

**ENVIRONMENTAL IMPACT
ASSESSMENT (EIA) STUDY FOR
BETANO REFINERY PROJECT IN
TIMOR-LESTE**

31 March – 8 April 2016

OUTLINE OF PRESENTATION

- EIA Objectives
- Methodology
- Project Information
- Existing Environmental Condition
- Environmental and Social Impact Assessment and Mitigation Measure
 - Pre-Construction Phase
 - Construction Phase
 - Operation Phase
 - Deactivation Phase

EIA OBJECTIVES

To prepare environmental management plan (EMP) to minimize environmental impact during pre-construction, construction, operation and deactivation phase based on comprehensive environmental impact assessment covering Physical Environment, Biological Environment, Socio-economic Environment, and Cultural and Visual Environment

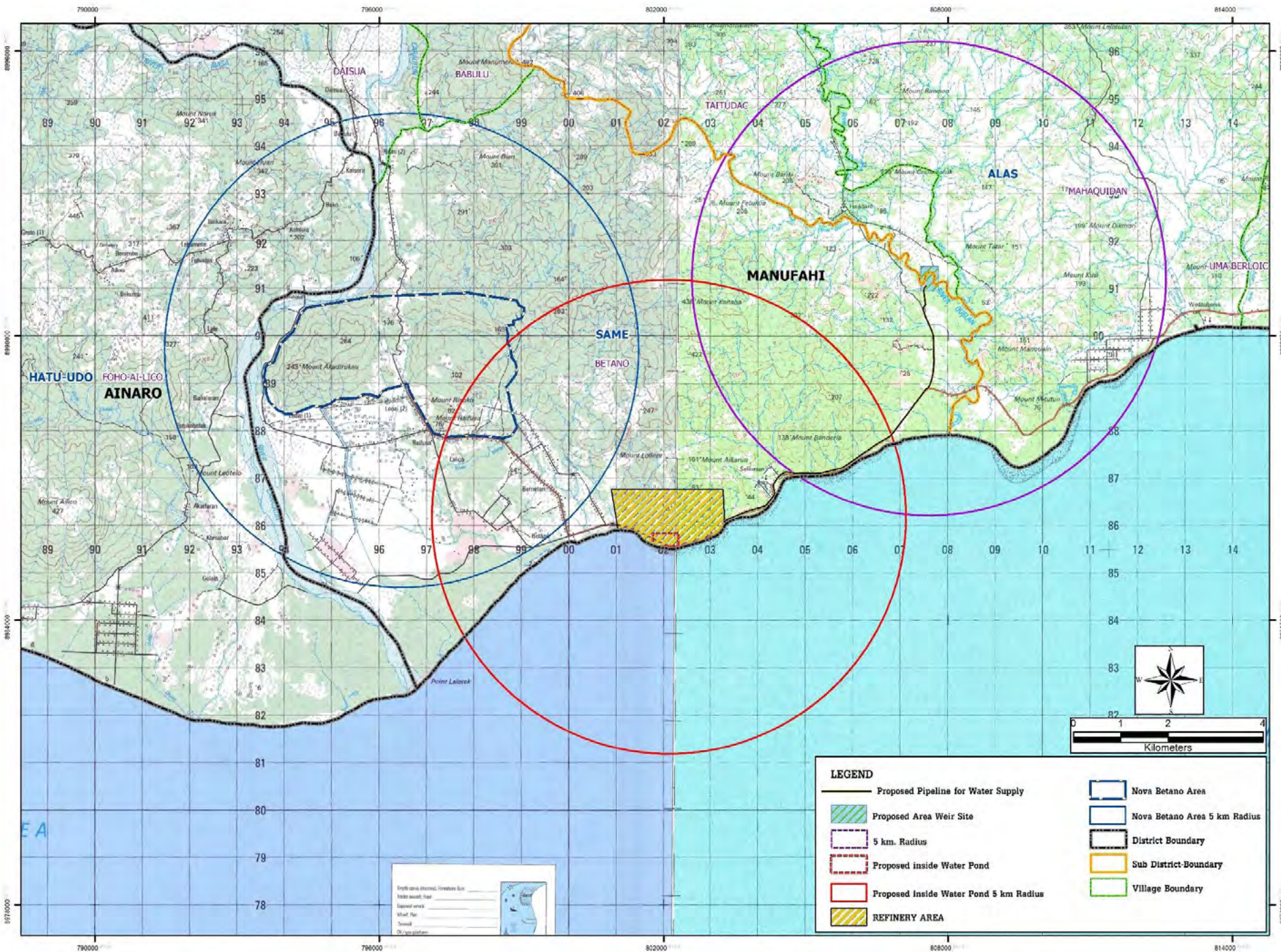
METHODOLOGY

- Study the existing environmental conditions around the project area
- Review the project features
- Identify and quantify the potential negative impacts and positive impact from the proposed project with respect to the environment (physical, biological, economic, social, and cultural)
- Propose prevention, mitigation, and monitoring measures

PROJECT BACKGROUND

The project comprises of two (2) components :

1. Component 1 for the Betano Refinery, Nova Betano and the Water Supply System, all located in Betano Area, and
2. Component 2 is the Condensate Pipeline to transport the refinery products from Betano Refinery to Suai Supply Base.

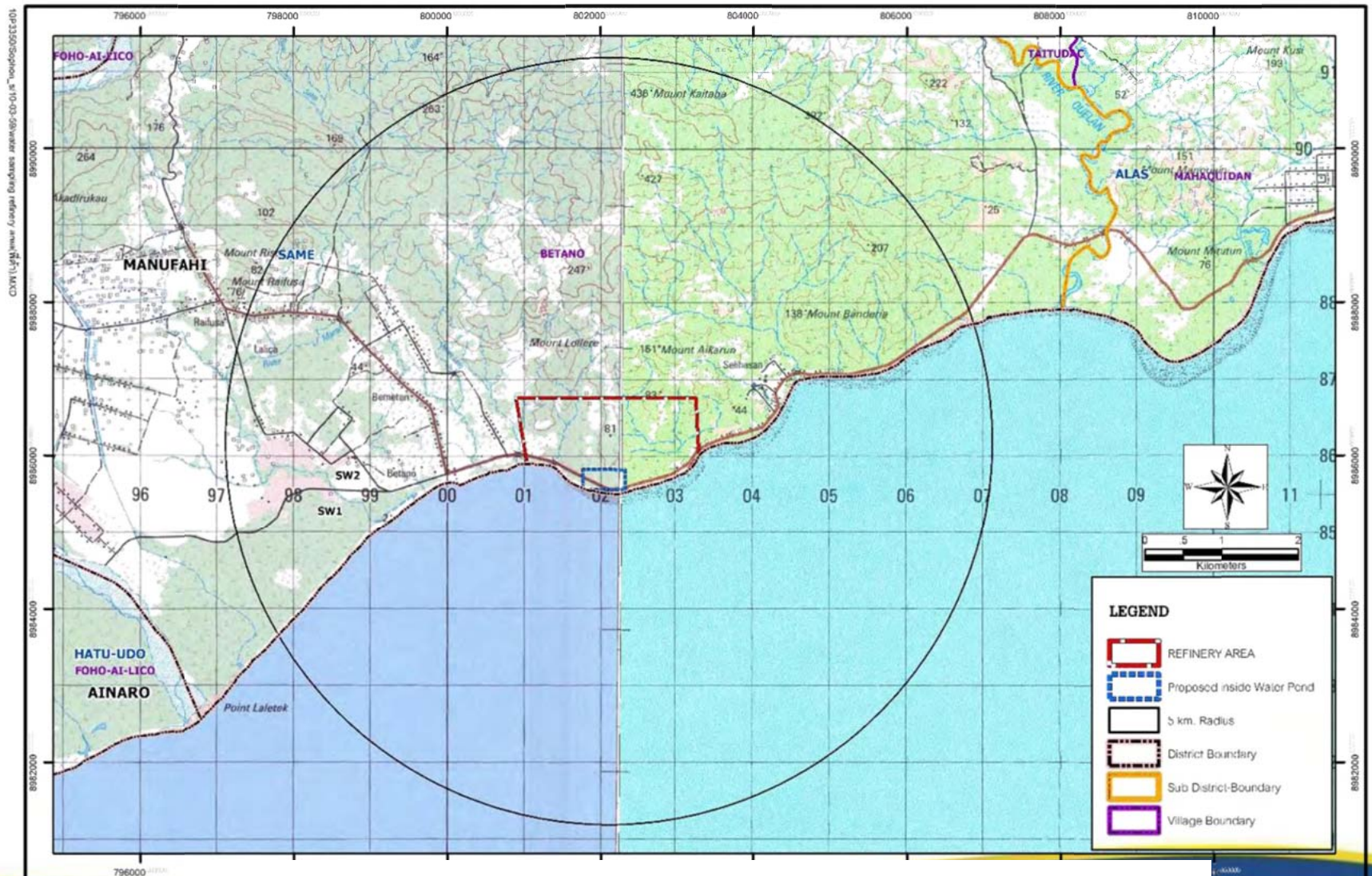


BETANO REFINERY

PROJECT INFORMATION

- **Location:** Betano Village, Same Sub-district, Manufahi District
- **Area:** 230 hectares between the new proposed highway and the southern coastal line
- **Capacity of the refinery:** 30,000 barrels of condensate per day
- **Product:** Diesel, Heavy and Light Naphtha, Gasoline & LPG
- **Project objective:** Domestic supply-demand and exportation of remaining products

BETANO REFINERY



Study Area: 5 km radius around the refinery

[illegible][illegible]

REFINERY



OIL STORAGE TANK



AUXILIARY FACILITIES



WATER STORAGE POND



WASTE WATER TREATMENT SYSTEM



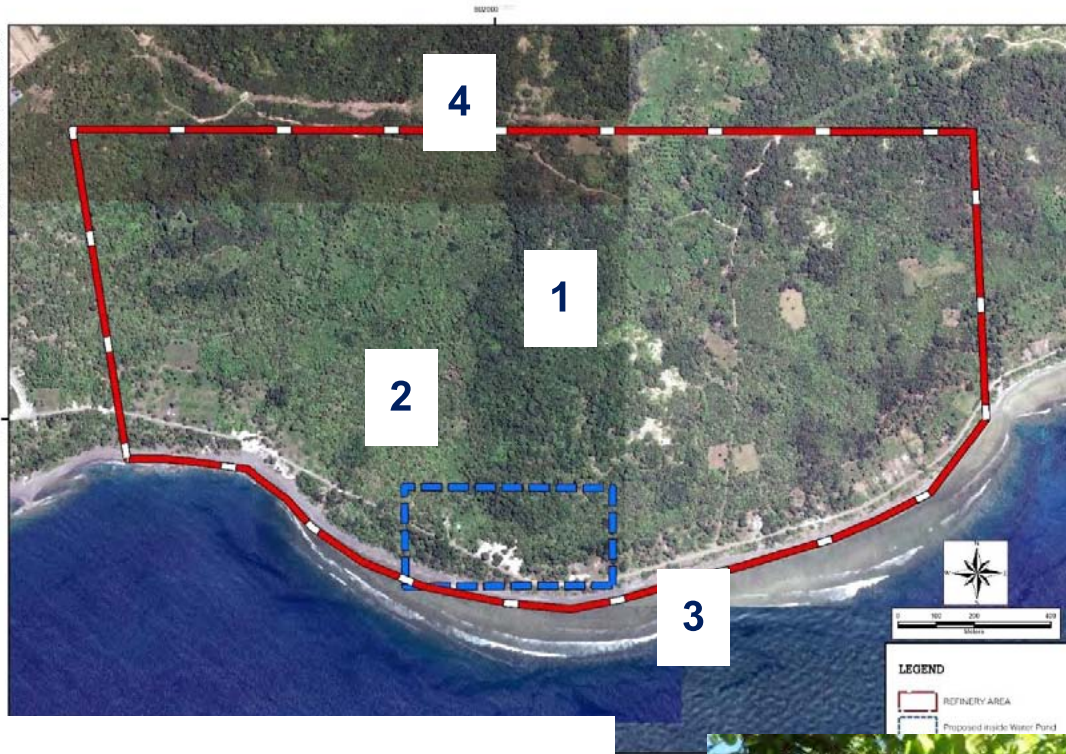
DRAINAGE SYSTEM



WAVE PROTECTION STRUCTURE



EXISTING LAND USE



**1 Mixed Deciduous Forest
and Palm $\approx 73\%$**



**4 Mixed Deciduous Forest
and Palm**

3 Beach Forest $\approx 5\%$



2 Teak and Perennial Plant $\approx 18\%$



NOVA BETANO

PROJECT INFORMATION

- **Location:** Approximately 5 km to the north of Betano village and adjacent to the Caraulun River (to the west)
- **Area:** Cover 1,190 Ha of land where Nova Betano is separated into two areas, Nova Betano West and Nova Betano East, by north-south road from Same towards the southern shoreline.
- **Project objective:** To establish Petroleum Administration City, resettlement site of relocated households from refinery construction and residence for staff of refinery

10P3350/Sophon_s/10-03-59/fig_Nova Betano.MXD

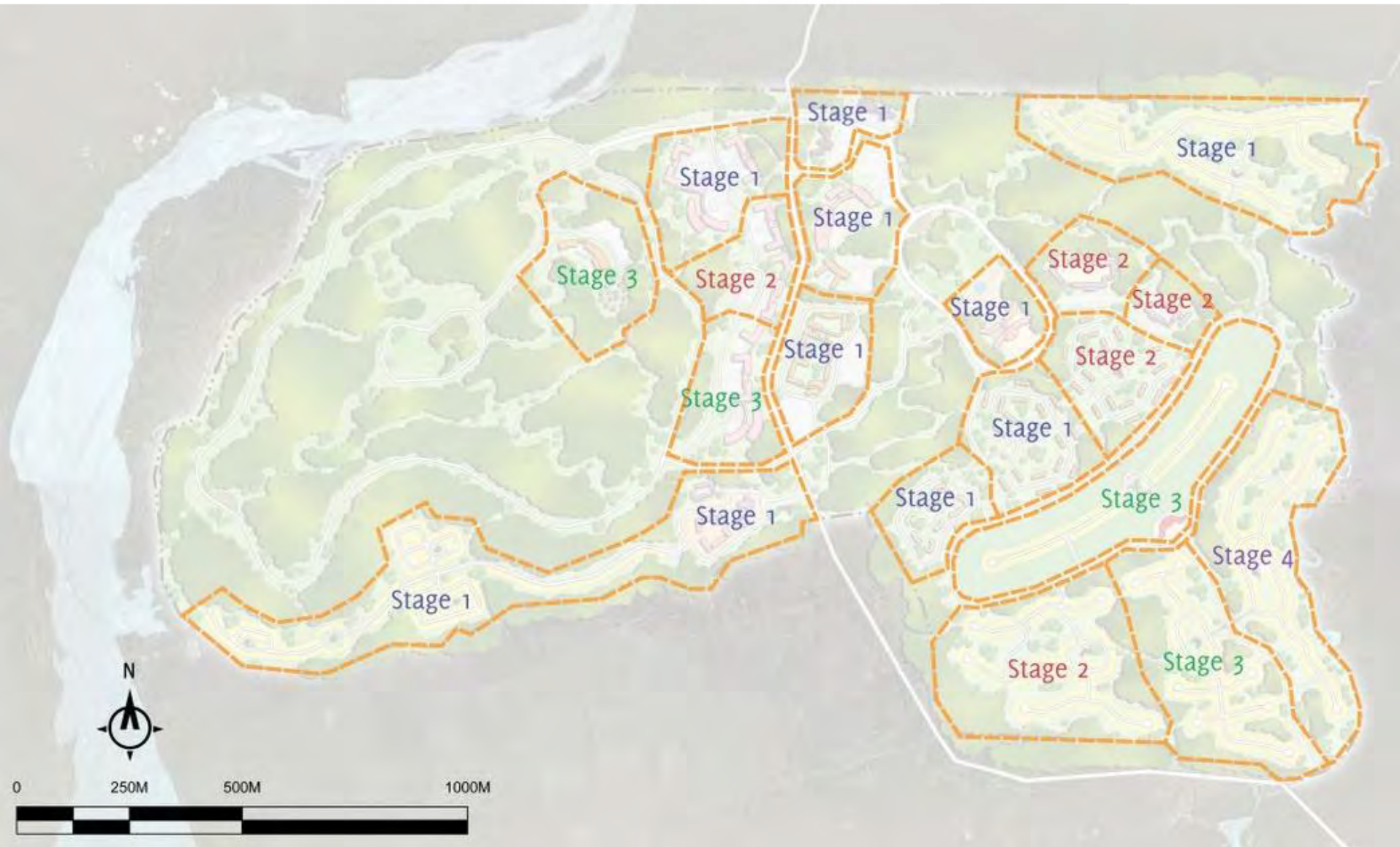


Study Area: 5 km radius around the site

NOVA BETANO



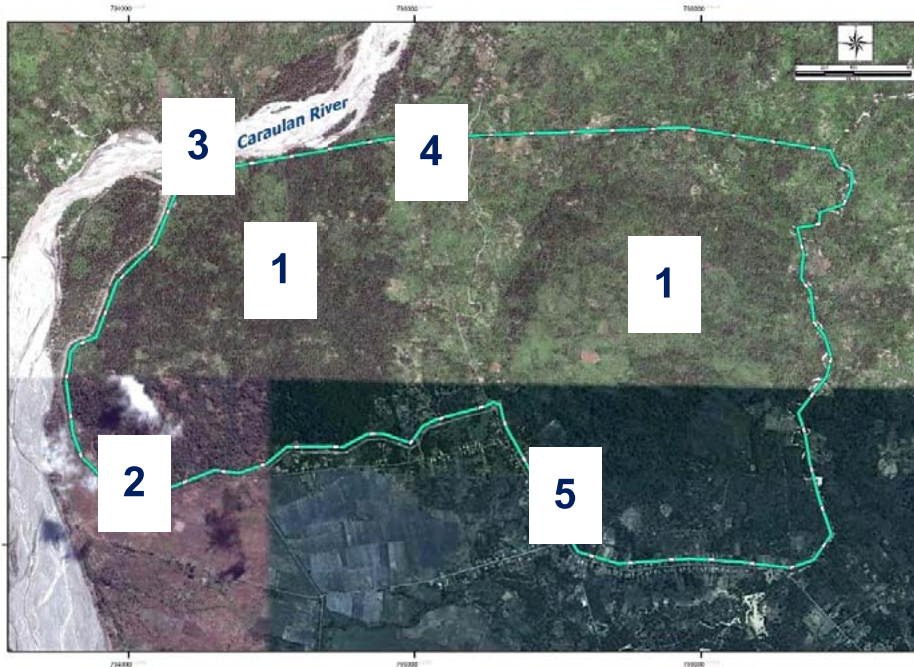
STAGING PLAN



SUSTAINABLE AND GREEN DEVELOPMENT



EXISTING LAND USE



1 Mixed Deciduous Forest $\approx 70\%$



2 Teak and perennial plant



3 Irrigation



4 Field crop $\approx 3.6\%$



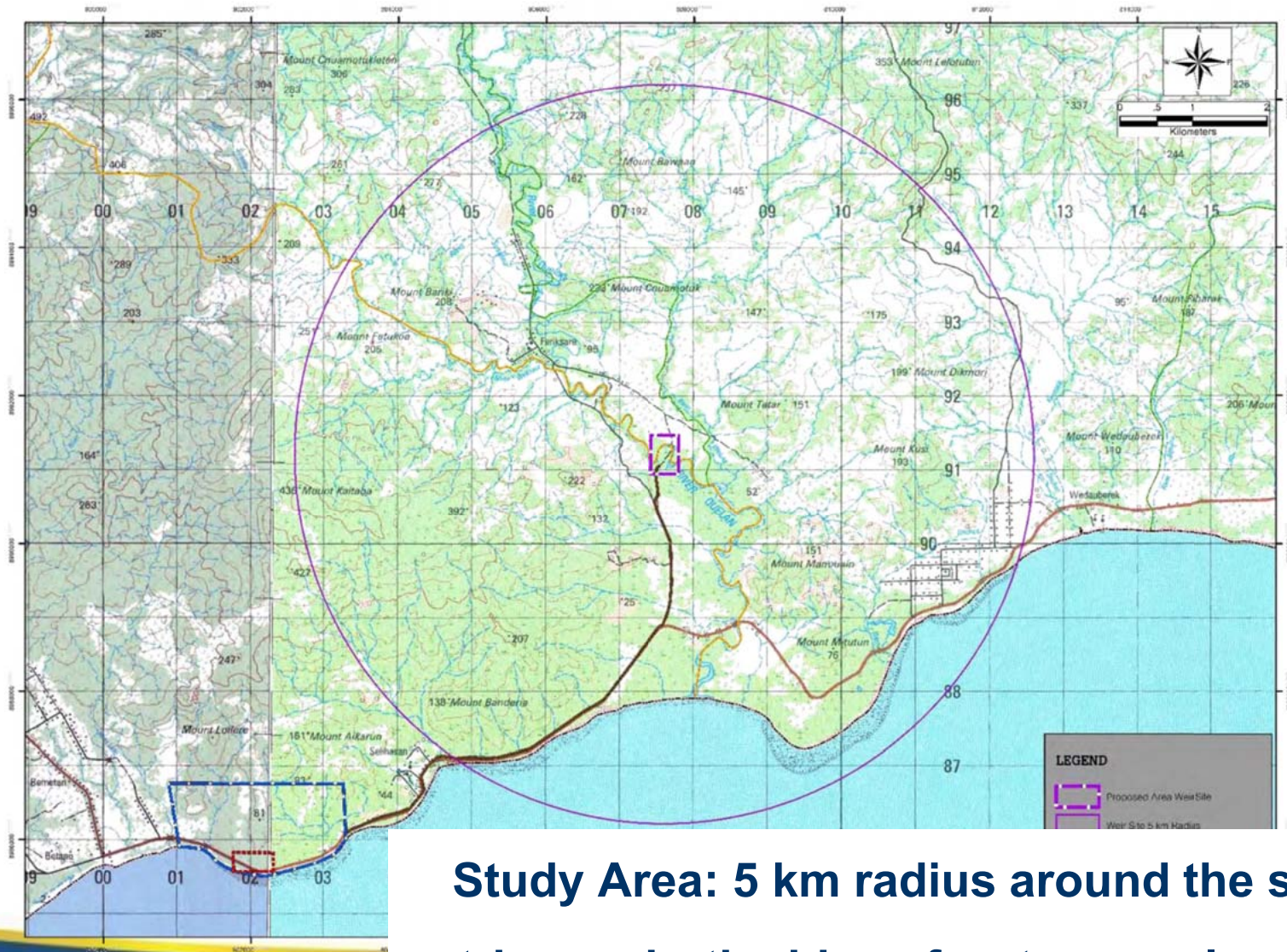
5 Residential area $\approx 0.5\%$

WATER SUPPLY SYSTEM

PROJECT INFORMATION

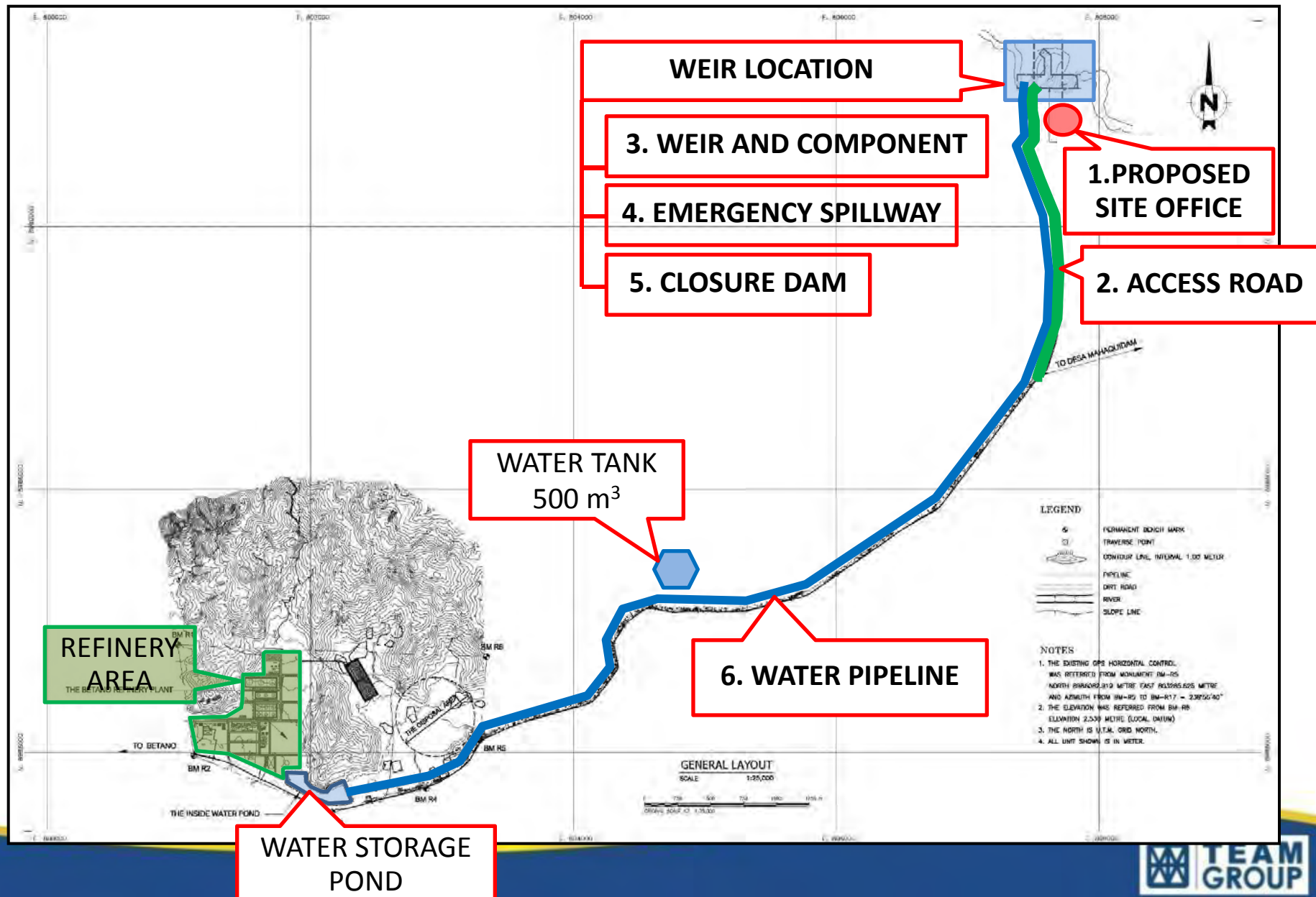
- **Location:** Weir is located about 10 km. to the northeast of the refinery
- **Length of water pipeline:** Approximately 10 km. (Φ 250-280 mm)
- **Capacity:** 40,000 cu.m for weir
- **Project objective:** To provide the raw water feedstock which will be used to produce the reverse osmosis (RO) water for other general uses such as Boiler Feed water, Demineralized water, Potable water etc.

WATER SUPPLY SYSTEM



Study Area: 5 km radius around the site and 50 m strips on both sides of water supply pipeline route

WATER SUPPLY SYSTEM FOR BETANO REFINERY PLANT



WATER SUPPLY SYSTEM



WATER PIPELINE



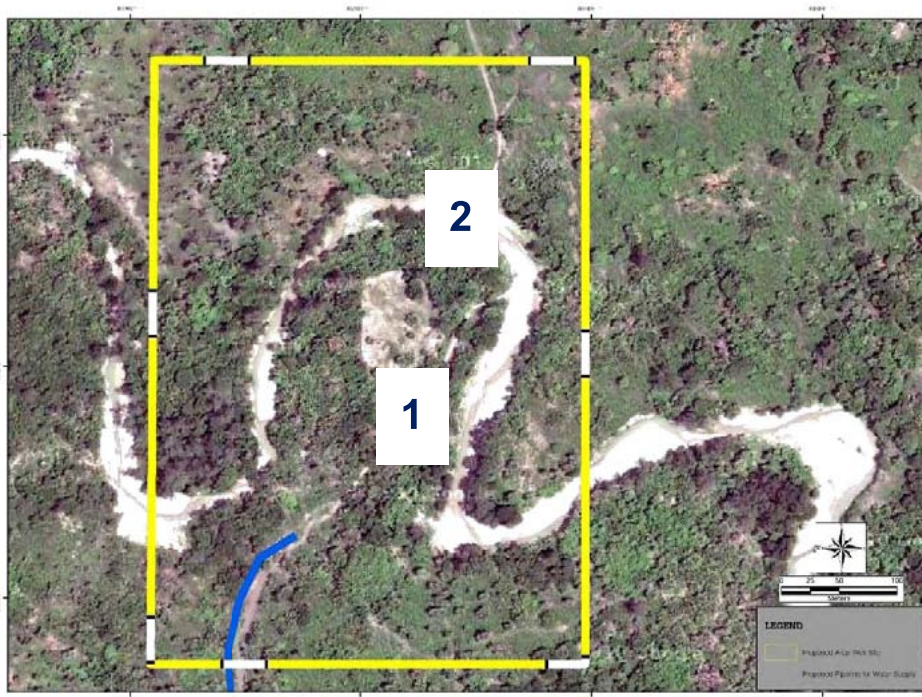
WATER TANK



WATER STORAGE POND



EXISTING LAND USE



**1 Mixed Deciduous Forest,
and Palm $\approx 96\%$**



2 Riparian Forest $\approx 4\%$

EXISTING ENVIRONMENTAL CONDITION

- Physical Environment
- Biological Environment
- Socio-economic Environment
- Cultural and Visual Environment



CLIMATE & METEOROLOGICAL

- The study areas display a typical tropical monsoonal climate
- There are 2 seasons, wet season; start from December to July and dry season from August to November.
- The average temperature range of 23.8-28.1 °C.
- The relative humidity range of 73.3-85.6 %
- The average wind speed range of 0.5-1.3 m/sec.
- The average annual rainfall is 1,494 mm/year.

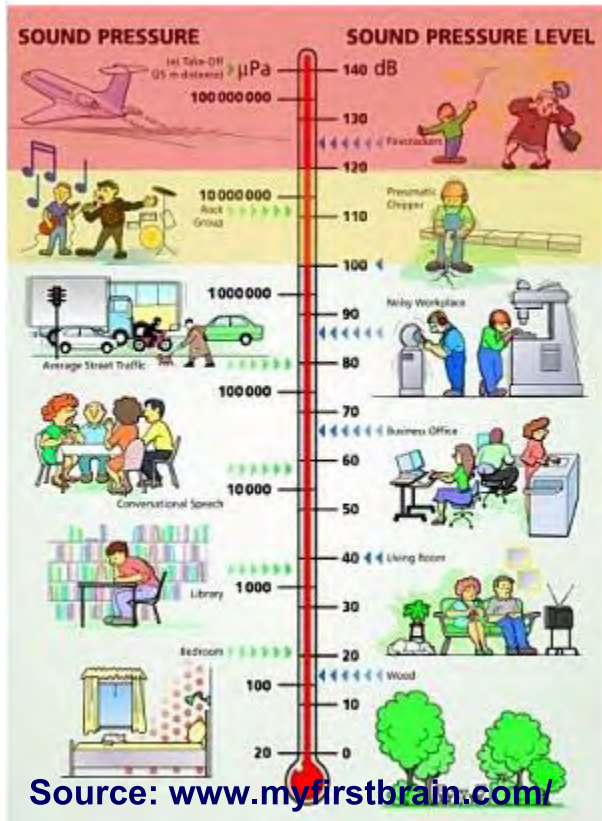
Source: Meteorological data during 2004-2015 of Betano Weather Station, Ministry of Agricultural, 2016.

AMBIENT AIR QUALITY

- Most of Study area is residential, food crop, and undeveloping area.
- The primary air pollutants is Particulate Matter (PM) or dust which cause by vehicular traffic.
- PM10 is approximately 25-27 $\mu\text{g}/\text{m}^3$ less than the 24-hr average of WHO and NEPM guidelines, and U.S. EPA standard, which 50 and 150 $\mu\text{g}/\text{m}^3$, respectively.
- Other air pollutions, i.e. NO_x , SO_x are less than the limit of reporting.

Source: Tasi Mane Project - Betano Petroleum Refinery and Beaco LNG Plant, Strategic Environmental Impact Statement, Final Report, 2012.

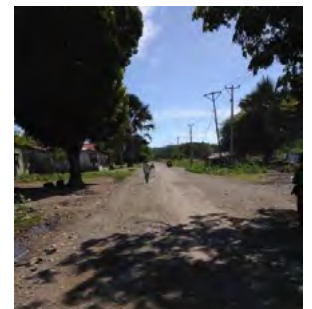
NOISE



- Most of Study area is residential, food crop, and un-developing area.
- The primary source of noise is vehicular traffic.
- L_{Aeq} is range of 45.5-62.4 dB

Source: Tasi Mane Project - Betano Petroleum Refinery and Beaco LNG Plant, Strategic Environmental Impact Statement, Final Report, 2012.

TRAFFIC SURVEY



Station	Direction	Vehicles	Traffic condition
TC1A	Same to Betano	1) Motorcycle 2) Passenger car 3) Light truck	Very good traffic flow
TC1B	Betano to Selihasan	1) Motorcycle 2) Bicycle 3) Light truck	Very good traffic flow



COASTAL WATER QUALITY FOR BETANO REFINERY PROJECT

- The concentrations of dissolved oxygen (6.11-6.62 mg/L) are in range of Indonesia Marine Water Quality Standards (2004).
- pH levels (7.9-8.1) are in range of National Recommended Water Quality Criteria (US EPA, 2009).
- Heavy metal together with organic contamination are within Indonesia Marine Water Quality Standards (2004) and National Recommended Water Quality Criteria (US EPA, 2009).
- Coastal water quality is suitable for coastal ecosystem.

Source: Tasi Mane Project - Betano Petroleum Refinery and Beaco LNG Plant,
Strategic Environmental Impact Statement, Final Report, 2012.



MARINE WATER QUALITY FOR BETANO REFINERY PROJECT

- The concentrations of dissolved oxygen (5.87-6.64 mg/L) are within Indonesia Marine Water Quality Standards (2004)
- pH levels (8.0-8.1) are in range of National Recommended Water Quality Criteria (US EPA, 2009)
- Heavy metal together with organic contamination are below Indonesia Marine Water Quality Standards (2004) and National Recommended Water Quality Criteria (US EPA, 2009)
- Marine water quality is suitable for marine ecosystem.

Source: Tasi Mane Project - Betano Petroleum Refinery and Beaco LNG Plant, Strategic Environmental Impact Statement, Final Report, 2012.

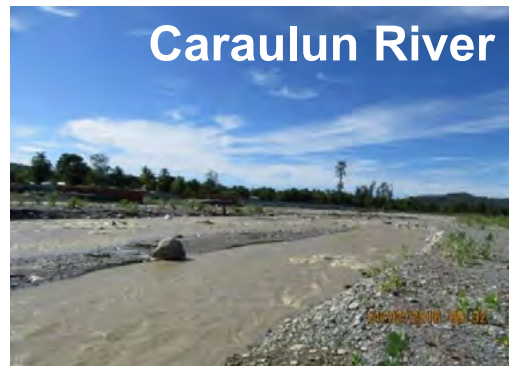


SURFACE WATER QUALITY

Betano Refinery Project

NOVA Betano Project

Water Supply System Project



The water quality of the rivers is within the standards and can be used as freshwater preservation, livestock and irrigation

GROUNDWATER QUALITY

Betano Refinery Project



NOVA Betano Project



Water Supply System Project



The water is suitable for domestic use and agriculture

TERRESTRIAL ECOLOGY

Class	Betano Refinery	NOVA Betano	Water Supply System
Plant	74	88	48
Wildlife			
Mammals	7	8	3
Birds	21	25	17
Reptiles	4	5	2
Amphibians	4	4	2
Total	36	42	24



Rosewood (*Pterocarpus indicus*)



Timor Friarbird (*Philemon inornatus*)



Streaky-breasted Honeyeater
(*Meliphaga reticulata*)

SOCIO-ECONOMIC SURVEY FOR BETANO REFINERY PROJECT



Manufahi District



Betano Village



Selihasan sub-village



Bematan sub-village

Opinion

- **Agree**
 - Job opportunity for local people
 - Community and country development

Suggestion

- present project affected area to local people
- Local people participation in each step of EIS study

SOCIO-ECONOMIC SURVEY FOR NOVA BETANO PROJECT



Leo Ai sub-village



Raifusa sub-village



Lalika sub-village

Opinion

Agree

- Country development
- Job opportunity

Suggestion

- Job opportunity from the project for local people
- Not need to resettle PAPs to live together in only one area, please arrange community which has different culture separately

SOCIO-ECONOMIC SURVEY FOR WATER SUPPLY SYSTEM PROJECT



Kakeulaletok sub-village

Maha Clusin sub-village

Selihasan sub-village

Opinion	Suggestion
Agree <ul style="list-style-type: none"> Job opportunity for local people Country development 	Availability for transportation via Dam Crest during project operation <ul style="list-style-type: none"> Water supply for community Job opportunity for local people

CULTURAL AND VISUAL ENVIRONMENT



Cemetery in Selihasan sub-village



Betano Name in Selihasan sub-village



Huilocco Cemetery in Maha Clusin sub-village



Portuguese Port in Betano village

PRE-CONSTRUCTION PHASE

Potential Impacts

- Land acquisition
- Fugitive dust from land preparation
- Waste from site clearance

Mitigation Measures

- Fair compensation
- Spray water
- Reuse for communities and agricultural activities

CONSTRUCTION PHASE

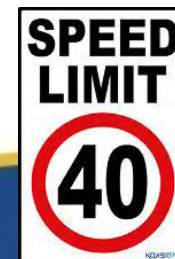
Potential Impacts

- Fugitive dust
- Traffic Problem and risks
- Gaseous emission from project vehicles and machinery



Mitigation Measures

- Spray water
- Cover truck transporting construction material with tarpaulin sheet
- Limit speed at 40 km/hr
- Installation of safety signs
- Avoid transportation in rush hours
- Routine maintenance of vehicles



CONSTRUCTION PHASE

Potential Impact

- Increase of noise level from construction activities

Mitigation Measures

- Regularly monitor ambient noise levels
- Conduct routine maintenance of machinery
- Set schedule for activities with high noise level only during day time

CONSTRUCTION PHASE

Potential Impact

- Community Health, Safety and Security



Mitigation Measures

- Provision of personal protective equipment for workers
- Installation of warning and prohibition signs
- Give priority to local employment during the construction period
- Grievance Redress Mechanism



CONSTRUCTION PHASE

Potential Impact

- Soil erosion/landslide
- Increased storm water, run-off

Mitigation Measures

- Limit excavated area and cut slope designed, and backfilling should be finished before opening the next section
- Using less time for construction near the water source
- Avoid construction during heavy rain
- Prohibition of discharge of waste to water sources

CONSTRUCTION PHASE

Potential Impact

- Agricultural area disturbance
- Vegetation and wildlife disturbance
- Blocking local road

Mitigation Measures

- Obtain permission for cutting trees from the relevant agencies
- Use efficient equipment to reduce noise level, dust and fume
- Inform construction plan to landowners 3-6 months in advance
- Provide temporary detour for local people

CONSTRUCTION PHASE

Potential Impact

- Increase solid waste

Mitigation Measures

- Prohibition of discharge of waste to water sources
- Monitor groundwater quality at the nearest well to the project area twice a year
- Provision of waste disposal site, and sewage treatment within the construction site

CONSTRUCTION PHASE

Potential Impact

- Socio-economic

Mitigation Measures

- Give priority to local employment during the construction period
- Inform construction schedule to villagers
- Grievance Redress Mechanism

OPERATION PHASE

Potential Impact

- Increase gaseous emission from combustion of **Betano Refinery Project**

Mitigation Measures

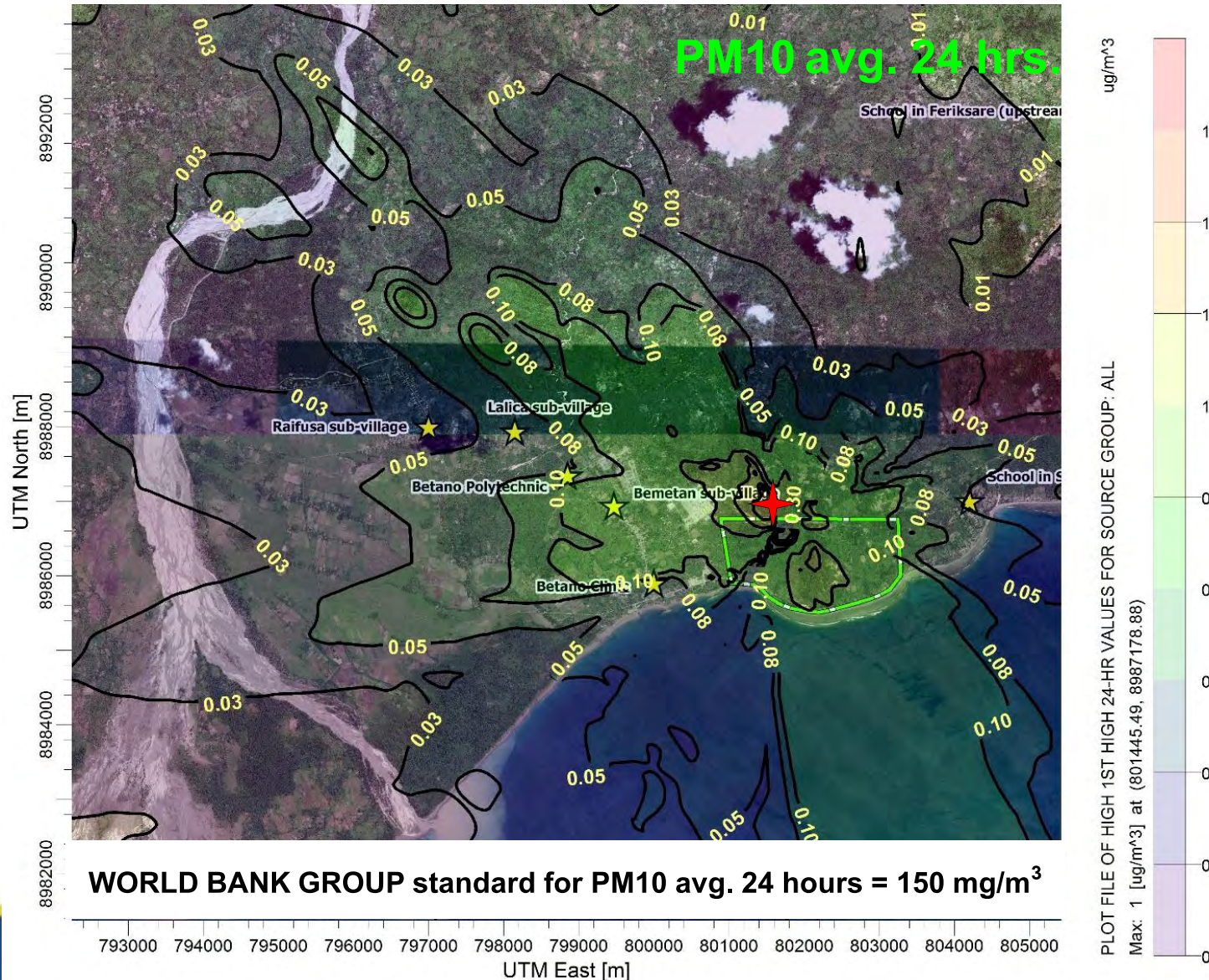
- Control the emission not to exceed the standard
- Install the Continuous Emission Monitoring System (CEMS)
- Properly maintain the operation of air pollution control systems
- Regularly record the shutdown period and duration of flare operation
- Monitor ambient air quality at sensitive receptor and emission stack twice a year

OPERATION PHASE

- **AERMOD has been used for prediction of air quality impact for refinery**
- **Study area: 10 x 10 km²**
- **Parameters: NOx, SOx, and PM**
- **All results within applicable standard (i.e. US. EPA., WHO, IFC)**

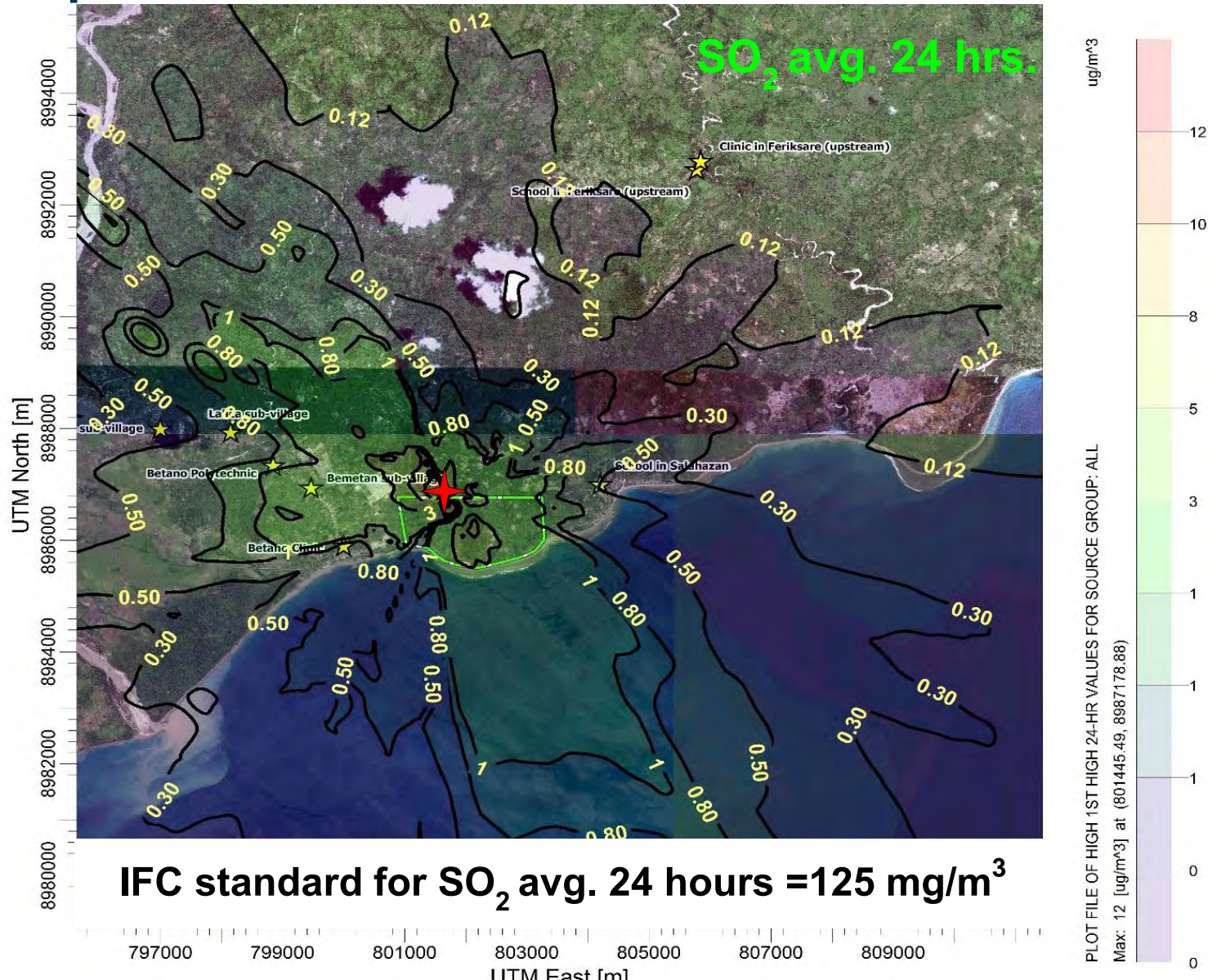
OPERATION PHASE

Example for AERMOD Result



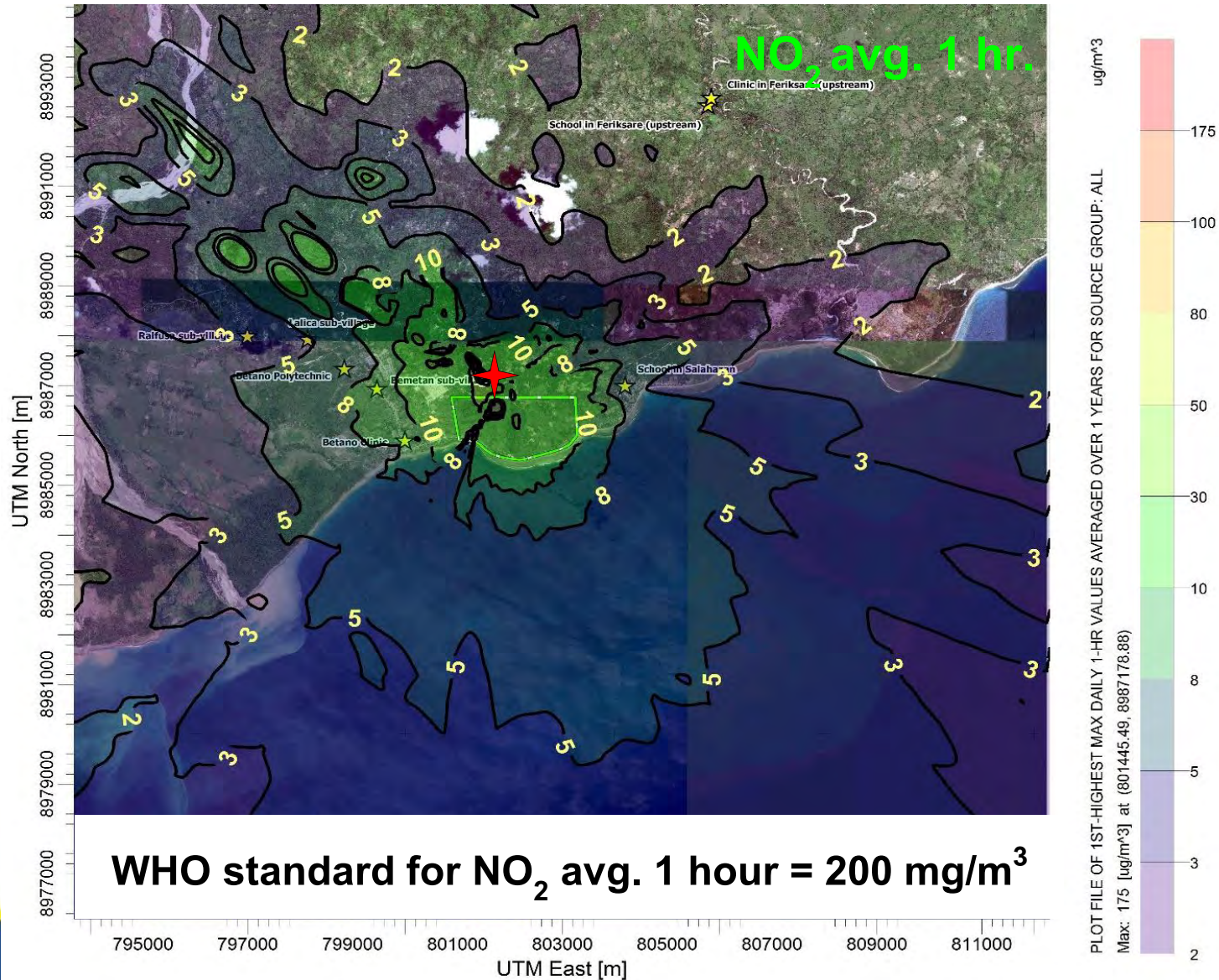
OPERATION PHASE

Example for AERMOD Result



OPERATION PHASE

Example for AERMOD Result



OPERATION PHASE

Potential Impact

- Generation of wastewater from **Betano Refinery** Project

Mitigation Measures

- Provide wastewater treatment system and control water quality to meet the standard
- Regularly maintain wastewater treatment system
- Monitor coastal water twice a year

OPERATION PHASE

Potential Impact

- Generation of wastewater and solid waste from **NOVA Betano Project**

Mitigation Measures

- All sewerage to be contained within the municipal sewer systems
- Provide proper waste management system
- Provision of water supply, waste disposal, and sewage treatment system within the area

OPERATION PHASE

Potential Impact

- Increase of noise level in existing communities due to project operation of **Betano Refinery**

Mitigation Measures

- Design the process building to reduce noise level
- Personal protective equipment
- Plant Operating Maintenance and Calibration Manuals, Procedures and Schedules

OPERATION PHASE

Potential Impact

- Impact on occupation health and safety from excessive noise, flammable and explosive hazards of **Betano Refinery**
- Public Health

Mitigation Measures

- Establish the committee for occupational health/safety
- Provide first aid system and fire extinguishers
- Regularly inspect and maintain the pollution control system
- Provide PPE
- Annual health check up for workers

OPERATION PHASE

Potential Impact

- The adverse impact might be generated by the **Betano Refinery** operation intense of noise and gas emission
- Community Health, Safety and Security
- Socio-economic

Mitigation Measures

- Corporate Social Responsibilities (CSR)
- Grievance Redress Mechanism

OPERATION PHASE

Potential Impact

- Transport obstruction from **water supply system** project

Mitigation Measures

- Provision of transportation route via weir crest (motorbike)
- Provide new local road to village (small truck)
- Support water to nearby communities and upgrade existing local road to weir site

OPERATION PHASE

Potential Impact

- Major hazard might cause impact to community i.e. fire and explosion of

Betano Refinery

Mitigation Measures

- Propose emergency plan
- Provide equipment and fire security system
- Installation of gas detection system and emergency valve
- Provide fire extinguishers

DEACTIVATION PHASE

Betano Refinery Project

- The majority activities will be demolition and removal structure including remediation.
- Impacts and mitigation measures of deactivation phase are as same as those of construction phase.

NOVA Betano and Water Supply System Project

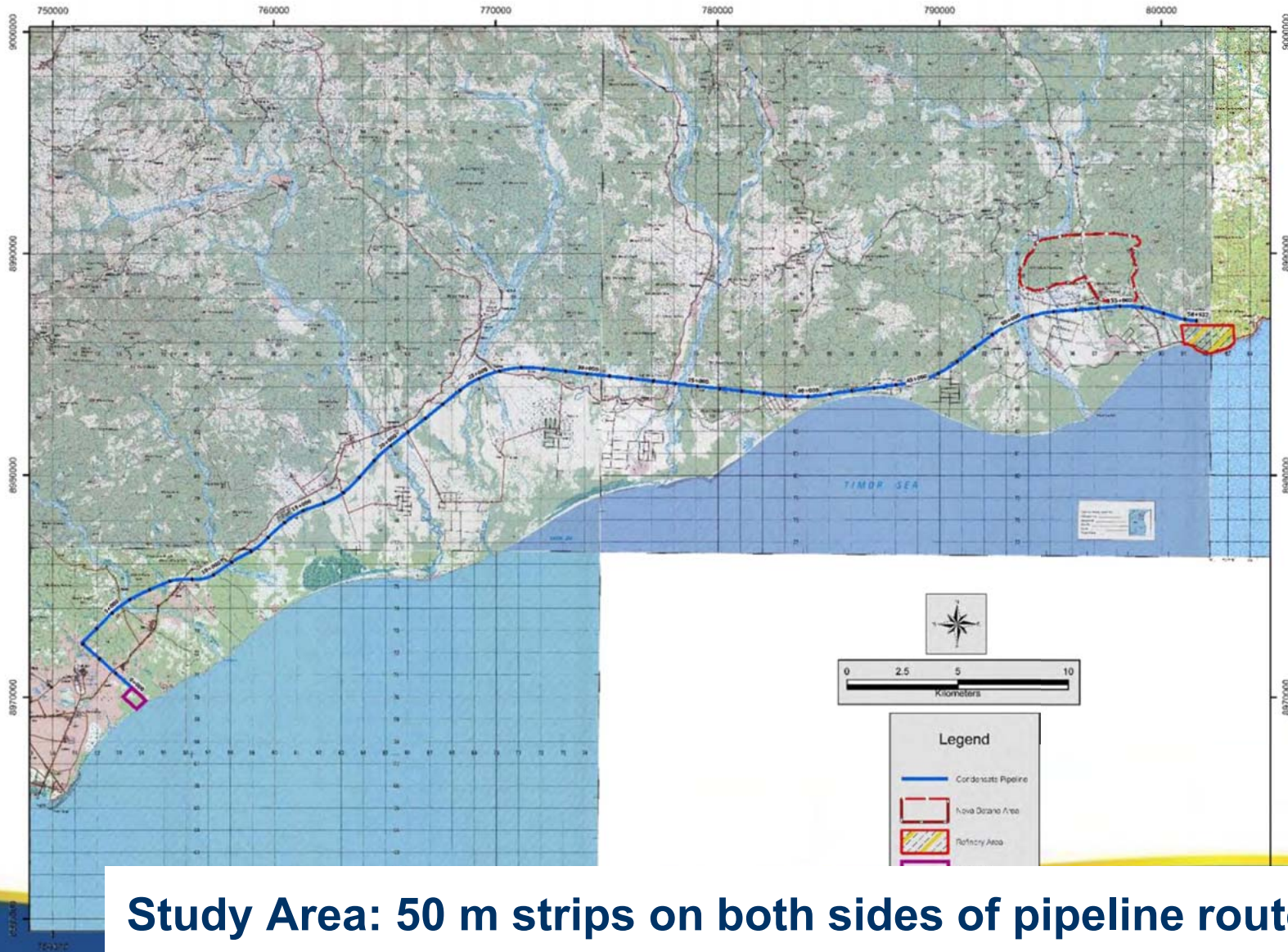
- There would be no deactivation phase

CONDENSATE PIPELINE

PROJECT INFORMATION

- **Location:** From Betano Refinery (Betano Village, Same Sub-district, Manufahi District) along southern shoreline to tank farm at Camenaãa Village, Suai Sub-district, Covalima District.
- **Length of condensate pipeline:** 78 km.
 - Light Naphtha, Heavy Naphtha and Diesel \varnothing 8 inches
 - Condensate \varnothing 12 inches.
- **Project objective:** Transportation of condensate

CONDENSATE PIPELINE



HIGHWAY



CONDENSATE PIPELINE



EXISTING ENVIRONMENTAL CONDITION

- Physical Environment
- Biological Environment
- Socio-economic Environment
- Cultural and Visual Environment



CLIMATE & METEOROLOGICAL

- The study areas display a typical tropical monsoonal climate.
- There are 2 seasons, wet season; start from December to July and dry season from August to November.
- The average temperature range of 23.8-28.1 °C.
- The relative humidity range of 43.9-85.6 %
- The average wind speed range of 0.3-1.3 m/sec.
- The average annual rainfall range of 1072-1494 mm/year.

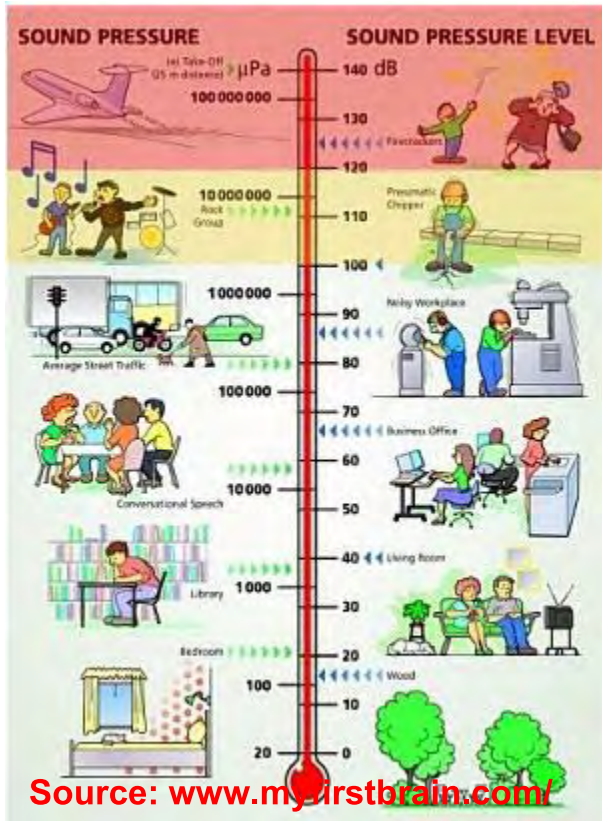
Source: Meteorological data during 2004-2015 of Manufahi Weather Station and Suai Weather Station, Ministry of Agricultural, 2016.

AMBIENT AIR QUALITY

- Some section is residential, food crop, and un-developing area.
- The primary air pollutants is Particulate Matter (PM) or dust which cause by vehicular traffic.
- PM10 is approximately 25-40 $\mu\text{g}/\text{m}^3$ less than the 24-hr average of WHO and NEPM guidelines, and U.S. EPA. standard, which 50 and 150 $\mu\text{g}/\text{m}^3$,respectively.
- Other air pollutions, i.e. NO_x , SO_x are less than the limit of reporting.

Source: Tasi Mane Project - Betano Petroleum Refinery and Beaco LNG Plant, Strategic Environmental Impact Statement, Final Report, 2012.

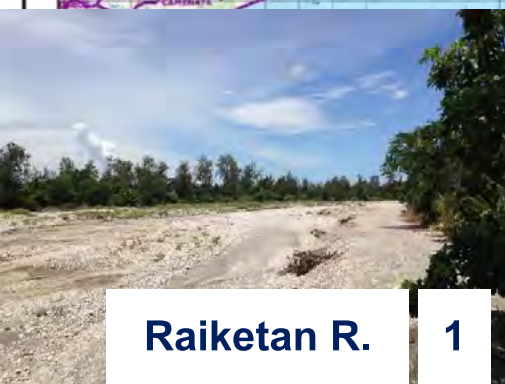
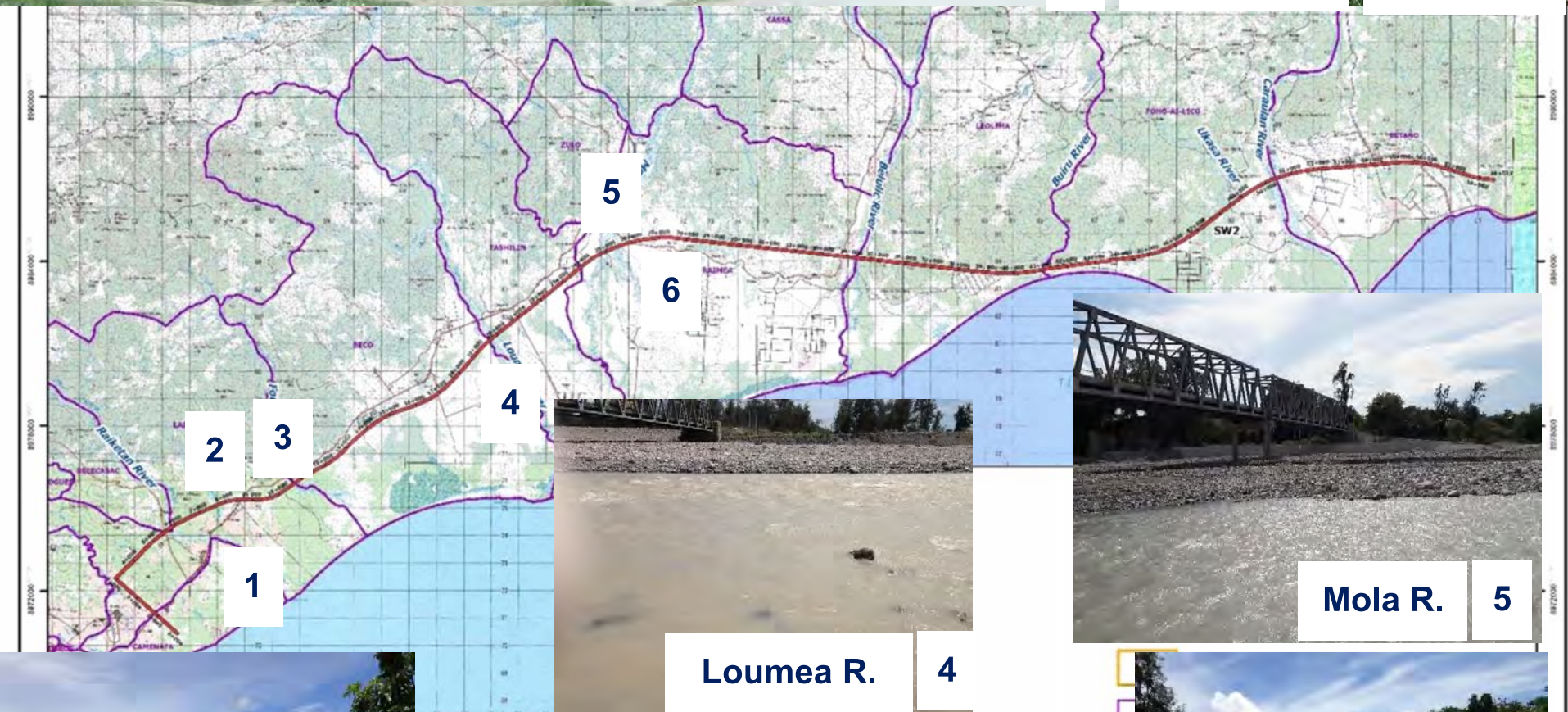
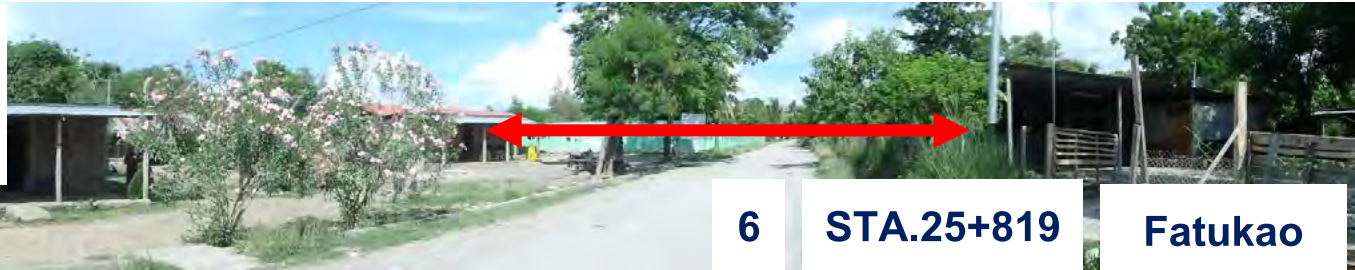
NOISE



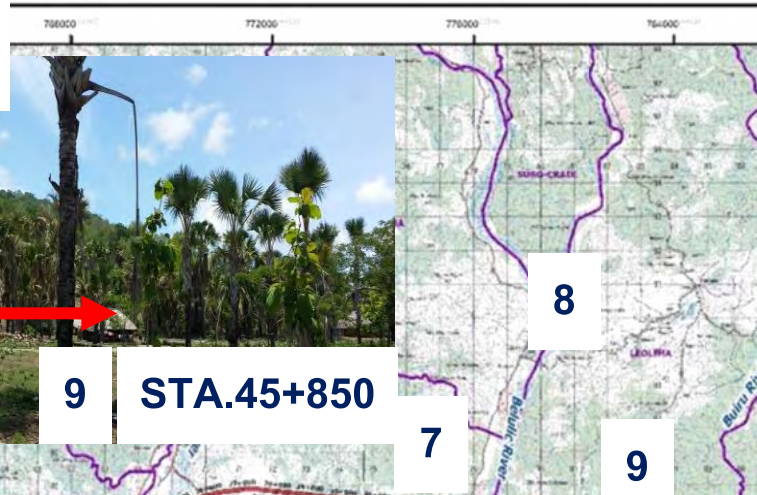
- Most of Study area is residential, food crop, and un-developing area.
- The primary source of noise is vehicular traffic.
- L_{Aeq} is range of 45.5-64.9 dB

Source: Tasi Mane Project - Betano Petroleum Refinery and Beaco LNG Plant, Strategic Environmental Impact Statement, Final Report, 2012.

KM1-KM26

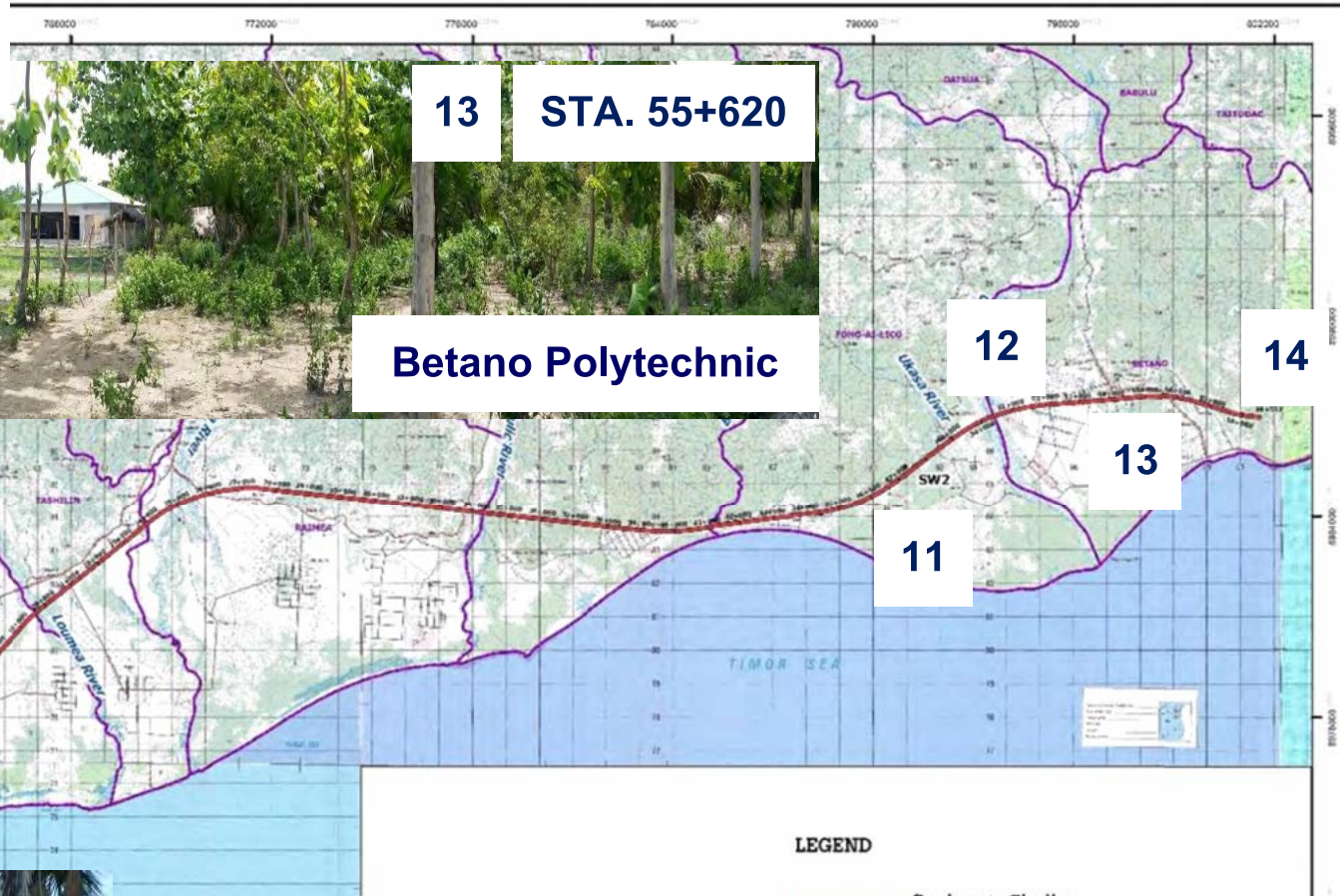


KM26-KM41



LEGEND

KM41-KM54



13

STA. 55+620

Betano Polytechnic

12

14

13

11

LEGEND

Condensate Pipeline



Bobe

11

STA.47+390



Caraulun R.

12



14 STA.56+440

Settlement area of power plant

SURFACE WATER QUALITY

Parameter	1. Caraulun River	2. Ukasa River	3 Belulic River	Standard	
				US EPA/ 2009	82/2001 Class I,II
Temp (°C)	31.4	32.6	25.6	-	± 3
pH	8.06	7.84	8.24	6.5-9	6-9
DO (mg/L)	7.13	6.83	7.33	3.5	≥ 4

The water quality of the three rivers is within the standards and can be used as freshwater preservation, livestock and irrigation.



1



2



3

SURFACE WATER QUALITY

Parameter	4. Caraulun River	5. Ukasa River	6. Belulic River	Standard	
				US EPA/ 2009	82/2001 Class I,II
Temp (°C)	29.5	30.2	34	-	± 3
pH	8.06	8.11	8.18	6.5-9	6-9
DO (mg/L)	7.19	7.03	6.47	3.5	≥ 4



4



5



6

The water quality of the three rivers is within the standards and can be used as freshwater preservation, livestock and irrigation.

GROUNDWATER QUALITY

Parameter	Unit	GW2	Standard of WHO
Conductivity	$\mu\text{S/cm}$	1,452	250
pH	-	6.77	6.5-8.5
Salinity	ppt	0.7	-
Total Dissolved Solids	g/l	1.30	-



The water is suitable for consumer such as, washing and agriculture

TERRESTRIAL ECOLOGY

Class	Condensate Pipeline
Plant	92
Wildlife	
Mammals	9
Birds	28
Reptiles	5
Amphibians	5
Total	47



Rosewood (*Pterocarpus indicus*)

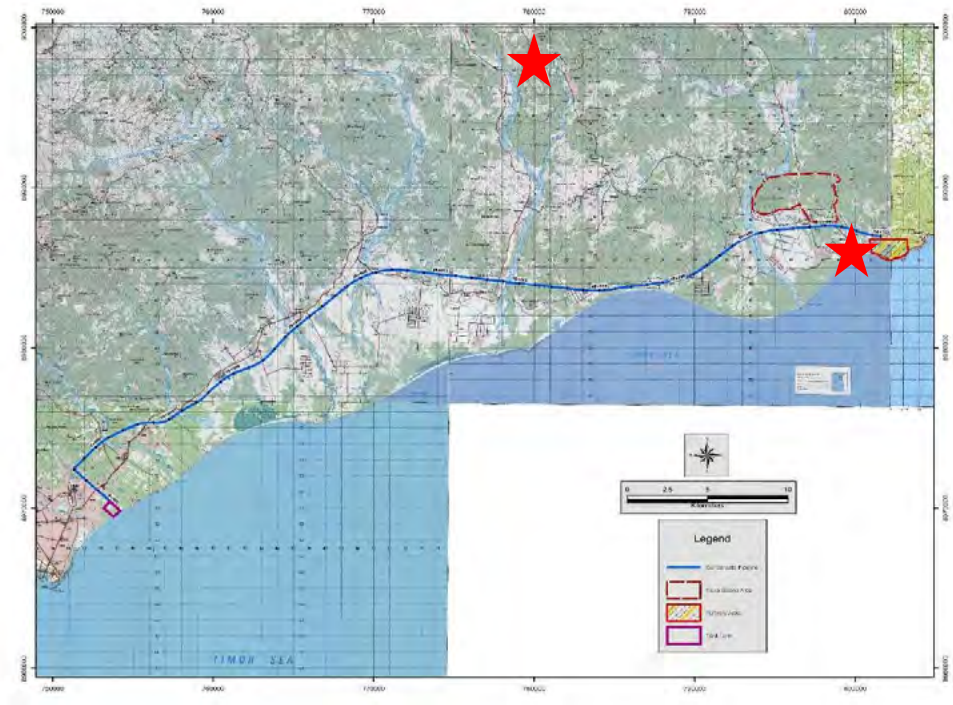


Timor Friarbird (*Philemon inornatus*)



Streaky-breasted Honeyeater
(*Meliphaga reticulata*)

TRAFFIC SURVEY



Access Road to Betano Refinery

Access Road to
Condensate Pipeline



Result of traffic counting at access road

Station	Direction	Vehicles	Traffic condition
TC1A	Same to Betano	1) Motorcycle 2) Passenger car 3) Light truck	Very good traffic flow
TC1B	Betano to Selihasan	1) Motorcycle 2) Bicycle 3) Light truck	Very good traffic flow
TC2A	Zumalai to Ainaro	1) Motorcycle 2) Bicycle 3) Light truck	Very good traffic flow
TC2B	Ainaro to Suai	1) Motorcycle 2) Light truck 3) Bicycle	Very good traffic flow

SOCIO-ECONOMIC SURVEY

Opinion

- Agree
- Community development (economic , benefit)
- Country development

Suggestion

- Appropriate compensation and same compensation rate
- Inform project construction plan to chief of village and local people prior to construction
- Concern sacred place
- Job opportunity for local people



Ainaro District



Ainaro Sub-district



Hato Udo Sub-district Leo Lima Village



Foho Ailico village



**Bobe and Bonuc
Community**

SOCIO-ECONOMIC SURVEY



Cova Lima District



Suai Sub-district



Zumalai Sub-district

Opinion	Suggestion
Agree	<ul style="list-style-type: none">• Spray water at construction area to mitigate dust
<ul style="list-style-type: none">• Community benefit and country development	<ul style="list-style-type: none">• Closely contact with chief of village during project construction period
<ul style="list-style-type: none">• Job opportunity	<ul style="list-style-type: none">• Project should respect to local culture
	<ul style="list-style-type: none">• Appropriate mitigation measures for project impact

SOCIO-ECONOMIC SURVEY



**Raimea, Tashilin , Zulo
village**



Beco village



Labarai village

Opinion

Agree

Suggestion

- Job opportunity from the project for local people
- Water supply system for community from river
- Closely contact with chief of village during project construction period

• Community benefit and country development

• Job opportunity

CULTURAL AND VISUAL ENVIRONMENT



Cemetery in Bobe sub-village (km. 35-50)

PRE-CONSTRUCTION PHASE

Potential Impact

- Fugitive dust from land preparation
- Land acquisition
- Waste from site clearance

Mitigation Measures

- Spray water
- Pay the compensation in fair price
- Reuse for communities and agricultural activities

CONSTRUCTION PHASE

Potential Impact

- Fugitive dust



Mitigation Measures

- Cover truck transporting construction material with tarpaulin sheet
- Limit speed 40 km/hr
- Routine maintenance of vehicles
- Avoid transportation in rush hours

CONSTRUCTION PHASE

Potential Impact

- Noise pollution and annoyance
- Traffic problem and risks

Mitigation Measures

- Inform local communities
- Limit work 06.00 a.m.-06.00 p.m.
- Provide temporary by-pass
- Put up indication and warning sign
- Avoid transportation in rush hours

CONSTRUCTION PHASE

Potential Impact

- Soil erosion/landslide
- Solid waste

Mitigation Measures

- Backfilling must be done immediately after pipe laying
- Using less time for construction near the water source
- Avoid construction during heavy rain
- Prohibition of discharge of waste to water sources

CONSTRUCTION PHASE

Potential Impact

- Agricultural area disturbance
- Vegetation and wildlife disturbance

Mitigation Measures

- Obtain permission for cutting trees from the relevant agencies
- Use efficient equipment to reduce noise level, dust and fume
- Inform construction plan to landowners 3-6 months in advance

CONSTRUCTION PHASE

Potential Impact

- Disturbance of Historic and Sacred Sites

Mitigation Measures

- Avoid the residential areas, historic and sacred places, education institute and government offices
- Consult with local leaders and relevant local agencies before construction
- Stop the construction and inform concerned authority for proper management if historic object is found

OPERATION PHASE

Potential Impact

- Pipeline Leakage Risk



Mitigation Measures

- Have welding inspection by expert
- Regularly maintain pipeline twice a year
- Provide SCADA system
- Organize emergency practices
- Leakage inspection once a year in compliance with the ASME B31.8 standard

OPERATION PHASE

Potential Impact

- Public health and safety for local resident



Mitigation Measures

- Support and participate in communities' activities
- Distribute Emergency manual to people
- Build up knowledge, understanding and confidence on pipeline system
- Provide first aid kits in project concerned sub-villages

DEACTIVATION PHASE

There would be no deactivation phase.

THANK YOU

For Your Attention