water current. It occupies the bottom tropic level and plays an important role in transferring energy from primary producer to consumer or organism at higher tropic levels. Based on its types, plankton can be divided into phytoplankton (plants) and zooplankton (animal).

Phytoplankton is a primary producer that can change chlorophyll (pigment) into enriched organic matter using photosynthesis process, which is very important in the food chain. Zooplankton occupies a higher tropic level after phytoplankton and is the main food source for fish, prawns, and the other aquatic biota.

In aquatic environment, plankton is a biological component with significant role. It is an indicator of richness and water quality. Moreover, plankton is the organism that balances and interacts with other aquatic organisms.

Their characteristic is supported by its behavior i.e. unable to move or have very weak movements. Changes in the environment influences plankton's life and distribution.

Samples were collected from rivers in the study area by PPSDL USU in March 2008. Laboratory results are presented in **Table III-9**.

Table III-9 Plankton composition in Batang Toru River

No	*Taxonomy*	*Location*			
		Bio-1	*Bio-2*	*Bio-3*	*Bio-4*
Phytoplankton					
I	**Class : Bacillariophyceae**				
	Fam : Fragilariaceae				
1	*Asterionella sp*	136		136	68
2	*Centronella sp*				68
3	*Diatoma sp*	136			
II	**Class : Chlorophyceae**				

No	Taxonomy	Location			
		Bio-1	Bio-2	Bio-3	Bio-4
	Fam : Chaetophoraceae				
4	*Pseudoulvella sp*		136		
	Fam : Characeae				
5	*Tolypella sp*	68			
	Fam : Cladophoraceae				
6	*Rhizoclonium sp*				136
	Fam : Desmidiaceae				
7	*Closierium sp*		68	68	68
8	*Cosmocladium sp*		272		
9	*Pleurotaenium sp*				136
	Fam : Mesotaeniaceae				
10	*Gonatozygon sp*	272	204	272	408
	Fam : Oocystaceae				
11	*Dactylococcus sp*	136			
12	*Pachycladon sp*	136			
13	*Selenastrum sp*	68		68	
	Fam : Schizogoniaceae				
14	*Prasiola sp*		126	68	
15	*Schizogonium sp*	68	68		
	Fam : Schizomeridaceae				
16	*Schizomeris sp*				136
	Fam : Tetrasporaceae				
17	*Tetraspora sp*		68	204	
	Fam : Ulotrichasceae				
18	*Rhaphidionema sp*	204		68	
	Fam : Ulvaceae				
19	*Enteromorpha sp*	272	136	68	
20	*Monostroma sp*	476	272	952	544
	Fam : Zygnemataceae				
21	*Pleurodiscus sp*		68		
III	**Class : Chrysophyceae**				
	Fam : Chrysocapsaceae				
22	*Phaeosphaera sp*		68	340	272
	Fam : Hydruraceae				
23	*Hydrurus sp*			204	
IV	**Class : Dinophyceae**				
	Fam : Gonyoulaceae				
24	*Gonyoulax sp*			204	
V	**Class : Euglenophyceae**				
	Fam : Colaciaceae				
25	*Eugldna sp*	68			
VI	**Class : Myxophyceae**				
	Fam : Rivulariaceae				

No	Taxonomy	Location			
		Bio-1	Bio-2	Bio-3	Bio-4
26	*Amphithrix sp*		136		
VII	**Class : Rhodophyceae**				
	Fam : Lemaneaceae				
27	*Lemanea sp*	68			136
	Fam : Thoreaceae				
28	*Thorea sp*				68
VIII	**Class : Xanthophyceae**				
	Fam : Pleurochloridaceae				
29	*Chlorogibba sp*		136		
30	*Tetraedriella sp*	68			
Zooplankton					
IX	**Class : Lobosa**				
	Fam : Nebelidae				
31	*Paraquadrula sp*	136			
Number of Taxonomy		15	13	12	11
Abundance (ind/L)		2.312	1.758	2.652	2.040
Diversity Index (H')		2,499	2,437	2,079	2,119
Similarity Index (E)		0,923	0,950	0,837	0,884

Source: Research Center for Natural and Environmental Resources analysis result, North Sumatera University (2008)

Location:
Bio-1 : Aquatic Biota in Batang Toru River Before SIL, N: 01^{0}49'30,1" / E: 099^{0}04' 38,6"
Bio-2 : Aquatic Biota in Batang Toru River After SIL N: 01^{0}48'01,4" / E: 099^{0}05'31,8."
Bio-3 : Aquatic Biota in Batang Toru River Before NIL N: 01^{0}53'16,0" / E: 099^{0}02'41,9"
Bio-4 : Aquatic Biota in Batang Toru River After NIL N: 01^{0}53'06,4" / E: 099^{0}02'52,1"

Plankton compositions at 4 locations in Batangtoru River indicated 8 classes of phytoplankton, i.e. *Bacillariophyceae* (3 genus), *Chlorophyceae* (18 genus), *Chrysophyceae* (2 genus), *Dinophyceae* (1 genus), *Euglenophyceae* (1 genus), *Mixophyceae* (1 genus), *Rhodophyceae* (2 genus), and *Xantophyceae* (2 genus). One class of zooplankton was found i.e. *Lobosa* (1 genus).

3.2.2.1.1 Species abundance

Abundance or density of plankton species ranged from 1,758 – 2,652 individuals/L (**Figure III-8)** with an average of 2,190 individuals/L. The highest abundance was at Bio-3 with 2,652 individuals/L whereas the lowest was found at Bio-2 with 1,758 individuals/L.

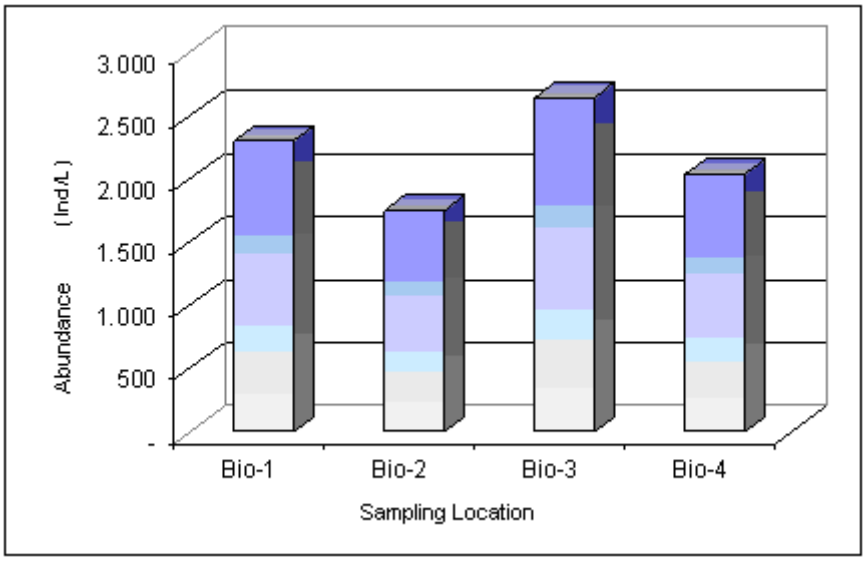


Figure III-8 Plankton abundance (individual/L) in the study area

3.2.2.1.2 Diversity Index

The abundance of each species and the number of species influence the diversity index. High number of species and high abundance indicates higher diversity than species with less number of species and inequitable abundance.

Diversity Indexes in the study area ranged from 2.079 to 2.499. The highest diversity was found at Bio-1 whilst Bio-3 had the lowest diversity (**Figure III-9**).

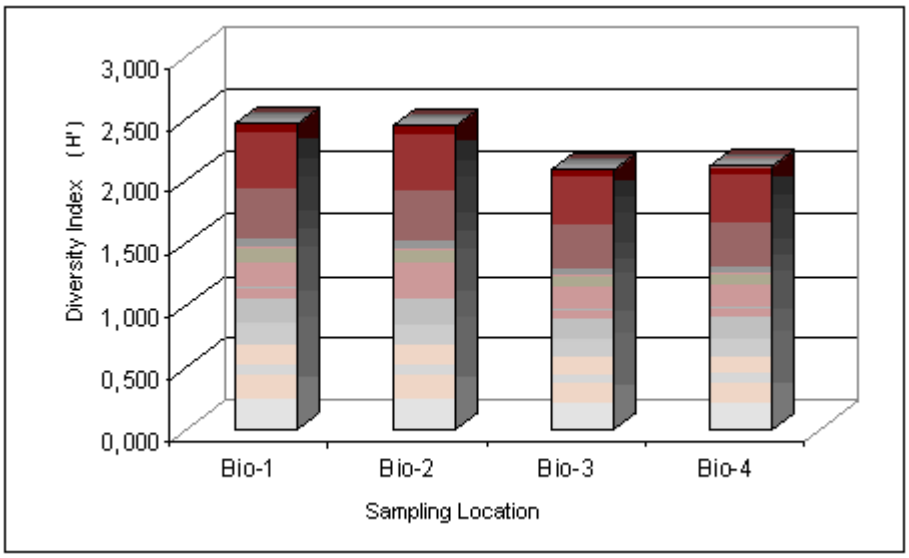


Figure III-9 Plankton Diversity Index in the study area

3.2.2.1.3 Evenness

Evenness index of phytoplankton in study area ranged from 0.837 to 0.923. The highest evenness was at station Bio-1 and the lowest at station Bio-3 (**Figure III-10**). The values showed high evenness i.e. good distribution of phytoplankton and no particular species dominated the water bodies.

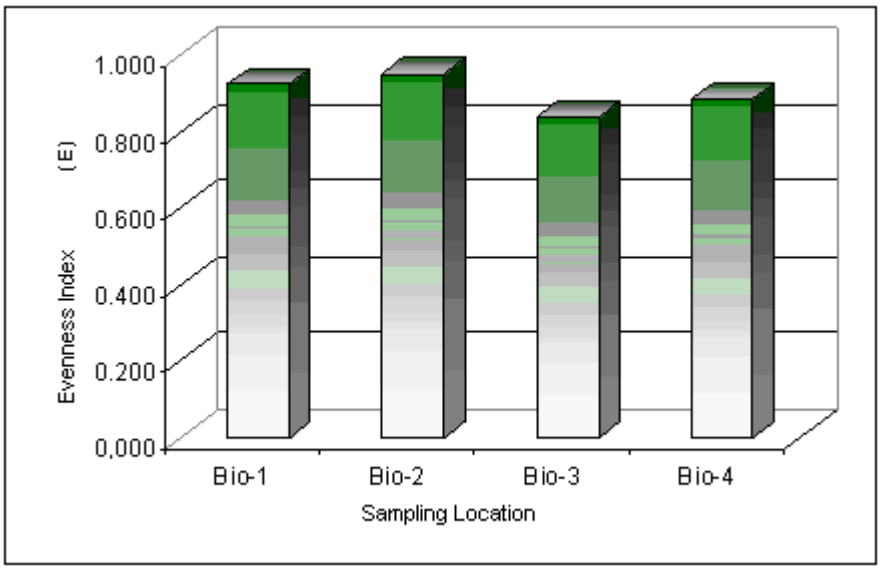


Figure III-10 Plankton evenness in the study area

3.2.2.2 Benthos

Benthos is organism that lives at the bottom of the water bodies. It cannot escape if there are any changes in water physical and chemical properties. Their characteristics make this organism used as an indicator of changes in aquatic environment either due to natural conditions or human alteration.

Habitat characteristics of an ecosystem define benthos compositions depending on its structure and other environmental factors in the ecosystem,

Benthos composition comprises species diversity, evenness, and relative abundance that are strongly related to water quality. Water body with high organism diversity indicates fertile water quality.

Benthos species composition in the study area is presented in **Table III-10**.

Table III-10 Benthos composition in Batang Toru River

No	Taxonomy	Location			
		Bio-1	Bio-2	Bio-3	Bio-4
I	**Class : Gastropoda**				
	Fam : Bulimidae				
1	*Tryonia sp*		88		
	Fam : Lymnaeidae				
2	*Lymnaea sp*		22		
II	**Class : Insecta**				
	Fam : Dysticidae				
3	*Agabinus sp*	11		11	
4	*Agabus sp*	33		22	22
	Fam : Psephenidae				
5	*Psephenus sp*				11
Number of Taxonomy		2	2	2	2
Abundance (ind/L)		44	111	33	33
Diversity Index (H')		0.562	0.500	0.637	0.637
Similarity Index (E)		0.811	0.721	0.919	0.919

Source: Research Center for Natural and Environmental Resources analysis result, North Sumatera University (2008)

Location:
Bio-1 : Aquatic Biota in Batang Toru River Before SIL, N: 01^{0}49'30,1" / E: 099^{0}04' 38,6"
Bio-2 : Aquatic Biota in Batang Toru River After SIL N: 01^{0}48'01,4"/E: 099^{0}05'31,8."
Bio-3 : Aquatic Biota in Batang Toru River Before NIL N: 01^{0}53'16,0"/E: 099^{0}02'41,9"
Bio-4 : Aquatic Biota in Batang Toru River After NIL N: 01^{0}53'06,4"/E: 099^{0}02'52,1"

The results identified 2 benthos classes i.e. *Gastropods* (2 genus), and *Insects* (3 genus).

3.2.2.3 *Species abundance*

Bottom substrate influences benthos composition, distribution, and abundance. It functions not only as living space but also as food source (Hawkes, 1979). Benthos abundance in the 4 monitoring sites were varied between 33 - 111 individuals/m^3 (**Figure III-11**).

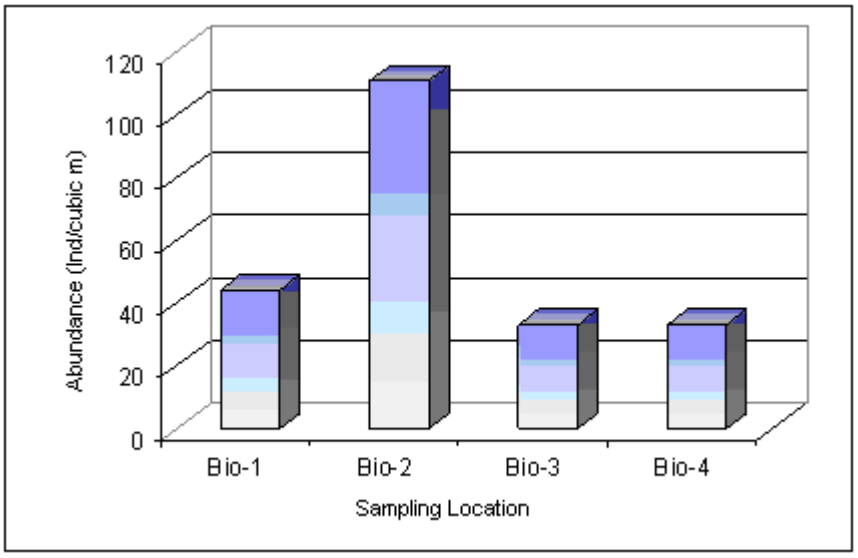


Figure III-11 Benthos Abundance (individual/L) in the study area

The substrate is muddy sand and interacts with turbidity as inhibitor affecting light penetration which consequently affects productivity of algae and other macrophyta. This ecosystem influences the number of benthos with algae and macrophyta as food sources.

3.2.2.3.1 Diversity Index

According to Odum (1971), the definition of species diversity is not limited to the number of species (species richness), but also referring to community characteristic which is determined by the number of species and its abundance.

Diversity index in the study area ranged from 0.500 to 0.637 (**Figure III-12**).

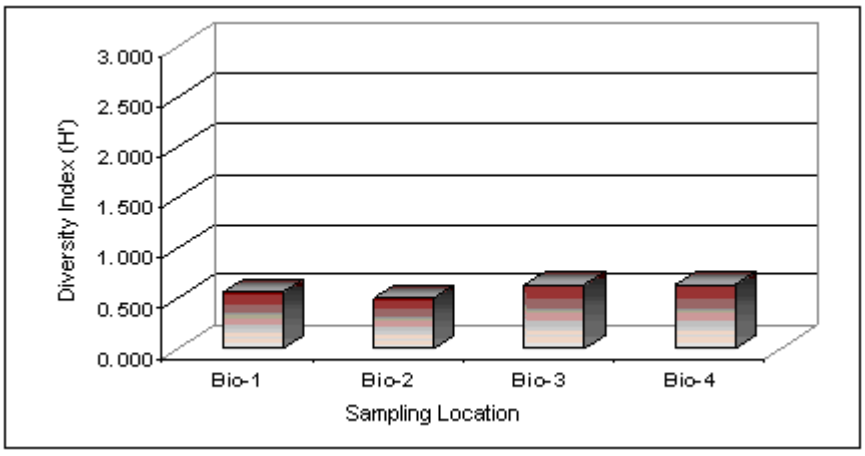


Figure III-12 Benthos Diversity Index in the study area

Benthos distribution is affected by physical, chemical, and biological properties. Physical properties include depth, current rate, turbidity, bottom substrate, and temperature. Chemical properties include pH, free-CO_2 concentration and dissolved oxygen content. Biological properties include

competition against living space and food, predation and primary productivity level of water body (Krebs, 1978).

3.2.2.3.2 Evenness

Benthos evenness index ranged from 0.721 to 0.919 (**Figure III-13**). This indicated that no particular benthos species dominated the study area. According to Krebs (1978), evenness index close to 1 means even spread of species distribution.

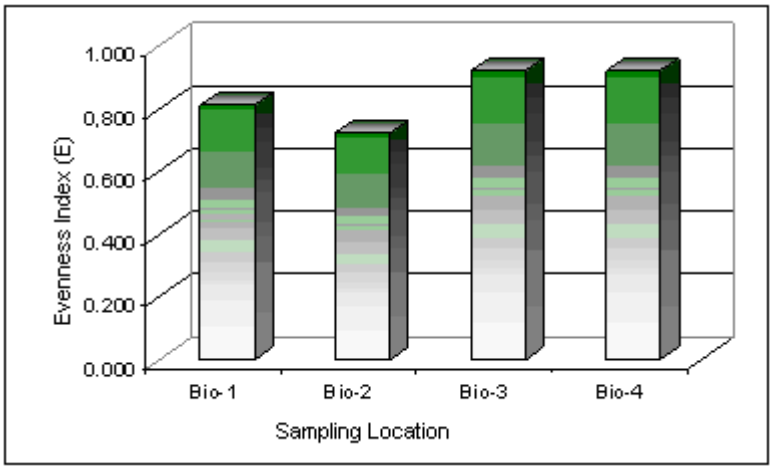


Figure III-13 Benthos evenness in the study area

3.2.2.3.3 Fish

Field observations and interviews with residents around Batang Toru River found 8 species in the study area i.e. Baung, Lele, Batak, Tin-head, Lelan, and Cencen fish. Existence of fish species indicated natural conditions. Furthermore, a number of species had economic values. Fish species found in the study area are presented in **Table III-11**.

Table III-11 Fish species in the study area

No	Local name	Scientific name	Location			
			Bio-1	Bio-2	Bio-3	Bio-4
1	Ikan Baung	*Macrones planiceps*	+	-	+	-
2	Ikan Lele	*Clarias teysmanni*	-	+		+
3	Ikan Batak	*Neollissochilus sp.*	+	+	+	+
4	Ikan Kepala Timah	*Panchax panchax*	+	+	+	+
5	Ikan Lelan	*Luciosoma spilopleura*	+	-	+	-
6	Ikan Cencen	*Albulichthys albuloides*	+	-	+	
7	Ikan Gabus	*Ophiocephalus gachua*	+	+	+	+

Source: Research Center for Natural and Environmental Resources analysis result, North Sumatera University (2008)

Location:

Bio-1 : Aquatic Biota in Batang Toru River Before SIL, N: 01^{0}49'30,1" / E: 099^{0}04' 38,6"

Bio-2 : Aquatic Biota in Batang Toru River After SIL N: 01^{0}48'01,4" /E: 099^{0}05'31,8."

Bio-3 : Aquatic Biota in Batang Toru River Before NIL N: 01^{0}53'16,0" /E: 099^{0}02'41,9"

Bio-4 : Aquatic Biota in Batang Toru River After NIL N: 01^{0}53'06,4" /E: 099^{0}02'52,1"

3.3 SOCIO-ECONOMIC AND SOCIO-CULTURAL COMPONENTS

Administratively, the development of Sarulla geothermal field and power plant is located in two districts i.e. Pahae Julu and Pahae Jae in North Tapanuli Regency, North Sumatera Province. Potentially affected villages in Pahae Julu District are Sibaganding, Lumban Jaean and Simataniari whilst in Pahae Jae District are Silangkitang, Sigurung-gurung, Pardomuan Nainggolan and Pardamaean Nainggolan.

The transmission lines will pass through Sibaganding, Lumban Jaean and Simataniari Villages in Pahae Julu District as well as Silangkitang Village in Pahae Jae District. These four villages are also the locations of geothermal field and power plant development.

3.3.1 Demography

3.3.1.1 Population and population density

In 2007, population in villages in the study area was 4,605 with 1,051 families. Each family consisted of 4.4 persons. On average, the number of individual in each family was slightly higher than the number at district level i.e. 4.3 persons per family. Further break down indicated that the highest number of person per family i.e. 4.8 was in Pardomuan Nainggolan Village whilst the lowest i.e. 4.0 was in Sigurung-gurung Village. Such households are classified as small families i.e. with less than 5 persons per family or generally to have 2 – 3 children.

Villages in the study area covered an area of 42.8 km^2, which means an average population density of 108 individuals/km^2. Population density ranged from 53 to 318 individuals/km^2 with the highest density in Pardomuan Nainggolan Village (318 persons/km^2) and the lowest in Sibaganding Village (53 persons/km^2). The average population density in villages in the study area was generally higher than in the districts i.e. 61 persons/km^2. Population, population density, and family size in the study districts and villages are presented in **Table III-12.**

Table III-12 Population, population density and family Size in the study area

No	Districts/Villages	Area (km^2)	Population (Individuals)			Density (persons /km^2)	Number of Family	Size (Person /fam)
			Men	Women	Amount			
A.	**Pahae Julu District**	**165.9**	**5,906**	**6,226**	**12,132**	**73**	**2,821**	**4.3**
1.	Sibaganding Village	8.8	216	252	468	53	108	4.3
2.	Lumban Jaean Village	8.7	251	282	533	61	123	4.3
3.	Simataniari Village	8.3	279	279	558	67	125	4.5
B.	**Pahae Jae District**	**203.2**	**5,051**	**5,493**	**10,544**	**52**	**2,404**	**4.4**
1.	Silangkitang Village	4.0	381	386	767	192	165	4.6
2.	Sigurung-gurung Village	4.0	343	351	694	174	173	4.0
3.	Pardomuan Nainggolan Village	3.0	445	510	955	318	200	4.8
4.	Pardamean Nainggolan Village	6.0	310	320	630	105	157	4.0
Average for each districts		**369.1**	**10,957**	**11,719**	**22,676**	**61**	**5,225**	**4.3**
Average for each villages		42.8	2,225	2,380	4,605	108	1,051	4.4

Source: - Pahae Jae District in Numbers 2007, Statistical Agency of North Tapanuli Regency
- Pahae Julu District in Numbers 2007, Statistical Agency of North Tapanuli Regency

Based on the classification of population density specified in Law No. 56/prp/1960 (see **Table III-13**), the study area is classified as a "less dense" area because its density was less than 250 persons/km^2. However, further breakdown revealed Pardomuan Nainggolan Village as a "quite dense" area with population density of more than 251 persons/km^2.

Table III-13 Population density classification according to Law No. 56/prp/1960

No.	Population Density (individuals/km^2)	Classification
1	1 - 50	Not Dense
2	51 - 250	Less Dense
3	251 - 400	Quite Dense
4	> 400	Very Dense

There were 2,225 males and 2,380 females in villages in the study area. Male to female ration was 93% i.e. for 100 females in the villages there were 93 males.

3.3.1.2 *Rate of population growth*

In 2005, population in the districts of Pahae Julu and Pahae Jae was 22,635 and in 2006, it increased to 22,676 individuals which means that there was a growth of 0.181%. The population growth in the districts was lower that in the villages in the study area i.e. 1.324%. Furthermore, the population growth in Pahae Julu District was reduced by 0.370%. This was probably due to economic migration.

The development of Sarulla geothermal field and power plant will encourage migrants to come to the project locations. It will consequently increase the rate of population growth. Rate of population growth in the districts of Pahae Julu and Pahae Jae is presented in **Table III-14**.

Table III-14 Rate of population growth in the study area (2005-2006)

No	District	Population (Individuals)		Population growth (%/thn)
		2005	2006	
1.	Pahae Julu	12,177	12,132	-0.370
2.	Pahae Jae	10,458	10,544	0.822
Average number		**22,635**	**22,676**	**0.181**

Source: - Pahae Jae District in Figures 2007, Statistical Agency of North Tapanuli Regency
- Pahae Julu District in Figures 2007, Statistical Agency of North Tapanuli Regency

3.3.1.3 *Population structure (age group)*

The population in Pahae Julu District was dominated by productive age group (15-59 years old) i.e. 6,140 persons or 50.61% of the total population in the district. The numbers of unproductive (>60 years old) and not-yet productive group (0-14 years old) were 1,468 (12.10%) and 4,524 (36.74%) respectively. Further details can be seen in **Table III-15**.

Table III-15 Population structure (age group) in the study area

No	Age group	Pahae Julu District			Pahae Jae District		
		Male	Female	Amount	Male	Female	Amount
1.	0 -4	656	684	1,340	536	578	1,141
2.	5 - 9	746	714	1,460	674	588	1,262
3.	10 – 14	902	822	1,724	778	777	1,555
4.	15 – 19	712	725	1,437	620	642	1,262
5.	20 -24	363	271	634	279	264	543
6.	25 -29	317	270	587	261	232	493
7.	30 – 34	326	308	634	251	270	521
8.	35 - 39	303	333	636	278	335	613
9.	40 -44	317	352	669	318	341	659
10.	45 -49	292	350	642	246	319	565
11.	50 -54	230	288	518	218	245	463
12.	55 -59	167	216	383	147	180	327
13.	60 -64	194	252	446	116	202	318

No	Age group	Pahae Julu District			Pahae Jae District		
		Male	Female	Amount	Male	Female	Amount
14.	65-69	113	197	310	118	143	261
15.	70-74	126	213	339	106	179	285
16.	>75	142	231	373	78	198	276
Total		**5,906**	**6,226**	**12,132**	**5,051**	**5,493**	**10,544**

Source: - Pahae Jae District in Figures 2007, Statistical Agency of North Tapanuli Regency
- Pahae Julu District in Figures 2007, Statistical Agency of North Tapanuli Regency

The population in Pahae Jae District was also dominated by productive age group (15-59 years old) i.e. 6,140 persons (51.65%). The numbers of unproductive (>60 years old) and not-yet productive group (0-14 years old) were 1,140 (10.81%) and 3,958 (37.54%) respectively.

It can be concluded that the ratio of living cost burden in Pahae Julu District was 97.6% whilst in Pahae Jae District it was 93.7%. Every 100 persons in the productive age group in Pahae Julu District have to support 98 persons in the non-productive age group.

3.3.1.4 Livelihoods

The main livelihood in the study was agriculture. Other jobs included formal sector like civil servant, and informal sector like entrepreneurs of small medium enterprises. Based on survey data of 150 respondents in March 2008, livelihood in the study area is presented in **Table III-16**.

Table III-16 Livelihood in the study area

No.	Livelihood	Pahae Julu District		Pahae Jae District	
		Number	%	Number	%
1	Farmer	76	84.4	48	80.0
2	Merchant/Laborer	2	2.2	2	3.3
3	Trader	2	2.2	1	1.7
4	Private Enterprise	3	3.3	3	5.0
5	Employee	7	7.8	6	10.0
Total		**90**	**100**	**60**	**100**

Source: Questionnaire tabulation, March 2008

This data reinforced the previous information that agriculture was the main livelihood in the study area. More than 80% of respondents were farmers. This fact is also supported by statistical data in North Tapanuli Regency highlighting agriculture as the economic backbone of this regency and providing work for most of the residents. Agriculture contributed to 55.16 % of total the regency's GRDP [2] in North Tapanuli Regency in 2006.

[2] Source: North Tapanuli Regency in Figures, 2007, page 141.

3.3.1.5 *Religions*

North Tapanuli Regency residents consisted of various ethnic groups with various religions. The majority ethnic group was Toba. The main religion in the study area was Christian Protestant, followed by Moslem. Within 15 districts in North Tapanuli Regency, there were 805 Protestant churches, 76 Catholic churches, 60 mosques, and 16 small mosques (*surau*). No temple was found in the study area. Religious facility data in the study area is presented in **Table III-17.**

Table III-17 Religious facilities in the study area

No.	Village/District	Religious facility				Amount
		Mosque	Small mosque	Protestant Church	Catholic Church	
A.	**Pahae Julu District**	**6**	**-**	**47**	**1**	**54**
1.	Sibaganding Village	-	-	1	-	1
2.	Lumban Jaean Village	-	-	2	-	2
3.	Simataniari Village	-	-	3	-	3
B.	**Pahae Jae District**	**7**	**1**	**20**	**1**	**29**
1.	Silangkitang Village	-	-	-	-	-
2.	Sigurung-gurung Village	-	-	1	-	1
3.	Pardomuan Nainggolan Village	-	-	2	-	2
4.	Pardamean Nainggolan Village	-	1	4	-	5
Total in study district		13	1	67	2	83
Total in study villages		-	1	13	-	14

Source: - Pahae Jae District in Figures 2007, Statistical Agency of North Tapanuli Regency
- Pahae Julu District in Figures 2007, Statistical Agency of North Tapanuli Regency

Based on the 2007 Statistical Agency data in Pahae Julu District, there were 54 religious facilities as follow 6 mosques, 47 Protestant churches, and 1 Catholic church. In Pahae Jae District, there were a total of 29 religious facilities i.e. 7 mosques, 1 small mosque, 20 Protestant churches, and 1 Catholic church.

Residents lived in religious harmony. There was no discrimination in the communities' social every day life. Each person respects other's belief and worships their religion peacefully.

3.3.1.6 *Education*

In the districts of Pahae Julu and Pahae Jae there were 35 elementary schools (SD), 2 *Madrasah Ibtidaiyah* (Islamic Primary School). In Pahae Julu District alone, there were 22 elementary schools and 1 *Madrasah Ibtidaiyah* with 1,968 students and 151teachers. In Pahae Jae District, there were 13 elementary schools and 1 *Madrasah Ibtidaiyah* with 1,848 students and 112 teachers.

At junior high school (SLTP) level, there were 6 SLTPs and 2 *Madrasah Tsanawiyah* (Islamic SLTP) in the two districts. In Pahae Julu District, there were 3 SLTPs and 1 *Madrasah Tsanawiyah* with 1,013 students and 65 teachers. In Pahae Jae District there were also 3 SLTPs and 1 *Madrasah Tsanawiyah* with 855 students and 57 teachers.

At senior high school (SLTA) level, there were 2 SLTAs and 1 *Madrasah Aliyah* (Islamic SLTA) in the study Districts. In Pahae Julu District, there were 1 SLTA and 1 *Madrasah Aliyah* with 453 students and 38 teachers. In Pahae Jae District, there was only 1 SLTA with 510 students and 32 teachers.

In terms of vocational school (SMK), there were 3 SMKs in the two districts. In Pahae Julu District there was 1 SMK with 65 students and 13 teachers whilst in Pahae Jae District there were 2 SMKs with 418 students and 27 teachers.

In the study districts, the ratio of SD/MI students to the institutions in 2006/2007 academic year was 103 i.e. each SD/MI accommodated an average of 103 students. For SLTP/MT level the ratio was 234 and for SLTA/MA the ratio was 321 students. Moreover, the ratio of students to teachers in SD/MI was 15 i.e. each teacher was responsible for 15 students. For SLTP/MT level, the students/teachers ratio was 15, and for SLTA/MA level and for SMK level the ratios were 14 and 12 respectively. Detailed data is available in **Table III-18**.

Table III-18 Numbers of schools, students, and teachers in the study area

No.	Village/District	Level of Education											
		SD/MI equivalent			SLTP/MTs Equivalent			SLTA Equivalent			SMK		
		School (Unit)	Student (Persons)	Teacher (Persons)	School (Unit)	Student (Persons)	Teacher (Persons)	School (Unit)	Student (Persons)	Teacher (Persons)	School (Unit)	Student (Persons)	Teacher (Persons)
A.	**Pahae Julu District**	**23**	**1,968**	**151**	**4**	**1,013**	**65**	**2**	**453**	**38**	**1**	**65**	**13**
1.	Sibaganding Village	1	86	7	-	-	-	-	-	-	-	-	-
2.	Lumban Jaean Village	1	92	5	1	71	5	-	-	-	-	-	-
3.	Simataniari Village	1	84	6	-	-	-	-	-	-	-	-	-
B.	**Pahae Jae District**	**14**	**1,848**	**112**	**4**	**855**	**57**	**1**	**510**	**32**	**2**	**418**	**27**
1.	Silangkitang Village	2	74	6	-	-	-	-	-	-	-	-	-
2.	Sigurung-gurung Village	1	189	13	-	-	-	-	-	-	-	-	-
3.	Pardomuan Nainggolan Village	1	102	8	-	-	-	-	-	-	-	-	-
4.	Pardamean Nainggolan Village	1	130	10	1	75	11	-	-	-	-	-	-
Total in study district		**37**	**3,816**	**263**	**8**	**1,868**	**122**	**3**	**963**	**70**	**3**	**483**	**40**
Total in study villages		**8**	**757**	**55**	**2**	**146**	**16**	**-**	**-**	**-**	**-**	**-**	**-**

Source: - Pahae Jae District in Figures 2007, Statistical Agency of North Tapanuli Regency
- Pahae Julu District in Figures 2007, Statistical Agency of North Tapanuli Regency

According to questionnaire data, most of the residents in Pahae Jae District graduated from SLTA/equivalent i.e. 46.7% followed by SLTP/equivalent graduates i.e. 23.3 %. Respondents' level of education is presented in **Table III-19**.

Table III-19 Respondents – level of education

No.	Education Level	Pahae Julu District		Pahae Jae District	
		Amount	%	Amount	%
1.	SD	16	17.8	10	16.7
2.	SLTP/ Equivalent	36	40.0	14	23.3
3.	SLTA/ Equivalent	35	38.9	28	46.7
4.	Diploma (D3)	1	1.1	6	10.0
5.	Bachelor (S1)	2	2.2	2	3.3
Total		**90**	**100.0**	**60**	**100.0**

Source: Questionnaire tabulation, March 2008

3.3.1.7 Workforce

Workforce is the number of persons in productive age (10 - 64 years) but not including housewives, students, and persons in early retirement or unemployed. Data presented in **Table III-20** is based on information from Employment and Transmigration Agency and PMD of North Tapanuli Regency in 2007.

Table III-20 Numbers of registered, successful and unsuccessful job seekers in North Tapanuli Regency (2006)

No	Level of Education	Registered job seekers			Successful job seekers			Unsuccessful job seekers		
		Men	Women	Amount	Men	Women	Amount	Men	Women	Amount
1	Uneducated	-	-	-		-	-	-	-	-
2	Not graduated from SD	-	-	-		-	-	-	-	-
3	SD	-	-	-		-	-	-	-	-
4	SLTP	1	-	1		-	-	1	-	1
5	SMU/SLTA	213	251	464		17	17	213	234	447
6	SPMA	3	-	3		-	-	3	-	3
7	STM	52	2	54		-	-	52	2	54
8	SPG/SGO	36	174	210		-	-	36	174	210
9	SMEA	126	575	701		-	-	126	575	701
10	SPK	6	158	164		-	-	6	158	164
11	Diploma I	155	322	477		-	-	155	322	477
12	Diploma II	124	173	297		-	-	124	173	297
13	Fresh Graduate (S1)	458	654	1,112		-	-	458	654	1,112
14	Bachelor (S1)	622	401	1,023		-	-	622	401	1,023
Total		**1,796**	**2,710**	**4,506**		**17**	**17**	**1,796**	**2,693**	**4,489**

Source: North Tapanuli Regency in Figures, 2007

Table III-20 shows that there were 4,506 registered job seekers in 2006 consisted of 1,796 males (40%) and 2,710 females (60 %). Ten percents i.e. 464 persons were SLTA graduates, 16% (701) were Senior Economic High School graduates, 4% (164) were nursing school graduates, 5% (210) were teacher training school graduates, 17%(774) were Diploma (D I/DII) graduates, 25% (1,112) were DIII graduates and 23% (1,023) were university graduates. The smallest number, 0.43%, were SLTP graduates. Of the 4,506 registered job seekers, only 0.4% or 17 persons were successful in their job applications and all were SLTA graduates. The number still unemployed reached 4,489 or 99.6%.

3.3.2 Socio-economic

3.3.2.1 Job and business opportunities

Based on natural environment conditions in the study area, economic development relied on agriculture. Therefore, the majority work forces were absorbed by the agricultural sector. The development of Sarulla geothermal fields and power plant in the two districts will provide job opportunities particularly for local residents living in the study area.

Job opportunity is defined as potential jobs for communities in the study area. Considering existence of businesses in the study area, job and business opportunities will be available for residents with specific skills such as in trading, transportation or other sectors that accelerate village development and increase community income. Economic opportunities will be the main target for business opportunities. Migrations and population growth create business opportunities.

3.3.2.2 Economic activity in the study area

Center of economic activities such as market (known as '*onan*' in Toba language) operated on a weekly basis. In Pahae Julu District, the market took place every Friday in Onan Hasang Village, at a 200m distance from Pahae Julu District Office. In the Pahae Jae District, Tuesday was market day. Another centre of economic activities was in the District of Siborong-borong. Larger economic centre was in Tarutung and took place twice a week, i.e. Wednesday and Saturday. Commodities available in '*onan*' were typical household needs such as clothes and food. There were also several traders from other districts like Balige and Parapat and vendor clothes traders.

Furniture, ceramics, medicines (from registered pharmacy), fertilizer for agricultural activity, spare parts for car or garages were available in Onan Hasang Market in Pahae Julu District or in Sarulla, the centre of Pahae Jae District. Several shops serve as wholesalers as the owners were local

residents. Banking activities e.g. BRI (*Bank Rakyat Indonesia*) could be found in Sarulla and Onan Hasang.

3.3.2.3 *Community income*

Community income in the study area, based on questionnaire data, is available in **Table III-21**.

Table III-21 Respondents – community income

No	Income category (IDR)	Pahae Julu District		Pahae Jae District	
		Amount	%	Amount	%
1.	≤ 500,000	40	44.44 %	16	26.66 %
2.	500,000 - 1,000,000	36	40 %	32	53.33 %
3.	1,000,000 - 1,500,000	7	7.77 %	6	10 %
4.	1,500,000 - 2,000,000	4	4.44 %	3	5 %
5.	2,000,000 - 2,500,000	2	2.22 %	2	3.33 %
6.	> 2,500,000	1	1.11 %	1	1.66 %
Total		**90**	**100**	**60**	**100**

Source: Questionnaire tabulation, March 2008

Average community income was in the level of ≤ 500,000 and between 500,000 to 1,000,000. The data did include rice, vegetables, and spices produced for their own use. The data was based economic sources from other activities to supply market demand. Community income in the study area was from coffee, candlenuts, betel nuts, chocolate, rubber, chicken livestock, duck, fish, durian, *petai*, coconut, sugar palms (fermented palm juice is typical Toba drink, i.e. palm wine/*tuak*). Some residents considered their income from paddy field after keeping parts of it for food. Respondents were pleased in recent months (end of 2007 – March 2008 when the survey was conducted) because of higher prices of chocolate and rubber.

Due to the low level of income, respondents expressed difficulties to cover family's needs and for education. Moreover, a portion of the income shall be used for traditional customs' expenses. Traditional customs require funding. In Toba tradition, a ritual must be attended for the continuation of social relations between relatives. This includes weddings, deaths, and others. Required funding is even more extensive if the venue is outside the village or in another district.

3.3.2.4 *Road and transportation facilities in the study area*

Adequate road infrastructure is necessary to support economic activities. Road infrastructure in the study area was considered as in good conditions due to its road width i.e. 5-6 m and existence of road networks across villages in every district. However, the road physical condition was relatively poor as

some sections parts were in bad conditions with cracks on the roads leading to Pahae Julu and Pahae Jae Districts.

Lengths of paved road networks in study villages in Pahae Jae District and in Pahae Jae District were 10 km and 22 km respectively. Road networks in Pahae Jae District is a short cut to Sipirok, 50–60 km from the District. Meanwhile, lengths of paved road networks in study villages in Pahae Julu District and in Pahae Julu District were 4.5 km and 36.2 km respectively.

Road length throughout the North Tapanuli Regency in 2006 was 1,478.36 km consisted of 134.9 km national road, 142 km provincial road and 1,201.46 km regency road. In 2006, 37.95% of the road was in good condition, 27.64 % was considered as in medium condition, and 34.41 % was in damaged and heavily damaged category.

Availability of public transportation was adequate for residents' routine mobility. Public transports in Pahae Jae and Pahae Julu Districts were Silindung and Aek Mual minibuses with 14 passengers capacity. The route was Tarutung to Capital of Pahae Julu District (Onan Hasang) with a fare of 7,000 IDR per person or Capital of Pahae Jae District (Sarulla) with a fare of 10,000 IDR per person. There was also motor-pedicab transport with various fares. Within the centre of the district, the fare was generally 3,000 IDR for one trip. Students typically used school buses (in the form of personal cars) with a fare of 1,500 IDR per passenger. In addition, there was inter regency transport passing through the study area i.e. Bintang Raja Tour with 25 passengers capacity, and inter province transport from Medan – Sipirok i.e. ALS (*Antar Lintas Sumatera*) with 45 passengers capacity.

3.3.2.5 Natural resources ownership and occupancy

Utilization of natural resources to livelihood in the study area included field and paddy field. Landowners were usually individuals with legal (proven by deed of sale) and illegal status.

Landowners without legal documents claimed their ownerships through communities' acknowledgements. Such lands are passed through inheritance without legal documents but through tradition known *panjaeon* i.e. given to married son to be used as business capital. This is common for local residents in the study area. Migrants normally already have deed of sale. This situation was confirmed by interviews where respondents stated that sales rarely happed because lands are inherited through generations. Interviewees also considered that the land is of limited size and not sufficient to support their own needs.

3.3.2.6 *Natural resources utilization*

As discussed above, the main livelihood in North Tapanuli Regency was agriculture with rice paddy field rice. Details of land utilization in the study are are shown in **Table III-22**.

Table III-22 Land use in the study area

No.	Villages/District	Land use (Ha)				Amount
		Paddy field	Field	Building	Others	
A.	**Pahae Julu District**					
1.	Sibaganding Village	47	57	11	764	879
2.	Lumban Jaean Village	50	46	7	772	875
3.	Simataniari Village	52	34	7	735	828
B.	**Pahae Jae District**					
1.	Silangkitang Village	176	154	50	20	400
2.	Sigurung-gurung Village	219	140	31	10	400
3.	Pardomuan Nainggolan Village	160	110	25	5	300
4.	Pardamean Nainggolan Village	296	254	20	30	600
Total		**1,000**	**795**	**151**	**2,336**	**4,282**

Source: - Pahae Jae District in Figures 2007, Statistical Agency of North Tapanuli Regency
- Pahae Julu District in Figures 2007, Statistical Agency of North Tapanuli Regency

The size of paddy field area was 1,000 Ha (23.4 %) from the total area of the land in the study villages (4,282 Ha), the field occupied an area of 795 Ha (18.6 %) whilst the land for building was 151 Ha (3.5 %). Other usage was 2,336 Ha (54.6 %) and this indicated unexploited area i.e. shrub, hills with overgrown trees, unutilized valleys, and forest areas.

Naturally, paddy field was utilized to plant rice. Field was for horticultural crops such as chocolate, coffee, rubber, candlenuts, coconut, durian, betel nuts, and *petai*. There were also sugar palms processed for drink i.e. palm wine/*tuak*.

3.3.2.7 *Gross Regional Domestic Product (GRDP)*

Gross Regional Domestic Product is a measurement of economic performance at a macro level in a region within a certain period time (typically one year). GRDP of a region indicates the following:

a. Indirect overview of regional economics structure, roles of economic sectors and any deviation based on GRDP (current price);
b. Economic growth rate (general and per sector);
c. Income per capita.

Based on the current price, North Tapanuli Regency GRDPs in 2005 and 2006 were 2,155,279.13 million and 2,418,455.22 million IDR respectively. According to the 2000 constant rate, the GRDPs in 2005 and 2006 were 1,232,292.14 million and 1,299,378.92 million IDR respectively. Economic growth rate of North Tapanuli Regency (based on 2000 GRDP constant price) was 5.04% in 2005, and slightly increased to 5.44% in 2006. In 2005, income per capita was 8,261,923 IDR and increased 9,430,734 IDR in 2006.

The agricultural sector was the biggest contributor to North Tapanuli Regency GRDP. In 2006, this sector contributed to 55.16% of the GRDP, followed by trade, hotel and restaurant sectors with 13.76%, service sector with 13.52%, other sectors with 17.56%, and mining and extractive sector with 0.12%.

Pahae Julu and Pahae Jae Districts' GRDPs (2000 – 2005) also showed agricultural sector as the biggest contributor followed by trade, hotel, and restaurant sectors. There were similar trends between the districts' GRDPs to North Tapanuli Regency's GRDP. **Table III-23** to **Table III-26** present GRDPs for the districts of Pahae Julu and Pahae Jae.

Table III-23 Gross Regional Domestic Product in Pahae Julu District based on current prices (2000 – 2005) in million IDR

No.	*Business sector*	*Year*					
		2000	*2001*	*2002*	*2003*	*2004*	*2005**
1	Agriculture	28,960.06	32,473.27	37,336.84	43,985.73	50,396.45	62,570.27
2	Mining and extractive	93.38	97.16	124.57	108.95	131.75	155.85
3	Industry	1,092.86	1,201.99	1,174.84	1,252.16	1,285.99	1,330.35
4	Electricity,gas and drinking water	317.14	638.14	807.03	971.54	1,112.14	1,418.26
5	Construction	2,775.88	4,249.68	4,816.77	5,729.89	6,443.30	7,123.35
6	Trade, hotel dan restaurant	5,143.34	6,461.48	7,507.70	9,310.06	10,744.07	12,468.29
7	Transportation and communication	1,036.29	1,338.17	1,680.31	1,975.75	2,335.73	3,092.50
8	Finance, insurance, and company services	1,209.26	2,008.79	2,466.71	2,948.83	3,459.04	3,879.77
9	Services	4,616.03	6,450.42	7,386.34	8,787.93	9,989.48	12,040.22
GRDP		**45,244.25**	**54,919.11**	**63,301.11**	**75,070.84**	**85,897.96**	**104,078.86**

Source: Pahae Julu District in Figures 2007
* = temporary figure

Table III-24 Gross Regional Domestic Product in Pahae Jae District based on current prices (2000 – 2005) in million IDR

No.	Business sector	Year					
		2000	2001	2002	2003	2004	2005*
1	Agriculture	25,141.52	26,940.82	29,014.94	31,842.36	36,430.23	44,464.30
2	Mining and extractive	32.65	38.95	44.42	43.38	60.86	66.26
3	Industry	709.10	758.53	782,72	804.69	894.55	1,027.00
4	Electricity,gas and drinking water	231.72	328.18	412.73	497.01	469.10	544.68
5	Construction	1,800.53	2,009.90	2,930.34	3,517.27	3,922.11	4,499.55
6	Trade, hotel dan restaurant	5,097.98	5,878.49	6,654.47	8,998.62	10,387.63	11,985.86
7	Transportation and communication	1,232.09	1,324.66	3,299.53	3,880.79	4,589.19	5,924.40
8	Finance, insurance, and company services	1,099.59	1,466.91	1,797.30	2,142.02	2,586.02	2,842.07
9	Services	4,773.94	3,353.78	6,176.56	8,968.53	10,252.62	11,376.84
GRDP		**40,119.12**	**44,208.23**	**51,107.02**	**60,691.68**	**69,591.31**	**82,730.95**

Source: Pahae Julu District in Figures 2007
* = temporary figure

Table III-25 Gross Regional Domestic Product in Pahae Julu District based on constant prices (2000 – 2005) in million IDR

No.	Business sector	Year					
		2000	2001	2002	2003	2004	2005*
1	Agriculture	28,960.06	29,927.93	31,372.90	32,710.89	34,206.49	36,190.66
2	Mining and extractive	93.38	96.45	99.17	103.62	109.34	109.46
3	Industry	1,092.86	1,125.36	1,167.63	1,234.44	1,267.30	1,289.46
4	Electricity,gas and drinking water	317.14	329.39	341.53	354.37	372.21	390.35
5	Construction	2,775.88	2,893.77	3,023.12	3,242.06	3,408.49	3,576.74
6	Trade, hotel dan restaurant	5,143.34	5,364.85	5,573.23	58,444.91	6,136.24	6,306.47
7	Transportation and communication	1,036.29	1,084.96	1,143.16	1,210.79	1,273.49	1,327.16
8	Finance, insurance, and company services	1,209.26	1,434.90	1,263.34	1,296.39	1,330.04	1,342.06
9	Services	4,616.03	4,949.00	5,218.23	5,498.59	5,792.61	6,125.00
GRDP		**45,224.25**	**47,206.59**	**49,202.31**	**51,496.07**	**53,896.22**	**56,657.35**

Source: Pahae Julu District in Figures 2007
* = temporary figure

Table III-26 Gross Regional Domestic Product in Pahae Jae District based on constant prices (2000 – 2005) in million IDR

No.	Business sector	Year					
		2000	2001	2002	2003	2004	2005*
1	Agriculture	25,141.52	26,162.90	27,251.84	28,422.22	29,730.25	31,143.48
2	Mining and extractive	32.65	33.73	34.69	36.26	38.27	38.92
3	Industry	709.10	730.39	758.05	801.65	813.23	847.59
4	Electricity,gas and drinking Water	231.72	240.73	249.68	259.14	272.27	284.80
5	Construction	1,800.53	1,877.53	1,962.02	2,104.71	2,213.40	2,334.62
6	Trade, hotel dan restaurant	5,097.98	5,319.06	5,527.24	5,798.34	6,089.10	6,321.62
7	Transportation and communication	1,232.09	1,290.33	1,359.93	1,440.81	1,515.85	1,617.95
8	Finance, insurance, and company services	1,099.59	1,123.22	1,149.41	1,179.82	1,210.80	1,223.94
9	Services	4,773.94	5,119.77	5,399.84	5,691.59	5,997.65	6,251.82
GRDP		**40,119.12**	**41,897.66**	**43,692.71**	**45,734.55**	**47,890.81**	**50,064.75**

Source: Pahae Julu District in Figures 2007
* = temporary figure

Table III-23 to **Table III-26** indicated significant increase in the districts' GRDP for the last 6 years which also represented significant economic growth and improvements for each sector. Economic structures of the two districts were based on agricultural sector, supported by trade, hotel, restaurant, and services sectors, and reinforced by six other sectors i.e. constrcution, transportation and communication, finance/insurance/company services, industry, electricity and gas, and mining and extractive industries.

Data of basic regional income (*Pendapatan Asli Daerah* = PAD) in Pahae Julu and Pahae Jae Districts showed that in 2006 PAD from land and building tax reached the target. This indicated positive attitude in fulfilling their tax obligation and communities support to the development in the area. **Table III-27** presents income taxes data in 2006.

Table III-27 Income taxes in the study area in 2006 (IDR)

No.	Levy type	Pahae Julu District			Pahae Jae District		
		Target	Realization	%	Target	Realization	%
1.	Land and building tax	19,223,503	19,223,503	100	13,582,596	13,582,596	100
2.	Local taxes	1,130,000	1,130,000	100	2,056,000	1,068,000	51.95
	• Restaurant	1,130,000	1,130,000	100	2,056,000	1,068,000	51.95
	• Construction permit	-	-		-	-	-
	• Alcoholic beverages	-	-		-	-	-
	• Entertainment	-	-		-	-	-

No.	Levy type	Pahae Julu District			Pahae Jae District		
		Target	Realization	%	Target	Realization	%
3.	Retribution	17,098,600	17,098,600	100	28,096,694	21,277,745	75.73
	• Daily market	7,793,000	7,793,000	100	14,199,200	10,555,000	74.34
	• Monthly rent	4,080,000	4,080,000	100	6,720,000	6,210,000	92.41
	• Land rent	507,600	507,600	100	2,294,244	1,764,295	76.90
	• Refuse	570,000	570,000	100	1,612,000	49,200	30.97
	• Nuisance license	4,148,000	4,148,000	100	3,271,250	2,249,250	69.76
4.	Miscellaneous/ toilet	-	-	-	-	-	-

Source: - Pahae Jae District in Figures 2007, Statistical Agency of North Tapanuli Regency
- Pahae Julu District in Figures 2007, Statistical Agency of North Tapanuli Regency

It is clear from the above table that Pahae Julu achieved targets for all types of levy but Pahae Jae did not achieve all targets e.g. only 75% from the target retributions. Hence, the district of Pahae Jae needed to strengthen its tax program in order to achieve targets which in the end would improve community welfare. Increased of districts' PAD contributes to North Tapanuli Regency's income and spending budget.

3.3.3 Socio-cultural

3.3.3.1 Social organizations

A community has to fulfill their daily needs in terms of socio-economic or socio-cultural aspects. In fulfilling socio-cultural needs, a community naturally forms traditional structures in managing their social life in order to create orders and regularities in the community. The structures determine role, status, and position of individuals in a community group.

In the study area, there were youth organizations (*karang taruna*) and religious-based organizations. *Karang Taruna* is a youth forum to develop their potentials. Other activities were church groups for Christian teenagers and adults (*na poso bulung*) and teenage moslem groups. These were local organizations for young people. These forums served as arena for socialization to improve social and religious aspects of their life.

Other religious-based organization is Christian prayer group (*partamiangan*) and Moslem prayer group (*wirid yasin*), usually takes place once one week.

Other informal organizations in the study area were "*Serikat Tolong Menolong*" (STM), or *punguan marga* (clan association), economic institution (market) and traditional institution (*Dalihan Na Tolu*). Religious-based organizations were already developed in the study area. There was also an Non-Governmental Organization called as *DOSROHA*.

Indirectlyl, these local organizations were a socialization forum as well as a forum to share information and discuss local issues. These organizations develop cultural values, which lead to harmony, peace and prosperity. Such values can be used as references to develop cooperation and to strengthen community participation. Active participation is necessary for everyone's progress i.e. local communities and SOL.

3.3.3.2 Customs and traditions

Customs are defined as norms, values and customs in every day life. In this study, wedding and funeral traditions (*saurmatua*) applicable in the study area were observed. Such rituals are important because they contain positive values to promote progress.

Conceptually, Toba customs and traditions are inspired by the basic concepts of Toba on harmony and perfection in life, i.e. principles of *hamoraon, hagabeon* and *hasangapon*. The principle of *hagabeon* refers to the ability to have offsprings. A person is regarded as successful in life and to achieve life vision if he can have many offsprings descendants. *Gabe* refers to longevity, and success in educating their children and having successful children. The principle of *hamoraon* is to have independent children and not to depend on their parents. In addition to *hagabeon* and *hamoraon*, it is also important to have *hasangapon* (honour). Culturally, these three principles are aims and visions of Toba people. Individuals with *gabe, mora* and *sangap* are role models in their communities.

In the study area, there are cultural values aimed to achieve harmony, peace, and welfare, reflected by the values implemented by Toba cultural leaders.

3.3.3.3 Toba social system: Dalihan na tolu

Dalihan Na Tolú is Batak Toba Community social system. There are three important elements of each ritual i.e. *dongan sabutuha, boru* and *hula-hula*.

Dongan sabutuha (relatives from one clan) are people from one clan based on patrilineal line with close relationship. In planning a traditional ceremony, it is very important to have a discussion with *dongan sabutuha* e.g. son-in-laws and daughters (*hela* and *boru*), father's sisters (*namboru*) and her husbands (*amang boru*) and their children. All families (*dongan sabutuha*) from the side that accepts daughter (husband to be side) are *boru*. *Boru*'s role is to provide assistance in preparing the ceremony (*suhut*) including provision of tools and equipment. The third element is *hula-hula*. *Hula-hula* is families from the side that give away daughter (wife to be side). In *dalihan na tolu* structure, *hula-hula* is well respected i.e. to give blessing in traditional ceremony (*pasu-pasu*).

This social system shows that customs and traditions are parts of a community system. This system is constructed and functioned to create

orders and welfare. Involvement of local social system in environmental planning and management will assist the development of Sarulla geothermal field and power plant in study area.

3.3.3.4 Changes in social conditions

Community's social and cultural life always evolves. The important part of this process is acceptance of the additional elements to become parts of local culture. The process needs to be assessed to understand the acceptance and refusal during the process of acculturation. Internal conflicts may happen without early anticipation. Questionnaire and field visit conducted in March 2008 showed an indication of community unrest in the study area. There was a tendency of social jealousy from local communities towards non-local workforce or not '*putra daerah*'. A dichotomy of 'non-local' and 'local people' existed in the communities since the commencement of Sarulla geothermal activity in the study area several years ago. This is a potential source of conflicts in the future particularly during recruitment process. Communities expected only to be audiences.

Community's perception on this proposed development potentially leads to non conducive development. Such perception should be anticipated as early as possible to prevent other social issues. In this case, close attention must be paid to how communities handle local conflicts and the tight connection in the social system that bond and safeguard the communities. As the changes occur, communities' positive attitude towards the development of Sarulla geothermal field and power plant develops.

3.3.3.5 Communities' perceptions and attitudes on the development of Sarulla geothermal field and power plant

The focus of this assessment was communities' perceptions and attitudes towards the development of Sarulla geothermal field and power plant.

3.3.3.5.1 Communitis' perceptions in the study area

Communities in the study area were aware of the project, especially those who lived in Pahae Jae District. The communities referred to the power plant project as 'Unocal' because it was written on the signpost and visible from the road. Three well clusters (SIL-1, SIL-2 and SIL-3) are located in Pahae Jae District i.e. in Pardomuan Nainggolan, Sigurunggurng and Silangkitang Villages. Further development is in Pahae Julu District with 3 well clusters (NIL-1, NIL-2 and NIL-3) where two clusters are located in Sibaganding and Lumban Jaean Villages and another cluster (NIL D) is in Simataniari Village.

Support and positive responses from the communities are provided given through various statements[3], as shown in **Table III-28**.

Table III-28 General responses towards the development of Sarulla geothermal field and power plant

No.	Responses	Pahae Julu District	Pahae Jae District
		Amount	Amount
1.	**Positive**	85 (94.44 %)	56 (93.33 %)
	- Happy		
	- Very good		
	- Optimistic		
	- Agree if for communities' benefits		
	- Very happy and support with great pleasure		
2.	**Not positive**	5 (5.5 %)	4 (6.66 %)
	- No idea		
	- No comment		
Total		**90 (100 %)**	**60 (100 %)**

Source: Questionnaire tabulation, March 2008

Questionnaire data indicated encouragement for project continuity. However, 6% of respondents were pessimistic because after almost 10 years since the project started in Pahae Jae District, the project was not in operation although these respondents did not refuse the project.

3.3.3.5.2 *Identification of positive communities' perceptions in the study area*

Communities provided supports to the project because they realized the positive benefits. Positive responses were given to an open question on their awareness about positive impacts of this project[4]. **Table III-29** provies further details.

Table III-29 Positive responses regarding the development of Sarulla geothermal field and power plant

No	Positive response	Amount
I.	**Pahae Julu District**	
1.	**Increase community income** • It will support the economy and develop the community • Businesses opportunities resulting from population increase • Job opportunities, unemployed will get job • More income from renting rooms	64 (71.11 %)

[3] What is your opinion regarding the development of geothermal field and power plants in Silangkitang and Namora I Langit project?

[4] Are you aware of the positive benefits from the project development of geothermal field and power plants in Silangkitang and Namora I Langit? Please state.

No	Positive response	Amount
2.	**Increase social interaction** • More people • There will be changes	5 (5.55 %)
3.	**Increase electricity supply** • New supply of electricity • No more black-out	6 (6.66)
4.	**Village development** • Development in North Tapanuli, especially our villages • Develop human resources • Increase regional income	11 (12.22 %)
5.	**Unsure**	4 (4.44 %)
Total		**90 (100 %)**
II.	**Pahae Jae District**	
1.	**Increase community income** • Equal quality of life • New job opportunities, higher income • Business opportunities resulting from migrant workers	43 (71.66 %)
2.	**Increase electricity supply** • Sufficient electricity supply, benefit for industry • Electricity is important, so this project is needed	4 (6.66 %)
3.	**Increase community knowledge** • Improve knowledge (ours and our children), particularly on geothermal power • Communities will be able to have discussion with migrants.	3 (5 %)
4.	**Village development** • More people, more progress • Supports from this project to develop our village which will benefit the communities.	10 (16.66 %)
Total		**60 (100 %)**

Source: Questionnaire tabulation, March 2008

The data above showed that respondents expressed the project benefits in different ways. Generally, the positive responses could be divided into 5 themes i.e. (1) increase community income, (2) increase social interaction (3) increase community knowledge, (4) village development, and (5) increase electricity supply.

The survey also investigated communities' supports for the project using a closed question[5] and the responses can be seen in **Table III-30.**

[5] What is your personal opinion, do you want the development of Silangkitang – Namora I Langit geothermal field and 330 MW capacity power plant in your area to be conducted soon?
a. Very much/Strongly agree
b. Yes/Agree
c. Not so much/Not agree
d. Refuse

Table III-30 Personal opinions towards the development of Sarulla geothermal field and power plant

No	Opinion	Pahae Julu District		Pahae Jae District	
		Amount	%	Amount	%
1.	Very much/Strongly agree	42	46.66	23	38.33
2.	Yes/Agree	46	51.11	33	55.00
3.	Not so much/Not agree	2	2.22	3	5.00
4.	Refuse	0	0	1	1.66
Total		**90**	**100**	**60**	**100**

Source: Questionnaire tabulation, March 2008

The survey indicated that the majority very much wanting and strongly agree for this project to start as soon as possible. The percentages of respondents in Pahae Julu District and in Pahae Jae District who did not want this project were 2.22 and 5% respectively. Furthermore, 1 respondent (1.66%) in Pahae Jae District refused the project because there seemed to be no intention from the project managerb to employ local communities according to their skills e.g. as security guards or other jobs that do not require particular skills. Moreover, there were also concerns regarding potential lack of water supply and poisonous gas leakage that would cause relocation.

Such opinions indicated considerable concerns within the communities about the future of their villages and families, which should be taken into consideration by SOL Project Director. The numbers of respondents not supporting and refuse the project were relatively small. These concerns should be addressed at an early stage as not to form negative opinions in the future that may disturb the project.

3.3.3.5.3 Communities' concerns towards the development of Sarulla geothermal field and power plant

The project developer must also pay attention to the communities' concerns related to the project plan. Their concerns included damage/destruction to the village environment, abandonment of local people, disturbance to agriculture the main livelihood; water pollution/disruption to water supply, health problem; crisis in faith as a consequence of any development, relocation because of project operation failure, causing offense to local customs and traditions, security disturbance, technical error/fire/well explosion, no clarity on project realization, and company's insensitivity. These concerns must be minimized and given attention at an earlier stage as these are sources of negative perceptions in the future. A list of communities' concerns is provided in **Table III-31.**

Table III-31 Communities' concerns towards the development of Sarulla geothermal field and power plant

District	*Concern*		*Amount*
Pahae Julu **90 respondents**	Damage/destruction to village environment	Landslide due to drilling Leakage, air pollution hence poisoning us Forests damage Unproductive soil	62 (68.88 %)
	Abandonment of local people	Abandonment of local people because assumed to be unskill No job opportunities for local people	
	Disturbance to agriculture	Less agricultural products as soils become less fertile Unhealth plants due to air pollution (toxic gases)	
	Water pollution	Water pollution due to wastewater from the operation Reduced water for a long period of time	
	Health problem	Asthma Tuberculosis	16 (17.77 %)
	Crisis in faith and offense to local customs and traditions	Crisis in faith due to high number of migrants Migrants have no respect on local customs and traditions, especially manners and morality	
	Security disturbance	Disturbanc to security due to high number of migrants More crime cases	12 (13.33%)
	Technical error	Explosion as occurred in Pahae Jae	
	Relocation	Relocation due to operational failure (toxic gas release) Similar case to "Lapindo Mud Disaster" as a result of drilling	
Pahae Jae **60 respondents**	Environmental damage	Flood and landslide Increased in temperature Forests damage	44 (73.33 %)
	Health problem	Asthma due to toxic gases and proximity to sulfur deposit Air pollution Water pollution due to wastewater and skin diseases	
	Abandonment of local people	No local people recruited Local people are assumed unskill Local people will only be audiences and migrants will get the benefits	
	Mountain water pollution and reduced amount	Reduced mountain water debit as geothermal fluid is pumped Wastewater to pollute drinking water and agriculture	
	Less agricultural products	Less agricultural products Less fertile soils Air pollution and many plants die	
	Relocation	Relocation due to toxic gas leakage, unfavored of it Relocation due to a disaster like Lapindo in Sidoarjo	11 (18.33)
	Offense to local customs and traditions	Migrants have no respect on local customs and traditions	
	SOL lack of sensitivity	SOL does not concern about village development. No supports for village development	
	Uncertainty	No uncertainty about the project	

District	Concern		Amount
		No realization, only talk	3 (5 %)
	Fire	Explosion as it happened before Fire and poisoned	
	No concerns as management measures have been considered		2 (3.33 %)

Source: Questionnaire tabulation, March 2008

The table above showed that the biggest concerns were in relation to environmental issues, workforce, agriculture and water as well as health. The environment was the main concern as it encompassed land, air and water. Consequently, daily activities and the main livelihood will be disturbed. These should be prevented. Communities' concerns covered natural environment, social, culture, and health.

3.3.3.5.4 Communities' suggestions concerning the development of Sarulla geothermal field and power plant

Communities in the study area provided a number of suggestions to the project proponent in relationto their concerns as described above. The suggestions (aimed **Table III-32**) aimed for village prosperity and development, and the success of the project operation.

Table III-32 Communities' suggestions concerning the development of Sarulla geothermal field and power plant

District	Suggestions
Pahae Julu **90 respondents**	The development should be beneficial for communities, environmentally friendly and prioritize village welfare.
	Job opportunities should be prioritized for local people according to their capabilities.
	Soil fertility should not be damaged because of geothermal pumping and as it is very important for agriculture.
	Prevent water pollution.
	Prevent pollution or release of toxic gases.
	Proper wastewater management system to prevent pollution to soil and water.
	In the case of diseases due to the project operation, the company should be fullly responsible.
	Migrants should respect local customs and traditions, and not bring negative influences that create immoral activities in community areas.
	Local communities should be employed as workers in the construction stage.
	Involvement from the company in maintaining security in the villages.
	In the case of toxic gas release, open information should be provided as it is important for community safety.
	Put up 'danger alert sign' in each village where drilling wells are located in order to alert the communities.
	To involve community leaders in solving problems.
	Direct negotiation for land acquistions to achieve fair prices and not to cause loss.

District	*Suggestions*
	Assist development in the villages, build religious facilities, and provide scholarships for high achievers without giving preference.
Pahae Jae **60 respondents**	Professional in project implementation, not to damage land, forest, and the environment.
	Proper wastewater management system to prevent pollution to soil and water.
	Compliance with environmental laws and regulations to achieve welfare.
	Prioritize local people according to their capabilities, considering many young people in the villages.
	If there is in-house capability, jobs should be prioritized for local people and not non-locals. There should be no corruption, collusion, and nepotism in workforce recruitment.
	Establish village cooperation to assist the development in agriculture as it is the main livelihood.
	Assisst the education development in the villages by building schools and providing scholarships for high achievers.
	Local communities should not only be audiences or not being able to benefit from natural resources in the villages.
	In the case of risk, the communities should be in informed immediately and 'danger alert sign' should be put up.
	Do not give promises that cannot be kept.
	This project should be in operation without delay to progress the villages.
	In the case of unlikely incidents such as Lapindo case or toxic gas release, relocation area should be readily available.

Source: Questionnaire tabulation, March 2008

The above suggestions were directed to the following points: to be on the community side by prioritizing job opportunities for local people, sustainable development, transparency in risk management, responsible for health issues and to assist the villages to progress. Expected assistance from the company included provisions of scholarships and physical development. Several suggestions were related to technical issues during the construction and post-construction processes in order to prevent pollution and manage risk that can threat community safety.

Early learning system should be implemented to anticipate gas leakage or well explosion in order to avoid the situation like Lapindo in Sidoarjo. Company should also guarantee and prepare safe relocation area. To avoid conflicts as occurred in other areas, the communities represented by local community and religious leaders should be involved in managing local conflicts. Existing local social system and an understanding of local traditions should be an integral part of conflict management.

The above suggestions shall be followed up as they are part of company and communities' interests, and company's social responsibility to the communities and surrounding environment. Corporate Social Responsibility (CSR) is a responsibility that should be undertaken as part of company's responsibility towards the environment i.e. natural environment, socio-

cultural and health at locations where the company profited from their investments.

3.4 PUBLIC HEALTH COMPONENTS

Public health baseline information consisted of the existing health condition and health system, community behaviour in terms of public health, neighborhood environmental health, health facilities, perceptions on illness, disease pattern, and perception on potential disease due to the development of Sarulla geothermal field and power plant .

3.4.1 Public health system and communities' attitudes

The project location is in the districts of Pahae Julu and Pahae Jae, North Tapanuli Regency. The two districts are on transportation route between Medan, Tarutung, Sipirok and Padang Sidempuan. Generally, the health condition and the existing health system are adequate to meet the health service requirements in the two districts. The health services can be categorized into two service groups i.e. public and private services.

Public health service is medical treatment and check-up by using government facilities, such as public hospitals and community health centres (*puskesmas*). Private health service is medical treatment and check-up provided by non-governmental or private facilities such as private hospitals, health clinics, doctor practice, midwife practice and traditional medical treatment.

Public service at a district level typically includes *Puskesmas*, supporting *Puskesmas* and *posyandu*. Medical services using such facilities are free of charge for the underprivileged members of the community with "*gakin*" card (underprivileged family) and health insurance (*askes*) for civil servants. Without those health accesses, costs of medical treatments are specified in regional regulation. Public health service at *Puskesmas* level is the first order of service i.e. if a patient cannot be treated due to limited facilities, the patient will be referred to the nearest hospital to get treatment.

From the survey, it can be seen that the respondents preferred midwife than *Puskesmas*. **Table III-33** shows that from 150 respondents, almost all (95.3%) visited midwife for medical treatment. Further investigation indicated that although the *pusksesmas* and midwife offer different services but essentially the health personnels were the same as the midwife also served in the *puskesmas*.

Table III-33 Respondents - health facilities in the study area

No.	Health facilities	District		Total (Amount/%)
		Pahae Julu (Amount/%)	Pahae Jae (Amount/%)	
1	*Puskesmas*	5 (5.6)	2 (3.3)	7 (4.7)

2	Midwife	85 (94.4)	58 (96.7)	143 (95.3)
Total		**90 (100.0)**	**60 (100.0)**	**150 (100.0)**

Source: Questionnaire tabulation, March 2008

Midwife was visited at different working hours to the *puskesmas* and therefore, the medical service was delivered in the midwife's house. This was probably because the distance between patient's house to the midwife's house which was closer than to *puskesmas*. Midwife practice, located within the communities, psychologically gives assurance to patients even though the treatment cost is more expensive than *puskesmas*. A range of treatment cost for a midwife in Pahae Jahe District was 35,000 IDR and in the Pahae Jae District was 40,000 IDR (**Table III-34**).

Table III-34 Respondents - Medical costs for midwives in the study area

No.	*Cost (IDR)*	*District*		*Amount (Amount/%)*
		Pahae Julu (Amount/%)	*Pahae Jae (Amount/%)*	
1	10,000 - 25,000	60 (70.6)	39 (67.2)	99 (69.2)
2	25,000 - 50,000	18 (21.2)	16 (27.6)	34 (23.8)
3	> 50,000	7 (8.2)	3 (5.2)	10 (7.0)
Total		**85 (100.0)**	**58 (100.0)**	**143 (100.0)**

* 7 respondents go to Puskesmas.

Source: Questionnaire tabulation, March 2008

Unserious work related injuries can be initially treated in the existing *puskesmas* and other health facilities. The company shall co-ordinate and work together to form a health mechanism related to the project (**Table III-35**).

Table III-35 Respondents – perceptions on health facilities in the study area

No.	*Perception on existing health facilities*	*District*		*Amount (Amount/%)*
		Pahae Julu (Amount/%)	*Pahae Jae (Amount/%)*	
1	Adequate	73 (81.1)	48 (80.0)	121 (80.7)
2	Inadequate	17 (18.9)	12 (20.0)	29 (19.3)
Total		**90 (100.0)**	**60 (100.0)**	**150 (100.0)**

Source: Questionnaire tabulation, March 2008

In general, most respondents (81.1% and 80% in Pahae Julu and Pahae Jae respectively) considered that the existing health facilities in the districts as adequate. However, perceptions regarding the emergency response unit were different as it was considered inadequate (**Table III-36**).

Refering to the, there is evident that the emergency response system was inadequate. Emergency response system includes ambulance availability and other emergency responses in the case of incidents. Therefore, attention should be given on emergency preparedness.

Table III-36 Respondents – perceptions on emergency response in the study area

No.	Perception on emergency response unit	District		Amount (Amount/%)
		Pahae Julu (Amount/%)	Pahae Jae (Amount/%)	
1	Adequate	10 (11.1)	7 (11.7)	17 (11.3)
2	Inadequate	80 (88.9)	53 (88.3)	133 (88.7)
Total		**90 (100.0)**	**60 (100.0)**	**150 (100.0)**

Source: Questionnaire tabulation, March 2008

3.4.2 Neighborhood environmental health

Baseline information on neighborhood environmental health included housing conditions, clean water sources, availability of toilet, refuse system and domestic waste disposal system. Generally, houses in the study area were semi-permanent (66.7% in Pahae Julu and 55% in Pahae Jae). Half-concrete and half-wood walls indicate the permanent condition. There were 24.4% and 33.3% non-permanent houses in Pahae Julu and Pahae Jae districts respectively. Only 8.9% of houses in Pahae Julu District and 11.7% in Pahae Jae District were permanent (**Table III-37**). This indicated that socio-economically the communities were in a lower economic class.

Table III-37 Respondents – housing conditions in the study area

No.	Housing condition	District		Amount (Amount/%)
		Pahae Julu (Amount/%)	Pahae Jae (Amount/%)	
1	Permanent	8 (8.9)	7 (117)	15 (10.0)
2	Semi-permanent	60 (66.7)	33 (550)	93 (62.0)
3	Non-permanent	22 (24.4)	20 (33.3)	42 (28.0)
Total		**90 (100.0)**	**60 (100.0)**	**150 (100.0)**

Source: Questionnaire tabulation, March 2008

In relation to clean water source, the source water for everyday use was mountain water, followed by wells and river. Geographically, these two districts are surrounded by mountains where the water flows. However, from observation, daily water use was not entirely depend on mountain water as for cooking and drinking water, half of the respondents used water from the well (**Table III-38)**.

Table III-38 Respondents – clean water sources in the study area

No.	Source	District		Amount (Amount/%)
		Pahae Julu (Amount/%)	Pahae Jae (Amount/%)	
1	Well	18 (19.9)	10 (16.6)	28 (18.7)
2	River	1 (1.1)	4 (6.7)	5 (3.3)
3	Mountain water	71 (78.9)	46 (76.7)	117 (78.0)
Total		**90 (100.0)**	**60 (100.0)**	**150 (100.0)**

Source: Questionnaire tabulation, March 2008

Neighborhood environmental health conditions could also be considered from toilet availability. Only 32.0% of respondents used toilet. The remainder used river for toilets (**Table III-39**). This trend was similar to 2005 *Puskesmas* report. In Pahae Julu District, toilet availability was only 30.2% and 11.7% in Pahae Jae District (North Tapanuli Health Service, 2005).

Table III-39 Respondents – toilet facilities in the study area

No.	Toilet	District		Amount (Amount/%)
		Pahae Julu (Amount/%)	Pahae Jae (Amount/%)	
1	Septic tank	31 (34.4)	17 (28.3)	48 (32.0)
2	Ditch/river	59 (65.6)	43 (71.7)	102 (68.0)
Total		**90 (100.0)**	**60 (100.0)**	**150 (100.0)**

Source: Questionnaire tabulation, March 2008

Refuse disposal management was generally good although some domestic waste still ended up in a waste disposal facility including in the river. This was a significant problem as the river was also the source of clean water. Such ignorance gradually contaminated water cleanliness, which consequently cause illnesses (**Table III-40** and **Table III-41**).

Table III-40 Respondents – communities' refuse management habit in the study area

No.	Refuse management method	District		Amount (Amount/%)
		Pahae Julu (Amount/%)	Pahae Jae (Amount/%)	
1	Disposal facility or burned	53 (58.9)	30 (50.0)	83 (55.3)
2	Anywhere	29 (32.2)	22 (36.7)	51 (34.0)
3	River	8 (8.9)	8 (13.3)	16 (10.7)
Total		**90 (100.0)**	**60 (100.0)**	**150 (100.0)**

Source: Questionnaire tabulation, March 2008

Table III-41 Respondents – domestic waste management in the study area

No.	Management system	District		Amount (Amount/%)
		Pahae Julu (Amount/%)	Pahae Jae (Amount/%)	
1	Drainage	34 (37.8)	19 (31.7)	53 (35.3)
2	Own yard	12 (13.3)	6 (10.0)	18 (12,0)
3	Anywhere	44 (48.9)	35 (58.3)	79 (52.7)
Total		**90 (100.0)**	**60 (100.0)**	**150 (100.0)**

Source: Questionnaire tabulation, March 2008

3.4.3 *Health facilities and personnel*

Health facilities in the study area included two support *puskesmas*, 5 *Polindes* and 8 *Posyandu* (**Table III-42**). More complete health facilities could be found in Tarutung with public hospital, maternal clinic, main *puskesmas*, medicine shop, pharmacy, etc. Those who cannot be treated in health facilities in the surrounding project area can be referred to the hospital in Tarutung.

Table III-42 Health facilities in the study area

No.	Village/District	Unit				
		Hospital	Puskesmas	Pustu	Polindes	Posyandu
A.	**Pahae Julu District**	**-**	**1**	**5**	**13**	**24**
1.	Sibaganding Village	-	-	1	1	1
2.	Lumban Jaean Village	-	-	-	-	1
3.	Simataniari Village	-	-	-	1	2
B.	**Pahae Jae District**	**-**	**1**	**1**	**13**	**16**
1.	Silangkitang Village	-	-	-	1	1
2.	Sigurung-gurung Village	-	-	-	1	1
3.	Pardomuan Nainggolan Village	-	-	1	1	1
4.	Pardamean Nainggolan Village	-	-	-	1	1
Total in districts		**-**	**2**	**6**	**26**	**40**
Total in villages		-	-	2	5	8

Source: - Pahae Jae District in Figures 2007, Statistical Agency of North Tapanuli Regency
- Pahae Julu District in Figures 2007, Statistical Agency of North Tapanuli Regency

Health personnel were essential resources to create healthy communities. Accessibility and the level of community health depend on the quantity and the quality of health personnel in an area. Health personnel in the study area consisted of 7 midwives, 1 nurse and 2 trained traditional midwives. There were 2 doctors in Pahae Julu District and 3 doctors in Pahae Jae District. Wide area coverage and limited accessibility caused unequal access to doctor

services. The numbers of health personnel in the study area are presented in **Table III-43.**

Midwife could be found in almost all villages, except in Lumban Jaean Village. Midwife was the most visited health personnel to receive medical treatment since the number of midwife as larger than other health personnel. This was in line with health vision 2010 to provide affordable health service for the underprivileged families.

Table III-43 Health personnel in the study area

No.	Village/District	Number of health personnels				
		Doctor	*Midwife*	*Nurse*	*Traditional Midwife*	*Others*
A.	**Pahae Julu District**	**2**	**17**	**4**	**16**	**-**
1.	Sibaganding Village	-	2	-	1	-
2.	Lumban Jaean Village	-	-	-	-	-
3.	Simataniari Village	-	1	-	1	-
B.	**Pahae Jae District**	**3**	**14**	**4**	**13**	**10**
1.	Silangkitang Village	-	1	-	-	-
2.	Sigurung-gurung Village	-	1	-	-	-
3.	Pardomuan Nainggolan Village	-	1	1	-	-
4.	Pardamean Nainggolan Village	-	1	-	-	-
Total in districts		**-**	**31**	**8**	**29**	**10**
Total in villages		**-**	**7**	**1**	**2**	**-**

Source: - Pahae Jae District in Figures 2007, Statistical Agency of North Tapanuli Regency
- Pahae Julu District in Figures 2007, Statistical Agency of North Tapanuli Regency

3.4.4 Illness and disease pattern

Achieving human quality of life in terms of health aspects requires an integrated approach covering physical and non-physical aspects. In the National Health System, health is considered to be closely related to all aspects of life that have wide and complex coverage. This is inline with World Health Organization definition of health i.e. health as overall health situation in terms of physical, spiritual and social and not limited to physical illness or or disability (WHO, 1981).

According to this definition, illness refers to a situation where human experience physical/spiritual/social dysfunctions and not limited to physical disability. The understanding of illness is different for each person and area. In the districts of Pahae Jae and Pahae Julu, illness was considered as physical disability, laziness, or loss of appetite (**Table III-44**). Respondents' understanding was similar to the theoretical meaning of illness.

In theory, the emphasis of illness is on the process and the communities in the study area focused on the consequences of illness. Regardless of the process, an illness causes physical dysfunction, being lazy and loss of appetite.

Table III-44 Respondents – meaning of illnesses in the study area

No.	Meaning of illness	District		Amount (Amount/%)
		Pahae Julu (Amount/%)	Pahae Jae (Amount/%)	
1	Fever	37 (41.1)	23 (38.3)	60 (40.0)
2	Tiredness	33 (36.7)	24 (40.0)	57 (38.0)
3	Loss of appetite	20 (22.2)	13 (21.7)	33 (22.0)
Total		**90 (100.0)**	**60 (100.0)**	**150 100.0)**

Source: Questionnaire tabulation, March 2008

It can be seen that the understanding of illness in the study area was correct. Further investigation into communities' disease pattern identified fever and cough as dominant diseases (84%). **Table III-45** presents the disease pattern in the districts of Pahae Julu and Pahae Jae.

Table III-45 Respondents – disease pattern in the study area

No.	Disease	District		Amount
		Pahae Julu	Pahae Jae	
1	Fever	39 (43.3)	16 (26.6)	55 (36.7)
2	Cough	32 (35.6)	39 (65.0)	71 (47.3)
3	Diarhea	3 (3.3)	3 (5.0)	6 (4.0)
4	Toxication	-	1 (1.7)	1 (0.6)
5	Itchy	9 (10.0)	1 (1.7)	10 (6.8)
6	Asthma	3 (3.3)	-	3 (2.0)
7	Toothache	2 (2.2)	-	2 (1.4)
8	Malaria	1 (1.1)	-	1 (0.6)
9	Cancer	1 (1.1)	-	1 (0.6)
Total		**90 (100.0)**	**60 (100.0)**	**150 (100.0)**

Source: Questionnaire tabulation, March 2008

Comparisons to *puskesmas* visit data in 2005 indicated similar pattern. Based on the *puskesmas* data, dominant illnesses in the study areas were upper and lower respiratory infections, including cough and fever. The *Puskesmas* data also showed non-infectious diseases like hypertension and muscle disturbance or rheumatism. There were also diseases related to bad sanitation i.e. gastrointestinal infection, skin infection and worm disease. Health agencies should be vigilant to the change in the disease pattern that shows non-infectious and degenerative diseases in the study area. Furthermore, project proponent's awareness in terms of monetary and non-monetary supports (working network with health agency units) is necessary really expected.

Table III-46 Disease pattern according to Puskesmas records in the study area

No.	Disease pattern	District		Total
		Pahae Julu	Pahae Jae	
1	Upper respiratory disease	1228	526	1754
2	Lower respiratory disease	1306	158	1464
3	Gastrointestinal infection	599	133	732
4	Muscle related disease	1462	222	1684
5	Worm disease	318	30	348
6	Hypertension	267	81	348
7	Ulcer	62	12	74
8	Asthma	34	142	176
9	Skin	363	-	363
10	Toothache	-	31	31
Total		**5,639**	**1,335**	**6, 974**

Source: - Pahae Jae District in Figures 2007, Statistical Agency of North Tapanuli Regency
- Pahae Julu District in Figures 2007, Statistical Agency of North Tapanuli Regency

3.4.5 *Illness vector and potential health risk associated with the project*

Direct observation on the illness vector indicated an uncertainty about a particular vector as media of distribution in the study area. Vectors that could potentially risk aquatic, forest, farming habitats and residential area were not found. However, there is still a possibility of it as the project operates. New migrants and area expansion are potential sources for vector spreading. Therefore, regular observation is necessary to prevent new trend of illness.

Furthermore, communities' perceptions on potential diseases associated with the project included coughing, asthma, breathless and tuberculosis. This was considered as a normal perception as communities' understanding about the proposed project was gas exploitation. Such gases could cause coughing, asthma and eventually tuberculosis. Therefore, information on the potential health impacts should be set as a routine agenda for the project proponent and local government.

Table III-47 Respondents – perceptions towards potential health risk associated with the project

No.	Potential health risk	District		Amount (Amount/%)
		Amount (Amount/%)	Amount (Amount/%)	
1	Cough	42 (46.7)	29 (48.3)	71 (47.3)
2	Asthma	38 (42.2)	25 (41.7)	63 (42.0)
3	Tuberculosis	10 (11.1)	6 (10.0)	16 (10.7)
Total		**90 (100.0)**	**60 (100.0)**	**150 (100.0)**

Source: Questionnaire tabulation, March 2008

Potential health risk from the development of Sarulla geothermal field and power plant is gas leakage wit toxic chemical properties and therefore can cause respiratory disease. This is similar to communities' perceptions and concerns on the potential for leakage that can cause coughing, asthma and tuberculosis. Considering lack of emergency preparedness in terms of ambulances and other facilities, there is a need for emergency preventative and management measures in the case of leakage. Therefore, risks can be minimized as well as economic, social, and psychological loss.

CHAPTER IV
STUDY COVERAGE

4.1 *IDENTIFICATION OF SIGNIFICANT IMPACTS*

The identification of potential and hypothetical significant impacts was conducted in the preparation of the ANDAL Terms of Reference (ToR). The process of identification is illustrated in **Figure IV-1**.

Detailed interactions of the significance between the environmental components and the impact sources (activities) are presented in **Table IV-1** and a summary of the significant impacts assessed in this ANDAL is presented in **Table IV-2**.

Table IV-1 List of hypothetical significant impacts

Priority	*Environmental Components*	*Parameter*
1.	Socio-cultural	– Community unrest
2.	Socio-economic	– Job opportunities – Business opportunities – Community income – Land ownership and occupancy
3.	Noise	– Noise level
4.	Surface water quality	– pH, temperature, TSS, TDS, SO_4, dissolved metals (As, Ba, B, Cr $^{6+}$, Cd, Cu, Fe, Co, Hg, Ni, K, Pb, Mg, Mn, Se, Na and Zn)
5.	Air quality	– TSP and H_2S
6.	Public health	– Morbidity
7.	Soil	– Soil erosion
8	Hydrology	– Surface water run-off – River water flow (debit)
9.	Electromagnetic field	– Exposure to electromagnetic field
10.	Transportation	– Ground traffic disturbance
11	Terrestrial biota	– Species compositions and protected species
12	Aquatic biota	– Abundances of plankton and benthos

Table IV-II Matrix of identification of potential impacts of the development of Sarulla geothermal field and power plant, and construction of transmission line

ENVIRONMENTAL COMPONENT / ACTIVITY COMPONENT			PRE-CONSTRUCTION	CONSTRUCTION							OPERATION				POST-OPERATION	
								Geothermal field	Power plant	Transmission		Power plant	Transmission			
			Land acquisition	Workforce recruitment	Mobilization of equipment and materials	Land preparation	Mechanical and electrical constructions	Well drilling and production test	Power plant constrcution	Installation of transmission	Workforce recruitment	Operation	High voltage electricity transmission	Maintenance of transmission lines	Workforce release	Land rehabilitation / revegetation
		PARAMETER														
Physical and chemical components	**Air quality**	TSP			●											
		SO_x														
		CO														
		H_2S						●				●				
	Noise	Noise level			●			●	●			●				
	Soil	Soil erosion				●										●
	Hydrology	Surface water run-off rate				●										●
		River water flow														
	Water quality	TSS				●		●								
		Temperature														
		pH						●				●				
		TDS						●				●				
		Dissolved Metals (As, Ba, B, Cd, Cr6+, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Na and Zn)						●				●				
	Electromagnetic field	Exposure to electromagnetic field											●			
Biological components	**Terrestrial biota**	Species compositions and protected species				●										
	Aquatic biota	Abundances of plankton and benthos				●										
Socio-economic, socio-cultural, and public health components	**Socio-economic**	Job opportunities		●						●	●				●	
		Business opportunities		●						●	●				●	
		Community income		●						●	●				●	
		Land ownership and occupancy	●													
	Socio-cultural	Community unrest	●	●				●		●	●		●		●	
	Transportation	Ground traffic disturbance			●											
	Public health	Morbidity			●											

Note:

● Impact Interaction

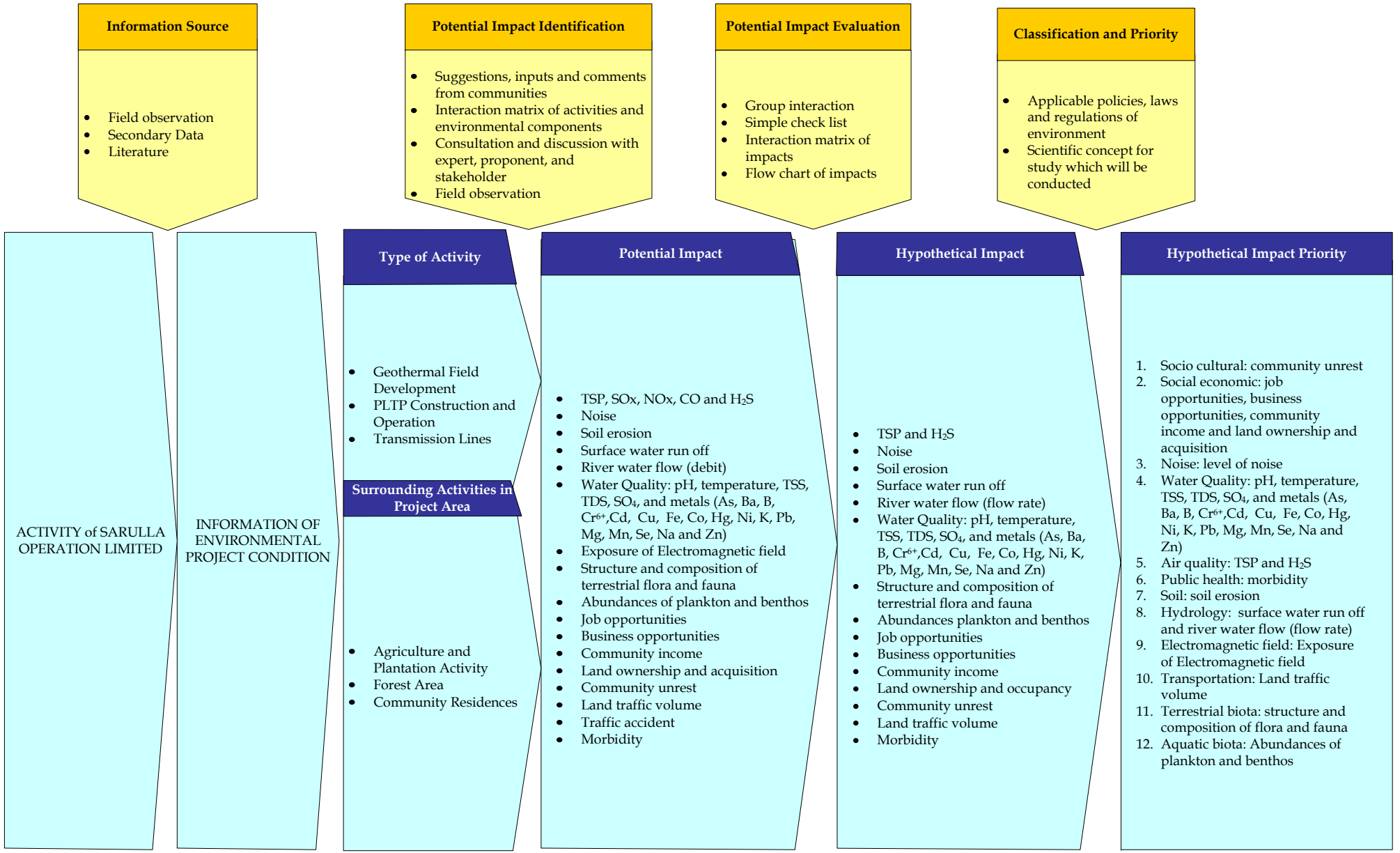


Figure IV-2 Summary of Flow Chart of Potential Impact Identification of Geothermal Field, Power Plant, and Transmission Development Activities

4.2 STUDY BOUNDARY AND PERIOD

4.2.1 Study boundary

4.2.1.1 Project boundary

The project boundary is the development of Sarulla geothermal field at SIL and NIL where the power plant will be built. The transmission line between SIL to NIL will be approximately 15 km length.

4.2.1.2 Ecological boundary

The ecological boundary is determined based on the impact distribution areas through water and air. Therefore, the ecological boundary of the development of Sarulla geothermal field, the construction and operation of Sarulla power plant includes the ecosystems of paddy field, plantation and mixed forest in SIL and Nil.

4.2.1.3 Social boundary

Social boundary is defined as areas in the vicinity of proposed activities where social interactions, with established norms and values, exist (including system and social structure). It is envisaged that the communities who live around the project area will be affected. The social boundary in this study covers villages where many activities will occur, i.e. Silangkitang, Sarulla, Sigurung-gurung and Pardomuan Nainggolan Villages.

4.2.1.4 Administrative boundary

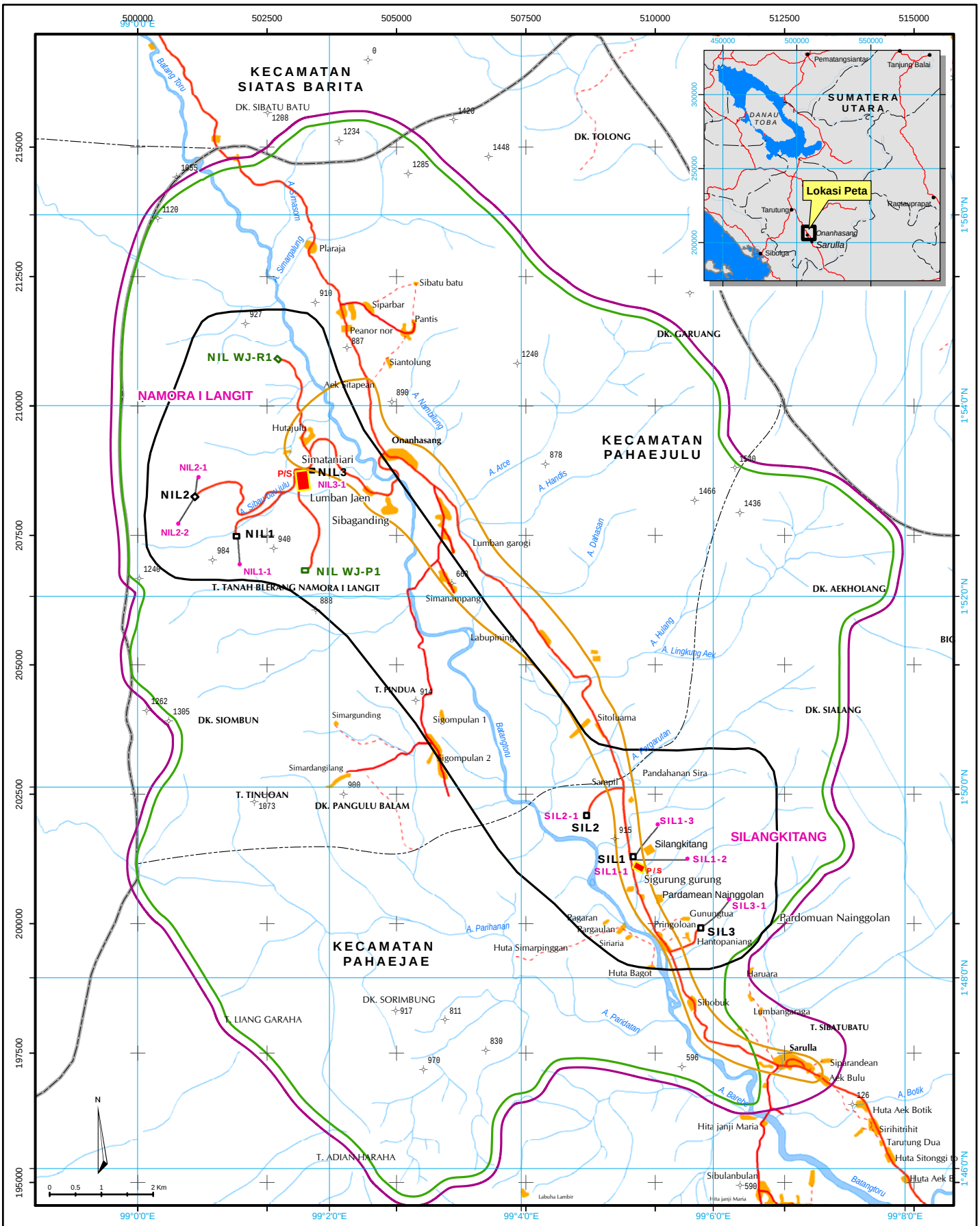
The administrative boundary includes the districts of Pahae Jae and Pahae Julu. Villages within these districts are directly and indirectly affected by the activities in developing Sarulla geothermal field and power plant. The villages are Silangkitang, Sigurung-gurung, Pardomuan Nainggolan, Sibaganding, Lumban Jaean, and Simataniari.

The ANDAL study boundary is determined based on the four boundaries defined above. The determination of the boundary also taking into account the following constraints: (1) accessibility, (2) study period, and (3) data sources. The ANDAL study boundary is shown on **Map IV-1.**

4.2.2 Study period

Study period is a time limit that will be used in predicting and undertaking an impact evaluation as part of the ANDAL assessment. The period is used as a basis to determine if there are any changes to the environmental baseline resulting from the project activities.

The study period is determined based on the time taken to develop and carry out a proposed activity up until completion. In this case, the anticipated time taken to develop Sarulla geothermal field, the construction and the operation of Sarulla power plant is 30 years starting from construction period in 2009.



Legenda
Legend

- Titik Ketinggian — *Elevation Point*
- Jalan Arteri — *Arteri Road*
- Jalan Kolektor — *Collector Road*
- Jalan Lokal — *Local Road*
- Batas Kecamatan — *Kecamatan Boundary*
- Sungai — *River*
- Permukiman — *Village*
- Sumur Eksplorasi Namora I Langit dan Silangkitang — *Namora I Langit and Silangkitang Exploration Wells*
- Lokasi Sumur Baru (West JEC) — *New Well Site (West JEC)*
- P/S — Pembangkit Listrik — *Power Station*

Batas - BatasStudy
Study Boundaries

- Batas Studi — *Study Boundary*
- Batas Proyek — *Project Boundary*
- Batas Sosial — *Social Boundary*
- Batas Ekologi — *Ecology Boundary*
- Batas Administrasi — *Administration Boundary*

Keterangan :
Note :

DK : Bukit — *Hill*
Aek : Sungai — *River*
T. :Tinggi — *Elevation*

Sumber (Source) :
Peta Topografi - BAKOSURTANAL, 1977, Skala 1 : 50,000.
Medco Geothermal Indonesia

ANALISIS DAMPAK LINGKUNGAN
ENVIRONMENTAL IMPACT STATEMENT

BATAS WILAYAH STUDI
STUDY BOUNDARY

Skala *Scale*	1 : 100.000	Digambar Oleh *Drafter*	GGG
Peta *Map*	IV - 1	Diperiksa Oleh *Proofreader*	ABU
Tanggal Revisi *Date Revision*	23/10/08	Digabung Oleh *Compilation*	ERM

CHAPTER V
PREDICTION OF SIGNIFICANT IMPACTS

5.1 PRE-CONSTRUCTION STAGE

5.1.1 Socio-economic, socio-cultural and public health components

5.1.1.1 Changes in land ownership and occupancy

The proposed project location is located in areas owned and controlled by local communities. SOL has to carry out a land acquisition process by providing appropriate compensations in accordance with applicable regulations. The compensations will be in forms of retributions towards land, plants or crops in communities' land. Until 2008, the land acquired by the project is 53 ha.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

   Land acquisition is generally a sensitive issue in Indonesia where in most cases, one affected person may cause significant problems. Therefore, for this criterion it is considered as significant negative impact.

2) *Impacted area*

   The remaining land to be acquired is 70 ha whilst the whole study area i.e. Pahae Jae and Pahae Julu Districts covers 370 ha. The total area to be acquired is only 19% of the total study area and therefore, based on the impacted area it is categorized as significant negative impact.

3) *Duration of impacts*

   When the project proponent owns the land, the local community will have no ownership or occupancy. Therefore, based on the duration of impact, the impact is categorized as negative significant.

4) *Intensity of impacts*

   The size of the impacted area and the number of persons affected are considered as significant. Many land owners will no longer have ownerships of their land. The lands are mainly inherited or family lands owned by more than one person, thus the land acquisition process generally takes a considerable amount of time. It is therefore categorized as significant negative impact.

5) *Number of impacted environmental components*

Land acquisition will cause the communities to loose their assets and thus will not be able to hand them over to future generation. Furthermore, the communities use the land for farming. It is therefore categorized as significant negative impact.

6) *Cumulative nature of impacts*

Land acquisition is a one time activity i.e. does not happen continuously. Therefore, it is considered as insignificant negative impact.

7) *Reversibility of impacts*

Once the land is acquired, the ownership will be transferred to the project proponent and will not be returned to the previous owners i.e. the communities. The impact is irreversible and classified as significant negative impact.

In conclusion, the impacts of land acquisition on land ownership and occupancy are categorized as ***significant negative impact (-S)***.

5.1.1.2 Community unrest

Community unrest is related to communities' dissatisfaction towards the transfers of land ownership and occupancy. Community dissatisfaction may relate to the amount of compensation received which consequently causes community unrest.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

In general, community unrest is caused not only by those whose lands will be acquired but also those with lands not required by SOL but prefer to sell it. Therefore, based on the number of impacted persons, it is categorized as significant negative impact.

2) *Impacted area*

Communities in rural area have close communication links with each other. This can potentially spread community unrest to a larger area. Therefore, based on the impacted area, it is categorized as significant negative impact.

3) *Duration of impacts*

Land acquisition has to be completed in a short period of time i.e. before activities at the project area commence. Based on the duration of impacts, it is categorized as insignificant negative impact.

4) *Intensity of impacts*

Since the number of impacted persons and the impacted area are considered as significant, based on the intensity of impact it is classified as significant negative impact.

5) *Number of impacted environmental components*

There is no derivative impacts resulting from community unrest. Therefore, it is categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

Community unrest will be resolved as the land acquisition process is completed. Hence, it is not considered as cumulative. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

The issue of community unrest will eventually be resolved. Hence, it is considered as reversible. Based on the reversibility character of impacts, it is categorized as insignificant negative impact.

In conclusion, the impacts on land acquisition towards community unrest are categorized as ***significant negative impact (-S).***

5.2 CONSTRUCTION PHASE

5.2.1 *Geophysical and chemical components*

5.2.1.1 *Air quality*

5.2.1.1.1 *TSP*

Poor air quality due to high TSP concentrations is predicted as an impact from construction activities i.e. movement of construction equipment in the project area.

Mobilization of construction equipment can be viewed from availability and operational aspects, i.e. the movements support construction activity. This study considers the types and numbers of construction equipment.

TSP measurements within the project area showed a range of concentration between 15-31 $\mu g/m^3$ which are below TSP standard specified by the Government. It is anticipated that construction equipment traffic causes dust dispersion onto the air. TSP concentrations depend on the frequency and duration of movements. Increased of TSP concentrations due to mobilization

of equipment and materials is expected not to exceed the standard of 230 $\mu g/m^3$.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

   The impacted persons are communities who live in the vicinity of the project area. The project location is relatively far from residential areas particularly at NIL. Thus, based on the number of impacted persons, it is considered as insignificant negative impact.

2) *Impacted area*

   The impacted area is limited to the locality of construction activities. Therefore, based on the impacted area, it is categorized as insignificant negative impact.

3) *Duration of impacts*

   The impact is only experienced during the construction stage. Based on the duration of impacts, it is categorised as insignificant negative impact.

4) *Intensity of impacts*

   Since the number of impacted persons and the impacted area are considered as insignificant, based on the intensity of impact it is classified as insignificant negative impact.

5) *Number of impacted environmental components*

   There is no derivative impacts resulting from increased of TSP concentrations. Therefore, it is categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

   TSP is dispersed in ambient air but not considered as cumulative as it is washed away by rain. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

   TSP concentrations in ambient air decrease as the construction stage is completed. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impacts of TSP on air quality are categorized as ***insignificant negative impact (-IS).***

5.2.1.1.2 H_2S

During well drilling and production testing, impacts on air quality are particularly caused by H_2S emission. Geothermal-fluid from production wells is separated into steam and brine. During production testing, steam is discharged through a silencer, while brine is re-injected to reinjection wells. Steam will have a dryness quality of about 99.95%. Non condensable gas (NCG) is about 2.1% weight in SIL and about 3.7% in NIL. The NCG contains H_2S in small amount[2].

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

   The total population within a 4 km radius in the proximity of the SIL well pad was approximately 780 people. Within a 500 m radius from the center of SIL, there were approximately 70 houses with an average of 5 persons per house. Thus, potentially there were 350 people impacted by the H_2S emission from the production test. At NIL, the closest villages were approximately 1000 m from the well pads. The population in the villages was 1,560. Compared to the total population in the study area, the number of impacted persons was considered as low. Therefore, based on the number of impacted persons it is considered as insignificant negative impact.

2) *Impacted area*

   The emission source is a silencer which is located 7.5 m above ground. This condition will prevent wide spread dispersion of the H_2S. In addition, H_2S is a dense gas which tends to settle down quickly. From those two factors, it is envisaged that H_2S will not be dispersed too far so that the impacted area will be limited. Thus based on the impacted area it is considered as insignificant negative impact.

3) *Duration of impacts*

   The impact only occurs during the production test which takes place for one month at each well. Based on the duration of impacts, it is categorized as insignificant negative impact.

4) *Intesity of impacts*

   To determine the amount of H_2S emission in NCG before conducting wells drilling and flow tests measurement is not a simple task. Nevertheless, as emission volume in SIL is 0.03 m^3/s and in NIL is 0.18 m^3/s, it is expected that the H_2S concentrations will be higher than the

[2] Other gases are CO_2 (96-97%) along with N_2, CH_4, O_2, H_2, Ar, He in trace quantities.

H_2S odor standard of 0.02 ppm specified in Minister of Environment Decree No. 50 of 1996 (Kep-50/MENLH/11/1996). From this point of view, the H_2S impact is considered as significant negative impact. H_2S concentrations will be monitored in accordance with the Environmental Management Plan during the construction stage. It is anticipated that the H_2S concentration will not cause any interference to human health in the vicinity of the wells since the level will be far below the concentration that could cause health disturbances (Threshold Limit Value is 10 ppm for a maximum of 8 hours exposure) stipulated in the Minister of Manpower Letter No. SE-01/MEN/1997 concerning Ambient Threshold Limit of Chemical Factors in the Working Environment. Therefore, from a public health point of view, it is considered as insignificant negative impact.

5) *Number of impacted environmental components*

There is no derivative impacts resulting from increased of H_2S emission to ambient air. Therefore, it is categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

The production well test will occur at certain time periods and therefore not considered as accumulative. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

H_2S emission will be dispersed in ambient air and its concentration will be decreased when the construction stage is completed. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impacts of H_2S on air quality are categorized as ***significant negative impact (-S).***

5.2.1.2 Noise

a. Mobilization of equipment and materials

Noise measurements in the project area showed a range of 32-44 dBA which is below the Indonesian noise standard for residential area. Mobilization of equipment and materials will increase noise level in the project area. Based on an assumption that heavy equipment mobilization is 6 hours per day at 10 locations (4 in SIL and 6 in NIL), the noise level from mobilization of equipment and materials is in a range of 60 – 70 dBA.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

The impacted persons are limited to those who live near the roads leading toward the project area. Therefore, based on the number of impacted persons it is categorized as insignificant negative impact.

2) *Impacted area*

The impacted area is limited to the villages next to roads leading toward the project area. Thus it is considered as insignificant negative impact.

3) *Duration of impacts*

The impact only occurs during the mobilization of equipment and materials. Based on the duration of impacts, it is categorized as insignificant negative impact.

4) *Intesity of impacts*

An increase of noise level due to the mobilization of equipment and materials is predicted to exceed the Indonesian standard for residential area of 55 dBA. Therefore, based on the intensity of impacts it is considered as significant negative impact.

5) *Number of impacted environmental components*

There is no derivative impacts resulting from increased of noise level. Therefore, it is categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

Mobilization of equipment and materials only occurs at certain periods of time and therefore not considered as cumulative. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

Noise generation stops once the mobilization of equipment and materials activity is completed. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impacts of mobilization of equipment and materials on noise level are categorized as ***significant negative impact (-S).***

b. Well drilling and production test

Noise measurements in the project area showed a range of 32-44 dBA which is below the Indonesian noise standard for residential area. It is anticipated that well drilling and production test will increase noise level in the project area so it is higher than the baseline level. Calculations predict a range of noise level between 75-79 dBA at well boundary due to well drilling. Based

on an assumption that production test (steam blowing) is 1 hour per day at 2 locations (1 in SIL and 1 in NIL), the noise level at 30 m from the project location is in a range of 100 – 110 dBA.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

   The total population within a 4 km radius in the proximity of the SIL well pad was approximately 780 people. Within a 500 m radius from the center of SIL, there were approximately 70 houses with an average of 5 persons per house. Thus, potentially there were 350 people impacted by increased noise level from the production test. At NIL, the closest villages were approximately 1000 m from the well pads. The population in the villages was 1,560. Compared to the total population in the study area, the number of impacted persons was considered as low. Therefore, based on the number of impacted persons it is considered as insignificant negative impact.

2) *Impacted area*

   The impacted area is limited to villages around the well pads. Thus, based on the impacted area it is considered as insignificant negative impact.

3) *Duration of impacts*

   The impact only occurs during the production test which takes place for one month at each well. Based on the duration of impacts, it is categorized as insignificant negative impact.

4) *Intesity of impacts*

   Noise from the production test can reach 110 dBA at well pads before silencer is used. At this level, the intensity of impact is considered as significant negative impact.

5) *Number of impacted environmental components*

   High noise level will only impact human at SIL whilst at NIL, it will also affect wildlife. Therefore, due to its potential impact on wildlife it is considered as significant negative impact.

6) *Cumulative nature of impacts*

   The production well test occurs at certain time periods and therefore not considered as cumulative. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

Noise generation stops once the production test is completed. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impacts of well drilling and production test on noise level are categorized as ***significant negative impact (-S).***

c. Power plant construction

Power plant construction activities will generate noise. It is predicted that the noise levels at a 100 m distance from construction sites during the construction stage are between 60-70 dBA with details as follow:

- Soil excavation 75 - 85 dBA
- Electric generator 55 - 65 dBA
- Pump 55 - 70 dBA
- Truck, cranes and other heavy equipment 60 - 70 dBA
- Pneumatic equipment 65 - 70 dBA

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

The total population within a 4 km radius in the proximity of the SIL well pad was approximately 780 people. Within a 500 m radius from the center of SIL, there were approximately 70 houses with an average of 5 persons per house. Thus, potentially there were 350 people impacted by increased noise level from the construction activities. At NIL, the closest villages were approximately 1000 m from the well pads. The population in the villages was 1,560. Compared to the total population in the study area, the number of impacted persons was considered as low. Therefore, based on the number of impacted persons it is considered as insignificant negative impact.

2) *Impacted area*

The impacted area is limited to villages around the power plant. Thus, based on the impacted area it is considered as insignificant negative impact.

3) *Duration of impacts*

The impact only occurs during the construction of the power plant i.e. 4 years. Based on the duration of impacts, it is categorized as insignificant negative impact.

4) *Intesity of impacts*

Noise from the power plant construction can reach 85 dBA at a 100 m distance. Thus based on the intensity of impacts, it is considered as significant negative impact.

5) *Number of impacted environmental components*

High noise level will only impact human at SIL whilst at NIL, it will also affect wildlife. Therefore, due to its potential impact on wildlife it is considered as significant negative impact.

6) *Cumulative nature of impacts*

The power plant construction only occurs within a 4 year period and therefore not considered as cumulative. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

Noise generation stops once the power plant construction is completed. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impacts of power plant construction on noise level are categorized as ***significant negative impact (-S).***

5.2.1.3 Soil erosion

Land preparation activity causes destruction of soil structure into granules which increase erosion potential. High amount of rainfall and rain erosivity (i.e. the ability of rain to cause erosion) in the project area potentially cause high surface water run-off rate and carry the granular soil onto a lower level area or into the river.

It is predicted that the erosion level in the area (using the USLE method) ranges between 40-1900 tonne/year. During the construction stage, the erosion level may increase to between 2370-4393 tonne/year.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

The total population within a 4 km radius in the proximity of the SIL well pad was approximately 780 people. Within a 500 m radius from the center of SIL, there were approximately 70 houses with an average of 5 persons per house. Thus, potentially there were 350 people impacted by increased soil erosion level from the construction activities. At NIL, the closest villages were approximately 1000 m from the well pads. The

population in the villages was 1,560. Compared to the total population in the study area, the number of impacted persons was considered as low. Therefore, based on the number of impacted persons it is considered as insignificant negative impact.

2) *Impacted area*

The project area coverage is expected to be approximately 115 hectares. Uncovered parts of land are exiting access roads and well pads. Hence, new activities are unlikely to increase erosion potential. Therefore, based on the impacted area it is considered as insignificant negative impact.

3) *Duration of impacts*

The area of 115 hectares is not cleared on one occasion. Therefore, based on the duration of impacts it is categorized as insignificant negative impact.

4) *Intesity of impacts*

Open area will be occupied by project structures i.e. buildings, paved and graveled roads, parks and plants during the construction period. Based on the intensity of impacts, it is categorized as insignificant negative impact.

5) *Number of impacted environmental components*

There is no derivative impacts resulting from land preparation activity. It is therefore categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

Soil erosion only occurs during the construction stage and therefore not considered as cumulative. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

Soil erosion causes loss of fertile top soil but the top soil is to be replaced during land rehabilitation. Therefore, based on the reversibility of impacts it is categorized as insignificant negative impact.

In conclusion, the impacts of land preparation on soil erosion are categorized as ***insignificant negative impact (-IS).***

5.2.1.4 Surface water run-off rate

Land preparation changes the surface water run-off rate due to the alterations of change of morphology and land cover.

Initial run-off coefficient in the project area is 0.3 and it is expected to increase to 0.7 following the land preparation activity. Such increase can increase erosion rate which directly impacts water ecosystem.

Estimated land areas prepared for geothermal activity is 70 ha whereby 19 ha of land with flat slope class (0-8%) and rain intensity of 16.60 mm/day is allocated for the power plant. The surface water run-off rates prior to the land preparation are 0.968 and 0.263 m^3/s for geothermal activity and power plant activity respectively. After the land preparation, the rates are expected to become 2.259 and 0.613 m^3/s for geothermal activity and power plant activity respectively.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

   Surface water run-off from the project area will flow to the nearest streams before reaching Batang Toru River. The impacted persons are limited to those who live in the river catchment areas. Therefore, based on the number of impacted persons it is categorized as insignificant negative impact.

2) *Impacted area*

   The project area coverage is expected to be approximately 115 hectares. Uncovered parts of land are exiting access roads and well pads. Hence, new activities are unlikely to increase surface water run-off rate potential. Therefore, based on the impacted area it is considered as insignificant negative impact.

3) *Duration of impacts*

   The area of 115 hectares is not cleared on one occasion. Therefore, based on the duration of impacts it is categorized as insignificant negative impact.

4) *Intesity of impacts*

   Open area will be occupied by project structures i.e. buildings, paved and graveled roads, parks and plants during the construction period. Based on the intensity of impacts, it is categorized as insignificant negative impact.

5) *Number of impacted environmental components*

   There is no derivative impacts of surface water run-off. It is therefore categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

Increased surface water run-off rate only occurs during the construction stage and therefore not considered as cumulative. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

Changes in the hydrology stop once the construction stage is completed. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impacts of land preparation on surface water run-off rate are categorized as ***insignificant negative impact (-IS)***.

5.2.1.5 Water quality

5.2.1.5.1 TSS

a. Land preparation

Field measurements showed that TSS concentrations in Batang Toru River were 114 -138 mg/L, which is higher than a standard of 50 mg/L.

The determination of impact significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

TSS is a derivative impact of surface water run-off. The impacted persons are limited to those who live in the river catchment areas. Therefore, based on the number of impacted persons it is categorized as insignificant negative impact.

2) *Impacted area*

The project area coverage is expected to be approximately 115 hectares. Uncovered parts of land are exiting access roads and well pads. Hence, new activities are unlikely to increase TSS concentration. Therefore, based on the impacted area it is considered as insignificant negative impact.

3) *Duration of impacts*

The area of 115 hectares is not cleared on one occasion. Therefore, based on the duration of impacts it is categorized as insignificant negative impact.

4) *Intesity of impacts*

Open area will be occupied by project structures i.e. buildings, paved and graveled roads, parks and plants during the construction period.

Based on the intensity of impacts, it is categorized as insignificant negative impact.

5) *Number of impacted environmental components*

There is no derivative impacts of TSS concentration. Furthermore, it is of small intensity and short duration. It is therefore categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

Increased TSS concentrations only occur during the construction stage and therefore not considered as cumulative. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

Higher TSS concentrations in the catchment areas will stop once the construction stage is completed. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impacts of land preparation on TSS concentration are categorized as ***insignificant negative impact (-IS)***.

b. Well drilling and production test

There is a potential for higher TSS concentrations following well drilling activities due to drill mud cutting from the sump pit.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

Higher TSS concentrations are anticipated in the surface water due to the run-off from the sump pit area. The impacted persons are limited to those who live in the river catchment areas. Therefore, based on the number of impacted persons it is categorized as insignificant negative impact.

2) *Impacted area*

The sump pit area is relatively small and only minimum spillage from it is expected. Therefore, based on the impacted area it is considered as insignificant negative impact.

3) *Duration of impacts*

The impacts are not continuous during drilling activity but only at times when there are spillages from the sump pit. Therefore, based on the duration of impacts it is categorized as insignificant negative impact.

4) *Intesity of impacts*

The possibility of spillage from the sump pit to occur is relatively small and limited. Based on the intensity of impacts, it is categorized as insignificant negative impact.

5) *Number of impacted environmental components*

There is no derivative impacts of TSS concentration. Furthermore, it is of small intensity and short duration. It is therefore categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

Increased TSS concentrations only occur during the construction stage and therefore not considered as cumulative. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

Higher TSS concentrations in the catchment areas will stop once the construction stage is completed. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impacts of well drilling and production test on TSS concentration are categorized as ***insignificant negative impact (-IS)***.

5.2.1.5.2 TDS and dissolved metals

Drilling and production test activities have the potential to increase TDS contents of surface water near the drilling locations. During drilling, fractions of the drill mud cutting could be released into shallow water courses, which could then enter Batang Toru River.

After the completion of drilling, liquid waste i.e. the remainder of drill mud will be transferred to mud pit. Such liquid waste contains water, non-toxic additive materials, cutting of rocks, and fractions of geothermal fluid. The fractions consist of dissolved metal (such as boron which can pollute surface and ground water). The dissolved metals potentially enter water bodies through surface water run-off or mud pit leak and therefore increases TDS contents of surface water.

PPSDAL USU laboratory analysis results revealed that TDS contents in Batang Toru River ranged between 114–138 mg/L. Surface water run-off as discussed above will potentially increase TDS contents in Batang Toru River. However, the increase is not anticipated to be of significance and the TDS contents will not exceed the standard of 1000 mg/L for the Class II water quality (based on Government Regulation No. 82/2001).

During production test, there is a potential for leakage from well casing. Hence, hot brine with high TDS contents may penetrate into the soil and finally into Batang Toru River. Nevertheless, the possibility of leakage is relatively small as the casing is specifically designed to prevent leakage.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

   The impacts of well drilling and production test to TDS contents have no direct consequences on human. Therefore, based on the number of impacted persons it is categorized as insignificant negative impact.

2) *Impacted area*

   Well drilling is to be conducted at SIL and NIL with the nearest Batang Toru River catchment and community wells nearby as the only directly impacted areas. Therefore, based on the impacted area it is considered as insignificant negative impact.

3) *Duration of impacts*

   The impacts are not continuous during drilling activity but periodically during drilling and only at times if well casing leakage occurs during production test. Therefore, based on the duration of impacts it is categorized as insignificant negative impact.

4) *Intesity of impacts*

   The increase of TDS in surface water close to the drilling location is relatively low and therefore, based on the intensity of impacts, it is categorized as insignificant negative impact.

5) *Number of impacted environmental components*

   There is no derivative impacts of TDS contents. Furthermore, it is of small intensity and short duration. It is therefore categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

   The increase of TDS in water catchment areas are not considered as cumulative due to its low intensity and that rain water will dilute the TDS. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

   The TDS contents in water catchment areas will be reversed naturally. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impacts of well drilling and production test on TDS and dissolved metals are categorized as ***insignificant negative impact (-IS)***.

5.2.1.5.3 pH

Well drilling activity has the potential to increase surface water pH and shallow groundwater close to drilling location i.e. to become alkaline (pH>7).

PPSDAL USU laboratory analysis results revealed that pH range of Batang Toru River is between 6.8-7.1, which meet the requirements of Class II water quality (based on Government Regulation No. 82/2001). Community wells sample at SIL and NIL varied between 6.7-6.9, which also showed compliance with the water quality standards in accordance with Minister of Health Regulation No. 416/PER/MENKES/IX/1990).

Surface water run-off and absorption of liquid waste with alkaline characteristic can potentially increase the pH of Batang Toru River and community wells. However, the increase is anticipated not to exceed the threshold of water quality standard i.e. 9.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

   The impacts of well drilling and production test to pH have no direct consequences on human. Therefore, based on the number of impacted persons it is categorized as insignificant negative impact.

2) *Impacted area*

   Well drilling is to be conducted at SIL and NIL with the nearest Batang Toru River catchment and community wells nearby as the only directly impacted areas. Therefore, based on the impacted area it is considered as insignificant negative impact.

3) *Duration of impacts*

   The impacts are not continuous during drilling activity but periodically during drilling and only at times if well casing leakage occurs during production test. Therefore, based on the duration of impacts it is categorized as insignificant negative impact.

4) *Intesity of impacts*

   The increase of pH in surface and groundwater close to the drilling location is relatively low and therefore, based on the intensity of impacts, it is categorized as insignificant negative impact.

5) *Number of impacted environmental components*

There is no derivative impacts of pH increase. It is therefore categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

The impacts are not continuous, hence are not considered as cumulative. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

The TDS contents in water catchment areas will be reversed naturally. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impacts of well drilling and production test on pH are categorized as ***insignificant negative impact (-IS)***.

5.2.2 Biological components

5.2.2.1 Species compositions and protected species

Land preparation during construction stage includes cutting trees and land clearing, which causes loss of vegetation cover. Consequently this reduces the numbers and types of vegetation in the project area.

Loss of vegetation has economical and ecological impacts. The economical impacts include loss of tree species, and community crops in plantation area and mixed forest. The ecological impacts include disturbance of forest functions i.e. water management and hydrological functions that support Batang Toru River. The area covered by such functions is relatively small compared to the whole forest area. The forest area is also wildlife habitat where loss of vegetation coverage causes a decrease in the number of wildlife.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

The impacts of land preparation to species compositions and protected species have no direct consequences on human due to the extent of wider forest area nearby. Local communities in the project area do not high dependency upon non-timber products. Therefore, based on the number of impacted persons it is categorized as insignificant negative impact.

2) *Impacted area*

The project will utilize an area of area coverage is expected to be approximately 115 hectares in which 12 ha will be cleared for power plant construction. Uncovered parts of land are exiting access roads and well pads. Hence, new activities are unlikely to impact existing flora habitat. Therefore, based on the impacted area it is considered as insignificant negative impact.

3) *Duration of impacts*

The impact only occurs during the construction stage and therefore, based on the duration of impacts, it is categorized as insignificant negative impact.

4) *Intesity of impacts*

Area to be cleared is relatively small which covers mixed community plantation area and forest, and bushes. Therefore, based on the intensity of impacts, it is categorized as insignificant negative impact.

5) *Number of impacted environmental components*

Land preparation in the wildlife habitat area is anticipated to have an impact. However, the area is not the primary or the only wildlife habitat. Furthermore, it is of relatively small coverage. It is therefore categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

The impacts are not continuous, hence are not considered as cumulative. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

Change of vegetation will recover once the construction stage is completed by undertaking rehabilitation and reclamation process. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impacts of land preparation on species compositions and protected species are categorized as ***insignificant negative impact (-IS)***.

5.2.2.2 Abundances of plankton and benthos

The impacts on of abundances of plankton and benthos are related to the decrease of water quality in Batang Toru River. The reduction of water quality is caused by an increase of TSS concentrations and turbidity level resulting from land preparation activity.

Higher level of TSS concentrations and turbidity level may disrupt aquatic biota photosynthesis (particularly phytoplankton) which consequently decreases the abundances of plankton and benthos.

It is predicted that the erosion level in the area (using the USLE method) ranges between 40-1900 tonne/year. During the construction stage, the erosion level may increase to between 2370-4393 tonne/year. With the predicted increase of erosion rate, TSS concentrations are expected to increase as well which are then affects the abundances of plankton and benthos.

The decrease of plankton and benthos population which is a food source for fishes in Batang Toru River will naturally reduce fish population. The reduction of fish population will also be affected by an increase of TSS concentrations.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

   The impacts of land preparation to aquatic biota have no direct consequences on human. Therefore, based on the number of impacted persons it is categorized as insignificant negative impact.

2) *Impacted area*

   The project will utilize an area of area coverage is expected to be approximately 115 hectares. Uncovered parts of land are exiting access roads and well pads. Hence, new activities are unlikely to impact existing aquatic biota. Therefore, based on the impacted area it is considered as insignificant negative impact.

3) *Duration of impacts*

   The impact only occurs during the construction stage and therefore, based on the duration of impacts, it is categorized as insignificant negative impact.

4) *Intensity of impacts*

   In relation to the number of impacted persons and impacted area, the intensity of impacts is categorized as insignificant negative impact.

5) *Number of impacted environmental components*

   There is no derivative impacts of abundances of plankton and benthos. Furthermore, it is of small intensity and short duration. It is therefore categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

The impacts are not continuous, hence are not considered as cumulative. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

Change of aquatic biota habitat will recover once the construction stage is completed by undertaking rehabilitation and reclamation process. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impact of land preparation on abundances of plankton and benthos is categorized as ***insignificant negative impact (-IS)***.

5.2.3 Socio-economic and socio-cultural components

5.2.3.1 Job opportunities

It is anticipated that the construction activities will involve approximately 1,410 persons during a 4 year period. The workforce requirements are (i) 150 persons for geothermal field construction activity; (ii) 1,200 persons for power plant construction; and (iii) 60 persons for construction of transmission line and tower. The company will recruit employees who fulfill company's requirements, as much as possible, from the nearby villages.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

The construction activities will provide job opportunities for 1,410 persons. Fifty percents of the total workforce is predicted to be fulfilled by local workers. There were 4,506 registered job seekers in the study area (North Tapanuli Regency) whereby 12% would have employment opportunities. Therefore, based on the number of impacted persons it is categorized as significant positive impact.

2) *Impacted area*

Areas with opportunities for job opportunities from construction activities are those around the project area. This means the opportunities will cover a relatively considerable area. Therefore, based on the impacted area it is considered as significant positive impact.

3) *Duration of impacts*

The impact occurs during the construction stage and therefore, based on the duration of impacts, it is categorized as significant positive impact.

4) *Intensity of impacts*

A 12% additional job in North Tapanuli Regency will consequently change community income which then increase community welfare and improve social conditions. Therefore, based on the intensity of impact, it is categorized as significant positive impact.

5) *Number of impacted environmental components*

Derivative impacts of additional job opportunities are an increase of community income, which will consequently improve community welfare. Therefore, it is categorized as significant positive impact.

6) *Cumulative nature of impacts*

Recruitment will be a repetitive and continous procuess during the construction stage. Based on the cumulative nature of impacts it is categorized as significant positive impact.

7) *Reversibility of impacts*

Once the construction stage is completed, a vast of numbers will be released. However, the workers will acquire invaluable work experience from the project and a smaller number will have the opportunity to be involved in the operation stage. Therefore, based on the reversibility of impacts, it is considered as insignificant positive impact.

In conclusion, the impact of workforce recruitment on job opportunities is categorized as ***significant positive impact (+S)***.

5.2.3.2 Business opportunities

As there will be 1,410 additional workers, there will also be further business opportunities particularly in terms of food stalls, restaurants, grocery stores and transportation services.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

Construction activities will offer job opportunities for 1,410 persons, and increase the business opportunity, in particular for providing stall and restaurant, groceries shops which provide daily needs, and transportation service. However, it is expected that there will only be limited number of people able to run such businesses and therefore, based on the number of impacted persons it is categorized as insignificant positive impact.

2) *Impacted area*

Business opportunities will reach further than surrounding project area particularly in terms of materials, equipment, and services from Medan, Jakarta and other places. Therefore, based on the impacted area it is considered as significant positive impact.

3) *Duration of impacts*

The impact occurs during the construction stage and therefore, based on the duration of impacts, it is categorized as significant positive impact.

4) *Intensity of impacts*

An increase of business opportunities will consequently change community income which then increase community welfare and improve social conditions. Therefore, based on the intensity of impact, it is categorized as significant positive impact.

5) *Number of impacted environmental components*

Derivative impact of additional business opportunities is an increase of community income, which will consequently improve community welfare. Therefore, it is categorized as significant positive impact.

6) *Cumulative nature of impacts*

At least for the four years of construction stage which is considered as sufficient, there will be more and more business opportunities. Based on the cumulative nature of impacts it is categorized as significant positive impact.

7) *Reversibility of impacts*

It is anticipated that not all of businesses started during the construction stage will remain. Some will have further opportunities to start new businesses in other areas equipped with enhanced knowledge and capital. Therefore, based on the reversibility of impacts, it is considered as insignificant positive impact.

In conclusion, the impact of workforce recruitment on business opportunities is categorized as ***significant positive impact (+S)***.

5.2.3.3 Community income

Workforce recruitment during the construction stage will include 1,410 persons for the 4 year duration. The workforce will be SOL employees but the majority will be contractors' workforce. Such additional workers, will also create further business opportunities particularly in terms of food stalls, restaurants, grocery stores and transportation services. Further job and businesses opportunities will benefit community income through direct

income as SOL or contractors' employees, and as entrepreneurs supporting construction activities and its employees.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

   Construction activities will offer job opportunities for 1,410 persons, and increase the business opportunity, in particular for providing stall and restaurant, groceries shops which provide daily needs, and transportation service. Business opportunities can be in forms of new business or increased capacity which may be in a modest number but will still create secondary business opportunities. Therefore, based on the number of impacted persons it is categorized as significant positive impact.

2) *Impacted area*

   Areas with the most potential to create business opportunities are villages around the project area. Therefore, based on the impacted area it is considered as significant positive impact.

3) *Duration of impacts*

   The impact will occur during the construction stage i.e. a 4 year duration and therefore, based on the duration of impacts, it is categorized as significant positive impact.

4) *Intensity of impacts*

   Due to its influence to increase community income, the impact is considered as significant positive. Therefore, based on the intensity of impact, it is categorized as significant positive impact.

5) *Number of impacted environmental components*

   Higher community income will consequently improve community welfare. Therefore, it is categorized as significant positive impact.

6) *Cumulative nature of impacts*

   Increased community income will last for the construction stage i.e. 4 years which is considered as cumulative during that period. Based on the cumulative nature of impacts it is categorized as significant positive impact.

7) *Reversibility of impacts*

   It is anticipated that once the construction stage is completed, the majority of workforce will be released and not all of businesses started during the construction stage will survive. However, the workers will acquire invaluable work experience from the project and a smaller

number will have the opportunity to be involved in the operation stage. Some businesses will have further opportunities to start new businesses in other areas equipped with enhanced knowledge and capital. Therefore, based on the reversibility of impacts, it is considered as insignificant positive impact.

In conclusion, the impact of workforce recruitment on community income is categorized as ***significant positive impact (+S)***.

5.2.3.4 Community unrest

5.2.3.4.1 Workforce recruitment

Community unrest is related to the selection process for construction workers. Community unrest can potentially happen if one feels capable and fulfill the recruitment criteria but not accepted to work, and if the local communities consider that the number of non-local workers recruited is higher than of local workers.

The determination of impacts significance is based on the following significant impacts criteria:

1) Number of impacted persons

Local communities expect employment but not all applications can be accepted. Therefore, based on the number of impacted persons it is categorized as significant negative impact.

2) Impacted area

Community unrest due to workforce recruitment will be limited to areas surrounding the project. Applicants from outside the project area will have greater acceptance in the case of being rejected than those from the nearby villages. Therefore, based on the impacted area it is considered as insignificant negative impact.

3) Duration of impacts

The impact will occur during the construction stage i.e. a 4 year duration and therefore, based on the duration of impacts, it is categorized as significant negative impact.

4) Intensity of impacts

Community unrest can potentially disrupt the construction activities through demonstration, uncooperative attitudes, blockage, and sabotage. Therefore, based on the intensity of impact, it is categorized as significant negative impact.

5) *Number of impacted environmental components*

There is no derivative impacts of community unrest. It is therefore categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

Community unrest will diminish as the construction stage progresses upon realization of reduced opportunities. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

Community unrest is not cumulative and will be reversed with times. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impact of workforce recruitment on community unrest is categorized as ***significant negative impact (-S)***.

5.2.3.4.2 Well drilling and production test

Another potential cause of community unrest is drilling activities due to the possibilities of well blow-up, increased ambient H_2S concentration, noise and spillage of geothermal fluid.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

Based on the previous consultation, local communities nearby the project area i.e. in the districts of Pahae Jae and Pahae Julu are generally concerned about well blow-up, increased ambient H_2S concentration, noise and spillage of geothermal fluid. Therefore, based on the number of impacted persons it is categorized as significant negative impact.

2) *Impacted area*

The concerns are limited to villages close to SIL and NIL. Therefore, based on the impacted area it is considered as insignificant negative impact.

3) *Duration of impacts*

The impact will only occur during the production test and therefore, based on the duration of impacts, it is categorized as insignificant negative impact.

4) *Intensity of impacts*

Community perception towards production test typically comes from sources that cannot be trusted such as rumors from other projects and not based on facts from the field. Therefore, based on the intensity of impact, it is categorized as insignificant negative impact.

5) *Number of impacted environmental components*

There is no derivative impacts of community unrest. It is therefore categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

Community unrest will diminish as the production test is completed. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility nature of impacts*

Once the production test ends, community unrest is expected to end. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impact of well drilling and production test on community unrest is categorized as ***significant negative impact (-S)***.

5.2.3.4.3 Installation of transmission line

Installation of transmission line can potentially cause community unrest due to land acquisition and disturbance during the construction of transmission line.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

The length of the transmission line is approximately 15km, passing through a number of different villages. Therefore, based on the number of impacted persons it is categorized as significant negative impact.

2) *Impacted area*

Due to the length of transmission line, coverage of the affected area is considerable. Therefore, based on the impacted area it is considered as significant negative impact.

3) *Duration of impacts*

The impact will only occur during the installation of transmission line and therefore, based on the duration of impacts, it is categorized as insignificant negative impact.

4) *Intensity of impacts*

Considering the significance of the number of impacted person and the impacted area, based on the intensity of impact, it is categorized as significant negative impact.

5) *Number of impacted environmental components*

Derivative impacts of the transmission line installation are (a) reduced land value and (b) reduced land productivity. However, the derivative impacts are considered as limited. It is therefore categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

The impact will only occur during the installation of transmission line, which considered as not cumulative. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

Community unrest can be managed by providing fair compensation and intensive consultation. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impact of installation of transmission line on community unrest is categorized as ***significant negative impact (-S)***.

5.2.3.5 Ground traffic disturbance

Mobilization of equipment and materials will increase ground traffic disturbance along the road leading to the project area. Main equipment and materials such as turbines, generators, transformers, pumps, motors, steel structure for construction, etc will be transported through Belawan Port. Other equipment and materials such as welding machines, grinding machines, cutting machines, bricks, concrete, etc will be transported through Sumatera Highways (Medan-Tarutung).

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

Mobilization of equipment and materials will affect road users along the road leading to the project area and those who live along the route. Therefore, based on the number of impacted persons it is categorized as significant negative impact.

2) *Impacted area*

The impacted area is areas along the route to mobilize equipment and materials, particularly close to the project location. Therefore, based on the impacted area it is considered as significant negative impact.

3) *Duration of impacts*

Each mobilization of equipment and materials will take 3 months. Therefore, based on the duration of impacts, it is categorized as insignificant negative impact.

4) *Intesity of impacts*

Mobilization includes heavy and extensive number of equipment and materials, and therefore journey progress will be slow. Considering the significance of the number of impacted person and the impacted area, based on the intensity of impact, it is categorized as significant negative impact.

5) *Number of impacted environmental components*

Derivative impacts of higher volume of traffic are delayed for other road users and increased risk of traffic accidents. It is therefore categorized as significant negative impact.

6) *Cumulative nature of impacts*

Ground traffic disturbance is not considered to be cumulative but only affects certain periods of time. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

Community unrest ends once traffic disturbance stops as the mobilization of equipment and materials activity is completed. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impact of mobilization of equipment and materials on ground traffic disturbance is categorized as ***significant negative impact (-S)***.

5.2.4 Public health components

5.2.4.1 Morbidity

Morbidity is due to mobilization of equipment and materials, and well drilling and production test. The activities can potentially increase the prevalence of airborne illnesses such as upper respiratory infections (*Infeksi Saluran Pernapasan Atas - ISPA*).

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

   Mobilization of equipment and materials will be conducted during non-peak hour period (night time) and therefore, the impacts to road users and communities along the route are predicted to be relatively small. Based on the number of impacted persons it is categorized as insignificant negative impact.

2) *Impacted area*

   The impacted area is along the route where equipment and materials will be transported, particularly close to the project area. Based on the coverage, the impacted area on morbidity is relatively small and therefore, it is considered as insignificant negative impact.

3) *Duration of impacts*

   Each mobilization of equipment and materials will take 3 months. Therefore, based on the duration of impacts, it is categorized as insignificant negative impact.

4) *Intesity of impacts*

   The increase of ambient TSP concentration due to equipment and material mobilization is predicted to be below the threshold limit of 230 $\mu g/m^3$. Thus, based on the intensity of impacts it is considered as insignificant negative impact.

5) *Number of impacted environmental components*

   No derivative impacts of morbidity on other environmental components. It is therefore categorized as significant negative impact.

6) *Cumulative nature of impacts*

   Ground traffic disturbance is not considered to be cumulative but only affects certain periods of time. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

   Morbidity due to equipment and materials mobilization will stop once the activity is completed. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impact of mobilization of equipment and materials on morbidity is categorized as ***insignificant negative impact (-IS)***.

5.3 OPERATION STAGE

5.3.1 Geophysical and chemical components

5.3.1.1 H_2S

Operational stage of geothermal power plant can cause significant impacts to air quality due to its H_2S emissions. High level of ambient H_2S concentrations affects human health and the environment. Steam from SIL and NIL is exploited from a geothermal reservoir. The steam is separated into steam and brine which will then sent to the power plants to generate electricity. Before the steam is sent to the turbine, it is purified in a separator to maintain a dryness of ±99.95% and non condensable gas (NCG) contents of ±2.1% weight in SIL and ±3.7% in NIL. The NCG consists of less than 1% of H_2S[3].

SOL commissioned a modeling study to predict H_2S concentrations in ambient air in order to predict the impacts of Sarulla Geothermal Plants[4] to air quality. The model was used to predict H_2S concentrations at SIL and NIL. The predicted concentrations were compared to the H_2S odor standard of 0.02 ppm specified in Minister of Environment Decree No. 50 of 1996 (Kep-50/MENLH/11/1996).

The dispersion modeling package ISC-AERMOD View was used in this study. It is a package incorporating popular US EPA (United States Environmental Protection Agency) models such as ISCST3, ISC-PRIME and AERMOD. The model is used extensively to assess pollution concentration from industrial sources. This dispersion modeling package required meteorological data representing the study area. The data from Aek Godang/Padang Sidempuan meteorological station was used due to its proximity to NIL and SIL geothermal fields and data availability[5]. The package is also supported by WRPLTView program that generates wind rose statistics (see **Figure V-1**), frequency tables and graphs for a wide variety of surface data file formats, and for the ISC pre-processed meteorological data file.

[3] Other gases are CO_2 (96-97%) along with N_2, CH_4, O_2, H_2, Ar, He in trace quantities.
[4] The modeling was undertaken by LAPI-ITB (*Lembaga Afiliasi Penelitian Indonesia – Institut Teknologi Bandung*).
[5] Indonesian Meteorology and Geophysics provided a list of meteorological stations in North Sumatra with data availabilities. The nearest meteorological station to NIL and SIL geothermal fields is Tarutung but in 2008 no data (0%) was available

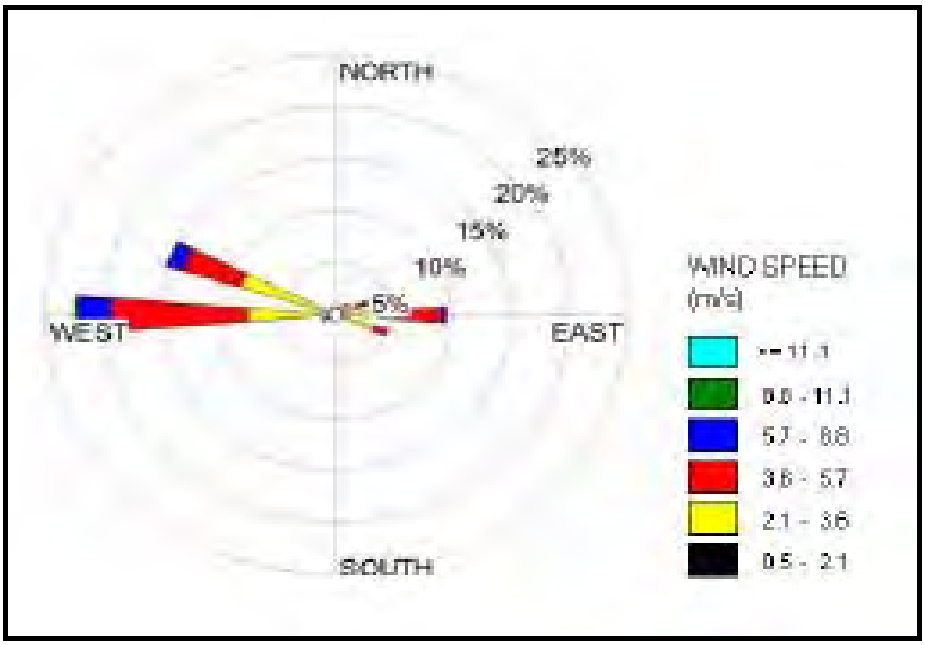


Figure V-1 Aek Godang Wind Rose

As no geothermal production wells were in place when the modeling took place, there were a number of assumptions incorporated into the model to predict the amount of H_2S that would be emitted at the operational phase. Data inputted into the model are shown in **Table V-1**.

Table V-1 Input data to model H_2S ambient concentrations

Data	Unit	SIL	NIL	Note
Air flow per fan	m^3/s	103.38	115.67	
Exhaust air temperature per fan	^0C	39.00	38.90	
H_2S density	g/m^3	1,327.39	1,327.81	At exhaust air temperature condition
Ejection speed per fan	m/s	5.61	6.25	Used as H_2S velocity when emitted from the point source
Outlet diameter	m	5.00	5.00	Typical for all outlet
Outlet height	m	7.50	7.50	Typical for all outlet
Outlet position above mean sea level	m	915	940	
H_2S emission volume	m^3/s	0.03	0.18	Based on H_2S premises calculation data
Number of emission sources		240	504	Blue frame in Figure V-2 and Figure V-3
H_2S emission volume per emission source	m^3/s	0.000125	0.000357	H_2S emission volume divided by number of fan
H_2S emission rate per emission source	g/s	0.1659	0.4742	H_2S emission volume per emission source multiplied by H_2S density
H_2S emission rate per emission source	$\mu g/m^3$	6.7	8.1	H_2S emission volume

Figure V-2 H_2S emission source at SIL (green line)

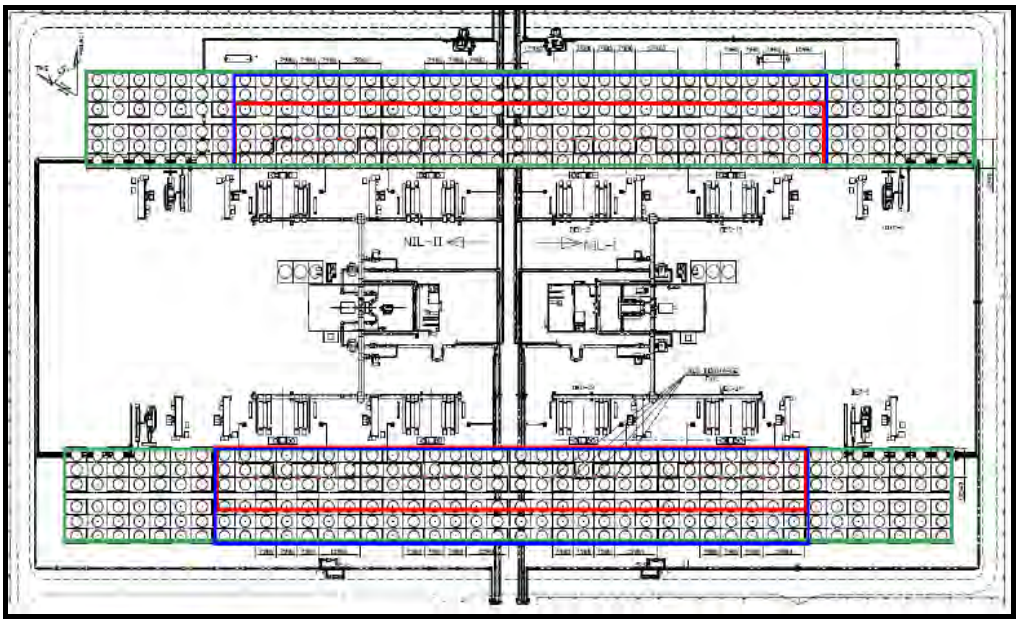


Figure V-3 H_2S emission source at NIL (green line)

H_2S concentrations were predicted at 100 receptor points around SIL and NIL as shown in **Figure V-4**.

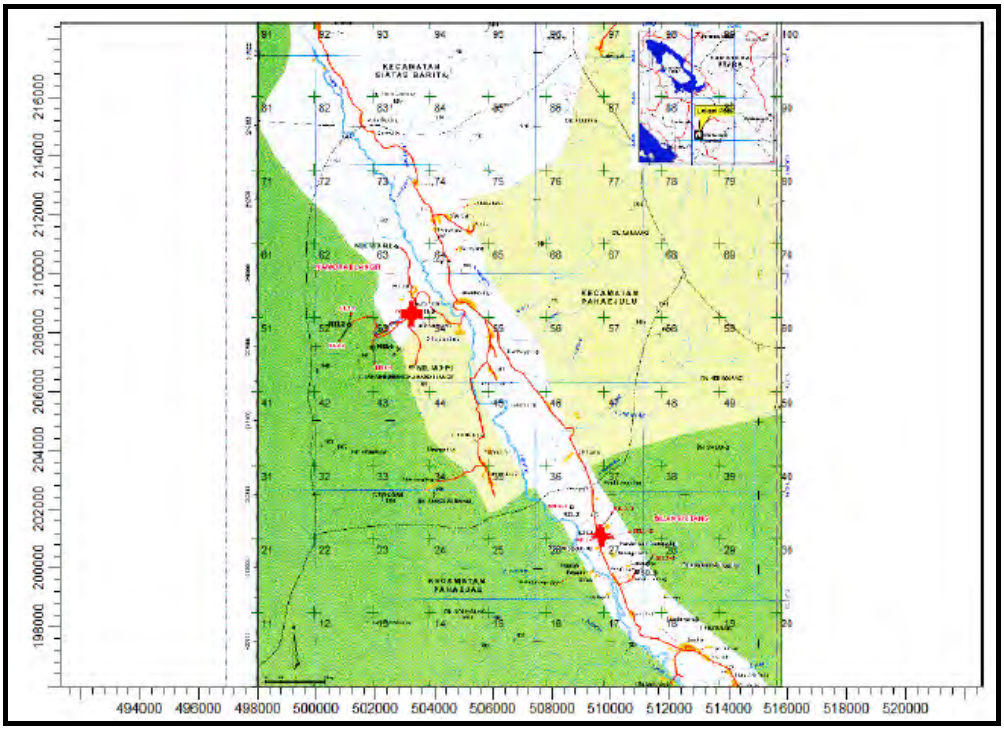


Figure V-4 Receptor points in SIL and NIL

The modeling output using ISC-AERMOD View Model presented in **Figure V-5** as isopleths. According to the model, the annual average H_2S concentration in ambient air is 0.02067 (which is equal to the standard of 0.02 ppm).

It is difficult to determine the amount of H_2S emission in NCG before conducting wells drilling and flow tests measurement. Therefore, the predicted H_2S concentrations displayed in the SIL and NIL isopleths above may vary when all production wells are in operating. H_2S concentrations will be monitored in accordance with the Environmental Management Plan during the operation stage.

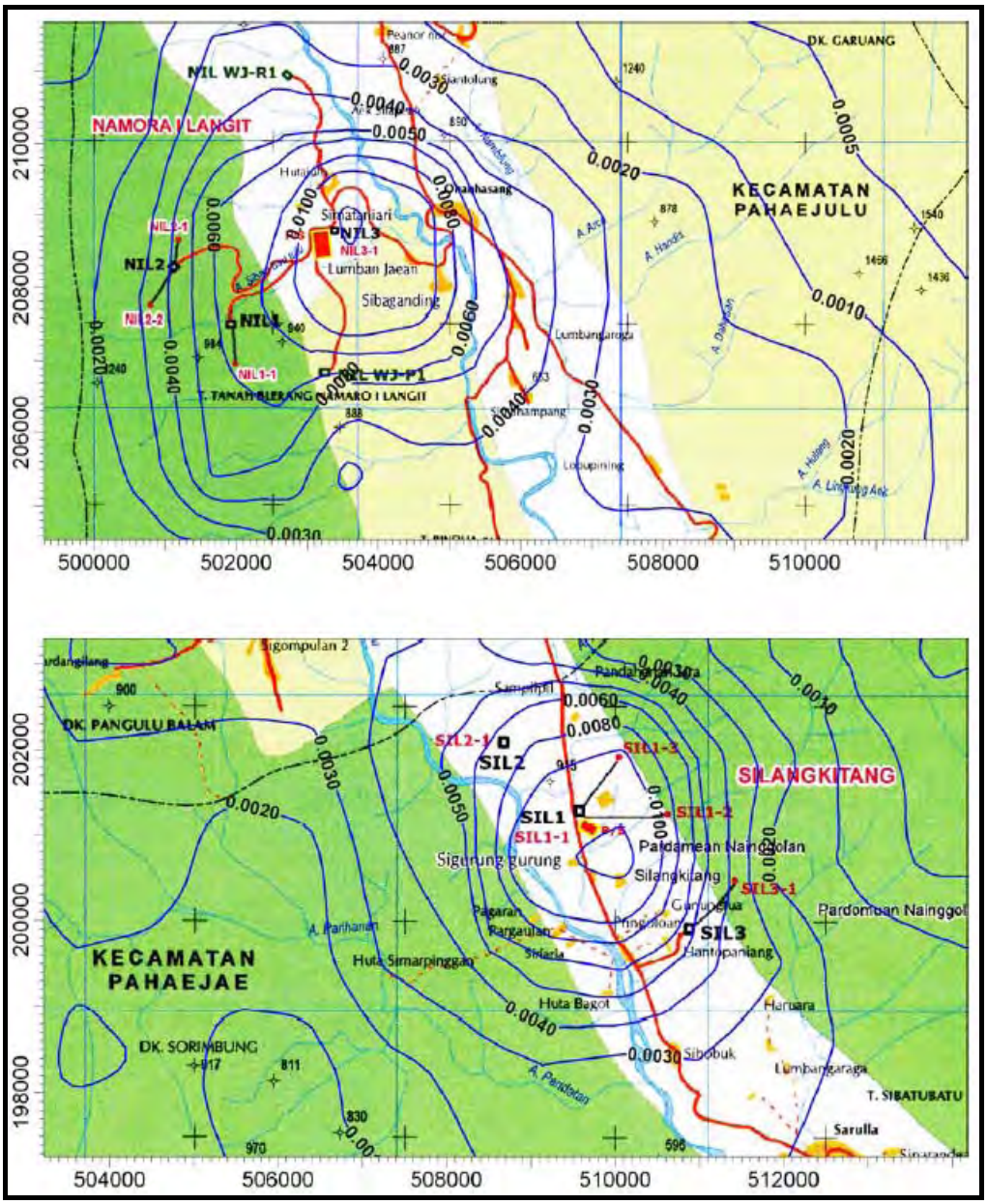


Figure V-5 Predicted H_2S concentration (annual average,) at NIL (above) and SIL (below)

Source: H_2S modelling by LAPI-ITB, May 2009

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

The number of households within 500 m radius from SIL was 70 houses. One house was typically occupied by 5 people. Thus the estimated population most likely to be affected by H_2S arising from the activity in SIL would be less than 350 people. At NIL, the nearest villages were located about 1,000 m from the wells. Population in the villages was around 1,560. Compared to the total population in the study area, the number of people that could potentially be affected was relatively small.

Therefore, based on the number of impacted persons, it is categorized as considered as insignificant negative impact.

2) *Impacted area*

H_2S concentration above the odor standard of 0.02 ppm was predicted at some distances from the proposed geothermal power plants for short periods of time. At SIL, the highest predicted H_2S concentration was at 142 m from the power plant. At NIL, the highest predicted H_2S concentration was located at 638 m distance from the power plant. Therefore, based on the impacted area, it is categorized as insignificant negative impact.

3) *Duration of impacts*

The impact will occur during the operation stage i.e. 30 years. Based on the duration of impacts, it is categorized as significant negative impact.

4) *Intensity of impacts*

The intensity of impact from H_2S concentration is determined based on the odor and its impacts to public health. At SIL, H_2S concentration was predicted to occur 18% in a year, while at NIL, the prediction was 45% in a year. Based on the modeling outcomes, it is categorized as significant negative impact.

However, as stated previously, the actual H_2S concentration may be lower than predicted after the drilling activity is completed. The predicted H_2S concentration will not cause any interference to human health in the vicinity of the power plants since it is far below the concentration that can cause health disturbances (Threshold Limit Value is 10 ppm for a maximum of 8 hours exposure) prescribed in the Minister of Manpower Letter No. SE-01/MEN/1997 Ambient Threshold Limit of Chemical Factors in the Working Environment. Therefore, from the public health point of view, it is categorized as insignificant negative impact.

5) *Number of impacted environmental components*

There is no derivative impact of H_2S emission in the air. Therefore, based on the number of impacted environmental components, it is categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

H_2S will be dispersed onto the air and therefore will not be accumulated. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

H_2S emissions will be dispersed onto the air and the concentration will be reduced as the operation stage is terminated. Therefore, based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impact of power plant operation on H_2S ambient concentration is categorized as ***significant negative impact (-S)***.

5.3.1.2 Noise

Noise measurements in the project area showed a range of 32-44 dBA. Noise level is expected to increase during the operation stage and at sampling points close to the project area, noise level will most likely be higher than 55 dBA but still below the regulatory limit for industrial area i.e. 70 dBA.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

The number of households within 500 m radius from SIL was 70 houses. One house was typically occupied by 5 people. Thus the estimated population most likely to be affected by H_2S arising from the activity in SIL would be less than 350 people. At NIL, the nearest villages were located about 1,000 m from the wells. Population in the villages was around 1,560. Compared to the total population in the study area, the number of people that could potentially be affected was relatively small. Therefore, based on the number of impacted persons, it is categorized as considered as insignificant negative impact.

2) *Impacted area*

The impacted area is limited to villages near the project area. Thus, based on the impacted area, it is categorized as insignificant negative impact.

3) *Duration of impacts*

The impact will occur during the operation stage i.e. 30 years. Based on the duration of impacts, it is categorized as significant negative impact.

4) *Intensity of impacts*

The power plant is designed to comply with the applicable noise standard. One of the sources of noise during the operation stage is steam blowing which conducted when new production wells are added. During this activity noise level is anticipated to reach 130 dBA. Therefore, based on the intensity of impacts, it is categorized as significant negative impact.

5) *Number of impacted environmental components*

At SIL, high noise level will only impact human but wildlife will also be affected at NIL. Due to the potential disturbance to wildlife, it is categorized as significant negative impact.

6) *Cumulative nature of impacts*

High noise level will only occur intermittently and therefore not considered as cumulative. Therefore, based on the cumulative nature of impacts, it is considered as insignificant negative impact.

7) *Reversibility of impacts*

Noise generation will cease as the operation stage is completed. Therefore, based on the reversibility characteristics, it is categorized as insignificant negative impact.

In conclusion, the impact of power plant operation on ambient noise level is categorized as ***significant negative impact (-S)***.

5.3.1.3 Water quality

5.3.1.3.1 TDS and dissolved metals

a. Condensate and brine reinjection

Re-injection of condensate and brine can potentially increase TDS concentration in surface water around the power plant, which can happen in the case of re-injection casing leakage where parts of brine and condensate are absorbed into shallow water bodies and eventually into Batang Toru River.

Another source of additional TDS concentration is brine temporary reservoir which will be used in emergency situation e.g. re-injection failure. Brine will be then transferred into re-injection wells. In the reservoir, brine fractions that contain dissolved metals such as boron and arsenic may enter the water bodies through surface water run-off or reservoir leakage, and consequently increase TDS concentrations.

PPSDAL USU laboratory analysis results revealed that TDS contents in Batang Toru River ranged between 114–138 mg/L. Surface water run-off as discussed above will potentially increase TDS contents in Batang Toru River. However, the increase is not anticipated to be of significance and the TDS contents will not exceed the standard of 1000 mg/L for the Class II water quality (based on Government Regulation No. 82/2001).

Nevertheless, the possibility of leakage from re-injection wells and temporary reservoir the casing and the reservoir are specifically designed to prevent leakage.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

   The impacts of re-injection to TDS contents have no direct consequences on human. Therefore, based on the number of impacted persons it is categorized as insignificant negative impact.

2) *Impacted area*

   Re-injection is to be conducted at SIL and NIL with the nearest Batang Toru River catchment and community wells nearby as the only directly impacted areas. Therefore, based on the impacted area it is considered as insignificant negative impact.

3) *Duration of impacts*

   The impacts are not continuous during the operation stage but very infrequent at times of well casing and reservoir leakage during re-injection. Therefore, based on the duration of impacts it is categorized as insignificant negative impact.

4) *Intesity of impacts*

   The increase of TDS in surface water close to re-injection wells is relatively low and therefore, based on the intensity of impacts, it is categorized as insignificant negative impact.

5) *Number of impacted environmental components*

   There is no derivative impacts of TDS contents. Furthermore, it is of small intensity and short duration. It is therefore categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

   The impact is not continuous hence, not considered as cumulative. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

   The TDS contents in water catchment areas will be reversed naturally. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impact of power plant operation on TDS and metal contents is categorized as ***insignificant negative impact (-IS)***.

b. pH

Re-injection has the potential to increase surface water pH in area close to drilling location i.e. to become alkaline (pH>7). PPSDAL USU laboratory analysis results revealed that pH range of Batang Toru River is between 6.8-7.1, which meet the requirements of Class II water quality (based on Government Regulation No. 82/2001).

Surface water run-off and absorption of condensate and brine can potentially increase the pH of Batang Toru River. However, the increase is anticipated not to exceed the threshold of water quality standard i.e. 9.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

   The impacts power plant operation to pH have no direct consequences on human. Therefore, based on the number of impacted persons it is categorized as insignificant negative impact.

2) *Impacted area*

   Re-injection is to be conducted at SIL and NIL with the nearest Batang Toru River catchment and community wells nearby as the only directly impacted areas. Therefore, based on the impacted area it is considered as insignificant negative impact.

3) *Duration of impacts*

   The impacts are not continuous during the operation stage but very infrequent at times of well casing and reservoir leakage during re-injection. Therefore, based on the duration of impacts it is categorized as insignificant negative impact.

4) *Intesity of impacts*

   The increase of pH in surface water close to re-injection wells is relatively low and therefore, based on the intensity of impacts, it is categorized as insignificant negative impact.

5) *Number of impacted environmental components*

   There is no derivative impacts of pH increase. Furthermore, it is of small intensity and short duration. It is therefore categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

   The impact is not continuous hence, not considered as cumulative. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

High level of pH in catchment areas will be reversed naturally. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impact of power plant operation on pH is categorized as ***insignificant negative impact (-IS)***.

5.3.1.4 *Exposure of electromagnetic field*

Electricity generated by SIL and NIL power plants will be transmitted to PLN transmission network. This can potentially create electromagnetic field.

Measurements of electromagnetic field at PLN transmission line in Padang Sidempuan with 275 kV were conducted in August 2007. The measurements were conducted at 1.4 m above ground, started from the middle point between two towers then at 20 m distance to the east and at 20 m distance to the west parallel to the towers. Measurement interval was every 2 m. The distance between measurement point and community household was approximately 20 m. Measurements indicated that the electric field ranged from 52.6 to 17.6 V/m whilst the magnetic field ranged from 35.8 to 23.2 mA/m. The measurements showed that the electric and magnetic field were below the thresholds recommended by IRPA and WHO[6]. Therefore, the transmission line planned for Sarulla, which is at a lower voltage i.e. 150 kV, is anticipated to meet the thresholds.

In addition, based on research presented in *Elektro Indonesia* Bulletin edition No. 32/VI/August 2000, the electromagnetic field from transmission line is classified as extremely low frequency with very low capability to move energy, hence incapable to influence chemical bonds in human cells. Human cells have electrical field of 10 million V/m which is stronger than external electric field.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

Installation of transmission line is far from residential areas to limit the number of persons impacted. Therefore, based on the number of impacted persons, it is categorized as insignificant negative impact.

[6] Currently Indonesia does not have exposure limit standards to electromagnetic fields from transmission lines. Reccomendations from International Radiation Protection Association (IRPA), and WHO 1990 are used for exposure limits to electromagnetic fields from frequency 50 to 60 Hz. According to both organizations, limits for continous exposure to general community are 5 kV/m for electric field and 0,1 mT for magnetic fields.

2) *Impacted area*

Installation of transmission line is far from residential areas. Therefore, based on the impacted area, it is categorized as insignificant negative impact.

3) *Duration of impacts*

Electromagnetic field will be radiated during transmission line operating period. Considering the low intensity and the distance to residential areas, based on the duration of impacts, it is categorized as insignificant negative impact.

4) *Intensity of impacts*

Electromagnetic field from 150 kV transmission line is considered as extremely low frequency. Therefore, based on the intensity of impacts, it is categorized as insignificant negative impact.

5) *Number of impacted environmental components*

There is no derivative of electromagnetic field to public health. Therefore, based on the number of impacted environmental components, it is categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

Transmission line route will not pass residential areas. Hence, no impact to public health and not considered as cumulative. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact

7) *Reversibility of impacts*

Electromagnetic field impact from transmission line is extremely low and no capability to influence chemical bonds in human cells. Therefore, based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impact of power plant operation on exposure of electromagnetic field is categorized as ***insignificant negative impact (-IS)***.

5.3.2 Socio-economic and socio-cultural components

5.3.2.1 Job opportunities

Workforce recruitment in the operation stage is much smaller than in the construction stage because the operation stage requires skilled workers. Opportunities are available for 250 persons.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

   The power plant operation will create job opportunities for 250 persons. Out of the 4,650 job seekers in the area, it is anticipated that 30-50% workforce who meet company's requirements will be from the vicinity of the project area. Therefore, based on the number of impacted persons it is categorized as significant positive impact.

2) *Impacted area*

   Areas with additional job opportunities from the power plant operation are 7 villages, which mean a relatively wide coverage area. Based on the impacted area it is considered as significant positive impact.

3) *Duration of impacts*

   The power plant operational period is 30 years. Therefore, based on the duration of impacts it is categorized as significant positive impact.

4) *Intensity of impacts*

   Additional job opportunities in the project area will change the level of income of communities' in the surrounding area, which consequently will change the level of community welfare and social status. Therefore, based on the intensity of impacts, it is categorized as significant positive impact.

5) *Number of impacted environmental components*

   Derivative impacts of having additional job opportunities are changes in the level of income, which will bring better community welfare. Therefore, based on the number of impacted environmental components, it is categorized as significant positive impact.

6) *Cumulative nature of impacts*

   The recruitment process will be repeated throughout the operation stage and therefore, based on the cumulative nature of impacts, it is categorized as significant positive impact.

7) *Reversibility of impacts*

   Once the operation stage is completed, significant number of workforce will be released. However, the workers will gain invaluable experience from the project. Based on the reversibility of impacts, it is categorized as insignificant positive impact.

In conclusion, the impact of workforce recruitment on job opportunities is categorized as ***significant positive impact (+S)***.

5.3.2.2 Business opportunities

Additional job opportunities will also create further business opportunities particularly in terms of accommodation, food stalls, restaurants, and grocery stores.

The determination of impacts significance is based on the following significant impacts criteria:

1) Number of impacted persons

Power plant operation activities will offer job opportunities for 250 persons, and increase the business opportunity, in particular for providing stall and restaurant, groceries shops which provide daily needs, and transportation service. However, it is expected that there will only be limited number of people able to run such businesses and therefore, based on the number of impacted persons it is categorized as insignificant positive impact.

2) Impacted area

Business opportunities will reach further than surrounding project area particularly in terms of materials, equipment, and services from Medan, Jakarta and other places. Therefore, based on the impacted area it is considered as significant positive impact.

3) Duration of impacts

Business opportunities will be available throughout the operation stage and therefore, based on the duration of impacts, it is categorized as significant positive impact.

4) Intensity of impacts

An increase of business opportunities will consequently change community income which then increase community welfare and improve social conditions. Therefore, based on the intensity of impact, it is categorized as significant positive impact.

5) Number of impacted environmental components

Derivative impact of additional business opportunities is an increase of community income, which will consequently improve community welfare. Therefore, it is categorized as significant positive impact.

6) Cumulative nature of impacts

Business opportunities will remain available during the operation stage which is a 30 year period. Based on the cumulative nature of impacts it is categorized as significant positive impact.

7) *Reversibility of impacts*

It is anticipated that not all of businesses started during the operation stage will remain. Some will have further opportunities to start new businesses in other areas equipped with enhanced knowledge and capital. Therefore, based on the reversibility of impacts, it is considered as insignificant positive impact.

In conclusion, the impact of workforce recruitment on business opportunities is categorized as ***significant positive impact (+S)***.

5.3.2.3 Community income

Additional job opportunities create further business opportunities particularly in terms of accommodation, food stalls, restaurants, grocery stores and transportation services. Further job and businesses opportunities will benefit community income through direct income as SOL or contractors' employees, and as entrepreneurs supporting construction activities and its employees.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

The operation stage will offer job opportunities for 250 persons, and increase the business opportunity, in particular for providing stall and restaurant, groceries shops which provide daily needs, and transportation service. Business opportunities can be in forms of new business or increased capacity which may be in a modest number but will still create secondary business opportunities. Therefore, based on the number of impacted persons it is categorized as significant positive impact.

2) *Impacted area*

Areas with the most potential to create business opportunities are villages around the project area. Therefore, based on the impacted area it is considered as significant positive impact.

3) *Duration of impacts*

The power plant operational period is 30 years. Therefore, based on the duration of impacts it is categorized as significant positive impact.

4) *Intensity of impacts*

Due to its influence to increase community income, the impact is considered as significant positive. Therefore, based on the intensity of impact, it is categorized as significant positive impact.

5) *Number of impacted environmental components*

Higher community income will consequently improve community welfare. Therefore, it is categorized as significant positive impact.

6) *Cumulative nature of impacts*

Increased community income will last for the operation stage i.e. 30 years which is considered as cumulative during that period. Based on the cumulative nature of impacts it is categorized as significant positive impact.

7) *Reversibility of impacts*

It is anticipated that once the operation stage is completed, the majority of workforce will be released and not all of businesses started during the operation stage will survive. However, the workers will acquire invaluable work experience from the project. Some businesses will have further opportunities to start new businesses in other areas equipped with enhanced knowledge and capital. Therefore, based on the reversibility of impacts, it is considered as insignificant positive impact.

In conclusion, the impact of workforce recruitment on community income is categorized as ***significant positive impact (+S)***.

5.3.2.4 Community unrest

5.3.2.4.1 Workforce recruitment

Community unrest is related to the selection process for construction workers, which requires skilled workers. Community unrest can potentially happen if one feels capable and fulfill the recruitment criteria but not accepted to work, and if the local communities consider that the number of non-local workers recruited is higher than of local workers.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

Local communities expect employment but not all applications can be accepted. Therefore, based on the number of impacted persons it is categorized as significant negative impact.

2) *Impacted area*

Community unrest due to workforce recruitment will be limited to areas surrounding the project. Applicants from outside the project area will have greater acceptance in the case of being rejected than those from the

nearby villages. Therefore, based on the impacted area it is considered as insignificant negative impact.

3) *Duration of impacts*

The impact will occur during the operation stage i.e. a 30 year duration and therefore, based on the duration of impacts, it is categorized as significant negative impact.

4) *Intensity of impacts*

Community unrest can potentially disrupt the construction activities through demonstration, uncooperative attitudes, blockage, and sabotage. Therefore, based on the intensity of impact, it is categorized as significant negative impact.

5) *Number of impacted environmental components*

There is no derivative impacts of community unrest. It is therefore categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

Community unrest will diminish as the construction stage progresses upon realization of reduced opportunities. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

Community unrest is not cumulative and will be reversed with times. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impact of workforce recruitment on community unrest is categorized as ***significant negative impact (-S)***.

5.3.2.4.2 High voltage electricity transmission

Community unrest is related to high voltage electricity transmission due to the strength of electromagnetic field which may affect the day to day activities of communities in the project area.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

The transmission line will be built in less populated area and once it is built, there should be no building underneath the transmission line. Therefore, based on the number of impacted persons, it is categorized as significant negative impact.

2) *Impacted area*

Community unrest is limited to areas where the transmission line is built. Therefore, based on the impacted area, it is categorized as insignificant negative impact.

3) *Duration of impacts*

Community unrest is not expected to last during the operation of the transmission line. Therefore, based on the duration of impact, it is categorized as insignificant negative impact.

4) *Intensity of impacts*

Considering that the number of impacted persons and impacted area, based on the intensity of impacts, it is categorized as insignificant negative impact.

5) *Number of impacted environmental components*

There is no derivative impacts of community unrest. It is therefore categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

Community unrest will diminish as the operation stage progresses. Communities will realize that their perception on the negative impacts of electromagnetic radiation is unproven. Therefore, based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

Community unrest can be managed by intensive consultation and therefore, based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impact of high voltage electricity transmission on community unrest is categorized as ***significant negative impact (-S)***.

5.3.3 Public health components

5.3.3.1 Morbidity

Operational stage of geothermal power plant can cause significant impacts to air quality due to its H_2S emissions. High level of ambient H_2S concentrations affects human health and the environment. Steam from SIL and NIL is exploited from a geothermal reservoir. The steam is separated into steam and brine which will then sent to the power plants to generate electricity. Before the steam is sent to the turbine, it is purified in a separator to maintain a

dryness of ±99.95% and NCG contents of ±2.1% weight in SIL and ±3.7% in NIL. The NCG consists of less than 1% of H_2S. Increased of H_2S concentration may decrease public health quality.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

   The number of households within 500 m radius from SIL was 70 houses. One house was typically occupied by 5 people. Thus the estimated population most likely to be affected by H_2S arising from the activity in SIL would be less than 350 people. At NIL, the nearest villages were located about 1,000 m from the wells. Population in the villages was around 1,560. Compared to the total population in the study area, the number of people that could potentially be affected was relatively small. Therefore, based on the number of impacted persons, it is categorized as considered as insignificant negative impact.

2) *Impacted area*

   Emission sources are stacks with 12 m height above ground to prevent wider dispersion of air pollutants. Furthermore, H_2S is dense gas which tends to settle down quickly. Based on these two factors, it is anticipated that H_2S dispersion area will be limited. Thus, it is categorized as insignificant negative impact.

3) *Duration of impacts*

   H_2S will be emitted during the power plant operation period. However, considering that based on air quality modeling, the highest predicted concentration is 0.02 ppm and this indicated no interference to human health in the vicinity of the power plants. The highest predicted concentration is far below the concentration that can cause health disturbances (Threshold Limit Value is 10 ppm for a maximum of 8 hours exposure) prescribed in the Minister of Manpower Letter No. SE-01/MEN/1997 Ambient Threshold Limit of Chemical Factors in the Working Environment. Therefore, it is categorized as insignificant negative impact.

4) *Intesity of impacts*

   The intensity of impact from H_2S concentration is determined based on the odor and its impacts to public health. It was predicted that ambient H_2S concentration during the operation stage would exceed 0.02 pm i.e. the threshold prescribed in Minister of Environment Decree No. 50 of 1996. However, the predicted H_2S concentration will not cause any interference to human health in the vicinity of the power plants since it is far below the concentration that can cause health disturbances

(Threshold Limit Value is 10 ppm for a maximum of 8 hours exposure) prescribed in the Minister of Manpower Letter No. SE-01/MEN/1997 Ambient Threshold Limit of Chemical Factors in the Working Environment. Therefore, based on the intensity of impacts, it is categorized as insignificant negative impact.

5) *Number of impacted environmental components*

There is no derivative impact of H_2S impact on public health. Therefore, based on the number of impacted environmental components, it is categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

H_2S will be dispersed onto the air and therefore will not be accumulated. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

H_2S emissions will be dispersed onto the air and the concentration will be reduced as the operation stage is terminated. Therefore, based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impact of power plant operation on morbidity is categorized as ***insignificant negative impact (-IS)***.

5.4 POST-OPERATION STAGE

5.4.1 Geophysical and chemical components

5.4.1.1 Soil erosion

The main objective of reclamation and rehabilitation is to restore the original functions and land use prior to Sarulla project.

Soil erosion is one of the factors land rehabilitation failure due to loss of soil organic materials and additional fertilizers. These cause inability of plants to grow and suspend the land rehabilitation which can increase environmental burden of the surrounding area. Sediments from fertilized rehabilitation area contain relatively high level of nutrients which will increase enrich the water bodies and consequently impacts aquatic biota and water quality.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

The total population within a 4 km radius in the proximity of the SIL well pad was approximately 780 people. Within a 500 m radius from the

center of SIL, there were approximately 70 houses with an average of 5 persons per house. Thus, potentially there were 350 people benefited by reduced soil erosion level. At NIL, the closest villages were approximately 1000 m from the well pads. The population in the villages was 1,560. Compared to the total population in the study area, the number of impacted persons was considered as low. Therefore, based on the number of impacted persons it is considered as insignificant positive impact.

2) *Impacted area*

The project area coverage is expected to be approximately 115 hectares but not all parts of land will be rehabilitated. Areas to be rehabilitated are power plants in SIL and NIL, and areas used for transmission line. Hence, land rehabilitation is not expected to reduce the erosion potential significantly. Therefore, based on the impacted area it is considered as insignificant positive impact.

3) *Duration of impacts*

The project area will not be rehabilitated in one occasion. Therefore, based on the duration of impacts it is categorized as insignificant positive impact.

4) *Intesity of impacts*

Considering the number of impacted persons and the impacted area, based on the intensity of impacts, it is categorized as insignificant positive impact.

5) *Number of impacted environmental components*

There is no derivative impacts resulting from land reclamation. It is therefore categorized as insignificant positive impact.

6) *Cumulative nature of impacts*

Soil erosion is not considered as cumulative and therefore, based on the cumulative nature of impacts, it is categorized as insignificant positive impact.

7) *Reversibility of impacts*

Soil erosion causes loss of fertile top soil but the top soil is to be replaced during land rehabilitation. Therefore, based on the reversibility of impacts it is categorized as insignificant positive impact.

In conclusion, the impact of land rehabilitation on soil erosion is categorized as ***insignificant positive impact (+IS).***

5.4.1.2 Surface water run-off rate

The main objective of reclamation and rehabilitation is to restore the original functions and land use prior to Sarulla project. Top soil will be spread evenly to support optimum growth of plants.

Initially, the impacts and coverage of land reclamation is expected to be similar to those of land preparation. The reclamation will continue until plants grow in the project area.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

Surface water run-off to the nearest small rivers will be reduced after land rehabilitation. The impacted persons are those who live in the river catchment areas, which is in limited number. Therefore, based on the number of impacted persons it is considered as insignificant positive impact.

2) *Impacted area*

The project area coverage is expected to be approximately 115 hectares but not all parts of land will be rehabilitated. Areas to be rehabilitated are power plants in SIL and NIL, and areas used for transmission line. Hence, land rehabilitation is not expected to reduce the surface water run-off potential significantly. Therefore, based on the impacted area it is considered as insignificant positive impact.

3) *Duration of impacts*

The project area will not be rehabilitated in one occasion. Therefore, based on the duration of impacts it is categorized as insignificant positive impact.

4) *Intesity of impacts*

Considering the number of impacted persons and the impacted area, based on the intensity of impacts, it is categorized as insignificant positive impact.

5) *Number of impacted environmental components*

There is no derivative impacts resulting from land reclamation. It is therefore categorized as insignificant positive impact.

6) *Cumulative nature of impacts*

Surface water run-off rate is not considered as cumulative and therefore, based on the cumulative nature of impacts, it is categorized as insignificant positive impact.

7) *Reversibility of impacts*

The hydrology will return to normal after land rehabilitation but the intensity is relatively small. Therefore, based on the reversibility of impacts it is categorized as insignificant positive impact.

In conclusion, the impact of land rehabilitation on surface water run-off rate is categorized as ***insignificant positive impact (+IS).***

5.4.2 Socio-economic and socio-cultural components

5.4.2.1 Workforce release

5.4.2.1.1 Job opportunities

Consultation with employees should be undertaken 2 years prior to workforce release in the post-operation stage.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

Employees will loose their jobs after the operation period is finished. From the total workforce released, around 10% will be local workers and this will increase the level of unemployment in the project area. Based on the number of impacted persons it is considered as significant negative impact.

2) *Impacted area*

While some of the employees are locals, the remainder is from outside the project area hence covering a wider area. Based on the impacted area it is considered as significant negative impact.

3) *Duration of impacts*

The release of workforce will not be undertaken at once but throughout a period of time. Therefore, based on the duration of impacts it is categorized as significant negative impact.

4) *Intensity of impacts*

Reduction in job opportunities will change community income significantly in a short period of time. Thus, based on the intensity of impacts, it is categorized as significant negative impact.

5) *Number of impacted environmental components*

Derivative impacts of loss of job opportunities are changes in community income which eventually lead to community unrest. Therefore, based on

the number of impacted environmental components, it is categorized as significant negative impact.

6) *Cumulative nature of impacts*

The impact is considered as cumulative due to secondary negative impacts i.e. reduction of community income and community unrest. Therefore, based on the cumulative nature of impacts, it is considered as significant negative impact.

7) *Reversibility of impacts*

Released employees will encounter difficulty in finding new jobs in a short period of time. Therefore, based on the reversibility of impacts it is categorized as significant negative impact.

In conclusion, the impact of workforce release on job opportunities is categorized as ***significant negative impact (-S).***

5.4.2.2 Community income

The workforce release will impact on business opportunities which will then reduce community income.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

Employees will loose their jobs after completion of the operation stage, which means loss of income. Based on the number of impacted persons it is considered as significant negative impact.

2) *Impacted area*

While some of the employees are locals, the remainder is from outside the project area hence covering a wider area. Based on the impacted area it is considered as significant negative impact.

3) *Duration of impacts*

The release of workforce will most likely be unemployed for a long period of time. Therefore, based on the duration of impacts it is categorized as significant negative impact.

4) *Intensity of impacts*

Based on the intensity of impacts on the level of community income, it is categorized as significant negative impact.

5) *Number of impacted environmental components*

Income reduction will also reduce community welfare. Therefore, based on the number of impacted environmental components, it is categorized as significant negative impact.

6) *Cumulative nature of impacts*

The impact is considered as cumulative because in the long term will cause community unrest. Therefore, based on the cumulative nature of impacts, it is considered as significant negative impact.

7) *Reversibility of impacts*

Once the operation stage is completed, significant number of workforce will be released and loss their incomes. Therefore, based on the reversibility of impacts it is categorized as significant negative impact.

In conclusion, the impact of workforce release on community income is categorized as ***significant negative impact (-S).***

5.4.2.3 Community unrest

Community unrest is related to the workforce release process which will create unemployment particularly for unskilled workers from villages near the project area.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

During the post-operation stage, 250 employees will be released whereby some of them are from the project area. Based on the number of impacted persons it is considered as significant negative impact.

2) *Impacted area*

The impacted area is 7 villages and other areas outside the project area. Hence, covering a large area. Based on the impacted area it is considered as significant negative impact.

3) *Duration of impacts*

The release of workforce will take several months. Therefore, based on the duration of impacts it is categorized as significant negative impact.

4) *Intensity of impacts*

Loss of jobs will reduce community income and furthermore reduce welfare. Based on the intensity of impacts, it is categorized as significant negative impact.

5) *Number of impacted environmental components*

There is no derivative impact of community unrest on other environmental components. Therefore, it is categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

Community unrest will diminish with times. Therefore, based on the cumulative nature of impacts, it is considered as insignificant negative impact.

7) *Reversibility of impacts*

Community unrest will be reversed with times. Therefore, based on the reversibility of impacts it is categorized as insignificant negative impact.

In conclusion, the impact of workforce release on community unrest is categorized as ***significant negative impact (-S).***

CHAPTER V
PREDICTION OF SIGNIFICANT IMPACTS

5.1 PRE-CONSTRUCTION STAGE

5.1.1 Socio-economic, socio-cultural and public health components

5.1.1.1 Changes in land ownership and occupancy

The proposed project location is located in areas owned and controlled by local communities. SOL has to carry out a land acquisition process by providing appropriate compensations in accordance with applicable regulations. The compensations will be in forms of retributions towards land, plants or crops in communities' land. Until 2008, the land acquired by the project is 53 ha.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

   Land acquisition is generally a sensitive issue in Indonesia where in most cases, one affected person may cause significant problems. Therefore, for this criterion it is considered as significant negative impact.

2) *Impacted area*

   The remaining land to be acquired is 70 ha whilst the whole study area i.e. Pahae Jae and Pahae Julu Districts covers 370 ha. The total area to be acquired is only 19% of the total study area and therefore, based on the impacted area it is categorized as significant negative impact.

3) *Duration of impacts*

   When the project proponent owns the land, the local community will have no ownership or occupancy. Therefore, based on the duration of impact, the impact is categorized as negative significant.

4) *Intensity of impacts*

   The size of the impacted area and the number of persons affected are considered as significant. Many land owners will no longer have ownerships of their land. The lands are mainly inherited or family lands owned by more than one person, thus the land acquisition process generally takes a considerable amount of time. It is therefore categorized as significant negative impact.

5) *Number of impacted environmental components*

Land acquisition will cause the communities to loose their assets and thus will not be able to hand them over to future generation. Furthermore, the communities use the land for farming. It is therefore categorized as significant negative impact.

6) *Cumulative nature of impacts*

Land acquisition is a one time activity i.e. does not happen continuously. Therefore, it is considered as insignificant negative impact.

7) *Reversibility of impacts*

Once the land is acquired, the ownership will be transferred to the project proponent and will not be returned to the previous owners i.e. the communities. The impact is irreversible and classified as significant negative impact.

In conclusion, the impacts of land acquisition on land ownership and occupancy are categorized as ***significant negative impact (-S)***.

5.1.1.2 Community unrest

Community unrest is related to communities' dissatisfaction towards the transfers of land ownership and occupancy. Community dissatisfaction may relate to the amount of compensation received which consequently causes community unrest.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

In general, community unrest is caused not only by those whose lands will be acquired but also those with lands not required by SOL but prefer to sell it. Therefore, based on the number of impacted persons, it is categorized as significant negative impact.

2) *Impacted area*

Communities in rural area have close communication links with each other. This can potentially spread community unrest to a larger area. Therefore, based on the impacted area, it is categorized as significant negative impact.

3) *Duration of impacts*

Land acquisition has to be completed in a short period of time i.e. before activities at the project area commence. Based on the duration of impacts, it is categorized as insignificant negative impact.

4) *Intensity of impacts*

Since the number of impacted persons and the impacted area are considered as significant, based on the intensity of impact it is classified as significant negative impact.

5) *Number of impacted environmental components*

There is no derivative impacts resulting from community unrest. Therefore, it is categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

Community unrest will be resolved as the land acquisition process is completed. Hence, it is not considered as cumulative. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

The issue of community unrest will eventually be resolved. Hence, it is considered as reversible. Based on the reversibility character of impacts, it is categorized as insignificant negative impact.

In conclusion, the impacts on land acquisition towards community unrest are categorized as ***significant negative impact (-S).***

5.2 CONSTRUCTION PHASE

5.2.1 *Geophysical and chemical components*

5.2.1.1 *Air quality*

5.2.1.1.1 *TSP*

Poor air quality due to high TSP concentrations is predicted as an impact from construction activities i.e. movement of construction equipment in the project area.

Mobilization of construction equipment can be viewed from availability and operational aspects, i.e. the movements support construction activity. This study considers the types and numbers of construction equipment.

TSP measurements within the project area showed a range of concentration between 15-31 $\mu g/m^3$ which are below TSP standard specified by the Government. It is anticipated that construction equipment traffic causes dust dispersion onto the air. TSP concentrations depend on the frequency and duration of movements. Increased of TSP concentrations due to mobilization

of equipment and materials is expected not to exceed the standard of 230 $\mu g/m^3$.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

   The impacted persons are communities who live in the vicinity of the project area. The project location is relatively far from residential areas particularly at NIL. Thus, based on the number of impacted persons, it is considered as insignificant negative impact.

2) *Impacted area*

   The impacted area is limited to the locality of construction activities. Therefore, based on the impacted area, it is categorized as insignificant negative impact.

3) *Duration of impacts*

   The impact is only experienced during the construction stage. Based on the duration of impacts, it is categorised as insignificant negative impact.

4) *Intensity of impacts*

   Since the number of impacted persons and the impacted area are considered as insignificant, based on the intensity of impact it is classified as insignificant negative impact.

5) *Number of impacted environmental components*

   There is no derivative impacts resulting from increased of TSP concentrations. Therefore, it is categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

   TSP is dispersed in ambient air but not considered as cumulative as it is washed away by rain. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

   TSP concentrations in ambient air decrease as the construction stage is completed. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impacts of TSP on air quality are categorized as ***insignificant negative impact (-IS).***

5.2.1.1.2 H_2S

During well drilling and production testing, impacts on air quality are particularly caused by H_2S emission. Geothermal-fluid from production wells is separated into steam and brine. During production testing, steam is discharged through a silencer, while brine is re-injected to reinjection wells. Steam will have a dryness quality of about 99.95%. Non condensable gas (NCG) is about 2.1% weight in SIL and about 3.7% in NIL. The NCG contains H_2S in small amount[2].

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

   The total population within a 4 km radius in the proximity of the SIL well pad was approximately 780 people. Within a 500 m radius from the center of SIL, there were approximately 70 houses with an average of 5 persons per house. Thus, potentially there were 350 people impacted by the H_2S emission from the production test. At NIL, the closest villages were approximately 1000 m from the well pads. The population in the villages was 1,560. Compared to the total population in the study area, the number of impacted persons was considered as low. Therefore, based on the number of impacted persons it is considered as insignificant negative impact.

2) *Impacted area*

   The emission source is a silencer which is located 7.5 m above ground. This condition will prevent wide spread dispersion of the H_2S. In addition, H_2S is a dense gas which tends to settle down quickly. From those two factors, it is envisaged that H_2S will not be dispersed too far so that the impacted area will be limited. Thus based on the impacted area it is considered as insignificant negative impact.

3) *Duration of impacts*

   The impact only occurs during the production test which takes place for one month at each well. Based on the duration of impacts, it is categorized as insignificant negative impact.

4) *Intesity of impacts*

   To determine the amount of H_2S emission in NCG before conducting wells drilling and flow tests measurement is not a simple task. Nevertheless, as emission volume in SIL is 0.03 m^3/s and in NIL is 0.18 m^3/s, it is expected that the H_2S concentrations will be higher than the

[2] Other gases are CO_2 (96-97%) along with N_2, CH_4, O_2, H_2, Ar, He in trace quantities.

H_2S odor standard of 0.02 ppm specified in Minister of Environment Decree No. 50 of 1996 (Kep-50/MENLH/11/1996). From this point of view, the H_2S impact is considered as significant negative impact. H_2S concentrations will be monitored in accordance with the Environmental Management Plan during the construction stage. It is anticipated that the H_2S concentration will not cause any interference to human health in the vicinity of the wells since the level will be far below the concentration that could cause health disturbances (Threshold Limit Value is 10 ppm for a maximum of 8 hours exposure) stipulated in the Minister of Manpower Letter No. SE-01/MEN/1997 concerning Ambient Threshold Limit of Chemical Factors in the Working Environment. Therefore, from a public health point of view, it is considered as insignificant negative impact.

5) *Number of impacted environmental components*

There is no derivative impacts resulting from increased of H_2S emission to ambient air. Therefore, it is categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

The production well test will occur at certain time periods and therefore not considered as accumulative. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

H_2S emission will be dispersed in ambient air and its concentration will be decreased when the construction stage is completed. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impacts of H_2S on air quality are categorized as ***significant negative impact (-S).***

5.2.1.2 Noise

a. Mobilization of equipment and materials

Noise measurements in the project area showed a range of 32-44 dBA which is below the Indonesian noise standard for residential area. Mobilization of equipment and materials will increase noise level in the project area. Based on an assumption that heavy equipment mobilization is 6 hours per day at 10 locations (4 in SIL and 6 in NIL), the noise level from mobilization of equipment and materials is in a range of 60 – 70 dBA.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

The impacted persons are limited to those who live near the roads leading toward the project area. Therefore, based on the number of impacted persons it is categorized as insignificant negative impact.

2) *Impacted area*

The impacted area is limited to the villages next to roads leading toward the project area. Thus it is considered as insignificant negative impact.

3) *Duration of impacts*

The impact only occurs during the mobilization of equipment and materials. Based on the duration of impacts, it is categorized as insignificant negative impact.

4) *Intesity of impacts*

An increase of noise level due to the mobilization of equipment and materials is predicted to exceed the Indonesian standard for residential area of 55 dBA. Therefore, based on the intensity of impacts it is considered as significant negative impact.

5) *Number of impacted environmental components*

There is no derivative impacts resulting from increased of noise level. Therefore, it is categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

Mobilization of equipment and materials only occurs at certain periods of time and therefore not considered as cumulative. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

Noise generation stops once the mobilization of equipment and materials activity is completed. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impacts of mobilization of equipment and materials on noise level are categorized as ***significant negative impact (-S).***

b. Well drilling and production test

Noise measurements in the project area showed a range of 32-44 dBA which is below the Indonesian noise standard for residential area. It is anticipated that well drilling and production test will increase noise level in the project area so it is higher than the baseline level. Calculations predict a range of noise level between 75-79 dBA at well boundary due to well drilling. Based

on an assumption that production test (steam blowing) is 1 hour per day at 2 locations (1 in SIL and 1 in NIL), the noise level at 30 m from the project location is in a range of 100 – 110 dBA.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

   The total population within a 4 km radius in the proximity of the SIL well pad was approximately 780 people. Within a 500 m radius from the center of SIL, there were approximately 70 houses with an average of 5 persons per house. Thus, potentially there were 350 people impacted by increased noise level from the production test. At NIL, the closest villages were approximately 1000 m from the well pads. The population in the villages was 1,560. Compared to the total population in the study area, the number of impacted persons was considered as low. Therefore, based on the number of impacted persons it is considered as insignificant negative impact.

2) *Impacted area*

   The impacted area is limited to villages around the well pads. Thus, based on the impacted area it is considered as insignificant negative impact.

3) *Duration of impacts*

   The impact only occurs during the production test which takes place for one month at each well. Based on the duration of impacts, it is categorized as insignificant negative impact.

4) *Intesity of impacts*

   Noise from the production test can reach 110 dBA at well pads before silencer is used. At this level, the intensity of impact is considered as significant negative impact.

5) *Number of impacted environmental components*

   High noise level will only impact human at SIL whilst at NIL, it will also affect wildlife. Therefore, due to its potential impact on wildlife it is considered as significant negative impact.

6) *Cumulative nature of impacts*

   The production well test occurs at certain time periods and therefore not considered as cumulative. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

Noise generation stops once the production test is completed. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impacts of well drilling and production test on noise level are categorized as ***significant negative impact (-S).***

c. Power plant construction

Power plant construction activities will generate noise. It is predicted that the noise levels at a 100 m distance from construction sites during the construction stage are between 60-70 dBA with details as follow:

- Soil excavation 75 - 85 dBA
- Electric generator 55 - 65 dBA
- Pump 55 - 70 dBA
- Truck, cranes and other heavy equipment 60 - 70 dBA
- Pneumatic equipment 65 - 70 dBA

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

The total population within a 4 km radius in the proximity of the SIL well pad was approximately 780 people. Within a 500 m radius from the center of SIL, there were approximately 70 houses with an average of 5 persons per house. Thus, potentially there were 350 people impacted by increased noise level from the construction activities. At NIL, the closest villages were approximately 1000 m from the well pads. The population in the villages was 1,560. Compared to the total population in the study area, the number of impacted persons was considered as low. Therefore, based on the number of impacted persons it is considered as insignificant negative impact.

2) *Impacted area*

The impacted area is limited to villages around the power plant. Thus, based on the impacted area it is considered as insignificant negative impact.

3) *Duration of impacts*

The impact only occurs during the construction of the power plant i.e. 4 years. Based on the duration of impacts, it is categorized as insignificant negative impact.

4) *Intesity of impacts*

Noise from the power plant construction can reach 85 dBA at a 100 m distance. Thus based on the intensity of impacts, it is considered as significant negative impact.

5) *Number of impacted environmental components*

High noise level will only impact human at SIL whilst at NIL, it will also affect wildlife. Therefore, due to its potential impact on wildlife it is considered as significant negative impact.

6) *Cumulative nature of impacts*

The power plant construction only occurs within a 4 year period and therefore not considered as cumulative. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

Noise generation stops once the power plant construction is completed. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impacts of power plant construction on noise level are categorized as ***significant negative impact (-S).***

5.2.1.3 Soil erosion

Land preparation activity causes destruction of soil structure into granules which increase erosion potential. High amount of rainfall and rain erosivity (i.e. the ability of rain to cause erosion) in the project area potentially cause high surface water run-off rate and carry the granular soil onto a lower level area or into the river.

It is predicted that the erosion level in the area (using the USLE method) ranges between 40-1900 tonne/year. During the construction stage, the erosion level may increase to between 2370-4393 tonne/year.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

The total population within a 4 km radius in the proximity of the SIL well pad was approximately 780 people. Within a 500 m radius from the center of SIL, there were approximately 70 houses with an average of 5 persons per house. Thus, potentially there were 350 people impacted by increased soil erosion level from the construction activities. At NIL, the closest villages were approximately 1000 m from the well pads. The

population in the villages was 1,560. Compared to the total population in the study area, the number of impacted persons was considered as low. Therefore, based on the number of impacted persons it is considered as insignificant negative impact.

2) *Impacted area*

The project area coverage is expected to be approximately 115 hectares. Uncovered parts of land are exiting access roads and well pads. Hence, new activities are unlikely to increase erosion potential. Therefore, based on the impacted area it is considered as insignificant negative impact.

3) *Duration of impacts*

The area of 115 hectares is not cleared on one occasion. Therefore, based on the duration of impacts it is categorized as insignificant negative impact.

4) *Intesity of impacts*

Open area will be occupied by project structures i.e. buildings, paved and graveled roads, parks and plants during the construction period. Based on the intensity of impacts, it is categorized as insignificant negative impact.

5) *Number of impacted environmental components*

There is no derivative impacts resulting from land preparation activity. It is therefore categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

Soil erosion only occurs during the construction stage and therefore not considered as cumulative. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

Soil erosion causes loss of fertile top soil but the top soil is to be replaced during land rehabilitation. Therefore, based on the reversibility of impacts it is categorized as insignificant negative impact.

In conclusion, the impacts of land preparation on soil erosion are categorized as ***insignificant negative impact (-IS).***

5.2.1.4 Surface water run-off rate

Land preparation changes the surface water run-off rate due to the alterations of change of morphology and land cover.

Initial run-off coefficient in the project area is 0.3 and it is expected to increase to 0.7 following the land preparation activity. Such increase can increase erosion rate which directly impacts water ecosystem.

Estimated land areas prepared for geothermal activity is 70 ha whereby 19 ha of land with flat slope class (0-8%) and rain intensity of 16.60 mm/day is allocated for the power plant. The surface water run-off rates prior to the land preparation are 0.968 and 0.263 m^3/s for geothermal activity and power plant activity respectively. After the land preparation, the rates are expected to become 2.259 and 0.613 m^3/s for geothermal activity and power plant activity respectively.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

   Surface water run-off from the project area will flow to the nearest streams before reaching Batang Toru River. The impacted persons are limited to those who live in the river catchment areas. Therefore, based on the number of impacted persons it is categorized as insignificant negative impact.

2) *Impacted area*

   The project area coverage is expected to be approximately 115 hectares. Uncovered parts of land are exiting access roads and well pads. Hence, new activities are unlikely to increase surface water run-off rate potential. Therefore, based on the impacted area it is considered as insignificant negative impact.

3) *Duration of impacts*

   The area of 115 hectares is not cleared on one occasion. Therefore, based on the duration of impacts it is categorized as insignificant negative impact.

4) *Intesity of impacts*

   Open area will be occupied by project structures i.e. buildings, paved and graveled roads, parks and plants during the construction period. Based on the intensity of impacts, it is categorized as insignificant negative impact.

5) *Number of impacted environmental components*

   There is no derivative impacts of surface water run-off. It is therefore categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

Increased surface water run-off rate only occurs during the construction stage and therefore not considered as cumulative. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

Changes in the hydrology stop once the construction stage is completed. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impacts of land preparation on surface water run-off rate are categorized as ***insignificant negative impact (-IS)***.

5.2.1.5 Water quality

5.2.1.5.1 TSS

a. Land preparation

Field measurements showed that TSS concentrations in Batang Toru River were 114 -138 mg/L, which is higher than a standard of 50 mg/L.

The determination of impact significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

TSS is a derivative impact of surface water run-off. The impacted persons are limited to those who live in the river catchment areas. Therefore, based on the number of impacted persons it is categorized as insignificant negative impact.

2) *Impacted area*

The project area coverage is expected to be approximately 115 hectares. Uncovered parts of land are exiting access roads and well pads. Hence, new activities are unlikely to increase TSS concentration. Therefore, based on the impacted area it is considered as insignificant negative impact.

3) *Duration of impacts*

The area of 115 hectares is not cleared on one occasion. Therefore, based on the duration of impacts it is categorized as insignificant negative impact.

4) *Intesity of impacts*

Open area will be occupied by project structures i.e. buildings, paved and graveled roads, parks and plants during the construction period.

Based on the intensity of impacts, it is categorized as insignificant negative impact.

5) *Number of impacted environmental components*

There is no derivative impacts of TSS concentration. Furthermore, it is of small intensity and short duration. It is therefore categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

Increased TSS concentrations only occur during the construction stage and therefore not considered as cumulative. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

Higher TSS concentrations in the catchment areas will stop once the construction stage is completed. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impacts of land preparation on TSS concentration are categorized as ***insignificant negative impact (-IS)***.

b. Well drilling and production test

There is a potential for higher TSS concentrations following well drilling activities due to drill mud cutting from the sump pit.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

Higher TSS concentrations are anticipated in the surface water due to the run-off from the sump pit area. The impacted persons are limited to those who live in the river catchment areas. Therefore, based on the number of impacted persons it is categorized as insignificant negative impact.

2) *Impacted area*

The sump pit area is relatively small and only minimum spillage from it is expected. Therefore, based on the impacted area it is considered as insignificant negative impact.

3) *Duration of impacts*

The impacts are not continuous during drilling activity but only at times when there are spillages from the sump pit. Therefore, based on the duration of impacts it is categorized as insignificant negative impact.

4) *Intesity of impacts*

The possibility of spillage from the sump pit to occur is relatively small and limited. Based on the intensity of impacts, it is categorized as insignificant negative impact.

5) *Number of impacted environmental components*

There is no derivative impacts of TSS concentration. Furthermore, it is of small intensity and short duration. It is therefore categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

Increased TSS concentrations only occur during the construction stage and therefore not considered as cumulative. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

Higher TSS concentrations in the catchment areas will stop once the construction stage is completed. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impacts of well drilling and production test on TSS concentration are categorized as ***insignificant negative impact (-IS)***.

5.2.1.5.2 TDS and dissolved metals

Drilling and production test activities have the potential to increase TDS contents of surface water near the drilling locations. During drilling, fractions of the drill mud cutting could be released into shallow water courses, which could then enter Batang Toru River.

After the completion of drilling, liquid waste i.e. the remainder of drill mud will be transferred to mud pit. Such liquid waste contains water, non-toxic additive materials, cutting of rocks, and fractions of geothermal fluid. The fractions consist of dissolved metal (such as boron which can pollute surface and ground water). The dissolved metals potentially enter water bodies through surface water run-off or mud pit leak and therefore increases TDS contents of surface water.

PPSDAL USU laboratory analysis results revealed that TDS contents in Batang Toru River ranged between 114–138 mg/L. Surface water run-off as discussed above will potentially increase TDS contents in Batang Toru River. However, the increase is not anticipated to be of significance and the TDS contents will not exceed the standard of 1000 mg/L for the Class II water quality (based on Government Regulation No. 82/2001).

During production test, there is a potential for leakage from well casing. Hence, hot brine with high TDS contents may penetrate into the soil and finally into Batang Toru River. Nevertheless, the possibility of leakage is relatively small as the casing is specifically designed to prevent leakage.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

   The impacts of well drilling and production test to TDS contents have no direct consequences on human. Therefore, based on the number of impacted persons it is categorized as insignificant negative impact.

2) *Impacted area*

   Well drilling is to be conducted at SIL and NIL with the nearest Batang Toru River catchment and community wells nearby as the only directly impacted areas. Therefore, based on the impacted area it is considered as insignificant negative impact.

3) *Duration of impacts*

   The impacts are not continuous during drilling activity but periodically during drilling and only at times if well casing leakage occurs during production test. Therefore, based on the duration of impacts it is categorized as insignificant negative impact.

4) *Intesity of impacts*

   The increase of TDS in surface water close to the drilling location is relatively low and therefore, based on the intensity of impacts, it is categorized as insignificant negative impact.

5) *Number of impacted environmental components*

   There is no derivative impacts of TDS contents. Furthermore, it is of small intensity and short duration. It is therefore categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

   The increase of TDS in water catchment areas are not considered as cumulative due to its low intensity and that rain water will dilute the TDS. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

   The TDS contents in water catchment areas will be reversed naturally. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impacts of well drilling and production test on TDS and dissolved metals are categorized as ***insignificant negative impact (-IS)***.

5.2.1.5.3 pH

Well drilling activity has the potential to increase surface water pH and shallow groundwater close to drilling location i.e. to become alkaline (pH>7).

PPSDAL USU laboratory analysis results revealed that pH range of Batang Toru River is between 6.8-7.1, which meet the requirements of Class II water quality (based on Government Regulation No. 82/2001). Community wells sample at SIL and NIL varied between 6.7-6.9, which also showed compliance with the water quality standards in accordance with Minister of Health Regulation No. 416/PER/MENKES/IX/1990).

Surface water run-off and absorption of liquid waste with alkaline characteristic can potentially increase the pH of Batang Toru River and community wells. However, the increase is anticipated not to exceed the threshold of water quality standard i.e. 9.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

   The impacts of well drilling and production test to pH have no direct consequences on human. Therefore, based on the number of impacted persons it is categorized as insignificant negative impact.

2) *Impacted area*

   Well drilling is to be conducted at SIL and NIL with the nearest Batang Toru River catchment and community wells nearby as the only directly impacted areas. Therefore, based on the impacted area it is considered as insignificant negative impact.

3) *Duration of impacts*

   The impacts are not continuous during drilling activity but periodically during drilling and only at times if well casing leakage occurs during production test. Therefore, based on the duration of impacts it is categorized as insignificant negative impact.

4) *Intesity of impacts*

   The increase of pH in surface and groundwater close to the drilling location is relatively low and therefore, based on the intensity of impacts, it is categorized as insignificant negative impact.

5) *Number of impacted environmental components*

There is no derivative impacts of pH increase. It is therefore categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

The impacts are not continuous, hence are not considered as cumulative. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

The TDS contents in water catchment areas will be reversed naturally. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impacts of well drilling and production test on pH are categorized as ***insignificant negative impact (-IS)***.

5.2.2 Biological components

5.2.2.1 Species compositions and protected species

Land preparation during construction stage includes cutting trees and land clearing, which causes loss of vegetation cover. Consequently this reduces the numbers and types of vegetation in the project area.

Loss of vegetation has economical and ecological impacts. The economical impacts include loss of tree species, and community crops in plantation area and mixed forest. The ecological impacts include disturbance of forest functions i.e. water management and hydrological functions that support Batang Toru River. The area covered by such functions is relatively small compared to the whole forest area. The forest area is also wildlife habitat where loss of vegetation coverage causes a decrease in the number of wildlife.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

The impacts of land preparation to species compositions and protected species have no direct consequences on human due to the extent of wider forest area nearby. Local communities in the project area do not high dependency upon non-timber products. Therefore, based on the number of impacted persons it is categorized as insignificant negative impact.

2) *Impacted area*

The project will utilize an area of area coverage is expected to be approximately 115 hectares in which 12 ha will be cleared for power plant construction. Uncovered parts of land are exiting access roads and well pads. Hence, new activities are unlikely to impact existing flora habitat. Therefore, based on the impacted area it is considered as insignificant negative impact.

3) *Duration of impacts*

The impact only occurs during the construction stage and therefore, based on the duration of impacts, it is categorized as insignificant negative impact.

4) *Intesity of impacts*

Area to be cleared is relatively small which covers mixed community plantation area and forest, and bushes. Therefore, based on the intensity of impacts, it is categorized as insignificant negative impact.

5) *Number of impacted environmental components*

Land preparation in the wildlife habitat area is anticipated to have an impact. However, the area is not the primary or the only wildlife habitat. Furthermore, it is of relatively small coverage. It is therefore categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

The impacts are not continuous, hence are not considered as cumulative. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

Change of vegetation will recover once the construction stage is completed by undertaking rehabilitation and reclamation process. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impacts of land preparation on species compositions and protected species are categorized as ***insignificant negative impact (-IS)***.

5.2.2.2 Abundances of plankton and benthos

The impacts on of abundances of plankton and benthos are related to the decrease of water quality in Batang Toru River. The reduction of water quality is caused by an increase of TSS concentrations and turbidity level resulting from land preparation activity.

Higher level of TSS concentrations and turbidity level may disrupt aquatic biota photosynthesis (particularly phytoplankton) which consequently decreases the abundances of plankton and benthos.

It is predicted that the erosion level in the area (using the USLE method) ranges between 40-1900 tonne/year. During the construction stage, the erosion level may increase to between 2370-4393 tonne/year. With the predicted increase of erosion rate, TSS concentrations are expected to increase as well which are then affects the abundances of plankton and benthos.

The decrease of plankton and benthos population which is a food source for fishes in Batang Toru River will naturally reduce fish population. The reduction of fish population will also be affected by an increase of TSS concentrations.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

   The impacts of land preparation to aquatic biota have no direct consequences on human. Therefore, based on the number of impacted persons it is categorized as insignificant negative impact.

2) *Impacted area*

   The project will utilize an area of area coverage is expected to be approximately 115 hectares. Uncovered parts of land are exiting access roads and well pads. Hence, new activities are unlikely to impact existing aquatic biota. Therefore, based on the impacted area it is considered as insignificant negative impact.

3) *Duration of impacts*

   The impact only occurs during the construction stage and therefore, based on the duration of impacts, it is categorized as insignificant negative impact.

4) *Intensity of impacts*

   In relation to the number of impacted persons and impacted area, the intensity of impacts is categorized as insignificant negative impact.

5) *Number of impacted environmental components*

   There is no derivative impacts of abundances of plankton and benthos. Furthermore, it is of small intensity and short duration. It is therefore categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

The impacts are not continuous, hence are not considered as cumulative. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

Change of aquatic biota habitat will recover once the construction stage is completed by undertaking rehabilitation and reclamation process. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impact of land preparation on abundances of plankton and benthos is categorized as ***insignificant negative impact (-IS)***.

5.2.3 Socio-economic and socio-cultural components

5.2.3.1 Job opportunities

It is anticipated that the construction activities will involve approximately 1,410 persons during a 4 year period. The workforce requirements are (i) 150 persons for geothermal field construction activity; (ii) 1,200 persons for power plant construction; and (iii) 60 persons for construction of transmission line and tower. The company will recruit employees who fulfill company's requirements, as much as possible, from the nearby villages.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

The construction activities will provide job opportunities for 1,410 persons. Fifty percents of the total workforce is predicted to be fulfilled by local workers. There were 4,506 registered job seekers in the study area (North Tapanuli Regency) whereby 12% would have employment opportunities. Therefore, based on the number of impacted persons it is categorized as significant positive impact.

2) *Impacted area*

Areas with opportunities for job opportunities from construction activities are those around the project area. This means the opportunities will cover a relatively considerable area. Therefore, based on the impacted area it is considered as significant positive impact.

3) *Duration of impacts*

The impact occurs during the construction stage and therefore, based on the duration of impacts, it is categorized as significant positive impact.

4) *Intensity of impacts*

A 12% additional job in North Tapanuli Regency will consequently change community income which then increase community welfare and improve social conditions. Therefore, based on the intensity of impact, it is categorized as significant positive impact.

5) *Number of impacted environmental components*

Derivative impacts of additional job opportunities are an increase of community income, which will consequently improve community welfare. Therefore, it is categorized as significant positive impact.

6) *Cumulative nature of impacts*

Recruitment will be a repetitive and continous procuess during the construction stage. Based on the cumulative nature of impacts it is categorized as significant positive impact.

7) *Reversibility of impacts*

Once the construction stage is completed, a vast of numbers will be released. However, the workers will acquire invaluable work experience from the project and a smaller number will have the opportunity to be involved in the operation stage. Therefore, based on the reversibility of impacts, it is considered as insignificant positive impact.

In conclusion, the impact of workforce recruitment on job opportunities is categorized as ***significant positive impact (+S)***.

5.2.3.2 Business opportunities

As there will be 1,410 additional workers, there will also be further business opportunities particularly in terms of food stalls, restaurants, grocery stores and transportation services.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

Construction activities will offer job opportunities for 1,410 persons, and increase the business opportunity, in particular for providing stall and restaurant, groceries shops which provide daily needs, and transportation service. However, it is expected that there will only be limited number of people able to run such businesses and therefore, based on the number of impacted persons it is categorized as insignificant positive impact.

2) *Impacted area*

Business opportunities will reach further than surrounding project area particularly in terms of materials, equipment, and services from Medan, Jakarta and other places. Therefore, based on the impacted area it is considered as significant positive impact.

3) *Duration of impacts*

The impact occurs during the construction stage and therefore, based on the duration of impacts, it is categorized as significant positive impact.

4) *Intensity of impacts*

An increase of business opportunities will consequently change community income which then increase community welfare and improve social conditions. Therefore, based on the intensity of impact, it is categorized as significant positive impact.

5) *Number of impacted environmental components*

Derivative impact of additional business opportunities is an increase of community income, which will consequently improve community welfare. Therefore, it is categorized as significant positive impact.

6) *Cumulative nature of impacts*

At least for the four years of construction stage which is considered as sufficient, there will be more and more business opportunities. Based on the cumulative nature of impacts it is categorized as significant positive impact.

7) *Reversibility of impacts*

It is anticipated that not all of businesses started during the construction stage will remain. Some will have further opportunities to start new businesses in other areas equipped with enhanced knowledge and capital. Therefore, based on the reversibility of impacts, it is considered as insignificant positive impact.

In conclusion, the impact of workforce recruitment on business opportunities is categorized as ***significant positive impact (+S)***.

5.2.3.3 Community income

Workforce recruitment during the construction stage will include 1,410 persons for the 4 year duration. The workforce will be SOL employees but the majority will be contractors' workforce. Such additional workers, will also create further business opportunities particularly in terms of food stalls, restaurants, grocery stores and transportation services. Further job and businesses opportunities will benefit community income through direct

income as SOL or contractors' employees, and as entrepreneurs supporting construction activities and its employees.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

   Construction activities will offer job opportunities for 1,410 persons, and increase the business opportunity, in particular for providing stall and restaurant, groceries shops which provide daily needs, and transportation service. Business opportunities can be in forms of new business or increased capacity which may be in a modest number but will still create secondary business opportunities. Therefore, based on the number of impacted persons it is categorized as significant positive impact.

2) *Impacted area*

   Areas with the most potential to create business opportunities are villages around the project area. Therefore, based on the impacted area it is considered as significant positive impact.

3) *Duration of impacts*

   The impact will occur during the construction stage i.e. a 4 year duration and therefore, based on the duration of impacts, it is categorized as significant positive impact.

4) *Intensity of impacts*

   Due to its influence to increase community income, the impact is considered as significant positive. Therefore, based on the intensity of impact, it is categorized as significant positive impact.

5) *Number of impacted environmental components*

   Higher community income will consequently improve community welfare. Therefore, it is categorized as significant positive impact.

6) *Cumulative nature of impacts*

   Increased community income will last for the construction stage i.e. 4 years which is considered as cumulative during that period. Based on the cumulative nature of impacts it is categorized as significant positive impact.

7) *Reversibility of impacts*

   It is anticipated that once the construction stage is completed, the majority of workforce will be released and not all of businesses started during the construction stage will survive. However, the workers will acquire invaluable work experience from the project and a smaller

number will have the opportunity to be involved in the operation stage. Some businesses will have further opportunities to start new businesses in other areas equipped with enhanced knowledge and capital. Therefore, based on the reversibility of impacts, it is considered as insignificant positive impact.

In conclusion, the impact of workforce recruitment on community income is categorized as ***significant positive impact (+S)***.

5.2.3.4 Community unrest

5.2.3.4.1 Workforce recruitment

Community unrest is related to the selection process for construction workers. Community unrest can potentially happen if one feels capable and fulfill the recruitment criteria but not accepted to work, and if the local communities consider that the number of non-local workers recruited is higher than of local workers.

The determination of impacts significance is based on the following significant impacts criteria:

1) Number of impacted persons

Local communities expect employment but not all applications can be accepted. Therefore, based on the number of impacted persons it is categorized as significant negative impact.

2) Impacted area

Community unrest due to workforce recruitment will be limited to areas surrounding the project. Applicants from outside the project area will have greater acceptance in the case of being rejected than those from the nearby villages. Therefore, based on the impacted area it is considered as insignificant negative impact.

3) Duration of impacts

The impact will occur during the construction stage i.e. a 4 year duration and therefore, based on the duration of impacts, it is categorized as significant negative impact.

4) Intensity of impacts

Community unrest can potentially disrupt the construction activities through demonstration, uncooperative attitudes, blockage, and sabotage. Therefore, based on the intensity of impact, it is categorized as significant negative impact.

5) *Number of impacted environmental components*

There is no derivative impacts of community unrest. It is therefore categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

Community unrest will diminish as the construction stage progresses upon realization of reduced opportunities. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

Community unrest is not cumulative and will be reversed with times. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impact of workforce recruitment on community unrest is categorized as ***significant negative impact (-S)***.

5.2.3.4.2 Well drilling and production test

Another potential cause of community unrest is drilling activities due to the possibilities of well blow-up, increased ambient H_2S concentration, noise and spillage of geothermal fluid.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

Based on the previous consultation, local communities nearby the project area i.e. in the districts of Pahae Jae and Pahae Julu are generally concerned about well blow-up, increased ambient H_2S concentration, noise and spillage of geothermal fluid. Therefore, based on the number of impacted persons it is categorized as significant negative impact.

2) *Impacted area*

The concerns are limited to villages close to SIL and NIL. Therefore, based on the impacted area it is considered as insignificant negative impact.

3) *Duration of impacts*

The impact will only occur during the production test and therefore, based on the duration of impacts, it is categorized as insignificant negative impact.

4) *Intensity of impacts*

Community perception towards production test typically comes from sources that cannot be trusted such as rumors from other projects and not based on facts from the field. Therefore, based on the intensity of impact, it is categorized as insignificant negative impact.

5) *Number of impacted environmental components*

There is no derivative impacts of community unrest. It is therefore categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

Community unrest will diminish as the production test is completed. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility nature of impacts*

Once the production test ends, community unrest is expected to end. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impact of well drilling and production test on community unrest is categorized as ***significant negative impact (-S)***.

5.2.3.4.3 Installation of transmission line

Installation of transmission line can potentially cause community unrest due to land acquisition and disturbance during the construction of transmission line.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

The length of the transmission line is approximately 15km, passing through a number of different villages. Therefore, based on the number of impacted persons it is categorized as significant negative impact.

2) *Impacted area*

Due to the length of transmission line, coverage of the affected area is considerable. Therefore, based on the impacted area it is considered as significant negative impact.

3) *Duration of impacts*

The impact will only occur during the installation of transmission line and therefore, based on the duration of impacts, it is categorized as insignificant negative impact.

4) *Intensity of impacts*

Considering the significance of the number of impacted person and the impacted area, based on the intensity of impact, it is categorized as significant negative impact.

5) *Number of impacted environmental components*

Derivative impacts of the transmission line installation are (a) reduced land value and (b) reduced land productivity. However, the derivative impacts are considered as limited. It is therefore categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

The impact will only occur during the installation of transmission line, which considered as not cumulative. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

Community unrest can be managed by providing fair compensation and intensive consultation. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impact of installation of transmission line on community unrest is categorized as ***significant negative impact (-S)***.

5.2.3.5 Ground traffic disturbance

Mobilization of equipment and materials will increase ground traffic disturbance along the road leading to the project area. Main equipment and materials such as turbines, generators, transformers, pumps, motors, steel structure for construction, etc will be transported through Belawan Port. Other equipment and materials such as welding machines, grinding machines, cutting machines, bricks, concrete, etc will be transported through Sumatera Highways (Medan-Tarutung).

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

Mobilization of equipment and materials will affect road users along the road leading to the project area and those who live along the route. Therefore, based on the number of impacted persons it is categorized as significant negative impact.

2) *Impacted area*

The impacted area is areas along the route to mobilize equipment and materials, particularly close to the project location. Therefore, based on the impacted area it is considered as significant negative impact.

3) *Duration of impacts*

Each mobilization of equipment and materials will take 3 months. Therefore, based on the duration of impacts, it is categorized as insignificant negative impact.

4) *Intesity of impacts*

Mobilization includes heavy and extensive number of equipment and materials, and therefore journey progress will be slow. Considering the significance of the number of impacted person and the impacted area, based on the intensity of impact, it is categorized as significant negative impact.

5) *Number of impacted environmental components*

Derivative impacts of higher volume of traffic are delayed for other road users and increased risk of traffic accidents. It is therefore categorized as significant negative impact.

6) *Cumulative nature of impacts*

Ground traffic disturbance is not considered to be cumulative but only affects certain periods of time. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

Community unrest ends once traffic disturbance stops as the mobilization of equipment and materials activity is completed. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impact of mobilization of equipment and materials on ground traffic disturbance is categorized as ***significant negative impact (-S)***.

5.2.4 Public health components

5.2.4.1 Morbidity

Morbidity is due to mobilization of equipment and materials, and well drilling and production test. The activities can potentially increase the prevalence of airborne illnesses such as upper respiratory infections (*Infeksi Saluran Pernapasan Atas - ISPA*).

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

   Mobilization of equipment and materials will be conducted during non-peak hour period (night time) and therefore, the impacts to road users and communities along the route are predicted to be relatively small. Based on the number of impacted persons it is categorized as insignificant negative impact.

2) *Impacted area*

   The impacted area is along the route where equipment and materials will be transported, particularly close to the project area. Based on the coverage, the impacted area on morbidity is relatively small and therefore, it is considered as insignificant negative impact.

3) *Duration of impacts*

   Each mobilization of equipment and materials will take 3 months. Therefore, based on the duration of impacts, it is categorized as insignificant negative impact.

4) *Intesity of impacts*

   The increase of ambient TSP concentration due to equipment and material mobilization is predicted to be below the threshold limit of 230 $\mu g/m^3$. Thus, based on the intensity of impacts it is considered as insignificant negative impact.

5) *Number of impacted environmental components*

   No derivative impacts of morbidity on other environmental components. It is therefore categorized as significant negative impact.

6) *Cumulative nature of impacts*

   Ground traffic disturbance is not considered to be cumulative but only affects certain periods of time. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

   Morbidity due to equipment and materials mobilization will stop once the activity is completed. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impact of mobilization of equipment and materials on morbidity is categorized as ***insignificant negative impact (-IS)***.

5.3 OPERATION STAGE

5.3.1 Geophysical and chemical components

5.3.1.1 H_2S

Operational stage of geothermal power plant can cause significant impacts to air quality due to its H_2S emissions. High level of ambient H_2S concentrations affects human health and the environment. Steam from SIL and NIL is exploited from a geothermal reservoir. The steam is separated into steam and brine which will then sent to the power plants to generate electricity. Before the steam is sent to the turbine, it is purified in a separator to maintain a dryness of ±99.95% and non condensable gas (NCG) contents of ±2.1% weight in SIL and ±3.7% in NIL. The NCG consists of less than 1% of H_2S[3].

SOL commissioned a modeling study to predict H_2S concentrations in ambient air in order to predict the impacts of Sarulla Geothermal Plants[4] to air quality. The model was used to predict H_2S concentrations at SIL and NIL. The predicted concentrations were compared to the H_2S odor standard of 0.02 ppm specified in Minister of Environment Decree No. 50 of 1996 (Kep-50/MENLH/11/1996).

The dispersion modeling package ISC-AERMOD View was used in this study. It is a package incorporating popular US EPA (United States Environmental Protection Agency) models such as ISCST3, ISC-PRIME and AERMOD. The model is used extensively to assess pollution concentration from industrial sources. This dispersion modeling package required meteorological data representing the study area. The data from Aek Godang/Padang Sidempuan meteorological station was used due to its proximity to NIL and SIL geothermal fields and data availability[5]. The package is also supported by WRPLTView program that generates wind rose statistics (see **Figure V-1**), frequency tables and graphs for a wide variety of surface data file formats, and for the ISC pre-processed meteorological data file.

[3] Other gases are CO_2 (96-97%) along with N_2, CH_4, O_2, H_2, Ar, He in trace quantities.
[4] The modeling was undertaken by LAPI-ITB (*Lembaga Afiliasi Penelitian Indonesia – Institut Teknologi Bandung*).
[5] Indonesian Meteorology and Geophysics provided a list of meteorological stations in North Sumatra with data availabilities. The nearest meteorological station to NIL and SIL geothermal fields is Tarutung but in 2008 no data (0%) was available

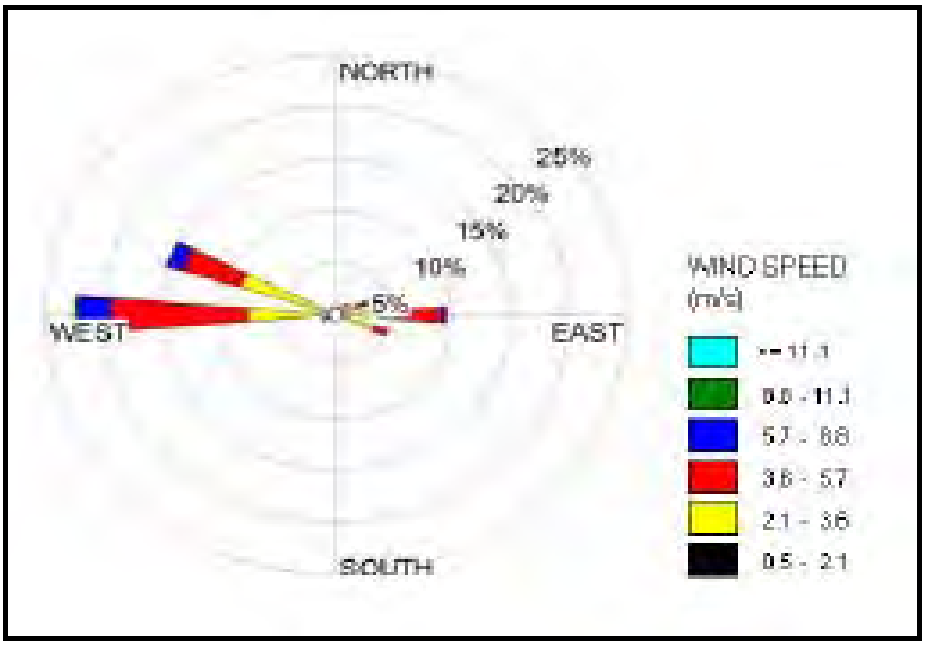


Figure V-1 Aek Godang Wind Rose

As no geothermal production wells were in place when the modeling took place, there were a number of assumptions incorporated into the model to predict the amount of H_2S that would be emitted at the operational phase. Data inputted into the model are shown in **Table V-1**.

Table V-1 Input data to model H_2S ambient concentrations

Data	Unit	SIL	NIL	Note
Air flow per fan	m^3/s	103.38	115.67	
Exhaust air temperature per fan	^0C	39.00	38.90	
H_2S density	g/m^3	1,327.39	1,327.81	At exhaust air temperature condition
Ejection speed per fan	m/s	5.61	6.25	Used as H_2S velocity when emitted from the point source
Outlet diameter	m	5.00	5.00	Typical for all outlet
Outlet height	m	7.50	7.50	Typical for all outlet
Outlet position above mean sea level	m	915	940	
H_2S emission volume	m^3/s	0.03	0.18	Based on H_2S premises calculation data
Number of emission sources		240	504	Blue frame in Figure V-2 and Figure V-3
H_2S emission volume per emission source	m^3/s	0.000125	0.000357	H_2S emission volume divided by number of fan
H_2S emission rate per emission source	g/s	0.1659	0.4742	H_2S emission volume per emission source multiplied by H_2S density
H_2S emission rate per emission source	$\mu g/m^3$	6.7	8.1	H_2S emission volume

Figure V-2 H_2S emission source at SIL (green line)

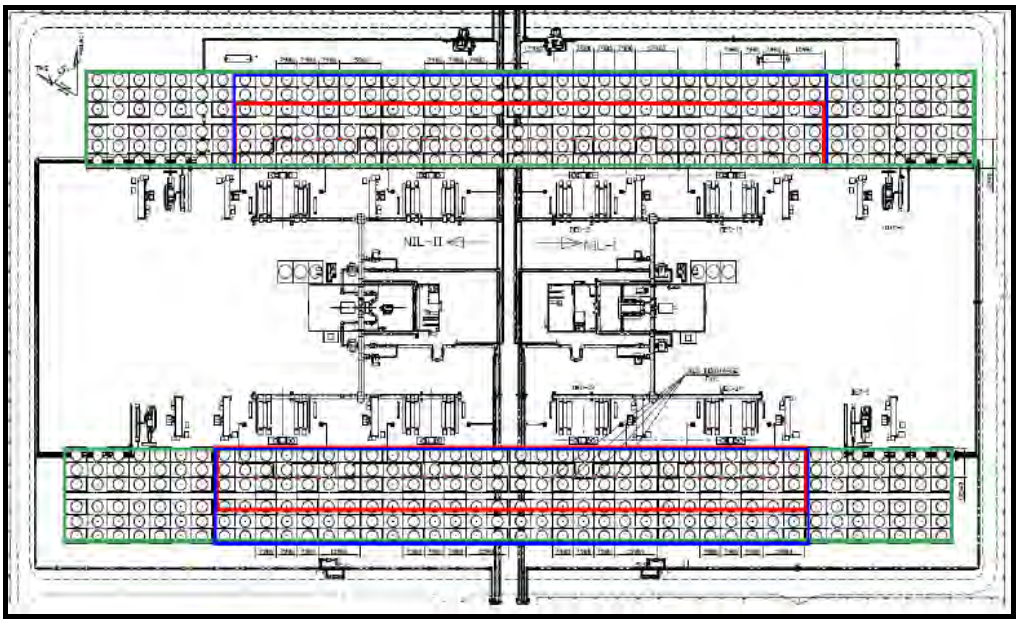


Figure V-3 H_2S emission source at NIL (green line)

H_2S concentrations were predicted at 100 receptor points around SIL and NIL as shown in **Figure V-4**.

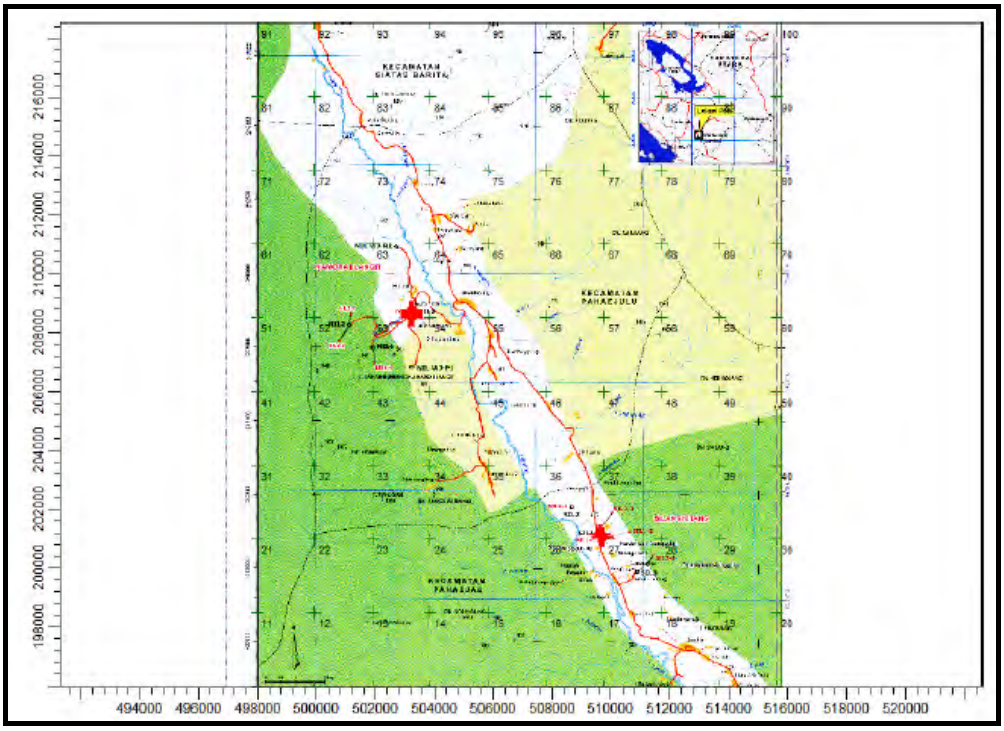


Figure V-4 Receptor points in SIL and NIL

The modeling output using ISC-AERMOD View Model presented in **Figure V-5** as isopleths. According to the model, the annual average H_2S concentration in ambient air is 0.02067 (which is equal to the standard of 0.02 ppm).

It is difficult to determine the amount of H_2S emission in NCG before conducting wells drilling and flow tests measurement. Therefore, the predicted H_2S concentrations displayed in the SIL and NIL isopleths above may vary when all production wells are in operating. H_2S concentrations will be monitored in accordance with the Environmental Management Plan during the operation stage.

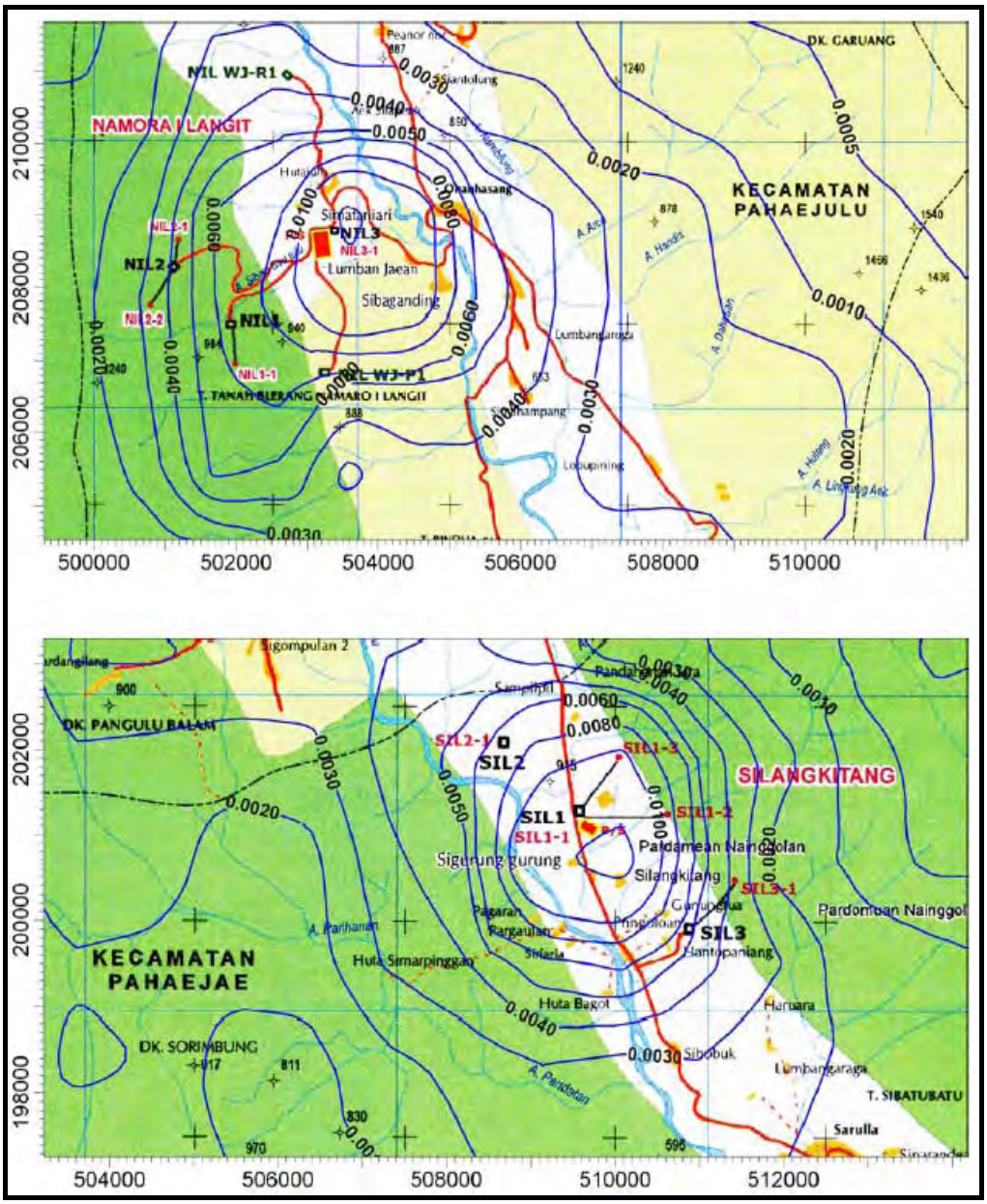


Figure V-5 Predicted H_2S concentration (annual average,) at NIL (above) and SIL (below)

Source: H_2S modelling by LAPI-ITB, May 2009

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

The number of households within 500 m radius from SIL was 70 houses. One house was typically occupied by 5 people. Thus the estimated population most likely to be affected by H_2S arising from the activity in SIL would be less than 350 people. At NIL, the nearest villages were located about 1,000 m from the wells. Population in the villages was around 1,560. Compared to the total population in the study area, the number of people that could potentially be affected was relatively small.

Therefore, based on the number of impacted persons, it is categorized as considered as insignificant negative impact.

2) *Impacted area*

H_2S concentration above the odor standard of 0.02 ppm was predicted at some distances from the proposed geothermal power plants for short periods of time. At SIL, the highest predicted H_2S concentration was at 142 m from the power plant. At NIL, the highest predicted H_2S concentration was located at 638 m distance from the power plant. Therefore, based on the impacted area, it is categorized as insignificant negative impact.

3) *Duration of impacts*

The impact will occur during the operation stage i.e. 30 years. Based on the duration of impacts, it is categorized as significant negative impact.

4) *Intensity of impacts*

The intensity of impact from H_2S concentration is determined based on the odor and its impacts to public health. At SIL, H_2S concentration was predicted to occur 18% in a year, while at NIL, the prediction was 45% in a year. Based on the modeling outcomes, it is categorized as significant negative impact.

However, as stated previously, the actual H_2S concentration may be lower than predicted after the drilling activity is completed. The predicted H_2S concentration will not cause any interference to human health in the vicinity of the power plants since it is far below the concentration that can cause health disturbances (Threshold Limit Value is 10 ppm for a maximum of 8 hours exposure) prescribed in the Minister of Manpower Letter No. SE-01/MEN/1997 Ambient Threshold Limit of Chemical Factors in the Working Environment. Therefore, from the public health point of view, it is categorized as insignificant negative impact.

5) *Number of impacted environmental components*

There is no derivative impact of H_2S emission in the air. Therefore, based on the number of impacted environmental components, it is categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

H_2S will be dispersed onto the air and therefore will not be accumulated. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

H_2S emissions will be dispersed onto the air and the concentration will be reduced as the operation stage is terminated. Therefore, based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impact of power plant operation on H_2S ambient concentration is categorized as ***significant negative impact (-S)***.

5.3.1.2 Noise

Noise measurements in the project area showed a range of 32-44 dBA. Noise level is expected to increase during the operation stage and at sampling points close to the project area, noise level will most likely be higher than 55 dBA but still below the regulatory limit for industrial area i.e. 70 dBA.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

The number of households within 500 m radius from SIL was 70 houses. One house was typically occupied by 5 people. Thus the estimated population most likely to be affected by H_2S arising from the activity in SIL would be less than 350 people. At NIL, the nearest villages were located about 1,000 m from the wells. Population in the villages was around 1,560. Compared to the total population in the study area, the number of people that could potentially be affected was relatively small. Therefore, based on the number of impacted persons, it is categorized as considered as insignificant negative impact.

2) *Impacted area*

The impacted area is limited to villages near the project area. Thus, based on the impacted area, it is categorized as insignificant negative impact.

3) *Duration of impacts*

The impact will occur during the operation stage i.e. 30 years. Based on the duration of impacts, it is categorized as significant negative impact.

4) *Intensity of impacts*

The power plant is designed to comply with the applicable noise standard. One of the sources of noise during the operation stage is steam blowing which conducted when new production wells are added. During this activity noise level is anticipated to reach 130 dBA. Therefore, based on the intensity of impacts, it is categorized as significant negative impact.

5) *Number of impacted environmental components*

At SIL, high noise level will only impact human but wildlife will also be affected at NIL. Due to the potential disturbance to wildlife, it is categorized as significant negative impact.

6) *Cumulative nature of impacts*

High noise level will only occur intermittently and therefore not considered as cumulative. Therefore, based on the cumulative nature of impacts, it is considered as insignificant negative impact.

7) *Reversibility of impacts*

Noise generation will cease as the operation stage is completed. Therefore, based on the reversibility characteristics, it is categorized as insignificant negative impact.

In conclusion, the impact of power plant operation on ambient noise level is categorized as ***significant negative impact (-S)***.

5.3.1.3 Water quality

5.3.1.3.1 TDS and dissolved metals

a. Condensate and brine reinjection

Re-injection of condensate and brine can potentially increase TDS concentration in surface water around the power plant, which can happen in the case of re-injection casing leakage where parts of brine and condensate are absorbed into shallow water bodies and eventually into Batang Toru River.

Another source of additional TDS concentration is brine temporary reservoir which will be used in emergency situation e.g. re-injection failure. Brine will be then transferred into re-injection wells. In the reservoir, brine fractions that contain dissolved metals such as boron and arsenic may enter the water bodies through surface water run-off or reservoir leakage, and consequently increase TDS concentrations.

PPSDAL USU laboratory analysis results revealed that TDS contents in Batang Toru River ranged between 114–138 mg/L. Surface water run-off as discussed above will potentially increase TDS contents in Batang Toru River. However, the increase is not anticipated to be of significance and the TDS contents will not exceed the standard of 1000 mg/L for the Class II water quality (based on Government Regulation No. 82/2001).

Nevertheless, the possibility of leakage from re-injection wells and temporary reservoir the casing and the reservoir are specifically designed to prevent leakage.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

   The impacts of re-injection to TDS contents have no direct consequences on human. Therefore, based on the number of impacted persons it is categorized as insignificant negative impact.

2) *Impacted area*

   Re-injection is to be conducted at SIL and NIL with the nearest Batang Toru River catchment and community wells nearby as the only directly impacted areas. Therefore, based on the impacted area it is considered as insignificant negative impact.

3) *Duration of impacts*

   The impacts are not continuous during the operation stage but very infrequent at times of well casing and reservoir leakage during re-injection. Therefore, based on the duration of impacts it is categorized as insignificant negative impact.

4) *Intesity of impacts*

   The increase of TDS in surface water close to re-injection wells is relatively low and therefore, based on the intensity of impacts, it is categorized as insignificant negative impact.

5) *Number of impacted environmental components*

   There is no derivative impacts of TDS contents. Furthermore, it is of small intensity and short duration. It is therefore categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

   The impact is not continuous hence, not considered as cumulative. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

   The TDS contents in water catchment areas will be reversed naturally. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impact of power plant operation on TDS and metal contents is categorized as ***insignificant negative impact (-IS)***.

b. pH

Re-injection has the potential to increase surface water pH in area close to drilling location i.e. to become alkaline (pH>7). PPSDAL USU laboratory analysis results revealed that pH range of Batang Toru River is between 6.8-7.1, which meet the requirements of Class II water quality (based on Government Regulation No. 82/2001).

Surface water run-off and absorption of condensate and brine can potentially increase the pH of Batang Toru River. However, the increase is anticipated not to exceed the threshold of water quality standard i.e. 9.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

   The impacts power plant operation to pH have no direct consequences on human. Therefore, based on the number of impacted persons it is categorized as insignificant negative impact.

2) *Impacted area*

   Re-injection is to be conducted at SIL and NIL with the nearest Batang Toru River catchment and community wells nearby as the only directly impacted areas. Therefore, based on the impacted area it is considered as insignificant negative impact.

3) *Duration of impacts*

   The impacts are not continuous during the operation stage but very infrequent at times of well casing and reservoir leakage during re-injection. Therefore, based on the duration of impacts it is categorized as insignificant negative impact.

4) *Intesity of impacts*

   The increase of pH in surface water close to re-injection wells is relatively low and therefore, based on the intensity of impacts, it is categorized as insignificant negative impact.

5) *Number of impacted environmental components*

   There is no derivative impacts of pH increase. Furthermore, it is of small intensity and short duration. It is therefore categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

   The impact is not continuous hence, not considered as cumulative. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

High level of pH in catchment areas will be reversed naturally. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impact of power plant operation on pH is categorized as ***insignificant negative impact (-IS)***.

5.3.1.4 *Exposure of electromagnetic field*

Electricity generated by SIL and NIL power plants will be transmitted to PLN transmission network. This can potentially create electromagnetic field.

Measurements of electromagnetic field at PLN transmission line in Padang Sidempuan with 275 kV were conducted in August 2007. The measurements were conducted at 1.4 m above ground, started from the middle point between two towers then at 20 m distance to the east and at 20 m distance to the west parallel to the towers. Measurement interval was every 2 m. The distance between measurement point and community household was approximately 20 m. Measurements indicated that the electric field ranged from 52.6 to 17.6 V/m whilst the magnetic field ranged from 35.8 to 23.2 mA/m. The measurements showed that the electric and magnetic field were below the thresholds recommended by IRPA and WHO[6]. Therefore, the transmission line planned for Sarulla, which is at a lower voltage i.e. 150 kV, is anticipated to meet the thresholds.

In addition, based on research presented in *Elektro Indonesia* Bulletin edition No. 32/VI/August 2000, the electromagnetic field from transmission line is classified as extremely low frequency with very low capability to move energy, hence incapable to influence chemical bonds in human cells. Human cells have electrical field of 10 million V/m which is stronger than external electric field.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

Installation of transmission line is far from residential areas to limit the number of persons impacted. Therefore, based on the number of impacted persons, it is categorized as insignificant negative impact.

[6] Currently Indonesia does not have exposure limit standards to electromagnetic fields from transmission lines. Reccomendations from International Radiation Protection Association (IRPA), and WHO 1990 are used for exposure limits to electromagnetic fields from frequency 50 to 60 Hz. According to both organizations, limits for continous exposure to general community are 5 kV/m for electric field and 0,1 mT for magnetic fields.

2) *Impacted area*

Installation of transmission line is far from residential areas. Therefore, based on the impacted area, it is categorized as insignificant negative impact.

3) *Duration of impacts*

Electromagnetic field will be radiated during transmission line operating period. Considering the low intensity and the distance to residential areas, based on the duration of impacts, it is categorized as insignificant negative impact.

4) *Intensity of impacts*

Electromagnetic field from 150 kV transmission line is considered as extremely low frequency. Therefore, based on the intensity of impacts, it is categorized as insignificant negative impact.

5) *Number of impacted environmental components*

There is no derivative of electromagnetic field to public health. Therefore, based on the number of impacted environmental components, it is categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

Transmission line route will not pass residential areas. Hence, no impact to public health and not considered as cumulative. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact

7) *Reversibility of impacts*

Electromagnetic field impact from transmission line is extremely low and no capability to influence chemical bonds in human cells. Therefore, based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impact of power plant operation on exposure of electromagnetic field is categorized as ***insignificant negative impact (-IS)***.

5.3.2 Socio-economic and socio-cultural components

5.3.2.1 Job opportunities

Workforce recruitment in the operation stage is much smaller than in the construction stage because the operation stage requires skilled workers. Opportunities are available for 250 persons.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

   The power plant operation will create job opportunities for 250 persons. Out of the 4,650 job seekers in the area, it is anticipated that 30-50% workforce who meet company's requirements will be from the vicinity of the project area. Therefore, based on the number of impacted persons it is categorized as significant positive impact.

2) *Impacted area*

   Areas with additional job opportunities from the power plant operation are 7 villages, which mean a relatively wide coverage area. Based on the impacted area it is considered as significant positive impact.

3) *Duration of impacts*

   The power plant operational period is 30 years. Therefore, based on the duration of impacts it is categorized as significant positive impact.

4) *Intensity of impacts*

   Additional job opportunities in the project area will change the level of income of communities' in the surrounding area, which consequently will change the level of community welfare and social status. Therefore, based on the intensity of impacts, it is categorized as significant positive impact.

5) *Number of impacted environmental components*

   Derivative impacts of having additional job opportunities are changes in the level of income, which will bring better community welfare. Therefore, based on the number of impacted environmental components, it is categorized as significant positive impact.

6) *Cumulative nature of impacts*

   The recruitment process will be repeated throughout the operation stage and therefore, based on the cumulative nature of impacts, it is categorized as significant positive impact.

7) *Reversibility of impacts*

   Once the operation stage is completed, significant number of workforce will be released. However, the workers will gain invaluable experience from the project. Based on the reversibility of impacts, it is categorized as insignificant positive impact.

In conclusion, the impact of workforce recruitment on job opportunities is categorized as ***significant positive impact (+S)***.

5.3.2.2 Business opportunities

Additional job opportunities will also create further business opportunities particularly in terms of accommodation, food stalls, restaurants, and grocery stores.

The determination of impacts significance is based on the following significant impacts criteria:

1) Number of impacted persons

Power plant operation activities will offer job opportunities for 250 persons, and increase the business opportunity, in particular for providing stall and restaurant, groceries shops which provide daily needs, and transportation service. However, it is expected that there will only be limited number of people able to run such businesses and therefore, based on the number of impacted persons it is categorized as insignificant positive impact.

2) Impacted area

Business opportunities will reach further than surrounding project area particularly in terms of materials, equipment, and services from Medan, Jakarta and other places. Therefore, based on the impacted area it is considered as significant positive impact.

3) Duration of impacts

Business opportunities will be available throughout the operation stage and therefore, based on the duration of impacts, it is categorized as significant positive impact.

4) Intensity of impacts

An increase of business opportunities will consequently change community income which then increase community welfare and improve social conditions. Therefore, based on the intensity of impact, it is categorized as significant positive impact.

5) Number of impacted environmental components

Derivative impact of additional business opportunities is an increase of community income, which will consequently improve community welfare. Therefore, it is categorized as significant positive impact.

6) Cumulative nature of impacts

Business opportunities will remain available during the operation stage which is a 30 year period. Based on the cumulative nature of impacts it is categorized as significant positive impact.

7) *Reversibility of impacts*

It is anticipated that not all of businesses started during the operation stage will remain. Some will have further opportunities to start new businesses in other areas equipped with enhanced knowledge and capital. Therefore, based on the reversibility of impacts, it is considered as insignificant positive impact.

In conclusion, the impact of workforce recruitment on business opportunities is categorized as ***significant positive impact (+S)***.

5.3.2.3 Community income

Additional job opportunities create further business opportunities particularly in terms of accommodation, food stalls, restaurants, grocery stores and transportation services. Further job and businesses opportunities will benefit community income through direct income as SOL or contractors' employees, and as entrepreneurs supporting construction activities and its employees.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

The operation stage will offer job opportunities for 250 persons, and increase the business opportunity, in particular for providing stall and restaurant, groceries shops which provide daily needs, and transportation service. Business opportunities can be in forms of new business or increased capacity which may be in a modest number but will still create secondary business opportunities. Therefore, based on the number of impacted persons it is categorized as significant positive impact.

2) *Impacted area*

Areas with the most potential to create business opportunities are villages around the project area. Therefore, based on the impacted area it is considered as significant positive impact.

3) *Duration of impacts*

The power plant operational period is 30 years. Therefore, based on the duration of impacts it is categorized as significant positive impact.

4) *Intensity of impacts*

Due to its influence to increase community income, the impact is considered as significant positive. Therefore, based on the intensity of impact, it is categorized as significant positive impact.

5) *Number of impacted environmental components*

Higher community income will consequently improve community welfare. Therefore, it is categorized as significant positive impact.

6) *Cumulative nature of impacts*

Increased community income will last for the operation stage i.e. 30 years which is considered as cumulative during that period. Based on the cumulative nature of impacts it is categorized as significant positive impact.

7) *Reversibility of impacts*

It is anticipated that once the operation stage is completed, the majority of workforce will be released and not all of businesses started during the operation stage will survive. However, the workers will acquire invaluable work experience from the project. Some businesses will have further opportunities to start new businesses in other areas equipped with enhanced knowledge and capital. Therefore, based on the reversibility of impacts, it is considered as insignificant positive impact.

In conclusion, the impact of workforce recruitment on community income is categorized as ***significant positive impact (+S)***.

5.3.2.4 Community unrest

5.3.2.4.1 Workforce recruitment

Community unrest is related to the selection process for construction workers, which requires skilled workers. Community unrest can potentially happen if one feels capable and fulfill the recruitment criteria but not accepted to work, and if the local communities consider that the number of non-local workers recruited is higher than of local workers.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

Local communities expect employment but not all applications can be accepted. Therefore, based on the number of impacted persons it is categorized as significant negative impact.

2) *Impacted area*

Community unrest due to workforce recruitment will be limited to areas surrounding the project. Applicants from outside the project area will have greater acceptance in the case of being rejected than those from the

nearby villages. Therefore, based on the impacted area it is considered as insignificant negative impact.

3) *Duration of impacts*

The impact will occur during the operation stage i.e. a 30 year duration and therefore, based on the duration of impacts, it is categorized as significant negative impact.

4) *Intensity of impacts*

Community unrest can potentially disrupt the construction activities through demonstration, uncooperative attitudes, blockage, and sabotage. Therefore, based on the intensity of impact, it is categorized as significant negative impact.

5) *Number of impacted environmental components*

There is no derivative impacts of community unrest. It is therefore categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

Community unrest will diminish as the construction stage progresses upon realization of reduced opportunities. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

Community unrest is not cumulative and will be reversed with times. Based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impact of workforce recruitment on community unrest is categorized as ***significant negative impact (-S)***.

5.3.2.4.2 High voltage electricity transmission

Community unrest is related to high voltage electricity transmission due to the strength of electromagnetic field which may affect the day to day activities of communities in the project area.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

The transmission line will be built in less populated area and once it is built, there should be no building underneath the transmission line. Therefore, based on the number of impacted persons, it is categorized as significant negative impact.

2) *Impacted area*

Community unrest is limited to areas where the transmission line is built. Therefore, based on the impacted area, it is categorized as insignificant negative impact.

3) *Duration of impacts*

Community unrest is not expected to last during the operation of the transmission line. Therefore, based on the duration of impact, it is categorized as insignificant negative impact.

4) *Intensity of impacts*

Considering that the number of impacted persons and impacted area, based on the intensity of impacts, it is categorized as insignificant negative impact.

5) *Number of impacted environmental components*

There is no derivative impacts of community unrest. It is therefore categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

Community unrest will diminish as the operation stage progresses. Communities will realize that their perception on the negative impacts of electromagnetic radiation is unproven. Therefore, based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

Community unrest can be managed by intensive consultation and therefore, based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impact of high voltage electricity transmission on community unrest is categorized as ***significant negative impact (-S)***.

5.3.3 Public health components

5.3.3.1 Morbidity

Operational stage of geothermal power plant can cause significant impacts to air quality due to its H_2S emissions. High level of ambient H_2S concentrations affects human health and the environment. Steam from SIL and NIL is exploited from a geothermal reservoir. The steam is separated into steam and brine which will then sent to the power plants to generate electricity. Before the steam is sent to the turbine, it is purified in a separator to maintain a

dryness of ±99.95% and NCG contents of ±2.1% weight in SIL and ±3.7% in NIL. The NCG consists of less than 1% of H_2S. Increased of H_2S concentration may decrease public health quality.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

   The number of households within 500 m radius from SIL was 70 houses. One house was typically occupied by 5 people. Thus the estimated population most likely to be affected by H_2S arising from the activity in SIL would be less than 350 people. At NIL, the nearest villages were located about 1,000 m from the wells. Population in the villages was around 1,560. Compared to the total population in the study area, the number of people that could potentially be affected was relatively small. Therefore, based on the number of impacted persons, it is categorized as considered as insignificant negative impact.

2) *Impacted area*

   Emission sources are stacks with 12 m height above ground to prevent wider dispersion of air pollutants. Furthermore, H_2S is dense gas which tends to settle down quickly. Based on these two factors, it is anticipated that H_2S dispersion area will be limited. Thus, it is categorized as insignificant negative impact.

3) *Duration of impacts*

   H_2S will be emitted during the power plant operation period. However, considering that based on air quality modeling, the highest predicted concentration is 0.02 ppm and this indicated no interference to human health in the vicinity of the power plants. The highest predicted concentration is far below the concentration that can cause health disturbances (Threshold Limit Value is 10 ppm for a maximum of 8 hours exposure) prescribed in the Minister of Manpower Letter No. SE-01/MEN/1997 Ambient Threshold Limit of Chemical Factors in the Working Environment. Therefore, it is categorized as insignificant negative impact.

4) *Intesity of impacts*

   The intensity of impact from H_2S concentration is determined based on the odor and its impacts to public health. It was predicted that ambient H_2S concentration during the operation stage would exceed 0.02 pm i.e. the threshold prescribed in Minister of Environment Decree No. 50 of 1996. However, the predicted H_2S concentration will not cause any interference to human health in the vicinity of the power plants since it is far below the concentration that can cause health disturbances

(Threshold Limit Value is 10 ppm for a maximum of 8 hours exposure) prescribed in the Minister of Manpower Letter No. SE-01/MEN/1997 Ambient Threshold Limit of Chemical Factors in the Working Environment. Therefore, based on the intensity of impacts, it is categorized as insignificant negative impact.

5) *Number of impacted environmental components*

There is no derivative impact of H_2S impact on public health. Therefore, based on the number of impacted environmental components, it is categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

H_2S will be dispersed onto the air and therefore will not be accumulated. Based on the cumulative nature of impacts, it is categorized as insignificant negative impact.

7) *Reversibility of impacts*

H_2S emissions will be dispersed onto the air and the concentration will be reduced as the operation stage is terminated. Therefore, based on the reversibility of impacts, it is categorized as insignificant negative impact.

In conclusion, the impact of power plant operation on morbidity is categorized as ***insignificant negative impact (-IS)***.

5.4 POST-OPERATION STAGE

5.4.1 Geophysical and chemical components

5.4.1.1 Soil erosion

The main objective of reclamation and rehabilitation is to restore the original functions and land use prior to Sarulla project.

Soil erosion is one of the factors land rehabilitation failure due to loss of soil organic materials and additional fertilizers. These cause inability of plants to grow and suspend the land rehabilitation which can increase environmental burden of the surrounding area. Sediments from fertilized rehabilitation area contain relatively high level of nutrients which will increase enrich the water bodies and consequently impacts aquatic biota and water quality.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

The total population within a 4 km radius in the proximity of the SIL well pad was approximately 780 people. Within a 500 m radius from the

center of SIL, there were approximately 70 houses with an average of 5 persons per house. Thus, potentially there were 350 people benefited by reduced soil erosion level. At NIL, the closest villages were approximately 1000 m from the well pads. The population in the villages was 1,560. Compared to the total population in the study area, the number of impacted persons was considered as low. Therefore, based on the number of impacted persons it is considered as insignificant positive impact.

2) *Impacted area*

The project area coverage is expected to be approximately 115 hectares but not all parts of land will be rehabilitated. Areas to be rehabilitated are power plants in SIL and NIL, and areas used for transmission line. Hence, land rehabilitation is not expected to reduce the erosion potential significantly. Therefore, based on the impacted area it is considered as insignificant positive impact.

3) *Duration of impacts*

The project area will not be rehabilitated in one occasion. Therefore, based on the duration of impacts it is categorized as insignificant positive impact.

4) *Intesity of impacts*

Considering the number of impacted persons and the impacted area, based on the intensity of impacts, it is categorized as insignificant positive impact.

5) *Number of impacted environmental components*

There is no derivative impacts resulting from land reclamation. It is therefore categorized as insignificant positive impact.

6) *Cumulative nature of impacts*

Soil erosion is not considered as cumulative and therefore, based on the cumulative nature of impacts, it is categorized as insignificant positive impact.

7) *Reversibility of impacts*

Soil erosion causes loss of fertile top soil but the top soil is to be replaced during land rehabilitation. Therefore, based on the reversibility of impacts it is categorized as insignificant positive impact.

In conclusion, the impact of land rehabilitation on soil erosion is categorized as ***insignificant positive impact (+IS).***

5.4.1.2 Surface water run-off rate

The main objective of reclamation and rehabilitation is to restore the original functions and land use prior to Sarulla project. Top soil will be spread evenly to support optimum growth of plants.

Initially, the impacts and coverage of land reclamation is expected to be similar to those of land preparation. The reclamation will continue until plants grow in the project area.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

Surface water run-off to the nearest small rivers will be reduced after land rehabilitation. The impacted persons are those who live in the river catchment areas, which is in limited number. Therefore, based on the number of impacted persons it is considered as insignificant positive impact.

2) *Impacted area*

The project area coverage is expected to be approximately 115 hectares but not all parts of land will be rehabilitated. Areas to be rehabilitated are power plants in SIL and NIL, and areas used for transmission line. Hence, land rehabilitation is not expected to reduce the surface water run-off potential significantly. Therefore, based on the impacted area it is considered as insignificant positive impact.

3) *Duration of impacts*

The project area will not be rehabilitated in one occasion. Therefore, based on the duration of impacts it is categorized as insignificant positive impact.

4) *Intesity of impacts*

Considering the number of impacted persons and the impacted area, based on the intensity of impacts, it is categorized as insignificant positive impact.

5) *Number of impacted environmental components*

There is no derivative impacts resulting from land reclamation. It is therefore categorized as insignificant positive impact.

6) *Cumulative nature of impacts*

Surface water run-off rate is not considered as cumulative and therefore, based on the cumulative nature of impacts, it is categorized as insignificant positive impact.

7) *Reversibility of impacts*

The hydrology will return to normal after land rehabilitation but the intensity is relatively small. Therefore, based on the reversibility of impacts it is categorized as insignificant positive impact.

In conclusion, the impact of land rehabilitation on surface water run-off rate is categorized as ***insignificant positive impact (+IS).***

5.4.2 Socio-economic and socio-cultural components

5.4.2.1 Workforce release

5.4.2.1.1 Job opportunities

Consultation with employees should be undertaken 2 years prior to workforce release in the post-operation stage.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

Employees will loose their jobs after the operation period is finished. From the total workforce released, around 10% will be local workers and this will increase the level of unemployment in the project area. Based on the number of impacted persons it is considered as significant negative impact.

2) *Impacted area*

While some of the employees are locals, the remainder is from outside the project area hence covering a wider area. Based on the impacted area it is considered as significant negative impact.

3) *Duration of impacts*

The release of workforce will not be undertaken at once but throughout a period of time. Therefore, based on the duration of impacts it is categorized as significant negative impact.

4) *Intensity of impacts*

Reduction in job opportunities will change community income significantly in a short period of time. Thus, based on the intensity of impacts, it is categorized as significant negative impact.

5) *Number of impacted environmental components*

Derivative impacts of loss of job opportunities are changes in community income which eventually lead to community unrest. Therefore, based on

the number of impacted environmental components, it is categorized as significant negative impact.

6) *Cumulative nature of impacts*

The impact is considered as cumulative due to secondary negative impacts i.e. reduction of community income and community unrest. Therefore, based on the cumulative nature of impacts, it is considered as significant negative impact.

7) *Reversibility of impacts*

Released employees will encounter difficulty in finding new jobs in a short period of time. Therefore, based on the reversibility of impacts it is categorized as significant negative impact.

In conclusion, the impact of workforce release on job opportunities is categorized as ***significant negative impact (-S).***

5.4.2.2 Community income

The workforce release will impact on business opportunities which will then reduce community income.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

Employees will loose their jobs after completion of the operation stage, which means loss of income. Based on the number of impacted persons it is considered as significant negative impact.

2) *Impacted area*

While some of the employees are locals, the remainder is from outside the project area hence covering a wider area. Based on the impacted area it is considered as significant negative impact.

3) *Duration of impacts*

The release of workforce will most likely be unemployed for a long period of time. Therefore, based on the duration of impacts it is categorized as significant negative impact.

4) *Intensity of impacts*

Based on the intensity of impacts on the level of community income, it is categorized as significant negative impact.

5) *Number of impacted environmental components*

Income reduction will also reduce community welfare. Therefore, based on the number of impacted environmental components, it is categorized as significant negative impact.

6) *Cumulative nature of impacts*

The impact is considered as cumulative because in the long term will cause community unrest. Therefore, based on the cumulative nature of impacts, it is considered as significant negative impact.

7) *Reversibility of impacts*

Once the operation stage is completed, significant number of workforce will be released and loss their incomes. Therefore, based on the reversibility of impacts it is categorized as significant negative impact.

In conclusion, the impact of workforce release on community income is categorized as ***significant negative impact (-S).***

5.4.2.3 Community unrest

Community unrest is related to the workforce release process which will create unemployment particularly for unskilled workers from villages near the project area.

The determination of impacts significance is based on the following significant impacts criteria:

1) *Number of impacted persons*

During the post-operation stage, 250 employees will be released whereby some of them are from the project area. Based on the number of impacted persons it is considered as significant negative impact.

2) *Impacted area*

The impacted area is 7 villages and other areas outside the project area. Hence, covering a large area. Based on the impacted area it is considered as significant negative impact.

3) *Duration of impacts*

The release of workforce will take several months. Therefore, based on the duration of impacts it is categorized as significant negative impact.

4) *Intensity of impacts*

Loss of jobs will reduce community income and furthermore reduce welfare. Based on the intensity of impacts, it is categorized as significant negative impact.

5) *Number of impacted environmental components*

There is no derivative impact of community unrest on other environmental components. Therefore, it is categorized as insignificant negative impact.

6) *Cumulative nature of impacts*

Community unrest will diminish with times. Therefore, based on the cumulative nature of impacts, it is considered as insignificant negative impact.

7) *Reversibility of impacts*

Community unrest will be reversed with times. Therefore, based on the reversibility of impacts it is categorized as insignificant negative impact.

In conclusion, the impact of workforce release on community unrest is categorized as ***significant negative impact (-S).***

CHAPTER VI
EVALUATION OF SIGNIFICANT IMPACTS

Impact evaluation is conducted to assess the significance of impacts of Sarulla project activities in a holistic and causative manner. The impact evaluation will show linkages between one impact to another, and to determine whether the impact is classified as a primary impact, a secondary or tertiary impact, and so on. From the evaluation of significant impacts, it can be concluded if the predicted significant impacts (as discussed in Chapter V) would be a significant impact that needs to be managed.

Matrix of significant impacts evaluation is provided on **Table VI-1**. **Figure VI-1** to **Figure VI-3** illustrate the linkages between one environmental impact to the other in order to determine the significance of impact i.e. primary, secondary and tertiary impact, and to determine which environmental components that receive the most impacts.

Table VI-1 Matrix of significant impacts evaluation of Sarulla Project

Project activity (Source of impact)	*Environmental component to receive impact*	*Significant impact*	*Significant Impact Determining Factor**							*Conclusion*
			A	*B*	*C*	*D*	*E*	*F*	*G*	
PRE-CONSTRUCTION STAGE										
Land acquisition	• Socio--economic	• Land ownership and occupancy	-S	-S	-S	-S	-S	-IS	-S	-S
	• Socio-cultural	• Community unrest	-S	-S	-IS	-S	-IS	-IS	-IS	-S
CONSTRUCTION STAGE										
Workforce recruitment	• Socio--economic	• Job opportunities	+S	+S	+S	+S	+S	+S	+IS	+S
		• Business opportunities	+IS	+S	+S	+S	+S	+S	+IS	+S
		• Community income	+S	+S	+S	+S	+S	+S	+IS	+S
	• Socio-cultural	• Community unrest	-S	-IS	-S	-S	-IS	-IS	-IS	-S
Mobilization of equipment and materials	• Air quality	• TSP	-IS	-IS	-IS	-IS	-IS	-IS	-IS	-IS
	• Noise	• Noise level	-IS	-IS	-IS	-S	-IS	-IS	-IS	-S
	• Transportation	• Ground traffic disturbance	-S	-S	-IS	-S	-S	-IS	-IS	-S
	• Public health	• Morbidity	-IS	-IS	-IS	-IS	-IS	-IS	-IS	-IS
Land preparation	• Soil	• Soil erosion	-IS	-IS	-IS	-IS	-IS	-IS	-IS	-IS
	• Hydrology	• Surface water run-off rate	-IS	-IS	-IS	-IS	-IS	-IS	-IS	-IS
	• Water quality	• TSS	-IS	-IS	-IS	-IS	-IS	-IS	-IS	-IS
	• Terrestrial Flora	• Species compositions and protected species	-IS	-IS	-IS	-IS	-IS	-IS	-IS	-IS
	• Aquatic Biota	• Abundances of plankton and benthos	-IS	-IS	-IS	-IS	-IS	-IS	-IS	-IS
Well drilling and production test	• Air quality	• H_2S	-IS	-IS	-IS	-S	-IS	-IS	-IS	-S
	• Noise	• Noise level	-IS	-IS	-IS	-S	-S	-IS	-IS	-S
	• Water quality	• TSS	-IS	-IS	-IS	-IS	-IS	-IS	-IS	-IS
		• pH	-IS	-IS	-IS	-IS	-IS	-IS	-IS	-IS
		• TDS and dissolved metals (B, Ba, Cd, Co, Cu, Pb, Ni, Se and Zn)	-IS	-IS	-IS	-IS	-IS	-IS	-IS	-IS
	• Socio-cultural	• Community unrest	-S	-IS	-IS	-IS	-IS	-IS	-IS	-S
Installation of transmission line	• Socio-cultural	• Community unrest	-S	-S	-IS	-S	-IS	-IS	-IS	-S

Project activity (Source of impact)	*Environmental component to receive impact*	*Significant impact*	*Significant Impact Determining Factor**							*Conclusion*
			A	*B*	*C*	*D*	*E*	*F*	*G*	
OPERATION STAGE										
Workforce recruitment	• Socio--economic	• Job opportunities	+S	+S	+S	+S	+S	+S	+IS	+S
		• Business opportunities	+IS	+S	+S	+S	+S	+S	+IS	+S
		• Community income	+S	+S	+S	+S	+S	+S	+IS	+S
	• Socio-cultural	• Community unrest	-S	-IS	-S	-S	-IS	-IS	-IS	-S
Power plant operation	• Air quality	• H_2S	-IS	-IS	-S	-S	-IS	-IS	-IS	-S
	• Noise	• Noise level	-IS	-IS	-S	-S	-S	-IS	-IS	-S
	• Water quality	• pH	-IS	-IS	-IS	-IS	-IS	-IS	-IS	-IS
		• TDS and dissolved metals (B, Ba, Cd, Co, Cu, Pb, Ni, Se and Zn)	-IS	-IS	-IS	-IS	-IS	-IS	-IS	-IS
	• Public health	• Morbidity	-IS	-IS	-IS	-IS	-IS	-IS	-IS	-IS
High voltage electricity transmission	• Electromagnetic field	• Exposure of electromagnetic field	-IS	-IS	-IS	-IS	-IS	-IS	-IS	-IS
	• Social culture	• Community unrest	-S	-IS	-IS	-IS	-IS	-IS	-IS	-S
POST-OPERATION STAGE										
Workforce release	• Socio--economic	• Job opportunities	-S	-S	-S	-S	-S	-S	-S	-S
		• Community income	-S	-S	-S	-S	-S	-S	-S	-S
	• Socio-cultural	• Community unrest	-S	-S	-IS	-S	-IS	-IS	-IS	-S
Land rehabilitation / re-vegetation	• Soil	• Soil erosion	+IS	+IS	+IS	+IS	+IS	+IS	+IS	+IS
	• Hydrology	• Surface water run-off rate	+IS	+IS	+IS	+IS	+IS	+IS	+IS	+IS

Footnote: * Significant Impact Guidance (based on Decree of the Head of BAPEDAL No. 56 of 1994)

A = Number of impacted persons
B = Impacted area
C = Duration of impacts
D = Intensity of impacts
E = Number of impacted environmental components
F = Cumulative nature of impacts
G = Reversibility of impacts

-IS = insignificant negative impact
+IS = insignificant positive impact
+S = significant positive impact
-S = significant negative impact

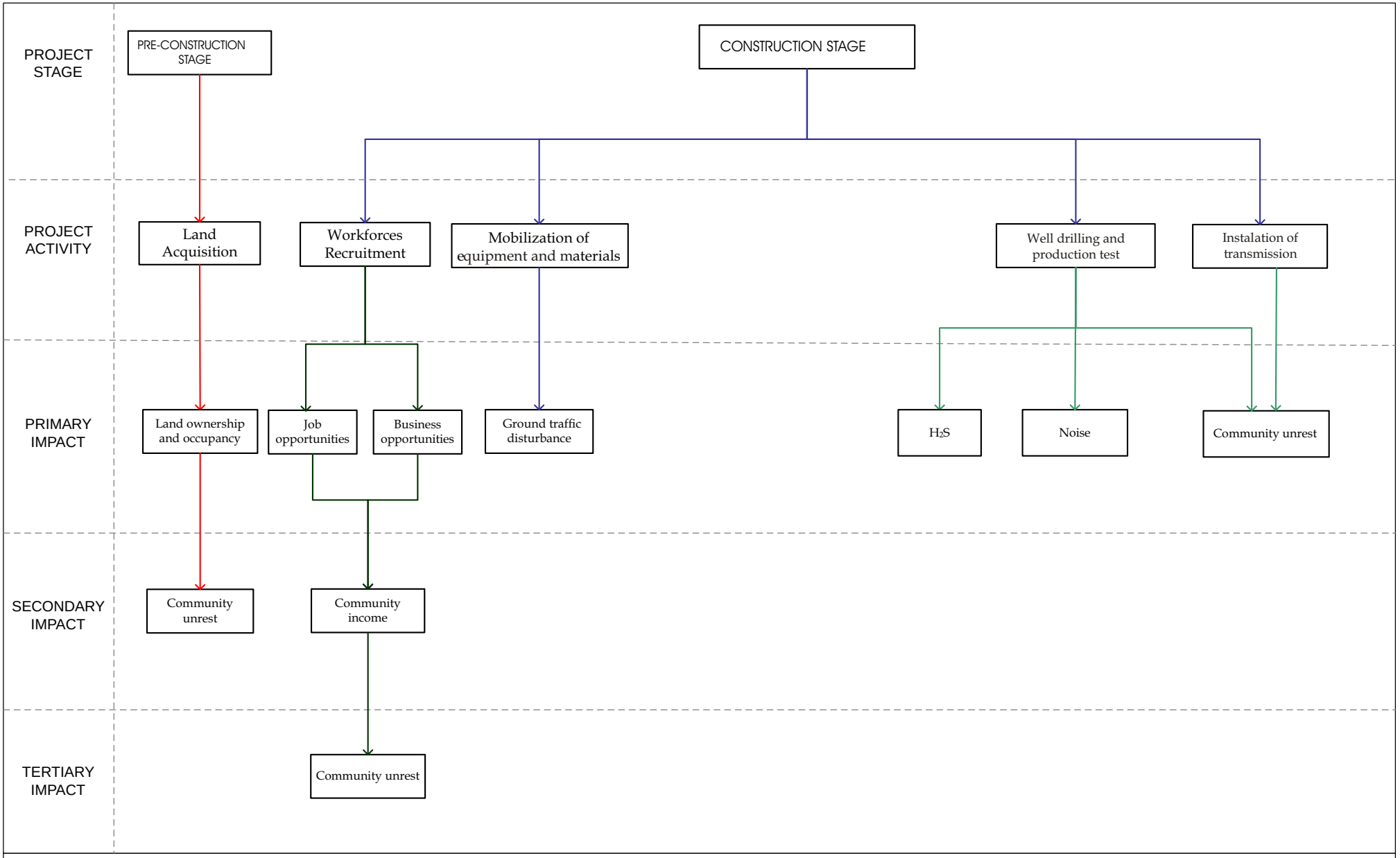


Figure VI.1 Evaluation of significant impacts of sarulla project : pre-construction and construction stages

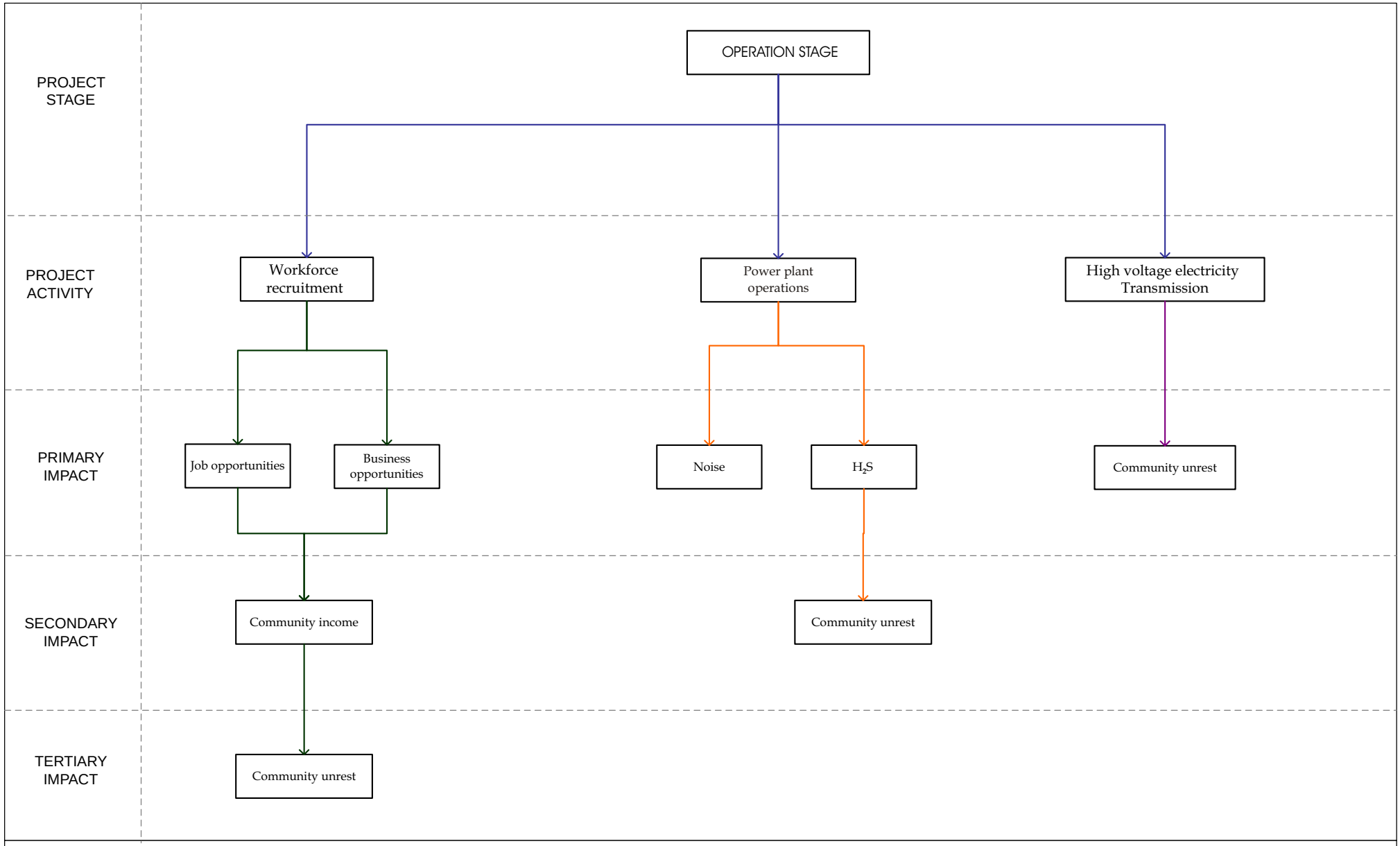


Figure VI.2 Evaluation of significant impacts of sarulla project : operation stage

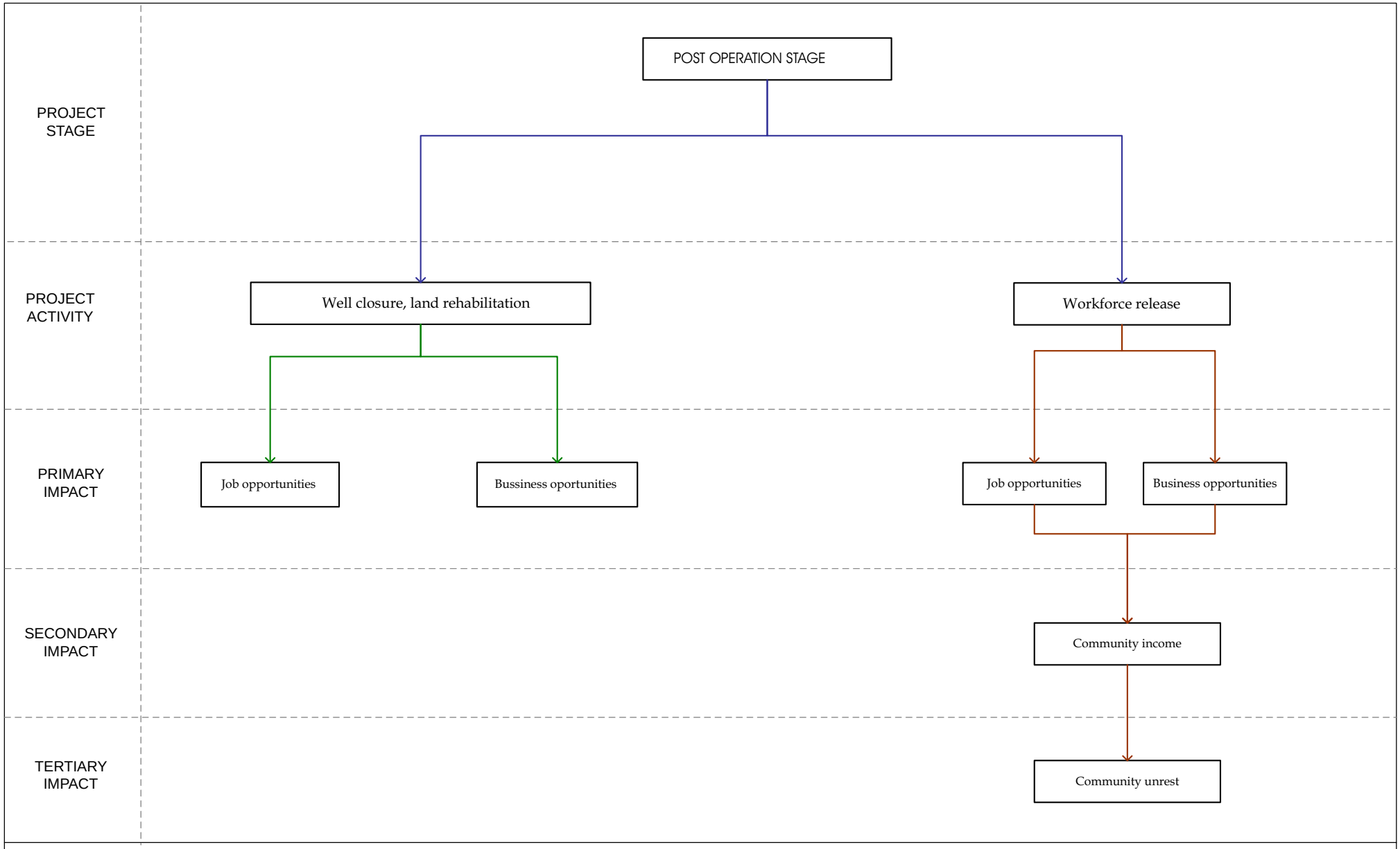


Figure VI.3 Evaluation of significant impacts of Sarulla Project : post-operations stage

6.1 REVIEW OF SIGNIFICANT IMPACTS

6.1.1 Pre-construction stage

In pre-construction stage, the project activity with negative significant impacts i.e. land ownership and occupancy, and community unrest will be land acquisition.

It is anticipated that the potential causes of community unrest are inadequate compensation or because the company approach is not in accordance with local customs.

6.1.2 Construction stage

6.1.2.1 Geophysical and chemical components

Air quality. Impact on air quality, i.e. increases of H_2S concentrations during construction stage, will be due to well drilling and production test.

Noise. Impact on noise level will be due to the following activities: mobilization of equipment and materials, well drilling and production test, and power plant construction. The noise level caused by these activities will be higher than the baseline noise level. Such impacts may disturb the community in the vicinity of the project area.

Ground traffic disturbance. Impact on traffic disturbance will be caused by mobilization of equipment and materials to and from project area.

6.1.2.2 Socio-economic, socio-cultural and public health components

Impacted socio-economic, socio-cultural and public health components will be job opportunities, business opportunities, community income, and community unrest. The activity workforce recruitment will have positive impacts towards like job and business opportunities, and community income.

Workforce recruitment during the construction stage between 1 to 2 year period will require approximately 1,410 workers. An increased in employment will create business opportunities for the nearby community especially in relation to the construction workers' needs such as accommodation, food stalls and restaurants, grocery stores, and transportation service. An increased in job opportunities, business opportunities will increase community income either directly as SOL employees or contractors, and entrepreneurs supporting the construction activity.

6.1.3 Operation stage

6.1.3.1 Geophysical and chemical components

Impacted physical-chemical components will be air quality (H_2S) and noise.

The operation of power plant may cause significant negative impacts on air quality mainly H_2S. Steam from SIL and NIL is exploited from a geothermal reservoir. The steam is separated into steam and brine which will then be sent to the power plants to generate electricity. Before the steam is sent to the turbine, it is purified in a separator to maintain a dryness of ±99.95% and NCG contents of ±2.1% weight in SIL and ±3.7% in NIL. The NCG consists of H_2S.

Noise level from this activity will increase. At a monitoring station near the project area, it is predicted that the noise level will exceed 55 dBA, which is still below the noise standard for industrial area of 70 dBA.

6.1.3.2 Socio-economic, socio-cultural and public health components

Impacted socio-economic, socio-cultural and public health components in the operation stage will be job opportunities, business opportunities, community income, and community unrest as the negative impact due to workforce recruitment. The number of workforce recruited during the operation stage will be lower than during the construction stage as the operation stage will require special skilled workers.

The recruitment process will potentially cause community unrest. Another cause of community unrest will be the feeling amongst local community that the number of migrant workers is higher than of local workers.

6.1.4 Post-operation stage

6.1.4.1 Socio-economic, socio-cultural and public health components

Impacted socio-economic, socio-cultural and public health components in the post-operation stage will be job opportunities, business opportunities, community income, and community unrest. Workers will be released from their jobs and this will reduce business opportunities, which will have further impact on community income.

6.2 ALTERNATIVE ASSESSMENT

The locations for and the technology used in the development of Sarulla geothermal field and power plant were already determined and therefore, no alternatives need to be assessed in this AMDAL study. Project sites, both in SIL and NIL, will be developed to utilize the geothermal resources to generate electricity. The electricity generated will be distributed to PLN grid.

6.3 *REVIEW OF SIGNIFICANT IMPACTS AS THE BASIS FOR MANAGEMENT*

The impacts of Sarulla project will include negative and positive impacts. The negative impacts shall be minimized and prevented if possible whereas the positive impacts shall be maintained and improved.

In this section, the management of impacts will be presented in general. The detailed management measures will be presented in the Environmental Management Plan document (*Rencana Pengelolaan Lingkungan* = RKL). Below are selections of measures to manage the predicted significant impacts from this project.

6.3.1 *Impact on air quality and noise*

The impacts will be an increase of H_2S concentrations and noise level from well drilling and production test and power plants operation.

The management efforts shall minimize the increase of H_2S concentrations and noise level.

The impacts on air quality and noise can have derivative impacts on public health components.

6.3.2 *Impact on land ownership and occupancy*

The impacts on land ownership and occupancy will be due to land acquisition.

The changes in land ownership and occupancy will potentially cause community unrest if not carried out accordingly.

The management efforts shall minimize and reduce the possibility of community unrest resulting from the land acquisition.

6.3.3 *Impact on job opportunities and business opportunities*

The impacts on job opportunities and business opportunities will be due to employment of local workers according to their abilities and skills and increased of business opportunities in trade and services sectors in the project area.

Not all local communities can be employed by the project workers and many will be unemployed after the land acquisition.

The management efforts shall provide training to local workers that would allow them to work outside the geothermal sector or by facilitating access to business capital.

6.3.4 Impact on community income

This impact is a derivate the impacts on job opportunities and business opportunities.

The management efforts for the impacts on community income will follow the efforts for the impacts on job opportunities and business opportunities. Open dialogue and communication with the community is the key to manage this impact.

6.4 RECOMMENDATIONS

Having considered (1) the significant impacts that will be generated by the project, (2) review on alternative assessment, and (3) review of significant impacts as the basis for the management, and in the views that (1) the impacts of the development of Sarulla geothermal field and power plant can be managed with the currently available technology, and (2) the procedures to prepare and compile AMDAL documents have followed the relevant regulations, therefore the development of Sarulla geothermal field and power plant of 330 MW capacity is environmentally feasible.

LAMPIRAN

LAMPIRAN – 1
TANGGAPAN/MASUKAN SECARA TERTULIS PEMBAHASAN ANDAL, RKL DAN RPL

PEMERINTAH PROVINSI SUMATERA UTARA
BADAN PENGENDALIAN DAMPAK LINGKUNGAN DAERAH
Jl. T. Daud No. 5 Telepon (061) 4537050 Fax. (061) 4537050
MEDAN

Medan, 19 - Nopember 2008

Nomor : 1544 /BPDL-SU/BTL/2008
Lampiran : 1 (satu) berkas
Sifat : --
Perihal : Perbaikan Dokumen ANDAL/RKL - RPL Pengembangan Lapangan Panas Bumi dan Pembangunan PLTP Sarulla Kapasitas 330 MW

Kepada Yth :
Direktur Sarulla Operations,Ltd
c/o Graha Niaga 8 th Floor
Jl. Jend. Sudirman Kav. 58
Jakarta 12190
di -
Jakarta

1. Berdasarkan hasil Sidang Komisi Penilai AMDAL Provinsi Sumatera Utara tanggal 11 Nopember 2008 dalam rangka Pembahasan dan Penilaian Dokumen ANDAL, RKL/RPL Pengembangan Lapangan Panas Bumi dan Pembangunan PLTP Sarulla Kapasitas 330 MW Provinsi Sumatera Utara, disampaikan tanggapan dan saran masukkan untuk perbaikan Dokumen dimaksud.

2. Diminta kepada Saudara untuk segera memperbaiki Dokumen ANDAL,RKL/RPL tersebut sesuai tanggapan dan saran masukan Komisi Penilai AMDAL Provinsi Sumatera Utara. Diinformasikan kepada Saudara bahwa waktu perbaikan dokumen selambatnya 30 (tiga puluh) hari setelah surat ini diterima dan keterlambatan dalam pengembalian dokumen dimaksud adalah tanggung jawab Saudara.

3. Dokumen ANDAL,RKL/RPL yang telah diperbaiki dan memenuhi maksud point 2 (dua) di atas adalah dasar penerbitan Keputusan Kelayakan Lingkungan Hidup rencana kegiatan dimaksud oleh Gubernur Sumatera Utara.

4. Demikian disampaikan atas perhatian dan kerjasama yang baik diucapkan terima kasih.

KEPALA BAPEDALDA PROVINSI
SUMATERA UTARA

BAPEDALDA

Prof. H. SYAMSUL ARIFIN, SH, MH
PEMBINA UTAMA
NIP. 130809985

Tembusan disampaikan kepada Yth :
1. Gubernur Sumatera Utara (sebagai laporan)
2. Pertinggal

TANGGAPAN DAN SARAN MASUKAN
RAPAT PEMBAHASAN DAN PENILAIAN DOKUMEN ANDAL,RKL/RPL
PENGEMBANGAN LAPANGAN PANAS BUMI DAN
PEMBANGUNAN PLTP SARULLA KAPASITAS 330 MW
HARI/TANGGAL : SELASA/ 11 NOVEMBER 2008
TEMPAT : AULA BAPEDALDA PROVINSI SUMATERA UTARA

NO	HAL	TANGGAPAN SARAN PERBAIKAN
1.		**Prof. Dr. Retno Widhiastuti, MS (Staf Ahli Bapedalda Provinsi Sumatera Utara)**
	III - 32	1. Buat dalam tabulasi jenis-jenis vegetasi pada hutan campuran. Melihat dari gambar III.5 hutan campuran tidak mungkin hanya laut dan kemenyan. Tabulasi buat dalam nama latin.
	III - 34	2. Habitat satwa liar, sebutkan jenis-jenis vegetasi dengan nama latinnya sebagai habitat satwa liar.
	III – 35 s/d 36	3. - Satwa liar, buat dalam tabulasi dan nama latinnya sebelum narasi pembahasan. - Tambahan satwa liar yang dilindungi sesuai dengan Peraturan Pemerintah No. 7 Tahun 1999 yang menjadi alasan Peraturan Pemerintah tersebut digunakan seperti yang ditulis di dokumen ANDAL hal 1-6.
	Bab VI & RKL III-5	4. Evaluasi dampak penting. Untuk mengurangi dampak kebisingan selain dengan alat peredam juga dapat dengan menanam vegetasi pohon yang berkampir lebar disekitar proyek.
2.		**Drs. Chairul Azhar, MSc (Staf Ahli Bapedalda Provinsi Sumatera Utara)**
	I - 1	1. Penulisan Pertamina sesuaikan dengan bagian yang menangani pabum (pertamina adalah pengertian umum).
	II - 2	2. Apakah dokumen ini merupakan AMDAL terpadu? Apa alasannya.
	II - 8	3. Apa maksudnya pH dikontrol dengan H_2SO4.
	II – 11	4. Tertulis "persiapan dan konstruksi tapak sumur" apa maksudnya?
	II – 18	5. Pembangunan PLTP. Jelaskan letak detail lokasi PLTP SIL dan NIL.
	II – 21	6. Pemasangan menara transmisi. Jelaskan luas tapak menara dan bahan yang dilalui transmisi, bagaimana status lahan dibawah transmisinya, jumlah menara dan jaraknya.
	II - 29	7. Tercantum kawasan hutan, hutan apa?
	III - 4	8. Kualitas udara : Bagaimana membandingkan parameter yang diperoleh dengan peraturan, satuannya berbeda?
	II – 24	9. Uji produksi sumur termasuk dampak penting. Lumpur bor harus dikelola saat pemboran.
	V – 26	10. Periksa prakiraan dampak penting dan sesuaikan dengan tabel VI-1 karena ada perbedaan. Sebagai contoh dampak H_2S diprediksi-TP, tetapi pada tabel VI-1 menjadi dampak–P, periksa juga yang lain. Kondisi ini terkait dengan RKL dan RPL.
	V – 45	11. Apakah air limpasan merupakan dampak positif?
3.		**Drs. Chairuddin, MS (Staf Ahli Bapedalda Provinsi Sumatera Utara)**
	III - 6	1. Kebisingan dibuat dengan harga rata-rata bahan range minimal/maksimal.
	III - 6	2. Satuan untuk kualitas udara ambien disesuaikan dengan PPRI Nomor 41 Tahun 1991 (µg/Nm3).
	III - 8	3. Kutipan literatur pembahasan kualitas air tidak tercantum dalam daftar pustaka.
	V - 43	4. Bagaimana kondisi medan listrik dan magnet pada rona awal.

NO	HAL	TANGGAPAN SARAN PERBAIKAN
	V - 17 (V-36)	5. Pernyataan tentang pengaruh pH air permukaan pada hal V-17 berbeda dengan pada halaman V-36.
	VI - 8	6. Pembahasan emisi H_2S pada hal V-5 dan VI-8 agar diuraikan lebih terinci.
	RPL 6	7. Matriks ringkasan RPL; tambahkan parameter SO_2 sesuai PPRI Nomor 41 tahun 1999.
	RKL/RPL	8. Sebutkan sumber karakteristik dan jumlah limbah B3 pada Bab II dan cantumkan uji Tclp dalam Rencana Pemantauan Lingkungan Hidup.
4.		**Ir. M. Eka Onwardana (Staf Ahli Bapedalda Provinsi Sumatera Utara)**
	III	1. Abstrak, mohon lihat Peraturan Menteri Negara Lingkungan Hidup Nomor 8 Tahun 2006. Mengemukakan berbagai kemungkinan dampak penting (mohon dirinci)
	II - 2	2. Point 2.21 masih menguraikan pernyataan AMDAL yang lama (sebaiknya cukup pada latar belakang).
	V - 3	3. Ada pernyataan RTRW Kabupaten Tapanuli Utara, mohon peta RTRW dilampirkan.
	II - 9	4. Tentang rencana penggunaan lahan, mohon ditabelisasi agar lebih gampang terlihat.
	II - 6	5. Tabel II.1 mohon dibuat rinci sesuai rencana pengembangan.
	II - 18	6. Point 2 mobilisasi peralatan dan bahan, mohon jalur jalan lintas Sumatera mana yang dipakai? diperjelas.
	II - 25	7. Point 2.2.2.3.3 perbaiki menjadi jaringan transmisi T/L 150 kV dari NIL ke GI mana? Bagian dari sub sistem sumbagut.
	V - 4 & V - 6	8. Kualitas udara, mohon dijelaskan angka 15-31 µg/m3 – 230 µg/m3 perhitungan. Kebisingan tahap konstruksi mohon dihitung
	V - 36	9. Point 5.3.1.4 medan EM, pernyataan .....sehingga tidak mampu mempengaruhi ikatan kimia pembentukan sel tubuh manusia. Medan EM terhadap kesehatan manusia oleh para ahli masih debatable, mohon pernyataan di dok, diperbaiki. Bab II mohon mengacu ke Peraturan Menteri Negara Lingkungan Hidup Nomor 8 Tahun 2006 seperti kondisi jika tidak ada proyek bandingkan dengan kondisi ada proyek. Tahap operasional dinyatakan 30 tahun, mohon kajian operasional adalah time series untuk 30 tahun.
	RKL	10. Pra konstruksi, mohon dilibatkan Kepala Desa dan buatkan sekema yang jelas, untuk sistem pengaduan dll, juga konstruksi karena triksi akan lebih tinggi.
	CV	11. Curiculum Vitae mohon ditanda tangani oleh yang bersangkutan.
	Umum	Saya kurang setuju pengambilan steam tahap I untuk membangkitkan turbin 110 MW. Pengambilan steam sebaiknya bertahap dengan MW yang lebih kecil hingga kebutuhan steam lebih kecil. Pengambilan steam besar ditahap awal akan mengganggu kesetimbangan fluids bawah permukaan.
5.		**Ir. Henny JM. Nainggolan (Bapedalda Provinsi Sumatera Utara)**
	II - 9	1. Dinyatakan tenaga kerja yang diperlukan untuk tahap konstruksi sekitar 100-150 orang tetapi pada hal II-15 (masih dalam tahap konstruksi) disebutkan tenaga kerja diperlukan 200-300 orang, yang mana yang benar? Berapa sebenarnya total tenaga kerja yang diperlukan.?
	II -15	2. Sebutkan bahan kimia apa saja yang termasuk B3 dan berapa banyak jumlahnya yang digunakan, demikian juga pemakaian oli; berapa volume pemakaian. Apakah tidak ada dibangun unit pengolahan khusus untuk ceceran limbah yang mengandung B3? Mengingat pada akhirnya limbah cair tersebut akan dibuang/dialirkan ke Sungai Batang Toru yang dimanfaatkan masyarakat setempat untuk kebutuhan hidupnya. Berapa jarak lokasi pembangunan PLTP khususnya outlet limbah cair dengan sungai Batang Toru.

NO	HAL	TANGGAPAN SARAN PERBAIKAN
	II – 25	3. Alinea 3-5 sebaiknya dibuat pada sub bab tersendiri.
		4. Sinkronkan komponen lingkungan tabel VI-1 hal VI-2 s/d VI-3 dengan tabel Matriks ringkasan Rencana Pengelolaan Lingkungan Hidup.
	II - 20	5. Material yang diperlukan sebagian didatangkan dari kota terdekat, sebutkan kota apa saja serta material apa? Supaya diprediksi dampaknya.
		6. Berapa luas lahan pertanian, perkebunan dan kawasan hutan yang akan dibebaskan? buat rincian masing-masing
		7. Lengkapi dokumen RKL antara lain : ▪ Upaya pengelolaan lingkungan dengan kegiatan yang jelas (contoh : jangan hanya bekerjasama dengan pihak terkait). Bentuk kegiatannya apa? ▪ Periode Pengelolaan Lingkungan Hidup buat yang jelas mis : 1x3 bln, 1x6 bln, dst (jangan selama periode tahap kegiatan). ▪ Pada tahap penerimaan tenaga kerja tambahan institusi pengawas adalah Dinas Tenaga Kerja Pemda Setempat.
6.		**Panusunan Harahap (Bappeda Provinsi Sumatera Utara)**
		1. Perlu membuat surat izin pinjam pakai ke Departemen Kehutanan apabila kawasan yang menjadi lokasi kegiatan melalui kawasan hutan.
		2. Kepada pihak pemrakarsa dan konsultan AMDAL agar benar-benar memperhatikan SK 44 Menhut- II/2005 tentang Penunjukan Kawasan Hutan di wilayah Provinsi Sumatera Utara.
		3. Mengenai perekrutan Tenaga Kerja agar diprioritaskan masyarakat yang berdomisili di lokasi kegiatan/proyek.
		4. Agar dibuat tabulasi tentang penggunaan lahan dan status lahan yang menjadi lokasi kegiatan, baik untuk jaringan transmisi dan bangunan pengeboran.
7.		**Dr. Tini Sembiring, MS (Pusllt SDAL - USU)**
	III – 3 s/d 4	1. RKL untuk parameter H2S pengelolaan hanya mengamankan lokasi sumur dst, apakah tidak ada upaya/teknologi mengabsorbsi/mereduksi, gas H_2S yang timbul sehingga kandungan yang kelingkungan lebih kecil.
	III – 11	2. Hal yang sama pada tahap operasional.
		3. Tahap pasca operasi, ada kualitas air permukaan tidak ada, tapi pada matriks ada, dan pada matriks lokasi pemantauan bukan Sungai Batang Toru, bagaimana ini? Apakah pada tahap operasi tidak ada dihasilkan limbah padat dan limbah cair? Bagaimana dampaknya ke air permukaan? Kualitas air permukaan, tidak ada pada pemantauan. Padahal rona awal ada.
		4. Kami tidak ada melihat komponen biologi, baik dalam pengelolaan maupun pemantauan, mengapa? Padahal ini penting dan rona awal lingkup diambil.
8.		**Suherman (Dinas Kesehatan Provinsi Sumatera Utara)**
	III – 78	1. Ada perbedaan antara narasi III-78 dengan tabel III.41 tentang jumlah dokter.
	V – 5	2. Dampak H_2S terhadap kesehatan masyarakat agar dipertimbangkan pada saat produksi dikaitkan dengan kesiapan pelayanan kesehatan saat produksi.
	V - 6	3. Kebisingan terhadap kesehatan masyarakat agar dikaji.
	III – 72	4. Agar dijelaskan..... sistem pelayanan privase gad & publik gad dengan warga proyek mengingat keterbatasan SD kesehatan dan banyaknya pekerja (900 s/d 1200) sedangkan penduduk hanya 400 orang (± 25%).
	I	5. Peraturan Perudang-undangan, tambahkan Keputusan Menteri Kesehatan Nomor 907.
	III - 75	6. Kualitas air bersih untuk RT agar diperiksa sebagai data awal sanitasi.
	III - 73	7. Keslapan kesehatan pada situasi darurat kurang memadai agar situasi darurat ini lebih dijelaskan pada bab prakiraan disebabkan oleh apa dan bagimana menyiapkannya.

NO	HAL	TANGGAPAN SARAN PERBAIKAN
9.		**M. Zulfan, SH (Kantor Wilayah BPN Provinsi Sumatera Utara)** 1. Dasar hukum agar dicantumkan juga : • Peraturan Pemerintah Nomor 16 Tahun 2004 tentang Pemetagunaan tanah • Peraturan Pemerintah Nomor 36 Tahun 2005 jo Peraturan Pemerintah Nomor 65 Tahun 2006 tentang Pengadaan Tanah Bagi Pelaksanaan Pembangunan untuk kepentingan umum. 2. Apakah sudah ada surat penetapan lokasi? kalau sudah ada harus dicantumkan juga. 3. Sebelum dilaksanakan pembebasan lahan, hendaknya dilakukan identifikasi dan inventarisasi terhadap lahan yang akan dibebaskan. Hal ini penting agar dalam pembebasan tanah tersebut dapat berjalan dengan tepat waktu dan sesuai dengan rencana sehingga tidak menimbulkan permasalahan-permasalahan dikemudian hari. 4. Berapa luas lahan yang termasuk kawasan hutan? 5. Cantumkan juga pada bagian dasar hukumnya Undang-undang kehutanan. 6. Cantumkan peta RTRW Kabupaten Tapanuli Utara. 7. Kurangnya sosialisasi kepada masyarakat mengenai rencana proyek ini. 8. Peta lokasi proyek.
10.		**Gunawan Arinto (Kodam I Bukit Barisan)** 1. Dampak negatif keresahan masyarakat penyerapan tenaga kerja baik skill dan Non skill agar dikaji kembali untuk semaksimal mungkin menggunakan tenaga lokal melalui : • Seleksi dan pelatihan oleh perusahaan • Perusahaan mempunyai program pelatihan bagi tenaga lokal dari non skill dan skill. 2. Pembebasan tanah. Hendaknya berpedoman kepada peraturan yang ada serta dibentuk panitia pembebasan lahan dan hindari keresahan masyarakat melalui pelibatan aparat desa, kelurahan dan kecamatan.
11.		**Effendi Siahaan, SE (Bainprom Sumatera Utara)** 1. Apabila perusahaan ini PMA tolong dicantumkan dulu dokumen surat persetujuan (SP) yang dikeluarkan oleh BKPM. 2. Mengenai dampak sosial ekonomi dan budaya tentang bantuan kepada masyarakat yang disebut dengan CSR (Community Sosiality Responsibility) tolong dimasukan dalam dokumen agar masyarakat mengetahui tingkat keseriusan dan transparan. 3. Penyerapan tenaga kerja agar hendaknya anak daerah dilatih supaya menjadi skill.
12.	II –21 II – 3	**Novelinna Limbong, S.Hut (Dinas Kehutanan Provinsi Sumatera Utara)** 1. Sejauh mana pembangunan tersebut tidak menimbulkan erosi dan tanah longsor (penyiapan lahan). 2. Apakah areal tersebut diluar kawasan hutan? Agar diplotkan pada peta kawasan hutan Sumatera Utara dan peta Tata Ruang Provinsi Sumatera Utara dan Kabupaten Tapanuli Utara. Sesuai peta pada hal II-30, kegiatan –kegiatan tersebut berada pada kawasan hutan produksi. Untuk itu agar diurus ijin pinjam pakai kawasan hutan dari Menteri Kehutanan.
13.	1 II.1	**Ir. Sumintarto (Dinas Pertambangan & Energi Provinsi Sumatera Utara)** 1. Judul pembangunan PLTP 330 MW ini kapasitas (1x330 MW) atau total 330 MW dengan tahapan pembangunan PLTP, misal (2x115). Pada RKL. Kata pengantar perlu dijelaskan bila pembangunan PLTP bertahap antara lain : dimensi sumppit, kapasitas boine untuk reinjeksi. 2. Bab II Pendekatan Pengelolaan Lingkungan teknologi pemboran perlu dijelaskan sumber air untuk lumpur pemboran, debit pengambilan dll.

NO	HAL	TANGGAPAN SARAN PERBAIKAN
	II.2	3. Limbah minyak zat kimia, agar dijelaskan juga pembuatan manifes pengumpulan dan penyaluran pelumas bekas.
	II.5	4. Community Development agar program CD dikoordinasikan dengan instansi terkait/PEMDA
	III.3	5. Tahap konstruksi, juga dimasukkan commisioning PLTP flow line, penanganan lumpur bor.
	III.4	6. Kapan dilakukan kepada tokisitas, penentuan lokasi akhir lumpur bor/certtying.
	III.11	7. Tahap Operasi : tidak hanya operasi PLTP, tetapi produksi sumur, reinjeksi, cooling uap, kondensate penompaan condensate.
14.		Ir. Untungta, M.App (Distamben SU)
	II-23	1. Paragraf 1. secara skematis memperlihatkan hubungan antara komponen uap dan brine. Apa maksud dari kalimat ini? Paragraf 2. penyebab penurunan kualitas sumur dengan sumur reinjeksi, kapan hal ini diperkirakan terjadi?
	II-25	2. Paragraf 1. mengapa terjadi perbedaan temperatur inlet dan outlet brine di SIL dan NIL 3. Zat-zat apa saja yang dapat ditemukan dari sumur bor panas bumi?
15.		Rudi Hartono Sitompul (Kepala Desa Simatahari, Pahae Julu) 1. Kami masyarakat Simataniari dekat ke NIL III jarak ± 300m. Dampak negatif yang kami takuti: • Konsentrasi H_2S masyarakat sangat takut terhadap gas H_2S. Supaya dikontrol setiap saat kalau sudah berjalan. • Kebisingan. Dampak negatif masyarakat sangat takut adanya gangguan terhadap kita terganggunya tidur, beribadah, dll. • Kami masyarakat Desa Simataniari. Kalau uda pekerja proyek mulai turun atau kontrol ke NIL I, II dan III supaya melaporkan ke Kepala Desa atau Tokoh Masyarakat karena kami tau apa yang dilakukan di NIL supaya kami tidak was-was. • Kami masyarakat kalau sudah berjalan proyek di NIL supaya pekerja dari desa yang dekat lokasi yang dipakai. Jangan seperti dicampakkan. Permintaan kami jangan seperti Indorayon. • Kami sangat mendukung atas bukanya PLTP Sarulla. • Kami mohon supaya mengganti nama desa Namora Ilangit menjadi desa yang terkait : 1. Desa Simataniari 2. Desa Lumban Jaran 3. Desa Sibaganding
16.		Marlan Sitompul (Kepala Desa Lumban Jalan – Kec. Pahae Julu) 1. Manfaat kegiatan : Salah satu manfaatnya adalah meningkatkan PAD Kabupaten dan Provinsi. Kenapa PAD Desa dan Kecamatan tidak ada ? 2. Hasil analisis laboratorium. Hal : Kualitas air tanah. Kami tidak pernah tahu bahwa pernah diadakan sampling kualitas air sumur penduduk. 3. Hasil analisis laboraotrium. Hal : kualitas udara. Kami tidak pernah dengar/tau nama desa Namora Ilangit tolong diperbaiki. 4. Pada saat penutupan sumur dan pembongkaran jaringan transmisi setelah semuanya selesai apakah lahan yang bekas digunakan proyek kembali ke pemilik sebelumnya. 5. Saat pembebasan lahan, kami Kepala Desa dan desa yang terkait ke proyek secara khusus harus dilibatkan.

NO	HAL	TANGGAPAN SARAN PERBAIKAN
17.		**Huntal Simatupang (Kepala Desa Pardamean Nainggolan – Kec. Pahae Julu)** 1. Mohon keadilan, kejujuran serta tranparansi yang tidak memandang sebelah mata, oleh pemerintah dan juga pihak perusahaan yang bekerja di pengembangan pembangunan Panas Bumi yang ada di daerah kec. Pahae Jae, Pahae Julu. 2. Mohon ditanggapi ke Silapan masyarakat pada waktu pembebasan lahan, agar apabila tanah tersebut tidak fungsikan lagi sesuai dengan pangsi PLTP, agar dikembalikan kepada masyarakat. Dasarnya tanah tersebut dijual dengan harga murah, demi pembangunan 3. Masalah kronologis pindah tangan tanah dari Unocal ke Pertamina/PLN. Apakah ini dasar bisnis? Tolong ini dijernihkan. 4. Mengenai jarak sumur ke tempat permukiman, apakah ini tidak bertentangan dengan kehidupan penduduk setempat ? Tolong dipikirkan secara sehat.
18.		**Sabar Simorangkir (Kepala Desa Silangkitang)** Permintaan kami dari Desa Silangkitang (masyarakat) supaya pekerjaan yang bisa kami kerjakan, supaya anak-anak kami masuk kerja dalam projek Pengembangan Lapangan Panas Bumi Dan Pembangunan PLTP Sarulla kapasitas 330 MW.
19.	11.12	**Novada Sitompul (Kepala Desa Sibaganding)** 1. Adanya keresahan masyarakat terhadap sumur bor dan uji produksi : a. Memang kami maklumi pada hari yang lalu Unocal belum sepenuhnya dialihkan ke PLN namun Unocal tidak benar memantau sumur bor, temyata terjadi kebocoran sumur pemboran di area NIL B. sehingga sempat meresahkan masyarakat sekitar lokasi. Maka mulai dari sekarang kami sangat mengharapkan agtar PT. SOI lebih was-was dan rutin memantau sumur pemboran setaip harinya. b. Kami yang secara langsung yang hidup di alam area proyek, Duku Pete sebagai hasil kebun rakyat setempat sebelum diperkirakan ± 10.000/minggu, setelah terjadi pemboran atau uji coba, petai tersebut pada bermatian atau tak berbuah lagi secara perlahan-lahan, hal apakah yang mengakibatkan terjadi dan kami tidak, apakah karena tambah panas. pH air kami dari masyarakat meminta agar pihak proyek bersama dengan pemerintah mengadakan riset atau penelitian khusus tentang hal tersebut.
20.	II – 4 RPL	**Maria Sihombing (Bappeda Kabupaten Tapanuli Utara)** 1. Salah satu dampak penting yang dipantau adalalah kandungan H_2S diudara. Ini berarti H_2S merupakan salah satu gas yang timbul akibat beroperasinya PLTP Sarulla. Apakah tidak ada gas ikutan lainnya yang terdeteksi yang timbul akibat beroperasinya proyek dimaksud. Jika ada, upaya apa yang dilakukan pihak pengembangan untuk mengatasinya. 2. Point 44. Supaya Dicantumkan Badan Pertanahan Nasional Kabupaten Tapanuli Utara atau Provinsi Sumatera Utara dan dicantumkan pada lampiran matriks ringkasan RKL. 3. Pembangunan Proyek PLTP Sarulla diperkirakan akan menimbulkan dampak bagi masyarakat disekitar lokasi dan di dalam AMDAL dijabarkan bahwa dampak yang ditimbulkan dapat dikelola dengan teknologi saat ini. Pendekatan teknologi apa yang dilaksanakan pihak pengembang untuk memimalisir dampak negatif yang ditimbulkan dan apakah teknologi tersebut telah pernah berhasil dilaksanakan di lokasi panas bumi lainnya di Indonesia. 4. Perlu juga air minum masyarakat di lokasi PLTP dipantau dan dicantumkan pada lampiran matriks ringkasan RPL.

NO	HAL	TANGGAPAN SARAN PERBAIKAN
	III – 2 RKL II - 5	5. Nama institusi pengelolaan lingkungan tertulis Bapedalda Provinsi Sumatera Utara seharusnya Kantor Lingkungan Hidup Kabupaten Tapanuli Utara. Supaya disesuaikan juga pada matriks ringkasan RKL. 6. Nama institusi pengelolaan lingkungan Tertulis Bapedalda Provinsi Sumatera Utara Bapedalda Kabupaten Tapanuli Utara Seharusnya Bapedalda Provinsi Sumatera Utara Kantor Lingkungan Hidup Kabupaten Tapanuli Utara Dan supaya disesuaikan pada matriks ringkasan RPL. 7. Pada RPL juga perlu pemantauan terhadap kesehatan masyarakat sekitarnya. Satuan : Untuk menganitisipasi dampak kesehatan bagi masyarakat, ada baiknya pihak pengembang melaksanakan penelitian terhadap database kesehatan masyarakat saat ini, Dengan demikian dapat dibandingkan dengan setelah proyek beroperasi. 8. Saran : Pelaksanaan kegiatan RKL dan RPL sebaiknya dilaporkan persemester/6 (enam) bulan sekali, 9. Saran : ada baiknya sosialisasi analisis dampak lingkungan, RKL, RPL } Pengembangan Lapangan Panas Bumi dan Pengembangan PLTP Sarulla dilaksanakan di lokasi sekitar PLTP Sarulla. 10. Dari hasil koordinasi/konsultasi kami ke Badan Koordinasi Penanaman Modal bahwa perusahaan (PT. SOI) tidak terdaftar sebagai PMA. Saran Supaya hal ini ditindaklanjuti perusahaan supaya ada surat persetujuan (SP) dari BKPM.
21.	 IV - 12 II – 63 II – 60 I – 4	**Jumaga Nainggolan, SKM, MSi (Kantor Lingkugnan Hidup Kabupaten Tapanuli Utara)** 1. Komponen kesehatan masyarakat, sebaiknya mencanturnkan angka kesakitan masyarakat, sebagai parameter pada daftar prioritas dampak penting hipotetik. 2. Upaya pencegahan penyakit menular seperti DBD (sebagai akibat mobilisasi karyawan) supaya dicanturnkan. 3. Gambar II – 10 tambah kotak (Kesehatan masyarakat). 4. Manfaat untuk meningkatkan PAD pada tingkat Kabupaten dan propinsi supaya dibuat kwantitatif. (berapa persen). 5. Garis koordinasi yang tegas menggambarkan peran Pemkab. Tapanuli Utara yang Kantor Lingkungan Hidup supaya dibuat.
22.		**Maju Tampubolon (Kantor Camat Pahae Jae)** 1. Dalam pelaksanaan tahapan-tahapan agar dilaksanakan sesuai jadwal 2. Tenaga kerja yang dibutuhkan agar benar-benar diprioritaskan penduduk/masyarakat setempat. 3. Balas budi bagi pemilik lahan agar dipertimbangkan untuk memperoleh imbalan lain berupa pemilikan (saham) disesuaikan dengan luas area yang diberikan. 4. Pengadaan tender pelaksanaan konstruksi agar dilibatkan/diprioritaskan terutama dalam pelaksanaan non teknis.
23.		**Erwin Kurnia Alamsyah Siregar (Orang Utan Conservation Services Program (OCSP) Medan)** 1. Kawasan operasi SOL berada dekat dan di dalam kawasan hutan batang toru, yang merupakan juga habitat satwa liar agar dapat penjaga keseimbangan ekosistem sekitarnya, sebaiknya SOL dapat menjalin kerjasama dengan lembaga-lembaga konservasi dan pihak-pihak lainya dalam membangun sinerjitas kerja demi keberlangsungan lingkungan hidup.

NO	HAL	TANGGAPAN SARAN PERBAIKAN
28.		**Manahara Sitompul, SE (Persatuan Luat Pahae Indonesia)** 1. Mohon jangan disahkan (diteken) dokumen ANDAL, RKL, RPL ini sebelum diperbaiki sesuai masukkan dan ketentuan yang berlaku. .... kepada Bapedalda Sumut dan KLH Tapanuli Utara. 2. Libatkan unsur masyarakat dan PLPI dalam hal dimaksud untuk ANDAL, RKL dan RPL
29.		**T.Sitompul (Tokoh masyarakat Silbaganding, Pahae Julu)** 1. Setelah kami baca dalam buku Draf dari SOL bahwa: ▪ Luas tanah tambahan akan dibebaskan di lokasi Silangkitang (Sil). Ril berjumlah 70 Ha (cara bertahap) yakni untuk tapak pembebasan dan jalan penghubung, dll. ▪ Sebagaimana kita ketahui tanah di area tersebut adalah tanah warisan dan dimiliki cara turun – temurun . ▪ Untuk pembebasan tanah sudah pasti suatu pekerjaan yang tidak mudah karena pemiliknya mungkin telah berada di daerah lain. ▪ Yang menjadi pertanyaan / saran : Apakah tidak lebih efektif seandainya pembebasan tanah didahulukan dari konstruksi/ pra konstruksi. 2. Transmisi / jaringan yang berjarak 15 km dari Sil ke Ril yang bertegangan tinggi sebesar 150 kV yang melalui kebon masyarakat / persawahan. Didalam buku draff dan sosialisasi yang kami dapat tidak akan diganti rugi karena tidak mengganggu – "aman". Pertanyaan : bahwa memang sudah siapkah masyarakat dengan hanya lebel "aman" untuk menerima keadaan ini ?
30.		**Pdt. Cipto Aman Sitompul Sth. (Tokoh masyarakat Silangkitang (pemilik lahan))** 1. Permohonan : harga tanah yang diganti rugi ke unocal 12 tahun yang lalu, supaya ditinjau kembali ,± 45 Ha (di samakan harganya dengan tanah yang 70 Ha lagi yang belum dibebaskan) Harus adil .....? 2. Pertanyaan ! Tanah yang 45 ha. Apakah sudah dijual ke PLN atau belum siapa yang bertanggung jawab atas tanah ini ? 3. Permintaan : anak sekitar harus diutamakan menjadi Karyawan (banyak disana tamatan SMA yang mengganggur). 4. Permintaan : Rumah ibadah harus dibangun di Huta Sampil-pil GPDI (perbatasan) Rumah Ibadah harus dibangun di Huta Sihobuk GBI (Perbatasan) Rumah Ibadah harus dibangun di Huta Godung Gereja Oikumene (Pertengahan). 5. Permintaan : jangan dilakukan pekerjaan di atas tanah yang belum dibebaskan : "Utamakan Keselamatan Penduduk " 1. Lokasi Perumahan (Pemukiman) 2. Utamakan Kesejahteraan Masyarakat 6. Permintaan : Agar pemasukan barang-barang ke Perusahaan (yang dibutuhkan) yang mengadakan supaya Anak Daerah (kontraktor).
31.		**Ir. Jones Simatupang (Putra daerah Pahae Julu)** 1. Secara umum RPL ini masih kurang lengkap dan nampaknya studi yang dilakukan kurang dalam pada hal proyek ini mempunyai dampak yang sangat kuat kepada masyarakat. Pertanyaan : Siapa pihak yang bertugas memantau semaunya pelaksanaan dan rencana : a. bagian dari proyek ? b. pemerintah? c. Independent (contoh Perguruan Tinggi) d. Konsorsium (kerjasama) antara perusahaan dan external. 2. Pesan : Perusahaan memperoleh profit wajar tetapi benefit bagi masyarakat manusiawi. Sesama manusia mari kita sama - sama menjaga kondisi.

NO	HAL	TANGGAPAN SARAN PERBAIKAN
32.		**Dr. Hulman Sitompul , SpOG (Ketua Umum Masyarakat Pahae Indonesia)** 1. Kita mendukung proyek ini. 2. nama Sarulla Operation Ltd. Perlu ditinjau lebih baik Pahae Ltd. Karena lokasi bukan diSarulla tetapi di Pangaeran dan Sibaganding Pahae. 3. Perlu keterbukaan yang sejelas – jelasnya kepada masyarakat apa untung rugi dan lingkungan akibat proyek ini. Dan perlu seminar berulang-ulang kepada masyarakat. 4. Bila timbul efek atau dampak lingkungan yang merugikan masyarakat siapa yang bertanggung jawab apakah Perusahaan, Pemda Taput, atau Pimpinan Rapat hari ini. 5. Masyarakat manakah yang disejarterakan proyek ini? Harapan kami yang pertama harus masyarakat Pahae terutama yang di daerah Lakasi baru Taput dll. Karena mereka telah menjual tanahnya yang selama ini susah hidupnya. 6. Untuk tenaga kerja perlu putra daerah dan disekolahkan dan dilatih supaya ada manfaat proyek ini kepada masyarakat. 7. Sehabis masa Proyek supaya tanah di kembalikan kepada masyarakat yang punya tanah sebelumnya.
33.		**Lamsiang Sitompul ,SH** 1. Pembayaran ganti rugi jangan ditekankan kepada Peraturan Perundang-undangan tapi harus lebih mengarah kepada memberikan keuntungan kepada masyarakat dan perlu harga yang transparan dari SOL. 2. Mendata jumlah potensi tenaga kerja dan kebutuhan akan tenaga kerja dan menyelaraskannya jangan terlalu ditekankan pada kualifikasi. 3. Peran serta masyarakat dalam setiap tahap. 4. Ada pajak , loyalti jangan di bayarkan oleh SOL harus dijelaskan pembagiannya sampai ke desa, Undang-undang Otonomi Daerah, Dana Perimbangan. 5. RPL disusun secara asal-asalan dibuktikan dengan penulisan desa yang tak benar antara lain : Siantolog, lumban garogi, labupiring, Siparbar plaraja, pembebasan lahan harus BPN. Tenaga kerja : Second Opinin harus ada sehingga proyek ini dapat dipertanggung jawabkan. 6. RUTR 7. Hutan → belum ada pemetaan dan Rekonstruksi batas sehingga sulit untuk mengetahui dan mengawasi.

KEPALA BAPEDALDA PROVINSI
SUMATERA UTARA
Selaku Ketua Komisi PeNILai AMDAL
Provinsi Sumatera Utara

Prof. H. SYAMSUL ARIFIN, SH, MH
PEMBINA UTAMA
NIP. 130869985

NO	HAL	TANGGAPAN SARAN PERBAIKAN
24.		**Pasonly Siburian (Pemuda Pahae)** 1. Informasi antar : - Dimana masyarakat bisa mendapatkan informasi tentang SOL 2. Dampak Sosial - Mohon diperhatikan budaya-budaya lokal (kearifan lokal) 3. Tenaga kerja - Memampukan/memberi beasiswa kepada masyarakat untuk memepelajari tentang geothermal 4. Kesehatan - Penanggulangan dampak-dampak kesehatan (kimia, dll) - Memberi pelayanan kesehatan 5. Lingkungan - Tidak merusak habitat asli - Mewaspadai gempa (pahae daerah patulan) sehingga pahae tidak bagian dari Sidoharjo sebagai pembangunan 6. Pembebasan lahan - Ini adalah pembodohan jika lahan tertentu sudah ditenderkan padahal belum ada ganti - untung rakyat siap bergerak mendampingi masyarakat pahae 7. CSR - Dimana ? Siapa yang mengelola ? 7. Konflik - Manajemen konflik yang potensial tidak membenturkan sesama orang lokal
25.		**Drs. H. Sitompul (LSM Pungak Keadilan Rakyat)** 1. Perlu didengar aspirasi masyarakat tentang tenaga kerja diprioritaskan kepada masyarakat sebagai tempat kedudukan perusahaan. 2. Mengenai pembebasan tanah harus sama-sama untung dan kalau boleh masyarakat yang terkena lahannya diikutkan sebagai pemilik saham. 3. Mengenai borongan atau tender yang layak dikerjakan perushaan lokal harus diprioritaskan kepada perusahaan lokal. 4. Pembuangan limbah harus jelas jangan dari jalan umum atau dari saluran air ke sawah masyarakat. 5. Apa tanggung jawab perusahaan apabila terjadi resiko yang sangat buruk yang diakibatkan perusahaan. 6. Bagaimana pembagian royalti kepada daerah atau DC.
26.		**Drs. H. Sitompul (LSM Pungak Keadilan Rakyat)** Pembahasan AMDAL Panas Bumi Sarulla hanya pembentukan suatu consultan yang terpadu. Antara pemerintah, perusahaan dan masyarakat yang dihunjuk dan dipercayai oleh masyarakat. Cari cara yang bisa memecahkan masalah pembahasan AMDAL Panas Bumi Sarulla.
27.		**Marali P. Pasaribu (Persatuan Pangaranto Luat Pahae)** 1. Apa latar belakang Pemrakarsa mengangkat nama menjadi SOL/Sarulla Operation Ltd, bukan memakai nama Pahae secara khusus padahal lokal area proyek adalah Pangaloan dan Pahae Kulu. Sub kontrak yang bagaimana kualitas yang diinginkan daripada SOL yang mengakibatkan kontraktor-kontraktor daerah pahae tidak dimasukkan. Kontribusi apa yang sudah diberikan oleh SOL kepada masyarakat lokasi proyek pada khususnya ? Di dalam matrik yang disajikan ada kolom pengawasan, kenapa dalam pengawasan tersebut tidak diikutsertakan pengawasan external atau tokoh masyarakat (dan lembaga lainnya)

TANGGAPAN DAN SARAN MASUKAN
RAPAT DAN PENILAIAN DOKUMEN – ANDAL, RKL, DAN RPL
PENGEMBANGAN LAPANGAN PANAS BUMI DAN PLTP SARULLA
DENGAN KAPASITAS 330 MW
HARI/TANGGAL : SELASA/11 NOVEMBER 2008
TEMPAT : AULA BAPEDALDA PROVINSI SUMATERA UTARA

No	Halaman lama	Tanggapan / Saran/Masukan	Perbaikan Tanggapan/Saran/Masukan	Halaman Baru
1		**Prof. Dr. Retno Widiastuti, MS (Staf Ahli Bapedalda Sumatera Utara)**		
	III-32	1. Buat dalam tabulasi jenis-jenis vegetasi pada hutan campuran. Melihat dari Gambar III.5, hutan campuran tidak mungkin hanya karet dan kemenyan. Tabulasi buat dalam nama latin.	❖ Gambar III-5 merupakan hasil foto lapangan yang menggambarkan kondisi hutan di lokasi studi, berdasarkan foto tersebut lokasi PLTP merupakan lahan hutan campuran yang sudah ditanami masyarakat dengan berbagai tanaman budidaya. ❖ Data vegetasi di lokasi studi ditampilkan pada Tabel III-7 dan data fauna ditampilkan pada Tabel III-8.	ANDAL, hal III-34 s.d III-35 ANDAL, hal III-34 s.d III-35 dan III-37 s.d III-38
	III-34	2. Sebutkan jenis-jenis vegetasi dengan nama latinnya sebagai habitat satwa liar.	❖ Jenis-jenis vegetasi yang berfungsi sebagai habitat satwa liar dijelaskan pada rona lingkungan tentang habitat satwa liar dan telah ditampilkan dalam Tabel III-7.	ANDAL, hal III-37 s.d III-38
	III-35 – III-36	3. - Satwa liar dibuat dalam tabulasi dengan nama latinnya Sebelum narasi pembahasan. - Tambahkan satwa liar yang dilindungi sesuai dengan PP No. 7 tahun 1999 yang menjadi alasan PP tersebut digunakan seperti yang dituliskan dalam dokumen ANDAL halaman I-6.	❖ Data satwa liar ditampilkan pada tabel III-8 dan sudah dilengkapi dengan informasi jenis-jenis satwa yang tergolong jenis-jenis dilindungi menurut PP No 7 Tahun 1999.	ANDAL, hal III-38 s.d III-39
	BAB VI dan RKL hal III-5	4. Evaluasi Dampak Penting. Untuk mengurangi dampak kebisingan selain dengan alat peredam juga dapat dengan menanam vegetasi pohon yang berkanopi lebar di sekitar lokasi proyek.	❖ Sudah ditambahkan pada dokumen RKL: Penanaman pohon dengan jenis-jenis yang mempunyai kanopi lebar sebagai peredam kebisingan, seperti bambu.	RKL, hal. III-5, III-14 dan Matrik RKL
2		**Drs. Chairul Azhar, MSc (Staf Ahli Bapedalda Provinsi Sumatra Utara)**		
	I-1	1. Penulisan nama Pertamina disesuaikan dengan bagian yang menangani panas bumi. Pertamina adalah pengertian umum.	❖ Penulisan nama Pertamina masih digunakan sebelum tahun 2007, sesuai dengan perkembangan bisnis Pertamina dimana bidang panas bumi ditangani oleh anak perusahaan Pertamina yaitu Pertamina Geothermal Energy. Telah diberi catatan kaki pada dokumen.	ANDAL, hal I-3
	II-2	2. Apakah dokumen ini merupakan AMDAL terpadu? Apa	❖ AMDAL Pengembangan Lapangan Panas Bumi dan Pembangunan PLTP Sarulla bukan merupakan Amdal Terpadu,	ANDAL, hal II-2

No	Halaman lama	Tanggapan / Saran/Masukan	Perbaikan Tanggapan/Saran/Masukan	Halaman Baru
		alasannya?	melainkan Amdal yang bersifat terintegrasi, dengan kegiatan yang terdiri dari Pengembangan lapangan panas bumi, pembangunan dan pengoperasian PLTP serta jaringan listrik dari SIL ke NIL yang kewenangan perijinan seluruh kegiatan tersebut hanya dari satu instansi yaitu Departemen Energi dan Sumberdaya Mineral.	
	II-8	3. Apa maksudnya pH dikontrol dengan H_2SO_4?	❖ Pengontrolan pH oleh H_2SO_4 dimaksudkan untuk mencegah terbentuknya kerak (*scaling*). Penambahan asam akan ditentukan berdasarkan karakteristik brine.	ANDAL, hal II-9
	II-11	4. Tertulis ”persiapan dan konstruksi tapak sumur”. Apa maksudnya?	Kalimat ”persiapan dan konstruksi tapak sumur” diubah menjadi ”persiapan lahan untuk tapak sumur dan pembangunan sumur” (sub bab 2.2.2.2.1 point 4b).	ANDAL, hal II-13
	II-18	5. Pembangunan PLTP. Jelaskan letak detail lokasi PLTP SIL dan NIL.	❖ Letak detail PLTP SIL dan NIL sudah ditambahkan pada Peta II-1.	ANDAL, hal II-5
	II-21	6. Pemasangan menara transmisi. Jelaskan tapak menara dan lahan yang dilalui transmisi. Bagaimana status lahan di bawah jaringan transmisi? Berapa jumlah menara dan jarak antar menara?	❖ Lahan sebagai tempat akan dibangunnya menara pada saat ini belum dibebaskan, lahan yang dilalui jaringan transmisi listrik akan diupayakan sedemikian rupa bukan merupakan lahan yang produktif, pemakaman umum, atau perumahan. ❖ Status lahan di bawah jaringan transmis listrik tetap merupakan lahan milik masyarakat yang tidak dibebaskan. Sedangkan lahan yang akan dibebaskan hanya pada tapak menara. ❖ Jarak antara menara adalah 350 meter dan jumlah menara yang akan dibangun diprakirakan sebanyak 40, Satu menara memerlukan lahan seluas 225m^2.	Hal. II-33, Lahan ditunjukan pada peta II-2
	II-29	7. Tercantum kawasan hutan. Hutan apa?	❖ Status kawasan hutan pada Peta II-3 didasarkan pada SK Menteri Kehutanan No 44/Menhut-II/2005 tentang Penunjukan Kawasan Hutan di Wilayah Sumatera Utara Seluas ± 3.742.120 Hektar. ❖ Berdasarkan penetapan kawasan tersebut diperoleh bahwa areal Pengembangan Lapangan Panas Bumi dan Pembangunan PLTP Sarulla terdiri dari Areal Penggunaan lain (APL), Hutan Produksi yang dapat di Konversi (HK) dan Hutan Produksi (HP).	ANDAL, Peta II-2, hal II-33
	III-4	8. Kualitas udara: Bagaimana membandingkan parameter yang diperoleh dengan peraturan? Satuannya berbeda.	❖ Parameter kualitas udara mengacu pada PP No 41 tahun 1999 yang meliputi: SOx, NOx, Pb, dan Debu, dengan satuan µg/Nm^3. ❖ Parameter H_2S dan NH_3 mengacu pada Kep-50/MENLH/11/1996 tentang Baku Mutu Tingkat Kebauan dengan satuan ppm (*part per million*). ❖ Satuan parameter-parameter tersebut telah sesuai dengan baku mutu yang diacu.	ANDAL, III-6

No	Halaman lama	Tanggapan / Saran/Masukan	Perbaikan Tanggapan/Saran/Masukan	Halaman Baru
	V-24	9. Uji produksi sumur termasuk dampak penting. Lumpur bor harus dikelola saat pemboran.	❖ Prosedur pengelolaan lumpur bor, limbah lumpur dan serbuk bor akan dikelola sesuai dengan Peraturan Menteri ESDM No. 045 Tahun 2006. Uraian pengelolaan lumpur bor telah dikemukakan dalam Bab II, sub bab 2.2.2.2 point c Pemboran dan Uji Produksi. ❖ Telah dicantumkan pada dokumen RKL Bab III sub bab 3.4.1.	ANDAL, hal II-16 dan II-17 RKL, hal III-19 s.d III-20
	V-26	10. Periksa perkiraan dampak penting dan sesuaikan dengan tabel VI.1 karena ada perbedaan. Sebagai contoh, dampak H_2S diprediksi –TP, tetapi pada tabel VI.1 menjadi –P. Periksa juga yang lain. Kondisi ini terkait dengan RKL dan RPL.	❖ Prakiraan dampak H_2S pada tahap konstruksi dengan kegiatan pemboran sumur dan uji produksi tergolong dampak –P (lihat subbab 5.2.1.1.2) dan ini sudah disesuaikan dengan Tabel VI.1 pada kolom kesimpulan dampak. ❖ Prakiraan dampak H_2S pada tahap operasi PLTP tergolong dampak –P (lihat subbab 5.3.1.1) dan ini sudah disesuaikan dengan Tabel VI.1 pada kolom kesimpulan dampak.	ANDAL, hal V-5 s.d V-7, Tabel VI-1 hal VI-2 s.d VI-3 ANDAL, hal V-33 s.d V-39, Tabel VI-1 hal VI-2 s.d VI-3
	V-45	11. Apakah air limpasan merupakan dampak penting?	❖ Berdasarkan hasil prakiraan dampak air limpasan dari kegiatan reklamasi dan rehabilitasi lahan tergolong dampak positif tidak penting (+TP).	ANDAL, hal. V-55 s.d V-57
3		**Drs Chairuddin, MS (Staff Ahli Bapedalda Provinsi Sumatera Utara)**		
	III-6	1. Kebisingan dibuat dengan harga rata-rata bukan range minimal/maksimum.	❖ Hasil pengukuran disamping nilai kisaran juga telah dicantumkan nilai rata-rata (lihat Tabel III-1).	ANDAL, hal III-6
	III-6	2. Satuan untuk kualitas udara ambient disesuaikan dengan PP No 41 tahun 1999 ($\mu g/Nm^3$).	❖ Telah disesuaikan dengan PP No 41 Tahun 1999 yaitu $\mu g/Nm^3$ (lihat Tabel III-1).	ANDAL, hal III-6
	III-8	3. Kutipan literatur pembahasan kualitas air tidak tercantum dalam DAFTAR PUSTAKA.	❖ Literatur Kualitas air sudah dimasukkan.	ANDAL, Daftar Pustaka
	V-43	4. Bagaimana kondisi medan listrik dan magnet pada rona awal?	❖ Pembahasan rona awal medan listrik dan medan magnet dapat dilihat pada sub bab 5.3.1.4.	ANDAL, hal V-44 s.d V-45
	V-17 (V-36)	5. Pernyataan tentang pengaruh pH air permukaan pada hal V-17 berbeda dengan pada halaman V-36.	❖ Pernyataan pada halaman V-18 s.d V-19 yang menjelaskan tentang dampak kegiatan pemboran dan halaman V-42 s.d V-43 menjelaskan tentang dampak kegiatan reinjeksi air panas dan brine.	ANDAL, hal V-18 s.d V-19 serta hal V-42 s/d V-43
	VI-8	6. Pembahasan emisi H_2S pada hal V-5 dan VI-8 diuraikan lebih rinci.	Pembahasan emisi H_2S telah diperbaiki.	Tahap Konstruksi: ANDAL, hal V-5 s.d V-7, Tabel VI-1 hal VI-2 s.d VI-3 Tahap Operasi: ANDAL, hal V-33 s.d V-39, Tabel VI-1 hal VI-2 s.d VI-3
	RKL/RPL	7. Sebutkan sumber, karakteristik dan jumlah limbah B3 dan cantumkan uji TCLP dalam Rencana Pemantauan	❖ Sumber, karakteristik dan jumlah limbah B3 telah dicantumkan pada Tabel II-9	ANDAL hal II-31 dan RPL, hal II-17

No	Halaman lama	Tanggapan / Saran/Masukan	Perbaikan Tanggapan/Saran/Masukan	Halaman Baru
		Lingkungan Hidup.	❖ Uji TCLP telah dicantumkan dalam RPL (lihat subbab 2.3.3.1)	
4		**Ir. M. Eka Onwardana (Staff Ahli Bapedalda Provinsi Sumatera Utara)**		
	iii	1. Abstrak. Mohon lihat Permen LH No. 8/2006 yang mengemukakan berbagai kemungkinan dampak penting (mohon dirinci).	❖ Penulisan abstrak telah diperbaiki sesuai dengan Permen LH No. 08/2008 yang berisi rencana usaha dan/atau kegiatan dengan berbagai kemungkinan dampak penting baik pada tahap prakonstruksi, konstruksi, operasi dan pasca operasi. ❖ Abstrak juga sudah mengemukakan masukan penting yang bermanfaat bagi pengambilan keputusan, perencanaan dan pengelolaan rencana usaha dan/atau kegiatan.	Abstrak
	II-2	2. Point 2.2.1 masih menguraikan pernyataan AMDAL yang lama (sebaiknya cukup pada latar belakang).	❖ Pernyataan AMDAL yang lama sudah dihilangkan.	ANDAL, hal. II-2
	II-3	3. Ada pernyataan RTRW Kabupaten Tapanuli Utara. Mohon peta RTRW dilampirkan.	❖ Peta Rencana Struktur Tata Ruang Kabupaten Tapanuli Utara sesuai dengan Perda Kabupaten Tapanuli Utara No. 21 Tahun 2001 ditampilkan pada Peta III-4.	Peta III-4, hal III-24
	II-4	4. Tentang rencana penggunaan lahan mohon ditabelisasikan agar lebih gampang terlihat.	❖ Rencana Penggunaan Lahan di SIL dan NIL telah dicantumkan pada Tabel II-2.	ANDAL, hal II-8 s.d II-9
	II-6	5. Tabel II-1 mohon dibuat rinci sesuai dengan rencana pengembangan.	❖ Tabel II-1 telah dilengkapi	ANDAL, hal II-6
	II-18	6. Poin 2 Mobilisasi Peralatan dan Bahan. Jalan-jalan lintas Sumatera mana yang dipakai? Diperjelas.	❖ Telah ditambahkan dengan rute Pelabuhan Belawan – Medan – Deli Serdang – Serdang Bedagai – Tebing Tinggi – Pematang Siantar – Parapat – Balige – Tarutung – Lokasi proyek Sarulla (Pahae Julu dan Pahae Jae)	ANDAL, hal II-20
	II-25	7. Poin 2.2.2.3.3 diperbaiki menjadi Jaringan Transmisi T/L 150 kV dari SIL ke NIL…..? Bagian dari subsistem Sumatera Bagian Utara	❖ Telah diperbaiki pada paragraph satu sub bab 2.2.2.3.3	ANDAL, hal II-28
	V-4 dan V-6	8. Mohon jelaskan angka 15-31 µg/m^3 → 230 µg/m^3 dalam perhitungan. Kebisingan tahap konstruksi mohon dihitung.	❖ Angka 15 – 31 µg/m^3 adalah nilai TSP berdasarkan pengukuran di lapangan (rona lingkungan) ❖ Angka 230 µg/m3 adalah nilai baku mutu TSP sesuai dengan PP No 41 Tahun 1999 ❖ Kebisingan pada saat pemboran sumur (dibatas tapak sumur) adalah 75 – 79 dBA ❖ Tingkat kebisingan puncak pada saat tahap konstruksi di PLTP diperkirakan sebagai berikut: o Kegiatan mobilisasi alat berat: 6 jam per hari, 10 titik (4 SIL-6 NIL), 60-70 dBA o Pelepasam uap (*Steam blowing*): 1 jam per hari, 2 titik (1 SIL-1 NIL), 30 meter dari lokasi sebesar 118 dBA	TSP: ANDAL, hal V-4 s.d V-5 Kebisingan: ANDAL, hal V-7 s.d V-11

No	Halaman lama	Tanggapan / Saran/Masukan	Perbaikan Tanggapan/Saran/Masukan	Halaman Baru
	V-36	9. Poin 5.3.1.4 Medan elektromagnetik. Pernyataan "…..sehingga tidak mampu mempengaruhi ikatan kimia pembentuk sel tubuh manusia" Pengaruh medan magnet terhadap kesehatan manusia masih diperdebatkan oleh para ahli. Mohon pernyataan di atas diperbaiki. Bab II mohon mengacu pada Peraturan Menteri Lingkungan Hidup No. 8/2006 seperti kondisi jika tidak ada proyek dibandingkan dengan setelah ada proyek. Tahap operasional dinyatakan selama 30 tahun. Mohon kajian operasional adalah time-series untuk 30 tahun.	❖ Penyataan yang tercantum tersebut merupakan penyataan yang disampaikan oleh para ahli (sumber: Buletin Elektro Indonesia, Edisi No. 32 Tahun ke-6 Agustus 2000 ❖ Bab II telah mengacu pada Peraturan Menteri Lingkungan Hidup No. 8/2006. Kondisi tidak ada proyek dikemukakan sebagai rona lingkungan yang tercantum pada Bab III. Perubahan terhadap kondisi lingkungan awal dikemukakan dalam prakiraan dampak yang tercantum pada Bab V. ❖ Masa operasional proyek Sarulla adalah berdasarkan kontrak WKP (Wilayah Kerja Pertambangan) yang berlaku selama 30 tahun sejak beroperasinya PLTP yang dapat diperpanjang sesuai ketentuan di dalam kontrak.	ANDAL, hal V-44 s.d V-45
	RKL	10. Prakonstruksi, mohon dilibatkan Kepala Desa dan buatkan skema yang jelas untuk sistem pengaduan dll, juga konstruksi karena friksi akan lebih tinggi.	❖ Pemrakarsa Proyek akan berkoordinasi dengan instansi terkait di tingkat Kabupaten dalam hal ini BPN Kabupaten Tapanuli Utara, camat serta melibatkan kepala desa yang lahan pada daerahnya terkena pembebasan.	RKL, hal III-1
	CV	11. Curriculum vitae mohon ditanda tangani oleh yang bersangkutan.	❖ CV tim studi sudah ditandatangani.	Lampiran
	Umum	12. Saya kurang setuju pengambilan steam tahap I untuk membangkitkan turbin 110 MW. Pengambilan steam sebaiknya bertahap dengan MW yang lebih kecil sehingga kebutuhan steam lebih kecil. Pegambilan steam besar di tahap awal akan mengganggu kesetimbangan fluida bawah permukaan.	❖ Pengambilan steam akan dilakukan secara bertahap terdiri dari enam tahapan selama 18 bulan dari awal produksi yang akan mencapai kapasitas maksimum dalam kurun waktu tersebut. Secara bertahap dalam periode 60 hari di SIL (tahap pertama).	ANDAL, hal II-25
5		**Ir. Henny JM. Nainggolan (Bapedalda Provinsi Sumatera Utara)**		
	II-9	1. Dinyatakan tenaga kerja yang diperlukan untuk tahap konstruksi sekitar 100-150 orang tetapi pada hal II-15 (masih dalam konstruksi) disebutkan tenaga kerja diperlukan 200-300 orang. Yang mana yang benar? Berapa sebenarnya total tenaga kerja yang diperlukan?	❖ Jumlah tenaga kerja tahap konstruksi yang akan direkrut adalah sebagai berikut: o 600 orang untuk kegiatan konstruksi pemboran o 1400 orang untuk kegiatan konstruksi PLTP o 300 orang untuk pembangunan jaringan transmisi ❖ Total tenaga kerja konstruksi adalah sekitar 2300 orang.	ANDAL, hal II-11
	II-15	2. Sebutkan bahan kimia apa saja yang termasuk B3 dan berapa banyak jumlah yang digunakan. Demikian juga pemakaian oli, berapa volume pemakaiannya? Apakah tidak ada dibangun unit pengelolaan khusus untuk ceceran limbah yang mengandung B3? Mengingat pada akhirnya limbah cair tersebut akan dibuang/dialirkan ke Sungai Batang Toru yang dimanfaatkan masyarakat setempat untuk kebutuhan hidup. Berapa jarak lokasi pembangunan PLTP khususnya outlet limbah cair dengan sungai Batang Toru.	❖ Jenis-jenis bahan kimia yang yang tergolong B3 dan volumenya dicantumkan pada tabel II-8 ❖ Jarak antara PLTP khususnya outlet limbah cair dengan Sungai Batang Toru yaitu: untuk PLTP SIL sejauh lebih kurang 800 m dan PLTP NIL sejauh lebih kurang 1000 m.	ANDAL, hal II-31

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	II-25	3. Alinea 3-5 sebaiknya dibuat sub-bab tersendiri (misal penanganan K3/Kesehatan dan Keselamatan Kerja serta perlindungan lingkungan).	❖ Penanganan Kesehatan dan Keselamatan Kerja (K3) sudah dibuat menjadi point tersendiri (lihat point f)	ANDAL, hal II-27 s.d. II-28
		4. Sinkronkan komponen-komponen lingkungan dalam Tabel VI.1 hal VI-2-VI-3 dengan Tabel Matriks Rencana Pengelolaan Lingkungan Hidup.	❖ Matrik Evaluasi Dampak Penting pada tabel VI-1 sudah disinkronkan dan menjadi acuan dalam penyusunan Rencana Pengelolaan Lingkungan (RKL).	ANDAL, hal VI-2 s.d VI-3
	II-20	5. Material-material yang diperlukan sebagian didatangkan dari kota terdekat. Sebutkan kota apa saja dan material apa? Supaya bisa diprediksi dampaknya.	❖ Material-material untuk keperluan pengembangan PLTP Sarulla akan didatangkan dari Medan dan Tarutung	ANDAL hal II-12
		6. Berapa luas lahan pertanian, perkebunan dan kawasan hutan yang akan dibebaskan? Buat rinciannya masing-masing?	❖ Saat ini pembebasan lahan adalah dalam proses pendataan yang belum selesai sepenuhnya sehingga belum dapat dikemukakan luas lahan pertanian, perkebunan dan kawasan hutan.	-
		7. Lengkapi RKL dengan antara lain: • Upaya pengelolaan lingkungan dengan kegiatan yang jelas (contoh: jangan hanya bekerja sama dengan pihak terkait, bentuk kegiatannya apa? • Periode pengelolaan lingkungan hidup dibuat yang jelas misal 1 x 3 bulan, 1 x 6 bulan, dan seterusnya (jangan selama periode tahap kegiatan). • Pada tahap penerimaan tenaga kerja, tambahkan institusi pengawas Dinas Tenaga Kerja Pemerintah Daerah setempat.	❖ Sesuai pedoman penyusunan RKL dari Permen LH No. 08 Tahun 2006, dokumen RKL hanya bersifat memberi pokok-pokok arahan, kriteria atau persyaratan untuk pencegahan/pengendalian dan penanggulangan dampak umum. ❖ Periode pengelolaan mengikuti tahap kegiatan (misalnya selama tahap konstruksi), sedangkan 1x3 bulan atau 1x6 bulan adalah frekuensi pemantauan yang dicantumkan dalam dokumen RPL ❖ Pada tahapan penerimaan tenaga kerja sudah memasukkan Dinas Tenaga Kerja sebagai institusi pengawas	RKL
6		**Ir. Panusun Harahap (Bappeda Provinsi Sumatera Utara)**		
		1. Perlu mebuat surat izin pinjam pakai ke Departemen Kehutanan apabila kawasan yang menjadi lokasi kegiatan melalui kawasan hutan.	❖ Memenuhi peraturan perundang-undangan yang berlaku, SOL akan mengajukan ijin pinjam pakai lahan untuk lokasi Pengembangan Lapangan Panas Bumi dan pembangunan PLTP Sarulla ke Departemen Kehutanan	-
		2. Kepada pihak pemrakarsa dan konsultan AMDAL agar benar-benar memperhatikan SK 44/Menhut-II/2005 tentang penunjukan kawasan hutan di wilayah Provinsi Sumatera Utara.	❖ Dokumen AMDAL yang disusun sudah memperhatikan Keputusan Menteri Kehutanan Nomor: SK.44/Menhut-II/2005 tentang Penunjukan Kawasan Hutan di Wilayah Provinsi Sumatera Utara Seluas ± 3.742.120 hektar. ❖ Surat Keputusan ini sudah dimasukkan dalam Tabel I.1	ANDAL, Tabel I.1 hal I-9
		3. Mengenai perekrutan tenaga kerja agar diprioritaskan masyarakat yang berdomisili di lokasi kegiatan/proyek.	❖ SOL akan memprioritaskan tenaga kerja lokal, sesuai kebutuhan dan kualifikasi tenaga kerja	RKL, hal III-6

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		4. Agar dibuat tabulasi tentang penggunaan lahan dan status lahan yang menjadi lokasi kegiatan baik untuk jaringan transmisi maupun bangunan pengeboran.	❖ Tabel penggunaan lahan dan status lahan yang menjadi lokasi kegiatan baik untuk jaringan transmisi maupun bangunan pengeboran dicantumkan pada Tabel II-2.	ANDAL, hal II-8
7		**Dr. Tini Sembiring, MS (Puslit SDAL - USU)**		
	III-3 s/d III-4	1. RKL – Untuk parameter H_2S, pengelolaan hanya mengamankan lokasi sumur dst. apakah tidak ada upaya/tekhnologi mengabsorbsi/mereduksi, gas H_2S yang timbul, sehingga kandungan yang ke lingkungan lebih kecil?	Pengelolaan H_2S tahap konstruksi: Jika berdasarkan hasil pemantauan sesuai SNI konsentrasi H_2S melebihi baku mutu yang ditetapkan, maka produksi sumur akan dikurangi sedemikian rupa sehingga konsentrasi H_2S di udara ambien berada di bawah baku mutu.	RKL hal III-4
	III-11	2. Hal yang sama pada tahap operasional.	Pengelolaan H_2S tahap operasi: Jika konsentrasi H_2S pada lokasi-lokasi pemantauan yang telah ditentukan melebihi baku mutu kebauan 0.02 ppm berdasarkan hasil pemantauan, emisi H_2S dari PLTP akan dikontrol menggunakan teknologi seperti LO-CAT sulfur recovery unit sampai konsentrasi H_2S memenuhi baku mutu kebauan tersebut.	RKL hal III-13
		3. Pada tahap pasca operasi, Kualitas air permukaan tidak ada, tapi pada matriks RPL dipantau. Pada matriks RPL, lokasi pemantauan bukan sungai Batangtoru, bagaimana ini? 4. Apakah pada tahap operasi tidak dihasilkan limbah padat dan limbah cair? dan bagaimana dampak ke air permukaan?	❖ Pemantauan terhadap kualitas air permukaan yang tercantum dalam matrik RPL telah diperbaiki dari sebelumnya terdapat di tahap pasca operasi (subbab 2.4.1.5) dipindahkan ke tahap operasi (subbab 2.3.3.1). ❖ RPL telah diperbaiki dan ditambahkan lokasi pemantauan di sungai Batang Toru. ❖ Limbah padat dan limbah cair domestik yang dihasilkan pada tahap operasi akan dikelola sesuai dengan jenis dan karakteristik dari masing-masing limbah (lihat dokumen RKL subbab 3.3.3.1). ❖ Dari hasil perakiraan dampak pengembangan lapangan panas bumi, terhadap air permukaan tergolong dampak negatif tidak penting.	RPL, hal II-16 RPL, hal II-18 RKL, hal III-19 s/d III-21 ANDAL, hal V-12 s.d V-14
		Kami tidak ada melihat komponen biologi baik dalam pengelolaan, maupun pemantauan, mengapa? padahal ini penting dari rona awal lengkap diambil.	❖ Berdasarkan hasil prakiraan dampak penting untuk komponen biologi tergolong dampak negatif tidak penting (-TP) sehingga tidak memerlukan pengelolaan maupun pemantauan.	ANDAL, hal V-19 s.d V-21
8		**Suherman (Dinas kesehatan Provinsi Sumatera Utara)**		
	III-78	1. Ada perbedaan antara narasi III-78 dengan tabel III-41 tentang jumlah dokter.	❖ Perbedaan narasi antara hal III-78 dengan Tabel III.41 telah diperbaiki. ❖ Penjelasan pada halaman III-78 menjelaskan bahwa jumlah dokter di masing-masing kecamatan dan semua dokter berdomisili di ibukota Kecamatan.	ANDAL, hal III-81, dan Tabel III-43 hal III-82
	V-5	2. Dampak H_2S terhadap kesehatan masyarakat agar	❖ Dampak H_2S terhadap kesehatan masyarakat telah	ANDAL, hal V-52 s.d

No	Halaman lama	Tanggapan / Saran/Masukan	Perbaikan Tanggapan/Saran/Masukan	Halaman Baru
		diperhitungkan pada saat produksi dikaitkan dengan kesiapan pelayanan kesehatan saat produksi.	diprakirakan pada bab V ANDAL, dan dampak ini sudah dikaitkan dengan kesiapan fasilitas pelayanan kesehatan yang ada pada tahap produksi (operasi)	V.54
	V-6	3. Kebisingan terhadap kesehatan masyarakat agar dikaji.	❖ Aspek kebisingan terhadap kesehatan manusia sudah ditambahkan pada prakiraan dampak serta evaluasi dampak penting.	ANDAL, hal V-7 s.d V-11
	III-72	4. Agar dijelaskan kaitan sistem pelayanan kesehatan private good dan public good dengan adanya proyek mengingat keterbatasan sumber daya kesehatan dan banyaknya pekerja (900 – 1200) sedangkan penduduk hanya 4605 orang (+/- 25 %).	❖ Dengan adanya proyek SOL diharapkan sistem pelayanan kesehatan baik untuk umum (*public-goods*) maupun perorangan (*private-goods*) akan menjadi lebih baik dari segi sarana maupun prasarana kesehatan. ❖ Kegiatan pelayanan kesehatan dalam kaitannya dengan pengembangan kesehatan di sekitar lokasi proyek telah dicantumkan dalam dokumen RKL sebagai bagian dari komitmen pemrakarsa untuk meningkatan sarana dan prasarana kesehatan di sekitar lokasi kegiatan yang terkait dengan program CSR.	RKL, hal. III-22 s.d III-23
	I	5. Peraturan Perundang-undangan → agar ditambahkan Keputusan Menteri Kesehatan 907 tahun 2002.	❖ Keputusan Menteri Kesehatan No 907 Tahun 2002 merupakan persyaratan dan pengawasan kualitas air minum dalam kemasan maupun air baku air minum yang telah diolah, sehingga SK Menkes ini tidak terkaitan dengan kegiatan proyek.	-
	III-75	6. Kualitas air bersih untuk rumah tangga agar diperiksa sebagai data kesehatan awal sanitasi.	❖ Hasil analisis Kualitas air bersih (sumur penduduk) di Desa Silangkitang dan desa Simataniari) telah dicantumkan pada Tabel III-3. ❖ Baku mutu air tanah/air sumur penduduk sebagai sumber air bersih mengacu pada Permenkes No. 416/PER/MENKES/IX/1990.	ANDAL, hal III-14
	III-37	7. Kesiapan pada situasi darurat kurang memadai → agar situasi darurat inilebih dijelaskan pada bab prakiraan, disebabkan oleh apa dan bagaimana menyiapkannya.	❖ Emergency Respon Plan dicantumkan pada lampiran 7.	Lampiran 7
9		**M. Zulfan, SH (Kanwil BPN Provinsi Sumatera Utara)**		
		1. Dasar hukum agar dicantumkan juga: • PP No. 16 tahun 2004 tentang Penatagunaan Tanah. • PP No. 36 tahun 2005 jo. PP No. 65 tahun 2006 tentang pengadaan tanah bagi pelaksanaan pembangunan untuk kepentingan umum. • Peraturan Kepala BPN No. 3/2007.	❖ PP No. 16 Tahun 2004 tentang Penatagunaan Tanah sudah ditambahkan sebagai dasar hukum. ❖ PP No. 36 Tahun 2005 tidak dimasukkan karena lahan yang dibebaskan bukan untuk kepentingan umum. ❖ Peraturan Kepala BPN No. 3 Tahun 2007 sudah dimasukkan dalam dasar hukum pada Tabel I-1. ❖ Selain peraturan tersebut peraturan yang digunakan adalah Peraturan Menteri Dalam Negeri No. 2 Tahun 1976 dan Peraturan Menteri Dalam Negeri No. 15 Tahun 1975.	ANDAL, Tabel I-1 hal I-5 s/d I-11

No	Halaman lama	Tanggapan / Saran/Masukan	Perbaikan Tanggapan/Saran/Masukan	Halaman Baru
		2. Apakah sudah ada surat Penetapan Lokasinya? Kalau sudah ada harus dicantumkan juga.	❖ Surat Permohonan Ijin lokasi telah diajukan oleh Pertamina Geothermal Energy (PGE) kepada Pemerintah Kabupaten Tapanuli Utara dan Badan Pertanahan Nasional (BPN) Kabupaten Tapanuli Utara. Dokumen lengkap telah diterima dan sedang dikaji oleh BPN dan Pemerintah Daerah Kabupaten Tapanuli Utara.	-
		3. Sebelum dilakukan pembebasan lahan, hendaknya dilakukan identifikasi dan inventarisasi terhadap lahan yang akan dibebaskan. Hal ini penting agar dalam pembebasan tanah tersebut dapat berjalan dengan tepat waktu dan sesuai dengan rencana sehingga tidak menimbulkan permasalahan-permasalahan di kemudian hari.	❖ SOL akan melakukan identifikasi dan survey lahan pada masing-masing lahan yang akan dibebaskan, standard kompensasi untuk harta benda yang berharga telah diberikan oleh Dinas Pertanian Kabupaten Tapanuli Utara. Standard kompensasi ini akan dijadikan panduan dalam negoisasi dan kompensasi. Kegiatan-kegiatan identifikasi dan survey lahan telah dilakukan untuk injeksi perpipaan.	ANDAL, hal II-9
		4. Berapa luas lahan yang termasuk kawasan hutan?	❖ Berdasarkan penetapan kawasan tersebut diperoleh bahwa areal Pengembangan Lapangan Panas Bumi dan Pembangunan PLTP Sarulla terdiri dari Areal Penggunaan lain (APL), Hutan Produksi yang dapat di Konversi (HK) dan Hutan Produksi (HP).	ANDAL, Peta II-2 hal II-34
		5. Cantumkan juga dasar hukumnya (UU Kehutanan).	❖ Dasar hukum (UU Kehutanan) sudah dicantumkan pada Tabel I-1.	ANDAL, Tabel I-1 hal I-5 s.d I-11
		6. Cantumkan peta RTRW Kabupaten Tapanuli Utara.	❖ Peta Struktur Tata Ruang kabupaten Tapanuli Utara berdasarkan Perda No. 21 tahun 2001 sudah dicantumkan pada Peta III-4.	Peta III-4, hal III-24
		7. Kurangnya sosialisasi kepada masyarakat mengenai rencana proyek ini.	❖ Kegitan-kegiatan sosialisasi dalam rangka Pengembangan Lapangan Panas Bumi dan Pembangunan PLTP Sarulla yang sudah dilaksanakan adalah: o Sosialisasi proyek di Silangkitang pada tanggal 5 Februari 2008, o Konsultasi Publik dalam rangka penyusunan AMDAL di Pahae Julu tanggal 28 Maret 2008, o Sosialisasi proyek dengan Lembaga Pemerintah di Tarutung pada tanggal 6 Mei 2008, o Sosialisasi proyek tentang pembebasan lahan untuk jalur reinjeksi 6 Juni 2008 o Sosialisasi kegiatan workover di Silangkitang pada tanggal 15 Juli 2008, o Upacara workover di Silangkitang pada tanggal 15 Agustus 2008 o Sosialisasi pembebasan lahan di Silangkitang pada tanggal 27 September 2008	ANDAL, Hal II-7

No	Halaman lama	Tanggapan / Saran/Masukan	Perbaikan Tanggapan/Saran/Masukan	Halaman Baru
		8. Cantumkan peta lokasi proyek.	❖ Peta Lokasi proyek terdapat pada Peta I-1 dan peta tata letak yang meliputi areal SIL dan NIL dicantumkan pada Peta II-1 dan II-2.	-
10		**Gunawan Arinto (Kodam I Bukit Barisan)**		
		1. Dampak negatif keresahan masyarakat penyerapan tenaga kerja baik skill dan non skill agar dikaji kembali untuk semaksimal mungkin menggunakan tenaga lokal melalui: • Seleksi dan pelatihan oleh perusahaan. • Perusahaan mempunyai program pelatihan bagi tenaga lokal dari non skill menjadi skill.	❖ SOL akan menggunakan tenaga kerja dari daerah setempat (lokal) sesuai dengan kebutuhan perusahaan dan persyaratan yang dibutuhkan. ❖ Perusahaan (SOL) akan membantu pelaksanaan pendidikan dan melaksankan pelatihan untuk peningkatan pengetahuan dan keterampilan bidang panas bumi kepada tenaga kerja lokal.	RKL, hal III-6 s.d III-7 dan III-21 s.d III-27
		2. Pembebasan tanah. Hendaknya berpedoman pada peraturan yang ada serta dibentuk panitia pembebasan lahan dan hindari keresahan masyarakat melalui keterlibatan aparat desa, kelurahan dan kecamatan.	❖ Kegiatan pembebasan lahan dilakukan dengan prinsip negosiasi dan kesepakatan harga antara SOL dengan pemilik lahan yang didukung oleh Pemerintah Kabupaten Tapanuli Utara. ❖ Sebelum kegiatan pembebasan lahan dilaksanakan, SOL terlebih dahulu melakukan sosialisasi kepada masyarakat.	-
11		**Effendi Siahaan, SE (Badan Investasi dan Promosi Provinsi Sumatera Utara)**		
		1. Apabila perusahaan dari PMA, tolong dicantumkan dalam dokumen Surat Persetujuan (SP) yang dikeluarkan oeh BKPM.	❖ SOL adalah perusahaan asing yang melakukan direct investment, sehingga tidak perlu surat persetujuan dari BKPM, ijin yg diperlukan adalah dari departemen terkait, yaitu Menteri Departemen ESDM dan SOL sudah memperolehnya pada tanggal 27 Agustus 2008 perihal Persetujuan Pengalihan Hak, Kepentingan dan Kewajiban PT PLN sebagai Contractor pada JOC PLTP Sarulla 300 MW (sudah dicantumkan di dalam lampiran).	Lampiran 6
		2. Mengenai Dampak Sosial Ekonomi dan Budaya tentang bantuan kepada masyarakat yang disebut CSR (Corporate Social Responsibility) tolong dimasukkan dalam dokumen agar masyarakat mengetahui tingkat keseriusan dan transparansi.	❖ Program CSR yang dimaksud sudah tercakup didalam Program Community Development (CD) yang sudah tercantum dalam dokumen Rencana Pengelolaan Lingkungan (RKL).	RKL, hal III-21 sampai III-27
		3. Penyerapan tenaga kerja agar hendaknya anak daerah dilatih supaya memiliki skill.	❖ Perusahaan (SOL) akan membantu pelaksanaan pendidikan dan melaksanakan pelatihan untuk peningkatan pengetahuan dan keterampilan bidang panas bumi kepada tenaga kerja lokal.	RKL, hal III-21 s.d III-22

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12		**Novelinna Limbong, S.Hut (Dinas Kehutanan Provinsi Sumatera Utara)**		
	II-21	1. Sejauh mana pembangunan tersebut tidak menimbulkan erosi dan tanah longsor.	❖ Sesuai hasil kajian Prakiraan dampak Penting (hal V-9 sd V-10) dampak penyiapan lahan terhadap erosi tanah dikategorikan sebagai dampak negatif tidak penting (-TP).	ANDAL, hal V-11 s.d V-12
	II-3	2. Apakah areal tersebut diluar kawasan hutan? agar diplotkan pada peta kawasan hutan Sumatera Utara dan Peta tata ruang Provinsi dan Kabupaten Tapanuli Utara. Sesuai peta pada hal II-30, kegiatan tersebut pada kawasan hutan produksi. untuk itu agar diurus ijin pinjam pakai kawasan hutan dari Menteri Kehutanan.	❖ Berdasarkan Keputusan Menteri Kehutanan No. 44 Tahun 2005 tentang Penetapan Kawasan Hutan dan Perairan Sumatera Utara maka areal pengembangan Lapangan Panas Bumi dan Pembangunan PLTP Sarulla termasuk kawasan hutan yaitu Hutan Produksi yang dapat di Konversi (HK) dan Hutan Produksi, Peta II-2. ❖ Perijinan yang berhubungan dengan penggunaan lahan pada kawasan hutan akan mengacu pada peraturan perundang-undangan yang berlaku.	ANDAL hal II-34
13		**Ir. Sumintarto (Dinas Pertambangan dan Energi Provinsi Sumatera Utara)**		
	I	1. Judul pembangunan PLTP ini kapasitasnya 1 x 330 MW atau total 330 MW dengan tahapan pembangunan PLTP, misal (2 x 115). Pada RKL. Kata Pengantar perlu dijelaskan bila pembangunan PLTP bertahap antara lain dimensi sump pit, kapasitas brine untuk reinjeksi.	❖ Pembangunan PLTP Sarulla dengan kapasitas total sebesar 330 MW terdiri dari tiga unit pembangkit yaitu satu unit di SIL dan dua unit di NIL dengan kapasitas masing-masing 110 MW setiap unit. ❖ Kata Pengantar pada RKL telah diperbaiki.	-
	II-1	2. BAB II PENDEKATAN PENGELOLAAN LINGKUNGAN. Teknologi pemboran → perlu dijelaskan sumber air untuk lumpur bor, debit pengambilan dan lain-lain.	❖ Sumber air untuk kegiatan pemboran diambil dari sungai Batang Toru dengan kebutuhan sebesar 400 m^3 setiap sumur.	RKL, hal II-1 dan ANDAL hal II-16
	II-2	3. Limbah minyak dan zat kimia → agar dijelaskan juga pembuatan manifest pengumpulan dan penyaluran pelumas bekas.	❖ Pembuatan manifest pengumpulan dan penyaluran limbah minyak dan bahan kimia dibuat saat limbah ini dikirim dari penghasil limbah kepada pengelola limbah yang mempunyai izin/lisensi. Selama proses pengumpulan akan dibuat catatan mengenai sumber, jumlah dan tempat penyimpanan dimana pengelolaan limbah B3 ini akan mengacu pada PP 18 tahun 1999 dan PP 85 tahun 1999.	RKL, hal III-19 s.d III-21
	II-5	4. Community Development → agar program CD dikoordinasikan dengan instansi terkait (PEMDA).	❖ Program CD akan dilaksanakan oleh SOL akan berkoordinasi dengan instansi terkait.	RKL, hal III-21
	III-3	5. TAHAP KONSTRUKSI → Juga dimasukkan commissioning PLTP.	❖ Commissioning atau pengujian akan dilakukan berdasarkan tonggak proyek (project milestone). Kegiatan ini akan terdiri dari uji operasi peralatan, uji fungsional, uji proteksi dan interlock, dan lain sebagainya. Semua pihak yang berwenang akan terlibat selama commissioning atau pengujian. Perwakilan PLN juga akan terlibat atau menyaksikan Uji Kapasitas Unit.	ANDAL, II-25 (subbab 2.2.2.3.2)

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	III-4	6. Flow Line, penanganan lumpur bor. Kapan dilakukan uji toksisitas, penentuan lokasi akhir lumpur bor/cutting.	❖ Pengelolaan lumpur bor, limbah lumpur dan serbuk bor mengacu pada Peraturan Men ESDM No 45 Tahun 2006. ❖ Uji toksisitas terutama TCLP akan dilakukan pada akhir proses pemboran terhadap lumpur bor, limbah lumpur dan serbuk bor untuk menentukan lokasi akhir penampungan atau pengelolaan lebih lanjut terhadap limbah-limbah tersebut sesuai dengan ketentuan peraturan perundang-undangan. Apabila lolos dari uji TCLP serta uji toksisitas lainnya maka limbah tersebut ditempatkan pada sump pit yang terdapat pada lokasi sumur yang dibor.	ANDAL, hal II-16 s.d II-19 RKL, hal III-19 s.d III-21
	III.11	7. TAHAP OPERASI → Tidak hanya operasi PLTP, tetapi produksi sumur, reinjeksi, kondensat, pemompaan kondensat.	❖ Sumber dampak penting H_2S pada tahap operasi hanya dari kegiatan pengoperasian PLTP. Sedangkan H_2S yang bersumber dari kegiatan pemboran sumur dan uji produksi (termasuk kegiatan produksi sumur, reinjeksi, kondensat, dan pemompaan kondensat) dikelola pada tahap konstruksi.	RKL hal III-3 dan III-12
14		**Ir. Untungta Kaban, M.App (DISTAMBEN Provisni Sumatera Utara)**		
	II-23	1. Paragraf 1 → ”Secara skematis memperlihatkan hubungan antara komponen uap dengan brine”. Apa maksud dari kalimat ini? Paragraf 2 → Penyebab penurunan kualitas sumur produksi dan sumur reinjeksi. Kapan hal ini diperkirakan terjadi?	❖ Kalimat tersebut sudah dihilangkan. ❖ Penurunan kualitas sumur produksi dan reinjeksi belum dapat ditentukan saat ini dan baru dapat diketahui setelah dilakukan pemantauan lebih lanjut terhadap sumur-sumur tersebut selama masa operasi. Penurunan kualitas sumur akan dikelola dengan melakukan pemboran sumur-sumur make-up baru secara bertahap selama 30 tahun masa operasi.	ANDAL, Hal II-25
	II-25	2. Paragraf 1 → Mengapa terjadi perbedaan temperatur inlet dan outlet brine di SIL dan NIL?	❖ Suhu inlet pada OEC Brine Unit adalah sebelum membangkitkan listrik sedangkan suhu outlet adalah suhu setelah memanfaatkan panas untuk pembangkitan listrik, oleh karena itu terdapat perbedaan suhu antara inlet dan outlet.	ANDAL, Hal II-26
		3. Zat-zat apa saja yang dapat ditemukan dari sumur bor panas bumi?	❖ Komponen kimia uap sudah dicantumkan pada Tabel II-7.	ANDAL. Hal II-26
15		**Rudi Hartono Sitompul (Kepala Desa Simataniari, Pahae Julu)**		
		1. Kami masyarakat Simataniari dekat ke NIL 3 dengan jarak lebih kurang 300 m. dampak negatip yang kami takuti: • Konsentrasi H_2S. masyarakat sangat takut terhadap gas H_2S. supaya di kontrol setiap saat kalau sudah berjalan	• Konsentrasi H_2S selama kegiatan pengeboran dan uji produksi berlangsung akan dilakukan seminggu sekali. Jika melembihi baku mutu yang ditetapkan maka produksi sumur akan dikurangi sehingga konsentrasi H_2S berada di bawah baku mutu. • Pada tahap operasi, akan dilakukan pemantauan setiap 3 bulan sekali. Jika konsentrasi H_2S pada desa-desa di sekitar tapak sumur melebihi ambang batas, emisi H_2S akan di kontrol menggunakan teknologi seperti LO-CAT sulfur recovery sampe konsentrasi H2S memenuhi baku mutu.	RKL, hal III-4; RPL, hal II-4 RKL, hal III-13 dan RPL, II-11

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		• Kebisingan, dampak negatip masyarakat sangat takut dan adanya gangguan terhadap kita, terganggu tidur, beribadah dll.	• Tingkat kebisingan akan dipantau sekali setiap 3 bulang dengan masa pengukuran 24 jam selama tahap operasi.	RPL, hal II-12
		• Kami masyarakat desa simataniari, kalau ada pekerja proyek mulai masuk buruh atau control ke nil, supaya melaporkan kepada desa atau ditolak masyarakat karena kami tau apa yang di lokasi di Nil supaya kami tidak was-was.	• SOL akan mengkoordinasikan mengenai pekerja yang masuk kepada kepala desa serta institusi yang terkait (Dinas Tenaga Kerja Kabupaten Tapanuli Utara).	RPL, hal II-6
		• Kami masyarakat. Kalau sudah berjalan proyek di NilL supaya pekerja dari desa yang dekat lokasi dipakai. Jangan seperti Indorayon, pertama dipakai lama kelamaan di campakan. Permintaan kami jangan seperti di Indorayon.	• Akan mengacu pada kebutuhan dan kualifikasi tenaga kerja yang dibutuhkan dengan prioritas kepada penduduk setempat yang memenuhi persyaratan.	ANDAL, RKL & RPL sehubungan dengan tenaga kerja
		• Kami sangat mendukung atas dibukanya PLTP Sarulla.	• Terima kasih atas dukungannya.	
		• Kami mohon supaya mengganti nama desa Namora Langit menjadi desa yang terkait. 1. Desa Simataniari, 2. Desa Lumban Jaran 3. Desa Sibaganding.	• Desa Namora I Langit telah diganti dengan Desa Simataniari.	
16		**Marlan Sitompul (Kepala Desa Lumban Jaean-Kec. Pahae Julu)**		
		1. Manfaat kegiatan: Salah satu manfaatnya adalah meningkatkan PAD Kabupaten dan provinsi, kenapa PAD desa dan kecamatan tidak ada?	❖ Berdasarkan standar statistik Indonesia, terminologi Pendapatan Asli Daserah (PAD) hanya untuk tingkat kabupaten dan propinsi. Tidak ada istilah PAD untuk desa dan kecamatan.	-
		2. Hasil Analis Laboratorium. Hal: kualitas air tanah, kami tidak pernah tahu bahwa pernah diadakan sampling kualitas air sumur penduduk.	❖ Pengambilan sampel kualitas air tanah (sumur penduduk) dilakukan atas ijin pemilik rumah pada tanggal 28 -29 Maret 2008.	-
		3. Hasil Analisis Laboratorium. Hal: Kualitas Udara. Kami tidak pernah dengar/tahu nama Desa Namora I Langit tolong diperbaiki.	❖ Desa Namora I Langit telah diganti dengan Desa Simataniari.	ANDAL, hal III-4
		4. Pada saat penutupan sumur dan pembongkaran jaringan transmisi setelah semuanya selesai apakah lahan yang bekas digunakan proyek kembali kepemilik sebelumnya.	❖ Status tanah merupakan milik Pertamina Geothermal Energy (PGE). SOL tidak mempunyai hak untuk mengembalikan tanah tersebut kepada pemilik sebelumnya.	ANDAL, hal II-4 dan seterusnya
		5. Saat pembebasan lahan, kami kepala desa dari desa yang terkait ke proyek secara khusus harus dilibatkan.	❖ Pada saat pembebasan lahan, perusahaan , pemerintah daerah termasuk kepala desa akan terlibat secara aktif.	RKL, hal III-1
17		**Huntal Simatupang (Kepala Desa Pardamean Nainggolan) kecamatan Pahae Jae**		
		1. Mohon keadilan, kejujuran serta transparansi yang tidak memandang sebelah mata oleh pemerintah dan juga pihak perusahaan yang bekerja di pengembangan	❖ Pada saat penerimaan tenaga kerja, akan memprioritaskan tenaga kerja lokal, transparan dan berkeadilan sesuai dengan kualifikasi yang diperlukan.	RKL, hal III-6 dan III-14

No	Halaman lama	Tanggapan / Saran/Masukan	Perbaikan Tanggapan/Saran/Masukan	Halaman Baru
		pembangunan panas bumi yang ada di daerah Kec. Pahae Jae, Pahae Julu.		
		2. Mohon ditanggapi kesilapan masyarakat pada waktu pembebasan lahan agar apabila tanah tersebut tidak di fungsikan lagi sesuai dengan fungsi PLTP agar dikembalikan kepada masyarakat, dasarnya tanah tersebut dijual dengan harga murah demi pembangunan.	❖ SOL tidak berhak untuk memperjual belikan serta menyerahkan lahan kepada pihak lainnya oleh karena status kepemilikan lahan setelah dibebaskan akan menjadi milik Pertamina Geothermal Energy.	ANDAL, hal I-1
		3. Masalah Kronologis pindah tangan tanah dari Unocal ke Pertamina/PLN, apakah ini ada dasar bisnis? Tolong ini dijernihkan.	❖ Projek ini dari awal, wilayah kerjanya dimiliki oleh Pertamina Geothermal Energy (PGE), dimana pada saat itu operatornya adalah UNOCAL, dengan maksud meningkatkan sistem kelistrikan di daerah Sumut. ❖ Seiring dengan berjalannya waktu pihak UNOCAL tidak mampu untk mengembangkan potensi panas bumi yang ada sehingga hak untuk pengembangan potensi panas bumi tersebut dialihkan ke PLN (hak atas tanah tetap dimiliki oleh Pertamina). ❖ Tahun 2006 hak pengembangan panas bumi tersebut dilelang secara terbuka yang pada akhirnya dimenangkan oleh Konsorsium/SOL, hak kepemilikan tanah sejak dikembangkan oleh UNOCAL sampai saat ini tetap menjadi milik Pertamina (PGE).	ANDAL, hal I-1
		4. Mengenai jarak sumur ke tempat pemukiman apakah ini tidak berbenturan dengan kehidupan penduduk setempat? Tolong dipikirkan secara sehat.	❖ Langkah-langkah pemindahan penduduk yang bermukim dekat dengan sumur yang mungkin akan terkena dampak akan dikelola selama proses pembebasan lahan.	RKL, hal III-1
18		**Sabar Simorangkir (Kepala Desa Silangkitang)**		
		Permintaan kami dari desa Silangkitang (masyarakat) supaya pekerjaan yang bisa kami kerjakan supaya anak-anak kami yang masuk kerja, dalam proyek pengambangan lapangan panas bumi dengan pembangunan PLTP sarula kapasitas 330MW.	❖ Penerimaan tenaga kerja akan memprioritaskan tenaga kerja dari daerah sekitar sesuai dengan kebutuhan dan kualifikasi yang diperlukan.	RKL, hal III-6 dan III-14
19		**Novada Sitompul (Kepala Desa Sibaganding)**		
		1. Adanya keresahaan masyarakat terhadap sumur bor dan uji produksi. • Memang kami maklumi pada hari yang lalu Unocal belum sepenuhnya dialihkan ke PLN. Namun Unocal tidak benar memantau sumur bor, ternyata terjadi kebocoran sumur pemboran diarea NIL B, sehingga sempat meresahkan masyarakat sekitar lokasi proyek. Maka mulai dari sekarang ini sangat mengharapkan agar PT SOL lebih was-was dan rutin memantau sumur pemboran setiap harinya. • Kami yang secara langsung yang hidup dialam area	❖ Di masa yang akan datang. pemantauan kebocoran sumur pemboran akan lebih diperhatikan, sehingga kenyamanan masyarakat yang berada di sekitar lokasi kegiatan tetap terjaga ❖ Saran diperhatikan. Apabila dipandang perlu.	-

No	Halaman lama	Tanggapan / Saran/Masukan	Perbaikan Tanggapan/Saran/Masukan	Halaman Baru
		proyek, dulu petai sebagai hasil kebun masyarakat setempat sebelum diperkirakan 10,000/minggu, terjadi pemboran atau uji coba, petai tersebut pada bermatian, atau tak berbuah lagi secara perlahan lahan, hal apakah yang mengakibatkan terjadi, dan kami tidak tahu, apakah karena tambah panas. Kami dari masyarakat meminta agar pihak projek bersama dengan pemerintah mengadakan riset atau penelitian khusus tentang hal tersebut.		
20		**Maria Sihombing (Bappeda Kabupaten Tapanuli Utara)**		
		1. Salah satu dampak penting yang dipantau adalah kandungan H_2S diudara ini berarti H_2S merupakan salah satu gas yang timbul akibat beroperasinya PLTP Sarula. Apakah tidak ada gas yang lainnya yang terdeteksi yang timbul akibat beroperasinya proyek yg dimaksud. Jika ada upaya apa yang dilakukan pihak pengembang untuk mengatasinya.	❖ Berdasarkan data pada tabel II-6 Komponnen Kimia Uap yang Akan Dipakai, gas-gas yang akan dihasilkan, antara lain CO_2, H_2S, CH_4. ❖ Dari jenis-jenis gas yang dihasilkan tersebut, gas H_2S merupakan jenis gas yang paling berpotensi menimbulkan dampak terhadap kesehatan manusia. Sedangkan gas CO_2 dan CH_4 tidak menimbulkan dampak terhadap kesehatan masyarakat. Emisi gas H_2S akan dipantau terus menerus selama masa operasi PLTP.	ANDAL, hal II-26
	II-4 RKL	2. Poin 44. Supaya dicantumkan Badan Pertanahan Nasional Kabupaten Tapanuli Utara atau Provinsi Sumatera Utara dan cantumkan pada Lampiran Matrik Ringkasan RKL	❖ Badan Pertanahan Nasional Kabupaten Tapanuli Utara sudah dicantumkan sebagai instansi pengawas dalam kegiatan Pengelolaan dampak pembebasan lahan (RKL)	RKL, hal III-2
		3. Pembangunan proyek PLTP Sarula diperkirakan akan menimbulkan dampak bagi masyarakat sekitar lokasi. Dan didalam ANDAL dijelaskan bahwa dampak yang ditimbulkan dapat dikelola dengan teknologi saat ini. Pendekatan teknologi apa yang dilaksanakan pihak pengembang untuk meminimalisir dampak negatif yang ditimbulkan dan apakah teknologi tersebut telah/pernah berhasil dilaksakan dilokasi panas bumi lainnya di Indonesia.	❖ Pengeboran dan pengujian sumur akan memenuhi peraturan yang berlaku dengan menggunakan peredam, lined sump pit, dan pengambilan sampel (analisa TCLP) ❖ PLTP Sarulla menggunakan pendingin udara (air cooler) yang meniadakan asap pada menara pendingin dan sedikit sekali menggunakan air.	-
		4. Perlu juga air minum masyarakat dilokasi PLTP dipantau dan dicantumkan pada lampiran Matriks Ringkasan RPL.	❖ Pemantauan kualitas air (sumur penduduk) sudah ditambahkan pada Rencana Pemantauan Lingkungan (RPL).	RPL, hal II-16 s.d II-17
	III-2	5. Nama Institusi pengelolaan lingkungan tertulis Bapedalda Provinsi Sumatera Utara, seharusnya Kantor Lingkungan Hidup Kabupaten Tapanuli Utara. Supaya disesuaikan juga pada matriks ringkasan RKL.	❖ Nama Bapedalda Kabupaten Tapanuli Utara sudah dirubah menjadi Kantor Lingkungan Hidup Kabupaten Tapanuli Utara ❖ Sudah disesuaikan dalam dokumen RKL.	RKL - RPL
	II-5	6. Nama Institusi Pemantauan Lingkungan Tertulis Bapedalda Sumatera Utara, Bapedalda Kabupaten Tapanuli Utara, seharusnya Bapedalda	❖ Nama Bapedalda Kabupaten Tapanuli Utara sudah dirubah menjadi Kantor Lingkungan Hidup Kabupaten Tapanuli Utara. ❖ Sudah disesuaikan dalam dokumen RPL.	RKL-RPL

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		Provinsi Sumatera Utara, Kantor Lingkungan Hidup Kabupaten Tapanuli Utara dan supaya disesuaikan pada matriks ringkasan RPL.		
		7. Pada RPL juga perlu pemantauan terhadap kesehatan masyarakat sekitar. Saran: untuk mengantisipasi dampak kesehatan bagi masyarakat. Ada baiknya pihak pengembang melaksanakan penelitian terhadap data base kesehatan masyarakat saat ini dengan demikian dapat dibandingkan dengan setelah proyek beroperasi.	❖ Pemantauan komponen kesehatan masyarakat sudah dicantumkan dalam dokumen Rencana Pemantauan Lingkungan (RPL). ❖ Kajian/studi kesehatan masyarakat di sekitar lokasi kegiatan telah dilakukan sebelum proyek beroperasi (ANDAL, bab 3). ❖ Pemantauan kesehatan masyarakat akan diakomodasi dalam program pengembangan masyarakat.	ANDAL, Hal III-75 s.d III-78 RPL, hal II-22
		8. Saran: pelaksanaan kegiatan RKL dan RPL sebaiknya dilaporkan persemester / enam bulan sekali.	❖ Laporan pelaksanaan RKL dan RPL mengacu pada KepMenLH No. 45 Tahun 2005, Frekuensi pelaporan pelaksanaan RKL dan RPL dilakukan sesuai dengan Surat Keputusan Kelayakan Lingkungan Hidup. Dalam hal frekuensi pelaporan tidak ditetapkan dalam Surat Keputusan Kelayakan Lingkungan Hidup, maka pelaporan akan dilakukan 6 (enam) bulan sekali. Peraturan perundang-undangan sudah dicantumkan pada Tabel I-1.	ANDAL hal I-10
		9. Saran: ada baiknya sosialisasi ANDAL, RKL dan RPL Pengembangan Lapangan Panas Bumi dan Pembangunan PLTP Sarula dilaksanakan di lokasi sekitar PLTP Sarula.	❖ Pelaksanaan Sosialisasi AMDAL Pengembangan Lapangan Panas Bumi dan Pembangunan PLTP Sarulla yang mengacu pada Kep Kepala Bapedal No 08 tahun 2000 sudah dilaksanakan pada tanggal 28 maret 2008 di kantor Camat Pahae Julu yang dihadiri oleh wakil masyarakat dari kecamatan Pahae Julu dan Pahae Jae. ❖ Pelaksanaan kegiatan sosilisasi kegiatan dapat dilaksanakan sesuai dengan kebutuhan dan rencana kegiatan proyek.	-
		10. Dari hasil koordinasi / konsultasi kami ke Badan Koordinasi Penanaman modal, Bahwa perusahaan (PT SOL) tidak terdaftar sebagai PMA. Saran: Supaya hal ini ditindak lanjuti perusahaan dalam mendapatkan Surat Persetujuan (SP) dari BKPM.	❖ SOL adalah perusahaan asing yang melakukan direct investment, sehingga tidak perlu surat persetujuan dari BKPM, ijin yg diperlukan adalah dari departemen terkait, yaitu MenESDM dan SOL sudah memperolehnya pada bulan Agustus 2008, ijin terlampir.	ANDAL, Lampiran 6
21		**Jumala Nainggolan (Kantor Lingkungan Hidup Kabupaten Tapanuli Utara)**		
	IV-12	1. Komponen kesehatan masyarakat, sebaiknya mencantumkan angka kesakitan masyarakat, sebagai parameter pada daftar prioritas dampak penting Hipotetik.	❖ Angka kesakitan masyarakat sudah dicantumkan dalam Tabel IV-1 Daftar Prioritas Dampak Penting.	ANDAL, hal IV-1
	II-63	2. Upaya pencegahan penyakit menular seperti DBD (sebagai akibat mobilisasi karyawan), supaya dicantumkan.	❖ DBD merupakan bagian dari kesehatan masyarakat yang akan diakomodasi dalam program pengembangan masyarakat.	RKL, hal III-22
	II-60	3. Gambar II-10 tambah kotak (kesehatan Masyarakat).	❖ Pada gambar Bagan Alir Evaluasi Dampak Penting sudah memasukkan komponen kesehatan masyarakat sebagai	ANDAL, Hal VI-4 s.d VI-6

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			dampak turunan dari H2S dan Kebisingan.	
	I-4	4. Manfaat untuk meningkatkan PAD pada tingkat kabupaten dan provinsi supaya dibuat kuantitatif (berapa persen?).	Kontribusi proyek PLTP Sarulla terhadap PAD kabupaten atau provinsi belum dapat diketahui secara kuantitatif saat ini.	-
		5. Garis koordinasi yang tegas menggambarkan peran Pemkab Tapanuli Utara dan kantor LH supaya dibuat.	❖ Pemerintah Kabupaten Tapanuli Utara khususnya Kantor Lingkungan Hidup Kabupaten Tapanuli Utara akan terlibat secara langsung dalam Pelaksanaan pengelolaan Lingkungan dan Pemantauan Lingkungan baik sebagai pengawas maupun sebagai instansi yang diberi laporan.	RKL, Bab III RPL, Bab II
22		**Maju Tampubolon (Kantor Camat Pahae Jae)**		
		1. Dalam pelaksanaan tahapan-tahapan agar dilaksanakan sesuai jadwal.	❖ Pelaksanaan tahapan kegiatan mulai dari tahap pra-konstruksi, konstruksi, dan operasi mengikuti jadwal proyek yang sudah disusun seperti dicantumkan pada Tabel II-1. ❖ Dalam pelaksanaan di lapangan jadwal ini dapat saja berubah sesuai dengan kondisi dan perkembangan yang ada.	ANDAL, hal II-6, Tabel II-1
		2. Tenaga kerja yang dibutuhkan agar benar-benar diprioritaskan penduduk/masyarakat setempat.	❖ Penerimaan tenaga kerja akan memprioritaskan tenaga kerja dari daerah sekitar sesuai dengan kebutuhan dan kualifikasi yang diperlukan.	RKL, hal III-6 dan III-15
		3. Balas budi bagi pemilik lahan agar dipertimbangkan untuk memperoleh imbalan lain berupa pemilikan (saham) disesuaikan dengan luas areal yang diberikan.	❖ SOL hanya merupakan operator dari proyek bukan pemilik wilayah kerja yang merupakan pemerintah (PGE). SOL tidak mempunyai hak dan kewajiban untuk memutuskan kepemilikan atas wilayah kerja.	RKL, Hal III-19 s..d III-25
		4. Pengadaan tender pelaksanaan kontruksi agar dilibatkan/diprioritaskan terutama dalam pelaksanaan non teknis.	❖ SOL akan memprioritaskan kontraktor lokal dalam penyediaan barang dan jasa yang mampu disediakan oleh kontraktor lokal.	RKL, Hal III-7
23		**Erwin Kurnia Alamsyah Siregar (Orangutan Conservation Service Program (OCSP) Medan)**		
		Kawasan operasi SOL berada dekat dan didalam kawasan hutan Batang Toru yang merupakan juga habitat satwaliar agar dapat penjaga keseimbangan ekosistem sekitarnya, sebaiknya SOL dapat menjalin kerjasama dengan lembaga-lembaga konservasi dan pihak-pihak lainnya dan membangun sinergitas kerja demi kelangsungan lingkungan hidup.	❖ Berdasarkan prediksi dampak, dampak kegiatan terhadap satwa liar adalah negatif tidak penting. Namun, SOL akan berkoordinasi dengan lembaga pemerintah setempat mengenai hal ini.	-
24		**Pasonly Siburian (Pemuda Pahae)**		
		1. Informasi antar: – Dimana masyarakat bisa mendapatkan informasi tentang SOL?	❖ Gedung Graha Niaga Lt. 8 Jl Jenderal Sudirman Kav. 58 Jakarta 12190 – Indonesia. Telp 021-2505459	-
		2. Dampak Sosial: – Tolong diperhatikan budaya-budaya lokal (kearifan	❖ Salah satu program pengembangan masyarakat yang akan dilaksanakan oleh SOL adalah pelestarian budaya.	RKL, Hal III-27

No	Halaman lama	Tanggapan / Saran/Masukan	Perbaikan Tanggapan/Saran/Masukan	Halaman Baru
		lokal).		
		3. Tenaga kerja – Memberi beasiswa kepada masyarakat untuk mempelajari tentang geothermal.	❖ Meningkatkan kemampuan masyarakat lokal adalah salah satu program pengembangan masyarakat.	RKL, Hal III-24
		4. Kesehatan – Penanggulangan dampak-dampak kesehatan (kimia,dll). – Memberi pelayanan kesehatan.	❖ Pelepasan bahan kimia seperti limbah padat, cair dan B3 akan dikelola sesuai dengan peraturan yang berlaku.	RKL, Hal III-20
		5. Lingkungan – Tidak merusak habitat asli; – Waspadai gempa (Pahae daerah patahan) sehingga Pahae tidak seperti kasus Sidoarjo sebagai korban pembangunan.	❖ Masukan diperhatikan. Masalah kegempaan telah tercantum di dalam dokumen ANDAL, Bab III Rona Lingkungan Hidup Awal subbab 3.1.7.2.	ANDAL, Hal III-21
		6. Pembebasan lahan – Ini adalah pembodohan jika lahan tertentu sudah ditenderkan padahal belum ada ganti untungnya. Rakyat siap bergerak mendampingi masyarakt Pahae.	❖ Saran diperhatikan.	-
		7. CSR Dimana? Siapa yang mengelola?	❖ Lokasi CSR akan ditentukan sesuai dengan kebutuhan dan dikelola oleh SOL bekerja sama dengan instansi pemerintah terkait, LSM dan perangkat pemerintahan setempat.	-
		8. Konflik – Manajemen konflik yang professional tidak membenturkan sesama orang lokal	❖ Saran diperhatikan.	-
25		**Drs H. Sitompul (LSM Penegak Keadilan Rakyat)**		
		1. Perlu didengar aspirasi masyarakat tentang tenaga kerja SOL diprioritaskan kepada masyarakat sebagai tempat kedudukan perusahaan.	❖ SOL akan memprioritaskan tenaga kerja lokal, sesuai kebutuhan dan kualifikasi tenaga kerja.	**RKL, hal III-6 dan III-15**
		2. Mengenai pembebasan tanah harus sama-sama untung, dan kalau boleh masyarakat yang terkena lahannya diikutkan sebagai pemilik saham	❖ Kegiatan pembebasan lahan dilakukan dengan prinsip negosiasi dan kesepakatan harga antara SOL dengan pemilik lahan yang didukung oleh Pemerintah Kabupaten Tapanuli Utara. SOL hanya merupakan operator dari proyek bukan pemilik dari wilayah kerja yang merupakan pemerintah (PGE). SOL tidak mempunyai hak dan kewajiban untuk memutuskan kepemilikan atas wilayah kerja.	**RKL, hal III-1**
		3. Mengenai borongan atau tender yang layak dikerjakan perusahaan lokal 4. Pembuangan limbah harus jelas jangan dari jalan umum	❖ Limbah tidak dibuang ke jalan umum atau saluran air masyarakat namun dikelola sesuai dengan ketentuan. Limbah padat akan ditampung di TPA, sedangkan untuk limbah cair	

No	Halaman lama	Tanggapan / Saran/Masukan	Perbaikan Tanggapan/Saran/Masukan	Halaman Baru
		atau ke saluran air dari sawah masyarakat.	sebelum dibuang ke lingkungan akan dikelola terlebih dahulu.	
		5. Apa tanggung jawab perusahaan apabila terjadi resiko yang sangat buruk yang diakibatkan perusahaan.	❖ Perusahaan akan bertanggung jawab sesuai dengan peraturan perundang-undangan yang berlaku	
		6. Bagaimana pembagian royalty kepada daerah atau DC.	❖ Royalti dan pajak akan dibayar sesuai dengan peraturan yang berlaku.	
26		**Tunggul Gultom (Local Community from Pahae)**		
		Pembahasan AMDAL Panas Bumi Sarulla hanya pembentukan suatu konsultan yang terpadu. Antara pemerintah, perusahaan dan masyarakat yang ditunjuk dan dipercayai oleh masyarakat. Cari cara yang bisa memecahkan masalah pembahasan AMDAL Panas Bumi Sarulla.	❖ Pemerintah dan anggota masyarakat setempat telah terwakili di dalam Komisi AMDAL Provinsi Sumatera Utara	-
27		**Marali R. Pasaribu SH (Persatuan Pangaranto Luat Pahae)**		
		1. Apa latar belakang pemrakarsa mengangkat nama menjadi SOL / Sarulla Operation Limited, bukan memakai nama Pahae secara khusus padahal lokasi area proyek adalah Pangaloan dan Pahae Julu. Subkontrak yang bagaimana kualitas yang di inginkan dari pada SOL yang mengakibatkan kontraktor-kontraktor daerah Pahae tidak dimasukan. Kontribusi apa yang sudah diberikan oleh SOL kepada masyarakat lokasi proyek pada khususnya? Didalam matrik yang disajikan ada kolom pengawasan kenapa dalam pengawasan tersebut tidak diikutsertakan pengawasan eksternal atau tokoh masyarakat (dan lembaga lainnya).	❖ Nama proyek berasal dari PLN. ❖ Pertanyan tidak terkait dengan masalah lingkungan. Namun SOL akan memprioritaskan sub kontraktor lokal. ❖ Kontribusi yang telah diberikan SOL seperti sumbangan bencana alam (gempa), partisipasi dalam kegiatan peringatan 17 Agustus di Pahae Jae, Pahae Julu dan Kabupaten. ❖ Institusi yang terlibat dalam pengawasan pelaksanaan RKL dan RPL sudah tercantum dalam dokumen RKL dan RPL, sedangkan pengawasan eksternal oleh tokoh masyarakat dan lembaga lainnya dapat secara mandiri mengawasi kegiatan SOL dan hasil pengawasan dapat disampaikan ke instansi yang berwenang (Kantor Lingkungan Hidup Kabupaten Tapanuli Utara)	-
28		**Manahara Sitompul, SE (Persatuan Luat Pahae Indonesia)**		
		1. Mohon jangan disahkan (diteken) dokumen ANDAL, RKL, RPL ini sebelum diperbaiki sesuai masukan dan ketentuan yang berlaku kepada Bapedalda Sumut dan KLH Taput	❖ Persetujuan Kelayakan Lingkungan Hidup akan diterbitkan apabila penyusunan dokumen ANDAL, RKL dan RPL telah memenuhi peraturan perundang-undangan seperti perbaikan dokumen sesuai dengan tanggapan dan saran masukan pada rapat pembahasan dan penilaian dokumen ANDAL, RKL dan RPL	-
		2. Libatkan unsur masyarakat dan PLPI dalam hal dimaksud ANDAL, RPL, RKL.	❖ Masyarakat dan lembaga kemasyarakatan telah diikutsertakan dalam proses penyusunan AMDAL melalui kegiatan konsultasi publik dan sidang Komisi AMDAL	-

No	Halaman lama	Tanggapan / Saran/Masukan	Perbaikan Tanggapan/Saran/Masukan	Halaman Baru
29		**T. Sitompul (Tokoh Masyarakat Sibaganding / Pahae Julu)**		
		1. Setelah kami baca dalam buku Draf dari SOL, bahwa: - Luas tanah tambahan yang akan dibebaskan di lokasi SIL dan NIL berjumlah 70 ha (cara bertahap/yakni untuk tapak pemboran dan jalan penghubung dll. - Sebagaimana kita ketahui tanah –tanah di area tersebut adalah tanah-tanah warisan dan dimiliki secara turun temurun. - Untuk pembebasan tanah sudah pasti sesuatu pekerjaan yang tidak mudah karena pemiliknya mungkin telah berada di daerah lain. - Yang menjadi pertanyaan /saran apakah tidak lebih efektip seandainya pembebasan tanah didahulukan dari konstruksi/pra konstruksi	❖ Kegiatan pembebasan lahan dilakukan dengan prinsip negosiasi dan kesepakatan harga antara SOL dengan pemilik lahan yang didukung oleh Pemerintah Kabupaten Tapanuli Utara. ❖ Pembebasan lahan akan dilakukan sebelum tahap konstruksi.	-
		2. Transmisi atau jaringan yang berjarak 15 km dari SIL ke NII yang bertegangan tinggi sebesar 150 kv yang melalui kebun-kebun masyarakat/persawahan. Informasi yang kami dapat baik dari buku draft dan sosialisasi yang telah dilaksanakan, seluruh jalur transmisi yang akan dilewati tidak tidak akan diganti rugi, yang diganti rugi adalah tapak-tapak menera transmisi karena tidak mengganggu – " aman" - Pertanyaan: bahwa memang sudah siapkah masyarakat dengan hanya label "aman" untuk menerima keadaan ini.	❖ Lahan yang akan dibebaskan untuk jaringan transmisi adalah hanya untuk tapak-tapak menara transmisi saja. Lahan di bawah jaringan listrik tidak akan dibebaskan. Hal ini telah diberitahukan kepada masyarakat melalui konsultasi publik, sidang KA, dan sidang AMDAL.	-
30		**Pdt Cipto Sitompul Sth (Tokoh Masyarakat Silangkitang (pemilik lahan)**		
		1. Permohonan: Harga tanah yang diganti rugi ke UNOCAL 12 tahun yang lalu, supaya ditinjau kembali, ± 45 ha (disamakan harganya dengan tanah yang 70 ha lagi yang belum dibebaskan) harus adil.	❖ SOL tidak memiliki kewenangan untuk menilai/merubah transaksi jual beli tanah yang telah terjadi pada masa UNOCAL	-
		2. Pertanyaan: Tanah yang 45 ha, apakah sudah dijual ke PLN atau belum, siapa yang bertanggung jawab atas tanah itu?	❖ Tanah yang digunakan untuk proyek ini (termasuk tanah seluas 45 ha yang telah dibebaskan) adalah hak milik Pertamina Geothermal Energy (PGE).	-
		3. Permintaan: anak sekitar harus diutamakan menjadi karyawan (banyak disana tamat SMA yang menganggur)	❖ Dalam kegiatan penerimaan tenaga kerja akan mengacu pada kebutuhan perusahaan dan spesifikasi yang dibutuhkan dan akan memprioritaskan tenaga kerja lokal	**RKL, hal III-7 dan III-15**
		4. Rumah ibadah harus dibangun di huta Sampilpil GPDI (Perbatasan);	❖ Saran dan permintaan diperhatikan	-

No	Halaman lama	Tanggapan / Saran/Masukan	Perbaikan Tanggapan/Saran/Masukan	Halaman Baru
		Rumah ibadah harus dibangun di huta Sihobuk GBI (Perbatasan); Rumah ibadah harus dibangun di huta Godung gereja Oikumene (Pertengahan).		
		5. Permintaan: Jangan dilakukan pekerjaan diatas tanah yang belum dibebaskan "Utamakan keselamatan penduduk" – Lokasi Perumahan (Pemukiman) – Utamakan kesejahteraan masyarakat	❖ Beberapa kegiatan yang mendesak telah dilakukan di atas tanah yang belum dibebaskan dengan izin dari pemilik tanah dan setelah negosiasi. ❖ Perusahan telah memperhatikan keselamatan dan kesejahteraan masyarakat dalam perencanaan proyek ini. Hal ini dibahas di dalam dokumen RKL.	-
		6. Permintaan: Agar pemasukan barang-barang ke perusahaan (yang dibutuhkan) yang mengadakan supaya anak daerah (Kontraktor)	❖ Penyediaan barang dan jasa akan diberikan kepada pengusaha lokal yang memenuhi persyaratan teknis dan administrasi.	**RKL, Hal III-25**
31		**Ir. Jones Simatupang (Putra Daerah Pahae Jae)**		
		1. Secara umum RPL ini Masih kurang lengkap dan nampaknya studi yang dilakukan kurang dalam padahal proyek ini mempunyai dampak yang sangat kuat kepada masyarakat. <u>Pertanyaan.</u> Siapa pihak yang bertugas memantau semua pelaksanaan dan rencana a. Bagian dari proyek? b. Pemerintah? c. Independence? d. Konsorsium (kerjasama) antar pengusaha dan eksternal.	❖ Institusi pemantau: o Bagian dari proyek = SOL (Manajer K3L) o Pemerintah = Pemerintah Kabupaten Tapanuli Utara (Kantor Lingkungan Hidup, BPN, Dinas Kesehatan, Dinas Tenaga Kerja, Dinas Pertanian, Dinas Pendidikan)	-
		2. Pesan: Perusahaan prioritaskan propit wajar tetapi benefit bagi masyarakat manuasiawi. Sesama manusia mari kita sama-sama menjaga kondisi	❖ Saran diperhatikan	
32		**Dr. Hulman Sitompul, SpOG (Ketua Umum Masyarakat Pahae Indonesia)**		
		1. Kita mendukung proyek ini	1. Terima kasih atas dukungannya kepada proyek ini	No. 2 mengacu penjelasan di atas. No. 3 Setuju No. 5 No. 6 Setuju
		2. Nama Sarulla Operation Ltd. Perlu ditinjau, lebih baik Pahae Operation Ltd. Karena lokasi bukan di Sarula tetapi di Pangaloan dan Sibaganding Desa Pahae.	2. Nama Sarulla Operation Ltd. berasal dari PLN.	
		3. Perlu keterbukaan yang sejelas-jelasnya kepada masyarakat apa untung rugi dan efek yang timbul kepada masyarakat dan lingkungan akibat projek ini, dan perlu seminar yang berulang – ulang kepada masyarakat (di Pahae).	3. Masyarakat di Pahae telah diberitahukan mengenai apa untung rugi dan efek yang timbul kepada masyarakat dan lingkungan akibat projek ini melalui sosialisasi (konsultasi publik, sidang KA, dan sidang AMDAL.)	
		4. Bila timbul efek atau dampak lingkungan yang merugikan masyarakat siapa yang bertanggung jawab	4. Perusahan akan bertanggung jawab bila timbul efek atau dampak lingkungan yang merugikan masyarakat sesuai dengan	

No	Halaman lama	Tanggapan / Saran/Masukan	Perbaikan Tanggapan/Saran/Masukan	Halaman Baru
		apakah perusahaan, Pemda Tapanuli Utara atau pimpinan rapat hari ini.	peraturan perundang-undangan.	
		5. Masyarakat manakah yang disejahterakan proyek ini? Harapan kami yang pertama harus masyarakat Pahae terutama yang didaerah lokasi, baru Tapanuli Utara dan lain-lain, karena mereka telah menjual tanah yang selama ini menghidupinya.	5. Diharapkan semua masyarakat khususnya di daerah proyek akan mendapatkan manfaat dari proyek ini seperti kesempatan kerja dan kesempatan berusaha.	ANDAL, hal I-1
		6. Untuk tenaga kerja putra daerah disekolahkan dan dilatih supaya ada manfaat proyek ini kepada masyarakat yang punya tanah sebelumnya.	6. Peningkatan kemampuan masyarakat lokal adalah salah satu program pengembangan masyarakat.	
		7. Sehabis masa proyek supaya tanah dikembalikan kepada masyarakat yang punya tanah sebelumnya	7. Tanah yang digunakan untuk proyek ini adalah hak milik Pertamina Geothermal Energy (PGE). SOL tidak mempunyai hak untuk mengembalikan tanah tersebut kepada pemiliknya.	
33		**Lamsiang Sitompul, SH (Putera Daerah)**		
		1. Pembayaran ganti rugi jangan ditekankan kepada peraturan perundang-undangan tapi harus lebih mengarah kepada memberikan keuntungan kepada masyarakat dan perlu harga yang transparan dari SOL.	1. SOL akan memberikan kontribusi kepada masyarakat melalui program-program pengembangan masyarakat.	-
		2. Mendata jumlah potensi tenaga kerja dan kebutuhan akan tenaga kerja dan kualifikasi menyelaraskannya. Jangan terlalu ditekankan pada peran serta.	2. Data jumlah tenaga kerja yang dibutuhkan dan kualifikasi yang diperlukan telah ditambahkan ke dalam dokumen.	
		3. Peran serta masyarakat dalam setiap tahapan.	3. Masyarakat akan dilibatkan dalam kegiatan-kegiatan proyek sesuai dengan kebutuhan dan kualifikasi.	
		4. Ada pajak, royalti yang dibayarkan oleh SOL harus dijelaskan pembagiannya sampai ke desa, UU otonomi daerah, dana perimbangan.	4. Pajak dan royalti akan dibayarkan oleh SOL sesuai dengan	
		5. RPL disusun secara asal-asalan dibuktikan dengan penulisan desa yang tidak benar; Siantolong, Lumban Garogi, Labu pining, Siparbar, Plaraju. Pembebasan lahan harus BPN. Tenaga kerja → second opinion harus ada sehingga proyek ini dapat dipertanggungjawabkan.	5. Peraturan perundang-undangan. Pembagian sampai ke desa diatur, berdasarkan kebijakan daerah masing-masing. Kesalahan nama-nama desa telah diperbaiki, Pembebasan lahan akan diawasi oleh BPN, Penerimaan tenaga kerja akan diawasi oleh Dinas Tenaga kerja	
		6. RUTR	6. Peta RUTR Sudah tercantum dalam dokumen ANDAL (lihat Peta III-4)	
		7. Hutan → belum ada pemetaan dan rekonsiliasi batas sehingga sulit untuk mengetahui dan mengawasi.	7. Sumber peta hutan adalah dari Badan Planologi Departemen Kehutanan.	

LAMPIRAN – 2
SURAT KESEPAKATAN KERANGKA ACUAN ANDAL

PEMERINTAH PROVINSI SUMATERA UTARA
BADAN PENGENDALIAN DAMPAK LINGKUNGAN DAERAH
Jl. T. Daud No. 5 Telepon (061) 4537050 Fax. (061) 4537050
MEDAN

Medan, 08 Agustus 2008

Nomor : 972 /BPDL.SU/BTL/2008
Lampiran : 1 (satu) berkas
Sifat :
Perihal : Penyampaian Kesepakatan KA-ANDAL Pengembangan Lapangan Panas Bumi dan Pembangunan PLTP Sarulla Kapasitas 330 MW di Kabupaten Tapanuli Utara.

Kepada Yth :
Sdr. Direktur Sarulla Operation Ltd.
C/o : Graha Niaga 8th Floor
Jl. Jend.Sudirman Kav.58
Jakarta 12190
di -
Jakarta

1. Sehubungan dengan surat Saudara tanggal 04 Juli 2008 Nomor : SOL-039/DIR/VII/2008 perihal perbaikan KA-ANDAL Rencana Kegiatan Pengembangan Lapangan Panas Bumi dan Pembangunan PLTP Sarulla Kapasitas 330 MW di Kabupaten Tapanuli Utara Provinsi Sumatera Utara dengan ini disampaikan hal sebagai berikut :

   a. Setelah memeriksa ulang hasil perbaikan dokumen dimaksud, secara umum telah mengakomodir tanggapan dan saran masukan yang disampaikan oleh Tim Teknis dan Komisi Penilai AMDAL Provinsi Sumatera Utara, untuk itu telah diterbitkan Kesepakatan KA-ANDAL Rencana Kegiatan Pengembangan Lapangan Panas Bumi dan Pembangunan PLTP Sarulla Kapasitas 330 MW di Kabupaten Tapanuli Utara Provinsi Sumatera Utara.

   b. Terlampir disampaikan kepada Saudara Keputusan Kepala Bapedalda Provinsi Sumatera Utara tentang Kesepakatan KA-ANDAL Rencana Kegiatan Pengembangan Lapangan Panas Bumi dan Pembangunan PLTP Sarulla Kapasitas 330 MW di Kabupaten Tapanuli Utara Provinsi Sumatera Utara, yang menjadi dasar dan acuan bagi Saudara untuk melaksanakan studi lingkungan dalam rangka penyusunan dokumen ANDAL/ RKL-RPL

2. Demikian disampaikan untuk dapat dimaklumi dan dipergunakan sebagaimana mestinya.

KEPALA BAPDALDA PROVINSI
SUMATERA UTARA

Prof.H.SYAMSUL ARIFIN,SH,MH.
PEMBINA UTAMA
NIP. 1300809985

Tembusan disampaikan kpada Yth :
1. Gubernur Sumatera Utara (sebagai laporan)
2. Bupati Tapanuli Utara di Tarutung
3. Pertinggal

PEMERINTAH PROVINSI SUMATERA UTARA
BADAN PENGENDALIAN DAMPAK LINGKUNGAN DAERAH
Jl. T. Daud No. 5 Telepon (061) 4537050 Fax. (061) 4537050
MEDAN

KEPUTUSAN
KEPALA BADAN PENGENDALIAN DAMPAK LINGKUNGAN DAERAH
PROVINSI SUMATERA UTARA
NOMOR : 973 /BPDL-SU/BTL/2008

TENTANG

KESEPAKATAN
KERANGKA ACUAN ANALISIS DAMPAK LINGKUNGAN HIDUP (KA-ANDAL)
PENGEMBANGAN LAPANGAN PANAS BUMI DAN PEMBANGUNAN PLTP SARULLA
KAPASITAS 330 MW DI KABUPATEN TAPANULI UTARA
PROVINSI SUMATERA UTARA

KEPALA BADAN PENGENDALIAN DAMPAK LINGKUNGAN DAERAH
PROVINSI SUMATERA UTARA

Membaca :

- Hasil Rapat Tim Teknis dan Komisi Penilai AMDAL Provinsi Sumatera Utara di Medan pada tanggal 22 Mei 2008 tentang Penilaian Draft Kerangka Acuan Analisis Dampak Lingkungan Hidup (KA-ANDAL) Pengembangan Lapangan Panas Bumi dan Pembangunan PLTP Sarulla di Kabupaten Tapanuli Utara Provinsi Sumatera Utara.

Menimbang :

a. Bahwa kegiatan Pengembangan Lapangan Panas Bumi dan Pembangunan PLTP Sarulla di Kabupaten Tapanuli Utara Provinsi Sumatera Utara merupakan kegiatan yang wajib dilengkapi dengan studi Analisis Mengenai Dampak Lingkungan Hidup;

b. bahwa Kerangka Acuan Analisis Dampak Lingkungan Hidup (KA-ANDAL) Pengembangan Lapangan Panas Bumi dan Pembangunan PLTP Sarulla di Kabupaten Tapanuli Utara sebagai salah satu bagian dari studi Analisis Mengenai Dampak Lingkungan Hidup wajib mendapat Keputusan Kesepakatan berdasarkan hasil penilaian Komisi Penilai AMDAL Provinsi Sumatera Utara ;

c. bahwa mengingat hal pada huruf a dan b di atas, perlu ditetapkan Kesepakatan atas Kerangka Acuan Analisis Dampak Lingkungan Hidup (KA-ANDAL) Pengembangan Lapangan Panas Bumi dan Pembangunan PLTP Sarulla di Kabupaten Tapanuli Utara Provinsi Sumatera Utara dengan Keputusan Kepala Badan Pengendalian Dampak Lingkungan Daerah Provinsi Sumatera Utara.

Mengingat :

1. Undang-undang Nomor 24 Tahun 1956 tentang Pembentukan Daerah Otonom Provinsi Aceh dan Perubahan Pembentukan Provinsi Sumatera Utara Jo. Peraturan Pemerintah Nomor 21 Tahun 1950 tentang Pembentukan Daerah Provinsi (Lembaran Negara Republik Indonesia Tahun 1956 Nomor 1103);

2. Undang-undang Nomor 26 Tahun 2007 tentang Penataan Ruang (Lembaran Negara Republik Indonesia Tahun 2007 Nomor 68, Tambahan Lembaran Negara Republik Indonesia Nomor 4725);

3. Undang-undang .....

3. Undang-undang Nomor 23 Tahun 1997 tentang Pengelolaan Lingkungan Hidup (Lembaran Negara Republik Indonesia Nomor 3699);

4. Peraturan Pemerintah Nomor 27 Tahun 1999 tentang Analisis Mengenal Dampak Lingkungan Hidup (Lembaran Negara Republik Indonesia Tahun 1999 Nomor 59; Tambahan Lembaran Negara Republik Indonesia Nomor 3838);

5. Peraturan Daerah Nomor 4 Tahun 2001 tentang Pembentukan Lembaga Teknis Daerah.

Memperhatikan :

1. Keputusan Menteri Negara Lingkungan Hidup Nomor 2 Tahun 2000 tentang Panduan Penilaian Dokumen Analisis Mengenai Dampak Lingkungan Hidup;

2. Keputusan Menteri Negara Lingkungan Hidup Republik Indonesia No.40 Tahun 2000 tentang Pedoman Tata Kerja Komisi Penilai Analisis Mengenai Dampak Lingkungan Hidup;

3. Keputusan Kepala Badan Pengendalian Dampak Lingkungan Hidup Nomor 08 Tahun 2000 tentang Keterlibatan Masyarakat dan Keterbukaan Informasi Dalam Proses AMDAL;

4. Peraturan Menteri Negara Lingkungan Hidup Nomor 08 Tahun 2006 tentang Pedoman Penyusunan Analisis Mengenai Dampak Lingkungan Hidup ;

5. Peraturan Menteri Negara Lingkungan Hidup Nomor 11 Tahun 2006 tentang Jenis Usaha dan/atau Kegiatan Yang Wajib Dilengkapi dengan Analisis Mengenai Dampak Lingkungan Hidup;

6. Keputusan Gubernur Sumatera Utara Nomor 061.1-435.K/Tahun 2002 tentang Tugas, Fungsi dan Tata Kerja Bapedalda Provinsi Sumatera Utara;

7. Keputusan Gubernur Sumatera Utara Nomor : 050/285/K/Tahun 2002 tentang Tata Laksana Proses AMDAL di Provinsi Sumatera Utara.

MEMUTUSKAN

Menetapkan : Keputusan Kepala Badan Pengendalian Dampak Lingkungan Daerah Provinsi Sumatera Utara tentang Kesepakatan Kerangka Acuan Analisis Dampak Lingkungan Hidup (KA-ANDAL) Pengembangan Lapangan Panas Bumi dan Pembangunan PLTP Sarulla di Kabupaten Tapanuli Utara Provinsi Sumatera Utara;

Kesatu : Keputusan Kesepakatan Kerangka Acuan Analisis Dampak Lingkungan Hidup (KA-ANDAL) sebagaimana dimaksud dalam diktum PERTAMA, mengandung arti bahwa ruang lingkup dan kedalaman kajian Analisis Dampak Lingkungan Hidup (ANDAL) bagi kegiatan Pengembangan Lapangan Panas Bumi dan Pembangunan PLTP Sarulla di Kabupaten Tapanuli Utara Provinsi Sumatera Utara oleh PT.Sarulla Operation, Ltd adalah sebagaimana tercantum dalam dokumen Kerangka Acuan Analisis Dampak Lingkungan Hidup (KA-ANDAL) terlampir;

Kedua : .....

Kedua : Kerangka Acuan Analisis Dampak Lingkungan Hidup (KA-ANDAL) Kegiatan Pengembangan Lapangan Panas Bumi dan Pembangunan PLTP Sarulla di Kabupaten Tapanuli Utara Provinsi Sumatera Utara oleh PT.Sarulla Operation, Ltd adalah dasar dan acuan yang tidak terpisahkan dalam pelaksanaan studi Analisis Dampak Lingkungan Hidup (ANDAL), Rencana Pengelolaan Lingkungan Hidup (RKL) dan Rencana Pemantauan Lingkungan Hidup (RPL) selanjutnya ;

Ketiga : Dalam proses Rencana Kegiatan Pengembangan Lapangan Panas Bumi dan Pembangunan PLTP Sarulla di Kabupaten Tapanuli Utara Provinsi Sumatera Utara oleh PT.Sarulla Operation, Ltd; tidak dibenarkan untuk melakukan kegiatan fisik/konstruksi sampai diterbitkannya Keputusan Kelayakan Lingkungan Hidup berdasarkan hasil Analisis Dampak Lingkungan Hidup (ANDAL), Rencana Pengelolaan Lingkungan Hidup (RKL) dan Rencana Pemantauan Lingkungan Hidup (RPL);

Keempat : Setiap kelalaian dan/atau penyimpangan yang dilakukan diluar Keputusan Kesepakatan ini dapat dikenakan sanksi sesuai peraturan yang berlaku.

Ditetapkan di : M E D A N
Pada Tanggal : 08 Agustus 2008

KEPALA BAPEDALDA PROVINSI
SUMATERA UTARA

Prof.H. SYAMSUL ARIFIN,SH.MH
PEMBINA UTAMA
NIP. 130809985

Tembusan disampaikan kepada Yth :
1. Menteri Dalam Negeri Republik Indonesia di Jakarta
2. Menteri Negara Lingkungan Hidup Republik Indonesia di Jakarta
3. Gubernur Sumatera Utara (sebagai laporan)
4. Bupati Tapanuli Utara di Tarutung
5. Komisi Penilai AMDAL Provinsi Sumatera Utara.
6. PT.Sarulla Opration, Ltd.
7. Pertinggal

LAMPIRAN – 3
HASIL ANALISIS LABORATORIUM

DEPARTEMEN PENDIDIKAN NASIONAL
UNIVERSITAS SUMATERA UTARA
PUSAT PENELITIAN
SUMBER DAYA ALAM DAN LINGKUNGAN
LEMBAGA PENELITIAN
Jl. Perpustakaan 3A, Kampus USU, Medan 20155
Telp / Fax. : 061 - 8210783

Hasil Analisis Laboratorium

Pemberi Order : PT ERM
Kegiatan : Pembangunan PLTP Sarulla
Hal : Kualitas Udara
Tanggal Sampling : 27 dan 28 Maret 2008
Parameter yang dianalisis : SO_2 , NO_2 , Pb, Debu, Kebisingan
Kode Lokasi :

UK-1 : SIL -1
N 01° 49' 13,3"
E 099° 05' 09,1"

UK-2 : SIL-2
N 01° 49' 44,1"
E 099° 05' 38,8"

UK-3 : NIL-3
N 01° 53' 03,04"
E 099° 00' 36,4"

UK-4 : Desa Namora Ilangit
N 01° 53' 34,1"
E 099° 01' 46,0"

No	Parameter	Satuan	Hasil				Baku Mutu	Metoda Analisis
			UK-1	UK-2	UK-3	UK-4		
1	SO_2	µg/m³	38,35	36,95	22,50	39,88	900	Pararosanilin
2	NO_2	µg/m³	28,55	20,.60	16,75	29,20	400	Saiztman
3	Pb	µg/m³	0,105	tt	tt	0,195	1	Ekstraksi/AAS
4	Debu	µg/m³	28,75	16,75	15,15	30,55	230	High Volume Sampler
5	Kebisingan	dBA	40-42	34-36	32-34	42-44	*55 **70	Sound Level Meter

Keterangan:

Baku Mutu Udara Ambien Nasional menurut PPRI No 41 Tahun 1999
*Baku Mutu Tingkat Kebisingan menurut :KEP-48/MENLH/11/1996 untuk Pemukiman
** Baku Mutu Tingkat Kebisingan menurut :KEP-48/MENLH/11/1996 untuk Kegiatan Industri
tt : *tak terdeteksi*

Medan, 6 April 2008
Koordinator Lab. Kimia

(Dr Tini Sembiring, MS)
NIP 130 353 143

DEPARTEMEN PENDIDIKAN NASIONAL
UNIVERSITAS SUMATERA UTARA
PUSAT PENELITIAN
SUMBER DAYA ALAM DAN LINGKUNGAN
LEMBAGA PENELITIAN
Jl. Perpustakaan 3A. Kampus USU., Medan 20155
Telp. - Fax. : 061 - 8210783

Hasil Analisis Laboratorium

Pemberi Order : PT ERM
Kegiatan : Pembangunan PLTP Sarulla
Hal : Kualitas Tingkat Kebauan
Tanggal Sampling : 27 dan 28 Maret 2008
Parameter yang dianalisis : NH_3, H_2S
Kode Lokasi :

UK-1 : SIL -1
N 01° 49' 13,3"
E 099° 05' 09,1"

UK-2 : SIL-2
N 01° 49' 44,1"
E 099° 05' 38,8"

UK-3 NIL-3
N 01° 53' 03,04"
E 099° 00' 36,4"

UK-4 : Desa Namora Bangit
N 01° 53' 34,1"
E 099° 01' 46,0"

No	Parameter	Satuan	Hasil				Baku Mutu	Metoda Analisis
			UK-1	UK-2	UK-3	UK-4		
3	NH_3	ppm	0,605	0,570	0,515	0,810	2,0	Indofenol
4	H_2S	ppm	tt	tt	0,0095	tt	0,02	Merkuritiosianat

Keterangan.
tt : tak terdeteksi
Baku Mutu Tingkat Kebauan menurut: KEP-50/MENLH/11/1996

Medan, 6 April 2008
Koordinator Lab. Kimia

(Dr Tini Sembiring, MS)
NIP 130 353 143

DEPARTEMEN PENDIDIKAN NASIONAL
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SUMBER DAYA ALAM DAN LINGKUNGAN
LEMBAGA PENELITIAN
Jl. Perpustakaan 3A. Kampus USU, Medan 20155
Telp / Fax : 061 - 8210783

Hasil Analisis Laboratorium

Pemberi Order : PT ERM
Kegiatan : Pembangunan PLTP Sarulla
Hal : Kualitas Air Permukaan
Tanggal Sampling : 27 dan 28 Maret 2008
Kode Lokasi :
KA-1 : Sungai Bt. Toru Before SIL 01° 49' 30,1" LU 099° 04' 38,6 BT
KA-2 : Sungai Bt.Toru After SIL 01° 48' 01,4" LU 099° 05' 31,8 BT
KA-3 : Sungai Bt.Toru Before NIL 01° 55' 38,9" LU 099° 01' 20,7 BT
KA-4 : Sungai Bt.Toru After NIL 01° 52' 06,4" LU 099° 02' 52,1 BT

No	*Parameter*	*Satuan*	*Hasil*				*Metode Analisis*	*Baku Mutu*
	A. FISIKA		KA-1	KA-2	KA-3	KA-4		
1	Suhu	°C	29	29	27	27	Termometer	Dev 3
2	Daya hantar Listrik	μmhos/cm	286	296	205	190	SCT-Meter	-
3	Padatan Tersuspensi	mg/l	36	40	30	34	Gravimetri	50
4	Padatan Terlarut	mg/l	128	138	114	124	Gravimetri	1000
5	Kekeruhan	NTU	3,27	3,38	2,63	2,86	Turbidimetri	-
	B. KIMIA							
6	pH	-	6,8	6,8	7,1	6,9	Elektrometri	6 - 9
7	Oksigen Terlarut	mg/l	5,55	5,53	5,92	5,65	DO-Meter	> 4
8	BOD	mg/l	2,06	2,27	1,85	1,97	Winkler	3
9	COD	mg/l	22,56	25,44	19,88	20,67	Refluks Titrimetri	25
10	Klorida	mg/l	10,22	25,84	8,81	10,99	Titrimetri	(-)
11	Sulfida	mg/l	//	//	//	//	Spektrofotometri	0,002
12	Sulfat	mg/l	48,50	54,20	38,25	39,75	Spektrofotometri	(-)
13	Nitrat	mg/l	4,14	4,20	3,52	3,89	Spektrofotometri	10
14	Nitrit	mg/l	0,078	0,082	0,075	0,078	Spektrofotometri	0,06
15	Amoniak	mg/l	1,27	1,33	0,97	1,14	Spektrofotometri	(-)
16	Kesadahan	mg/l	87,5	82,5	89,5	81,0	Titrimetri	-
17	Fosfat	mg/l	0,60	0,64	0,43	0,45	Spektrofotometri	0,2
18	Kalsium	mg/l	26,65	26,25	22,50	25,80	Titrimetri	-
19	Magnesium	mg/l	40,50	48,60	44,20	44,90	Titrimetri	-
20	Kadmium	mg/l	//	//	//	//	AAS	0,01
21	Besi	mg/l	0,3112	0,3293	0,1631	0,2235	Spektrofotometri	(-)
22	Krom Heksavalen	mg/l	//	//	//	//	AAS	0,05
23	Timbal	ug/l	0,0212	0,0212	0,0225	0,0275	AAS	0,03
24	Tembaga	mg/l	0,0122	0,0105	0,0085	0,0107	AAS	0,02
25	Seng	mg/l	0,0520	0,0521	0,0415	0,0498	AAS	0,05
26	Kobalt	mg/l	0,0253	0,0245	0,0240	0,0246	AAS	0,2

Keterangan:
// : *tak terdeteksi*
Baku Mutu : Pengelolaan Kualitas Air Dan Pengendalian Pencemaran Air Kelas II
(PP No 82 Tahun 2001)

Medan, 6 April 2008

Koordinator Lab. Kimia

(Dr. Tini Sembiring, MS)

DEPARTEMEN PENDIDIKAN NASIONAL
UNIVERSITAS SUMATERA UTARA
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LEMBAGA PENELITIAN
Jl. Perpustakaan 3A, Kampus USU, Medan 20155
Telp : Fax. : 061 - 8210783

Hasil Analisis Laboratorium

Pemberi Order : PT ERM
Kegiatan : Pembangunan PLTP Sarulla
Hal : Kualitas Air Tanah
Tanggal Sampling : 27 dan 28 Maret 2008
Kode Lokasi :

AT-1 : Air Sumur Penduduk di SIL — N 01° 48' 38,0" E 099° 05' 19,8"
AT-2 : Air Sumur Penduduk di NIL — N 01° 52' 56,1" E 099° 02' 39,5"

No	*Parameter*	*Satuan*	*Hasil*		*Metode Analisis / Peralatan*	*Baku Mutu*
	A. FSIKA		AT-1	AT-2		
1	Rasa dan Bau	-	//	//	-	Tak Berbau dan berasa
2	TDS	mg/l	142	94	Gravimetri	1500
3	TSS	mg/l	18	14	Gravimetri	-
4	Kekeruhan	NTU	1,32	1,31	Turbidimetri	25
5	Suhu	°C	27	29	Mercury Thermometer	Suhu Udara ± 3°
6	Warna	TCU	6,2	5,8	Spectrofotometri	50
	B.KIMIA					
7	pH	-	6,7	6,9	Elektrometri	6,5-9,0
8	Besi(Fe)	mg/l	0,0423	0,0332	Spectrofotometri	1,0
9	Mangan(Mn)	mg/l	0,121	0,100	AAS	0,5
10	Seng(Zn)	mg/l	0,2250	0,2104	AAS	15
11	KromVI(Cr^{6+})	mg/l	//	//	AAS	0,05
12	Tembaga(Cu)	mg/l	0,1024	0,1010	AAS	-
13	Sianida	mg/l	//	//	Spectrofotometri	0,1
14	Sulfida	mg/l	//	//	Spectrofotometri	-
15	Nitrat	mg/l	2,07	2,36	Spectrofotometri	10
16	Nitrit	mg/l	0,81	0,52	Spectrofotometri	1,0
17	Sulfat	mg/l	88,25	70,10	Spectrofotometri	400
18	Klorida	mg/l	16,88	12,78	Titrimetri	600
19	Kesadahan Total	mg/l	137	81	Titrimetri	500
20	Amonia	mg/l	0,24	0,25	Spectrofotometri	-
21	Fosfat	mg/l	//	//	Spectrofotometri	-
	Kimia Organik					
22	Zat Organik sbg $KMnO_4$	mg/l	3,10	2,12	Titrimetri	10
	Mikrobiologi					
23	Total Coliform	Jlh/100 ml	50	42	MPN	1000
24	Fecal Coliform	Jlh/100 ml	12	10	MPN	1000

Keterangan:

// : tak terdeteksi

Baku Mutu : Peraturan Menteri Kesehatan RI No. 416/PER/MENKES/IX/1990 Tentang Persyaratan Kualitas Air Bersih

Medan, 6 April 2008
Koordinator Lab. Kimia

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Telp. / Fax. : 061 - 8210783

Analisis Laboratorium Sampel Plankton PLTP Sarulla
Sampling, 27-28 Maret 2008

No	TAKSA	LOKASI			
		Bio-1	Bio-2	Bio-3	Bio-4
Fitoplankton					
I	**Class : Bacillariophyceae**				
	Fam : Fragilariaceae				
1	*Asterionella sp*	136		136	68
2	*Centronella sp*				68
3	*Diatoma sp*	136			
II	**Class : Chlorophyceae**				
	Fam : Chaetophoraceae				
4	*Pseudoulvella sp*		136		
	Fam : Characeae				
5	*Tolypella sp*	68			
	Fam : Cladophoraceae				
6	*Rhizoclonium sp*				136
	Fam : Desmidiaceae				
7	*Closterium sp*		68	68	68
8	*Cosmocladium sp*		272		
9	*Pleurotaenium sp*				136
	Fam : Mesotaeniaceae				
10	*Gonatozygon sp*	272	204	272	408
	Fam : Oocystaceae				
11	*Dactylococcus sp*	136			
12	*Pachycladon sp*	136			
13	*Selenastrum sp*	68		68	
	Fam : Schizogoniaceae				
14	*Prasiola sp*		126	68	
15	*Schizogonium sp*	68	68		
	Fam : Schizomeridaceae				
16	*Schizomeris sp*				136
	Fam : Tetrasporaceae				
17	*Tetraspora sp*		68	204	
	Fam : Ulotrichaceae				
18	*Rhaphidionema sp*	204		68	
	Fam : Ulvaceae				
19	*Enteromorpha sp*	272	136	68	
20	*Monostroma sp*	476	272	952	544
	Fam : Zygnemataceae				
21	*Pleurodiscus sp*		68		
III	**Class : Chrysophyceae**				
	Fam : Chrysocapsaceae				
22	*Phaeosphaera sp*		68	340	272

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Telp. / Fax. : 061 - 8210783

	Fam : Hydruraceae				
23	*Hydrurus sp*			204	
IV	**Class : Dinophyceae**				
	Fam : Gonyoulaceae				
24	*Gonyoulax sp*			204	
V	**Class : Euglenophyceae**				
	Fam : Colaciaceae				
25	*Euglena sp*	68			
VI	**Class : Myxophyceae**				
	Fam : Rivulariaceae				
26	*Amphithrix sp*		136		
VII	**Class : Rhodophyceae**				
	Fam : Lemaneaceae				
27	*Lemanea sp*	68			136
	Fam : Thoreaceae				
28	*Thorea sp*				68
VIII	**Class : Xanthophyceae**				
	Fam : Pleurochloridaceae				
29	*Chlorogibba sp*		136		
30	*Tetraedriella sp*	68			
Zooplankton					
IX	**Class : Lobosa**				
	Fam : Nebelidae				
31	*Paraquadrula sp*	136			
Jumlah Taksa		15	13	12	11
Jumlah Kelimpahan (ind/L)		2312	1758	2652	2040
Indeks Keanekaragaman (H')		2.499	2.437	2.079	2.119
Indeks Keseragaman (E)		0.923	0.950	0.837	0.884

Keterangan Lokasi :

1. Bio-1 : Biota air yang terdapat di Hulu Sungai Batang Toru (SIL)
   N:01°49'30,1" / E 099°04'38,6"
2. Bio-2 : Biota air yang terdapat di Hilir Sungai Batang Toru (SIL)
   N:01°48'01,4" / E 099°05'31,8"
3. Bio-3 : Biota air yang terdapat di Hulu Sungai Batang Toru (NIL)
   N:01°53'16,0" / E 099°02'41,9"
4. Bio-4 : Biota iar yang terdapat di Hilir Sungai Batang Toru (NIL)
   N:01°53'06,4" / E 099°02'52,1"

Medan, 8 April 2008
Kepala Lobaratorium Biologi
Pusat Penelitian SDAL
Universitas Sumatera Utara

(Prof. Dr. Ing. Ternala Alexander Barus, M.Sc)

UNIVERSITAS SUMATERA UTARA
LEMBAGA PENELITIAN
PUSAT PENELITIAN
SUMBER DAYA ALAM DAN LINGKUNGAN
Jl. Perpustakaan 5, Kampus USU, Medan 20155
Telp. / Fax. : 061 - 8210783

Analisis Laboratorium Sampel Benthos PLTP Sarulla
Sampling, 27-28 Maret 2008

No	TAKSA	LOKASI			
		Bio-1	Bio-2	Bio-3	Bio-4
I	Class : Gastropoda				
	Fam : Bulimidae				
1	*Tryonia sp*		88.889		
	Fam : Lymnaeidae				
2	*Lymnaea sp*		22.222		
II	Class : Insecta				
	Fam : Dysticidae				
3	*Agabimus sp*	11.111		11.111	
	Agabus sp	33.333		22.222	22.222
	Fam : Psephenidae				
4	*Psephenus sp*				11.111
Jumlah Taksa		2	2	2	2
Jumlah Kepadatan (Ind/m^2)		44.444	111.111	33.333	33.333
Keanekaragaman (H')		0.562	0.500	0.637	0.637
Keseragaman (E)		0.811	0.721	0.919	0.919

Keterangan Lokasi :

1. Bio-1 : Biota air yang terdapat di Hulu Sungai Batang Toru (SIL)
   N:01°49'30,1" / E 099°04'38,6"
2. Bio-2 : Biota air yang terdapat di Hilir Sungai Batang Toru (SIL)
   N:01°48'01,4" / E 099°05'31,8"
3. Bio-3 : Biota air yang terdapat di Hulu Sungai Batang Toru (NIL)
   N:01°53'16,0" / E 099°02'41,9"
4. Bio-4 : Biota iar yang terdapat di Hilir Sungai Batang Toru (NIL)
   N:01°53'06,4" / E 099°02'52,1"

Medan, 8 April 2008
Kepala Laboratorium Biologi
Pusat Penelitian SDAL
Universitas Sumatera Utara

(Prof. Dr. Ing. Ternala Alexander Barus, M.Sc)

UNIVERSITAS SUMATERA UTARA
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Telp. / Fax. : 061 - 8210783

Jenis-jenis ikan yang terdapat di lokasi penelitian

No	Nama Lokal	Nama Ilmiah	Lokasi			
			Bio-1	Bio-2	Bio-3	Bio-4
1	Ikan Baung	*Macrones planiceps*	+	-	+	-
2	Ikan Lele	*Clarias teysmanni*	-	+	-	+
3	Ikan Batak	*Neollissochilus sp.*	+	+	+	+
4	Ikan Kepala Timah	*Panchax panchax*	+	+	+	+
5	Ikan Lelan	*Luciosoma spilopleura*	+	-	+	-
6	Ikan Cencen	*Albulichthys albuloides*	+	-	+	-
7	Ikan Gabus	*Ophiocephalus gachua*	+	+	+	+

Bentuk fisik sungai Lebar ± 15 m dan kedalaman ± 1m. Warna air sungai keruh berlumpur sedikit berpasir serta berbatu agak besar. Arus air mengalir dengan deras. Ditumbuhi vegetasi tanaman rumput-rumputan yang besar dan rimbun dilokasi SIL. Bentuk fisik sungai Lebar ± 15 – 20 m dan kedalam 1-1,5 m. Warna air sungai keruh berpasir serta berbatu besar. Arus sungai deras. Ditumbuhi vegetasi tanaman rumput-rumputan yang besar dan lebat dilokasi NIL.

Keterangan Lokasi :

5. Bio-1 : Biota air yang terdapat di Hulu Sungai Batang Toru (SIL)
   N:01°49'30,1" / E 099°04'38,6."
6. Bio-2 : Biota air yang terdapat di Hilir Sungai Batang Toru (SIL)
   N:01°48'01,4" / E 099°05'31,8."
7. Bio-3 : Biota air yang terdapat di Hulu Sungai Batang Toru (NIL)
   N:01°53'16,0" / E 099°02'41,9."
8. Bio-4 : Biota iar yang terdapat di Hilir Sungai Batang Toru (NIL)
   N:01°53'06,4" / E 099°02'52,1."

Medan, 8 April 2008
Kepala Laboratorium Biologi
Pusat Penelitian SDAL
Universitas Sumatera Utara

(Prof. Dr. Ing. Ternala Alexander Barus, M.Sc)

Intertek Caleb Brett

TEST REPORT

Dr. Ir. Yahya Husin
PT. ERM INDONESIA
Wisma Aldiron Dirgantara 2nd Floor
Suite#238-239. Jl. Jend. Gatot Subroto
Kav. 72 Jakarta

Job Number :	083915EV	**Date received :**	06/23/2008
Client Ref :	-	**Date reported :**	07/11/2008

Number of samples : 6

Report Comprising : Cover Sheet, Sample Information, Results

Total Pages : 6

Notes :
N.A = Not Analyzed
I.S = Insufficient Sample
L.N.R = Listed Not Received
R.N.L = Received Not Listed

Client Notes :

Approved Signature :

Reginald C. de Wit
Technical Advisor - Environmental

This report relates specifically to the sample(s) tested in so far as that the sample(s) is truly representative of the sample source as received.

This report was prepared solely for the use of the client named in this report. PT Intertek Utama Services accepts no responsibility for any loss, damage or liability suffered by any third party as a result of any reliance upon or use of this report.

DO NOT PHOTOCOPY

Intertek

SAMPLE INFORMATION

JOB NO : 083915EV
CUSTOMER : PT. ERM INDONESIA
CUSTOMER REF : -
PROJECT : SARULLA
SAMPLE MATRIX : Water

No.	Laboratory Sample I.D.	Customer Sample I.D.	Sample Matrix	Date Sampled	Time Sampled	Date Received	Sample by	Coordinates	
								South	East
1	083915EV - 1	KA -1	Water	19-Jun-08	14.08	23-Jun-08	-	-	-
2	083915EV - 2	KA -2	Water	19-Jun-08	13.32	23-Jun-08	-	-	-
3	083915EV - 3	KA -3	Water	19-Jun-08	09.15	23-Jun-08	-	-	-
4	083915EV - 4	KA -4	Water	19-Jun-08	11.13	23-Jun-08	-	-	-
5	083915EV - 5	AT - 1	Water	19-Jun-08	13.04	23-Jun-08	-	-	-
6	083915EV - 6	AT - 2	Water	19-Jun-08	10.47	23-Jun-08	-	-	-

PT Intertek Utama Services
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KAN
Komite Akreditasi Nasional
Laboratorium Penguji
LP-130-IDN

JOB NO : 083915EV
CUSTOMER : PT. ERM INDONESIA
CUSTOMER REF : -
PROJECT : SARULLA
SAMPLE MATRIX : Water

	Laboratory Sample I.D.			083915EV - 1	083915EV - 2	083915EV - 3
	Customer Sample I.D.			KA -1	KA -2	KA -3
	Date Sampled			19-Jun-08	19-Jun-08	19-Jun-08
	Time Sampled			14.08	13.32	09.15
	Date Received			23-Jun-08	23-Jun-08	23-Jun-08
	Sampled by			-	-	-
	Coordinates		South	-	-	-
			East	-	-	-
No.	Test Description	Unit	Technique	Results		
	Dissolved Metals					
1	Arsenic, As	mg/L	HVAAS	0.0005	0.0007	< 0.0005
2	Barium, Ba	mg/L	FAAS	< 0.1	< 0.1	< 0.1
3	Boron, B	mg/L	Colorimetric	0.1	0.1	< 0.1
4	Cadmium, Cd	mg/L	FAAS	< 0.005	< 0.005	< 0.005
5	Calcium, Ca	mg/L	FAAS	9.67	9.76	9.52
6	Chromium Hexavalent, Cr^{6+}	mg/L	Colorimetric	< 0.002	0.002	0.003
7	Cobalt, Co	mg/L	FAAS	< 0.02	< 0.02	< 0.02
8	Copper, Cu	mg/L	FAAS	< 0.01	< 0.01	< 0.01
9	Iron, Fe		FAAS	0.16	0.31	0.15
10	Lead, Pb	mg/L	GFAAS	< 0.001	< 0.001	< 0.001
11	Magnesium, Mg	mg/L	FAAS	2.25	2.25	2.25
12	Manganese, Mn	mg/L	FAAS	0.02	0.04	0.02
13	Mercury, Hg	mg/L	CVAAS	0.00025	0.00037	0.00008
14	Nickel, Ni	mg/L	FAAS	< 0.02	< 0.02	< 0.02
15	Potassium, K	mg/L	FAAS	4.84	4.85	4.78
16	Selenium, Se	mg/L	HVAAS	< 0.0005	< 0.0005	< 0.0005
17	Sodium, Na	mg/L	FAAS	8.49	8.91	6.61
18	Zinc, Zn	mg/L	FAAS	< 0.005	< 0.005	< 0.005

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JOB NO : 083915EV
CUSTOMER : PT. ERM INDONESIA
CUSTOMER REF : -
PROJECT : SARULLA
SAMPLE MATRIX : Water

	Laboratory Sample I.D.			083915EV - 4	083915EV - 5	083915EV - 6
	Customer Sample I.D.			KA -4	AT - 1	AT - 2
	Date Sampled			19-Jun-08	19-Jun-08	19-Jun-08
	Time Sampled			11.13	13.04	10.47
	Date Received			23-Jun-08	23-Jun-08	23-Jun-08
	Sampled by			-	-	-
	Coordinates		South	-	-	-
			East	-	-	-
No.	Test Description	Unit	Technique	Results		
	Dissolved Metals					
1	Arsenic, As	mg/L	HVAAS	< 0.0005	< 0.0005	< 0.0005
2	Barium, Ba	mg/L	FAAS	< 0.1	< 0.1	< 0.1
3	Boron, B	mg/L	Colorimetric	< 0.1	< 0.1	0.1
4	Cadmium, Cd	mg/L	FAAS	< 0.005	< 0.005	< 0.005
5	Calcium, Ca	mg/L	FAAS	9.39	38.2	15.3
6	Chromium Hexavalent, Cr^{6+}	mg/L	Colorimetric	< 0.002	< 0.002	< 0.002
7	Cobalt, Co	mg/L	FAAS	< 0.02	< 0.02	< 0.02
8	Copper, Cu	mg/L	FAAS	< 0.01	< 0.01	< 0.01
9	Iron, Fe		FAAS	0.18	< 0.05	< 0.05
10	Lead, Pb	mg/L	GFAAS	< 0.001	< 0.001	< 0.001
11	Magnesium, Mg	mg/L	FAAS	2.21	2.75	3.45
12	Manganese, Mn	mg/L	FAAS	0.03	0.04	< 0.01
13	Mercury, Hg	mg/L	CVAAS	0.00009	0.00007	0.00024
14	Nickel, Ni	mg/L	FAAS	< 0.02	< 0.02	< 0.02
15	Potassium, K	mg/L	FAAS	4.90	4.70	8.35
16	Selenium, Se	mg/L	HVAAS	< 0.0005	< 0.0005	< 0.0005
17	Sodium, Na	mg/L	FAAS	6.61	7.27	14.1
18	Zinc, Zn	mg/L	FAAS	< 0.005	0.031	< 0.005

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QUALITY CONTROL - PRECISION

JOB NO : 083915EV
CUSTOMER : PT. ERM INDONESIA
CUSTOMER REF : -
PROJECT : SARULLA
SAMPLE MATRIX : Water

No	Description	UNITS	Technique	Laboratory Replicate		
				083915EV - 6	083915EV - 6 (Replicate)	%RPD
	Dissolved Metals					
1	Arsenic, As	mg/L	HVAAS	< 0.0005	< 0.0005	-
2	Barium, Ba	mg/L	FAAS	< 0.1	< 0.1	-
3	Boron, B	mg/L	Colorimetric	0.1	0.1	0.0%
4	Cadmium, Cd	mg/L	FAAS	< 0.005	< 0.005	-
5	Calcium, Ca	mg/L	FAAS	15.3	15.6	1.9%
6	Chromium Hexavalent, Cr^{6+}	mg/L	Colorimetric	< 0.002	< 0.002	-
7	Cobalt, Co	mg/L	FAAS	< 0.02	< 0.02	-
8	Copper, Cu	mg/L	FAAS	< 0.01	< 0.01	-
9	Iron, Fe	mg/L	FAAS	< 0.05	< 0.05	-
10	Lead, Pb	mg/L	GFAAS	< 0.001	< 0.001	-
11	Magnesium, Mg	mg/L	FAAS	3.45	3.31	4.1%
12	Manganese, Mn	mg/L	FAAS	< 0.01	< 0.01	-
13	Mercury, Hg	mg/L	CVAAS	0.00024	0.00021	13.3%
14	Nickel, Ni	mg/L	FAAS	< 0.02	< 0.02	-
15	Potassium, K	mg/L	FAAS	8.35	8.31	0.5%
16	Selenium, Se	mg/L	HVAAS	< 0.0005	< 0.0005	-
17	Sodium, Na	mg/L	FAAS	14.1	14.0	0.7%
18	Zinc, Zn	mg/L	FAAS	< 0.005	< 0.005	-

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QUALITY CONTROL - ACCURACY

JOB NO : 083915EV
CUSTOMER : PT. ERM INDONESIA
CUSTOMER REF : -
PROJECT : SARULLA
CRM MATRIX : Water

No	Description	Units	Detection Limits	Blank	Reference Material		% Recovery
					Expected Value	Result	
	Dissolved Metals						
1	Arsenic, As	mg/L	0.0005	< 0.0005	0.694	0.728	105%
2	Barium, Ba	mg/L	0.1	< 0.1	1.9	2.0	105%
3	Boron, B	mg/L	0.1	< 0.1	0.8	0.9	111%
4	Cadmium, Cd	mg/L	0.005	< 0.005	0.022	0.021	96%
5	Calcium, Ca	mg/L	0.05	< 0.05	21.2	21.8	103%
6	Chromium Hexavalent, Cr^{6+}	mg/L	0.002	< 0.002	0.125	0.120	96%
7	Cobalt, Co	mg/L	0.02	< 0.02	0.08	0.08	100%
8	Copper, Cu	mg/L	0.01	< 0.01	0.33	0.34	105%
9	Iron, Fe	mg/L	0.05	< 0.05	0.50	0.50	100%
10	Lead, Pb	mg/L	0.001	< 0.001	2.58	2.33	90%
11	Magnesium, Mg	mg/L	0.05	< 0.05	15.6	15.4	99%
12	Manganese, Mn	mg/L	0.01	< 0.01	1.18	1.05	89%
13	Mercury, Hg	mg/L	0.00005	< 0.00005	0.0135	0.0111	82%
14	Nickel, Ni	mg/L	0.02	< 0.02	1.42	1.41	99%
15	Potassium, K	mg/L	0.05	< 0.05	16.0	15.9	99%
16	Selenium, Se	mg/L	0.0005	< 0.0005	1.27	1.33	105%
17	Sodium, Na	mg/L	0.05	< 0.05	70.3	73.5	105%
18	Zinc, Zn	mg/L	0.005	< 0.005	0.103	0.108	105%

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LAMPIRAN – 4

CURRICULUM VITAE DAN SURAT PERNYATAAN TENAGA AHLI

Yahya Abdul Husin

Consultant

Yahya Abdul Husin is a consultant within ERM expertise in Environmental Impact Assessment.

He holds a PhD in Natural Resource and Environmental Management and before he joins ERM Yahya was Environmental Department Manager at Freeport Indonesia, one of the world biggest Copper and Gold Mine. He was also responsible for Freeport's environmental data collection likely the most chalanging baseline job in Indonesia.

His work experience on environmental impact assessment, environmental pollution, and environmental management and monitoring projects since 1978 until now has qualified him as an environmental expert. He has been involved in many environmental impact studies related to several projects in Indonesia such as chemical industry, oil and gas exploration & exploitation, transmigration, forest logging, dam, coal mining, tin mining, and copper & gold mining. His involvement in environmental impact assessment and environmental pollution projects and studies has familiarized him with environmental problems and management issues in Indonesia. His work experiences in (1) SEAMEO-BIOTROP (Tropical Biology Research Center) as a researcher, (2) in Bogor Agricuture University as a lecturer at Under Graduate & Post Graduate School, (3) in Environmental Research Center IPB as senior staff, (4) as free lance consultants from 1979 to 1997, as well as (4) in PT. Freeport Indonesia as senior staff and Enviornmental Department Manager, has acquainted him with strong background on environmental physical, chemical and biology sciences. He has participated in many environmental related training cources as well as national and international seminars, workshops and conferences. With his strong environmental experiences, he has good ability in QA/QC-ing environmental data, peer reviewing as well as writing environmental reports.

Fields of Competence

- Environmental Impact Assessment

Education

- 1988 - 1994, Ph.D. (Cum Laude) in Natural Resource and Environmental Management at Post Graduate Program, Bogor Agricultural University, Bogor and Oregon Graduate Institute, Oregon, USA (Dissertation in English)
- 1979 – 1983, M.S. in Natural Resource and Environmental Management at Post Graduate Program, Bogor Agricultural University, Bogor.
- 1970 – 1974, B.S. (Hons.) in Analytical Chemistry at College of Analytical Chemistry, Bogor.

Training

- February 21- 22, 2001, A short cource on Environmental Risk Assesment. Conducted by ACMER in Hobart, Tasmania, Australia.
- May 3 – 7, 1999, Environmental System Auditor Training (EARA Acredited Quality Assurance Training Program) conducted by QAS (Quality Assurance Services), Australia.
- August 8 - 15, 1994, Training Workshop on Modelling and Measuring Soil Organic Matter Dynamics and Greenhouse Gas Emissions after Forest Conversion. Conducted by ASB-Indonesia, ICRAF, TSBF and IPB. Bogor.
- Sep. 27 - Nov. 17, 1992, Job Training at Global Change Center, Oregon Graduate Institute. Oregon, USA.
- Aug. 19 - Sep. 26, 1991, International Postgraduate Training Course on Assesment and Management of Environmental Pollution. Conducted by the Center for Environmental Sanitation at the University of Ghent. Belgium.
- May 3 - May 13, 1988, UNEP-COBSEA Training Course on the Assessment of Pollution from Land-Based Sources and Their Impact on the Environment. Conducted by the Ministry of Environment Singapore in Cooperation with UNEP-COBSEA. Singapore
- Oct. 1987 - Dec. 1987, Advance Environmental Impact Analysis Training Course. Conducted by the State Ministry for Population and Environment in Cooperation with Research Center for Natural Resource Management and Environmental Studies, Padjadjaran University. Bandung.
- May 1985 - June 1985, Training Course on Current Techniques for Ecophysiology Studies of Plants. Conducted by National University of Singapore. Singapore.
- June 1976 - July 1976, Training Course on Environmental Toxicology. Conducted by Institute of Ecology, Padjadjaran University. Bandung.
- Mar. 1975 - Mar. 1979, English Course (Basic up to Advance Skill), Institute of Indonesia - America Friendship (LIA). Jakarta.
- Apr. 1975 - Aug. 1975, English Upgrading Course, SEAMEO- BIOTROP. Bogor.
- July 1973 - Aug. 1973, Fortran IV Computer Programming Training Course, Conducted by the Department of Public Work and Electricity. Jakarta

Languages

- Indonesian, native speaker
- English, good

Key Industry Sectors

- Mining industry
- Oil & gas industry

Professional Affiliation

- ASAI (Indonesian Water Resource Association)
- ISOI (Indonesian Oceanology Scientist Association)
- HKI (Indonesian Chemist Association)
- Indonesian Wildlife Societies

Publications

- 2005, Husin, Y.A., Pratita Puradyatmika, Robert Sarwom,Joe Macpherson, and Don Chamberlain. Potential of PTFI Tailings Deposition Area for Non-Conventional Estate Crop. Paper presented at Seminar Kebijakan Fiskal untuk Meningkatkan Kinerja Industri Perkebunan. Jakarta, 24 November. (in Enlish)
- 2005: Husin, Y.A., Wisnu Susetyo, Pratita Puradyatmika, Robert Sarwom, Joe Macpherson, and Don Chamberlain. Reclamation and Natural Succession in PTFI Tailings Depposition Area. Paper presented at the Indonesian Mining Association Conference: The Indnesian Mining Industry, To Promote Mining Investment and Activities. Jakarta, 21- 22 September 2005 (in English)
- 2005: Balen, Bas van., Ani Mardiastuti and Y. A. Husin. Birds of Mimika: An Introduction to the Lowlands Birds in PT Freeport Indonesia Contract

of Work Area, Mimika, Papua. 101 pages. (in English and Indonesian)

- 2003: Husin, Y.A., Wisnu Susetyo, Gesang Setyadi, Pratita Puradyatmika and Dedi Mahdar.
- Care for the Environment: Another Face of Mining. Paper presented at the Indonesian Mining Association Conference:The Indnesian Mining Industry, Chalenges Going Forward. Jakarta, 1- 2 October. (in English)
- 1999, Husin, Y. A., and W. Susetyo.Efforts of Impacts Prevention and Mitigation of PT. Freeport Indonesia Mining Activities on Geobiophysical Environment Aspects. Paper presented at Seminar on Impact of Natural Resources Exploitation on Environment and Community in Irian Jaya. Jayapura 15 – 16 December. (in Indonesian)
- 1996, Husin, Y.A., and D. Murdiyarso.
- Relationship between Ambient Methane Concentration and Flux from Rice Fields as Affected by Microclimatic Conditions. Paper Presented at Workshop on Paddy Fields: Control of Greenhouse Gas Emissions and Sustainable Agriculture. Tsukuba, Japan, March 7 - 9. (in English)
- 1996, Husin, Y.A., D. Murdiyarso, Yusmin, I. Amin, and R.T.M. Sutamihardja.
- Methane Emission from Rice Agriculture in Indonesia. Paper Presented at IPCC/OECD Meeting of Experts on Emission Factors for Methane from Wetland Rice Cultivation. Bangkok, April 30 - May 2. (in English)
- 1995, Husin,Y.A., D. Murdiyarso, M.A.K. Khalil, R.A. Rasmussen, M.J. Shearer, S. Sabiham, A. Sunar, and H. Adijuwana. Methane Flux from Indonesian Weland Rice: The Effect of Water Management and Rice Variety. Chemosphere 31 (4): 3153-3180. (in English)
- 1995, Husin, Y.A., D. Murdiyarso, Yusmin, I. Amin and R.T.M. Sutamihardja. Inventtory of Methane Emissions and Sinks from Agriculture in Indonesia. Paper Presented at Regional Workshop on Green House Gas Emissions and Mitigation for Asian and Pacific Countries. Seoul, Korea, September 25 -28. (in English)
- 1995, D. Murdiyarso and Y.A. Husin. Green House Gases Emission and Carbon Balance in Slash and Burn Practices. Paper Presented at Regional Workshop for Alternatives to Slash and Burn. Bogor, June 6 - 9. (in English)
- 1995, Husin, Y.A. and D. Murdiyarso. Methane Flux from Irrigated Rice Fields in North Coast of West Java. Paper Presented at National Workshop on Inventory of Emissions and Sinks of Green House Gases in Indonesia. August 4 -5. (in Indonesian)
- 1995, Husin, Y.A. Environmental Chemistry Course in Higher Education to Cope with Environmental Problems. Paper Presented at Workshop on the Curricula Development of College of Analytical Chemistry, Bogor. March 20, 1995. (in Indonesian)
- 1995, Husin, Y.A. Fresh Water Pollution Problems and Their Mitigation Efforts in Indonesia. Paper Presented at Seminar during the Lustrum VII of College of Analytical Chemistry, Bogor. March 18, 1995. (in Indonesian)
- 1995, Husin, Y.A. Fresh Water Environmental Chemistry. Paper Presented at Workshop Basic Science IAEUP. Denpasar, March 12 - 15. (in Indonesian)
- 1995, Murdiyarso, D., Y.A. Husin, S. Sabiham, H. Adijuwana and Sunar. Wetland Rice Agriculture Techniques and Agroecology Aspects in Reference with Controlling Methane Emissions at Optimal Rice Production. Environmental Research Center, Bogor Agric. Univ. (in Indonesian).
- 1994, Husin, Y.A. Methane Flux from Indonesian Wetland Rice: The Effects of Water Management and Rice Variety. Ph.D. Dissertation, Post Graduate Program, Bogor Agricultural University, Bogor, Indonesia. (in English)
- 1992, Husin, Y.A. Charecteristic of Waste from Oil and Gas Exploration and Exploitation Activities. Paper Presented at the National Seminar on

Treatment Technology for Hazardous and Toxic Waste. Bogor 11 February 1992. (inIndonesian)

- 1992, Husin, Y.A., H. Suharsono and M. Sobri. Level of Air Pollution and Acid Rain in Bogor. Paper Presented at Nasional Seminar on Results of Researches under Ministry of Education and Culture. Cisarua, Bogor, February 22 - 27. (in Indonesian)
- 1991, Husin, Y. A. and Sjaiful Bahri. Water Quality Index of Water Streams in Mount Salak Geothermal Project Area. Paper Presented at 10th National Conference of Environmental Reseach Centers in Indonesia. Bogor, January 7 - 10. (in Indonesian)
- 1989, Husin, Y.A., G. Adnan, Sudaryanto and S. Anggadinata. Assessment of the Quantity and Type of Pollution from Land-Based Sources to the Marine Environment in Indonesia. Country Paper Presented at the Seminar on the Assessment of Pollution from Land-Based Sources and Their Impact on the Environment. Singapore, January 25 -27. (In English).
- 1988,usin, Y.A., G. Adnan, and Sudaryanto. Environmental Problems and Water Pollution in Indonesia. Country Paper Presented at the Training Course on the Assessment of Pollution from Land-Based Sources and Their Impact on the Environment. Singapore, May 3 - 13. (In English).
- 1987, Husin, Y.A. Impact of Acid Rain on Aquatic Environment. Paper Presented in the Seminar at the Department of Forest Resource Conservation, Faculty of Forestry, Bogor Agricultural University. Bogor, July 23. (in Indonesian)
- 1987, Parakasi, A., Y. A. Husin, S. Simamora, A. Priyanto, A. Safei and K. Mudikdjo. Study on the Pollution Level of Piggery and Its Mitigation in West Jakarta. Paper Presented at the Seminar on Animal Waste Utilization. Bogor, August 11. (in Indonesian)
- 1986, Djuangsih, N., W. Ciptadi, Y. A. Husin, S. Hudyastuti and R.T.M. Sutamihardja. Physical and Chemical Water Quality Index. Paper Presented at the Seminar on Water Quality Indices. Jakarta, June 24. (in Indonesian)
- 1984, Wiroatmodjo, J. and Y. A. Husin. Industrial Waste Water Treatment through Biofiltration Techniques. Paper Presented at the Panel Discussion on the Protection of Pollution at Industrial and Work Environment. Bogor, April 24 - 26. (in Indonesian)
- 1981, Wiroatmodjo, J., Y. A. Husin, T. Iswadi, R.T.M. Sutamihardja dan M. Siraj. Development of Potable Water Supply in Transmigration Areas in Indonesia. Paper Presented at the Seminar on Development of Rural Water Supply. Jakarta, May 25. (in Indonesian)
- 1980, Widyanto, L.S., D.H. Harsono, Y. A. Husin and J. Wiroatmodjo. The Ability of Activated-Peat to Absorp Heavy Metals from Industrial Waste Water. Paper Presented at the Symposium on Water Quality and Development. Cisarua, Bogor, September 1 - 3. (in Indonesian)
- 1980, Tjitrosoedirdjo, S., Kasno, S. Wirjahardja, I.H. Utomo, Y. A. Husin, D. Duryadi and J. Wiroatmodjo. Management of Alang-Alang Field. Paper Presented at the Meeting on Alang-Alang Field Management. Bogor, September 16 -17. (in Indonesian)
- 1977, Husin, Y.A., L. Sutanto and D. Permadi. Herbicide Release from a Rubber-Based Formulation to Control Waterhyacinth (Eichhornia crassipes (Mart.) Solms). Paper Presented at the Sixth Asian Pacific Weed Science Society Conference. Jakarta, July 11 - 17. (In English).
- 1977, Tjitrosemito, S. and Y. A. Husin. Photosynthesis of Water Hyacinth (Echhornia crassipes). In Final Report Rawa Pening 1976/1977, Doc. BIOTROP/TP/77/247. (in Indonesian)
- 1977, Chosin, A. and Y. A. Husin. The Ability of Water Hyacinth (Eichhornia crassipes) to absorp 2,4-D and Paraquat Residue. In Final Report Rawa Pening 1976/1977, Doc. BIO TROP/TP/77/247. (in Indonesian)

- 1976, Husin, Y.A. Aquatic Weed Control. Paper Presented at the Workshop on Integrated Weed Control. LE-UNPAD, Bandung, June 19. (in English)
- 1976, Susilo, H. and Y. A. Husin. Analysis of Herbicide Residues in Water. In Final Report Rawa Pening 1975/1976, Doc. BIOTROP/TP/ 76/208. (in Indonesian)
- 1976, Utomo, I.H., B. Risdiono and Y. A. Husin. Utilization of Water Hyacinth as Mulch. In Final Report Rawa Pening 1975/1976, Doc. BIOTROP/TP/76/208. (in Indonesian)
- 1976, Utomo, I.H., Y. A. Husin and B. Risdiono. Growth and Physical Control Method of Water Hyacinth. In Final Report Rawa Pening 1975/1976, Doc. BIOTROP/TP/76/ 208. (in Indonesian)

Key Projects

- 2007 Environmental Impact Analysis Process (AMDAL) of Coal Conversion Project PT Inco, Sorowako
- During working with PT Freeport Indonesia (1997 2006) he has been involved in several projects either as team member or team leader, among others: Ecological Risk Assessment, Ajkwa River Diversion Environmental Management Program, RKL-RPL Revision, preparation and implementation of Environmental Management System, Tailings Reclamation Projects, Environmental Monitoring, Environmental Database Development and Implementation, and many other projects.
- 1996 – 1997, Environmental Impact Analysis Process (AMDAL) of Coal Mining Project at Batulicin Block for PT. Arutmin Indonesia as Team Leader
- 1995 – 1996, Environmental Impact Analysis Process (AMDAL) of Coal Mining Project at Sepapah Block for PT. Arutmin Indonesia at Kotabaru Regency, South Kalimantan as Team Leader
- 1994 – 1995 Environmental Impact Analysis Process (AMDAL) of Coal Mining Project at Asam-Asam Block for PT. Arutmin Indonesia at Tanah Laut and Kotabaru Regencies, South Kalimantan as Team Leader
- 1994 – 1995 AMDAL Study of Amoco's PTA (Purified Terephtalic Acid) Project at Cilegon for Amoco Chemical Company at Cilegon, West Java as Team Leader.
- 1994 Investigation of Incenarator Technologies for Arun Field Gas Production Facilitiesfor Mobil Oil Indonesia Inc. at Lhok Sukon, Aceh as Environmental Chemist
- 1994 - 1996 Green House Gases Emission and Carbon Balance in Slash and Burn Practices for International Center for Research in Agroforestry (ICRAF) at Jambi and Lampung as Atmospheric Chemistry Specialist
- 1994 Computer-Based System for Environmental Impact Assessment (EIA) to Support Environmental Assessment Activities in ASEAN DMCs for Asian Dvelopment Bank (ADB) at South East Asia as Local Domain Expert
- 1994 Integrated Environmental Impact Analysis of Forest Plantation and Pulp & Paper Factory Project of Kalimanis Group for PT. Kiani Kertas and PT Tanjung Redeb Hutani at Berau, East Kalimantan as Water Quality and Sediment Chemistry Specialist
- 1994 Environmental Management Effort (UKL) and Environmental Monitoring Effort (UPL) of Environmental Management Center (EMC) for BAPEDAL at Serpong, West Java as Environmental Chemist
  1992/1993 - 1995/1996 Pollution Control Model of Lake Toba. For BAPEDAL at Lake Toba, North Sumatera as Team Leader
- 1993/1994 - 1996/1997 Study on the Relation of Methane Flux and Agroecological Aspects of Wetland Rice for Ministry of Education and Culture at West Java as Atmospheric Chemistry Specialist
- 1991/1992 - 1995/1996, Development of Model on Environmental Monitoring System of Transmigration Project in Indonesia for Ministry of Transmigration at Sumatera, Kalimantan, Sulawesi and Irian Jaya as Team Member
- 1992 Waste Inventory and Analysis of Arun Field Gas Production Facility for Mobil Oil Indonesia Inc. at Lok Sukon, Aceh as Environmental Chemist
- 1992 Pesticide Usage Survey of Mobil Oil Indonesia Inc. Facilities in Arun and Jakarta for Mobil Oil Indonesia Inc. at Arun, Aceh, and Jakarta as Environmental Chemist
- 1992 Environmental Impact Analysis of Coal Washing Plant of Arutmin Coal Mining Project at Senakin Block for PT. Arutmin Indonesia at Sangsang, South Kalimantan as Environmental Chemist
- 1992 Environmental Impact Analysis of PT.Riau Andalan Pulp and Paper Project for PT. Riau Andalan Pulp and Paper at Pangkalan Kerinci, Riau as Resource Person
- October 1991 – March 1992 Environmental Evaluation Study (SEL) of Oil Exploration and Exploitation Project of ARRI at BIMA and NWC Field for PT. ARRI at Jakarta Bay as Water Quality Specialist
- March 1991 - October 1991 Environmental Evaluation Study (SEL) of logging activity of PT. Kiani Lestari Forest Concession for Kiani Lestari at Batuampar, East Kalimantan as Team Leader
- March 1991 - October 1991. Environmental Impact Analysis (ANDAL) of Forest Plantation Project of PT. Kiani Lestari at Batuampar, East kalimantan for PT. Kiani Lestari at Batuampar, East Kalimantan as Team Leader
- February 1991 - October 1991 Environmental Impact Analysis (ANDAL), Environmental Management Plant (RKL) and Environmental Monitoring Plan (RPL) of Enhanced Oil Recovery Project of PT. Caltex Pacific Indonesia (CPI) at Zamrud Field, Riau at Zamrud, Riau as Team Leader
- October 1990 - October 1991 Environmental Evaluation Study (SEL) of logging activity of PT. Bintuni Murni Wood Industries at Bintuni, Irian Jaya as Team Leader

- August 1991 - January 1992 Environmental Management Plan (RKL) and Environmental Monitoring Plan (RPL) of Sea Sand Dredging Activities at Tanjung Pasir, West Java for PT. Yama International Company at Tanjung Pasir, Tangerang, West Java as Team Leader
- November 1990 - March 1991 Establishment of Important Impacts Criteria Guidelines for State Ministry for Population and Environment in Desk Study (Bogor) as Team Member
- March 1990 - March 1991 Study on the Level of Air Pollution and Acid Rain in Bogor for Ministry of Education and Culture as Team Leader
- May 1990 - November 1990 Environmental Evaluation Study (SEL) of Oil Exploration and Exploitation Project of PERTAMINA EP IV at Bunyu, East Kalimantan for PERTAMINA EP IV Kalimantan as Co-Team Leader and Water Quality Specialist
- May 1990 - November 1990 Environmental Management Plan (RKL) and Environmental Monitoring Plan of Methanol Industry for PERTAMINA EP IV Kalimantan at Bunyu, East Kalimantan as Water Quality Specialist
- April 1990 - July 1990 Environmental Impact Analysis (ANDAL), Environmental Management Plan (RKL) and Environmental Monitoring Plan (RPL) of Oil Exploration and Exploitation Project of HUDBAY OIL at Melibur Concession Area for Hudbay Oil Company at Melibur, Riau as Resource Person
- February 1990 - August 1990 Environmental Evaluation Study (SEL), Environmental Management Plan (RKL) and Environmental Monitoring Plan (RKL) of Oil and Gas Exploration and Exploitation Development Project of ASAMERA OIL (INDONESIA) Ltd. at Block "A" Concession Area for ASAMERA OIL (INDONESIA) Ltd., at Aceh Timur Regency, Aceh as Team Leader
- December 1989 - July 1990 Environmental Evaluation Study (SEL), Environmental Management Plan (RKL) and Environmental Monitoring Plan (RPL) of Oil Exploration and Exploitation Project of UNOCAL Northern Operation Area for UNOCAL Oil Company at Santan, East Kalimantan asTeam Member
- August 1989 - July 1990 Environmental Evaluation Study (SEL), Environmental Management Plan (RKL) and Environmental Monitoring Plan (RPL) of Oil and Gas Exploration and Exploitation Project of VICO Indonesia at Pamaguan-Mutiara Operation Area for VICO Indonesia Oil Company at Pamaguan and Mutiara, East Kalimantan asTeam Member
- August 1989 - July 1990 Environmental Evaluation Study (SEL), Environmental Management Plan (RKL) and Environmental Monitoring Plan (RPL) of Tin Mining in Bangka Island for PT. Tambang Timah at Bangka Island, South Sumatera as Team Leader of Physical-chemical Aspects
- November 1989 - April 1990 Guideline for Scoping Process and EIA Evaluation Procedure for State Ministry for Population and Environment on Desk Study (Bogor) as Team Member
- December 1989 - March 1990 Guidelines for Supervising Environmental Management and Monitoring Activities of Dam Projects for Ditjen Listrik Energi Baruon Desk Study (Bogor) as Team Member
- December 1989 - April 1990 Initial Environmental Impact Statement (PIL) of Crocodile Breeding Project in Irian Jaya for PT. (PERSERO) INHUTANI II at Irian Jaya as Environmental Chemist
- February 1989 - August 1989, Environmental Evaluation Study (SEL), Environmental Management Plan (RKL) and Environmental Monitoring Plan (RPL) of Oil Exploration and Exploitation Project of HUDBAY OIL at Kurau and Pulau Padang Selatan Concession Area as Resource Person
- November 1988 - February 1989, Technical Guidelines of Environmental Impact Analysis (ANDAL) and Environmental Evaluation Study (SEL) for Transmigration Projects, Ministry of Transmigration on Desk Study (Bogor) as Team Member
- January 1988 - August 1988, Environmental Impact Analysis (ANDAL) of Bukit Harapan Coal Mining Project for PT. Multi Harapan Utama at Kutai, East Kalimantan as Water Quality and Hydrology Specialist
- January 1988 - July 1988, Environmental Management Plan (RKL) and Environmental Monitoring Plan (RPL) of Sangatta Coal Mining Project for PT. Kaltim Prima Coal at Sangatta, East Kalimantan as Water Quality and Hydrology Specialist
- January 1988 - June 1988, Environmental Impact Analysis (ANDAL) of Sea Sand Dredging Activities at Tanjung Pasir, West Java for PT. Yama International Company at Tanjung Pasir, Tangerang, West Java as Team Leader
- December 1987 - March 1988, Environmental Monitoring Plan (RPL) of Parambahan Coal Mining Project for PT. Allied Indo Coal at Parambahan, West Sumatera as Water Quality and Hydrology Specialist

- October 1987 - February 1988, Initial Environmental Impact Evaluation (PEL) of Oil and Gas Exploration and Exploitation Project of Stanvac South Sumatera Concession Area for PT. Stanvac Indonesia at South Sumatera as Water Quality Specialist
- August 1987 - January 1988, Initial Environmental Impact Statement (PIL) of Oil and Gas Exploration Project of PERTAMINA Northern Central Java Operation Area for PERTAMINA UEP III, Cirebon at Central Java as Water Quality and Hydrology Specialist
- September 1987 - December 1987, Initial Environmental Impact Evaluation (PEL) of Oil and Gas Exploration and Exploitation Project of Stanvac Central Sumatera Concession Area for PT. Stanvac Indonesia at Kampar and Indragiri Hulu, Riau as Water Quality Specialist
- August 1987 - October 1987, Initial Environmental Impact Evaluation (PEL) of Oil Exploitation Project of PERTAMINA Lirik-Buatan Operation Area for PERTAMINA UEP II, Plaju at Lirik-Buatan, Riau as Water Quality and Hydrology Specialist
- August 1987 - September 1987, Environmental Baseline Study of Oil Exploration Project of Trend Sumatera Ltd. Riau Concession Area for Trend Sumatera Ltd. At Riau as Water Quality and Hydrology Specialist
- April 1987 - August 1987, Initial Environmental Impact Statement (PIL) of Mutiara Gas Facilities Project for HUFFCO Indonesia at Mutiara, East Kalimantan as Water Quality and Hydrology Specialist
- March 1987 - June 1987, Initial Environmental Impact Statement (PIL) of Oil and Gas Exploration Project of PERTAMINA Northern Central Java Operation Area for PERTAMINA UEP III, Cirebon at Pemalang, Central Java as Water Quality Specialist
- January 1987 - June 1987, Environmental Management Plan (RKL) of Parambahan Coal Mining Project for PT. Allied Indo Coal at Parambahan, West Sumatera as Water Quality and Hydrology Specialist
- August 1986 - June 1987, Environmental Impact Analysis (ANDAL) of Sangatta Coal Mining Project for PT. Kaltim prima Coal at Sangatta, East Kalimantan as Water Quality and Hydrology Specialist
- June 1986 - April 1987, Academic Manuscript of Regulation Legislation in Preventing Soil Pollution for "BPHN", Ministry of Justice on Desk Study (Bogor) as Team Member
- June 1985 - April 1986, Academic Manuscript of Regulation Legislation in Preventing Water Pollution for "BPHN", Ministry of Justice on Desk Study (Bogor) as Team Member
- April 1985 - April 1986, Environmental Impact Analysis (ANDAL) of PERTAMINA MB-4 Oil and Gas Exploration Project for PERTAMINA UEP III, Cirebon at Sedari, Karawang, West Java as Team Member
- April 1985 - April 1986, Initial Environmental Impact Statement (PIL) of PERTAMINA RDL-A, RDO-A and RDP-A Oil and Gas Exploration Project for PERTAMINA UEP III, Cirebon at Rengas Dengklok, November 1985 - April 1986, Karawang, West Java as Water Quality Specialist
- Environmental Impact Analysis (ANDAL) of WPP IX/E Transmigration Project at East Timor forMinistry of Transmigration at Kovalima and Ainaro Regencies, East Timor as Environmental Chemist
- August 1985 - April 1986, Environmental Impact Analysis (ANDAL) of Wonorejo Dam Project and Tulung Agung Irrigation Project for Ministry of Public Works at Tulung Agung, East Java as Environmental Chemist
- November 1984 - November 1985, Salt Water Intrusion Control at Air Sugihan Tidal Swamp Transmigration Project for Ministry of Transmigration at Air Sugihan, South Sumatera as Water Quality Specialist
- September 1984 - June 1985, Environmental Impact Analysis (ANDAL) of Zamrud Oil Field Exploitation Project for PT. Caltex Pacific Indonesia at Zamrud, Duri Regency, Riau as Water Quality Specialist
- 1984 – 1985, Environmental Impact Analysis (ANDAL) of Wonogiri Dam Project for Ministry of Public Works at Wonogiri, Central Java as Environmental Chemist
- January 1984 - January 1985, Study on the Problem of Water Resource Supply Continuity of Lake Rawa Cidanau at Serang (West Java) for PT. Krakatau Steel at West Java as Water Quality Specialist
- 1983 – 1984, Environmental Impact Analysis (ANDAL) of Karawang-Cikampek Industrial Zone Covering Several Industries i.e. PT. Pupuk Kujang, PT. Bridgestone Tire, PT. Pindo Deli Pulp and Paper Mills, PT. South Pacific Viscose, PT. Indo Bharat Rayon, PT. Kertas Bekasi Teguh and PT. Noree Indonesia Paper Factory for Consortium of the Industries in the Industrial Zone at Karawang-Cikampek, West Java as Water Quality Specialist
- 1982 – 1985, Study on Sunter-Cakung Watershed Environmental Management Model for State Ministry for Population and Environment at

Sunter-Cakung Watershed, Jakarta as Environmental Chemist

- 1979 – 1986, Study on Water Quality Status of Several Rivers in Java and Sumatera i.e. Ciliwung-Cisadane, Citanduy, Bengawan Solo, Brantas, Jratunseluna, Musi and Siak River for State Ministry for Population and Environment at Main Rivers in Java and Sumatera as Water Quality Specialist
- Fiscal Year 1979/1980 - 1983/1984, Formulating the Utilization of Rain Water and Surface Water with Reference to Supply Fresh Water and Environmental Sanitation at Transmigration Projects Through Out Sumatera and Kalimantan for Ministry of Manpower and Transmigration at Sumatera and Kalimantan as Team Member

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Kami, Rektor selaku Ketua Senat Institut Pertanian Bogor, menerangkan bahwa :

Yahya Abdul Kusin

lahir di Klungkung (Bali) tanggal 18 Agustus 1949 lulus ujian sarjana dalam ilmu Kimia Analisis di Akademi Kimia Analisis Bogor pada hari 30 bulan Maret tahun 1974 telah menyelesaikan semua persyaratan pendidikan Doktor, termasuk membuat dan mempertahankan disertasi dalam bidang ilmu Pengelolaan Sumberdaya Alam dan Lingkungan pada Program Pascasarjana Institut Pertanian Bogor berjudul Methane Flux From Indonesian Wetland Rice: The Effects Of Water Management And Rice Variety

Berdasarkan hak yang diberikan kepada kami, kami mengangkat

Yahya Abdul Kusin, MS.

menjadi Doktor dalam Ilmu Pengelolaan Sumberdaya Alam dan Lingkungan serta memberikan kepadanya segala hak dan kehormatan yang bertalian dengan gelar itu menurut undang-undang, adat dan kebiasaan. Sebagai bukti maka diberikan kepadanya piagam ini yang ditandatangani oleh Rektor dan Direktur Program Pascasarjana serta dibubuhi meterai Institut Pertanian Bogor.

Bogor, 22 Maret 1994

Direktur Program Pascasarjana

(Prof. Dr. Ir. Edi Guhardja)

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UNIVERSITAS PADJADJARAN

LEMBAGA PENELITIAN

PUSAT PENELITIAN SUMBER DAYA ALAM DAN LINGKUNGAN

Sertifikat ini diberikan kepada :

Yahya A. Husin, M.S.

Yang telah menyelesaikan :

KURSUS PENYUSUNAN ANALISIS DAMPAK LINGKUNGAN

Diselenggarakan di Bandung dari tanggal 1 Oktober sampai dengan 7 Desember 1987

bekerjasama dengan Kantor Menteri Negara Kependudukan dan Lingkungan Hidup.

Bandung, 7 Desember 1987

Rektor
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Yupun Wirasasmita, M.Sc.

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Certificate of Achievement

Education and Training

Yahya Husin

has successfully completed the EARA accredited Quality Assurance Training program

Environmental Systems Auditor Training

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David F Gray
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QAS
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UNIVERSITEIT GENT

University of Ghent, Belgium
Centre for Environmental Sanitation

CENTRE FOR ENVIRONMENTAL SANITATION

CERTIFICATE

The Government of Belgium, Ministry of Foreign Affairs, Foreign Trade and Development Cooperation,
The University of Ghent, Centre for Environmental Sanitation,

hereby declare that

Yahya Abdul Husin

has followed and successfully completed the postgraduate training course on

ASSESSMENT AND MANAGEMENT OF ENVIRONMENTAL POLLUTION

organized from August 19. through September 26., 1991.
by the ~~Centre for~~ Environmental Sanitation at the University of Ghent in Belgium.

Ghent, September 26, 1991

The Minister of
Development Cooperation

The Rector of the
University of Ghent

The President of the
Centre for Environmental Sanitation

BOTANY DEPARTMENT, NATIONAL UNIVERSITY OF SINGAPORE

AND

SEAMEO REGIONAL CENTER FOR TROPICAL BIOLOGY (BIOTROP)

hereby award this

CERTIFICATE OF COMPLETION

to

YAHYA A HUSIN

for having satisfactorily attended the

TRAINING COURSE ON CURRENT TECHNIQUES FOR ECOPHYSIOLOGICAL STUDIES ON PLANTS

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DEPARTMENT OF TOXICOLOGY
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It is hereby certified that

Yahya A.H. B.Sc.

has successfully participated in the Workshop and Course on Environmental Toxicology held in Bandung from 14 June to 14 July 1976.

Bandung, 14 July 1976

Co-directors,

Rector
Padjadjaran University.

(Prof. Dr. Ir. Otto Soemarwoto) (Prof. Dr. J. H. Koeman) (Prof. Drs. Hindersah Wiraatmadja)

LAMPIRAN SERTIFIKAT
KURSUS PENYUSUNAN ANALISIS DAMPAK LINGKUNGAN ANGKATAN V
PUSAT PENELITIAN SUMBER DAYA ALAM DAN LINGKUNGAN, LEMBAGA PENELITIAN - UNIVERSITAS PADJADJARAN
BEKERJASAMA DENGAN
KANTOR MENTERI NEGARA KEPENDUDUKAN DAN LINGKUNGAN HIDUP

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THIS IS TO CERTIFY THAT

Mr Yahya Abdul Husin

HAS COMPLETED THE COURSE ON

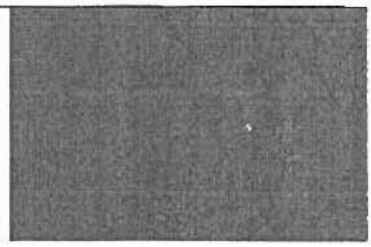
THE ASSESSMENT OF POLLUTION FROM LAND-BASED SOURCES AND THEIR IMPACT ON THE ENVIRONMENT

AT THE MINISTRY OF THE ENVIRONMENT, SINGAPORE
FROM 3 MAY 88 TO 13 MAY 88
SPONSORED BY
THE UNITED NATIONS ENVIRONMENT PROGRAMME
IN COLLABORATION WITH
THE MINISTRY OF THE ENVIRONMENT,
SINGAPORE

DEPUTY SECRETARY
MINISTRY OF THE ENVIRONMENT
SINGAPORE

Ir. Hafid Hadi, MM

Tanah dan Reklamasi



Hafid Hadi sudah berpengalaman di bidang AMDAL, Audit Lingkungan Hidup, Pemantauan Lingkungan Hidup dan Evaluasi Program dan Perencanaan lebih dari 15 tahun. Keahliannya di bidang pertanahan, lingkungan hidup, dan faktor sosial ekonomi yang berhubungan dengan konsesi hutan, pertambangan, minyak dan gas, perkayuan, industri transportasi kereta api, pelabuhan, *pulp and paper*, tekstil, minyak kelapa sawit, dan perkebunan karet. Ia telah bekerja di Jawa, Sumatera, Kalimantan, Sulawesi, Maluku, dan Papua (Irian Jaya). Ia juga telah menggunakan keahliannya di bidang lain, yaitu sebagai penilai dan pemantau program lingkungan hidup (contoh: transportasi kereta api, pelabuhan, industri, transmigrasi, minyak dan gas). Selain itu dia juga sudah terbiasa dengan metodologi baru-baru ini untuk pengumpulan dan penerjemahan data lapangan, dan sudah berpengalaman dengan penulisan report. Ia memiliki sertifikat AMDAL B yang diperoleh dari asosiasi INKINDO (perkumpulan Agen-Agen Konsultan) pada tahun 1995.

Ia mampu bertanggung jawab untuk mengkoordinasi tenaga ahli di lapangan untuk studi lingkungan hidup dan proses lingkungan hidup (sebagai project manager). Ia juga dapat membantu segala aspek kerja lapangan dan area teknis sebuah proyek, termasuk mengorgansasi tim lapangan, mendukung anggota tim, dan mengumpulkan laporan. Selain itu, Hafid dapat dan bertanggung jawab untuk menjadi penghubung antara proyek dengan pemerintah Indonesia.

Sesuai dengan KepMenLH No. 283/2006 tertanggal 2 Agustus 2006, ia terpilih sebagai komite teknikal pada tingkat nasional dalam bidang pembuatan standard kompetensi personil dan lingkungan hidup di Indonesia (sampi sekarang).

Keahlian

- Ilmu Tanah
- Sosial Ekonomi
- Evaluasi Lingkungan Hidup
- AMDAL
- Program Pemantauan Lingkungan

Pendidikan

- Management Magister (MM), Jakarta Management of University, Jakarta, Indonesia (1999)
- Ir. (setara B.Sc.) Pertanahan, Fakultas Pertanian, Institut Pertanian Bogor, Bogor, Jawa Barat, Indonesia (1989)

Training

- AMDAL A & B, INKINDO, Jakarta, Indonesia. 1995
- AMDAL, Fakultas Kehutanan, Universitas Gajah Mada, Jogyakarta, Indonesia. 1991
- AMDAL, Institut Pertanian Bogor, Bogor. 1990
- Secretariat of Management Course, Institut Pertanian Bogor, Bogor, Indonesia. 1986
- Seminar mengenai Rubber Wood Quality, P3HH, Bogor, Indonesia. 1992.
- Seminar mengenai Wood Conservation dan Drying Techniques, Pusat Riset dan Pengembangan Hutan, Manggala Wanabhakti, Jakarta, Indonesia. 1991.
- Seminar mengenai Land Productivity Using Organic Compost, Pusat Riset dan Pengembangan Hutan, Manggala Wanabhakti, Jakarta, Indonesia. 1991.
- Seminar mengenai Land Reforestation dan Rehabilitation in Indonesia, Fakultas Kehutanan, Institut Pertanian Bogor, Bogor. 1991.

- Seminar mengenai Indonesian Natural Forestry System, Fakultas Kehutanan, Institut Pertanian Bogor, Bogor. 1991.
- Seminar mengenai Developing Excellent Customer Relations, Kartika Plaza Hotel, Jakarta, Indonesia. 1990.
- Training mengenai Future Trading, Lippo Center, Jakarta, Indonesia. 1989
- Seminar, workshop dan training di Kementrian Lingkungan Hidup, 1999-2003.

Bahasa
- Indonesia, bahasa nasional
- Inggris, baik

Sektor Industri Utama
- Pertanian dan Kehutanan
- Kelapa Sawit dan Perkebunan
- Minyak dan Gas
- Pertambangan
- Hutan Tanaman Industri
- Tekstil
- Transportasi Kereta Api
- Pelabuhan

Pengalaman Bekerja
- PT ERM Indonesia, Jakarta, Indonesia. 2007-sekarang
- PT Hatfield Indonesia, Bogor, Indonesia. 1996-2007
- PT Reka Paramitra, Jakarta, Indonesia. 1992-1996
- Kayu Mas Group, Jakarta, Indonesia. 1990-1992
- PT Cahaya Citra Permai, Jakarta. 1989-1990
- Fakultas Ilmu Pengetahuan Dan Matematika, Institut Pertanian Bogor, Bogor, Indonesia. 1985-1989
- Fakultas Pertanian, Institut Pertanian Bogor, Bogor, Indonesia. 1987-1988

Proyek Utama
- Pertamina- Consortium (MedcoEnergy), Kabupaten Tapanuli Tengah, Province of South Sumatera. AMDAL of Sarulla 300 MW Geothermal Project. January 2008 - ongoing
- PT Weda Bay Nickel, Kabupaten Halmahera Tengah, Provinsi Maluku Utara. AMDAL of Nickel and Cobalt Mining Project of PT Weda Bay Nickel. June 2007 – ongoing.
- PT Marathon Oil, Kabupaten Mamuju Utara, Province Sulawesi Barat. UKL-UPL of Seismik 3D Survey, Block Pasangkayu. June 2007 - ongoing
- PT Anadarko (Bunga Mas International Co), Kabupaten Lahat dan Kabupaten Muara Enim Provinsi Sumatera Selatan. UKL-UPL of Seismik 2D Survey, Blok Bunga Mas. May - September 2007
- PT Agincourt, Kabupaten Tapanuli Selatan, Propinsi Sumatera Utara. Amdal Tambang dan Proses Pengolahan Emas PT Agincourt. July 2007 - ongoing
- PT Inco, Amdal Peningkatan dan Optimalisasi Produksi Penambangan dan Pengolahan Bijih Nikel PT Inco hingga Mencapai 225 Juta Pon Nikel dalam Matte per Tahun. Kabupaten Luwu Timur, Propinsi Sulawesi Selatan. February 2007 - sekarang
- Wordbank. Ecological risk assessment untuk Aceh Singkil dan Aceh Selatan
- PT Weda Bay, Halmahera, Maluku Utara- Test Pit Activity on Forestry, Lingkungan Hidup dan Land Rehabilitation Plan..
- PT UBC Indonesia, Kalimantan Selatan, Indonesia - UKL-UPL for upgraded brown coal. Memimpin survey lapangan, analisis data, penulisan laporan, dan penerimaan Pemerintah Daerah Tanah Bumbu District, Kalimantan Selatan. September 2006 – sekarang
- UNDP Program – Performance Verification of 2005 Activities for CFC consumption in Indonesia. July - September 2006
- PT Central Java Power, Jepara, Jawa Tengah, Indonesia – Lingkungan Hidup Monitoring (air quality dan water quality parameter) untuk Tanjung Jati B thermal power plant. Memimpin survey lapangan, analisis data, dan penulisan laporan. January – December 2006
- PT Proflex Indonesia, Bogor, Jawa Barat, Indonesia – Lingkungan Hidup Management dan Monitoring Activities (UKL-UPL) for a vehicle accessories manufacturing company. Memimpin survey lapangan, analisis data, panulisan laporan, dan penerimaan dari Pemerintah. Juga termasuk Lingkungan Hidup Awareness dan HSE Training untuk karyawan. April – July 2006
- Care International, Provinsi NAD, Indonesia - UKL-UPL Program transmigrasi di Jantho, Lampulo

Lambaro dan Lam Lam District. Memimpin survey lapangan, analisis data, penulisan laporan, dan pencapaian penerimaan dari Pemerintah. June 2006

- Canadian Red Cross Service Center, Banda Aceh, Provinsi NAD, Indonesia - Lingkungan Hidup Management dan Monitoring Activities (UKL-UPL) for resettlement project in Aceh Jaya District. Memimpin survey lapangan, analisis data, penulisan laporan, dan pencapaian penerimaan drti Pemerintah. June 2006 - February 2007
- PT Jorong Barutama Greston, Kalimantan Selatan – Public Perception Interviews as Part of PT Jorong Barutama Greston Lingkungan Hidup Master Plan Development. Responsible as Socio Economic specialist. February 2005
- PT Newmont Horas Nauli, Batang Toru, North Sumatra – Baseline Terrestrial Ecology Survey of The Martabe Project Area. Bertanggung jawab atas koordinasi lapangan, sebagai spesialis tanah. March 2004-2005
- PT Indorama Tbk, Purwakarta, Jawa Barat – Site Investigation in the textile industry area. Bertanggung jawab mengatur semua aktivitas di lapangan dan pengumpulan laporan, sebagai specialis tanah. Oktober 2003
- PT Tanjungenim Lestari Pulp & Paper, Muara Enim, South Sumatra – Lingkungan Hidup Management dan Monitoring Study of Pulp Mill. Bertanggung jawab mengatur semua aktivitas di lapangan dan pengumpulan laporan, sebagai spesialis ekonomi sosial. 2000-sekarang.
- PT Tanjungenim Lestari Pulp & Paper, Palembang/Lampung – Lingkungan Hidup Management dan Monitoring Study of Railway dan Port Operations. Bertanggung jawab mengatur semua aktifitas di lapangan dan pengumpulan laporan. Juga sebagai Spesialis ekonomi social dan penganalisa dalam program pemantauan. 2000-sekarang.
- Premier Oil Natuna Sea B.V, Jakarta – Anggota Tim. RKL dan RPL Natuna Sea Block "A" Oil dan Gas Fields Development in Natuna Regency, Riau Province. Bertanggung jawab mengorganisasi dan meninjau laporan mengenai Lingkungan Hidup science dan GOI regulations, serta menulis bagian social ekonomi. 2002.
- PT Caltex Pacific Indonesia, Pekanbaru, Riau, Indonesia – Anggota Tim. Technical Assistance for Implementation of Native Forest Restoration Pilot Project, sebagai Soil Science Specialist. May 2001 – April 2002.
- PT Tanjungenim Lestari Pulp & Paper, Muara Enim, South Sumatra – ISO 9001 dan 14001 Program for Pulp Mill. Bertanggung jawab mempersiapkan *baseline data.* Juni 2001 – Juni 2002.
- PT Tanjungenim Lestari Pulp & Paper, Muara Enim, South Sumatra – Lingkungan Hidup Management dan Monitoring Study of Pulp Mill. Bertanggung jawab mengatur semua aktivitas lapangan dan penumpulan data laporan, juga sebagai Socio-Economic Specialist dan evaluator dalam program pemantauan. Januari – Desember 2002.
- PT Tanjungenim Lestari Pulp & Paper, Palembang/Lampung – Lingkungan Hidup Management dan Monitoring Study of Railway dan Port Operations. Bertanggung jawab mengatur semua aktifitas di lapangan dan pengumpulan laporan, serta sebagai Socio-Economic Specialist dan evaluator untuk monitoring program. January – December 2002.
- PT Tanjungenim Lestari Pulp & Paper, Muara Enim, South Sumatra – Lingkungan Hidup Management dan Monitoring Study of Pulp Mill. Bertanggung jawab untuk semua aktifitas di lapangan dan pengumpulan laporan, juga sebagai Socio-Economic Specialist dan evaluator untuk monitoring program. Januari – Desember 2001.
- PT Paiton Energy, Probolinggo, Jawa. – Lingkungan Hidup Monitoring Program. Bertanggung jawab untuk mengorganisasi kru lapangan dan pengumpulan report, juga menulis evaluasi program lingkungan hidup. 2001.
- PT Tanjungenim Lestari Pulp & Paper, Palembang/Lampung – Lingkungan Hidup Management dan Monitoring Study of Railway dan Port Operations. Bertanggung jawab untuk semua aktifitas di lapangan dan pengumpulan laporan, juga sebagai Socio-Economic Specialist dan evaluator untuk monitoring program. January – December 2001.
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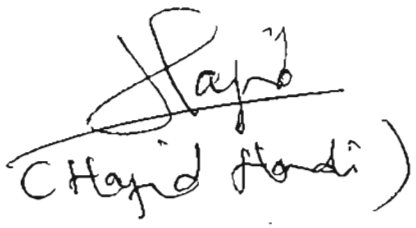


Departemen Pendidikan dan Kebudayaan

Institut Pertanian Bogor

Memberikan kepada : H A F I D H A D I

Nomor Pendaftaran : A1 [illegible]61

Lahir di : T A N G E R A N G pada tanggal 17 PEBRUARI 1966

Fakultas : P E R T A N I A N

Ijazah : [illegible]

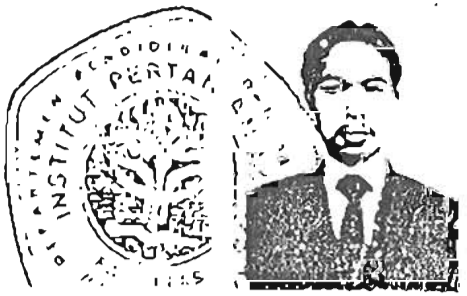
Program Studi : [illegible]

setelah memenuhi semua persyaratan yang diperlukan untuk memperoleh ijazah. Kepadanya diberikan segala wewenang dan hak yang berhubungan dengan ijazah yang dimilikinya.

Bogor, 28 SEPTEMBER 1989

Dekan Fakultas,

DR. IR. SOLEH SOLAHUDDIN



Rektor,

PROF. DR. IR. H. SITANALA ARSYAD

Sertifikat

No.A649/KDA/XII/43/95

Diberikan kepada :

Ir. Hafid Hadi

lahir di Tangerang pada tanggal 17 Pebruari 1966

yang telah mengikuti

KURSUS

DASAR-DASAR ANALISIS MENGENAI DAMPAK LINGKUNGAN (AMDAL)

Angkatan ke - XII

yang diselenggarakan oleh

IKATAN NASIONAL KONSULTAN INDONESIA

bekerjasama dengan

PUSAT PENGKAJIAN MANAJEMEN LINGKUNGAN

UNIVERSITAS KRISNADWIPAYANA

dan

BADAN PENGENDALIAN DAMPAK LINGKUNGAN

dari tanggal 18 Oktober sampai dengan 2 November 1995

di Jakarta

Ketua Umum
Dewan Pengurus Pusat
Ikatan Nasional Konsultan Indonesia

Drs. H. Poedji Rahardjo

Dekan Fakultas Ekonomi dan
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Ir. H. Malondang

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Sertifikat

No.8 512 / KPA / XII / 30 / 95

Diberikan kepada :

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KURSUS

PENYUSUN ANALISIS MENGENAI DAMPAK LINGKUNGAN (AMDAL)

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BADAN PENGENDALIAN DAMPAK LINGKUNGAN

dari tanggal 6 November sampai dengan 15 Desember 1995

di Jakarta

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Ikatan Nasional Konsultan Indonesia

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Ketua Pusat Pengkajian Manajemen Lingkungan
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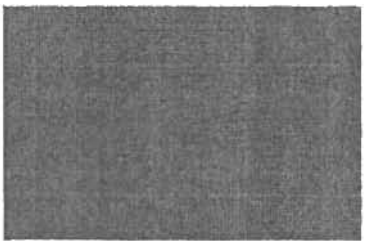
Badan Pengendalian Dampak Lingkungan

Budi Hadi Haryawan

Environmental Geologist/Geotechnical Engineer



Budi Hadi haryawan has more than 20 years experience in various field work. He spent one year as well site geologist for coal exploration in Bukit Asam, South Sumatra. As an engineering geologist, he was involved in several hydroelectric power projects in West Java, South Sulawesi, West Sumatra and Riau. He was also involved in detailed design for Irrigation and Dam project and several small irrigation projects. Budi assisted with design for the Port Development Project, which included works covering geological mapping, core description, in-situ tests such as SPT, a Permeability Test, and a Grouting test.

Budi's experience as a hydrogeologist includes conducting permeability tests, and providing designs for well construction. As geotechnical instrumentation engineer, he was involved in coordinating the installation of various piezometers, inclinometers, and extensor meters. He also conducted in-situ rock mechanical tests, such as the jack test and block shear test. As Civil Engineer, Budi was involved in computation of hydrology for the Provincial and Agricultural Development Project in South Sulawesi. He was likewise involved in road design, simple building design, retaining wall and drainage system, and spreads in 112 projects during the Asian Development Bank grant distribution in the Majalengka Regency.

Budi has more than three years of experience in environmental site assessment, waste management, and groundwater monitoring as an environmental geologist. Budi has conducted environmental field work oversight and documentation, including borehole and trench lithologic logging and environmental sampling for many types of field investigation approaches. Budi also assisted with proposal and report writing. He has completed environmental site assessments for many types of oilfield facilities and features, including gathering stations, gas plants, canals/drainages and waste management facilities, and coordinated oversight of drilling, trenching and hand auger activities for various Phase II Environmental Site Assessments. He also acted as field geologist during a field program assessment of a large oil waste management facility. His clients include the Department of Public Works, National Electric Company, Department of Transportation, Unocal, Chevron Pacific Indonesia, Syngenta, British Petroleum, PT. Aneka Tambang, Batu Bara Tanjung Enim, and the University of California in San Diego.

Professional Affiliations & Registrations

- Association of Geologist Indonesia, Member 1980 – present

Fields of Competence

- Geotechnical Engineering
- Hydrogeology
- In-situ Rock Mechanical Test
- Geotechnical instrumentation
- Environmental Phase I and Phase II Site Assessment
- Environmental Impact Assessment

Education

- Bachelor degree in Geology, Academy of Geology and Mining, Bandung
- Bachelor degree in Civil Engineering, Faculty of Engineering, Hasanuddin University, Makassar

Languages

- Indonesia, Native Speaker
- English, fair

Key Industry Sectors

- Oil and Gas
- Mining
- Engineering and construction
- Irrigation
- Hydroelectric power

Environmental Phase 2 Site Assessment

- World Bank, Sediment Quality Sampling for Jakarta Emergency Dredging Initiative.,2008
- Confidential Client in Yogyakarta,2008
- Installation of seven (7) new monitoring wells, PT. Syngenta Indonesia, Gunung Putri ,Bogor, 2008
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- Phase II, Pfizer, Sentul, Bogor, 2006.
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- Panti – Rao Irrigation, Detail Design, West Sumatra, 1983.
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Rock Mechanic in-situ test.

- Cirata HEPP, Jack Test and Block Shear Test, West Java, 1982
- Bakaru HEPP, Jack Test at Headrace Tunnel Audit, Pimrang, South Sulawesi, 1982
- Bakaru HEPP, Jack Test at Surge Tank Audit , Pinrang, South Sulawesi, 1989.

Hydrogeology

- Dip Tube installation and supervision on pumping test, PT. Syngenta Indonesia,, 2008.
- Completed water well drilling in Palopo, Makassar, and Sengkang as well as Saengga, Tanah Merah Baru, Onar Lama and Onar Baru of Teluk Bintuni Regency, Papua Province, 2005-2006

Mining

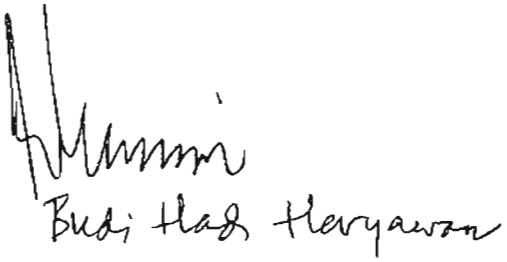
- Coal exploration, Bukit Asam, Tanjung Enim, South Sumatra, 1978-1979.

Grouting

- Grouting test for Bakaru Dam, Pinrang South Sulawesi, 1982
- Grouting Test for Bili Bili Multi Purpose Dam, Gowa, South Sulawesi 1986.
- Grouting Treatment for Hanga-Hanga, Luwuk, Central Sulawesi, 1984

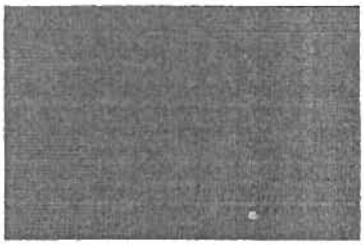
Civil Works,

- Design of road pavement, simple building, retaining wall, and drainage system, included in totally 112 projects, spreads in Majalengka, as Asian Development Bank Grant Distribution.
- Hydrological computation for Provincial Irrigated and Agricultural Project, South Sulawesi, 1994



Dra. Eva Marlina Ginting, M.Si

Asóciate Konsultan



Eva Marlina Ginting bekerja sebagai Asóciate Konsultan di ERM, Jakarta. Memiliki pengalaman yang luas dalam Analisis Dampak Lingkungan.

Eva Marlina Ginting menyelesaikan pendidikannya pada Jurusan Fisika, Fakultas MIPA, Universitas Sumatera Utara, Medan

Dengan keahliannya di bidang Fisika, beliau terlibat dalam beberapa Studi Mengenai Analisis Dampak Lingkungan dan beberapa proyek Pengelolaan Lingkungan di seluruh Indonesia.

Kompeten dalam Bidang

- Analisis Dampak Lingkungan (AMDAL)

Pendidikan

- Lulus S1 dari Fakultas Fisika, Universitas Sumatera Utara, Medan, 1991
- Master dalam bidang Pengelolaan SDAL, 2002
- Kursus Dasar-dasar Analisis Dampak Lingkungan (AMDAL-B), Puslit Lingkungan USU - Medan, Maret 2001
- Kursus Penilai Analisis Dampak Lingkungan (AMDAL-C), PPL – ILP - USU - Medan, April - Juni 2001

Bahasa

- Indonesia, Bahasa Nasional
- Inggris, baik

Sektor Industri

- Perhotelan
- Minyak dan Gas
- Kemasyarakatan

Pengalaman proyek

Analisis Mengenai Dampak Lingkungan (AMDAL)

- Studi AMDAL Pembangunan Hotel Marriot Medan, 2006 - 2007
- Studi Revisi AMDAL Mall Gran Palladium, Sumatera Utara, 2006 - 2007
- Studi AMDALApartemen dan Ruko The Royal Residence, Sumatera Utara, 2006
- Studi AMDAL Pembangunan PLTU Paluh Sernai, Sumatera Utara, 2005
- Environmental Baseline Study, ExxonMobil Lhoksukon NAD, 2005
- Studi AMDAL Crown International Hotel, Sumatera Utara, 2004
- Studi RKL – RPL Pembangkit Listrik Tenaga Panas Bumi, Sumatera Utara, 2004
- Studi Pemantauan Lingkungan Geothermal Panas Bumi Pertamina Sibayak, Sumatera Utara, 2004
- Studi UKL dan UPL Rehabilitasi Lapangan Minyak Telaga Said, Sumatera Utara, 2003
- Studi AMDAL Perluasan Dermaga PT. Multi Nabati Asahan, Sumatera Utara, 2003
- Studi ANDAL PLTU Labuhan Angin Sibolga, Tapanuli Tengah, 2003
- Studi UKL dan UPL PT. Fujiyama Steel Industry, Medan – Belawan, 2002
- Studi UKL dan UPL Rumah Sakit Kasih Kartini Perkebunan PT. Bakrie, Tbk, Kisaran, 2002
- Environmental Baseline Study Kisaran Block – Rantau Prapat, PT. Caltex Pasific Indonesia Cooperation with URS Jakarta, 2002
- Studi UKL dan UPL RS. Monginsidi, Sumatera Utara, 2001
- Studi ANDAL Perkebunan Kelapa Sawit, PT. AMKS, Barumun Tengah, Kab. Tapanuli Tengah, 2001
- Environmental Baseline Study Project Normandy, Barumun Tapanuli Tengah, 2001
- Studi UKL – UPL RSS. Estomihi Medan, Sumatera Utara, 2001
- Studi RKL – RPL Pertamina Panas Bumi Sibayak, Berastagi, 2000
- Studi RKL – RPL Pertamina Asset Rantau dan Pangkalan Susu, Sumatera Utara, 2000
- Studi ANDAL Pelabuhan Tanjung Balai Karimun, Riau, 2000

Departemen Pendidikan Dan Kebudayaan

Universitas Sumatera Utara

Memberikan Kepada : Ira. Marlina Ginting

Nomor Registrasi : 850801014.

Lahir Di : Medan Pada Tanggal 22 April 1967.

Fakultas : Matematika dan Ilmu Pengetahuan Alam.

Bidang Ilmu : Fisika.

Jasah :

Program Studi : Fisika

Setelah Memenuhi Semua Persyaratan yang Ditentukan, Maka Memperoleh Jasah Tersebut Kepadanya Diberikan Segala Kewenang dan Hak yang Berhubungan dengan Jasah yang Dimilikinya.

15 Oktober 1991.

Dekan Fakultas

Drs. Hasan, M.C

NIP. 130 515 094.

Rektor

Prof. Dr. Yusuf Hanafiah

NIP. 130 175 765.

PENGESAHAN

Departemen Pendidikan Nasional
UNIVERSITAS SUMATERA UTARA

dengan ini menyatakan bahwa :

Eva Marlina Ginting

NIM : 992104007

Lahir di Medan tanggal 22 April 1967

telah memenuhi semua persyaratan yang ditentukan dan lulus ujian Magister pada Program Studi Pengelolaan Sumber Daya Alam Dan Lingkungan

oleh sebab itu kepadanya diberikan gelar

Magister Sains

beserta segala hak dan kewajiban yang melekat pada gelar tersebut.

Diberikan di Medan pada tanggal 28 Maret 2002

DIREKTUR
PROGRAM PASCASARJANA

Dr. Ir. Sumono, MS
NIP 130535819

REKTOR

Prof. Chairuddin P. Lubis, DTM&H, Sp.A(
NIP 130565289

UNIVERSITAS SUMATERA UTARA
LEMBAGA PENELITIAN
PUSAT PENELITIAN LINGKUNGAN
JL. PERPUSTAKAAN J-A KAMPUS USU MEDAN 20155, INDONESIA
TLP. : (061) 8210783 FAX. PPL - LP USU 061 - 8210783 E-mail : sdal@kpret.usu.ac.id

Jika membalas surat ini harap disebutkan tanggal dan nomornya / In reply, please refer to no. date of this letter

SURAT KETERANGAN

No : 660 /JO5.9/PM/2003

Kepala Pusat Penelitian Lingkungan – Lembaga Penelitian Universitas Sumatera Utara (PPL – LP – USU) dengan ini menerangkan bahwa Saudari :

Nama : Dra. Eva M. Ginting, MSi

Berdasarkan data yang ada pada kami, benar telah mengikuti Kursus Amdal Tipe B pada tanggal 20 Pebruari – 24 Maret 2001 di PPL – LP – USU.

Surat keterangan ini dibuat sebagai pengganti sertifikat Kursus AMDAL atas nama tersebut diatas yang dinyatakan telah hilang.

Demikian surat keterangan ini kami perbuat, untuk digunakan semestinya

Medan, 11 September 2003
Kepala PPL-LP-USU

Prof.Dr. Hemat.R.Brahmana, MSc
NIP. 130-353 135

DEPARTEMEN PENDIDIKAN NASIONAL
UNIVERSITAS SUMATERA UTARA
Lembaga Penelitian - Pusat Penelitian Lingkungan
Bekerja sama dengan BAPEDAL Pusat

SERTIPIKAT

No. 182 /005.9.PM/2001

dengan ini dinyatakan bahwa :

Ora Gyl M. Ginting

telah mengikuti

KURSUS EVALUATOR / PENILAI
ANALISIS MENGENAI DAMPAK LINGKUNGAN
(AMDAL TIPE - C)
ANGKATAN II

yang berlangsung dari tanggal 9 - 21 April 2001

Pusat Penelitian Lingkungan
Universitas Sumatera Utara
Kepala,

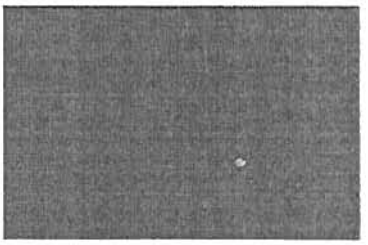
Prof. DR. Hemat R. Brahmana, MSc
NIP. 130 353 135

Medan, 21 April 2001
Universitas Sumatera Utara
Rektor,

Prof. Chairuddin P. Lubis, DTM & H,Sp.A (K)
NIP. 130 365 289

Muhamad Nizar

Konsultan, ERM Indonesia



Muhamad Nizar adalah seorang Konsultan untuk ERM yang berbasis di Jakarta, Indonesia.

Muhamad Nizar adalah Sarjana Teknik Kimia yang sangat memahami bagaimana mendesain proses-proses kimia. Dia mampu menghitung neraca massa, neraca panas, spesifikasi peralatan, dan estimasi biaya suatu proyek pabrik. Terbiasa dengan beberapa perangkat lunak teknik kimia seperti HYSYS, Pro II, ChemCAD, ASPEN BJAC..

Muhamad Nizar adalah anggota Persatuan Insinyur Indonesia, Cabang Jakarta dan juga anggota *Indonesian Institute for Process Safety* (IIPS).

Publikasi

- Laporan Tugas Akhir Tahun 2007: Pra Rencana Pabrik Pembuatan Hidrogen dengan Metode Gasifikasi Kayu Karet Bertekanan Rendah dengan Kapasitas 22000 Ton per Tahun.
  Isi: Simulasi proses produksi dengan with HYSYS 3.0.1. Perhitungan neraca massa dan panas, spesifikasi peralatan, dan analisa ekonomi.
- Laporan Riset Tahun 2006 Pembuatan Bioetanol dari Serbuk Kayu Kulim dengan Metode Hidrolisa-Fermentasi.
  Isi: Studi prospek pembuatan bioetanol dari kayu (serbuk kayu) dengan mengukur yield glukosa dan etanol yields.
- Laporan Kerja Praktek Tahun 2005 di PERTAMINA Unit Pengolahan II, Dumai, Riau: Evaluasi Kinerja Pre-Heater Train B pada Crude Distillation Unit.
  Isi: Evaluasi kinerja masing-masing alat penukar panas di pre-heater train B untuk mengetahui apakah memerlukan perawatan atau tidak

Keanggotaan Organisasi

- Persatuan Insinyur Indonesia, Cabang Jakarta
- *Indonesian Institute for Process Safety* (IIPS)

Bidang Kompetensi

- Simulasi proses-proses kimia
- Penilaian dampak lingkungan (AMDAL)

Pendidikan

- Sarjana Teknik di bidang Teknik Kimia dari Universitas Sriwijaya Palembang, 2007

Training

- Training Quality Management System ISO 9001:2000 dari 19 September sampai 20 September, 2007, di Japanese Study Center, Universitas Indonesia (UI), Depok
- Awareness & Interpretation Training of OHSAS 18001:2007 dari 24 November dampai 25 November 25, 2007, di gedung PII (Persatuan Insinyur Indonesia), Jakarta.

Bahasa

- Indonesian : Bahasa Ibu
- Inggris : Sangat baik

Sektor Industri Utama

- Pertambangan
- Minyak dan Gas

Pengalaman Kerja

- Konsultan, PT ERM Indonesia, Jakarta, Indonesia. November 2007 – sekarang
- Asisten Khusus pada Laboratorium Operasi Teknik Kimia, Salah Satu Laboratorium di Jurusan Teknik Kimia Universitas Sriwijaya, dari Februari 2006 sampai dengan Februari 2007
- Kerja Praktek di PT. Pertamina (Persero), Unit Pengolahan II, Dumai, Riau, dari 5 September 2005 sampai 5 Oktober 2005.
- Asisten Khusus pada Seksi Laboratorium Kimia Organik, Laboratorium Dasar Bersama, Universitas Sriwijaya, dari 8 September 2003 sampai dengan 8 September 2005
- Pengajar Bahasa Inggris di *Intensive English Course*, Palembang, dari Juli 2003 sampai April 2004

Pengalaman Proyek

Upaya Pengelolaan Lingkungan dan Upaya Pemantauan Lingkungan, (UKL dan UPL) Kegiatan Survei Seismik 2-D di Sunda Platform, Provinsi Jawa Barat, 2008
Membantu penyelesaian proyek. Menterjemahkan dokumen-dokumen dari Bahasa Indonesia ke Bahasa Inggris dan sebaliknya. Menyiapkan bahan-bahan presentasi laporan.

Penterjemahan Dokumen-dokumen AMDAL dari Bahasa Indonesia ke Bahasa Inggris dan Sebaliknya

Dokumen-dokumen yang telah diterjemahkan adalah:
- Kerangka Acuan (KA) Proyek Penambangan Nikel dan Kobalt Mining PT Weda Bay Nickel (Ing – Ind)
- Kerangka Acuan (KA), Rencana Pengelolaan dan pemantauan Lingkungan (RKL dan RPL), Analisa Dampak Lingkungan (ANDAL), dan Ringkasan Eksekutif (RE) untuk Proyek Peningkatan dan Optimalisasi Produksi dan Pengolahan Bijih Nikel PT INCO sampai dengan 225 Juta Pon Nickel dalam Matte per Tahun (Ind – Ing)
- Kelayakan Lingkungan untuk Wilayah Hutan Lindung, Proyek Penambangan Timbal dan Seng, PT. Dairi Prima Mineral (Ind – Ing)

Abu Bakar Harahap

Senior Environmental Consultant

Abu Bakar Harahap adalah Konsultan Senior untuk ERM yang berbasis di Jakarta, Indonesia.

Beliau lulus dari Institut Pertanian Bogor jurusan Ilmu Biologi pada tahun 1990 dan mendapatkan gelar Master di bidang Pengolahan Wilayah Pesisir Terpadu dari institut yang sama pada tahun 2005. Dari tahun 1990 sampai dengan 1995, beliau bekerja untuk sebuah perusahaan konsultan di Bogor dan dari tahun 1995 sampai dengan 2007, beliau bergabung dengan Pusat Kajian Sumber Daya Pesisir dan Laut, Institut Pertanian Bogor (ditunjuk sebagai Manajer Divisi Pengelolaan Lingkungan).

Abu Bakar Harahap memiliki pengalaman yang luas dalam konsultansi lingkungan. Beliau telah melakukan dan memimpin studi Analisis Dampak Lingkungan, (AMDAL), Upaya Pengelolaan dan Pemantauan Lingkungan (UKL-UPL), Studi Rona Lingkungan, Pengelolaan Pesisir Terpadu, khususnya proyek-proyek pengelolaan Sumber Daya Pesisir dan Laut di Indonesia.

Kompetensi : (1) Pengelolaan Lingkungan, termasuk Analisis Mengenai Dampak Lingkungan (KA, ANDAL, RKL dan RPL), Upaya Pengelolaan dan Pemantauan Lingkungan (UKL dan UPL), Studi Rona Lingkungan, Indeks Kepekaan Lingkungan (IKL), untuk wilayah darat, pantai dan laut; (2) Proyek manajemen, pengaturan tender proposal, manajemen pribadi, survei lapangan, pelaporan, presentasi dan pembuatan perjanjian; (3) Pengembangan Bisnis, pengembangan institusi dalam menciptakan usaha dan jaringan/klien, pengembangan komunikasi dengan pemangku jabatan baik di pusat maupun di daerah; dan (4) Pengelolaan Pesisir Terpadu, khususnya proyek-proyek pengelolaan sumber daya pantai dan laut

Bidang Keahlian

- Pengelolaan lingkungan
- Analisis Mengenai Dampak Lingkungan (AMDAL),
- Upaya Pengelolaan dan Pemantauan Lingkungan (UKL dan UPL),
- Studi Rona Lingkungan, Indeks Kepekaan Lingkungan (IKL)
- Pengelolaan Pesisir dan Laut Terpadu,

Pendidikan

- Master Sains di bidang Pengolahan Wilayah Pesisir Terpadu dari Program Pasca Sarjana. Institut Pertanian Bogor, 2005
- Sarjana Biologi (Ekologi), Fakultas Matematika dan Ilmu Pengtahuan Alam, Institut Pertanian Bogor, 1990
- Lokakarya Nasional tentang AMDAL, yang diselenggarakan oleh Menteri Negara Lingkungan Hidup. Jakarta, 9-11 Mei 2006.
- Lokakarya MarkPlus, Breaking Distribution Barriers. Jakarta, Agustus 25 – 26, 2006.
- Seminar Forensik Lingkungan, diselenggarakan oleh Menteri Negara Lingkungan Hidup, Jakarta 23 Mei 2006.
- Lokakarya Tanggung Jawab Sosial Perusahaan (CSR) untuk Penguatan Lembaga Masyarakat Pantai, Bogor 13 Sep 2006.
- Kursus Audit Lingkungan PPLH-IPB. Bogor 4 – 8 Maret 2002.
- Asisten Penanganan Dampak Lingkungan untuk Minyak dan Gas Sub Sektor MIGAS Grup II, Jan 2002
- Pelatihan Bioremediasi Ekosistem Perairan, Juni 2001. SEAMO BIOTROP
- Kursus Audit Sistem Pengelolaan Lingkungan (EMS) Menengah untuk professional di bidang lingkungan pada Sep. 2000 di Jakarta yang diselenggarakan oleh SGS International Certification Services, Indonesia.

Bahasa
- Indonesian, bahasa ibu
- Inggris,

Sektor Industri Utama
- Minyak & Gas
- Pemerintah
- Kehutanan

Proyek-proyek Utama

Pengelolaan Lingkungan, Industri Minyak dan Gas

2007 Upaya Pengelolaan Lingkungan dan Upaya Pemantauan Lingkungan, (UKL dan UPL) Kegiatan Seismik 3D Lepas Pantai di Blok Bawean Timur II, Husky Oil Energy East Bawean Ltd. Kabupaten Sumenep, Jawa Timur.

2007. Upaya Pengelolaan Lingkungan and Upaya Pemantauan Lingkungan (UKL dan UPL) Eksplorasi Pengeboran Sumur di Blok Sembakung-3 Selatan Simenggaris JOB Pertamina Medco Simenggaris Pty Ltd. Kabupaten Bulungan, Kalimantan Timur.

2007. Upaya Pengelolaan Lingkungan and Upaya Pemantauan Lingkungan (UKL dan UPL) Eksplorasi Pengeboran Sumur TAPAK x, TAPAK y, TAPAK1, TAPAK3, dan PAD 8 TAC Pertamina – MEDCO E & P Sembakung di Lapangan Sembakung Nunukan Municipality, Kalimantan Timur.

2006 Tinjauan Dokumen Rencana Pengelolaan dan Pemantauan Lingkungan (RKL-RPL) Pipa Transmisi Gas Sakernan – Kuala Tungkal – Batam – Singapura (Perbatasan). PT. Transportasi Gas Indonesia bekerja sama dengan Pusat Studi Sumber Daya Pesisir dan Laut IPB

2006. Pengembangan Data Bank Lingkungan untuk Minyak dan Gas. Direktorat Jenderal Minyak dan Gas, Departemen Energi dan Sumber Daya Mineral bekerja sama dengan PT. Plarenco.

2006. Analisis Mengenai Dampak Lingkungan (AMDAL)
Pengembangan Lapangan Gas Senoro dan Pipanisasi Gas Senoro – Kintom, Banggai Municipality, Sulawesi Tengah. JOB Pertamina – Medco E & P Tomori Sulawesi bekerja sama dengan Pusat Kajian Sumber Daya Pesisir dan Laut -IPB
2006. AMDAL untuk lapangan gas Terang Sirasun, Batur (TSB) Sumenep, Jawa Timur. EMP Kangean Ltd bekerja sama dengan PKSPL-IPB.

2005 AMDAL Transmisi Pipa dan Distribusi Gas di Desa Terate, Kabpaten Serang, Panunggangan, Tangerang, Banten, PT. PGN (Persero) bekerja sama dengan PKSPL-IPB.

2005. Studi Kebijakan Pembangunan Berkelanjutan bekerja sama dengan Dinas Kerja Sama Luar Negeri dan Perencanaan, Sekretaris Jenderal Departemen

Energi dan Sumber Daya Mineral bekerja sama dengan PT. Plarenco.

2004 Tinjauan Dokumen Rencana Pengelolaan dan Pemantauan Lingkungan (RKL-RPL) Transmisi Pipa Gas Grissik-Duri. PT. Transportasi Gas Indonesia bekerja sama dengan PKSPL-IPB.

2004. Program Aksi Kebijakan untuk Sektor Energi dan Sumber Daya Mineral sebagai Tindakan Menengah dari Konferensi Internasional Johannesburg tahun 2002.

2004. Dinas Kerja Sama Luar Negeri dan Perencanaan, Sekretaris Jenderal Departemen Energi dan Sumber Daya Mineral bekerja sama dengan PT. Edecon Prima Mandiri.

2003 Pembaruan AMDAL untuk pembanguan pipa gas di Jawa Bagian Barat, kerja sama antara PT. Perusahaan Gas Negara (Persero) dengan PKSPL-IPB.

Kebijakan untuk Sektor Energi dan Sumber Daya Mineral sebagai tindakan menengah dari Konferensi Internasional Johannesburg tahun 2002.

Planning and Foreign Cooperation Bureau, Secretary General of Department of Energi dan Sumber Daya Mineral bekerja sama dengan PKSPL-IPB.

2002 Upaya Pengelolaan Lingkungan dan Upaya Pemantauan Lingkungan (UKL dan UPL) Kilang LPG Mini Cilamaya, Pertamina DOH Hulu Cirebon.

Upaya Pengelolaan Lingkungan dan Upaya Pemantauan Lingkungan Distribusi Gas PT. Perusahaan Gas Negara (Persero) Cabang Medan, kerja sama antara PT. PGN (Persero) dengan CV. Biro Bangun Sitompul.

Studi Lingkungan Energi dan Tenaga Listrik di PLTU dan PLTGU dengan MFO dan HSD (PLTU Tambak Lorok Surabaya dan Grati Pasuruan), P3TEK LEMIGAS.

2001 Revisi AMDAL untuk pengembangan Minyak dan Gas UNOCAL dan Pertamina, Indonesia Daerah Operasi Bagian (DOB) Utara, Kabupaten Kutai Kalimantan Timur

Revisi AMDAK untuk Proyek Pipanisasi Gas Transsentral Sumatra. PT. Perusahaan Gas Negara (Persero) Rencana Aksi untuk Pembebasan Lahan, dan Ganti Rugi kepada Masyarakat

Pembangunan Transmisi Pipa Gas Grissik/Sakernan – Batam – Singapura. PT. Perusahaan Gas Negara (Persero)

2000 AMDAL Transmisi Pipa Gas PT Perusahaan Gas Negara (Persero) Batam – Singapura (Perbatasan) 1999 Revisi AMDAL Transmisi Pipa Gas PT Perusahaan Gas Negara (Persero) Sumatra Selatan –Jawa Barat.

AMDAL Pipa Distribusi Gas Provinsi Lampung PT Perusahaan Gas Negara (Persero) AMDAL Transmisi Pipa Gas Provinsi Jambi PT Perusahaan Gas Negara (Persero)

AMDAL Transmisi Pipa Gas Grissik – Pagardewa PT Perusahaan Gas Negara (Persero)

AMDAL Gas Distribution Development Pipeline West Java 1998 AMDAL Pipa Bawah Laut West Natuna Grup (Conoco Indonesia Inc ; Gulf Resources (Kakap) Ltd; Premier Oil Natuna Sea Ltd) di Kabupaten Dati II Kepulauan Riau dan Batam Provinsi Riau, PKSPL-IPB.

1997 AMDAL Pengembangan Pipa Gas Trans Sumatra Selatan –Jawa Barat PT. Perusahaan Gas Negara (Persero) bekerja sama dengan PT. Elnusa Ehaesindo.

1996 AMDAL Pegembangan Produksi Minyak dan Gas Pasircatang, Pertamina EP operasi Karangampel, Kabupaten Dati II Indramayu Propinsi Dati I Jawa Barat, PT. Elnusa Ehaesindo.

Pengelolaan Wilayah Pesisir Terpadu

2005 Penelitian partisipatif untuk Pendapatan Alternatif dan Ekosistem Delta Mahakam yang Berkelanjutan (Kasus: Desa Saliki, Muara Badak, Kutai Kartanegara). Kerja sama antara PKSPL-IPB dengan Bapedalda Kutai Kartanegara.

Skala Kecil-MCRMP di Desa Gambus Laut, Asahan, Sumatra Utara kerja sama antara PKSPL-IPB dengan Bappeda Asahan.

Survei untuk Pemetaan Lokasi Tertentu secara Menyeluruh (MCRMP) kerja sama antara PKSPL-IPB dengan Bappeda Asahan.

Lokakarya Program Regulasi Pengelolaan Pesisir (MCRMP) kerja sana antara PKSPL-IPB dengan Bappeda Asahan.

2004 Forum Perencanaan Studi pada Tingkat Kabupaten dari Kabupaten Administrasi Kepulauan Seribu. Bekerja sama antaraPKSPL-IPB dan Bapekab Administrasi Kepulauan Seribu.

Studi Pengembangan Perikanan Laut di Kepulauan Seribu. Bekerja sama antaraPKSPL-IPB dengan Bapekab Administrasi Kepulauan Seribu.

Studi Pengembangan Model Budaya Laut di Pulau Semak Daun. Bekerja sama antara PKSPL-IPB dengan Dinas Perikanan Kepulauan Seribu.

2003 Pengaturan Sektor-sektor Ekonomi Kabupaten Administrasi Kepulauan Seribu, bekerja sama antara PKSPL-IPB dengan Bapekab Administrasi Kepulauan Seribu.

Pengelolaan Wilayah Pesisir Terpadu Kabupaten Langkat, Sumatra Utara, Bekerja sama antaraSumatra Utara Fisheries Agency and PKSPL-IPB.

2002 Pengelolaan Wilayah Pesisir Terpadu Kabupaten Langkat, Sumatra Utara, Bekerja sama antara Dinas Perikanan Sumatra Utara dengan PKSPL-IPB.

Evaluasi Pengembangan Kabupaten Administrasi Kepulauan Seribu, bekerja sama antaraPKSPL-IPB dengan Bapekab Administrasi Kepulauan Seribu.

Rencana Dasar Zonasi Pengelolaan Pesisir dan Laut di Kabupaten Asahan, Deli Serdang and Langkat, Sumatra Utara.

Studi Kegiatan-kegiatan Tambak yang Berhubungan dengan Kegiatan Minyak dan Gas di Delta Mahakam, bekerja sama antara PKSPL-IPB dengan Bapedalda Kutai Kertanegara.

2001 Evaluasi Ekonomi Sumber Daya Alam Pesisir dan Laut di Selat Malaka. Bekerja sama antara Bapedal dengan PKSPL-IPB.

2000 Studi Pengembangan Sumber Daya Pesisir dan Laut Berdasarkan Pola Penguatan Lembaga Ekonomi Masyarakat. Bekerja sama antara Bappeda Mollucan Utara dan PKSPL-IPB.
1998 AMDAL Proyek Reklamasi dan Pengembangan Laut Benoa Bali (Studi Eksosistem Pesisir), Badung, Bali, PKSPL-IPB.

Penentuan Metode dan Identifikasi Sumber dalam Penyusunan Pemetaan Tingkat Polusi di Wilayah Perairan (Studi Kasus di Teluk Lampung), Bekerja sama antara Dinas Agribisnis, Departemen Pertanian dan PKSPL-IPB.

1997 AMDAL Terpadu Pengembangan TIR Transmigrasi Berbasis Industri Perikanan Terpadu PT. Kamalcahaya Putra, Muna, Sulawesi Tenggara, PKSPL-IPB.

AMDAL Studi Pendahuluan Pulau Natuna. BPPT dan PKSPL-IPB.

AMDAL Pembangunan Pelabuhan Perikanan Samudra Bitung, Direktoral Jenderal Perikanan, Propinsi Dati I Sulawesi Utara, PT. Amythas Expres Consultant.

Program Penguatan Lembaga Masyarakat Pesisir

2005 Penerapan Action Plan Sea Farming dengan menggunakan Kultur Sangkar. Bekerja sama antara Suku Dinas Perikanan Kepulauan Seribu dengan PT Edecon Primamandiri
Penerapan Action Plan Sea Farming dengan menggunakan Kultur Pena. Bekerja sama antara Suku Dinas Perikanan Kepulauan Seribu dengan PT PLarenco.

Pelatihan Pengelolaan Kegiatan Bekerja sama antara Bekerja sama antara Suku Dinas Perikanan Kepulauan Seribu dengan PT Sugitek Indotama.

Pengelompokan Pengelolaan Sea Farming di wilayah Pulau Semak Daun. Bekerja sama antara Bekerja sama antara Suku Dinas Perikanan Kepulauan Seribu dengan PT Pranata Pola Cipta.

Bantuan Ilmiah Sea Farming. Bekerja sama antara Bekerja sama antara Suku Dinas Perikanan Kepulauan Seribu dengan PT Sugitek Indotama.

Rehabilitasi Infrastruktur dari Grouper Culture dalam hal Sea Farming di Pulau Semak Daun. Bekerja sama antara Bekerja sama antara Suku Dinas Perikanan Kepulauan Seribu dengan PT Sugitek Indotama.

2004 Pengelolaan Sumber Daya Alam Skala Kecil, MCRMP Proyek KAbupaten Asahan. Bekerja sama antara Bappeda Asahan dengan PKSPL-IPB.

2003 Penelitian Adaptif dan Ekstensif Kabupaten Asahan, Sumatra Utara. Bekerja sama antara MCRMP Asahan dengan PKSPL-IPB.

Pelestarian Sumber Daya Alam

2007 AMDAL Rehabilitasi dan Rekonstruksi Pelabuhan Calang, Kabupaten Aceh Jaya, Nangro Aceh Darussalam. Bekerja sama antara UNDP Dinas Transportasi Nangro Aceh Darussalam dengan PKSPL-IPB.

2002 Identifikasi dan Potensi Gangguan Kebakaran Hutan di Danau Toba, Bekerja sama antara Dinas Kehutanan Sumatra Utara denfan CV Cibindo Consultant.

Studi Pengembangan dan Sistem Pgeolahan Kebakaran Hutan dan Lahan Memadai di Danau Toba. Bekerja sama antara Dinas Kehutanan Sumatra Utara dengan CV. C.A. Consultant

2000 Survei Terumbu Karang Batam – Singapura (Perbatasan) PT. Perusahaan Gas Negara (Persero) Studi Pengembangan Hutan Bakau Berdasarkan Masayrakat.Bekerja sama antaraBAPPEDA North Mollucan and PKSPL-IPB.

1997 UKL-UPL Perkebunan dan Produksi Kelapa dan Karet PT. Cakung Permata Nusa, Tabalong, Kalimantan Selatan, PT. Indusma Kreasi Consultant.

UKL-UPL Perkebunan Kelapa PT. Cakradenta Agung Pertiwi, Tabalong, Kalimantan Selatan, PT. Indusma Kreasi Consultant.

UKL-UPL Perkebunan Kelapa PT. Gunung Sejahtera Yoli, Kotawaringin Barat, Kalimantan Tengah, PT. Indusma Kreasi Consultant.

UKL-UPL Documents of Perkebunan Karet and Production PT. Gunung Sejahtera Ibu Pertiwi, Kotawaringin Barat, Central Kalimantan, PT. Indusma Kreasi Consultant.

UKL-UPL Perkebunan dan Produksi Karet PT. Gunung Sejahtera Puti Pesona, Kabupaten Kotawaringin Barat, Kalimantan Tengah, PT. Indusma Kreasi Consultant.

UKL-UPL Perkebunan Karet PT. Surya Indah Nusantara Pagi, Kotawaringin Barat, Kalimantan Tengah, PT. Indusma Kreasi Consultant.

Audit Lingkungan Rumah Sakit Pusat Pertamina (RSPP) Jakarta, Bogor Agricultural University.

1996 AMDAL Terpadu Pabrik Semen PT. Himkonam Pertiwi, in Grobongan Central Java, PPLH-LP IPB.

AMDAL Perkebunan Karet and Production PT. Lestari Unggul Jaya, Central Kalimantan, PT. Shantika Mitra Wiguna.

AMDAL Perkebunan dan Produksi Karet PT. Binasawit Abadipratama, Kalimantan Tengah, PT. Shantika Mitra Wiguna.

Rencana Pengelolaan dan Pemantauan Lingkungan Kegiatan Pariwisata Alam PT. Samukti Karya Lestari, Sumatra Utara, PT. Dwi Bina Silva.

AMDAL Perkebunan dan Produksi Karet PT. Multi Gambut Industri, Riau, PT. Indusma Consultant.

AMDAL Perkebunan dan Produksi Karet PT. Ekadura, Riau, PT. Indusma Consultant.

Rencana Pengelolaan dan Pemantauan Lingkungan (RKL dan RPL) HPH PT. TAIWI IV, di Propinsi Dati I Irian Jaya, PT. Binareka.

1995 AMDAL HTI PT. Menara Hutan Buana, Kalimantan Barat, PT. Pro Natres Development.

Studi Kelayakan HTI PT. Kumala Karya Lestari, Sumatra Utara.

1994 Studi Diagnostik HPH Bina Desa Hutan HPH PT. Tunas Sawaerma Irian Jaya, PT. Alsaif Pratama.

AMDAL HPH PT. Puncak Sawmill Kalimantan Barat, PT. Pro Natres Development.

AMDAL HPH PT. Hutan Domas Raya Kalimantan Tengah, PT. Pro Natres Development.

AMDAL HPH PT. Palopo Timber Sulawesi Tengah, PT. Pamudji Buana.

AMDAL Pabrik Pestisida PT. Agricon LTD, Bogor Municipality, West Java, PT. Alsaif Pratama.

1993 Environmental Information Service (PIL) Natural Tourist Activity PT. Samukti Karya Lestari in Tahura Bukit Barisan, Sumatra Utara, PT. Alsaif Pratama.

AMDAL HPH PT. Tunas Sawaerma di Irian Jaya, PT. Alsaif Pratama. AMDAL HPH PT. Wana Kayu Hasilindo in Irian Jaya, PT. Mukti Bhakti.

1992 AMDAL HPH PT. Bade Makmur Orissa di Irian Jaya, PT. Alsaif Pratama.

Studi Evaluasi Lingkungan (SEL) HPH PT. Green Delta di Pulau Morotai, Propinsi Dati I Maluku, PT. Alsaif Pratama.

AMDAL HPH PT. Artika Optima Inti Unit I di Irian Jaya PT. Alsaif Pratama.

Proposal Kegiatan pariwisata Alam PT. Ganosa Kawar Indah Lawu Kawar Lake Sumatra Utara, PT. Alsaif Pratama. Environmental Information Service (PIL)

Kegiatan Pariwisata Alam PT. Murindra Karya Lestari di Hutan Wisata Angke Kapuk DKI Jakarta, PT. Alsaif Pratama.

Program Koordinasi Terpadu Reboisasi Aliran Sungai Ciliwung, Dinas Lingkungan Hidup, DKI Jakarta.

Program Koordinasi Terpadu Reboisasi di Pasar Rebo, Dinas Lingkungan Hidup, DKI Jakarta.
Rencana Penataan Hijau untuk Pengolahan Polusi, Dinas Tata Kota DKI Jakarta.

1991 AMDAL HPH PT. Kamundan Raya di Irian Jaya, Pusat Pengembangan dan Studi Lingkungan (CDES).

AMDAL HPH PT. Kartika Rona Usaha di Sulawesi Tengah PT. Duta Rimba Persada.

1990 Studi Komposisi untuk Tipe dan Struktur Komunitas Hutan di Wilayah Pelestarian Leuweung Sancang, Jawa Barat.

Studi Komposisi untuk Tipe dan Struktur Komunitas Tumbuhan pada Sistem Agro-hutan di Wilayah Pelestarian Condet.

Abu Bakar S Harahap

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PENGESAHAN
Telah diperiksa kebenarannya
dan sesuai dengan aslinya
Pascasarjana IPB
... Magister
..., M.Si
NIP. 131 861 464

dengan ini menyatakan bahwa :

Abu Bakar Siddik Harahap

(NIM. 98427)

lahir di Sigulangan tanggal 17 Juli 1966 telah menyelesaikan dengan baik dan memenuhi

segala persyaratan pendidikan pada

Program Studi Ilmu Pengelolaan Sumberdaya Pesisir dan Lautan
Sekolah Pascasarjana

dan oleh karena itu kepadanya diberikan gelar :

Magister Sains (M.Si.)

beserta segala hak dan kewajiban yang melekat dengan gelar tersebut.

Diberikan di Bogor pada tanggal Dua Puluh Tujuh September Dua Ribu Lima

Dekan Sekolah Pascasarjana,

Prof. Dr. Ir. Sjafrida Manuwoto, M.Sc.
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Fakultas : MATEMATIKA DAN ILMU PENGETAHUAN ALAM

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setelah memenuhi semua persyaratan yang ditentukan untuk memperoleh ijazah. Kepadanya diberikan segala wewenang dan hak yang berhubungan dengan ijazah yang dimilikinya.

Bogor, 26 JANUARI 1991

Dekan Fakultas,

PROF. DR. BARIZI, MES.
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Rafeldy Noviar, S.Si

Konsultan

Rafeldy Noviar bekerja sebagai Konsultan di ERM, Jakarta. Memiliki pengalaman yang luas dalam Analisis Dampak Lingkungan.

Rafeldy menyelesaikan pendidikannya pada Fakultas Biologi, Universitas Nasional, Jakarta

Dengan keahliannya di bidang Biologi, beliau terlibat dalam beberapa Studi Mengenai Analisis Dampak Lingkungan dan beberapa proyek Pengelolaan Lingkungan di seluruh Indonesia.

Kompeten dalam Bidang

- Analisis Dampak Lingkungan (AMDAL)

Pendidikan

- Lulus dari Fakultas Biologi, Universitas National, Jakarta, 1994
- Kursus Dasar-dasar Analisis Dampak Lingkungan (AMDAL-A), PPSML – UI Jakarta, 1994

Bahasa

- Indonesia, Bahasa Nasional
- Inggris, baik

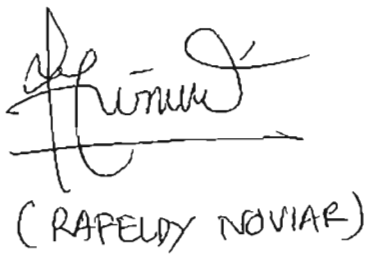
Sektor Industri

- Pertambangan
- Minyak dan Gas
- Pabrik
- Farmasi
- Kemasyarakatan

Pengalaman proyek

Analisis Mengenai Dampak Lingkungan (AMDAL)

- Studi ANDAL, RKL dan RPL Peningkatan dan Optimalisai Penambangan dan Pengolahan Bijih Nikel PT Inco, Sorowako, 2007
- Studi ANDAL, RKL dan RPL Penambangan Emas PT Meares Soputan Mining, 2006
- Studi ANDAL, RKL dan RPL Penambangan Emas PT Tambang Tondano Nusajaya, 2006
- Studi ANDAL, RKL dan RPL Peningkatan dan Konstruksi Jalan Parongil – Sidikalang PT Dairi Prima Mineral, 2006
- Studi ANDAL, RKL dan RPL Rehabilitasi and Pembangunan Jalan Banda Aceh ke Meulaboh, USAID, 2005
- Studi ANDAL, RKL dan RPL Industry Farmasi, PT. Aventis Pharma, Jakarta, 2005
- Studi ANDAL, RKL dan RPL Kawasan Industri PT. Nikomas Gemilang, Serang, Banten, 2005
- Studi ANDAL, RKL dan RPL Bendungan Sungai Sepinggan II River, Balikpapan, Kalimantan Timur, 2004
- Studi UKL dan UPL Pembangunan Jembatan Duwung, Kabupaten Brebes, Jawa Tengah, 2004
- Studi UKL dan UPL Pembangunan Jembatan Kabuyutan, Kabupaten Brebes, Jawa Tengah, 2004
- Studi ANDAL, RKL dan RPL Sungai Kayan, Kabupaten Bulungan, Kalimantan Timur, CV Mikros Konsultan, 2003
- Studi UKL dan UPL Batching Plant Adhimix Precast Indonesia di Lokasi Tanjung Duren, Jakarta, 2002
- Studi UKL dan UPL Rumah Sakit Kasih Insani, Kota Cilegon, Jawa Barat, 2002
- Studi UKL dan UPL Rawa Muara Adang, Kalimantan Timur, CV Wydia Aika, 2001
- Studi UKL dan UPL Rawa Muara Adang, Kalimantan Timur, CV Wydia Aika, 2001
- Studi UKL dan UPL Rawa Tanjung Aru, East Timur Kalimantan, CV Reka Citra, 2001
- Studi Pengembangan Institusi Dinas Kebersihan DKI Jakarta, , PT. Sewun Indo Konsultan, 2000
- Studi ANDAL, RKL dan RPL Revisi Train A – G LNG Factory and Perluasan Train H Expansion, Bontang, Kalimantan Timur, 1997
- Studi ANDAL, RKL dan RPL Kawasan Industri PT Grahapermai Raharja, Tangerang, West Java, 1997
- Studi UKL dan UPL Industry Baja, PT. Jakarta Kyoei Steel, 1996
- Studi ANDAL, RKL dan RPL Kawasan Industri Median PT KIM, Medan, Sumatera Utara, 1996
- Studi Pedoman Teknis Audit Lingkungan untuk Transportasi Laut, Dep. Perhubungan – IPB Bogo
- Studi ANDAL, RKL dan RPL Pembangunan dan Pengoperasian Apartment and Hotel Atap Merah, Jakarta, 1995
- Studi ANDAL, RKL dan RPL Kawasan Industri, PT Nikomas Gemilang, West Java, 1995
- Studi ANDAL, RKL dan RPL Kawasan Industri, PT Siti Swadaya, Karawang, West Java, 1995
- Studi ANDAL, RKL dan RPL Kawasan Industri PT Pancapuri Indoperkasa, Karawang, West Java, 1995
- Studi ANDAL, RKL dan RPL Kawasan Industri Golden Industrial Park Area, Karawang, West Java, 1995
- Studi ANDAL, RKL dan RPL Pembangan Apartemen Casablanca, Jakarta 1995
- Penyusunan Pedoman Teknis Upaya Pengelolaan Lingkungan dan Departemen Perhubungan - IPB, 1994
- Studi ANDAL, RKL dan RPL Pembangan Hotel Reagent Hotel, 1994



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UNIVERSITAS NASIONAL
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Memberikan Ijazah kepada : Rafeldy Novitar.

Tempat dan tanggal lahir : Jakarta, 09 November 1968.

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Program Pendidikan : SARJANA STRATA SATU

Fakultas : Biologi.

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Program Studi : Biologi.

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Tanggal 9 September 1985

Ijazah ini diberikan setelah yang bersangkutan memenuhi semua persyaratan yang ditentukan, dan kepadanya dilimpahkan segala wewenang dan hak yang berhubungan dengan Ijazah yang dimilikinya, serta berhak memakai Gelar Akademik Sarjana Sains (S.Si)

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Koordinator Kopertis Wilayah III
Tanggal 13 Juni 1995

Prof. dr. H. Arjatmo Tjokronegoro, Ph.D.
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Rektor,

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SERTIFIKAT

TELAH MENGIKUTI KURSUS
DASAR-DASAR ANALISIS MENGENAI DAMPAK LINGKUNGAN
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DIBERIKAN KEPADA

Rafeldy Noviar, SSi.

YANG DISELENGGARAKAN OLEH
PUSAT PENELITIAN SUMBERDAYA MANUSIA DAN LINGKUNGAN
LEMBAGA PENELITIAN UNIVERSITAS INDONESIA
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REKTOR UNIVERSITAS INDONESIA

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Ir. Syarief Bastaman

Ahli Lingkungan Dan Sosial Ekonomi

Syarief Bastaman bekerja sebagai Senior Konsultan di ERM, Jakarta.

Beliau adalah Ahli dalam bidang Sosial Ekonomi Pertanian, dengan pengalaman 22 tahun. Beliau pernah bertugas sebagai Ahli Perkembangan Komunitas pada beberapa proyek bantuan dana, dan sebagai Ahli Kemasyarakatan pada beberapa proyek Penelitian Pengairan dan Reklamasi di sejumlah tempat di Indonesia.

Pengalaman kerja Syarief Bastaman termasuk sebagai Konsultan Lingkungan untuk Studi Analisis Dampak Lingkungan dan Sosial, Studi Hidrologi, dan Pengelolaan Pemanfaatan Air untuk Proyek Darajat Geothermal; Proyek Pengembangan Pertanian Telong dan Saleh di Sumatera Selatan atas bantuan pinjaman IBRD, Studi Perencanaan Pengelolaan Air Sungai Citarum, Ahli Institusi untuk Proyek Komponen Irigasi Sektor Gabungan atas dana dari ABD, dan Proyek Monitor dan Evolusi dari Reklamasi kedua, Karang Agung I dan Karang Agung II Tidal Scheme atas dana dari IBRD.
Beliau juga memiliki Sertifikat AMDAL A dan B.

Kompetensi dalam Bidang

- Sosial Ekonomi
- Lingkungan
- Sosiologi

Pendidikan

- Fakultas Pertanian, Jurusan Sosial Ekonomi Pertanian, Universitas Padjadjaran (UNDAP), Bandung.

Pelatihan dan Kursus

- Kursus dasar AMDAL dan Kompilasi AMDAL, Institut Teknologi Bandung, September –november 1998
- Kursus Sistem Managemen Lingkungan, BSI, London, Inggris
- Kursus Environmental Management System (EMS) for Lead Auditor ISO 14000, BSI, London, Inggris
- Workshop on Main Streaming Freshwater Biodiversity for Water Development Project, Florida, USA, The World Bank
- Training on Environmental Auditor & Quality Management System, TüV Rheinland, Germany
- Workshop on Spatial and Urban Planning for West Java (Based on Regional Economic View Point)
- Workshop on the preparation of Feasibility Study for Industrial Project, sponsored by Inkindo and Small-Medium Enterprise Project - Technical Assistance Unit (SMIEP-TAU) Jakarta
- Course on Monitoring and Evaluation for Irrigation Development Project, Directorate of Planning and Programming. DGWRD
- Workshop on Project Proposal Preparation for Agricultural Development Project, Indonesian Consultancy Development Body (Bangkosulindo), association with Indonesian National Consultant Association (INKINDO

Bahasa

- Indonesia, Bahasa Nasional
- Inggris, Baik

Sektor Industri

- Pertambangan
- Minyak dan Gas

Pengalaman Proyek

- Konsultan Sosial Ekonomi untuk Studi AMDAL pada Proyek Penambangan dan Pengolahan Bauksit, Tayan, Kabupaten Sanggau, Propinsi Kalimantan Barat.
- Team Leader untuk Studi Kelayakan Lingkungan Terhadap Kawasan Hutan Lindung, Proyek Penambangan Timbal dan Seng PT. Dairi Prima Mineral
- PT Sebukit Energi, Peat land Utilization and Protection, Kalimantan Barat, Indonesia.
- Konsultan Sosial Ekonomi untuk studi AMDAL pada proyek pengembangan lapangan Seturian, unocal di Kalimantan.
- Konsultan Sosial-ekonomi untuk penyusunan RKL/RPL ,Semen Cibinong, Jawa Barat.
- Konsultan Social-ekonomi untuk Studi AMDAL pada proyek Cibaliung Gold Mine, Austindo, di Cibaliung, Banten.
- Konsultan Sosial-ekonomi untuk Studi AMDAL padaProyek Dairi Timbal/Seng, Dairi Prima Mineral/Herald Resources, di Sopokomil, Kabupaten Dairi, Sumatra Utara.
- Asisten teknik dan pengembangan untuk sarana pendukung komunitas dan pemerintah lokal, Loan ADB No. 1678-INO, Posisi : Ahli pengembangan komunitas, Periode : Juli 2002 – September 2003, Lokasi : Kabupaten Majalengka
- Asisten teknik dan pengembangan untuk sarana pendukung komunitas dan pemerintah lokal, Loan ADB No. 1678-INO, Posisi : Ahli pengembangan komunitas, Periode : Juni 2001 – June 2002, Lokasi : Kabupaten Majalengka
- Studi untuk National Policy of Operation and Maintenance pada proyek rawa, Posisi : Ahli Sosiologi Rural, Periode : Juli 2000 – February 2001, Lokasi : Riau dan Kalimantan Barat.
- Data Analisis Landsat pada kondisi Land Cover di Area Catchment, Batutegi Dam, Posisi : Principal, Period : Oktober 2000 – Juli 2000, Lokasi : Lampung, Sumatera
- Detailed Design untuk Bulk Water Reservoir, Posisi : Ahli Lingkungan/Sosial-ekonomi, Periode : Agustus 1999 – September 2000, Lokasi : Bengkulu
- Formasi Data Base untuk Area Flood dan Sungai kritis pada Sungai Basins di Bengkulu, Posisi : Ahli Sosial-Ekonom, Periode : November 1998 - Juli 1999, Lokasi · Bengkulu
- Studi Hydrology dan Pengelolaan dan pemanfaatan air untuk Proyek Darajat Geothermal, Amoseas Indonesia, Posisi : Ahli Lingkungan, Periode : Juli 1998 - Oktober 1998, Lokasi : Garut, Jawa Barat
- Studi Pengoptimalan untuk Rancangan dan Pengembangan Air dan Pengelolaan Air di Nasal-Alas-Talo River Basin, Bengkulu Selatan, Posisi : Ketua Tim, Periode : November 1997 – Juli 1998, Lokasi : Bengkulu
- Feasibility Study of Kinine Plantation Development in West Java, Position : Team Leader/Socio-Economist, Period : November 1996 - August1997, Location : West Java
- Telang and Saleh Agricultural Development Project, South Sumatera Provinces (IISP), Position : Environment Specialist/Socio-Economist, Period : June1995 – October 1996, Location : South Sumatera
- Study for Water Management Planning of Upper Citarum River Basin, West Java, Position : Environment Specialist/Institutional Specialist, Period : June 1994 - March 1995, Location : West Java
- Consulting Services for Irrigation Component of the Integrated Irrigation Sector Project, Position : Institutional/Monitoring Spec, Period : January 1994 – May 1994, Location : Southeast Sulawesi
- Survey Investigation and Detailed Design of Gebang Malang, Tanjung Bayur, Sukakerta, Pedes, Irrigation Project, Jatiluhur Multipurpose Project, Position : Institutional Specialist, Period : September 1993 – December 1994, Location : Karawang, Jawa Barat
- Management Planning for Swamp Resources in 7 Provinces of Sumatera (Phase II Study), Position : Team Leader/Institutional Specialist, Period : March 1993 – September 1993, Location : Sumatera
- Provincial Irrigation Agriculture Development Project (PIADP) in 14 Provinces of Sumatera, Kalimantan and Sulawesi, Directorate General of Water Resources Development, Position : Socio-economist, Period : August 1992 – August 1993, Location : Sumatera, Kalimantan & Sulawesi
- Management Planning for Swamp Resources in 8 Provinces of Sumatera (Phase I Study), Phase II Study for Riau Province, Directorate of Swamp, Position : Environment Specialist/Socio-economist, Period : May 1992 – August 1992, Location : Sumatera and Riau
- Survey Investigation and Detailed Design Irrigation Sector Project, Tegal Asem, Benda and Kertalaya Irrigation Schemes, Jatiluhur Multi Proposed Project, Position : Socio-economist/Institutional Specialist, Period : January 1992 – April 1992, Location : West Java

- Consulting Services, Irrigation Component of The Integrated Irrigation Sector Project, Position : PBME Specialist/Institutional Specialist, Period : June 1991-December 1991, Location : Southeast Sulawesi
- Feasibility Study and Detailed Engineering Design for Transmigration Settlement Development Project, Phase IIIA, Batumpang and Gelumbang, Position : Environment Specialist, Period : January 1991 – May 1991, Location : South Sumatera

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UNIVERSITAS PADJADJARAN

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Sjarif Bastaman Burhanudin

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Dengan demikian ia berhak mencapai gelar Doctor dalam ilmu

Pertanian

dengan membuat dan mempertahankan Thesis.

Bandung, 19 Desember 1981

Ketua	Dekan	Rektor,
Dewan Penguji,	Fakultas Pertanian,	
Prof. Dr. Ir. Gunawan Satari	Ir. Achmad [illegible]	

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Sosial Budaya

Sri Alem memiliki pengalaman yang luas dalam bidang Antropologi.

Sri menyelesaikan pendidikan Pasca Sarjana Program Studi Antropologi, Universitas Indonesia, Jakarta.

Pendidikan

- FISIP Jur. Antropologi, USU, Medan, 1992
- Pasca Sarjana Program Studi Antropologi, Universitas Indonesia, Jakarta, 2000

Training dan Seminar

- Seminar Sehari " Pelestarian Rumah Adat Karo", FISIP USU MEDAN, 1989
- Lokakarya "Patron Klien Pada Masyarakat Nelayan" IKIP USU Medan, 1990
- Lokakarya dan Simulasi Pendidikan Praktis Periklanan" PPP I - USU, 1990
- Seminar Sehari "Pesikap Kuta Kemulihenta", Yayasan Merga Silima, Brastagi, Kab. Karo, SUMUT, 1990
- Sarasehan Mahasiswa Antropologi Se-Indonesia ke-II, Denpasar, Bali, 1991
- Seminar "Prilaku Bangsa Jepang dan Pengembangan Organisasi" FISIP-USU, Medan, 1994
- Seminar "Dialog Pembauran Visi-Visi Generasi Muda Tentang Integrasi Masyarakat di Sumatera Utara" FISIP-USU, Medan, 1994
- Seminar" Budaya Batak", Pemda tk II, Tg. Balai, Kab. Asahan, SUMUT, Moderator, 1994
- Seminar "Menyiapkan Anak Menuju Milinium Ke-3; Pentingnya Peranan Ayah". Jakarta, 1999
- Diskusi Panel tentang Partisipasi Perempuan dalam Proses Pengambilan Keputusan, Medan, 2002
- Diskusi Panel 'Tata Pemerintahan yang Baik', Medan, 2002
- Diskusi Panel `Prilaku Sexual, HIV / AIDS dan NAZA, Medan, 2003
- Lokakarya Nasional " Pembangunan Berwawasan Budaya "Medan, 2004
- Seminar Sehari " Sumatera Utara Setelah Mengalami Masa Krisis " FISIP USU, 2004
- Workshop" Pendidikan Kepala Desa se-Sumatera Utara", Lab.Otonomi Daerah Fisip USU, 2004
- "Dialog Budaya Daerah Sumatera Utara", Departemen Kebudayaan dan Pariwisata-Balai Pelestarian Sejarah dan Nilai Tradisional Banda Aceh – Museum Medan, 2007

- Seminar Nasional "Komersialisasi Riptek Melalui Jejaring A – B – G DalamMeningkatkan Daya saing Bangsa Secara Berkelanjutan", Bidang Pengembangan Sistem IPTEK Nasional Kementrian Negara RISTEK – LP USU, Medan, 2007
- Lokakarya Memperingati 50 Tahun Antropologi Universitas Indonesia "Konflik dan Disharmoni Sosial pada Era reformasi di Indonesia: Sumbangan Pemikiran Antropologi untuk Pembangunan Demokrasi", Departemen Antropologi Univ. Indonesia, Jakarta, 2007
- Workshop "Pengelolaan Medan Magnet dan Medan Listrik Serta Sosialisasi Hasil Pemantauan di Bawah Jaringan Transmisi 150 KV", LP USU – PLN P3B, Medan, 2007
- Workshop "Hasil Audit Kinerja Pemko Medan", SCBD – Pemko Medan, Medan, 2008
- Seminar "Strategi Arah Kebijakan Pengembangan Riset dan Teknologi", KNRT (Kementrian Negara Riset dan Teknologi – Fisip USU, Medan, 2008
- Latihan Kepemimpinan Tingkat Dasar (LTC BASIC), PMKRI Cab. Medan, 1988
- Pelatihan Videografi, Fak. Sastra-USU Medan, 1989
- Pelatihan Komputer "Paket Perkantoran", KKB-USU, Medan, 1991
- Latihan Metodologi Penelitian LP3-EM, USU Medan, 1993
- Latihan Metode Penelitian, Jurusan Antropologi FISIP UI, Jakarta, 2001
- ToT (Training of Trainer), Pelatihan Untuk Pelatih Pemantau Pemilu Tingkat Propinsi, Medan, 2003
- Latihan Metode Penelitian, Jurusan Antropologi FISIP UI, Jakarta, 2001
- ToT (Training of Trainer) Pemantau Pemilu Tingkat Propinsi, Sumatera Village Resort, CETRO – PusKIP, 2004
- Trainer Pemantauan Pantarlih Pemilu 2004 di Fisip – USU, CETRO – LIPDem, 2004
- Trainer Pemantauan Logistik I Pemilu 2004 di Fisip – USU, CETRO – LIPDem, 2004
- Trainer Pemantauan Kampanye Pemilu 2004 di Fisip CETRO – LIPDem, 2004.
- Trainer Pemantauan Logistik II Pemilu 2004 di Fisip – USU, CETRO – LIPDem, 2004
- Trainer Pemantauan Hari 'H' Pemilu 2004 di Fisip – USU, CETRO – LIPDem, 2004
- Pelatihan Kader Lingkungan untuk Meningkatkan Peran Masyarakat Adat dalam Pengelolaan Lingkungan Hidup, Pelestarian SDA dan Penanaman Pohon, KLH, Medan, 2004
- Base Line Training "Medan Food Security and Nutrition", Save The Children, Medan, 2005
- Pelatihan Penyusunan Proposal Hibah Kompetensi Departemen-departemen di Lingkungan USU, USU, 2006
- Training LGAT (Local Governance Assessment Tool), USAID, Berastagi, 2006
- Kurus Penyusun Analisis Mengenai Dampak Lingkungan (AMDAL), Lembaga Penelitian – Pusat Penelitian Sumber Daya Alam dan Lingkungan Bekerjasama dengan Kantor Menteri Negara Lingkungan Hidup, USU – Medan, 2007

Penelitian

- Asisten Penelitian Lapangan "Architecture of Karo Tradisional House", Medan, 1990
- Asisten Penelitian Lapangan "Midwife in Karo Traditional Society, Sumatera Utara, 1990
- Asisten Penelitian Lapangan "Migration in Karo, Sumatera Utara, 1991
- Penelitian Utama "Guru Si Baso : Peranan dan Fungsi Sosial Dukun Wanita Sebagai Spirit Medium di Lingkungan Sosial Masyarakat Karo", Skripsi Sarjana (S-1), Fisip USU, 1992
- Asisten Penelitian Lapangan "Symbolic Meaning of Plants Agriculture, Holy Places, Rituals and Healing Among Karo Society", Medan, 1992
- Praktik Tanam Campuran: Kajian Proses Pengambilan Keputusan Petani dalam Memilih Jenis Tanaman Hortikultura di Desa Gurusinga, Kec. Berastagi, Kab.Karo. Prop.Sumatera Utara, 1999 – 2000
- Tanggapan Masyarakat tentang Pemilu 2004, CETRO – UPIIS FISIP USU, Medan, 2001
- Modal Sosial dalam Komunitas Kuta Etnis Karo dan Relevansinya dengan Otonomi Daerah (Studi Kasus di Desa Bukit Kec.Tiga Panah), 2003
- Koordinator Sosial Budaya Penelitian AMDAL untuk berdirinya Pertambangan Seng dan Timah Hitam di Kec. Silima Pungga-Pungga Kab. Dairi, 2004
- Kesiapan masyarakat Menghadapai PEMILU 2004, CETRO – UPIIS FISIP USU, Medan, 2004
- Pemantau Pelaksanan Pemilu 2004 di Kec.Medan Tuntungan, CETRO – LIPDem, 2004
- Koordinator Penelitian Masalah Sosial Budaya dan Sumber Konflik dalam Kasus Pertambangan Seng dan Timah di Kec. Silima Pungga-Pungga Kab. Dairi, 2005
- Koordinator Studi Management Konflik di 8 unit Kebun PTPN IV, Kerjasama PTPN IV SUMUT dengan Laboratorium Pengembangan Masyarakat Jurusan Antropologi Fisip-USU, 2005

- Koordinator Penelitian Pengetahuan Lokal Petani dan Stabilitas Ekosistem Ladang: Kompetensinya dalam Peningkatan Pendapatan dan Sistem Pertanian Berkelanjutan di Berastagi –Kab.Karo. LP USU-Dikti, 2005
- Field Supervisior Base Line Survey "Medan Food Security and Nutrition Program", Save The Children, Medan, 2005
- Land Acquisition Process di Pertambangan Timah dan Seng PT.DPM, Kab.Dairi, Sumatera Utara, 2006
- LGAT (Local Governance Assessment Tool) untuk Simalungun, USAID- LPM Antropologi Fisip USU, Simalungun, 2006
- Ketua Tim Sosial Ekonomi Budaya dalam Revisi Rencana Pengelolaan Lingkungan (RKL) dan Rencana Pemantauan Lingkungan (RPL) Pengerukan Sedimen di Muara Sungai Percut, LP USU – PT.Adhi Karya (Persero), Percut Sei Tuan, Deli Serdang, 2007
- Ass.Social Specialist "Baseline Study PLTA Asahan-3 HEPP",Nippon Koei Consultant,Kab.Asahan dan Kab.Tobasa,Prov.Sumatera Utara, 2007
- Ketua Tim Sosial Ekonomi Budaya Studi Pelaksanaan Pemantauan Lingkungan Ketenagalistrikan SUTT 150 KV Wilayah Kerja PT. PLN (Persero) Penyaluran dan Pusat Pengatur Beban1P3B) Sumatera UPT Medan,P3B – LP USU, 2007
- Peneliti Utama "Identifikasi dan Kajian Organisasi Sosial Lokal di Desa Tomok Kecamatan Simanindo Kabupaten Samosir ", Departemen Kebudayaan dan Pariwisata Direktorat Jendral Nilai Budaya, Seni dan Film Direktorat Tradisi, 2007
- Ketua Tim Sosial Ekonomi Budaya Studi AMDAL "Pembangunan Transmisi 275 kV Asahan 1 – GI Simangkuk dan 150 kV GI Simangkuk GI Porsea, 2007
- Ketua Tim Sosial Ekonomi Budaya Studi AMDAL "Pembanguanan Kebun dan PKS Proyek Madina PTPN IV (Persero) di Kabupaten Mandailing Natal Prov.Sumatera Utara, 2007
- Ketua Tim Sosial Ekonomi Budaya Studi Revisi RKL/RPL PT.Pertamina Geothermal Sibayalc, Berastagi. PT. Pertamina (Persero) Sibayak –LP USU, 2007
- Peneliti Senior "Kehidupan Sosial Ekonomi Budaya Migran Nias di Batang Toru", Conservation International Indonesia – Departemen Antropologi, 2007
- Peneliti-Tim Ahli SCBD (Sustainable Capacity Building for Decentralization) untuk survei "Audit Kinerja Pemko Medan" , Medan, 2007

Bahasa

- Indonesia, Bahasa Nasional
- Inggris, baik

Afiliasi

- Anggota Organisasi Kemasyarakatan "Perhimpunan Mahasiswa Katolik Republik Indonesia" Cab. Medan, 1990
- Anggota Organisasi Keseniam "Kembaren Group", Medan, 1995
- Anggota Organisasi Kesian "Sado Ribu Group". Medan, 1993
- Anggota Organisasi Profesi "Asosiasi Antropologi Indonesia", 1998.
- Sekretaris Lab. Antropologi FISIP USU, 2001 – 2002.
- Sekretaris LPM – Antrop. FISIP USU, 2003 – 2004.
- Staf Ahli, PusKIP (Pusat Kajian dan Investigasi Pemilu) FISIP USU, 2003.
- Dewan Redaksi dalam Tabloid Sora Mido, 2005
- Wakil Pimpinan Perusahaan Tabloid Sora Mido, 2006
- Kepala Laboratorium Pengembangan Masyarakat-Departemen Antropologi Fisisp USU, 2006 – sekarang
- Dewan Redaksi dalam Tabloid Sora Sirulo 2006 – sekarang

Karya Ilmiah

- "Guru Si Baso : Peranan dan Fungsi Sosial Dukun Wanita sebagai Spirit Medium di Lingkungan Sosial Masyarakat Karo. Skripsi Sarjana S-1, 1992
- "Fungsi dan Arti Simbolik Asesoris Melayu". Editor, Juara Ginting, Sumatera Utara, Medan, 1990
- "Sistem Medis Tradisional Karo", dalam Penyembuh dan Penyembuhan Tradisional di Sumatera Utara, Jurnal Antrop. Untuk Kalangan Sendiri, 1990. Editor. Ny. Fachruddin, Juara Ginting, Agustrisno.
- "Peranan Ahli Antropologi dalam Penanganan Penderita Gang_ guan Jiwa yang Dirawat di Rumah Sakit Jiwa." Perpustakaan USU, 1999
- "Pentingnya Perhatian Kepada 'Indigenous Communication' Selain Kepada Indogenous Knowledge'." Perpustakaan USU, 1999
- "Refleksi Metodologi: Perjalanan Penelitian Menghasilkan Etnografi". Perpustakaan USU, 2001
- "Saluran Komunikasi Lokal dalam Pertukaran Inovasi Teknologi Pertanian: Kajian Antropologi dalam Komunitas Petani di Berastagi Kab. Karo. Prop. Sumatera Utara. ". Perpustakaan USU, 2001
- "Guru (Tabib) dalam Masyarakat Karo (Kajian Antropologgi mengenai Konsep Orang Karo tentang Guru dan Kosmos)". Perpustakaan USU, 2001

- "Penataan Lingkungan Sosial bagi Penderita Dimensia (Pikun) dan RTA (Retardasi Mental)". Perpustakaan USU, 2001
- "Petani Karo:Apa Masalah Sebenamya",Tabloid Sora Mido Edisi IV/I Juli 2004.
- Sembahe Merintih" : Sebuah Tagedi Atas Tragedi Bukit Lawang dalam Tabloid Sora Mido, XI/II 26 Jan-11 Peb 2004
- "Konflik Dipelihara Untuk Menggoarkan Sebuah Tujuan :Telah Berlangsungkah di Tanah Karo?",Tabloid Sora Mido,Edisi XIVII 09-23 Maret 2005
- "Kampung Tradisional Karo di `Ketiak' Kota Medan Metropolitan" dalam Tabloid Sora Mido, Edisi XIV/II 7 -21 Mei, 2005
- Penanglcar,Peramu dan Penjual Ramuan Obat (Bag 1) : "Arti Hutan untuk Tanaman Obat Langka" dalam Tabloid Sora Mido, Edisi XV/II 26 Mei S/D 13 Juni 2005
- "Pemusnahan Hutan adalah Pemusnahan Budaya" dalam Tabloid Sora Mido, Edisi XVI/II 18 Jun S/D 3 Jul 2005
- Penangkar,Peramu dan Penjual Ramuan Obat (Bag 2) : "Pinangko Kayu Pinangko Tambar" (Pencuri Kayu adalah Pencuri Obat,pen) dalam Sora Mido, Edisi XVII/II 8 S/D22 Juli 2005
- "Pertanian yang Ramah Lingkungan dan Lingkungan yang Tidak Ramah" dalam Tabloid Sora Mido, Edisi XVIUII 8 S/D22 Juli 2005.
- "Dilemma Petani dan Residu Pestisida" dalam Tabloid Sora Mido, Edisi XVIII Agustus 2005.
- Tanah Karo Sedang Dirias Oleh Elit Penguasa: Semakin Molekkah? " dalam Tabloid Sora Mido, Edisi XIX/II 26 Agst S/D 10 Sept.2005
- Sinetron dan Jenujung: Universalkah.....?dalam Tabloid Sora Mido Edisi XX November 2005
- "Sinetron dan Jinujung: Universalkah ?" dalam Tabloid Sora Mido, Edisi XXVII 26 OktS/D Nop'05
- "Peduma-juma Ndai Nge Lalap Si Kurang Pantas" (Petani yang Selalu Disalahkan, pen) dalam Tabloid Sora Mido, Edisi 29 Nop'05 S/D 17 Des 2005.
- Pengetahuan Petani dan Stabilitas Ekosistem Ladang: Urgensinya dalam Sistem Pertanian Berkelanjutan dalam ETNOVISI-Jumal Antropologi Sosial Budaya, Vol I No.2 Oktober 2005
- 'Guru Si Baso' dalam Ritual Orang Karo: Berlahannya Sisi Tradisional dari Arus Modemisasi dalam ETNOVISI-Jumal Antropologi Sosial Budaya, Vol I No.3 Desember 2005
- "Kai Kin Stabilitas Ekosistem" (Apa itu Ekosistem,pen) dalam Tabloid Sora Mido, Edisi XXIII/II 27Des'05 S/D 15 Jan 2006
- "Matahari Akan Memakan Bumi, Bagaimana Bisa?": Sebuah Refleksi atas Apa yang Terjadi dengan Hutan Karo, Tabloid Sora Mido, Edisi XXV/II Maret 2006
- Dilemma Petani (Perjuma) di Tiga Berastagi - "Lalap La i Lepas Barang e, Piah Turun Dungna, dalam Tabloid Sora Mido, Edisi XXVI/II April 2006
- 28. Orang Karo Pintar Ramuan Obat? Tabloid Sora Mido,Edisi XXIX/II Agustus 2006

Pengalaman proyek

- Penyuluhan Tentang Pendekatan Aspek Sosial Budaya dalam Pembangunan, USU (pelaksana), 2000
- Sosialisasi tentang Partisipasi Perempuan dalam Proses Pengambilan Keputusan di Kalangan Jemaat GKPPD Padang Bulan, USU (pelaksana), 2002
- Penyuluhan HIV AIDS dan Narkoba Bagi Remaja Mesjid dan Gereja, Medan (pelaksana),. 2003
- Sosialisasi tentang Penganekaragaman Tanaman Pangan dalam Upaya Peningkatan Pendapatan Masyarakat di Kel. Terjun Kec Medan Marelan (pelaksana), 2004
- Sosialisasi Partisipasi Masyarakat dalam Pelestarian Karagaman Tanaman dan Konservasi Hutan di kawasan Wisata Sembahe, Kab.Deli Serdang (pelaksana), 2004
- Revitalisasi Situs-situs Budaya untuk Menunjuang Pengembangan Kawasan Wisata di Kelurahan Lau Cih Kecamatan Medan Selayang (pelaksana), 2006
- Membangun Kemitraan untuk Pengembangan Desa Wisata Berbasis Masyarakat di Kelurahan Lau Cih Kecamatan Medan Selayang (koordinator), 2006
- Menumbuhkan Prilaku Sehat Ibu dalam Keluarga di Kelurahan Timbang Deli Kecamatan Medan Amplas (pelaksana), 2007
- Sosialisasi Program Penganekaragaman Tanaman Pangan dan Integrasi Jaringan Pasar Buah di Kecamatan Pancur Batu (pelaksana), 2009

UNIVERSITAS INDONESIA

memberikan kepada

Sri Alem Br. Sembiring

lahir pada tanggal 23 Agustus 1969 di Medan

Ijazah

MAGISTER

dalam **Antropologi**

dengan segala hak dan kewajiban yang berhubungan dengan sebutan gelar yang dimilikinya.

Jakarta, 19 Oktober 2000

Rektor

Prof. Dr. dr. A. Boedisantoso R., SpPD. KE

NIP. 130 353 753

Dekan Fakultas Ilmu Sosial dan Ilmu Politik

Prof. Kamanto Sunarto, S.H., Ph. D.

NIP. 130 280 963

Departemen Pendidikan Dan Kebudayaan

Universitas Sumatera Utara

Memberikan Kepada : Sri Alem Br. Sembiring

Nomor Registrasi : 870905039

Lahir Di : Meo-meo Pada Tanggal 23 Agustus 1969

Fakultas : Ilmu Sosial dan Ilmu Politik

Bidang Ilmu : Sosial

Jiazah : Sarjana

Program Studi : Antropologi Sosial

Setelah Memenuhi Semua Persyaratan Yang Diperlukan Untuk Memperoleh Jiazah Tersebut Kepadanya

Diberikan Segala Wewenang dan Hak yang Berhubungan dengan Jiazah yang Dimilikinya

Medan, 19 Agustus 1992

Dekan Fakultas

Prof. Dr. Hj. Asma Ayan Nasution

Nip. 130055259.

Rektor

Prof. Dr. Yusuf Hanafiah

Nip. 130175765.

PIAGAM PENGHARGAAN

KEMENTERIAN LINGKUNGAN HIDUP

diberikan kepada

SRI ALEM Br. SEMBIRING

sebagai

KADER LINGKUNGAN

untuk meningkatkan peran masyarakat adat dalam
pengelolaan lingkungan hidup, pelestarian sumber daya alam
dan penanaman pohon

Medan, 12 Juni 2004
Deputi Menteri Negara Lingkungan Hidup
Bidang Pengembangan Peran Masyarakat

Dr. Ir. D. D. Djoekardi, MA

Save the Children

CERTIFICATE OF PARTICIPATION

This is to certify that

Sri Alem Sembiring

has participated in and successfully completed the
BASELINE TRAINING MFSN PROGRAM
BPLP Building, Jl. Ngalengko No. 1, Medan
28 November 2005 - 03 December 2005

Tania Dora Warokka
Trainer Coordinator

Wilson Sitorus
DAP Manager

Save the Children

CERTIFICATE OF PARTICIPATION

This is to certify that

Sri Alem Sembiring

As Field Supervisor

has participated in and successfully completed the
Baseline Survey for Medan Food Security & Nutrition Program
December 05, 2005 - December 23, 2005

Wilson Sitorus
DAP Manager

Luis Rámirez
Deputy Director

SERTIFIKAT

Lokakarya

PEMBANGUNAN BERWAWASAN BUDAYA

YOGYAKARTA - DENPASAR - BANDUNG - SAMARINDA - MAKASSAR - MEDAN - PADANG

Memberikan penghargaan kepada :

Dra Sri Alem Sembiring, M Si

Sebagai

Peserta

Medan, 29 Januari 2004

Kementerian
Kebudayaan dan Pariwisata

Dr. Anhar Gonggong

Universitas Gadjah Mada
Pusat Studi Pariwisata

Dr. Hendrie Adji Kusworo, M.Sc.

LAMPIRAN – 5

FOTO-FOTO RONA AWAL LINGKUNGAN

Kondisi Perairan, Vegetasi, dan Areal Pertanian di Sekitar Lokasi Kegiatan

Perkampungan, Terminal, dan Pasar di Sekitar Lokasi Kegiatan

LAMPIRAN - 7

RENCANA TANGGAP DARURAT (EMERGENCY RESPON PLAN/ERP) SARULLA OPERATION LIMITED

MENTERI ENERGI DAN SUMBER DAYA MINERAL
REPUBLIK INDONESIA

Nomor : 1903/34/MEM.B/2008 27 Agustus 2008
Sifat : Biasa
Lampiran : -
Hal : Persetujuan Pengalihan Hak, Kepentingan dan Kewajiban PT PLN sebagai *Contractor* pada JOC PLTP Sarulla 300 MW

Yang terhormat
Direktur Utama PT PLN (Persero)
di
Jakarta

Sehubungan dengan surat Saudara Nomor 00130/125/DIRUT/2008 tanggal 22 Januari 2008 dan Nomor 00939/125/DIRUT/2008 tanggal 22 April 2008 perihal tersebut di atas, dengan ini kami sampaikan bahwa pada prinsipnya kami dapat menyetujui Pengalihan Hak, Kepentingan dan Kewajiban PT PLN (Persero) sebagai *Contractor* pada JOC PLTP Sarulla 300 MW kepada Konsorsium (Sarulla Operations Ltd., PT Medco Geopower Sarulla, Sarulla Power Asset Ltd., OrSarulla Inc. dan Kyuden Sarulla Pte. Ltd.).

Demikian untuk dilaksanakan dengan sebaik-baiknya.

Menteri Energi dan Sumber Daya Mineral

Purnomo Yusgiantoro

Tembusan:
1. Sekretaris Jenderal Dep. Energi dan Sumber Daya Mineral
2. Direktur Jenderal Mineral, Balubara dan Panas Bumi
3. Direktur Jenderal Listrik dan Pemanfaatan Energi

DEPARTEMEN ENERGI DAN SUMBER DAYA MINERAL REPUBLIK INDONESIA
DIREKTORAT JENDERAL LISTRIK DAN PEMANFAATAN ENERGI
Jl. H.R. Rasuna Said Blok X 2, Kav. 07 dan 08 Kuningan Jakarta 12950

Tromol Pos 3043/Jkt 10002 Telepon : (021) - 5225180 (5 saluran) Faks : 5256014-5256066 Web: www.djlpe.esdm.go.id

Nomor : 3445 / 20 /630.2/2007 20 Nopember 2007
Hal : Izin Usaha Ketenagalistrikan untuk Kepentingan Umum (IUKU) Konsorsium Medco Ormat Itochu

Yang terhormat,

Direktur Pembangkitan dan Energi Primer
PT PLN (Persero)
Jl. Trunojoyo Blok MI/136
Jakarta

Menindaklanjuti surat kami Nomor 4094/43/630.2/2006 tanggal 29 Nopember 2006 dan dengan telah ditunjuknya Konsorsium Medco Ormat Itochu sebagai pengembang PLTP Sarulla (300 MW) oleh PT PLN (Persero), dengan ini kami sampaikan sebagai berikut:

1. Mengacu Pasal 6 ayat (4) Peraturan Pemerintah Nomor 10 Tahun 1989 Jis Peraturan Pemerintah Nomor 3 Tahun 2005 dan Peraturan Pemerintah Nomor 26 Tahun 2006, maka usaha penyediaan tenaga listrik untuk kepentingan umum lintas provinsi, baik sarana maupun energi listriknya yang tidak terhubung ke dalam Jaringan Transmisi Nasional atau usaha penyediaan tenaga listrik yang terhubung ke dalam Jaringan Transmisi Nasional didasarkan atas Izin Usaha Ketenagalistrikan untuk Kepentingan Umum (IUKU), yang dikeluarkan oleh Menteri;
2. PT PLN (Persero) selaku pembeli produksi tenaga listrik PLTP Sarulla dari Konsorsium Medco Ormat Itochu diminta untuk memberitahukan kepada yang bersangkutan agar segera mengajukan permohonan Izin Usaha Ketenagalistrikan untuk Kepentingan Umum (IUKU) kepada Menteri Energi dan Sumber Daya Mineral c.q Direktur Jenderal Listrik dan Pemanfaatan Energi.

Atas perhatian Saudara, kami ucapkan terima kasih.

Direktur Pembinaan Pengusahaan Ketenagalistrikan

Agoes Triboesono
NIP 1000009477

Tembusan:
Direktur Jenderal Listrik dan Pemanfaatan Energi

DEPARTEMEN ENERGI DAN SUMBER DAYA MINERAL REPUBLIK INDONESIA
DIREKTORAT JENDERAL LISTRIK DAN PEMANFAATAN ENERGI
Jl. H R. Rasuna Said Blok X 2, Kav. 07 dan 08 Kuningan Jakarta 12950

Tromol Pos 3043/Jkt 10002 Telepon : (021) - 5225180 (5 saluran) Faks : 5256044-5256066 Web: www.djlpe.esdm.go.id

Nomor : 2736/20/630.2/2008 26 September 2008
Lampiran : 1 (satu) berkas
Hal : Penyampaian IUKU-Sementara

Yang terhormat,

Direktur Utama PT Pertamina Geothermal Energy
Menara Cakrawala Lantai 15
Jl. M.H. Thamrin No. 9
Jakarta 10340

Sehubungan dengan surat Saudara nomor 229/PGE100/2008-S0 tanggal 17 September 2008 dengan ini kami sampaikan Izin Usaha Ketenagalistrikan untuk Kepentingan Umum (IUKU) Sementara atas nama PT Pertamina Geothermal Energy, nomor 330-12/20/600.3/2008 tanggal 25 September 2008.

Dengan telah diterbitkannya IUKU-Sementara tersebut, maka PT Pertamina Geothermal Energy diwajibkan untuk melaporkan kegiatan pelaksanaan IUKU-Sementara secara berkala, setiap 3 (tiga) bulan kepada Direktur Jenderal Listrik dan Pemanfaatan Energi, sebagaimana dipersyaratkan dalam Peraturan Menteri Energi dan Sumber Daya Mineral Nomor 0010 Tahun 2005 tentang Tata Cara Perizinan Usaha Ketenagalistrikan Untuk Lintas Provinsi Atau Yang Terhubung Dengan Jaringan Transmisi Nasional.

Atas perhatian Saudara, kami ucapkan terima kasih.

a.n. Direktur Pembinaan Pengusahaan Ketenagalistrikan
Kasubdit Pelayanan Usaha Tenaga Listrik

Tri Handoko
NIP 100007659

Tembusan:
Direktur Jenderal Listrik dan Pemanfaatan Energi

MENTERI ENERGI DAN SUMBER DAYA MINERAL
REPUBLIK INDONESIA

KEPUTUSAN MENTERI ENERGI DAN SUMBER DAYA MINERAL

NOMOR : 330-12/20/600.3/2008

TENTANG

IZIN USAHA KETENAGALISTRIKAN UNTUK KEPENTINGAN UMUM (IUKU) SEMENTARA PT PERTAMINA GEOTHERMAL ENERGY

MENTERI ENERGI DAN SUMBER DAYA MINERAL,

Membaca :

1. Surat Direksi PT Pertamina Geothermal Energy Nomor 229/PGE100/2008-S0 tanggal 17 September 2008;
2. Surat Direktur Utama PT PLN (Persero) Nomor 01336/125/DIRUT/2008 tanggal 11 Juni 2008;

Menimbang :

a. bahwa untuk memenuhi kebutuhan tenaga listrik di Provinsi Sumatera Utara, diperlukan tambahan kapasitas penyediaan tenaga listrik;
b. bahwa PT Pertamina Geothermal Energy telah mengikat kontrak jual beli tenaga listrik jangka panjang dengan PT PLN (Persero);
c. bahwa PT Pertamina Geothermal Energy telah melengkapi dokumen untuk penerbitan Izin Usaha Ketenagalistrikan untuk Kepentingan Umum (IUKU) Sementara;
d. bahwa berdasarkan butir a, b dan c tersebut di atas, perlu menetapkan Keputusan tentang Izin Usaha Ketenagalistrikan untuk Kepentingan Umum (IUKU) Sementara PT Pertamina Geothermal Energy;

Mengingat :

1. Undang-Undang Nomor 15 Tahun 1985 tentang Ketenagalistrikan (Lembaran Negara Republik Indonesia Tahun 1985 Nomor 74, Tambahan Lembaran Negara Republik Indonesia Nomor 3317);
2. Peraturan Pemerintah Nomor 10 Tahun 1989 tentang Penyediaan dan Pemanfaatan Tenaga Listrik (Lembaran Negara Republik Indonesia Tahun 1989 Nomor 24, Tambahan Lembaran Negara Republik Indonesia Nomor 3394) sebagaimana telah dua kali diubah terakhir dengan Peraturan Pemerintah Nomor 26 Tahun 2006 (Lembaran Negara Republik Indonesia Tahun 2006 Nomor 56, Tambahan Lembaran Negara Republik Indonesia Nomor 4628);
3. Keputusan Presiden Nomor 187/M Tahun 2004 tanggal 20 Oktober 2004 tentang Pembentukan Kabinet Indonesia Bersatu sebagaimana telah beberapa kali diubah, terakhir dengan Keputusan Presiden Nomor 77/P Tahun 2007 tanggal 28 Agustus 2007;
4. Keputusan Presiden Nomor 60/M Tahun 2006 tanggal 8 Juni 2006 tentang Pengangkatan Pejabat Eselon I di Lingkungan Departemen Energi dan Sumber Daya Mineral;
5. Peraturan Menteri Energi dan Sumber Daya Mineral Nomor 0010 Tahun 2005 tentang Tata Cara Perizinan Usaha Ketenagalistrikan Untuk Lintas Provinsi Atau Yang Terhubung Dengan Jaringan Transmisi Nasional;
6. Peraturan Menteri Energi dan Sumber Daya Mineral Nomor 001 Tahun 2006 tentang Prosedur Pembelian Tenaga Listrik Dan/Atau Sewa Menyewa Jaringan Dalam Usaha Penyediaan Tenaga Listrik untuk Kepentingan Umum sebagaimana telah diubah dengan Peraturan Menteri Energi dan Sumber Daya Mineral Nomor 004 Tahun 2007;

MEMUTUSKAN:

Menetapkan : KEPUTUSAN MENTERI ENERGI DAN SUMBER DAYA MINERAL TENTANG IZIN USAHA KETENAGALISTRIKAN UNTUK KEPENTINGAN UMUM (IUKU) SEMENTARA PT PERTAMINA GEOTHERMAL ENERGY

KESATU : Memberikan Izin Usaha Ketenagalistrikan untuk Kepentingan Umum (IUKU) Sementara kepada:

Nama Perusahaan	:	PT Pertamina Geothermal Energy
Alamat Perusahaan	:	Menara Cakrawala Lantai 15 Jl. M.H. Thamrin No. 9 Jakarta 10340
Jenis Pembangkit	:	Pembangkit Listrik Tenaga Panas Bumi (PLTP)
Sumber Energi	:	Panas Bumi
Kontrak Daya	:	330 MW
Lokasi Pembangkit	:	Desa Silangkitang & Desa Namora I Langit Kabupaten Tapanuli Utara, Provinsi Sumatera Utara

KEDUA : Dalam melaksanakan IUKU-Sementara sebagaimana dimaksud dalam diktum KESATU, PT Pertamina Geothermal Energy wajib memenuhi ketentuan sebagai berikut:

a. tenaga listrik yang dihasilkan PLTP tersebut hanya dapat dijual kepada PT PLN (Persero);

b. pembangunan PLTP tersebut wajib mengikuti ketentuan peraturan perundang-undangan yang berlaku, dan

c. melaporkan kegiatan pelaksanaan IUKU-Sementara setiap 3 (tiga) bulan kepada Direktur Jenderal Listrik dan Pemanfaatan Energi.

KETIGA : IUKU-Sementara ini berlaku 2 (dua) tahun sejak ditetapkan.

KEEMPAT : Keputusan Menteri ini mulai berlaku pada tanggal ditetapkan.

Ditetapkan di Jakarta
pada tanggal 25 September 2008

a.n MENTERI ENERGI DAN SUMBER DAYA MINERAL
DIREKTUR JENDERAL LISTRIK DAN
PEMANFAATAN ENERGI,

J. PURWONO

Tembusan:
1. Menteri Energi dan Sumber Daya Mineral
2. Sekretaris Jenderal Dep. Energi dan Sumber Daya Mineral
3. Inspektur Jenderal Dep. Energi dan Sumber Daya Mineral
4. Direktur Utama PT PLN (Persero)

PERTAMINA
GEOTHERMAL ENERGY

Jakarta, 23 Oktober 2008
No. 324 /PGE200/2008-S0

Lampiran : 1 (satu) set
Perihal : **Penyampaian IUKU-Sementara**

Yang terhormat,

1. Deputi Direktur IPP Strategis PT. PLN (Persero)
   Selaku Kontraktor KOB Sarulla
   Jl. Trunojoyo Blok MI / 135 Kebayoran Baru
   Jakarta – 12160
2. Konsorsium Medco - Itochu - Ormat
   Att. Sdr. Aries Pardjimanto
   Graha Niaga Lt. 8
   Jl. Jenderal Sudirman Kav. 58
   Jakarta Pusat

Dengan hormat,

Bersama ini kami sampaikan Surat Keputusan Menteri Energi dan Sumber Daya Mineral Nomor 330-12/20/600.3/2008 tanggal 25 September 2008 tentang Izin Usaha Ketenagalistrikan Untuk Kepentingan Umum (IUKU) Sementara PT Pertamina Geothermal Energy daerah Sarulla.

Adapun pelaporan kegiatan pelaksanaan IUKU-Sementara kepada Direktur Jenderal Listrik dan Pemanfaatan Energi agar disampaikan melalui PT Pertamina Geothermal Energy.

Demikian kami sampaikan, atas perhatian dan kerjasama Saudara, kami ucapkan terimakasih.

Direktur Operasi

Suryadarma

Tembusan :
- Direktur Utama PT Pertamina Geothermal Energy (sebagai laporan)

Kantor Pusat
Menara Cakrawala Lantai 15
Jalan MH. Thamrin No. 9
Jakarta 10340 Indonesia
T +62 21 398 33 222 F +62 21 398 33 230
www.pgeindonesia.com

DEPARTEMEN ENERGI DAN SUMBER DAYA MINERAL REPUBLIK INDONESIA
DIREKTORAT JENDERAL LISTRIK DAN PEMANFAATAN ENERGI
Jl. H.R. Rasuna Said Blok X 2, Kav. 07 dan 08 Kuningan Jakarta 12950

Tromol Pos 3043/Jkt 10002 Telepon : (021) - 5225180 (5 saluran) Faks : 5256044-5256064 Web. www.djlpe.esdm.go.id

Nomor : 2736/20/630.2/2008 26 September 2008
Lampiran : 1 (satu) berkas
Hal : Penyampaian IUKU-Sementara

Yang terhormat,

Direktur Utama PT Pertamina Geothermal Energy
Menara Cakrawala Lantai 15
Jl. M.H. Thamrin No. 9
Jakarta 10340

Sehubungan dengan surat Saudara nomor 229/PGE100/2008-S0 tanggal 17 September 2008 dengan ini kami sampaikan Izin Usaha Ketenagalistrikan untuk Kepentingan Umum (IUKU) Sementara atas nama PT Pertamina Geothermal Energy, nomor 330-12/20/600.3/2008 tanggal 25 September 2008.

Dengan telah diterbitkannya IUKU-Sementara tersebut, maka PT Pertamina Geothermal Energy diwajibkan untuk melaporkan kegiatan pelaksanaan IUKU Sementara secara berkala, setiap 3 (tiga) bulan kepada Direktur Jenderal Listrik dan Pemanfaatan Energi, sebagaimana dipersyaratkan dalam Peraturan Menteri Energi dan Sumber Daya Mineral Nomor 0010 Tahun 2005 tentang Tata Cara Perizinan Usaha Ketenagalistrikan Untuk Lintas Provinsi Atau Yang Terhubung Dengan Jaringan Transmisi Nasional.

Atas perhatian Saudara, kami ucapkan terima kasih.

a.n. Direktur Pembinaan Pengusahaan
Ketenagalistrikan
Kasubdit Pelayanan Usaha
Tenaga Listrik

Tri Handoko
NIP 100007659

Tembusan:
Direktur Jenderal Listrik dan Pemanfaatan Energi

MENTERI ENERGI DAN SUMBER DAYA MINERAL
REPUBLIK INDONESIA

KEPUTUSAN MENTERI ENERGI DAN SUMBER DAYA MINERAL

NOMOR : 330-12/20/600.3/2008

TENTANG

IZIN USAHA KETENAGALISTRIKAN UNTUK KEPENTINGAN UMUM (IUKU) SEMENTARA PT PERTAMINA GEOTHERMAL ENERGY

MENTERI ENERGI DAN SUMBER DAYA MINERAL,

Membaca :

1. Surat Direksi PT Pertamina Geothermal Energy Nomor 229/PGE100/2008-S0 tanggal 17 September 2008;
2. Surat Direktur Utama PT PLN (Persero) Nomor 01336/125/DIRUT/2008 tanggal 11 Juni 2008;

Menimbang :

a. bahwa untuk memenuhi kebutuhan tenaga listrik di Provinsi Sumatera Utara, diperlukan tambahan kapasitas penyediaan tenaga listrik;
b. bahwa PT Pertamina Geothermal Energy telah mengikat kontrak jual beli tenaga listrik jangka panjang dengan PT PLN (Persero);
c. bahwa PT Pertamina Geothermal Energy telah melengkapi dokumen untuk penerbitan Izin Usaha Ketenagalistrikan untuk Kepentingan Umum (IUKU) Sementara;
d. bahwa berdasarkan butir a, b dan c tersebut di atas, perlu menetapkan Keputusan tentang Izin Usaha Ketenagalistrikan untuk Kepentingan Umum (IUKU) Sementara PT Pertamina Geothermal Energy;

Mengingat :

1. Undang-Undang Nomor 15 Tahun 1985 tentang Ketenagalistrikan (Lembaran Negara Republik Indonesia Tahun 1985 Nomor 74, Tambahan Lembaran Negara Republik Indonesia Nomor 3317);
2. Peraturan Pemerintah Nomor 10 Tahun 1989 tentang Penyediaan dan Pemanfaatan Tenaga Listrik (Lembaran Negara Republik Indonesia Tahun 1989 Nomor 24, Tambahan Lembaran Negara Republik Indonesia Nomor 3394), sebagaimana telah dua kali diubah terakhir dengan Peraturan Pemerintah Nomor 26 Tahun 2006 (Lembaran Negara Republik Indonesia Tahun 2006 Nomor 58, Tambahan Lembaran Negara Republik Indonesia Nomor 4628);
3. Keputusan Presiden Nomor 187/M Tahun 2004 tanggal 20 Oktober 2004 tentang Pembentukan Kabinet Indonesia Bersatu sebagaimana telah beberapa kali diubah, terakhir dengan Keputusan Presiden Nomor 77/P Tahun 2007 tanggal 28 Agustus 2007;
4. Keputusan Presiden Nomor 60/M Tahun 2008 tanggal 8 Juni 2006 tentang Pengangkatan Pejabat Eselon I di Lingkungan Departemen Energi dan Sumber Daya Mineral;
5. Peraturan Menteri Energi dan Sumber Daya Mineral Nomor 0010 Tahun 2005 tentang Tata Cara Perizinan Usaha Ketenagalistrikan Untuk Lintas Provinsi Atau Yang Terhubung Dengan Jaringan Transmisi Nasional;
6. Peraturan Menteri Energi dan Sumber Daya Mineral Nomor 001 Tahun 2006 tentang Prosedur Pembelian Tenaga Listrik Dan/Atau Sewa Menyewa Jaringan Dalam Usaha Penyediaan Tenaga Listrik untuk Kepentingan Umum sebagaimana telah diubah dengan Peraturan Menteri Energi dan Sumber Daya Mineral Nomor 004 Tahun 2007;

MEMUTUSKAN:

Menetapkan . KEPUTUSAN MENTERI ENERGI DAN SUMBER DAYA MINERAL TENTANG IZIN USAHA KETENAGALISTRIKAN UNTUK KEPENTINGAN UMUM (IUKU) SEMENTARA PT PERTAMINA GEOTHERMAL ENERGY.

KESATU . Memberikan Izin Usaha Ketenagalistrikan untuk Kepentingan Umum (IUKU) Sementara kepada:

Nama Perusahaan	:	PT Pertamina Geothermal Energy
Alamat Perusahaan	:	Menara Cakrawala Lantai 15 Jl. M.H. Thamrin No. 9 Jakarta 10340
Jenis Pembangkit	:	Pembangkit Listrik Tenaga Panas Bumi (PLTP)
Sumber Energi	:	Panas Bumi
Kontrak Daya		330 MW
Lokasi Pembangkit	:	Desa Silangkitang & Desa Namora I Langit Kabupaten Tapanuli Utara, Provinsi Sumatera Utara

KEDUA . Dalam melaksanakan IUKU-Sementara sebagaimana dimaksud dalam diktum KESATU, PT Pertamina Geothermal Energy wajib memenuhi ketentuan sebagai berikut:

a. tenaga listrik yang dihasilkan PLTP tersebut hanya dapat dijual kepada PT PLN (Persero);

b. pembangunan PLTP tersebut wajib mengikuti ketentuan peraturan perundang-undangan yang berlaku; dan

c. melaporkan kegiatan pelaksanaan IUKU-Sementara setiap 3 (tiga) bulan kepada Direktur Jenderal Listrik dan Pemanfaatan Energi.

KETIGA : IUKU-Sementara ini berlaku 2 (dua) tahun sejak ditetapkan.

KEEMPAT : Keputusan Menteri ini mulai berlaku pada tanggal ditetapkan.

Ditetapkan di Jakarta
pada tanggal 25 September 2008

a.n. MENTERI ENERGI DAN SUMBER DAYA MINERAL
DIREKTUR JENDERAL LISTRIK DAN
PEMANFAATAN ENERGI,

J. PURWONO

Tembusan:
1. Menteri Energi dan Sumber Daya Mineral
2. Sekretaris Jenderal Dep. Energi dan Sumber Daya Mineral
3. Inspektur Jenderal Dep. Energi dan Sumber Daya Mineral
4. Direktur Utama PT PLN (Persero)

BUPATI TAPANULI UTARA

Jl. Letjend. Suprapto No. 1, Tarutung 22411, Sumatera Utara
Telp. (0633) 21220; Fax. : (0633) 21440
Web site : http://www.taputkab.go.id; E-mail : bupati@taputkab.go.id; wabup@taputkab.go.id

Tarutung, 06 Mei 2008

Nomor : 354 /Bappeda/III/2008
Sifat : Penting
Lampiran : 1 (satu) set
Perihal : Persyaratan Perizinan

Kepada
Yth. DIREKTUR UTAMA
PT. PERTAMINA GEOTHERMAL ENERGY
di-
JAKARTA

Sehubungan dengan Surat Saudara Nomor : 242/PGE000/2008-SO tanggal 14 April 2008 perihal Surat Izin Akses Masuk Wilayah Kerja Sarulla dan Nomor : 243/PGE000/2008-SO tanggal 14 April 2008 perihal Surat Izin Pemakaian Air (SIPA) serta Hasil Pertemuan Pemerintah Kabupaten Tapanuli Utara dengan Pihak Konsorsium (Itochu Corporation Indonesia dan Medco Geothermal Energy) pada tanggal 21 April 2008 yang lalu, disampaikan bahwa ada beberapa perizinan yang dibutuhkan dalam rangka pembangunan lanjutan Proyek PLTP Sarulla tersebut.

Sekaitan dengan hal tersebut, terlampir disampaikan beberapa Persyaratan Perizinan (Izin Peruntukan Penggunaan Lahan, Izin Mendirikan Bangunan dan Izin Gangguan) dengan mempedomani Keputusan Bupati Tapanuli Utara Nomor 245 Tahun 2007 tentang Pedoman Standar Pelayanan Minimal Penerbitan Perizinan untuk melengkapi persyaratan yang dapat dipergunakan dalam rangka percepatan pelaksanaan pembangunan lanjutan Proyek PLTP Sarulla dimaksud.

Terkait dengan perizinan tersebut diatas, kami akan memfasilitasi dengan memberikan kemudahan-kemudahan di dalam pengurusannya sepanjang tidak bertentangan dengan peraturan perundang-undangan yang berlaku.

Demikian disampaikan, atas perhatian serta kerjasama yang baik diucapkan terima kasih.

BUPATI TAPANULI UTARA

TORANG LUMBANTOBING

Tembusan :

Lampiran Surat Bupati Tapanuli Utara
Nomor : 354/BAPPEDA/III/2008
Tanggal : 06 Mei 2008

PERSYARATAN PERIZINAN DALAM RANGKA PERCEPATAN PELAKSANAAN PEMBANGUNAN PROYEK PLTP SARULLA

1. **PERSYARATAN IZIN PERUNTUKAN PENGGUNAAN TANAH**
   - ✓ Fotocopi KTP Pemilik Tanah;
   - ✓ Fotocopi Sertifikat Tanah (Surat Keterangan Tanah);
   - ✓ Surat Keterangan Kepala Desa menerangkan bahwa tanah tersebut tidak bersengketa dan diketahui Camat;
   - ✓ Pas photo pemohon ukuran 3 x 4 sebanyak 2 lembar berwarna;
   - ✓ Fotocopi KTP Pemohon sebanyak 2 lembar.

2. **PERSYARATAN IZIN MENDIRIKAN BANGUNAN (IMB)**

   a. **Persyaratan Administrasi**
      - ✓ Membuat Surat Permohonan;
      - ✓ Fotocopi KTP Pemohon sebanyak 2 lembar;
      - ✓ Fotocopi Sertifikat Tanah (Surat Keterangan Tanah);
      - ✓ Surat Keterangan Kepala Desa/ Lurah menerangkan bahwa tanah tersebut tidak bersengketa dan diketahui Camat:
      - ✓ Taksasi Bangunan;
      - ✓ Fotocopi bukti lunas PBB tahun berjalan;
      - ✓ Rekomendasi Camat;
      - ✓ Keterangan Situasi Bangunan;
      - ✓ Fotocopi Sertifikat Izin Peruntukan Tanah (bagi bangunan yang berfungsi sebagai jasa komersil yang disesuaikan dengan Rencana Tata Ruang Wilayah (RTRW);
      - ✓ Pas photo ukuran 3 x 4 sebanyak 2 lembar berwarna;
      - ✓ Berita Acara Pemeriksaan Lokasi yang akan dibangun dan dibuat oleh Tim diketahui oleh Camat;
      - ✓ Surat Pengumuman Camat 14 hari sejak tanggal dikeluarkannya Pengumuman;
      - ✓ Surat Perintah Tugas.

   b. **Persyaratan Teknis**
      - ✓ Gambar Bangunan dengan skala 1:100;
      - ✓ Gambar Denah, tampak potongan dengan skala 1:10;
      - ✓ Gambar Detail Konstruksi dengan skala 1:10 sampai dengan 1:20;
      - ✓ Gambar Situasi dengan skala 1: 500 atau sesuai kebutuhan;
      - ✓ Semua gambar harus diketahui oleh Camat;
      - ✓ Pemilik bangunan harus lebih dahulu membuat papan nama IMB dengan mencantumkan nomor dan tanggal yang tercantum di dalamnya;
      - ✓ Bangunan harus satu garis lurus dengan bangunan di kiri kanan, serta tidak menganggu terhadap kepentingan jalan umum;
      - ✓ Membuat pagar keliling guna pengawasan pelasanaan pekerjaan bangunan;
      - ✓ Bangunan harus memiliki kamar mandi, WC dan Septitank;
      - ✓ Saluran terbuka/ tertutup harus dapat mengalirkan air dengan kemiringan saluran 2 %.

3. PERSYARATAN IZIN GANGGUAN (IG)

a. Persyaratan Administrasi

- ✓ Fotocopi KTP Pemohon sebanyak 2 lembar;
- ✓ Pas photo ukuran 3 x 4 sebanyak 2 lembar berwarna;
- ✓ Fotocopi Surat Status Kepemilikan Tanah;
- ✓ Fotocopi bukti lunas PBB tahun berjalan;
- ✓ Surat Pernyataan Pemohon bermaterai Rp.6.000,- tentang tidak keberatan izin dicabut apabila melanggar ketentuan;
- ✓ Surat Keterangan Kepala Desa/ Lurah;
- ✓ Surat Pernyataan tidak keberatan dari tetangga yang disahkan oleh Kepala Desa/ Lurah;
- ✓ Rekomendasi Camat;
- ✓ Fotocopi Akte Pendirian Perusahaan yang dilegalisir.

b. Persyaratan Teknis

- ✓ Surat Rekomendasi dari Dinas PERINDAGTAMBEN Kab. Tapanuli Utara;
- ✓ Berita Acara Pemeriksaan dan Peninjauan ke Lapangan oleh Tim Teknis;
- ✓ Industri yang mencemari Lingkungan wajib memiliki Dokumen Pengelolaan Lingkungan (UPL dan UKL) atau AMDAL.

Tarutung, 06 Mei 2008

KANTOR PELAYANAN PERIZINAN TERPADU
KABUPATEN TAPANULI UTARA
K E P A L A

Drs. POSMA SITOMPUL, SmHk
PEMBINA
NIP. 010 160 557.-

BUPATI TAPANULI UTARA

Jl. Let.Jend Suprapto No. 1 Tarutung 22411
Sumatera Utara No. Telp. (0633) 21220 Fax. (0633) 21440
Web site : http//www.taputkab.go.id; E-mail: bupati@taputkab.go.id, wabup@taputkab.go.id

Tarutung, 29 April 2008

Nomor : 540/2930/KSB-III/EKON/2008
Sifat : Penting
Lampiran :
Perihal : Izin Akses Masuk Wilayah Kerja Sarulla.

Kepada :
Yth. Direktur Utama PT. Pertamina Geothermal Energy
di-
Jakarta.

Sesuai dengan surat Saudara Nomor : 242/PGE000/2008-SO perihal Surat Izin Masuk Wilayah Kerja Sarulla, dimana dalam waktu dekat PT. Pertamina Geothermal Energy akan melakukan kegiatan Topographic Survey dan Soil Investigation.

Dalam kaitan itu, Pemerintah Kabupaten Tapanuli Utara pada prinsipnya memberikan Izin Akses Masuk Wilayah Kerja Sarulla dan mendukung sepenuhnya rencana PT. Pertamina Geothermal Energy untuk melakukan pekerjaan Topographic Survey dan Soil Investigation dimaksud di Kecamatan Pahae Julu dan Pahae Jae Kabupaten Tapanuli Utara.

Demikian disampaikan untuk maklum dan atas perhatiannya diucapkan terimakasih.-

BUPATI TAPANULI UTARA

TORANG LUMBANTOBING

Tembusan Yth :
1. Menteri Energi dan Sumber Daya Mineral RI di Jakarta
2. Direktur Utama PLN di Jakarta
3. Pimpinan Itochu Coorporation di Jakarta
4. Direktur Utama PT. Medco Geothermal Indonesia di Jakarta
5. Kepala Dinas Pertambangan dan Energi Propsu di Medan
6. Direktur PT.PLN Proyek Induk Pembangkit dan Jaringan Sumut Aceh-Riau di Medan.

BUPATI TAPANULI UTARA

Jl. Letjend. Suprapto No. 1, Tarutung 22411, Sumatera Utara
Telp. (0633) 21220; Fax. : (0633) 21440
Wb site : http://www.taputkab.go.id; E-mail : bupati@taputkab.go.id; wabup@taputkab.go.id

Tarutung, 6 Mei 2008

Nomor : 2015 /Bid.IV/BPKKD/2008
Sifat : Penting
Lampiran : - , -
Perihal : Rekomendasi Surat Izin Pemakaian Air (SIPA)

Kepada
Yth. **GUBERNUR SUMATERA UTARA**

di-

M E D A N

Sehubungan dengan Surat Saudara Nomor : 243/PGE000/2008-SO tanggal 14 April 2008 perihal Surat Izin Pemakaian Air (SIPA) dan menghunjuk Undang-undang Nomor 7 Tahun 2004 tentang Sumberdaya Air serta menindaklanjuti Hasil Pertemuan Pemerintah Kabupaten Tapanuli Utara dengan Pihak Konsorsium (Itochu Corporation Indonesia dan Medco Geothermal Energy) pada tanggal 21 April 2008 yang lalu, dimana direncanakan akan dimulai kegiatan reparasi (work over) sumur SIL 1-2 dan SIL 1-3 dari Sungai Batang Toru pada bulan Juni s/d Juli 2008 dalam rangka percepatan pelaksanaan pembangunan lanjutan Proyek PLTP Sarulla.

Sekaitan dengan hal tersebut, pada prinsipnya Pemerintah Kabupaten Tapanuli Utara mendukung sepenuhnya percepatan pelaksanaan pembangunan lanjutan Proyek PLTP Sarulla dimaksud dan memberikan rekomendasi perihal Surat Izin Pemakaian Air (SIPA) untuk melengkapi persyaratan yang akan dipergunakan dalam rangka memperoleh Surat Izin Pemakaian Air (SIPA) dari Pemerintah Provinsi Sumatera Utara.

Demikian rekomendasi ini kami perbuat untuk dapat dipergunakan seperlunya.

BUPATI TAPANULI UTARA

TORANG LUMBANTOBING

Tembusan :
1. Kepala Dinas Pengairan Provinsi Sumatera Utara, di Medan;
2. Kepala Dinas Pertambangan dan Energi Prov. Sumatera Utara, di Medan;
3. Direktur Utama PT. Pertamina Geothermal Energy, di Jakarta;
4. Pimpinan Itochu Corporation Indonesia, di Jakarta;
5. Pimpinan Medco Geothermal Energy, di Jakarta

Sarulla Operations Limited
CKO Graha Niaga 8th Floor
Jl Jend.Sudirman Kav.58
Jakarta 12190 - Indonesia
Phone. +6221 250 5459 Fax +6221 522 5977

Sarulla Operations Ltd

No. SOL-057/DIR/VIII/2008

Jakarta, 27 Agustus 2008

Kepada Yth.
Departemen Pekerjaan Umum
Jl. Sakti Lubis No. 1
Medan. 20219

Up : **Ir. A. Sofian Lubis, M.Si**

Perihal : Permohonan Perpanjangan Izin Penggunaan Bahu Jalan

Dengan Hormat,

Menindaklanjuti surat Bapak nomor: P10.03.01/BBPJN-I/813 tanggal 08 Juli 2008 perihal Penggunaan Bahu Jalan pada ruas jalan Tarutung – Sipirok link 014.1 untuk pemanfaatan Proyek Pembangkit Listrik Tenaga Panasbumi (PLTP) Sarulla di lokasi Desa Silangkitang Kecamatan Pahae Jae Kabupaten Tapanuli Utara, dengan ini kami memohon perpanjangan izin penggunaan bahu jalan sampai dengan bulan Maret 2009 dikarenakan akan dilakukan pekerjaan Production Test.

Demikian kami sampaikan dan atas perhatian dan kerjasamanya kami ucapkan terima kasih.

Hormat Kami,
SARULLA OPERATIONS LTD.

Aries Pardjimanto
Direktur

DEPARTEMEN PEKERJAAN UMUM
DIREKTORAT JENDERAL BINA MARGA
BALAI BESAR PELAKSANAAN JALAN NASIONAL - I
Jalan Sakti Lubis No. 1 Medan (20219) Telepon (061) 7864521

Nomor : PW.03-01/BBPJN-I/013
Lamp : -

Medan, 08 Juli 2008

Kepada Yth. :
Supervisor Lapangan PT. Medco Geothermal Sarulla
di –
Tempat

Perihal : **Penggunaan Bahu Jalan**

Sesuai dengan surat Saudara nomor : 003/SOL/VII/2008 tanggal 4 Juli 2008 perihal Pemberitahuan Penggunaan Bahu Jalan, pada ruas jalan Tarutung – Sipirok link 014.1 untuk pemanfaatan Proyek Pembangkit Listrik Panas Bumi (PLTP) Sarulla di lokasi Desa Silangkitang Kecamatan Pahae Jae Kabupaten Tapanuli Utara, dengan ini kami beritahukan sebagai berikut :

1. Apabila terjadi kerusakan pada badan jalan perbaikannya menjadi tanggung jawab PT. Medco Geothermal Sarulla
2. Pemasangan pipa tersebut harus berkoordinasi dengan Satuan Kerja Pemeliharaan Jalan dan Jembatan Provinsi Sumatera Utara / PPK Pemeliharaan Jalan Siborong borong – Tarutung – Pal XI
3. Pemasangan pipa tersebut jangan sampai mengganggu kelancaran lalu lintas
4. Apabila terjadi sesuatu hal yang tidak diinginkan (kecelakaan) yang diakibatkan oleh adanya pemasangan pipa tersebut menjadi tanggung jawab PT. Medco Geothermal Sarulla

Demikian disampaikan dan atas perhatiannya diucapkan terima kasih.

a.n. Kepala Balai
Kepala Bidang Pelaksanaan

Ir. A. Sofian Lubis, M.Si
NIP 19004150

Tembusan disampaikan Kepada Yth. :
1. Kepala SNVT Pemeliharaan Jalan dan Jembatan Provinsi Sumatera Utara
2. Bagian Pelaksana Kegiatan Pemeliharaan Jalan dan Jembatan Siborong borong – Tarutung – Pal XI
3. Kepala Dinas PUK Kab. Tapanuli Utara
4. Camat Pahae Jae
5. Dan Ramil Pahae Jae
6. Kapolsek Pahae Jae
7. Kepala Desa Terkait
8. Pertinggal

Received 09/7/08

PT PLN (PERSERO)
KANTOR PUSAT

Jalan Trunojoyo Blok M I/135 Kebayoran Baru - Jakarta 12160
Telp. : (021) 7251875, 7251122, 7262234
(021) 7251234, 7250550
Kotak Pos : 4322/K55 Faximile : (021) 7221330 Alamat Kawat : PLNPST

Nomor : 088 /121/DDIPP/2008 02 April 2008
Surat Sdr. No. : -
Lampiran : 1 (satu) lembar
Perihal : Ijin Work Over and Well Checking untuk PLTP Sarulla

Kepada :
PT PERTAMINA GEOTHERMAL ENERGY
Menara Cakrawala Lantai 15
JL MH Thamrin No. 9
Jakarta 10340

Up. Yth. Direktur Operasi

Menunjuk Surat Sarulla Operation Ltd No. SOL-006/DIR/V/2008 tanggal 3 April 2008, bersama ini kami mengharapkan dapat diberikan ijin beberapa kegiatan sebagai persiapan untuk pelaksanaan Work Over dan Well Checking untuk PLTP Sarulla sesuai surat SOL terlampir.

Kegiatan tersebut direncanakan dilaksanakan sebelum dimulainya kegiatan Work Over dan Weel Checking pada bulan Juni 2008.

Demikian disampaikan, atas perhatian diucapkan terima kasih.

DEPUTI DIREKTUR
PENGELOLAAN KONTRAK IPP

KANTOR PUSAT

NASRI SEBAYANG

Tembusan :
- Yth. DIRREN (sebagai laporan)
- Sarulla Operations Ltd
- MKIPP

MODEL 1C01

DEPARTEMEN ENERGI DAN SUMBER DAYA MINERAL REPUBLIK INDONESIA
DIREKTORAT JENDERAL MINERAL, BATUBARA DAN PANAS BUMI
DIREKTORAT TEKNIK DAN LINGKUNGAN MINERAL, BATUBARA DAN PANAS BUMI
Jln. Prof. Dr. Supomo, SH No. 10 Jakarta 12870

Telepon : (021) 8357503, 8357505 Faksimili : 8357505

Nomor : 1254/37.04/DBT/2008 8 Agustus 2008
Lampiran : Satu lembar
Hal : Pengesahan Wakil Kepala Teknik Tambang Sementara

Yang terhormat
Direktur Sarulla Operation Limited
Graha Niaga, Lantai 8
Jl. Jenderal Sudirman Kav. 58
Jakarta 12190

Sehubungan dengan surat Saudara nomor: SOL-041/DIR/VI/2008 tanggal 21 Juli 2008 perihal sebagaimana tersebut pada pokok surat, dengan ini kami mengesahkan pengangkatan Sdr. Arief Pramono Sunu sebagai Wakil Kepala Teknik Tambang sementara terhitung sejak tanggal surat ini untuk bertanggung jawab atas terlaksananya pengelolaan Keselamatan dan Kesehatan Kerja serta Lindungan Lingkungan pada Wilayah Pengembangan dan Pengusahaan Panasbumi Lapangan Sarulla Operation Limited, yang berlokasi di Kabupaten Tapanuli Utara, Provinsi Sumatera Utara.

Sehubungan dengan itu kami minta agar Saudara memberitahukan Wakil Kepala Teknik Tambang yang bersangkutan untuk melakukan pendaftaran isi dari Surat Keterangan (terlampir) ke dalam Buku Tambang di sebelah kiri pada lajur 1 dan 2 dengan membubuhkan nomor urut dan tanggal pendaftaran serta menandatanganinya, kemudian fotokopi pendaftaran tersebut disampaikan kepada kami untuk didaftarkan dalam duplikat Buku Tambang yang ada di Kantor Direktorat Teknik dan Lingkungan Mineral, Batubara dan Panas Bumi.

Apabila Wakil Kepala Teknik Tambang tersebut berhenti atau mengundurkan diri supaya segera diberitahukan kepada kami.

Atas perhatian Saudara, kami ucapkan terima kasih.

Direktur/
Kepala Pelaksana Inspeksi Tambang

M.S. Marpaung
NIP. 100006898

Tembusan:
1. Dirjen Mineral, Batubara dan Panas Bumi
2. Direktur Pembinaan Pengusahaan Panas Bumi dan Pengelolaan Air Tanah
3. Kepala Dinas Pertambangan dan Energi Provinsi Sumatera Utara
4. Kepala Dinas Pertambangan dan Energi Kabupaten Tapanuli Utara
5. Kepala Teknik Tambang Sarulla Opertaion Limited
6. Wakil Kepala Teknik Tambang Sarulla Opertaion Limited

Lampiran Surat Nomor : 1254 /37.04/DBT/2008
Tanggal : 8 Agustus 2008

Pendaftaran menurut permintaan Direktur Teknik dan Lingkungan Mineral, Batubara dan Panas Bumi/Kepala Pelaksana Inspeksi Tambang.

dengan surat : 1254 /37.04/DBT/2008
tanggal : 8 Agustus 2008

SURAT KETERANGAN

Berdasarkan pasal 5 ayat (2) dan (4) Keputusan Menteri Pertambangan dan Energi nomor 555.K/26/M.PE/1995 tentang Keselamatan dan Kesehatan Kerja Pertambangan Umum dan Pasal 4 ayat (1) dan (2) Keputusan Menteri Pertambangan dan Energi nomor 1211.K/008/M.PE/1995 tentang Pencegahan dan Penanggulangan Perusakan dan Pencemaran Lingkungan pada kegiatan usaha pertambangan umum, Kepala Pelaksana Inspeksi Tambang mengesahkan:

Sdr. Arief Pramono Sunu

Berkedudukan sebagai	: Health & Safety Manager
yang telah ditunjuk oleh	: Direktur Sarulla Operation Limited
dengan suratnya nomor	: SOL-041/DIR/VI/2008
tertanggal	: 21 Juli 2008
kualifikasi	: Telah lulus ujian kompetensi bagi pengawas operasional pertama
nomor sertifikat	: 8458/37.04/DBT/2008
sebagai	: Wakil Kepala Teknik Tambang Sementara

untuk bertanggung jawab atas terlaksananya pengelolaan Keselamatan dan Kesehatan Kerja serta Lindungan Lingkungan pada wilayah Pengembangan dan Pengusahaan Panasbumi Lapangan Sarulla Operation Limited, yang berlokasi di Kabupaten Tapanuli Utara, Provinsi Sumatera Utara.

Direktur/
Kepala Pelaksana Inspeksi Tambang,

M.S. Marpaung
NIP. 100006898

DEPARTEMEN ENERGI DAN SUMBER DAYA MINERAL REPUBLIK INDONESIA
DIREKTORAT JENDERAL MINERAL, BATUBARA DAN PANAS BUMI
DIREKTORAT TEKNIK DAN LINGKUNGAN MINERAL, BATUBARA DAN PANAS BUMI
Jln. Prof. Dr. Supomo, SH No. 10 Jakarta 12870

Telepon : (021) 8357503, 8357505 Faksimili : 8357505

Nomor : 1251/37.04/DBT/2008 8 Agustus 2008
Lampiran : Satu lembar
Hal : Pengesahan Kepala Teknik Tambang

Yang terhormat
Direktur Sarulla Operation Limited
Graha Niaga, Lantai 8
Jl. Jenderal Sudirman Kav. 58
Jakarta 12190

Sehubungan dengan surat Saudara nomor: SOL-041/DIR/VI/2008 tanggal 21 Juli 2008 perihal sebagaimana tersebut pada pokok surat, dengan ini kami mengesahkan pengangkatan Sdr. Aidil Hasibuan sebagai Kepala Teknik Tambang terhitung sejak tanggal surat ini untuk bertanggung jawab atas terlaksananya pengelolaan Keselamatan dan Kesehatan Kerja serta Lindungan Lingkungan pada Wilayah Pengembangan dan Pengusahaan Panasbumi Lapangan Sarulla Operation Limited, yang berlokasi di Kabupaten Tapanuli Utara, Provinsi Sumatera Utara.

Sehubungan dengan itu kami minta agar Saudara memberitahukan Kepala Teknik Tambang yang bersangkutan untuk melakukan pendaftaran isi dari Surat Keterangan (terlampir) ke dalam Buku Tambang di sebelah kiri pada lajur 1 dan 2 dengan membubuhkan nomor urut dan tanggal pendaftaran serta menandatanganinya, kemudian fotokopi pendaftaran tersebut disampaikan kepada kami untuk didaftarkan dalam duplikat Buku Tambang yang ada di Kantor Direktorat Teknik dan Lingkungan Mineral, Batubara dan Panas Bumi.

Apabila Kepala Teknik Tambang tersebut berhenti atau mengundurkan diri supaya segera diberitahukan kepada kami.

Atas perhatian Saudara, kami ucapkan terima kasih.

Direktur
Kepala Pelaksana Inspeksi Tambang

M.S. Marpaung
NIP. 100006898

Tembusan:
1. Dirjen Mineral, Batubara dan Panas Bumi
2. Direktur Pembinaan Pengusahaan Panas Bumi dan Pengelolaan Air Tanah
3. Kepala Dinas Pertambangan dan Energi Provinsi Sumatera Utara
4. Kepala Dinas Pertambangan dan Energi Kabupaten Tapanuli Utara
5. Kepala Teknik Tambang Sarulla Opertaion Limited

Lampiran Surat Nomor : 1252 /37.04/DBT/2008
Tanggal : 8 Agustus 2008

Pendaftaran menurut permintaan Direktur Teknik dan Lingkungan Mineral, Batubara dan Panas Bumi/Kepala Pelaksana Inspeksi Tambang.

dengan surat : 1252 /37.04/DBT/2008
tanggal : 8 Agustus 2008

SURAT KETERANGAN

Berdasarkan pasal 5 ayat (2) dan (4) Keputusan Menteri Pertambangan dan Energi nomor 555.K/26/M.PE/1995 tentang Keselamatan dan Kesehatan Kerja Pertambangan Umum dan Pasal 4 ayat (1) dan (2) Keputusan Menteri Pertambangan dan Energi nomor 1211.K/008/M.PE/1995 tentang Pencegahan dan Penanggulangan Perusakan dan Pencemaran Lingkungan pada kegiatan usaha pertambangan umum, Kepala Pelaksana Inspeksi Tambang mengesahkan:

Sdr. Aidil Hasibuan

Berkedudukan sebagai	: Vice President of Upstream
yang telah ditunjuk oleh	: Direktur Sarulla Operation Limited
dengan suratnya nomor	: SOL-041/DIR/VI/2008
tertanggal	: 21 Juli 2008
kualifikasi	: Telah lulus ujian kompetensi bagi pengawas operasional utama
nomor sertifikat	: 0188/POU-DTM/III/2004
sebagai	: Kepala Teknik Tambang

untuk bertanggung jawab atas terlaksananya pengelolaan Keselamatan dan Kesehatan Kerja serta Lindungan Lingkungan pada Wilayah Pengembangan dan Pengusahaan Panasbumi Lapangan Sarulla Opertation Limited, yang berlokasi di Kabupaten Tapanuli Utara, Provinsi Sumatera Utara.

Direktur/
Kepala Pelaksana Inspeksi Tambang

M.S. Marpaung
NIP. 100006898

DEPARTEMEN ENERGI DAN SUMBER DAYA MINERAL REPUBLIK INDONESIA
DIREKTORAT JENDERAL MINERAL, BATUBARA DAN PANAS BUMI
DIREKTORAT TEKNIK DAN LINGKUNGAN MINERAL, BATUBARA DAN PANAS BUMI
Jln. Prof. Dr. Supomo, SH No 10 Jakarta 12870

Telepon : (021) 8357503, 8357505 Faksimili : 8357505

Nomor : 1255/37.04/DBT/2008 8 Agustus 2008
Lampiran : Satu lembar
Hal : Pengesahan Wakil Kepala Teknik Tambang Sementara

Yang terhormat
Direktur Sarulla Operation Limited
Graha Niaga, Lantai 8
Jl. Jenderal Sudirman Kav. 58
Jakarta 12190

Sehubungan dengan surat Saudara nomor: SOL-041/DIR/VI/2008 tanggal 21 Juli 2008 perihal sebagaimana tersebut pada pokok surat, dengan ini kami mengesahkan pengangkatan Sdr. Andang Atmanto sebagai Wakil Kepala Teknik Tambang sementara terhitung sejak tanggal surat ini untuk bertanggung jawab atas terlaksananya pengelolaan Keselamatan dan Kesehatan Kerja serta Lindungan Lingkungan pada Wilayah Pengembangan dan Pengusahaan Panasbumi Lapangan Sarulla Operation Limited, yang berlokasi di Kabupaten Tapanuli Utara, Provinsi Sumatera Utara.

Sehubungan dengan itu kami minta agar Saudara memberitahukan Wakil Kepala Teknik Tambang yang bersangkutan untuk melakukan pendaftaran isi dari Surat Keterangan (terlampir) ke dalam Buku Tambang di sebelah kiri pada lajur 1 dan 2 dengan membubuhkan nomor urut dan tanggal pendaftaran serta menandatanganinya, kemudian fotokopi pendaftaran tersebut disampaikan kepada kami untuk didaftarkan dalam duplikat Buku Tambang yang ada di Kantor Direktorat Teknik dan Lingkungan Mineral, Batubara dan Panas Bumi.

Apabila Wakil Kepala Teknik Tambang tersebut berhenti atau mengundurkan diri supaya segera diberitahukan kepada kami.

Atas perhatian Saudara, kami ucapkan terima kasih.

Direktur,
Kepala Pelaksana Inspeksi Tambang

M.S. Marpaung
NIP. 100006898

Tembusan:
1. Dirjen Mineral, Batubara dan Panas Bumi
2. Direktur Pembinaan Pengusahaan Panas Bumi dan Pengelolaan Air Tanah
3. Kepala Dinas Pertambangan dan Energi Provinsi Sumatera Utara
4. Kepala Dinas Pertambangan dan Energi Kabupaten Tapanuli Utara
5. Kepala Teknik Tambang Sarulla Opertaion Limited
6. Wakil Kepala Teknik Tambang Sarulla Opertaion Limited

Lampiran Surat Nomor : 1255 /37.04/DBT/2008
Tanggal : 8 Agustus 2008

Pendaftaran menurut permintaan Direktur Teknik dan Lingkungan Mineral, Batubara dan Panas Bumi/Kepala Pelaksana Inspeksi Tambang.

dengan surat : 1255 /37.04/DBT/2008
tanggal : 8 Agustus 2008

SURAT KETERANGAN

Berdasarkan pasal 5 ayat (2) dan (4) Keputusan Menteri Pertambangan dan Energi nomor 555.K/26/M.PE/1995 tentang Keselamatan dan Kesehatan Kerja Pertambangan Umum dan Pasal 4 ayat (1) dan (2) Keputusan Menteri Pertambangan dan Energi nomor 1211.K/008/M.PE/1995 tentang Pencegahan dan Penanggulangan Perusakan dan Pencemaran Lingkungan pada kegiatan usaha pertambangan umum, Kepala Pelaksana Inspeksi Tambang mengesahkan:

Sdr. Andang Atmanto

Berkedudukan sebagai	: Drilling Manager
yang telah ditunjuk oleh	: Direktur Sarulla Operation Limited
dengan suratnya nomor	: SOL-041/DIR/VI/2008
tertanggal	: 21 Juli 2008
kualifikasi	: Telah lulus ujian kompetensi bagi pengawas operasional pertama
nomor sertifikat	: 8858/37.04/DBT/2008
sebagai	: Wakil Kepala Teknik Tambang Sementara

untuk bertanggung jawab atas terlaksananya pengelolaan Keselamatan dan Kesehatan Kerja serta Lindungan Lingkungan pada wilayah Pengembangan dan Pengusahaan Panasbumi Lapangan Sarulla Operation Limited, yang berlokasi di Kabupaten Tapanuli Utara, Provinsi Sumatera Utara.

Direktur/
Kepala Pelaksana Inspeksi Tambang,

M.S. Marpaung
NIP. 100006898

DEPARTEMEN ENERGI DAN SUMBER DAYA MINERAL REPUBLIK INDONESIA
DIREKTORAT JENDERAL MINERAL, BATUBARA DAN PANAS BUMI
DIREKTORAT TEKNIK DAN LINGKUNGAN MINERAL, BATUBARA DAN PANAS BUMI
Jln. Prof. Dr. Supomo, SH No. 10 Jakarta 12870

Telepon : (021) 8357503, 8357505 Faksimili : 8357505

Nomor : 1253 /37.04/DBT/2008 8 Agustus 2008
Lampiran : Satu lembar
Hal : Pengesahan Wakil Kepala Teknik Tambang Sementara

Yang terhormat
Direktur Sarulla Operation Limited
Graha Niaga, Lantai 8
Jl. Jenderal Sudirman Kav. 58
Jakarta 12190

Sehubungan dengan surat Saudara nomor: SOL-041/DIR/VI/2008 tanggal 21 Juli 2008 perihal sebagaimana tersebut pada pokok surat, dengan ini kami mengesahkan pengangkatan Sdr. Encep Sutisna sebagai Wakil Kepala Teknik Tambang sementara, terhitung sejak tanggal surat ini untuk bertanggung jawab atas terlaksananya pengelolaan Keselamatan dan Kesehatan Kerja serta Lindungan Lingkungan pada Wilayah Pengembangan dan Pengusahaan Panasbumi Lapangan Sarulla Operation Limited, yang berlokasi di Kabupaten Tapanuli Utara, Provinsi Sumatera Utara.

Sehubungan dengan itu kami minta agar Saudara memberitahukan Wakil Kepala Teknik Tambang yang bersangkutan untuk melakukan pendaftaran isi dari Surat Keterangan (terlampir) ke dalam Buku Tambang di sebelah kiri pada lajur 1 dan 2 dengan membubuhkan nomor urut dan tanggal pendaftaran serta menandatanganinya, kemudian fotokopi pendaftaran tersebut disampaikan kepada kami untuk didaftarkan dalam duplikat Buku Tambang yang ada di Kantor Direktorat Teknik dan Lingkungan Mineral, Batubara dan Panas Bumi.

Apabila Wakil Kepala Teknik Tambang tersebut berhenti atau mengundurkan diri supaya segera diberitahukan kepada kami.

Atas perhatian Saudara, kami ucapkan terima kasih.

Direktur
Kepala Pelaksana Inspeksi Tambang

M.S. Marpaung
NIP. 100006898

Tembusan:
1. Dirjen Mineral, Batubara dan Panas Bumi
2. Direktur Pembinaan Pengusahaan Panas Bumi dan Pengelolaan Air Tanah
3. Kepala Dinas Pertambangan dan Energi Provinsi Sumatera Utara
4. Kepala Dinas Pertambangan dan Energi Kabupaten Tapanuli Utara
5. Kepala Teknik Tambang Sarulla Opertaion Limited
6. Wakil Kepala Teknik Tambang Sarulla Opertaion Limited

Lampiran Surat Nomor : 1253 /37.04/DBT/2008
Tanggal : 8 Agustus 2008

Pendaftaran menurut permintaan Direktur Teknik dan Lingkungan Mineral, Batubara dan Panas Bumi/Kepala Pelaksana Inspeksi Tambang.

dengan surat : 1253 /37.04/DBT/2008
tanggal : 8 Agustus 2008

SURAT KETERANGAN

Berdasarkan pasal 5 ayat (2) dan (4) Keputusan Menteri Pertambangan dan Energi nomor 555.K/26/M.PE/1995 tentang Keselamatan dan Kesehatan Kerja Pertambangan Umum dan Pasal 4 ayat (1) dan (2) Keputusan Menteri Pertambangan dan Energi nomor 1211.K/008/M.PE/1995 tentang Pencegahan dan Penanggulangan Perusakan dan Pencemaran Lingkungan pada kegiatan usaha pertambangan umum, Kepala Pelaksana Inspeksi Tambang mengesahkan:

Sdr. Encep Sutisna

Berkedudukan sebagai	: Vice President of General Service
yang telah ditunjuk oleh	: Direktur Sarulla Operation Limited
dengan suratnya nomor	: SOL-041/DIR/VI/2008
tertanggal	: 21 Juli 2008
kualifikasi	: -
nomor sertifikat	: -
sebagai	: Wakil Kepala Teknik Tambang Sementara

untuk bertanggung jawab atas terlaksananya pengelolaan Keselamatan dan Kesehatan Kerja serta Lindungan Lingkungan pada wilayah Pengembangan dan Pengusahaan Panasbumi Lapangan Sarulla Operation Limited, yang berlokasi di Kabupaten Tapanuli Utara, Provinsi Sumatera Utara.

Direktur/
Kepala Pelaksana Inspeksi Tambang,

M.S. Marpaung
NIP. 100006898

DEED OF ASSIGNMENT
FOR THE SARULLA
JOINT OPERATION CONTRACT AND
ENERGY SALES CONTRACT

This Deed of Assignment (the "Assignment") is made and entered into by and between:

1. PT PLN (PERSERO), a limited liability company, established and existing under the laws of the Republic of Indonesia, having its office at Jl. Trunojoyo Blok MI/135, Kebayoran Baru Jakarta 12160, Indonesia, (hereinafter referred to as "PLN/ASSIGNOR"); and

2. PT MEDCO GEOPOWER SARULLA, a limited liability company established under the laws of the Republic of Indonesia ("MEDCO"), ORSARULLA INC., a limited liability company established under the laws of the Cayman Islands ("ORMAT"), SARULLA POWER ASSET LTD, a limited liability company established under the laws of the Cayman Islands ("ITOCHU") and SARULLA OPERATIONS LTD, a limited liability company established under the laws of the Cayman Islands ("OPCO") (with MEDCO, ORMAT, ITOCHU and OPCO jointly being hereinafter referred to as the "CONSORTIUM/ASSIGNEE").

with each of PLN/ASSIGNOR, MEDCO, ORMAT, ITOCHU and OPCO being hereinafter referred to individually as "Party" and collectively as "Parties".

WITNESSETH

WHEREAS on February 27, 1993 Unocal North Sumatra Geothermal, Ltd ("UNSG") and Perusahaan Pertambangan Minyak dan Gas Bumi Negara (hereinafter referred to as "PERTAMINA"), the Indonesian state-owned oil and gas corporation entered into a Joint Operation Contract ("Original JOC") for Geothermal Operations in the Sarulla Contract Area ("Sarulla Project");

WHEREAS on the same date UNSG, PERTAMINA and PERUSAHAAN UMUM LISTRIK NEGARA the predecessor in interest of PLN/ASSIGNOR, entered into an Energy Sales Contract ("Original ESC") for the purchase by PLN/ASSIGNOR of Electricity or Geothermal Energy produced pursuant to Geothermal Operations from the Sarulla Area;

WHEREAS Article 14.3 of the Original JOC and Section X of the Original ESC allow UNSG to assign to a third party in whole its undivided rights, interests and obligations under the CONTRACTS (as defined below) subject to the written consent of the Minister of Mines and Energy, the predecessor of the Minister of Energy and Mineral Resources in the case of the Original JOC and PERTAMINA and PLN/ASSIGNOR in the case of the Original ESC;

WHEREAS pursuant to the Deed of Assignment dated 23 January 2004 between PLN/ASSIGNOR and UNSG as amended by the Addendum to the Deed of Assignment dated 6 February 2004, the Sarulla Project has been assigned to PLN/ASSIGNOR effective February 24, 2004 pending designation by PLN/ASSIGNOR of the entity who will be the holder of Sarulla JOC interest;

WHEREAS, with regards to the Deed of Assignment dated 23 January 2004 between PLN/ASSIGNOR and UNSG as amended by the Addendum to the Deed of Assignment dated 6

February 2004, PLN/ASSIGNOR has already paid compensation to UNSG the amount of sixty million United States Dollars (US$ 60.000.000.00);

WHEREAS, pursuant to Article 7(2) of Government Regulation No. 31 of 2003 on the Change of the Form of Perusahaan Pertambangan Minyak dan Gas Bumi Negara (Pertamina) to a State Owned Company (Perusahaan Perseroan (Persero)), PERTAMINA must transfer all of its geothermal activities to a subsidiary (namely PT Pertamina Geothermal Energy or "PGE"). Pursuant to a Transfer Agreement between PERTAMINA and PGE dated 9 November 2007, PERTAMINA transferred (effective from 1 January 2007) all of its rights and obligations under the Original JOC and Original ESC to PGE (which was acknowledged by PLN/ASSIGNOR on 15 November 2007);

WHEREAS, at the time of execution of this Assignment, PGE and CONSORTIUM/ASSIGNEE are entering into an amendment to the Original JOC (the "JOC Amendment") and PLN/ASSIGNOR, PGE and CONSORTIUM/ASSIGNEE are entering into an amendment to the Original ESC (the "ESC Amendment"). The Original JOC (as may be amended by the JOC Amendment) and the Original ESC (as may be amended by the ESC Amendment) are hereinafter referred to as the "ESC" and "JOC" respectively, and collectively as the "CONTRACTS";

WHEREAS, in accordance with the limited bidding process conducted by PLN/ASSIGNOR, PLN/ASSIGNOR will assign the entire undivided rights, interests and obligations under the CONTRACTS to CONSORTIUM/ASSIGNEE in the participating interests provided for in Article 2.2 of this Assignment;

NOW THEREFORE, in consideration of the premises hereinabove and of the mutual covenants herein contained, the Parties agree as follows:

ARTICLE 1 - REPRESENTATIONS AND WARRANTIES

1.1 Each Party represents and warrants to the other that:

(i) it has the authority and legal right to execute and deliver this Assignment and to perform and observe the terms and conditions hereof; and

(ii) it has taken all necessary legal and corporate action to authorize the execution and delivery of this Assignment and the performance and observance of the terms and conditions hereof; and

(iii) this Assignment constitutes a valid and binding obligation of such Party enforceable in accordance with its term; and

(iv) the making and performance by it of this Assignment and all documents required to be executed and delivered by it hereunder do not and will not violate any law or regulation of the Republic of Indonesia or the jurisdiction of its organization or any other law or regulation applicable to it; and

(v) to the best of the Parties knowledge, the CONTRACTS shall, as of the Assignment Date, be in full force and effect.

1.2 PLN/ASSIGNOR represents and warrants to CONSORTIUM/ASSIGNEE that:

(i) PLN/ASSIGNOR is not in default in the performance or fulfillment of any material obligation or condition contained in the CONTRACTS; and

(ii) PLN/ASSIGNOR represents and warrants to CONSORTIUM/ASSIGNEE that all approvals and authorizations of, all filings with and all actions by, any governmental authority which are required to be obtained by PLN/ASSIGNOR necessary for the validity or enforceability of PLN/ASSIGNOR's obligations under this Assignment have been obtained; and

(iii) PLN/ASSIGNOR has complied with all relevant Indonesian laws, regulations, decrees and other binding requirements in relation to this Assignment; and

(iv) at the signing of this Assignment, PLN/ASSIGNOR has good title to, and is the sole legal and beneficial holder of the entire 100% participating interest as the "Company" (as defined in the ESC) and "Contractor" (as defined in the JOC) under the ESC and JOC respectively, and the interests it holds are free and clear of all liens, security interests, claims participations or other charges or encumbrances of any nature whatsoever.

1.3. CONSORTIUM/ASSIGNEE represents and warrants to PLN/ASSIGNOR that all approvals and authorizations of, all filings with and all actions by any governmental authority which are required to be obtained by CONSORTIUM/ASSIGNEE necessary for the validity and enforceability of CONSORTIUM/ASSIGNEE's obligations under this Assignment have been obtained.

1.4 Each Party agrees that it shall indemnify and hold harmless the other from and against all loss or damage sustained by the latter as a result of any breach by the former of any of its warranties or representations in this Assignment, but excluding any indirect or consequential damages such but not limited to loss of profit or business interruption.

1.5 Unless the context otherwise requires, a reference in this Assignment to any of the CONTRACTS is a reference to that CONTRACT as amended, transferred, novated or supplemented.

ARTICLE 2 - ASSIGNMENT OF INTEREST AND ASSUMPTIONS

2.1 Subject to the provisions herein contained, PLN/ASSIGNOR hereby:

(i) subject to Article 2.5, transfers and assigns on the Assignment Date (as hereinafter described) to CONSORTIUM/ASSIGNEE on an "as-is, where-is" condition without representation or warranty of any kind except as expressly set forth herein, and CONSORTIUM/ASSIGNEE hereby accepts and assumes on an "as-is, where-is" condition, all assets, plant and equipment in respect of which PLN/ASSIGNOR has a right to use; and

(ii) transfers, novates and assigns on the Assignment Date (as hereinafter described) to CONSORTIUM/ASSIGNEE (in the participating interests refered to in Article 2.2) the total undivided rights, interests and obligations of PLN/ASSIGNOR as the

"Company" (as defined in the ESC) and "Contractor" (as defined in the JOC) under the ESC and JOC respectively.

2.2 As a result of the aforementioned transfer, novation and assignment and subject to the provisions herein contained, as of the Assignment Date, the undivided participating interests of the Parties as the "Company" (as defined the ESC) and "Contractor" (as defined in the JOC) under the ESC and JOC respectively shall be as follows:

PLN/ASSIGNOR	0%
MEDCO	49.5%
ORMAT	24.75%
ITOCHU	24.75%
OPCO	1%

2.3 With the effectiveness of the assignment, novation and transfer of the CONTRACTS, all interests, rights and obligations of PLN/ASSIGNOR as the "Company" (as defined the ESC) and "Contractor" (as defined in the JOC) under the ESC and JOC respectively shall be transferred and novated from PLN/ASSIGNOR to CONSORTIUM/ASSIGNEE (in the respective participating interests specified in Article 2.2).

2.4 PLN/ASSIGNOR will assist CONSORTIUM/ASSIGNEE in CONSORTIUM/ASSIGNEE taking possession of all assets, contracts, all information, analyses and documentation available to PLN/ASSIGNOR relating to the geothermal activities and studies undertaken for the Sarulla Project by UNSG and/or PLN/ASSIGNOR ("the Geothermal Data"), books and accounts relating to the Sarulla Project, and to the extent that any such assets or contracts are currently owned by or held in the name of PLN/ASSIGNOR, PLN/ASSIGNOR shall sign all such further documents as may be requested by CONSORTIUM/ASSIGNEE to legally effect the transfer of such assets, contracts, Geothermal Data, books and accounts to CONSORTIUM/ASSIGNEE. All such costs incurred thereof shall be the sole responsibility of and for the sole account of CONSORTIUM/ASSIGNEE.

2.5 On or prior to the execution of this Assignment, PLN/ASSIGNOR and CONSORTIUM/ASSIGNEE shall carry out an inventory of materials, buildings, parts and equipment located in the "Contract Area" (as defined in the JOC) (excluding all sub-surface well installations) which are at that date in the possession of PLN/ASSIGNOR ("Sarulla Materials") and shall agree a detailed list of such Sarulla Materials. Such Sarulla Materials shall remain in the care, custody and control of PLN/ASSIGNOR until the Assignment Date.

CONSORTIUM/ASSIGNEE shall take out insurance covering damage to, or loss of, or third party liability arising out of such Sarulla Materials, and such insurance shall name PERTAMINA, PGE, PLN and CONSORTIUM/ASSIGNEE as named insureds. The terms of such insurance shall be approved by PLN/ASSIGNOR prior to the execution of this Assignment.

On the Assignment Date (or such other date agreed between PLN/ASSIGNOR and CONSORTIUM/ASSIGNEE), PLN/ASSIGNOR and CONSORTIUM/ASSIGNEE shall carry out a second inventory of the Sarulla Materials which remain in the possession of PLN/ASSIGNOR as at the date of such second inventory.

If at any time on or prior to the Assignment Date, CONSORTIUM/ASSIGNEE becomes aware that any of the Sarulla Materials are damaged, destroyed or otherwise lost (excluding

IN WITNESS WHEREOF, the parties hereto have caused this Assignment to be executed in five originals in the English language each of which shall have the force and effect of an original, by their respective officers or representatives hereunto duly authorized, all as of the 14th day of December 2007.

PT PLN (Persero)

By : Eddie Widiono. S

Title: President Director

PT MEDCO GEOPOWER SARULLA

By : Aries Pardjimanto

Title: President Director

ORSARULLA INC

By : David Citrin

Title: Attorney-in-fact

SARULLA POWER ASSET LTD

By : Takao Shinohara

Title: Director

SARULLA OPERATIONS LTD

By : Aries Pardjimanto

Title: Director

Deed of Assignment

AMENDMENT AGREEMENT TO
SARULLA JOINT OPERATION CONTRACT

This Amendment Agreement to the Sarulla Joint Operation Contract (the "JOC **Amendment Agreement**"), made in Jakarta in the Republic of Indonesia by and among:

1. PT PERTAMINA GEOTHERMAL ENERGY, a corporation established under the laws of the Republic of Indonesia ("PGE"); and

2. PT MEDCO GEOPOWER SARULLA, a limited liability company established under the laws of the Republic of Indonesia ("**Medco**"), ORSARULLA INC., a limited liability company established under the laws of the Cayman Islands ("**Ormat**"), SARULLA POWER ASSET LTD, a limited liability company established under the laws of the Cayman Islands ("**Itochu**") and SARULLA OPERATIONS LTD, a limited liability company established under the laws of the Cayman Islands ("**OpCo**"), with Medco, Ormat, Itochu and OpCo jointly being referred to as the ("**Contractor**"),

and PGE, Medco, Ormat, Itochu and OpCo are individually referred to as a "**Party**" and collectively the "**Parties**".

WITNESSETH:

A. WHEREAS, PERUSAHAAN PERTAMBANGAN MINYAK DAN GAS BUMI NEGARA and UNOCAL NORTH SUMATRA GEOTHERMAL, LTD (hereinafter "UNSG"), entered into a certain Joint Operation Contract as of 27th February 1993 (hereinafter "**Original JOC**"), whereby PERUSAHAAN PERTAMBANGAN MINYAK DAN GAS BUMI NEGARA, by virtue of Presidential Decree No. 22 Year 1981, as amended by Presidential Decree No. 45 Year 1991, wished to promote the development of the Sarulla area and UNSG, in its capacity as a contractor to PERUSAHAAN PERTAMBANGAN MINYAK DAN GAS BUMI NEGARA, desired to join and assist PERUSAHAAN PERTAMBANGAN MINYAK DAN GAS BUMI NEGARA in accelerating the exploration and development of the potential Geothermal Energy resources within the Sarulla area and the conversion of such Geothermal Energy resources to Electricity on the basis of laws and regulations referred to in the third recital of the Original JOC;

B. WHEREAS, on 27 February 1993, PERUSAHAAN PERTAMBANGAN MINYAK DAN GAS BUMI NEGARA, UNSG, and PERUSAHAAN UMUM LISTRIK NEGARA, entered into a certain energy sales contract (hereinafter "**Original ESC**"), whereby UNSG was authorized by PERUSAHAAN PERTAMBANGAN MINYAK DAN GAS BUMI NEGARA and was responsible for the production, financing and the risk of the Geothermal Energy from the Sarulla area and the conversion of such Geothermal Energy to Electricity and the delivery of such Electricity to PLN on behalf of PERUSAHAAN PERTAMBANGAN MINYAK DAN GAS BUMI NEGARA, as seller of such Electricity, under the Original ESC. PERUSAHAAN UMUM LISTRIK NEGARA, by virtue of Government Regulation No. 23 of 1994, was then transformed to become PT. PLN (Persero) (hereinafter "PLN");

C. WHEREAS PERUSAHAAN PERTAMBANGAN MINYAK DAN GAS BUMI NEGARA, by virtue of Government Regulation No. 31 of 2003 regarding the Transformation of

PERTAMINA to become a state-owned limited liability corporation (Persero), was transformed to become PT. PERTAMINA (Persero);

D. WHEREAS, Law No. 27 Year 2003 regarding Geothermal Resources ("Law No.27"), stipulates that all cooperation contracts with respect to the undertaking of the mining of Geothermal Resources executed prior to the promulgation of Law No. 27 shall remain valid until the expiry of the terms of the respective contracts; and that the fostering and supervision of the performance of the cooperation contracts with respect to the undertaking of the mining of Geothermal Resources executed prior to the promulgation of Law No. 27 are transferred to the Government;

E. WHEREAS, pursuant to a Deed of Assignment between PLN and UNSG dated January 23, 2004, as amended by the Addendum to the Deed of Assignment dated February 6, 2004, UNSG assigned and transferred all its rights and obligations arising out of or relating to the Original ESC and Original JOC to PLN effective on February 24,2004;

F. WHEREAS, pursuant to a Transfer Agreement between PT PERTAMINA (Persero) and PGE dated 9 November 2007, PT PERTAMINA (Persero) transferred (effective from 1 January 2007) all of its rights and obligations under the Original JOC and Original ESC to PGE (which was acknowledged by PLN on 15 November 2007), and accordingly, all references from such date to "PERTAMINA" in the Original ESC and Original JOC refer to PGE;

G. WHEREAS, pursuant to the Deed of Assignment between PLN and Contractor signed on the same date as the date of signing of this JOC Amendment Agreement ("New DoA"), PLN has agreed to assign, novate and transfer (amongst other things) all rights and obligations as "Contractor" (as defined in the Original JOC) arising out of or relating to the Original JOC, to each of the parties comprising the Contractor in the following participating interests:

Medco	:	49.5%
Ormat	:	24.75%
Itochu	:	24.75%
OpCo	:	1%,

such assignment, novation and transfer (being referred to as the "**Contractor Transfer**") becoming effective on the date defined in the New DoA as the "Assignment Date";

H. WHEREAS, pursuant to an agreement between PT PERTAMINA (Persero) and PGE dated 29 November 2007, PT PERTAMINA (Persero) has granted to PGE certain rights to utilize certain land and assets owned and/ or controlled by PT PERTAMINA (Persero) related to the Sarulla project for the purposes of Geothermal Operations ("**Land and Assets Utilization Agreement**");

I. WHEREAS, in contemplation of the Contractor Transfer becoming effective, Contractor and PGE desire to modify certain terms and conditions of the Original JOC on the terms and conditions set out in this JOC Amendment Agreement, with such modifications taking effect from the Assignment Date (as defined in the New DoA).

NOW, THEREFORE, it is agreed as follows:

SECTION 1
DEFINITIONS

1.1 Original JOC Definitions. For all purpose of this JOC Amendment Agreement, capitalized terms used herein and not otherwise defined herein shall, subject to Section 2.1, have the meaning set forth in the Original JOC.

1.2 Amended JOC Definitions. Despite Section 6, the definitions set out in the Section 6.1.5 to 6.1.38 be incorporated into this JOC Amendment Agreement by reference, effective from the date of signing of this JOC Amendment Agreement, and such incorporated definitions shall supersede any definitions contained in the Original JOC.

1.3 Additional Definitions. In this JOC Amendment Agreement, the following terms shall have the meanings given to them below:

"**Amended ESC**" means the Original ESC as amended by the terms of the ESC Amendment Agreement;

"**Amended JOC**" means the Original JOC as amended by the terms of this JOC Amendment Agreement;

"**Amendment Date**" has the meaning given to it in the ESC Amendment Agreement;

"**ESC Amendment Agreement**" means the agreement dated on or about the date of this JOC Amendment Agreement between Contractor, PLN and PGE pursuant to which such parties have agreed to amend certain terms of the Original ESC.

1.4 Reference Date. Without prejudice to the date of execution of this JOC Amendment Agreement and the time when this JOC Amendment Agreement becomes effective and binding on the Parties as provided for in the closing paragraph of this JOC Amendment Agreement which follows Article 7.15, as a result of the official declaration of 30 October 2007 relating to the Sarulla project, the Parties agree that for future reference purposes, this JOC Amendment Agreement shall be referred to as the "JOC Amendment Agreement dated 30 October 2007".

SECTION 2
EFFECTIVENESS OF AMENDMENTS

2.1 Amendment Date. Subject to Section 2.2, this JOC Amendment Agreement and the amendments to the Original JOC set out herein shall become effective upon the Amendment Date.

IN WITNESS WHEREOF, the parties hereto have caused this JOC Amendment Agreement to be executed in five originals in the English language each of which shall have the force and effect of an original, by their respective officers or representatives hereunto duly authorized, all as of the 14th day of December, 2007.

PT PERTAMINA GEOTHERMAL ENERGY

By: _____

Name: Bambang Kustono

Title: President Director

ORSARULLA INC.

By: _____

Name: David Citrin

Title: Attorney-in-fact

PT MEDCO GEOPOWER SARULLA

By: _____

Name: Aries Pardjimanto

Title: President Director

SARULLA POWER ASSET LTD

By: _____

Name: Takao Shinohara

Title: Director

SARULLA OPERATIONS LTD

By: _____

Name: Aries Pardjimanto

Title: Director

JOC

AMENDMENT AGREEMENT TO
SARULLA ENERGY SALES CONTRACT

This Amendment Agreement to the Sarulla Energy Sales Contract (the "ESC Amendment Agreement"), made in Jakarta in the Republic of Indonesia by and among:

1. PT PLN (PERSERO), a limited liability company duly established and existing under the laws of the Republic of Indonesia, having its office at Jl. Trunojoyo Blok M/ 135, Kebayoran Baru Jakarta 12160, Indonesia ("PLN");

2. PT PERTAMINA GEOTHERMAL ENERGY, a limited liability company duly established and existing under the laws of the Republic of Indonesia, having its office at 15th Floor, Menara Cakrawala, Jl MH Thamrin No 9, Jakarta 10340, Indonesia ("PGE"); and

3. PT MEDCO GEOPOWER SARULLA, a limited liability company duly established and existing under the laws of the Republic of Indonesia, having its office at 8th Floor, Graha Niaga, Jl Jend. Sudirman Kav 58, Jakarta 12190 Indonesia ("Medco"), ORSARULLA INC., a limited liability company duly established and existing under the laws of the Cayman Islands, having its office at C/O M&C Corporate Services Limited, PO Box 309GT, Ugland House, South Church Street, George Town, Grand Cayman, Cayman Islands ("Ormat"), SARULLA POWER ASSET LTD, a limited liability company duly established and existing under the laws of the Cayman Islands, having its office at C/O M&C Corporate Services Limited, PO Box 309GT, Ugland House, South Church Street, George Town, Grand Cayman, Cayman Islands ("Itochu") and SARULLA OPERATIONS LTD, a limited liability company duly established and existing under the laws of the Cayman Islands, having its office at 8th Floor, Graha Niaga, Jl Jend. Sudirman Kav 58, Jakarta 12190 Indonesia ("OpCo"), with Medco, Ormat, Itochu and OpCo jointly being referred to as the "COMPANY",

and PLN, PGE, Medco, Ormat, Itochu and OpCo are individually referred to as a "Party" and collectively the "Parties".

WITNESSETH:

A. WHEREAS, Perusahaan Umum Listrik Milik Negara, Perusahaan Pertambangan Minyak dan Gas Bumi Negara and Unocal North Sumatra Geothermal Ltd. ("UNSG") entered into the Sarulla Energy Sales Contract dated February 27, 1993 (the "Original ESC");

B. WHEREAS, Perusahaan Pertambangan Minyak dan Gas Bumi Negara and UNSG entered into Sarulla Joint Operation Contract ("Original JOC") also dated February 27, 1993;

C. WHEREAS, pursuant to Law No 21 of 2001 on Oil and Gas and Government Regulation 31/2003, PT PERTAMINA (Persero) assumed all rights and obligations of Perusahaan Pertambangan Minyak dan Gas Bumi Negara under the Original ESC and the Original JOC;

D. WHEREAS, pursuant to Government Regulation 23 year 1994, PLN assumed all rights and obligations of Perusahaan Umum Listrik Milik Negara under the Original ESC;

E. WHEREAS, pursuant to a Deed of Assignment between PLN and UNSG dated January 23, 2004, as amended by the Addendum to the Deed of Assignment dated February 6, 2004, UNSG assigned and transferred all its rights and obligations arising out of or relating to the Original ESC and Original JOC to PLN effective on February 24,2004;

F. WHEREAS, pursuant to a Transfer Agreement between PT PERTAMINA (Persero) and PGE dated 9 November 2007, PT PERTAMINA (Persero) transferred (effective from 1 January 2007) all of its rights and obligations under the Original JOC and Original ESC to PGE (which was acknowledged by PLN on 15 November 2007);

G. WHEREAS, pursuant to the Deed of Assignment between PLN and COMPANY signed on the same day as the signing of this ESC Amendment Agreement ("**New DoA**"), PLN has agreed to assign, novate and transfer:

(i) all rights and obligations as "COMPANY" (as defined in the Original ESC) arising out of or relating to the Original ESC to COMPANY; and

(ii) all rights and obligations as "Contractor" (as defined in the Original JOC) arising out of or relating to the Original JOC to:

(1) Medco, in respect of a forty nine point five percent (49.5%) participating interest in such Original JOC;

(2) Ormat, in respect of a twenty four point seventy five percent (24.75%) participating interest in such Original JOC;

(3) Itochu, in respect of a twenty four point seventy five percent (24.75%) participating interest in such Original JOC; and

(4) OpCo, in respect of a one percent (1%) participating interest in such Original JOC,

such assignment, novation and transfer (being referred to as the "**Contractor Transfer**") becoming effective on the date defined in the New DoA as the "Assignment Date";

H. WHEREAS, pursuant to an agreement between PT PERTAMINA (Persero) and PGE dated 29 November 2007, PT PERTAMINA (Persero) has granted to PGE certain rights to utilize certain land and assets owned and/ or controlled by PT PERTAMINA (Persero) related to the Sarulla project for the purposes of Geothermal Operations ("**Land and Assets Utilization Agreement**").

I. WHEREAS, in contemplation of the Contractor Transfer becoming effective, PLN, COMPANY and PGE desire to modify certain terms and conditions of the Original ESC on the terms and conditions set out in this ESC Amendment Agreement with effect from the Assignment Date.

NOW, THEREFORE, it is agreed as follows:

ARTICLE 1
DEFINITIONS

1.1 Original ESC Definitions. For all purpose of this ESC Amendment Agreement, capitalized terms used herein and not otherwise defined herein shall, subject to Article 2.1, have the meaning set forth in the Original ESC.

1.2 Amended ESC Definitions. Despite Article 6, the definitions set out in Articles 6.1.9 to 6.1.56 (inclusive) shall be incorporated into this ESC Amendment Agreement by reference, effective from the date of signing of this ESC Amendment Agreement, and such incorporated definitions shall supersede any definitions contained in the Original ESC.

1.3 Additional Definitions. In this ESC Amendment Agreement, the following terms shall have the meanings given to them below:

"**Amended ESC**" means the Original ESC as amended by the terms of this ESC Amendment Agreement;

"**Amended JOC**" means the Original JOC as amended by the terms of the JOC Amendment Agreement;

"**Amendment Date**" has the meaning given to it in Article 2.1;

"**Assignment Date**" has the meaning given to it in the New DoA;

"**Conditions Precedent**" means those conditions and events specified in Article 3 of this ESC Amendment Agreement;

"**Financial Close**" means the date on which first drawdown of senior debt under the Financing Agreements occurs;

"**Financial Close Deadline**" means the date which is twelve (12) Months after the date on which the Minister of Energy and Mineral Resources issues the approval referred to in Article 3.1.1, provided that the Financial Close Deadline shall be extended by:

(a) the period of any delay caused due to a force majeure (as specified in Section 9.1 of the Amended ESC); or

(b) the period of any delay caused due to any default of PLN in the performance of its obligations under Articles 4.2, 4.3 and 4.4 of this ESC Amendment Agreement;

"**JOC Amendment Agreement**" means the agreement dated on or about the date of this ESC Amendment Agreement between COMPANY and PGE pursuant to which such parties have agreed to amend certain terms of the Original JOC;

"**Performance Security Stage I**" means a performance security having a value of Rp 20,000,000,000 (Rupiah twenty billion) in substantially the same form as that set out in Attachment A of this ESC Amendment Agreement.

IN WITNESS WHEREOF, the parties hereto have caused this ESC Amendment Agreement to be executed in six originals in the English language each of which shall have the force and effect of an original, by their respective officers or representatives hereunto duly authorized, all as of the 14th day of December, 2007.

PT PLN (PERSERO)

By: _____

Name: Eddie Widiono S.

Title: President Director

PT PERTAMINA GEOTHERMAL ENERGY

By: _____

Name: Bambang Kustono

Title: President Director

ORSARULLA INC.

By: _____

Name: David Citrin

Title: Attorney-in-fact

PT MEDCO GEOPOWER SARULLA

By: _____

Name: Aries Pardjimanto

Title: President Director

SARULLA POWER ASSET LTD

By: _____

Name: Takao Shinohara

Title: Director

SARULLA OPERATIONS LTD

By: _____

Name: Aries Pardjimanto

Title: Director

ESC

LAMPIRAN - 7

RENCANA TANGGAP DARURAT (EMERGENCY RESPON PLAN/ERP) SARULLA OPERATION LIMITED

RENCANA TANGGAP DARURAT

Selama beroperasinya proyek Pembangkit Listrik Tenaga Panas Bumi Sarulla, SOL berkewajiban;

- Mematuhi standard-standard dan peraturan-peraturan pemerintah/ internasional.
- Mengelola komitmen bisnis dengan rekan-rekan bisnis
- Memperkecil kerusakan lingkungan dari kegiatan proyek yang berlangsung
- Jika terjadi pencemaran lingkungan, langkah pengelolaan akan segera dilakukan
- Menjaga hubungan yang baik dengan pemerintah di sekitar lokasi proyek dalam rangka meningkatkan tanggung jawab sosial perusahaan (CSR).

- Direktur
- Tim Manajemen

Pusat Krisis

- Pusat penanganan masalah-masalah K3
- Menerima informasi
  - Mengevaluasi penyebab masalah
  - Menganalisis opsi dalam memecahkan masalah
- Mengatur penanganan masalah handle

Petugas / Pegawai Evakuasi

Petugas Evakuasi Aset Fisik

Petugas K3
Lingkungan, Keselamatan, Kesehatan, Rehabilitasi Lingkungan, Penanganan Kesehatan, Pegawai/Masyarakat Lokal

Petugas Pelayanan Umum
-Pusat Informasi
-Hubungan Eksternal
-Menyiapkan Bahan-bahan pendukung

Hulu

Hilir

Masyarakat Lokal

Hulu
- Alat-alat Pengukur
- Dokumen-dokumen penting

Kantor
- Dokumen-dokumen penting
- Komputer

Hilir
- Alat-alat pengukur
- Dokumen-dokumen penting