ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

ក្រសួងបរិស្ថាន
លេខ : ៤៦៩ សជណ ប.ស្ថ

សូមគោរពជូន

ឯកឧត្តម រដ្ឋមន្ត្រី ក្រសួងសាធារណការ និងដឹកជញ្ជូន

កម្មវត្ថុ៖ ករណីពិនិត្យ និងផ្តល់យោបល់លើរបាយការណ៍វាយតម្លៃហេតុប៉ះពាល់បរិស្ថានពេញលេញ សម្រាប់គម្រោងស្តារឡើងវិញនូវកំណាត់ផ្លូវជាតិលេខ៥ (ផ្នែកខាងត្បូង) ព្រែកក្តាម-ធ្លាម្អម

យោង ៖
- ព្រះរាជក្រមលេខ នស.រកម ១២៩៦-៣៦ ចុះថ្ងៃទី២៤ ខែធ្នូ ឆ្នាំ១៩៩៦ ដែលប្រកាសឱ្យប្រើច្បាប់ស្តីពីកិច្ចការពារបរិស្ថាន និងការគ្រប់គ្រងធនធានធម្មជាតិ
- អនុក្រឹត្យលេខ ៧២ អនក្រ.បក ចុះថ្ងៃទី១១ ខែសីហា ឆ្នាំ១៩៩៩ ស្តីពីកិច្ចដំណើរការវាយតម្លៃហេតុប៉ះពាល់បរិស្ថាន
- លិខិតលេខ ៣០៩០ សក.នសអ ចុះថ្ងៃទី០៣ ខែកញ្ញា ឆ្នាំ២០១៣ របស់ក្រសួងសាធារណការ និងដឹកជញ្ជូន
- លិខិតលេខ ៥៩៧ សជណ ប.ស្ថ ចុះថ្ងៃទី២៥ ខែវិច្ឆិកា ឆ្នាំ២០១៣ របស់ក្រសួងបរិស្ថាន
- លិខិតលេខ ៣៩២៥ សក ចុះថ្ងៃទី២៦ ខែវិច្ឆិកា ឆ្នាំ២០១៣ របស់ក្រសួងសាធារណការ និងដឹកជញ្ជូន
- កិច្ចសន្យាការពារបរិស្ថានលេខ ៣៩២៦ សក ចុះថ្ងៃទី២៦ ខែវិច្ឆិកា ឆ្នាំ២០១៣ របស់ក្រសួងសាធារណការ និងដឹកជញ្ជូន

សេចក្តីដូចមានចែងក្នុងកម្មវត្ថុ និងយោងខាងលើ ខ្ញុំសូមជម្រាបជូន **ឯកឧត្តម រដ្ឋមន្ត្រី** មេត្តាជ្រាបថា៖ ក្រសួងបរិស្ថានឯកភាពលើរបាយការណ៍វាយតម្លៃហេតុប៉ះពាល់បរិស្ថានពេញលេញ សម្រាប់គម្រោងស្តារឡើងវិញនូវកំណាត់ផ្លូវជាតិលេខ៥ (ផ្នែកខាងត្បូង) ចាប់ពីព្រែកក្តាម ដល់ធ្លាម្អម ដែលមានទីតាំងស្ថិតនៅក្នុងភូមិសាស្ត្រខេត្តកណ្តាល ខេត្តកំពង់ឆ្នាំង និងខេត្តពោធិ៍សាត់ របស់ក្រសួងសាធារណការ និងដឹកជញ្ជូន តំណាងដោយ ឯកឧត្តម រដ្ឋមន្ត្រី **ក្រសួងសាធារណការ និងដឹកជញ្ជូន** ជាម្ចាស់គម្រោង។ ជាមួយគ្នានេះដែរ ម្ចាស់គម្រោងត្រូវ៖

១- គោរពច្បាប់ស្តីពីកិច្ចការពារបរិស្ថាន និងការគ្រប់គ្រងធនធានធម្មជាតិ

២- អនុវត្តទៅតាមខ្លឹមសារនៃរបាយការណ៍វាយតម្លៃហេតុប៉ះពាល់បរិស្ថានពេញលេញ សម្រាប់គម្រោងស្តារឡើងវិញនូវកំណាត់ផ្លូវជាតិលេខ៥ (ផ្នែកខាងត្បូង) ដែលក្រសួងបរិស្ថានបានឯកភាព

៣- គោរពកិច្ចសន្យាការពារបរិស្ថានលេខ ៣៩២៦ សក ចុះថ្ងៃទី២៦ ខែវិច្ឆិកា ឆ្នាំ២០១៣ របស់ក្រសួងសាធារណការ និងដឹកជញ្ជូន

៤- មានការឯកភាពលើកិច្ចការពារបរិស្ថានពីក្រសួងបរិស្ថាន ក្នុងករណីមានការកែប្រែបាយការណ៍សិក្សាសមទ្ធិលទ្ធភាព (Feasibility Study) ឬបង្កើតផ្នែកថ្មីណាមួយនៃគម្រោង ត្រូវជូនដំណឹងមកក្រសួងបរិស្ថានឱ្យបានមុន ០១ខែ។

សេចក្តីដូចបានជម្រាបជូន សូម **ឯកឧត្តម រដ្ឋមន្ត្រី** ទទួលអនុវត្តឱ្យបានត្រឹមត្រូវតាមខ្លឹមសារខាងលើនេះ។

សូម **ឯកឧត្តម រដ្ឋមន្ត្រី** ទទួលនូវការគោរពរាប់អានពីខ្ញុំ។

រាជធានីភ្នំពេញ ថ្ងៃទី ខែ ឆ្នាំ២០១៣

រដ្ឋមន្ត្រី

ឈាយ សំអាល់

ចម្លងជូន៖

- ទីស្តីការគណៈរដ្ឋមន្ត្រី
- ក្រសួងសេដ្ឋកិច្ច និងហិរញ្ញវត្ថុ
- ក្រសួងរៀបចំដែនដី នគរូបនីយកម្ម និងសំណង់
- ក្រសួងកសិកម្ម រុក្ខាប្រមាញ់ និងនេសាទ
- ក្រសួងធនធានទឹក និងឧតុនិយម
- ក្រសួងឧស្សាហកម្ម រ៉ែ និងថាមពល
- ក្រសួងវប្បធម៌ និងវិចិត្រសិល្បៈ
- សាលាខេត្តកណ្តាល ខេត្តកំពង់ឆ្នាំង ខេត្តពោធិ៍សាត់
- មន្ទីរបរិស្ថានខេត្តកណ្តាល ខេត្តកំពង់ឆ្នាំង ខេត្តពោធិ៍សាត់
- ឯកសារ កាលប្បវត្តិ

KINGDOM OF CAMBODIA
NATION RELIGION KING

NATIONAL ROAD Nº.5 REHABILITATION PROJECT
PREK KDAM – THLEA MA'AM (SOUTH SECTION)

ENVIRONMENTAL IMPACT ASSESSMENT

FINAL COMPLETION REPORT

AUGUST 2013

PREPARED BY MINISTRY OF PUBLIC WORKS AND TRANSPORT
With Assistance of
KATAHIRA AND ENGINEERS INTERNATIONAL AND
KEY CONSULTANTS CAMBODIA LTD.,
Under Sponsorship of
JAPAN INTERNATIONAL COOPERATION AGENCY

EXECUTIVE SUMMARY

1. INTRODUCTION

Cambodia's significant economic growth in the last recent years has urged the RGC to make further efforts in an attempt to improve such growth at highest level for the country. In this regard, the RGC have prioritized many sectors to be improved, one of which is road network. Road transport accounts for a share of the total transported volume of passengers (65%) and freight (70%). The road network is, therefore, considered as the lifeline of development and covers all major regions in the country. One of the Cambodia's NRs is the NR No. 5. It has been designed as a part of Asian Highway No.1 or Southern Economic Corridor of the Greater Mekong Sub-region. Along the NR No. 5 was damaged by the flood in 2000 and was temporarily repaired. Although the repairs were made, the surface condition is being deteriorated. As a result, the traffic flow has been hampered. Given this, the RGC has been trying to request either grant aid or concession loan without interest rate from foreign donors and development agencies to rehabilitate the priority NRs. In response to the request, the GOJ, the biggest donor of Cambodia, entrusted the JICA for a preparatory survey from Battambang to Serei Saophoan section of the NR No.5. The survey was already finished in 2012. During April, 2013 the GOJ also provided loan for rehabilitating the above-studied section. Seeing the further necessity of the NR No.5 rehabilitation, the JICA has started another preparatory survey from Prek Kdam to Thlea Ma'Am. As a part of the survey, the EIA is prepared.

The purpose of the EIA was to investigate in the field on the present situation of natural and social environments and pollution, to analyze the possible impacts to those resources due to the project activities, and to provide mitigation measures for the impacts. The general objectives were to screen social and natural environments and pollution that may impact by the proposed project, to access potential impacts of the project during pre-construction, construction, and operation and to provide mitigation measures and EMP to minimize the adverse effects. Specifically core objective was to ensure that the project is environmentally sound and sustainable and that any negative environmental and social impacts were well recognized early and taken into account before project implementation.

2. POLICY, LEGAL AND ADMINISTRATION FRAMEWORKS

The EIA Sub-Decree is regarded as the major regulation regarding the environmental assessment requirements in Cambodia. Moreover, several other laws and regulations related to environmental safeguarding are used since they are relevant and also part of the EIA process. They are as follows:

- Law on Environmental Protection and Natural Resources Management;
- Sub-Decree on Water Pollution Control;
- Sub-Decree on Solid Waste Management
- Sub-Decree on Air Pollution and Noise Disturbance Control;
- Land Law;
- Expropriation Law;
- Law on Land Traffic; and
- Sub-Decree on the Ozone Depleting Substances.

Also, JICA Guidelines for Environmental and Social Considerations 2010 was applied. The objectives of the guidelines are to encourage Project proponents etc. to have appropriate consideration for environmental and social impacts, as well as to ensure that JICA's support for and examination of environmental and social

considerations are conducted accordingly. The guidelines outline JICA's responsibilities and procedures, along with its requirements for project proponents etc., in order to facilitate the achievement of these objectives. In doing so, JICA endeavors to ensure transparency, predictability, and accountability in its support for and examination of environmental and social considerations.

3. PROJECT DESCRIPTION

The NR No.5 is an arterial international road connecting Phnom Penh and the border point with Thailand. It traverses provinces of Banteay Meanchey and Battambang whose population are 3rd and 4th largest in the country. It is generally considered as an important highway not only for domestic transport but also for International transport in ASEAN and the GMS. Connecting with the NR No.1 forms a route connecting Bangkok, Phnom Penh and Ho Chi Minh City.

- The surveyed areas were Kandal, Kampong Speu, Kampong Chhnang, and Pursat provinces. The target section is the southern section with 139 km long.

- The present condition of the South Section of the NR No.5 can be summarized as follows:
  - **Road Width:** There are two types of typical cross section in the South Section. The average width of pavement of the section between Prek Kdam Bridge and Kampong Chhnang is 9.8m and that of the section between Kampong Chhnang and Thlea Ma'am is 7.7m. This 7.7m width is minimal as an opposed 2-lane road. High-speed vehicles such as passenger cars and slow vehicles such as bicycles and agricultural tractors are travelling same lane, resulting in hazardous traffic condition.
  - **Horizontal and Vertical Alignment:** The horizontal alignment of the NR No.5 is generally generous but there are some curve sections with small radii and need improvement. The vertical alignment is also generally flat.
  - **Pavement:** The road surface is DBST with gravel shoulder except in limited part in the urbanized area of Kampong Chhnang City.
  - **Bridges:** There are bridges along the South Section. Some of them need rehabilitation and some others need widening.
  - **Roadside Land Use:** The towns and villages are developed along the road. Many factories, shops, stalls, vendors, benches and houses are observed just beside the road. The basic form of land use outside of urbanized area is agriculture, especially rice paddy.

- The problems of present South Section can be summarized as follows:
  - **Traffic Safety:** Because of narrow road width, high-speed vehicles such as passenger cars and slow vehicles included bicycles and agricultural tractors are travelling same lane, resulting hazardous traffic condition.
  - **Narrow Road Width:** The width of existing pavement is 7.7 - 9.8m. In view of the fact that the widths of Motor-trailers or small agriculture tractors are 1.2 - 1.5m, 9.8m wide pavement cannot provide with sufficient space for these slow vehicles if central part of 3.5m wide is used as the travel lane for 4 wheel vehicles. Thus, widening to 4 lanes will become necessary before year 2030.
  - **Weak Pavement:** Existing pavement is the DBST. Because of small bearing capacity of the DBST, severe damages occur every year, especially after flood/inundation season. Also, because of

potholes and other defects, vehicles are forced to slowdown. This is causing great economic loss as a result. Thus, improvement of pavement to AC is needed.

- **Vulnerability to Inundation/Flood:** Every year, many sections are inundated or flooded. Traffic is forced to slow down or stop due to inundation/ flood, resulting in economic loss.
- **Necessity of Bypass:** The existing South Section of the NR No.5 is passing through towns such as Kampong Chhnang and Odongk where traffic congestion and traffic accidents have been caused. Basic solution to these problems is construction of bypasses.

- **Project Outline**
  - **Improved Section:** The South Section is divided into 5 sections as described below:
    i. Section I: Thlea Ma'am - Intersection of existing NR5 and Kamopong Chhnang Bypass in the north of Kamopong Chhnang City (L = 73.0km);
    ii. Section II: Kampong Chhnang Bypass (L = 11.8km);
    iii. Section III: Intersection of existing NR 5 and Kampong Chhnang Bypass in the south of Kamopong Chhnang City (L = 41.4km);
    iv. Section IV: Town of Odongkk (L = 4.9km); and
    v. Section V: Odongkk – Prek Kdam (L = 4.3km).

    Sections I, III and V are proposed to be widened (into 4 lanes). Bypasses are proposed to be constructed around Kampong Chhnang and Odongk to avoid resettlement of large number of households/buildings.
  - **Widening of South Section of the NR No.5:** Widening of the South Section is to widen the existing 2-lane road (approximately 11~13m wide including shoulders) into either 4-lane (approximately 20.5m or 25.5m wide including shoulders). Together with widening of the existing the NR No.5, the pavement is to be improved to AC from the existing DBST. Widening of the existing NR No.5 is executed by construction additional embankment generally on the both sides of the existing road.
  - **Kampong Chhnang Bypass:** A new road with cross section of 4-lane is to be constructed traversing mainly agricultural land (rice paddy) in the west suburbs of Kampong Chhnang Town. Pavement of the bypass is planned as AC.
  - **Odongk Bypass:** Also a new road with cross section of 4-lane is to be constructed traversing mainly agricultural land (rice paddy) in the north suburbs of Odongk town. Pavement of the bypass is also planned as AC.

- **Objectives of Project:** The project objective of is to solve or mitigate problems of the exiting South Section. This included:
  - Improvement of traffic safety by providing separate lanes for high-speed traffic and slow traffic;
  - Provision of sufficient traffic capacity by widening and mitigate traffic congestion which is anticipated in the near future;
  - Improvement of pavement into AC to support heavy traffic; and
  - Construction of bypasses to let the through traffic detour Kampong Chhnang and Odongk towns and avoidance of widening of the existing NR No.5 which necessitates resettlement of large number of houses and families.

4. BASELINE DATA

- **Physical Environment**
  - **Geography:** The project area is a segment of the NR No.5 or National Highway No. 1. The NR No.5 connects the capital of Phnom Penh with Thailand where its ending point is Poi Pet town with a length of 407.45 km.
  - **Topography:** Topographical condition in the project area is generally flat ranging from 9.69 to 41.19 m above mean sea level.
  - **Geology and Surface Soil:** Geological condition in the project area consists of two eras: Quaternary and Jurassic-Cretaeous. The Quaternary era formed Alluvial Plain Deposits, Beach Ridges and Levees, Deltaic Deposits Floodplains, Lake Bed Deposits, Pediments, and Terrace Alluvial Deposits. The Jurassic-Cretaeous Era formed Dacite. Based on Croaker 1962, soils in the project area are classified into four categories: (i) Alluvial Lithosols (ii) Lacustrine Alluvial Soils, (iii) Red-Yellow podzols, and (iv) Cultural Hydromorphics.
  - **Soil Erosion and Sediment:** Some erosion was observed at banks of rivers and streams crossing the project area. According to interviews with local people living nearby such rivers and streams it was found that previously such rivers and streams were deeper and narrower than that of the present time. The erosion has also brought sedimentations to downstream areas. One of the downstream areas is the Tonle Sap Great Lake.
  - **Climate:** The climate influenced by tropical monsoon and consists of the dry season and the rainy season. The dry season lasts for six months, starting from November to April. The rainy season also lasts for six months, starting from May to October.

    (a) Rainfall: Total annual rainfalls in Kandal are 1,439.3, 1,495.4, and 1,336.9 mm for the year 2010, 2011, and 2012, respectively. Total annual rainfalls in Kampong Chhnang are 1,220, 1,929, and 1,831.1 mm for the year 2010, 2011, and 2012, respectively. Total annual rainfalls in Pursat are 1,389.8, 1,488.4 and 1,640.2 mm for the year 2010, 2011, and 2012, respectively.

    (b) Humidity: Humidity rate changes with the seasons. The most humid month is July and the driest month is February. Generally, humidity ranges between 65 to 70 percent in January and 85 to 90 percent in August. The humidity at Kandal ranged from 65.8 to 77.3 percent in the dry season and from 69 to 82.4 percent in the rainy season during the last three years: 2010, 2011, and 2012. The humidity at Pursat ranged from 59.4 to 88.0 percent in the dry season and from 69 to 90 percent in the rainy season during the last three years: 2010, 2011, and 2012. Generally, it is found that humidity is high at night throughout the year.

    (c) Temperature: Monthly temperature of Kandal and Pursat varies between maximum from 38 – 40 ^{0}C during the hottest months of April and May and from 18.5 – 22.4 ^{0}C in December-January the coldest months.

    (*d) Wind*: The wind speeds varied from month to month and from year to year. Generally, in the Kandal province the lowest wind speeds were from Jan to April while the highest ones were from May to Oct. The medium speeds were also found from Nov to Dec. On the average basis, the wind speeds were 6.5, 13.1, and 10.6 m/s for 2010, 2011, and 2012, respectively. Similar to the Kandal province, in the Pursat province the lowest wind speeds were from Jan to April while the highest ones were from May to Oct. The medium speeds were also found from Nov to Dec. On the average basis, the wind speeds were 8.8, 6.9, and 7.2 m/s for 2010, 2011, and 2012, respectively.

- **Air Quality:** 5 locations in the Dry Season were surveyed for air pollution concentration in the project area. Each location was at the road side and more than 100 m from the road side. The surveys at the road sides were to know of the current situation of air pollution concentration while at places with more than 100 m away from the road sides were to know of the air pollution background concentration. Generally, NO_2 and SO_2 were lower than the MoE's standards. PM 2.5 was also lower than WHO's standard. However, PM 10 was found to be higher than the WHO's standard at most of the places. 5 locations in the Rainy Season, which are identical to the surveyed locations during the Dry Season, were surveyed for air pollution concentration in the project area. NO_2 and SO_2 were lower than the MoE's standards. PM 2.5 was also lower than WHO's standard. However, PM 10 was found to be higher than the WHO's standard at road side in Kandol Sar Village, Beung Kantuot Commune, Krakor District, Pursat Province (Around 170 Kilometer Post). High concentration of PM10 may be due to dust from transportation activities along the NR No.5 since no any wood burning was identified during the sampling period.
- **Noise and Vibration:** 5 locations, which were the same to the air quality survey locations, were also surveyed for noise and vibration levels in the project area. Each location was at the road side and more than 100 m from the road side. Identical to the air quality survey, the surveys at the road sides were to know of the current situation of the noise and vibration levels while at places with more than 100 m away from the road sides were to know of their backgrounds. Noise levels at the road sides of the 5 surveyed cross sections were a bit lower than the MoE's standard during day time and were higher than that of the standard during night time. At the places with more than 100 m away from the road sides, the noise levels were lower than the standard during the day time and were a bit lower than that of the standard during the night time. Higher noise level during the night time is mostly due to active transportation activities of heavy trucks in the project area. Vibration levels at the road sides and at the places with more than 100 m away from the road sides of the 5 cross sections were generally lower than the MoE's standard either day time or night time.
- **Water Quality:** During the Dry Season pH at all the water sampling locations was in the MoE's standard. The TSS was found to be higher than the MoE's standard at 5 water sampling locations: Sampov Meas Reservoir, River at Provincial Boundary, A channel in Svay Commune, Cheung Kreav River, and Ou Chankok River. High in the TSS may be due to sediments from erosion and then resuspended them from the bottom of the rivers and the reservoirs. The BOD ranged in the MoE's standard level. The COD in the river at provincial boundary was higher than its standard level. This may be due to the sampling location is surrounded by residential area, disposing wastewater into the river. It is notable that the higher the chemical oxygen demand, the higher the amount of pollution in river. The Total Coliform heavily exceeded water quality standard in public water area for lake and reservoir determined by the MoE. This is due to the fact that agricultural runoff and animal manures at upstream areas washing out by rains during the rainy season to the rivers and streams. During the Rainy Season: pH at all the water sampling locations was in the MoE's standard. The TSS was found to be higher than the MoE's standard at 8 water sampling locations: Tonle Sap River, River at Provincial Boundary, A channel in Svay Commune, Cheung Kreav River, and Ou Chankok River. High in the TSS may be due to sediments from erosion during the rainy season and then resuspended them from the bottom of the rivers and the reservoirs. The BOD ranged in the MoE's standard level. Total Coliform heavily exceeded water quality standard at

only 1 location. This is due to the fact that runoff at upstream areas washing out by rains during the rainy season to the river.

- **Solid Waste Condition:** 7 locations having official waste management or waste collection service were identified. They are Odongk market in Kampong Speu province, Sala Lek 5 Market, Prey Khmer Market, Kompong Chhnang Town, Pong Ro Market, and Punley Market in Kampong Chhnang province, and Krakor Market in Pursat province. These locations are managed by the wastes collection service providers. Those service providers have Challenges and complained about their difficulties in the service operation. This is due to the fact that some households did not pay for the service but they also disposed their wastes at the market. Another common challenge in wastes management is lack of labour due to high wage while income from the service was limited.
- **Dumping Site:** All open dumping sites were not properly treated. There was no separated wastes disposal at those sites. As a result, organic, toxic, and recyclable wastes were thus disposed together. Burning was the common practice in wastes management of all the service providers. Most of the service providers disposed wastes on their own lands since local authorities were unable to find out proper dumping sites for them. There were two service providers in the Prey Khmer market and the Pong Ro market disposed wastes at the designed areas. The dumping sites were generally a bit far from the urban areas.
- **Illegal Wastes Disposal:** It was common to see people throwing away their wastes into side drains and on road shoulders. In an attempt to know more in-depth, some of those people were asked and then reported that their disposed wastes would disappear either by water flow or somebody else would clean up the wastes due to public areas. As a result, many illegal wastes disposal sites were found and usually observed at bridges, near the rest areas, and at the end of urban areas. There were 11 major illegal wastes disposal areas were noticed. Main sources of the illegal waste disposal are from residents, vendors, and passengers.
- **Offensive Odor:** Offensive odor was mostly observed at dumping sites and market areas where local people disposed garbage. In the project area, a channel at provincial boundary between Kampong Speu and Kampong Chhnang provinces and a channel nearby the Krakor market were found to have offensive odors. This was due to the fact that local people disposed the garbage into those channels.
- **Subsidence:** No any report has been stated about land subsidence in the project area.

- **Natural Environment**
  - Ecosystem around the project area consists of the following land uses:
    + Paddy field and farm land
    + Residential and Urban Areas
    + Natural River and Channel
    + Wetland and Flood Plain
    + Shrublands

    Flora: Vegetation along the project area is mixed. Since the observation area was limited, no any significant forest was found. Fruit trees such as palm, mango, coconut, Jack were commonly observed at villages where people have been living while wild trees were separately found at non-residential areas. Based on direct observations, 117 floras including vine were found along the

project area and the Kampong Chhnang Bypass. Some of the plants could not be written either scientific name or family name.

Fauna: Fauna here refers to fish species, reptiles and amphibians, and bird species that can be found through their presences passing by the project area. 33 main fish species were found through family-scale fishing activities at rivers and streams crossing the project area. Most of those fish species were found during the rainy season. Besides, 8 Mammals, 7 Reptiles, 5 Amphibians and 26 main birds were mainly identified and reported.

Effects of Flood: In the project area, some parts used to get flooded in 2000. Generally, it is said that the benefits of natural floods almost certainly outweight the negative aspects. On the positive side, floods can distribute large amounts of water and suspended river sediment over large areas. The sediment helps replenish valuable topsoil components to lands which are useful for agricultural productivity. On the negative side, flood disrupts physical infrastructures in urban areas and people's daily livelihoods in particular in rural areas. If it is severe enough, toxic materials (paints, pesticides, gasoline, etc..) can release into the local environment..

- **Protected Areas:** There is no protected area in the project area.
- **Hydrology:** Many rivers and streams crossing the project area were identified. Some rivers and streams dried up (seasonal gentle flow) while the other rivers and streams still had little flow (annual gentle flow).

▪ **Social Environment**

- **Administrative Boundary:** The project area, the section from Prek Kdam to Thlea Ma'Am, covers Kandal, Kampong Chhnang, and Pursat provinces with 6 districts. 35 communes is traversed by the existing road and proposed two bypasses.
- **Population:** Population and households included sex ratio and average household size in the project related provinces are shown in table 1. Table 2 shows ratio of population and households in the vicinities of the project area compared to the whole provinces.

Table 1: Population and Households in the Project Related Provinces

Province	Population			Sex Ratio (Male/Female)	Households	Average Household Size
	Total	Male	Female			
Kandal	1,265,280	612,692	652,588	93.9 %	258,393	4.9
Kampong Chhnang	472,341	227,007	245,334	92.5 %	101,260	4.6
Pursat	397,161	192,954	204,207	94.5%	83,745	4.7

Table 2: Ratio of Project Related Population and Household

Province	Population			Household		
	(1)Whole Province	(2) Project Vicinity	Ratio (2)/(1)	(1)Whole Province	(2) Project Vicinity	Ratio (2)/(1)
Kandal	1,265,280	18,090	1.4%	258,393	3,569	1.4%
Kampong Chhnang	472,341	232,560	49.2%	101,260	50,460	49.8%
Pursat	397,161	51,181	12.9%	83,745	10,892	13.0%

- **Culture and Tourism:** The NR No.5 is the main access route to cultural and historical places and tourism zones. The zones are Odongk and Longveak areas are located around 40 km northwest of Phnom Penh. This area was the old capital city of Cambodia after the Angkor era. Rich aquatic ecosystem of the Tonle Sap Lake and rivers can attract foreign tourists for Ecotourism. Kampong Chhnang Port has a small floating jetty for tourist boats and visitors can enjoy cursing. Floating villages where Vietnamese are living, fish cultivation, and flooded forests are the important tourism resources. There are some other points where people can access to the Tonle Sap floating villages and ecosystem along the project area.
- **Physical and Cultural Heritage:** No any physical and cultural heritage was found.
- **Historical and Archaeological, Pale-Ontological or Architectural Significance:** no any historical and archaeological, or architectural significance was found.
- **Socio-Economic Profile of the Affected Households:** 2,111 AHs 62.68% of all AHs (3,368 AHs) losing partially or entirely their assets such as structures, lands and/or trees, were interviewed. The aim is to know of general living conditions in their households. The AHs composed of 10,184 people (5,284 (51.9%) females and 4,900 (48.1%) males). An average household size is 4.8 and sex ratio is 92.7. 92.1% of affected household heads are Khmer and Khmer speaking, 7 % are ethnic minority Cham, who are legally registered as Cambodian citizens; and 0.1 %. Is Christian.

  + Literacy: The male household head literacy rate is 96.4% and female spouse literacy rate is 88.9%. Adult literacy rate of both male and female are 91.2% which is considerably high and the single literacy rate of male and female 96.1% and 86.7%, respectively.

  + Current School Attendance: Information on school attendance was collected in respect to the population aged from 6 to 14 years old and was defined as enrolment and studying at a primary and lower secondary school. The attendance in primary education is 95.3%, while lower secondary school is 96.1%.

  + Affected Households' Head Engaged in Farming and Non-Farming: 28.4% and 66.8% of household heads are working on farms and non-farming, respectively. The rests 4.8% are disable or unable to work.

  + Main Sources of Income of Affected Households: the main income sources of the AHs include 72.8% business/trade followed by 63.8% from agricultural sector, and 57.9% from wages/salary. Remittance of 8.9% from family members is also another main household income source.

  + Affected Households Income: 75.3% of male household heads reported that they are earning an annual income higher than USD 3,000 (among them, 46.6% earning more than USD 5,000 a year), while 15.1% reported an annual income between 2,000 and USD 3,000. Only 0.3% of the male household heads reported that their earnings are less than USD 600 a year. Meanwhile, 51.5% of female household heads reported that they are earning an annual income higher than USD 3,000 (among them, 26.2% earning more than USD 5,000 a year), while 20.2% reported an annual income between USD 2,000 and USD 2,500. The average monthly income of household and capita is USD 525.00 and USD 105.00, respectively. Of all interviewed households, 59.22% has their main income from business/trade, 24.43% has their second main income from wages or salary and 5.58% has their third main income from agricultural sector.

  + Sanitation: regarding to water sources for drinking and cooking, only 4.6% use pipe water from waterworks and 58.1% from protected wells. Moreover, 29.3% buy clean water during the dry

season for their daily consumption. 7.4% use rainwater during the wet season, while 10.8% use water from unprotected wells. Lake/pond was the source of drinking water for only 0.6%, while 0.2% still uses water from stream/river. 73.0% always boil water for drinking purpose. 6.9% sometimes boil water before drinking, while 20.1% drink water without boiling. Besides, 73.2% of the interviewed households have own latrine, while 26.8% do not have access to toilet facilities as they depend on open defecation or sharing toilets with their neighbours.

+ Energy Sources: 16% of the AHs claimed that they use rechargeable stationary batteries for lighting while 77.5% use publicly provided electricity. 6.9% use kerosene lamp. 0.5% of the AHs reported that they use their own generators. Meanwhile, 25.4% use liquefied petroleum gas as their source for cooking, while 70.1% and 36.4% use firewood and charcoal, respectively. Only 3.6% use electricity as their energy source for cooking.

+ Transportation: 65.7% and 75.6% have bicycles and motorbikes, respectively. 3.3% and 10.8% households have trucks and car/pickup/minibus.

5. ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

- **Environmental Pollution:** The potential impacts regarding to environmental pollution is shown in Table 3. The recommended mitigation measures for each identified impact are also presented.

Table 3: Impacts Regarding Environmental Pollution and Mitigation Measures

Item	Impact	Mitigation
Air pollution	**Construction Phase:** ▪ Operation of construction equipment will generate dust and emission gas. ▪ Traffic congestion in construction site will cause increase in exhaust gas from vehicles. ▪ Dust will occur in borrow pit or quarry site. **Operation Phase:** ▪ In the future, total amount of air pollutant caused by vehicle exhaust gas due to increment of vehicle will increase. ▪ On the other hand, the amount is expected to be reduced due to improved traffic efficiency compared to without project.	**Construction Phase:** ▪ The contractor shall prepare and strictly implement dust control measures such as periodical water spray. ▪ The contractor actively uses electrically-powered equipment. ▪ The contractors shall maintain their construction equipments in adequate working conditions. ▪ The contractors shall keep clean road surfaces. ▪ The driver of construction vehicles comply with speed limits to minimize road dust. ▪ The contractor and supervision consultant shall provide prior notification to the local community on schedule of construction activities. ▪ The contractor shall prepare and strictly implement a traffic management plan around construction site. ▪ The supervision consultant shall monitor dust, exhaust gas and complaint from the local people. ▪ If the local residents and pedestrians complain about the dust and gas, the supervision consultant and contractors should reconsider the construction technique and method. **Operation Phase:** ▪ The regulations on fuel quality and importing old cars are to be prepared by MoE in the future. ▪ Emission gas control shall be strictly implemented. ▪ A relevant agency shall monitor air quality on roadside.
Water pollution	**Construction Phase:** ▪ Turbid water caused by construction works is likely to affect	**Construction Phase:** ▪ Construction works in and around rivers streams, reservoirs or channels shall be concentrated in dry

Item	Impact	Mitigation
	existing surface water resources. ▪ Human wastewater will cause surface water contamination. ▪ In case of accidental massive leaking of fuel or oil, water pollution including ground water may occur. ▪ In case of inadequate management in borrow pit or quarry site, turbid water from borrow pit or quarry site by rainfall may cause surface water contamination. **Operation Phase:** ▪ Considerable water pollution is unlikely to occur. ▪ In case of inadequate management or recovery in borrow pit or quarry site, turbid water from borrow pit or quarry site by rainfall may cause surface water contamination.	period. ▪ The contractors shall maintain their construction equipments in adequate working conditions. ▪ The contractor should consider installation of cofferdam as necessary. ▪ The contractor shall strictly control waste oil and other waste. ▪ The contractors will be prohibited from washing the construction tools along the rivers, streams, reservoirs and other public water to prevent further pollution. ▪ In construction works in and around rivers streams, reservoirs or channels, the supervision consultant and contractor should monitor and control the turbid water as necessary. ▪ The wastewater septic tank facility in the workers camp and/or other necessary locations shall be properly maintained. ▪ The supervision consultant shall monitor water quality. ▪ The contractor shall prepare and strictly implement an environmental management plan on borrow pit or quarry site. ▪ In case of purchase from quarry firm, the environmental management shall be included in the contract. **Operation Phase:** ▪ The supervision consultant shall monitor environmental condition in borrow pit or quarry site. ▪ If the condition has risk of soil erosion, the supervision consultant should consider the countermeasures.
Waste	**Construction Phase:** ▪ Construction waste caused by construction works and general waste from construction office will be generated. ▪ Solid waste due to demolish works of facilities in the ROW will generate. **Operation Phase:** ▪ Illegal dumping of solid waste may increase along the newly constructed bypass.	**Construction Phase:** ▪ The contractor shall prepare and strictly implement a proper waste management plan including waste due to demolish works. ▪ The waste management plan should be approved by the local relevant authority in advance of construction works. ▪ The contractors shall provide temporary sanitation facilities such as portable toilets and garbage bins to ensure that the domestic wastes to be generated by the construction personals. ▪ The solid waste should be separated into hazardous, non-hazardous and reusable waste streams and store temporary on site. ▪ Office building for construction contractor shall be provided with toilets and septic tanks to handle domestic sewage. ▪ The contractor shall consider and implement proper re-use plans of the construction waste. ▪ The supervision consultant shall monitor the waste disposal ▪ The local relevant authority should maintain closely consultation with the contractor on the collection of garbage.

Item	Impact	Mitigation
		Operation Phase: ▪ A relevant agency shall monitor and control illegal dumping.
Soil pollution	**Construction Phase:** ▪ Soil pollution caused by construction works will not occur normally. ▪ In case of accidental massive leaking of fuel or oil, soil pollution may occur. **Operation Phase:** ▪ Because the target road mostly passes through agricultural land, leaking of fuel, oil and harmful cargo by traffic accident is likely to cause agricultural soil pollution.	**Construction Phase:** ▪ Because the surplus soil containing contaminated materials may cause negative impact on drainage condition in agricultural land, the proper disposal site should be selected. ▪ Bitumen, diesel and waste oil shall be handled and stored carefully to prevent leakage or spill. Waste oil shall be collected, stored in drums and disposed at a site approved by the local relevant authority. ▪ Waste oil storage shall be in drums, raised off the ground, covered to keep rain out and surrounded by a bund to contain any spills and simplify clean up. **Operation Phase:** ▪ A relevant agency shall monitor and control vehicle speed and laden weight to reduce traffic accident.
Noise and vibration	**Construction Phase:** ▪ Construction works is likely to increase in the noise and vibration level. ▪ Noise and vibration will occur in borrow pit or quarry site. **Operation Phase:** ▪ In the future, noise and vibration levels caused by vehicle driving will increase. ▪ On the other hand, the levels on road side are expected to be reduced due to widening and improved smooth surface compared to without project.	**Construction Phase:** ▪ A proper work schedules should be prepared not to concentrate the construction equipment at a certain point for long time. ▪ The contractors shall maintain their construction equipments in adequate working conditions. ▪ Construction works with heavy noise and vibration shall be prohibited during night (10:00 pm - 6:00 am) to avoid noise disturbance in residential, commercial and other noise-sensitive areas. ▪ The contractor selects quiet equipment and working methods as much as possible. ▪ The contractor and supervision consultant shall provide prior notification to the local community on schedule of construction activities. ▪ The supervision consultant shall monitor noise, vibration and complaint from the local people in construction site, borrow pit and quarry site. ▪ If the local residents and pedestrians complain about the noise and vibration, the supervision consultant and contractors should reconsider the construction technique and method. **Operation Phase:** ▪ The proper countermeasures to reduce noise and vibration such as slow speed in curve sections should be included in the plan and design. ▪ A relevant agency shall monitor noise and vibration on roadside. ▪ If the noise level reaches a significant level such as exceeding the environmental standards, the relevant agency should consider mitigation measures on noise control.
Ground subsidence	**Construction Phase:** ▪ Subsidence near the road due to added soil weight may occur. ▪ Because there are soft ground areas along the proposed bypass,	**Construction Phase:** ▪ Detailed soil investigations should be conducted at subsidence-prone locations in the planning stage. ▪ In the detailed design stage, the detailed geological surveys should be conducted.

Item	Impact	Mitigation
	subsidence near the road due to the soil weight filled on the rice field may occur.	▪ The proper structure design and construction technique should be considered on the basis of the survey results. ▪ The supervision consultant and contractor should monitor the ground subsidence. ▪ If the ground subsidence occurs, the consultant and contractors should reconsider the construction technique.
Offensive odors	**Construction Phase:** ▪ Offensive odors caused by construction works, especially operation of ill-serviced construction equipment and asphalt mixing plant will be generated. **Operation Phase:** ▪ Exhaust gas from vehicles with incomplete combustion may cause offensive odors.	**Construction Phase:** ▪ The contractors shall maintain their construction equipments in adequate working conditions. ▪ The supervision consultant shall monitor offensive odors and complaint from the local people. ▪ If the local residents and pedestrians complain about the offensive odors, the supervision consultant and contractors should reconsider the construction technique and method. **Operation Phase:** ▪ The regulations on fuel quality and importing old cars are to be prepared by the MoE in the future. ▪ Emission gas control shall be strictly implemented.
Bottom sediment	**Construction Phase:** ▪ Filled soil may be eroded by heavy rain and flow into rivers or streams, and be accumulated at the bottom of rivers or streams. Such soil can finally flow into Tonle Sap Lake. However, the impact is likely to be relatively small. ▪ In case of inadequate management in borrow pit or quarry site, erosion in borrow pit or quarry site by rainfall may cause sedimentation on riverbed. **Operation Phase:** ▪ In case of inadequate road design, construction and maintenance, filling sections may collapse and the debris may cause sedimentation on riverbed. ▪ In case of inadequate management or recovery in borrow pit or quarry site, erosion in borrow pit or quarry site by rainfall may cause sedimentation on riverbed.	**Construction Phase:** ▪ Construction works in and around rivers streams, reservoirs or channels shall be concentrated in dry period. ▪ The contractor should consider installation of cofferdam as necessary. ▪ The proper structure design and construction technique should be considered on the basis of the geological survey results. ▪ The contractor shall prepare and strictly implement an environmental management plan on borrow pit or quarry site. ▪ In case of purchase from quarry firm, the environmental management shall be included in the contract. **Operation Phase:** ▪ The supervision consultant shall monitor environmental condition in borrow pit or quarry site. ▪ If the condition has risk of soil erosion, the supervision consultant should consider the countermeasures.
Trans-boundary impacts or climate change	**Construction Phase:** ▪ Trans-boundary impacts including climate change will not occur. ▪ Operation of construction equipment will generate CO_2. **Operation Phase:** ▪ In the future, total amount of CO_2 emission from vehicles will increase. However, because of improved traffic efficiency, the	**Construction Phase:** ▪ The contractor actively uses electrically-powered equipment. ▪ The contractors shall maintain their construction equipments in adequate working conditions. **Operation Phase:** ▪ Relevant agencies should estimate total amount of CO_2 emission from vehicle traffic.

Item	Impact	Mitigation
	amount may be reduced compared to without project.	

- **Natural Environment:** The potential impacts regarding natural environment is shown in Table 4. The recommended mitigation measures for each identified impact are also presented.

Table 4: Impacts Regarding Natural Environment and Mitigation Measures

Item	Impact	Mitigation
Protected areas	**Construction Phase:** ▪ Because the distance between the target section of NR 5 and the core areas is sufficient long, the impacts on the core areas are unlikely to occur. ▪ Because the construction works will be limited within the ROW of NR 5 or the outside of the TSBR, the direct impacts on natural resources in the buffer or transition zone of the TSBR are unlikely to occur. ▪ Rivers or streams that have direct and/or indirect connections with TSBR will be temporarily disturbed by construction works. ▪ Road widening will require loss of existing vegetation along the buffer or transition zone of the TSBR. **Operation Phase:** ▪ Because natural tree clearing and change of river flow will not be required, direct impacts on the natural resources are unlikely to occur. ▪ The project is unlikely to cause new environmental issues or deteriorate existing issues in TSBR. ▪ However, because a portion of the target road runs alongside the line of the buffer zone in TSBR, indirect impacts on some components in the TSBR may occur sometime in the future.	**Construction Phase:** ▪ Vegetation loss for land clearing should be minimal and in limited areas of the ROW. ▪ To identify impacts on aquatic life and consider the mitigations, the supervision consultant should staff specialists on fauna or ecosystem as necessary. **Operation Phase:** ▪ Relevant agencies should monitor the environmental conditions along the target section in the buffer zone or transition zone. ▪ If troubles of some sort occur, the agencies should consider the countermeasures.
Ecosystem	**Construction Phase:** ▪ Vegetation in roadside including trees will be lost by widening works. However, tree clearing of community or flooded forest will not be required. ▪ Agricultural ecosystem will be lost or disturbed by construction works. ▪ Turbid water caused by bridge construction is likely to affect aquatic life.	**Construction Phase:** ▪ Vegetation loss for land clearing should be minimal and in limited areas of the ROW. ▪ The contractor and supervision consultant shall prepare and strictly implement vegetative restoration plans such as tree planting and sowing on road side. ▪ The supervision consultant shall consider impacts of foreign species in the vegetative restoration plans. ▪ The contractor and supervision consultant shall prepare and strictly implement proper construction plans to minimize disturbance in existing agricultural

Item	Impact	Mitigation
	▪ Ecosystem in wetland around Ou Prong River crossing point may be disturbed by the construction activity. **Operation Phase:** ▪ Because the target road mostly passes through well developed area such as agricultural land and urban area, impact on biodiversity is unlikely to occur. ▪ Because the distance between the target road and Tonle Sap lakeside is approximately 4 km at the nearest point, direct impact on ecosystem in Tonle Sap Lake is unlikely to occur. ▪ If the embankment sections choke off or change existing surface water flow, impact on remote aquatic ecosystem may occur.	cannels and reservoirs. ▪ The supervision consultant shall monitor water quality including turbidity. ▪ Construction works in and around rivers, streams, reservoirs or channels shall be concentrated in dry period. ▪ To reduce turbid water, steel sheet pile construction method should be selected in bridge construction works as necessary. ▪ To identify impacts on aquatic life and consider the mitigations, the supervision consultant should staff specialists on fauna or ecosystem as necessary. ▪ The contractor should consider installation of cofferdam as necessary. **Operation Phase:** ▪ To maintain existing surface flow condition, locations of existing bridges and culverts should not be changed. ▪ The proper countermeasures to maintain existing surface flow condition in embankment sections should be included in the design such as sufficient cross-section area of flow and culverts with sufficient flow capacity.
Hydrology	**Construction Phase:** ▪ Water flow in the river or stream may be altered during construction works. But the impact will be temporary and in limited area. **Operation Phase:** ▪ Because some project sites are located in flood plain, impact caused by newly constructed embankment on surface water flow may occur.	**Construction Phase:** ▪ The contractor and supervision consultant shall prepare and strictly implement proper construction plans to minimize disturbance in rivers and existing agricultural cannels. **Construction Phase:** ▪ Locations of the existing bridges and culverts should not be changed. ▪ The proper countermeasures to keep existing surface water flow in embankment sections should be included in the design such as culverts with sufficient capacity.
Geographical features	**Construction Phase:** ▪ Topography will be changed in bypass or embankment sections on a small scale. ▪ Topography will be changed in borrow pit and quarry site. **Operation Phase:** ▪ Impact on geographical features is unlikely to occur.	**Construction Phase:** ▪ The contractor shall prepare and strictly implement an environmental management plan on borrow pit or quarry site. ▪ In case of purchase from quarry firm, the environmental management shall be included in the contract.

- **Social Environment:** The potential impacts regarding social environment is shown in Table 5. The recommended mitigation measures for each identified impact are also presented.

Table 5: Impacts Regarding Social Environment and Mitigation Measures

Item	Impact	Mitigation
Resettlement/ Land Acquisition	**Pre-Construction Phase:** ▪ Resettlement and additional land acquisition will be required. ▪ Affected households including partial asset losses may be more than 2,000. **Construction Phase:** ▪ Additional small scale land acquisition and resettlement may be required. ▪ Temporal lease of land will be required for construction yard. **Operation Phase:** ▪ Additional physical resettlement and land acquisition will not be required.	**Pre-Construction Phase:** ▪ Authorities concerned shall prepare and strictly implement a proper Resettlement Action Plan (RAP) and Land Acquisition Plan (LAP). **Construction Phase:** ▪ Authorities concerned shall prepare and strictly implement the proper RAP and the LAP. ▪ The contractor shall provide proper compensation to land owners or users.
Poor people	**Pre-Construction Phase:** **Construction Phase:** **Operation Phase:** ▪ Some of the poor people who do not have their own land living within Right of Way or Provisional Road Width will be affected by resettlement and lose their business opportunity.	**Pre-Construction Phase:** **Construction Phase:** **Operation Phase:** ▪ Authorities concerned shall prepare and strictly implement the proper RAP and the LAP including fair compensating methods.
Ethnic minorities and indigenous peoples	**Pre-Construction Phase:** **Construction Phase:** ▪ Road widening may cause resettlement or other impacts on Ethnic Cham and Vietnamese living along the NR No.5 **Operation Phase:** ▪ Impact on ethnic minorities is unlikely to occur.	**Pre-Construction Phase:** **Construction Phase:** ▪ Authorities concerned shall prepare and strictly implement the proper RAP and the LAP including fair compensating methods.
Local economies, such as employment, livelihood, etc.	**Pre-Construction Phase:** ▪ Land acquisition and resettlement may cause livelihood degradation of Project Affected Persons (PAPs). ▪ Road widening will require acquisition of agricultural lands as agricultural resources. However, the required land will be very small to the total agricultural land. **Construction Phase:** ▪ Construction will create job opportunities to local people. ▪ Bridge construction works may	**Pre-Construction Phase:** ▪ Authorities concerned shall prepare and strictly implement the proper RAP and the LAP including fair compensating methods. ▪ Proper compensations including recovery fee for roadside agricultural lands should be provided to the land owners or users. **Construction Phase:** ▪ The contractor shall prepare and strictly implement a fair hiring plan of local people as construction worker. ▪ The contractor should give priority to the PAPs in hiring local people. ▪ The contractor and supervision consultant shall

Item	Impact	Mitigation
	have impacts on local fishery. **Operation Phase:** ▪ Reduction of travel time will contribute to local economies and promote tourism. ▪ Change of access to local resources may widen gap in local economy. ▪ If the embankment sections choke off or change existing surface water flow, impact on local fishery may occur.	provide prior notification to the local community and fisherpersons on the schedule of construction activities and restricted areas, especially bridge construction works. ▪ The contractor and supervision consultant should periodically hold sufficient local stakeholder meetings in the pre-construction stage and during construction works, and establish mutual understanding with the PAPs as necessary. **Operation Phase:** ▪ The local government should monitor local economy and livelihood. ▪ If troubles of some sort occur, the local government should consider the countermeasures.
Land use and utilization of local resources	**Construction Phase:** ▪ Bypass sections will require change of land use, mainly from agricultural land to ROW. **Operation Phase:** ▪ Especially in bypass sections, land use along the NR No.5 will be changed and be developed economically and socially. ▪ Improved transportation will contribute to effective utilization of local resources.	**Construction Phase:** ▪ The contractor and supervision consultant shall provide prior notification to the local community on schedule of construction activities. ▪ The contractor and supervision consultant should periodically hold sufficient local stakeholder meetings in the pre-construction stage and during construction works, and establish mutual understanding with the PAPs as necessary. **Operation Phase:** ▪ The local government should monitor local economy and land use. ▪ If troubles of some sort occur, the local government should consider the countermeasures.
Water usage	**Construction Phase:** ▪ Existing agricultural channels located in roadside will be affected by widening works. **Operation Phase:** ▪ Newly constructed embankment or culverts may change surface water flow.	**Construction Phase:** ▪ The contractor and supervision consultant shall provide prior notification to users of agricultural channels on schedule of construction activities. ▪ The contractor and supervision consultant should periodically hold sufficient local stakeholder meetings in the pre-construction stage and during construction works, and establish mutual understanding with the PAPs as necessary. ▪ The proper countermeasures to reduce impact on present water usage should be included in the construction plan. **Operation Phase:** ▪ The proper countermeasures to reduce impact on present water usage should be included in the road design. ▪ Relevant agencies should monitor water usage and flow. ▪ If troubles of some sort occur, the agencies should consider the countermeasures.
Existing social infrastructures and services	**Pre-Construction Phase:** ▪ Relocation or protection of existing utilities, such as electric poll, water pipe and optical fiber cable will be required.	**Pre-Construction Phase:** ▪ Detailed existing survey should be conducted in the planning stage. ▪ The contractor and supervision consultant should periodically hold sufficient meetings with the utility owners in every stage and establish mutual

Item	Impact	Mitigation
	Construction Phase: ▪ Temporary traffic congestion in construction site including NR 5 and other rural roads will occur. **Operation Phase:** ▪ Access to social services will be improved. ▪ Road crossing of pedestrians and livestock will become harder due to widening. ▪ Spilt of local communities or widening disparity may occur in bypass section.	understanding. ▪ Proper relocation plans should be prepared and strictly implemented in advance of contraction works. **Construction Phase:** ▪ The contractor and supervision consultant shall provide prior notification to local people and drivers on schedule of construction activities. ▪ The contractor shall prepare and strictly implement a traffic management plan around construction site. **Operation Phase:** ▪ The proper countermeasures to support road crossing of pedestrians and livestock, such as crosswalk or road traffic sign to inform livestock crossing should be considered on the basis of site survey in the detail design stage. ▪ Relevant agencies should monitor the utility and local communities. ▪ If troubles of some sort occur, the agencies should consider the countermeasures.
Social institutions such as social infrastructure and local decision-making institutions	**Construction Phase:** **Operation Phase:** ▪ Because of improvement project of existing road, considerable impact on social institutions is unlikely to occur. ▪ Spilt of local communities or widening disparity may occur in bypass section.	**Construction Phase:** **Operation Phase:** ▪ The local government should monitor community relationship around road. ▪ If troubles of some sort occur, the local government should consider the countermeasures.
Misdistribution of benefits and damages	**Pre-Construction Phase:** **Construction Phase:** ▪ Considerable misdistribution of benefit is unlikely to occur. ▪ In case of unfair hiring of construction workers, misdistribution of benefit may occur. **Operation Phase:** ▪ After the traffic flow is changed to new bypass, some shops along the existing NR No.5 (old route) will lose their business opportunity, while shops set up along bypass will make profit.	**Pre-Construction Phase:** **Construction Phase:** ▪ The contractor shall prepare and strictly implement a fair hiring plan of local people as construction worker. **Operation Phase:** ▪ The local government and supervision consultant shall provide prior notification to the shop owners on schedule of the bypass project in early stage.
Cultural heritage	**Pre-Construction Phase:** **Construction Phase:** ▪ Proposed Odongk bypass will have minor impacts on Longveaek remains. **Operation Phase:** ▪ Road improvement will promote tourism and worship to religious heritage. Religious value may be spoiled by tourism development.	**Pre-Construction Phase:** **Construction Phase:** ▪ Authorities concerned shall conduct a proper archeological survey and preserve the record in advance of construction works. ▪ Archeological fragments found during construction works should be stored in proper facilities. **Operation Phase:** ▪ Relevant agencies should monitor the cultural heritage.

Item	Impact	Mitigation
		▪ If troubles of some sort occur, the agencies should consider the countermeasures.
Landscape	**Construction Phase:** ▪ Vegetation at existing roadside including high trees will be lost by widening works, and cause change of landscape. **Operation Phase:** ▪ Because there are no protected scenic view areas, considerable impact on landscape is unlikely to occur. ▪ Embankment road may not blend in with paddy field scene.	**Construction Phase:** ▪ Minimal vegetation should be lost for land clearing. **Operation Phase:** ▪ The contractor and supervision consultant shall prepare and strictly implement vegetative restoration plans such as tree planting and sowing on road side.
Gender	**Construction Phase:** **Operation Phase:** ▪ Impact on street venders, especially women, may occur.	**Construction Phase:** **Operation Phase:** ▪ The contractor and supervision consultant should periodically hold sufficient local stakeholder meetings in the pre-construction stage and during construction works, and establish mutual understanding with the PAPs as necessary.
Children's rights	**Construction Phase:** ▪ Considerable impact only on children's rights is unlikely to occur. **Operation Phase:** ▪ Road improvement may cause traffic accident of children due to more traffic volume and faster vehicle speed. ▪ Traffic venerable people including children can be separated safely from main vehicle lane.	**Operation Phase:** ▪ Relevant agencies shall monitor and control vehicle speed to reduce traffic accident. ▪ Local educational institutes should conduct traffic safety training to children.
Infectious diseases such as HIV/AIDS	**Construction Phase:** ▪ Infection risks of HIV/AIDS may be increased among construction workers and local business offering food and entertainment. **Operation Phase:** ▪ Considerable impact on infectious diseases is unlikely to occur.	**Construction Phase:** ▪ The contractor shall prepare and strictly implement educational program on infection risks for construction workers. ▪ The educational program should be included in the construction contract.
Working conditions (including occupational safety)	**Construction Phase:** ▪ Dust and emission gas caused by construction works may affect workers health. ▪ Sanitary conditions around construction site may get worse due to waste from workers and toilet. **Operation Phase:** ▪ Considerable impact on working conditions is unlikely to occur.	**Construction Phase:** ▪ The contractor shall prepare and strictly implement dust control measures such as periodical water spray. ▪ The contractors shall maintain their construction equipments in adequate working conditions. ▪ The contractors shall provide temporary sanitation facilities such as portable toilets and garbage bins to ensure that the domestic wastes to be generated by the construction personals. ▪ The solid waste should be separated into hazardous, non-hazardous and reusable waste streams and store temporary on site.

Item	Impact	Mitigation
		▪ The supervision consultant shall monitor the waste disposal
Accidents	**Construction Phase:** ▪ Traffic accident may occur surrounding of construction site. **Operation Phase:** ▪ Traffic safety including pedestrians will be improved by road widening and vehicle separation ▪ Traffic accident due to more traffic volume and faster vehicle speed may increase ratio of traffic accident.	**Construction Phase:** ▪ The contractor shall prepare and strictly implement a traffic management plan around construction site. **Operation Phase:** ▪ The proper countermeasures to reduce traffic accident should be included in the road design. ▪ A relevant agency shall monitor and control vehicle speed to reduce traffic accident. ▪ The local government should conduct traffic safety campaign.

- **Positive Impacts:** The proposed development project will provide a long term numerous beneficial impacts either environmental factor or socio-economic factor to individuals, communities, as well as to the entire country. Environmentally, the project will have improved air quality, reduced noise/vibration disturbance due to reduction traffic congestion in the project area. Socioeconomically, beneficial impacts will appear during the construction and operation phases, all of which are as follows:
- **During the Construction Phase:** Three beneficial impacts including Employment Generation, Skill Enhancement, and Local Trade and Business Opportunity are identified.
  + Employment Generation: The project will generate direct employment opportunities to the local people in the project construction zone. As the project involves construction work it will offer a grand opportunity for various skilled and non-skilled work forces. The amount of money earned by the local people will directly affect the local economy thereby reducing the chances of seasonal migration of the local people. The project will provide short term direct employment benefit to majority of the construction workers. In order to augment such benefits, priority will be given to employ local laborers as far as possible.
  + Skill Enhancement: The construction of the project will not only provide direct employment opportunities but also ensure the transfer of skills and technical proficiency to the local workforce. The project activities such as constructing bridges, culverts, and related infrastructures will provide transferable skills. In future these skills will be a plus point for the locals in any relevant work as such.
  + Local Trade and Business Opportunity: The project will directly add in building business opportunity in particular in the newly constructed bypass. As construction work involves a lot of manpower, a number of shops pertaining to food items will gain a momentum around the vicinity of the construction site. This will boost on local trade and business sector.
- **During the Operation Phase:** Availability of the newly widened road and the newly constructed bypass is one of the necessary human needs and will significantly contribute towards improving the quality of life. People will save travel time through smooth traffic from the project rehabilitation and reduce accident costs due to the reduced traffic densities compared to the original road. Finally, the project would significantly promote Cambodia's economic growth.

6. ANALYSIS OF ALTERNATIVES

- For the improvement of the project area, three alternatives of cross section and 0 option were studied. Table 6 compares advantages and disadvantages of these alternatives. After discussions among relevant organizations including the MPWT, the DPWT and the JICA Team, Alternative 2 was adopted.

Table 6: Comparison of Alternatives of Improvement of the Existing NR No.5

Alternatives	Alt-0 : Zero Option; No action	Alt-1 : Existing road width is maintained; Only pavement is improved into asphalt concrete.	Al-2 : Widen into 4-lane; pavement is improved into asphalt concrete.	Alt-3 : Widen into 'Opposed 2-lane + MC lane on both sides; pavement is improved into asphalt concrete
Objective	Maintain the existing conditions. No impact to social & natural environment. No construction cost is required.	Resettlement is not required. Pavement is improved so that maintenance cost can be reduced.	Secure sufficient traffic capacity and smooth traffic. Improve traffic safety by slow traffic & fast traffic.	Reduce construction cost and number of households/houses to be relocated, securing required traffic capacity.
Social Impact	No resettlement required.	Same as Alt-1.	Large number of households/ houses	Considerable number of (less than in Alt-2) households/houses need to be relocated.
Impact to Natural Environment	Exiting conditions are maintained and no impact to natural environment is anticipated.	Only pavement structure is changed and practically no impact to natural environment is anticipated.	Since the main work is widening of an existing road, no large impacts are anticipated.	Same as Alt-2.
Impact to Living Environment/ Pollution	There is a high possibility of traffic jam as traffic volume increase in future. When traffic jam occurs, travel speed is decreased and frequency of stop & start increases, resulting in increase in emission of pollutant.	Same as Alt-0.	Possibility of traffic jam is substantially reduced eve if traffic volume increase in future and increase of emitted pollutant is prevented.	Same as Alt-2 in principle; however, smaller traffic capacity than in Alt-2 will result in traffic jam and increase of emitted pollutants starting at earlier time in future.
Traffic Safety	High risk of traffic accident due to narrow road width which forces travelling in the opposite lane when overtaking.	Same as Alt-0: Risk of accident increases due to higher travel speed which becomes possible owing to improved road surface.	Slow traffic, such as agricultural tractor, and fast traffic, such as passenger car, are separated resulting in less risk of accident. Also, risk of head-on collision is decreased since necessity to travel in the opposite lane for overtaking is greatly reduced. On the other hand, risk of accident may increase due to increased travel speed of vehicles.	Slow traffic and fast traffic are separated and risk of accident is decreased, although to less extent than in Alt-2.

Alternatives	Alt-0 : Zero Option; No action	Alt-1 : Existing road width is maintained; Only pavement is improved into asphalt concrete.	Al-2 : Widen into 4-lane; pavement is improved into asphalt concrete.	Alt-3 : Widen into 'Opposed 2-lane + MC lane on both sides; pavement is improved into asphalt concrete
Road/transport Function	Smooth traffic cannot be secured due to traffic jam which will occur as traffic volume increase in future.	Same as Alt-0.	Smooth traffic can be secured owing to sufficient traffic capacity.	Same as Alt-2 in principle; however, traffic jam will start to occur at earlier time in future than in Alt-2 because traffic capacity is smaller than Alt-2.
Influence to Socio-Economic Activities and Regional Development	Sound growth of socio-economic activities is hampered, resulting in impedance in regional development, caused by traffic congestion.	Same as Alt-0.	Smooth traffic is secured resulting in growth in socio-economic activities and regional development. Increased job opportunities for local laborers and increase demand for consumer goods contributes to increase in gross income of the region.	Same as Alt-2 in principle; however, there is a possibility that traffic congestion start earlier than in Alt-2 and socio-economic activities and regional development will be hampered.
Construction Cost/ Maintenance Cost	No construction cost is required while maintenance cost remains large due to vulnerable pavement.	Cost for improvement of pavement is required. On the other hand, maintenance cost is reduced since pavement becomes durable.	Costs for resettlement, civil works of widening, pavement etc are required. On the other hand, maintenance cost is reduced owing to improved durability of pavement.	Same as Alt-2 in principle; costs for resettlement, widening, pavement etc are smaller than in Alt-2 due to narrower road width.

- Bypass Construction Table 7 and 8 compare advantages and disadvantages of the main alternatives "Kampong Chhnang Bypass" and "Odongk Bypass". In the selection of these alternative routes, the factors such as Number of houses which need to be relocated, Traffic function as a bypass, Formation of future expansion of urbanized area, Loss of agricultural land, Construction cost, Impact to ecosystem including the Tonle Sap Lake, and Results of stakeholder meetings were considered. After discussions among relevant organizations including the MPWT, the DPWT, local governments and the JICA Team, Alternative 2 Route 3 as Kampong Chhnang Bypass and Alternative 2 Route 2 as Odongk Bypass were adopted, respectively.

Table 7: Comparison of Alternatives of Kampong Chhnang Bypass

Alternatives	Alt-1: Widening of the Existing NR No.5	Alt-2: Bypass Construction		
		Route 1 (L=4.9 km)	Route 2 (L=9.6 km)	Route 3 (L=12.1 km)
Resettlement of Households/ Houses	Many households/ houses need to be relocated since the NR No.5 is passing through an urbanized area.	Many households/ houses need to be relocated since the road to be widened is passing through an urbanized area.	Number of households/ houses which needs to be relocated is less than that in Route 1, since the road to be widened is located in the suburbs. Still considerable number of	Less than 10 houses need to be relocated at and near the intersection with the existing NR 5 in the north. Thus, the number of houses to be relocated is much

Alternatives	Alt-1: Widening of the Existing NR No.5	Alt-2: Bypass Construction		
		Route 1 (L=4.9 km)	Route 2 (L=9.6 km)	Route 3 (L=12.1 km)
			households/ houses need to be relocated.	less than those in Route 1 and 2.
Land Acquisition	No land acquisition is necessary since the land within 30m from the road center has been designated as the right of way (ROW).	Acquisition of additional land is necessary for widening of the existing road. In addition, acquisition of whole ROW is necessary for the section from the intersection with the NR No.53 to east which is newly constructed.	Same as Route 1, in general. The area to be newly acquired becomes larger than in Route 1 since the length of newly constructed section is longer than in Route 1.	ROW over whole section length and whole road width needs to be newly acquired. Loss of agricultural land becomes larger than in other alternative routes.
Acceptance by the Affected People	People living in the roadside lands usually welcome improvement of the road in front of their property (land) since the value of the land becomes higher. However, in case that the road is already wide and paved, they may oppose to road improvement.	People living in the roadside lands usually welcome improvement of the road in front of their property (land) since the value of the land becomes higher. Thus, improvement and/or widening of the suburban road is usually well accepted by the affected people.	Same as in Route 1.	Owner of the properties along the Bypass welcome construction of the Bypass since the value of the land becomes higher.
Noise, Vibration, Air Pollution	Through traffic passes through the city center, resulting in increased noise, vibration and air pollution.	Through traffic is expected to divert to the Bypass. However, this will simply divert or distribute the source of noise, vibration and air pollution to the Bypass and not reduce them in total.	Through traffic will divert to the Bypass in the suburban area whose roadside is less populated, and noise, vibration and air pollution in the city center will decrease.	Through traffic will divert to the Bypass in the suburban area whose roadside is sparsely populated, and noise, vibration and air pollution in the urbanized area will decrease.
Traffic Accident	Through traffic passes through the city center and risks of traffic accident will increase as the traffic demand will grow in the future.	Risks of traffic accident are expected to decrease since the road is traversing less-densely populated suburban area. However, the Bypass passes through residential area and degree of decrease in traffic accident is less than that in Route 3.	While traffic volume passing through the city center and traffic accident will decrease, there will be newly created risks of accidents on the Bypass. Total number of traffic accident is expected to decrease since the safety environment of the Bypass is more favorable than that of existing NR No.5 in the	Same as in Route 2.

Alternatives	Alt-1: Widening of the Existing NR No.5	Alt-2: Bypass Construction		
		Route 1 (L=4.9 km)	Route 2 (L=9.6 km)	Route 3 (L=12.1 km)
			city center.	
Impact on Natural Environment	No substantial change is anticipated since the project is to widen the road which has been existing for long time.	The section from the intersection with the NR No. 53 to east which is newly constructed in the land which is mainly use for agriculture. This may cause interruption or separation of activity areas of biology.	The section from the intersection with the NR No. 53 to east which is newly constructed in the land which is mainly use for agriculture. This may cause interruption or separation of activity areas of the biology.	The newly constructed Bypass may interrupt/ separate the activity areas of the biology.
Road Function/Traffic Function	Travel speed of vehicles is forced to slowdown by congestion, signals at intersections and other obstacles, resulting in reduction in efficiency of transport. In addition there are many bends in the existing NR No.5 in the urbanized area of Kampong Chhnang which forces further slowdown of traffic.	The proposed route traverses the periphery of existing urbanized area. Thus, it provides easier access to/from the city center. On the other hand, roadside area of the Bypass will be urbanized and the function as bypass may be lost in the near future.	The proposed route is sufficiently away from the existing urbanized area and it is expected that the Bypass maintain the function of bypass for long future.	Diversion of through traffic is fully attained. This is essential function of a bypass. The route is sufficiently away from the exiting urbanized area and it is expected that the Bypass maintain the function of bypass for long future. Further, the proposed route short-cut the existing NR No.5 and travel distance is reduced.
Construction Cost	Volume of required works is less than other alternatives, and the cost is a minimum price among the alternatives.	Lowest next to Alt-1.	Larger than Route 1.	Larger than Route 1 and 2 because the length of the Bypass is longer than in Route 1 and 2.

Table 8: Comparison of Alternatives of Odongk Bypass

Alternatives	Alt-1: Widening of the Existing NR No.5	Alt-2: Bypass Construction	
		Route 1 South of Odongk Town (L=9.9 km)	Route 2 North of Odongk Town (L=4.9 km)
Resettlement of Households/ Houses	Many households/houses need to be relocated since the NR No.5 is passing through an urbanized area.	Large scale relocation is not required.	Large scale relocation is not required.
Land Acquisition	No land acquisition is necessary since the land within 30m from the road center has been designated as the right of way (ROW).	Acquisition of additional land is necessary for widening of the existing road.	Same as Route 1, in general. The area to be newly acquired becomes smaller than in Route 1 since the length of newly constructed section is shorter than in Route 1.
Acceptance by the Affected People	People living in the roadside lands usually	Owner of the properties along the Bypass welcome	Same as in Route 1.

Alternatives	Alt-1: Widening of the Existing NR No.5	Alt-2: Bypass Construction	
		Route 1 South of Odongk Town (L=9.9 km)	Route 2 North of Odongk Town (L=4.9 km)
	welcome improvement of the road in front of their property (land) since the value of the land becomes higher. However, in case that the road is already wide and paved, they may oppose to road improvement.	construction of the Bypass since the value of the land becomes higher.	
Noise, Vibration, Air Pollution	Through traffic passes through the city center, resulting in increased noise, vibration and air pollution.	Through traffic will divert to the Bypass in the suburban area whose roadside is sparsely populated, and noise, vibration and air pollution in the urbanized area will decrease.	Same as in Route 1.
Traffic Accident	Through traffic passes through the city center and risks of traffic accident will increase as the traffic demand will grow in the future.	While traffic volume passing through the city center and traffic accident will decrease, there will be newly created risks of accidents on the Bypass. Total number of traffic accident is expected to decrease since the safety environment of the Bypass is more favorable than that of the existing NR No.5 in the city center.	Same as in Route 1.
Impact on Natural Environment or others	No substantial change is anticipated since the project is to widen the road which has been existing for long time.	The proposed route has high possibility of encountering historical heritage due to looseness to Phnom Odongk.	The proposed route is away from Phnom Odongk
Road Function/Traffic Function	Travel speed of vehicles is forced to slowdown by congestion, signals at intersections and other obstacles, resulting in reduction in efficiency of transport. In addition there are many bends in the existing NR No.5 in the urbanized area of Odongk Town which forces further slowdown of traffic.	The proposed route directly connecs to NR No.51 (A) and passes west hemisphere of urbanized area. Road side area will be urbanized & function of bypass will be reduced in near future. Travel distance becomes longer than the existing NR No.5.	Pass hemisphere of urbanized area. Road side area will be urbanized & function of bypass will be reduced in near future. Horizontal alignment is not smooth.
Construction Cost	Volume of required works is less than other alternatives, and the cost is a minimum price among the alternatives.	Larger than Route 2 because the length of the Bypass is longer than in Route 2.	Lowest next to Alt-1.

7. ENVIRONMENTAL MANAGEMENT PLAN

The EMP provides institutional arrangement, environmental monitoring plan during construction and operation, and training and staffing. The EMP objectives are to show the tasks which will be implemented by relevant governmental institutions at local, provincial and national levels and to suggest parameters need to be monitored in the project phases. It should be noted that the EMP is considered as an operational document that will be frequently updated by the project owner/ the MPWT with assistance/advice from a supervision consultant to reflect on-site project activities.

- **Institutional Arrangement:** Implementation of the EMP will be carried out by the project owner, the MPWT, in cooperation with governmental institutions at national, provincial and local levels. At the national level, the MPWT will cooperate with Department of EIA and Department of Pollution Control of the MoE, Department of Hydrology and River Works of Ministry of Water Resources and Meteorology, the Ministry of Land Management, Urban Planning and Construction and Inter-Ministerial Resettlement Committee of the Ministry of Economic and Finance. At the provincial level, the MPWT will closely work with its departments, Provincial Department of Environment, Provincial Department of Water Resources and Meteorology, Provincial Department of Land Management Urbanized Planning and Construction, related governmental departments and local authorities in all the relevant provinces. At local level, the MPWT will work with local authorities for the facilitation, controlling, and solving of any social conflicts that may happen in the project area.
- **Environmental Monitoring Plan:** The EMoP is one of the vital processes of the EMP. It is included items to be monitored by project phase, location, frequency, and responsible unit. Table 9 shows suggested EMoP need to be monitored.

Table 9: Suggested Monitoring Parameters

Items	Unit	Location	Frequency	Responsible Unit
Construction Phase				
I- Air pollution 1- PM 10µm 2- PM 2.5µm 3- NO2 4- SO2)	 mg/m^3 mg/m^3 mg/m^3 mg/m^3	Construction site	One time in the dry season and one time in the rainy season through the entire construction period	Supervision Consultant (Analyzed by DPC)
5- Dust Condition (Visible survey)	-	Construction site	Daily	Supervision Consultant Construction Contractor
II- Noise and Vibration	dB	Construction site	Two time per year through the entire construction period	Supervision Consultant (Analyzed by DPC)
III- Surface water quality 1- pH 2- TSS 3- BOD5 4- COD 5- Total Coliform	 - mg/l mg/l mg/l MPN/100ml	Bridge or culvert construction sites and construction sites adjacent to agricultural channels and reservoirs	One time in the dry season and one time in the rainy season through the entire construction period	Supervision Consultant (Analyzed by DPC)
6-pH (by potable pH meter 7-Turbidity	- NTU etc.	Construction site	Monthly As required	Supervision Consultant Construction

Items	Unit	Location	Frequency	Responsible Unit
				Contractor
IV- Construction Wastes	-	Construction sites and worker camps	Daily	Supervision Consultant Construction Contractor
V- Roadside tree felling and vegetation loss	-	Construction site	Daily	Supervision Consultant
VI- Opinion from local people	-	Construction sites and worker camps	Monthly As required	Supervision Consultant
VII- Environmental condition in borrow pit and quarry site	-	Borrow pit and quarry site	Monthly	Supervision Consultant
VIII- Accident	-	Construction site	Daily	Supervision Consultant
Operation Phase				
I- Air pollution 1- PM 10µm 2- PM 2.5µm 3- NO2 4- SO2	 mg/m^3 mg/m^3 mg/m^3 mg/m^3	3 cross-sections in the target section of NR 5	One time in the dry season and one time in the rainy season during two years	MPWT (Analyzed by DPC)
II- Noise and Vibration	dB	3 cross-sections in the target section of the NR No.5	One time per year during two years	MPWT (Analyzed by DPC)
III- Environmental condition in borrow pit and quarry site	-	Borrow pit and quarry site	One time in rainy period during two years	MPWT
IV- Environmental condition in TSBR	-	Buffer zone or Transition zone of the TSBR along the NR No.5	One time per year during five years	MPWT Cambodia National Mekong Committee
V- Social and economical aspect such as land use, market price and economic activities	-	Cities and towns along the NR No.5	One time per year during two years	MPWT Local Government

- **Training and Staffing:** In order to assist the project construction phase smoothly, trainings will be provided for few engineers from the MPWT and the MoE due to their limitations in site monitoring and management and environmental knowledge. 4 and 2 engineers are for site monitoring and management and for environmental monitoring, respectively. The training budget is responsible by the MPWT and is about US$ 8,550.
- **Cost Estimation of the EMP:** The estimation for environmental monitoring cost is US$ 24,000.

8. PUBLIC PARTICIPATION AND CONSULTATION

The consultation meetings with the AHs were conducted with participation from commune/village leaders. The purpose of the meeting is to inform the AHs about the Project, land acquisition, IOL survey schedule and cut-off date. There were questions and answers recorded. The key questions raised include replacement value and options for resettlement. The AHs were assured that they would be paid at replacement cost reflecting the current market price and as per the entitlement matrix, which will be disclosed to the affected people/community.

9. RESETTLEMENT ACTION PLAN

- Generally, a PRW of the project is within ROW which is the state land, except the two bypasses that need to acquire private land for the project implementation. For the project area, the RAP is required based on the Cambodian Laws and Regulations and the JICA Guidelines for Environmental and Social Considerations as of April 2010. The RAP is prepared based on census and IOL, and baseline SES.
- The objective of the Project Resettlement Policy is to ensure that AHs are not worse off because of the Project. The Project should provide an opportunity for the local people to derive benefits from it, and it should likewise serve as an occasion for the local people to participate in its planning and implementation, thereby engendering a sense of ownership over the same.
- The IOL was conducted along the project area and the new bypasses within the PRW of 20 meters from the centerline. As a result, a total of 3,368 households will be affected by the Project. Of the total AHs, 706 AHs will lose their private land and 1,079 AHs along the project area and the two bypasses will lose their main structures (house, house-shop and/or shop/restaurant). A total of 609,483.50 m² of private land in the two bypasses, in which 579,255.87 m² (95.04% of the total affected private land) is rice land, will be acquired for the Project. The affected private land belongs to 1,060 AHs along the project area, and 19 AHs along the two bypasses. A total of 14,326 trees of various species and ages were identified. They are collectively shown in table 10.

Table 10: Affected households along the project area and the bypasses

Province/District	#AHs by section			Total AHs
	The Project Area	Bypass		
		Kampong Chhnang	Odong	
Pursat/ Krakor district	616	0	0	616
Kampong Chhnang	1,948	585	78	2,611
Baribour district	651	0	0	652
Kampong Tralach district	671	0	78	749
Rolea B'ier district	489	585	0	1,074
Sameakki Mean Chey district	137	0	0	137
Kandal/ Ponhea Leu district	98	0	43	141
Total	**2,662**	**585**	**121**	**3,368**

- The estimated costs for resettlement and land acquisition is **USD 10,037,464.10**, which includes cash compensation and assistance of USD 8,882,711.60, external monitoring and income restoration of USD 266,481.35, administration cost of 5% equivalent to USD 444,135.58, and contingency of 5% or equivalent to USD 444,135.58.

10. PROJECT ECONOMIC EVALUATION

- **Estimation of Economic Cost:** Economic cost is a monetary expression of goods and services to be actually consumed for implementation of the Project. Also, economic cost is converted from financial cost by deducting tax portions and applying the standard conversion factor to the non-trade. Travel costs consist of Vehicle operating costs and travel time cost. Besides, the costs of construction, maintenance and land acquisition are also used in the economic evaluation.
- **Cost Benefit Analysis:** The analysis is evaluated in terms of EIRR, BCR and NPV with assumed operation period of 30 years. Evaluation of the economic viability is undertaken through these three approaches and using discount rate of 12.0%. Compared with such large value of discount rate, it can be said that economic viability is estimated at a feasible level.

11. CONCLUSION AND RECOMMENDATION

The project is aimed at improving the existing road condition in the project area. Environmentally and socioeconomically, the positive impacts will much surpass the limited negative ones. The environmentally negative impacts will be limited or minimized due to the implementation of the mitigation measures. The socioeconomically negative impacts in particular on the PAPs included their livelihoods would be fully mitigated by the implementation of the RAP. Overall, the final project impacts will be limited due to the implementation of the mitigation measures and the RAP. This should be integrated with the project information management system so that all related activities are effectively managed. In conclusion, the proposed project can be implemented in the environmentally and socioeconomically acceptable manner. The project should, therefore, be proceeded to a detail design stage.

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ABBREVIATIONS AND ACRONYMS

AHs	Affected Households
BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
DBST	Double Bituminous Surface Treatment
DPC	Department of Pollution Control
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMoP	Environmental Monitoring Plan
GDP	Gross Domestic Product
GOJ	Government of Japan
IEE	Initial Environmental Examination
IOL	Inventory of Losses
IRC	Inter-ministerial Resettlement Committee
JICA	Japan International Cooperation Agency
km	Kilometer
KoC	Kingdom of Cambodia
MEF	Ministry of Economic and Finance
MLMUPC	Ministry of Land Management Urban Planning and Construction
mm	Millimeter
MoE	Ministry of Environment
MOWRAM	Ministry of Water Resources and Meteorology
MPWT	Ministry of Public Works and Transport
NO_2	Nitrogen Dioxide
NR	National Road
PAPs	Project Affected Persons
PM	Particulate Matter
RAP	Resettlement Action Plan
RGC	Royal Government of Cambodia
SES	Socioeconomic Survey
SO_2	Sulfur Dioxide
TSBR	Tonle Sap Biosphere Reserve
TSS	Total Suspended Solid

1. INTRODUCTION

1.1 Background

Cambodia is located in the southwestern part of the Indochina peninsula. It shares a 2,615 kilometers (km) boarder with Vietnam (1,270 km), Thailand (805 km), and Laos (540 km). Its total area is 181,035 square kilometers. Total population is approximately 13.4 million in 2008. Gross Domestic Product (GDP) has been steadily grown with 43,057 billion Riels in 2009 and 47,048 billion Riels in 2010 and is projected to be 52,141 billion Riel in 2011 (approximately USD 12.9 billion) and 57, 363 billion Riel in 2012 (approximately USD 14.2 billion). Per capita GDP has also steadily increased since 1998 when the Riel greatly depreciated against the USD. Per capita GDP in 2010 reached USD 830, an increase of approximately 70% from 487 US dollars in 2005. It is projected to reach USD 904 in 2011 and USD 984 in 2012 respectively, according to the Ministry of Economic and Finance (MEF)'s forecast[1]. Agricultural, industry, and services sector shares 34.7%, 24.3% and 41% (2012 est.) of the GDP, respectively[2].

In parallel with the economic growth, Royal Government of Cambodia (RGC) have prioritized many sectors to be improved, one of which is road network. The road network is divided into three main categories: National Road (NR) (one digit and two digits), provincial road and rural road with a total network length of more than 47,000 km, out of which the NR (accumulation of one and two digit roads) is more than 5,600 km[3]. Road transport accounts for a share of the total transported volume of passengers (65%) and freight (70%). The road network is, therefore, considered as the lifeline of development and covers all major regions in the country[4].

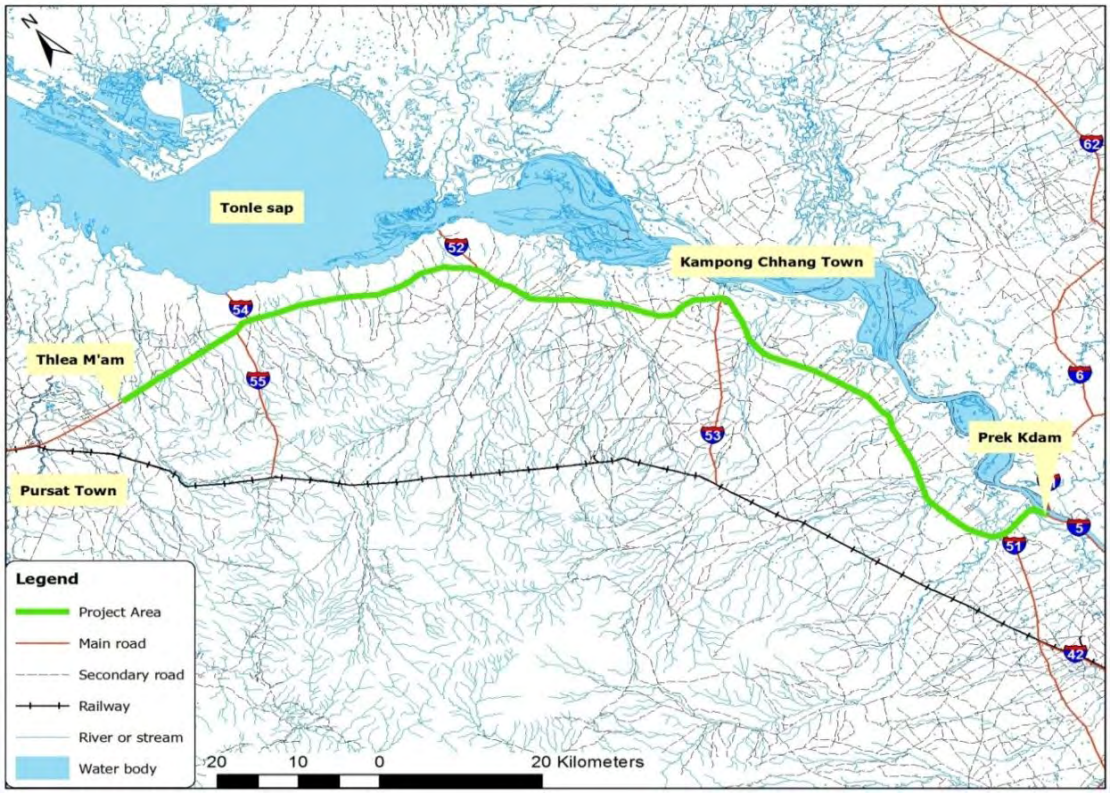


Figure 1-1: Road Network from Prek Kdam to Thlea Ma'am Source: JICA GIS Data set, 2002

[1] http://www.cambodiainvestment.gov.kh/country-overview/
[2] https://www.cia.gov/library/publications/the-world-factbook/fields/2012.html
[3] Overview on Transport Infrastructure Sectors in the Kingdom of Cambodia, 2012
[4] Sum, M. 2008. 'Infrastructure Development in Cambodia', in Kumar, N. (ed.), International Infrastructure Development in East Asia – Towards Balanced Regional Development and Integration, ERIA Research Project Report 2007-2, Chiba:IDE-JETRO, pp.32-84.

One of the Cambodia's NRs is the NR No. 5. It has been designed as a part of Asian Highway No.1 or Southern Economic Corridor of the Greater Mekong Sub-region. Along the NR No. 5 was damaged by the flood in 2000 and was temporarily repaired. The outline of repair work is below table 1-1.

Table 1-1: The Outline of Repair Work

Resource	Section	Distance (km)	Inauguration Year
Army	Phnom Penh to Kampong Chhnang	91	2003
ADB	Kampong Chhnang to Thlea Ma'Am	80	2004
	Thlea Ma'am to Battambang	130	2003
	Battambang to Serei Saophoan	68	2004
	Serei Saophoan to Poipet	49	2008

Source: Inception Report of JICA Study Team March, 2011

Although the above mentioned repairs were made, the surface condition is being deteriorated. As a result, the traffic flow has been hampered. Given this, the RGC has been trying to request either grant aid or concession loan without interest rate from foreign donors and development agencies to rehabilitate the priority NRs. In response to the request, the Government of Japan (GOJ), the biggest donor of Cambodia, entrusted Japan International Cooperation Agency (JICA) for a preparatory survey from Battambang to Serei Saophoan section of the NR No.5. The survey was already finished in 2012. During April, 2013 the GOJ also provided loan for rehabilitating the above-studied section. Seeing the further necessity of the NR No.5 rehabilitation, the JICA has started another preparatory survey from Prek Kdam to Thlea Ma'Am. As a part of the survey, An Environmental Impact Assessment (EIA) is prepared.

1.2 Objectives of the Environmental Impact Assessment Study

The purpose of the EIA was to investigate in the field on the present situation of natural and social environments and pollution, to analyze the possible impacts to those resources due to the project activities, and to provide mitigation measures for the impacts. The general objectives were to:

- Screen social and natural environments and pollution that may impact by the proposed project;
- Access potential impacts of the project during pre-construction, construction, and operation; and
- Provide mitigation measures and environmental management plan (EMP) to minimize the adverse effects.

Specifically core objective was to ensure that the project is environmentally sound and sustainable and that any negative environmental and social impacts were well recognized early and taken into account before project implementation.

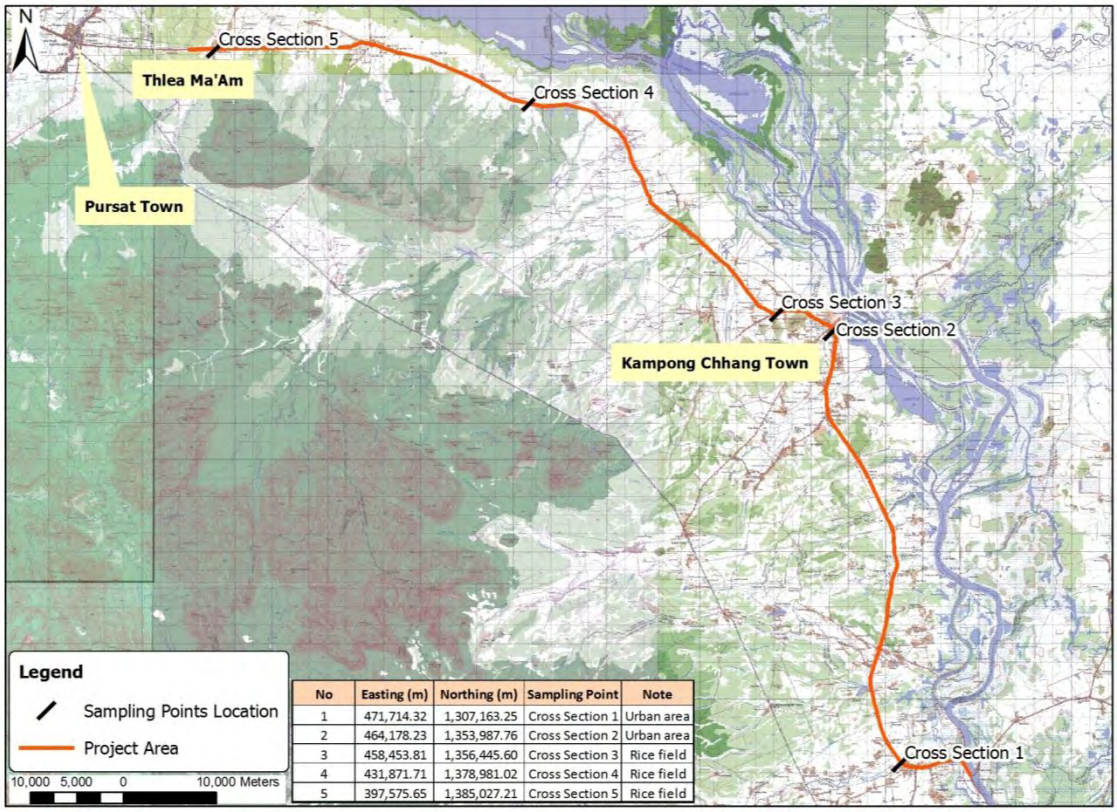
1.3 Scope of the Study

From Prek Kdam to Thlea Ma'Am, which is an approximate length of 139 km with a proposed Kampong Chhnang bypass and its roadside areas, traverses lowland area from southwest to northwest of the Tonle Sap Lake (Hereinafter called The Project Area). Five main items were identified, all of which were specifically scoped as follows:

1.3.1 Air Quality Survey

Survey items for air quality were particulate matter (PM 10 μm and PM 2.5 μm), Nitrogen Dioxide (NO_2), and Sulfur Dioxide (SO_2). Five cross sections were defined for the survey during the rainy and dry seasons. They are as follows:

- Cross Section 1: Around Odongk Referral Hospital in Veang Chas Commune;
- Cross Section 2: Around Department of Social Veteran and Youth Rehabilitation in Kampong Chhnang;
- Cross Section 3: Northern part of Kampong Chhnang urban area (Around 97 kilometer post);
- Cross Section 4: Eastern edge of Pusat Province (Around 135 kilometer post); and
- Cross Section 5: Eastern side of Ou Chankok River (Around 170 kilometer post).



No	Easting (m)	Northing (m)	Sampling Point	Note
1	471,714.32	1,307,163.25	Cross Section 1	Urban area
2	464,178.23	1,353,987.76	Cross Section 2	Urban area
3	458,453.81	1,356,445.60	Cross Section 3	Rice field
4	431,871.71	1,378,981.02	Cross Section 4	Rice field
5	397,575.65	1,385,027.21	Cross Section 5	Rice field

Figure 1-2: Locations of Cross Sections for Air Quality and Noise and Vibration Surveys

1.3.2 Noise and Vibration Survey

Survey items were equivalent continuous A-weighted sound pressure Level (LAeq) and vibration level. The survey points were also the same as the air quality survey either the dry season or the rainy season.

1.3.3 Water Quality Survey

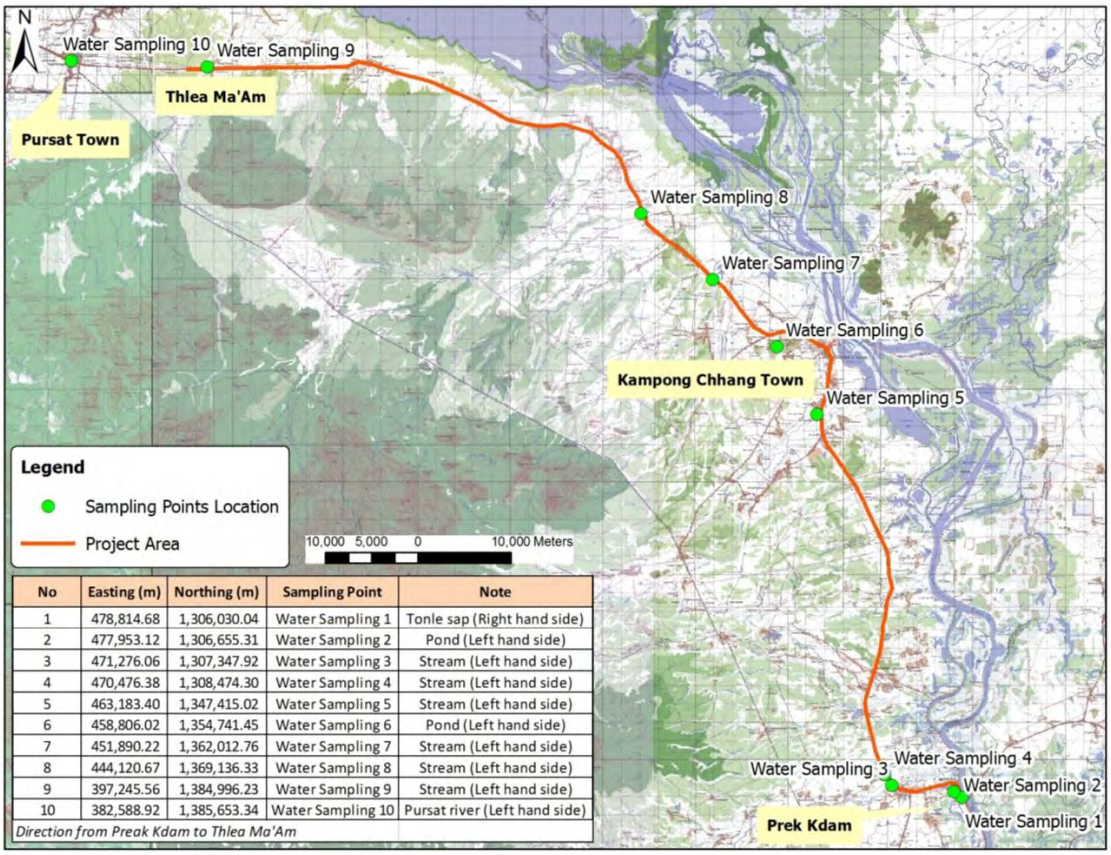
Survey items were pH, Temperature, Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Suspended Solid (TSS), and Coliform. 10 sampling locations were identified. Detailed locations coordination is shown in figure 1-3.

1.3.4 Waste Survey

Waste survey was focused on official waste management system in urban areas and illegal waste dumping sites in the project area.

1.3.5 Ecosystem Survey

Ecosystem survey was mainly focused on flora and fauna. The flora survey was conducted through direct field observations while the fauna survey was based on the limited local people interview of a consultant team.



No	Easting (m)	Northing (m)	Sampling Point	Note
1	478,814.68	1,306,030.04	Water Sampling 1	Tonle sap (Right hand side)
2	477,953.12	1,306,655.31	Water Sampling 2	Pond (Left hand side)
3	471,276.06	1,307,347.92	Water Sampling 3	Stream (Left hand side)
4	470,476.38	1,308,474.30	Water Sampling 4	Stream (Left hand side)
5	463,183.40	1,347,415.02	Water Sampling 5	Stream (Left hand side)
6	458,806.02	1,354,741.45	Water Sampling 6	Pond (Left hand side)
7	451,890.22	1,362,012.76	Water Sampling 7	Stream (Left hand side)
8	444,120.67	1,369,136.33	Water Sampling 8	Stream (Left hand side)
9	397,245.56	1,384,996.23	Water Sampling 9	Stream (Left hand side)
10	382,588.92	1,385,653.34	Water Sampling 10	Pursat river (Left hand side)

Direction from Preak Kdam to Thlea Ma'Am

Figure 1-3: Locations of Water Sampling Points

1.4 Methodology

In compliance with the guideline for conducting Initial Environmental Examination (IEE) or EIA of the JICA, the study focused on social and natural environments and pollution which were mainly on primary data. The main aims of the data collection were to make precise results in terms of determining environmentally and socially negative impacts in the project area. Furthermore, secondary data was also collected as a supplementary for the study. The collected data must finally be ensured that they were in useful, appropriate, and acceptable manners.

1.4.1 Data Collection

1.4.1.1 Primary Data Collection

The primary data collection included fauna and flora surveys along the project area and the proposed Kampong Chhnang bypass, survey and analysis of water quality, air, noise and vibration and hydrology surveys. Consultation meetings with relevant stakeholders were also conducted.

1.4.1.2 Secondary Data Collection

The Information on environment, laws, policies, guidelines and technical reports such as Inception Report, Interim Preparatory Survey Report for the NR No. 5, and other relevant documents was collected and reviewed.

1.4.2 Analysis and Assessment of Potentially Environmental and Social Impacts

After data collection completed, analysis and compilation of the information were started. Assessment of potentially environmental and social impacts was then conducted. The assessment was mainly based on the direct field observations. The impacts of project proponents on the environment are also assessed. Mitigation

measures, environmental management and monitoring plans were finally provided during the project phases: pre-construction, construction, and operation.

1.4.3 Preparation of EIA Report

The report is organized to comply with the guideline of the JICA guidelines as of April, 2010 for Environmental and Social Considerations. It is mainly included the following points:

- Baseline information including physical, natural, and social environments;
- Resettlement action plan;
- Environmental impacts and mitigation measures;
- Analysis of alternatives;
- Environmental management plan;
- Public participation and consultation; and
- Conclusion and recommendation.

1.5 Structure of the Report

Structure of the EIA report is developed to comply with the guideline for conducting EIA of the JICA. The report consists of 11 chapters, all of which are as follows:

- Chapter 1 consists of introduction, objective, scope, methodology, and structure of the report;
- Chapter 2 provides the legislations and guidelines in Cambodia and that of JICA, which are pertinent to the proposed development project;
- Chapter 3 presents the Project Description;
- Chapter 4 provides Baseline Data including Physical, Natural, And Social Environments;
- Chapter 5 presents Environmental Impacts and Mitigation Measures;
- Chapter 6 describes an Analysis of Alternatives;
- Chapter 7 provides the Environmental Management Plan;
- Chapter 8 consists of Public Participation and Consultation;
- Chapter 9 presents Resettlement Action Plan;
- Chapter 10 is Project Economic Evaluation; and
- Chapter 11 provides Conclusion and Recommendation.

2. POLICY, LEGAL AND ADMINISTRATION FRAMEWORKS

2.1 National Legal Frameworks related to Environmental Impact Assessment

Conducting environmental studies, laws, sub-decrees, and guidelines apply to the subproject are as follows:

2.1.1 Constitution of Kingdom of Cambodia

The Constitution of The Kingdom of Cambodia (KoC) in 1993 stated that:

Article 44: All persons, individually or collectively, shall have the right to ownership. Only Khmer legal entities and citizens of Khmer nationality shall have the right to own land. Legal private ownership shall be protected by law. The right to confiscate properties from any person shall be exercised only in the public interest as provided for under the law and shall require fair and just compensation in advance.

Article 58: State property notably comprises land, mineral resources, mountains, sea, underwater, continental shelf, coastline, airspace, islands, rivers, canals, streams, lakes, forests, natural resources, economic and cultural centers, bases for national defence and other facilities determined as State property. The control, use and management of State properties shall be determined by law.

Article 59: The State shall protect the environment and balance of abundant natural resources and establish a precise plan of management of land, water, air, wind, geology, ecological system, mines, energy, petrol and gas, rocks and sand, gems, forests and forestry products, wildlife, fish and aquatic resources.

Article 61: The State shall promote economic development in all sectors and remote areas, especially in agriculture, handicrafts, industry, with attention to policies of water, electricity, roads and means of transport, modern technology and a system of credit.

2.1.2 Law on Environmental Protection and Natural Resources Management

Environmental Protection and Natural Resources Management Law was enacted in 1996 by the National Assembly and launched by the Preah Reach Kram/NS-RKM-1296/36. The law has the following objectives:

- ✓ To protect and upgrade the environment quality and public health by means of prevention, reduction, and control of pollution;
- ✓ To assess the environmental impacts of all proposed projects prior to the issuance of a decision by the RGC;
- ✓ To ensure the rational and sustainable preservation, development, management and the use of the natural resources of the KoC;
- ✓ To encourage and provide possibility to public to participate in the protection of environment and the management of the natural resources; and
- ✓ To suppress any acts which may affect on environment

In view of this, project owners and/or project developers need to prepare the IEE or the EIA report for their proposed projects as described as follows:

Article 6: The EIA shall be carried out on every project and activity of either private or public and shall be examined and evaluated by Ministry of Environment (MoE) before it is submitted to the RGC for decision. This assessment shall also be applicable for those existing activities and those which are being under process and

which their environmental impacts have yet not been assessed. Procedure for the EIA shall be determined by Sub-decree following a proposal of the MoE. Nature and size of the proposed projects as well as the existing activities and activities under process of both private and public which are subject to assessment of their environmental impacts, shall be determined by Sub-decree following a proposal of the MoE.

Article 7: Every Investment Project Application and proposed project which are submitted by the State, shall enclose with them a preliminary IEE or EIA as stated the article 6 of this law. The MoE shall consider and make recommendations on the preliminary IEE or EIA to relevant competent bodies within a period as determined in the Law on Investment of the KoC.

Article 8: Natural resources of the KoC which primarily consist of land, water, airspace, air, geology, ecological systems, minerals, energy, petroleum and gas, rocks and sand, gems and stones, forests and forest sub-products, wildlife, fish and aquatic resources, shall be preserved, developed and managed to use in a rational and sustainable manner.

2.1.3 Sub-Decree on Water Pollution Control

The sub-decree No 27 ANK/BK on Water Pollution Control dated April 06, 1999, the key articles are as follows:

Article 1: The purpose of this sub-decree is to regulate the water pollution control in order to prevent and reduce the water pollution of the public water areas so that the protection of human health and the conservation of bio-diversity should be ensured.

Article 2: This sub-decree applies to all sources of pollution and all activities that cause pollution of the public water areas.

Article 8: The disposal of solid waste or any garbage or hazardous substances into public water areas or into public drainage system shall be strictly prohibited. The storage or disposal of solid waste or any garbage and hazardous substances that lead to the pollution of water of the public water areas shall be strictly prohibited.

Article 10: The discharge or transport of wastewater from any sources of pollution to other places for any purpose is subject to prior permit from the MoE. The application for this permit shall be copied to the concerned ministries or agencies.

Article 25**:** The water quality standard of public water areas for the purpose of the conservation of the bio-diversity is stipulated in the Annex 4 of this sub-decree.

Table 2-1: River

No	Parameter	Unit	Standard Value
1	pH	mg/l	6.5 – 8.5
2	BOD_5	mg/l	1.0 – 10
3	Suspended Solid	mg/l	25 – 100
4	Dissolved Oxygen	mg/l	2.0 – 7.5
5	Coliform	MPN/100ml	< 5000

Table 2-2: Lakes and Reservoirs

No	Parameter	Unit	Standard Value
1	pH	mg/l	6.5 – 8.5
2	COD	mg/l	1.0 – 8.0
3	Suspended Solid	mg/l	1.0 – 15
4	Dissolved Oxygen	mg/l	2.0 - 7.5
5	Coliform	MPN/100ml	< 1000
6	Total Nitrogen	mg/l	1.0 – 0.6
7	Total Phosphorus	mg/l	0.005 – 0.05

2.1.4 Sub-Decree on Solid Waste Management

The sub-decree No 36 ANK/BK on Solid Waste Management dated April 27, 1999, the key articles are as follows:

Article 1: The purpose of this sub-decree is to regulate the solid waste management with proper technical manner and safe way in order to ensure the protection of human health and the conservation of biodiversity.

Article 2: This sub-decree applies to all activities related to disposal, storage, collection, transport, recycling, dumping of garbage and hazardous waste.

Article 5: The collection, transport, storage, recycling, minimizing and dumping of waste in the provinces and cities is the responsibility of the authorities of provinces and city. The implementation as mentioned in the first paragraph of the article 5 shall comply with the guideline on the sound management of waste specified by the Prakas (declaration) of the MoE.

Article 6: The MoE shall monitor the implementation in disposal, collection, transport, storage, recycling, minimizing and dumping of the household waste in the provinces and cities.

2.1.5 Sub-Decree on Air Pollution and Noise Disturbance Control

The sub-decree No 42 ANK/BK on the Control of Air Pollution dated July 10, 2000, the key articles are as follows:

Article 1: The purpose of this sub-decree is to protect the quality of the environment quality and public health from air pollutants and noise disturbance through monitoring, curbing and mitigating activities.

Article 4: Air quality standard shall be specified in the table 2-3.

Table 2-3: Ambient Air Quality Standards

No	Parameter	1 Hour Average mg/m^3	8 Hours Average mg/m^3	24 Hours Average mg/m^3	1 Year Average mg/m^3
1	Carbon Monoxide (CO)	40	20	-	-
2	Nitrogen Dioxide (NO_2)	0.3	-	0.1	-
3	Sulfur dioxide (SO_2)	0.5	-	0.3	0.1
4	O Zone (O_3)	0.2	-		-
5	Lead (Pb)	-	-	0.005	-
6	Total Suspended particulate (TSP)	-	-	0.33	0.1

Article 5: This standard of smoke emission from movable sources shall be specified as in table 2-4.

Table 2-4: Gas Emission Standard of Mobile Sources

No	**Kind of Vehicle**	**Kind of Fuel**	**Level of Emission**				
			CO (%)		HC (ppm)		Dark Fume %
			A	B	A	B	
1	Motorcycle contain 2 stroke combustion	Petrol	4,5	4	10,000	3,000	-
2	Motorcycle contain 4 stroke combustion	Petrol	4,5	4	10,000	2,400	-
3	All kinds of vehicles	Petrol	4,5	4	1,200	800	-
4	All kinds of vehicles	Diesel	-	-	-	-	50

Remark: This Standard applied to control of gases emission of mobile sources into atmosphere.
A) Refer to all kinds of vehicles used over 5 years counting from year of production.
B) Refer to all kinds of vehicles that are newly imported in the first 5 years counting from year of production.

Article 7: The standard for noise emission from various sources like vehicles, manufacturing places and the standard for maximum noise emission for public and residential areas shall be specified in the Table 2-5, 2-6, and 2-7.

Table 2-5: Maximum Standard of Noise Emission Level Allowable for Vehicles on Public Roads

No	**Category of Vehicles**	**Maximum Noise Level permitted** (dB (A))
1	Motorcycles, cylinder capacity (cc) of engine <125cm^3	85
2	Motorcycles, cylinder capacity (cc) of engine ≥125cm^3	90
3	Motorize Tricycles	90
4	Cars, taxi, bus with capacity of < 12 passengers	80
5	Bus with capacity of ≥ 12 passengers;	85
6	Truck with loading capacity of <3,5 tons	85
7	Truck with loading capacity of ≥ 3,5 tons	88
8	Truck with engine capacity of ≥ 150 kw	89
9	Other machinery (tractors/trucks) that are not listed above	91

Table 2-6: Maximum Standard of Noise Level Allowable in the Public and Residential Areas (dB(A))

No	Area	Period of Time		
		From 6 am to 18 pm	From 18 pm to 22 pm	From 22 pm to 6 am
1	Quiet Areas - Hospital - Library - School - Kindergarten	45	40	35
2	Residential Areas - Hotel - Administrative office - House	60	50	45
3	Commercial and service areas and area of multiple businesses	70	65	50
4	Small industrial factories mingling in residential area	75	70	50

Article 26: The MoE shall regularly control and monitor the situation of the air quality in order to take measures to prevent and reduce air pollution.

Article 28: If it is found that any area is affected by air pollution which may threaten human life or environmental quality, the MoE shall immediately notify the public about such danger and investigate to find out the sources of pollution and shall take measure to prevent air pollution and to restore the air quality.

Table 2-7: Noise Control Standard at Workshop, Factory and Industry

Noise Level (dB (A))	Maximum Period of Time	Level
75	32	Ear protection equipment shall be provided to worker who works at a location with noise level over 80dB(A)
80	16	
85	8	
90	4	
95	2	
100	1	
105	0.5	
110	0.25	
115	0.125	

Article 30: Where there is a complaint or report that any source of pollution discharges, air pollutant, noise, vibration which cause any harm to human health or public property, the MoE, in collaboration with concerned ministries, is entitled to conduct inspection at such source of pollution and take samples for testing.

2.1.6 Land Law

The Land Law was passed by the National Assembly on July 20, 2001. The relevant articles are as follows:

Article 3: All persons shall respect the property of the State and legally acquired private property. The management of the cadastral administration of immovable property belonging to the State and the competence to issue titles related to immovable property throughout the KoC are under the authority of Ministry of Land Management Urban Planning and Construction (MLMUPC). The regulations and procedures for the administration immovable properties will be determined by sub-decree.

Article 5: No person may be deprived of his ownership, unless it is in the public interest. An ownership deprivation shall be carried out in accordance with the forms and procedures provided by law and regulations and after the payment of fair and just compensation in advance.

Article 7: Any regime of ownership of immovable property prior to the year 1979 shall not be recognized.

Article 18: The following are null and void and cannot be made legal in any form whatsoever:

- any entering into possession of public properties of the State and public legal entities and any transformation of possession of private properties of the State into ownership rights that was not made pursuant to the legal formalities and procedures that had been stipulated prior to that time, irrespective of the date of the creation of possession or transformation;
- any transformation of a land concession, into a right of ownership, regardless of whether the transformation existed before this law came into effect, except concessions that are in response to social purposes; and

- any entering into possession of properties in the private property of the State, through any means, that occurs after this law comes into effect.

Article 19: Persons whose title or factual circumstances fall within the scope of article 18 of this law shall not have the right to claim compensation or reimbursement for expenses paid for the maintenance or management of immovable property that was illegally acquired. Any illegal and intentional or fraudulent acquisition of public properties of the State or of public legal entities shall be penalized pursuant to article 259 of this law. The penalties shall be doubled where any acquisition of land from the public properties causes damage or delay to works undertaken in the general interest, in particular any acquisition of roadway reserves. In all cases, if an offender does not cease his illegal occupation within the time limit set by the competent authority, the authority may begin the process to evict the offender from the land.

Article 30: Any person who, for no less than five years prior to the promulgation of this law, enjoyed peaceful, uncontested possession of immovable property that can lawfully be privately possessed, has the right to request a definitive title of ownership. In case the granting of a definitive title to ownership is subject to an opposition, the claimant has to prove that he himself fulfills the conditions of peaceful, uncontested possession for no less than five years over the contested immovable property or to prove that he purchased the immovable property from the original possessor or his legal beneficiary or from the person to whom the ownership was transferred, or from their successors.

2.1.7 Expropriation Law

Article 1: This law aims to define an expropriation in the KoC by defining the principles, mechanisms, and procedures of expropriation, and defining fair and just compensation for any construction, rehabilitation, and public physical infrastructure expansion project for the public and national interests and development of Cambodia.

Article 3: This law shall be applied to expropriations involving public physical infrastructure projects in the KoC. This law does not govern any issues on expropriation in any agreement or memorandum on supporting investment between the RGC and partner countries. In case there is no such agreement or in case the agreement or the memorandum does not deal with expropriation, any expropriation shall be governed by this law.

Article 5: Public physical infrastructure primarily refers to:

a) construction or expansion of railroads, roads, bridges, airports, ports and accompanying structures and equipment;
b) construction or expansion of power stations, structures, equipment and lines for transmission and distribution of electrical energy;
c) construction or expansion of buildings and equipment for postal, telecommunication and information technology systems;
d) construction or expansion of roads, city space, vehicle parking lots, markets, parks, and public squares;
e) construction or expansion of irrigation systems, clean water supply systems, sewage systems, and public interest spaces;
f) construction or expansion of buildings for education, training, science, culture, health care, social security, and stadiums for performances to public audiences;

g) construction or expansion of refineries, purification stations, buildings and equipment for protection of nature and the environment;
h) construction or expansion of buildings and equipment for research and exploiting mines and other natural resources;
i) construction or expansion of gas systems, fuel pipes, oil refineries, oil rigs, and other systems;
j) construction or expansion of buildings/residences which are seriously destroyed by natural disasters such as earthquakes, floods, fires, and landslides etc., and for preparation for resettlement;
k) construction or expansion of buildings for protecting and supporting residents;
l) construction or expansion of border crossing posts;
m) construction or expansion of or preparation for necessary construction for national defense or security;
n) establishment of new sites for protection of natural resources, forests, cultural and archeological sites or protection of the environment; and
o) the implementation as required by the nation in accordance with the determination made by the government.

Article 12: An Expropriation Committee shall be established and shall be led by a representative of Ministry of Economy and Finance, and representatives of concerned ministries/institutions shall be involved. The establishment and functioning of the Committee shall be determined by sub-decree.

Article 13: An Expropriation Sub-Committee that shall assist the Expropriation Committee shall be established and led by a board of municipal-provincial governors, and representatives of concerned provincial departments and authorities shall be involved. The establishment and functioning of the sub-committee shall be determined by the sub-decree provided for in Article 12 of This law.

Article 14: A Complaint Resolution Committee shall be established and led by representatives of Ministry of Land Management, Urban Planning and Construction, and representatives of other concerned ministries/institutions shall be involved. The organization and functioning of the Complaint Resolution Committee shall be determined by a separate sub-decree.

Article 19: The expropriation of the ownership of immovable property and real right to immovable property can be exercised only if the Expropriation Committee has paid fair and just compensation to the property's owner and/or rightful owner in advance, in accordance with the compensation procedures and principles set out in Section 3 of Chapter 4 of this law. The expropriation remains able to be exercised, even though the resolution of a dispute has not been completed. The owner and/or the rightful owner who has already received compensation from the Expropriation Committee still has the right to continue their complaint according to the procedure of complaining and dispute resolution set out in Article 34 in Chapter 6 of this law.

Article 22: Financial compensation given to the property owner and/or rightful owner shall be based on a market price or replacement price on the date of declaration of the expropriation. The market price or the replacement price shall be determined by an independent committee or agent selected by the Expropriation Committee.

2.1.8 Law on Land Traffic

Article 1: The law governs all road users in the KoC

Article 2: The Law is aimed at:

- Maintaining order and safety in road trafficking, which allowed for public traffic throughout the KoC;
- Protection human and animal lives and environment;
- Curbing the effect on human health and the damage of the state and private properties; and
- Curbing the offenses stemmed from the use of the roads.

Article 3: The road users have to respect the regulations, which are determined by this law properly.

Article 4: Driving of all kinds of vehicles in the KoC has to be adhered to the right-hand side.

- All vehicles, which are moving along the roads, MUST have drivers.

Article 17: The driving speeds of vehicles are defined in accordance with the conditions as follows:

1- The driving speeds for vehicles in general:

➢ In towns:

- The drivers of all motorcycles and tricycles must drive in the maximum speed of 30 km/h.
- The drivers of all kinds of cars must drive in the maximum speed of 40 km/h.

➢ Outside towns:

- The drivers of all kinds of vehicles must drive in the maximum speed of 90km/h, except for the trucks with net weight of over 3.5 tons is limited with 70 km/h and the maximum speed of vehicles with trailers is limited with 60 km/h.

2- The driving speeds for vehicles loading with dangerous substances:

➢ In towns:

- The drives of motorcycles or tricycles must drive in the maximum speed of 30 km/h.
- The drivers of vehicles must drive in the maximum speed of 40 km/h.

➢ Outside towns:

- The drivers of vehicles must drive in the maximum speed of 70 km/h for the vehicles with net weight not over 3.5 tons and vehicles with net weight over 3.5 tons using the braking system to hold the tires from stiffness
- The maximum driving speed of the vehicles with maximum net weight of over 3.5 tons is 60 km/h only those vehicles without the braking system to hold the tires from stiffness.

3- The driving speeds for the vehicles driving on the motorways:

➢ In towns:

- The drivers of all types of vehicles must drive in the maximum speed of 60 km per hour.

➢ Outside towns:

- The drivers must drive in maximum of 100 km per hour for all types of vehicles, except for the trucks with maximum net weight over 3.5 tons will be limited to 80km per hour and that the vehicles with trailers will be limited to 70 km per hour in the maximum.

4- Driving speed for vehicles with priorities:

- The regulations stated in Point 1 and 2 of the Article do not apply to the drivers who drive the police, military, military police vehicles, fire engines, ambulances, and some other vehicles equipped with sirens and special light signs on duty.

- The drivers must not drive in an abnormally slow speed without proper reasons because it disturbs other vehicles.
- The drivers who drive in a slow speed must stay on the right hand side by leaving the other drivers who drive in a high speed to be able to overtake easily on the left hand side. Any drivers who are forced to slow down in an abnormal manner must alert the other drivers by using emergency light signs and keep driving on the most right hand side of the roads.

2.1.9 Sub-Decree on the Ozone Depleting Substances

The 2005 Sub-decree on Ozone Depleting Substances was put into place to respond to the obligations under the Vienna Convention and the Montréal Protocol. Its objective is to stop the use of ozone depleting substances and manage all business activities and consumption identified by the Convention and the Protocol. This sub-decree applies to the import, export, handling, production and the use of ozone depleting substances.

2.1.10 Sub-Decree on EIA Process

The key relevant articles as stated in the sub-decree on the EIA 1999 are as follows:

Article 1: The objectives are:

1) The EIA shall be done on every project and activity, private or public, and shall be reviewed by the MoE before being submitted to the RGC for decision;
2) Determining the type and size of the proposed project and activities including existing and ongoing activities in both private and public prior to undertaking the EIA process; and
3) Encouraging public participation in the implementation of the EIA process and taking into account of their conceptual input and suggestion for re-consideration prior to the implementation of any project.

Article 2: This Sub-decree applies to every proposed project and activities and existing and in-process, private, joint-venture and public projects that listed in an Annex of this Sub-decree, except projects deemed necessary to react to a declared state of emergency and approved by the RGC.

Article 3: The MoE shall: (i) evaluate and review the EIA report in collaboration with other Governmental Institutions and (ii) take appropriate administrative, conduct surveillance and monitor to ensure that the EMP during project construction, operation, and closure, which contained in an approved EIA report.

Article 4: Governmental Institutions in their capacity as the Approval Institution shall approve the project that listed in the Annex of this Sub-decree only after consideration of the findings and recommendations of the MoE on the EIA report.

Article 6: The project owner shall conduct IEIA for the project required EIA as listed in an Annex of this Sub-decree.

Article 7: The Project owner will submit the Environmental Application for reviewing IEIA report and pre-feasibility study to the MoE.

Article 8: The project owner will submit the Environmental Application for reviewing full-scale EIA report and feasibility study to the MoE for the projects deemed serious impact to the natural resources, ecosystem, health and public welfare.

Article 16: In case the project required full-scale EIA report determined by the MoE, the project owner shall conduct and submit the report as stipulated in Article 8 of this Sub-decree to the MoE in the same time as submit the investment application to the Approval Institution.

Article 17: The MoE will review the report as stipulated in Article 16 and will submit findings and recommendations to the project owner within 30 working-days follow the receipt the EIA report and feasibility study from the Project owner.

Article 20: Prior to implementing the proposed project, the project owner must receive consent from the MoE in advance on the report of IEIA or EIA.

2.1.11 EIA Process in Cambodia

The sub-degree on EIA process is used as an environmental management tool for all development projects in Cambodia by requiring that "an EIA shall be done on every project and activity, private and public, and shall be reviewed and evaluated by the MoE before being submitted to the RGC for decision", (Article 6 of the Law). The Sub-decree on EIA Process contains a requirement that an IEE or EIA report shall be submitted along with the feasibility study documentations of the project to the MoE for reviewing and approval. Figure 4 shows the EIA process for the proposed project approved by Cambodia Development Council.

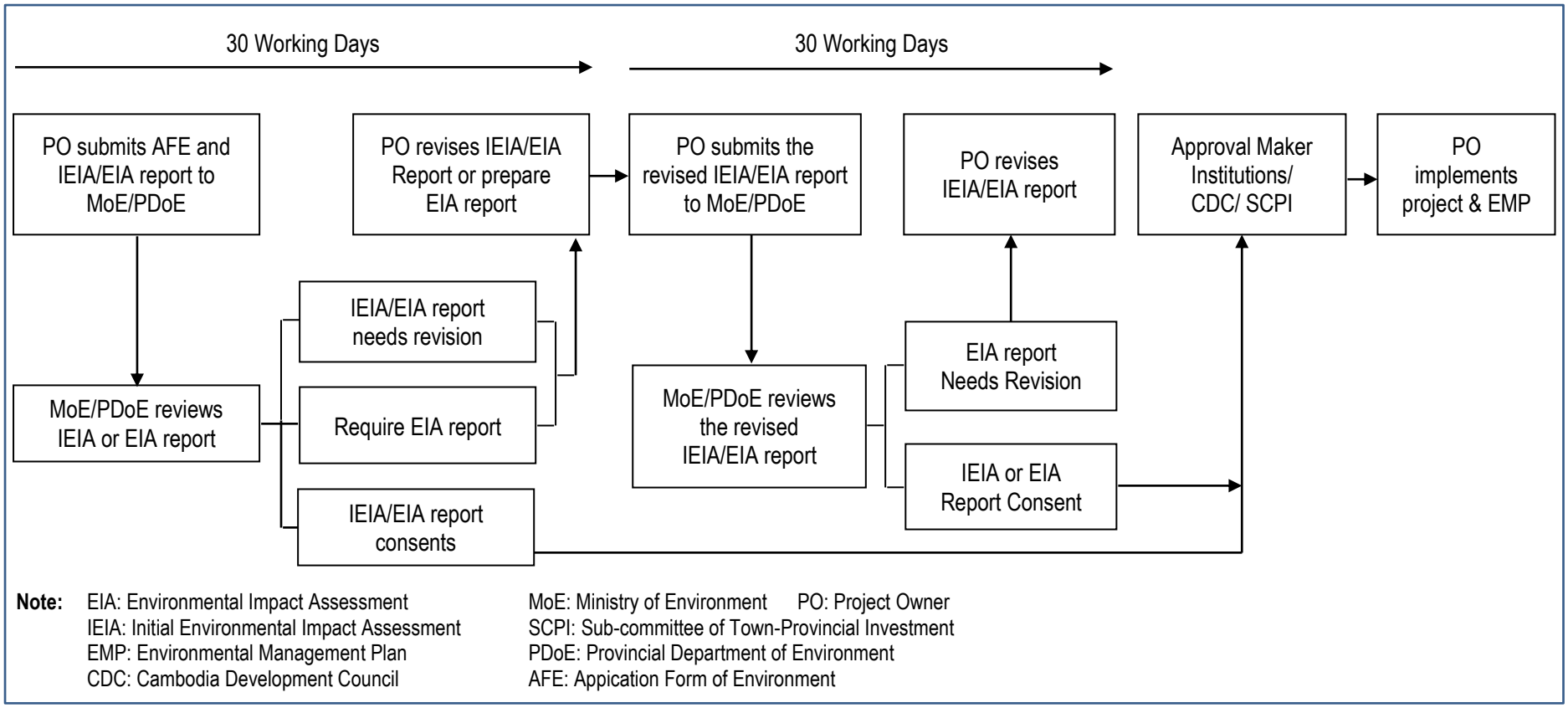


Figure 2-1: IEE/EIA process for proposed projects approved by the RGC

2.2 JICA Guidelines for Environmental and Social Considerations 2010

The objectives of the guidelines are to encourage Project proponents etc. to have appropriate consideration for environmental and social impacts, as well as to ensure that JICA's support for and examination of environmental and social considerations are conducted accordingly. The guidelines outline JICA's responsibilities and procedures, along with its requirements for project proponents etc., are to facilitate the achievement of these objectives. In doing so, JICA endeavors to ensure transparency, predictability, and accountability in its support for and examination of environmental and social considerations.

According to the guidelines, JICA classifies development projects into four categories with regards to the extent of environmental and social impacts, and taking into account the outlines, scale, site and other conditions. The four categories are as follows:

(1) Category A: Proposed projects are likely to have significant adverse impacts on the environment and society.
(2) Category B: Proposed projects are classified as Category B if their potential adverse impacts on the environment and society are less adverse than those of Category A projects.
(3) Category C: Proposed projects are classified as Category C if they are likely to have minimal or little adverse impact on the environment and society.
(4) Category FI: Proposed projects are classified as Category FI if they satisfy all of the following requirements:
    - JICA's funding of projects is provided to a financial intermediary or executing agency;
    - The selection and appraisal of the sub-projects is substantially undertaken by such an institution only after JICA's approval of the funding, so that the sub-projects cannot be specified prior to JICA's approval of funding (or project appraisal); and
    - Those components are expected to have a potential impact on the environment.

In JICA's preparatory survey, JICA conducts environmental and social surveys at the EIA level for Category A projects and at the IEE level for Category B projects and Master Plan Studies. JICA prepares drafts of mitigation measures - including avoidance, minimization, and compensation - as well as drafts of monitoring plans and of institutional arrangements for environmental and social considerations.

Over a certain period of time, JICA confirms with project proponents etc. the results of monitoring the items that have significant environmental impacts. This is done in order to confirm that project proponents etc. are undertaking environmental and social considerations for projects that fall under Categories A, B, and FI.

"The NR No.5 (South Section) Improvement Project" is classified as "Category A", according to JICA Guidelines (2010), which causes a significant adverse impact due the large scale of involuntary resettlement. Thus, preparation of the survey report at EIA level is required.

3. PROJECT DESCRIPTION

3.1 Introduction

3.1.1 Background

The NR No.5 is an arterial international road (National Highway No.1) connecting Phnom Penh and the border point with Thailand. It traverses provinces of Banteay Meanchey and Battambang whose population are 3rd and 4th largest in the country. The NR No.5 therefore accommodates the traffic needed for the day-to-day activities of the citizens, including access to the public services such as hospital and school along the highway.

The NR No.5 also accommodates the transportion of goods and passengers between the major cities along the highway such as Serei Saophoan, Battambang, Pursat, Kampong Chhnang and Phnom Penh. Further it is connected via Phnom Penh to National Road No. 1 (NR No.1) which reaches to Ho Chi Min City in Vietnam and National Road No. 3 (NR No.3) and National Road No.4 (NR No.4) which reach to Sihanoukville, the largest international seaport of Cambodia. It is generally considered as an important highway not only for domestic transport in Cambodia but also for International transport in ASEAN and the Greater Mekong Subregion (GMS). Connecting with the NR No.1 forms a route connecting Bangkok, Phnom Penh and Ho Chi Minh City.

3.1.2 Survey Area and Target Section

The surveyed areas were Kandal, Kampong Speu, Kampong Chhnang, and Pursat provinces. The target section is the southern section (139 km long).

3.1.3 Present Condition of the South Section

The present condition of the South Section of the NR No.5 can be summarized as follows:

3.1.3.1 Road Width

There are two types of typical cross section in the South Section. The average width of pavement of the section between Prek Kdam Bridge and Kampong Chhnang is 9.8m and that of the section between Kampong Chhnang and Thlea Ma'am is 7.7m. This 7.7m width is minimal as an opposed 2-lane road. High-speed vehicles such as passenger cars and slow vehicles such as bicycles and agricultural tractors are travelling same lane, resulting in hazardous traffic condition.

3.1.3.2 Horizontal and Vertical Alignment

The horizontal alignment of the NR No.5 is generally generous but there are some curve sections with small radii and need improvement. The vertical alignment is also generally flat.

3.1.3.3 Pavement

The road surface is Double Bituminous Surface Treatment (DBST) with gravel shoulder except in limited part in the urbanized area of Kampong Chhnang City.

3.1.3.4 Bridges

There are bridges along the South Section. Some of them need rehabilitation and some others need widening.

3.1.3.5 Roadside Land Use

The towns and villages are developed along the road. Many factories, shops, stalls, vendors, benches and houses are observed just beside the road. The basic form of land use outside of urbanized area is agriculture, especially rice paddy.

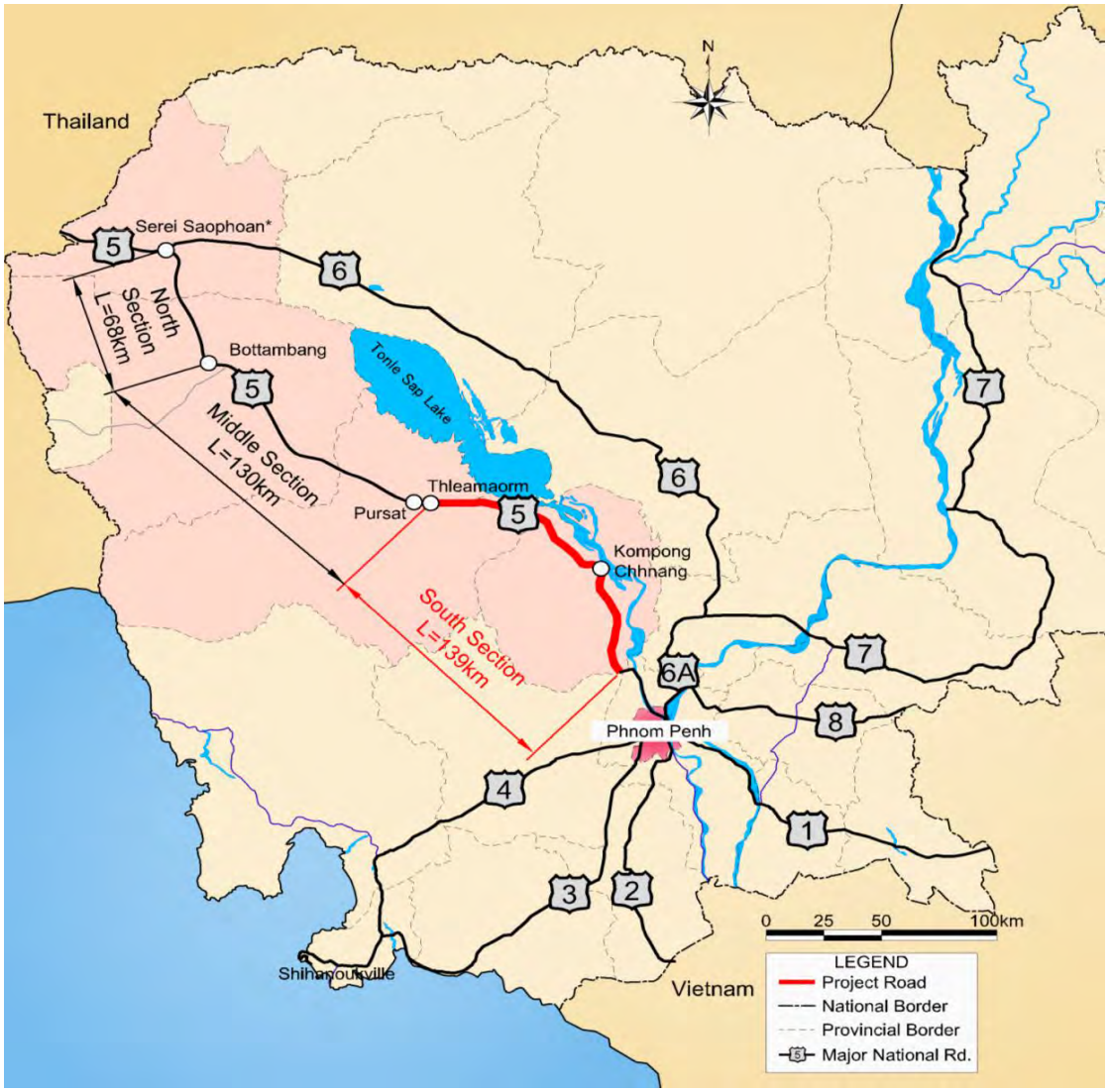


Figure 3-1: Location Map

3.1.4 Problems of the Present South Section

Problems of the present South Section can be summarized as follows:

3.1.4.1 Traffic Safety

Because of narrow road width, high-speed vehicles such as passenger cars and slow vehicles included bicycles and agricultural tractors are travelling same lane, resulting hazardous traffic condition.

3.1.4.2 Narrow Road Width

The width of existing pavement is 7.7 - 9.8m. In view of the fact that the widths of Motor-trailers or small agriculture tractors are 1.2 - 1.5m, 9.8m wide pavement cannot provide with sufficient space for these slow

vehicles, if central part of 3.5m wide is used as the travel lane for 4 wheel vehicles. Thus, widening to 4 lanes will become necessary before year 2030.

3.1.4.3 Weak Pavement

Existing pavement is the DBST. Because of small bearing capacity of the DBST, severe damages occur every year, especially after flood/inundation season. Because of potholes and other defects, vehicles are forced to slowdown. This is causing great economic loss as a result. Thus, improvement of pavement to asphalt concrete (AC) is needed.

3.1.4.4 Vulnerability to Inundation/Flood

Every year, many sections are inundated or flooded. Traffic is forced to slow down or stop due to inundation/ flood, resulting in economic loss.

3.1.4.5 Necessity of Bypass

The existing South Section of the NR No.5 is passing through towns such as Kampong Chhnang and Odongk where traffic congestion and traffic accidents have been caused. Basic solution to these problems is construction of bypasses.

3.2 Project Outline

3.2.1 Improved Section

The South Section is divided into 5 sections as described below:

vi. Section I: Thlea Ma'am - Intersection of the existing NR No.5 and Kamopong Chhnang Bypass in the north of Kamopong Chhnang Town (L = 73.0km);
vii. Section II: Kampong Chhnang Bypass (L = 11.8km);
viii. Section III: Intersection of the existing NR No.5 and Kampong Chhnang Bypass in the south of Kamopong Chhnang Town (L = 41.4km);
ix. Section IV: Town of Odongk (L = 4.9km); and
x. Section V: Odongk – Prek Kdam (L = 4.3km).

Sections I, III and V are proposed to be widened (into 4 lanes). Bypasses are proposed to be constructed around Kampong Chhnang and Odongk to avoid resettlement of large number of households/buildings (Figure 3-2).

3.2.2 Widening of South Section of the NR No.5

Widening of the South Section is to widen the existing 2-lane road (approximately 11~13m wide including shoulders) into either 4-lane (approximately 20.5m or 25.5m wide including shoulders). Together with widening of the existing the NR No.5, the pavement is to be improved to AC from the existing DBST. Widening of the existing NR No.5 is executed by construction additional embankment generally on the both sides of the existing road.

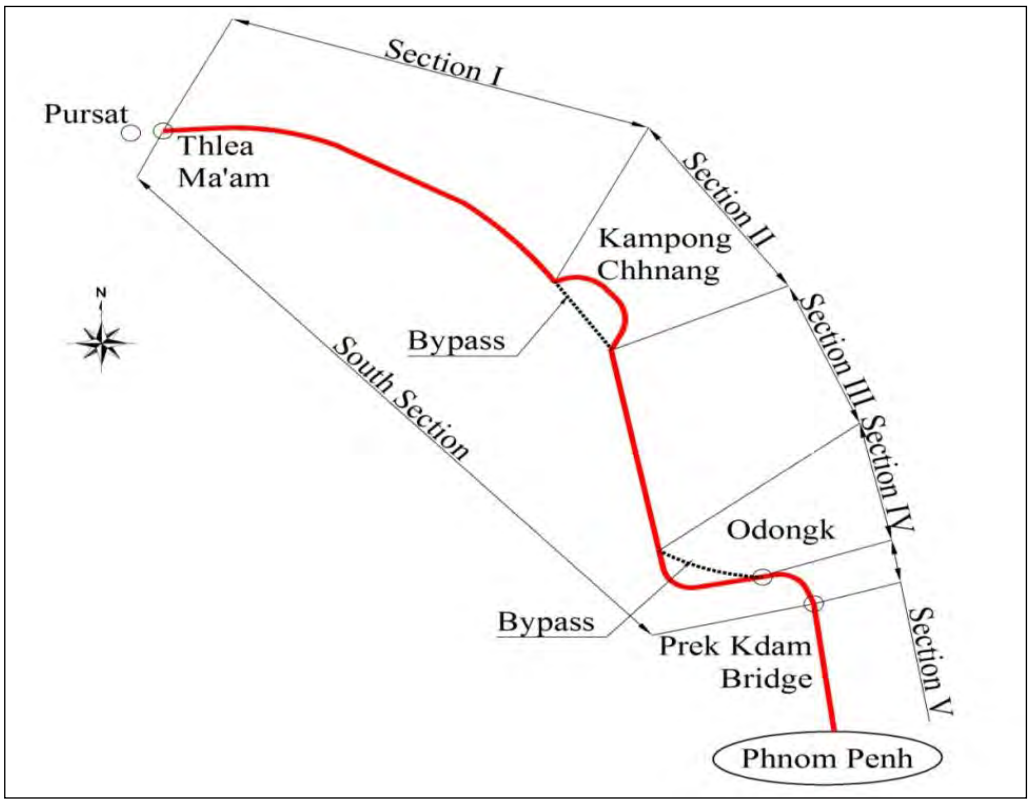


Figure 3-2: Improved Section

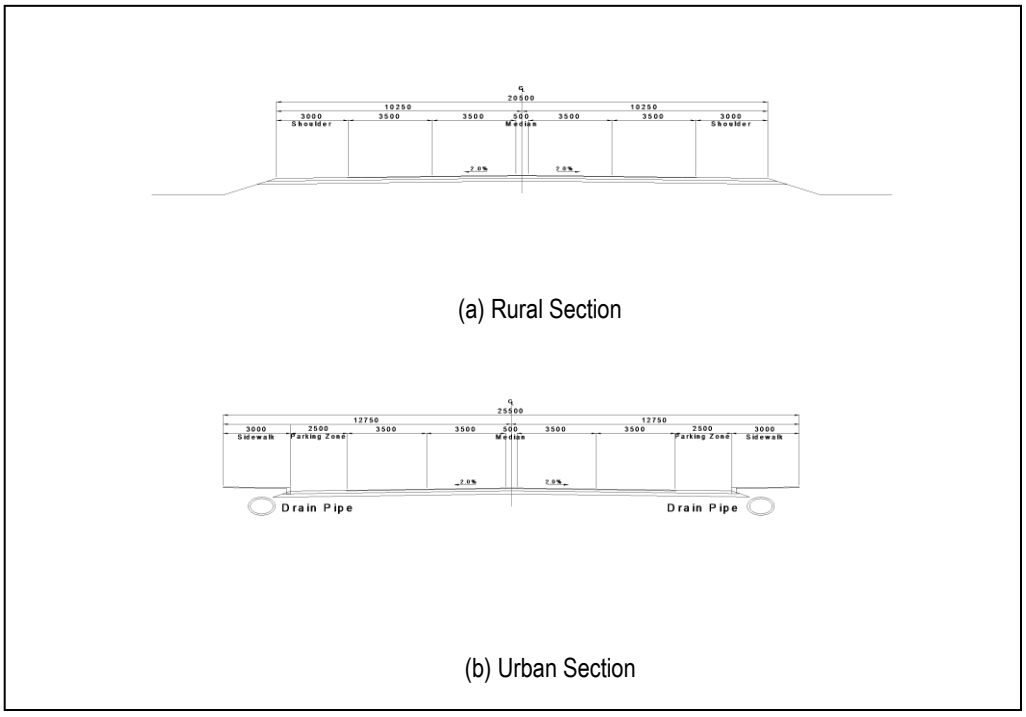


Figure 3-3: Cross Section of Widening of the NR No.5 and Bypasses

3.2.3 Kampong Chhnang Bypass

A new road with cross section of 4-lane is to be constructed traversing mainly agricultural land (rice paddy) in the west suburbs of Kampong Chhnang Town. Pavement of the bypass is planned as AC.

Figure 3-4: Route of Kampong Chhnang Bypass

3.2.4 Odongk Bypass

Also a new road with cross section of 4-lane is to be constructed traversing mainly agricultural land (rice paddy) in the north suburbs of Odongk town. Pavement of the bypass is also planned as AC.

3.3 Objectives of Project

The project objective of is to solve or mitigate problems of the exiting South Section. This included:

- Improvement of traffic safety by providing separate lanes for high-speed traffic and slow traffic;
- Provision of sufficient traffic capacity by widening and mitigate traffic congestion which is anticipated in the near future;
- Improvement of pavement into AC to support heavy traffic; and
- Construction of bypasses to let the through traffic detour Kampong Chhnang and Odongk towns and avoidance of widening of the existing NR No.5 which necessitates resettlement of large number of houses and families.

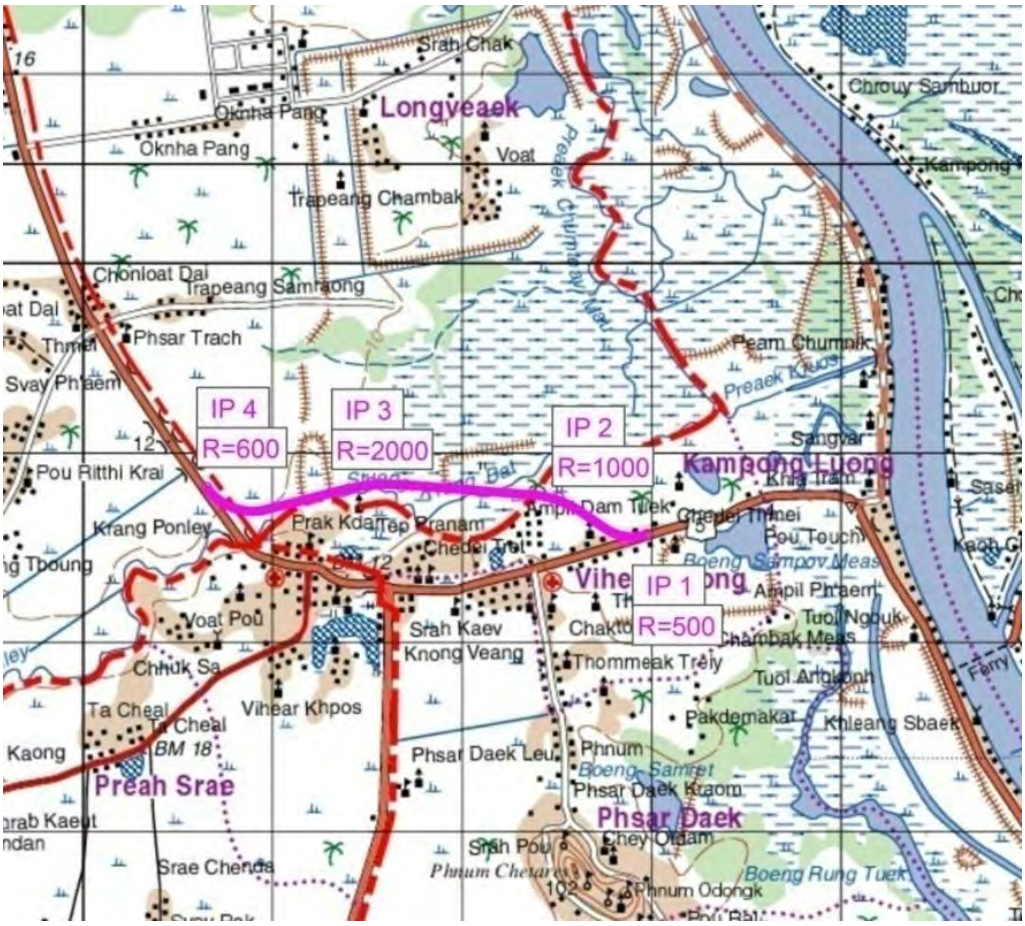


Figure 3-5: Route of Odongk Bypass

4. BASELINE DATA

4.1 Physical Environment

4.1.1 Geography

The project area is a segment of the NR No.5 or National Highway No. 1. The NR No.5 connects the capital of Phnom Penh with Thailand where its ending point is Poi Pet town with a length of 407.45 km.

4.1.2 Topography

Topographical condition in the project area is generally flat ranging from 9.69 to 41.19 m above mean sea level.

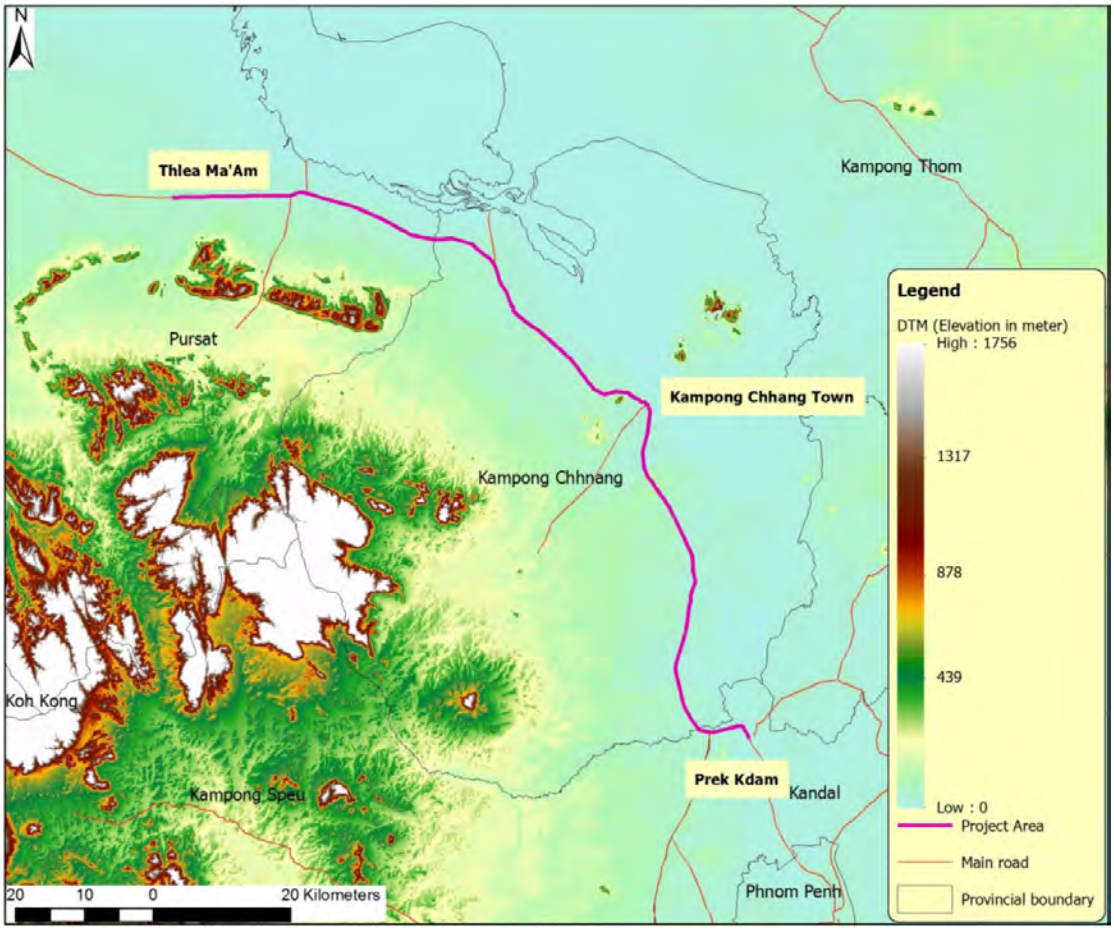


Figure 4-1: Topographical Map in the Project Area Source: Mekong River Commission, 2001

4.1.3 Geology and Surface Soil

Geological condition in the project area consists of two eras: Quaternary and Jurassic-Cretaeous. The Quaternary era formed Alluvial Plain Deposits, Beach Ridges and Levees, Deltaic Deposits Floodplains, Lake Bed Deposits, Pediments, and Terrace Alluvial Deposits. The Jurassic-Cretaeous Era formed Dacite (Figure 4-2).

Based on Croaker 1962, soils in the project area are classified into four categories: (i) Alluvial Lithosols (ii) Lacustrine Alluvial Soils, (iii) Red-Yellow podzols, and (iv) Cultural Hydromorphics (Figure 4-3).

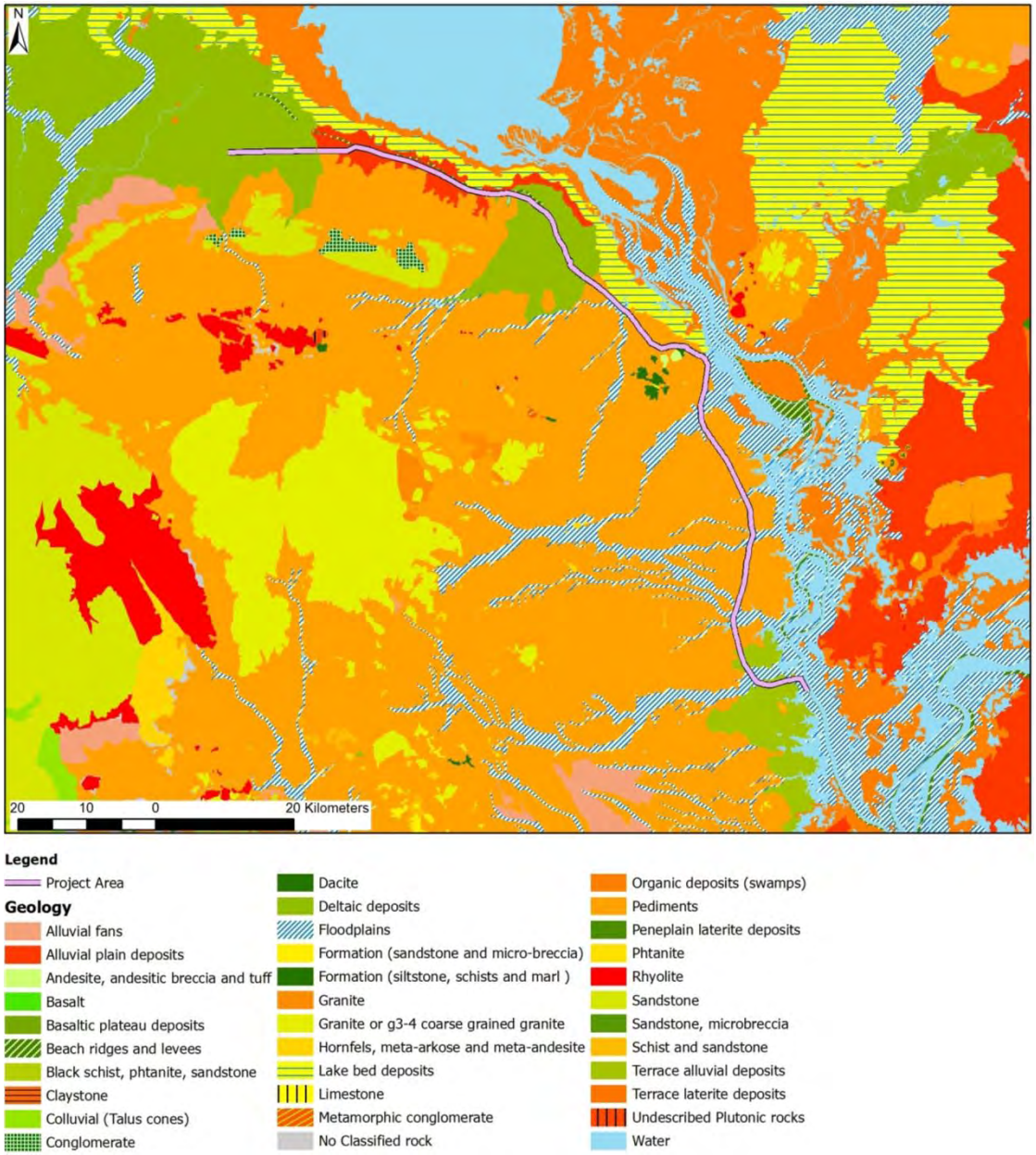


Figure 4-2: Geological Map in and around the Project Area Source: JICA GIS Data set, 2002

Most of the soils stretching on the project area are low and medium productivity soils (Figure 4-4). Also, high productivity soil was observed at right hand side from Phnom Penh direction.

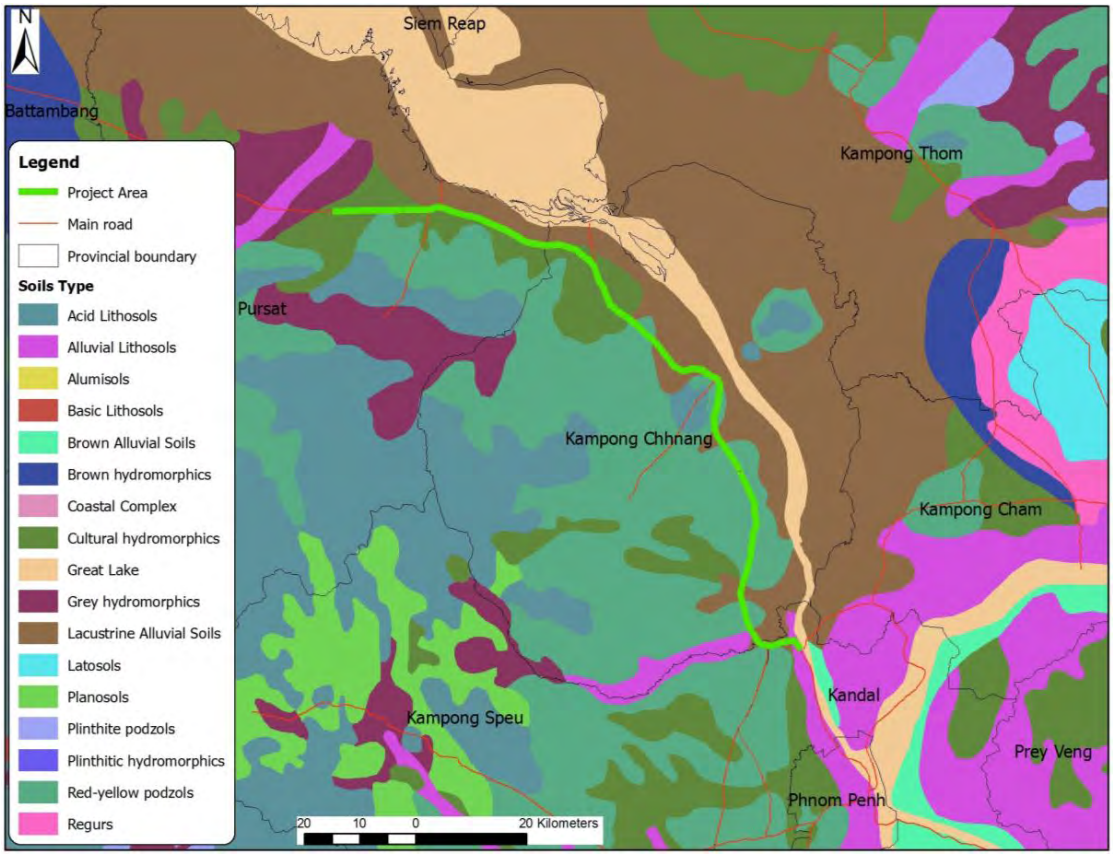


Figure 4-3: Soil Types in and around the Project Area Source: Crocker, 1962

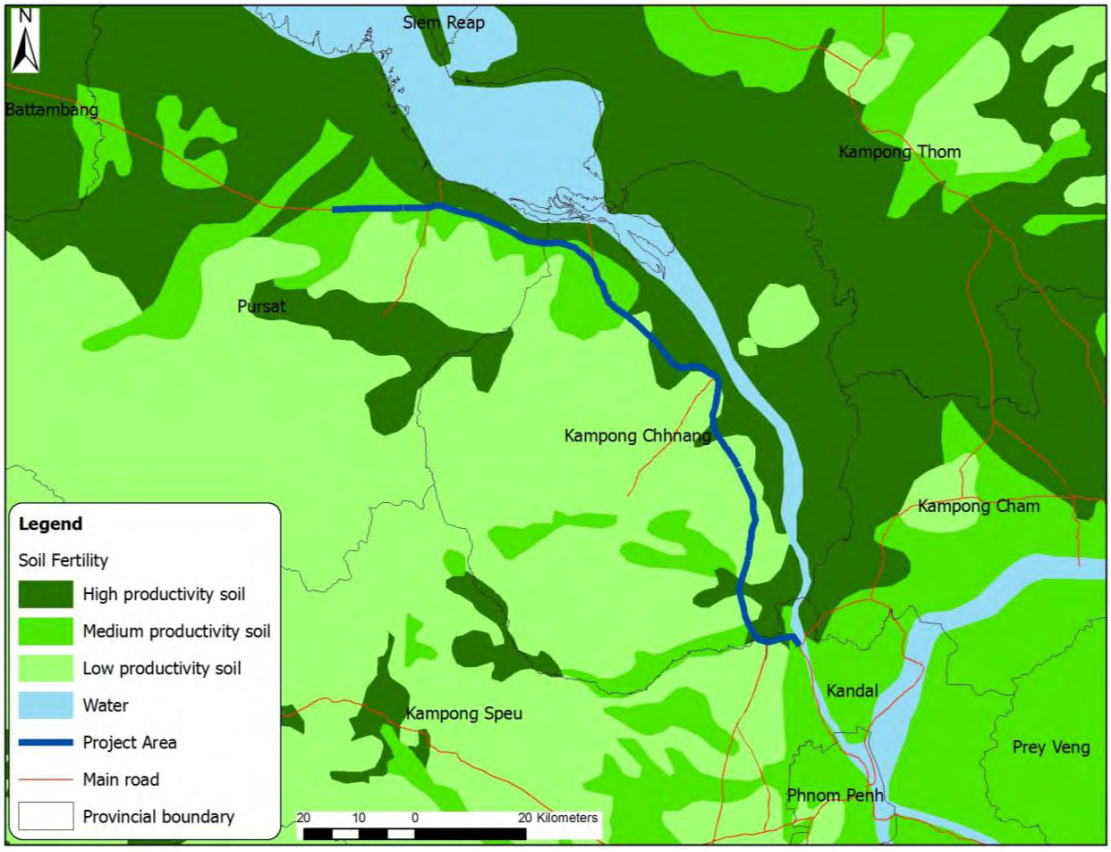


Figure 4-4: Soil Fertility in and around the Project Area Source: CARDI, 2002

4.1.4 Soil Erosion and Sediment

Some erosion was observed at banks of rivers and streams crossing the project area. According to interviews with local people living nearby such rivers and streams it was found that previously (about more than 20 years ago) such rivers and streams were deeper and narrower than that of the present time. But something has been changed since rivers and streams widths have been moderate increase and depths have become shallower. The erosion has also brought sedimentations to downstream areas. One of the downstream areas is the Tonle Sap Great Lake.

Figure 4-5: Typical Views of Soil Erosion

4.1.5 Climate

In the project area, the climate is considered be the same to Cambodia's climate. The climate influenced by tropical monsoon and consists of the dry season and the rainy season. The dry season lasts for six months, starting from November to April. It is divided into two seasons: summer and spring. The summer is from February to April while the spring is from November to January which brings cold air from Siberia. The rainy season also lasts for six months, starting from May to October. During the season, wind blows from southwest of country bringing moisture from Indian Ocean and drops rainwater which is vital for irrigation of agricultural crops and plants.

Some last updated meteorological data were collected through Provincial Departments of Water Resources and Meteorology of Kandal, Kampong Speu, Kampong Chhnang, and Pursat Provinces. Those data included rainfall, temperature, wind speed, and humidity. They are consecutively describes as the following matters:

(a) Rainfall

Rainfalls in the Project Area differ from province to province and vary from year to year. Total annual rainfalls in Kandal are 1,439.3, 1,495.4, and 1,336.9 mm for the year 2010, 2011, and 2012, respectively (Table 4-1). Total annual rainfalls in Kampong Chhnang are 1,220, 1,929, and 1,831.1 mm for the year 2010, 2011, and 2012, respectively (Table 4-2). Total annual rainfalls in Pursat are 1,389.8, 1,488.4 and 1,640.2 mm for the year 2010, 2011, and 2012, respectively (Table 4-3).

Table 4-1: Monthly Rainfall in Millimeter (mm) from 2010 – 2012 at Kandal Province

Year	Month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
2010	0.0	0.0	35.6	55.9	27.3	254.3	79.1	194.7	342.6	372.1	77.7	0.0	1,439.3
2011	0.8	0.0	11.4	130.9	131.4	113.3	227.8	249.7	244.4	311.7	67.0	7.0	1,495.4
2012	26.5	40.8	28.8	77.8	185.8	84.1	166.7	105.6	267.7	138.2	214.7	0.2	1,336.9

Table 4-2: Monthly Rainfall in Millimeter from 2010 – 2012 at Kampong Chhnang

Year	Month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
2010	26.2	22.1	148.6	40.5	191.6	80.8	126.5	147.4	147.4	236.8	51.7	0.0	1,220.0
2011	0.0	0.0	73.0	185.0	138.0	249.0	259.7	265.0	301.0	237.0	210.5	11.0	1,929.0
2012	94.0	17.0	24.0	96.0	135.4	187.5	318.1	293.5	180.5	269.5	212.3	3.3	1,831.1

Table 4-3: Monthly Rainfall in Millimeter from 2010 – 2012 at Pursat

Year	Month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
2010	0.0	26.7	30.1	107.9	86.8	238.4	196.0	237.6	167.1	273.8	25.4	0.0	1,389.8
2011	0.0	0.7	62.7	51.3	114.3	106.1	201.0	214.9	206.1	418.1	69.2	44.0	1,488.4
2012	12.1	26.3	156.4	161.5	170.6	57.8	252.6	155.8	248.1	209.5	189.5	0.0	1,640.2

(b) Humidity

Humidity rate changes with the seasons. The most humid month is July and the driest month is February. Generally, humidity ranges between 65 to 70 percent in January and 85 to 90 percent in August. The humidity at Kandal ranged from 65.8 to 77.3 percent in the dry season and from 69 to 82.4 percent in the rainy season during the last three years: 2010, 2011, and 2012 (Table 4-4). The humidity at Pursat ranged from 59.4 to 88.0 percent in the dry season and from 69 to 90 percent in the rainy season during the last three years: 2010, 2011, and 2012 (Table 4-5). Generally, it is found that humidity is high at night throughout the year.

Table 4-4: Average Monthly of humidity (%) at Kandal

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	71.7	70.1	65.8	68.2	69.0	79.2	79.9	81.5	82.9	84.1	77.3	74.6
2011	67.9	70.6	67.1	72.3	77.4	77.5	79.5	82.2	83.3	81.5	78.4	73.1
2012	73.2	73.7	71.7	73.5	78.6	74.9	80.0	77.3	84.0	81.9	82.4	74.5

Table 4-5: Average Monthly of humidity (%) at Pursat

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	68.7	68.3	59.4	68.5	71.0	78.2	80.8	83.1	84.0	81.6	76.0	73.3
2011	73.2	71.4	70.4	76.5	77.6	79.0	80.2	83.6	84.2	83.9	78.4	78.7
2012	79.0	80.0	70.0	65.0	69.0	72.0	75.0	85.0	89.0	90.0	88.0	85.0

(c) Temperature

Within the project area of the four provinces, there are only two provinces measuring temperatures: Kandal and Pursat. Kampong Chhang and Kampong Speu provinces have not had equipment to measure the temperature. Monthly temperature of Kandal and Pursat varies between maximum from 38 – 40 ^{0}C during the hottest months of April and May and from 18.5 – 22.4 ^{0}C in December-January the coldest months (Table 4-6 and 4-7).

Table 4-6: Monthly maximum and minimum temperature at Kandal Province (Pochentong Station)

Year	Temp (°C)	Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	Max	35.3	38.1	40.0	38.8	40.0	39.2	35.5	34.8	34.6	33.5	32.5	32.7
	Min	21.4	22.7	23.1	24.1	24.5	23.5	23.8	22.4	23.3	22.3	22.2	20.0
2011	Max	34.7	34.8	35.3	39.0	37.0	35.2	35.4	35.0	34.0	33.4	32.8	37.2
	Min	18.5	20.8	21.5	22.5	23.5	23.2	22.8	22.5	23.3	23.5	22.5	19.4
2012	Max	33.7	34.5	36.1	38.2	37.0	36.9	35.3	36.5	34.4	33.5	33.7	34.8
	Min	22.4	23.3	20.9	24.0	22.6	24.8	23.8	24.0	23.7	25.3	23.8	22.0

Table 4-7: Monthly maximum and minimum temperature at Pursat Province

Year	Temp (°C)	Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	Max	30.8	32.7	34.2	34.5	36.0	35.0	34.0	32.7	32.1	31.1	32.5	32.0
	Min	20.8	21.0	23.0	23.0	23.4	23.1	22.7	22.0	20.6	20.2	21.1	19.1
2011	Max	32.8	35.0	36.3	37.5	36.2	35.1	34.7	35.3	37.5	37.0	33.0	32.8
	Min	21.2	0.5	17.8	21.3	24.0	24.0	23.4	23.0	23.3	21.6	22.0	26.5
2012	Max	34.5	36.1	36.8	38.5	36.8	36.5	35.5	37.0	34.8	35.0	35.0	35.1
	Min	22.7	22.4	24.3	24.4	24.7	25.2	22.0	20.0	22.0	20.4	21.0	26.5

(d) Wind

Identical to the above mentioned temperature and humidity, there are only two provinces measuring wind speed: Kandal and Pursat. Kampong Chhang and Kampong Speu provinces have not yet had equipment to measure the wind speed. The wind speeds varied from month to month and from year to year. Generally, in the Kandal province the lowest wind speeds were from Jan to April while the highest ones were from May to Oct. The medium speeds were also found from Nov to Dec (Table 4-8). On the average basis, the wind speeds were 6.5, 13.1, and 10.6 m/s for 2010, 2011, and 2012, respectively. Similar to the Kandal province, in the Pursat province the lowest wind speeds were from Jan to April while the highest ones were from May to Oct. The medium speeds were also found from Nov to Dec (Table 4-9). On the average basis, the wind speeds were 8.8, 6.9, and 7.2 m/s for 2010, 2011, and 2012, respectively.

Table 4-8: Monthly Maximum Wind Speed (m/s) and Wind Direction at Kandal

Year	Direction	Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	WD	NE	SE	NW	S	SSE	W	S	SW	SE	N	SE	N
	WS	4.0	2.0	4.0	3.0	8.0	8.0	10.0	6.0	14.0	7.0	6.0	6.0
2011	WD	NE	NE	NE/N	SE/S	SW	W	W	SW/NE	S/W	E	N	N
	WS	10.0	10.0	10.0	8.0	17.0	18.0	19.0	12.0	12.0	16.0	13.0	12.0
2012	WD	SSE	S	SSW	SSW	SW	SW	SW	SSW	SW	SW	N	N
	WS	7.0	8.0	13.0	14.0	15.0	12.0	10.0	10.0	10.0	10.0	8.0	10.0

Table 4-9: Monthly Maximum Wind Speed (m/s) and Wind Direction at Pursat

Year	Direction	Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	WD	NE	W/S	SW/S	S/SE	SW/S	W/S	E/W	W/S	SE	W/NE	N/NW	N/NE
	WS	4.0	6.0	4.0	10.0	7.0	10.0	11.0	9.0	12.0	11.0	10.0	12.0
2011	WD	NE	E	NE	E	W/S	SW	SW	S/W	W	SW	N/NW	N/NE
	WS	5.0	6.0	7.0	5.0	6.0	10.0	9.0	10.0	5.0	8.0	5.0	7.0
2012	WD	E/NE	E/NE	E/NE	E/S	SE/SW	W/SW	SE/SW	SW/W	SW/E	SW/E	N/SW	N/W
	WS	4.0	4.0	3.0	4.0	6.0	9.0	10.0	9.0	11.0	7.0	9.0	10.0

Note: WD = Wind Direction WS = Wind Speed

4.1.6 Air Quality

4.1.6.1 During the Dry Season

Five locations were surveyed for air pollution concentration in the project area. Each location was at the road side and more than 100 m from the road side. The surveys at the road sides were to know of the current situation of air pollution concentration while at places with more than 100 m away from the road sides were to know of the air pollution background concentration. The result of the air quality survey is shown as in table 4-10. Generally, NO_2 and SO_2 were lower than the MoE's standards. PM 2.5 was also lower than WHO's standard. However, PM 10 was found to be higher than the WHO's standard at most of the places. These are due to the following matters:

At the cross section 1, during the air sampling period there was a medium air current in the afternoon. At the cross section 2 and 3, during the air sampling period there was a strong air current along the road in the afternoon. At the cross section 4 and 5, during the air sampling period there was also a strong air current either day time or night time. The current air coincidently occurred at all the sampling locations. The air current brought some dusts into the atmosphere and then may deposit into air samples. As a result, PM10 concentration was higher than the WHO's standard.

Table 4-10: Result of Air Quality Survey during the Dry Season

No.	Location	Ambient Air Pollution Concentration (mg/m^3)			
		NO_2	SO_2	PM2.5	PM10
1	Road side around Oudong Referral Hospital in Veang Chas Commune	0.021	0.009	0.016	0.014
2	More than 100 m away from the road side around Oudong Referral Hospital in Veang Chas Commune	0.011	0.004	0.004	0.104
3	Road side around Department of Social Veteran and Youth Rehabilitation in Kampong Chhnang	0.018	0.013	0.017	0.107
4	More than 100 m away from the road side around Department of Social Veteran and Youth Rehabilitation in Kampong Chhnang	0.011	0.008	0.012	0.066
5	Road side in Trapaing Por Village, Pong Ro Commune, Rolea B'iea District, Kampong Chhnang Province (Around 97 Kilometer Post)	0.009	0.006	0.015	0.080
6	More than 100 m away from the road side in Trapaing Por Village, Pong Ro Commune, Rolea B'iea District, Kampong Chhnang Province (Around 97 Kilometer Post)	0.006	0.004	0.006	0.075
7	Road side in Kbal Damrei Village, Ansar Chambork Commune, Krakor District, Pursat Province (Around 135 Kilometer Post)	0.025	0.019	0.016	0.129
8	More than 100 m away from the road side in Kbal Damrei Village, Ansar Chambork Commune, Krakor District, Pursat Province (Around 135 Kilometer Post)	0.007	0.006	0.007	0.077
9	Road side in Kandol Sar Village, Beung Kantuot Commune, Krakor District, Pursat Province (Around 170 Kilometer Post)	0.019	0.010	0.010	0.127
10	More than 100 m away from the road side in Kandol Sar Village, Beung Kantuot Commune, Krakor District, Pursat Province (Around 170	0.007	0.003	0.003	0.076

No.	Location	Ambient Air Pollution Concentration (mg/m³)			
		NO_2	SO_2	PM2.5	PM10
	Kilometer Post)				
Standards of the MoE		**0.1 (24 Hours)**	**0.3 (24 Hours)**	**0.02* (24 Hours)**	**0.05* (24 Hours)**

Note: No Cambodian Standards for PM2.5 and PM10
The asterisk (*) refers to WHO's Standards

4.1.6.2 During the Rainy Season

Five locations, which are identical to the surveyed locations during the Dry Season, were surveyed for air pollution concentration in the project area. Each location was at the road side and more than 100 m from the road side. The surveys at the road sides were to know of the current situation of air pollution concentration while at places with more than 100 m away from the road sides were to know of the air pollution background concentration. The result of the air quality survey is shown as in table 4-11. Generally, NO_2 and SO_2 were lower than the MoE's standards. PM 2.5 was also lower than WHO's standard. However, PM 10 was found to be higher than the WHO's standard at road side in Kandol Sar Village, Beung Kantuot Commune, Krakor District, Pursat Province (Around 170 Kilometer Post). High concentration of PM10 may be due to dust from transportation activities along the NR No.5 since no any wood burning was identified during the sampling period.

Table 4-11: Result of Air Quality Survey during the Rainy Season

No.	Location	Ambient Air Pollution Concentration (mg/m³)			
		NO_2	SO_2	PM2.5	PM10
1	Road side around Oudong Referral Hospital in Veang Chas Commune	0.007	0.002	0.012	0.043
2	More than 100 m away from the road side around Oudong Referral Hospital in Veang Chas Commune	0.004	0.001	0.004	0.026
3	Road side around Department of Social Veteran and Youth Rehabilitation in Kampong Chhnang	0.008	0.005	0.010	0.054
4	More than 100 m away from the road side around Department of Social Veteran and Youth Rehabilitation in Kampong Chhnang	0.005	0.003	0.006	0.039
5	Road side in Trapaing Por Village, Pong Ro Commune, Rolea B'iea District, Kampong Chhnang Province (Around 97 Kilometer Post)	0.004	0.003	0.013	0.036
6	More than 100 m away from the road side in Trapaing Por Village, Pong Ro Commune, Rolea B'iea District, Kampong Chhnang Province (Around 97 Kilometer Post)	0.004	0.002	0.003	0.025
7	Road side in Kbal Damrei Village, Ansar Chambork Commune, Krakor District, Pursat Province (Around 135 Kilometer Post)	0.010	0.006	0.011	0.041
8	More than 100 m away from the road side in Kbal Damrei Village, Ansar Chambork Commune, Krakor District, Pursat Province (Around 135 Kilometer Post)	0.005	0.003	0.011	0.013
9	Road side in Kandol Sar Village, Beung Kantuot Commune, Krakor District, Pursat Province (Around 170 Kilometer Post)	0.008	0.004	0.015	0.068

No.	Location	Ambient Air Pollution Concentration (mg/m³)			
		NO_2	SO_2	PM2.5	PM10
10	More than 100 m away from the road side in Kandol Sar Village, Beung Kantuot Commune, Krakor District, Pursat Province (Around 170 Kilometer Post)	0.004	0.002	0.003	0.027
Standards of the MoE		**0.1 (24 Hours)**	**0.3 (24 Hours)**	**0.02* (24 Hours)**	**0.05* (24 Hours)**

Note: No Cambodian Standards for PM2.5 and PM10
The asterisk (*) refers to WHO's Standards

4.1.7 Noise and Vibration

Five locations, which were the same to the air quality survey locations, were also surveyed for noise and vibration levels in the project area. Each location was at the road side and more than 100 m from the road side. Identical to the air quality survey, the surveys at the road sides were to know of the current situation of the noise and vibration levels while at places with more than 100 m away from the road sides were to know of their backgrounds. As a result, the noise and vibration levels are as follows:

Noise levels at the road sides of the 5 surveyed cross sections were a bit lower than the MoE's standard during day time and were higher than that of the standard during night time. At the places with more than 100 m away from the road sides, the noise levels were lower than the standard during the day time and were a bit lower than that of the standard during the night time (Figure 4-6 to 4-15). Higher noise level during the night time is mostly due to active transportation activities of heavy trucks in the project area.

Vibration levels at the road sides and at the places with more than 100 m away from the road sides of the 5 cross sections were generally lower than the MoE's standard either day time or night time (Figure 4-16 to 4-25).

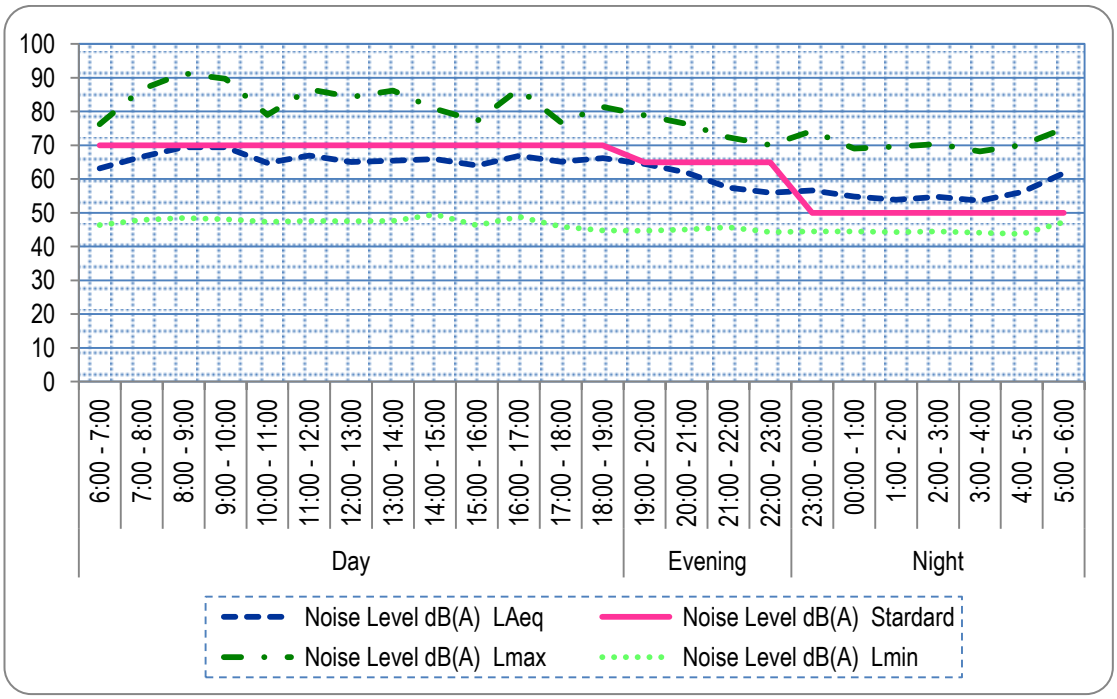


Figure 4-6: Noise Level at Cross Section 1 at the Road Side

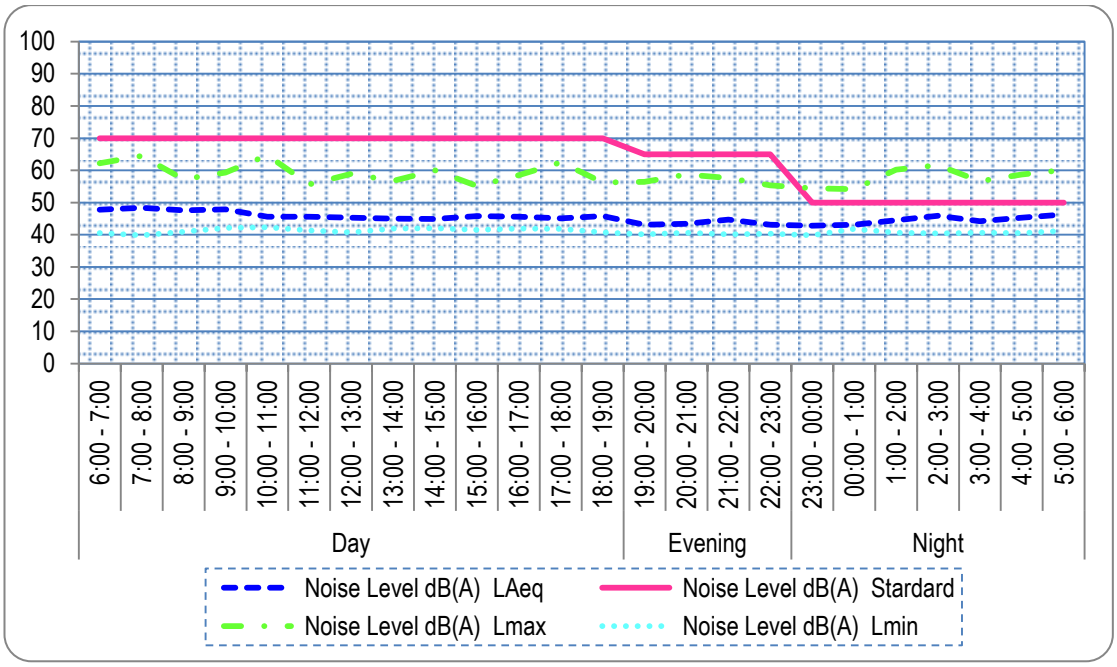


Figure 4-7: Noise Level at Cross Section 1 more than 100 m away from the Road Side

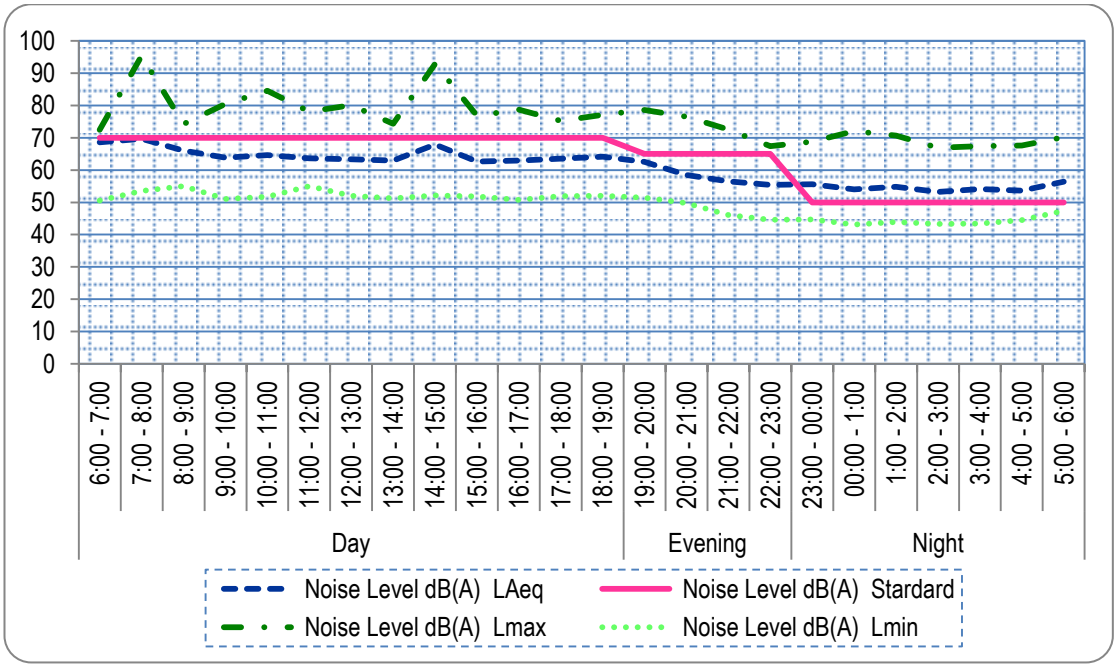


Figure 4-8: Noise Level at Cross Section 2 at the Road Side

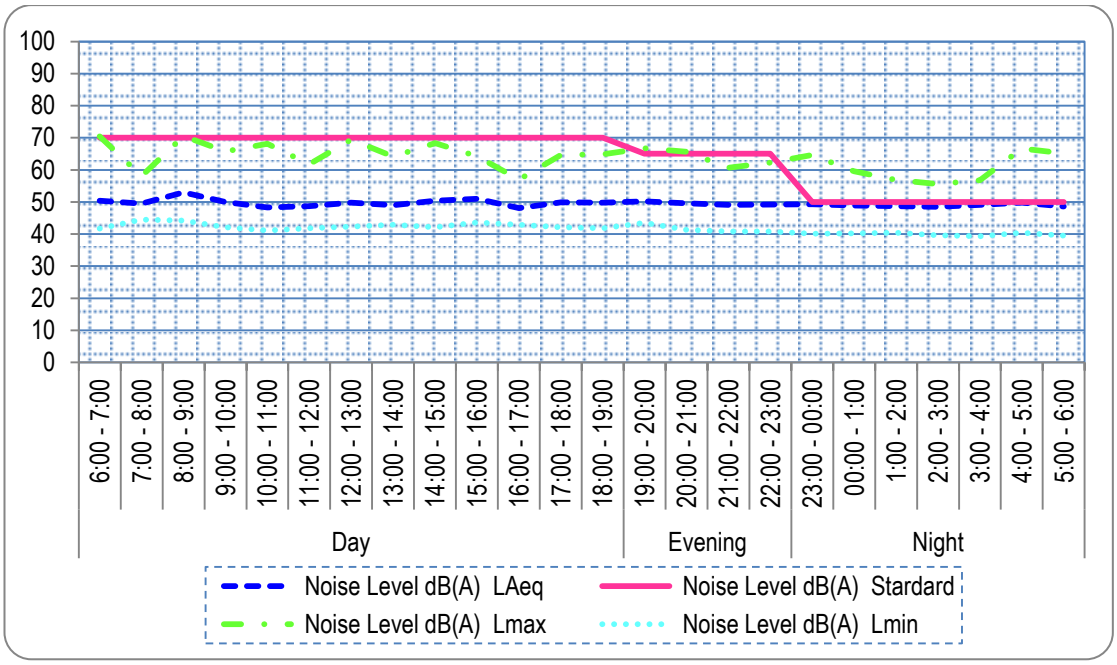


Figure 4-9: Noise Level at Cross Section 2 more than 100 m away from the Road Side

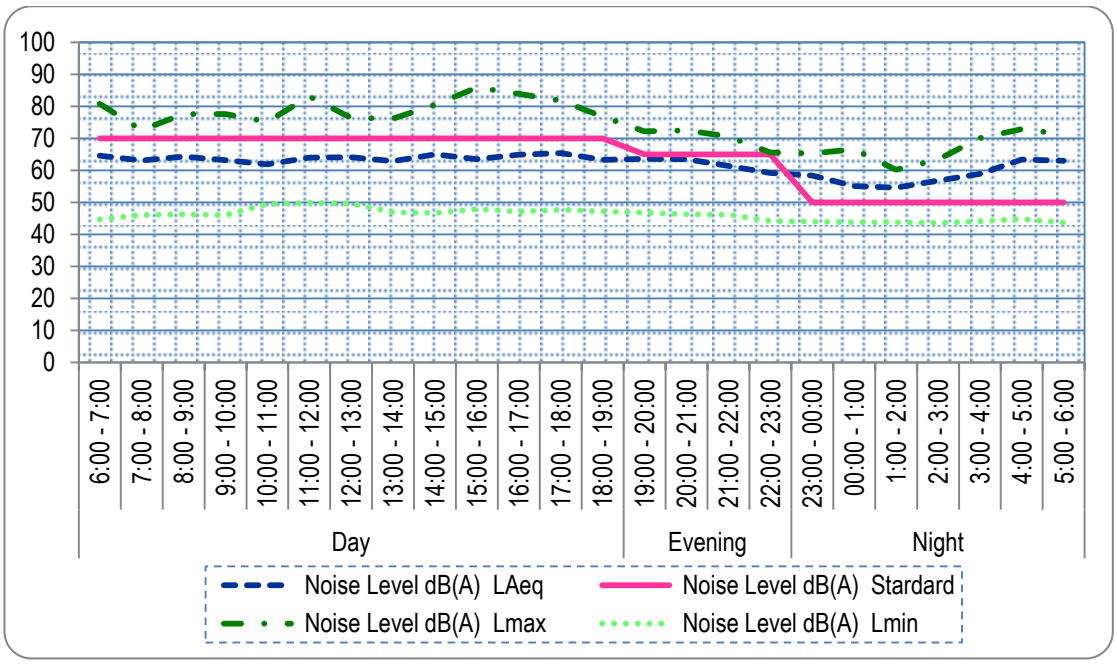


Figure 4-10: Noise Level at Cross Section 3 at the Road Side

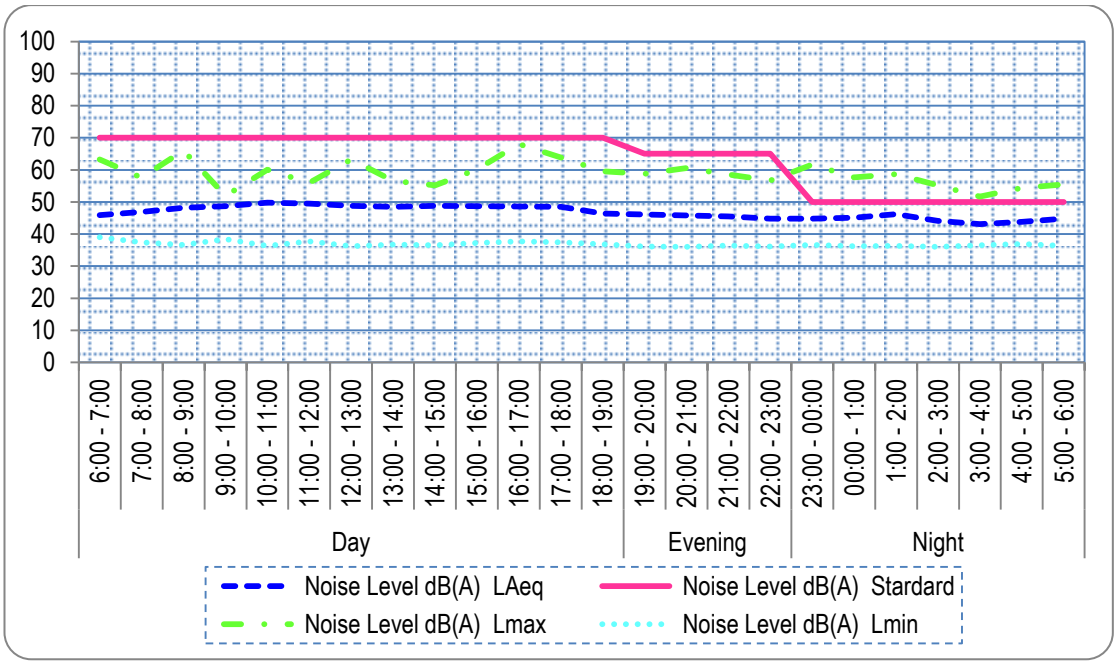


Figure 4-11: Noise Level at Cross Section 3 more than 100 m away from the Road Side

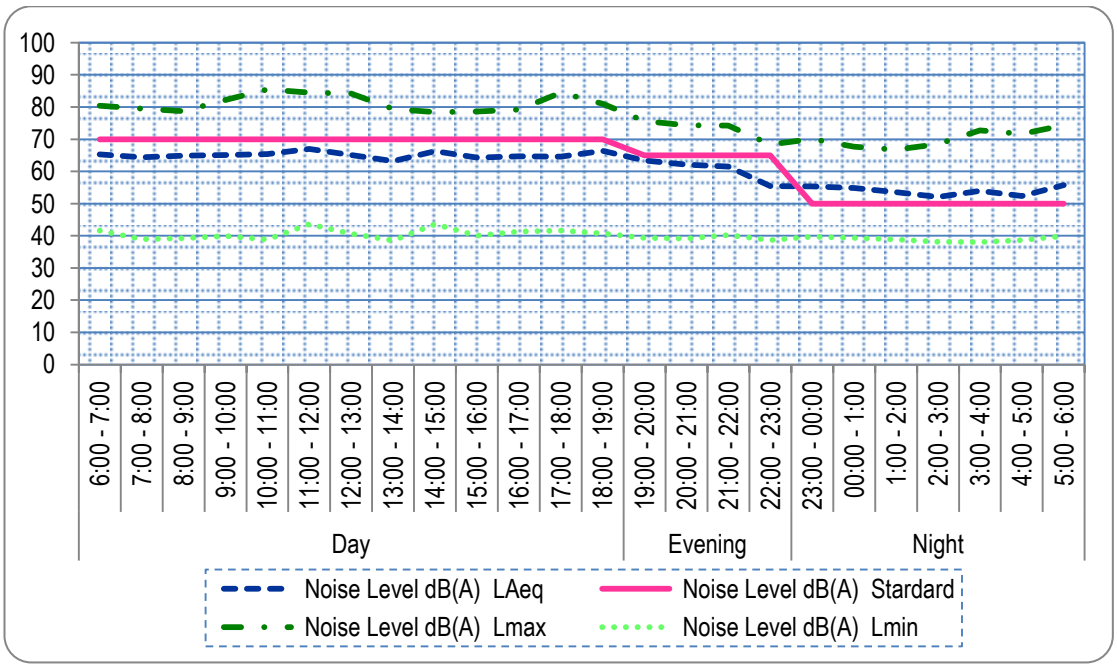


Figure 4-12: Noise Level at Cross Section 4 at the Road Side

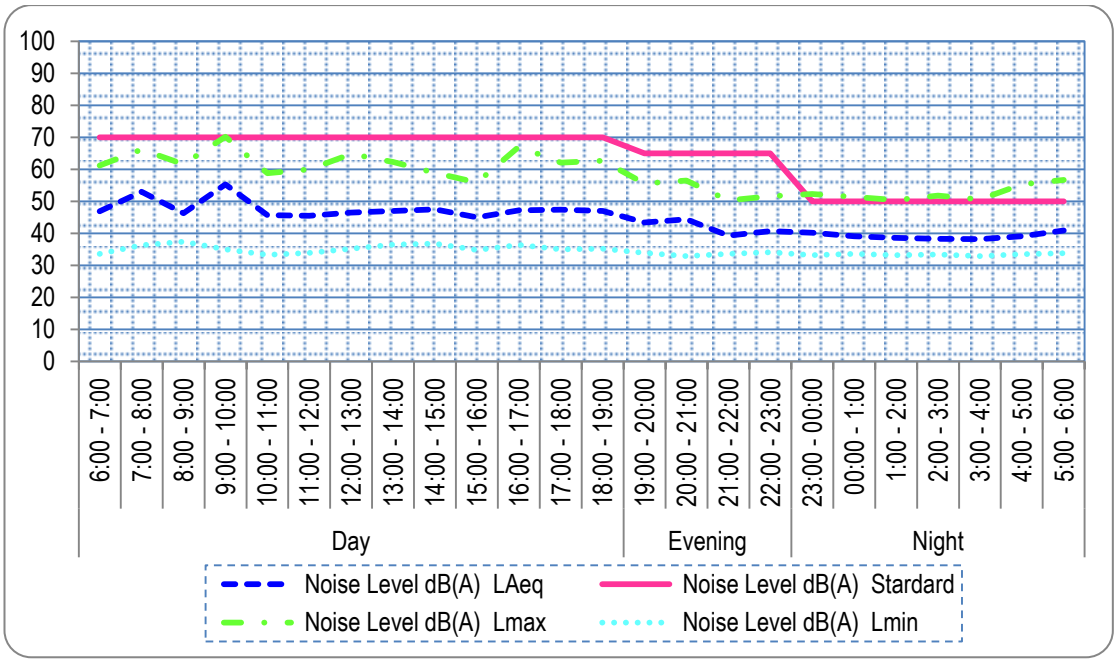


Figure 4-13: Noise Level at Cross Section 4 more than 100 m away from the Road Side

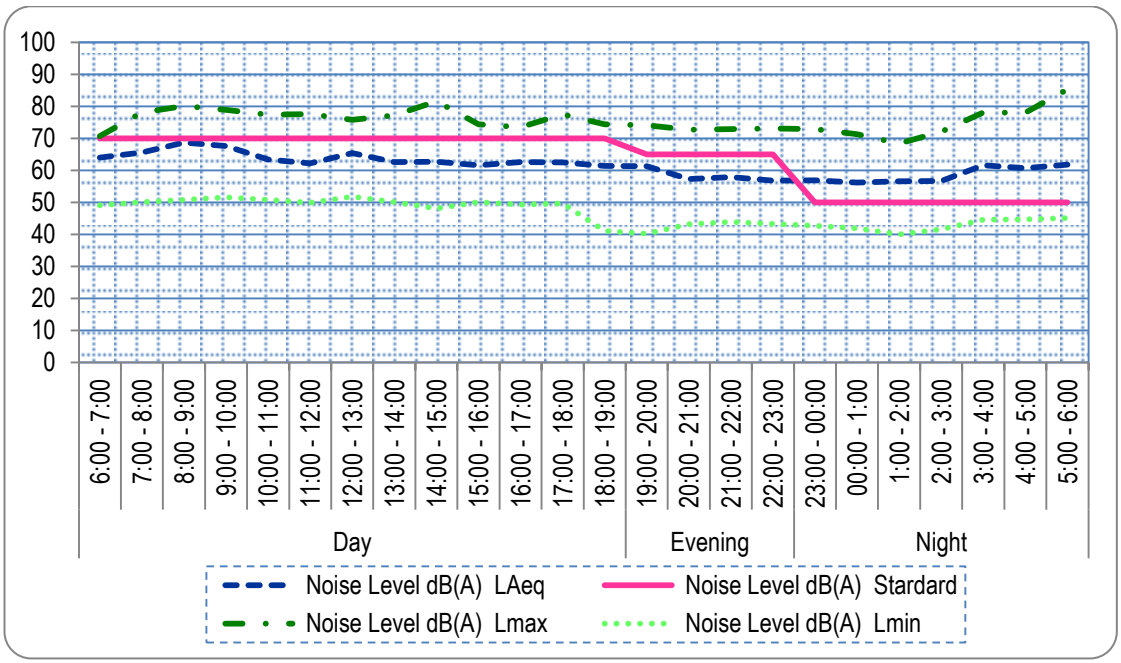


Figure 4-14: Noise Level at Cross Section 5 at the Road Side

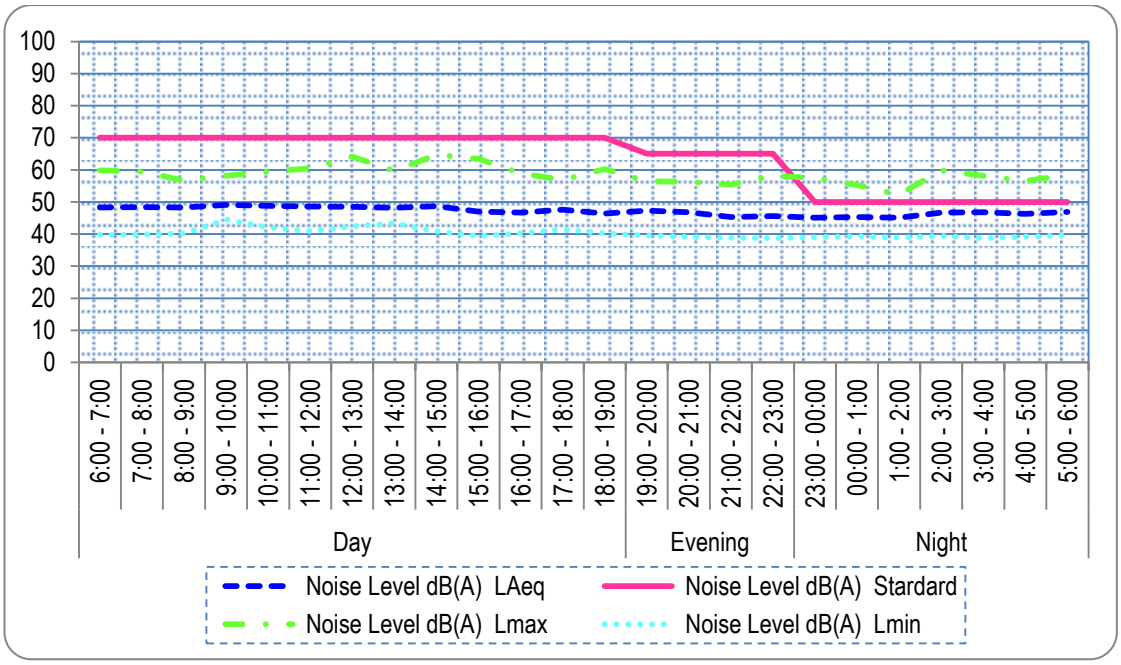


Figure 4-15: Noise Level at Cross Section 5 more than 100 m away from the Road Side

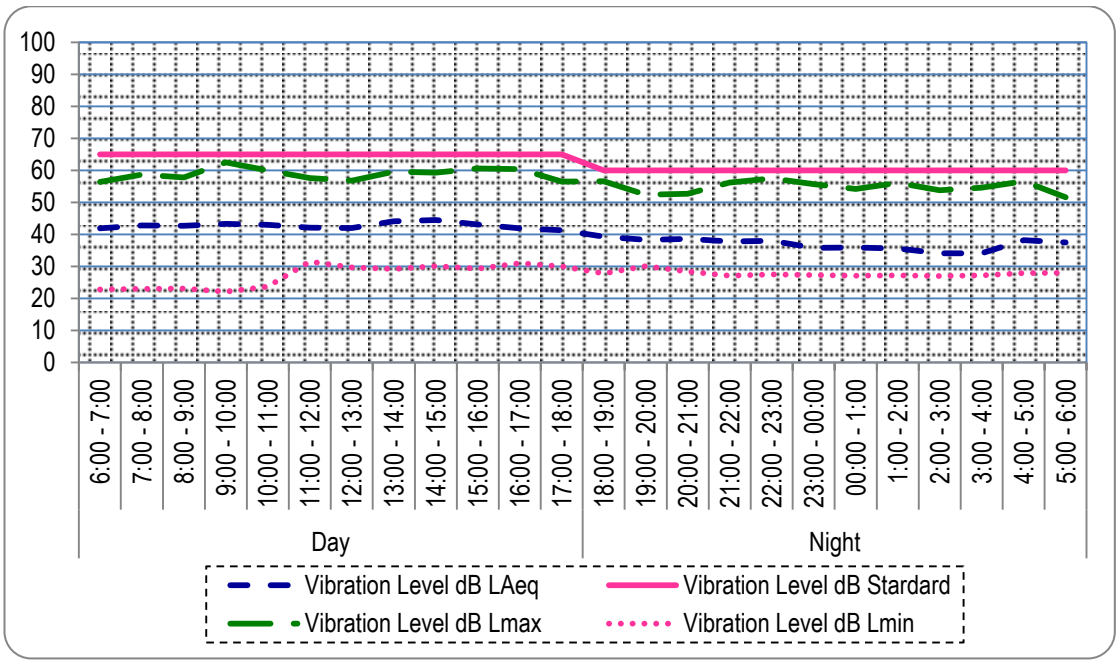


Figure 4-16: Vibration Level at Cross Section 1 at the Road Side

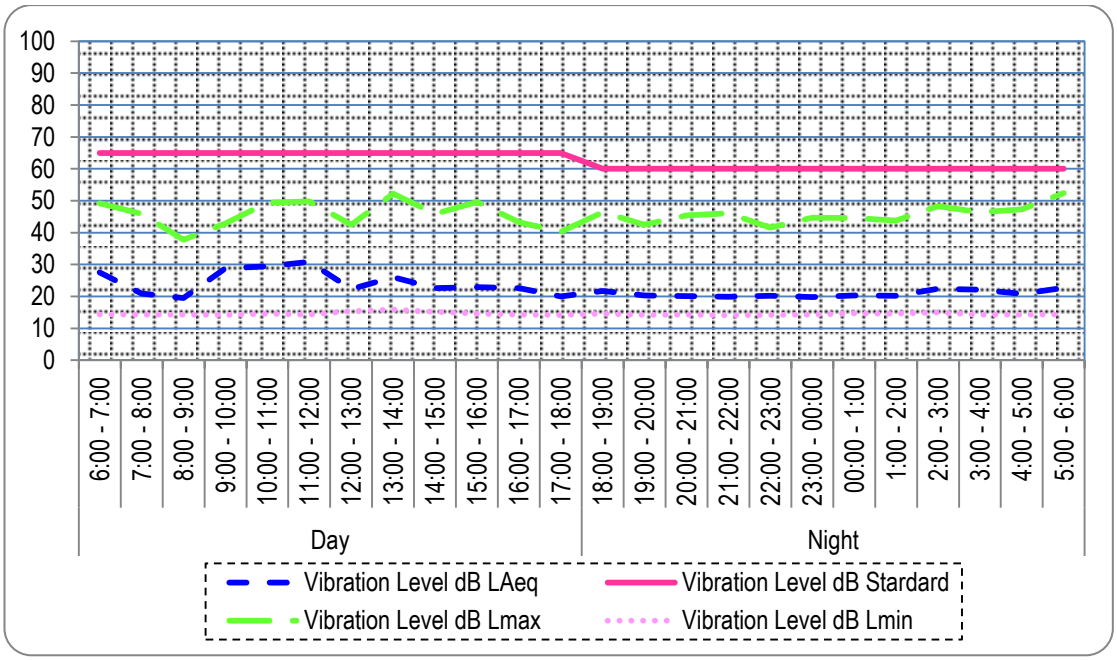


Figure 4-17: Vibration Level at Cross Section 1 more than 100 m away from the Road Side

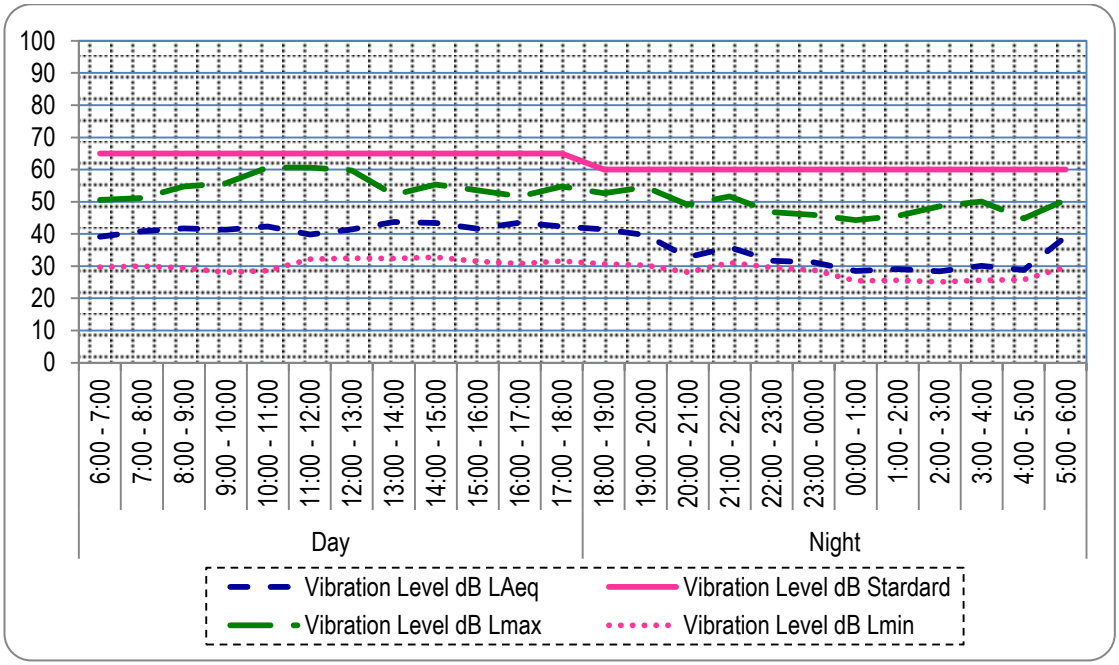


Figure 4-18: Vibration Level at Cross Section 2 at the Road Side

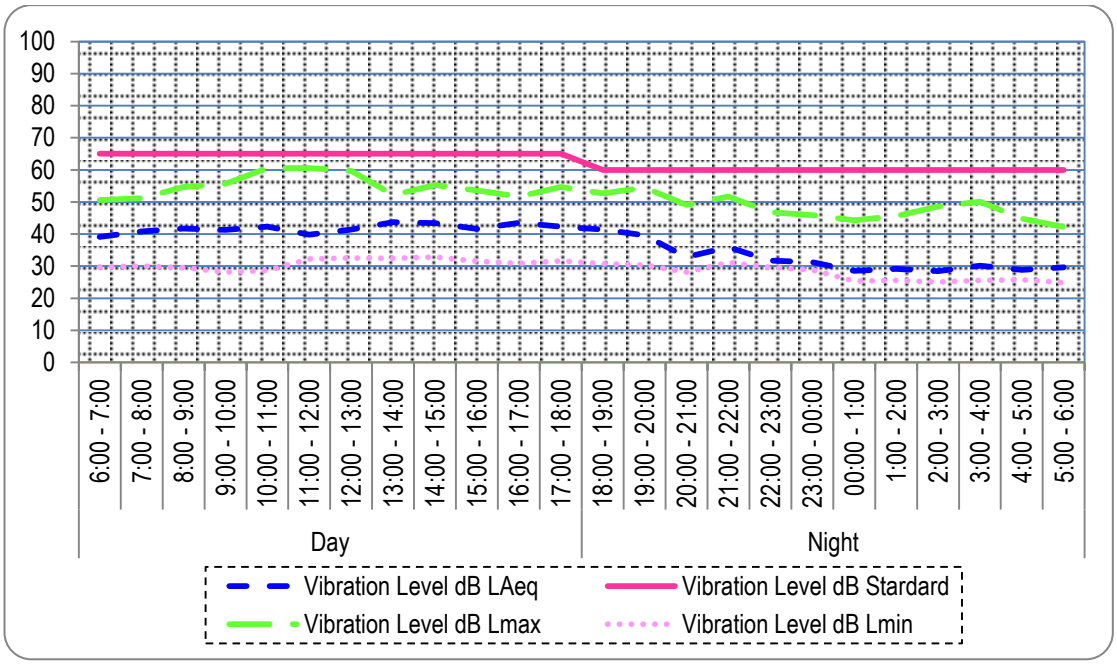


Figure 4-19: Vibration Level at Cross Section 2 more than 100 m away from the Road Side

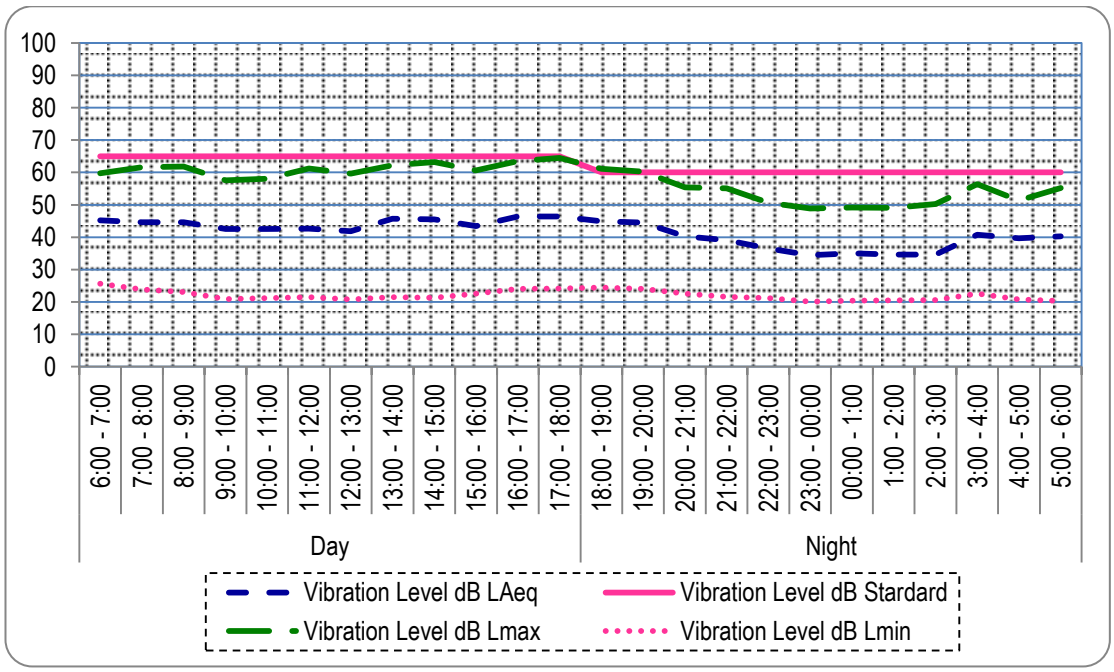


Figure 4-20: Vibration Level at Cross Section 3 at the Road Side

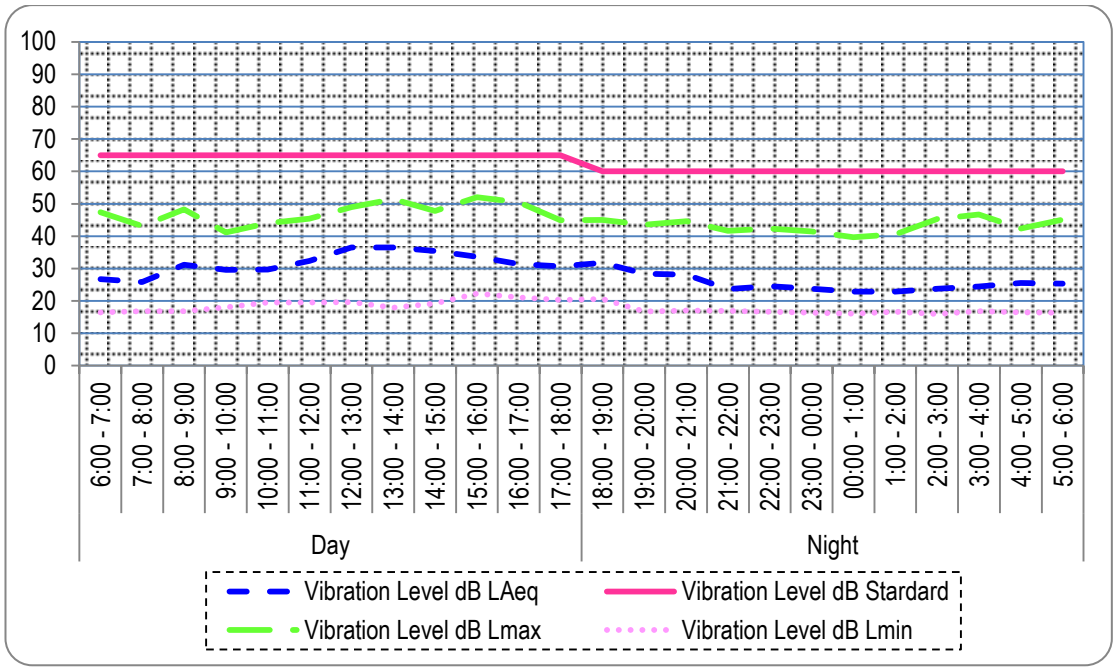


Figure 4-21: Vibration Level at Cross Section 3 more than 100 m away from the Road Side

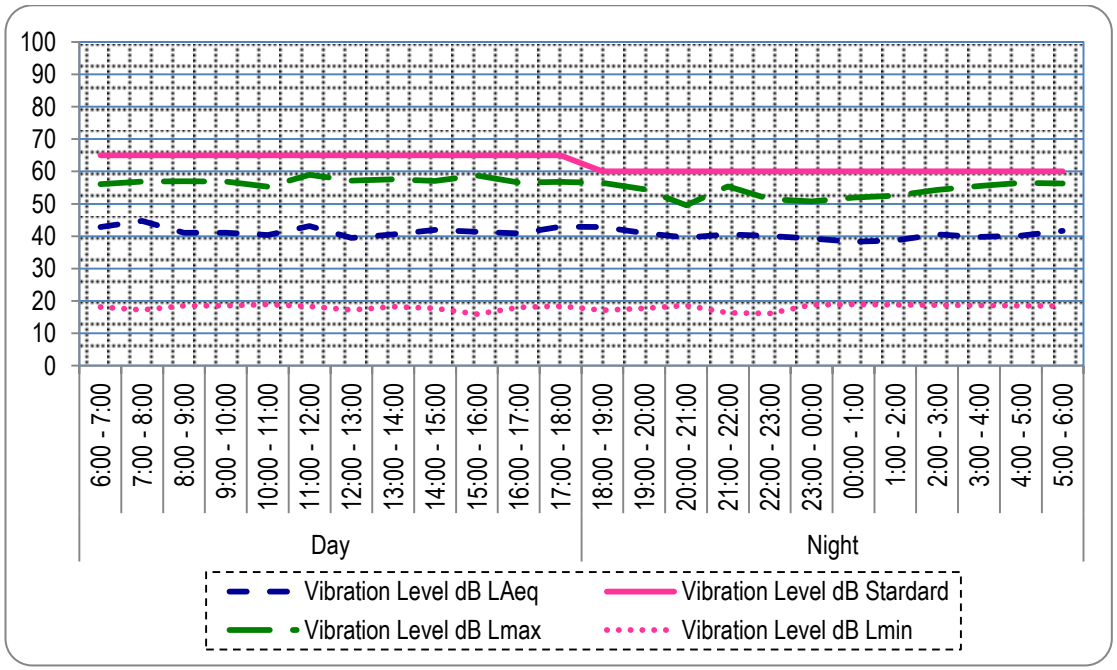


Figure 4-22: Vibration Level at Cross Section 4 at the Road Side

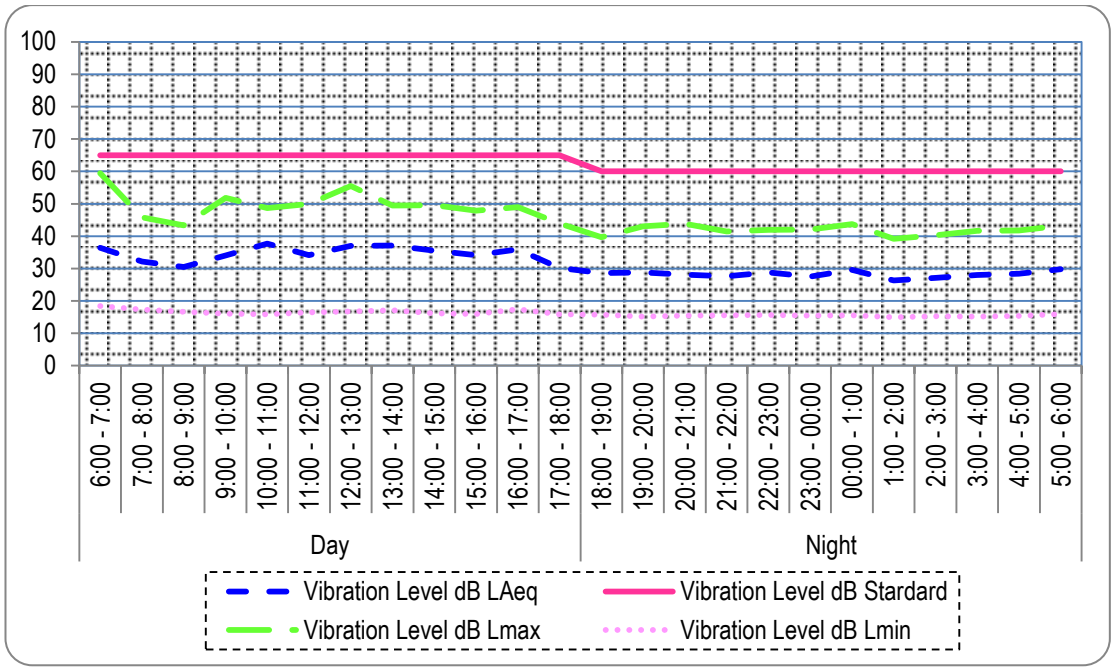


Figure 4-23: Vibration Level at Cross Section 4 more than 100 m away from the Road Side

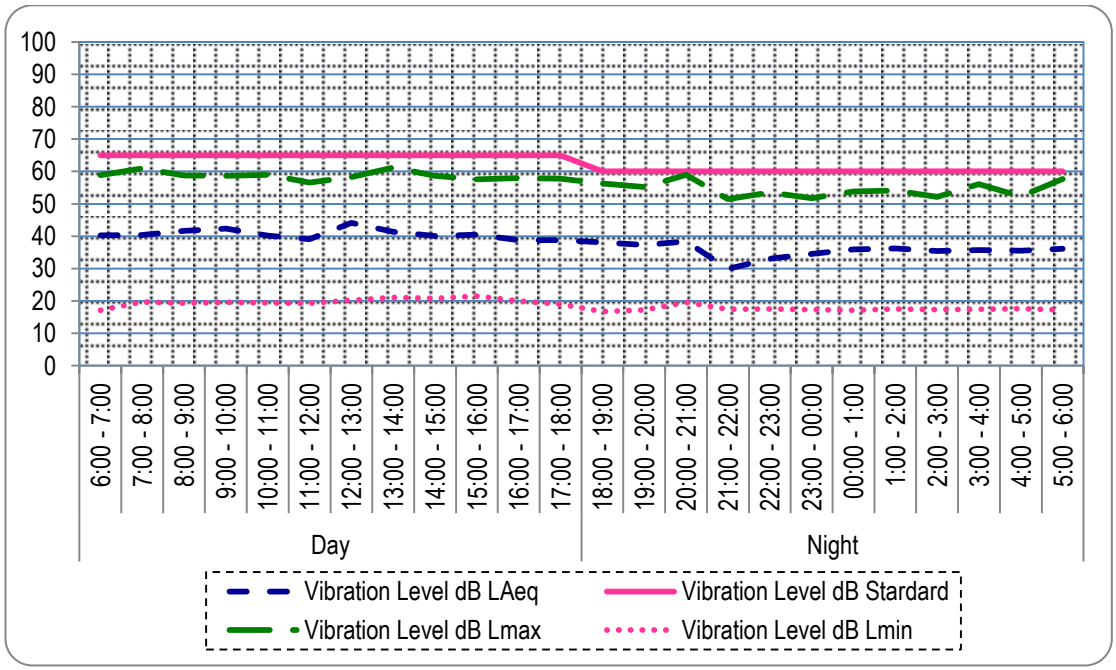


Figure 4-24: Vibration Level at Cross Section 5 at the Road Side

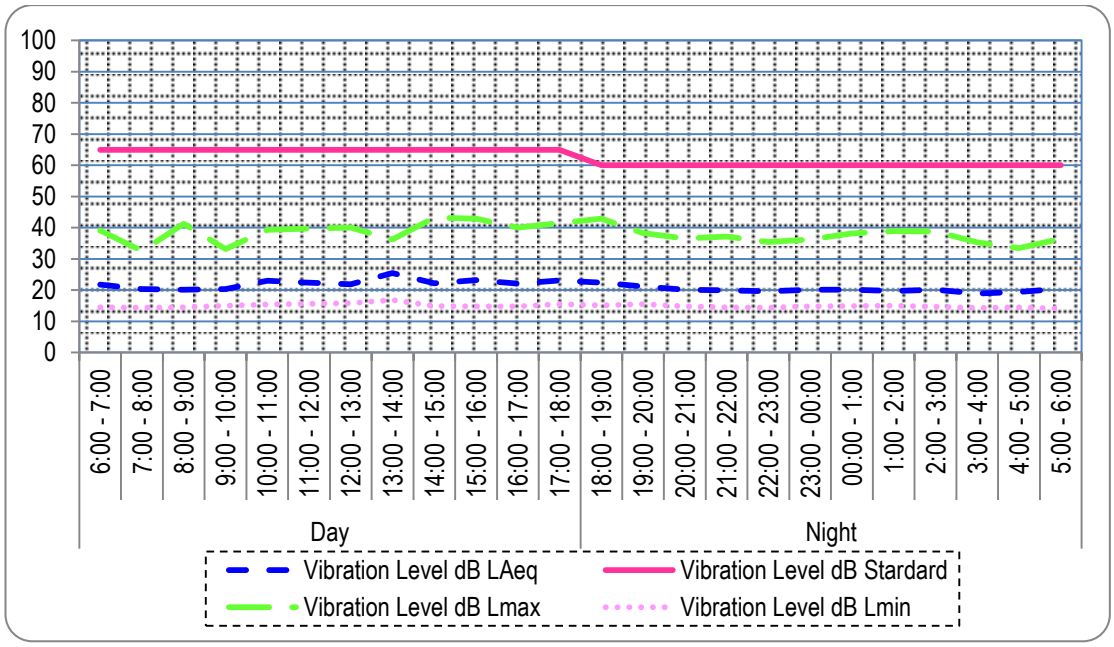


Figure 2-25: Vibration Level at Cross Section 5 more than 100 m away from the Road Side

4.1.8 Water Quality

4.1.8.1 During the Dry Season

Result of water quality analysis is shown in table 4-12. pH at all the water sampling locations was in the MoE's standard. The TSS was found to be higher than the MoE's standard at 5 water sampling locations: Sampov Meas Reservoir, River at Provincial Boundary, A channel in Svay Commune, Cheung Kreav River, and Ou Chankok River. High in the TSS may be due to sediments from erosion and then resuspended them from the bottom of the rivers and the reservoirs. The TSS is generally considered that with a concentration less than 20 mg/l to be clear, between 40 and 80 mg/l tends to appear cloudy, and over 150 mg/l usually appears dirty. The BOD ranged in the MoE's standard level. The COD in the river at provincial boundary was higher than its standard level. This may be due to the sampling location is surrounded by residential area, disposing wastewater into the river. It is notable that the higher the chemical oxygen demand, the higher the amount of pollution in river. The Total Coliform heavily exceeded water quality standard in public water area for lake and reservoir determined by the MoE. This is due to the fact that agricultural runoff and animal manures at upstream areas washing out by rains during the rainy season to the rivers and streams.

Table 4-12: Result of Water Quality Analysis during the Dry Season

No.	Location	Temp (^{0}C)	pH	TSS (mg/l)	BOD (mg/l)	COD (mg/l)	Total Coliform (MPN/100ml)
1	Tonle Sap River**	32.4	7.0	86.00	2.25	5.00	2,400
2	Sampov Meas Reservoir*	32.5	7.7	112.00	1.25	3.92	74
3	River at Provincial Boundary**	31.6	7.4	110.00	3.00	10.19	2,400
4	A channel in Svay Commune**	31.2	7.6	338.00	3.60	6.27	930
5	Cheung Kreav River**	30.1	6.9	132.00	2.20	5.35	4,600
6	Phnom Lech Reservoir*	30.6	8.2	66.00	1.25	5.48	4,600
7	Ou Prong River**	30.3	6.5	60.00	1.20	2.17	2,400
8	Bonbou River**	29.7	6.8	76.00	0.85	1.98	110,000
9	Ou Chankok River**	29.8	6.5	142.00	2.40	7.05	110,000
10	Pursat River**	30.9	7.5	78.00	2.65	3.74	46,000
Standard of the MoE			6.5 – 8.5	25 – 100	1 – 10	1 – 8	*<1,000 or **<5,000

Note: Total Coliform Standard in Reservoir <1,000 and Total Coliform Standard in River <5,000

4.1.8.2 During the Rainy Season

Result of water quality analysis is shown in table 4-13. pH at all the water sampling locations was in the MoE's standard. The TSS was higher than the MoE's standard at 8 water sampling locations: Tonle Sap River, River at Provincial Boundary, A channel in Svay Commune, Cheung Kreav River, Phnom Lech Reservoir, Bonbou River, Ou Chankok River, and Pursat River. High in the TSS may be due to sediments from erosion during the rainy season and then resuspended them from the bottom of the rivers and the reservoirs. The BOD and COD ranged in the MoE's standard level. Total Coliform heavily exceeded water quality standard at only 1 location. This is due to the fact that runoff at upstream areas washing out by rains during the rainy season to the river.

Table 4-13: Result of Water Quality Analysis during the Rainy Season

No.	Location	Temp (^{0}C)	pH	TSS (mg/l)	BOD (mg/l)	COD (mg/l)	Total Coliform (MPN/100ml)
1	Tonle Sap River**	33.5	7.6	162.00	0.70	1.57	$1.5x10^4$
2	Sampov Meas Reservoir*	32.5	7.8	94.00	1.06	1.76	94
3	River at Provincial Boundary**	31.4	7.5	398.00	2.59	4.70	$4.3x10^3$
4	A channel in Svay Commune**	32.2	7.5	398.00	2.70	4.90	$2.3x10^3$
5	Cheung Kreav River**	30.1	6.9	396.00	3.95	5.88	$4.3x10^3$
6	Phnom Lech Reservoir*	31.6	7.4	110.00	2.95	7.84	$3.0x10^2$
7	Ou Prong River**	31.1	6.5	74.00	2.85	6.27	74
8	Bonbou River**	28.7	6.9	318.00	2.65	4.70	$2.4x10^3$
9	Ou Chankok River**	28.4	6.9	416.00	3.95	5.49	$4.3x10^2$
10	Pursat River**	28.8	7.0	198.00	1.35	3.72	$4.3x10^2$
Standard of the MoE			6.5 – 8.5	25 – 100	1 – 10	1 – 8	*<1,000 or **<5,000

4.1.9 Solid Waste Condition

4.1.9.1 Official Waste Management System

Waste conditions were investigated. The main objectives were focused on the official waste management system and the illegal dumping sites in the project area. As a result, 7 locations having official waste management or waste collection service were identified, all of which are consecutively described as follows:

A. Kampong Speu Province

Starting from Kampong Speu province, there is one urban area named Odongk market (PK 38), the place where many business activities were located. Solid waste collection service was provided. However, the service covered only at the market and some nearby areas. The service provider, Mr. Ung Sokheng, has received permission from Odongk district councils to collect solid wastes from the market, restaurants, and houses. The service contract period is for 3 years. The service fee was charged based on the amount of wastes (Table 4-14). Based on the interview, the service provider reported that 2 (1.5-tonne) trucks were operated every day to collect the wastes from the market and the nearby areas. The wastes were finally disposed at an open dumping site which is about 2 km away from the urban area. Wastes composition was not identified since the collected wastes from various sources were not separated.

Table 4-14: Charges for Solid Waste Collection Service at the Oudong Market

No	Type of Business	Service Fee (Riel/month)	Frequency of Collection
1	Stall in the market	2,000 - 3,000	Every day
2	Restaurant/hotel	10,000 - 15,000	1 time/2 days
3	Big business house	8,000	1 time/2 days
4	Small business house	6,000	1 time/2 days
5	Non-business house	5,000	1 time/2 days

B. Kampong Chhnang Province

The wastes collection service was also found. 5 locations were identified during the study period, all of which are as follows:

B.1 Sala Lek 5 Market (PK 53)

Some business activities were also found at this location. The wastes collection was operated by the service provider, Mr. Om Rin, getting permission from Kampong Tralach district councils. The service contract period is for 1 year to collect the wastes from the market and nearby houses and to finally dispose at an open dumping site, where is about 1 km away from the market. The service was charged as in table 4-15.

Table 4-15: Charges for Solid Waste Collection Service at the Sala Lek 5 Market

No	Type of Business	Service Fee (Riel/month)	Frequency of Collection
1	Stall in the market	3,000	Every day
2	Restaurant/hotel	5,000	Every day
3	Big business house	5,000	2 – 3 times/week
4	Small Business house	5,000	2 – 3 times/week
5	Non-business house	5,000	2 – 3 times/week

B.2 Prey Khmer Market (PK 79 – 80)

Between PK-79 to 80, there is one small peri-urban area where the wastes collection service, just only in the market, was provided. The wastes collection was operated by a service provider getting permission from Rolea B'ier district councils. The service contract is for 1 year to collect wastes from the market and dispose at an open dumping site, which is about 1.5 km away from the market. The fee was charged based on the size of each stall and waste generation, ranging from 3,000 to 6,000 Riel per month.

B.3 Kompong Chhnang Town

The Kampong Chhnang town has many business activities. The wastes collection service was also found and operated by a service provider, Mr. Yim Thy, getting permission from provincial councils to collect wastes from Leu market, Kroam market, and some parts of residential areas. Regarding to wastes composition, the service provider could not estimate the composition collected from market and households. Anyway, based on the observation he found that plastic products were dominated amongst other wastes. The wastes amount was disposed about 3t/day at an open dumping site locating 2 km away from the town. The service fee was charged based on business types as in table 4-16.

Table 4-16: Charges for Solid Waste Collection Service at the Kampong Chhnang Town

No	Type of Business	Service Fee (Riel/month)	Frequency of Collection
1	Stall in the market	4,000	Every day
2	Restaurant/hotel	10,000	2 – 3 times/week
3	Big business house	6,000	2 – 3 times/week
4	Small Business house	5,000	2 – 3 times/week
5	Non-business house	3,000	2 – 3 times/week

B.4 Pong Ro Market (PK 100)

It is a small town where the wastes collection service was found. The service coverage was just only in the market and houses around. The service provider has received permission from Rolea B'íer district councils to look over the market and also provides the wastes collection service. The service contract is for 1 year to collect the wastes from the market and dispose at an open dumping site, where is about 3 km away from the market.

The amount of wastes disposal was 1 cart or about 400 kg/day. The fee charge ranged from 300 to 500 Riel per day.

B.5 Punley Market (PK 123)

Similar to the Pong Ro market, the wastes collection service was found. The service coverage was just only in the market and houses around. The amount of wastes disposal is about 1 cart or about 400 kg/day. The service charge was 4,000 Riel/month for vendors, business owners and houses. All wastes were collected from a designed storage place in the market and disposed at an open dump site locating at 2 km away from the market.

In the whole Kampong Chhnang province total wastes disposal was about 143 tons/day. However, only 9.9% of the wastes were disposed at landfill according to Kampong Chhnang Provincial Department of Environment, (Table 4-17).

Table 4-17: Wastes Generation in the Kampong Chhnang Province

No	Solid Wastes	Quantity (tons/day)	Percent (%)
1	Recyclable wastes	2.050	1.4
2	Solid wastes disposed at landfill	14.190	9.9
3	Illegal wastes disposal	127.291	88.7
Total Wastes Disposal		**143.531**	**100**

Source: Kampong Chhnang Provincial Department of Environment as of December 2012

C. Pursat Province

C.1 Krakor Market (PK 153)

In the Pursat province, only one urban area, Krakor market, where the wastes collection service was operated. The service provider has received permission from provincial councils to collect the wastes from the market and houses around. The service contract is for 1 year to collect the wastes from the market and dispose at an open dumping site, where is about 3 km away from the market. The amount of wastes disposal was from 1 to 2 carts (about 430 kg/cart) every day. It was hard to quantify wastes composition since people disposed wastes together. The service fee was charged based on business types as shown in Table 4-18.

Table 4-18: Charges for Solid Waste Collection Service at the Krakor Market

No	Type of Business	Service Fee (Riel/month)	Frequency of Collection
1	Stall in the market	4,000	Every day
2	Restaurant/hotel	10,000	2 – 3 times/week
3	Big business house	8,000	2 – 3 times/week
4	Small business house	6,000	2 – 3 times/week
5	Non-business house	6,000	2 – 3 times/week

D. Challenges of Wastes Collection Service

Most of the service providers have complained about their difficulties in the service operation. Mr. Ung Sokheng, the service provider at the Odongk market, addressed that some households did not pay for the service but they also disposed their wastes at the market. It was very difficult to control over the matter. Another service provider in Kompong Chhnang town identically said that lack of participation from people caused a lot of problems. Some people brought their wastes to dispose at the market. Thus, they didn't need to pay for the service. It was also hard to identify who disposed them. Mr. Om Rin, the service provider at the Sala Lek 5 market, also shared similar perception with this matter, adding that people didn't understand about wastes disposal and didn't want to

spend money for the collection service. Another common challenge in wastes management is lack of labour due to high wage while income from the service was limited.

4.1.9.2 Dumping Site

All open dumping sites were not properly treated. There was no separated wastes disposal at those sites. As a result, organic, toxic, and recyclable wastes were thus disposed together. Burning was the common practice in wastes management of all the service providers. Most of the service providers disposed wastes on their own lands since local authorities were unable to find out proper dumping sites for them. There were two service providers in the Prey Khmer market (PK79-80) and the Pong Ro market (PK100) disposed wastes at the designed areas. In case of the Kampong Chhnang town, the service provider has received permission to dispose wastes on other private land. The dumping sites were generally a bit far from the urban areas. Details of the dumping sites are shown in Table 4-19.

4.1.9.3 Illegal Wastes Disposal

It was common to see people throwing away their wastes into side drains and on road shoulders. In an attempt to know more in-depth, some of those people were asked and then reported that their disposed wastes would disappear either by water flow or somebody else would clean up the wastes due to public areas. As a result, many illegal wastes disposal sites were found and usually observed at bridges, near the rest areas, and at the end of urban areas. There were 11 major illegal wastes disposal areas were noticed (Table 4-20). Main sources of the illegal waste disposal are from residents, vendors, and passengers.

Table 4-19: Open Dumpsites

No.	PK No.	Location	Condition	Sources	Photo of the Dumping Site
1	38	The location is about 2 km away from the Odongk market.	All waste types were disposed together since there was no separated wastes disposal. The wastes were treated by burning. The wastes composition mainly consisted of plastic and toxic products.	Market, restaurants, business houses and houses.	
2	53	The location is about 1 km away from the Sala Lek 5 market.	All waste types were disposed together since there was no separated wastes disposal. The wastes were treated by burning. The wastes composition mainly consisted of plastic and toxic products.	Market, restaurants and houses.	
3	79 – 80	The location is about 1.5 km away from the Prey Khmer market	All waste types were disposed together since there was no separated wastes disposal. The wastes were treated by burning. The wastes composition was mainly plastic and toxic products.	Market, restaurants and houses.	

No.	PK No.	Location	Condition	Sources	Photo of the Dumping Site
4	87	The location is about 2 km away from the Kampong Chhnang town.	All waste types were disposed together since there was no separated wastes disposal. The wastes were treated by burning. The wastes composition was dominated by plastic products.	Market, restaurants and houses.	
5	100	The location is about 3 km away from the Pong Ro market.	All waste types were disposed together since there was no separated wastes disposal. The wastes were treated by burning. The wastes composition was mainly plastic and toxic products.	Market, restaurant and houses.	
6	123	The location is about 2 km away from the Punley market	All waste types were disposed together since there was no separated wastes disposal. The wastes composition was mainly plastic products.	Market, restaurants and houses.	

No.	PK No.	Location	Condition	Sources	Photo of the Dumping Site
7	153	The location is about 3 km away from the Krakor market.	All waste types were disposed together since there was no separated wastes disposal. The wastes were treated by burning. The wastes composition was mainly plastic and toxic products.	Market, restaurants, houses and pharmacies.	

Table 4-20: Illegal Wastes Disposal along the Project Area

No	PK No.	Location	Condition	Source	Photo of Illegal Wastes Disposal
1	31	Prek Kdam	Wastes were disposed on the road shoulder. Wastes composition consisted of organic, plastic, recyclable, and toxic wastes. Burning such wastes was a common practice.	Restaurants, business houses, vendors, passengers and residents.	
2	35	Near gate to Odongk mountain	Wastes were disposed on the road shoulder. Wastes composition consisted of organic and plastic. Burning the wastes was a common practice of vendors and some households.	Vendors from the market in front of Odongk Mountain gate and some residents	
3	41 – 42	Trach market	Wastes were disposed on the road shoulder. Waste composition mostly consisted of organic product. Burning such wastes was a common practice of vendors.	Vendors from the market	

No	PK No.	Location	Condition	Source	Photo of Illegal Wastes Disposal
4	46 – 48	Poar Village	Wastes were disposed on the side drain. Wastes composition mostly consisted of plastic product. Burning such wastes was a common practice.	Residents and restaurants	
5	60	Thnol Toteung market	Wastes were disposed on the road shoulder. Plastic waste dominated among other wastes. Burning the wastes was a common practice.	Vendors and residents	
6	66	Saeb Village	Wastes were disposed on the road shoulder. Plastic waste dominated among other wastes. Burning the wastes was a common practice.	Vendors and residents	

No	PK No.	Location	Condition	Source	Photo of Illegal Wastes Disposal
7	80 – 81	Near the Prey Khmer market	Wastes were disposed on the road shoulder. Plastic waste dominated among other wastes. Burning the wastes was a common practice.	Local residents and passengers.	
8	104	Thmor Keo Village	Wastes were disposed into the side drain. Plastic waste dominated among other wastes. Burning the wastes was a common practice.	Vendors and residents	
9	117	Psar Village	Wastes were disposed on the road shoulder. Plastic waste dominated among other wastes. Burning the wastes was a common practice.	Vendors from the market and local residents	

No	PK No.	Location	Condition	Source	Photo of Illegal Wastes Disposal
10	127	Near Chork primary school	Wastes were disposed on the road shoulder. Plastic and organic wastes dominated among other wastes. Burning the wastes was a common practice.	Restaurants	
11	141	Koal market	All of wastes were generated from the market and some residents and were then burnt. Plastic products were much more than other wastes.	Vendors and some of households around this area.	

4.1.9.4 Solid Wastes Disposal Condition at Kampong Chhnang Bypass

The current condition of wastes disposal at the Kampong Chhnang Bypass is not a concern. Some plastic bags were found at the business houses in villages. The common practice of their wastes management were composting and burning for organic waste and plastic one, respectively.

4.1.10 Offensive Odor

Offensive odor was mostly observed at dumping sites and market areas where local people disposed garbage. In the project area, a channel at provincial boundary between Kampong Speu and Kampong Chhnang provinces and a channel nearby the Krakor market were found to have offensive odors (Figure 4-26). This was due to the fact that local people disposed the garbage into those channels.

Figure 4-26: A) A channel at the provincial boundary B) A channel near the Krakor market

4.1.11 Subsidence

No any report has been stated about land subsidence in the project area.

4.2 Natural Environment

The project area is located at the Southern-Western border of the Tonle Sap Great Lake. During the rainy season in particular from September to November, the lake expands its area to vicinity of the NR No.5 due to flood water coming from the Mekong River. Therefore, the project area has transitional relation to natural environment of the Tonle Sap ecosystem.

4.2.1 Ecosystem

4.2.1.1 Agricultural Ecosystem

Agricultural ecosystem (paddy field and farm land) was observed along the project area. Starting from Prek Kdam (Direction from Phnom Penh) till Thlea MA'am, the ending of the project area, paddy field was found on both sides, starting from PK 39 + 829 m on both sides of the NR No.5. The ending point of the paddy field on the right side is at KP 148 + 517 m ~ 149 + 729 m and that of the left hand side is at KP 148 + 517m ~ 149 + 955 m. In between, there are many locations were also observed. Meanwhile, farm land, cashew farm, was found at KP 130+ 790m ~ 131 + 930 m on the left hand side while its ending point is located at KP 145 ~ 145 + 578 m on both sides. The detailed locations of paddy field and farm land in the project area in shown in table 4-21.

Table 4-21: Detailed Locations of Paddy Field and Farm Land

Type of Land Use	Location Right side (Northeast)	Location Left side (Southwest)
Paddy Field	KP 39 + 829m ~ 41+ 799m	KP 39 + 829m ~ 41+ 799m
	KP 48 + 500m ~ 50 + 756m	KP 43 + 152m ~ 44
	KP 55 + 869 m ~ 56 + 704m	KP 48 + 500m ~ 49 + 462m
	KP 61 + 852m ~ 63 + 535m	KP 60 + 814m ~ 61 + 218m
	KP 64 + 114m ~ 65 + 846m	KP 61 + 852m ~ 65 + 846m
	KP 66 + 520m ~ 67	KP 69 + 332m ~ 71 + 931m
	KP 69 + 332m ~ 71 + 627m	KP 81 + 146m ~ 82 + 882m
	KP 81 + 146m ~ 82 + 882m	KP 112 + 735m ~ 113 + 395m
	KP 148 + 517m ~ 149 + 729m	KP 129 ~ 129 + 525m
	-	KP 148 + 517m ~ 149 + 955m
Farm Land	-	KP 130+ 790m ~ 131 + 930m
	KP 145 ~ 145 + 578 m	KP 145 ~ 145 + 578m

Note: KP = Kilometer Post

Figure 4-27: Paddy Field and Farm Land

4.2.1.2 Ecosystem in Residential and Urban Areas

Kampong Chhnang and Baribour towns were observed as major urban areas. These areas are very active in daily economic activities. Many residential areas of small communities on both sites along the project area were found. The detailed locations are shown in table 4-22.

Table 4-22: Detailed Locations of Residential Area

Type of Land Use	Location Right side (Northeast)	Location Left side (Southwest)
Residential area	KP 31 ~ 31+ 706m	KP 31 ~ 31+ 706m
	KP 31+ 925m ~ 33 + 507m	KP 32+ 736m ~ 33 + 240m
	KP 34 + 801m ~ 39 + 829m	KP 34 + 801m ~ 39 + 829m
	KP 41 + 799m ~ 48+ 500m	KP 41 + 799m ~ 43+ 152m
	KP 50 + 756m ~ 55 + 869m	KP 44 ~ 48 + 500m
	KP 56 + 704m ~ 61 + 852m	KP 49 + 462m ~ 60 + 814m
	KP 63 + 535m ~ 64+ 114m	KP 61 + 218m ~ 61 + 852m
	KP 65 + 846m ~ 66 + 520m	KP 65 + 846m ~ 67 + 758m
	KP 67 ~ 67 + 758m	KP 68 + 98 m ~ 69 + 332m
	KP 68 + 98m ~ 69 + 332m	KP 71 + 931m ~ 81 + 146m
	KP 71 + 627m ~ 81 + 146m	KP 98 + 100m ~ 105 + 118m
	KP 98 + 100m ~ 105 + 338m	KP 107 + 457m ~ 112 + 735m
	KP 107 + 457m ~ 112 + 735m	KP 149 + 955m ~ 171

Type of Land Use	Location Right side (Northeast)	Location Left side (Southwest)
	KP 114 ~ 130 + 790m	KP 114 ~ 129
	KP 131 + 930m ~ 134 + 110m	KP 129 + 525m ~ 130 + 790m
	KP 134 + 565m ~ 145	KP 131 + 930m ~ 134 + 110m
	KP 145 + 578m ~ 148 + 517m	KP 145 + 578m ~ 148 + 517m
	KP 149 + 729m ~ 171	KP 134 + 565m ~ 145

4.2.1.3 Ecosystem in Natural River and Channel

Agricultural channels and small rivers are found though the project area. These channels and most of the small rivers usually dry up during the dry season. It is notable that during the rainy season, the small rivers have direct and/or indirect connections with the Tonle Sap Great Lake.


Figure 4-28: Rivers in the Project Area

4.2.1.4 Ecosystem in Wetland and Flood Plain

A considerable wetland with high biodiversity is located at KP 105 + 338 m ~ 107 + 457 m (Right site or Northeast) and KP 105 + 118m ~ 107 + 457 m (Left side or Southwest) around Ou Prong River crossing point to the northwest of Kampong Chhnang town. The starting point of flood plain is located at KP 31+ 706 m ~ 31+ 925 m on the right hand side and at KP 31+ 706m ~ 32 + 736 m of the left hand side prior to reaching Odongk town. The ending point of the flood plain is located on both sides at KP 67 + 758 m ~ 68 + 98 m. This flood plain is used as fish farm by local people during dry period. Either locations of flood plain or wetland are collectively shown in table 4-23.

Table 4-23: Locations of Flood Plain and Wetland

Type of Land Use	Location Right side (Northeast)	Location Left side (Southwest)
Flood Plain	KP 31+ 706m ~ 31+ 925m	KP 31+ 706m ~ 32 + 736m
	KP 33 + 507m ~ 34 + 801m	KP 33 + 240m ~ 34 + 801m
	KP 67 + 758m ~ 68 + 98m	KP 67 + 758m ~ 68 + 98m
Wetland	KP 105 + 338m ~ 107 + 457m	KP 105 + 118m ~ 107 + 457m

4.2.1.5 Ecosystem in Shrub Land

Major Shrublands are found at KP 112 + 735 m ~ 114 on the right hand side and KP 113 + 395 m ~ 114 on the left hand side, while its ending point is at KP 134 + 110 m ~ 134 + 565 m on the right hand side (Table 4-24).

Table 4-24: Locations of Shrubland

Type of Land Use	Location Right side (Northeast)	Location Left side (Southwest)
Shrubland	KP 112 + 735m ~ 114	KP 113 + 395m ~ 114
	KP 130+ 790m ~ 131 + 930m	KP 134 + 110m ~ 134 + 565m
	KP 134 + 110m ~ 134 + 565m	-

4.2.1.6 Roadside Tree

Roadside trees within 7m on both sides from the road center line were identified in this survey. Main roadside tree species are shown in Table 4-25. However, vegetation along the project area is mixed. Fruit trees such as palm, mango, coconut, Jack were commonly observed at villages where people have been living while wild trees were separately found at non-residential areas. Based on direct observations, 117 floras including vine (climbing plant) were found along the project area and the Kampong Chhnang Bypass. Some of the plants could not be written either scientific name or family name. Those floras are shown in Annex B page 66 – 68 and some of the flora pictures can be found at Annex B page 77 – 88.

Table 4-25: Main Roadside Tree Species

Location Right Side	Tree Name	English Name	Location Left Side	Tree Name	English Name
KP 32 + 934m	Ampil Barang	Rain Tree	KP 32 + 730m	Ampiltoeuk	Manila tamarind
KP 34 + 157m	Ampil Barang	Rain Tree	KP 32 + 720m	Chek	Banana tree
KP 35 + 36	Tnaot	Sugar Plam	KP 46 + 120m	Acacia	-
	Putrea	Jujube tree	KP 57 + 90m	Breng Khyal	-
KP 36 + 37	Ampil	Tamarind Tree	KP 58 + 270m	Breng Khyal	-
	Tnaot	Sugar palm		Acacia	-
KP 37 + 375m	Chhat	Indian Almond	KP 60 + 61	Acacia	-
KP 38 + 39	Teuk Dah Kou	Milk fruit		Angkanh	-
	Chhat	Indian Almond		Breng khyal	-
KP 39 + 175m	Acacia	-	KP 66 + 67	Chhat	Indian Almond
KP 44 + 160m	Breng Khyal	-		Ampil Barang	Rain Tree
KP 57 + 120m	Breng Khyal	-		Svay Chanty	Cashew tree
KP 59 + 625m	Porpealkhae	-		Acacia	-
KP 60 + 85m	Breng Khyal	-	KP 68 + 132m	Putrea	Jujube tree
KP 65 + 66	Acacia	-	KP 73 + 188m	Tnoat	Sugar palm
	Breng khyal	-	KP 74 + 805m	Roluoanhi	-
KP 66 + 38m	Acacia	-	KP 75 + 76	Trasek	-
KP 67 + 470m	Svay Chanty	Cashew tree		Roluoanhi	-
KP 68 + 69	Thkouv	-		Breng khyal	-
	Acacia	-	KP 79 + 80	Tnaot	Sugar palm
KP 69 + 70	Tnaot	Sugar palm		Ampil	Tamarind Tree
	Breng khyal	-	KP 80 + 81	Loeurng Reach	Golden Shower Tree
KP 74 + 405m	Ampil toeuk	-		Chhat	Indian Almond
KP 75 + 192m	Tnaot	Sugar palm	KP 81 + 82	Angkanh	-
KP 76 + 257m	Tnaot	Sugar palm		Acacia	-
KP 81 + 82	Acacia	-		Breng khyal	-
	Breng khyal	-	KP 100 + 101	Thkouv	-
KP 98 + 99	Putrea	Jujube tree		Chras	Albizia tree
	Ampil Barang	Rain Tree		Breng khyal	-
KP 100 + 101	Loeurng Reach	Golden Shower Tree	KP 105 + 106	Breng khyal	-
	Maysak	Teak tree		Acacia	-
	Krangaok	Peacock flower	KP 106 + 333m	Breng khyal	-
KP 101 + 102	Breng khyal	-		Acacia	-
	Ampil barang	Rain Tree	KP 107 + 108	Breng khyal	-
	Trasek	-	KP 108 + 109	Kor	Kapok tree
	Putrea	-		Thkouv	-

Location Right Side	Tree Name	English Name	Location Left Side	Tree Name	English Name
KP 103 + 104	Breng khyal	-		Breng khyal	-
	Acacia	-		Acacia	-
KP 105 + 106	Thkouv	-		Trasek	-
	Acacia	-		Poutea	Jujube tree
KP 108 + 740m	Thkouv	-	KP 109 + 110	Putrea	Jujube tree
KP 110 + 700m	Breng khyal	-		Acacia	-
KP 111 + 112	Breng khyal	-		Maysak	Teak tree
KP 114 + 115	Breng khyal	-	KP 110 + 111	Acacia	-
	Acacia	-		Ampilbarang	Rain Tree
KP 115 + 116	Acacia	-		Trabaek	Guava tree
KP 116 + 353m	Breng khyal	-		Trabaekprey	Queen flower
	Acacia	-	KP 111 + 112	Putrea	Jujube tree
KP 117 + 118	Breng khyal	-		Breng khyal	-
	Acacia	-	KP 112 + 113	Chamriek	-
	Thkouv	-		Svay chanty	Cashew tree
KP 118 + 119	Thkouv	-		Breng khyal	-
	Acacia	-	KP 113 + 114	Acacia	-
	Ampil barang	Rain Tree		Breng khyal	-
	Trabaekprey	Queen flower	KP 114 + 115	Breng khyal	-
KP 119 + 120	Thkouv	-		Acacia	-
	Trasek	-		Kor	Kapok tree
	Trabaek	Guava tree		Putrea	Jujube tree
KP 120 + 121	Pring	Jambolan tree	KP 115 + 116	Breng khyal	-
	Thkouv	-		Acacia	-
KP 122 + 117m	Breng khyal	-		chamriek	-
KP 123 + 670m	Chhat	Indian Almond	KP 117 + 118	Breng khyal	-
KP 124 + 125	Trabaekprey	Queen flower		Acacia	-
	Putrea	Jujube tree		Phkar Krangoak	Peacock flower
	Chhat	Indian Almond		Pring	Jambolan tree
KP 125 + 126	Trabaek	Guava tree	KP 118 + 119	Breng khyal	-
	Trabaekpry	Queen flower		Ampilbarang	Rain Tree
	Breng khyal	-		Ounh Mounh	Cassia grandis
	Tnoat	Sugar palm		Chamriek	-
	Thkouv	-		Trabaek	Guava tree
	Putrea	Jujube tree	KP 119 + 120	Chamriek	-
KP 126 + 127	Thkouv	-		Kor	Kapok tree
	Putrea	Jujube tree		Angkanh	-
KP 127 + 474m	Putrea	Jujube tree		Ampilbarang	Rain Tree
KP 128 + 129	Tnoat	Sugar palm		Chhat	Indian Almond
	Putrea	Jujube tree		Putrea	Jujube tree
	Chamriek	-	KP 120 + 121	Thkouv	-
	Trabaek	Guava tree		Tnaot	Sugar palm
	Ampilbarang	Rain tree		Svay Chanty	Cashew tree
KP 129 + 130	Tnoat	Sugar palm		Ampil	Tamarind Tree
	Putrea	Jujube tree		Ampilbarang	Rain Tree
	Krasang	-		Pring	Jambolan tree
	Pring	Jambolan tree		Trasek	-
	Trasek	-		Putrea	Jujube tree
KP 132 + 855m	Svay Chanty	Cashew tree	KP 122 + 123	Acacia	-
KP 133 + 886m	Thkouv	-		Chhat	Indian almond
KP 143 + 54m	Brengkhyal	-		Doung	Coconut tree
KP 151 + 670m	Ampilbarang	Rain Tree	KP 123 + 204m	Mien	Logan tree
KP 155 + 156	Acacia	-		Chhat	Indian almond
	Tnoat	Sugar palm	KP 124 + 125	Doung	Coconut tree
	Por	Banyan Tree		Ampilbarang	Rain Tree
KP 156 + 157	Acacia	-		Putrea	Jujube tree

Location Right Side	Tree Name	English Name	Location Left Side	Tree Name	English Name
KP 158 + 780m	Tnoat	Sugar palm		Toeukdas Kou	-
	Por	Banyan Tree		Chhat	Indian Almond
	Chamriek	-	KP 125 + 126	Thkouv	-
KP 159 + 950m	Chheuteal	-		Putrea	Jujube tree
	Acacia	-		Trabaek	Guava tree
KP 160 + 161	Ampilbarang	Rain Tree		Pring	Jambolan tree
	Prengkhyal	-		Trasek	-
	Pring	Jambolan tree		Trakiebktam	-
KP 161 + 830m	Acacia	-		Tnoat	Sugar palm
KP 162 + 163	Pring	Jambolan tree		Svay	Mango tree
	Ampilbarang	Rain Tree	KP 126 + 127	Russei Srok	Bamboo
KP 163 + 164	Acacia	-		Ampilbarang	Rain Tree
	Poutrea	Jujube tree	KP 128 + 129	Pring	Jambolan tree
KP 164 + 165	Tbaeng	-		Acacia	-
	Acacia	-		Ampilbarang	Rain Tree
KP 166 + 906m	Tnoat	Sugar palm		Thkouv	
KP 167 + 450m	Tnoat	Sugar palm		Putrea	Jujube tree
KP 169 + 170	Tnoat	Sugar palm	KP 129 + 130	Pring	Jambolan tree
	Pring	Jambolan tree		Trasek	-
KP 170 + 171	Poutrea	Jujube tree		Putrea	Jujube tree
	Ampil	Tamarind Tree		Tnoat	Sugar palm
	Phkar Krangoak	Peacock flower		Ampilbarang	Rain Tree
	Prengkhyal	-		Trabaek	Guava tree
	Acacia	-	-	-	-
Only on Left Side					
Location	**Tree Name**	**English Name**	**Location**	**Tree Name**	**English Name**
KP 130 + 131	Kor	Kapok tree	KP 160 + 161	Acacia	-
	Chamriek	-		Tnoat	sugar palm
	Tnoat	Sugar palm		Acacia	-
KP 132 + 813m	Svay Chanty	Cashew tree	KP 161 + 162	Ampilbarang	Rain Tree
	Chamriek	-		Acacia	-
KP 135 + 136	Acacia	-	KP 162 + 163	Chrey	-
	Putrea	Jujube tree		Trasek	-
	Chamriek	-		Tnoat	sugar palm
KP 137 + 138	Svay chanty	Cashew tree		Acacia	-
	Breng khyal	-	KP 163 + 164	Brengkhyal	-
	Kor	Kapok tree		Acacia	-
KP 138 + 284m	Thkouv	-	KP 164 + 165	Acacia	-
KP 140 + 141	Phkar Krangoak	Peacock flower		Thlork	-
	Ampilbarang	Rain Tree		Trabaekprey	Queen flower
	Ampiltoeuk	Manila tamarind	KP 165 + 166	Ampilbarang	Rain Tree
KP 141 + 142	Tnoat	Sugar palm		Pring	Jambolan tree
	Ampilbarang	Rain Tree	KP 167 + 168	Tnoat	sugar palm
	Acacia	-		Phkar Krangoak	Peacock flower
KP 142 + 615m	Acacia	-		Acacia	-
	Thkouv	-		Poun	-
KP 143 + 350m	Putrea	Jujube tree	KP 168 + 169	Ampilbarang	Rain Tree
KP 146 + 147	Acacia	-		Tnoat	sugar palm
KP 147 + 148	Acacia	-		Ampil	Tamarind Tree
	Tnoat	Sugar palm	KP 169 + 170	Tnoat	sugar palm
	Svaychanty	Cashew tree		Chambak	-
KP 155 + 156	Tnoat	Sugar palm	KP 170 + 171	Ampilbarang	Rain Tree
	Trasek	-		Ampil	Tamarind Tree
	Chrey	-		Tnoat	sugar palm
KP 156 + 157	Tnoat	sugar palm		Brengkhyal	-
KP 159 + 950m	Pring	Jambolan tree		Acacia	-

4.2.1.7 Fauna

Fauna here refers to fish species, reptiles and amphibians, and bird species that can be found through their presences passing by the project area. Based on the information obtained from the interviews of local people, the results are as follows:

A) Fish Species

33 main fish species were found through family-scale fishing activities at rivers and streams crossing the project area. Most of those fish species were found during the rainy season. However, some of the species could not be written in English. It is notable that wetlands at eastern side (Zone 1, figure 4-30) along the project area including small rivers have direct and/or indirect connections with the Tonle Sap Great Lake in particular during the rainy season.

B) Mammals, Reptiles, and Amphibians

8 Mammals, 7 Reptiles, and 5 Amphibians were mainly identified and reported.

C) Birds

26 main birds were reported by local people. Their habitats were unknown. What the local people observed was that those birds migrated from other areas and passed by the project area. During the rainy season, more birds were observed. This may be concluded that one of their habitats is from the flooded forests of the Great Lake where is next to the project area. The number of main fauna species is shown in table 4-26. The number of all fauna species is collectively shown in Annex B 69 - 76.

Table 4-26: List of Main Faunas

No.	Local Name	English Name	Scientific Name	Identified Location	IUCN Red List Classification
I- Fish and crustacean species					
1	Trey Deap/Trey Chdau	Giant Snakehead	*Chnna mucropeltes*	Paddy Field, Wetland and Flood Plain	N/A
2	Trey Andaeng Roeng	Walking Catfish	*Clariasbatrachus*	Wetland and Flood Plain	LC
3	Trey Andaengtun	Black Skin Catfish	*Clariasmeladerma*		N/A
4	Trey Bra Kae		Pangasiusconchophilus		LC
5	Trey Bra Kchao		Pangasiusbocourti		LC
6	Trey Bra Thom	Sutchi Catfish	Pangasianodonhypophthalmus		N/A
7	Treypor	Spot Pangaasius	Pangasiuslarnaudii		LC
8	Trey Andat Chke	Whitelip Sole	*Achiroides Leucorhynchos*		N/A
9	Trey Chhkaok		*Cyclocheichthys Enoplos*		N/A
10	Trey Chhpin	Goldfin Tinfoil Barb	*Hypsibarbus Malcolmi*		LC
11	Trey Proloung	Hoven's Carp/Mad Barb	*Leptobarbus Hoevenii*		N/A
12	Trey Domrey	Marble Goby	*Oxyeleotris Marmorata*		LC
13	Trey Ka-Ek	Black Sharkminnow	*Labeo Chrysophekadion*		LC
14	Trey Kaes		*Micronemacheveyi*		N/A
15	Trey Kahe	Goldfoil/Tinfoil Barb	*Barbonymus Schwanenfeldii*		LC
16	Trey Kampulbai/Trey Chhkaok Kda	Papillocheilus Ayuthiae Smith 1945	*Cosmochilus Harmandi*		LC
17	Trey Kanhchrouk	Skunk Botia	*Yasuhikotakia Morleti*		LC
18	Trey Khchoeung	Frecklefin Eel	*Trey Chonluanh Moan*		N/A
19	Trey Khman	Hampala Barb	*Hampala Macrolepidota*		LC
20	Trey Kray	Clown Featherback	*Chitala Ornata*		LC
21	Trey Krolang/Trey Prul	Small Scale Mud Carp	*Cirrhinus Mucrolepis*		N/A
22	Trey Kromorm	Butter Catfish	*Ompokbimaculatus*		N/A
23	Trey Kros	Pla Rong Mai Tub	*Osteochilus Microcephalus*		LC
24	Trey Krum		*Osteochilus Melanopleurus*		N/A
25	Trey Krus	Dusky Face Carp	*Osteochilus Lini*		LC
26	Trey Phtuok/Trey Ros	Snakehead Murrel	*Channa Striata*		LC
27	Trey Proma	Boeseman Croader	*Boesemania*		NT
28	Trey Sanday/Trey Kropoit	Wallago	*Wallagoattu*		N/A
29	Trey Slat	Bronze Featherback	*Notopterus Notopterus*		LC
30	Trey Stuok		*Wallagoleerii*		N/A
31	Trey Ta Oan		*Ompokhypophthalmus*		N/A

No.	Local Name	English Name	Scientific Name	Identified Location	IUCN Red List Classification
32	Trey Chhlaing	Asian Redtail Catfish	*Hemibagrusnemurus*		N/A
33	Trey Khcha		*Hemibagruswyckioides*		N/A
II- Mammals					
1	Kdan Nhaeng	Lesser Mousedeer	*Tragulus Javanicus*	Wetland, Flood Plain, and Kampong Chhnang Bypass	DD
2	Tunsay Kul	Burmese Hare	*Lepus Pequensis*		N/A
3	Kanthuek	Northern Treeshrew	*Tupain Belangeri*		N/A
4	Kambrok Por	Variable Squirrel	*Callosciurus Erythraeus*		LC
5	Sam Pouch Vor	Small Indian Civet	*Viverricula Indica*	Kampong Chhnang Bypass	LC
6	Skar Touch	Small Asian Mongoose	*Herpestes Javanicus*		LC
7	Chhlous	Red Muntjac	*Muntiacus Muntjak*		LC
8	Chrouk Prey	Wild Pig	*Sus Scrofa*		LC
III- Reptiles					
1	Pous Vek Dom Bouk	Indochinese Spitting Cobra	*Naja Siamensis*	Paddy Field, Wetland, Flood Plain, and Kampong Chhnang Bypass	VU
2	Kam Broma	East Asian Porcupine	*Hystrix Brachyura*	Wetland and Flood Plain	LC
3	Pous Vek Krobei	Monocled Cobra	*Naja Kaouthia*		LC
4	Pous Thlan Touch	Burmese Python	*Pyfthon Molurus Bivittaftus*		N/A
5	Pous Thlan Thom	Reticulate Python	*Python Reticulatus*		N/A
6	Kan Theay	Asian Soft Shell Turtle	*Amyda Cartilaginea*		VU
7	An Deurk	Turtle	*Malayemys subtrijuga*		VU
IV- Amphibians					
1	Kingkuok	Common Asian Toad	*Bufo Melanosttrictus*	All the interviewed location	N/A
2	Hing	Common Asian Bullfrog	*Kaloula Pulchra*		LC
3	Kangkeb	Paddy Frog	*Fejevarya Limnocharis*		N/A
4	Kangkebkob	Regulose Bullfrog	*Hoblobatrachus Rugulosus*		N/A
5	Kanhchanhchek	Common Tree Frog	*Polypedates Leucomystax*		LC
V- Birds					
1	Bakou	Common Hoopoe	*Upupa Epops*	Wetland and Flood Plain	LC
2	Popustoek	Little Grebe	*Tachybaptus Ruficollis*		LC
3	Populchampusthum	Thick-Billed Green Pigeon	*Treron Curvirostra*		LC
4	Populchoeung	Yellow-Footed Green Pigeon	*Treron Phoenicoptera*		N/A
5	Chochatkrem	Common Kingfisher	*Alcedo Atthis*		LC
6	Porltouk Thngaskhmao	Blue-Eared Barbet	*Megalaima Australis*		LC
7	Porltouk Kbal	Lineated Barbet	*Megalaima Lineata*		LC

No.	Local Name	English Name	Scientific Name	Identified Location	IUCN Red List Classification
8	Porltouk Ambuk	Coppersmith Barbet	*Megalaima Haemacephala*		LC
9	Chek Tum	Black-Naped Oriole	*Oriolus Chinensis*		LC
10	Ka Ek	Large-Billed Crow	*Corvus Macrohynchos*		N/A
11	Meam Touch Prey	Asian Barred Owlet	*Glaucidium Cucloides*		N/A
12	Sek Sourm	Alexandrine Parakeet	*Psittacula Eupatria*		LC
13	Sek Sork	Red-Breasted Parakeet	*Loriculus Vemalis*		N/A
14	Kvaek	Black-Crowned Night Heron	*Nycticorax Nycticorax*		LC
15	Ngeav Kork	Stork-Billed Kingfisher	*Halcyon Capensis*		N/A
16	Antep Toing	Greater Racket-Tailed Drongo	*Dicrurus Paradiseus*		LC
17	Kok Krourng	Intermediate Egret	*Egretta Intermedia*		N/A
18	Kok Kmao Thleurm Andeurk	Black Bittem	*Bupetor Flavicollis*		N/A
19	La Out Thom	Greater Coucal	*Centropus Sinensis*		LC
20	Mean Toek Kmoa	Common Moorhen	*Gallinula Chloropus*		LC
21	Mean Toek Troung Sor	White-Breasteed Waterhen	*Amauromis Phoenicurus*		N/A
22	Preab Srok	Rock Pigeon	*Columba Livia*		LC
23	Pror Voek	Lesser Whistling Duck	*Dedrocygna Javanica*		N/A
24	Tror Ses Knorng Plerng Toch	Common Flamedback	*Dinopium Javanense*		LC
25	Tavao	Common Koel	*Eudynamys Scolopacea*		N/A
26	Teav Kiev	Indian Roller	*Coracias Benghalensis*		LC

Note: LC = Least Concern, NT = Near Threatened, VU = Vulnerable, N/A = Not Available, DD = Data Deficient in IUCN Red List
Source: Interview with local people in March and July, 2013

Fauna species of residential areas were surveyed at	104°44'29.24"E	11°49'27.11"N
	104°40'18.68"E	12°9'22.95"N
Fauna species of wetland and flood plain were surveyed at	104°33'29.05"E	12°19'12.40"N
	104°29'4.32"E	12°23'4.02"N
Fauna species of Kampong Chhnang Bypass were surveyed at	104°36'52.60"E	12°15'54.94"N
	104°37'23.27"E	12°15'16.96"N
Fauna species of paddy field were surveyed at	104°43'22.02"E	11°50'38.15"N
	104°43'57.79"E	12°1'7.59"N
	104°42'51.31"E	12°4'55.16"N

4.2.1.8 Effects of Flood

In the project area, some parts (KP 31 – 36, KP 48 – 52, KP 91 – 93, KP 96 – 116) used to get flooded in 2000. Generally, it is said that the benefits of natural floods almost certainly outweight the negative aspects. On the positive side, floods can distribute large amounts of water and suspended river sediment over large areas. The sediment helps replenish valuable topsoil components to lands which are useful for agricultural productivity. On the negative side, flood disrupts physical infrastructures in urban areas and people's daily livelihoods in particular in rural areas. If it is severe enough, toxic materials (paints, pesticides, gasoline, etc..) can release into the local environment..

4.2.2 Protected Areas

Protected conservation areas approximately covered 4.6 million hectares in Cambodia's territory (Figure 4-29). They consist of 7 national parks, 10 wildlife sanctuaries, 3 protected landscape areas, and 3 protected areas[5]. The national parks are located in the coastal, mountain, plateau and lake regions covering 742,300 million hectares and 4.138 million hectares for wildlife sanctuaries. The protected landscapes areas covered 97,000 hectares including archaeological and cultural sites and protected areas covered 403,900 hectares. However, there is no protected area in the project area.

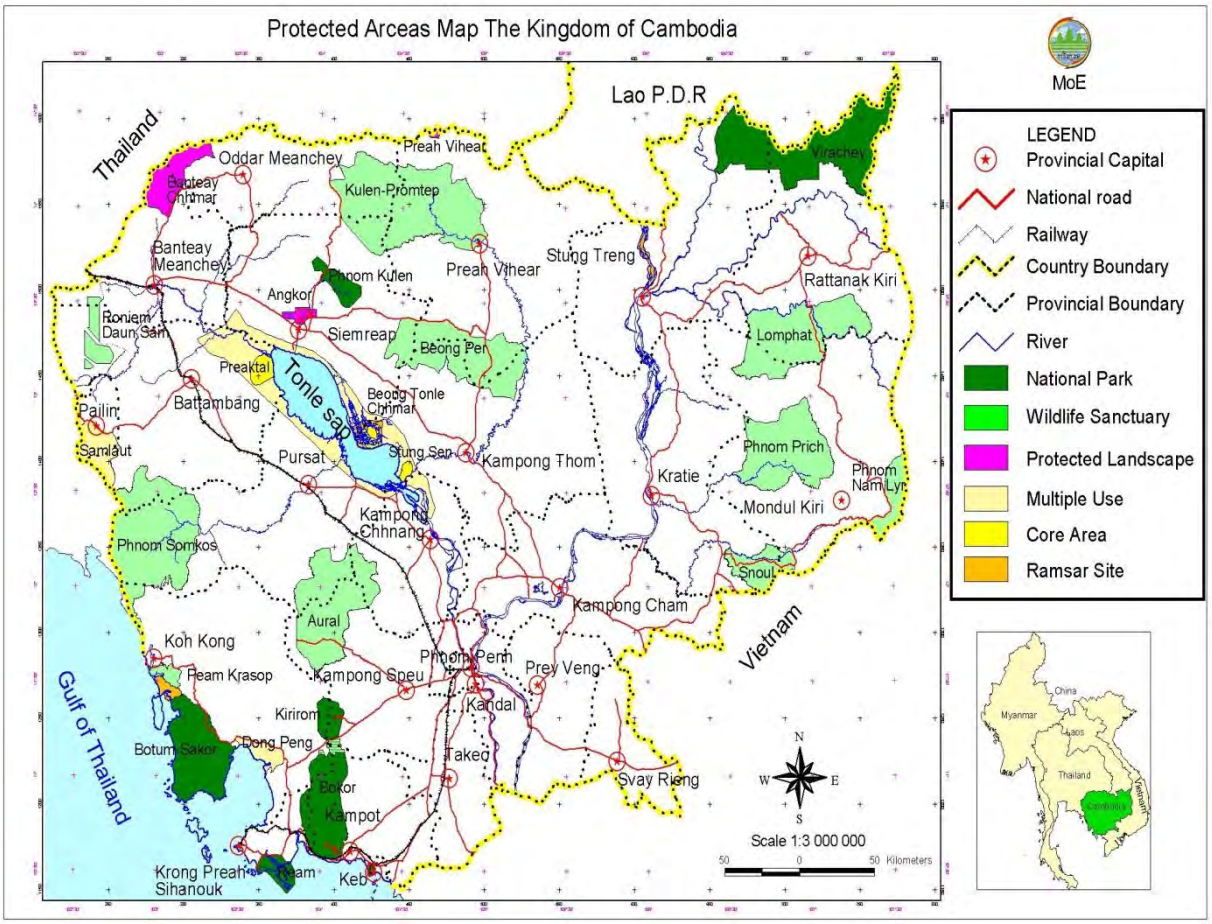


Figure 4-29: Map of Protected Areas

[5] Source: Cambodia Environment Outlook 2009

One of the most concerns regarding to the project is the impacts on Tonle Sap Biosphere Reserve (TSBR)[6]. The TSBR is currently under the control of Cambodia National Mekong Committee and is the area surrounding the Tonle Sap Great Lake between the NRs No.5 and No.6 and covering Kampong Chhnang, Pursat, Battambang, Bonteay Meanchey, Siem Reap and Kampong Thom provinces. Besides TSBR, Tonle Sap Authority has defined three zones based on the geographical and hydrological characteristics of the Lake's vicinity. Zone 1 covers 417,451 hectares and Zones 2 and 3 comprise of 365,300 hectares and 642,794 hectares, respectively. The details of each zone are shown in figure 4-30. Zones 1 and 2 are for agricultural development while Zone 3 is the conservation zone to be fully protected. The project area has bordered with the zone 1, the agricultural zone, and construction of some physical infrastructures within this zone is allowed.

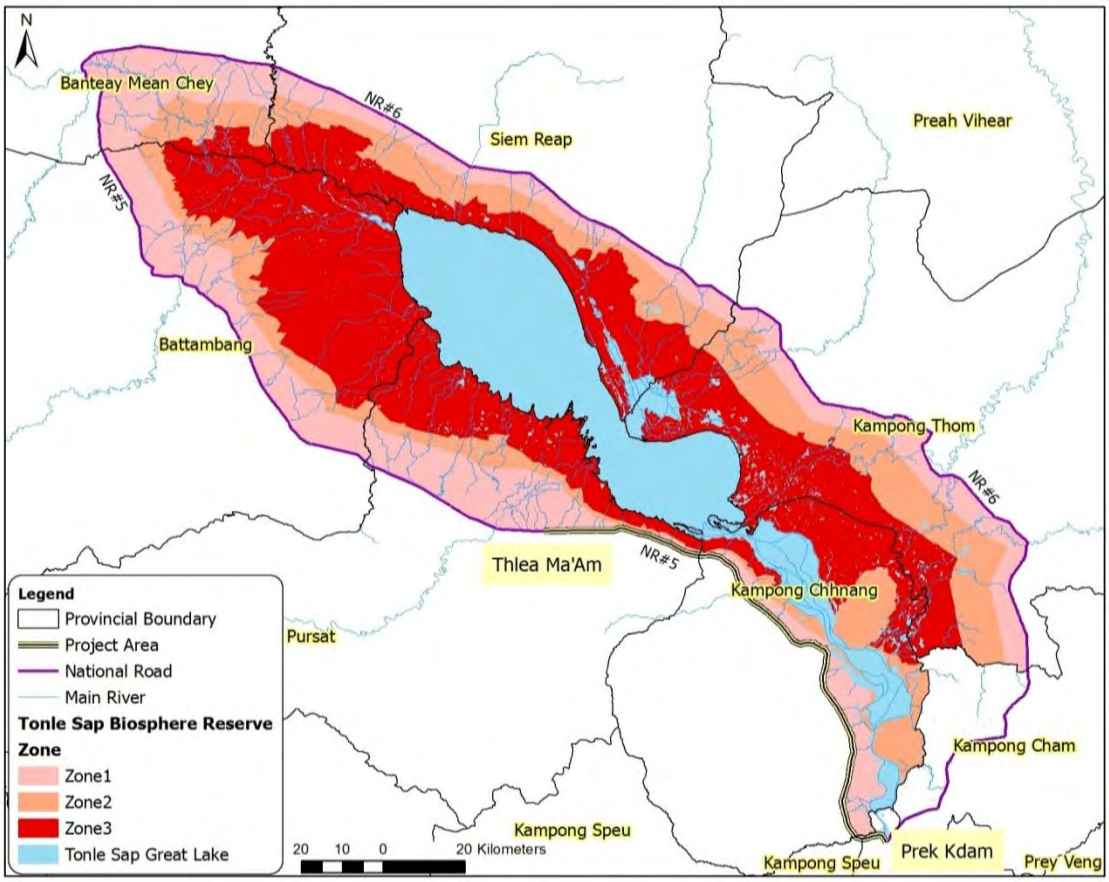


Figure 4-30: Map of Zone 1, 2 and 3 around the Tonle Sap Great Lake

4.2.3 Hydrology

Many rivers and streams crossing the project area were identified (Figure 4-31). Some rivers and streams dried up (seasonal gentle flow) while the other rivers and streams still had little flow (annual gentle flow).

[6] The TSBR was established by Royal Decree in December 2001.

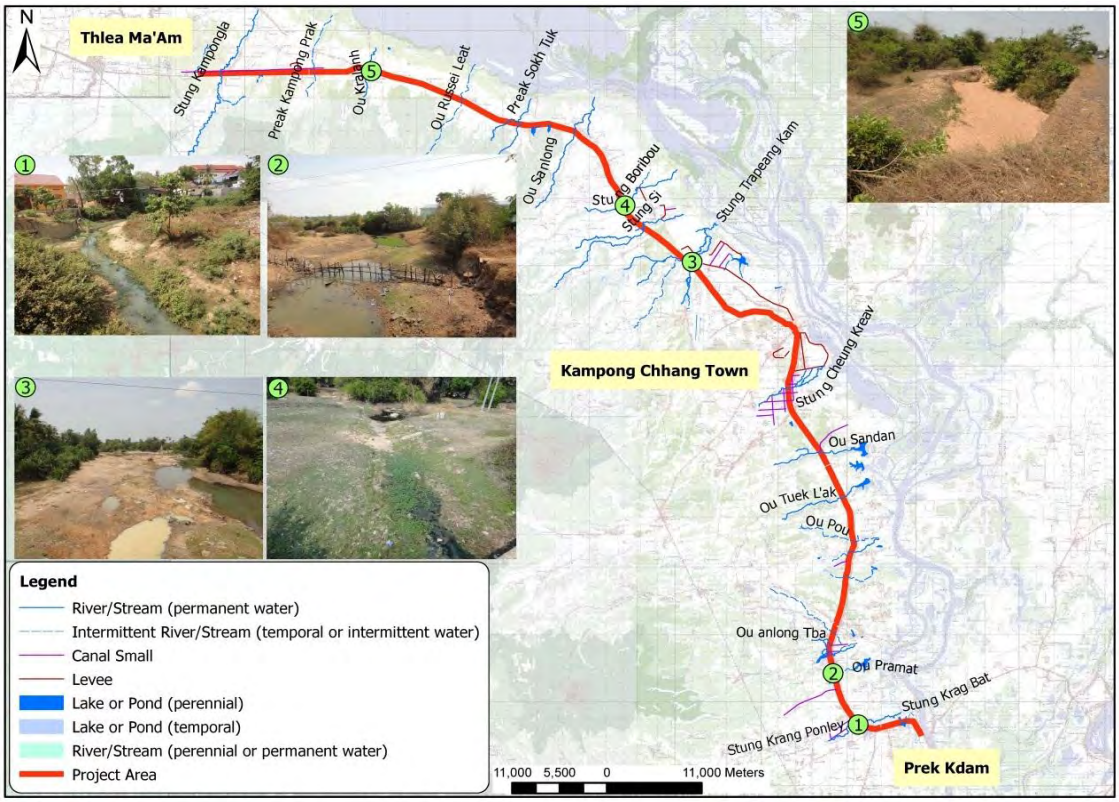


Figure 3: Rivers and Streams crossing the Project Area Source: JICA GIS Data Set, 2002

4.3 Social Environment

4.3.1 Administrative Boundary

The project area, the section from Prek Kdam to Thlea Ma'Am, covers 3 provinces: Kandal, Kampong Chhnang, and Pursat. Under the three provinces, there are 6 districts where the project area is going across. As lower administrative division under each district, 35 communes might be traversed by the existing road and proposed two bypasses. Figure 4-32 and 4-33 show Administrative Boundary (1) and (2), respectively and describe administrative boundaries along the project area.

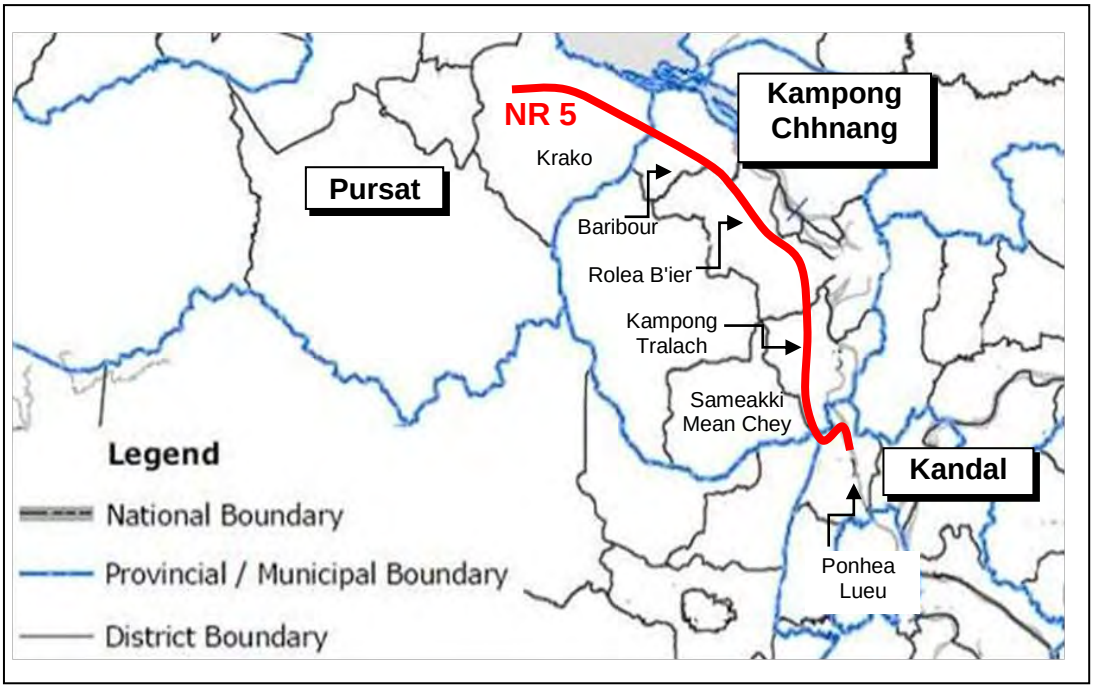


Figure 4: The NR No.5 (South Section) and Administrative Boundary (1)

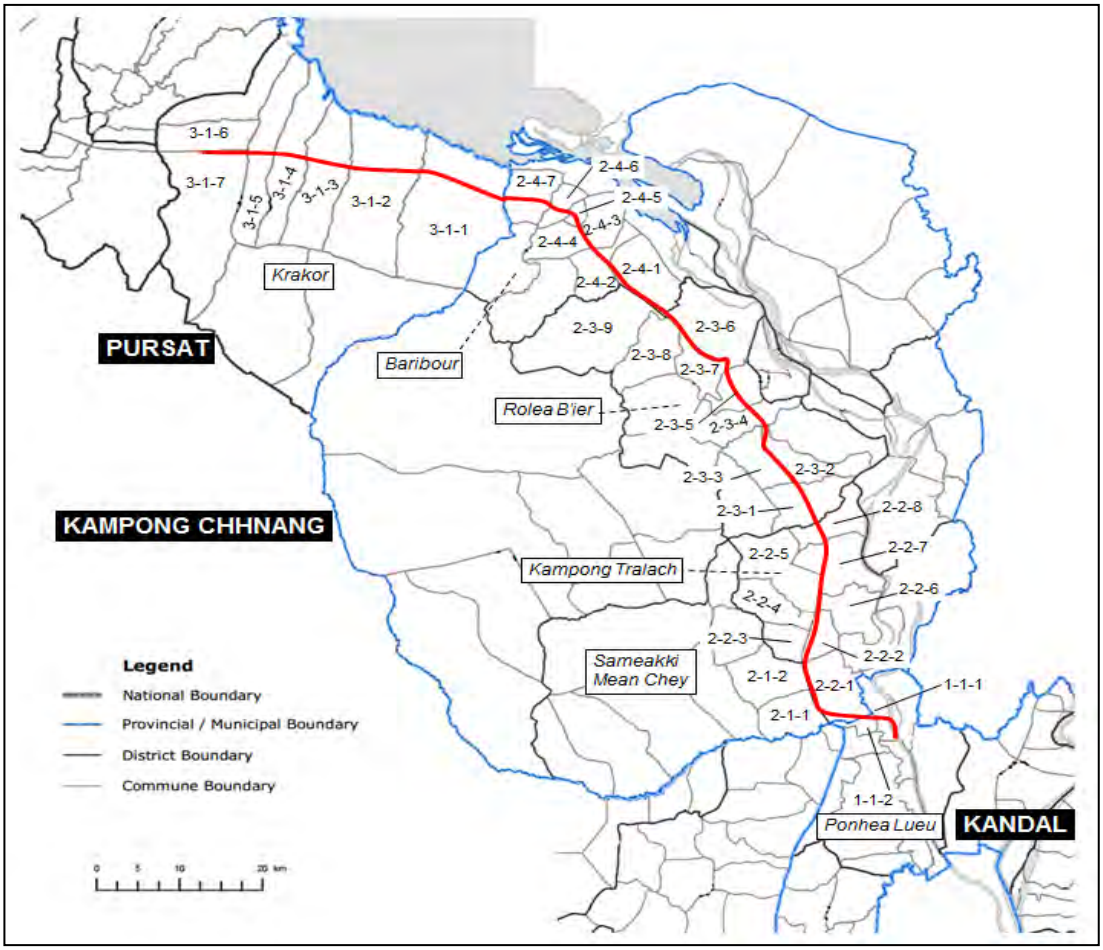


Figure 5: The NR No.5 (South Section) and Administrative Boundary (2)

4.3.2 Population

The latest General Population Census of Cambodia was implemented in 2008. Based on the census, population and household data on three provinces in the project area are presented in table 4-27. Population and households included sex ratio and average household size in the project related provinces are also shown in table 4-28.

Table 4-27: Households and Populations in the Project Area

Province		District		Commune		Households	Population
1	Kandal	1-1	Ponhea Lueu	1-1-1	Kampong Luong	2,108	10,694
				1-1-2	Vihear Luong	1,461	7,396
2	Kampong Chhnang	2-1	Sameakki Mean Chey	2-1-1	Svay	2,360	10,546
				2-1-2	Sedthei	1,414	7,905
		2-2	Kampong Tralach	2-2-1	Longveaek	1,526	7,243
				2-2-2	Ou Ruessei	1,845	8,229
				2-2-3	Peani	1,527	7,183
				2-2-4	Thma Edth	988	4,444
				2-2-5	Chhuk Sa	1,958	8,470
				2-2-6	Chres	2,081	9,216
				2-2-7	Ta Ches	2,440	11,486
				2-2-8	Saeb	1,459	6,871
		2-3	Rolea B'ier	2-3-1	Tuek Hout	1,638	7,757
				2-3-2	Andoung Snay	1,207	5,588
				2-3-3	Rolea B'ier	1,805	7,673
				2-3-4	Chrey Bak	2,240	10,128
				2-3-5	Srae Thmei	2,396	10,614
				2-3-6	Svay Chrum	2,950	13,217
				2-3-7	Pongro	1,711	7,284
				2-3-8	Banteay Preal	955	3,983
				2-3-9	Prasnoeb	1,200	5,171
		2-4	Baribour	2-4-1	Melum	889	3,814
				2-4-2	Phsar	1,251	5,317
				2-4-3	Khon Rang	1,597	6,985
				2-4-4	Popel	1,126	5,095
				2-4-5	Ponley	1,674	7,275
				2-4-6	Chak	680	2,856
				2-4-7	Trapeang Chan	1,132	5,080
3	Pursat	3-1	Krakor	3-1-1	Asna Chambak	1,412	6,915
				3-1-2	Kbal Trach	1,653	8,137
				3-1-3	Anlong Tnot	2,071	9,606
				3-1-4	Sna Ansa	1,010	4,570
				3-1-5	Ou Sandan	1,069	4,633
				3-1-6	Boeng Kantuot	1,282	5,700
				3-1-7	Tnot Chum	2,395	11,620

Source: General Population Census of Cambodia 2008.
Household and Population describe total number of whole commune (not exclusive to project affected areas).

Table 4-28: Population and Households in the Project Related Provinces

Province	Population			Sex Ratio (Male/Female)	Households	Average Household Size
	Total	Male	Female			
Kandal	1,265,280	612,692	652,588	93.9 %	258,393	4.9
Kampong Chhnang	472,341	227,007	245,334	92.5 %	101,260	4.6
Pursat	397,161	192,954	204,207	94.5%	83,745	4.7

Source: General Population Census of Cambodia 2008, National Institute of Statistics, Ministry of Planning

Table 4-29 shows ratio of population and households in the vicinities of the project area compared to the whole provinces. The table 4-29 indicates that Kampong Chhnang and Pursat Provinces have relatively large direct impacts from the project while Kandal Province occupies limited area and small impacts in the project area.

Table 4-29: Ratio of Project Related Population and Household

Province	Population			Household		
	(1)Whole Province	(2) Project Vicinity	Ratio (2)/(1)	(1)Whole Province	(2) Project Vicinity	Ratio (2)/(1)
Kandal	1,265,280	18,090	1.4%	258,393	3,569	1.4%
Kampong Chhnang	472,341	232,560	49.2%	101,260	50,460	49.8%
Pursat	397,161	51,181	12.9%	83,745	10,892	13.0%

Source: General Population Census of Cambodia 2008, National Institute of Statistics, Ministry of Planning

* (2) Project Vicinity covers communes where the NR No.5 passing by

4.3.3 Gender

4.3.3.1 Key Factors

According to United Nations Development Program in Cambodia, key facts about gender equality in Cambodia are as follows:

a) Cambodia ranks 99 out of 145 countries on the Gender Inequality Index (GII) in the Human Development Report 2011. The GII is a new measurement replacing the Gender-related Development Index and Gender Empowerment Measure;
b) Over the past decades, there have been improvements on the status of women in Cambodia. Yet, they remain less visible in public sphere. Women comprise 34 percent of civil servants and hold 22 percent of seats in the National Assembly;
c) Almost the same number of boys and girls attend school until the age of 14. However, fewer girls continue in higher education. Adult literacy rates are also unequal: only 70.9 percent of adult females are literate, compared to 85.1 percent of their male peers;
d) The number of men and women in the total workforce is almost the same (49.4 percent women). However, more women are self-employed or unpaid family workers (83 percent of female employment vs. 76 percent of male employment). This informal economy provides low, irregular income and unstable employment. More importantly, because many tend to operate unregistered, there is little or no access to organized markets, credits and training institutions and to other public services; and
e) Like many other countries in East Asia, Cambodia has the Law on Prevention of Domestic Violence and Protection of Victims. Despite the law, 22.5 percent of married women experienced violence within their homes and up to 89 percent do not report the incident, according to a survey by Ministry of Women's Affairs in 2009.

4.3.3.2 Statistics from Census

Based on the 2008 Cambodia Socio-Economic Survey, in Cambodia's rural areas including the Tonle Sap Zone, around 20% of agricultural household is female headed (Figure 4-34). The median age of the agricultural household heads is 46 years old, and male heads have a lower median age than female heads (Figure 4-35).

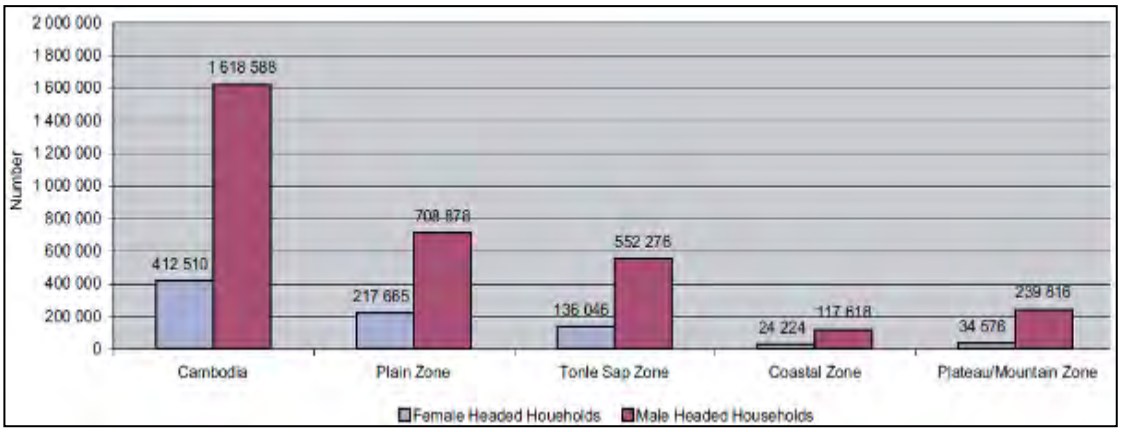


Figure 64: Number of Male and Female Headed Households Source: 2008 Cambodia Socio-Economic Survey

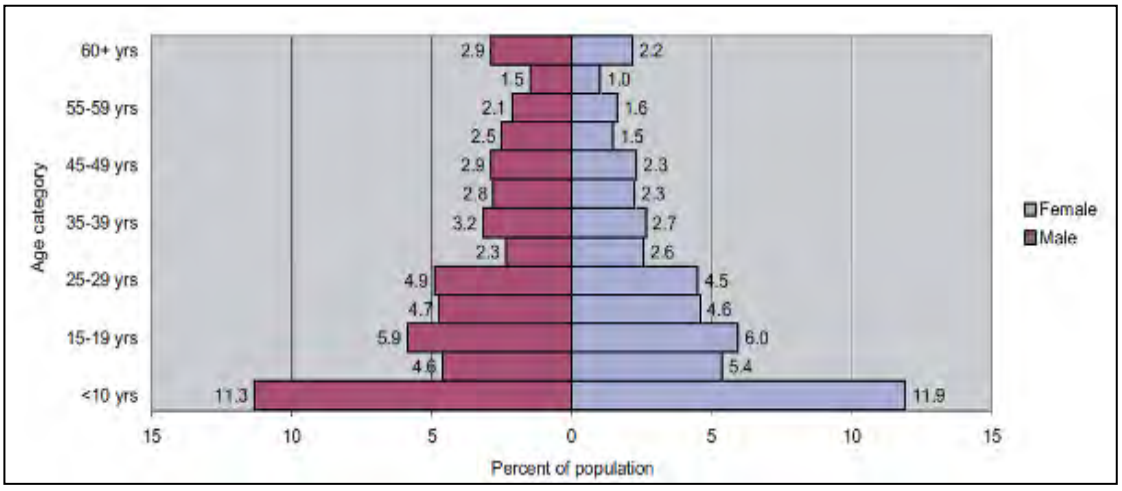


Figure 7: Age pyramid in agricultural area in Cambodia

4.3.3.3 Gender in Education

As a gender indicator, enrollment rate shows slightly defferent between boys and girls. Among the provinces where the NR No.5 (South Section) passing by, Pursat is the lowest enrollment rate. Boys can study at lower secndary school more than girls in all provinces. This situation causes differences of illiteracy between male and female.

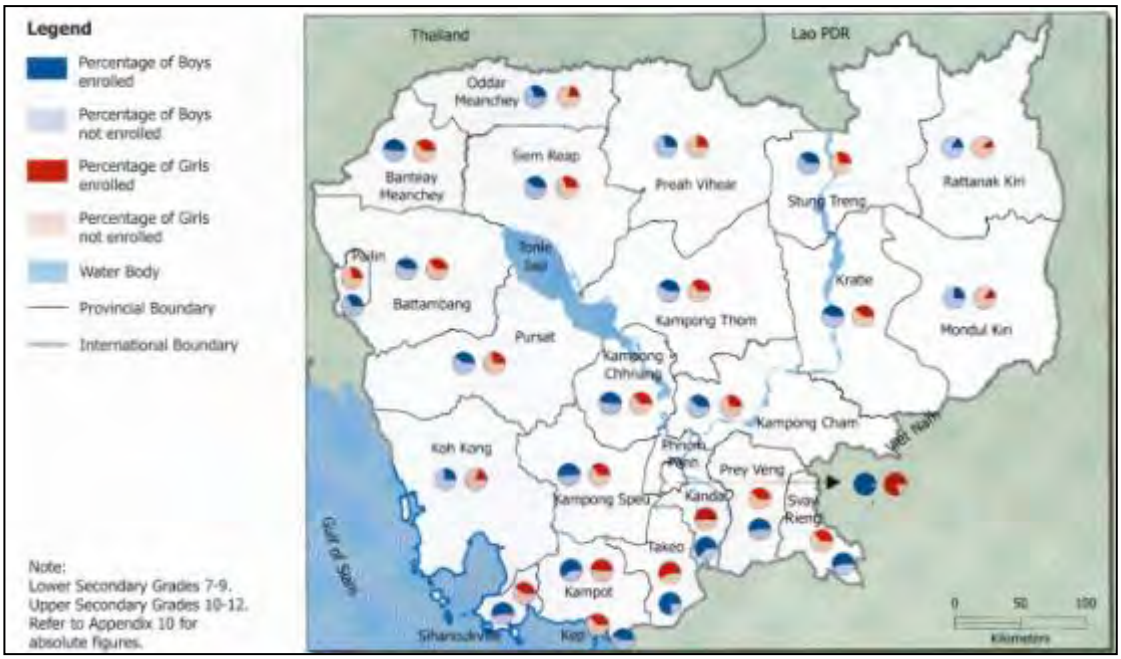


Figure 8: Lower Secondary (age 7-9) School Enrollment Status
Source: The Atlas of Cambodia, National Poverty and Environment Maps, Save Cambodia's Wildlife (2006)

4.3.4 Community Fishery

Community Fishery (CF) was proposed and developed under the ADB's initiative to realize the sustainable natural resources management in the Tonle Sap Lake. Traditional tendering for fishing lots caused violence and other unfavorable social problems after 1993. As a result, the RGC has tried to introduce the CF with aims of ecosystem management, fishery resource management, and poverty reduction. The CF has been set entire country except for Mondulkiri Province, and there are some CFs area along the NR No.5 in Kampong Chhnang and Pursat Provinces. Some parts of unloaded fishes and swamp small animals are transported to neighboring local markets including Phnom Penh through the NR No.5.

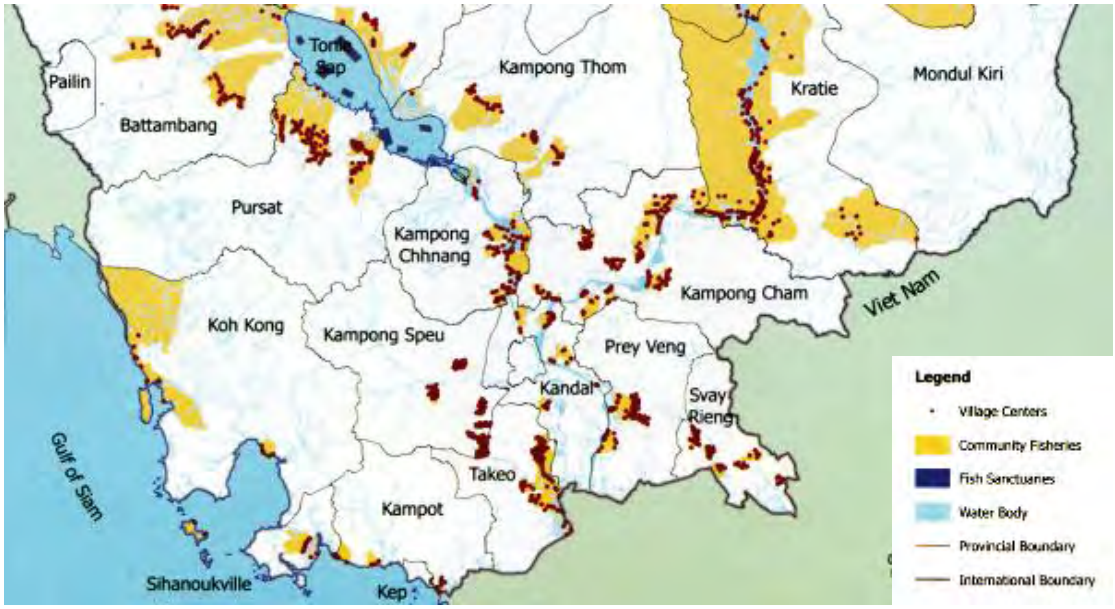


Figure 9: Community Fishery Distribution in Cambodia
Source: The Atlas of Cambodia, National Poverty and Environment Maps, Save Cambodia's Wildlife (2006)

4.3.5 Culture and Tourism

The NR No.5 is the main access route to cultural and historical places and tourism zones, all of which are as follows:

4.3.5.1 Longveak and Odongk Area

Odongk area is located around 40 km northwest of Phnom Penh. This area was the old capital city of Cambodia after the Angkor era. Longveak area in Kampong Chhnang Province is in the north side of the NR No.5 and there are several ancient paths between present Odongk town. In the south side of NR No.5, there is Odongk Mountain (or Phnom Odongk) in Kandal Province. Pagodas at the top and around the hill are popular day-trip site from Phnom Penh for both domestic and foreign visitors. Odongk Mountain is located from around one kilometer south from Odongk market area.

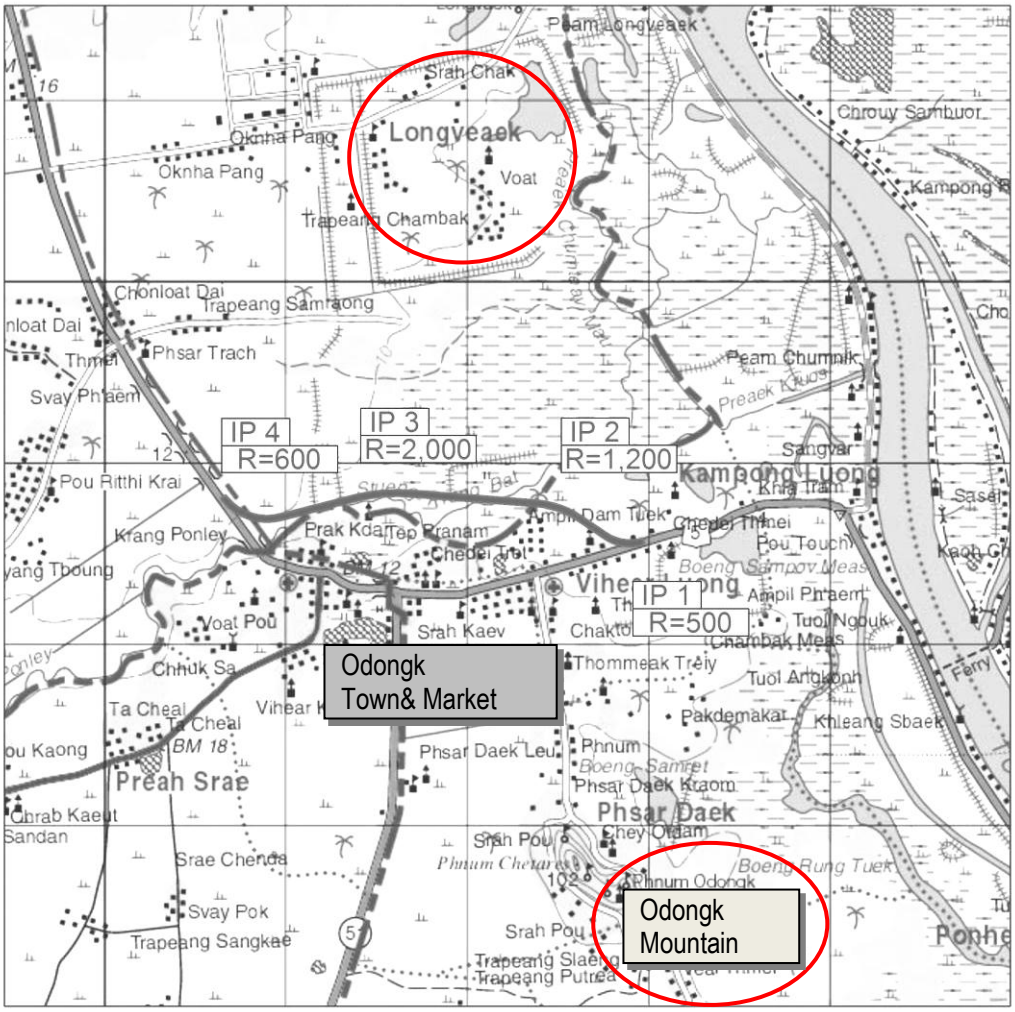


Figure 10: Cultural Heritage in Longveak and Odongk Areas (1)

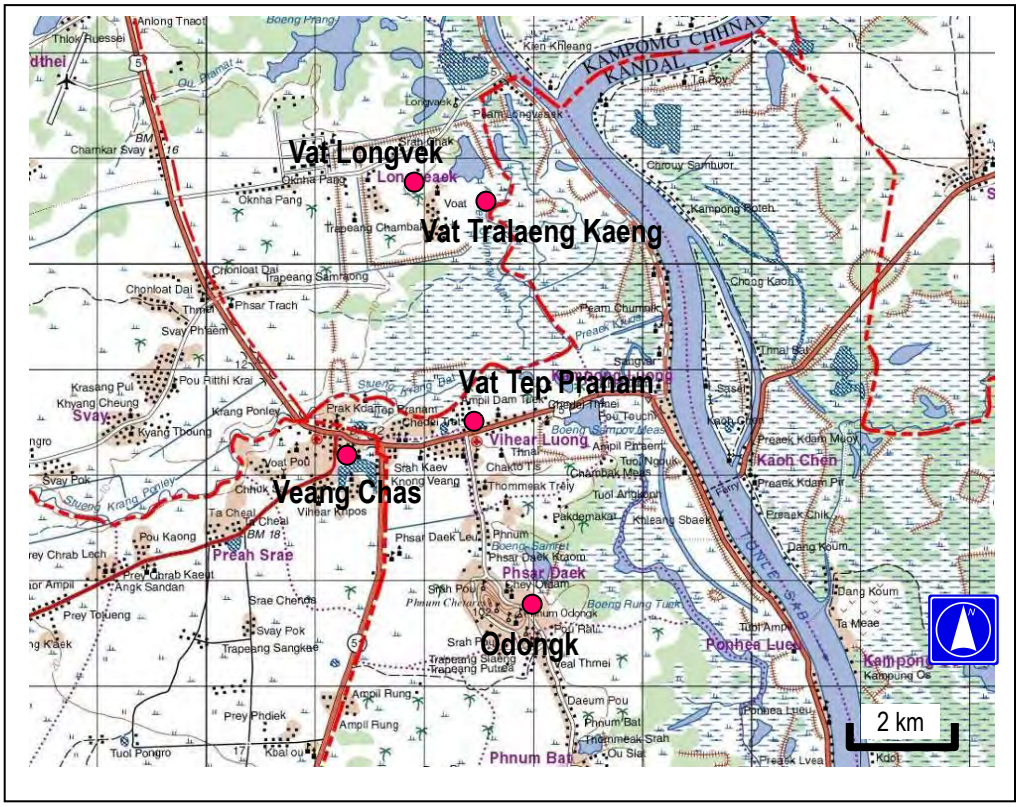


Figure 11: Cultural Heritage in Longveak and Odongkk Areas (2)
Source: Sambor Prei Kuk et le bassin du Tonle Sap

4.3.5.2 Tonle Sap Ecotourism

Rich aquatic ecosystem of the Tonle Sap Lake and rivers can attract foreign tourists. Kampong Chhnang Port has a small floating jetty for tourist boats and visitors can enjoy cursing. Floating villages where Vietnamese are living, fish cultivation, and flooded forests are the important tourism resources. There are some other points where people can access to the Tonle Sap floating villages and ecosystem along the NR No.5 (South Section).

Figure 12: Eco Tourism in the Tonle Sap Lake in Kampong Chhnang

4.3.6 Physical and Cultural Heritage

No any physical and cultural heritage was found within 7m on both sides from the road center line.

4.3.7 Historical and Archaeological, Pale-Ontological or Architectural Significance

Based on the field observation, no any historical and archaeological, or architectural significance was found in the project area.

4.3.8 Socio-Economic Profile of the Affected Households

The Socioeconomic survey (SES) of Affected Households (AHs) was also conducted at the same time of Inventory of Losses (IOL) survey. Most of the AHs, losing partially or entirely their assets such as structures, lands and/or trees, were interviewed for the purpose of gaining more information on their situation and present living standards. This activity was carried out aiming to prepare a more responsive RAP for people and households affected by the Project. Since there were instances when the AHs were unattended to during the survey, only 2,111 AHs along the existing NR No.5 and the bypasses were interviewed. The interviewed AHs represented 62.68% of all AHs (3,368 AHs). The main objective of the SES is to create baseline survey by collecting accurate statistical information about AHs' living standards. The topics were investigated in the survey were basic demography, literacy and education, economically active population, housing condition, possession of durable goods and livestock, household expenditure and income. Additionally, the survey was also directed to study the perception of the AHs on the Project.

4.3.8.1 Population and Household Composition

The total studied households are 2,111, which is composed of 10,184 people (5,284 (51.9%) females and 4,900 (48.1%) males). Table 4-30 shows the details of population, sex ratio, as well as household size of the three provinces. An average household size is 4.8 and sex ratio is 92.7.

Table 4-30: Population and Household Composition

Stratum	No. of Households	Average HH Size	Population					Sex Ratio*
			Both	Male		Female		
				No.	%	No.	%	
Project Survey	2,111	4.8	10,184	4,900	48.1	5,284	51.9	92.7
Pursat	395	5.2	2,067	979	47.4	1,088	52.6	90.0
Kampong Chhnang	1,637	4.7	7,698	3,713	48.2	3,985	51.8	93.2
Kandal	79	5.3	419	208	49.6	211	50.4	98.6

Data source: Project Survey conducted in January – April 2013.
*Sex Ratio = (Number of male) / (Number of female) x 100(%).

4.3.8.2 Age Structure and Dependency

The survey results for the age-sex distribution of the affected communes are set out in Table 4-31. Information is included by sex and age group (0-13 years, 14-60 years, 60 years and over). The population age structure affects key socioeconomic issues. Young populations aged less than 18 years old is 35.1%. High percentage of the young, under age 18, need to invest more in schools, while high percentage of the old (ages 60 and over) need to invest more in the health sector.

Table 4-31: Age-Sex Distribution

Stratum	Population		Age									
			0-5		6-13		14-18		19-60		60+	
			No.	%	No.	%	No.	%	No.	%	No.	%
Project Survey	M	4,900	584	11.9	689	14.1	511	10.4	2,848	58.1	268	5.5
	F	5,284	530	10.0	729	13.8	543	10.3	3,050	57.7	432	8.2
	T	10,184	1,114	10.9	1,418	13.9	1,054	10.3	5,898	57.9	700	6.9
Pursat	M	979	105	10.7	149	15.2	98	10.0	583	59.6	44	4.5
	F	1,088	111	10.2	155	14.2	124	11.4	619	56.9	79	7.3
	T	2,067	216	10.4	304	14.7	222	10.7	1,202	58.2	123	6.0
Kampong Chhnang	M	3,713	458	12.3	517	13.9	391	10.5	2,143	57.7	204	5.5
	F	3,985	402	10.1	543	13.6	394	9.9	2,313	58.0	333	8.4
	T	7,698	860	11.2	1,060	13.8	785	10.2	4,456	57.9	537	7.0
Kandal	M	208	21	10.1	23	11.1	22	10.6	122	58.7	20	9.6
	F	211	17	8.1	31	14.7	25	11.8	118	55.9	20	9.5
	T	419	38	9.1	54	12.9	47	11.2	240	57.3	40	9.5

Data source: Project Survey conducted in January – April 2013

The dependency ratio used to measure the proportion of children (below 15 years) and old people (from 65 years and over) compared to the proportion of people of workforce age (15-64 years). The age dependency ratio is defined as the ratio of the sum of the population below 15 years and population from 65 years taken together divided by the active population between the age groups of 15 to 64 years. It is a summary indicator that indicates the burden falling on the population of working age. The age composition in table 4-32 shows that 68.5% of the population was aged between 15-64 years. 26.6% was below 15 years and 4.9% was 65 years and over. The table also provided detail about youth dependency ratio (38.8%) and old age dependency ration (7.2%). The total dependency ratio is 46.0%. This means there were 46.0 persons outside the usual working age group for every 100 persons in the age group 15-64 years who are economically dependent for economic support.

Table 4-32: Age Composition and Dependency Ratio

Stratum	Population		Below 15		15-64		65+		Dependency Ratio		
			No.	%	No.	%	No.	%	Youth	Old Age	Total
Project Survey	M	4,900	1,348	27.5	3,369	68.8	183	3.7	38.8%	7.2%	46.0%
	F	5,284	1,360	25.7	3,606	68.2	318	6.0			
	T	10,184	2,708	26.6	6,975	68.5	501	4.9			
Pursat	M	979	269	27.5	680	69.5	30	3.1	40.2%	6.0%	46.2%
	F	1,088	299	27.5	734	67.5	55	5.1			
	T	2,067	568	27.5	1,414	68.4	85	4.1			
Kampong Chhnang	M	3,713	1,032	27.8	2,539	68.4	142	3.8	38.7%	7.5%	46.2%
	F	3,985	1,007	25.3	2,727	68.4	251	6.3			
	T	7,698	2,039	26.5	5,266	68.4	393	5.1			
Kandal	M	208	47	22.6	150	72.1	11	5.3	34.2%	7.8%	42.0%
	F	211	54	25.6	145	68.7	12	5.7			
	T	419	101	24.1	295	70.4	23	5.5			

Data source: Project Survey conducted in January – April 2013

Although not significant statistically, the age-sex figures are valuable in demonstrating that this is, comparatively, an ageing population, with a predominantly middle-aged population with a bulge in the 20-24 and 25-29 age group (11.7% and 11.0% respectively) and a corresponding bulge in the 10-19 year old age group (19.7% of the population), while the youngest two age groups, 5-9 year old, have only 8.6%. The relevance of these statistics is the likely higher impact on secondary school in-take in the project impact area than in the primary-school in-take.

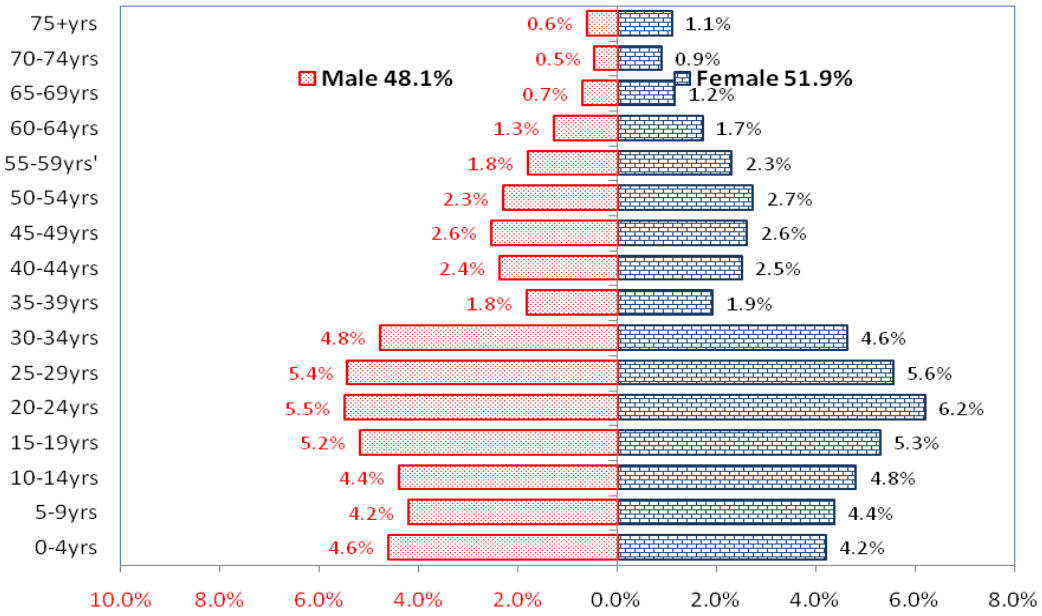


Figure 4-41: Age Pyramid by 5 years of Age Group
Data source: Project Survey conducted in January – April 2013

4.3.8.3 Marital Status

For classifying the marital status, 4 categories were used such as single (never married), currently married, divorced/separate and widowed. The currently married group included person who were living together whether or not their marriage had legal status. Although marital status information was collected for all age groups, it is useful to present data for the population aged 15 years and over only. For both sexes, 36.1% they are never married, 54.8% were currently married, 7.0% were widowed and 2.1% were divorced or separated.

Table 3: Marital Status for Both Sexes by Age Group

Age Group	Population	Single		Married		Divorced/separate		Widowed	
		No.	%	No.	%	No.	%	No.	%
15+ yrs	**7,476**	**2,699**	**36.1**	**4,095**	**54.8**	**159**	**2.1**	**523**	**7.0**
15 – 19 yrs	1,066	1,045	98.0	19	1.8	1	0.1	1	0.1
20 - 24 yrs	1,191	893	75.0	286	24.0	8	0.7	4	0.3
25 - 29 yrs	1,120	495	44.2	585	52.2	28	2.5	12	1.1
30 - 34 yrs	957	160	16.7	757	79.1	29	3.0	11	1.1
35 - 39 yrs	381	29	7.6	325	85.3	14	3.7	13	3.4
40 - 44 yrs	497	13	2.6	451	90.7	13	2.6	20	4.0
45 - 49 yrs	526	16	3.0	471	89.5	16	3.0	23	4.4
50 - 54 yrs	513	13	2.5	418	81.5	20	3.9	62	12.1
55 - 59 yrs	419	18	4.3	327	78.0	15	3.6	59	14.1
60 - 64 yrs	305	4	1.3	210	68.9	7	2.3	84	27.5
65 - 69 yrs	191	7	3.7	116	60.7	4	2.1	64	33.5
70 - 74 yrs	136	3	2.2	60	44.1	3	2.2	70	51.5
75+ yrs	174	3	1.7	70	40.2	1	0.6	100	57.5

Source: Project Survey conducted in January – April 2013

4.3.8.4 Ethnic Group and Religion

92.1% of affected household heads are Khmer and Khmer speaking, while 7 % are ethnic minority Cham, who are legally registered as Cambodian citizens. They live and work as the Cambodians and they are not vulnerable in terms of their livelihoods.

Table 4-34: First Language and Ethnic Group of Household Heads

Stratum	No. H/H	Mother tongue and Ethnic Group					
		Khmer		Cham		Other	
		No.	%	No.	%	No.	%
Project Survey	2,111	1,945	92.1	148	7.0	18	0.9
Pursat	395	385	97.5	9	2.3	1	0.2
Kampong Chhnang	1,637	1,493	91.2	127	7.8	17	1.0
Kandal	79	67	84.8	12	15.2	0	0.0

Data source: Project Survey conducted in January – April 2013

Buddhism has been the dominant religion in Cambodia since the reign of Jayavarman VII (c. 1181-1200). In Cambodia, it is currently estimated to be the faith of 95% of the population, but through the survey results it was found only 92.8 % is Buddhism, 7.0 % is Muslim and Christian is 0.1 %.

Table 5-35: Religion of Household Heads

Stratum	No. H/H	Mother tongue and Ethnic Group					
		Buddhism		Muslim		Christian	
		No.	%	No.	%	No.	%
Project Survey	2,111	1,960	92.8	148	7.0	3	0.1
Pursat	395	386	97.7	9	2.3	0	0.0
Kampong Chhnang	1,637	1,507	92.1	127	7.8	3	0.2
Kandal	79	67	84.8	12	15.2	0	0.0

Data source: Project Survey conducted in January – April 2013.

4.3.8.5 Vulnerable Groups

The study indicates to different type of vulnerable groups included elderly without supporting from youth, window and female-headed households, physically and mentally handicapped, landless and poor households which their incomes are under national poverty line. Table 4-36 reported that 13.2 % of the samples are widow and female household heads. Poor woman household heads are forced by necessity to increasingly take men's roles and responsibilities due to absence of male labour and inability to hire adult male labor. Female-headed households are indeed facing the double burden of taking care of the well-being of family members and other aspects compared to couple households. Based on the survey results, an average percentage of each vulnerable factor in three different areas (Pursat, Kampong Chhnang, and Kandal) of disabled household head, aged[7] household head, household living below poverty line (<20$/capita/month) and landless household is 0.9%, 17.7 %, 1.8%, and 5.3%, respectively.

Table 4-36: Vulnerable Household Head

Stratum	Number of HHs	Aged (≥60years)*		Female HHs		Disabled HHs		Landless		<USD 20/month/cap	
		No.	%	No.	%	No.	%	No.	%	No.	%
Project Survey	2,111	373	17.7	278	13.2	19	0.9	111	5.3	37	1.8
Pursat	395	63	15.9	43	10.9	2	0.5	19	4.8	3	0.8
Kampong Chhnang	1,637	285	17.4	217	13.3	17	1.0	90	5.5	33	2.0
Kandal	79	25	31.6	18	22.8	0	0.0	2	2.5	1	1.3

* "Aged" Vulnerable Household; HH head is older than 60 years old and with no other means of support.
* No child-headed household was found in the project area.
Data source: Project Survey conducted in January – April 2013.

[7] Aged was defined as a person who is more than 60 years old and without young to support.

4.3.8.6 Literacy

A) Literacy of the Affected Households' Heads and Spouses

The male household head literacy rate is 96.4% and female spouse literacy rate is 88.9%. There is a small gap between the literacy rate of male household heads and their spouses. Among 526 female household heads, 389 (74.0%) of them are literacy. Women, in general, receive less education than men, especially for widows. The survey results show that female household heads are about 22% less literate than male household heads (Table 4-37). Therefore, women enter the labor market with a lower education and less vocational skills than men. Even thought, they (men and women) work the same job and same quality of work, but sometimes women still get a salary less than men.

Table 4-37: Literacy of Affected Households' Heads and Spouses

Stratum	Male AH Head			Female AH Head			Female Spouse		
	# AH	Yes	%	# AH	Yes	%	# AH	Yes	%
Project Survey	1,585	1,528	96.4	526	389	74.0	1,521	1,352	88.9
Pursat	329	318	96.7	66	52	78.8	322	288	89.4
Kampong Chhnang	1,200	1,155	96.3	437	322	73.7	1,147	1,014	88.4
Kandal	56	55	98.2	23	15	65.2	52	50	96.2

Source: Project Survey conducted in January – April 2013

B) Adult Literacy (age from 18 years and over)

Adult literacy rate is the percentage of the population aged 18 years and over who can both read and write a simple message. Table 4-38 presents an adult literacy rate of both male and female of 91.2% which is considerably high and the single literacy rate of male and female 96.1% and 86.7%, respectively.

Table 4-38: Adult Literacy (age from 18 years and over)

Stratum	Both Sex			Male			Female		
	Pop.	Yes	%	Pop.	Yes	%	Pop.	Yes	%
Project Survey	7,476	6,817	91.2	3,552	3,413	96.1	3,924	3,404	86.7
Pursat	1,499	1,390	92.7	710	689	97.0	789	701	88.8
Kampong Chhnang	5,659	5,133	90.7	2,681	2,569	95.8	2,978	2,564	86.1
Kandal	318	294	92.5	161	155	96.3	157	139	88.5

Source: Project Survey conducted in January – April 2013

4.3.8.7 Educational Attainment of the Population

Since 2000, education for all Cambodians has been re-energized by the world's commitment to the Millennium Development Goal (MDG). Based on its commitment toward the MDG, the RGC with assistance from development partners and NGO communities has made its efforts to develop a National Education Plan. Furthermore, the Ministry of Education, Youth and Sport has developed the Education for all policy documents. Cambodian MDG (Global MDG2) aims to ensure that by 2015, all children will be able to complete a full course of 9-year basic education[8].

[8] Cambodia Millennium Development Goals Report, November 2003.

Table 4-39: Education Attainment of Population aged 5 years and over

Stratum	Sex	None or Little	Primary Not Completed	Completed Primary Education	Completed Lower Secondary Education	Completed Upper Secondary Education	Post-Secondary Education
		%	%	%	%	%	%
Project Survey	Male	11.0	24.2	23.3	19.2	12.7	9.6
	Female	17.6	30.2	23.8	15.7	7.7	5.0
	Both	14.5	27.3	23.6	17.4	10.1	7.2
Pursat	Male	10.2	22.0	23.9	19.2	14.1	10.7
	Female	16.2	29.4	23.6	16.5	9.7	4.6
	Both	13.3	25.9	23.7	17.8	11.8	7.5
Kampong Chhnang	Male	11.4	24.9	23.4	19.4	11.9	9.1
	Female	17.9	30.3	24.0	15.4	7.3	5.1
	Both	14.8	27.7	23.7	17.3	9.5	7.0
Kandal	Male	8.4	21.6	20.5	15.8	18.9	14.7
	Female	19.0	33.5	21.5	17.0	4.5	4.5
	Both	13.8	27.7	21.0	16.4	11.5	9.5

Source: Project Survey conducted in January – April 2013

In the Project area, 14.5% of the population (both male and female) has no or little education. The difference of none and little education between sexes is more than one and half with 17.6 % for females and 11.0% for males. Around 23.6% of education attainment for both male and female has at least completed primary education. As shown in Table 47, there are only 17.4 % who have completed lower secondary schooling and 7.2% having attended post-secondary education. The gap between sexes increases nearly double for higher level of education, for instacne 9.6% of males have post-secondary education compared to females, which is only 5.0%.

4.3.8.8 Current School Attendance

Information on school attendance was collected in respect to the population aged from 6 to 14 years old. School attendance was defined as enrolment and studying at a primary and lower secondary school. School attendance in primary education is 95.3%, while lower secondary school is 96.1%. The percentage of primary school attendance is smaller than lower secondary school attendance due to the fact that most of pupils in primary school are too young/small and they often leave school after a few months of school enrolment/registration. Rural poor families in the past, young girls are usually allowed to attend school of grade 6 in primary school and after that they stay at home to help their families as additional agricultural labor. At the present, most of the families send and encourage their daughters to go to school in higher level of education. Table 4-40 shows about 96% of pupils have attended secondary school, while about 4% of the pupils have dropped out secondary school to help their families in income-generating activities.

Table 4-40: Current School Attendance for Primary and Lower Secondary

Stratum	Sex	Primary School			Lower Secondary School		
		Age: 6-11	Attending	%	Age: 12-14	Attending	%
Project Survey	Male	485	463	95.5	279	268	96.1
	Female	501	477	95.2	329	316	96.0
	Both	986	940	95.3	608	584	96.1
Pursat	Male	105	103	98.1	59	58	98.3
	Female	105	101	96.2	83	81	97.6
	Both	210	204	97.1	142	139	97.9
Kampong Chhnang	Male	365	347	95.1	209	199	95.2
	Female	375	357	95.2	230	220	95.7
	Both	740	704	95.1	439	419	95.4

Stratum	Sex	Primary School			Lower Secondary School		
		Age: 6-11	Attending	%	Age: 12-14	Attending	%
Kandal	Male	15	13	86.7	11	11	100.0
	Female	21	19	90.5	16	15	93.8
	Both	36	32	88.9	27	26	96.3

Source: Project Survey conducted in January – April 2013

4.3.8.9 Affected Households' Head Engaged in Farming and Non-Farming

28.4% and 66.8% of household heads are working on farms and non-farming, respectively. The rests 4.8% are disable or unable to work. Table 4-41 shows that the percentage of household heads working on farms is highest in Kampong Chhnang with 30.1% at locations where the bypass mostly traverses through rice fields and orchard land. A sizeable number of male and female household heads surveyed (356 persons or 29.7% and 137 persons or 31.4%, respectively) are engaged in farming.

Table 4-41: Farming and Non-farming Affected Households' Head

Stratum	Number of Households		Non-farming		Farming	
			No.	%	No.	%
Project Survey	Male	1,585	1,081	68.2	446	28.1
	Female	526	330	62.7	153	29.1
	Total	2,111	1,411	66.8	599	28.4
Pursat	Male	329	245	74.5	75	22.8
	Female	66	49	74.2	14	21.2
	Total	395	294	74.4	89	22.5
Kampong Chhnang	Male	1,200	799	66.6	356	29.7
	Female	437	265	60.6	137	31.4
	Total	1,637	1,064	65.0	493	30.1
Kandal	Male	56	37	66.1	15	26.8
	Female	23	16	69.6	2	8.7
	Total	79	53	67.1	17	21.5

Source: Project Survey conducted in January – April 2013

4.3.8.10 Fishing Community

Among 130 AHs interviewed, there are only 17 AHs (13.1%) are engaged in fishing activities as a part of their incomes. 12 AHs of the 17 AHs (70.6%) of the fishing families, only fish during their free time for families' consumption, while 5 AHs (29.4%) get income from this activity.

Table 4-42: Fishing Activities around Odongk Town

Stratum	Number of HH	Fishing		Leisure/ Eating		Selling/Money	
		Yes	%	Yes	%	Yes	%
Project Survey	130	17	13.1	12	70.6	5	29.4
Kampong Tralach (Kampong Chhnang)	51	5	9.8	5	100.0	0	0.0
Ponhea Leu (Kandal)	79	12	15.2	7	58.3	5	41.7

Source: Project Survey conducted in January – April 2013

Based on the socio-economic survey, the main sources of fishing for the 17 fishing families are streams or small rivers, reservoirs and the Tonle Sap Great Lake.

Table 4-43: Places to Conduct the Fishing

Stratum	Number of HHs	Reservoir		Tonle Sap river		Stream/small river	
		Yes	%	Yes	%	Yes	%
Project Survey	17	4	23.5	5	29.4	8	47.1
Kampong Tralach (Kampong Chhnang)	5	0	0.0	2	40.0	3	60.0
Ponhea Leu (Kandal)	12	4	33.3	3	25.0	5	41.7

Source: Project Survey conducted in January – April 2013

Of the 17 fishing families, 76.5% do fishing only in the rainy season, 11.8% do fishing in the dry season and 11.8% do fishing for the whole year. 2 of the 17 fishing families, in Ponhea Leu district, have joined in fishery community.

Table 4-44: Duration of the Fishing

Stratum	Number of HH	Whole year		Rainy season		Dry season	
		Yes	%	Yes	%	Yes	%
Project Survey	17	2	11.8	13	76.5	2	11.8
Kampong Tralach (Kampong Chhnang)	5	0	0.0	5	100.0	0	0.0
Ponhea Leu (Kandal)	12	2	16.7	8	66.7	2	16.7

Source: Project Survey conducted in January – April 2013

4.3.8.11 Main Sources of Income of Affected Households

According to the survey, the main income sources of the AHs include 72.8% business/trade followed by 63.8% from agricultural sector (agricultural production, livestock and fishing), and 57.9% depend on wages/salary. Remittance of 8.9% from family members is also another main household income source.

Table 4-45: Main Source of Income of the AHs

Province	Project Survey		Pursat		Kampong Chhnang		Kandal	
Number of Households	2,111		395		1,637		79	
Item	No.	%	No.	%	No.	%	No.	%
Wages/salary	1,209	57.3	243	61.5	907	55.4	59	74.7
Farming hired labor	12	0.6	1	0.3	9	0.5	2	2.5
Business/trade	1,537	72.8	328	83.0	1,153	70.4	56	70.9
Agricultural production	990	46.9	168	42.5	789	48.2	33	41.8
Livestock	330	15.6	87	22.0	230	14.1	13	16.5
Fishing	28	1.3	3	0.8	24	1.5	4	5.1
Equipment making	116	5.5	4	1.0	110	6.7	2	2.5
Equipment rental	7	0.3	1	0.3	6	0.4	0	0.0
Transportation	86	4.1	15	3.8	69	4.2	2	2.5
House/land rental	85	4.0	13	3.3	71	4.3	1	1.3
Remittance	176	8.3	28	7.1	141	8.6	7	8.9
Other	155	7.3	40	10.1	109	6.7	6	7.6

Source: Project Survey conducted in January – April 2013

4.3.8.12 Affected Households Income

Under the survey purposes, the affected household income included earnings from all sources received by all household members during the last year. Participants in the economic activity include employers, own account workers, employees or unpaid family workers, rentals (house, land, equipment, etc.) or recipient of pensions,

grants, etc. A significant number (75.3%) of male household heads reported that they are earning an annual income higher than USD 3,000 (among them, 46.6% earning more than USD 5,000 a year), while 15.1% reported an annual income between 2,000 and USD 3,000. Only 0.3% of the male household heads reported that their earnings are less than USD 600 a year.

Table 4-46: Annual Income (USD) of AHs Headed by Males

Stratum	<= 600		600+ - 1,000		1,000+ -2,000		2,000+ -3,000		3,000+ - 4,000		4,000+ - 5,000		5,000+		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Pro. Survey	5	0.3	13	0.8	135	8.5	240	15.1	236	14.9	218	13.8	738	46.6	1,585	100.00
Pursat	0	0.0	2	0.6	15	4.6	36	10.9	33	10.0	40	12.2	203	61.7	329	100.00
K.Chhnang	5	0.4	11	0.9	118	9.8	198	16.5	198	16.5	170	14.2	500	41.7	1,200	100.00
Kandal	0	0.0	0	0.0	2	3.6	6	10.7	5	8.9	8	14.3	35	62.5	56	100.00

Source: Project Survey conducted in January – April 2013

Likewise, a significant number (51.5%) of female household heads reported that they are earning an annual income higher than USD 3,000 (among them, 26.2% earning more than USD 5,000 a year), while 20.2% reported an annual income between USD 2,000 and USD 2,500. It is noted that all female household heads in KDL province earn income higher than USD 1,000 a year.

Table 4-47: Annual Income (USD) of AHs Headed by Females

Stratum	<= 600		600+ - 1,000		1,000+ -2,000		2,000+ -3,000		3,000+ - 4,000		4,000+ - 5,000		5,000+		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Pro. Survey	13	2.5	26	4.9	110	20.9	106	20.2	72	13.7	61	11.6	138	26.2	526	100.00
Pursat	1	1.5	5	7.6	8	12.1	13	19.7	11	16.7	9	13.6	19	28.8	66	100.00
K.Chhnang	12	2.7	21	4.8	101	23.1	91	20.8	55	12.6	47	10.8	110	25.2	437	100.00
Kandal	0	0.0	0	0.0	1	4.3	2	8.7	6	26.1	5	21.7	9	39.1	23	100.00

Source: Project Survey conducted in January – April 2013

Table 4-48 shows the sources of cash income of all 2,111 households interviewed. It reveals that the average monthly income of household and capita is USD 525.00 and USD 105.00, respectively. Of all interviewed households in the Project area, there are 59.22% has their main income from business/trade, 24.43% has their second main income from wages or salary and 5.58% has their third main income from agricultural sector (i.e. agricultural production, livestock and fishing).

Table 4-48: Average Annual and Monthly Income (USD) per Capita

Items	Annual Income			
	No. HH	USD	%	Average
Wages/salary	1,209	3,234,089.83	24.32	2,675.01
Farming hired labor	12	14,609.75	0.11	1,217.48
Business/trade	1,537	7,875,813.13	59.22	5,124.15
Agricultural production	990	361,889.82	2.72	365.55
Livestock	330	336,523.13	2.53	1,019.77
Fishing	31	43,501.25	0.33	1,403.27
Equipment making	116	220,277.25	1.66	1,898.94
Equipment rental	7	12,015.50	0.09	1,716.50
Transportation	86	300,420.63	2.26	3,493.26
House/land rental	85	163,518.15	1.23	1,923.74
Remittance	176	238,639.23	1.79	1,355.90

Items	Annual Income			
	No. HH	USD	%	Average
Other	155	497,976.73	3.74	3,212.75
	Total	13,299,274.37	100.00	
Currency in USD	Annual		Monthly	
Number of Interviewed AHs = 2,111				
Household income**	6,299.99		525.00	
Capita income***	1,260.00		105.00	

* Each household gets income from more than one source
** [Household income]=[Total Annual Income]/[Total Number of Interviewed HHs]
*** A HH has 5 persons in average. (Capita income=Household income / 5)
Source: Project Survey conducted in January – April 2013

4.3.8.13 Credit

Generally, households in the project area have access to credits or loans from various agencies, both private/official and non-official credit institutions. The survey showed that 41.6% (878 AHs) of the 2,111 AHs have received credit from different agencies. The credit sources of the 878 AHs include 50.7% from private bank institutions, 25.9% from NGOs, 4.7% from credit providers, 14.6% from relatives, 2.5% from landlords/traders, and the rest of 1.7% from other credit sources (Table 4-49).

Table 4-49: Credit Acquired During the Last Year

Stratum	No. HHs	Received credits		Private Bank		NGOs/ Society		Landlord/ Traders		Credit Providers		Relatives		Others	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Project Survey	2,111	878	41.6	445	50.7	227	25.9	22	2.5	41	4.7	128	14.6	15	1.7
Pursat	395	214	54.2	110	51.4	59	27.6	9	4.2	8	3.7	21	9.8	7	3.3
K. Chhnang	1,637	628	38.4	317	19.4	161	9.8	11	0.7	26	1.6	105	6.4	8	0.5
Kandal	79	36	45.6	18	50.0	7	19.4	2	5.6	7	19.4	2	5.6	0	0.0

Source: Project Survey conducted in January – April 2013

Generally, households acquire loans for various purposes such as for farming, health treatment, starting/ expanding business, and family support. As shown in Table 4-50, most households (73.5%) get loans for expanding their businesses, followed by 16.5% for supporting family members 15% for house repairing/building and 11.8% for health care.

Table 4-50: Purposes of Acquiring the Credit

Items	Project		Pursat		Kampong Chhnang		Kandal	
	No.	%	No.	%	No.	%	No.	%
Number of HHs	878		214		628		36	
Food consumption	72	8.2	8	3.7	56	8.9	8	22.2
Health care	104	11.8	21	9.8	77	12.3	6	16.7
Schooling costs	63	7.2	16	7.5	42	6.7	5	13.9
Building/repairing house	132	15.0	29	13.6	98	15.6	5	13.9
Ceremony/wedding	12	1.4	2	0.9	9	1.4	1	2.8
Farming	58	6.6	10	4.7	46	7.3	2	5.6
Business expanding	645	73.5	168	78.5	447	71.2	30	83.3
Supporting family members	145	16.5	15	7.0	128	20.4	2	5.6
Others	18	2.1	4	1.9	14	2.2	0	0.0

Source: Project Survey conducted in January – April 2013

4.3.8.14 Sanitation

A) Water Sources for Drinking and Cooking

Of the interviewed households in the Project area, only 4.6% use pipe water from waterworks and 58.1% from protected wells. Moreover, 29.3% buy clean water during the dry season for their daily consumption. Approximately, 7.4% use rainwater during the wet season, while 10.8% use water from unprotected wells. Lake/pond was the source of drinking water for only 0.6% (or 13 AHs) of the 2,111 AHs surveyed, while 0.2% still use water from stream/river (Table 4-51).

Table 4-51: Water Sources for Drinking and Cooking

Stratum	No. HHs	Stream/River		Lake/Pond		Protected Well		Unprotected Well		Rainwater		Buying		Waterworks	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Project Survey	2,111	4	0.2	13	0.6	1,227	58.1	229	10.8	156	7.4	618	29.3	97	4.6
Pursat	395	1	0.3	3	0.8	127	32.2	95	24.1	48	12.2	111	28.1	51	12.9
K. Chhnang	1,637	3	0.2	3	0.2	1,095	66.9	134	8.2	94	5.7	443	27.1	45	2.7
Kandal	79	0	0.0	7	8.9	5	6.3	0	0.0	14	17.7	64	81.0	1	1.3

Source: Project Survey conducted in January – April 2013

73.0% of the interviewed households always boil their drinking water. Boiling water is by far the most common method for Cambodian people to protect from any bacteria. In addition, 6.8% of the interviewed households sometimes boil water before drinking, while 20.1% drink water without boiling (Table 4-52).

Table 4-52: Boiling Water for Drinking

Stratum	Number of Households	Boiling Water for Drinking					
		Always		Sometimes		Never	
		No.	%	No.	%	No.	%
Project Survey	2,111	1,542	73.0	144	6.8	425	20.1
Pursat	395	277	70.1	42	10.6	76	19.2
Kampong Chhnang	1,637	1,205	73.6	93	5.7	339	20.7
Kandal	79	60	75.9	9	11.4	10	12.7

Source: Project Survey conducted in January – April 2013

Approximately 19.0% of interviewed households have to buy water for washing/bathing during the dry season. Wells and rainwater (78.9%) are the most common water sources for the local people to make a bath and wash (Table 4-53).

Table 4-53: Water Sources for Washing and Bathing

Stratum	No. HHs	Stream/River		Lake/Pond		Protected Well		Unprotected Well		Rainwater		Buying		Waterworks	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Project Survey	2,111	6	0.3	15	0.7	1,371	64.9	246	11.7	48	2.3	402	19.0	96	4.5
Pursat	395	3	0.8	6	1.5	153	38.7	105	26.6	3	0.8	79	20.0	55	13.9
K. Chhnang	1,637	3	0.2	1	0.1	1,210	73.9	140	8.6	30	1.8	263	16.1	40	2.4
Kandal	79	0	0.0	8	10.1	8	10.1	1	1.3	15	19.0	60	75.9	1	1.3

Source: Project Survey conducted in January – April 2013

B) Toilet

In the Project area, 73.2% of the interviewed households have own latrine, while 26.8% do not have access to toilet facilities as they depend on open defecation or sharing toilets with their neighbours. 84.8% of respondents in Ponhea Leu District of Kandal and 66.1% of AHs in Rolea B'ier District of Kampng Chhnang have their own toilets.

4.3.8.15 Energy Sources for Lighting and Cooking

Battery is still the most commonly used energy source for lighting in Cambodia's rural areas, where electricity is not available. However, in the Project area about 16% of the surveyed AHs claimed that they use rechargeable stationary batteries for lighting. Moreover, 75.7% use publicly provided electricity (state and private company) as their sources, while 6.9% use kerosene lamp. About 1.8% of AHs reported that they use their own generators (Table 4-54).

Table 4-54: Energy Sources for Lighting

Stratum	No. HHs	Private Generator		State Electricity		Battery		Gas/Kerosene	
		No.	%	No.	%	No.	%	No.	%
Project Survey	2,111	37	1.8	1,597	75.7	339	16.1	146	6.9
Pursat	395	10	2.5	304	77.0	73	18.5	11	2.8
K. Chhnang	1,637	27	1.6	1,217	74.3	264	16.1	135	8.2
Kandal	79	0	0.0	76	96.2	2	2.5	0	0.0

Source: Project Survey conducted in January – April 2013

Based on the survey results, 25.4% of interviewed households use liquefied petroleum gas as their source for cooking, while 70.1% and 36.4% use firewood and charcoal, respectively. Only 3.6% of the interviewed households in the Project area use electricity as their energy source for cooking (Table 4-55).

Table 4-55: Energy Sources for Cooking

Stratum	No. HHs	Firewood		State Electricity		Charcoal		Gas/Kerosene	
		No.	%	No.	%	No.	%	No.	%
Project Survey	2,111	1,480	70.1	77	3.6	769	36.4	537	25.4
Pursat	395	257	65.1	8	2.0	148	37.5	82	20.8
K. Chhnang	1,637	1,179	72.0	55	3.4	592	36.2	417	25.5
Kandal	79	44	55.7	14	17.7	29	36.7	38	48.1

Source: Project Survey conducted in January – April 2013

4.3.8.16 Transportation

Bicycles are more commonly used as a mode of transportation in rural areas, while motorcycles are more conveniently and more commonly used in urban areas. In the study, it reveals that around 65.7% of interviewed households have bicycles and 75.6% have motorbikes. 3.3% households have trucks and 10.8% have a car/pickup/minivan. It was estimated that the average value of transport equipment in the Project area is around USD 2,214 per household (Table 4-56).

Table 4-56: Transport Equipment and Its Values

Mode of Transport	Total Value (KHR)	Total AHs = 2,111	
		# AHs Occupied	%
Bicycle	130,064,000	1,387	65.7
Motorbike	6,148,180,000	1,595	75.6
Car/pickup/minivan	9,682,800,000	228	10.8
Truck	2,684,700,000	69	3.3
Boat without engine	21,470,000	19	0.9
Boat with engine	30,550,000	6	0.3
Grand Total	18,697,764,000 (KHR)		
Average/Household	8,857,302 (KHR)	2,214 (USD)	

Exchange rate: USD 1 = KHR 4,000
Data source: Project Survey conducted in January – April 2013

4.3.8.17 Household Appliances

Telephones are the most common household appliance among the AHs interviewed, with 1,926 households (91.2%) reporting that they own at least one up to more than five per household. The second most common appliance is TV/VRC/VCP (76.0%). Table 4-57 shows the percentage of households owning other types of electrical appliances, such as 24.6% owning radio/cassette players, and 13.7% owning sewing machines. A small proportion of households own equipment for convenience such as generators at 9.7%, washing machines and air conditioners at 1.9%, and refrigerators 4.7%. It was estimated that the average value of other assets in the target area is around USD 196.70 per household.

Table 4-57: Household Appliances and Its Values

Stratum	Total Value (KHR)	Total Households = 2,111	
		# AHs Occupied	%
Radio/cassette player	31,073,500	519	24.6
TV/VCR/VCP	486,372,000	1,605	76.0
Sewing machine	121,956,000	290	13.7
Air conditioner	61,920,000	40	1.9
Washing machine	25,360,000	41	1.9
Refrigerator	90,340,000	100	4.7
Telephone	594,326,000	1,926	91.2
Generator	249,500,000	205	9.7
Grand Total	1,660,847,500 (KHR)		
Average/Household	786,759 (KHR)	196.70 (USD)	

Exchange rate: USD 1 = KHR 4,000
Source: Project Survey conducted in January – April 2013

4.3.8.18 Housing Characteristic

A) Dwelling Space by Household

There are 2,111 dwellings in the sample. Average floor area of dwellings is 57.9 square meters (sqm) per household or 12.1 square meters per person (average household size is 4.8). For all Cambodia (CSES-2004), the average dwelling space per household is 42.0 sqm. The average floor area of dwelling ranged from 39.0 sqm per household in rural areas to 48.8 sqm in other urban areas, and to 64.3 sqm in Phnom Penh City (Table 4-58).

Table 4-58: Dwelling Space

Stratum	No. H/H	Total size in m²	Average in m²	≤ 20 m²		20+ - 50 m²		50+ - 100 m²		100+ m²	
				No.	%	No.	%	No.	%	No.	%
Project Survey	2,111	122,315.4	57.9	170	8.1	916	43.4	791	37.5	208	9.9
Pursat	395	23,483.9	59.5	28	7.1	172	43.5	144	36.5	47	11.9
K. Chhnang	1,637	93,347	231	139	8.5	714	43.6	614	37.5	150	9.2
Kandal	79	5,484.7	69.4	3	3.8	30	38.0	33	41.8	11	13.9

Source: Project Survey conducted in January – April 2013

B) Building Material

In the studied area 66.2% of the roofs are built from galvanized iron, fibrocement and plastic sheet. There is 26.0% from roofing title and only 2.8% from thatch. 53.8% of houses have wooden walls, the rest being mainly brick with 21.9%. 47.2% have wooden floors. The remaining 21.7% and 23.7% are of floor tile and mortar, respectively (Table 4-59).

Table 4-59: Building Material

Construction Material (Total HH = 2,111)	Roof		Wall		Floor	
	No.	%	No.	%	No.	%
Thatch	59	2.8	254	12.0	-	-
Tin / Fibro/ Plastic Sheet	1,397	66.2	233	11.0	-	-
Wood	-	-	1,136	53.8	997	47.2
Bamboo	-	-	-	-	43	2.0
Roofing Tile	549	26.0	-	-	-	-
Floor Tile	-	-	-	-	458	21.7
Mortar	-	-	-	-	501	23.7
Concrete	80	3.8	-	-	-	-
Earth	-	-	-	-	86	4.1
Brick	-	-	462	21.9	-	-

Source: Project Survey conducted in January – April 2013

4.3.8.19 People's Perception regarding to the Development Project

A) Satisfaction with the Project

The AHs generally showed satisfaction with the Project. 12.7% and 49.6% of the interviewed households rated the Project as 'very good' and 'good', respectively. However, 34.4% rated the Project as 'good and bad'. Bad is because the Project they will: 1) increase daily expense, 2) loss of good trading site, 3) increase accident, 4) disturbs people and community, 5) affect on house/shop, 6) loss of land use in PRW, 7) worsen access to school, 8) worsen environment, 9) decrease household income,10) affect public facilities, 11) loss of occupation, 12) worsen people health condition, and 13) make people migration away.

Table 4-60: Satisfaction with the Project

Items	Project		Pursat		Kampong Chhnang		Kandal	
	No.	%	No.	%	No.	%		
No answer	5	0.2	1	0.3	4	0.2	-	-
Bad	64	3.0	10	2.5	47	2.9	7	8.86
Good and bad	726	34.4	90	22.8	619	37.8	17	21.52
Good	1,048	49.6	240	60.8	764	46.7	44	55.70
Very good	268	12.7	54	13.7	203	12.4	11	13.92
Total	2,111	100.0	395	100.0	1,637	100.0	79	100.00

Source: Project Survey conducted in January – April 2013

B) Benefits of the Project

In the area of improvements, 75.2% of the AHs believed that the Project will help decrease congestion/accident when travelling, while 52.2% mentioned it will improve access to other facilities. About 43.8% responded that the Project will improve cargo transportation. Table 4-61 shows more detailed information on the Project benefits.

Table 4-61: Three ranks of Project Benefits

Most Important Benefits	Total Number of HHs = 2,111							
	Total		First		Second		Third	
	No.	%	No.	%	No.	%	No.	%
Improve cargo transportation	924	43.8	430	46.5	318	34.4	176	19.0
Appreciation of land prices	159	7.5	15	9.4	60	37.7	84	52.8
Reduced daily expenditures	195	9.2	8	4.1	35	17.9	152	77.9
Decrease of congestion/accidents	1,588	75.2	911	57.4	498	31.4	179	11.3
Improve access to other facilities	1,102	52.2	245	22.2	493	44.7	364	33.0
Flood prevention	35	1.7	9	25.7	13	37.1	13	37.1
Improve travel of tourists	546	25.9	107	19.6	207	37.9	232	42.5
Improve environment	399	18.9	64	16.0	128	32.1	207	51.9
Big push to outskirts area	582	27.6	160	27.5	123	21.1	299	51.4
Attract more investment	192	9.1	35	18.2	74	38.5	83	43.2
Create more direct/indirect jobs	276	13.1	46	16.7	87	31.5	143	51.8
Improve local product marketing	34	1.6	5	14.7	4	11.8	25	73.5

Source: Project Survey conducted in January – April 2013

C) Perception of Affected Households with Regards to Relocation

In terms of the perception of the AHs concerning relocation due to the Project, 90.8% of the interviewed households said that they agree to move from the provisional road width (PRW) but will need some assistance from the Project. Meanwhile, 6.8% replied that they will voluntarily move without any compensation or assistance. About 2.1% did not answer. However, 0.3% of the AHs refused to move their structures from the PRW (Table 4-62).

Table 4-62: Perception of AHs with Regards to Relocation

Stratum	No. HHs	No Answer		Refuse to Relocate		Agree with Assistance		Voluntarily Move	
		No.	%	No.	%	No.	%	No.	%
Project Survey	2,111	22	1.0	6	0.3	1,957	92.7	126	6.0
Pursat	395	3	0.8	1	0.3	332	84.1	59	14.9
K. Chhnang	1,637	19	1.2	5	0.3	1,549	94.6	64	3.9
Kandal	79	0	0.0	0	0.0	76	96.2	3	3.8

Source: Project Survey conducted in January – April 2013

5. ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

5.1 Introduction

The proposed development project for widening of the NR No. 5 and the construction of the Kampong Chhnang and Odongk bypasses has been focusing on the natural and social environments and pollution. Environmental and social impacts were identified based on the field investigations, project specifications, and baseline information.

5.2 Environmental Pollution

5.2.1 Impact and Mitigation

The potential impacts regarding to environmental pollution is shown in Table 5-1. The recommended mitigation measures for each identified impact are also presented.

Table 5-1: Impacts Regarding Environmental Pollution and Mitigation Measures

Item	Impact	Mitigation
Air pollution	**Construction Phase:** ▪ Operation of construction equipment will generate dust and emission gas. ▪ Traffic congestion in construction site will cause increase in exhaust gas from vehicles. ▪ Dust will occur in borrow pit or quarry site. **Operation Phase:** ▪ In the future, total amount of air pollutant caused by vehicle exhaust gas due to increment of vehicle will increase. ▪ On the other hand, the amount is expected to be reduced due to improved traffic efficiency compared to without project.	**Construction Phase:** ▪ The contractor shall prepare and strictly implement dust control measures such as periodical water spray. ▪ The contractor actively uses electrically-powered equipment. ▪ The contractors shall maintain their construction equipments in adequate working conditions. ▪ The contractors shall keep clean road surfaces. ▪ The driver of construction vehicles comply with speed limits to minimize road dust. ▪ The contractor and supervision consultant shall provide prior notification to the local community on schedule of construction activities. ▪ The contractor shall prepare and strictly implement a traffic management plan around construction site. ▪ The supervision consultant shall monitor dust, exhaust gas and complaint from the local people. ▪ If the local residents and pedestrians complain about the dust and gas, the supervision consultant and contractors should reconsider the construction technique and method. **Operation Phase:** ▪ The regulations on fuel quality and importing old cars are to be prepared by MoE in the future. ▪ Emission gas control shall be strictly implemented. ▪ A relevant agency shall monitor air quality on roadside.
Water pollution	**Construction Phase:** ▪ Turbid water caused by construction works is likely to affect existing surface water resources. ▪ Human wastewater will cause surface water contamination. ▪ In case of accidental massive leaking of fuel or oil, water pollution including ground water may occur. ▪ In case of inadequate management in borrow pit or quarry site, turbid	**Construction Phase:** ▪ Construction works in and around rivers streams, reservoirs or channels shall be concentrated in dry period. ▪ The contractors shall maintain their construction equipments in adequate working conditions. ▪ The contractor should consider installation of cofferdam as necessary. ▪ The contractor shall strictly control waste oil and other waste. ▪ The contractors will be prohibited from washing the

Item	Impact	Mitigation
	water from borrow pit or quarry site by rainfall may cause surface water contamination. **Operation Phase:** ▪ Considerable water pollution is unlikely to occur. ▪ In case of inadequate management or recovery in borrow pit or quarry site, turbid water from borrow pit or quarry site by rainfall may cause surface water contamination.	construction tools along the rivers, streams, reservoirs and other public water to prevent further pollution. ▪ In construction works in and around rivers streams, reservoirs or channels, the supervision consultant and contractor should monitor and control the turbid water as necessary. ▪ The wastewater septic tank facility in the workers camp and/or other necessary locations shall be properly maintained. ▪ The supervision consultant shall monitor water quality. ▪ The contractor shall prepare and strictly implement an environmental management plan on borrow pit or quarry site. ▪ In case of purchase from quarry firm, the environmental management shall be included in the contract. **Operation Phase:** ▪ The supervision consultant shall monitor environmental condition in borrow pit or quarry site. ▪ If the condition has risk of soil erosion, the supervision consultant should consider the countermeasures.
Waste	**Construction Phase:** ▪ Construction waste caused by construction works and general waste from construction office will be generated. ▪ Solid waste due to demolish works of facilities in the ROW will generate. **Operation Phase:** ▪ Illegal dumping of solid waste may increase along the newly constructed bypass.	**Construction Phase:** ▪ The contractor shall prepare and strictly implement a proper waste management plan including waste due to demolish works. ▪ The waste management plan should be approved by the local relevant authority in advance of construction works. ▪ The contractors shall provide temporary sanitation facilities such as portable toilets and garbage bins to ensure that the domestic wastes to be generated by the construction personals. ▪ The solid waste should be separated into hazardous, non-hazardous and reusable waste streams and store temporary on site. ▪ Office building for construction contractor shall be provided with toilets and septic tanks to handle domestic sewage. ▪ The contractor shall consider and implement proper re-use plans of the construction waste. ▪ The supervision consultant shall monitor the waste disposal ▪ The local relevant authority should maintain closely consultation with the contractor on the collection of garbage. **Operation Phase:** ▪ A relevant agency shall monitor and control illegal dumping.
Soil pollution	**Construction Phase:** ▪ Soil pollution caused by construction works will not occur normally. ▪ In case of accidental massive	**Construction Phase:** ▪ Because the surplus soil containing contaminated materials may cause negative impact on drainage condition in agricultural land, the proper disposal site should be selected.

Item	Impact	Mitigation
	leaking of fuel or oil, soil pollution may occur. **Operation Phase:** ▪ Because the target road mostly passes through agricultural land, leaking of fuel, oil and harmful cargo by traffic accident is likely to cause agricultural soil pollution.	▪ Bitumen, diesel and waste oil shall be handled and stored carefully to prevent leakage or spill. Waste oil shall be collected, stored in drums and disposed at a site approved by the local relevant authority. ▪ Waste oil storage shall be in drums, raised off the ground, covered to keep rain out and surrounded by a bund to contain any spills and simplify clean up. **Operation Phase:** ▪ A relevant agency shall monitor and control vehicle speed and laden weight to reduce traffic accident.
Noise and vibration	**Construction Phase:** ▪ Construction works is likely to increase in the noise and vibration level. ▪ Noise and vibration will occur in borrow pit or quarry site. **Operation Phase:** ▪ In the future, noise and vibration levels caused by vehicle driving will increase. ▪ On the other hand, the levels on road side are expected to be reduced due to widening and improved smooth surface compared to without project.	**Construction Phase:** ▪ A proper work schedules should be prepared not to concentrate the construction equipment at a certain point for long time. ▪ The contractors shall maintain their construction equipments in adequate working conditions. ▪ Construction works with heavy noise and vibration shall be prohibited during night (10:00 pm - 6:00 am) to avoid noise disturbance in residential, commercial and other noise-sensitive areas. ▪ The contractor selects quiet equipment and working methods as much as possible. ▪ The contractor and supervision consultant shall provide prior notification to the local community on schedule of construction activities. ▪ The supervision consultant shall monitor noise, vibration and complaint from the local people in construction site, borrow pit and quarry site. ▪ If the local residents and pedestrians complain about the noise and vibration, the supervision consultant and contractors should reconsider the construction technique and method. **Operation Phase:** ▪ The proper countermeasures to reduce noise and vibration such as slow speed in curve sections should be included in the plan and design. ▪ A relevant agency shall monitor noise and vibration on roadside. ▪ If the noise level reaches a significant level such as exceeding the environmental standards, the relevant agency should consider mitigation measures on noise control.
Ground subsidence	**Construction Phase:** ▪ Subsidence near the road due to added soil weight may occur. ▪ Because there are soft ground areas along the proposed bypass, subsidence near the road due to the soil weight filled on the rice field may occur.	**Construction Phase:** ▪ Detailed soil investigations should be conducted at subsidence-prone locations in the planning stage. ▪ In the detailed design stage, the detailed geological surveys should be conducted. ▪ The proper structure design and construction technique should be considered on the basis of the survey results. ▪ The supervision consultant and contractor should monitor the ground subsidence. ▪ If the ground subsidence occurs, the consultant and contractors should reconsider the construction technique.

Item	Impact	Mitigation
Offensive odors	**Construction Phase:** ▪ Offensive odors caused by construction works, especially operation of ill-serviced construction equipment and asphalt mixing plant will be generated. **Operation Phase:** ▪ Exhaust gas from vehicles with incomplete combustion may cause offensive odors.	**Construction Phase:** ▪ The contractors shall maintain their construction equipments in adequate working conditions. ▪ The supervision consultant shall monitor offensive odors and complaint from the local people. ▪ If the local residents and pedestrians complain about the offensive odors, the supervision consultant and contractors should reconsider the construction technique and method. **Operation Phase:** ▪ The regulations on fuel quality and importing old cars are to be prepared by the MoE in the future. ▪ Emission gas control shall be strictly implemented.
Bottom sediment	**Construction Phase:** ▪ Filled soil may be eroded by heavy rain and flow into rivers or streams, and be accumulated at the bottom of rivers or streams. Such soil can finally flow into Tonle Sap Lake. However, the impact is likely to be relatively small. ▪ In case of inadequate management in borrow pit or quarry site, erosion in borrow pit or quarry site by rainfall may cause sedimentation on riverbed. **Operation Phase:** ▪ In case of inadequate road design, construction and maintenance, filling sections may collapse and the debris may cause sedimentation on riverbed. ▪ In case of inadequate management or recovery in borrow pit or quarry site, erosion in borrow pit or quarry site by rainfall may cause sedimentation on riverbed.	**Construction Phase:** ▪ Construction works in and around rivers streams, reservoirs or channels shall be concentrated in dry period. ▪ The contractor should consider installation of cofferdam as necessary. ▪ The proper structure design and construction technique should be considered on the basis of the geological survey results. ▪ The contractor shall prepare and strictly implement an environmental management plan on borrow pit or quarry site. ▪ In case of purchase from quarry firm, the environmental management shall be included in the contract. **Operation Phase:** ▪ The supervision consultant shall monitor environmental condition in borrow pit or quarry site. ▪ If the condition has risk of soil erosion, the supervision consultant should consider the countermeasures.
Trans-boundary impacts or climate change	**Construction Phase:** ▪ Trans-boundary impacts including climate change will not occur. ▪ Operation of construction equipment will generate CO_2. **Operation Phase:** ▪ In the future, total amount of CO_2 emission from vehicles will increase. However, because of improved traffic efficiency, the amount may be reduced compared to without project.	**Construction Phase:** ▪ The contractor actively uses electrically-powered equipment. ▪ The contractors shall maintain their construction equipments in adequate working conditions. **Operation Phase:** ▪ Relevant agencies should estimate total amount of CO_2 emission from vehicle traffic.

5.2.2 Prediction of Air Pollution and CO_2 Emission

According to the traffic demand forecast estimated in this survey, the total traffic demand in the each forecasted station in 2016 will increase by 144 ~ 179 percent as Passenger Car Unit from the traffic volume in 2012. Air pollutants and CO_2 emitted by the vehicle traffic will also increase. The total emission volume of SPM (Suspended Particulate Matter), NOx (Nitrogen oxides) and CO_2 emitted by the vehicle traffic from the whole target road in 2016 is estimated in case of "With Project" and "Without Project" at a preliminary level.

The "total emission volume" is calculated as:

$$BR_i = \sum_j \sum_l (Q_{ijl} \times L_l \times \beta_j) \times 365 \div 1{,}000{,}000$$

Where:

BR_I : Total Emission Volume in case of development i (ton/year)

Q_{ijl} : Traffic Volume in case of development i, link l and vehicle type j (number/day)

L_l : Length of link l (km)

β_j : Emission factor by vehicle type j (gram/ (number*km))

j : vehicle type

l : link

The emission factors are calculated on the basis of "Grounds for the Calculation of Motor Vehicle Emission Factors using Environment Impact Assessment of Road Project etc (Revision of FY 2010, National Institute for Land and Infrastructure Management, Japan".

The approximation formulas are as follows:

$FE=A/V+B \times V+C \times V^2+D$

where:

FE: Emission factor

V: Average vehicle travel speed (km/h)

Table 5-2: The Calculated Emission Factors

ITEMS	A	B	C	D
Light Vehicle				
NOx	-0.1874248100	-0.0039820000	0.0000312900	0.1827117200
SPM	0.0204858053	-0.0001713205	0.0000015448	0.0058884575
CO_2	1501.20185	-2.40935	0.02115	174.47635
Heavy Vehicle				
NOx	5.3968052000	-0.0782455300	0.0006706800	3.2657883600
SPM	0.5264308649	-0.0017836421	0.0000140949	0.0846006568
CO_2	908.52069	-23.49899	0.18396	1364.81344

The emission factors for motorcycles are adopted 30 percent of the light Vehicle values. The total emission volume is the sum of emission volume from the whole target road 139 km long. The result of traffic volume forecast, average vehicle travel speed and emission factors to estimate the total emission volume are shown in Table 5-3. The result of estimation of the total emission volume is shown in Table 5-4. The total emission volumes of SPM, NOx and CO_2 in case of "With Project" are approximately 13, 10 and 8 percent less than "Without Project"

one respectably. However, because the emissions factors will change in the future, the recalculation should be considered at the future stage.

Table 5-3: Traffic Volume, Average Vehicle Speed and Emission Factors

Item	Motorcycle	Light Vehicle	Heavy Vehicle
Traffic Volume "Without Project" in 2016 (number*km/day)	742,995	653,802	204,952
Traffic Volume "With Project" in 2016 (number*km/day)	799,277	625,598	197,719
Average Vehicle Speed "Without Project" in 2016 (km/hr)	49	49	49
Average Vehicle Speed "With Project" in 2016 (km/hr)	58	58	58
Emission Factor SPM "Without Project" in 2016 (g/ (number*km))	0.00049	0.00162	0.04179
Emission Factor SPM "With Project" in 2016 (g/ (number*km))	0.00045	0.00150	0.03753
Emission Factor NOx "Without Project" in 2016 (g/ (number*km))	0.018	0.059	1.152
Emission Factor NO_x "With Project" in 2016 (g/ (number*km))	0.016	0.054	1.076
Emission Factor CO_2 "Without Project" in 2016 (g-CO_2/ (number*km))	41.4	137.8	673.6
Emission Factor CO_2 "With Project150" in 2016 (g-CO_2/ (number*km))	39.5	131.6	635.5

Table 5-4: Result of Estimation of Total Emission Volume

Parameter	"Without Project" in 2016	"With Project" in 2016	Reduction Rate
Total Emission of SPM (ton/year)	3.64	3.18	12.7%
Total Emission of NO_x (ton/year)	105.0	94.6	9.9%
Total Emission of CO_2 (ton-CO_2/year)	94,500	87,433	7.5%

5.2.3 Prediction of Noise Level

According to the noise survey, the levels along the target road are less than the environmental standards in the daytime. However, in the future, the noise levels may rise by the environmental standard due to increased traffic volume and speed. The level at a cross-section in southern suburb of Kampong Chhnang, where is forecasted the most traffic volume at the peak traffic volume hour in the target section of the NR No.5, is predicted by using following brief calculation method of LAeq under simple condition in "ASJ RTN-Model 2008 by The Acoustical Society of Japan".

$$L_{Aeq,T} = 82.3 + 10 \log_{10}(1+3.47\,q) - 10 \log_{10} l + 20 \log_{10} V + 10 \log_{10} N_T + 10 \log_{10} 3.6/2T$$

where:

$L_{Aeq,T}$: Equivalent continuous A-weighted sound pressure Level of time T (dB)
V : Vehicle speed (km/h)
T : Time (s)
N_T : Traffic volume in time T (number)
l : Distance from carriageway to survey point (l)
q : Heavy vehicle ratio (< 1)

The input data are based on the conceptual road design and traffic forecast result in this survey. These input data to predict noise level are setting as follows:

Table 5-5: Input Data for Noise Level Prediction

V :	58 km/hr
T :	From 6:00 to 18:00 43,200 s
	From 18:00 to 22:00 14,400 s
	From 22:00 to 6:00 28,800 s
N_T	From 6:00 to 18:00 997 (Number/hr) x 12 hr (Daily Volume x 0.824)
	From 18:00 to 22:00 370 (Number/hr) x 4 hr (Daily Volume x 0.102)
	From 22:00 to 6:00 134 (Number/hr) x 8 hr (Daily Volume x 0.074)
l	6.5 m and 14.0 m
q	0.11

The result of noise levels caused by vehicle traffic at the end point of road is shown in Table 5-6. The predicted noise levels are same as the standards during 6:00 ~ 22:00. The predicted level during 22:00 ~6:00 is 11 dB higher than the standard. However, actual noise levels around roadside houses become lower than the predicted levels depending on the distance to the road.

Table 5-6: Predicted Noise Level Caused by Vehicle Traffic on Roadside

Time	6:00 to 18:00	18:00 to 22:00	22:00 to 6:00
Predicted Noise Level (dB)	70	65	61
Cambodia Maximum Noise Level Standard (Commercial and service and mix area) (dB)	70	65	50

5.3 Natural Environment

The potential impacts regarding natural environment is shown in Table 5-7. The recommended mitigation measures for each identified impact are also presented.

Table 5-7: Impacts Regarding Natural Environment and Mitigation Measures

Item	Impact	Mitigation
Protected areas	**Construction Phase:** ▪ Because the distance between the target section of the NR No.5 and the core areas is sufficient long, the impacts on the core areas are unlikely to occur. ▪ Because the construction works will be limited within the ROW of the NR No.5 or the outside of the TSBR, the direct impacts on natural resources in the buffer or transition zone of the TSBR are unlikely to occur. ▪ Rivers or streams that have direct and/or indirect connections with TSBR will be temporarily disturbed by construction works. ▪ Road widening will require loss of existing vegetation along the buffer	**Construction Phase:** ▪ Vegetation loss for land clearing should be minimal and in limited areas of the ROW. ▪ To identify impacts on aquatic life and consider the mitigations, the supervision consultant should have specialists on fauna or ecosystem as necessary. **Operation Phase:** ▪ Relevant agencies should monitor the environmental conditions along the target section in the buffer zone or transition zone. ▪ If troubles of some sort occur, the agencies should consider the countermeasures.

Item	Impact	Mitigation
	or transition zone of the TSBR. **Operation Phase:** ▪ Because natural tree clearing and change of river flow will not be required, direct impacts on the natural resources are unlikely to occur. ▪ The project is unlikely to cause new environmental issues or deteriorate existing issues in TSBR. ▪ However, because a portion of the target road runs alongside the line of the buffer zone in the TSBR, indirect impacts on some components in the TSBR may occur sometime in the future.	
Ecosystem	**Construction Phase:** ▪ Vegetation in roadside including trees will be lost by widening works. However, tree clearing of community or flooded forest will not be required. ▪ Agricultural ecosystem will be lost or disturbed by construction works. ▪ Turbid water caused by bridge construction is likely to affect aquatic life. ▪ Ecosystem in wetland around Ou Prong River crossing point may be disturbed by the construction activity. **Operation Phase:** ▪ Because the target road mostly passes through well developed area such as agricultural land and urban area, impact on biodiversity is unlikely to occur. ▪ Because the distance between the target road and Tonle Sap lakeside is approximately 4 km at the nearest point, direct impact on ecosystem in Tonle Sap Lake is unlikely to occur. ▪ If the embankment sections choke off or change existing surface water flow, impact on remote aquatic ecosystem may occur.	**Construction Phase:** ▪ Vegetation loss for land clearing should be minimal and in limited areas of the ROW. ▪ The contractor and supervision consultant shall prepare and strictly implement vegetative restoration plans such as tree planting and sowing on road side. ▪ The supervision consultant shall consider impacts of foreign species in the vegetative restoration plans. ▪ The contractor and supervision consultant shall prepare and strictly implement proper construction plans to minimize disturbance in existing agricultural cannels and reservoirs. ▪ The supervision consultant shall monitor water quality including turbidity. ▪ Construction works in and around rivers, streams, reservoirs or channels shall be concentrated in dry period. ▪ To reduce turbid water, steel sheet pile construction method should be selected in bridge construction works as necessary. ▪ To identify impacts on aquatic life and consider the mitigations, the supervision consultant should staff specialists on fauna or ecosystem as necessary. ▪ The contractor should consider installation of cofferdam as necessary. **Operation Phase:** ▪ To maintain existing surface flow condition, locations of existing bridges and culverts should not be changed. ▪ The proper countermeasures to maintain existing surface flow condition in embankment sections should be included in the design such as sufficient cross-section area of flow and culverts with sufficient flow capacity.
Hydrology	**Construction Phase:** ▪ Water flow in the river or stream may be altered during construction works. But the impact will be temporary and in limited area.	**Construction Phase:** ▪ The contractor and supervision consultant shall prepare and strictly implement proper construction plans to minimize disturbance in rivers and existing agricultural cannels.

Item	Impact	Mitigation
	Operation Phase: ▪ Because some project sites are located in flood plain, impact caused by newly constructed embankments on surface water flow may occur.	**Construction Phase:** ▪ Locations of the existing bridges and culverts should not be changed. ▪ The proper countermeasures to keep existing surface water flow in embankment sections should be included in the design such as culverts with sufficient capacity.
Geographical features	**Construction Phase:** ▪ Topography will be changed in bypass or embankment sections on a small scale. ▪ Topography will be changed in borrow pit and quarry site. **Operation Phase:** ▪ Impact on geographical features is unlikely to occur.	**Construction Phase:** ▪ The contractor shall prepare and strictly implement an environmental management plan on borrow pit or quarry site. ▪ In case of purchase from quarry firm, the environmental management shall be included in the contract.

5.4 Social Environment

The potential impacts regarding social environment is shown in Table 5-8. The recommended mitigation measures for each identified impact are also presented.

Table 5-8: Impacts Regarding Social Environment and Mitigation Measures

Item	Impact	Mitigation
Resettlement/ Land Acquisition	**Pre-Construction Phase:** ▪ Resettlement and additional land acquisition will be required. ▪ Affected households including partial asset losses may be more than 2,000. **Construction Phase:** ▪ Additional small scale land acquisition and resettlement may be required. ▪ Temporal lease of land will be required for construction yard. **Operation Phase:** ▪ Additional physical resettlement and land acquisition will not be required.	**Pre-Construction Phase:** ▪ Authorities concerned shall prepare and strictly implement a proper Resettlement Action Plan (RAP) and Land Acquisition Plan (LAP). **Construction Phase:** ▪ Authorities concerned shall prepare and strictly implement the proper RAP and the LAP. ▪ The contractor shall provide proper compensation to land owners or users.
Poor people	**Pre-Construction Phase:** **Construction Phase:** **Operation Phase:** ▪ Some of the poor people who do not have their own land living within Right of Way or Provisional Road Width will be affected by resettlement and lose their business opportunity.	**Pre-Construction Phase:** **Construction Phase:** **Operation Phase:** ▪ Authorities concerned shall prepare and strictly implement the proper RAP and the LAP including fair compensating methods.
Ethnic minorities and indigenous	**Pre-Construction Phase:**	**Pre-Construction Phase:**

Item	Impact	Mitigation
peoples	**Construction Phase:** ▪ Road widening may cause resettlement or other impacts on Ethnic Cham and Vietnamese living along the NR No.5 **Operation Phase:** ▪ Impact on ethnic minorities is unlikely to occur.	**Construction Phase:** ▪ Authorities concerned shall prepare and strictly implement the proper RAP and the LAP including fair compensating methods.
Local economies, such as employment, livelihood, etc.	**Pre-Construction Phase:** ▪ Land acquisition and resettlement may cause livelihood degradation of Project Affected Persons (PAPs). ▪ Road widening will require acquisition of agricultural lands as agricultural resources. However, the required land will be very small to the total agricultural land. **Construction Phase:** ▪ Construction will create job opportunities to local people. ▪ Bridge construction works may have impacts on local fishery. **Operation Phase:** ▪ Reduction of travel time will contribute to local economies and promote tourism. ▪ Change of access to local resources may widen gap in local economy. ▪ If the embankment sections choke off or change existing surface water flow, impact on local fishery may occur.	**Pre-Construction Phase:** ▪ Authorities concerned shall prepare and strictly implement the proper RAP and the LAP including fair compensating methods. ▪ Proper compensations including recovery fee for roadside agricultural lands should be provided to the land owners or users. **Construction Phase:** ▪ The contractor shall prepare and strictly implement a fair hiring plan of local people as construction worker. ▪ The contractor should give priority to the PAPs in hiring local people. ▪ The contractor and supervision consultant shall provide prior notification to the local community and fisherpersons on the schedule of construction activities and restricted areas, especially bridge construction works. ▪ The contractor and supervision consultant should periodically hold sufficient local stakeholder meetings in the pre-construction stage and during construction works, and establish mutual understanding with the PAPs as necessary. **Operation Phase:** ▪ The local government should monitor local economy and livelihood. ▪ If troubles of some sort occur, the local government should consider the countermeasures.
Land use and utilization of local resources	**Construction Phase:** ▪ Bypass sections will require change of land use, mainly from agricultural land to ROW. **Operation Phase:** ▪ Especially in bypass sections, land use along the NR No.5 will be changed and be developed economically and socially. ▪ Improved transportation will contribute to effective utilization of local resources.	**Construction Phase:** ▪ The contractor and supervision consultant shall provide prior notification to the local community on schedule of construction activities. ▪ The contractor and supervision consultant should periodically hold sufficient local stakeholder meetings in the pre-construction stage and during construction works, and establish mutual understanding with the PAPs as necessary. **Operation Phase:** ▪ The local government should monitor local economy and land use. ▪ If troubles of some sort occur, the local government should consider the countermeasures.
Water usage	**Construction Phase:** ▪ Existing agricultural channels located in roadside will be affected	**Construction Phase:** ▪ The contractor and supervision consultant shall provide prior notification to users of agricultural

Item	Impact	Mitigation
	by widening works. **Operation Phase:** ▪ Newly constructed embankment or culverts may change surface water flow.	channels on schedule of construction activities. ▪ The contractor and supervision consultant should periodically hold sufficient local stakeholder meetings in the pre-construction stage and during construction works, and establish mutual understanding with the PAPs as necessary. ▪ The proper countermeasures to reduce impact on present water usage should be included in the construction plan. **Operation Phase:** ▪ The proper countermeasures to reduce impact on present water usage should be included in the road design. ▪ Relevant agencies should monitor water usage and flow. ▪ If troubles of some sort occur, the agencies should consider the countermeasures.
Existing social infrastructures and services	**Pre-Construction Phase:** ▪ Relocation or protection of existing utilities, such as electric poll, water pipe and optical fiber cable will be required. **Construction Phase:** ▪ Temporary traffic congestion in construction site including the NR No.5 and other rural roads will occur. **Operation Phase:** ▪ Access to social services will be improved. ▪ Road crossing of pedestrians and livestock will become harder due to widening. ▪ Spilt of local communities or widening disparity may occur in bypass section.	**Pre-Construction Phase:** ▪ Detailed existing survey should be conducted in the planning stage. ▪ The contractor and supervision consultant should periodically hold sufficient meetings with the utility owners in every stage and establish mutual understanding. ▪ Proper relocation plans should be prepared and strictly implemented in advance of contraction works. **Construction Phase:** ▪ The contractor and supervision consultant shall provide prior notification to local people and drivers on schedule of construction activities. ▪ The contractor shall prepare and strictly implement a traffic management plan around construction site. **Operation Phase:** ▪ The proper countermeasures to support road crossing of pedestrians and livestock, such as crosswalk or road traffic sign to inform livestock crossing should be considered on the basis of site survey in the detail design stage. ▪ Relevant agencies should monitor the utility and local communities. ▪ If troubles of some sort occur, the agencies should consider the countermeasures.
Social institutions such as social infrastructure and local decision-making institutions	**Construction Phase:** **Operation Phase:** ▪ Because of improvement project of existing road, considerable impact on social institutions is unlikely to occur. ▪ Spilt of local communities or widening disparity may occur in bypass section.	**Construction Phase:** **Operation Phase:** ▪ The local government should monitor community relationship around road. ▪ If troubles of some sort occur, the local government should consider the countermeasures.
Misdistribution of benefits and damages	**Pre-Construction Phase:** **Construction Phase:** ▪ Considerable misdistribution of	**Pre-Construction Phase:** **Construction Phase:** ▪ The contractor shall prepare and strictly implement a

Item	Impact	Mitigation
	benefit is unlikely to occur. ▪ In case of unfair hiring of construction workers, misdistribution of benefit may occur. **Operation Phase:** ▪ After the traffic flow is changed to new bypass, some shops along the existing NR No.5 (old route) will lose their business opportunity, while shops set up along bypass will make profit.	fair hiring plan of local people as construction worker. **Operation Phase:** ▪ The local government and supervision consultant shall provide prior notification to the shop owners on schedule of the bypass project in early stage.
Cultural heritage	**Pre-Construction Phase:** **Construction Phase:** ▪ Proposed Odongk bypass will have minor impacts on Longveaek remains. **Operation Phase:** ▪ Road improvement will promote tourism and worship to religious heritage. Religious value may be spoiled by tourism development.	**Pre-Construction Phase:** **Construction Phase:** ▪ Authorities concerned shall conduct a proper archeological survey and preserve the record in advance of construction works. ▪ Archeological fragments found during construction works should be stored in proper facilities. **Operation Phase:** ▪ Relevant agencies should monitor the cultural heritage. ▪ If troubles of some sort occur, the agencies should consider the countermeasures.
Landscape	**Construction Phase:** ▪ Vegetation at existing roadside including high trees will be lost by widening works, and cause change of landscape. **Operation Phase:** ▪ Because there are no protected scenic view areas, considerable impact on landscape is unlikely to occur. ▪ Embankment road may not blend in with paddy field scene.	**Construction Phase:** ▪ Minimal vegetation should be lost for land clearing. **Operation Phase:** ▪ The contractor and supervision consultant shall prepare and strictly implement vegetative restoration plans such as tree planting and sowing on road side.
Gender	**Construction Phase:** **Operation Phase:** ▪ Impact on street venders, especially women, may occur.	**Construction Phase:** **Operation Phase:** ▪ The contractor and supervision consultant should periodically hold sufficient local stakeholder meetings in the pre-construction stage and during construction works, and establish mutual understanding with the PAPs as necessary.
Children's rights	**Construction Phase:** ▪ Considerable impact only on children's rights is unlikely to occur. **Operation Phase:** ▪ Road improvement may cause traffic accident of children due to more traffic volume and faster vehicle speed. ▪ Traffic venerable people including	**Operation Phase:** ▪ Relevant agencies shall monitor and control vehicle speed to reduce traffic accident. ▪ Local educational institutes should conduct traffic safety training to children.

Item	Impact	Mitigation
	children can be separated safely from main vehicle lane.	
Infectious diseases such as HIV/AIDS	**Construction Phase:** ▪ Infection risks of HIV/AIDS may be increased among construction workers and local business offering food and entertainment. **Operation Phase:** ▪ Considerable impact on infectious diseases is unlikely to occur.	**Construction Phase:** ▪ The contractor shall prepare and strictly implement educational program on infection risks for construction workers. ▪ The educational program should be included in the construction contract.
Working conditions (including occupational safety)	**Construction Phase:** ▪ Dust and emission gas caused by construction works may affect workers health. ▪ Sanitary conditions around construction site may get worse due to waste from workers and toilet. **Operation Phase:** ▪ Considerable impact on working conditions is unlikely to occur.	**Construction Phase:** ▪ The contractor shall prepare and strictly implement dust control measures such as periodical water spray. ▪ The contractors shall maintain their construction equipments in adequate working conditions. ▪ The contractors shall provide temporary sanitation facilities such as portable toilets and garbage bins to ensure that the domestic wastes to be generated by the construction personals. ▪ The solid waste should be separated into hazardous, non-hazardous and reusable waste streams and store temporary on site. ▪ The supervision consultant shall monitor the waste disposal
Accidents	**Construction Phase:** ▪ Traffic accident may occur surrounding of construction site. **Operation Phase:** ▪ Traffic safety including pedestrians will be improved by road widening and vehicle separation ▪ Traffic accident due to more traffic volume and faster vehicle speed may increase ratio of traffic accident.	**Construction Phase:** ▪ The contractor shall prepare and strictly implement a traffic management plan around construction site. **Operation Phase:** ▪ The proper countermeasures to reduce traffic accident should be included in the road design. ▪ A relevant agency shall monitor and control vehicle speed to reduce traffic accident. ▪ The local government should conduct traffic safety campaign.

5.5 Positive Impacts

The proposed development project will provide long term numerous beneficial impacts either environmental factor or socio-economic factor to individuals, communities, as well as to the entire country. Environmentally, the project will have improved air quality, reduced noise/vibration disturbance due to reduction traffic congestion in the project area. Socioeconomically, beneficial impacts will appear as follows:

5.5.1 During the Construction Phase

Three beneficial impacts are identified, all of which are (i) Employment Generation, (ii) Skill Enhancement, and (iii) Local Trade and Business Opportunity.

5.5.1.1 Employment Generation

The project will generate direct employment opportunities to the local people in the project construction zone. As the project involves construction work it will offer a grand opportunity for various skilled and non-skilled work forces. The amount of money earned by the local people will directly affect the local economy thereby reducing the chances of seasonal migration of the local people. The project will provide short term direct employment benefit to majority of the construction workers. In order to augment such benefits, priority will be given to employ local laborers as far as possible.

5.5.1.2 Skill Enhancement

The construction of the project will not only provide direct employment opportunities but also ensure the transfer of skills and technical proficiency to the local workforce. The project activities such as constructing bridges, culverts, and related infrastructures will provide transferable skills. In future these skills will be a plus point for the locals in any relevant work as such.

5.5.1.3 Local Trade and Business Opportunity

The project will directly add in building business opportunity in particular in the newly constructed bypass. As construction work involves a lot of manpower, a number of shops pertaining to food items will gain a momentum around the vicinity of the construction site. This will boost on local trade and business sector.

5.5.2 During the Operation Phase

Availability of the newly widened road and the newly constructed bypass is one of the necessary human needs and will significantly contribute towards improving the quality of life. People will save travel time through smooth traffic from the project rehabilitation and reduce accident costs due to the reduced traffic densities compared to the original road. Finally, the project would significantly promote Cambodia's economic growth.

6. ANALYSIS OF ALTERNATIVES

6.1 South Section of the NR No.5

For the improvement of the South Section of the NR No.5, three alternatives of cross section and 0 option were studied. Table 6-1 compares advantages and disadvantages of these alternatives. After discussions among relevant organizations including the MPWT, the DPWT and the JICA Team, Alternative 2 was adopted.

Table 6-1: Comparison of Alternatives of Improvement of the Existing NR No.5

Alternatives	Alt-0: Zero Option; No action	Alt-1: Existing road width is maintained; Only pavement is improved into asphalt concrete.	Alt-2: Widen into 4-lane; pavement is improved into asphalt concrete.	Alt-3: Widen into 'Opposed 2-lane + MC lane on both sides; pavement is improved into asphalt concrete
Objective	Maintain the existing conditions. No impact to social & natural environment. No construction cost is required.	Resettlement is not required. Pavement is improved so that maintenance cost can be reduced.	Secure sufficient traffic capacity and smooth traffic. Improve traffic safety by slow traffic & fast traffic.	Reduce construction cost and number of households/houses to be relocated, securing required traffic capacity.
Social Impact	No resettlement required.	Same as Alt-0.	Large number of households/ houses	Considerable number of (less than in Alt-2) households/houses need to be relocated.

Alternatives	Alt-0: Zero Option; No action	Alt-1: Existing road width is maintained; Only pavement is improved into asphalt concrete.	Alt-2: Widen into 4-lane; pavement is improved into asphalt concrete.	Alt-3: Widen into 'Opposed 2-lane + MC lane on both sides; pavement is improved into asphalt concrete
Impact to Natural Environment	Exiting conditions are maintained and no impact to natural environment is anticipated.	Only pavement structure is changed and practically no impact to natural environment is anticipated.	Since the main work is widening of an existing road, no large impacts are anticipated.	Same as Alt-2.
Impact to Living Environment/ Pollution	There is a high possibility of traffic jam as traffic volume increase in future. When traffic jam occurs, travel speed is decreased and frequency of stop & start increases, resulting in increase in emission of pollutant.	Same as Alt-0.	Possibility of traffic jam is substantially reduced eve if traffic volume increase in future and increase of emitted pollutant is prevented.	Same as Alt-2 in principle; however, smaller traffic capacity than in Alt-2 will result in traffic jam and increase of emitted pollutants starting at earlier time in future.
Traffic Safety	High risk of traffic accident due to narrow road width which forces travelling in the opposite lane when overtaking.	Same as Alt-0: Risk of accident increases due to higher travel speed which becomes possible owing to improved road surface.	Slow traffic, such as agricultural tractor, and fast traffic, such as passenger car, are separated resulting in less risk of accident. Also, risk of head-on collision is decreased since necessity to travel in the opposite lane for overtaking is greatly reduced. On the other hand, risk of accident may increase due to increased travel speed of vehicles.	Slow traffic and fast traffic are separated and risk of accident is decreased, although to less extent than in Alt-2.
Road/transport Function	Smooth traffic cannot be secured due to traffic jam which will occur as traffic volume increase in future.	Same as Alt-0.	Smooth traffic can be secured owing to sufficient traffic capacity.	Same as Alt-2 in principle; however, traffic jam will start to occur at earlier time in future than in Alt-2 because traffic capacity is smaller than Alt-2.
Influence to Socio-Economic Activities and Regional Development	Sound growth of socio-economic activities is hampered, resulting in impedance in regional development, caused by traffic congestion.	Same as Alt-0.	Smooth traffic is secured resulting in growth in socio-economic activities and regional development. Increased job opportunities for local laborers and increase demand for consumer goods contributes to increase in gross income of the region.	Same as Alt-2 in principle; however, there is a possibility that traffic congestion start earlier than in Alt-2 and socio-economic activities and regional development will be hampered.

Alternatives	Alt-0: Zero Option; No action	Alt-1: Existing road width is maintained; Only pavement is improved into asphalt concrete.	Alt-2: Widen into 4-lane; pavement is improved into asphalt concrete.	Alt-3: Widen into 'Opposed 2-lane + MC lane on both sides; pavement is improved into asphalt concrete
Construction Cost/ Maintenance Cost	No construction cost is required while maintenance cost remains large due to vulnerable pavement.	Cost for improvement of pavement is required. On the other hand, maintenance cost is reduced since pavement becomes durable.	Costs for resettlement, civil works of widening, pavement etc are required. On the other hand, maintenance cost is reduced owing to improved durability of pavement.	Same as Alt-2 in principle; costs for resettlement, widening, pavement etc are smaller than in Alt-2 due to narrower road width.

6.2 Bypass Construction

Table 6-2 and 6-3 compare advantages and disadvantages of the main alternatives "Kampong Chhnang Bypass" and "Odongk Bypass". In the selection of these alternative routes, the following factors were considered.

- Number of houses which need to be relocated
- Traffic function as a bypass
- Formation of future expansion of urbanized area
- Loss of agricultural land
- Construction cost
- Impact to ecosystem including the Tonle Sap Lake
- Result of stakeholder meetings

After discussions among relevant organizations including the MPWT, the DPWT, local governments and the JICA Team, Alternative 2 Route 3 as Kampong Chhnang Bypass and Alternative 2 Route 2 as Odongk Bypass were adopted respectively.

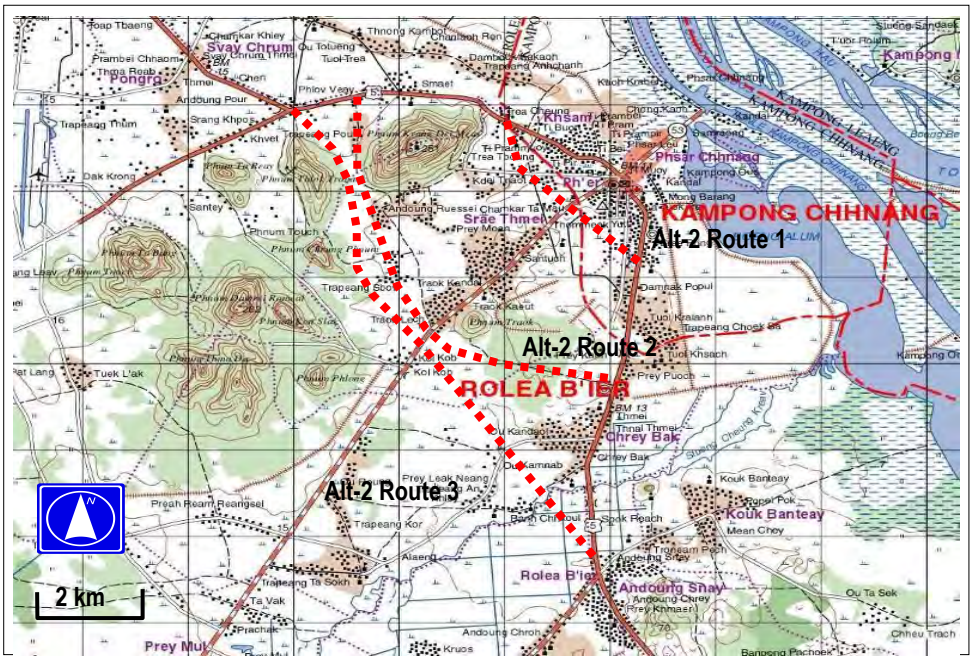


Figure 13: Location of Proposed Kampong Chhnang Bypass Route

Table 6-2: Comparison of Alternatives of Kampong Chhnang Bypass

Alternatives	Alt-1: Widening of the Existing NR No.5	Alt-2: Bypass Construction		
		Route 1 (L=4.9 km)	Route 2 (L=9.6 km)	Route 3 (L=12.1 km)
Resettlement of Households/ Houses	Many households/ houses need to be relocated since the NR No.5 is passing through an urbanized area.	Many households/ houses need to be relocated since the road to be widened is passing through an urbanized area.	Number of households/ houses which needs to be relocated is less than that in Route 1, since the road to be widened is located in the suburbs. Still considerable number of households/ houses need to be relocated.	Less than 10 houses need to be relocated at and near the intersection with the existing NR 5 in the north. Thus, the number of houses to be relocated is much less than those in Route 1 and 2.
Land Acquisition	No land acquisition is necessary since the land within 30m from the road center has been designated as the right of way (ROW).	Acquisition of additional land is necessary for widening of the existing road. In addition, acquisition of whole ROW is necessary for the section from the intersection with NR No.53 to east which is newly constructed.	Same as Route 1, in general. The area to be newly acquired becomes larger than in Route 1 since the length of newly constructed section is longer than in Route 1.	ROW over whole section length and whole road width needs to be newly acquired. Loss of agricultural land becomes larger than in other alternative routes.
Acceptance by the Affected People	People living in the roadside lands usually welcome improvement of the road in front of their property (land) since the value of the land becomes higher. However, in case that the road is already wide and paved, they may oppose to road improvement.	People living in the roadside lands usually welcome improvement of the road in front of their property (land) since the value of the land becomes higher. Thus, improvement and/or widening of the suburban road is usually well accepted by the affected people.	Same as in Route 1.	Owner of the properties along the Bypass welcome construction of the Bypass since the value of the land becomes higher.
Noise, Vibration, Air Pollution	Through traffic passes through the town center, resulting in increased noise, vibration and air pollution.	Through traffic is expected to divert to the Bypass. However, this will simply divert or distribute the source of noise, vibration and air pollution to the Bypass and not reduce them in total.	Through traffic will divert to the Bypass in the suburban area whose roadside is less populated, and noise, vibration and air pollution in the city center will decrease.	Through traffic will divert to the Bypass in the suburban area whose roadside is sparsely populated, and noise, vibration and air pollution in the urbanized area will decrease.
Traffic Accident	Through traffic passes through the city center and risks of traffic accident will increase as the traffic demand will grow in the future.	Risks of traffic accident are expected to decrease since the road is traversing less-densely populated suburban area. However, the Bypass passes through residential	While traffic volume passing through the city center and traffic accident will decrease, there will be newly created risks of accidents on the Bypass. Total number of traffic accident is	Same as in Route 2.

Alternatives	Alt-1: Widening of the Existing NR No.5	Alt-2: Bypass Construction		
		Route 1 (L=4.9 km)	Route 2 (L=9.6 km)	Route 3 (L=12.1 km)
		area and degree of decrease in traffic accident is less than that in Route 3.	expected to decrease since the safety environment of the Bypass is more favorable than that of existing NR No.5 in the city center.	
Impact on Natural Environment	No substantial change is anticipated since the project is to widen the road which has been existing for long time.	The section from the intersection with the NR No. 53 to east which is newly constructed in the land which is mainly use for agriculture. This may cause interruption or separation of activity areas of biology.	The section from the intersection with NR No. 53 to east which is newly constructed in the land which is mainly use for agriculture. This may cause interruption or separation of activity areas of the biology.	The newly constructed Bypass may interrupt/ separate the activity areas of the biology.
Road Function/Traffic Function	Travel speed of vehicles is forced to slowdown by congestion, signals at intersections and other obstacles, resulting in reduction in efficiency of transport. In addition there are many bends in the existing NR No.5 in the urbanized area of Kampong Chhnang which forces further slowdown of traffic.	The proposed route traverses the periphery of existing urbanized area. Thus, it provides easier access to/from the town center. On the other hand, roadside area of the Bypass will be urbanized and the function as bypass may be lost in the near future.	The proposed route is sufficiently away from the existing urbanized area and it is expected that the Bypass maintain the function of bypass for long future.	Diversion of through traffic is fully attained. This is essential function of a bypass. The route is sufficiently away from the exiting urbanized area and it is expected that the Bypass maintain the function of bypass for long future. Further, the proposed route short-cut the existing NR No.5 and travel distance is reduced.
Construction Cost	Volume of required works is less than other alternatives, and the cost is a minimum price among the alternatives.	Lowest next to Alt-1.	Larger than Route 1.	Larger than Route 1 and 2 because the length of the Bypass is longer than in Route 1 and 2.

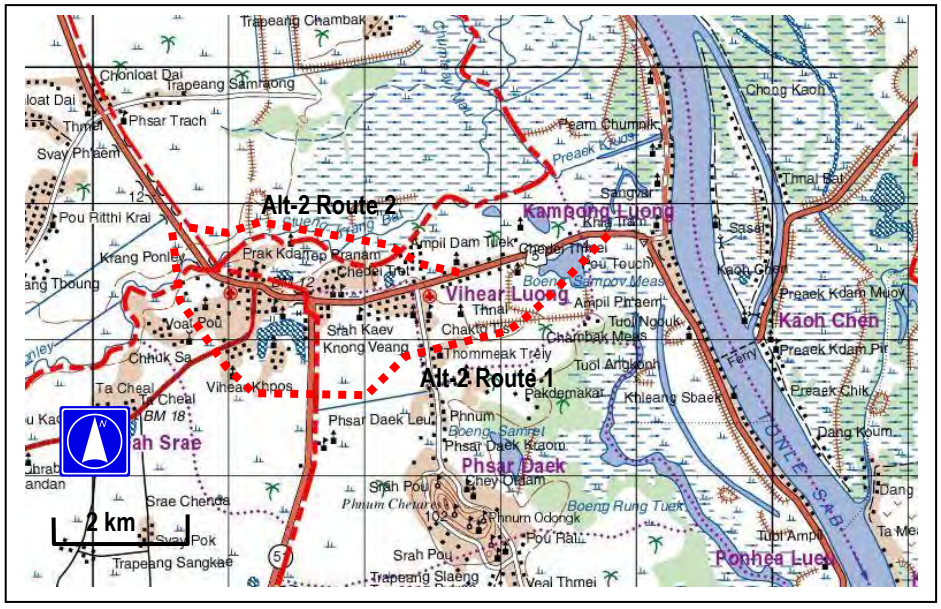


Figure 14: Location of Proposed Kampong Odongk Bypass Route

Table 6-3: Comparison of Alternatives of Odongk Bypass

Alternatives	Alt-1: Widening of the Existing NR No.5	Alt-2: Bypass Construction	
		Route 1 South of Odongk Town (L=9.9 km)	Route 2 North of Odongk Town (L=4.9 km)
Resettlement of Households/ Houses	Many households/houses need to be relocated since NR No.5 is passing through an urbanized area.	Large scale relocation is not required.	Large scale relocation is not required.
Land Acquisition	No land acquisition is necessary since the land within 30m from the road center has been designated as the right of way (ROW).	Acquisition of additional land is necessary for widening of the existing road.	Same as Route 1, in general. The area to be newly acquired becomes smaller than in Route 1 since the length of newly constructed section is shorter than in Route 1.
Acceptance by the Affected People	People living in the roadside lands usually welcome improvement of the road in front of their property (land) since the value of the land becomes higher. However, in case that the road is already wide and paved, they may oppose to road improvement.	Owner of the properties along the Bypass welcome construction of the Bypass since the value of the land becomes higher.	Same as in Route 1.
Noise, Vibration, Air Pollution	Through traffic passes through the city center, resulting in increased noise, vibration and air pollution.	Through traffic will divert to the Bypass in the suburban area whose roadside is sparsely populated, and noise, vibration and air pollution in the urbanized area will decrease.	Same as in Route 1.
Traffic Accident	Through traffic passes through the city center and	While traffic volume passing through the city center and	Same as in Route 1.

Alternatives	Alt-1: Widening of the Existing NR No.5	Alt-2: Bypass Construction	
		Route 1 South of Odongk Town (L=9.9 km)	Route 2 North of Odongk Town (L=4.9 km)
	risks of traffic accident will increase as the traffic demand will grow in the future.	traffic accident will decrease, there will be newly created risks of accidents on the Bypass. Total number of traffic accident is expected to decrease since the safety environment of the Bypass is more favorable than that of the existing NR No.5 in the city center.	
Impact on Natural Environment or others	No substantial change is anticipated since the project is to widen the road which has been existing for long time.	The proposed route has high possibility of encountering historical heritage due to looseness to Phnom Odongk.	The proposed route is away from Phnom Odongk
Road Function/Traffic Function	Travel speed of vehicles is forced to slowdown by congestion, signals at intersections and other obstacles, resulting in reduction in efficiency of transport. In addition there are many bends in the existing NR No.5 in the urbanized area of Odongk Town which forces further slowdown of traffic.	The proposed route directly connecs to NR No.51 (A) and passes west hemisphere of urbanized area. Road side area will be urbanized & function of bypass will be reduced in near future. Travel distance becomes longer than the existing NR No.5.	Pass hemisphere of urbanized area. Road side area will be urbanized & function of bypass will be reduced in near future. Horizontal alignment is not smooth.
Construction Cost	Volume of required works is less than other alternatives, and the cost is a minimum price among the alternatives.	Larger than Route 2 because the length of the Bypass is longer than in Route 2.	Lowest next to Alt-1.

7. ENVIRONMENTAL MANAGEMENT PLAN

7.1 Introduction

The Environmental Management Plan (EMP) provides institutional arrangement, environmental monitoring plan during construction and operation, and training and staffing. The EMP objectives are to show the tasks which will be implemented by relevant governmental institutions at local, provincial and national levels and to suggest parameters need to be monitored in the project phases. It should be noted that the EMP is considered as an operational document that will be frequently updated by the project owner/ the MPWT with assistance/advice from a supervision consultant to reflect on-site project activities.

7.2 Institutional Arrangement

Implementation of the EMP will be carried out by the project owner, the MPWT, in cooperation with governmental institutions at national, provincial and local levels.

At the national level, the MPWT will cooperate with Department of EIA and Department of Pollution Control of the MoE, Department of Hydrology and River Works of Ministry of Water Resources and Meteorology, the Ministry of Land Management, Urban Planning and Construction and Inter-Ministerial Resettlement Committee of the Ministry of Economic and Finance.

At the provincial level, the MPWT will closely work with its departments, Provincial Department of Environment, Provincial Department of Water Resources and Meteorology, Provincial Department of Land Management Urbanized Planning and Construction, related governmental departments and local authorities in all the relevant provinces.

At local level, the MPWT will work with local authorities for the facilitation, controlling, and solving of any social conflicts that may happen in the project area.

7.3 Environmental Monitoring Plan

Environmental monitoring plan (EMoP) is one of the vital processes of the EMP. It is included items to be monitored by project phase, location, frequency, and responsible unit. The EMoP can help to adjust potential problems that might result from the project activities and allow prompt implementation of effectively corrective measures. It aims at assessing environmental conditions, monitoring the effective implementation of mitigation measures, and warning significant deteriorations in environmental quality for further prevention action. The monitoring results will be a practical document for the MPWT to maintain compliance with environmental laws and regulations, work safety, and appropriate implementation of the mitigation measures.

Implementation of the EMoP will cover the construction and operation phases of the project. This summarizes what important parameters will be monitored and how frequent will be for measurements. The following Table 7-1 shows suggested EMoP need to be monitored.

Table 7-1: Suggested Monitoring Parameters

Items	Unit	Location	Frequency	Responsible Unit
Construction Phase				
I- Air pollution 1- PM 10µm 2- PM 2.5µm 3- NO2 4- SO2)	 mg/m^3 mg/m^3 mg/m^3 mg/m^3	Construction site	One time in the dry season and one time in the rainy season through the entire construction period	Supervision Consultant (Analyzed by DPC)
5- Dust Condition (Visible survey)	-	Construction site	Daily	Supervision Consultant Construction Contractor
II- Noise and Vibration	dB	Construction site	Two time per year through the entire construction period	Supervision Consultant (Analyzed by DPC)
III- Surface water quality 1- pH (by potable pH meter) 2- TSS 3- BOD5 4- COD 5- Total Coliform	 - mg/l mg/l MPN/100ml	Bridge or culvert construction sites and construction sites adjacent to agricultural channels and reservoirs	One time in the dry season and one time in the rainy season through the entire construction period	Supervision Consultant (Analyzed by DPC)
6- Turbidity	- NTU etc.	Construction site	Monthly As required	Supervision Consultant Construction Contractor
IV- Construction Wastes	-	Construction sites and worker camps	Daily	Supervision Consultant Construction Contractor
V- Roadside tree felling and vegetation loss	-	Construction site	Daily	Supervision Consultant
VI- Opinion from local people	-	Construction sites and worker camps	Monthly As required	Supervision Consultant
VII- Environmental condition in borrow pit and quarry site	-	Borrow pit and quarry site	Monthly	Supervision Consultant
VIII- Accident	-	Construction site	Daily	Supervision Consultant
Operation Phase				
I- Air pollution 1- PM 10µm 2- PM 2.5µm 3- NO2 4- SO2	 mg/m^3 mg/m^3 mg/m^3 mg/m^3	3 cross-sections in the target section of the NR No.5	One time in the dry season and one time in the rainy season during two years	MPWT (Analyzed by DPC)
II- Noise and Vibration	dB	3 cross-sections in the target section of the NR No.5	One time per year during two years	MPWT (Analyzed by DPC)
III- Environmental condition in borrow pit and quarry site	-	Borrow pit and quarry site	One time in rainy period during two years	MPWT
IV- Environmental condition in the TSBR	-	Buffer zone or Transition zone of the TSBR along the NR No.5	One time per year during five years	MPWT Cambodia National Mekong Committee
V- Social and economical	-	Cities and towns	One time per year during	MPWT

Items	Unit	Location	Frequency	Responsible Unit
aspect such as land use, market price and economic activities		along the NR No.5	two years	Local Government

Note: DPC = Department of Pollution Control of the MoE

7.4 Training and Staffing

7.4.1 Participants

In order to assist the project construction phase smoothly, trainings will be provided for few engineers from the MPWT and the MoE due to their limitations in site monitoring and management and environmental knowledge. List of the proposed trainees is shown as in Table 7-2. Training contents will be developed by highly-qualified trainers. The trainings should be commenced before or at early of the construction phase.

Table 7-2: List of the Proposed Trainees

No	Institution	Number of trainees	Engineers Involved
1	The MPWT	4	Engineers for site monitoring and management
2	The MoE	2	Environmental technicians/engineers

7.4.2 Training Budget

The training budget is responsible by the MPWT. Each training session will provide 2 days in class and 2 days for field practice. The trainees for site monitoring and management will work closely with the construction engineers to learn day to day on site monitoring and management. The trainees or environmental technicians/engineers can assist the construction engineers to do daily environmental monitoring and evaluation the contractor performance in compliance with the EMP in the EIA report and other environmental safeguards stated in the construction contract. The detailed cost estimate for the trainings is shown in Table 7-3.

7.5 Organization for the EMP

The proposed draft organization chart for the EMP in the construction phase is shown in Figure 7-1.

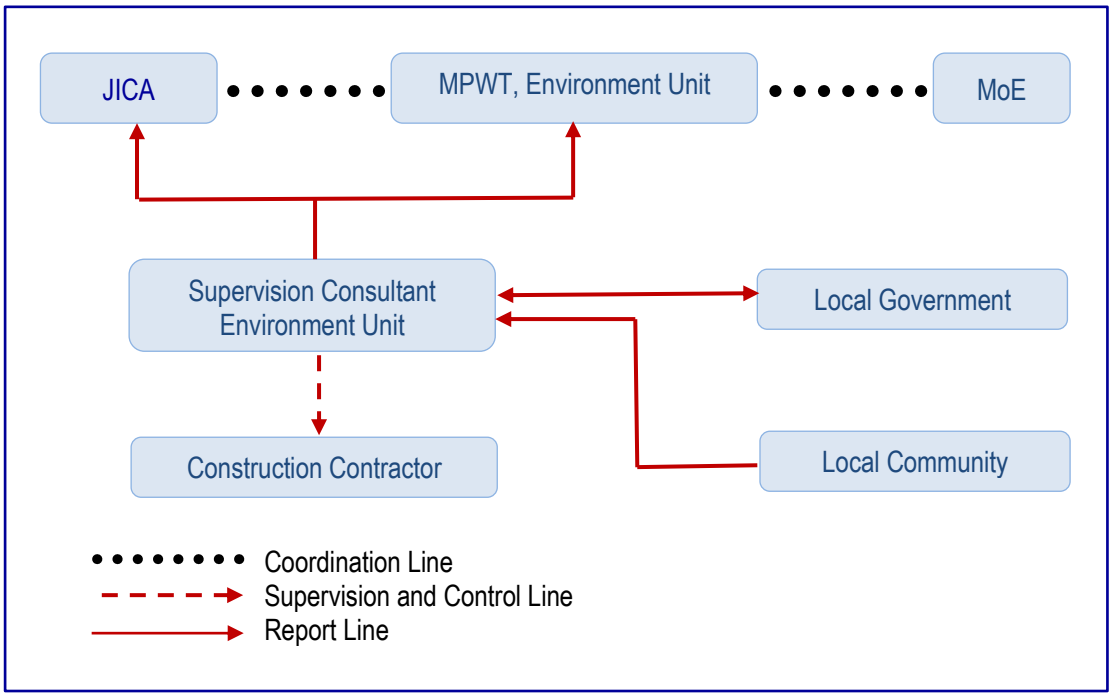


Figure 7-1: Organization Chart for the EMP

7.6 Cost Estimation of the EMP

The cost estimation for the EMP such as environmental monitoring cost and training one is shown in Table 7-3.

Table 7-3: Cost Estimation for the EMP

No	Description	Unit	Quantity	Unit Rate	Total Cost Estimate in US$
I. Environmental Monitoring					
1	Air quality (Constriction Phase)	Sample	4	1,400	5,600
2	Air quality (Operation Phase)	Sample	4	1,400	5,600
3	Water Quality (Construction Phase)	Sample	4	700	2,800
4	Potable pH Meter	LS	1	100	100
5	Potable Turbidity Meter	LS	1	1,900	1,900
6	Noise and Vibration (Construction Phase)	Sample	4	800	3,200
7	Noise and Vibration (Operation Phase)	Sample	6	800	4,800
				Sub-Total	24,000
II. Training Fee					
1	Training course on environmental management and field practice	Course	1	1,500	1,500
2	Training course on site monitoring and field practice	Course	1	1,500	1,500
3	Training course on general site management	Course	1	1,500	1,500
4	Transportation for the field practices	Time	3	400	1,200

No	Description	Unit	Quantity	Unit Rate	Total Cost Estimate in US$
5	Training materials and snacks for all the courses	Lump Sum	1	450	450
				Sub-Total	6,150
III. Training Allowance					
-	-	-	-	Daily Stipend Allowance (US$)	-
1	Engineers from the MPWT	Man-Day	4	100 x 4 Days	1,600
2	Engineers from the MoE	Man-Day	2	100 x 4 Days	800
				Sub-Total	2,400
				Grand Total	**32,550**

Note: Daily stipend allowance included food, accommodation and transportation.
Venue fee is included for the training courses.

8. PUBLIC PARTICIPATION AND CONSULTATION

Stakeholders of the project include provincial/district, commune/village officials, local people along the existing NR No.5, Kampong Chhnang and Odongk Bypasses, and managers and staffs of PDPWT. Participation provided for the opportunity and the process by which stakeholders influence and become co-responsible for development initiatives and decisions that affect them. Through the participation, the needs and priorities of the local population are solicited; the adverse social impacts of the Project including the corresponding mitigating measures are collectively identified. Also, commitments and feeling of ownership over the project is engendered among the AHs.

8.1 Participatory Activities in Resettlement Action Plan

The general people in particular the AHs, road users and the local governments were consulted in order to collect their opinions regarding to the development project. Table 8-1 summarizes the roles and responsibilities of the EA, local governments, and AHs in the preparation of the RAP.

Table 8-1: Participatory Activities in RAP Planning

Project Process Stage	Participatory Activities and Participants	Outputs	Responsible Institution
Preparation or Feasibility	Briefing of the provincial, district, commune, village officials, local people along the NR No.5, Kampong Chhnang and Udong Bypass, and PDPWT about the Project technical assistance, the resettlement impact, and activities of the consultant (provincial and first commune stakeholder meeting).	The local population including AHs and their representatives, local government officials, and managers and technical staff of PDPWT participated in the meeting and were consulted on the objectives, planning and impact of the project and of resettlement.	MPWT and Consultant (JICA Study Team)
	Conduct of the IOL, census of the AHs, social impact assessment, and the RCS.	The IOL, census of the AHs and the RCS were conducted and the results were included in the RAP.	Consultants (JICA Study Team), assisted by local authorities and PDPWT.
	Discussion/consultation with IRC-RD and PMU-MPWT about the proposed project resettlement policy.	IRC were made fully aware of and consulted about social impact and resettlement policy.	Consultant (JICA Study Team)
	Initial disclosure meeting with the AHs to discuss the results of the IOL and gather suggestions on how to minimize and mitigate impacts, and discuss about relocation options (second commune stakeholder meeting).	AHs and community leaders are informed of social impact and any damage or loss of property including land losses, and consulted on impact mitigation and resettlement including any relocation.	MPWT and Consultant (JICA Study Team)
	Drafting of the RAP and project information booklet (PIB)[9] and submission to PMU-MPWT, IRC-RD and JICA for review and approval.	Draft of RAP and PIB will be provided to and reviewed by MPWT, IRC-RD and JICA for approval.	Consultant (JICA Study Team)

[9] The Project information booklet will be written in Khmer. The PIB will be distributed to each AH during the DMS, and updated PIB will be distributed before signing contract with AHs. An English version draft of PIB in *Appendix 1: Project Information Booklet (English Draft Version)* will be translated in Khmer and be distributed during the DMS. The updated PIB to be distributed before signing contract with AHs, information of rehabilitation options (including outline of IRP) will be added.

8.2 Public Consultations during Resettlement Action Plan Preparation

During RAP preparation stage, the following public consultations were held, all of which are:

(i) Provincial stakeholder meeting
Participants: Local Government Officers including representative of PAPs

(ii) Public Consultation Meeting (before cut-off date)
Participants: Possible Project Affected Persons

8.2.1 Schedule of Stakeholder Meetings

The schedules of stakeholder meetings held regarding the NR No.5 are shown in Table 8-2.

Table 8-2: Public Meetings Held Regarding to the NR No.5 and the Two Bypasses

Province	District/Commune	Venue	Date	Participants
Provincial Stakeholder Meeting				
K. Chhnang	Krong Kampong Chhnang	PDPWT Office	6 Dec. 2012 at 9:30 am	Male=26 Female=2
Pursat	Krong Pursat	PDPWT Office	6 Dec. 2012 at 2:30 pm	Male=14 Female=1
Public Consultation Meeting (before cut-off date)				
1-K. Chhnang	Sameakki Mean Chey and Kampong Tralach District - Svay - Sedthei - Long Vaek	Svay commune center	25 Dec. 2012 at 8:30 am	Male=12 Female=5
2- K. Chhnang	Kampong Tralach District - Ou Ruessei - Peani - Tma Edth	Ou Ruessei commune center	25 Dec. 2012 at 10:00 am	Male=20 Female=6
3- K. Chhnang	Kampong Tralach District - Chhouk Sar - Chres - Ta Chres	Praseah Thmey Mosque	25 Dec. 2012 at 2:00 pm	Male=33 Female=30
4- K. Chhnang	Kampong Tralach District - Saeb	Saeb commune center	25 Dec. 2012 at 3:30 pm	Male=28 Female=8
5- K. Chhnang	Rolea B'ier District - Rolea B'ier - Chrey Bak - Srae Thmey	Chrey Bak pagoda	26 Dec. 2012 at 8:00 am	Male=12 Female=5
6- K. Chhnang	Rolea B'ier District - Svay Chrum - Pongro	Preah Theat pagoda	26 Dec. 2012 at 9:30 am	Male=9 Female=5
7- K. Chhnang	Baribour District - Melum - Phsar	Psar Baribour pagoda	26 Dec. 2012 at 2:00 pm	Male=35 Female=40
8- K. Chhnang	Baribour District - Khon Rang - Popel	Angk pagoda	26 Dec. 2012 at 3:30 pm	Male=42 Female=67
9- K. Chhnang	Baribour District - Trapeang Chan	Trapeang Chan Commune Centre	28 Dec. 2012 at 8:30 am	Male=18 Female=25
10- K. Chhnang	Baribour District - Ponley	Ponley pagoda	28 Dec. 2012 at 10:00 am	Male=63 Female=29

Province	District/Commune	Venue	Date	Participants
	- Chak			
11-K. Chhnang	Rolea B'ier District - Toeuk Haut	Toeuk Haut commune center	28 Dec. 2012 at 10:00 am	Male=25 Female=43
12-Pursat	Krakor District - Boeung Kantuot - Thnaot Chum	Boeung Kantuot Commune Centre	27 Dec. 2012 at 8:00 am	Male=36 Female=40
13-Pursat	Krakor District - Sna Ansa - Ou Sandan	Sna Ansa Commune Centre	27 Dec. 2012 at 9:30 am	Male=26 Female=72
14-Pursat	Krakor District - Kbal Trach - Along Thnaot	CPP Centre of Krakor	27 Dec. 2012 at 2:30 pm	Male=36 Female=22
15-Pursat	Krakor District - Ansa Chambak	Ansa Chambak Commune Centre	27 Dec. 2012 at 4:00 pm	Male=15 Female=3
16-Kandal	Ponhea Leu District - Kampong Luong - Vihear Luong	Vihear Luong Commune Centre	10 Apr. 2013 at 8:30 am	Male=80 Female=100
17-K. Chhnang	Kampong Tralach District - Longvaek	Psar Trach primary school	10 Apr. 2013 at 10:00 am	Male=32 Female=10

8.2.2 Key Points Raised and Discussed

8.2.2.1 Provincial Stakeholder Meetings

Two provincial stakeholder meetings were conducted at the same day in Kampong Chhnang (included Kandal and Kampong Speu province) and Pursat province. During the meetings, a representative of MPWT made a short presentation which focused on background of the NR No.5 and its current situation, the Project and its impacts (positive and negative), results of initial survey, information about schedule of the IOL and baseline survey (in July 2011). All participants were also provided with opportunities to discuss on bypass option. The key points raised and discussed during the pre-IOL public meetings are as follows:

(i) Background of the NR No.5 and its current situation;
(ii) Technical assistance objective including Project background and its impacts (positive and negative);
(iii) The schedule of main activities for conduct the IOL, census of APs, social impact assessment, and replacement cost study (RCS);
(iv) Discussion about the bypass options; and
(v) Discussion of other issues including question and answer portions.

8.2.2.2 Public Consultation Meeting (before cut-off date)

A few days before the IOL commenced on 1st January 2013 and 17th April 2013, the first of a series of public meetings with stakeholders (e.g., road users, residents of traversed communities, transport operators, government agencies, civil society, etc.) was held in Pursat, Kampong Chhnang and Kandal Provinces by the PMU-MPWT and the Consultants (JICA Study Team) for the purpose of discussing at the following aspects:

(i) Project technical assistance background and objectives;
(ii) Main activities of the research team (conduct of the SES, the IOL, the RCS, etc.);
(iii) The Project's policy on involuntary resettlement;
(iv) Probable positive and adverse impacts of the Project, and recommendations on how to avoid and mitigate negative impacts;

(v) Informing on Cut-Off Date: 1st January 2013 for the NR No.5 and Kampong Chhnang Bypass and 11th April 2013 for Odongk Bypass; and

(vi) Questions and Responses.

After an introduction of Local Authority, Director of International Cooperation Department (ICD)/MPWT described the background of the NR No.5 and its current situation, background of the project and its impacts (both positive and negative). In each meeting, there was also an open floor for discussion among the participants. The results of discussion are summarized in Table 8-3.

Table 8-3: Questions and Responses of the Public Consultation Meeting (Provincial level and before cut-off date)

Question	Response
1. About the project implementation	
Can the project provide us a detailed design of the new road?	**ICD/MPWT**: This stage is a feasibility (initial) study, so we do not yet have any detailed road designing. It will be done during the detailed study or project implementation.
When will the civil works start?	**ICD/MPWT**: At the moment we do not exactly know, because the project is still studying. We will know when the project is approved.
Where will Kampong Chhnang bypass be located?	**ICD/MPWT**: The bypass will be approximately started from PK: 82+000 crosses Chrey Bak commune, then goes to Srae Thmey commune before it crosses Phnom Tauch and continues to a conjunction between the NR No.5 and the access road to Kampong Chhnang Airport. The bypass construction will require on private land, therefore the Project will compensate to the owners at the replacement cost based on the market price. From 1st January 2013, people will not be permitted to build any structure on the PRW, particular for the bypass area. For bypass road, the study team will identify PRW alignment by pegging out in mid-January. After that, any construction in the PRW will not be allowed and only cropping will be permitted.
What is the size of the actual road after the construction?	**ICD/MPWT**: The Project will take 40m for the road construction area (PRW), but do not mean that the actual road is 40m width. The actual road size will be known during the detailed design. According to the government policy, the Project will try to minimize its resettlement impact as much as possible. The road will be constructed in 4 lanes and two road sides for pedestrian and bicycle.
2. About the ROW/PRW	
The PRW is 20m. How will it be measured, from the road center line?	**ICD/MPWT**: Yes, it will be measured from the road center line. So in total, it is 40m. The ROW of the NR No.5 is 30m, in total is 60m. Therefore, the affected land will not be compensated, except affected structures and trees.
What size is the ROW in urban area?	**ICD/MPWT**: According to the sub-degree No.197, issued on 23 November 2009 stated that in urban area, the ROW will be defined by provincial or city governor in particularly.
What size of PRW of the Kampong Chhnang bypass?	**ICD/MPWT**: It will be took 20m in each side the same as the NR No.5.
3. About the relocation	
What will the Project do with the landless household?	**ICD/MP WT**: Now, we do not know how many there are landless households. Therefore, we have to conduct the IOL survey and then the Project will find a solution to solve the problem. It is development project. Therefore, local people will get the benefit from the project. It means their livelihoods will be better because of the road construction.
Who will respond for removing the affected stalls and/or houses?	**ICD/MPWT**: There are four stages in resettlement implementation: 1- Data collection stage: IRC Working Group (IRC WG) will conduct the DMS to collect and register all affected properties and AHs.

Question	Response
	2- Contract making stage: After DMS conducting, the IRC WG comes to make a negotiation with AHs for contact signing. 3- Compensation stage: After the contact signing, the IRC WG will make compensation to the agreed AHs. 4- The last stage is relocation. The AHs will be given enough time for relocating their affected properties.
The Project implementation will affect my house in PRW. The remained land will be too small. What can the Project do for that?	**ICD/MPWT**: 1- The affected house will be compensated at replacement cost which will be calculated by engineer or master carpenter. The construction materials and labor cost will be calculated in market price in the local area. 2- Because the affected land in the PRW/ROW, it is a state land and will not be compensated by the Project. But during the Project implement phase, the RGC would have a clear policy to help the AHs. In case of the AHs do not have any more land or the remained land is not suitable for living, the Project will help them to solve the problem.
To avoid any lost, how many meters from the road that people can construct their houses?	**ICD/MPWT**: People have to construct their houses outside the ROW. It means more than 30m from the road center line.
Can people continue to use on their remained land (10m) in the ROW?	**ICD/MPWT**: People can continue to use the remained land only in crop cultivation purpose. In order to avoid any loss, permanent structures such as houses or shops will not be allowed to be built.
In the urban area, the PRW will be narrowed?	**ICD/MPWT**: In this stage it will be the same 20m-20m for the whole Project. During the detailed design, it may be narrowed in some parts in order to minimize resettlement impact as much as possible or other bypass will be considered, e.g. Odongk Bypass.
4. About the compensation	
Will the Project compensate for affected electricity poles?	**ICD/MP WT**: There are two options: 1- In case it is a state property, it will be a special case that IRC have to negotiate with EDC. 2- If it is a private property, the budget for reconstruction will be covered by the construction road budget.
Will the Project compensate for affected structures and trees?	**ICD/MP WT**: It will be compensated at replacement cost which will study by an independent consultant. The affected structures and trees will be classified by size, age and types.
I have bought a land in ROW. Will the Project compensate for the affected land?	**ICD/MP WT**: As everybody knows, the land in ROW is the state land. Therefore, there is no compensation at all for such affected land. People who have bought the land in ROW are illegally.
Will the Project compensate for the whole structure if it is affected in a part?	**ICD/MP WT**: It will be based on the actual structure figure. Sometimes, the structure is affected a part, but it cannot be cut so the compensation have to be done for the whole structure. On the contrary, if the structure can cut in affected part, so the compensation will be done only the affected size. The compensation for the affected structure will be divided by type, size and number of floors.
Will the Project compensate for my affected well in the PRW?	**ICD/MP WT**: Of course, people will get compensation for their affected wells, even though it is constructed in the ROW.
Will the Project compensate for land improvement in the PRW?	**ICD/MPWT**: If the people have been filling the land (for house construction or business activity against a pond resulted from previous road construction) in the PRW, the land improvement will not be compensated, because after the road construction all the land in the PRW will be reinstated by a contractor. After the Project implementation, it will be the same as or better than the original condition.
What will the Project do with severely affected	**ICD/MPWT**: The government would not make someone to be suffered

Question	Response
persons who cannot restore their properties by the amount of compensation provided?	by the Project development. The Project policy will be approved, not only by the Cambodia government, but also by the Project donor. Moreover, the compensation rates (the replacement cost based on the market prices) will be studied by the independent agency. In addition, the compensation rate will refer to the different types of houses such as zincs house, concrete house, etc. It also includes labor force and construction materials and transportation fee. The construction material price will refer to the prices in the local areas of AHs. And for the trees, the compensation will refer to the different types and ages of trees such as small or medium trees. The Project is developed for public interest. It is different from private investments. The public interest will be strongly considered by the Project. The income restoration program also will be provided by the project to help the AHs to improve their household incomes.
I have paid about USD 10,000.00 for my house construction. Would the Project compensate for the same amount?	**ICD/MPWT**: The study team will conduct the RCS in mid-January 2013. The RCS results are based on market price for both construction materials and labor cost. Therefore, with the compensation rate people can rebuild their houses in the same previous houses.
Will the Project pay for the affected public fence?	**ICD/MPWT**: Affected fence will be replaced with new ones, if they are public property. In case it is a private property, the Project will compensate to the owner with replacement cost. It means people can restore their fences by the compensation to be provided.
If the construction work affects religious worship places such as spirit houses, how does the Project compensate for the community?	**ICD/MPWT**: In this case, the Project will be tried to avoid its impact as much as possible. In case, it could not avoid the Project will discuss with the community to find a suitable place to reconstruct it. It ensure that the new one is the same as or better than the old one. The cost for ceremony also will be provided if it is needed.
Land in the PRW of the NR No.5 belongs to the government, but people have planted their crops and trees in the area. Do the Project compensate for it or not?	**ICD/MPWT**: The Project will compensate in order to support the AHs' income because their incomes from the crops or trees will be temporarily decreased by the Project Impact.
Are there any compensation for the affected land?	**ICD/MPWT**: The affected lands will be divided into two types of land: 1- For land in the ROW, the project will not compensate because it is a state land. 2- For private land, the project will compensate to owner with replacement cost. So affected people can have enough money to buy a similar land to the affected land.

9. RESETTLEMENT ACTION PLAN

9.1 Introduction

9.1.1 Resettlement Plan

Generally, a PRW of the project is within ROW which is the state land, except the two bypasses that need to acquire private land for the project implementation. For the South Section of the NR No.5, the RAP is required based on the Cambodian Laws and Regulations and the JICA Guidelines for Environmental and Social Considerations as of April 2010. The RAP is prepared based on census and the IOL, the SES and its main contents include scope of land acquisition and resettlement, compensation policy, assistance and allowances, entitlement matrix, role & responsibility, grievance redress mechanism and relocation strategy. During the RAP preparation from January to May 2013, a number of Stakeholder Meetings (SHM) were also conducted to allow them understand about the Project.

9.1.2 Project Location and Impact Areas

The study has focused only on the South Section of NR No.5 with an approximate length of 139 km, starting from PK: 31+570 in Praek Kdam in Ponhea Leu District of Kandal Province to PK: 170+680 inThlea Ma'am in Krakor District of Pursat Province and the two Bypasses in Kampong Chhnang and Odongk towns. The two bypasses are Odongk with length of 4.90 km, which will run through in Ponhea Leu district and Kampong Tralach District of Kampong Chhnang province, and Kampong Chhnang Bypass with a length of 11.80 km which will run through Rolea B'ier District of Kampong Chhnang province.

Table 9-1: Provinces and Districts Traversed by the Project Area and the Two Bypasses

Province/District	#AHs by section			Total (AHs)
	The NR No.5	Kampong Chhnang Bypass	Odongk Bypass	
Pursat	**616**	**0**	**0**	**616**
Krakor district	616	0	0	616
Kampong Chhnang	**1,948**	**585**	**78**	**2,611**
Baribour district	651	0	0	652
Kampong Tralach district	671	0	78	749
Rolea B'ier district	489	585	0	1,074
Sameakki Mean Chey district	137	0	0	137
Kandal	**98**	**0**	**43**	**141**
Ponhea Leu district	98	0	43	141
Total (the Project)	**2,662**	**585**	**121**	**3,368**

Source: Project Survey conducted in January-April 2013

9.1.3 Measures to Minimize Impacts

Measures to reduce resettlement impacts include the following:

(i) Resettlement impacts will be minimized for the Project by building the two bypasses rather than enlarging the existing road sections in populous areas at Odongk and Kampong Chhnang Towns. As a result, the proposed bypasses Odongk and Kampong Chhnang Towns will reduce the affected main structures (houses, shops and restaurants) from 190 to 20 and from 299 to 12 respectively.

(ii) The PRW (20m-20m) is narrow than the ROW (30m-30m) to minimize resettlement impact.

(iii) Where platforms, ramps, culverts and similar structures serve as access to buildings from the road embankment, these will be removed to allow construction to proceed and replaced as soon as construction is completed.

(iv) At locations where underground infrastructures are damaged, relocated or affected temporarily or permanently due to civil works for road improvement, such will be repaired, replaced and restored by the contractor to pre-project functional conditions as soon as construction is completed.

9.2 Project Resettlement Policy

9.2.1 Objectives

The objective of the Project Resettlement Policy is to ensure that AHs are not worse off because of the Project. The Project should provide an opportunity for the local people to derive benefits from it and should likewise serve as an occasion for the local people to participate in its planning and implementation, thereby engendering a sense of ownership over the same.

9.2.2 Key Principles

The key principles of the resettlement policy are as follows:

(i) Involuntary resettlement and loss of means of livelihoods are to be avoided when feasible by exploring all viable alternatives. When, after such an examination, avoidance is proved to be unfeasible, effective measures to minimize impacts and to compensate for losses must be agreed upon with the people who will be affected.

(ii) People who must be resettled involuntarily and people whose means of livelihoods will be hindered or lost must be sufficiently compensated and supported by the RGC in a timely manner. Compensation, at full replacement cost, must be provided. The RGC must make efforts to enable people affected by the project and to improve their living standards, income opportunities, and production levels, or at least to restore these to pre-project levels. Measures to achieve this may include: providing land and monetary compensation for losses (to cover land and property losses), supporting means for an alternative sustainable livelihoods, and providing the expenses necessary for the relocation and re-establishment of communities at resettlement sites.

(iii) Appropriate participation by affected people and their communities must be promoted in the planning, implementation, and monitoring of the RAP and measures to prevent the loss of their means of livelihood. In addition, appropriate and accessible grievance mechanisms must be established for the affected people and their communities.

(iv) The RAP must be prepared and made available to the public. In preparing the RAP, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people.

9.2.3 The Cut-off Date for Eligibility

For the project, the cut-off date coincides with the first day of the census of AHs and the IOL thereat was conducted. The cut-off date for the existing NR No.5 and Kampong Chhnang Bypass is on **1st January 2013**, and for Odongk Bypass is on **11th April 2013**. This means that any land occupation or transfer, or structures to be built on affected land after the cut-off date will not be entitled to any compensation including the land use right.

The cut-off date was informed to AHs at stakeholder meetings before and after the cut-off dates at stakeholder meetings during RAP preparation stage. At those meetings, AHs were informed that all structures constructed after the cut-off date (IOL survey) will not be entitled for any compensation from the Project and that all people

have to stop constructing any new buildings in the delineated area. The information will be continuously disseminated to prevent further population influx.

9.2.4 Eligibility

Persons excluded in the census are not eligible for compensation and other entitlements, unless they can show proof that:

(i) They have been inadvertently missed out during the census and the IOL and certified by local authorities; or
(ii) They have lawfully acquired the affected assets following completion of the census and the IOL and prior to the conduct of the DMS.

Eligible AHs include anyone who, at the cut-off date of the Project, was located within the Project area or any of its component or part thereof, and would have their:

(i) Standard of living adversely affected;
(ii) Right, title or interest in any house, land (including residential, commercial, agricultural and for grazing), water resources, or any other movable or fixed assets acquired or possessed, in full or in part, temporarily or permanently by public sector acquisition; or
(iii) Business, occupation, place of work or residence or habitat adversely affected by public sector intervention.

An affected household refers to the household consisting of all members residing under one roof and operating as a single economic unit, who are adversely affected by the Project. For resettlement purposes, AHs will be considered as members of the Project AHs including single person households.

9.3 Project Impacts

9.3.1 Methodology Used in Preparing the Resettlement Plan

The following sections describe the processes and methods employed in the survey on adverse social impacts. The impact survey involved the conduct of the IOL wherein all fixed assets (i.e., lands used for residence, commerce, agriculture, including ponds, dwelling units, stalls and shops, miscellaneous structures such as fences, wells, trees with commercial value; etc.) located inside the PRW were identified and measured. The owners of those properties were identified and their replacement values were also calculated. Likewise, the severity of impact on the affected assets, the livelihood, and productive capacity of the AHs were determined. Photographs of the affected assets along with the AHs were also taken. Also, information on the members of the AHs, sources of livelihood, income level, and ownership of productive assets were collected. The impacts survey and census of the AHs were conducted from January – April 2013.

9.3.1.1 Data Gathering Instrument

The basic tool used in the IOL and census of the AHs was the survey questionnaire. Detailed socio-economic information on the AHs whose main structures (i.e., houses and shops excluding government buildings) will be partially or entirely affected was obtained through the Khmer translated questionnaire. The questionnaire covered concerns on socio-economic conditions of the AH, in addition to basic information on the household head, such as gender, age, educational attainment, and primary source of income. It also included the affected assets and income and their perception on the Project.

9.3.1.2 Survey Team

In addition to the Study Team leader (resettlement specialist), a recruited team of 41 local research assistants including one field survey coordinator, 3 field supervisors, 18 enumerators, 15 local assistants, 3 data entry clerks, one data developer, and 4 replacement cost (market rates) researchers, including one field team leader, was organized to prepare this RAP. Except for the data developer, the rest of the local research assistants were based in the field. The survey team is divided into 3 survey groups. Each IOL survey group included one supervisor, 6 enumerators, 5 local assistant (for measuring), one data entry clerk and local authorities. Field data gathering for the project area including the Kampong Chhnang Bypass commenced on 1st January 2013 and was completed on 12th February 2013, while for the Odongk Bypass was started from 17th to 26th April 2013. The research team was accompanied by commune or village authorithies during their data gathering activities.

9.3.1.3 Setting of the Cut-off Date

The IOL and census of the AHs were conducted by a series of public consultation meetings in commune centres along the project area. The purpose of the public consultation meetings was to brief the local people about the Project background, activities of the survey team, the policy of JICA and the Cambodian government on involuntary resettlement for the Project including the policy requirement on the cut-off date. The local people were informed that the cut-off date is the first day of holding the IOL and census of the AHs, which was on **1st January 2013 for the project area and Kampong Chhnang Bypass** and on **11th April 2013 for Odongk Bypass**.

9.3.2 Inventory of Affected Assets

9.3.2.1 Land

The inventory of affected land (PRW: 20 m - 20 m) on both sides from the centreline of the road) in ROW (30 m - 30 m) of the NR No.5 was not performed since the ROW is public state land. It will not be compensated by the Project for the affected area (20 m - 20 m). Nevertheless, the survey team also determined the categories of the land occupants and if the affected lands are accompanied with immovable assets such as trees, houses, shops and/or other structures. **The landless households were also considered.**

There were instances when the survey team could not complete their interviews with the AHs because the owners of the affected houses and shops were either closed or unattended during the survey. In such case, the survey team was only able to estimate the area of ROW lands used for residential or commercial purposes (i.e., footprint of the structures) and those that are fenced. These estimates will be validated and corrected as necessary during the updating of the RAP, with the assistance of commune officials who will also sit as members of the Provincial Resettlement Sub-committee-Working Group (PRSC-WG), the main resettlement body that is tasked to carry out the DMS.

A total of 609,483.50 m² of land will be required for the construction of the two bypasses. Of these, 95.04% (579,255.87 m²) is used for growing rice, 6,478.89 m² is used as orchard land, 4,716.56 m² is flooded land, 296.00 m^2 is commercial land, and 18,736.18 m^2 is residential land. Table 9-2 shows the affected land area and the number of owners identified as the AHs.

Table 9-2: Number of Affected Households who will lose their Private Lands due to the Bypasses

Province	District	Rice Field		Orchard		Flooded Area		Commercial		House Plot/ Home Garden	
		AHs	m²	AH	m²	AH	m²	AH	m²	AH	m²
K. Chhnang	Rolea B'ier	561	422,557.96	1	1,269.00	5	2,040.96	1	296.00	18	7,284.39
	Kampong Tralach	77	110,402.96	1	379.14	0	0	0	0	10	90.00
Kandal	Ponhea Leu	29	46,294.95	4	4,830.75	2	2,675.60	-	.	12	11,361.79
Total		**667**	**579,255.87**	**6**	**6,478.89**	**7**	**4,716.56**	**1**	**296.00**	**40**	**18,736.18**

Source: Project Survey conducted in January-April 2013

9.3.2.2 Main Structures

A total of 1,079 AHs along the project area and the two bypasses, whose main structures (house, house-shop and/or shop/restaurant) will be affected by the Project. Of the AHs, 1,060 and 19 AHs are residing along the project area and along the two bypasses, respectively.

Table 9-3 Number of Affected Households who will lose their Main Structures according to Type of Uses

Road section	Province	District	AHs According to Type of Structure					
			House	House-Shop	Shop/ Restaurant	Shelter	Other Structures	Total
The Project Area	Pursat	Krakor	123	71	0	168	82	444
		Subtotal	**123**	**71**	**0**	**168**	**82**	**444**
	K. Chhnang	Baribour	201	122	3	171	39	536
		Kampong Tralach	148	116	3	149	84	500
		Rolea B'ier	113	75	0	124	42	354
		Sameakki Mean Chey	41	12	1	33	21	108
		Subtotal	**503**	**325**	**7**	**477**	**186**	**1,498**
	Kandal	Ponhea Leu	29	2	0	20	15	66
		Subtotal	**29**	**2**	**0**	**20**	**15**	**66**
	Subtotal		**655**	**398**	**7**	**665**	**283**	**2,008**
Bypass	K. Chhnang	Kampong Tralach	1	0	0	0	0	1
		Rolea B'ier	12	1	0	0	2	15
		Subtotal	**13**	**1**	**0**	**0**	**2**	**16**
	Kandal	Ponhea Leu	5	0	0	0	0	**5**
		Subtotal	**5**	**0**	**0**	**0**	**0**	**5**
	Subtotal		**18**	**1**	**0**	**0**	**2**	**21**
Total	Pursat	Krakor	123	71	0	168	82	444
		Subtotal	**123**	**71**	**0**	**168**	**82**	**444**
	K. Chhnang	Baribour	201	122	3	171	39	536
		Kampong Tralach	149	116	3	149	84	501
		Rolea B'ier	125	76	0	124	44	369
		Sameakki Mean Chey	41	12	1	33	21	108
		Subtotal	**516**	**326**	**7**	**477**	**188**	**1,514**
	Kandal	Ponhea Leu	34	2	0	20	15	71
		Subtotal	**34**	**2**	**0**	**20**	**15**	**71**
	Grand Total for the Project		**673**	**399**	**7**	**665**	**285**	**2,029**

Source: Project Survey conducted in January-April 2013

Table 9-4: Floor Area (in m^2) of Affected Main Structures by Type of Materials

Type of Structure (m^2)	House	House/ Shop	Kitchen	Grange/ Storage	Shop/ Restaurant	Craft / Workshop	Stall / Market stall	Other	Total
1A	54.75	67.80	39.79	0.00	0.00	20.40	0.00	0.00	**182.74**
1B	86.90	16.00	0.00	0.00	0.00	0.00	0.00	0.00	**102.90**
1C	211.59	92.50	0.00	0.00	0.00	14.00	0.00	3.60	**321.69**
1D	0.00	28.80	0.00	0.00	0.00	38.50	116.18	55.50	**238.98**
2A	278.30	205.34	0.00	0.00	0.00	42.94	140.59	13.50	**680.67**
2B	245.66	522.15	0.00	0.00	0.00	183.80	826.92	82.29	**1,860.82**
2C	566.98	385.16	3.00	0.00	0.00	0.00	336.47	35.60	**1,327.21**
2D	202.05	20.00	0.00	0.00	0.00	0.00	46.75	0.00	**268.80**
2E	557.91	504.45	30.85	0.00	0.00	52.20	549.79	5.70	**1,700.90**
2F	97.80	129.16	171.00	0.00	0.00	0.00	155.96	238.00	**791.92**
2G	2,246.18	2,902.80	24.45	14.25	24.80	1,498.06	5,414.34	1,041.31	**13,166.19**
2H	339.08	147.83	0.00	0.00	0.00	26.40	336.93	17.60	**867.84**
2I	5,377.89	3,146.84	43.90	77.90	0.00	455.62	4,738.15	426.45	**14,266.75**
2J	3,286.94	2,358.05	85.18	55.06	122.00	1,150.36	2,881.06	1,245.35	**11,184.00**
2K	73.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**73.06**
2L	739.96	520.98	0.00	0.00	0.00	0.00	0.00	0.00	**1,260.94**
3B	928.43	0.00	16.00	0.00	73.80	31.39	0.00	7.20	**1,056.82**
3C	87.70	253.22	0.00	0.00	0.00	87.50	89.70	0.00	**518.12**
3D	1,140.08	230.35	0.00	0.00	0.00	0.00	0.00	0.00	**1,370.43**
4A	864.45	661.83	0.00	0.00	0.00	0.00	0.00	0.00	**1,526.28**
4B	881.13	737.71	0.00	0.00	0.00	0.00	0.00	0.00	**1,618.84**
4C	100.29	48.28	0.00	0.00	0.00	0.00	0.00	0.00	**148.57**
S1	0.00	0.00	0.00	0.00	0.00	255.84	255.42	408.45	**919.71**
S2	0.00	0.00	77.20	80.00	223.01	3,759.42	2,064.16	17,981.82	**24,185.61**
S3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	370.64	**373.64**

Source: Project Survey conducted in January-April 2013

Table 9-5: Other Structures, including Public Assets

Items	Unit	Total	Items	Unit	Total
Concrete Well	set	228	PETROL STATION		
Pump Well	set	74	Petrol Measure	set	26
Mortar	m^2	11,838	Fuel Tank (10,000L)	set	4
Vehicle washing place	set	6	Fuel Tank (20,000L)	set	7
Toilet	set	53	Fuel Tank (30,000L)	set	5
Culvert	m	261	GRAVE/STUPA/CHEDEY		
FENCE			Concrete grave	set	7
Timber post with wire	lm	3,007	Chedey/Stupa (7.0m x 4.0m x 4.0m)	set	1
Concrete post with wire	lm	2,349	GATEWAY		
Brick Wall, 100mm	lm	3,227	Pagoda gate (3.8m x 7.8m)	set	9
Brick Wall, 200mm	lm	1,606	Gate of public service office (Normal)[10]	set	19

Source: Project Survey conducted in January-April 2013

9.3.2.3 Affected Crops and Trees

The start of civil works and the cropping schedule of the AHs cultivating within the ROW and the bypasses will be synchronized to allow smooth transition between harvesting of standing crops and the start of the project area construction. Therefore, standing crops will not be affected if those can be harvested before the road construction,

[10] The public service office means such as school, health center, commune center, administrative police office, party office, etc.

but if they cannot be harvested before that, the unharvested crops will be compensated at replacement cost. However, fruit or timber trees along the PRW will be cleared for the road construction. In this regard, there were a total of 14,326 fruit and timber tress with various species and ages along the project area and the two bypasses were counted during the IOL. Of 14,326 fruit and timber trees, except some trees along the Kampong Chhnang Bypass, are not commercially grown. They are sporadically planted inside the ROW.

Table 9-6: Affected Trees

No.	Type of Tree	Unit	Number	No.	Type of Tree	Unit	Number
1	Bamboo	Thicket	228	16	Longan	Tree	64
2	Banana	Tree	494	17	Sdau	Tree	29
3	Coconut	Tree	1,996	18	Orange	Tree	12
4	Tamarind	Tree	73	19	Grapefruit	Tree	22
5	Chan Kiri	Tree	43	20	Custard apple	Tree	59
6	Sapodilla	Tree	10	21	Sour sop	Tree	10
7	Kantuot	Tree	35	22	Guava	Tree	86
8	Kamping Reach	Tree	24	23	Teuk Dos Kou	Tree	312
9	Khvet	Tree	4	24	Acacia/Eucalyptus	Tree	498
10	Jack Fruit	Tree	331	25	Lemon	Tree	34
11	Krasang	Tree	32	26	Mango	Tree	7,235
12	Korki	Tree	10	27	Papaya	Tree	22
13	Pring	Tree	74	28	Sugar Palm	Tree	1,211
14	Jujube	Tree	34	29	Cashew	Tree	684
15	Mkak	Tree	22	30	Other	Tree	638

Source: Project Survey conducted in January-April 2013

9.3.3 Impact on Vulnerable Households

The AHs, that are more vulnerable to impoverishment caused by involuntary resettlement, are the poor (i.e. under the national poverty line: income <20$ per month/person), households headed by women, elderly, disabled without support mechanisms and landless households. The households falling within these groups were identified during the IOL will be updated at the time of DSM. They will get special cash assistance is needed to help them. The IOL result showed that there are 640 AHs with a total of 818 vulnerability factors (Table 9-7). The additional special cash assistance for vulnerable AHs is $100.00 per vulnerable AH.

Table 9-7: Vulnerable Factors and Vulnerable AHs (VAHs)

Province	District	Aged ≥60 Yrs	Widow	Disabled	Landless	Poor	VAHs
Pursat	Krakor	63	43	2	19	3	**105**
	Sub-total	**63**	**43**	**2**	**19**	**3**	**105**
Kampng Chhnang	Baribour	75	58	6	27	4	128
	Rolea B'ier	129	101	7	26	25	219
	Kampong Tralach	63	54	3	30	3	128
	Samekki Mean Chey	18	4	1	7	1	26
	Sub-total	**285**	**217**	**17**	**90**	**33**	**501**
Kandal	Ponhea Leu	25	18	0	2	1	**34**
	Sub-total	**25**	**18**	**0**	**2**	**1**	**34**
Grand Total for the Project		**373**	**278**	**19**	**111**	**37**	**640**
		818 factors					**640 AHs**

Source: Project Survey conducted in January-April 2013

9.4 Implementation Schedule

During the detailed design stage, the DMS and the RCS will be conducted under management of the IRC-WG. The DMS will be implemented by the IRC-WG in close cooperation with PRSC-WG and relevant local authorities. The RSC will be updated by independent agency hired by the IRC. Based on the results of the DMS and the RCS, IRC will calculate compensation amounst and request budget disbursement to the RGC.

During the DMS, consultation meetings will be held and project information booklet will be distributed to all AHs by the IRC-WG assisted by the PRSC-WG. The information program will precede the marking of the PRW. Grievance procedures and structure will be established prior to the DMS. The preparation for the updating of the RAP will follow immediately after the final identification survey and the DMS.

After the compensation amount is expected to be undertaken simultaneously for different sections of the road, the compensation process including agreement, certified record of quantities, valuation of properties and physical payment of cash compensation, and formal transfer of property in the form of land will take place before any construction start in a designated stretch of the road. Compensation payments are made at least 30 days before the construction starts. The external monitor will be conducted during all of the above stages of implementation of the RAP. The external monitor's benchmark survey will be carried out prior to any physical relocation of the AHs and AH structures.

The IRC will mobilize its working group to work closely with PRSC-WG and the EMA before commencement of any resettlement activities, i.e., before RAP updating. Land acquisition and relocation of AHs will not commence until the updated RAP has been reviewed and approved by both the IRC and the JICA.

The MPWT will ensure that contractor will not be issued notice to commence for any part of a section of a road to begin construction work unless it has (a) satisfactorily completed in accordance with the approved updated RAP, compensation payment and relocation; (b) ensured that income restoration program is in place; and (c) area required for civil works is free of all encumbrances. Table 9-8 summarizes the various inter-related activities connected with the updating and implementation of the RAP.

Table 9-8: Indicative Schedule of Resettlement Activities

ACTIVITIES	SCHEDULE
JICA Approval of Draft RAP	October 2013
RAP Updating following Detailed Design	Mar – Aug 2015
Submission and JICA Approval of Updated RAP	Sep 2015
Implementation of the Approved Updated RAP	Oct 2015 – Sep 2016
Internal Monitoring (Submission of Quarterly Progress Reports)	Oct 2015 and forwarding
External Monitoring (Intermittent)	Nov 2015 to January 2017
Post-evaluation	Nov - Dec 2017
Start of Civil Works*	Oct 2016

* For sections where there are no resettlement impacts.

9.5 Grievance Redress

Grievances of the AHs in connection with the implementation of the RAP will be handled through negotiation with the aim of achieving consensus. Complaints will go through three stages before they may be elevated to a court of law as a last resort.

9.5.1 First Stage, Commune Level

An aggrieved AH may bring his/her complaint to the commune leader. The commune leader will call for a meeting of the group to decide the course of action to resolve the complaint within 15 days, following the lodging of complaint by the aggrieved AH. The meeting of the group consists of the commune leader, representative/s from the PRSC-WG of the district offices, and the aggrieved AH. The commune leader is responsible for documenting and keeping file of all complaints that are coursed through him/her. If after 15 days the aggrieved AH does not hear from Village or Commune, or if the AH is not satisfied with the decision taken by in the first stage, the complaint may be brought to the District Office either in writing or verbally.

9.5.2 Second Stage, District Office

The District office has 15 days within which to resolve the complaint to the satisfaction of all concerned. If the complaints cannot be solved in this stage, the district office will bring the case to the Provincial Grievance Redress Committee.

9.5.3 Third Stage, Provincial Grievance Redress Committee

The Provincial Grievance Redress Committee, which consists of Provincial Governor or Deputy Governor as a committee chairman and Directors of relevant Provincial Departments as members will be established in each province prior to DMS, meets with the aggrieved party and tries to resolve the complaint. The Committee may ask to PRSC-WG for a review of the DMS by the EMA. Within 30 days of the submission of the grievance the Committee must make a written decision and submit a copy of the same to MPWT, the EMA, IRC and the AH.

9.5.4 Final Stage, the Court Procedures

If the aggrieved AH is not satisfied with the solution made by the Provincial Grievance Redress Committee based on the agreed policy in the RAP, the committee shall file administrative procedures against the AHs with the participation of provincial prosecutors. The case will be brought to the Provincial Court and the same will be litigated under the rules of the court. At the same time, the AH can bring the case to the Provincial court. During the litigation of the case, the RGC will request to the court that the project proceed without disruption while the case is being heard. If any party is unsatisfied with the ruling of the provincial court, that party can bring the case to a higher court. The RGC shall implement the decision of the court.

9.6 Income Restoration Strategy

Restoring the incomes of AHs, whose means of livelihood has been disturbed or removed, is a high priority for the RGC and the JICA. This is of particular concern with respect to households whose livelihoods as well as property are lost as a result of the road improvement. Therefore, an Income Restoration Program (IRP) will be developed during resettlement implementation stage, after DMS is conducted. The IRC will contract out to implement the IRP.

Possible measures to restore livelihood depend on sort of income sources. The Vulnerable, Severely and Relocating AHs will be entitled to the IRP to restore income and livelihood as affected by the project. Thus, the

contents of income restoration should be discussed based on situations and need assessment of target groups. The result of SES and other surveys such as the DMS can be utilized for the discussion to design the effective IRP.

9.7 Costs and Budget

The cost for resettlement will be covered by the government counterpart funds. Funds for the implementation of the RAP are part of the Project Cost. The land acquisition and resettlement cost has been estimated based on results of the IOL and the RCS conducted during the Project Study in January-April 2013.

9.7.1 Procedures for Flow of Funds

The IRC will request the resettlement budget from MEF and the compensation amount will be transferred to relevant PDEF for releasing compensation and allowances to AHs. Payment of compensation and other entitlements will be in cash and will be distributed in public place (commune centre, school, pagoda etc.). The AHs will be notified through the village chiefs with regards to the schedule of payment of compensation and other entitlements.

9.7.2 Updating of the Compensation Rates

The RCS were conducted by local consultant during the project preparatory study as basis unit rate toestimate the cost for resettlement and land acquisition. Since compensation to AHs will be commenced in 2015 or 2016 (tentative schedule), the conducted RCS will be updated to reflect the current market price of affected property. The RCS updating will be conducted in parallel with the DMS.

9.7.3 Estimated Costs for Resettlement

The estimated costs for resettlement and land acquisition based on the RCS and the IOL during the project preparatory study is USD 10,037,464.10, which includes cash compensation and assistance for USD 8,882,711.60, external monitoring and income restoration of USD 266,481.35, administration cost of 5% equivalent to USD 444,135.58, and contingency of 5% or equivalent to USD 444,135.58. The Government will ensure timely provision of funds for resettlement costs and will meet any unforeseen obligations in excess of the resettlement budget in order to satisfy resettlement objectives. The resettlement estimated cost will be updated during the resettlement implementation based on the DMS and the RCS.

10. PROJECT ECONOMIC EVALUATION

10.1 Estimation of Economic Cost

Economic cost is a monetary expression of goods and services to be actually consumed for implementation of the Project. Also, economic cost is converted from financial cost by deducting tax portions and applying the standard conversion factor to the non-trade. Travel costs consist of two components, all of which are as follows:

- Vehicle operating costs are the physical costs of operating a vehicle such as consumption of fuel, lubricants, spare parts, deprecation, crew costs, and so on; and
- Travel time cost (TTC) is the value of time spent in travelling.

10.1.1 Vehicle Operating Cost

The vehicle operating costs (VOC) estimated in "the Preparatory Survey for National Road No. 5 Rehabilitation Project in the Kingdom of Cambodia" implemented by JICA in 2011-2012 was used as the basic reference for this survey. The VOC in this Survey was estimated considering consumer price in 2013. Inputs for vehicle operating costs required for calculating the VOC are as follows.

10.1.1.1 Shadow Wage Rate

The shadow wage rate (SWR) is an estimate of the economic price of labor. The labor divided into two categories: skilled and unskilled corresponding to different degrees of scarcity. The SWR applied the below factors.

Table 10-1: Shadow Wage Rate

	Skilled Labor	Unskilled Labor
Shadow Wage Rate	1.00	0.50

Source: Cost-Benefit Analysis for development a practical Guide 2013

10.1.1.2 Standard Conversion Factor

The Standard Conversion Factor (SCF) is a standard method of incorporating, which converts domestic prices to border prices by adjusting the distortions of prices in the domestic market. The SCF used 0.90 in the Survey. It is usually adopting this range of figure.

10.1.1.3 Vehicle Price

The vehicle price is estimated on the basis of average prices for new vehicles purchased from vehicle dealers. Most of vehicles are imported to Cambodia as second hand reconditioned vehicles. However, as second hand price is uncertain and depends on the frequency of use. However, a new vehicle prices are used in this Survey. For the purpose of calculating the economic price of each vehicle taxes and import duties have been subtracted from the retail price. The resulting economic price includes elements of Cost Insurance and Freight (CIF) price, retailer's margin.

Table 10-2: Vehicle Prices and Characteristics

Type	Fuel Type	Km per driven (Annual Km)	Service Life	Financial Price (US$)	Economic Price (US$)
Motor Cycle	Petrol	10,000	10	1,500	936
Car	Petrol	30,000	10	40,000	23,250
Pick-Up	Petrol	30,000	10	30,000	21,360
Mini Bus	Petrol	30,000	10	47,500	33,428

Type	Fuel Type	Km per driven (Annual Km)	Service Life	Financial Price (US$)	Economic Price (US$)
Big Bus	Diesel	70,000	10	83,000	58,420
Light Truck	Diesel	60,000	8	32,000	22,535
Medium Truck	Diesel	100,000	12	85,000	59,808
Heavy Truck	Diesel	100,000	12	108,000	75,988

Source: Car dealers

10.1.1.4 Tire Cost

The economic costs of tires assessed in the same way as vehicle prices. Suppliers in Phnom Penh were surveyed to assess general prices of different types (motorcycle, passenger car, bus and truck) of tire. New tires are subject to import duty and value added tax (VAT), the rate of which varies depending on type of tire. Custom Import duty is principally charged at 15% of the CIF value of the tire. The rate of VAT and special tax are 25% and 15% for all types of tire (Special tax for motorcycle tire is tax free). For the purpose of calculating the economic price of each vehicle tire, taxes and import duties have been subtracted from the retail price. The resulting economic price includes elements of the CIF price and retailer's margin.

Table 10-3: Tire Cost

Type	No. of Tire	Financial Price (US$)	Economic Price (US$)
Motor Cycle	2	44.0	35.9
Car	4	224.0	149.3
Small Bus	4	292.0	194.7
Large Bus	6	2,280.0	1,520.0
Light Truck	4	700	466.7
Medium Truck	6	1,770	1,180.0
Heavy Truck	10	3,800	2,533.3

Source: Retail shop

10.1.1.5 Fuel and Lubrications

Fuel and lubricants prices estimated based on a survey of market prices. There are a number of suppliers in Cambodia operating competitively. Fuels are subject to import duty, special tax, and VAT. For the purpose of calculating the economic price of fuel and lubricants, these taxes and import duty subtracted from the retail price. The resulting economic price includes elements of the CIF price, customs import duty, VAT and retailer's margin.

Table 10-4: Fuel and Tire Cost

Type	Financial Price (US$) / liter	Economic Price (US$) / liter
Gasoline Regular	1.27	1.03
Diesel	1.20	0.98
Lubricant (motorcycle)	3.60	2.93 (0.8ℓ)
Lubricant (4 wheels or more)	7.50	6.11

Source: Retail shop

10.1.1.6 Spare Parts Cost

Spare parts costs are as applied 1% of the vehicle price (economic price).

10.1.1.7 Maintenance Labor Cost

The maintenance costs estimated based on a survey of the average monthly cost of skilled supervisors and mechanics. Average working hours applied 200 hours per month.

Table 10-5: Maintenance Labor Cost

Items	Motor Cycle	Car	Pick-up	Bus		Truck		
				Mini	Large	Light	Medium	Heavy
Wages per month								
Supervisor	400	400	400	400	400	400	400	400
Mechanic	150	150	150	150	150	150	150	150
Owner	0	0	0	0	0	0	0	0
Maintained by (%)								
Supervisor	10	25	25	25	50	25	50	50
Mechanic	40	50	50	50	50	50	50	50
Owner	50	25	25	25	0	25	0	0
Maintenance hours per year	40	70	70	250	300	250	300	350
Average hourly rate for services(US$)	20.0	61.3	61.3	218.8	412.5	218.8	412.5	481.3
Shadow wage rate factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Economic Price (US$)	20.0	61.3	61.3	218.8	412.5	218.8	412.5	481.3

10.1.1.8 Crew Cost

The crew costs estimated based on a survey of unit costs per drivers and conductors or assistants, number of staff per vehicle, and number of hours per vehicle. In Cambodia, unit costs for drivers are estimated at around 150 to US$ 300 per driver depend on the type of vehicle, while unit cost for conductors or assistants are estimated to be one half of the average monthly cost of skilled supervisor and semi-skilled worker, respectively.

Table 10-6: Crew Cost

Items	Motor Cycle	Car	Pick-up	Bus		Truck		
				Mini	Large	Light	Medium	Heavy
Number of drivers	0.2	0.25	0.5	1	1	1	1	1
Average monthly wage rate	150	250	250	250	300	250	300	300
Working Hour	200	200	200	200	200	200	200	200
Average hourly rate for driver	0.150	0.313	0.625	1.250	1.500	1.250	1.500	1.500
Skilled wage factor – Semi - skilled	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Driver cost (Economic)	0.150	0.313	0.625	1.250	1.500	1.250	1.500	1.500
Number of conductors	0	0	0	0.5	1	1	1	1
Average monthly wage rate	0	0	0	125	150	125	150	150
Working Hour	200	200	200	200	200	200	200	200
Average hourly rate for conductor	0.000	0.000	0.000	0.313	0.750	0.625	0.750	0.750
Skilled wage factor – Unskilled	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Conductor cost (Economic)	0.000	0.000	0.000	0.156	0.375	0.313	0.375	0.375
Total Crew Cost	0.150	0.313	0.625	1.406	1.875	1.563	1.875	1.875

10.1.1.9 Depreciation

Depreciation cost can be expressed as a percent of new vehicle cost and is given by the following formula:

Vehicle per 1,000 veh-km = DEP/ New vehicle prices

A vehicle is a medium-term asset. The purchase cost represents an investment which yields services over several years. The market value of the asset declines with both the passage of time and with amount and type of usage. It is the loss of market value that represents vehicle depreciation. The vehicle depreciation per km is a function of the average annual depreciation and annual utilization.

DEP = ADEP/AKM

Where: ADEP: Average annual depreciation, expressed as % of average new vehicle cost

ADEP: (1 / LIFE)*100

LIF is average vehicle service life

AKM: Average number of kilometers driven per vehicle per year

10.1.1.10 Insurance Cost

Insurance cost was assumed to be 1% or 3% of vehicle price.

10.1.1.11 Overhead Cost

Overhead cost was calculated at 10% of the sub-total of the VOC. Based on the above mentioned discussion and estimations the basic vehicle operating costs are calculated and are shown in Table 10-7.

Table 10-7: Vehicle Operating Cost by Vehicle Type Unit US$/ 1,000 km

Type	Item	Motor Cycle	Car	Pick-up	Bus		Truck		
					Mini	Large	Light	Medium	Heavy
Distance related VOC	Fuel cost	309.3	3,093.1	3,093.1	4,021.0	13,733.7	10,006.0	19,619.6	32,372.4
	Lubricant cost	5.9	73.3	91.7	122.2	1604.2	366.7	1833.3	1833.3
	Tire cost	17.9	112.0	112.0	146.0	2128.0	560.0	2360.0	5066.7
	Maintenance cost	9.4	232.5	213.6	334.3	584.2	225.3	598.1	759.9
	Depreciation cost	0.6	14.4	13.2	20.6	36.1	17.4	30.8	39.1
	S-total	343.0	3,525.3	3,523.5	4,644.2	18,086.2	11,175.4	24,441.8	40,071.4
	Overhead cost	0.0	0.0	352.4	464.4	1,808.6	1,117.5	2,444.2	4,007.1
	Total	343.0	3,525.3	3,875.9	5,108.6	19,894.8	12,293.0	26,886.0	44,078.5
Time related VOC	Crew cost	90.0	234.4	468.8	2,250.0	3,281.3	2,500.0	3,750.0	4,500.0
	Maintenance cost	20.0	61.3	61.3	218.8	412.5	218.8	412.5	481.3
	Insurance cost	28.1	697.5	640.8	334.3	584.2	225.3	598.1	759.9
	Depreciation cost	0.3	7.7	7.1	11.1	19.4	9.4	16.6	21.1
	S-total	138.4	1,000.9	1,177.9	2,814.1	4,297.4	2,953.5	4,777.2	5,762.2
	Overhead cost	0.0	0.0	117.8	281.4	429.7	295.3	477.7	576.2
	Total	138.4	1,000.9	1,295.7	3,095.6	4,727.1	3,248.8	5,254.9	6,338.4
Total		481.4	4,526.1	5,171.6	8,204.2	24,621.9	15,541.8	32,140.9	50,416.9
VOC /1000 km		48.1	150.9	172.4	273.5	351.7	259.0	321.4	504.2

10.1.2 Travel Time Cost

Travel time costs (TTC) also referred to as Value of Travel Time (VTT) is to the cost of time spent on transport. It includes costs to work and businesses of the time their employees and vehicles spent on travel. If the alternative activity can have monetary value assigned to it, this can be used as a part of road user cost in the economic appraisal of the projects, particularly road improvement projects.

In order to estimate the travel time costs, the average wage approach method is taken into consideration. The wage rates of vehicle occupants are assessed and then their average rate is estimated to reflect the value of time of occupants in different vehicles. An assessment of number of passengers in working time and non-working time is made for each vehicle type. The TTC for working time is then taken as the estimated wage rate. The TTC for non-working time is not taken into account in this study.

Unit costs were converted to unique passenger vehicle cost averaged by share of volume of each type of vehicle, which were forecasted by the study. Converted and calibrated unit VOC in 2012, 2021 and 2030 are shown in Table 10-8.

Table 10-8: Forecast of Time Value per vehicle Unit: US$/ hour

	Motorcycle	Light Vehicle	Bus	Truck
Vehicle occupancy (Person)	1.8	3.5	18.0	2.0
2012	0.49	6.31	6.89	1.24
2021	0.70	9.00	9.83	1.77
2030	1.41	17.99	19.66	3.53

10.1.3 Construction Cost, Maintenance Cost and Land Acquisition Cost

The costs of construction, maintenance and land acquisition are used in the economic evaluation. Some basic presumptions assumed in the economic analysis are as follows:

Escalation factor : Price escalation is not taken into account for construction cost, maintenance cost and land acquisition cost.
Tax and import duty : Value added tax and import duty are excluded from cost.
Land acquisition cost : Land acquisition cost is included.

10.1.4 Cost Benefit Analysis

The result of the economic analysis is shown in Table 10-9. The analysis is based on the annual user's benefit and cost estimate as shown in Table 10-7, construction of Thlea Ma'am and Prek Kdam Bridge (4-lanes but inner city of Kampong Chhnag and Odongk section are not improved) and Kampong Chhnang Bypass (4-lanes) and Odongk Bypass (4-lanes) are evaluated in terms of EIRR, BCR and NPV with assumed operation period of 30 years. Evaluation of the economic viability is undertaken through these three approaches and using discount rate of 12.0%. Compared with such large value of discount rate, it can be said that economic viability is estimated at a feasible level.

Table 10-9: Result of Economic Analysis

Indicator	Result
EIRR	21.6
B/C	3.37
NPV （Million US$）	394.12

The cost-benefit analysis streams are the 30 year project life is shown in Table 10-10.

Table 10-10: Cost Benefit Stream of the Project

Unit: x 1,000 US$

SQ	Year	Project Cost	Maintenance Cost	Total Cost	Saving VOC	Saving Value of Time	Benefit	Net Benefit	Discount Cash Flow (at 12%)		
									Cost	Benefit	Net Benefit
	2015	10,162		10,162				-10,162.1	10,162.1	0.0	-10,162.1
	2016	22,069		22,069				-22,069.0	19,704.5	0.0	-19,704.5
	2017	64,422		64,422				-64,422.4	51,357.1	0.0	-51,357.1
	2018	63,926		63,926				-63,925.7	45,501.1	0.0	-45,501.1
	2019	45,646		45,646				-45,646.4	29,009.1	0.0	-29,009.1
1	2020	149	396	544	0.29	9,916.8	9,917.0	9,372.7	308.9	5,627.2	5,318.3
2	2021		396	396	0.66	16,020.2	16,020.8	15,625.0	200.5	8,116.7	7,916.1
3	2022		396	396	0.71	18,461.7	18,462.4	18,066.6	179.1	8,351.5	8,172.4
4	2023		396	396	1.45	25,390.9	25,392.4	24,996.5	159.9	10,255.6	10,095.7
5	2024		396	396	2.50	33,215.6	33,218.1	32,822.3	142.7	11,978.8	11,836.0
6	2025		396	396	3.13	42,028.4	42,031.5	41,635.6	127.5	13,533.0	13,405.6
7	2026		396	396	4.77	51,930.3	51,935.1	51,539.2	113.8	14,930.1	14,816.3
8	2027		396	396	5.71	63,032.2	63,037.9	62,642.0	101.6	16,180.3	16,078.7
9	2028		396	396	14.83	75,454.9	75,469.7	75,073.8	90.7	17,295.7	17,205.0
10	2029		28,324	28,324	16.56	89,330.4	89,346.9	61,023.2	5,795.6	18,282.2	12,486.6
11	2030		396	396	134.14	209,605.9	209,740.0	209,344.2	72.3	38,318.7	38,246.4
12	2031		396	396	139.90	220,086.2	220,226.1	219,830.2	64.6	35,923.6	35,859.1
13	2032		396	396	145.92	231,090.5	231,236.4	230,840.6	57.7	33,678.3	33,620.6
14	2033		396	396	152.19	242,645.0	242,797.2	242,401.4	51.5	31,573.3	31,521.8
15	2034		396	396	136.06	254,777.3	254,913.3	254,517.5	46.0	29,597.2	29,551.2
16	2035		396	396	141.91	267,516.1	267,658.1	267,262.2	41.0	27,747.2	27,706.2
17	2036		396	396	172.68	280,892.0	281,064.6	280,668.8	36.6	26,015.2	25,978.6
18	2037		396	396	180.11	294,936.5	295,116.7	294,720.8	32.7	24,389.2	24,356.5
19	2038		396	396	161.02	309,683.4	309,844.4	309,448.5	29.2	22,862.8	22,833.6
20	2039		28,324	28,324	167.94	325,167.5	325,335.5	297,011.7	1,866.0	21,433.8	19,567.8
21	2040		396	396	202.40	338,174.2	338,376.6	337,980.8	23.3	19,904.4	19,881.1
22	2041		396	396	179.21	351,701.2	351,880.4	351,484.6	20.8	18,481.0	18,460.3
23	2042		396	396	215.98	365,769.3	365,985.2	365,589.4	18.6	17,162.4	17,143.8
24	2043		396	396	191.23	380,400.0	380,591.3	380,195.4	16.6	15,935.1	15,918.5
25	2044		396	396	197.54	395,616.0	395,813.6	395,417.7	14.8	14,796.8	14,782.0
26	2045		396	396	204.06	411,440.7	411,644.7	411,248.9	13.2	13,739.8	13,726.6
27	2046		396	396	210.80	427,898.3	428,109.1	427,713.3	11.8	12,758.4	12,746.6
28	2047		396	396	217.75	445,014.2	445,232.0	444,836.1	10.5	11,847.0	11,836.5
29	2048		396	396	224.94	462,814.8	463,039.7	462,643.9	9.4	11,000.8	10,991.4
30	2049		28,324	28,324	193.63	395,616.0	395,809.7	367,485.9	600.8	8,396.0	7,795.2
	Total	206,374	95,659	302,033			7,039,246.7	6,737,213.4	165,991.5	560,112.0	394,120.4

10.1.5 Sensitive Analysis

A sensitivity analysis is conducted to see the influence of fluctuation of benefit and construction cost. The analysis is made on the cases with +10% in the cost and -10% in the benefit. These changes in cost and benefit are supposed to represent unfavorable scenarios. The analysis results are shown in Table 10-11. As the results, even if the worst case which the benefits are decreased in 10 % and the project costs are increased in 10 % is occurred. The project EIRR of the all cases exceeds over the opportunity of capital in Cambodia of 12 %. The implementation of the project is economically feasible from view point of national and regional economy.

Table 10-11: Results of the Sensitivity Analysis

Case		Economic Indicator	Benefits		
			-10%	Base Case	10%
Costs	-10%	NPV (US$ million)	316.70	366.71	416.72
		B/C	3.37	3.75	4.12
		EIRR (%)	21.6%	22.5%	23.5%
	Base Case	NPV (US$ million)	301.88	394.12	401.90
		B/C	3.04	3.37	3.71
		EIRR (%)	20.6%	21.6%	22.5%
	10%	NPV (US$ million)	287.06	300.96	344.54
		B/C	2.76	3.07	3.35
		EIRR (%)	19.8%	20.7%	21.6%

10.2 Justification of the Project

The significant benefits of the project are summarized as the enhancement of traffic safety and environmental conservation by well-designed Asphalt paved road, the integration of production and consuming centers in terms of regional context, and the reduction of transport cost to provide better market accessibility for more competition toward low prices and to increase job opportunities for the local poor especially in the development corridor between Thlea Ma'am and Prek Kdam. The project will also stimulate the development of the AH No.1 and induce incremental demand of domestic cargo as well as international trade to Thailand. Such transformation will accrue considerable degrees of both direct and indirect benefits, especially by relieving transport constraints such as traffic bottlenecks of the towns and traffic safety and strengthening social and cultural links between settled areas in the country.

11. CONCLUSION AND RECOMMENDATION

11.1 Conclusion

The project is aimed at improving the existing road condition in the project area. Environmentally and socioeconomically, the positive impacts will much surpass the limited negative ones. The environmentally negative impacts will be limited or minimized due to the implementation of the mitigation measures. The socioeconomically negative impacts in particular on the PAPs included their livelihoods would be fully mitigated by the implementation of the RAP. Overall, the final project impacts will be limited due to the implementation of the mitigation measures and the RAP. This should be integrated with the project information management system so that all related activities are effectively managed. In conclusion, the proposed project can be implemented in the environmentally and socioeconomically acceptable manner.

11.2 Recommendation

The project should, therefore, be proceeded to a detail design stage.

ANNEX

ANNEX A

- RESULT OF AIR QUALITY ANALYSIS DURING THE DRY SEASON
- RESULT OF AIR QUALITY ANALYSIS DURING THE RAINY SEASON
- RESULT OF NOISE ANALYSIS DURING THE DRY SEASON
- RESULT OF VIBRATION ANALYSIS DURING THE DRY SEASON
- PICTURES OF AIR QUALITY, NOISE AND VIBRATION SURVEYS DURING THE DRY SEASON
- PICTURES OF AIR QUALITY SURVEY DURING THE RAINY SEASON
- RESULT OF WATER QUALITY ANALYSIS DURING THE DRY SEASON
- PICTURES OF WATER QUALITY SURVEY DURING THE DRY AND RAINY SEASON
- NAMES AND MODEL NUMBERS OF ANALYTICAL INSTRUMENTS

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ព្រឹត្តិបត្រលទ្ធផលវិភាគ
Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)
Survey Point: Point No.1 (Road Side), Oudong Referral Hospital, Veang Chas Commune, X=471679, Y=1307155
Sampling date: 14/03/2013
Sampling Period: 7:00 AM to 7:00 AM next day

Table Result of Air Quality Monitoring

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសាស្ត្រវិភាគ Reference Method
1	Nitrogen Dioxide (NO2)	mg /m^{3}N	0.021	0.1	Saltzman Method
2	Sulfur Dioxide (SO2)	mg /m^{3}N	0.009	0.3	Pararosaniline Method
3	PM2.5	mg /m^{3}N	0.016	-	Method Weight Concentration Measuring
4	PM10	mg /m^{3}N	0.145	-	Method Weight Concentration Measuring

ចេញអោយនៅថ្ងៃទី ខែ ឆ្នាំ២០១៣

ប្រធានការិយាល័យ

Date of Issue:
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បានឃើញនៅថ្ងៃទី ខែ ឆ្នាំ២០១៣

ប្រធាននាយកដ្ឋាន

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លេខ /N°:.....

ព្រឹត្តិបត្រលទ្ធផលវិភាគ
Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)
Survey Point: Point No.1 (100m from the Road), Oudong Referral Hospital, Veang Chas Commune, X=471664, Y=1307060
Sampling date: 15/03/2013
Sampling Period: 7:15 AM to 7:15 AM next day

Table Result of Air Quality Monitoring

លេខ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសាស្ត្រវិភាគ Reference Method
1	Nitrogen Dioxide (NO2)	mg /m^{3}N	0.011	0.1	Saltzman Method
2	Sulfur Dioxide (SO2)	mg /m^{3}N	0.004	0.3	Pararosaniline Method
3	PM2.5	mg /m^{3}N	0.004	-	Method Weight Concentration Measuring
4	PM10	mg /m^{3}N	0.104	-	Method Weight Concentration Measuring

ចេញអោយនៅ ថ្ងៃទី ខែ ឆ្នាំ២០១៣
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Date of Issue:
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លេខ ៤៨ ផ្លូវវិថី ព្រះសីហនុ ទន្លេបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ ទូរស័ព្ទលេខ: ០២៣ ២១០ ៤៩២

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លេខ /N°/:.......០.១១.....៣៥........

ព្រឹត្តិបត្រលទ្ធផលវិភាគ
Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)
Survey Point: Point No.2 (Road Side), មណ្ឌលកុមារកំព្រាខេត្តកំពង់ឆ្នាំង, X=464118, Y=1354042
Sampling date: 18/03/2013
Sampling Period: 6:30 AM to 6:30 AM next day

Table Result of Air Quality Monitoring

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសាស្ត្រវិភាគ Reference Method
1	Nitrogen Dioxide (NO2)	mg /m³N	0.018	0.1	Saltzman Method
2	Sulfur Dioxide (SO2)	mg /m³N	0.013	0.3	Pararosaniline Method
3	PM2.5	mg /m³N	0.017	-	Method Weight Concentration Measuring
4	PM10	mg /m³N	0.107	-	Method Weight Concentration Measuring

បានឃើញនៅ ថ្ងៃទី ០៤ ខែ មេសា ឆ្នាំ២០១៣
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Was seen on date:
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Date of Issue:
Laboratory Chief
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ព្រឹត្តិបត្រលទ្ធផលវិភាគ
Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)
Survey Point: Point No.2 (100m from the Road), មណ្ឌលកុមារកំព្រាខេត្តកំពង់ឆ្នាំង, X=464060, Y=1353978
Sampling date: 19/03/2013
Sampling Period: 6:45 AM to 6:45 AM next day

Table Result of Air Quality Monitoring

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសាស្ត្រវិភាគ Reference Method
1	Nitrogen Dioxide (NO2)	mg /m^3N	0.011	0.1	Saltzman Method
2	Sulfur Dioxide (SO2)	mg /m^3N	0.008	0.3	Pararosaniline Method
3	PM2.5	mg /m^3N	0.012	-	Method Weight Concentration Measuring
4	PM10	mg /m^3N	0.066	-	Method Weight Concentration Measuring

ចេញអោយនៅ ថ្ងៃទី ០៨ ខែ មីនា ឆ្នាំ២០១៣
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លេខ /N°/:.......១៧...៣៩..........

ព្រឹត្តិបត្រលទ្ធផលវិភាគ
Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)
Survey Point: Point No.3 (Road Side), ភូមិត្រពាំងពោធិ៍ ឃុំពង្រ ស្រុករលាប្អៀរ ខេត្តកំពង់ឆ្នាំង, No.97 Kilometer Post, X=458438, Y=1356435
Sampling date: 20/03/2013
Sampling Period: 7:15 AM to 7:15 AM next day

Table Result of Air Quality Monitoring

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសាស្ត្រវិភាគ Reference Method
1	Nitrogen Dioxide (NO_2)	mg /m^{3}N	0.009	0.1	Saltzman Method
2	Sulfur Dioxide (SO_2)	mg /m^{3}N	0.006	0.3	Pararosaniline Method
3	PM2.5	mg /m^{3}N	0.015	-	Method Weight Concentration Measuring
4	PM10	mg /m^{3}N	0.08	-	Method Weight Concentration Measuring

ចេញអោយនៅ ថ្ងៃទី ០៤ ខែ មេសា ឆ្នាំ២០១៣
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ព្រឹត្តិបត្រលទ្ធផលវិភាគ
Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)
Survey Point: Point No.3 (100m from the Road) ភូមិត្រពាំងពោធ៍ ឃុំពង្រ ស្រុកលោរប្អៀរ ខេត្តកំពង់ឆ្នាំង, No.97 Kilometer Post, X=458459, Y=1356332
Sampling date: 21/03/2013
Sampling Period: 7:25 AM to 7:25 AM next day

Table Result of Air Quality Monitoring

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសស្ត្រវិនាគ Reference Method
1	Nitrogen Dioxide (NO2)	mg /m^{3}N	0.006	0.1	Saltzman Method
2	Sulfur Dioxide (SO2)	mg /m^{3}N	0.004	0.3	Pararosaniline Method
3	PM2.5	mg /m^{3}N	0.006	-	Method Weight Concentration Measuring
4	PM10	mg /m^{3}N	0.075	-	Method Weight Concentration Measuring

ចេញអោយនៅ ថ្ងៃទី ខែ ឆ្នាំ២០១៣

ប្រធានការិយាល័យ

Date of Issue:
Laboratory Chief

ឃើញនៅ ថ្ងៃទី ខែ ឆ្នាំ២០១៣

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Laboratory Office

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ជាតិ សាសនា ព្រះមហាក្សត្រ
Kingdom of Cambodia
Nation Religion King

លេខ /N°:.....

ព្រឹត្តិប័ត្រលទ្ធផលវិភាគ
Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)
Survey Point: Point No.4 (Road Side) ភូមិក្បាលដំរី ឃុំអន្សារចំបក់ ស្រុកក្រគរ ខេត្តពោធិ៍សាត់, No.135 Kilometer Post, X=431323, Y=1379108
Sampling date: 22/03/2013
Sampling Period: 8:00 AM to 8:00 AM next day

Table Result of Air Quality Monitoring

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសាស្ត្រវិនាត Reference Method
1	Nitrogen Dioxide (NO2)	mg /m^{3}N	0.025	0.1	Saltzman Method
2	Sulfur Dioxide (SO2)	mg /m^{3}N	0.019	0.3	Pararosaniline Method
3	PM2.5	mg /m^{3}N	0.016	-	Method Weight Concentration Measuring
4	PM10	mg /m^{3}N	0.129	-	Method Weight Concentration Measuring

ចេញអោយនៅ ថ្ងៃទី ... ខែ ... ឆ្នាំ២០១៣
ប្រធានការិយាល័យ
Date of Issue:
Laboratory Chief

បានឃើញនៅ ថ្ងៃទី ... ខែ ... ឆ្នាំ២០១៣
ប្រធាននាយកដ្ឋាន
Was seen on date:
Director Department

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

Kingdom of Cambodia
Nation Religion King

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ

Ministry of Environment
Department of Pollution Control
Laboratory Office

លេខ /N°:.....

ព្រឹត្តិបត្រលទ្ធផលវិភាគ

Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)

Survey Point: **Point No.4** (100m from the Road) ភូមិក្បាលដំរី ឃុំអន្សារចំបក់ ស្រុកក្រគរ ខេត្តពោធិ៍សាត់ No.135 Kilometer Post, X=431363, Y=1379192

Sampling date: 23/03/2013

Sampling Period: 8:15 AM to 8:15 AM next day

Table Result of Air Quality Monitoring

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសាស្ត្រវិភាគ Reference Method
1	Nitrogen Dioxide (NO2)	mg /m^{3}N	0.007	0.1	Saltzman Method
2	Sulfur Dioxide (SO2)	mg /m^{3}N	0.006	0.3	Pararosaniline Method
3	PM2.5	mg /m^{3}N	0.007	-	Method Weight Concentration Measuring
4	PM10	mg /m^{3}N	0.077	-	Method Weight Concentration Measuring

ចេញអោយនៅ ថ្ងៃទី ខែ ឆ្នាំ២០១៣

ប្រធានការិយាល័យ

Date of Issue:

Laboratory Chief

បានឃើញនៅ ថ្ងៃទី ខែ ឆ្នាំ២០១៣

ប្រធាននាយកដ្ឋាន

Was seen on date:

Director Department

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

Kingdom of Cambodia
Nation Religion King

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ

Ministry of Environment
Department of Pollution Control
Laboratory Office

លេខ /N°/:.....

ព្រឹត្តិបត្រលទ្ធផលវិភាគ

Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)
Survey Point: Point No.5 (Road Side) ភូមិកណ្តាស ឃុំបឹងកន្ទួត ស្រុកក្រគរ ខេត្តពោធិ៍សាត់, No.170 Kilometer Post, X=398515, Y=1385052
Sampling date: 25/03/2013
Sampling Period: 6:00 AM to 6:00 AM next day

Table Result of Air Quality Monitoring

លេខ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសាស្ត្រយោង Reference Method
1	Nitrogen Dioxide (NO2)	mg /m^{3}N	0.019	0.1	Saltzman Method
2	Sulfur Dioxide (SO2)	mg /m^{3}N	0.010	0.3	Pararosaniline Method
3	PM2.5	mg /m^{3}N	0.010	-	Method Weight Concentration Measuring
4	PM10	mg /m^{3}N	0.127	-	Method Weight Concentration Measuring

ចេញអោយនៅ ថ្ងៃទី ខែ ឆ្នាំ២០១៣
ប្រធានការិយាល័យ
Date of Issue:
Laboratory Chief

ឆែក-រដ្ឋ

បានឃើញនៅ ថ្ងៃទី ខែ ឆ្នាំ២០១៣
ប្រធាននាយកដ្ឋាន
Was seen on date:
Director Department

លោ-ណារ័ត

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

Kingdom of Cambodia

Nation Religion King

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ

Ministry of Environment
Department of Pollution Control
Laboratory Office

លេខ /Nº/:........៣២.....៣.ស........

ព្រឹត្តិបត្រលទ្ធផលវិភាគ

Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)

Survey Point: Point No.5 (100m from the Road) ភូមិកណ្តុរស ឃុំបឹងកន្ទួត ស្រុកក្រគរ ខេត្តពោធ៍សាត់, No.170 Kilometer Post, X=398513, Y=1385155

Sampling date: 26/03/2013

Sampling Period: 6:15 AM to 6:15 AM next day

Table Result of Air Quality Monitoring

ល.រ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសាស្ត្រវិភាគ Reference Method
1	Nitrogen Dioxide (NO_2)	mg /m^{3}N	0.007	0.1	Saltzman Method
2	Sulfur Dioxide (SO_2)	mg /m^{3}N	0.003	0.3	Pararosaniline Method
3	PM2.5	mg /m^{3}N	0.003	-	Method Weight Concentration Measuring
4	PM10	mg /m^{3}N	0.076	-	Method Weight Concentration Measuring

ចេញអោយនៅ ថ្ងៃទី ០៤ ខែ មេសា ឆ្នាំ២០១៣
ប្រធានការិយាល័យ

Date of Issue:
Laboratory Chief

ឆេត-វជ្ជ

បានឃើញនៅ ថ្ងៃទី ០៤ ខែ មេសា ឆ្នាំ២០១៣
ប្រធាននាយកដ្ឋាន

Was seen on date:
Director Department

ហេង-ណារ៉េត

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

Kingdom of Cambodia
Nation Religion King

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ

Ministry of Environment
Department of Pollution Control
Laboratory Office

លេខ /N°:.....

ព្រឹត្តិបត្រលទ្ធផលវិភាគ

Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)
Survey Point: Point No.1 (Road Side), Oudong Referral Hospital, Veang Chas Commune, X=471681, Y=1307161
Sampling date: 11/07/2013
Sampling Period: 9:00 AM to 9:00 AM next day

Table Result of Air Quality Monitoring

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសាស្ត្រវិភាគ Reference Method
1	Nitrogen Dioxide (NO2)	mg /m^3	0.007	0.1	Saltzman Method
2	Sulfur Dioxide (SO2)	mg /m^3	0.002	0.3	Pararosaniline Method
3	PM2.5	mg /m^3	0.012	-	Method Weight Concentration Measuring
4	PM10	mg /m^3	0.043	-	Method Weight Concentration Measuring

ចេញអោយនៅថ្ងៃទី ខែ ឆ្នាំ២០១៣
ប្រធានការិយាល័យ
Date of Issue:
Laboratory Chief

បានឃើញនៅថ្ងៃទី ខែ ឆ្នាំ២០១៣
ប្រធាននាយកដ្ឋាន
Was seen on date:
Director Department

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ
Ministry of Environment
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ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ
Kingdom of Cambodia
Nation Religion King

លេខ /N°/:.....

ព្រឹត្តិបត្រលទ្ធផលវិភាគ
Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)
Survey Point: Point No.1 (100m from the Road), Oudong Referral Hospital, Veang Chas Commune, X=471662, Y=1307067
Sampling date: 12/07/2013
Sampling Period: 9:30 AM to 9:30 AM next day

Table Result of Air Quality Monitoring

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសាស្ត្រវិភាគ Reference Method
1	Nitrogen Dioxide (NO2)	mg /m^3	0.004	0.1	Saltzman Method
2	Sulfur Dioxide (SO2)	mg /m^3	0.001	0.3	Pararosaniline Method
3	PM2.5	mg /m^3	0.004	-	Method Weight Concentration Measuring
4	PM10	mg /m^3	0.026		Method Weight Concentration Measuring

ចេញអោយនៅ ថ្ងៃទី ១៤ ខែ កក្កដា ឆ្នាំ២០១៣
ប្រធានការិយាល័យ
Date of Issue:
Laboratory Chief

ឆេក-ស្ដេ

បានឃើញនៅ ថ្ងៃទី ១៤ ខែ កក្កដា ឆ្នាំ២០១៣
ប្រធាននាយកដ្ឋាន
Was seen on date:
Director Department

លេខ ៤៨ ក្រវិថី ព្រះសីហនុ ទន្លេបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ ទូរស័ព្ទលេខ: ០២៣ ២១០ ៤៩២

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

Kingdom of Cambodia
Nation Religion King

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ

Ministry of Environment
Department of Pollution Control
Laboratory Office

លេខ /N°/:.....

ព្រឹត្តិបត្រលទ្ធផលវិភាគ

Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)
Survey Point: Point No.2 (Road Side), មណ្ឌលកុមារកំព្រាខេត្តកំពង់ឆ្នាំង, X=464119, Y=1354045
Sampling date: 09/07/2013
Sampling Period: 8:10 AM to 8:10 AM next day

Table Result of Air Quality Monitoring

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសាស្ត្រវិភាគ Reference Method
1	Nitrogen Dioxide (NO2)	mg /m^3	0.008	0.1	Saltzman Method
2	Sulfur Dioxide (SO2)	mg /m^3	0.005	0.3	Pararosaniline Method
3	PM2.5	mg /m^3	0.010	-	Method Weight Concentration Measuring
4	PM10	mg /m^3	0.054	-	Method Weight Concentration Measuring

ចេញអោយនៅថ្ងៃទី ខែ ឆ្នាំ២០១៣

ប្រធានការិយាល័យ

Date of Issue:
Laboratory Chief

ឆេក-រដ្ឋ

បានឃើញនៅថ្ងៃទី ខែ ឆ្នាំ២០១៣

ប្រធាននាយកដ្ឋាន

Was seen on date:
Director Department

មោទ-ណារ៉េត

លេខ ៤៨ ក្រុវិថី ព្រះសីហនុ ទន្លេបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ ទូរស័ព្ទលេខ: ០២៣ ២១០ ៤៩២

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ
Kingdom of Cambodia
Nation Religion King

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ
Ministry of Environment
Department of Pollution Control
Laboratory Office

លេខ /N°/:....៤១.....៣៣................

ព្រឹត្តិប័ត្រលទ្ធផលវិភាគ
Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)
Survey Point: Point No.2 (100m from the Road), មណ្ឌលកុមារកំព្រាខេត្តកំពង់ឆ្នាំង, X=464057, Y=1353976
Sampling date: 10/07/2013
Sampling Period: 8:35 AM to 8:35 AM next day

Table Result of Air Quality Monitoring

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសាស្ត្រវិភាគ Reference Method
1	Nitrogen Dioxide (NO_2)	mg/m^3	0.005	0.1	Saltzman Method
2	Sulfur Dioxide (SO_2)	mg/m^3	0.003	0.3	Pararosaniline Method
3	PM2.5	mg/m^3	0.006	-	Method Weight Concentration Measuring
4	PM10	mg/m^3	0.039	-	Method Weight Concentration Measuring

បានឃើញនៅ ថ្ងៃទី ០៤ ខែ កក្កដា ឆ្នាំ២០១៣
ប្រធាននាយកដ្ឋាន
Was seen on date:
Director Department

ម៉េង-សាខឿន

ចេញអោយនៅ ថ្ងៃទី ០៤ ខែ កក្កដា ឆ្នាំ២០១៣
ប្រធានការិយាល័យ
Date of Issue:
Laboratory Chief

ឆេក-រដ្ឋ

លេខ ៤៨ មហាវិថី ព្រះសីហនុ ទន្លេបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ ទូរស័ព្ទលេខ: ០២៣ ២១០ ៤៩២

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ
Ministry of Environment
Department of Pollution Control
Laboratory Office

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ
Kingdom of Cambodia
Nation Religion King

លេខ /N°:.....

ព្រឹត្តិបត្រលទ្ធផលវិភាគ
Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)
Survey Point: Point No.3 (Road Side), ភូមិត្រពាំងពោធិ៍ ឃុំពង្រ ស្រុករលាប្អៀរ ខេត្តកំពង់ឆ្នាំង, No.97 Kilometer Post, X=458437, Y=1356419
Sampling date: 05/07/2013
Sampling Period: 9:15 AM to 9:15 AM next day

Table Result of Air Quality Monitoring

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសស្ត្រវិនាគ Reference Method
1	Nitrogen Dioxide (NO2)	mg /m^3	0.004	0.1	Saltzman Method
2	Sulfur Dioxide (SO2)	mg /m^3	0.003	0.3	Pararosaniline Method
3	PM2.5	mg /m^3	0.013	-	Method Weight Concentration Measuring
4	PM10	mg /m^3	0.036	-	Method Weight Concentration Measuring

ចេញអោយនៅថ្ងៃទី ខែ ឆ្នាំ២០១៣
ប្រធានការិយាល័យ
Date of Issue:
Laboratory Chief

បានឃើញនៅថ្ងៃទី ខែ ឆ្នាំ២០១៣
ប្រធាននាយកដ្ឋាន
Was seen on date:
Director Department

ក្រសួងបរិស្ថាន នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន ការិយាល័យពិសោធន៍ និង វិភាគ **Ministry of Environment** **Department of Pollution Control** **Laboratory Office**	ព្រះរាជាណាចក្រកម្ពុជា ជាតិ សាសនា ព្រះមហាក្សត្រ **Kingdom of Cambodia** **Nation Religion King**

លេខ /N°/:...៤៣...១៩............

ព្រឹត្តិបត្រលទ្ធផលវិភាគ
Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)

Survey Point: Point No.3 (100m from the Road) ភូមិត្រពាំងពោធិ៍ ឃុំពង្រ ស្រុករលាប្អៀរ ខេត្តកំពង់ឆ្នាំង, No.97 Kilometer Post, X=458448, Y=1356341

Sampling date: 08/07/2013

Sampling Period: 7:15 AM to 7:15 AM next day

Table Result of Air Quality Monitoring

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសាស្ត្រវិភាគ Reference Method
1	Nitrogen Dioxide (NO_2)	mg/m^3	0.004	0.1	Saltzman Method
2	Sulfur Dioxide (SO_2)	mg/m^3	0.002	0.3	Pararosaniline Method
3	PM2.5	mg/m^3	0.003	-	Method Weight Concentration Measuring
4	PM10	mg/m^3	0.025	-	Method Weight Concentration Measuring

បានឃើញនៅ ថ្ងៃទី ០៤ ខែ កក្កដា ឆ្នាំ២០១៣ ប្រធាននាយកដ្ឋាន Was seen on date: Director Department ម៉ោង-ណារ៉េត	ចេញអោយនៅ ថ្ងៃទី ០៤ ខែ កក្កដា ឆ្នាំ២០១៣ ប្រធានការិយាល័យ Date of Issue: Laboratory Chief ឆេក_រដ្ឋ

លេខ ៤៨ វិថី ព្រះសីហនុ ទន្លេបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ ទូរស័ព្ទលេខ: ០២៣ ២១០ ៤៩២

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ
Kingdom of Cambodia
Nation Religion King

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ
Ministry of Environment
Department of Pollution Control
Laboratory Office

លេខ /N°/: ៤៤ ៣.៩

ព្រឹត្តិបត្រលទ្ធផលវិភាគ
Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)

Survey Point: Point No.4 (Road Side) ភូមិក្បាលដំរី ឃុំអន្សារចំបក់ ស្រុកក្រគរ ខេត្តពោធិ៍សាត់, No.135 Kilometer Post, X=431323, Y=1379101

Sampling date: 03/07/2013

Sampling Period: 8:00 AM to 8:00 AM next day

Table Result of Air Quality Monitoring

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសាស្ត្រវិភាគ Reference Method
1	Nitrogen Dioxide ($NO2$)	mg/m^3	0.010	0.1	Saltzman Method
2	Sulfur Dioxide ($SO2$)	mg/m^3	0.006	0.3	Pararosaniline Method
3	PM2.5	mg/m^3	0.011	-	Method Weight Concentration Measuring
4	PM10	mg/m^3	0.041		Method Weight Concentration Measuring

ចេញអោយនៅ ថ្ងៃទី ២៤ ខែ កក្កដា ឆ្នាំ២០១៣
ប្រធានការិយាល័យ
Date of Issue:
Laboratory Chief
សេក_វឌ្ឍ

បានឃើញនៅ ថ្ងៃទី ២៤ ខែ កក្កដា ឆ្នាំ២០១៣
ប្រធាននាយកដ្ឋាន
Was seen on date:
Director Department
ហេង-ណារ៉េត

លេខ ៤៨ រុក្ខវិថី ព្រះសីហនុ ទន្លេបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ ទូរស័ព្ទលេខ: ០២៣ ២១០ ៤៩២

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ
Kingdom of Cambodia
Nation Religion King

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ
Ministry of Environment
Department of Pollution Control
Laboratory Office

លេខ /N°/:...៤៥.....៣.ស................

ព្រឹត្តិប័ត្រលទ្ធផលវិភាគ
Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)

Survey Point: Point No.4 (100m from the Road) ភូមិក្បាលដំរី ឃុំអន្លង់ចំបក់ ស្រុកក្រគរ ខេត្តពោធិ៍សាត់ No.135 Kilometer Post, X=431351, Y=1379195

Sampling date: 04/07/2013

Sampling Period: 8:15 AM to 8:15 AM next day

Table Result of Air Quality Monitoring

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសាស្ត្រវិភាគ Reference Method
1	Nitrogen Dioxide (NO_2)	mg/m^3	0.005	0.1	Saltzman Method
2	Sulfur Dioxide (SO_2)	mg/m^3	0.003	0.3	Pararosaniline Method
3	PM2.5	mg/m^3	0.011	-	Method Weight Concentration Measuring
4	PM10	mg/m^3	0.013	-	Method Weight Concentration Measuring

ចេញអោយនៅ ថ្ងៃទី ០៤ ខែ កក្កដា ឆ្នាំ២០១៣

ប្រធានការិយាល័យ

Date of Issue:

Laboratory Chief

ផេក_វឌ្ឍ

បានឃើញនៅ ថ្ងៃទី ០៤ ខែ កក្កដា ឆ្នាំ២០១៣

ប្រធាននាយកដ្ឋាន

Was seen on date:

Director Department

ហេង-ណារ៉េត

លេខ ៤៨ ព្រះវិថី ព្រះសីហនុ ទន្លេបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ ទូរស័ព្ទលេខ: ០២៣ ២១០ ៤៩២

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

Kingdom of Cambodia
Nation Religion King

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ

Ministry of Environment
Department of Pollution Control
Laboratory Office

លេខ /N°/:.....

ព្រឹត្តិបត្រលទ្ធផលវិភាគ

Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)
Survey Point: Point No.5 (Road Side) ភូមិកណ្តាស ឃុំបឹងកន្ទួត ស្រុកក្រគរ ខេត្តពោធិ៍សាត់, No.170 Kilometer Post, X=398502, Y=1385053
Sampling date: 01/07/2013
Sampling Period: 7:00 AM to 7:00 AM next day

Table Result of Air Quality Monitoring

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសស្ត្រវិនាន Reference Method
1	Nitrogen Dioxide (NO2)	mg /m^3	0.008	0.1	Saltzman Method
2	Sulfur Dioxide (SO2)	mg /m^3	0.004	0.3	Pararosaniline Method
3	PM2.5	mg /m^3	0.015	-	Method Weight Concentration Measuring
4	PM10	mg /m^3	0.068	-	Method Weight Concentration Measuring

ចេញអោយនៅថ្ងៃទី ខែ ឆ្នាំ២០១៣

ប្រធានការិយាល័យ

Date of Issue:
Laboratory Chief

បានឃើញនៅថ្ងៃទី ខែ ឆ្នាំ២០១៣

ប្រធាននាយដ្ឋាន

Was seen on date:
Director Department

លេខ ៤៨ ផ្លូវវិថី ព្រះសីហនុ ទន្លេបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ ទូរស័ព្ទលេខ: ០២៣ ២១០ ៤៩២

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ
Kingdom of Cambodia
Nation Religion King

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ
Ministry of Environment
Department of Pollution Control
Laboratory Office

លេខ /N°/: ៤៧ ៣.១៣

ព្រឹត្តិប័ត្រលទ្ធផលវិភាគ

Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)
Survey Point: Point No.5 (100m from the Road) ភូមិកណ្តាស យុំបឹងកន្ទួត ស្រុកក្រគរ ខេត្តពោធិ៍សាត់, No.170 Kilometer Post, X=398506, Y=1385160
Sampling date: 26/03/2013
Sampling Period: 7:15 AM to 7:15 AM next day

Table Result of Air Quality Monitoring

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសាស្ត្រវិភាគ Reference Method
1	Nitrogen Dioxide (NO_2)	mg/m^3	0.004	0.1	Saltzman Method
2	Sulfur Dioxide (SO_2)	mg/m^3	0.002	0.3	Pararosaniline Method
3	PM2.5	mg/m^3	0.003	-	Method Weight Concentration Measuring
4	PM10	mg/m^3	0.027	-	Method Weight Concentration Measuring

ចេញអោយនៅ ថ្ងៃទី ០៤ ខែ កក្កដា ឆ្នាំ២០១៣
ប្រធានការិយាល័យ
Date of Issue:
Laboratory Chief

ឈើក_រដ្ឋ

បានឃើញនៅ ថ្ងៃទី ០៤ ខែ កក្កដា ឆ្នាំ២០១៣
ប្រធាននាយកដ្ឋាន
Was seen on date:
Director Department

សោម-ណាវ៉ែត

លេខ ៤៨ ព្រះវិថី ព្រះសីហនុ ទន្លេបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ ទូរស័ព្ទលេខ: ០២៣ ២១០ ៤៩២

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ
Kingdom of Cambodia
Nation Religion King

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ
Ministry of Environment
Department of Pollution Control
Laboratory Office

លេខ /N°/:.....០៦.....០៣.១៣...........

ព្រឹត្តិបត្រលទ្ធផលវិភាគ
Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)

Point: Construction: Point No.1 (Road Side), Oudong Referral Hospital, Veang Chas Commune, X=471679, Y=1307155

Table Results of Measuring Noise Level

Date: 14/03/2013

Time	Survey Period	Noise Level dB(A)				Remarks
		LAeq	Standard	Lmax	Lmin	
Day	6:00 - 7:00	63.2	70	76.2	46.4	
	7:00 - 8:00	66.6		86.6	47.9	
	8:00 - 9:00	69.4		91.3	48.5	
	9:00 - 10:00	69.4		89.7	48.1	
	10:00 - 11:00	64.8		79.0	47.3	
	11:00 - 12:00	67.0		86.6	47.6	
	12:00 - 13:00	65.1		84.3	47.5	
	13:00 - 14:00	65.4		86.2	47.6	
	14:00 - 15:00	65.9		80.8	49.5	
	15:00 - 16:00	64.0		77.2	46.3	
	16:00 - 17:00	66.9		86.7	48.8	
	17:00 - 18:00	65.2		76.8	45.9	
	18:00 - 19:00	66.2		81.4	44.8	
Evening	19:00 - 20:00	64.5	65	78.9	44.7	
	20:00 - 21:00	61.9		76.3	45.1	
	21:00 - 22:00	57.5		72.4	45.7	
	22:00 - 23:00	56.0		70.1	44.3	
Night	23:00 - 00:00	56.6	50	74.3	44.5	
	00:00 - 1:00	54.8		69.0	44.5	
	1:00 - 2:00	53.9		69.6	44.3	
	2:00 - 3:00	54.7		70.4	44.5	
	3:00 - 4:00	53.6		68.2	44.1	
	4:00 - 5:00	56.1		70.1	43.7	
	6:00 - 7:00	61.7		74.9	47.2	
24 hours Average		62.10		78.21	46.20	

Remark1. The unit of noise data in this table is dB (A). Sound Level Meter NL-21

Remark2. Noise level standard by the sub-degree on Air and Noise Pollution Control in Cambodia.

ចេញអោយនៅ ថ្ងៃទី ០៤ ខែ មីនា ឆ្នាំ២០១៣

ប្រធានការិយាល័យ

Date of Issue:

Laboratory Chief

បានឃើញនៅ ថ្ងៃទី ០៤ ខែ មីនា ឆ្នាំ២០១៣

ប្រធាននាយកដ្ឋាន

Was seen on date:

Director Department

លេខ ៤៨ វិថី ព្រះសីហនុ ទន្លេបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ ទូរស័ព្ទលេខ: ០២៣ ២១០ ៤៩២

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ
Ministry of Environment
Department of Pollution Control
Laboratory Office

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ
Kingdom of Cambodia
Nation Religion King

លេខ /N°:.....

ព្រឹត្តិបត្រលទ្ធផលវិភាគ
Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)

Point: Construction: Point No.1 (100m from the Road), Oudong Referral Hospital, Veang Chas Commune, X=471664, Y=1307060

Table Results of Measuring Noise Level

Date: 15/03/2013

Time	Survey Period	Noise Level dB(A)				Remarks
		LAeq	Standard	Lmax	Lmin	
Day	6:00 - 7:00	47.8	70	62.2	40.5	
	7:00 - 8:00	48.4		64.5	39.8	
	8:00 - 9:00	47.6		57.2	40.9	
	9:00 - 10:00	47.9		59.3	42.1	
	10:00 - 11:00	45.6		64.7	42.3	
	11:00 - 12:00	45.6		55.6	41.3	
	12:00 - 13:00	45.3		58.9	40.7	
	13:00 - 14:00	45.0		56.7	41.9	
	14:00 - 15:00	44.9		60.0	42.0	
	15:00 - 16:00	45.8		55.1	41.5	
	16:00 - 17:00	45.6		58.5	41.9	
	17:00 - 18:00	45.1		62.5	41.8	
	18:00 - 19:00	45.8		56.2	40.7	
Evening	19:00 - 20:00	43.1	65	56.4	40.1	
	20:00 - 21:00	43.4		58.7	40.6	
	21:00 - 22:00	44.7		57.6	40.1	
	22:00 - 23:00	43.1		55.3	40.3	
Night	23:00 - 00:00	42.8	50	54.4	39.8	
	00:00 - 1:00	43.1		54.2	41.8	
	1:00 - 2:00	44.5		60.2	40.6	
	2:00 - 3:00	45.9		61.6	40.4	
	3:00 - 4:00	44.2		56.6	40.6	
	4:00 - 5:00	45.3		58.7	40.5	
	6:00 - 7:00	46.3		60.1	41.2	
24 hours Average		45.28		58.55	40.98	

Remark1. The unit of noise data in this table is dB (A). Sound Level Meter NL-21

Remark2. Noise level standard by the sub-degree on Air and Noise Pollution Control in Cambodia.

ចេញអោយនៅ ថ្ងៃទី ខែ ឆ្នាំ២០១៣

ប្រធានការិយាល័យ

Date of Issue:

Laboratory Chief

បានឃើញនៅ ថ្ងៃទី ខែ ឆ្នាំ២០១៣

ប្រធាននាយកដ្ឋាន

Was seen on date:

Director Department

លេខ ៤៨ វិថីព្រះសីហនុ ទន្លេបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ ទូរស័ព្ទលេខ: ០២៣ ២១០ ៤៩២

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ
Ministry of Environment
Department of Pollution Control
Laboratory Office

លេខ /N°:.......១៤....៣.៥.........

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ
Kingdom of Cambodia
Nation Religion King

ព្រឹត្តិបត្រលទ្ធផលវិភាគ
Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)

Point: Construction: Point No.2 (Road Side), មណ្ឌលកុមារកំព្រាខេត្តកំពង់ឆ្នាំង, X=464118, Y=1354042

Table Results of Measuring Noise Level

Date: 18/03/2013

Time	Survey Period	Noise Level dB(A)				Remarks
		LAeq	Standard	Lmax	Lmin	
Day	6:00 - 7:00	68.6	70	72.5	50.6	
	7:00 - 8:00	69.7		95.4	53.5	
	8:00 - 9:00	66.0		74.2	55.0	
	9:00 - 10:00	63.8		80.5	51.1	
	10:00 - 11:00	64.6		84.6	51.7	
	11:00 - 12:00	63.6		78.1	55.0	
	12:00 - 13:00	63.3		80.1	52.0	
	13:00 - 14:00	62.9		74.3	51.3	
	14:00 - 15:00	67.9		92.9	52.1	
	15:00 - 16:00	62.7		76.8	51.8	
	16:00 - 17:00	62.9		78.7	50.8	
	17:00 - 18:00	63.5		75.2	51.9	
	18:00 - 19:00	64.1		77.1	52.0	
Evening	19:00 - 20:00	62.6	65	78.6	51.4	
	20:00 - 21:00	58.5		76.5	49.8	
	21:00 - 22:00	56.5		72.6	46.1	
	22:00 - 23:00	55.4		67.4	44.6	
Night	23:00 - 00:00	55.6	50	68.8	44.7	
	00:00 - 1:00	54.0		72.1	43.1	
	1:00 - 2:00	54.8		70.7	43.9	
	2:00 - 3:00	53.2		66.9	43.3	
	3:00 - 4:00	54.1		67.4	43.4	
	4:00 - 5:00	53.6		67.6	44.5	
	6:00 - 7:00	56.4		70.2	47.4	
24 hours Average		60.76		75.80	49.21	

Remark1. The unit of noise data in this table is dB (A). Sound Level Meter NL-21

Remark2. Noise level standard by the sub-degree on Air and Noise Pollution Control in Cambodia.

ចេញអោយនៅ ថ្ងៃទី ០៤ ខែ មេសា ឆ្នាំ២០១៣

ប្រធានការិយាល័យ

Date of Issue:

Laboratory Chief

ឆេក_រដ្ឋ

បានឃើញនៅ ថ្ងៃទី ០៤ ខែ មេសា ឆ្នាំ២០១៣

ប្រធាននាយកដ្ឋាន

Was seen on date:

Director Department

ហេង·ណារ៉េត

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

Kingdom of Cambodia

Nation Religion King

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ

Ministry of Environment
Department of Pollution Control
Laboratory Office

លេខ /N°/:......១៥......ព.ស..........

ព្រឹត្តិបត្រលទ្ធផលវិភាគ

Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)

Point: Construction: Point No.2 (100m from the Road), មណ្ឌលកុមារកំព្រាខេត្តកំពង់ឆ្នាំង, X=464060, Y=1353978

Table Results of Measuring Noise Level

Date: 19/03/2013

Time	Survey Period	Noise Level dB(A)				Remarks
		LAeq	Standard	Lmax	Lmin	
Day	6:00 - 7:00	50.4	70	70.4	41.7	
	7:00 - 8:00	49.5		58.1	44.5	
	8:00 - 9:00	53.0		70.5	44.2	
	9:00 - 10:00	50.0		65.7	42.1	
	10:00 - 11:00	48.3		68.1	41.1	
	11:00 - 12:00	48.7		61.8	41.8	
	12:00 - 13:00	49.8		69.4	42.3	
	13:00 - 14:00	49.0		64.1	42.9	
	14:00 - 15:00	50.4		68.3	42.1	
	15:00 - 16:00	51.0		64.2	43.6	
	16:00 - 17:00	48.1		57.0	42.9	
	17:00 - 18:00	49.9		64.6	42.1	
	18:00 - 19:00	49.8		64.8	41.8	
Evening	19:00 - 20:00	50.2	65	66.7	43.5	
	20:00 - 21:00	49.6		65.6	41.3	
	21:00 - 22:00	49.1		60.7	40.8	
	22:00 - 23:00	49.2		62.3	40.8	
Night	23:00 - 00:00	49.3	50	64.6	40.1	
	00:00 - 1:00	48.9		59.6	40.2	
	1:00 - 2:00	48.7		56.9	40.4	
	2:00 - 3:00	48.5		55.6	39.6	
	3:00 - 4:00	49.1		56.8	39.3	
	4:00 - 5:00	49.8		66.6	40.4	
	6:00 - 7:00	48.6		65.1	39.5	
24 hours Average		49.54		63.65	41.63	

Remark1. The unit of noise data in this table is dB (A). Sound Level Meter NL-21

Remark2. Noise level standard by the sub-degree on Air and Noise Pollution Control in Cambodia.

ចេញអោយនៅ ថ្ងៃទី ០៤ ខែ មេសា ឆ្នាំ២០១៣

ប្រធានការិយាល័យ

Date of Issue:

Laboratory Chief

ឆេង-វិជ្ជ

បានឃើញនៅ ថ្ងៃទី ០៤ ខែ មេសា ឆ្នាំ២០១៣

ប្រធាននាយកដ្ឋាន

Was seen on date:

Director Department

ហេង-ណារ៉េត

លេខ ៤៨ វិថី ព្រះសីហនុ ខណ្ឌចំការមន ភ្នំពេញ ទូរស័ព្ទលេខ: ០២៣ ២១០ ៤៩២

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

Kingdom of Cambodia
Nation Religion King

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ

Ministry of Environment
Department of Pollution Control
Laboratory Office

លេខ /N°:.....១៨.....ត.ស.....

ព្រឹត្តិបត្រលទ្ធផលវិភាគ
Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)

Point: Construction: **Point No.3** (Road Side), ភូមិត្រពាំងពោធ៍ ឃុំពង្រ ស្រុករលាប្អៀរ ខេត្តកំពង់ឆ្នាំង, No.97 Kilometer Post, X=458438, Y=1356435

Table Results of Measuring Noise Level

Date: 20/03/2013

Time	Survey Period	Noise Level dB(A)				Remarks
		LAeq	Standard	Lmax	Lmin	
Day	6:00 - 7:00	64.6	70	80.8	44.7	
	7:00 - 8:00	63.1		72.6	46.1	
	8:00 - 9:00	64.3		77.6	46.3	
	9:00 - 10:00	63.2		77.6	46.0	
	10:00 - 11:00	61.9		75.2	49.5	
	11:00 - 12:00	64.0		83.1	49.9	
	12:00 - 13:00	64.1		76.4	49.7	
	13:00 - 14:00	62.9		76.2	46.9	
	14:00 - 15:00	65.0		80.5	46.7	
	15:00 - 16:00	63.5		85.9	47.9	
	16:00 - 17:00	64.9		83.9	47.1	
	17:00 - 18:00	65.4		81.8	47.7	
	18:00 - 19:00	63.3		76.8	47.2	
Evening	19:00 - 20:00	63.6	65	72.2	46.8	
	20:00 - 21:00	63.5		72.5	46.3	
	21:00 - 22:00	61.4		70.6	46.2	
	22:00 - 23:00	59.2		65.6	44.2	
Night	23:00 - 00:00	58.4	50	65.3	44.0	
	00:00 - 1:00	55.1		66.6	43.8	
	1:00 - 2:00	54.6		60.2	43.8	
	2:00 - 3:00	56.8		63.4	43.6	
	3:00 - 4:00	58.9		70.1	44.1	
	4:00 - 5:00	63.4		72.9	44.8	
	6:00 - 7:00	63.0		71.3	43.7	
24 hours Average		62.00	-	74.13	46.13	

Remark1. The unit of noise data in this table is dB (A). Sound Level Meter NL-21

Remark2. Noise level standard by the sub-degree on Air and Noise Pollution Control in Cambodia.

ចេញអោយនៅ ថ្ងៃទី ០៤ ខែ មីនា ឆ្នាំ២០១៣

ប្រធានការិយាល័យ

Date of Issue:
Laboratory Chief

ឈេក-រដ្ឋ

បានឃើញនៅ ថ្ងៃទី ០៤ ខែ មីនា ឆ្នាំ២០១៣

ប្រធាននាយកដ្ឋាន
Was seen on date:
Director Department

ហេខ-ណារ៉ន

លេខ ៤៨ វិថី ព្រះសីហនុ ទន្លេបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ ទូរស័ព្ទលេខ: ០២៣ ២១០ ៤៩២

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ
Ministry of Environment
Department of Pollution Control
Laboratory Office

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ
Kingdom of Cambodia
Nation Religion King

លេខ /N°/:.....

ព្រឹត្តិបត្រលទ្ធផលវិភាគ
Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)

Point: Construction: **Point No.3** (100m from the Road), ភូមិត្រពាំងពោធ៍ ឃុំពង្រ ស្រុករលាប្អៀរ ខេត្តកំពង់ឆ្នាំង, No.97 Kilometer Post, X=458459, Y=1356332

Table Results of Measuring Noise Level

Date: 21/03/2013

Time	Survey Period	Noise Level dB(A)				Remarks
		LAeq	Standard	Lmax	Lmin	
Day	6:00 - 7:00	45.9	70	63.3	39.0	
	7:00 - 8:00	46.9		57.6	37.4	
	8:00 - 9:00	48.2		66.0	36.6	
	9:00 - 10:00	48.7		51.9	38.4	
	10:00 - 11:00	49.8		60.1	36.3	
	11:00 - 12:00	49.5		56.0	37.7	
	12:00 - 13:00	48.8		63.3	36.2	
	13:00 - 14:00	48.5		56.6	36.7	
	14:00 - 15:00	48.8		55.2	36.5	
	15:00 - 16:00	48.7		60.2	37.2	
	16:00 - 17:00	48.6		68.0	37.7	
	17:00 - 18:00	48.5		63.8	37.4	
	18:00 - 19:00	46.4		59.6	36.8	
Evening	19:00 - 20:00	46.1	65	58.8	36.1	
	20:00 - 21:00	45.8		60.6	36.0	
	21:00 - 22:00	45.5		58.6	36.4	
	22:00 - 23:00	44.8		56.7	36.1	
Night	23:00 - 00:00	44.8	50	61.7	36.6	
	00:00 - 1:00	45.1		57.7	36.2	
	1:00 - 2:00	46.2		58.7	36.3	
	2:00 - 3:00	44.1		55.2	36.0	
	3:00 - 4:00	43.1		51.7	36.5	
	4:00 - 5:00	43.8		54.4	36.9	
	6:00 - 7:00	44.8		55.5	36.3	
24 hours Average		46.73		58.80	36.80	

Remark1. The unit of noise data in this table is dB (A). Sound Level Meter NL-21

Remark2. Noise level standard by the sub-degree on Air and Noise Pollution Control in Cambodia.

ចេញអោយនៅថ្ងៃទី ០៤ ខែ មេសា ឆ្នាំ២០១៣

ប្រធានការិយាល័យ

Date of Issue:

Laboratory Chief

បានឃើញនៅថ្ងៃទី ០៤ ខែ មេសា ឆ្នាំ២០១៣

ប្រធាននាយកដ្ឋាន

Was seen on date:

Director Department

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការពារបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ
Ministry of Environment
Department of Pollution Control
Laboratory Office

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ
Kingdom of Cambodia
Nation Religion King

លេខ /N°:.....

ព្រឹត្តិបត្រលទ្ធផលវិភាគ
Analysis Report

Name of Company: ក្រុមប៊ឹន Key Consultants (Cambodia)

Point: Construction: **Point No.4** (Road Side) ភូមិក្បាលដំរី ឃុំអន្សារចំបក់ ស្រុកក្រគរ ខេត្តពោធិ៍សាត់, No.135 Kilometer Post, X=431323, Y=1379108

Table Results of Measuring Noise Level

Date: 22/03/2013

Time	Survey Period	Noise Level dB(A)				Remarks
		LAeq	Standard	Lmax	Lmin	
Day	6:00 - 7:00	65.3	70	80.4	41.6	
	7:00 - 8:00	64.4		79.5	38.9	
	8:00 - 9:00	64.9		78.7	39.2	
	9:00 - 10:00	65.1		82.2	39.9	
	10:00 - 11:00	65.4		85.5	38.8	
	11:00 - 12:00	67.0		84.5	43.6	
	12:00 - 13:00	65.1		84.2	40.6	
	13:00 - 14:00	63.2		79.4	38.5	
	14:00 - 15:00	66.3		78.4	43.6	
	15:00 - 16:00	64.3		78.6	40.0	
	16:00 - 17:00	64.7		79.2	41.3	
	17:00 - 18:00	64.6		84.5	41.6	
	18:00 - 19:00	66.4		81.0	40.7	
Evening	19:00 - 20:00	63.4	65	75.6	39.3	
	20:00 - 21:00	62.1		74.3	39.1	
	21:00 - 22:00	61.5		74.2	40.2	
	22:00 - 23:00	55.4		68.4	38.6	
Night	23:00 - 00:00	55.3	50	70.1	39.7	
	00:00 - 1:00	54.8		67.7	39.3	
	1:00 - 2:00	53.6		66.8	38.8	
	2:00 - 3:00	52.1		68.5	38.1	
	3:00 - 4:00	54.0		72.7	38.0	
	4:00 - 5:00	52.4		71.7	38.6	
	6:00 - 7:00	55.7		74.3	39.9	
24 hours Average		61.13		76.68	39.91	

Remark1. The unit of noise data in this table is dB (A). Sound Level Meter NL-21

Remark2. Noise level standard by the sub-degree on Air and Noise Pollution Control in Cambodia.

ចេញអោយនៅ ថ្ងៃទី ០៤ ខែ ឆ្នាំ២០១៣

ប្រធានការិយាល័យ

Date of Issue:

Laboratory Chief

បានឃើញនៅ ថ្ងៃទី ០៤ ខែ ឆ្នាំ២០១៣

ប្រធាននាយកដ្ឋាន

Was seen on date:

Director Department

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ
Kingdom of Cambodia
Nation Religion King

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ
Ministry of Environment
Department of Pollution Control
Laboratory Office

លេខ /N°/:.......

ព្រឹត្តិបត្រលទ្ធផលវិភាគ

Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)

Point: Construction: **Point No.4** (100m from the Road) ភូមិក្បាលដំរី ឃុំអន្លង់ចំបក់ ស្រុកក្រគរ ខេត្តពោធិ៍សាត់ No.135 Kilometer Post, X=431363, Y=1379192

Table Results of Measuring Noise Level

Date: 23/03/2013

Time	Survey Period	Noise Level dB(A)				Remarks
		LAeq	Standard	Lmax	Lmin	
Day	6:00 - 7:00	46.9	70	61.2	33.6	
	7:00 - 8:00	53.0		66.2	36.3	
	8:00 - 9:00	46.3		61.6	37.4	
	9:00 - 10:00	55.3		70.2	35.0	
	10:00 - 11:00	45.7		58.8	33.3	
	11:00 - 12:00	45.5		60.0	33.9	
	12:00 - 13:00	46.5		64.8	35.2	
	13:00 - 14:00	47.0		62.3	36.5	
	14:00 - 15:00	47.5		58.9	36.8	
	15:00 - 16:00	45.0		55.9	34.8	
	16:00 - 17:00	47.2		67.1	36.4	
	17:00 - 18:00	47.4		62.1	35.0	
	18:00 - 19:00	47.0		62.7	35.2	
Evening	19:00 - 20:00	43.4	65	55.6	33.9	
	20:00 - 21:00	44.4		56.5	32.9	
	21:00 - 22:00	39.3		50.3	33.6	
	22:00 - 23:00	40.7		51.6	34.1	
Night	23:00 - 00:00	40.2	50	52.3	33.2	
	00:00 - 1:00	39.1		51.4	33.6	
	1:00 - 2:00	38.6		50.4	33.2	
	2:00 - 3:00	38.3		51.8	33.4	
	3:00 - 4:00	38.2		50.6	32.9	
	4:00 - 5:00	39.1		55.3	33.5	
	6:00 - 7:00	40.9		56.7	33.8	
24 hours Average		44.27	-	58.10	34.48	

Remark1. The unit of noise data in this table is dB (A). Sound Level Meter NL-21

Remark2. Noise level standard by the sub-degree on Air and Noise Pollution Control in Cambodia.

ចេញអោយនៅ ថ្ងៃទី ០៤ ខែ មេសា ឆ្នាំ២០១៣
ប្រធានការិយាល័យ
Date of Issue:
Laboratory Chief

បានឃើញនៅ ថ្ងៃទី ០៤ ខែ មេសា ឆ្នាំ២០១៣
ប្រធាននាយកដ្ឋាន
Was seen on date:
Director Department

លេខ ៤៨ វិថី ព្រះសីហនុ ទន្លេបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ ទូរស័ព្ទលេខ: ០២៣ ២១០ ៤៩២

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

Kingdom of Cambodia
Nation Religion King

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ

Ministry of Environment
Department of Pollution Control
Laboratory Office

លេខ /N°:.....

ព្រឹត្តិបត្រលទ្ធផលវិភាគ

Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)

Point: Construction: **Point No.5** (Road Side) ភូមិកណ្តាលស ឃុំបឹងកន្ទួត ស្រុកក្រគរ ខេត្តពោធិ៍សាត់, No.170 Kilometer Post, X=398515, Y=1385052

Table Results of Measuring Noise Level

Date: 25/03/2013

Time	Survey Period	Noise Level dB(A)				Remarks
		LAeq	Standard	Lmax	Lmin	
Day	6:00 - 7:00	64.0	70	70.7	49.1	
	7:00 - 8:00	65.6		78.1	50.1	
	8:00 - 9:00	68.7		80.1	50.8	
	9:00 - 10:00	67.6		78.9	51.6	
	10:00 - 11:00	63.4		77.4	50.8	
	11:00 - 12:00	62.2		77.6	49.9	
	12:00 - 13:00	65.4		75.8	51.8	
	13:00 - 14:00	62.6		77.2	50.1	
	14:00 - 15:00	62.7		81.6	48.1	
	15:00 - 16:00	61.6		74.4	50.1	
	16:00 - 17:00	62.6		73.5	49.3	
	17:00 - 18:00	62.5		77.5	49.7	
	18:00 - 19:00	61.4		74.4	41.1	
Evening	19:00 - 20:00	61.3	65	74.1	40.2	
	20:00 - 21:00	57.3		72.7	43.2	
	21:00 - 22:00	57.9		72.9	43.9	
	22:00 - 23:00	56.8		73.1	43.3	
Night	23:00 - 00:00	56.9	50	72.9	42.7	
	00:00 - 1:00	56.2		71.3	41.9	
	1:00 - 2:00	56.6		68.4	40	
	2:00 - 3:00	56.7		72.1	41.6	
	3:00 - 4:00	61.6		78.1	44.6	
	4:00 - 5:00	60.7		78.0	44.7	
	6:00 - 7:00	61.8		85.3	45.1	
24 hours Average		61.42	-	75.67	46.40	

Remark1. The unit of noise data in this table is dB (A). Sound Level Meter NL-21

Remark2. Noise level standard by the sub-degree on Air and Noise Pollution Control in Cambodia.

ចេញអោយនៅថ្ងៃទី ខែ ឆ្នាំ២០១៣

ប្រធានការិយាល័យ

Date of Issue:
Laboratory Chief

បានឃើញនៅថ្ងៃទី ខែ ឆ្នាំ២០១៣

ប្រធាននាយកដ្ឋាន

Was seen on date:
Director Department

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ
Ministry of Environment
Department of Pollution Control
Laboratory Office

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ
Kingdom of Cambodia
Nation Religion King

លេខ /N°/:.....

ព្រឹត្តិបត្រលទ្ធផលវិភាគ
Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)

Point: Construction: **Point No.5** (100m from the Road) ភូមិកណ្តាស ឃុំបឹងកន្ទួត ស្រុកក្រគរ ខេត្តពោធិ៍សាត់, No.170 Kilometer Post, X=398513, Y=1385155

Table Results of Measuring Noise Level

Date: 26/03/2013

Time	Survey Period	Noise Level dB(A)				Remarks
		LAeq	Standard	Lmax	Lmin	
Day	6:00 - 7:00	48.3	70	59.9	39.8	
	7:00 - 8:00	48.4		59.5	39.8	
	8:00 - 9:00	48.3		56.7	40.2	
	9:00 - 10:00	49.1		58.2	44.5	
	10:00 - 11:00	48.8		59.5	42.1	
	11:00 - 12:00	48.6		60.5	40.9	
	12:00 - 13:00	48.5		64.1	42.4	
	13:00 - 14:00	48.2		59.7	43.4	
	14:00 - 15:00	48.7		64.7	40.8	
	15:00 - 16:00	47.0		63.5	39.4	
	16:00 - 17:00	46.7		59.0	40.2	
	17:00 - 18:00	47.6		56.9	41.5	
	18:00 - 19:00	46.4		60.3	40.2	
Evening	19:00 - 20:00	47.3	65	56.5	39.6	
	20:00 - 21:00	46.8		56.3	39.1	
	21:00 - 22:00	45.3		55.4	38.8	
	22:00 - 23:00	45.6		58.2	38.7	
Night	23:00 - 00:00	45.1	50	57.5	39.0	
	00:00 - 1:00	45.3		55.3	39.3	
	1:00 - 2:00	45.1		52.3	38.9	
	2:00 - 3:00	46.7		59.9	39.4	
	3:00 - 4:00	46.8		58.2	38.7	
	4:00 - 5:00	46.3		56.6	39.2	
	6:00 - 7:00	46.9		58.4	39.6	
24 hours Average		47.16	-	58.63	40.23	

Remark1. The unit of noise data in this table is dB (A). Sound Level Meter NL-21

Remark2. Noise level standard by the sub-degree on Air and Noise Pollution Control in Cambodia.

ចេញអោយនៅ ថ្ងៃទី ... ខែ ... ឆ្នាំ២០១៣

ប្រធានការិយាល័យ

Date of Issue:
Laboratory Chief

បានឃើញនៅ ថ្ងៃទី ... ខែ ... ឆ្នាំ២០១៣

ប្រធាននាយកដ្ឋាន

Was seen on date:
Director Department

លេខ ៤៨ ផ្លូវទី ព្រះសីហនុ ទន្លេបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ ទូរស័ព្ទលេខ: ០២៣ ២១០ ៤៩២

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង ឯកភាគ
Ministry of Environment
Department of Pollution Control
Laboratory Office

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ
Kingdom of Cambodia
Nation Religion King

លេខ /N°:.....

ព្រឹត្តិបត្រលទ្ធផលវិភាគ
Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)
Point: Construction: Point No.1 (Road Side), Oudong Referral Hospital, Veang Chas Commune, X=471679, Y=1307155
Table Results of Measuring Vibration Level
Date: 14/03/2013

	Survey Period	Vibration Level dB				Remarks
		Leq	Standard(Leq)	Lmax	Lmin	
Day	6:00 - 7:00	41.9	65	56.4	22.8	
	7:00 - 8:00	42.8		58.7	23.0	
	8:00 - 9:00	42.7		57.8	23.1	
	9:00 - 10:00	43.3		62.5	22.1	
	10:00 - 11:00	43.0		60	23.7	
	11:00 - 12:00	42.1		57.6	31.5	
	12:00 - 13:00	42.0		56.8	29.7	
	13:00 - 14:00	44.1		59.6	29.2	
	14:00 - 15:00	44.5		59.3	30.1	
	15:00 - 16:00	43.1		60.6	29.3	
	16:00 - 17:00	41.9		60.4	31.0	
	17:00 - 18:00	41.3		56.5	30.0	
Night	18:00 - 19:00	39.3	60	56.6	27.8	
	19:00 - 20:00	38.3		52.4	30.1	
	20:00 - 21:00	38.6		52.7	28.4	
	21:00 - 22:00	37.8		56.2	27.1	
	22:00 - 23:00	38.0		57.5	27.5	
	23:00 - 00:00	35.8		55.7	27.3	
	00:00 - 1:00	35.9		54.2	27.1	
	1:00 - 2:00	35.6		56.1	27.2	
	2:00 - 3:00	34.1		53.8	27.0	
	3:00 - 4:00	34.1		54.6	27.2	
	4:00 - 5:00	38.2		56.6	27.9	
	5:00 - 6:00	37.5		51.6	28.0	
24 hours Average		39.83	-	56.84	27.42	

Remark1.The unit of Vibration data in this table is db., Vibration Level Meter VM - 53A.
Remark2.Vibration level standard is Environmental Quality Standard of Japan

ចេញអោយនៅ ថ្ងៃទី ... ខែ ... ឆ្នាំ២០១៣
ប្រធានការិយាល័យ
Date of Issue:
Laboratory Chief

បានឃើញនៅ ថ្ងៃទី ... ខែ ... ឆ្នាំ២០១៣
ប្រធាននាយកដ្ឋាន
Was seen on date:
Director Department

លេខ ៤៨ វិថី ព្រះសីហនុ ទន្លេបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ ទូរស័ព្ទលេខ: ០២៣ ២១០ ៤៩២

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ
Ministry of Environment
Department of Pollution Control
Laboratory Office

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ
Kingdom of Cambodia
Nation Religion King

លេខ / N°/: ០៦០ ៣៥

វិញ្ញាបនបត្រលទ្ធផលវិភាគ
Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)

Point: Construction: **Point No.1** (100m from the Road), Oudong Referral Hospital, Veang Chas Commune, X=471664, Y=1307060

Table Results of Measuring Vibration Level

Date: 15/03/2013

	Survey Period	Vibration Level dB				Remarks
		Leq	Standard(Leq)	Lmax	Lmin	
Day	6:00 - 7:00	27.5	65	49.2	14.4	
	7:00 - 8:00	20.9		45.9	14.3	
	8:00 - 9:00	19.5		37.8	14.3	
	9:00 - 10:00	28.8		42.9	14.2	
	10:00 - 11:00	29.4		49.4	14.6	
	11:00 - 12:00	30.8		49.8	14.3	
	12:00 - 13:00	22.3		42.5	15.4	
	13:00 - 14:00	26.0		52.2	15.9	
	14:00 - 15:00	22.6		45.9	15.2	
	15:00 - 16:00	22.9		49.6	14.6	
	16:00 - 17:00	22.6		43.3	14.3	
	17:00 - 18:00	20.0		40.3	14.2	
Night	18:00 - 19:00	21.7	60	46.4	14.6	
	19:00 - 20:00	20.3		42.5	14.2	
	20:00 - 21:00	20.1		45.4	14.3	
	21:00 - 22:00	19.9		46.1	14.1	
	22:00 - 23:00	20.2		41.6	14.2	
	23:00 - 00:00	19.8		44.7	14.3	
	00:00 - 1:00	20.3		44.6	14.7	
	1:00 - 2:00	20.2		43.8	14.6	
	2:00 - 3:00	22.4		48.3	15.0	
	3:00 - 4:00	22.1		46.4	14.3	
	4:00 - 5:00	20.8		47.3	14.3	
	5:00 - 6:00	22.7		52.4	14.4	
24 hours Average		22.66		45.76	14.53	

Remark1. The unit of Vibration data in this table is db., Vibration Level Meter VM - 53A.

Remark2. Vibration level standard is Environmental Quality Standard of Japan

ចេញអោយនៅ ថ្ងៃទី ០៤ ខែ មេសា ឆ្នាំ២០១៣
ប្រធានការិយាល័យ
Date of Issue:
Laboratory Chief

សេក_វជ្ជ

បានឃើញនៅ ថ្ងៃទី ០៤ ខែ មេសា ឆ្នាំ២០១៣
ប្រធាននាយកដ្ឋាន
Was seen on date:
Director Department

ម៉េង-ណារ៉េត

លេខ ៤៨ វិថី ព្រះសីហនុ ទន្លេបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ ទូរស័ព្ទលេខ: ០២៣ ២១០ ៩៩២

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ
Kingdom of Cambodia
Nation Religion King

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ
Ministry of Environment
Department of Pollution Control
Laboratory Office

លេខ /N°:......១៣.......[illegible]......

ព្រឹត្តិប័ត្រលទ្ធផលវិភាគ
Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)

Point: Construction: Point No.2 (Road Side), មណ្ឌលកុមារកំព្រាខេត្តកំពង់ឆ្នាំង, X=464118, Y=1354042

Table Results of Measuring Vibration Level

Date: 18/03/2013

	Survey Period	Vibration Level dB				Remarks
		Leq	Standard(Leq)	Lmax	Lmin	
Day	6:00 - 7:00	39.1	65	50.6	29.7	
	7:00 - 8:00	40.8		51.2	30.0	
	8:00 - 9:00	41.7		54.7	29.5	
	9:00 - 10:00	41.3		55.7	28.1	
	10:00 - 11:00	42.3		60.6	28.6	
	11:00 - 12:00	39.8		60.6	32.2	
	12:00 - 13:00	41.4		59.7	32.5	
	13:00 - 14:00	43.7		52.2	32.4	
	14:00 - 15:00	43.4		55.3	32.8	
	15:00 - 16:00	41.6		53.6	31.5	
	16:00 - 17:00	43.5		51.7	30.8	
	17:00 - 18:00	42.3		54.7	31.6	
Night	18:00 - 19:00	41.4	60	52.7	30.7	
	19:00 - 20:00	39.6		54.5	30.3	
	20:00 - 21:00	32.8		49.1	28.1	
	21:00 - 22:00	35.9		51.7	31.1	
	22:00 - 23:00	31.7		46.8	29.6	
	23:00 - 00:00	31.2		45.9	28.8	
	00:00 - 1:00	28.5		44.3	25.4	
	1:00 - 2:00	29.1		45.6	25.6	
	2:00 - 3:00	28.4		48.6	25.1	
	3:00 - 4:00	30.1		50.1	25.6	
	4:00 - 5:00	28.8		44.8	25.8	
	5:00 - 6:00	39.1		50.6	29.7	
24 hours Average		37.00		51.54	29.20	

Remark1. The unit of Vibration data in this table is db., Vibration Level Meter VM - 53A.

Remark2. Vibration level standard is Environmental Quality Standard of Japan

ចេញអោយនៅ ថ្ងៃទី ០៤ ខែ មេសា ឆ្នាំ២០១៣

ប្រធានការិយាល័យ

Date of Issue:

Laboratory Chief

បានឃើញនៅ ថ្ងៃទី ០៤ ខែ មេសា ឆ្នាំ២០១៣

ប្រធាននាយកដ្ឋាន

Was seen on date:

Director Department

លេខ ៤៨ វិថី ព្រះសីហនុ ទន្លេបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ ទូរស័ព្ទលេខ: ០២៣ ២១០ ៤៩២

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ
Ministry of Environment
Department of Pollution Control
Laboratory Office

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ
Kingdom of Cambodia
Nation Religion King

លេខ /N°/:.......១២.......៣៩.........

ព្រឹត្តិប័ត្រលទ្ធផលវិភាគ
Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)

Point: Construction: Point No.2 (100m from the Road), មណ្ឌលកុមារកំព្រាខេត្តកំពង់ឆ្នាំង, X=464060, Y=1353978

Table Results of Measuring Vibration Level

Date: 19/03/2013

	Survey Period	Vibration Level dB				Remarks
		Leq	Standard(Leq)	Lmax	Lmin	
Day	6:00 - 7:00	39.1	65	50.6	29.7	
	7:00 - 8:00	40.8		51.2	30.0	
	8:00 - 9:00	41.7		54.7	29.5	
	9:00 - 10:00	41.3		55.7	28.1	
	10:00 - 11:00	42.3		60.6	28.6	
	11:00 - 12:00	39.8		60.6	32.2	
	12:00 - 13:00	41.4		59.7	32.5	
	13:00 - 14:00	43.7		52.2	32.4	
	14:00 - 15:00	43.4		55.3	32.8	
	15:00 - 16:00	41.6		53.6	31.5	
	16:00 - 17:00	43.5		51.7	30.8	
	17:00 - 18:00	42.3		54.7	31.6	
Night	18:00 - 19:00	41.4	60	52.7	30.7	
	19:00 - 20:00	39.6		54.5	30.3	
	20:00 - 21:00	32.8		49.1	28.1	
	21:00 - 22:00	35.9		51.7	31.1	
	22:00 - 23:00	31.7		46.8	29.6	
	23:00 - 00:00	31.2		45.9	28.8	
	00:00 - 1:00	28.5		44.3	25.4	
	1:00 - 2:00	29.1		45.6	25.6	
	2:00 - 3:00	28.4		48.6	25.1	
	3:00 - 4:00	30.1		50.1	25.6	
	4:00 - 5:00	28.8		44.8	25.8	
	5:00 - 6:00	29.6		42.2	24.9	
24 hours Average		37.00		51.54	29.20	

Remark1. The unit of Vibration data in this table is db., Vibration Level Meter VM - 53A.

Remark2. Vibration level standard is Environmental Quality Standard of Japan

ចេញអោយនៅ ថ្ងៃទី ០៤ ខែ មេសា ឆ្នាំ២០១៣
ប្រធានការិយាល័យ
Date of Issue:
Laboratory Chief

ឆេក រដ្ឋ

បានឃើញនៅ ថ្ងៃទី ០៤ ខែ មេសា ឆ្នាំ២០១៣
ប្រធាននាយកដ្ឋាន
Was seen on date:
Director Department

សោខ ណារ៉េត

លេខ ៤៨ វិថី ព្រះសីហនុ ទន្លេបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ ទូរស័ព្ទលេខ: ០២៣ ២១០ ៤៩២

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ
Ministry of Environment
Department of Pollution Control
Laboratory Office

លេខ /N°/:......១៩........៣.៧..........

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ
Kingdom of Cambodia
Nation Religion King

ព្រឹត្តិប័ត្រលទ្ធផលវិភាគ

Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)

Point: Construction: Point No.3 (Road Side), ភូមិត្រពាំងពោធិ៍ ឃុំពង្រ ស្រុករលាប្អៀរ ខេត្តកំពង់ឆ្នាំង, No.97 Kilometer Post, X=458438, Y=1356435

Table Results of Measuring Vibration Level

Date: 20/03/2013

	Survey Period	Vibration Level dB				Remarks
		Leq	Standard (Leq)	Lmax	Lmin	
Day	6:00 - 7:00	45.2	65	59.7	25.6	
	7:00 - 8:00	44.6		61.6	23.9	
	8:00 - 9:00	44.6		61.8	23.1	
	9:00 - 10:00	42.5		57.6	20.9	
	10:00 - 11:00	42.5		58.1	21.2	
	11:00 - 12:00	42.6		61.2	21.5	
	12:00 - 13:00	41.8		59.6	20.8	
	13:00 - 14:00	45.7		62.2	21.5	
	14:00 - 15:00	45.5		63.2	21.3	
	15:00 - 16:00	43.4		60.6	22.6	
	16:00 - 17:00	46.4		63.5	24.1	
	17:00 - 18:00	46.4		64.5	24.2	
Night	18:00 - 19:00	44.9	65	61.1	24.5	
	19:00 - 20:00	44.5		60.2	24.1	
	20:00 - 21:00	40.3		55.4	22.6	
	21:00 - 22:00	39.1		55.1	21.6	
	22:00 - 23:00	36.5		50.6	21.2	
	23:00 - 00:00	34.4		48.9	20.1	
	00:00 - 1:00	35.0		49.2	20.4	
	1:00 - 2:00	34.6		49.1	20.5	
	2:00 - 3:00	34.6		50.2	20.6	
	3:00 - 4:00	40.8		56.4	22.6	
	4:00 - 5:00	39.7		51.3	20.8	
	5:00 - 6:00	40.3		55.2	20.3	
24 hours Average		41.50		57.35	22.08	

Remark1. The unit of Vibration data in this table is db., Vibration Level Meter VM - 53A.

Remark2. Vibration level standard is Environmental Quality Standard of Japan

បានឃើញនៅ ថ្ងៃទី ០៤ ខែ មេសា ឆ្នាំ២០១៣

ប្រធាននាយកដ្ឋាន

Was seen on date:

Director Department

ហេង-ណារ៉េត

ចេញអោយនៅ ថ្ងៃទី ០៤ ខែ មេសា ឆ្នាំ២០១៣

ប្រធានការិយាល័យ

Date of Issue:

Laboratory Chief

សេក-រដ្ឋ

លេខ ៤៨ វុក្មវិថី ព្រះសីហនុ ទន្លេបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ ទូរស័ព្ទលេខ: ០២៣ ២១០ ៤៩២

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យគ្រប់គ្រងបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ
Ministry of Environment
Department of Pollution Control
Laboratory Office

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ
Kingdom of Cambodia
Nation Religion King

លេខ /N°/:.....

ព្រឹត្តិបត្រលទ្ធផលវិភាគ
Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)

Point: Construction: Point No.3 (100m from the Road), ភូមិត្រពាំងពោធ៍ ឃុំពង្រ ស្រុកលោរប៉ៀរ ខេត្តកំពង់ឆ្នាំង, No.97 Kilometer Post, X=458459, Y=1356332

Table Results of Measuring Vibration Level

Date: 21/03/2013

	Survey Period	Vibration Level dB				Remarks
		Leq	Standard(Leq)	Lmax	Lmin	
Day	6:00 - 7:00	26.7	65	47.4	16.4	
	7:00 - 8:00	25.8		43.1	16.8	
	8:00 - 9:00	31.2		48.3	16.8	
	9:00 - 10:00	29.6		41.2	18.0	
	10:00 - 11:00	29.7		44	19.5	
	11:00 - 12:00	32.4		45.4	19.5	
	12:00 - 13:00	36.5		49	19.6	
	13:00 - 14:00	36.5		51.4	17.9	
	14:00 - 15:00	35.4		47.8	19.2	
	15:00 - 16:00	33.6		52	22.3	
	16:00 - 17:00	31.4		50.4	21.1	
	17:00 - 18:00	30.7		44.9	20.3	
Night	18:00 - 19:00	31.8	60	45.0	20.6	
	19:00 - 20:00	28.4		43.5	16.7	
	20:00 - 21:00	28.1		44.6	17.0	
	21:00 - 22:00	23.7		41.6	16.9	
	22:00 - 23:00	24.6		42.3	16.6	
	23:00 - 00:00	23.8		41.5	16.3	
	00:00 - 1:00	22.9		39.7	16.1	
	1:00 - 2:00	22.9		40.6	16.6	
	2:00 - 3:00	23.8		45.3	16.0	
	3:00 - 4:00	24.5		46.7	16.8	
	4:00 - 5:00	25.5		42.3	16.4	
	5:00 - 6:00	25.3		45.1	16.3	
24 hours Average		28.53	-	45.13	17.90	

Remark1.The unit of Vibration data in this table is db., Vibration Level Meter VM - 53A.

Remark2.Vibration level standard is Environmental Quality Standard of Japan

ចេញអោយនៅ ថ្ងៃទី ខែ ឆ្នាំ២០១៣

ប្រធានការិយាល័យ

Date of Issue:

Laboratory Chief

បានឃើញនៅ ថ្ងៃទី ខែ ឆ្នាំ២០១៣

ប្រធាននាយកដ្ឋាន

Was seen on date:

Director Department

លេខ ៤៨ ផ្លូវវិថី ព្រះសីហនុ ទន្លេបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ ទូរស័ព្ទលេខ: ០២៣ ២១០ ៤៩២

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យគ្រោះមហន្តរាយបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ
Ministry of Environment
Department of Pollution Control
Laboratory Office

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ
Kingdom of Cambodia
Nation Religion King

លេខ /N°/:.....

ព្រឹត្តិបត្រលទ្ធផលវិភាគ
Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)

Point: Construction: Point No.4 (Road Side) ភូមិក្បាលដំរី ឃុំអន្សារចំបក់ ស្រុកក្រគរ ខេត្តពោធិ៍សាត់, No.135 Kilometer Post, X=431323, Y=1379108

Table Results of Measuring Vibration Level

Date: 22/03/2013

	Survey Period	Vibration Level dB				Remarks
		Leq	Standard(Leq)	Lmax	Lmin	
Day	6:00 - 7:00	42.8	65	56.1	18.1	
	7:00 - 8:00	44.7		56.9	17.2	
	8:00 - 9:00	41.1		57	18.5	
	9:00 - 10:00	41.1		56.9	18.5	
	10:00 - 11:00	40.4		55.3	18.9	
	11:00 - 12:00	43.1		58.9	18.3	
	12:00 - 13:00	39.5		57.2	17.2	
	13:00 - 14:00	40.6		57.6	18.2	
	14:00 - 15:00	41.9		57.1	17.7	
	15:00 - 16:00	41.4		58.7	16.0	
	16:00 - 17:00	40.9		56.6	18.0	
	17:00 - 18:00	42.9		56.8	18.4	
Night	18:00 - 19:00	42.8	60	56.5	17.1	
	19:00 - 20:00	41.0		54.5	17.7	
	20:00 - 21:00	39.6		49.6	18.6	
	21:00 - 22:00	40.6		55.4	16.3	
	22:00 - 23:00	40.1		51.4	16.2	
	23:00 - 00:00	39.3		50.7	18.8	
	00:00 - 1:00	38.3		51.9	18.9	
	1:00 - 2:00	38.7		52.5	18.8	
	2:00 - 3:00	40.6		54.3	18.7	
	3:00 - 4:00	39.8		55.5	18.6	
	4:00 - 5:00	40.2		56.5	18.5	
	5:00 - 6:00	41.6		56.3	18.4	
24 hours Average		40.96		55.43	17.98	

Remark1.The unit of Vibration data in this table is db., Vibration Level Meter VM - 53A.

Remark2.Vibration level standard is Environmental Quality Standard of Japan

ចេញអោយនៅថ្ងៃទី ០៤ ខែ ឆ្នាំ២០១៣

ប្រធានការិយាល័យ

Date of Issue:

Laboratory Chief

បានឃើញនៅថ្ងៃទី ០៤ ខែ ឆ្នាំ២០១៣

ប្រធាននាយកដ្ឋាន

Was seen on date:

Director Department

លេខ ៤៨ ផ្លូវវិថី ព្រះសីហនុ ទន្លេបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ ទូរស័ព្ទលេខ: ០២៣ ២១០ ៤៩២

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ
Kingdom of Cambodia
Nation Religion King

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ
Ministry of Environment
Department of Pollution Control
Laboratory Office

លេខ /N°:..........

ព្រឹត្តិបត្រលទ្ធផលវិភាគ
Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)

Point: Construction: Point No.4 (100m from the Road) ភូមិក្បាលដំរី ឃុំអន្សាចំបក់ ស្រុកក្រគរ ខេត្តពោធិ៍សាត់ No.135 Kilometer Post, X=431363, Y=1379192

Table Results of Measuring Vibration Level

Date: 23/03/2013

	Survey Period	Vibration Level dB				Remarks
		Leq	Standard(Leq)	Lmax	Lmin	
Day	6:00 - 7:00	36.4	65	59.4	18.4	
	7:00 - 8:00	32.2		45.8	17.3	
	8:00 - 9:00	30.5		43.3	16.6	
	9:00 - 10:00	34.0		51.8	16.1	
	10:00 - 11:00	37.7		48.7	15.9	
	11:00 - 12:00	34.1		50.0	16.4	
	12:00 - 13:00	37.0		55.5	16.7	
	13:00 - 14:00	37.1		49.5	17.1	
	14:00 - 15:00	35.5		49.6	16.2	
	15:00 - 16:00	34.1		47.9	16.0	
	16:00 - 17:00	35.9		49.0	17.4	
	17:00 - 18:00	30.2		43.9	15.9	
Night	18:00 - 19:00	28.6	60	39.7	15.8	
	19:00 - 20:00	28.8		43.0	15.2	
	20:00 - 21:00	28.1		43.8	15.5	
	21:00 - 22:00	27.6		41.5	15.6	
	22:00 - 23:00	28.8		41.9	15.7	
	23:00 - 00:00	27.5		42.0	15.5	
	00:00 - 1:00	29.6		43.7	15.6	
	1:00 - 2:00	26.3		39.2	15.0	
	2:00 - 3:00	27.1		40.3	15.3	
	3:00 - 4:00	28.0		41.6	15.2	
	4:00 - 5:00	28.4		41.7	15.4	
	5:00 - 6:00	29.8		43.2	16.0	
24 hours Average		31.39	-	45.67	16.08	

Remark1.The unit of Vibration data in this table is db., Vibration Level Meter VM - 53A.

Remark2.Vibration level standard is Environmental Quality Standard of Japan

បានឃើញនៅ ថ្ងៃទី ០៤ ខែ មេសា ឆ្នាំ២០១៣
ប្រធាននាយកដ្ឋាន
Was seen on date:
Director Department

ចេញអោយនៅ ថ្ងៃទី ០៤ ខែ មេសា ឆ្នាំ២០១៣
ប្រធានការិយាល័យ
Date of Issue:
Laboratory Chief

លេខ ៤៨ រុក្ខវិថី ព្រះសីហនុ ទន្លេបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ ទូរស័ព្ទលេខ: ០២៣ ២១០ ៤៩២

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

Kingdom of Cambodia
Nation Religion King

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ

Ministry of Environment
Department of Pollution Control
Laboratory Office

លេខ /N°:.....

ព្រឹត្តិបត្រលទ្ធផលវិភាគ

Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)

Point: Construction: **Point No.5** (Road Side) ភូមិកណ្តាស ឃុំបឹងកន្លួត ស្រុកក្រគរ ខេត្តពោធិ៍សាត់, No.170 Kilometer Post, X=398515, Y=1385052

Table Results of Measuring Vibration Level

Date: 25/03/2013

	Survey Period	Vibration Level dB				Remarks
		Leq	Standard(Leq)	Lmax	Lmin	
Day	6:00 - 7:00	40.3	65	58.8	17.1	
	7:00 - 8:00	40.4		60.9	19.7	
	8:00 - 9:00	41.6		58.7	19.3	
	9:00 - 10:00	42.3		58.6	19.6	
	10:00 - 11:00	40.2		58.9	19.4	
	11:00 - 12:00	39.1		56.6	19.3	
	12:00 - 13:00	44.1		58.3	20.2	
	13:00 - 14:00	41.4		61.2	21.1	
	14:00 - 15:00	40.1		58.6	20.8	
	15:00 - 16:00	40.5		57.6	21.5	
	16:00 - 17:00	38.8		58.0	20.0	
	17:00 - 18:00	38.8		57.8	19.0	
Night	18:00 - 19:00	38.1	60	56.3	16.7	
	19:00 - 20:00	37.3		55.2	17.2	
	20:00 - 21:00	38.4		58.9	19.6	
	21:00 - 22:00	29.9		51.4	17.4	
	22:00 - 23:00	33.1		53.5	17.5	
	23:00 - 00:00	34.5		51.7	17.3	
	00:00 - 1:00	35.9		53.8	17.1	
	1:00 - 2:00	36.2		54.1	17.5	
	2:00 - 3:00	35.4		52.1	17.3	
	3:00 - 4:00	35.7		56.1	17.4	
	4:00 - 5:00	35.5		52.3	17.6	
	5:00 - 6:00	36.1		57.7	17.2	
24 hours Average		38.07	-	56.55	18.62	

Remark1.The unit of Vibration data in this table is db., Vibration Level Meter VM - 53A.

Remark2.Vibration level standard is Environmental Quality Standard of Japan

ចេញអោយនៅថ្ងៃទី ខែ ឆ្នាំ២០១៣

ប្រធានការិយាល័យ

Date of Issue:

Laboratory Chief

បានឃើញនៅថ្ងៃទី ខែ ឆ្នាំ២០១៣

ប្រធាននាយកដ្ឋាន

Was seen on date:

Director Department

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

Kingdom of Cambodia

Nation Religion King

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ

Ministry of Environment
Department of Pollution Control
Laboratory Office

លេខ /N°/: ០៦ ៣.ស

ព្រឹត្តិបត្រលទ្ធផលវិភាគ

Analysis Report

Name of Company: ក្រុមហ៊ុន Key Consultants (Cambodia)

Point: Construction: **Point No.5** (100m from the Road) ភូមិកណ្ដុរស ឃុំបឹងកន្ទួត ស្រុកក្រគរ ខេត្តពោធិ៍សាត់, No.170 Kilometer Post, X=398513, Y=1385155

Table Results of Measuring Vibration Level

Date: 26/03/2013

	Survey Period	Vibration Level dB				Remarks
		Leq	Standard (Leq)	Lmax	Lmin	
Day	6:00 - 7:00	21.8	65	39.1	14.5	
	7:00 - 8:00	20.4		32.6	14.4	
	8:00 - 9:00	20.1		41.3	14.5	
	9:00 - 10:00	20.4		33.2	15.0	
	10:00 - 11:00	23.0		39.3	15.4	
	11:00 - 12:00	22.4		39.7	15.6	
	12:00 - 13:00	21.9		40.0	15.8	
	13:00 - 14:00	25.5		36.2	16.9	
	14:00 - 15:00	22.2		43.2	14.9	
	15:00 - 16:00	23.2		42.9	14.8	
	16:00 - 17:00	22.1		40.0	14.8	
	17:00 - 18:00	23.1		41.5	15.5	
Night	18:00 - 19:00	22.4	60	42.9	15.1	
	19:00 - 20:00	21.2		38.3	15.5	
	20:00 - 21:00	20.1		36.6	14.8	
	21:00 - 22:00	19.9		37.2	14.5	
	22:00 - 23:00	19.6		35.4	14.4	
	23:00 - 00:00	20.2		36.3	14.8	
	00:00 - 1:00	20.1		38.2	14.9	
	1:00 - 2:00	19.7		38.9	15.0	
	2:00 - 3:00	20.2		38.8	14.7	
	3:00 - 4:00	18.9		35.3	14.3	
	4:00 - 5:00	19.4		33.5	14.5	
	5:00 - 6:00	20.5		36.5	14.1	
24 hours Average		21.18		38.20	14.95	

Remark1. The unit of Vibration data in this table is db., Vibration Level Meter VM - 53A.

Remark2. Vibration level standard is Environmental Quality Standard of Japan

បានឃើញនៅ ថ្ងៃទី ០៤ ខែ មេសា ឆ្នាំ២០១៣

ប្រធាននាយកដ្ឋាន

Was seen on date:

Director Department

ហេង·ណារ៉េត

ចេញអោយនៅ ថ្ងៃទី ០៤ ខែ មេសា ឆ្នាំ២០១៣

ប្រធានការិយាល័យ

Date of Issue:

Laboratory Chief

ឆេក_វេជ្ជ

លេខ ៤៨ វិថី ព្រះសីហនុ ទន្លេបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ ទូរស័ព្ទលេខ: ០២៣ ២១០ ៤៩២

PICTURES OF AIR QUALITY, NOISE AND VIBRATION SURVEYS DURING THE DRY SEASON

PICTURES OF AIR QUALITY SURVEY IN THE RAINY SEASON

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ
Ministry of Environment
Department of Pollution Control
Laboratory Office

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ
Kingdom of Cambodia
Nation Religion King

លេខ /N°/:.....

ព្រឹត្តិបត្រលទ្ធផលវិភាគ
Analysis Report

ប្រភពសំណាក/Sample Source : ក្រុមហ៊ុន Key Consultants (Cambodia)
ថ្ងៃ ខែ ឆ្នាំទទួលសំណាក/Date: 22/03/2013
ប្រភេទសំណាក/Type of Sample: Sample (WQ 1), Tonle Sap River, X= 478,814.68, Y=1,306,030.04

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសាស្ត្រវិភាគ/ឧបករណ៍ Reference Method
1	Total Suspended Solid (TSS)	mg/l	86.00	25-100	Method 2540 D
2	Biochemical Oxygen Demand (BOD)	mg/l	2.25	1.0-10	Method 5210 B
3	Chemical Oxygen Demand (COD)	mg/l	5.00	-	Method JIS K 0102
4	Total Coliform	MPN/100 ml	$2.4x10^3$	< 5000	Method NF T 90-421

Note: ការយកសំណាក ការរក្សាទុក និងការដឹកជញ្ជូនសំណាកទឹកមកមន្ទីពិសោធន៍ ក្រុមហ៊ុន(គំរោង)អនុវត្តដោយខ្លួនឯង។

ចេញអោយនៅ ថ្ងៃទី ខែ ឆ្នាំ២០១៣
ប្រធានការិយាល័យ
Date of Issue:
Laboratory Chief

បានឃើញនៅ ថ្ងៃទី ខែ ឆ្នាំ២០១៣
ប្រធាននាយកដ្ឋាន
Was seen on date:
Director Department

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

Kingdom of Cambodia
Nation Religion King

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យគុណភាពបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ

Ministry of Environment
Department of Pollution Control
Laboratory Office

លេខ /N°/:.....

ព្រឹត្តិបត្រលទ្ធផលវិភាគ
Analysis Report

ប្រភពសំណាក/Sample Source : ក្រុមហ៊ុន Key Consultants (Cambodia)
ថ្ងៃ ខែ ឆ្នាំទទួលសំណាក/Date: 22/03/2013
ប្រភេទសំណាក/Type of Sample: Sample (WQ 2), Boeng Sampov Meas, A reservoir in Kampong Luong Commune, Kandal Province
X= 477,953.12, Y=1,306,655.31

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសាស្ត្រវិភាគ/ឯកសារយោង Reference Method
1	Total Suspended Solid (TSS)	mg/l	112.00	1.0-15	Method 2540 D
2	Biochemical Oxygen Demand (BOD)	mg/l	1.25	-	Method 5210 B
3	Chemical Oxygen Demand (COD)	mg/l	3.92	1.0-8.0	Method JIS K 0102
4	Total Coliform	MPN/100 ml	74	< 1000	Method NF T 90-421

Note: ការយកសំណាក ការក្សារទុក និងការដឹកជញ្ជូនសំណាកទឹកមកមន្ទីពិសោធន៍ ក្រុមហ៊ុន(គំរោង)អនុវត្តដោយខ្លួនឯង។

ចេញអោយនៅ ថ្ងៃទី ០៤ ខែ មេសា ឆ្នាំ២០១៣
ប្រធានការិយាល័យ
Date of Issue:
Laboratory Chief

បានឃើញនៅ ថ្ងៃទី ០៤ ខែ មេសា ឆ្នាំ២០១៣
ប្រធាននាយកដ្ឋាន
Was seen on date:
Director Department

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ
Ministry of Environment
Department of Pollution Control
Laboratory Office

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ
Kingdom of Cambodia
Nation Religion King

លេខ /N°:.....

ព្រឹត្តិបត្រលទ្ធផលវិភាគ
Analysis Report

ប្រភពសំណាក/Sample Source : ក្រុមហ៊ុន Key Consultants (Cambodia)
ថ្ងៃ ខែ ឆ្នាំទទួលសំណាក/Date: 22/03/2013
ប្រភេទសំណាក/Type of Sample: Sample (WQ 3), River at provincial boundary between Kampong Speu and Kampong Chhnang Province
X= 471,276.06, Y=1,307,347.92

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសាស្ត្រវិនាត/ឯកសារយោង Reference Method
1	Total Suspended Solid (TSS)	mg/l	110.00	1.0-15	Method 2540 D
2	Biochemical Oxygen Demand (BOD)	mg/l	3.00	-	Method 5210 B
3	Chemical Oxygen Demand (COD)	mg/l	10.19	1.0-8.0	Method JIS K 0102
4	Total Coliform	MPN/100 ml	$2.4x10^3$	< 1000	Method NF T 90-421

Note: ការយកសំណាក ការរក្សារទុក និងការដឹកជញ្ជូនសំណាកទឹកមកមន្ទីពិសោធន៍ ក្រុមហ៊ុន(គំរោង)អនុវត្តដោយខ្លួនឯង។

ចេញអោយនៅថ្ងៃទី ខែ ឆ្នាំ២០១៣
ប្រធានការិយាល័យ
Date of Issue:
Laboratory Chief

បានឃើញនៅថ្ងៃទី ខែ ឆ្នាំ២០១៣
ប្រធាននាយកដ្ឋាន
Was seen on date:
Director Department

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

Kingdom of Cambodia
Nation Religion King

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ

Ministry of Environment
Department of Pollution Control
Laboratory Office

លេខ /N°:.....

ព្រឹត្តិបត្រលទ្ធផលវិភាគ

Analysis Report

ប្រភពសំណាក/Sample Source : ក្រុមហ៊ុន Key Consultants (Cambodia)
ថ្ងៃ ខែ ឆ្នាំទទួលសំណាក/Date: 22/03/2013
ប្រភេទសំណាក/Type of Sample: Sample (WQ 4), A channel in Svay Commune, Kampong Chhnang Province, X= 470,476.38, Y=1,308,474.30

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសាស្ត្រវិភាគ/ឯកសារយោង Reference Method
1	Total Suspended Solid (TSS)	mg/l	338.00	1.0-15	Method 2540 D
2	Biochemical Oxygen Demand (BOD)	mg/l	3.60	-	Method 5210 B
3	Chemical Oxygen Demand (COD)	mg/l	6.27	1.0-8.0	Method JIS K 0102
4	Total Coliform	MPN/100 ml	$9.3x10^2$	< 1000	Method NF T 90-421

Note: ការយកសំណាក ការរក្សារទុក និងការដឹកជញ្ជូនសំណាកទឹកមកមន្ទីពិសោធន៍ ក្រុមហ៊ុន(គំរោង)អនុវត្តដោយខ្លួនឯង។

ចេញអោយនៅថ្ងៃទី ០៤ ខែ ឆ្នាំ២០១៣

ប្រធានការិយាល័យ
Date of Issue:
Laboratory Chief

បានឃើញនៅថ្ងៃទី ០៤ ខែ ឆ្នាំ២០១៣
ប្រធាននាយកដ្ឋាន
Was seen on date:
Director Department

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ
Ministry of Environment
Department of Pollution Control
Laboratory Office

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ
Kingdom of Cambodia
Nation Religion King

លេខ /N°/:......៦៤......៣ស..........

ព្រឹត្តិប័ត្រលទ្ធផលវិភាគ
Analysis Report

ប្រភពសំណាក/Sample Source : ក្រុមហ៊ុន Key Consultants (Cambodia)
ថ្ងៃ ខែ ឆ្នាំទទួលសំណាក/Date: 22/03/2013
ប្រភេទសំណាក/Type of Sample: Sample (WQ 5), Cheung Kreav River in Chrey Bak Commune, Kampong Chhnang Province
X= 463,183.40, Y=1,347,415.02

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសាស្ត្រវិភាគ/ឧបករណ៍ Reference Method
1	Total Suspended Solid (TSS)	mg/l	132.00	1.0-15	Method 2540 D
2	Biochemical Oxygen Demand (BOD)	mg/l	2.20	-	Method 5210 B
3	Chemical Oxygen Demand (COD)	mg/l	5.35	1.0-8.0	Method JIS K 0102
4	Total Coliform	MPN/100 ml	$4.6x10^3$	< 1000	Method NF T 90-421

Note: ការយកសំណាក ការរក្សាទុក និងការដឹកជញ្ជូនសំណាកទឹកមកមន្ទីរពិសោធន៍ ក្រុមហ៊ុន(តំរោង)អនុវត្តដោយខ្លួនឯង។

ចេញអោយនៅ ថ្ងៃទី ០៤ ខែ មេសា ឆ្នាំ២០១៣
ប្រធានការិយាល័យ
Date of Issue:
Laboratory Chief

សេក_វឌ្ឍ

បានឃើញនៅ ថ្ងៃទី ០៤ ខែ មេសា ឆ្នាំ២០១៣
ប្រធាននាយកដ្ឋាន
Was seen on date:
Director Department

មោខ-ណារ៉ាវ

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ
Kingdom of Cambodia
Nation Religion King

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ
Ministry of Environment
Department of Pollution Control
Laboratory Office

លេខ /N°:......០៥......៣៣..........

ព្រឹត្តិប័ត្រលទ្ធផលវិភាគ
Analysis Report

ប្រភពសំណាក/Sample Source : ក្រុមហ៊ុន Key Consultants (Cambodia)
ថ្ងៃ ខែ ឆ្នាំទទួលសំណាក/Date: 22/03/2013
ប្រភេទសំណាក/Type of Sample: Sample (WQ 6), Phnom Lech Reservoir in Pongro Commune, Kampong Chhnang Province
X= 458,806.02, Y=1,354,741.45

ល.រ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសាស្ត្រវិភាគ/ឧបករណ៍ Reference Method
1	Total Suspended Solid (TSS)	mg/l	66.00	1.0-15	Method 2540 D
2	Biochemical Oxygen Demand (BOD)	mg/l	1.25	-	Method 5210 B
3	Chemical Oxygen Demand (COD)	mg/l	5.48	1.0-8.0	Method JIS K 0102
4	Total Coliform	MPN/100 ml	$4.6x10^3$	< 1000	Method NF T 90-421

Note: ការយកសំណាក ការរក្សាទុក និងការដឹកជញ្ជូនសំណាកទឹកមកមន្ទីរពិសោធន៍ ក្រុមហ៊ុន(គំរោង)អនុវត្តដោយខ្លួនឯង។

បានឃើញនៅ ថ្ងៃទី ០៤ ខែ មេសា ឆ្នាំ២០១៣
ប្រធាននាយកដ្ឋាន
Was seen on date:
Director Department

ទេព-ណារ៉ៃ

ចេញអោយនៅ ថ្ងៃទី ០៤ ខែ មេសា ឆ្នាំ២០១៣
ប្រធានការិយាល័យ
Date of Issue:
Laboratory Chief

សេក_វឌ្ឍ

លេខ ៤៨ វិថី ព្រះសីហនុ ទន្លេបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ ទូរស័ព្ទលេខ: ០២៣ ២១០ ៤៩២

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

Kingdom of Cambodia
Nation Religion King

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ

Ministry of Environment
Department of Pollution Control
Laboratory Office

លេខ /N°:.....

ព្រឹត្តិបត្រលទ្ធផលវិភាគ
Analysis Report

ប្រភពសំណាក/Sample Source : ក្រុមហ៊ុន Key Consultants (Cambodia)
ថ្ងៃ ខែ ឆ្នាំទទួលសំណាក/Date: 22/03/2013
ប្រភេទសំណាក/Type of Sample: Sample (WQ 7), Ou Prong River in Prasnoeb Commune, Kampong Chhnang Province
X= 451,890.22, Y=1,362,012.76

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសាស្ត្រវិភាគ/ឯកសារយោង Reference Method
1	Total Suspended Solid (TSS)	mg/l	60.00	1.0-15	Method 2540 D
2	Biochemical Oxygen Demand (BOD)	mg/l	1.20	-	Method 5210 B
3	Chemical Oxygen Demand (COD)	mg/l	2.17	1.0-8.0	Method JIS K 0102
4	Total Coliform	MPN/100 ml	$2.4x10^3$	< 1000	Method NF T 90-421

Note: ការយកសំណាក ការរក្សារទុក និងការដឹកជញ្ជូនសំណាកទឹកមកមន្ទីពិសោធន៍ ក្រុមហ៊ុន(គំរោង)អនុវត្តដោយខ្លួនឯង។

ចេញអោយនៅ ថ្ងៃទី ០៤ ខែ មីនា ឆ្នាំ២០១៣
ប្រធានការិយាល័យ
Date of Issue:
Laboratory Chief

បានឃើញនៅ ថ្ងៃទី ០៤ ខែ មីនា ឆ្នាំ២០១៣
ប្រធាននាយដ្ឋាន
Was seen on date:
Director Department

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ
Kingdom of Cambodia
Nation Religion King

ក្រសួងបរិស្ថាន
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Ministry of Environment
Department of Pollution Control
Laboratory Office

លេខ /N°/:.......២៧.....១៦.........

ព្រឹត្តិបត្រលទ្ធផលវិភាគ
Analysis Report

ប្រភពសំណាក/Sample Source : ក្រុមហ៊ុន Key Consultants (Cambodia)
ថ្ងៃ ខែ ឆ្នាំទទួលសំណាក/Date: 22/03/2013
ប្រភេទសំណាក/Type of Sample: Sample (WQ 8), Bonbou River in Phumi Phasar Town, Kampong Chhnang Province
X= 444,120.67, Y=1,369,136.33

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសាស្ត្រវិភាគ/ឧបករណ៍ Reference Method
1	Total Suspended Solid (TSS)	mg/l	76.00	25-100	Method 2540 D
2	Biochemical Oxygen Demand (BOD)	mg/l	0.85	1.0-10	Method 5210 B
3	Chemical Oxygen Demand (COD)	mg/l	1.98	-	Method JIS K 0102
4	Total Coliform	MPN/100 ml	$1.1x10^5$	< 5000	Method NF T 90-421

Note: ការយកសំណាក ការរក្សាទុក និងការដឹកជញ្ជូនសំណាកទឹកមកមន្ទីរពិសោធន៍ ក្រុមហ៊ុន(គំរោង)អនុវត្តដោយខ្លួនឯង។

ចេញអោយនៅ ថ្ងៃទី ០៤ ខែ មេសា ឆ្នាំ២០១៣
ប្រធានការិយាល័យ
Date of Issue:
Laboratory Chief

ឆេក-រដ្ឋ

បានឃើញនៅ ថ្ងៃទី ០៤ ខែ មេសា ឆ្នាំ២០១៣
ប្រធាននាយកដ្ឋាន
Was seen on date:
Director Department

ហេង-ណារ៉េត

លេខ ៤៨ វិថី ព្រះសីហនុ ទន្លេបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ ទូរស័ព្ទលេខ: ០២៣ ២១០ ៤៩២

ព្រះរាជាណាចក្រកម្ពុជា
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Kingdom of Cambodia
Nation Religion King

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ
Ministry of Environment
Department of Pollution Control
Laboratory Office

លេខ / N°/: ២៨ ៣៩

ព្រឹត្តិបត្រលទ្ធផលវិភាគ
Analysis Report

ប្រភពសំណាក/Sample Source : ក្រុមហ៊ុន Key Consultants (Cambodia)
ថ្ងៃ ខែ ឆ្នាំទទួលសំណាក/Date: 22/03/2013
ប្រភេទសំណាក/Type of Sample: Sample (WQ 9), Ou Chankok River in Tnot Chum Commune, Pursat Province
X= 397,245.56, Y=1,384,996.23

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសាស្ត្រវិភាគ/ឯកសារយោង Reference Method
1	Total Suspended Solid (TSS)	mg/l	142.00	25-100	Method 2540 D
2	Biochemical Oxygen Demand (BOD)	mg/l	2.40	1.0-10	Method 5210 B
3	Chemical Oxygen Demand (COD)	mg/l	7.05	-	Method JIS K 0102
4	Total Coliform	MPN/100 ml	$1.1x10^5$	< 5000	Method NF T 90-421

Note: ការយកសំណាក ការរក្សាទុក និងការដឹកជញ្ជូនសំណាកទឹកមកមន្ទីរពិសោធន៍ ក្រុមហ៊ុន(គំរោង)អនុវត្តដោយខ្លួនឯង។

ចេញអោយនៅ ថ្ងៃទី ០៤ ខែ មេសា ឆ្នាំ២០១៣
ប្រធានការិយាល័យ
Date of Issue:
Laboratory Chief
សេក_រដ្ឋ

បានឃើញនៅ ថ្ងៃទី ០៤ ខែ មេសា ឆ្នាំ២០១៣
ប្រធាននាយកដ្ឋាន
Was seen on date:
Director Department
ហេង-ណារ៉េត

លេខ ៤៨ ព្រះវិថី ព្រះសីហនុ ទន្លេបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ ទូរស័ព្ទលេខ: ០២៣ ២១០ ៤៩២

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ
Kingdom of Cambodia
Nation Religion King

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ
Ministry of Environment
Department of Pollution Control
Laboratory Office

លេខ /N°/: ៥៩ ... ៣៩

ព្រឹត្តិបត្រលទ្ធផលវិភាគ
Analysis Report

ប្រភពសំណាក/Sample Source : ក្រុមហ៊ុន Key Consultants (Cambodia)
ថ្ងៃ ខែ ឆ្នាំទទួលសំណាក/Date: 22/03/2013
ប្រភេទសំណាក/Type of Sample: Sample (WQ 10), Pursat River Water, Pursat Province, X= 382,588.92, Y=1,385,653.34

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសាស្ត្រវិភាគ/ឧបករណ៍ Reference Method
1	Total Suspended Solid (TSS)	mg/l	78.00	25-100	Method 2540 D
2	Biochemical Oxygen Demand (BOD)	mg/l	2.65	1.0-10	Method 5210 B
3	Chemical Oxygen Demand (COD)	mg/l	3.74	-	Method JIS K 0102
4	Total Coliform	MPN/100 ml	$4.6x10^4$	< 5000	Method NF T 90-421

Note: ការយកសំណាក ការរក្សាទុក និងការដឹកជញ្ជូនសំណាកទឹកមកមន្ទីរពិសោធន៍ ក្រុមហ៊ុន(គំរោង)អនុវត្តដោយខ្លួនឯង។

បានឃើញនៅ ថ្ងៃទី ០៤ ខែ មេសា ឆ្នាំ២០១៣
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Was seen on date:
Director Department

ហេង-ណារ៉េត

ចេញអោយនៅ ថ្ងៃទី ០៤ ខែ មេសា ឆ្នាំ២០១៣
ប្រធានការិយាល័យ
Date of Issue:
Laboratory Chief

សេក_រដ្ឋ

លេខ ៤៨ ព្រះវិថី ព្រះសីហនុ ទន្លេបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ ទូរស័ព្ទលេខៈ ០២៣ ២១០ ៤៩២

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

Kingdom of Cambodia
Nation Religion King

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ

Ministry of Environment
Department of Pollution Control
Laboratory Office

លេខ /N°:...

ព្រឹត្តិបត្រលទ្ធផលវិភាគ

Analysis Report

ប្រភពសំណាក/Sample Source : ក្រុមហ៊ុន Key Consultants (Cambodia)
ថ្ងៃ ខែ ឆ្នាំទទួលសំណាក/Date: 05/07/2013
ប្រភេទសំណាក/Type of Sample: Sample (WQ 1), Tonle Sap River, X= 478,814.68, Y=1,306,030.04

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសាស្ត្រវិភាគ Reference Method
1	Total Suspended Solid (TSS)	mg/l	162.00	25-100	Method 2540 D
2	Biochemical Oxygen Demand (BOD)	mg/l	0.70	1.0-10	Method 5210 B
3	Chemical Oxygen Demand (COD)	mg/l	1.57	-	Method JIS K 0102
4	Total Coliform	MPN/100 ml	$1.5x10^4$	< 5000	Method NF T 90-421

Note: ការយកសំណាក ការរក្សាទុក និងការដឹកជញ្ជូនសំណាកទឹកបម្រុងពិសោធន៍ ក្រុមហ៊ុន(គំហាង)អនុវត្តដោយខ្លួនឯង។

ចេញអោយនៅ ថ្ងៃទី ខែ ឆ្នាំ២០១៣
ប្រធានការិយាល័យ
Date of Issue:
Laboratory Chief

បានឃើញនៅ ថ្ងៃទី ខែ ឆ្នាំ២០១៣
ប្រធាននាយកដ្ឋាន
Was seen on date:
Director Department

ព្រះរាជាណាចក្រកម្ពុជា
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ក្រសួងបរិស្ថាន
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លេខ /N°/: ៦៨ ០៣ ...

ព្រឹត្តិបត្រលទ្ធផលវិភាគ
Analysis Report

ប្រភពសំណាក/Sample Source : ក្រុមហ៊ុន Key Consultants (Cambodia)
ថ្ងៃ ខែ ឆ្នាំទទួលសំណាក/Date: 05/07/2013
ប្រភេទសំណាក/Type of Sample: Sample (WQ 2), Boeng Sampov Meas, A reservoir in Kampong Luong Commune, Kandal Province
X= 477,953.12, Y=1,306,655.31

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសាស្ត្រវិភាគ Reference Method
1	Total Suspended Solid (TSS)	mg/l	94.00	1.0-15	Method 2540 D
2	Biochemical Oxygen Demand (BOD)	mg/l	1.06	-	Method 5210 B
3	Chemical Oxygen Demand (COD)	mg/l	1.76	1.0-8.0	Method JIS K 0102
4	Total Coliform	MPN/100 ml	94	< 1000	Method NF T 90-421

Note: ការយកសំណាក ការរក្សាទុក និងការដឹកជញ្ជូនសំណាកទឹកមកមន្ទីរពិសោធន៍ ក្រុមហ៊ុន(គំរោង)អនុវត្តដោយខ្លួនឯង។

បានឃើញនៅ ថ្ងៃទី ០៤ ខែ កក្កដា ឆ្នាំ២០១៣
ប្រធាននាយកដ្ឋាន
Was seen on date:
Director Department

ចេញអោយនៅ ថ្ងៃទី ០៤ ខែ កក្កដា ឆ្នាំ២០១៣
ប្រធានការិយាល័យ
Date of Issue:
Laboratory Chief

លេខ ៤៨ ព្រះវិថី ព្រះសីហនុ ទន្លេបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ ទូរស័ព្ទលេខ: ០២៣ ២១០ ៤៩២

ក្រសួងបរិស្ថាន
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ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ
Kingdom of Cambodia
Nation Religion King

លេខ /N°/:...០៧០.....០៣.៨៣...............

ព្រឹត្តិប័ត្រលទ្ធផលវិភាគ
Analysis Report

ប្រភពសំណាក/Sample Source : ក្រុមហ៊ុន Key Consultants (Cambodia)

ថ្ងៃ ខែ ឆ្នាំទទួលសំណាក/Date: 05/07/2013

ប្រភេទសំណាក/Type of Sample: Sample (WQ 3), River at provincial boundary between Kampong Speu and Kampong Chhnang Province X= 471,276.06, Y=1,307,347.92

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសាស្ត្រវិភាគ Reference Method
1	Total Suspended Solid (TSS)	mg/l	398.00	10-15	Method 2540 D
2	Biochemical Oxygen Demand (BOD)	mg/l	2.59	-	Method 5210 B
3	Chemical Oxygen Demand (COD)	mg/l	4.70	1.0-8.0	Method JIS K 0102
4	Total Coliform	MPN/100 ml	4.3×10^3	< 1000	Method NF T 90-421

Note: ការយកសំណាក ការរក្សាទុក និងការដឹកជញ្ជូនសំណាកទឹកមកមន្ទីរពិសោធន៍ ក្រុមហ៊ុន(គំរោង)អនុវត្តដោយខ្លួនឯង។

បានឃើញនៅ ថ្ងៃទី ០៤ ខែ កក្កដា ឆ្នាំ២០១៣
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Was seen on date:
Director Department

ហេង-ណារ៉េត

ចេញអោយនៅ ថ្ងៃទី ០៤ ខែ កក្កដា ឆ្នាំ២០១៣
ប្រធានការិយាល័យ
Date of Issue:
Laboratory Chief

ឆេក-រដ្ឋ

លេខ ៤៨ ព្រះវិថី ព្រះសីហនុ ទន្លេបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ ទូរស័ព្ទលេខ: ០២៣ ២១០ ៤៩២

ព្រះរាជាណាចក្រកម្ពុជា
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Kingdom of Cambodia
Nation Religion King

ក្រសួងបរិស្ថាន
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Ministry of Environment
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Laboratory Office

លេខ /N°/:.....

ព្រឹត្តិបត្រលទ្ធផលវិភាគ
Analysis Report

ប្រភពសំណាក/Sample Source : ក្រុមហ៊ុន Key Consultants (Cambodia)
ថ្ងៃ ខែ ឆ្នាំទទួលសំណាក/Date: 05/07/2013
ប្រភេទសំណាក/Type of Sample: Sample (WQ 4), A channel in Svay Commune, Kampong Chhnang Province, X= 470,476.38, Y=1,308,474.30

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសាស្ត្រវិភាគ Reference Method
1	Total Suspended Solid (TSS)	mg/l	398.00	1.0-15	Method 2540 D
2	Biochemical Oxygen Demand (BOD)	mg/l	2.70	-	Method 5210 B
3	Chemical Oxygen Demand (COD)	mg/l	4.90	1.0-8.0	Method JIS K 0102
4	Total Coliform	MPN/100 ml	$2.3x10^3$	< 1000	Method NF T 90-421

Note: ការយកសំណាក ការរក្សារទុក និងការដឹកជញ្ជូនសំណាកទឹកមកមន្ទីពិសោធន៍ ក្រុមហ៊ុន(គំរោង)អនុវត្តដោយខ្លួនឯង។

ចេញអោយនៅ ថ្ងៃទី ខែ ឆ្នាំ២០១៣
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Date of Issue:
Laboratory Chief

ឈ្មោះ

បានឃើញនៅ ថ្ងៃទី ខែ ឆ្នាំ២០១៣
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Director Department

ឈ្មោះ

លេខ ៤៨ វិថី ព្រះសីហនុ ទន្លេបាសាក់ ខណ្ឌចំការមន រាជធានីភ្នំពេញ ទូរស័ព្ទលេខ: ០២៣ ២១០ ៤៩២

ព្រះរាជាណាចក្រកម្ពុជា
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Kingdom of Cambodia
Nation Religion King

ក្រសួងបរិស្ថាន
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Ministry of Environment
Department of Pollution Control
Laboratory Office

លេខ /N°:.....

ព្រឹត្តិបត្រលទ្ធផលទិតាគ

Analysis Report

ប្រភពសំណាក/Sample Source : ក្រុមហ៊ុន Key Consultants (Cambodia)
ថ្ងៃ ខែ ឆ្នាំទទួលសំណាក/Date: 05/07/2013
ប្រភេទសំណាក/Type of Sample: Sample (WQ 5), Cheung Kreav River in Chrey Bak Commune, Kampong Chhnang Province
X= 463,183.40, Y=1,347,415.02

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសាស្ត្រវិភាគ Reference Method
1	Total Suspended Solid (TSS)	mg/l	396.00	1.0-15	Method 2540 D
2	Biochemical Oxygen Demand (BOD)	mg/l	3.95	-	Method 5210 B
3	Chemical Oxygen Demand (COD)	mg/l	5.88	1.0-8.0	Method JIS K 0102
4	Total Coliform	MPN/100 ml	$4.3x10^3$	< 1000	Method NF T 90-421

Note: ការយកសំណាក ការរក្សារទុក និងការដឹកជញ្ជូនសំណាកទឹកមកមន្ទីពិសោធន៍ ក្រុមហ៊ុន(គំរោង)អនុវត្តដោយខ្លួនឯង។

ចេញអោយនៅ ថ្ងៃទី ០៤ ខែ កក្កដា ឆ្នាំ២០១៣
ប្រធានការិយាល័យ
Date of Issue:
Laboratory Chief

ឆេក-រដ្ឋ

បានឃើញនៅ ថ្ងៃទី ០៤ ខែ កក្កដា ឆ្នាំ២០១៣
ប្រធាននាយកដ្ឋាន
Was seen on date:
Director Department

លេខ ៤៨ វិថី ព្រះសីហនុ ទន្លេបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ ទូរស័ព្ទលេខ: ០២៣ ២១០ ៤៨២

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ
Kingdom of Cambodia
Nation Religion King

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ
Ministry of Environment
Department of Pollution Control
Laboratory Office

លេខ /N°/:.....៧៣.....១.៩.........

ព្រឹត្តិបត្រលទ្ធផលវិភាគ
Analysis Report

ប្រភពសំណាក/Sample Source : ក្រុមហ៊ុន Key Consultants (Cambodia)
ថ្ងៃ ខែ ឆ្នាំទទួលសំណាក/Date: 22/03/2013
ប្រភេទសំណាក/Type of Sample: Sample (WQ 6), Phnom Lech Reservoir in Pongro Commune, Kampong Chhnang Province
X= 458,806.02, Y=1,354,741.45

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសាស្ត្រវិភាគ Reference Method
1	Total Suspended Solid (TSS)	mg/l	110.00	1.0-15	Method 2540 D
2	Biochemical Oxygen Demand (BOD)	mg/l	2.95	-	Method 5210 B
3	Chemical Oxygen Demand (COD)	mg/l	7.84	1.0-8.0	Method JIS K 0102
4	Total Coliform	MPN/100 ml	$3.0x10^2$	< 1000	Method NF T 90-421

Note: ការយកសំណាក ការរក្សាទុក និងការដឹកជញ្ជូនសំណាកទឹកមកមន្ទីរពិសោធន៍ ក្រុមហ៊ុន(តំរោង)អនុវត្តដោយខ្លួនឯង។

ចេញអោយនៅ ថ្ងៃទី ២៤ ខែ កក្កដា ឆ្នាំ២០១៣
ប្រធានការិយាល័យ
Date of Issue:
Laboratory Chief

សេក_វឌ្ឍ

បានឃើញនៅ ថ្ងៃទី ២៤ ខែ កក្កដា ឆ្នាំ២០១៣
ប្រធាននាយកដ្ឋាន
Was seen on date:
Director Department

ហេង-ណារ៉ែត

លេខ ៤៨ ព្រះវិថី ព្រះសីហនុ ទន្លេបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ ទូរស័ព្ទលេខ: ០២៣ ២១០ ៤៩២

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ
Kingdom of Cambodia
Nation Religion King

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ
Ministry of Environment
Department of Pollution Control
Laboratory Office

លេខ /N°/:.....៣៤...១៣...........

ព្រឹត្តិប័ត្រលទ្ធផលវិភាគ
Analysis Report

ប្រភពសំណាក/Sample Source : ក្រុមហ៊ុន Key Consultants (Cambodia)
ថ្ងៃ ខែ ឆ្នាំទទួលសំណាក/Date: 05/07/2013
ប្រភេទសំណាក/Type of Sample: Sample (WQ 7), Ou Prong River in Prasnoeb Commune, Kampong Chhnang Province
X= 451,890.22, Y=1,362,012.76

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសាស្ត្រវិភាគ Reference Method
1	Total Suspended Solid (TSS)	mg/l	74.00	1.0-15	Method 2540 D
2	Biochemical Oxygen Demand (BOD)	mg/l	2.85	-	Method 5210 B
3	Chemical Oxygen Demand (COD)	mg/l	6.27	1.0-8.0	Method JIS K 0102
4	Total Coliform	MPN/100 ml	74	< 1000	Method NF T 90-421

Note: ការយកសំណាក ការរក្សាទុក និងការដឹកជញ្ជូនសំណាកទឹកមកមន្ទីរពិសោធន៍ ក្រុមហ៊ុន(គំរោង)អនុវត្តដោយខ្លួនឯង។

ចេញអោយនៅ ថ្ងៃទី ២៤ ខែកក្កដា ឆ្នាំ២០១៣
ប្រធានការិយាល័យ
Date of Issue:
Laboratory Chief

សេក_វឌ្ឍ

បានឃើញនៅ ថ្ងៃទី ២៤ ខែកក្កដា ឆ្នាំ២០១៣
ប្រធាននាយកដ្ឋាន
Was seen on date:
Director Department

ម៉ោខ-ណារ៉េត

លេខ ៤៨ វិថី ព្រះសីហនុ ទន្លេបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ ទូរស័ព្ទលេខ: ០២៣ ២១០ ៤៩២

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ
Kingdom of Cambodia
Nation Religion King

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ
Ministry of Environment
Department of Pollution Control
Laboratory Office

លេខ /Nº/: [illegible]

ព្រឹត្តិប័ត្រលទ្ធផលវិភាគ
Analysis Report

ប្រភពសំណាក/Sample Source : ក្រុមហ៊ុន Key Consultants (Cambodia)
ថ្ងៃ ខែ ឆ្នាំទទួលសំណាក/Date: 05/07/2013
ប្រភេទសំណាក/Type of Sample: Sample (WQ 8), Bonbou River in Phumi Phasar Town, Kampong Chhnang Province
X= 444,120.67, Y=1,369,136.33

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសាស្ត្រវិភាគ Reference Method
1	Total Suspended Solid (TSS)	mg/l	318.00	25-100	Method 2540 D
2	Biochemical Oxygen Demand (BOD)	mg/l	2.65	1.0-10	Method 5210 B
3	Chemical Oxygen Demand (COD)	mg/l	4.70	-	Method JIS K 0102
4	Total Coliform	MPN/100 ml	$2.4x10^3$	< 5000	Method NF T 90-421

Note: ការយកសំណាក ការរក្សាទុក និងការដឹកជញ្ជូនសំណាកទឹកមកមន្ទីរពិសោធន៍ ក្រុមហ៊ុន (គំរោង) អនុវត្តដោយខ្លួនឯង។

បានឃើញនៅ ថ្ងៃទី ០៤ ខែ កក្កដា ឆ្នាំ២០១៣
ប្រធាននាយកដ្ឋាន
Was seen on date:
Director Department

ហេង-ណារ៉េត

ចេញអោយនៅ ថ្ងៃទី ០៤ ខែ កក្កដា ឆ្នាំ២០១៣
ប្រធានការិយាល័យ
Date of Issue:
Laboratory Chief

សេក_វឌ្ឍ

លេខ ៤៨ វិថី ព្រះសីហនុ ទន្លេបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ ទូរស័ព្ទលេខ: ០២៣ ២១០ ៤៩២

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

Kingdom of Cambodia
Nation Religion King

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ

Ministry of Environment
Department of Pollution Control
Laboratory Office

លេខ /N°/:.....

ព្រឹត្តិបត្រលទ្ធផលវិភាគ

Analysis Report

ប្រភពសំណាក/Sample Source : ក្រុមហ៊ុន Key Consultants (Cambodia)
ថ្ងៃ ខែ ឆ្នាំទទួលសំណាក/Date: 05/07/2013
ប្រភេទសំណាក/Type of Sample: Sample (WQ 9), Ou Chankok River in Tnot Chum Commune, Pursat Province
X= 397,245.56, Y=1,384,996.23

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសាស្ត្រវិភាគ Reference Method
1	Total Suspended Solid (TSS)	mg/l	416.00	25-100	Method 2540 D
2	Biochemical Oxygen Demand (BOD)	mg/l	3.95	1.0-10	Method 5210 B
3	Chemical Oxygen Demand (COD)	mg/l	5.49	-	Method JIS K 0102
4	Total Coliform	MPN/100 ml	$4.3x10^2$	< 5000	Method NF T 90-421

Note: ការយកសំណាក ការរក្សាទុក និងការដឹកជញ្ជូនសំណាកទឹកមកមន្ទីពិសោធន៍ ក្រុមហ៊ុន(គំរោង)អនុវត្តដោយខ្លួនឯង។

ចេញអោយនៅថ្ងៃទី ខែ ឆ្នាំ២០១៣
ប្រធានការិយាល័យ
Date of Issue:
Laboratory Chief

បានឃើញនៅថ្ងៃទី ខែ ឆ្នាំ២០១៣
ប្រធាននាយកដ្ឋាន
Was seen on date:
Director Department

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

Kingdom of Cambodia
Nation Religion King

ក្រសួងបរិស្ថាន
នាយកដ្ឋានត្រួតពិនិត្យការបំពុលបរិស្ថាន
ការិយាល័យពិសោធន៍ និង វិភាគ
Ministry of Environment
Department of Pollution Control
Laboratory Office

លេខ /N°:.....

ព្រឹត្តិបត្រលទ្ធផលវិភាគ
Analysis Report

ប្រភពសំណាក/Sample Source : ក្រុមហ៊ុន Key Consultants (Cambodia)
ថ្ងៃ ខែ ឆ្នាំទទួលសំណាក/Date: 22/03/2013
ប្រភេទសំណាក/Type of Sample: Sample (WQ 10), Pursat River Water, Pursat Province, X= 382,588.92, Y=1,385,653.34

លេខ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ស្តង់ដារ Standard	វិធីសាស្ត្រវិភាគ Reference Method
1	Total Suspended Solid (TSS)	mg/l	198.00	25-100	Method 2540 D
2	Biochemical Oxygen Demand (BOD)	mg/l	1.35	1.0-10	Method 5210 B
3	Chemical Oxygen Demand (COD)	mg/l	3.72	-	Method JIS K 0102
4	Total Coliform	MPN/100 ml	$4.3x10^2$	< 5000	Method NF T 90-421

Note: ការយកសំណាក ការរក្សាទុក និងការដឹកជញ្ជូនសំណាកទឹកមកមន្ទីពិសោធន៍ ក្រុមហ៊ុន(គំរោង)អនុវត្តដោយខ្លួនឯង។

ចេញអោយនៅថ្ងៃទី ខែ ឆ្នាំ២០១៣
ប្រធានការិយាល័យ
Date of Issue:
Laboratory Chief

បានឃើញនៅថ្ងៃទី ខែ ឆ្នាំ២០១៣
ប្រធាននាយកដ្ឋាន
Was seen on date:
Director Department

Water Sampling Point (Pursat River)
(X: 382,588.92 ; Y: 1,385,653.34)

Water Sampling Point (Ou Chankok River)
(X: 397,245.56 ; Y: 1,384,996.23)

Water Sampling Point (Bonbou River)
(X: 444,120.67 ; Y: 1,369,136.33)

Water Sampling Point (Ou Prong River)
(X: 451,890.22 ; Y: 1,362,012.76)

Water Sampling Point (Phnom Lech Reservoir)
(X: 458,806.02 ; Y: 1,354,741.45)

Water Sampling Point (A channel in Svay Commune)
(X: 470,476.38 ; Y: 1,308,474.30)

Water Sampling Point (Pursat River)
(X: 382,588.92 ; Y: 1,385,653.34)

Water Sampling Point (Ou Chankok River)
(X: 397,245.56 ; Y: 1,384,996.23)

Water Sampling Point (Bonbou River)
(X: 444,120.67 ; Y: 1,369,136.33)

Water Sampling Point (Ou Prong River)
(X: 451,890.22 ; Y: 1,362,012.76)

Water Sampling Point (Phnom Lech Reservoir)
(X: 458,806.02 ; Y: 1,354,741.45)

Water Sampling Point (A channel in Svay Commune)
(X: 470,476.38 ; Y: 1,308,474.30)

Names and Model Numbers of Analytical Instruments

No.	Item	Reference Method	Analytical Instrument
I- Air Quality			
1	Nitrogen Dioxide (NO2)	Saltzman	KIMOTO Handy Sampler, Cintra 202 Spectrophotometer (GBC)
2	Sulfur Dioxide (SO2)	Pararosaniline	KIMOTO Handy Sampler, Cintra 202 Spectrophotometer (GBC)
3	PM2.5	Weight Concentration Measuring	ECOTECH, MicroVol1100, Low-Flow Airsampler and Electronic Balance.
4	PM10	Weight Concentration Measuring	KC-120H Intelligent Mid-Flow TSP, PM10 and PM2.5 Sampler
II- Water Quality			
1	Total Suspended Solid (TSS)	2540 D	Charles Austen Pumps (CAPEX L2C), Drying Own and Electronic Balance.
2	Biochemical Oxygen Demand (BOD)	5210 B	BOD Incubator
3	Chemical Oxygen Demand (COD)	JIS K 0102	Titration
4	Total Coliform	NF T 90-421	MEMMERT Incubator

ANNEX B

- LIST OF FLORAS
- LIST OF FAUNAS
- SOME FLORA PICTURES
- PICTURES OF FLORA SURVEY
- PICTURES OF FAUNA SURVEY

Table 1: List of Floras

No.	Local Name	Scientific Name	Family	IUCN Red List Status
1	Breng Khyol	*Eucalyptus Camaldulensis Dehnh.*	Myrtaceae	N/A
2	Chrey	*Ficus Sp*	Moraceae	N/A
3	Tnaot	*Borassus Madagascariensis*	Palmae	EN
4	Putrea	*Zizyphus Mauritiana*	Rhamnaceae	LC
5	Ang Kanh	*Cassia Siamensis Lam.*	Leguminosae	N/A
6	Trabaek	*Psidium Guajava*	Myrtaceae	N/A
7	Teuk Dah Ko	*Chrysophyllum Cainito*	Sapotaceae	N/A
8	Trabaek Prey	*Lagerstroemia Floribunda*	Lythraceae	N/A
9	Snay	*Sterblus Asper*	Moraceae	N/A
10	Dongkieb Kdam	*Antidesma Cochinensis*	Euphorbiaecae	N/A
11	Pring	*Eugenia Spp.*	Myrtaceae	N/A
12	Thbaeng	*Dipterocapus Obtusifolius,Teysm*	Dipterocarpaceae	N/A
13	Kanthum Thet	*Leucaena Leucocephala*	Leguminosae	N/A
14	Sangke	*Combritum Quarangulare*	Combritaceae	N/A
15	Chhoeuteal	*Dipterocapus Costatus,Gaertn.*	Dipterocarpaceae	N/A
16	Acacia Sleuk Touch	*Acacia Auriculiformis Muell.*	Mimosaceae	N/A
17	Por	*Ficus Religiosa L.*	Moraceae	N/A
18	Chan Kiri	*Albizia Saman*	Leguminosae	N/A
19	Kdol	*Sarcoccphalus Cordatus, Mig.*	Rubiaceae	N/A
20	Svay	*Mangifera Indica*	Anacardiaceae	N/A
21	Cham Bak	*Irvingia Malayana*	Simaroubaceae	LC
22	Poun Sva	*Spondias Sp*	Anacardiaceae	N/A
23	Sdav	*Azadirachta Indica Ant. Juss.*	Meliaceae	N/A
24	Raing Toek	*Barringtonia Acutangula (L.) Gaertn.*	Lecythidaceae	N/A
25	Trosek	*Peltophorum Dasyrrhachis*	Leguminosae	N/A
26	Thlork	*Parinarium Annamensis, Hance*	Rosaceae	N/A
27	Kor	*Ceiba Pentandra*	Bombacaceae	N/A
28	Pong-Ro	*Schleicheria Oleosa*	Sapindaceae	N/A
29	Lvea	*Ficus Racemosa*	Moraceae	N/A
30	Thkov	*Anthocephalus Chinensis*	Rubiaceae	N/A
31	Svay Chan Ti	*Anacadium Occidentale L.*	Anacardiaceae	N/A
32	Chonlos	*Erioglossum Edule*	SAPINDACEAE	N/A
33	La Ngeang	*Cratoxylon Prunifolium, Dyer.*	Hyperieaceae	N/A
34	Trasek	*Peltophorum Ferrugieum*	Ceasalpiniaceae	N/A
35	Tramaeng	*Carallia Lucida, Roxb.*	Rhizophoraceae	N/A
36	Phnom Phnaeng	*Hymenocaedia Wallichii*	Euphorbiaceae	N/A
37	Ampil Toek	*Pithecellobium Dulce*	Leguminosae	N/A
38	Popea Khe	*Terminalia Bialata*	Combretaceae	N/A
39	Sla	*Areca Catechu*	Palmae	N/A
40	Kantuot	*Phyllanthus Acidus*	Euphorbiaceae	N/A
41	Khnol	*Artocarpus Heterophyllus*	Moracea	N/A
42	Tiep	*Annona Squamosa*	Annonaceae	N/A
43	Am Pil	*Tamarindus Indica*	Leguminosae	N/A
44	Doung	*Cocos Nucifera*	Palmae	N/A
45	Tra Yoeng	*Diospyros Helferi, C.B.Clarke*	Ebcnaceae	N/A
46	Maisak	*Tectona Grandis,L.F.*	Verbenaceae	N/A
47	Thnong	*Pterocarpus Pedatus, Pierre*	Papilionaccac	N/A
48	Chonlus	*Erioglossum Edule*	Sapindaceae	N/A
49	Kray Sor	*Albizia Thorelii, Poir.*	Mimosaceae	N/A
50	Char	*Butea Monosperma*	Leguminosae	N/A
51	Kandoal	*Careya Spaerica*	Myrtaceae	N/A
52	Trahs	*Combretum Trifoliatum*	Combretaceae	N/A
53	Phka Kradahs	*Bougainvillea Buttiana*	Nyctaginaceae	N/A
54	Russey Khlei	*Bambusa Bambos*	Poaceae	N/A

No.	Local Name	Scientific Name	Family	IUCN Red List Status
55	Russey Srok	*Dendrocalamus Membranaceus*	Gramineae	N/A
56	Russey Ping Pong	*Gigantochloa Albociliata*	Poaceae	N/A
57	Ka Bas Prey	*Cochlospermum Religiosum*	Cochlospermaceae	N/A
58	Totuem	*Punica Granatum*	Punicaceae	LC
59	Andat Koa	*Achyranthes Aspera*	Amaranthaceae	N/A
60	Chek	*Musa Spp.*	Musaceae	N/A
61	Thmenh Trey	*Ichnocarpus Oxypetalus*	Apocynaceae	N/A
62	Kantrieng Khaet	*Chromolaena Odorata*	Compositae	N/A
63	Ban La Bay Dam Noeub	*Acacia Concinna*	Fabaceae	N/A
64	Rom Chek	*Pandanus Humilis*	Pandanaceae	N/A
65	Sbov	*Imperata Cylindrica*	Gramineae	N/A
66	Kan Troob	*Murraya Koenigii*	Rutaceae	N/A
67	Voi Sao Mav	*Passiflora Foetida*	Passifloraceae	N/A
68	Pramaoy Damrei	*Heliotropium Indicum*	Boraginaceae	N/A
69	Kamphlaok	*Eichhornia Crassipes*	Pontedderiaceae	N/A
70	Lhong Khvorng	*Jatropha Curcas*	Euphorbiaceae	N/A
71	Trav	*Colocasia Esculenta Var. Esculenta*	Araceae	N/A
72	Cheng Tokae	*Coldenia Procumbens*	Boraginaceae	N/A
73	Choeung Kou/Sleng Por	*Bauhinia Acuminata*	Ceasalpiniaceae	LC
74	Kak	*Cyperus Cyperiodes*	Cyperaceae	N/A
75	Bay Kdaing	*Leea Indica*	Leeaceae	N/A
76	Cheung Chab Srok	-	-	-
77	Sangkhor	-	-	-
78	Banla Ouyas	-	-	-
79	Preal	-	-	-
80	Kam Polbay	-	-	-
81	Voer Chuy	-	-	-
82	Changrang Seh	-	-	-
83	Sandaek Khmoach	-	-	-
84	Ban Tiel Krong Samrith	-	-	-
85	Anhanh	-	-	-
86	Lpak	-	-	-
87	Suos	-	-	-
88	Kom Siev	-	-	-
89	Day Tun	-	-	-
90	Kravan (Flower)	-	-	-
91	Kravan (Kdor Ta)	-	-	-
92	Kra Saing	-	-	-
93	Dong Het	-	-	-
94	Mrech Thonsay	-	-	-
95	Chong Krang Sva	-	-	-
96	Pka Sareka Keo	-	-	-
97	Sleuk Kri	-	-	-
98	Puoch	-	-	-
99	Voi Doskuon	-	-	-
100	Voi Kneung	-	-	-
101	Bunla Chheur Em	-	-	-
102	Trakuon Tech	-	-	-
103	Ach Kandol	-	-	-
104	Nheinh	-	-	-
105	Traeng	-	-	-
106	Por Phenh Nhi	-	-	-
107	Por Phenh Chhmoul	-	-	-
108	Ro Luos Chhmoul	-	-	-
109	Chhat	-	-	-

No.	Local Name	Scientific Name	Family	IUCN Red List Status
110	Makak	-	-	-
111	Nhar Srok	-	-	-
112	Ba Buoy	-	-	-
113	Nhchey	-	-	-
114	Phka Kra Ngoak	-	-	-
115	Kra Khob	-	-	-
116	Loeurng Riech	-	-	-
117	Ro Luos Nhi	-	-	-

Note: En = Endanger, LC = Least Concern

Table 2: List of Faunas

No.	Local Name	English Name	Scientific Name	Identified Location	IUCN Red List Classification
I- Fish and crustacean species					
1	Trey Changva Chunh Cheak	Reticulate Flying Fox	Cyclocheilichthys Reticulatus	Paddy Field	N/A
2	Trey Riel Angkam		*Henicorhynchus Lobatus*		LC
3	Trey Andaeng Roeng	Walking Catfish	*Clariasbatrachus*		N/A
4	Trey Andaengtun	Black Skin Catfish	*Clariasmeladerma*		N/A
5	Trey Ankot Brak		*Puntius Rhombeus*		LC
6	Trey Changva Chnout	Pavie's Rasbora	*Rasbora Paviei*		N/A
7	Trey Changva Phleang	Long-Fin Flying Minnow	*Esomus Longimanus*		DD
8	Trey Changwa Moul	Southeast Asian Yellowtail Rasbora	*Rasbora Tornieti*		N/A
9	Trey Changwa Ronoung		*Garra Fasciacauda*		LC
10	Trey Chhlonh	Peacock	*Macrognathus Siamensis*		LC
11	Trey Kamphleanh Sre	Three Spot Gourami	*Trichogaster Trichopterus*		LC
12	Trey Kranh	Climbing Perch	*Anabas Testudineus*		DD
13	Trey Deap/Trey Chdau	Giant Snakehead	*Chnna Mucropeltes*		N/A
14	Trey Ptoung	Freshwater Garfish	*Xenentodon Cancila*		LC
15	Trey Riel Top	Siamese Mud Carp	*Henicorhnchus Siamensis*		N/A
1	Trey Changva Chunh Cheak	Reticulate Flying Fox	Cyclocheilichthys Reticulatus	Wetland and Flood Plain	N/A
2	Trey Riel Angkam		*Henicorhynchus Lobatus*		N/A
3	Trey Andaeng Roeng	Walking Catfish	*Clariasbatrachus*		LC
4	Trey Andaengtun	Black Skin Catfish	*Clariasmeladerma*		N/A
5	Trey Ankot Brak		*Puntius Rhombeus*		N/A
6	Trey Changva Chnout	Pavie's Rasbora	*Rasbora Paviei*		LC
7	Trey Changva Phleang	Long-Fin Flying Minnow	*Esomus Longimanus*		N/A
8	Trey Changwa Moul	Southeast Asian Yellowtail Rasbora	*Rasbora Tornieti*		DD
9	Trey Changwa Ronoung		*Garra Fasciacauda*		N/A
10	Trey Chhlonh	Peacock	*Macrognathus Siamensis*		LC
11	Trey Kamphleanh Sre	Three Spot Gourami	*Trichogaster Trichopterus*		LC
12	Trey Kranh	Climbing Perch	*Anabas Testudineus*		LC
13	Trey Deap/Trey Chdau	Giant Snakehead	*Chnna Mucropeltes*		DD
14	Trey Ptoung	Freshwater Garfish	*Xenentodon Cancila*		N/A
15	Trey Riel Top	Siamese Mud Carp	*Henicorhnchus Siamensis*		LC
16	Trey Bra Kae		Pangasiusconchophilus		LC

No.	Local Name	English Name	Scientific Name	Identified Location	IUCN Red List Classification
17	Trey Bra Kchao		Pangasiusbocourti		LC
18	Trey Bra Thom	Sutchi Catfish	Pangasianodonhypophthalmus		N/A
19	Trey Sroka Kdam	Highfin Barb	Cyclocheilichthys Armatus		LC
20	Trey Sroka Kdam	White Eye Barb	Cyclocheilichthys Repasson		LC
21	Trey Chhveat		Pangasiuselongatus		N/A
22	Trey Chhveat Doung		Pteropangasiusmicronemus		N/A
23	Treypor	Spot Pangaasius	Pangasiuslarnaudii		LC
24	Trey Ach Kok	*Dangila Siamensis* Sauvage	*Labiobarbus Siamensis*		LC
25	Trey Ampiltum	Swamp Barb	*Puntius Brevis*		LC
26	Trey Andat Chke	Whitelip Sole	*Achiroides Leucorhynchos*		N/A
27	Trey Andat Chke Veng	Speckled Tonguesole	*Cynoglossus Puncticeps*		N/A
28	Trey Bandol Ampov	Borneo River Sprat	*Clupeoides Borneensis*		LC
29	Trey Chhkaok		*Cyclocheichthys Enoplos*		N/A
30	Trey Chhpin	Goldfin Tinfoil Barb	*Hypsibarbus Malcolmi*		LC
31	Trey Chhpin Prak	Java/Silver Barb	*Barbonymus Goniomotus*		N/A
32	Trey Chra Keng	Sickle Fin Barb	*Puntioplites Falcifer*		LC
33	Trey Proloung	Hoven's Carp/Mad Barb	*Leptobarbus Hoevenii*		N/A
34	Trey Dang Dao	Shark Minnow	*Luciosoma Bleekeri*		LC
35	Trey Domrey	Marble Goby	*Oxyeleotris Marmorata*		LC
36	Trey Ka Ok	Spotted Catfish	*Ariusmaculatus*		N/A
37	Trey Ka-Ek	Black Sharkminnow	*Labeo Chrysophekadion*		LC
38	Trey Kaes		*Micronemacheveyi*		N/A
39	Trey Kahe	Goldfoil/Tinfoil Barb	*Barbonymus Schwanenfeldii*		LC
40	Trey Kahe Krohom	Red Tailed Tinfoil	*Barbonymus Altus*		LC
41	Trey Kahjoskrobey		*Glyptothoraxfuscus*		N/A
42	Trey Kambot Chramos		*Amblyrhynchichthys Truncatus*		N/A
43	Trey Kamphleanh Phlouk	Moonlight Gourami	*Trichogaster Microlepis*		N/A
44	Trey Kampleav		*Kryptopterusmoorei*		N/A
45	Trey Kampleavbrak		*Kryptopteruslimpok*		N/A
46	Trey Kampleavsteuong		*Micronemaapogon*		N/A
47	Trey Kampulbai/Trey Chhkaok Kda	Papillocheilus Ayuthiae Smith 1945	*Cosmochilus Harmandi*		LC
48	Trey Kanh Chaksla	Spotted Archerfish	*Toxotes Chatareus*		N/A
49	Trey Kanh Chanh Chras	Iridescent Glassy Perchlet	*Parambassis Apogonoides*		LC

No.	Local Name	English Name	Scientific Name	Identified Location	IUCN Red List Classification
50	Trey Kanhchrouk	Skunk Botia	*Yasuhikotakia Morleti*		LC
51	Trey Kanhchrouk Chhnout	Tiger Botia	*Syncrossus Helodes*		LC
52	Trey Kanhchrouk Loeurng	Yellow Loach	*Yasuhikotakia Modesta*		LC
53	Trey Kanhchrouk Krohorm	Orangefin Loach	*Yasuhikotakia Lecontei*		LC
54	Trey Kanhjos		*Mystusrhegma*		N/A
55	Trey Kanhjoskdorng		*Mystusbocourti*		N/A
56	Trey Kanhjosthmor	Asian Bumblebee Catfish	*Pseudomystussiamensis*		N/A
57	Trey Kanthor	Snakeskin Gourami	*Trichogaster Pectoralis*		N/A
58	Trey Kantrong Breng	Duskyfin Glassy Perchlet	*Parambassis Wolffii*		LC
59	Trey Kantrop	Captopra	*Pristolepis Fasciata*		LC
60	Trey Kdang Hay		*Belodonticchthystruncatus*		N/A
61	Trey Khchoeung	Frecklefin Eel	*Trey Chonluanh Moan*		N/A
62	Trey Khman	Hampala Barb	*Hampala Macrolepidota*		LC
63	Trey Kray	Clown Featherback	*Chitala Ornata*		LC
64	Trey Krolang/Trey Prul	Small Scale Mud Carp	*Cirrhinus Mucrolepis*		N/A
65	Trey Kromorm	Butter Catfish	*Ompokbimaculatus*		N/A
66	Trey Kros	Pla Rong Mai Tub	*Osteochilus Microcephalus*		LC
67	Trey Krum		*Osteochilus Melanopleurus*		N/A
68	Trey Krus	Dusky Face Carp	*Osteochilus Lini*		LC
69	Trey Linh		*Thynnichthys Thynnoides*		LC
70	Trey Loloksor	Grey Bony-Lip Carp	*Osteochilus Schlegeli*		DD
71	Trey Phtuok/Trey Ros	Snakehead Murrel	*Channa Striata*		LC
72	Trey Proma	Boeseman Croader	*Boesemania*		NT
73	Trey Roeus Chek	Dwarf Horseface Loach	*Acanthopsoides Gracilentus*		N/A
74	Trey Sanday/Trey Kropoit	Wallago	*Wallagoattu*		N/A
75	Trey Sleuk Russey	*Culter Riveroi*	*Paralaubuca Riveroi*		LC
76	Trey Slat	Bronze Featherback	*Notopterus Notopterus*		LC
77	Trey Sroka Kdam	Beardless Barb	*Cyclocheilichthys Apogon*		LC
78	Trey Stuok		*Wallagoleerii*		N/A
79	Trey Ta Oan		*Ompokhypophthalmus*		N/A
80	Trey Troseik/Trey Pa Phean		*Scaphognathops Stejnegeri*		LC
81	Trey Chhveat		*Pteropangasiuspleurotaenia*		N/A
82	Trey Chhlaing	Asian Redtail Catfish	*Hemibagrusnemurus*		N/A
83	Trey Kanhjos		*Mystusalbolineatus*		N/A

No.	Local Name	English Name	Scientific Name	Identified Location	IUCN Red List Classification
84	Trey Kanhjos Bay		*Mystussingaringan*		N/A
85	Trey Kanhjoschhnout		*Mystusatrifasciatus*		N/A
86	Trey Khcha		*Hemibagruswyckioides*		N/A
87	Trey Tronel		*Hemibagrusfilamentus*		N/A
II- Mammals					
1	Kandol Breng	Rat		Paddy Field and Residential Area	N/A
2	Bror Chiev	Bats	*(Order: Chiroptera)*		N/A
1	Kandol Breng	Rat		Wetland and Flood Plain	N/A
2	Bror Chiev	Bats	*(Order: Chiroptera)*		N/A
3	Tong Haen	Berdmore's Squirrel	*Menetes Berdmorel*		N/A
4	Kdan Nhaeng	Lesser Mousedeer	*Tragulus Javanicus*		N/A
5	Tunsay Kul	Burmese Hare	*Lepus Pequensis*		N/A
6	Kanthuek	Northern Treeshrew	*Tupain Belangeri*		N/A
7	Kambrok Por	Variable Squirrel	*Callosciurus Erythraeus*		LC
1	Kandol Breng	Rat		Kampong Chhnang Bypass	N/A
2	Bror Chiev	Bats	*(Order: Chiroptera)*		N/A
3	Tong Haen	Berdmore's Squirrel	*Menetes Berdmorel*		N/A
4	Kdan Nhaeng	Lesser Mousedeer	*Tragulus Javanicus*		DD
5	Tunsay Kul	Burmese Hare	*Lepus Pequensis*		N/A
6	Kanthuek	Northern Treeshrew	*Tupain Belangeri*		N/A
7	Kambrok Por	Variable Squirrel	*Callosciurus Erythraeus*		LC
8	Sam Pouch Vor	Small Indian Civet	*Viverricula Indica*		LC
9	Skar Touch	Small Asian Mongoose	*Herpestes Javanicus*		LC
10	Chhlous	Red Muntjac	*Muntiacus Muntjak*		LC
11	Chrouk Prey	Wild Pig	*Sus Scrofa*		LC
III- Reptiles					
1	Tokae	Tockay	*Gekko Gecko*	Paddy Field	N/A
2	Thlaen Srakala'et	Small-Scaled Water Skink	*Tropidrophorus Microlepis*		N/A
3	Bangkuoy Trachiek Touch	Scale-Bellied Tree Lizard	*Acanthosanra Lepidogaster*		N/A
4	Pous Breng Touch	Common Blind Snake	*Ramphoryphlops Braminus*		N/A
5	Pous Prey	Indochinese Ratsnake	*Pyftas Korros*		N/A
6	Pous Khse Kor	Striped Keelback	*Amphiesma Stolota*		N/A
7	Pous San Soeur	Keeled Rat Snake	*Ptyas Caranita*		N/A
8	Pous Sam Leab Kong Keb	Chequered Keelback	*Xenochrophis Piscutor*		N/A

No.	Local Name	English Name	Scientific Name	Identified Location	IUCN Red List Classification
9	Pous Vek Dom Bouk	Indochinese Spitting Cobra	*Naja Siamensis*		VU**
10	Pous Khiev	Pope's Pit-Viper	*Trimeresurus Popeiorum*		LC
11	Bang Kuoy	Lizard			N/A
1	Tokae	Tockay	*Gekko Gecko*	Wetland and Flood Plain	N/A
2	Thlaen Srakala'et	Small-Scaled Water Skink	*Tropidrophorus Microlepis*		N/A
3	Bangkuoy Trachiek Touch	Scale-Bellied Tree Lizard	*Acanthosanra Lepidogaster*		N/A
4	Pous Breng Touch	Common Blind Snake	*Ramphoryphlops Braminus*		N/A
5	Pous Prey	Indochinese Ratsnake	*Pyftas Korros*		N/A
6	Pous Khse Kor	Striped Keelback	*Amphiesma Stolota*		N/A
7	Pous San Soeur	Keeled Rat Snake	*Ptyas Caranita*		N/A
8	Pous Sam Leab Kong Keb	Chequered Keelback	*Xenochrophis Piscutor*		N/A
9	Pous Vek Dom Bouk	Indochinese Spitting Cobra	*Naja Siamensis*		VU**
10	Pous Khiev	Pope's Pit-Viper	*Trimeresurus Popeiorum*		LC
11	Bang Kuoy	Lizard			N/A
12	Pous Srkachas	Russull's Viper	*Dabota Russelli*		N/A
13	Kantrorng	Water Dragon	*Physignathus Cocincinus*		N/A
14	Kam Broma	East Asian Porcupine	*Hystrix Brachyura*		LC
15	Pous Vek Krobei	Monocled Cobra	*Naja Kaouthia*		LC
16	Pous Thlan Touch	Burmese Python	*Pyfthon Molurus Bivittaftus*		N/A
17	Pous Thlan Thom	Reticulate Python	*Python Reticulatus*		N/A
18	Kan Theay	Asian Soft Shell Turtle	*Amyda Cartilaginea*		VU
19	An Deurk	Turtle	*Malayemys subtrijuga*		VU
1	Tokae	Tockay	*Gekko Gecko*	Kampong Chhnang Bypass	N/A
2	Thlaen Srakala'et	Small-Scaled Water Skink	*Tropidrophorus Microlepis*		N/A
3	Bangkuoy Trachiek Touch	Scale-Bellied Tree Lizard	*Acanthosanra Lepidogaster*		N/A
4	Pous Breng Touch	Common Blind Snake	*Ramphoryphlops Braminus*		N/A
5	Pous Prey	Indochinese Ratsnake	*Pyftas Korros*		N/A
6	Pous Khse Kor	Striped Keelback	*Amphiesma Stolota*		N/A
7	Pous San Soeur	Keeled Rat Snake	*Ptyas Caranita*		N/A
8	Pous Sam Leab Kong Keb	Chequered Keelback	*Xenochrophis Piscutor*		N/A
9	Pous Vek Dom Bouk	Indochinese Spitting Cobra	*Naja Siamensis*		VU**
10	Pous Khiev	Pope's Pit-Viper	*Trimeresurus Popeiorum*		LC
11	Bang Kuoy	Lizard			N/A
12	Pous Srkachas	Russull's Viper	*Dabota Russelli*		N/A

No.	Local Name	English Name	Scientific Name	Identified Location	IUCN Red List Classification
13	Kantrorng	Water Dragon	*Physignathus Cocincinus*		N/A
14	Kam Broma	East Asian Porcupine	*Hystrix Brachyura*		LC
15	Pous Vek Krobei	Monocled Cobra	*Naja Kaouthia*		LC
16	Pous Thlan Touch	Burmese Python	*Pyfthon Molurus Bivittaftus*		N/A
17	Pous Thlan Thom	Reticulate Python	*Python Reticulatus*		N/A
IV- Amphibians					
1	Kingkuok	Common Asian Toad	*Bufo Melanosttrictus*		N/A
2	Hing	Common Asian Bullfrog	*Kaloula Pulchra*		LC
3	Kangkeb	Paddy Frog	*Fejevarya Limnocharis*	All the interviewed location	N/A
4	Kangkebkob	Regulose Bullfrog	*Hoblobatrachus Rugulosus*		N/A
5	Kanhchanhchek	Common Tree Frog	*Polypedates Leucomystax*		LC
V- Birds					
1	Popich Bampongkorsor	Puff-Throated Bulbul	*Alophoixus Pallidus*		LC
2	Popichpukmoat	Stripe-Throated Bulbul	*Pycnonotus Finlaysoni*		LC
3	Popichtrocheak	Streak-Eared Bulbul	*Pycnonotus Blanfordi*		LC
4	Popichtrocheak	Red-Whiskered Bulbul	*Pycnonotus Jocosus*		LC
5	Chabpouktroung	Asian Golden Weaver	*Ploecus Hypoxanthus*		N/A
6	Chabpouktroung	Baya Weaver	*Ploceus Philippinus*		LC
7	Chabpouktroung	Streaked Weaver	*Ploceus Manyar*		LC
8	Chab Angkrong	Scaly-Breasted Munia	*Lonchura Punctulata*		LC
9	Chabchankrong	White-Rumped Munia	*Lochura Striata*	Paddy Field, Residential Area, and Kampong Chhnang Bypass	N/A
10	Chabchankrong	Black-Headed Munia	*Lonchura Malacca*		LC
11	Chabdangkovpor	Rufescent Prinia	*Prinia Rufescens*		LC
12	Chabdangkov	Plain Prinia	*Prinia Inormata*		N/A
13	Chabdangkov	Yellow-Bellied Prinia	*Prinia Flaviventris*		N/A
14	Chabdangkov	Grey-Breasted Prinia	*Prinia Hodgsonii*		LC
15	Chabdounta	Oriental Reed Wabler	*Acrocephalus Orientalis*		N/A
16	Chabdounta	Black-Browed Reed Wabler	*Acrocephalus Bistrigiceps*		LC
17	Chabpreyveng	Yellow-Breasted Bunting	*Emberiza Aureola*		VU
18	Chabtet	Common Tailorbird	*Orthotomus Sutorius*		LC
1	Popich Bampongkorsor	Puff-Throated Bulbul	*Alophoixus Pallidus*		LC
2	Popichpukmoat	Stripe-Throated Bulbul	*Pycnonotus Finlaysoni*		LC
3	Popichtrocheak	Streak-Eared Bulbul	*Pycnonotus Blanfordi*	Wetland and Flood Plain	LC
4	Popichtrocheak	Red-Whiskered Bulbul	*Pycnonotus Jocosus*		LC

No.	Local Name	English Name	Scientific Name	Identified Location	IUCN Red List Classification
5	Chabpouktroung	Asian Golden Weaver	*Ploecus Hypoxanthus*		N/A
6	Chabpouktroung	Baya Weaver	*Ploceus Philippinus*		LC
7	Chabpouktroung	Streaked Weaver	*Ploceus Manyar*		LC
8	Chab Angkrong	Scaly-Breasted Munia	*Lonchura Punctulata*		LC
9	Chabchankrong	White-Rumped Munia	*Lochura Striata*		N/A
10	Chabchankrong	Black-Headed Munia	*Lonchura Malacca*		LC
11	Chabdangkovpor	Rufescent Prinia	*Prinia Rufescens*		LC
12	Chabdangkov	Plain Prinia	*Prinia Inormata*		N/A
13	Chabdangkov	Yellow-Bellied Prinia	*Prinia Flaviventris*		N/A
14	Chabdangkov	Grey-Breasted Prinia	*Prinia Hodgsonii*		LC
15	Chabdounta	Oriental Reed Wabler	*Acrocephalus Orientalis*		N/A
16	Chabdounta	Black-Browed Reed Wabler	*Acrocephalus Bistrigiceps*		LC
17	Chabpreyveng	Yellow-Breasted Bunting	*Emberiza Aureola*		VU
18	Chabtet	Common Tailorbird	*Orthotomus Sutorius*		LC
19	Bakou	Common Hoopoe	*Upupa Epops*		LC
20	Popleakchang	Large-Tailed Nightjar	*Caprimulgus Macrurus*		LC
21	Popustoek	Little Grebe	*Tachybaptus Ruficollis*		LC
22	Populchampusthum	Thick-Billed Green Pigeon	*Treron Curvirostra*		LC
23	Populchoeung	Yellow-Footed Green Pigeon	*Treron Phoenicoptera*		N/A
24	Chabtet Prey	Dark-Necked Tailorbird	*Orthotomus Atrogularis*		LC
25	Chabkanlang	Purple-Throated Sunbird	*Nectarinia Sperata*		LC
26	Chabkanlang	Copper-Throated Sunbird	*Nectarinia Calcostetha*		LC
27	Chabkanlang	Crimson Sunbird	*Aethopyga Siparaja*		LC
28	Chabpteas	Eurasian Tree Sparrow	*Passer Montanus*		LC
29	Chabkroch	Yellow-Vented Bulbul	*Pycnonotus Goiavier*		LC
30	Chabsrok	Plain-Backed Sparrow	*Passer Flaveolus*		LC
31	Chochatkrem	Common Kingfisher	*Alcedo Atthis*		LC
32	Porltouk Thngaskhmao	Blue-Eared Barbet	*Megalaima Australis*		LC
33	Porltouk Kbal	Lineated Barbet	*Megalaima Lineata*		LC
34	Porltouk Ambuk	Coppersmith Barbet	*Megalaima Haemacephala*		LC
35	Chek Tum	Black-Naped Oriole	*Oriolus Chinensis*		LC
36	Ka Ek	Large-Billed Crow	*Corvus Macrohynchos*		N/A
37	Meam Touch Prey	Asian Barred Owlet	*Glaucidium Cucloides*		N/A
38	Sek Sourm	Alexandrine Parakeet	*Psittacula Eupatria*		LC

No.	Local Name	English Name	Scientific Name	Identified Location	IUCN Red List Classification
39	Sek Sork	Red-Breasted Parakeet	*Loriculus Vemalis*		N/A
40	Kleng Srark	Bam Owl	*Tyto Alba*		LC
41	Kvaek	Black-Crowned Night Heron	*Nycticorax Nycticorax*		LC
42	Ngeav Kork	Stork-Billed Kingfisher	*Halcyon Capensis*		N/A
43	Antep Toing	Greater Racket-Tailed Drongo	*Dicrurus Paradiseus*		LC
44	Klom	Watercock	*Gallicrex Cinerea*		LC
45	Kok Kroung Thom	Great Egretta	*Egretta Alble*		N/A
46	Kok Krourng	Intermediate Egret	*Egretta Intermedia*		N/A
47	Kok Kmao Thleurm Andeurk	Black Bittem	*Bupetor Flavicollis*		N/A
48	La Out Thom	Greater Coucal	*Centropus Sinensis*		LC
49	Lolork Bay	Spotted Dove	*Streptopelia Chinensis*		N/A
50	Mean Toek Kmoa	Common Moorhen	*Gallinula Chloropus*		LC
51	Mean Toek Troung Sor	White-Breasteed Waterhen	*Amauromis Phoenicurus*		N/A
52	Preab Srok	Rock Pigeon	*Columba Livia*		LC
53	Pror Voek	Lesser Whistling Duck	*Dedrocygna Javanica*		N/A
54	Kruoch En	Rufous-Winged Bushlark	*Mirafra Assamica*		LC
55	Kruoch Eut	Barred Buttonquail	*Tumix Suscitator*		N/A
56	Tror Cheak Kam	Barn Swallow	*Hirundo Rustica*		LC
57	Tror Dev Kor Vech Toch	Red-Wattled Lapwing	*Vanellus Indicus*		LC
58	Tror Ses Knorng Plerng Toch	Common Flamedback	*Dinopium Javanense*		LC
59	Sarika Keokor	Common Myna	*Acridotheres Tristis*		LC
60	Sarika Keo Krobey	White-Vented Myna	*Acridotheres Javanicus*		N/A
61	Tavao	Common Koel	*Eudynamys Scolopacea*		N/A
62	Teav Kiev	Indian Roller	*Coracias Benghalensis*		LC
63	Chab Porpich Sre	Paddyfield Pipit	*Anthus Rufulus*		LC

Note: LC = Least Concern, NT = Near Threatened, VU = Vulnerable, N/A = Not Available DD = Data Defient in IUCN Red List Source: Interview with local people in March and July, 2013

Fauna species of residential areas were surveyed at	104°44'36.27"E	10°0'53.81"N
	104°40'18.68"E	12°9'22.95"N
Fauna species of wetland and flood plain were surveyed	104°33'29.05"E	12°19'12.40"N
	104°29'4.32"E	12°23'4.02"N
Fauna species of Kampong Chhnang Bypass were surveyed	104°36'52.60"E	12°15'54.94"N
	104°37'23.27"E	12°15'16.96"N
Fauna species of paddy field were surveyed	104°43'22.02"E	11°50'38.15"N
	104°43'57.79"E	12°1'7.59"N
	104°42'51.31"E	12°4'55.16"N

Russey Srok (Dendrocalamus membranaceus)

Russey Ping Pong (Gigantochloa Albociliata)

Cham Bak (Irvingia Malayana)

Pring (Eugenia Spp.)

Ang Kanh (Cassia Siamensis Lam.)

Nhchey

Trabaek (Psidium Guajava)

Pong Ro (Schleicheria Oleosa)

Sdav (Azadirachta Indica Ant. Juss.)

Thnong (Pterocarpus Pedatus, Pierre)

Thbaeng (Dipterocapus Obtusifolius,Teysm)

Kor (Ceiba Pentandra)

Chhat (Terminalia.Catappa)

Kabas Prey (Cochlospermum Religiosum)

Kantuot (Phyllanthus Acidus)

Chek (Musa Spp.)

Popeal Khae (Terminalia Bialata)

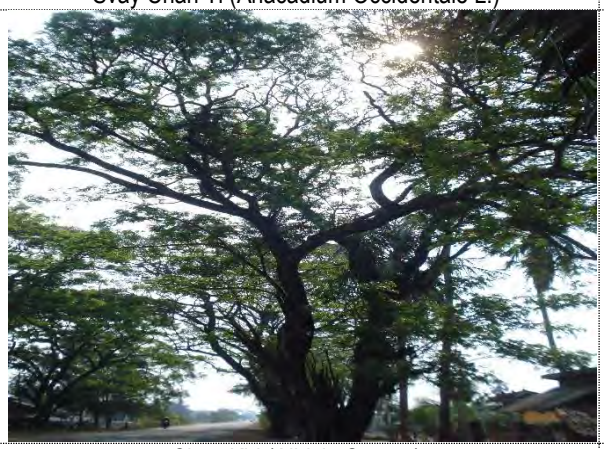
Kanthum Thet (Leucaena Leucocephala)

Trayoeung (Diospyros Helferi, C.B.Clarke)

Krasaing

Svay Chan Ti (Anacadium Occidentale L.)

Svay (Mangifera Indica)



Chan Kiri (Albizia Saman)

Kdol (Sarcoccphalus Cordatus, Mig.)

	
Tnaot (Borassus Flabellifer)	Acacia Sleuk Touch (Acacia Auriculiformis Muell.)
	
Ro Luos Chhmoul	Banla Ouyas
	
Loeurng Riech	Phnom Phnaeng (Hymenocaedia Wallichii)
	
Kamphlaok (Eichhornia Crassipes)	Kravan

Kravan

Sla (Areca Catechu)

Putrea (Zizyphus Mauritiana)

Puoch

Makak

Trabek Prey (Lagerstroemia Floribunda)

Voer Doskuon

Lhong Khvong (Jatropha Curcas)

Kandoal (Careya Spaerica)

Russey Khli (Bambusa Bambos)

Choeung Kou/Sleng Por

Ach Kandol

Bunla Chheur Em

Cheng Tokae (Coldenia Procumbens)

Snay (Sterblus Asper)

Trakuon Tech

Kantroob (Murraya Koenigi)

Voer Thmenh Trey (Ichnocarpus Oxypetalus)

Dong Het

Nheinh

Lpak

Kray Sor (Albizia Thorelii, Poir)

Ba Buoy

Kak (Cyperus Cyperiodes)

Por Phenh Chhmoul

Por Phenh Nhi

Trahs (Combretum Trifoliatum)

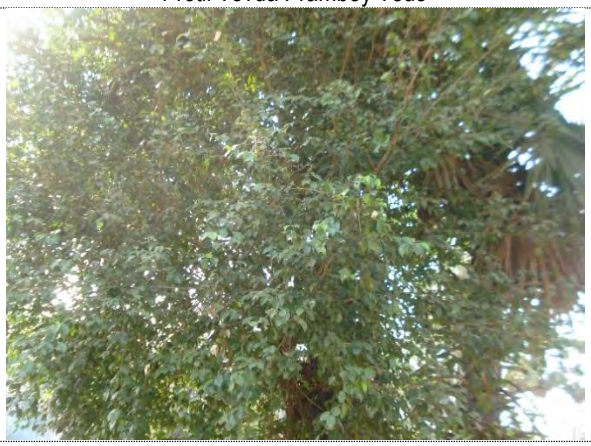
Bay Kdang (Leea Indica)

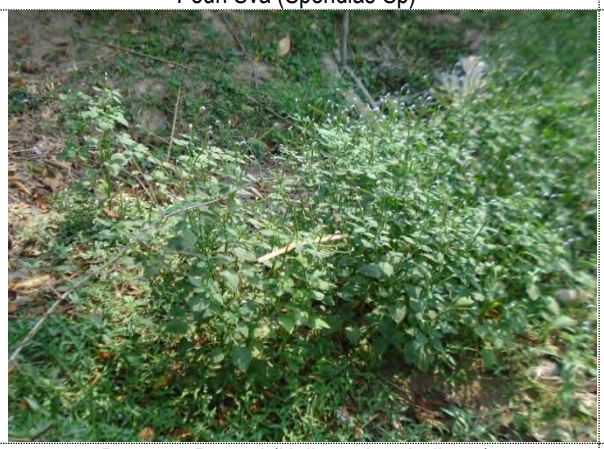
Mrech Thonsay

Rom Chek (Pandanus Humilis)

Char (Butea Monosperma)

Totuem (Punica Granatum)

	
Pka Sareka Keo	Protil Tevda Prambey Teus
	
Choeung Chab Srok	Chrey (Ficus Sp)
	
Por (Ficus religiosa L.)	Phka Kradahs (Bougainvillea Buttiana)
	
Ban La Bay Dam Neub (Acacia Concinna)	Sangkhor

	
Sandaek Khmoach	Changrang Seh
	
Raing Toek (Barringtonia Acutangula L.)	Kra Khob
	
Poun Sva (Spondias Sp)	Ban Tiel Krong Samrith
	
Pramaoy Damrei (Heliotropium Indicum)	Anhanh

	
Sbov (Imperata Cylindrica)	Trosek (Peltophorum Dasyrrhachis)
	
Thlork (Parinarium Annamensis, Hance)	Chheu Teal (Dipterocapus Costatus,Gaertn.)
	
Preal	Ro Luos Nhi
	
Thkov (Anthocephalus Chinensis)	Kam Polbay

	
Ampil Toek (Pithecellobium Dulce)	Chonlos (Erioglossum Edule)
	
Kom Siev	Voer Sao Mav (Passiflora Foetida)
	
Tramaeng (Carallia Lucida, Roxb.)	Lvea (Ficus Racemosa)

Note: Floras were written in local name or Khmer and scientific name was expressed in the bracket.






FLORA SURVEY ALONG THE PROJECT AREA AND KAMPONG CHHNANG BYPASS

FAUNA SURVEY